Our Electricity Future

Nova Scotia's Electricity Plan 2015-2040

NOVA SCOTIA

Our Electricity Future

Nova Scotia's Electricity Plan 2015-2040

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Executive Summary

The big picture

Nova Scotia is undergoing a massive power shift. Power rates will be more stable and predictable; technological innovation will be encouraged and promoted; the electricity regulatory system will be transparent and accountable; and competition will have space to flourish. By 2040, the province will have moved from among the most carbon-intense electricity generators in the country to a green powerhouse.

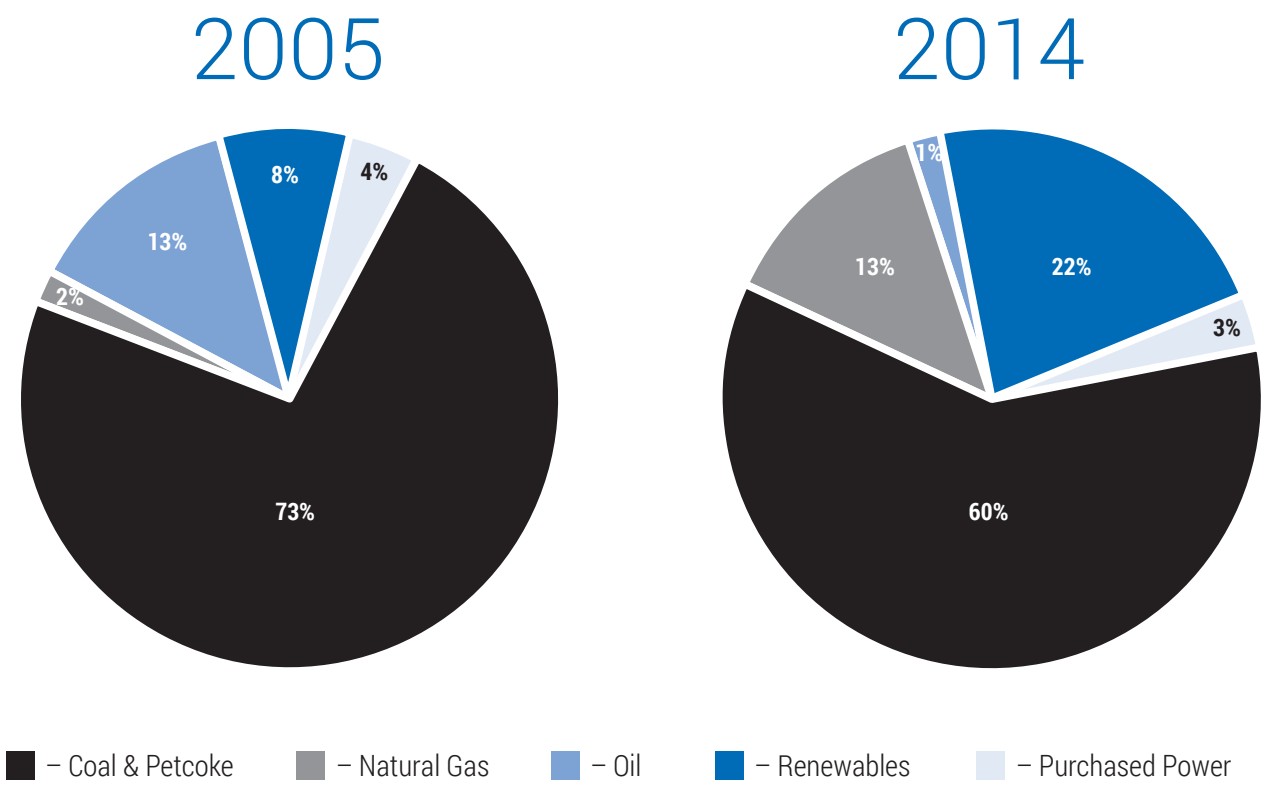
Today, no one knows with precision what a low- or no-carbon power future looks like. Urgency and necessity will continue to drive far-reaching technical innovation in power generation, some of it as yet unforeseen. Yet climate change itself is accepted globally as real, and carbon emissions are the major cause that must be addressed. The green transformation of Nova Scotia's electricity system, already underway, is essential to the province's future.

Indeed, Nova Scotians know what the big picture should look like, and they spelled it out for the government during the 2014–15 Electricity System Review consultation. The broad strokes they painted frame this plan. Phase one takes us from now to 2020, a period marked by much-needed power rate stability, a more competitive electricity marketplace, and continued reduction in carbon emissions. This is also a time to monitor, learn, and test new technologies, policies and partnerships.

The lessons learned in the next few years will arm Nova Scotians for sensible, informed choices in 2020, the next wave of change, and phase two of this plan. In the next decade and beyond, more and more energy – including for heat and transportation – is expected to come from clean electricity.

Nova Scotians want an environmentally responsible energy future, with stable power rates in an accountable and transparent electrical system. They support innovation, but not at any price.

Figure 1: Electricity generation of the past decade



Short-term action, long-term change

In the near term, 2016–2020, policy and operational changes will support the development of a more sustainable, diverse, competitive, affordable, and transparent long-term electricity marketplace.

Increased accountability and transparency begins with new legislation, in Fall 2015. New standards for performance will be accompanied by increased emphasis on reporting results in a manner that is more readily understood by consumers. The legislation will also bring in measures to enable rate stability, innovation and competitively priced community solar. Future considerations on large-scale generation will be more transparent and competitive.

Given the recent past, the sensitivity of Nova Scotians to power rate increases is understandable. Over the past decade, the average cost of power in Nova Scotia has

increased by more than 70 per cent, far exceeding the cost of living increase of just over 22 per cent.[1] Not coincidentally, the international price for coal climbed by as much as 70 per cent over the same period.

Coal prices have levelled off, and Nova Scotia's improving and pending access to renewable electricity sources tied to long-term, fixed-price contracts positions the province for cost stability. Therefore, Nova Scotia Power will be required to develop a fuel stability plan to minimize and smooth future price increases and make the cost of electricity predictable to the end of the decade (2019). During this period, NS Power will be expected to manage its non-fuel costs without rate increases, except and unless an unforeseen event, such as a massive storm, significantly damages the electrical system.

Price stability provides Nova Scotia a solid platform for transition. Less than a decade ago, more than 85 per cent of the province's electricity depended on high-carbon fuel – mostly coal. Today, more than 25 per cent comes from clean renewables, and that will rise to more than 40 per cent around 2018. In 2010, NS Power's generators produced 97 per cent of the province's electricity. In 2018 or 2019, that number will be less than 75 per cent, due to a shift to regional electrical sources – Newfoundland and Labrador and New Brunswick – and more local, renewable sources.

Beginning in 2016, renewable power producers will have the opportunity to compete in the renewable-to-retail electricity market. Future large-scale generation will be open to fair competition as well.

Also in the near term, pilot projects will help a number of communities gain experience with solar photovoltaic (PV) electricity. Other projects will support new technologies to shift, store, and manage local, renewable electricity supplies. Small-scale projects will build local knowledge and open new business opportunities, while large projects – notably tidal power – have the potential to foster significant economic development and exportable knowledge, even before tidal power proceeds to full-scale commercial operation.

Important information will be captured over the next few years on how new regional transmission systems will change our energy marketplace. Nova Scotia's coal-fired plants will operate less, and more of the province's electricity needs will be met on the open market.

Nova Scotia will produce surplus power from renewable sources at various times of the day and year. The province's position on the energy corridor between Newfoundland and New England could open opportunities for the development and export of clean electricity.

[1] *http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ150c-eng.htm*

*Figure 2: **Future energy loop for Atlantic Canada***

A clear horizon

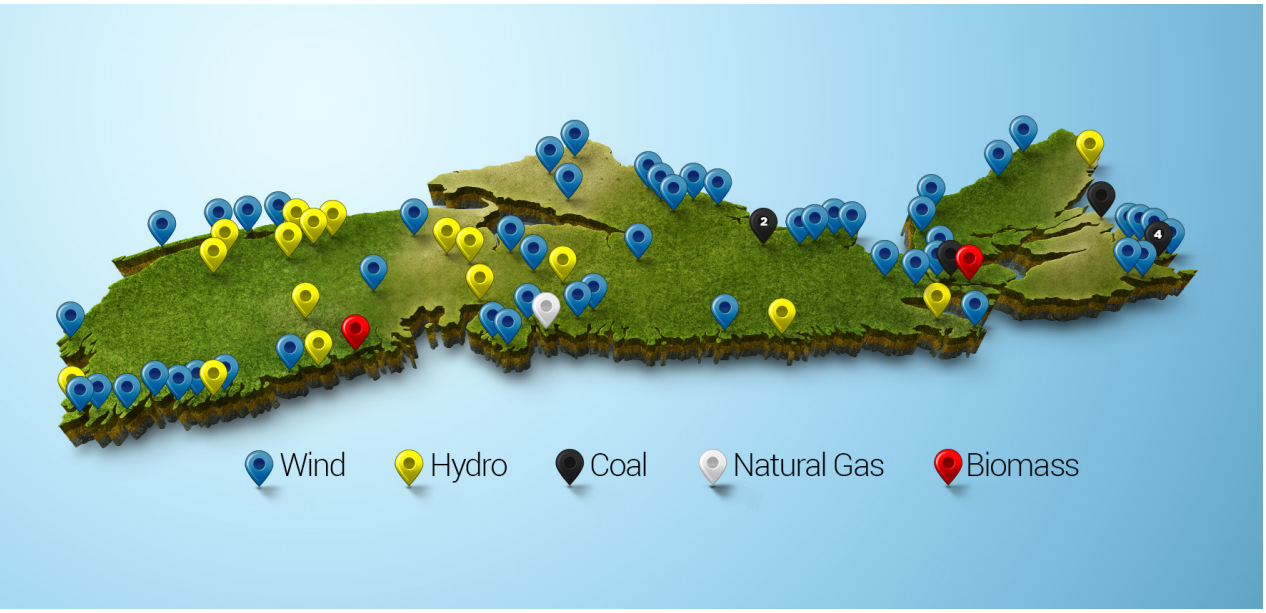
Into the next few decades, the province's electricity system will retain the flexibility to adapt to a future where the goal is clear, but the course to achieve it will need corrections along the way.

No new large-scale power generation is likely to be needed in Nova Scotia before 2030. But decisions on new sources of electricity will have to be made early in the next decade, and those decisions will consider emerging and anticipated environmental rules and new technologies.

Coal's role as an electricity fuel will continue to decline along with the province's carbon footprint. Cleaner, greener, renewable electricity will increasingly heat our homes and buildings and fuel our vehicles. By 2050 or before, Nova Scotia's electricity utilities may be nearly carbon free.

The electricity sector is the largest contributor of greenhouse gas (GHG) emissions in Nova Scotia. Significant reductions in this one sector help the province meet its GHG reduction targets. Reductions are also required across the rest of the economy, consistent with G7 commitments for deep reductions in GHGs by 2050 and a carbon-free economy by 2100. Most importantly, reductions are required to meet our moral obligations to future Nova Scotians.

Figure 3: Energy sources in Nova Scotia (2015)



Nova Scotia Today

In 2015, our electricity comes from
coal, natural gas, wind, hydro, and biomass.

Nova Scotia's Electricity System – The plan for 2015-2040

Introduction

In the fall of 2013, the Electricity Reform Act was passed, committing the government to the first extensive review of the province's power system in more than a decade.

Throughout 2014 and into 2015, the Department of Energy conducted a broad, comprehensive review of all aspects of the province's electricity system. In public and stakeholder consultations, Nova Scotians offered their thoughts on our electricity future.

This plan translates the energy priorities of Nova Scotians into strategies and actions that will deliver price stability, cleaner energy, and more choice. Achieving that vision requires a more accountable and transparent regulatory system and innovative ways to manage and store renewable energy sources. The result will be a much lower carbon future.

Themes

Four main themes emerged from the consultations and will guide the transformation of our electricity system: price stability, innovation, accountability, and competition.

Price stability: Nova Scotians want more stable electricity prices than they have experienced in recent years. They are justified in looking for more predictable rates so they can better manage their costs of living and doing business. After years of rising energy costs – mainly due to global markets – stable and predictable electricity prices over the remainder of this decade are important to Nova Scotians. To this end, the Electricity Plan includes piloting a three-year rate stability period to smooth rate pressures and make increases predictable.

Innovation: With stable and predictable pricing in place, innovation will set the stage for significant changes to the electricity system – innovations to promote customer control, integrate systems, and increase the value of renewable, non-carbon-based power generation – and increase its use in heating and transportation. The result will be new businesses and jobs, and over time, Nova Scotia will move much closer to a carbon-free economy.

Accountability: NS Power is heavily regulated, but because the regulatory process is detailed, lengthy, and often complex, it is difficult to understand. NS Power is not seen as being held accountable for its performance. The Utility and Review Board (UARB) will establish performance standards related to power reliability, storm response, and possibly customer service. NS Power's performance will be measured against these standards, and penalties may be imposed if they are not met. The province will work with the UARB and NS Power to ensure that decisions and the utility's performance are clearly and consistently reported to Nova Scotians.

Competition: The Nova Scotia electricity marketplace is changing. The Electricity Reform Act cleared the way for competition, and in 2016, the new "Renewables to Retail" market officially opens. Regionally, the Maritime Link and increasing co-operation between the Nova Scotia and New Brunswick utilities will provide new electricity options and choices. For new local projects, rate guarantees will not be used. Instead we will use a fair, competitive process to understand the impact of new technologies. We will also select micro-innovation projects on a competitive basis and provide them with access to the grid.

Three phases: near, medium and long-term

This plan charts a course to a new electricity future in Nova Scotia over a near, medium, and more-distant time frame. The immediate, near-term plan is well formed. Thereafter, flexibility is critical as new technologies emerge and new energy sources come on-stream, and lessons will be learned.

From 2015 to 2019, price stability is paramount. Fuel costs will be managed to remain well below recent increases. The utility is expected to manage its other costs in 2016, 2017, 2018, and 2019 without the need for a rate increase.

Pilot projects will test new ideas, regional collaboration will increase, and business opportunities will be created. The Renewable to Retail program will provide opportunities for consumers to have a choice of suppliers, and innovation pilots will encourage the development of new tools to help align their electricity use to the greener power grid. Performance standards for NS Power will be developed and

applied. At the end of this first phase – the end of the decade – all of these changes will be assessed and preparations made for more changes to come.

During the next phase – the medium-term, from 2020 to 2040 – lessons learned will be applied. NS Power's aging coal-fired generators will be replaced by new regional and local supplies. Increased use of clean electricity for heat and transportation will demand efficiencies, including new tools to manage and store renewable electricity.

Finally, in the long term, post-2040, it is possible that new renewable supplies from tidal, solar, or sources not yet developed, along with cost-effective storage technology, will have flourished and allow considerable growth in local supplies of clean electricity.

The end of the plan also marks an important regional milestone: at this point, a very significant amount of clean, renewable hydro power from Newfoundland and Labrador will become available after Quebec Hydro's contract for power from the 5500 MW Upper Churchill project in Labrador finally expires.[2] By this point, Newfoundland and Labrador may have developed other hydro projects in Labrador and opted to send power to markets through Nova Scotia. Within this context of great but as yet uncertain potential, the prudence of flexibility becomes clear, and a much lower carbon future for Nova Scotia becomes possible.

[2] *http://powerinourhands.ca/pdf/UpperChurchill.pdf*

The plan for 2015-2019

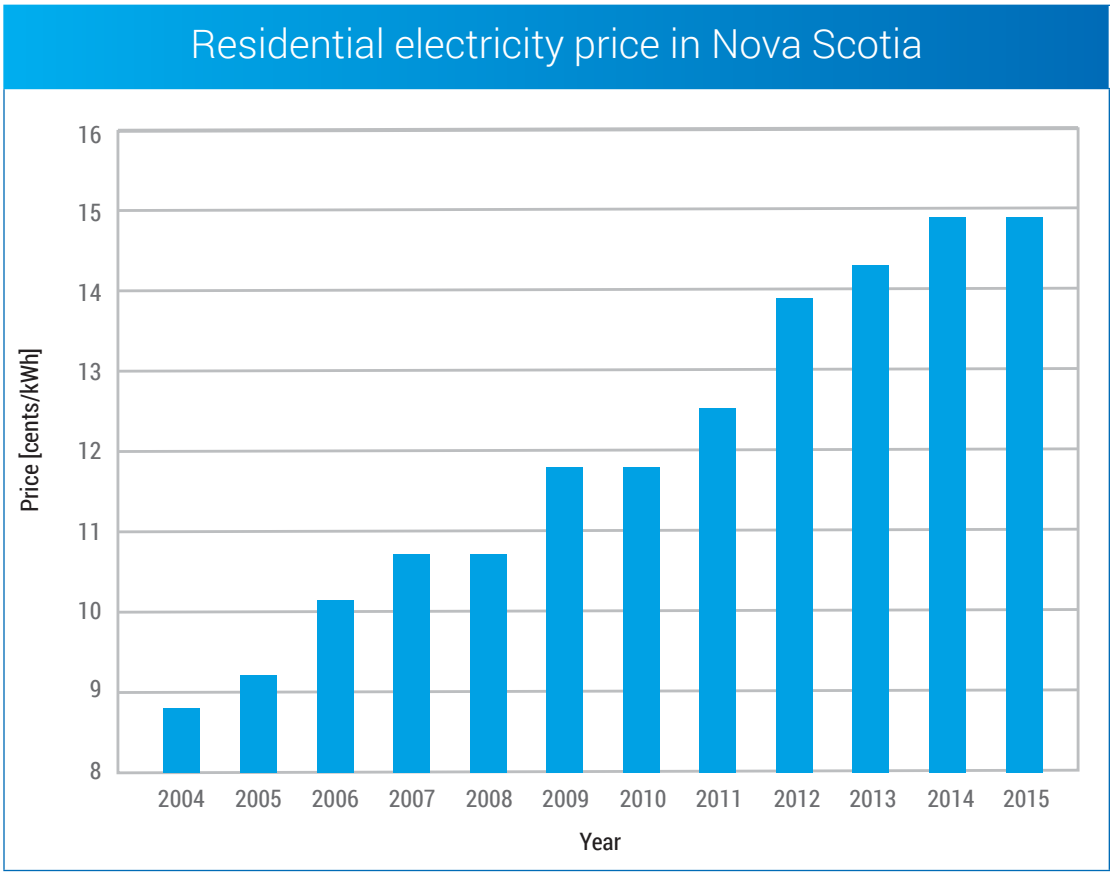
By 2019, our electricity will come from hydro (including Maritime Link), coal, natural gas, wind, solar and tidal.

Nova Scotia's Electricity System – The plan for 2015-2019

Rate stability

The past decade has been hard on NS Power customers. The years of stable rates built on plentiful, cheap coal ended when the global economy took off, and with it the price of coal. Coal prices jumped 70 per cent – almost three times the cost of living – and power bills in Nova Scotia mirrored the climb. More recently, coal prices fell and other costs started to emerge, but the cost of coal has been the major driver of higher power bills.

Figure 4: Cost of electricity (see also Appendix III)



During the Electricity System Review, Nova Scotians clearly said price stability and predictability is their immediate priority. Consumers, businesses, and institutions all need to know where prices are going in order to make sensible investments in efficiency upgrades and new heating systems. While the global economy struggles, the price of oil, and with it coal, is expected to stay relatively low. The market conditions appear to be right to lock in today's prices. NS Power has also taken steps to manage interest and employee costs through a four-year labour agreement. All of this makes stability not only desirable but achievable.

The province has taken action to minimize future pressures on rates. In August 2015, it closed the Community Feed-in Tariff (COMFIT) program to new entrants. COMFIT provided guaranteed, higher-than-market rates for community-owned projects.

For future procurement of renewables, competition will replace the COMFIT guaranteed rates and help lower cost pressure. With technology costs rapidly falling, opportunities to sharpen bids should realistically result in stable costs for ratepayers. Future community programs will focus on smaller-scale pilots. Lessons will be learned, so when successful projects are pressed into broader use, their costs to users will be competitive.

The August 2015 ruling by the UARB on the level of spending on electricity efficiency over the next three years (2016, 2017, and 2018) noted that at least for 2016, NS Power had sufficient savings elsewhere to avoid a rate increase. Some of these savings will continue, and NS Power is expected to find other savings as well to manage the efficiency costs.

The province also amended the Air Quality Regulations in Fall 2014 to increase compliance flexibility and choice while ensuring that environmental outcomes are met. The increased flexibility allows NS Power the freedom to purchase longer-term, more cost-effective coal contracts, buffer against volatile swings in the fossil fuel market, and bring more stability to the fuel cost forecast.

Price stability will be enhanced by a changing mix of fuel for electricity. Renewable energy comes with upfront capital costs that are paid off over the life of the contract, but operating costs are low, so the move to renewable electricity brings more predictable prices. It also reduces coal use and exposure to global price fluctuations.

Consumer demand, coal prices, and the growth in renewables support rate stability, based on clear and predictable fuel costs and limited or no rate increases to cover non-fuel costs. To ensure that these goals are met, a three-year formal Rate Stability Period (2017–2019) will be created, during which:

- The utility has until April 30, 2016, to file a case for a non-fuel-related rate increase. After that date, NS Power will be unable to seek such an increase until 2019.

- NS Power's fuel costs will be forecast and smoothed to make them predictable. The utility will be required to file a three-year fuel stability plan (2017, 2018, 2019), with a strategy to lock in prices to reduce volatility. The fuel stability plan will also include Maritime Link costs, averaged over multiple years and beginning in 2017 or early 2018.
- All costs will continue to be reported. Earnings over the NS Power rate cap will flow into the fuel side to benefit ratepayers, and efficiency charges will be included.

At the end of three years, the UARB will ensure that the fuel costs are trued up and may seek further accounting, if required. The province will review the outcomes to see if the rate stability measures should continue.

Innovation

It may be a cliché, but in the energy world it is true: the only constant is change. Prices change. Technologies change. Policies change. Even the science and understanding of energy changes. Finding ways to adapt to and anticipate change is the secret to energy and economic success. Innovation, therefore, is a major part of the Electricity Plan – immediate innovation and innovation to ride the crest of each wave of change.

Change is complex. Many of its drivers are related, even mutually dependent. For example, new technologies that allow energy to be stored cost-effectively create new opportunities for renewables such as wind, solar, and tidal. Storage increases the value of renewables because it allows power from wind, sun, and tides to be held for use when needed. Without cost-effective storage, the energy from those renewable sources must be used as it is generated.

The ability to store power, or to time demand to when renewable electricity is plentiful, will to a significant extent determine how near the low-carbon future is. The question is, how to support the innovations – the commercial breakthroughs – to make them happen.

The pace of innovation is weighed down by investment decisions based on long-term prospects. Innovation is slowed by the need to prove its value. Even in open markets, new ideas tend to come from outside large utilities. At a spring 2015 National Symposium in Halifax, the point was made that the climate for change is easier to create by supporting many small risks than taking a few big ones.

This is where public policy can increase the pace of private sector innovation. Support from taxpayers can move an idea to a concept, to a model, to a viable commercial solution. When that happens, innovation furthers social and economic progress – in this case, a low-carbon economy and stable prices along with new businesses and jobs.

Innovation serves another purpose. It offers the experience required to adapt to the bigger changes that will follow. One of the key questions facing electricity systems around the world is what happens if and when the cost of creating electricity from solar panels becomes cheaper than the cost of buying from the grid. This is already the case in some places, but not yet in Nova Scotia. Every system has its own unique characteristics. Building more knowledge about solar, storage, and reducing the costly peaks in demand on our system are important tasks ahead.

In the near term then, innovation sets the stage for business opportunities, experience, and future change. Over the next four years, innovation is about testing, monitoring, and learning.

Part of the opportunity to learn comes from our own situation. Nova Scotians use more electricity in the winter than in the spring, and more electricity in the evening than overnight. Too often, renewable power is produced when demand is low. Nova Scotian consumers will benefit more if demand and supply of electricity can be aligned.

Development of technologies that report when renewable electricity production is high and the carbon footprint is low will be supported. Such technology can open opportunities for consumers to shift their electricity use – manually or digitally – to times when renewable power is more plentiful. Data on how people use this information will help shape future policies and programs.

Knowing when renewables are plentiful and demand for electricity is low provides another insight. It establishes a real value for the electricity produced. The real value of renewable electricity changes, depending on whether renewables are plentiful or scarce. In an open market, it makes sense to pay producers the real value rather than a set rate. This concept is new to Nova Scotia, so information about prices will be gathered in pilots to better understand how it can work.

Pilot projects will be developed for homeowners, businesses, and institutions to sell surplus power from renewable sources. These small-scale pilots (20 kW or less) will use a new net-metering regime, which will require new sensor capabilities to report on real-time production and use. That information will be matched with information on the real value of the electricity, and NS Power will report on the value of the electricity. The data generated will also be useful for setting future rates.

Nova Scotian communities have proven ability to contribute to innovation. Halifax's Solar City Pilot Project is an example of local leadership, where the property tax system was used to finance projects to encourage the installation of home solar panels to heat water.

The COMFIT program to support community energy initiatives was broad-based and relatively expensive. To gain knowledge and support for innovation, a more cost-effective, targeted program will be established. A new Community Buildings Solar PV Pilot Program will promote installation of solar panels on community buildings such as town halls, fire halls, and community centres.

Projects will be reviewed and approved based on a competitive process. Firm supplier contracts will be required to avoid the approval of unrealistic, lowball bids that do not proceed. Power purchase agreements will be streamlined for the winning community projects. The program will be capped and controlled to ensure that there are no significant negative impacts on rate stability.

In addition to the net-metering program and the community solar programs over the next few years, an Electricity Innovation Pilot Program will award funding, on a competitive basis, to research projects.

The new pilot programs will support innovation while limiting effects on power rates to less than a 0.1 percent increase over three years. All projects will be awarded by the end of 2019. Participants will share data on their use and production, and the lessons learned will be evaluated during the review of the Electricity Plan.

Opportunity from the oceans

The development of an in-stream tidal power sector is an opportunity for more renewable, clean electricity, and an export opportunity. If it achieves its production goal of 300 MW within the next decade, there will be times when tidal power is surplus to Nova Scotia's needs and could be exported. Even before tidal power reaches that size, it will have created business development export opportunities:

- The Electricity Plan reaffirms the direction and goals of the Marine Renewable Energy Strategy.

- In the near term, the goal is to have between 16 and 22 MW of electricity from in-stream tidal in production or under active development by the early 2020s at the FORCE site near Parrsboro. This should maintain Nova Scotia's position as one of three global leaders in tidal power development. The deployments have market support through a feed-in tariff (FIT), but the estimated impact on rates is less than 2 per cent over three to six years.
- The deployment of devices will be accompanied by extensive consultations with local communities; observance and respect for the rights of First Nations and support for Mi'kmaq business development; and a robust local and international environmental and technical research program.
- New sector research funding will be available from the Department of Energy to leverage private funds and complement funding by the Offshore Energy Research Association (OERA). The OERA funding was established through grants from the province in the 2000s.
- Progress toward large-scale development will follow the passage of the new Marine Renewable Energy Act and the establishment of a new area for commercial development – the Marine Renewable Electricity Area.
- The province will continue to work with the federal government to support development of tidal power as an opportunity to build a new industrial sector for Canadian businesses.
- The expansion of in-stream tidal electricity production in Nova Scotia will result in a combination of export and local use. The opening of the Maritime Link in late 2017 or early 2018 will allow excess tidal and wind power to be bundled with NL Hydro to create new export markets. Additional development opportunities, including licences and access to Nova Scotia markets, will be granted on a competitive basis.

Monitoring, shifting and storing

To gain maximum value from intermittent renewable electricity, new ways of managing electricity use are required. The first step is synchronizing electricity demand with the tides, the wind, and the sun. New technology can be developed to help people make those seemingly impossible decisions, or to make the decisions for them.

In Nova Scotian homes and businesses, most of the energy is used to heat space and water. Traditionally, electricity has to be used as it is produced, but when it's turned into heat it can be stored. Pre-heating a home or turning down a water heater are

two of the most effective ways to smooth out electricity needs and align use with renewable production.

Storing electricity in the form of heat is already encouraged by low night-time power rates for customers who use thermal storage. Many homes are also adding air-source heat pumps. These heat pumps were originally designed as air conditioners for use in hot climates. The province supports research to develop new standards for good-quality heat pumps for colder climates. The heat pumps can also be managed automatically to time their use to periods when renewables are abundant and prices are lower. The province expects this trend to continue and accelerate. It will also work with the electrical sector to encourage high standards for installation.

Other technologies are in development to better manage the use and production of electricity. Nova Scotia's universities are working on battery solutions. InnovaCorp recently awarded $50,000 to a company that grew out of a lab at Dalhousie University. The company, Neothermal, is working on a new heat storage system that can be more easily retrofitted in homes than traditional ceramic block storage. That type of targeted research support spawns solutions and develops new business opportunities.

Another potential storage solution is the LightSail project in Queens County, where an innovative approach to storing wind energy in colder climates through compressed air is being tested. The concept was developed by Danielle Fong, a scientist from Nova Scotia, and is backed by investors from Silicon Valley, California.

The province is committed to funding promising technology projects over the next few years. Selection, on a competitive basis, will involve technical and business experts. Many of the projects will connect to the grid. Not all of these emerging technologies will be successful, but those that demonstrate success or promise are likely be embraced by private sector interests.

Measuring what we use and when

Many of the innovations contemplated in this plan require some form of sensor or device to capture data in real, or near-real, time and report back. Technology already exists to give accurate readings on electricity use, including times of use. New technology can be created to do some of these things at a much lower cost using the Internet. Collecting the information allows NS Power to understand and report on the true value or cost of electricity at a given time.

Broad adoption of more advanced information technology in Nova Scotia is likely, and it will come with considerable benefits. For example, near-real-time reporting enables

a utility to pinpoint where power has gone out. This is clearly a useful tool in getting the power back on. The technology can also create an instant, accurate, up-to-date bill for customers. Near-real-time measurement is also a tool to inform consumers about their electricity use and help them make choices and to cut peak consumption and costs.

However, the right timing for broad implementation of this technology across Nova Scotia is not yet clear. Equipping the homes and businesses of the province with current advanced meter technology could cost between $100 million and $150 million. Other utilities across North America made this investment and are now finding the technology obsolete. Timing is critical in technology investment. The so-called "cutting edge" is not always the best place to be.

NS Power is looking at a variety of technologies and, for the pilot projects, will measure and report electricity use, including the electricity's value and the carbon content of production, in near-real time. Those projects are expected to begin in the latter part of 2016.

A broader rollout of technology to measure and control power production and consumption will require normal approval by the UARB. In the meantime, annual reports on the state and cost of the technology will be prepared. Other utilities in the province could benefit from participation and from lessons learned.

Expanding the use of electricity and efficiency

Renewable, cleaner, and greener power is, for most, more desirable power. The increased use of highly efficient air-source heat pumps is a good example of how electricity can supplement oil and wood heat in older homes. In newer homes or homes with inefficient baseboard heat, the combination of air-source and electrical heat storage has become an appliance of choice. The savings to consumers is considerable, and the reduction in carbon is significant.

Electrically powered transportation is another area of future growth. To some extent, this idea has come full circle. Until 1969, a forebear of NS Power (Nova Scotia Light and Power) ran Halifax's public transit system with electric-powered trolley buses.[3] The primary focus in the immediate future, however, is electric-powered private vehicles, or EVs.

The future of EVs is promising, but there are challenges. Success over the long term depends on EVs being competitive in cost and range with conventionally powered vehicles. The arrival time of new technology is uncertain, and the popularity of electric vehicles in the near term may vary by region and climate.

In Nova Scotia, large-scale EV adoption is unlikely in the immediate future, and no subsidies are planned.[4]

However, the province will be open to ideas for a pilot project that would integrate EVs, particularly when the vehicles are charged while electricity is plentiful and are able to put electricity back on the grid when electricity needs are great. The marketplace is responding to the need for EV charging stations. This private sector initiative is welcome and expected to continue.

Performance standards

Nova Scotians said during the review that they want accountability from their regulated power monopoly, NS Power. Many people are frustrated by the complexity of the regulatory system and do not see much risk that the utility will not earn what appears to be a guaranteed profit.

In reality, the utility is highly regulated, and significant sums of money are spent to audit, examine, and cross-examine NS Power. Experts hired by the UARB, consumer and business advocates, and other interested groups participate fully in board proceedings. The board sifts through hundreds, at times thousands, of pages of evidence and testimony to arrive at its decision. Little of this is known to the public.

Nova Scotians also identified a gap in UARB authority to penalize NS Power if the utility does not do a good job. That gap will be closed, and the board will establish clear performance standards and have authority to impose administrative penalties of up to $1 million annually should NS Power fail to meet the standards.

In 2016, the board will begin to establish the following standards to measure NS Power's performance:

- Reliability – NS Power's ability to keep the lights and heat on is a fundamental measure of how good a job it does. But some interruptions are an unfortunate reality, and complete avoidance of service interruption would come at a cost too high to pay. There is a balance, and the UARB will be expected to set a proper balance.

  Other utilities in North America adhere to benchmarks for reliability, which may be adapted to Nova Scotian circumstances. These benchmarks are developed by the North American Electric Reliability Council (NERC). At the local level, the distribution system must meet a variety of industry standards,[5] and the UARB will be required to incorporate them into a performance standard.

[3] *http://home.cc.umanitoba.ca/~wyatt/alltime/halifax-ns.html*
[4] *http://energy.novascotia.ca/sites/default/files/files/Electricity-Review-NS-DOE-Emerging-Technologies-Report.pdf*

- Storm response – Storms happen and the power will go out from time to time. How quickly the utility can get it back on is another measure of performance. The standard here has to be sensitive to the storm force and the scope of damage. Nevertheless, it should be possible to develop a reasonable and meaningful standard based on the average of other electric utilities along the North Atlantic seaboard.
- Customer service – This is another area where Nova Scotians expect the utility to perform. It would be useful for the board to determine a number of categories of customer satisfaction, collect baseline information on current customer service levels, and set standards to improve on that performance. This is a complex process. Therefore, the board will have discretion as to how and when standards are developed and applied in this area. Initially, at least, penalty provisions will not apply.

Performance standards are expected to be realistic and achievable. They are not intended to require or incent NS Power to significantly increase spending. They may be amended as circumstances warrant. For example, once real-time measurement technology is in place, a utility could pinpoint where the power is out more quickly and accurately. The standard for storm response once such technology is widely available should be higher than the standard when the utility can only monitor to the substation level.

The board may apply the new administrative penalties if standards are not achieved. Any penalty would effectively reduce the utility's profit, or rate of return. This process is consistent with measures that already affect NS Power profits, including legislation that caps executive salaries, payments for low-income electricity efficiency, and any other expenses disallowed by the board. In 2014, the board removed millions of dollars in NS Power spending[6] from allowed expenses, resulting in a reduction in shareholders' return from 9.25 per cent to 8.67 per cent. Failure to perform would reduce profits and rate of return in the same fashion.

Nova Scotians want a clearer window into the electricity regulatory process. Following consultations, there will be a requirement to improve and simplify reporting on matters that are critical to public understanding. In addition, by the end of 2016, electronic summaries of information on proceedings and decisions will be available in a form that is accessible and meaningful to most Nova Scotians. The UARB is currently in a strategic planning exercise, which will involve external stakeholders. Building greater public awareness of, and confidence in, its work is a goal for the board.

[5] For example, it meets System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), and Customer Average Interruption Duration Index (CAIDI) standards, as modified for local conditions.
[6] Items removed as allowable expenses included payments to executives beyond the level paid to a Nova Scotia deputy minister, disallowances for imprudence by the UARB, and payments made for improvements to low-income electricity-heated homes.

In Nova Scotia, the Utility and Review Board (UARB) sets the allowed profit range for NS Power investors. As of 2013, the maximum they can earn is 9.25%. This can be impacted by lower than expected electricity sales, administrative penalties levied by the UARB and future performance standards.

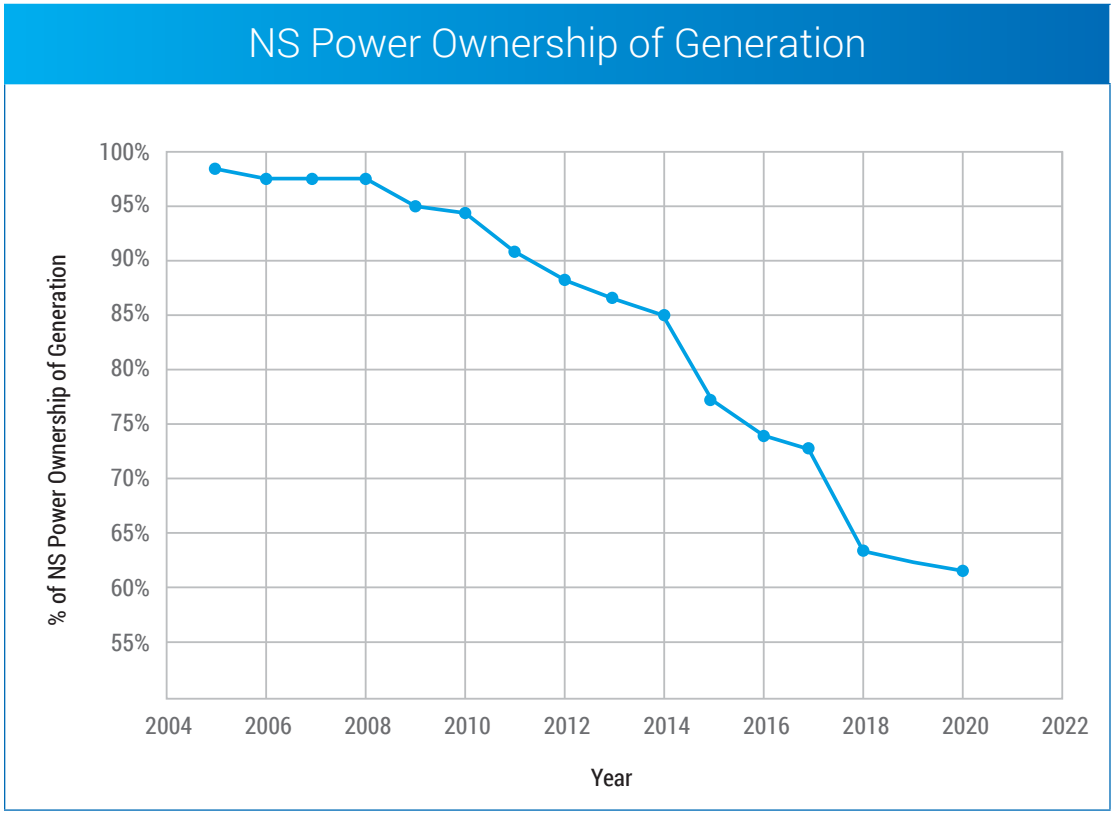
Creating competition

In the past, electric utilities were seen as natural monopolies. It made sense for one company to build and own the generators, the transmission systems, and the wires into homes and businesses. Today, in many parts of the world, those systems or parts of the system have been broken up and opened to competition. In some cases, open competition worked well. Elsewhere, where competition did not materialize, it did not, and power rates increased.

Competition is about more than price. It's also about consumer choice. The government recently set the stage for new players to compete with NS Power by offering consumers power from renewable sources. The new rules go into effect in early 2016. How popular the "go for green electricity" option is with customers won't be fully known for some time, and will be reassessed as part of the next review of this plan.

Even before the go for green option is available, NS Power is losing its monopoly over generation. Early in this century, almost all the electricity in the province came from Nova Scotia Power plants. Today there is an array of independent power producers, many with a strong commercial focus looking to expand, others with a social focus looking to put profits back into the community.

*Figure 5: **Chart of NS Power ownership of generation***



NS generation assets

Over the past decade the amount of generation owned by NS power is slowly decreasing.

2004: Independent wind projects begin

2008: Call to bids for distribution level electricity

2009: Large wind project (Dalhousie Mountain)

2011: Large wind project (Glen Dhu)

2015: Large wind projects (Sable, South Canoe)

2016: Alternative Resource Energy Authority-wind project

2018: Maritime Link online, Lingan 2 retires

Although NS power still supplies 95 per cent of our power, the province has been requiring them to buy from other sources.

Within a few years – by late 2017 or early 2018 – the picture will change again. The Maritime Link will open, creating opportunities and incentives for NS Power to buy electricity from others. Once the Link opens, on any given day or hour the utility will be able to choose to buy electricity from Newfoundland or New Brunswick or even Hydro Quebec, or use its own generators, depending on the lowest cost. Exactly how this market will operate is difficult to predict, but the change is expected to be significant.

A NS Power pilot project with New Brunswick Power is another example of the changing landscape. The two utilities have agreed to co-operate and sell power back and forth in order to lower costs to both. This Joint Dispatch Pilot takes advantage of the fact that the utilities have a surplus of power at different times. For example, NS Power may have extra coal-fired power to sell in the winter, and NB Power has surplus hydro in the spring when the rivers run strong.

In 2016, that pilot project is expected to expand to determine how the two systems can operate together, almost in real time. The system operators will choose the lowest-cost power option almost minute-by-minute, while still meeting GHG and renewable electricity requirements. The result will be a regional system operating virtually as one across Nova Scotia, New Brunswick, and Prince Edward Island. Newfoundland and Labrador is examining the feasibility of joining once Newfoundland is linked to the Maritime grid.

Meanwhile, new technologies for producing electricity from the sun and tides are expected to get better and cheaper. Cost reductions in power storage solutions will make all forms of renewable energy more cost-effective, which will also improve competition.

While these positive trends continue, the reality is that Nova Scotia's coal plants still exist. Their life can be extended well into the future, and even as they run less often, they play a key role in system operations. At a minimum, ratepayers are committed to pay for NS Power generating systems until those systems reach the end of their current economic life. In some cases that date is near, but in other cases it is decades away.

Figure 6: Generating plant life

Unit Name	Commissioning Year	End of 45-year Life	Capacity (MW)
Lingan 1	1979	2024	155
Lingan 2	1980	2025	155
Lingan 3	1983	2028	155
Lingan 4	1984	2029	155
Point Aconi 1	1994	2039	171
Point Tupper 1	1973	2018	154
Trenton 5	1969	2014	154
Trenton 6	1991	2036	154

With new renewable electricity coming on and long-term investments already made in wind and coal, experts agree that no major new sources of electricity will be needed until nearly 2030.

NS Power's monopoly over generation continues to be reduced, and new competition could result from access to new supplies and new local generation. The rules for future competition will depend on how and when market trends emerge. With the benefit of some time to get it right, the basic principle applies: all major new forms of electricity generation must be open to full and fair competition. While there is some time, new competitive rules for large-scale generation have to be established well before the need emerges, so consultation on that issue will begin when the Electricity Plan is up for review.

Related matters

Efficiency

Nova Scotia's electricity future will have to be more efficient as well as low-carbon. Conserving energy lowers costs. In 2014, the province released an efficiency plan called *Using Less Energy: Nova Scotia's Electricity Efficiency and Conservation Plan*.[7] The plan highlighted the value of saving fuel in present and future use. Competition for the lowest-cost fuel source – including the value of not using fuel at all – becomes the foundation for the future of the electricity system.

[7] *http://energy.novascotia.ca/sites/default/files/Using%20Less%20Energy%20-%20Nova%20Scotia%2527s%20Electricity%20Efficiency%20and%20Conservation%20Plan%20.pdf*

How quickly we invest in efficiency measures and programs has to balance long-term savings against short-term affordability – especially in light of the commitments for rate stability. To ensure a proper balance, the next multi-year budget for efficiency spending will take place as the rate stability plan comes to an end. An integrated resource plan update that includes regional plans and options for efficiency would also be helpful.

Environmental performance

Nova Scotians want positive environmental change that comes with a price tag they can afford. Achieving positive environmental outcomes in a cost-effective way is a core principle in this electricity plan. Nova Scotia has a series of short, medium and long-range, regulated caps for GHG, sulphur dioxide (SO2), nitrous oxide (NOx), and mercury. The clear timelines for reductions provide predictability and certainty when decisions are made for future investments.

In 2014, the province amended the Air Quality Regulations to include a more flexible compliance mechanism that benefits ratepayers while still achieving significantly improved environmental outcomes. As a result, the province remains on track to achieve an 89 percent reduction in mercury, an 86 percent reduction in SO2, and a 69 percent reduction in NOx by 2030[8]. Each reduction helps improve the health of Nova Scotians and reduces the damage from acid rain.

Nova Scotia's caps on GHG production from electricity production are working. By 2030, we plan to reduce GHG emissions from electricity by more than half. The electricity system of the future will be under increasing pressure to continue decreasing emissions and to be accountable for the cost of carbon pollution.

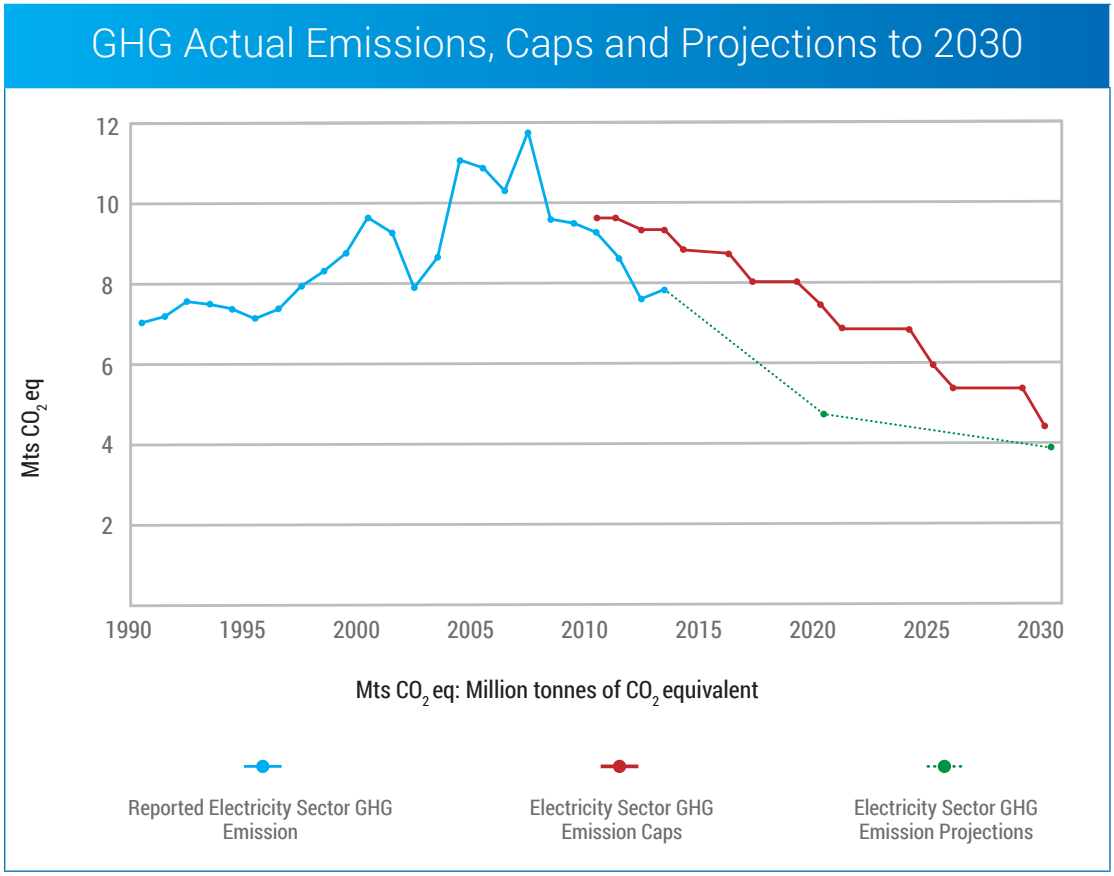
This will not happen in a vacuum: as the electricity sector transitions to low carbon, so will the rest of the economy.

Notwithstanding our air quality improvements, the reduction in GHGs remains a critical environmental challenge for the province and the world. Nova Scotians are determined to play their part in global efforts to mitigate climate change.

The science is not in doubt: climate change is happening, and mainly caused when people burn carbon-based fuels and generate GHGs.[9] The world is already seeing the effects of climate change in warmer, wetter winters and hotter, drier summers compared to even a few decades ago. We are experiencing more floods and more dry spells, and more frequent extreme weather events, which are compounded by rising sea levels. The impact of climate change is expected to accelerate and intensify over time.[10]

[8] https://www.novascotia.ca/just/regulations/regs/envairqt.htm
[9] Greenhouse Gases, (GHG's) – mainly carbon dioxide, methane and nitrous oxide, - trap energy produced by the sun. As more GHG's are added to the atmosphere they act like the glass roof of a greenhouse, allowing sunlight to reach the surface of the earth, but prevent heat from radiating back out into space. Ever so slowly, this causes the planet to warm overall – but changes in climate could result in cooling in some places as well.
[10] Intergovernmental Panel on Climate Change, Climate Change 2014, Synthesis Report, Topic 2; Future Climate Changes, Risks and Impacts.

*Figure 7: **Nova Scotia electricity sector GHG emissions***



Sources: 1. 2020 target: Canada-Nova Scotia Agreement in Principle on Efforts to Address Climate Change, January 25, 2010 (The Equivalency Agreement) 2. 2020 & 2030 projections: 2014 Integrated Resource Plan, Nova Scotia Power, October 15, 2014 ; 3.Emissions data: Nova Scotia Environment ; 2020 Projections based on Nova Scotia Power's 2014 Integrated Resource Plan are dependent on electricity load (positive or negative growth), the amount of market energy purchased from Maritime Link and the volume of demand side management (DSM) occurring.

The province is committed to reducing GHG emissions by up to 80 per cent by 2050 (from 2009 levels). In June 2015, G7 leaders issued a statement recognizing the need to decarbonize the global economy by the second half of this century and supported global GHG reductions of 40 per cent to 70 per cent by 2050.

Nova Scotia's major global trading partners are making or planning deep GHG reductions. By 2025, the United States will cut emissions to levels 26 to 28 per cent below 2005. China has committed to stop emissions growth by 2030, and by that same year, the European Union will reduce GHG emissions by 40 per cent below 1990. Also by 2030, Canada is committed to reduce emissions to a level 30 per cent below those of 2005.

The world agrees, aggressive action is required. The province's plan to significantly lower the carbon footprint of the electricity sector is not only a goal, it is inevitable and will be achieved by clear milestones and required reductions. So preparation is not merely practical, it is essential.

Electricity security

Electricity system security has several requirements. First and foremost, the infrastructure must be safe and reliable. Much has been done in Canada to make electricity grids safer and more secure. NS Power is part of those efforts and the new performance standards will ensure it remains in compliance.

Security also demands reduced risk of supply shortages or price shocks . The best way to reduce these risks is to diversify the province's electricity fuel supplies and not depend on one fuel or supply. The province will encourage the production and use of homegrown sources of energy from Nova Scotia and its neighbours, and improve transmission connections regionally to enhance export and import opportunities.

The role of natural gas

Natural gas remains an important source of lower-carbon energy. With a GHG intensity half that of coal and heavy oil, gas is helping to meet carbon reduction targets around the world. NS Power has the flexibility to use current offshore gas supplies to meet almost 25 per cent of the province's electricity requirements, but price is a barrier. In the winter, when Nova Scotia's power needs are greatest, the price of natural gas is at its highest, so it is a last-resort fuel source for electricity. In the spring and fall, and to some extent in the summer, natural gas plays a more significant role in meeting the province's electricity needs.

The future of natural gas as an alternative to oil as a source of heat remains promising. However, as a fuel for electricity, the future of gas depends on factors like supply and price. Current supplies are dwindling, so more discoveries and the development of existing offshore discoveries would improve both price and supply. It is a flexible and useful source of electricity, so it may make sense to maintain some natural gas capacity even into the 2040s. This decision will be taken in the context of alternatives that emerge in the next 10 to 20 years, including regional hydro and local renewables, and the cost of storage.

The impact of LNG

Although not directly linked to NS Power's electricity system, the potential for the construction and operation of new facilities to chill natural gas and condense it into a liquid (liquid natural gas, or LNG) for export has to be taken into account. With new pipeline capacity and a full range of export permits, a number of these projects could be built, and they would need massive new supplies of electricity.

That power could come from any of a number of sources, including self-generation from natural gas, contracting for electricity from elsewhere, or buying it from NS Power. Along with the economic opportunities from construction and operation, there are environmental obligations as well.

The province's current GHG reduction regulations relate only to emissions from power generation by NS Power. The self-supply option for LNG production would be addressed by national requirements and provincial policies to ensure best practices. In addition, the option to use new sources of imported hydroelectricity may be feasible.

The role of domestic coal

The use of coal in Nova Scotian electrical generation is in significant decline – driven by security demands to diversify and by the need to reduce our carbon footprint. Planning decisions are bound by the renewable electricity regulations and are significantly influenced by strict GHG and Air Quality Regulations. The GHG Equivalency agreement with the Government of Canada means that Nova Scotia can use its provincial approach or hard caps to ensure GHG reductions out to 2030.[11] While the GHG caps ensure that emissions will continue to decline, NS Power has flexibility in how it will achieve the reductions.

Regardless, coal will likely play a role in the Nova Scotian electricity system until at least 2042, when the last coal plant at Point Aconi reaches the end of its normal economic life. During this period, other, older coal units will likely be used on a seasonal basis. Therefore, there is a window of opportunity for some amount of domestic coal – from Donkin or other mines – to be used in the province for the next 25 years if the economics of burning domestic coal are in the best interest of ratepayers.

First Nations

The responsible development of energy resources through energy efficiency and renewable energy production is consistent with the long-held traditional perspectives

[11] *https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=1ADECEDE-1*

of the Mi'kmaq of Nova Scotia. With support from the province, the Assembly of Nova Scotia Mi'kmaq Chiefs drafted and ratified a Mi'kmaq Renewable Energy Strategy in July 2011. This strategy affirmed a commitment to move toward a more energy-aware and energy-secure future, and it set the stage to launch new initiatives – to create partnerships and development investment opportunities for the Mi'kmaq in the energy sector.

In response to the finding that Mi'kmaq households consumed 1.9 times more electricity than the average Nova Scotian home, the Assembly launched the Mi'kmaq Energy Efficiency Program. With funding from the government of Nova Scotia and in partnership with Efficiency Nova Scotia, the program trained Mi'kmaq community members to install energy-efficient lighting, electric hot water tank and pipe wrap, low-flow showerheads, and other upgrades in Mi'kmaq homes. This program resulted in 1,880 on-reserve homes receiving no-charge efficiency upgrades for an expected combined annual savings to Mi'kmaq bands of $330,000 each year.

Provincial policies have also enabled Mi'kmaq involvement in the renewable energy generation sector. There are seven Mi'kmaq-owned large wind COMFIT projects under construction or in operation with a combined generation capacity of 25.4 MW. Two of these projects, with a generation capacity of 10 MW, are collectively owned and managed on behalf of the Kwilmu'kw Maw-klusuaqn Negotiation Office of the Assembly of Nova Scotia Mi'kmaq Chiefs.

The Mi'kmaq of Nova Scotia will continue to be important partners in phase one of Nova Scotia's Electricity Plan. The Community Buildings Solar PV Pilot Program will promote the installation of solar panels on Mi'kmaq band-owned community buildings and create a new revenue stream for communities. The province will continue to work to identify ways the Mi'kmaq can benefit from and contribute to the goals of the Marine Renewable Energy Strategy. Finally, the Electricity Innovation Pilot Program will encourage Mi'kmaq participation and investment in new electricity technology pilots.

Primary forest biomass for electricity

For some groups in Nova Scotia, the issue of cutting trees in our forest for the primary purpose of generating electricity has proven to be controversial. At the same time other forms of renewable biomass such as farm waste have found more public support, although these other forms face challenges in implementation.

The controversy has been mainly about whether the biomass harvested from forests for electricity could be put to higher and better uses and whether biomass is a cost-effective technology compared to other renewable energy options. As new renewable sources of electricity become available, including sources, which like biomass are

able to be controlled as to when they are avoidable, the justification for primary forest biomass becomes narrower. At times of great demand for electricity, biomass is a useful addition to the supply. At other times there are more cost effective and reliable alternatives.

As the province's renewable targets are being exceeded, in general, higher cost sources should be reduced unless there are significant economic development opportunities to support a modest amount of generation. Nova Scotia will therefore look for opportunities to reduce the use of primary forest biomass for electricity.

Community feed in tariff program and community distributed electricity

In 2010, the province established four key paths for developing renewable electricity:

- competitive bids by an independent administrator
- NS Power–built projects
- opening the NS marketplace to hydroelectricity from elsewhere
- support for community organizations to produce local supplies

The last was to be achieved through the creation of community feed-in tariffs, which would offer UARB-set rates at a level that enabled smaller projects and community groups to participate.

The program uptake was intended to be constrained by a limited amount of local distribution capacity, and the approval process was built on the assumption that not all approved projects would be able to overcome technical and financial barriers. As those assumptions proved wrong, the program was suspended, reviewed, and then closed. In the end, it was a very successful program for community participants. Future reporting will help judge its benefits to communities and its role in testing community economic development models.

However, it is now expected that community-driven programs can be designed with much lower costs. The Community Buildings Solar Program will focus on smaller-scale, competitively chosen projects. The program will have clear caps and limits. Over time, the cost of technology will likely continue to fall, and local or "distributed electricity" will become more attractive on its own merits. Thus, the Community Buildings Solar Program is intended as a bridge and to help us learn.

Affordability of electricity

Affordability is an issue for many Nova Scotians, especially since the large jump in prices over the past decade. The best long-term solution remains investing in the upgrades that will lower both the amount of electricity consumed and the bill. In general the approach has been to save electricity, not subsidize its use. Efficiency policy supports NS Power's commitment to spend $37 million to help low-income homeowners reduce power costs.

The HomeWarming program offers a no-charge energy assessment and free home upgrades such as draft-proofing and insulation to income-qualified homeowners to help reduce heating and power bills. HomeWarming is proudly sponsored by Nova Scotia Power and the Province of Nova Scotia. Nova Scotia Power has volunteered to fund $37 million for a 10-year low-income energy efficiency program for electrically heated homes to be delivered by the Clean Foundation. The Province of Nova Scotia will continue to fund non-electric low-income energy efficiency programs, which will be delivered by Efficiency Nova Scotia.

But many low-income Nova Scotians live in rental accommodation, and the province is working to find fair and equitable solutions in their case. The issue of energy upgrades for rental units is not a simple one. Upgrades to an apartment building will lower costs but not necessarily reduce rents. The province is working with EfficiencyOne to test a number of ideas to make efficiency more cost-effective for those who most need to benefit. A roundtable dialogue between low-income groups and property owners is planned for 2016 to further test policies, plans, and programs that would help, within the current budgets for low-income energy efficiency.

Export of electricity

Increasing the use of renewables in Nova Scotia means we are also creating the conditions for frequent periodic surpluses. A good example is tidal power. In the winter, with power demand reaching 2200 MW on very cold days, the 300 MW of in-stream tidal that could be produced would be welcome and manageable. But in spring, demand drops by as much as two-thirds, and the tides continue to ebb and flow. As a result, Nova Scotia will have more tidal, wind, and hydro than it needs.

Surplus renewable power creates the opportunity to bundle Nova Scotia renewable electricity with hydro from New Brunswick or Newfoundland and Labrador and sell the surpluses into markets that will pay a premium for a package of diverse renewable electricity supplies they can count on. Under these conditions, projects may also emerge that are designed solely for export. This could help accelerate development of tidal generation and increase opportunities for the wind sector, creating more jobs and business activity in Nova Scotia.

The plan for 2020-2040

From 2020 to 2040 and beyond, our electricity will primarily come from hydro (including Maritime Link), natural gas, wind, solar and tidal.
Energy storage systems will allow us to use more renewable energy sources.
Electrically-powered vehicles will add to our electricity demands.

Nova Scotia's Electricity System – The plan for 2020-2040

Reviewing the plan

Experience is the best guide along the path to greater accountability, rate stability, competition, and a much-lower-carbon future. In 2020, Nova Scotians will take a hard look at the first four years of the plan and start to apply lessons learned. That review will have the clarity of hindsight. Today, looking ahead, the trends that will require examination appear to be market conditions and competition, utility performance outcomes, state of technology evolution, economic growth, and environmental goals and regulation.

Market conditions and competition

In 2020, the implications of competition from inside and outside the province should be much clearer. The regional systems will likely be operating as one. Electricity will be flowing east and west. The marketing power of renewables – available at retail to homes and businesses that want to go green fast – will have been established.

There may be significant benefits from regional developments. Newfoundland and Labrador has a huge undeveloped resource on the Lower Churchill River. Gull Island is nearly three times larger than Muskrat Falls, and the development cost per MW is significantly less. With potential markets in New England and Ontario as the big draw, connections to Newfoundland could expand, and even more market-priced electricity could be available. Quebec is also bringing on new electricity sources and will likely upgrade ties at the New Brunswick border. The end of this decade and beginning of the next could prove to be a time of significant choices for Nova Scotia's electricity future.

Utility performance outcomes

2020 will be a time for accounting. Did NS Power meet fuel cost forecasts? Did it meet performance standards? How is Nova Scotia performing compared to other jurisdictions? Should rate stability continue?

State of technology evolution

By 2020, experience will teach a great deal about the costs and benefits of the technologies both tested and on the drawing board today. There will also be new technologies and new ways to use and pay for current technologies. Every day brings innovation, invention, new ideas, and new markets. In four years, today's innovations will have had nearly 1500 days to flourish or flounder.

In four years, the cost of emerging ideas on storing electricity through compressed air, hydrogen, and new chemical batteries will be better known. The size, cost, and capacity of batteries will make or break the future of electric vehicles. How well underwater turbines perform in tidal currents will be another critical question that may be answered, but how much the costs can be reduced may still be in doubt.

Nova Scotia's experience with its pilot projects over the next few years should be starting to bear fruit by 2020. The outcomes will influence future policies and direction on

- energy conservation and efficiency
- the adoption and distribution of advanced electricity management systems
- the growth of local and community electricity generation

Economic growth

Economic growth significantly increases demand for electricity. A strong economy means more people living and working in Nova Scotia. Several prospects on the near horizon could drive Nova Scotia's economy in a positive way. They include offshore oil exploration results, LNG exports, and the growth of the ocean technology sector (including tidal power and shipbuilding). By 2020, the economic impact and load growth from these and other factors will be better known.

Environmental goals and regulation

Nova Scotia has a good record in achieving its environmental performance targets. The caps on GHG production from electricity production are working. By 2030, we plan to reduce GHG emissions from electricity by more than half from 2009 levels. The electricity system of the future will be under increasing pressure to continue decreasing emissions and be accountable for the cost of carbon pollution. This will

not happen in a vacuum – as the electricity sector transitions to low carbon so will the rest of the economy.

In December 2015, nations of the world gather in Paris to negotiate a new global agreement on climate change post-2020. The Canadian Energy Strategy, adopted by all premiers in July 2015 underlines the importance of addressing climate change in Canada's energy future. Nova Scotia's electricity system will be operating in a world that is increasingly concerned with the impact of carbon emissions. Nova Scotia's action to date in the electricity sector is good preparation for future policies to reduce the carbon footprint of all economic activity. As the need to lower emissions and account for of carbon continues, Nova Scotia's strengths in efficiency, renewables, regional collaboration, and innovation will prove to be useful experience.

Nova Scotia's equivalency agreement with the federal government ensures that the province can use more flexible provincial regulations to achieve GHG reductions in the electricity sector. That agreement is renegotiated or renewed every five years, and new rules will be required after 2030, the last year of current GHG caps. The new rules will affect how, where, and when Nova Scotia replaces its remaining coal plants.

Planning direction for 2020-2040

The period leading up to the 2020 review, and the findings from it, will inform Nova Scotia's planning for new and replacement electrical generation. The approach could be regional, and it will take into account the sometimes competing priorities of low carbon and reliable supply. Reliability is determined by the capacity of that energy to be there when it is needed.

Failure to take capacity into account – or failure to provide the economic and regulatory support for capacity – causes problems in electricity systems around the world as they shift to renewable and local sources.

In Nova Scotia, local distributed systems may continue to grow and provide electricity to local users. At some point, technology to store and manage power may be cost-effective enough to enable these distributed systems to provide capacity as well as energy. Cost-effective storage and management is key; otherwise, use of renewables can become costly and sacrifice reliability for lower carbon emissions.

Ultimately, our electricity system will reach a balance. Large regional grids will deliver capacity and reliability using controllable electricity. Local grids will produce their own power and reduce the carbon footprint. How much electricity comes from each source is yet to be determined.

Beyond 2040

Looking out past 2040, the only certainty is that the world of electrical power will be very different than it is today. But for the next 25 years, four key factors will drive many decisions and influence policy in Nova Scotia:

- the cost of local distribution technologies (storage, solar, wind, etc.)
- the emergence of tidal as a predictable, cost-effective source of electricity
- the state of the economy and demand for electricity that could be the primary source of energy for light, heat, and transportation
- the state of the regional system and regional market

On the last point, within the next 10 to 15 years, the big question will be how Newfoundland and Labrador plans to get Upper Churchill hydro power to market. Those 5500 MW of clean, storable electricity, most of which has been under long-term contract to Quebec Hydro, will become available in 2042. In 2016, Quebec will exercise its option and renew the contract at a price set in the 1960s: $2 per MWh, or $0.002 per kWh.[12] The contract runs to 2042. Unless it is renegotiated, or transmission rights through Quebec are secured, Newfoundland and Labrador may be looking to flow the electricity through Nova Scotia.

If Nova Scotia becomes a waypoint on such a massive flow of clean electricity, the province's electricity marketplace changes radically, right at the time when it must plan for replacement of its last coal plants. Point Aconi may be the last coal plant in operation by the 2030s, and its useful life ends in 2042. It could last longer, but only with significant and costly upgrades to meet the environmental standards at that time.

The energy that runs the world is changing, and clean electricity is moving to the vanguard. Depending on the big breakthroughs – tidal, Churchill Falls, technology, electrification of transportation and space heating – a low-carbon and, later, no-carbon economy could be within sight.

[12] *http://powerinourhands.ca/pdf/UpperChurchill.pdf*

Appendix I

Glossary

Biomass - Any material originating from a living organism, such as wood, grass, manure or kitchen waste

Demand Response (DR) - Programs designed to reduce the amount of electricity drawn from the grid during peak demand periods and/or increase the amount used when there is surplus renewable generation that would otherwise be wasted. Customers could be responding to changes in the price of electricity during the day, incentive payments and/or other mechanisms.

Distribution - An electrical distribution system carries electricity from the transmission system and delivers it to consumers. Typically, the network would include medium-voltage power lines, substations, pole-mounted transformers, low-voltage power lines and electricity meters.

Feed-in Tariff (FIT) - A guaranteed electricity price paid to suppliers that provides stable prices through long-term contracts for energy generated using renewable resources.

Fuel Adjustment Mechanism (FAM) - A regulatory system that adjusts electricity rates based on the actual costs paid by the utility for fuel.

Greenhouse Gases (GHGs) - Gases that contribute to the capture of heat in the Earth's atmosphere. Carbon dioxide is the most prominent GHG. It is released into the earth's atmosphere as a result of the burning of fossil fuels such as coal, oil or natural gas (to a lesser extent). GHGs are widely acknowledged as contributing to climate change.

Integration - The way an electricity system combines and delivers electricity from various sources, conservation and demand management to ensure consumers have dependable and reliable electricity.

Intermittent Power Generation - Generation sources that produce power at varying times and rates of production, such as wind and solar generators whose output depends on wind speed and solar intensity.

In-stream tidal - Technology that extracts energy from the flow of tides without requiring a dam or similar barrier to natural currents.

Kilowatt (kW) - A standard unit of power that is equal to 1,000 watts (W). Ten 100-watt light bulbs operated together require one kW of power.

Kilowatt-hour (kWh) - A measure of energy production or consumption over time. Ten 100-watt light bulbs, operated together for one hour, consume one kWh of energy.

Load or Demand Management - Measure undertaken to control the level of energy use at a given time, by increasing or decreasing consumption or shifting consumption to some other time period.

Maritime Link - The Maritime Link Project is part of a larger strategy to address the growing demand for more clean renewable energy. It will enable the transmission of clean, renewable and reliable electricity from Newfoundland and Labrador to Nova Scotia and beyond. It will also allow Nova Scotia to import hydro electricity from the Muskrat Falls generating station in Labrador, which is being developed by Nalcor Energy as part of the Lower Churchill Project. Currently under construction and scheduled for completion by 2017, the project involves building 170 kilometres of subsea high-voltage direct current transmission cables under the Cabot Strait, with overhead transmission in Newfoundland and Labrador and Nova Scotia.

Megawatt (MW) - A unit of power equal to 1,000 kilowatts (kW) or 1341 Horsepower.

Megawatt-hour (MWh) - A measure of energy production or consumption over time; a one MW generator, operating at capacity for 24 hours, generates 24 MWhs of energy. 1 MWh is enough energy to charge an iPhone 183,486 times or supply an average home in Nova Scotia for almost 4 weeks.

Net-metering - A program made available to customers with low impact renewable electricity generation installations sized to meet their annual electricity needs (currently capped at 1 MW of capacity per installation) which allows them to sell excess generated renewable electricity to the electricity grid.

Peak Capacity - Generating sources typically used to meet the highest demand for electricity.

Peak Demand - Describes the demand during the period in a year in which the demand for electricity is highest.

Solar photo-voltaic - A technology for converting solar energy into electrical energy (typically by way of photovoltaic cells or panels comprising a number of cells).

Storage - Any of a number of methods for storing electrical energy for later use, such as batteries, compressed air and stored heat.

Supply Mix - The combination of different resources that are used to meet electricity demand requirements in a given jurisdiction.

Terawatt-hour (TWh) - A unit of power equal to 1 billion kilowatt-hours. Nova Scotia uses about 11 TWhs each year.

Transmission -The electrical system that moves large quantities of electricity at high voltages, usually over long distance, from generation sites to large consumers directly and local distribution systems for smaller consumers.

Renewable energy - Energy that comes from resources that are naturally replenished such as sunlight, wind, biomass, tides, waves, and geothermal heat.

Regulatory process - A procedure before the Utility and Review Board that could involve filing of evidence, requesting of information, and a formal hearing.

Utility - An entity supplying electricity, gas, water or wastewater to consumers.

Upper Churchill -The Churchill Falls Generating Station is a hydroelectric power station located on the Churchill River in Newfoundland and Labrador.

Renewable to Retail - Legislation in Nova Scotia that will enable independent renewable energy producers to sell directly to retail consumers.

Tidal power - A form of hydropower that converts the energy of tides into useful forms of power, mainly electricity. It is also called tidal energy.

Independent Power Producers (IPP) - Companies that produce electricity using renewable energy sources.

Appendix II

*Figure 8: **Electricity plan overview***

What We Heard in the Electricity System Review

Nova Scotians told us that they want stable and predictable power rates. They support renewable energy and innovation (but not at any cost). A combination of small-scale local electricity production and more regional solutions is preferred, and more accountability and transparency from utilities and the Utility and Review Board is needed.

Technical experts told us that we have enough energy capacity for the next 10-15 years, and our focus should be on exploring new opportunities for 2030 and beyond.

Actions	Rate Stability	Innovation	Competition	Accountability
Short-Term	•NSPI to file fuel stability plan to 2019 •Rate stability period (2016-2019) •Work with Efficiency One to devlop pilots addressing low income groups	•Support development of storage technologies •Begin testing tidal technology •Establish innovation funding program •Develop solar net-metering program for communities (2016) •Begin innovation pilots	•Build regional connections with NL and NB •Completion of Maritime Link	•Utility performance standards set •Penalties imposed by UARB in the case of non-compliance •UARB to provide clearer, more accessible reporting on decisions and process
Medium-Term	•Review period one:apply lessons learned •Increase use of less volatile fuel sources (local renewables) •Continue efficiency programs to manage demand •Retire coal plants as they reach end of lifespan	•Expand on storage technologies for renewables •Bring tidal to commercial operation •Improve grid management with small-scale developments and storage		
Long-Term	•Increase use of less volatile fuel sources (local renewables) •Continued efficiency programs to manage demand		•Potential to negotiate for hydro from Upper Churchill	

Outcomes

- Stable and predictable electricity prices
- Growth in local and renewable clean energy sources
- Fair and open competition resulting in more suppliers of electricity
- Access to renewable hydro electricity from NL and/or Quebec
- A commercially viable tidal energy sector
- A low-carbon electricity system
- Utilities held accountable to rate payers

Appendix III

*Figure 9: **Electricity costs from 2004-2015***

Year	Rate	% Increase	Cumulative
2004	8.61	0.0%	0.0%
2005	9.22	7.1%	7.1%
2006	10.13	9.9%	17.7%
2007	10.67	5.3%	23.9%
2008	10.67	0.0%	23.9%
2009	11.796	10.6%	37.0%
2010	11.796	0.0%	37.0%
2011	12.54	6.3%	45.6%
2012	13.923	11.0%	61.7%
2013	14.363	3.2%	66.8%
2014	14.947	4.1%	73.6%
2015	14.947	0.0%	73.6%

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