# Nova Scotia power sector: Current situation, recent developments and challenges, and SWOT analysis


*Prepared for the Nova Scotia Department of Energy by London Economics International LLC*

***Nova Scotia's power system is relatively small, and dominated by the incumbent utility. It is partly liberalized, with wholesale competition allowed, and work is already underway to facilitate renewable-to-retail competition in the near future. The sector benefits from an open legislative and regulatory process. Nova Scotia is well-positioned to benefit from its access to natural gas supply and potential gas storage. The largest threats to its power system are potential power price increases, driven by a number of factors, and slowing load growth faced by the incumbent utility. Current legislative and regulatory initiatives are focused on electricity efficiency and renewable power.***

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# 1 Executive summary

Nova Scotia's power system serves a population of just under 1 million residents. Its total generation capacity under the control of NSPI which currently totals at about 2,700 MW (owned and contracted from independent power producers ("IPPs")) is fuel-diverse. It is currently anticipated that only one utility-owned coal unit may be retired in the near term to facilitate the importation of base block firm capacity supplied by the Maritime Link, and renewable power supplied from IPPs is growing. Nova Scotia's system has limited interconnection with other power systems, with only one large transmission line, connecting it to New Brunswick. Nova Scotia has high power prices relative to some other Canadian provinces, but these prices are not out of line in comparison with similar-sized markets and locations, particularly when adjusted for hydro power endowments in other provinces.

The main power provider is Nova Scotia Power, Incorporated ("NSPI"). NSPI is owned by Emera, which also owns generation and transmission assets in New Brunswick, Newfoundland and Labrador, and Maine, as well as natural gas infrastructure in the region. There are a number of municipal utilities in Nova Scotia as well with an approximate market share of 2% of sales. IPPs own about 10 percent of operating capacity. The system operator is owned by, but functionally unbundled from, NSPI.

The power sector is partly liberalized, with wholesale competition in power generation, and open access to its transmission system in place. The power sector is regulated by the Nova Scotia Utility and Review Board ("UARB"), an independent quasi-judicial body. Key legislation governing the power sector in Nova Scotia has evolved from general oversight of public utilities, to enabling a somewhat more competitive electric power market, to pursuit of environmental goals.

The power system faces a number of challenges. Load could significantly decline somewhat through 2020, which will pose challenges to the incumbent utility. Some of this decline may possibly be driven by the loss of large industrial customers. Demand-side management and conservation programs will reduce load growth. Under the circumstances, traditional rate design may not be well suited to supporting utility investment while assuring the lowest sustainable prices for customers and the regulatory and legislative authorities are examining alternatives. Investment in transmission and distribution, and some degree of smart grid technology will be required in order to integrate intermittent and distributed renewable power.

Nova Scotia also has a unique combination of strengths. Its geology can accommodate construction of natural gas storage facilities, which could be a valuable addition to natural gas supply in New England and or natural gas suppliers/customers in Nova Scotia. Potential on-shore gas resources and new deepwater offshore gas may turn out to be commercially viable. Potential tidal power resources have only begun to be developed. Investment in smart grid technology to support renewables and distributed generation could support new businesses such as delivering voice and data services, which could help offset the cost of smart grid investment.


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This document should be read in conjunction with "Literature Review: Regulatory economics and performance-based ratemaking," May 2, 2014, prepared for the Nova Scotia Department of Energy, by London Economics International LLC.



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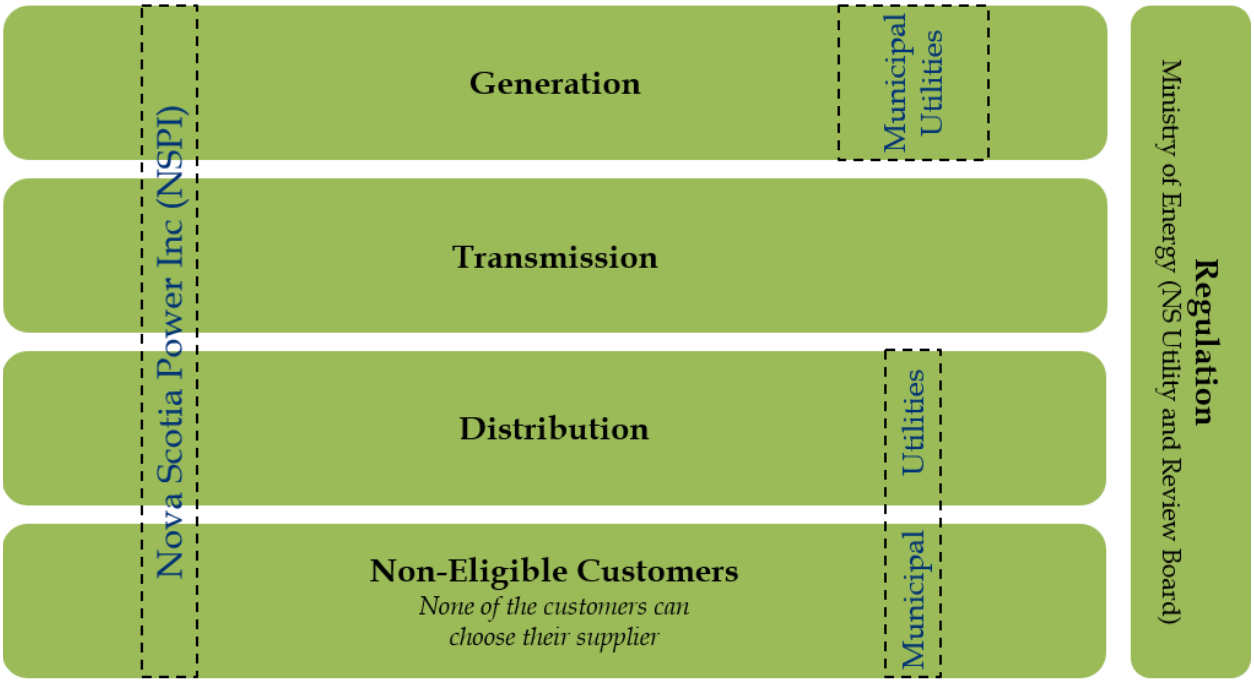
## 2 Electricity system overview

Nova Scotia's power system serves a population of slightly less than 1 million residents with installed capacity of about 2,700 megawatts ("MW"). Figure 1 provides an overview of economic and power market indicators and overall power market structure in Nova Scotia. Power demand in Nova Scotia peaks in the winter (December through February), owing to the predominance of electric heating over the relatively small air conditioning load.

**Figure 1. Electricity industry structure**

| Macroeconomic indicators | | |
|---|---|---|
| Population (2013) | 940,789 | |
| GDP per capita (2012) | 40,473 | CDN $ |
| Population density (2012) | 18 | p/sq.km |
| GDP growth (2012) | 0.66% | p.a |
| **Electricity sector statistics** | | |
| Installed capacity (2013) | 2,730 | MW |
| Peak load (2013) | 2,033 | MW |
| Consumption (2013) | 10,467 | GWh |
| Load growth (2011-2013) | -3.35% | p.a. |
| Net Imports (2013) | 417 | GWh |

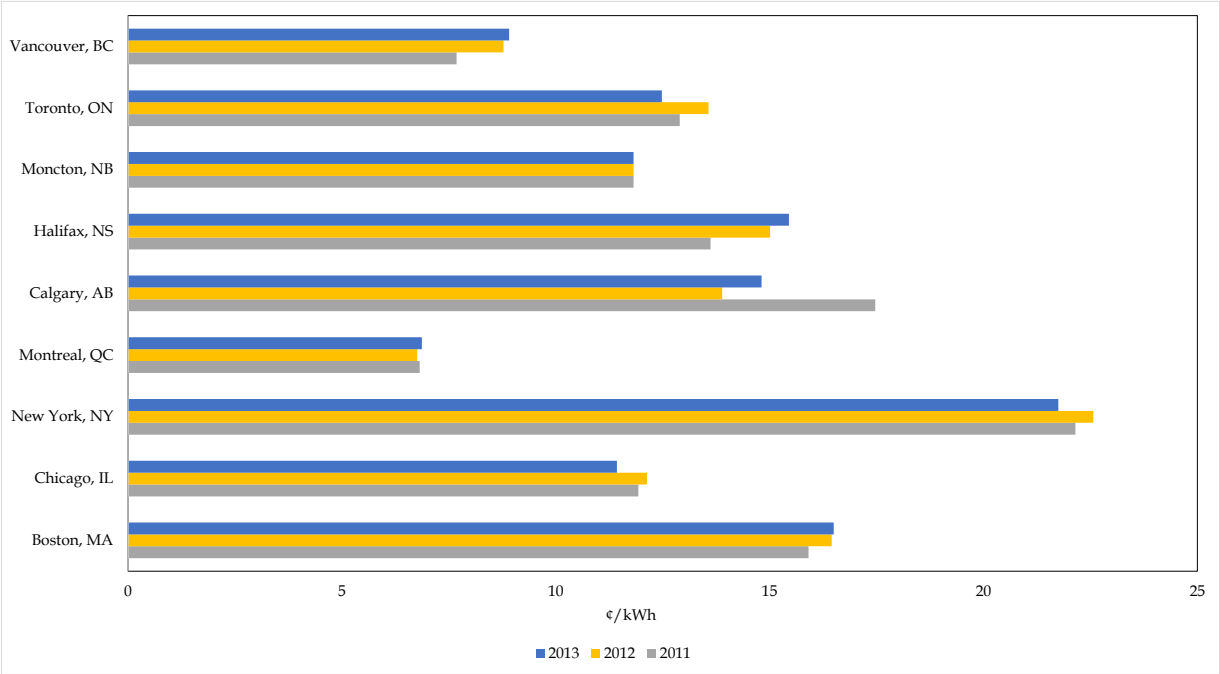




The main power provider in Nova Scotia is Nova Scotia Power Incorporated ("NSPI"). It is a vertically-integrated utility which owns over 95% of generation, transmission and distribution

systems, and serves about 500,000 customers. NPSI is a regulated utility, subject to Nova Scotia Utility and Review Board ("UARB") and regulation set out in Nova Scotia's Public Utilities Act. Other utilities in Nova Scotia are municipal utilities, which also come under UARB regulation. Wholesale power markets are open to competitive providers, but they are not allowed to supply retail customers directly (except for low impact renewable electricity in the near future). They are allowed to sell to NSPI and the municipal utilities. A wholesale power provider must submit an interconnection request, and pay a deposit towards the cost of an interconnection feasibility study.[1] A certificate of public good ("CPG") is not required.

Nova Scotia has some of the highest retail power prices in Canada though prices are lower than in key cities in the United States (see Figure 2).

**Figure 2. Electricity costs for residential customers, selected North American cities**




Source: Hydro Quebec. (Note: prices do not include taxes)

There is active public discussion as to the reasons Nova Scotia's rates are high compared with other Canadian cities. Some cite high fuel prices, while others point to lack of utility incentives as a driver.[2] As noted by LEI, an indicative scan of smaller, more isolated, yet well-developed

[1] Nova Scotia Power. *Standard Generator Interconnection Procedures (GIP)*. October 2009 http://oasis.nspower.ca/site/media/oasis/RevisedGIPFeb102010.pdf>.

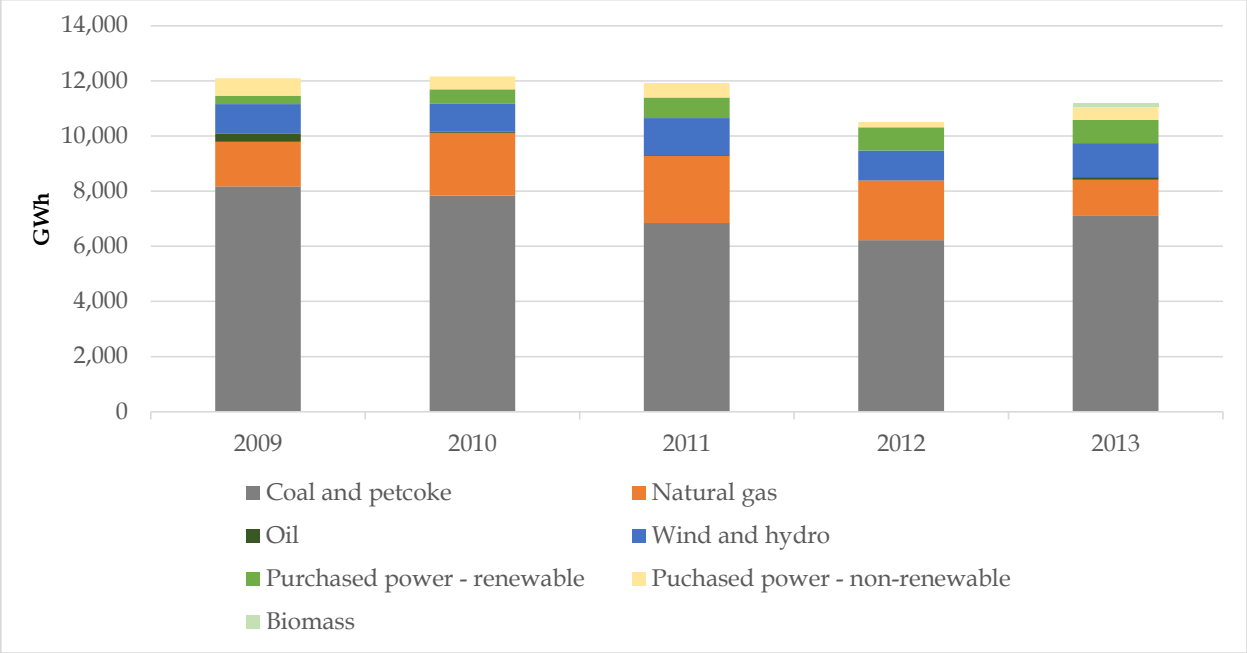
[2] CBC News Nova Scotia. "Power rate increase could begin in 2016: Emera." May 7, 2014. <http://www.cbc.ca/news/canada/nova-scotia/power-rate-increase-could-begin-in-2016-emera-1.2635547> .The Chronicle Herald. "Political promises on Nova Scotia Power need a good audit." October

jurisdictions tes
are not anomalous.[3] In addition, because Nova Scotia's system is investor-owned and not publicly-owned, power prices do not reflect the implicit subsidies often found in public power. These implicit subsidies include lower-cost debt and the lower returns that shareholders tend to demand from public companies relative to private companies, as well as several other factors.[4]

## 2.1 Electric power system characteristics

Power generation in NSPI includes coal, petroleum coke, oil, natural gas, biomass, wind, tidal and hydro power plants (see Figure 3).

**Figure 3. Annual electricity production by type of fuel, NSPI**




Source: NSPI.

26, 2012. <http://thechronicleherald.ca/tags/nova-scotia-power>. The Chronicle Herald. "Audit: NSP too cosy (sic) with natural gas provider." September 19, 2012.

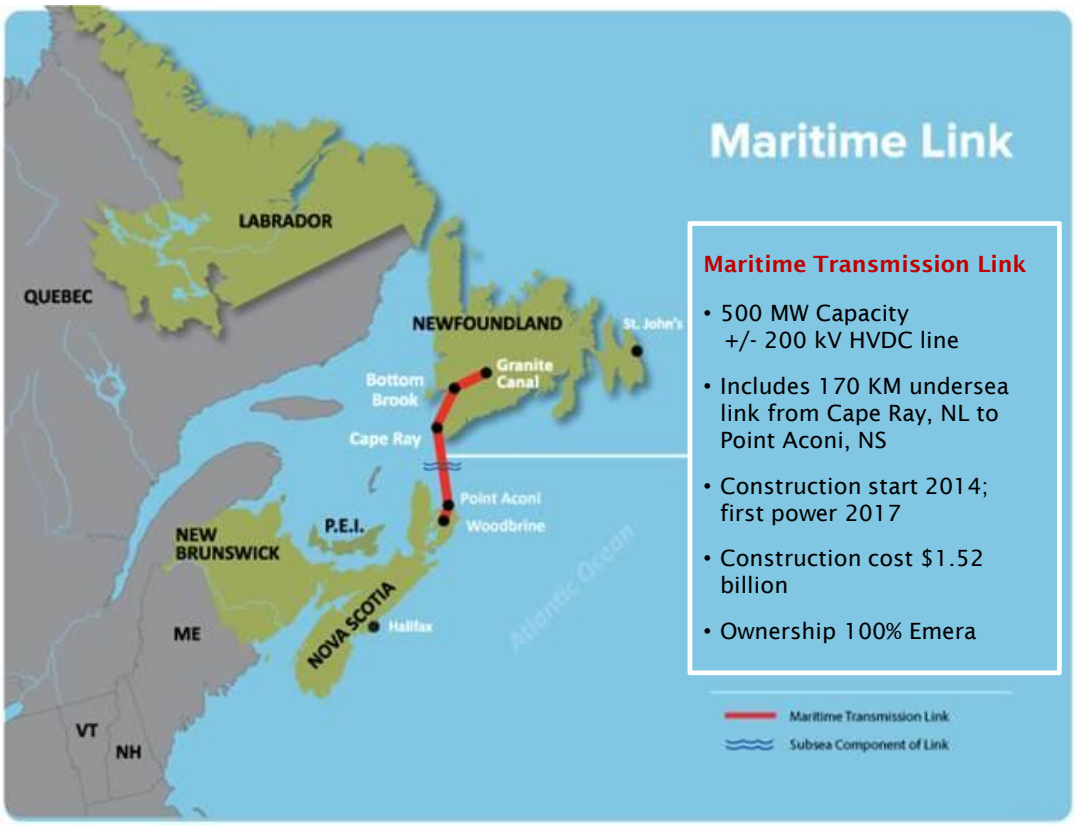
[3] "Regulatory economics and performance-based ratemaking." *London Economics International, LLC*. Prepared for NS DOE. May 2, 2014.

[4] "Power prices in context: Comparing Alberta delivered electricity prices to other Canadian provinces on a level playing field." *London Economics International, LLC.* Prepared for Independent Power Producers Society of Alberta (IPPSA) and others. March 2, 2011.

The majority of Nova Scotia's power production is from solid fuels—coal and petroleum coke. This is a legacy of the time when Nova Scotia mined its own coal. However, the mines closed around 2000, and now Nova Scotia imports low-sulfur and low mercury coal. Nova Scotia has also been a substantial producer of natural gas, which will be discussed in more detail in a following section.

As a virtual electricity island, Nova Scotia has very limited interconnections with other markets. At the moment, there is only one major link: the 350 MW non-firm NS Power/NB Power inter-tie that connects Nova Scotia to New Brunswick, allowing imports into Nova Scotia. A second link, the Maritime Link Transmission Project, is under development by Emera, Inc. It will connect the Island of Newfoundland with Cape Breton, Nova Scotia. It consists of two high voltage direct current ("HVDC") lines, rated at 250 MW each, for a total of 500 MWs of non-firm capacity, to bring renewable energy (hydropower) into Nova Scotia from Newfoundland (See Figure 4).

**Figure 4. Maritime Power Link**




Source: Emera, Inc. "Maritime Transmission Link."
<http://www.emeranl.com/site/media/emeranl/MaritimeLink_02.05.14.png>.

The project was approved by the UARB in December 2013, and construction is under way. This hydro power project is expected to be one of the key sources of renewable power to meet Nova Scotia's renewable targets for 2020 (discussed in more detail in Section 3.2 and Section 4.2).

Plans are for operations to begin in 2017. Nova Scotia is actively evaluating other transmission options in cooperation with Labrador, Newfoundland, and New Brunswick.[5]

NSPI's transmission system comprises 5,300 kilometers (operating at voltages from 69 KV to 345 KV) of transmission lines and roughly 29,500 transmission towers. NSPI also owns most of the province's distribution system, with 500,000 distribution poles and 190 substations.

Nova Scotia's grid is interconnected with New Brunswick's transmission system. The New Brunswick System Operator ("NBSO") serves as the reliability coordinator for the Maritime Provinces (Nova Scotia and New Brunswick), while the Nova Scotia Power System Operator ("NSPSO") is the balancing authority within Nova Scotia. The NSPSO is responsible for managing the complex short-term interactions on the network, monitoring and maintaining system reliability, and for the safe operation of the transmission grid. Its responsibilities also include taking actions determined by NBSO to preserve the security of the Nova Scotia transmission system. NSPSO is not an independent stand-alone organization in the way that, for example, the New England ISO is. Instead, NSPSO is a functionally unbundled part of NSPI. In contrast, as of New Brunswick's Electricity Act of October 2013, NBSO became amalgamated with the New Brunswick Power Corporation ("NBPC"), as the law reintegrated NBPC into a vertically-integrated utility.[6] Thus, the system operations functions of NBSO are now contained within NBPC.

The Nova Scotia Electricity Act passed in 2004 opened the power sector to wholesale competition, in that it allowed the Municipal Electric Utilities of Nova Scotia ("MEUNS") to purchase power from entities other than NSPI.[7] The MEUNS and NSPI are the only entities allowed by law to buy wholesale power. Open access to the transmission grid is required. To support open access, NSPSO operates an Open Access Same time Information System ("OASIS"). NSPI has contracted NBSO to manage its OASIS web site. The process for a generator to connect to the grid is defined in the Standard Generator Interconnection procedures approved by the UARB.[8]

The Electricity Reform Act passed in 2013 allows licensed generators to sell low impact renewable electricity generated within the province directly to NSPI's retail customers (see Section 3.2 for discussion of Electricity Reform Act). The Municipal Electric Utilities' retail

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[5] Transmission Planning Committee (sponsored by the Government of Canada). *Atlantic Energy Gateway Transmission Modeling Study*. March 30, 2012.

[6] New Brunswick Legislature. *Electricity Ac*t. 2013. < http://www.gnb.ca/legis/bill/pdf/57/3/Bill-39.pdf>.

[7] Nova Scotia Legislature. *Electricity Act*. 2004. <http://nslegislature.ca.leg c/statutes/elctrcty.htm >.

[8] Nova Scotia Power. *Standard Generator Interconnection Procedures (GIP)*. October 2009. <http://oasis.nspower.ca/site/media/oasis/RevisedGIPFeb102010.pdf>.



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market is exempted from this renewable to retail market opening. [9] It could take a year or so before new "renewable-to-retail" tariffs are in place, which would enable such transactions (currently not expected before 2015).[10] Other than that, the retail market is not open to competition.

### 2.1.1 Reliability

The power system in Nova Scotia is part of the North American Electric Reliability Corporation ("NERC") region known as Northeast Power Coordinating Council ("NPCC"), and is subject to NERC's mandatory reliability rules (discussed in more detail in Section 3.8). NERC however does not have the ability to fine NSPI for reliability violations. NSPI maintains a minimum planning reserve margin of 20 percent above forecasted firm peak demand in order to comply with NPCC reliability criteria.

There are no official reliability or customer service targets in Nova Scotia.[11] NSPI does however track commonly-used reliability metrics: System Average Interruption Frequency Index ("SAIFI"); System Average Interruption Duration Index ("SAIDI") and Customer Average Interruption Duration Index ("CAIDI") (see Figure 5).

**Figure 5. Commonly used measurements of reliability**

| Reliability Standard | Calculation | Units | Good For |
|---|---|---|---|
| **SAIDI** | (Total Min. each customer is without service) / (Total number of System Customers) | Minutes per customer per year | Transmission |
| **SAIFI** | (Frequency that customer is without service) / (Total number of System Customers) | Outages per customer per year | Transmission |
| **CAIDI** | SAIDI / SAIFI | Minutes per outage | Distribution |

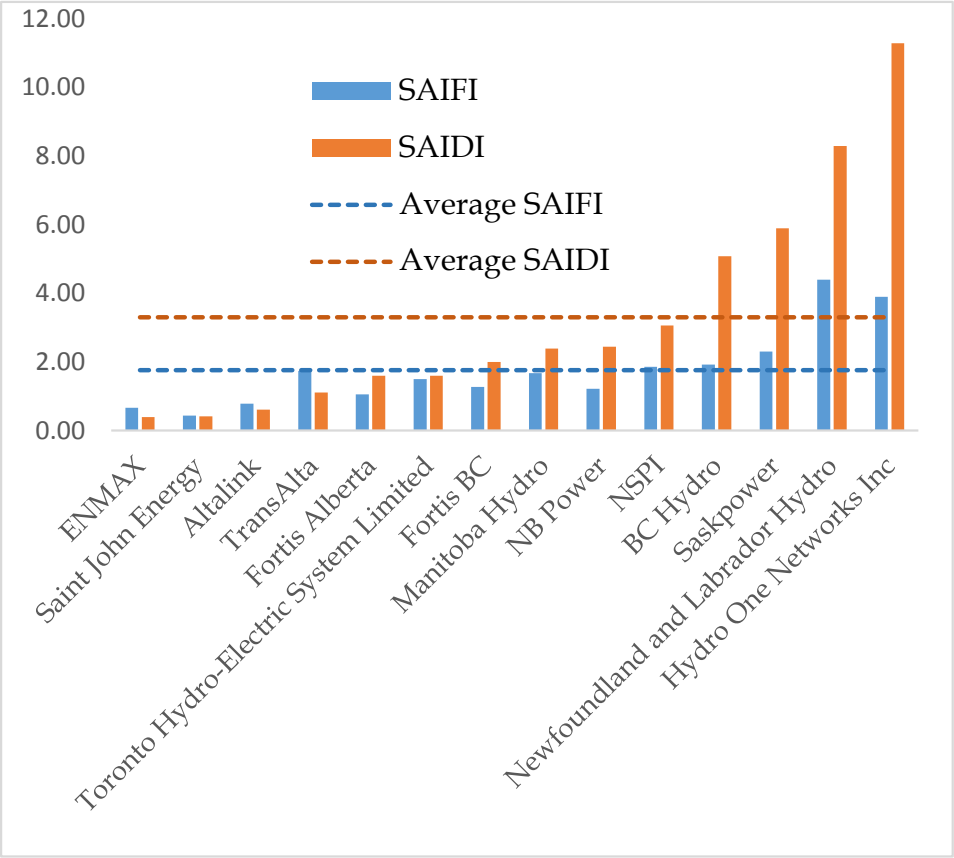
For 2012 NSPI's reliability was about average compared with an indicative sample of other Canadian utilities (see Figure 6). There is no forward capacity market in Nova Scotia. Long-term reliability is addressed in UARB's requirements for a system planning process, discussed in more detail in Section 3.9.

[9] Nova Scotia Legislature. *Electricity Reform Act.* 2014.
<http://nslegislature.ca/legc/bills/61st_1st/3rd_read/b049.htm>.

[10] Emera, Inc. "Management's Discussion and Analysis."
<http://www.snl.com/Cache/1001183246.PDF?Y=&O=PDF&D=&fid=1001183246&T=&iid=4072693>.

[11] Nova Scotia Legislature. *Bill No. 4. Public Utilities Act (amended).* First reading November 29, 2013
<http://nslegislature.ca/legc/bills/62nd_1st/1st_read/b004.htm>.

**Figure 6. System reliability in 2012, selected Canadian utilities**




Sources: Utility annual reports, regulator websites.

### 2.1.2 Number of players in each segment of the industry

The generation sector in Nova Scotia comprises only a handful of players. The investor-owned utility, NSPI, owns most of the operating generation capacity (2,450 MW) (see Figure 7). IPPs own a number of wind plants and other renewables totalling 273 MW, 10 percent of Nova Scotia's operating capacity. There is one municipal utility which owns a small generating plant, and one consumer (a pulp and paper mill) which also owns a small plant (see Figure 8).

The dominant utility, NSPI, was created in 1992 when the Crown Corporation Nova Scotia Power was privatized. In 1999, NSPI became a subsidiary of Emera Inc., an international energy firm based in Halifax. Emera also owns electric utilities in Maine, New Brunswick, Newfoundland and Labrador, and several Caribbean countries. Emera invests in generation, transmission and distribution, as well as gas transmission and utility energy services. It owns the Maritime Link transmission project. Emera also owns gas transmission from the Canaport liquefied natural gas ("LNG") terminal in New Brunswick, and is a minority owner of the Maritimes and Northeast pipeline ("M&NP"), both discussed in more detail in Section 2.2.

**Figure 7. Operating generation capacity in Nova Scotia by fuel type and owner (MW)**

| Type of fuel | Type of owner | | | | |
|---|---|---|---|---|---|
| | Investor-owned utility | IPP | Municipal utility | Consumer | Total |
| Coal/Coke | 1,246 | | | | 1,246 |
| Gas | 498 | | | | 498 |
| Oil | 202 | | | | 202 |
| Water | 382 | 1 | | 5 | 387 |
| Wind | 120 | 190 | | | 310 |
| Other Renewable | 3 | 82 | 2 | | 87 |
| Total | 2,450 | 273 | 2 | 5 | 2,730 |

Source: Commercial database provider.

The bi-annual audit of NSPI's fuel purchases commissioned by the UARB in 2012 raised concerns about the impact of the ownership structure of NSPI on its ability to purchase gas at the lowest possible price. The UARB eventually ruled that NSPI overpaid for gas and coal in the amount of $4.5 million, about 1% of NSPI's fuel costs. The other 99 percent of fuel costs were approved, and the UARB found that NSPI's fuel procurement team was competent and professional.[12]

There are six municipal distribution utilities in Nova Scotia: the Antigonish Electric Utility, the Berwick Electric Light Commission; the Canso Electric Light Commission; the Lunenburg Electric Utility; the Mahone Bay Electric Utility; and the Riverport Electric Light Commission. These cooperate as the Municipal Electric Utilities of Nova Scotia ("MEUNS"). The Electricity Act passed in 2004 enabled municipal utilities to purchase power from generators other than NSPI, either from IPPs or producers located outside of the province. In practice the MEUNS purchase most of their electricity from NSPI.

[12] Nova Scotia Utility and Review Board. Docket M04972. December 21, 2012.

**Figure 8. Owners of power generation in Nova Scotia**

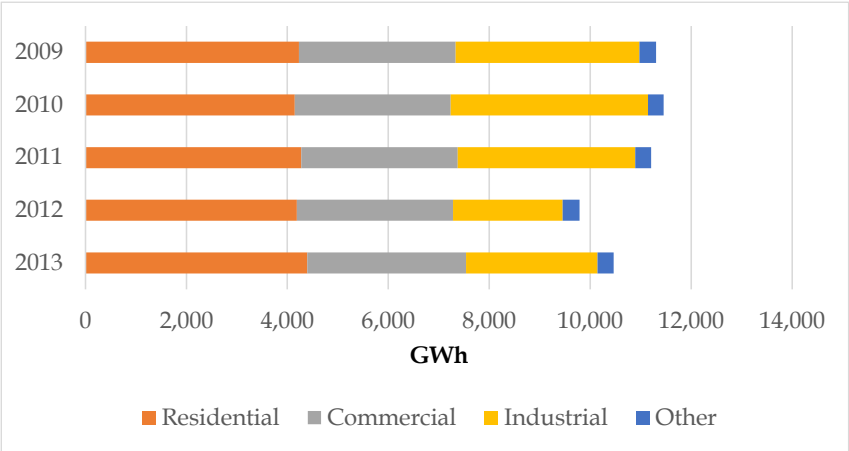
| Owner | Type | Capacity (MW) |
|---|---|---|
| **Cape Breton Power** | Independent power producer | 18 |
| **Confederation Power Inc** | Independent power producer | 1 |
| **Firelight Infrastructure Partners LP** | Independent power producer | 15 |
| **FPLE Canadian Wind Ulc** | Independent power producer | 31 |
| **Glen Dhu Wind Energy LP** | Independent power producer | 62 |
| **Halifax Regional Municipality** | Municipal utility | 2 |
| **Minas Basin Pulp & Power Ltd** | Consumer | 5 |
| **Morgan Falls Power Co** | Independent power producer | 1 |
| **Nova Scotia Power Inc** | Investor-owned utility | 2,450 |
| **Renewable Energy Services Ltd** | Independent power producer | 12 |
| **Springhill Riverhurst Wind Power Ltd** | Independent power producer | 6 |
| **Sprott Power Corp** | Independent power producer | 16 |
| **Wind Prospect Developments Ltd** | Independent power producer | 4 |

Source: Commercial database provider.

### 2.1.3 Electric power end-users in each customer category

Residential customers comprise the largest power load in Nova Scotia (see Figure 9). Industrial customers were formerly the second largest customer type served by NSPI, but in 2012 two large pulp and paper mills closed. The substantial decline in sales in 2012 and 2013 compared to previous years illustrates the exposure of a small utility such as NSPI to the decisions of a handful of customers.

**Figure 9. Electricity sales volumes by customer type, NSPI**

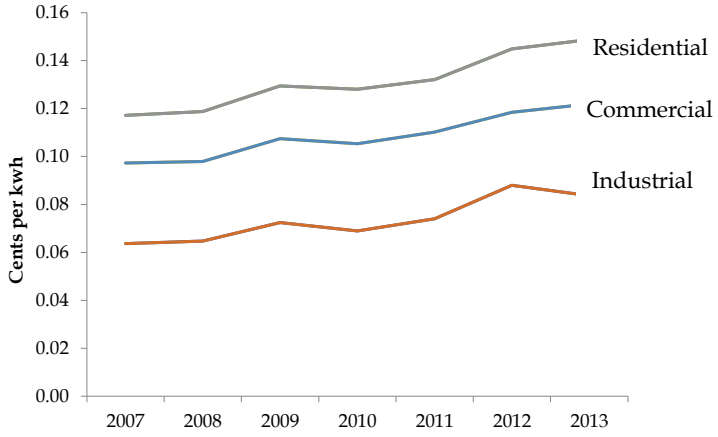



Source: NSPI.
Note: "Other" includes exports, municipal utilities, and street lights.

### 2.1.4 End-use electricity rates, by customer category

Rates paid by utility end-users generally comprise demand charges and consumption charges, and sometimes include other types of charges and taxes. Rates for commercial and industrial customers often vary by size of the customer. An overall sense of the trend in electricity rates for a customer class as a whole can be arrived at by dividing total annual revenues from the customer class by total annual sales to that customer class. This calculation shows that rates in Nova Scotia (for NSPI customers) have been generally increasing over the past few years (see Figure 10).

**Figure 10. Effective rates (annual revenues/sales volumes), NSPI customers**




Source: NSPI.

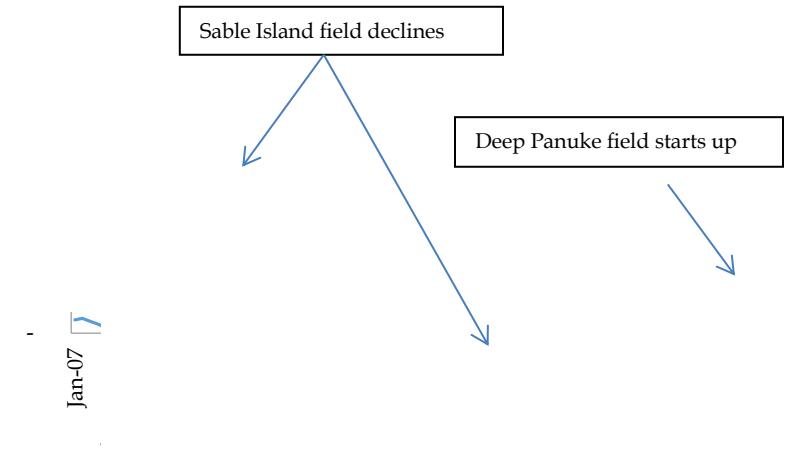
## 2.2 Natural gas supplies and flows

Nova Scotia has and continues to be a substantial producer of natural gas. The Sable Island Offshore Energy project ("SOEP") began producing gas in 2000, and produced at a peak of more than 550 MMcf/d in 2001. This field is now in decline, producing about 150MMcf/d. A second field, Deep Panuke, began producing in 2013. Deep Panuke's owners expect it to produce for 13 years (to 2026) at an average rate of about 300 MMcf/d, but incorporating a steep decline rate like SOEP. There is a currently very little new offshore natural gas exploration under way.

The trends in gas production in Nova Scotia have important implications for power prices. As Sable Island gas production declined, Nova Scotia became short on gas in the winter and in 2012/13 had to import natural gas and subsequently the natural gas market prices from New England (see Figure 11). New England is itself at the far end of the United States gas transport network, and often suffers from pipeline bottlenecks in the winter. So wintertime gas purchases for Nova Scotia were and are projected to remain expensive in the near term. During 2013, gas production from Deep Panuke started up, and gas exports began to increase again.

Nova Scotia exports gas via Spectra's M&NP, to New Brunswick and New England. Spectra (the majority owner, along with Exxon and Emera) in February 2014 announced plans to reverse the flow of the pipeline, to bring Marcellus shale gas from New York and Pennsylvania into New England and the Maritimes.[13] The reversal would still allow gas to be exported from Nova Scotia, when market conditions call for it.

**Figure 11. Nova Scotia key natural gas trends, 2007-2014**




Source: Statistics Canada

[13] Spectra Energy. "New Projects and Our Process." <http://www.spectraenergy.com/Operations/New-Projects-and-Our-Process/New-Projects-in-US/Atlantic-Bridge/>. 2014.

LNG is imported into the Canaport terminal in Saint John, New Brunswick. The terminal has re-gasification and a send-out capacity of 1.2 Bcf/day. Canaport is connected to the M&NP (at Baileyville, Maine) via the Emera-owned Brunswick Pipeline, rated at 850 MMcf/d. Thus, gas from Canaport flows into the United States first—it has no direct connection with consumers in Nova Scotia. Canaport has been operating mostly in the winter to help meet gas demand in peak months, with minimal flows during other seasons.[14]

An LNG export facility at Goldboro (where SOEP and Deep Panuke gas comes ashore) is under development. The gas supply is intended to come from onshore production such as the Marcellus shale in the US northeast via the MN&P, to be exported to markets in Europe, Latin America, and Asia.[15]

Currently there are no gas storage facilities operating in Nova Scotia. One project is under development, the Alton Natural Gas Storage project. Planned capacity is 4-5 billion cubic feet ("Bcf") in underground salt caverns. It could eventually be expanded to 20 Bcf or more. [16]

Nova Scotia has an estimated 69 trillion cubic feet ("Tcf") of unconventional gas in place, including shale gas and gas from coal fields.[17] Typically, only a small percentage of oil or gas resources in place are eventually commercially recoverable, and this is determined by geological factors, technology, and commodity prices. Several exploration wells were drilled in 2007 and 2008, but drilling is now on hold, as the Nova Scotia government has not, since 2011 approved any permits for gas production that involves hydraulic fracturing ("fracking"). The moratorium will remain in place until the summer of 2014, when a provincial review of fracking is expected to be completed.[18] This review involves public consultation, and is currently under way.

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[14] Nova Scotia. The Future of Natural Gas Supply for Nova Scotia, 2013. March 28, 2013. <http://0-fs01.cito.gov.ns.ca.legcat.gov.ns.ca/deposit/b10664245.pdf>.

[15] Goldboro LNG. "June 18 2013 Open House Presentation." *Goldboro LNG*. <www.goldborolng.com/reviews-assessments/meeting-matierals/.>

[16] Nova Scotia. The Future of Natural Gas Supply for Nova Scotia, 2013. March 28, 2013. <http://0fs01.cito.gov.ns.ca.legcat.gov.ns.ca/deposit/b10664245.pdf>.

[17] "Shale Gas in Canada: Resource Potential, Current Production, and Economic Implications." Jed Chong, Milana Simikian. January 30, 2014. <www.parl.gc.ca.>

[18] Nova Scotia. "Nova Scotia Review of Hydraulic Fracturing." *Nova Scotia.* www.nova scotia.ca>.

# 3 Governing institutions and the legal and regulatory framework

The institutional landscape of the Nova Scotia power sector includes the organizations (federal and provincial, legislative and regulatory) that design and enforce the "rules of the game." They are responsible for policy-making, regulation design, and enforcement.

## 3.1 Governing institutions

Policy-making is the purview of Nova Scotia Legislative Assembly. The Nova Scotia Department of Energy ("DOE") serves to execute energy-related policy. The DOE's mandate is outlined in the *Public Service Act (Chapter 376 of the Revised Statues, 1989)*.[19] Briefly, DOE's role is to "manage and promote energy resources to achieve optimum economic, social, and environmental value from the energy sector." The DOE participates in UARB proceedings.

Power sector regulation design and enforcement are the purview of the UARB. The UARB is a quasi-judicial body with regulatory and adjudicative jurisdiction based on the Utility and Review Board Act of 1992.[20] The Act allows for 8-10 board members, to be appointed by the Governor in Council. The UARB has regulatory authority, and exercises general supervision over any electric utilities operating as public utilities in the province. The UARB reports to the Nova Scotia Legislature.

The UARB is also the authority that grants franchises for natural gas distribution in Nova Scotia, and exercises general regulatory supervision over gas distribution, pipelines, gas plants, and underground storage facilities. This jurisdiction includes "setting rates, tolls, and charges; regulations for provision of services; approval of capital expenditures greater than $250,000, and any other matter the Board feels is necessary to properly exercise its mandate."[21] As the power sector regulator, the UARB also investigates customer complaints concerning power utilities. The UARB conducts a public hearing process for utility rate setting described in more detail in Section 3.4. The Renewable Energy Administrator ("REA") is responsible for conducting bidding for renewable energy projects,[22] and has awarded projects to IPPs, with NSPI as minority partner.[23]

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[19] Nova Scotia. *Public Service Act (Chapter 376 of the Revised Statues, 1989*). <http://nslegislature.ca/legc/statutes/public%20service.pdf>.

[20] Nova Scotia. *Utility and Review Board A*ct. 1992. < http://nslegislature.ca/legc/statutes/utility.htm >.

[21] Nova Scotia Utility and Review Board. "Electricity." < http://nsuarb.novascotia.ca/content/electricity>.

[22] The Chronicle Herald. "Wind farm winners announced." August 2, 2012. *The Chronicle Herald*. <http://thechronicleherald.ca/business/123220-wind-farm-winners-announced>

[23] Nova Scotia. *Renewable Electricity Plan*, April 2010.

Environment Canada is the federal agency responsible for administration of the Canadian Environmental Protection Act ("CEPA") 1999, which covers toxic air pollutants including greenhouse gases ("GHGs"). Nova Scotia has successfully negotiated an Equivalency Agreement that will enable Nova Scotia to apply a more flexible but equivalent alternative to the federal coal regulations.

The National Energy Board ("NEB") is an independent federal agency regulating pipelines, energy development and trade. Its scope of authority includes international and interprovincial aspects of the oil, gas, and electric utility industries. This includes electricity exports, international and inter-provincial power lines, and nuclear safety. The NEB is accountable to the Canadian Parliament through the Minister of Natural Resources Canada. Within a province's own boundaries, the provincial government has jurisdiction over electricity generation, transmission and distribution. Securities and financial regulation are the purview of the Nova Scotia Securities Commission.

### 3.2 Key legislation governing the electric power sector

Key legislation governing the power sector in Nova Scotia has evolved over time. Legislation has evolved from general oversight of public utilities, to enabling a somewhat more competitive electric power market, to pursuit of environmental goals (see Figure 12).

The Public Utilities Act outlined the responsibilities of the UARB as well as the responsibilities of any public utility operating in Nova Scotia.[24] The Nova Scotia Power Privatization Act required and specified the process for privatizing the Crown Corporation Nova Scotia Power. The Electricity Act opened the Nova Scotia market to wholesale competition.

Several environmental protection acts passed during the 1990s authorized GHG and air emissions regulations.[25] Under the Environment Act of 2004 and its amendments, Nova Scotia Greenhouse Gas Emissions Regulations specify hard caps on GHG emissions.[26] Regulations call for a reduction from 10 to 7.5 million tonnes from 2010 to 2020 for NSPI. The Nova Scotia Air Quality Regulations also specify emission caps for sulfur dioxide ($SO_2$), nitrogen oxide ("$NO_x$") and mercury ("Hg").[27]

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[24] Nova Scotia. *Public Service Act (Chapter 376 of the Revised Statues, 1989).* <http://nslegislature.ca/legc/statutes/public%20service.pdf>.

[25] Nova Scotia. *Environmental Goals and Sustainable Prosperity Act (Chapter 7 of the Acts of 2007*). <http://nslegislature.ca/legc/statutes/environmental%20goals%20and%20sustainable%20prosperity.pdf>.

[26] Nova Scotia. *Greenhouse Gas Emissions Regulations made under subsection 28(6) and Section 112 of the Environment Act.* <http://www.novascotia.ca/just/regulations/regs/envgreenhouse.htm > Environmental Goals and Sustainable Prosperity Act Chapter 7 of the Acts of 2007. <http://nslegislature.ca/legc/statutes/environmental%20goals%20and%20sustainable%20prosperity.pdf

[27] Nova Scotia. *Air Quality Regulations made under Section 112 of the Environment Act.* Amended December 2010.

**Figure 12. Key legislation governing the electric power sector**

| Legislation/Regulation | Year | Key components |
|---|---|---|
| **Public Utilities Act** | 1989 | Outlines DOE's mandate and authorizes the UARB |
| **Nova Scotia Power Privatization Act** | 1992 | Privatized the Crown Corporation, Nova Scotia Power |
| **Environment Act** | 1994-95 | Authorized greenhouse gas emissions regulations and air quality regulations |
| **Canadian Environmental Protection Act (CEPA)** | 1999 | Authorized regulations that cap $CO_2$ emissions from coal plants at 420 tons per GWh (comparable to CCGT emissions). These go into effect July 1, 2015 |
| **Electricity Act** | 2004, went into force 2007, amended in 2010, 2011 | Opened power sector to wholesale competition (but not retail competition); enabled municipal utilities to buy power from IPPs or producers outside of Nova Scotia<br><br>Created Renewable Electricity Administrator, required Energy Minister to make regulations to achieve 40% renewable power by 2020. Authorized Renewable Electricity Standards |
| **Renewable Energy Standard** | 2007 | Required 25% renewable electricity generation by 2015; replaced by Renewable Electricity Standards authorized by the Energy Reform Act in 2013 |
| **Environmental Goals and Sustainable Prosperity Act (EGSPA)** | 2007, amended in 2012 | Required economy-wide GHG emission target of 10% below 1990 by 2020. This was put into force with Greenhouse Gas Emissions Regulations. EGSPA also required reductions $NO_x$, $SO_2$ and Hg emissions. |
| **Efficiency Nova Scotia Corporation Act** | 2009 | Created Efficiency Nova Scotia ("ENS"), an independent non-profit corporation tasked with implementing demand-side management ("DSM") programs, to promote efficiency and conservation of energy; creates DSM fund |
| **Electricity Reform Act** | 2013 | Allows renewable power to be sold directly to retail customers<br><br>Required Energy Minister to complete a public consultation on future energy policy, plans, programs, and regulations |
| **Electricity Efficiency and Conservation Restructuring Act** | 2014 | Amends the Public Utilities Act (1989) to promote energy efficiency and conservation, by among other things, requiring NSPI to provide information as is necessary for the first franchise holder (franchise granted by the Energy Minister to exclusively provide NSPI with cost-effective electricity efficiency and conservation activities) to provide such electricity |
| **Equivalency Agreement** | Signed in 2014, effective July 2015 | Recognizes that the effects on emissions levels of the limits determined by Nova Scotia's *GHG Emissions Regulations* under Nova Scotia's *Environment Act,* and *Canada's Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* under *CEPA* are functionally equivalent, for the years 2015-2019. For 2020-2030, Nova Scotia agreed to amend its regulations. |

Source: Nova Scotia. *Public Utilities Act.* 1989; Nova Scotia. *Nova Scotia Power Privatization Act*. 1992; Nova Scotia. *Environment Act.* 1995; Government of Canada. *Canadian Environmental Protection Act*. 1999; Nova Scotia. *Electricity Act.* 2004; Government of Canada. Equivalency Agreement; Nova Scotia. *Renewable Electricity Regulations*. 2014; Nova Scotia. *Environmental Goals and Sustainable Prosperity Act.* 2007; Nova Scotia. *Efficiency Nova Scotia Corporation Act*. 2009; Nova Scotia. *Electricity Reform Act.* 2013; Nova Scotia. *Electricity Efficiency and Conservation Restructuring Act.* 2014.

Pursuant to the CEPA 1999, the Canadian government developed regulations on coal-fired power plants. These performance standards apply to new coal-fired electricity generation units

<http://www.novascotia.ca/just/regulations/regs/envairqt.htm>.

(units that began producing power after June 30, 2015), and units when they have reached the end of their useful lives (50 years). Nova Scotia was able to obtain an equivalency agreement with the federal government which allows the province to use provincial regulations to achieve the same or better GHG reductions from the electricity sector as would occur under federal regulation. The provincial GHG regulations require the electricity sector to reduce its GHG emissions to 7.5 MT by 2020 and 4.5 MT by 2030. The required reductions are approximately 25% below 2007 levels by 2020 and 55% below 2007 levels by 2030. If the Province had not been successful in negotiating the equivalency agreement, the electricity sector in Nova Scotia would have needed to comply with the federal coal regulation, resulting in earlier shutdowns of several coal units.

Upon finalization of the equivalency agreement and the federal government issuing of an Order in Council that stands down the application of the federal coal regulation in Nova Scotia, Nova Scotia's coal fired generating stations will not be required to conform to the Federal Government's Coal Regulation. The federal coal regulation requires each facility to meet an annual emissions performance target of 0.42 tonnes of $CO_2$/MWh at 50 years of age. Instead, Nova Scotia's regulatory approach provides flexibility to meet emissions caps (single year or multiyear) through 2030 in whatever ways are most cost effective.

However Nova Scotia's coal fired fleet is aging (8 coal fired units vary in vintage from 1969 to 1994), and it is our assumption that these units will require significant investment (retrofit, refurbishment) or retirement at 60 years of age (50 years of full capacity plus 10 final years of reduced capacity). As such, we expect that important decisions (invest or retire) that will impact Nova Scotia's current generating capacity of 1,250 MW will need to be made in the coming years.

NSPI has said that completion of the Maritime Link transmission project will allow the company to replace the coal-fired power from two Lingan units with renewable power, with fewer upgrades to the transmission system than if other plants were to be retired (see Section 4.1).

Renewable power and efficiency are addressed in the more recent legislation. Nova Scotia's Renewable Electricity Regulations require 25 percent renewable electricity supply by 2015, and 40 percent by 2020 (see Figure 13).[28] These targets have the force of regulation, with penalties for missing targets. The majority of Nova Scotia's power is generated by coal and petroleum coke—in order to achieve 40% renewable power, there will have to be a large shift in the generation fuel mix. Renewable projects can be built by IPPs, under the request for proposal ("RFP") process administered by the REA; NSPI is also required to help meet the renewable power target by building new plants itself. NSPI is also supporting imports of renewable power on its transmission system by retiring the Lingan coal unit to make way for the Maritime Link project.

[28] Nova Scotia. *Renewable Electricity Regulations*. 2014. <http://www.novascotia.ca/just/regulations/regs/elecrenew.htm>.

**Figure 13. Nova Scotia Renewable Electricity Standard: Key Components**

| Renewable Electricity Standard<br>Key components |
|---|
| **Definition:** Defines "renewable low-impact electricity generation facility" as a facility in the province that generates renewable power from any of the following sources: solar, wind, run-of-river hydro, ocean-powered energy, tidal energy, wave energy, sustainably-harvested biomass, landfill gas, and other sources that in the opinion of the Minister and consistent with Canadian practices are able to be replenished through natural or sustainable processes; and has received all required approvals and permits |
| **Retail access:** Allows licensed generators to sell low-impact renewable power generated within the province directly to retail customers |
| **Penalties:** Requires all load-serving entities ("LSEs") to provide renewable power to customers with penalties for non-compliance |
| **Municipal utilities:** Each year from 2015-2020, any municipal utility that purchases power from generators other than NSPI must ensure that at least 25% of its electricity supply from other than NSPI be met by renewable energy. Each year beginning in 2020, that percentage is 40% |
| **NSPI:** Each year from 2015-2020, any LSE including NSPI, must supply its customers with at least 25% renewable electricity. Each year beginning in 2020, that percentage is 40% |
| **Feed-in tariff:** UARB must set a community feed-in tariff ("COMFIT") for renewable power. To qualify, a renewable project must be community-owned and connected at the distribution grid. |
| **REA:** Renewable Electricity Administrator was appointed for a short period of time, to manage procurement of large -scale IPP wind procurement program: running the bidding process, evaluating proposals, and awarding power purchase agreements ("PPAs") |

Source: Nova Scotia. *Renewable Energy Regulations made under Section 5 of the Electricity Act*. 2014.

The Renewable Energy Regulations offer a community feed-in tariff ("COMFIT") to locally-based renewable electricity projects. To qualify, a project must be community-owned (owned by a municipality, First Nations, co-operatives, and non-profit groups) and connected at the distribution grid. The tariff guarantees a fixed price for a fixed period of time; the price reflects the cost of generating the power, plus a reasonable return for the producer.[29] The UARB sets the COMFIT rate; see Figure 14 for recent rates. The COMFIT program's target was 100 MW when launched in 2011; by January 2014, 200 MW had been approved, though the province does not expect all of the projects to go forward.[30] The provincial government is currently reviewing the

[29] Nova Scotia. *Renewable Energy Plan*. April 2010.

[30] Nova Scotia. *Community Feed-In-Tariff Program Results Available*. March 6, 2014. <http://novascotia.ca/news/release/?id=20140306001 >.

program (as planned), as it assesses the feasibility and cost-effectiveness of integrating the already-approved projects into the grid.

**Figure 14. Community feed-in tariff ("COMFIT") rates**

| Technology | COMFIT rate |
|---|---|
| Wind > 50 kW | $131 per MWh |
| Wind ≤ 50 kW | $499 per MWh |
| Biomass combined heat and power ("CHP") | $175 per MWh |
| Small-scale in-stream tidal | $652 per MWh |
| Run-of-river hydroelectricity | $140 per MWh |

Source: Nova Scotia. *Report on the Review of the Community Feed-In-Tariff Program.*

In 2009 Nova Scotia created an independent entity, Efficiency Nova Scotia Corporation ("ENSC"), tasked with implementing demand-side management ("DSM") programs, to promote efficiency and conservation of electricity. In terms of DSM, NSPI currently offers time of day rates to customers who use electric thermal storage heating systems.

In 2013 the Electricity Reform Act also stipulated a review of the electricity sector, including policy, planning, and potential impacts of technology and market factors.[31] In January 2014, in response to the Electricity Reform Act, the DOE began a year-long comprehensive review of the province's electricity system.[32]

In May 2014, the Electricity Efficiency and Conservation Restructuring Act amended the Public Utilities Act to include the addition of an energy efficiency and conservation. The legislation removes the efficiency tax from electricity bills effective January 1st, 2015. It also requires NSPI to purchase "cost effective, reasonably available" energy efficiency from Efficiency Nova Scotia. The UARB will provide regulatory oversight of efficiency programs and determine affordability.[33]

[31] Nova Scotia. *Electricity Reform Act.* 2013. <http://nslegislature.ca/legc/bills/61st_1st/3rd_read/b049.htm>.

[32] Nova Scotia. *Scope of Work: Nova Scotia's Electricity System Review*. March 2014. <http://novascotia.ca/electricityfuture/pubs/NS-Electricity-Review-Scope-of-Work.pdf>.

[33] Nova Scotia. "Efficiency tax to come off, power bills to go down." *Nova Scotia Canada*. April 7, 2014. <http://novascotia.ca/news/release/?id=20140407005>.

### 3.3 Main power sector regulatory texts

The Public Utility Act is the legislation governing the UARB. The UARB, in turn promulgates regulations in various orders and decisions.

The main regulations governing the wholesale power market are the Wholesale Market Rules and Regulations published by the NSPSO Market Administrator.[34] These define the rights and obligations of the NSPSO and the market participants. They include defining the scope and objectives of the market; administration of the market, including compliance and monitoring, dispute resolution, data collection and analysis; defining planning and reliability functions; scheduling of energy transactions and ancillary services; and settlement.

NSPI's Open Access Transmission Tariff ("OATT") allows IPPs and municipalities to transact in the wholesale market. The OATT sets out the terms and rates under which NSPI's transmission system can be used by transmission customers for delivery of power produced by third parties.

UARB has mandatory Standards of Conduct ("SOC"), which serve as Nova Scotia's system for ensuring compliance with a range of NERC and the United States' Federal Energy Regulatory Commission ("FERC") requirements. These requirements mostly relate to Open Access to the transmission system. This is for reciprocity purposes only, as FERC has no direct jurisdiction over the Nova Scotia system.

### 3.4 Ratemaking regime and approval process

NSPI and the municipal electric utilities in Nova Scotia are regulated under a cost of service ("COS") model. As discussed in detail in the Literature Review document, COS provides clarity of investment signals as well as a transparent process. The major downside of COS is that it can encourage over-investment in utility capital.

The overall level of electricity rates is governed by the Public Utilities Act cited above, and electricity rates are subject to UARB approval. Adjustments to rates occur through either a General Rate Application ("GRA") or the Fuel Adjustment Mechanism ("FAM") process. Applications under either mechanism are adjudicated by the UARB through a public ratemaking regime and approval process (see Figure 15).[35]

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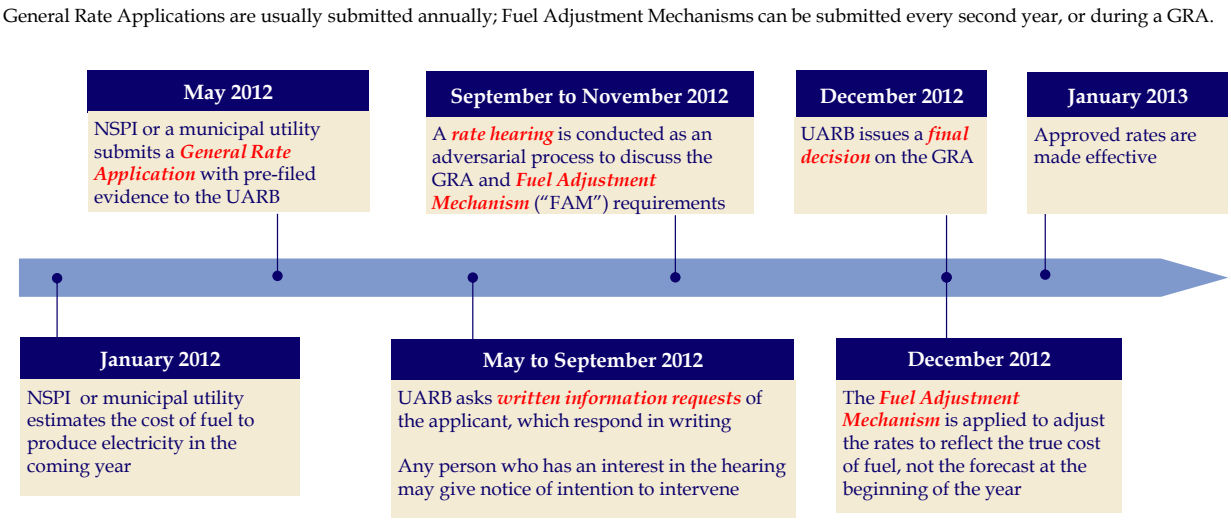
[34] Market Administrator, Nova Scotia Power System Operator. *Wholesale Market Rules and Regulations.* 2004. <http://oasis.nspower.ca/site/media/oasis/>.

[35] Nova Scotia Utility and Review Board. "Electricity." *Nova Scotia Utility and Review Board.* 2014. <http://nsuarb.novascotia.ca/content/electricity>.

After a public utility files an application there is an intervening period when the UARB asks for written information from the applicant. There are also oral hearings. There is no set period for filing rate applications, but NSPI is restricted to filing once per year.

**Figure 15. Ratemaking regime and approval process, most recent GRA**




Source: Nova Scotia UARB. "Electricity." *Nova Scotia Utility and Review Board*. 2014. Nova Scotia UARB. *Decision - E - NSPI - 2013 GRA*. December 21, 2012.

Applications under the FAM process (to address any over or under recovery of fuel costs and to establish the new base cost of fuel) are considered every second year. The FAM was implemented in 2009 to help address volatility of fuel prices, and is essentially a cost pass-through. A portion of the actual versus forecast fuel cost difference is allocated to NSPI. For differences up to $50 million, 90% of the savings or increase (over or under recovery) is passed on to ratepayers while 10% remains the responsibility of the utility. Any variance in excess of $50 million is passed on to ratepayers. Therefore, the total maximum effect on the utility in any given year is capped at $5 million. All of this is subject to the audit and hearing process. In addition, the UARB reviews NSPI's fuel costs and procurement practices throughout the year.

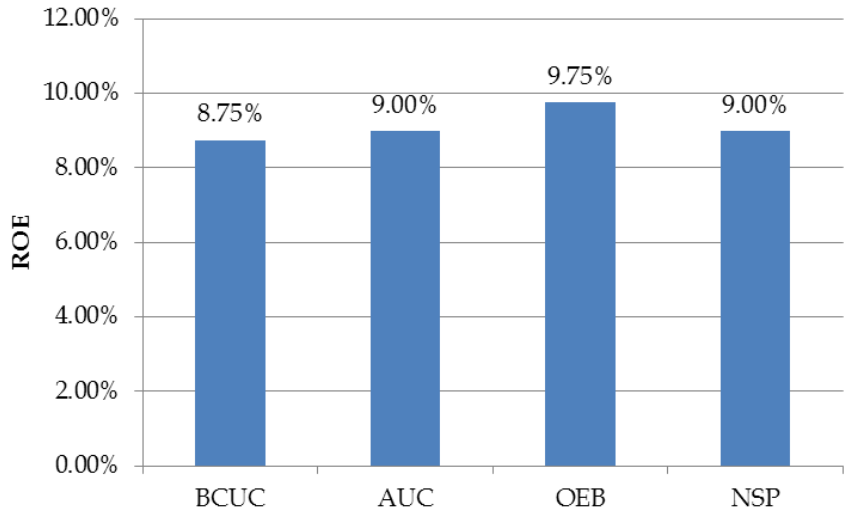
### 3.5 Allowed rate of return

Under the Public Utilities Act, a utility is entitled to earn a rate of return on equity ("ROE") that is deemed just and reasonable by the UARB. The standard of just and reasonable is more or less what an investor could expect to earn on an investment of similar risk in other sectors.[36] In NSPI's general rate application for 2013 and 2014, the UARB set the ROE at 9.0%, with a range

[36] Nova Scotia Energy and Review Board. *Public Utilities Act. S 45(1).* <http://nslegislature.ca/legc/statutes/public%20utilities.pdf>.

of 8.75% to 9.25%.[37] NSPI's ROE is similar to that of other Canadian electric utilities, based on LEI's review of the generic cost of capital proceedings by the British Columbia Utilities Commission ("BCUC"), the Alberta Utilities Commission ("AUC"), and Ontario Energy Board ("OEB") (see Figure 16).

**Figure 16. Return on equity for Canadian electricity utilities**




Sources: British Columbia Utilities Commission. *Generic Cost of Capital Proceeding (Stage 1), Decision*. May 10, 2013.
Alberta Utilities Commission. *2011 Generic Cost of Capital, Decision 2011-474*. December 8, 2011.
Ontario Energy Board. *Report of the Board on Cost of Capital for Ontario's Regulated Utilities (EB- 2009-0084)*. December 11, 2009.

### 3.6 Tariff design

Tariffs are filed yearly as part of the GRA and subject to approval by UARB and the public process described above.[38] Factors considered in tariff design are enumerated in Figure 17.

This process determines the total cost of delivering all aspects of electricity service, and establishes the revenue requirement. Enumeration of these factors comprises a large portion of the utility's GRA filing with the UARB.

[37] Nova Scotia Energy and Review Board. *2012 NSUARB 227. M04972*.
<http://nsuarb.novascotia.ca/sites/default/files/PDFs/nsuarb-212090-v1-decision_-_nspi_2013_gra.pdf>.

[38] Nova Scotia Power. *2013 General Rate Application*. May 2012.
<https://www.nspower.ca/site/media/Parent/NSPI%202013%20GRA%20-%201%20DE%2002-04.pdf >.

**Figure 17. Factors considered in Nova Scotia power tariff design**

| Factor | Description |
|---|---|
| **Load forecasts** | Total demand and peak demand, including system power requirements: residential, commercial, and industrial sales, plus exports and associated losses |
| **Strategies for managing loss of load** | Mothballing versus running some plants at lower capacity |
| **Rate base and infrastructure additions** | Investments made to improve service and product quality, such as the purchase of new plants and equipment, and maintenance expenses on existing assets |
| **Pension costs** | Pension paid to retired employees per defined benefit pension plans |
| **Deferrals and regulatory obligations** | Approved costs incurred in a specific year, but that are recovered gradually over time |
| **Depreciation** | The decrease in value of property, plant, and equipment |
| **Stranded costs** | Costs associated with the early retirement of assets |
| **Reliability and operating costs** | Costs associated with providing more reliable service and faster restoration following outages |
| **Purchased power costs** | Costs associated with imported power from outside of Nova Scotia, and the purchases from IPPs within Nova Scotia |
| **Fuel costs** | The delivered cost of solid fuels, natural gas, oil, and purchased power, offset by the net proceeds from export energy sales |
| **Sales mix** | Residential customers are more expensive per unit of power to serve than commercial or industrial customers |
| **The weighted average cost of capital** | Comprises the effective tax rate, the cost of debt, and the cost of equity |
| **Rate affordability for customers** | Costs are kept as low as possible to avoid price increases to the customers |
| **Return on equity** | A fair rate of return as compensation for the equity investor |

Source: NSPI. 2013 General Rate Application

NSPI customer tariffs include a domestic service tariff (including a domestic service time-of-day tariff available to customers who use electric thermal storage heating systems); a general service tariff (separate tariffs for small, medium and large customers); an industrial tariff (separate tariffs for small medium, and large customers), as well as interruptible tariffs for large industrial customers, real-time pricing tariffs for high-load customers served at high voltage, wholesale customer tariffs, and several tariffs designed for specific types of customers.[39] NSPI has a load retention tariff that applies to large customers that have alternative supplies of power or are in economic distress. Under the load retention tariff, in cases where retaining that customer is better for other electric customers (in terms of keeping prices lower) than losing that customer, and the revenue from serving the customer under the tariff is greater than the cost to serve the customer and makes a significant contribution to covering the fixed costs of the system, NSPI is allowed to offer a load retention tariff.

[39] NSPI. *Tariffs*.2014. <https://www.nspower.ca/site/media/Parent/Tariffs%20January%201%202014%20-%20updated%20and%20effective%20Feb%206%20PHP%20LRT%20Pricing%20Mechanism.pdf>.

Demand-side management cost recovery riders apply to most of NSPI's tariffs. NSPI recovers these costs from customers and pays the proceeds to ENSC, to fund ENSC's programs (as approved by the UARB).

Nova Scotia is one of the less-wealthy provinces in Canada, and received equalization payments from the Canadian government, in the amount of about $1.5 billion (of the total $16 billion paid to all receiving provinces) for 2013-2014.[40] NPSI does not have specific tariffs for low-income customers, but ENSC provides a heating assistance rebate program, and helps to fund energy efficiency upgrades for low-income customers who use electric heat.[41,42]

### 3.7 Cost allocation framework

Cost allocation involves sharing the cost of a public utility across its customers. After determining the revenue requirement, rates for the various classes of customers must be established, so that the revenue requirement is spread across ratepayers. The shape of peak demand and the level of demand (consumption) of the various customer types play an important role in cost allocation. The process of allocating costs is complex, but defined in a detailed set of rules approved by UARB in a series of Orders.[43]

### 3.8 Reliability requirements

As a member of the Maritimes Area of the NPCC and of NERC, Nova Scotia complies with NERC and NPCC reliability standards. These standards are written and operationally implemented by the NSPSO, its balancing authority Nova Scotia Power's Control Centre Operations Unit, and by its reliability coordinator; the New Brunswick System Operator. Long-term reliability is addressed through the system planning process outlined below. The system is required to have a 20 percent reserve margin.

### 3.9 System planning process

The key objective of the system planning process is to ensure that sufficient investments are made to maintain reliability. Utilities (just NSPI, in the case of Nova Scotia) file Integrated

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[40] Department of Finance Canada. "Federal Support to Provinces and Territories." *Department of Finance Canada.* <http://www.fin.gc.ca/fedprov/mtp-eng/asp>.

[41] Efficiency Nova Scotia Corporation. "Low Income Homeowner Service." *Efficiency Nova Scotia Corporation.* <http://www.novascotia.ca/snsmr/access/individuals/heating-assistance-rebate-program/general-faq.asp>.

[42] Nova Scotia. "Heating Assistance Rebate Program." *Access Nova Scotia.* <http://www.efficiencyns.ca/energy-solutions/low-income-service/>.

[43] Nova Scotia Utility and Review Board. "SR-01 Cost of Service Study" and "OP-10 Customers by Rate Class."

Resource Plans ("IRPs") describing long-term plans to guide future energy efficiency, generation, transmission, and distribution investments (see Figure 18).

**Figure 18. Components of IRP, NSPI**

| Assumptions | Case scenarios |
|---|---|
| **Load forecasts** | The combination of three load forecasts and three demand-side management scenarios creates nine load scenarios to test |
| **Environmental/Emissions Constraints** | $CO_2$ emissions limit may either continue to decline to 3.4Mt in 2040, or remain uniform post 2030 |
| **Future Supply Options** | New supply-side options are reviewed and upgrades to existing assets are provided |
| **Hydro Generation** | An estimate of over $500M in sustaining capital costs is required to maintain the operating capability of existing hydro systems |
| **Import Options** | Import capacities of 100MW nonfirm, 100MW firm, or 300MW firm from New Brunswick are considered |
| **Transmission Options** | Any new generation in Cape Breton will supply load growth east of Onslow. This will require an increase in Cape Breton Export, Onslow Import and Onslow South |
| **Capital Planning** | Useful life of capital assets are determined based on regulatory requirements, performance, and replacement cost |
| **Financials** | A before-tax WACC of 7.78%, after-tax 6.49% WACC, and 25 year average inflation rate of 2.0% are assumed |
| **Fuels Forecast** | A Low Case, Base Case, and High Case price forecast of various fuel sources are assumed |
| **Demand-side management** | Three different levels of demand-side management are considered: 50% of Low Case from ENS, Base Case from ENS, and High Case from ENS |
| **Demand Response** | Several direct load control solutions are modeled to mitigate peak demand and provide some ancillary services |

Source: NSPI. *10 Year System Outlook*.

The rules governing operation of the NSPSO that specify reliability planning requirements are found in Nova Scotia's Wholesale Market Rules and Regulations. They require that NSPSO submit a system plan to the UARB. It must file a 10-year energy and demand forecast by the end of April every year, for the 10 year period beginning the following January. At the end of June every year, the NSPSO must release its forecast of system capacity and adequacy, for the same forecast period. The NSPSO system plan explicitly considers the impact of DSM and energy efficiency in its load forecasts. The process is consultative, and requires NSPSO to solicit input from other parties. Figure 19 shows NSPI's annual capital plant investment for 2014, based on its 2013 outlook.

**Figure 19. 2014 Annual Capital Expenditure Plan, NSPI**

| Project Area | Category | Projects | Project Total |
|---|---|---|---|
| **Generation** | ***Hydro*** | • Pipeline replacement<br>• Power plant overhauls | $2,175,569 |
| | ***Steam*** | • Refurbishments on mill, boilers, engines, water pumps, travelling screens<br>• Replacements of water treatment plant siding, filters, condenser vacuum pump, station & unit transformer connection cable<br>• Construction of an analytical panel, continuous emissions monitor, and lubrication and chemical storage facility<br>• Fire protection<br>• Coal system upgrades | $6,998,060 |
| | ***Gas Turbine*** | • Engine refurbishment<br>• Control upgrade | $1,688,300 |
| | ***Point Aconi Generating Station**** | • Replacements of refractory, auxiliary boiler, gland packing, AVR, screw cooler trough, boiler arrowhead, miscellaneous valve component<br>• Turbine fire suppression | $4,285,924 |
| **Transmission** | ***Transmission*** | • Replacements of insulators, switches, breakers, cables<br>• Equipment removals | $9,203,513 |
| **Distribution** | ***Distribution*** | • New feeder<br>• Load transfer<br>• Phase-out for pole top transformers<br>• Build-to-roadside | $3,265,021 |
| **General Plant** | ***Outage Performance*** | • RTU replacements | $687,839 |
| | ***Telecommunications*** | • Multiplexer network upgrades<br>• Microwave system capacity upgrades | $833,346 |

Source: Nova Scotia Power. "2014 Annual Capital Expenditure Plan."

# 4 Recent developments and challenges

Recognizing a confluence of technological, environmental, and cost factors are impacting Nova Scotia's power system, the Electricity Reform Act required the Minister of Energy to conduct in 2014 a public consultation on future policies and regulations for electricity.[44] In LEI's view, the Nova Scotia power system is exposed to the following developments and challenges:

- Lack of load growth owing to loss of large industrial customers, and projections of slow growth of residential and commercial load;
- Meeting renewables targets and phasing out coal;
- Incorporating intermittent and distributed (renewable) generation into the grid;
- Securing new gas supplies; and
- Meeting customer and stakeholder expectations.

## 4.1 Lack of load growth

NSPI expects load may decline. The loss of two large pulp and paper mill customers in 2011 reduced load substantially. One mill was eventually shut down permanently and the other mill is now on a load retention rate until 2019. Post 2013, NSPI expects a slight decline in net system requirement, as the effects of conservation and DSM programs are projected to offset load growth.[45] NSPI projects about 10,710 gigawatt hours ("GWh") energy sales in 2020, lower than the 11,003 GWh estimated for 2013, and peak demand of 2,079 MW, compared with 2,085 MW in 2013. NSPI projects DSM programs (which are administered by ENSC) to reduce demand growth and consumption by 202 MW and 1,324 GWh respectively in 2020 relative to its initial targets of 2,281 MW and 12,034 GWh.[46]

This projection of declining load is consistent with the nine load scenarios modeled in NSPI's IRP. Although a few scenarios project modestly-increasing load, on balance, there is more downside risk than upside risk to the projections. For 2020, the range of the load scenarios is about 9,500 GWh to 11,700 GWh (compared with 11,003 GWh in 2013).[47] Most of the downside risk is related to potential variability of Port Hawkesbury Paper's load.

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[44] Nova Scotia. "Scope of Work: Nova Scotia's Electricity System Review," March 2014. <http://novascotia.ca/electricityfuture/pubs/NS-Electricity-Review-Scope-of-Work.pdf>.

[45] Nova Scotia Power. *10 Year System Outlook*. 2013. <http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf >.

[46] Nova Scotia Power. *10 Year System Outlook*. 2013. <http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf >.

[47] Nova Scotia Power. *2014 IRP-- Finalized Assumptions*. April 11, 2014. .

The loss or reduced operations of large industrial customers implies that power prices for other customers would increase, under the current rate-making regime. System fixed costs would need to be spread across the remaining customers (with the approval of UARB) increasing power prices and potentially further depressing demand. However, the loss of a large industrial customer would also allow more flexibility to purchase potentially less expensive fuels under the provincial emissions cap.

Slow-growing demand could also have a detrimental impact on NSPI as renewable targets are implemented. If the load were growing quickly, then incremental load could be met by renewables (along with dispatchable power such as gas, to provide resource adequacy). With no growth in load, renewables will have to replace existing generation. Existing plants will run less (at lower capacity also implying lower efficiency), and thus take longer to earn expected returns. This would reduce the value of the existing fleet, most of which is owned by NSPI.

### 4.2 Meeting renewables targets, phasing out coal

As mentioned earlier, the majority of Nova Scotia's power is generated by coal and petroleum coke—meeting a 40% renewable power requirement requires a substantial shift in the generation fuel mix. A 40% target by 2020 is equivalent to about 4,300 GWh of generation (based on NSPI's projection of 10,710 GWh energy sales in 2020).[48] Nova Scotia expects to meet the target by combining a number of approaches. An important approach is the construction of large-scale and medium-scale projects, including investment by NSPI (subject to approval by UARB) and IPPs (under competitive bidding). Producing 300 GWh from new IPP wind projects (the province's target) implies building 113 MW of wind capacity, assuming a capacity factor of 30%. NSPI's projections assume the wind projects awarded by the REA in 2012 (South Canoe at 102 MW and Sable at 13.8 MW) are in service early in 2015.

Another approach is encouragement of small-scale projects (typically less than 2 MW but potentially up to 5-6 MW), supported by the COMFIT, which however are not included in the 40% RES target. Finally, an enhanced net metering program is in place to credit commercial and residential customers for excess renewable power they supply to the grid, for power generation up to 1 MW. NSPI's 2013 outlook assumes the achievement of the 40 percent Renewable Electricity Standard ("RES") by 2020 (see Figure 20).[49]

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[48] Nova Scotia. *Renewable Energy Plan.* April 2010. Nova Scotia Power. *10 Year System Outlook*. 2013.<http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf >.

[49] Nova Scotia Power. *10 Year System Outlook*. 2013. <http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf >.

Nova Scotia's solar resources are estimated at 3-3.5 kilowatt hours ("kWh") per square meter per day. This is less than the US southwest (at about 6 kWh per square meter per day) but similar to Germany, a country which has extensive distributed solar capacity installed.[50] Nova Scotia's onshore wind resources are world-class, with wind speeds of 18-21 mph in the Cape Breton area.[51]

**Figure 20. Projections for meeting Renewable Energy Standard (RES), NSPI**

| (GWh unless otherwise noted) | 2013 | 2020 |
|---|---|---|
| Sales | 10,318 | 10,039 |
| RES% | 10% | 40% |
| RES requirement | 1,032 | 4,016 |
| | | |
| NSPI wind | 254 | 254 |
| Post-2001 IPPs | 727 | 727 |
| PH biomass project | 186 | 357 |
| Distribution-connected IPPs | 0 | 55 |
| Eligible pre-2001 IPPs | 0 | 156 |
| Eligible NSPI legacy hydro | 0 | 985 |
| Maritime Link | 0 | 1,135 |
| REA procurement from IPPs | 0 | 353 |
| | | |
| Total Renewable Energy | 1,167 | 4,022 |

Source: NSPI. *10 Year System Outlook*. Note: Sales presented in this table are slightly different from sales projected by NSPI cited earlier in this report. Both sets of figures are from the *10 Year System Outl*ook report.

Nova Scotia's Marine Energy Strategy calls for production of 300 MW of tidal energy by 2020.[52] Activity is underway to install and test turbines and other equipment, but it could be several years before the first new projects begin to produce power, and meeting the 300 MW target by 2020 could be challenging. See Section 5.3.3 for further discussion of the tidal power opportunity.

Importing renewables via the Maritime link, as discussed earlier, will allow imports of renewable power (hydro power generated in Labrador) to help meet targets, as well as allow

[50] "Global Horizontal Irradiation." *Solar GIS*. 2013. <http://solargis.info/doc/_pics/freemaps/1000px/ghi/SolarGIS-Solar-map-World-map-en.png>.

[51] "Nova Scotia Wind Atlas." <http://www.novascotiawindatlas.ca>.

[52] Nova Scotia. *Marine Renewable Energy Strategy*. May 2012 <http://energy.novascotia.ca/sites/default/files/Nova-Scotia-Marine-Renewable-Energy-Strategy-May-2012.pdf>

retirement of a Lingan coal unit to meet GHG reduction targets. NSPI is planning on 153 MW of firm power from the Maritime Link transmission project under construction.[53]

### 4.3 Securing natural gas supplies

As discussed in Section 2.2, natural gas supplies in Nova Scotia became increasingly scarce as the Sable Island field declined over the last several years. The start-up of Deep Panuke will boost domestic gas supplies for a few years, but production from Deep Panuke is likely to decline steeply, as is typical for gas fields of its type. Nova Scotia will eventually need to import gas from other sources—LNG from Canaport, or US Marcellus Shale gas delivered by M&NP (if flows are reversed). The construction of the Alton gas storage facility, also discussed in Section 2.2, would also help meet wintertime demand for gas. At 20 Bcf, the storage facility would be large enough to serve not only Nova Scotia, but New England as well; we discuss this opportunity in more detail in Section 5.3.1.

A recent government report, "The Future of Natural Gas Supply for Nova Scotia, 2013" examines potential long-term solutions for supply gas to the Maritimes (New Brunswick and Nova Scotia), to help reduce high wintertime gas prices and associated high wintertime power prices.[54] The report examined several alternatives, including contracting for firm pipeline capacity from the Marcellus region and shipping via an interconnection with M&NP; buying gas in New England and shipping via M&NP, and buying LNG shipped from Canaport. The report found that the most cost-effective option would be contracting (for 100-600 MMcf/d) of firm pipeline capacity from the Marcellus. The main difficulty would be that Maritimes gas demand on its own is too small to support a pipeline expansion, which would need contracts from shippers in New England; but the situation in New England is complicated. Local gas distribution companies (who can offer firm contracts) do not need large pipeline expansions; power generators need more gas transmission, but have no mechanism to recover the costs of firm contracts. New England governors, state agencies, state regulators, ISO-New England, and trade associations are in active discussions about potential solutions to the problem.

### 4.4 Integrating renewables and distributed generation

The traditional power grid was designed to send power in one direction—out from the utility to the customer. Utility planning entailed estimating load growth and building or buying power. Transmission systems required balancing supply from power plants and demand from customers. The addition of intermittent renewable power such as wind and solar power, and distributed renewable generation adds new levels of complexity in operating the power system.

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[53] Nova Scotia Power. *10 Year System Outlook*. 2013.
<http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf >.

[54] Nova Scotia. *The Future of Natural Gas Supply for Nova Scotia, 2013*.
<.http://0fs01.cito.gov.ns.ca.legcat.gov.ns.ca/deposit/b10664245.pdf>.

Intermittent renewables make it more difficult to forecast the hour-by-hour availability of resources to meet demand. Power supply can drop off suddenly when clouds pass over large solar arrays, and when wind speeds change. Power systems need relatively more flexible services to ramp up and down to offset changes in wind and solar generation. The simple math of integrating more and smaller producers into the grid adds to complexity in scheduling power.

Generation that is attached to the distribution grid presents challenges as well. The distribution grid is designed to send power out, not to receive it. Safe interconnection of distributed resources requires that distributed sites must be equipped so that they go offline quickly when there is a power outage on the grid. This equipment can be expensive; but there are smart grid technologies that can provide protection and isolation.[55] Apart from new infrastructure and equipment needed to integrate distributed generation, new systems and operational processes may be needed, including advanced communications and automated controls (smart grid technology), changes in design standards, changes in operating practices and maintenance, and changes to regulatory frameworks.[56] Distributed generation makes it more complicated to schedule daily and hourly power needs.

### 4.5 Meeting ratepayer and stakeholder expectations

As ratepayers, Nova Scotians, and the UARB that represents their interest, focus understandably on reliability and rates. As stakeholders in the environment, they expect cleaner power. And as participants in the economy, they expect the power system to support and create jobs.

The province is well on the road to cleaner power; however, it will come at the cost of higher power prices, at least in the near term. This is widely recognized, and an expectation of price increases along the lines of 1-2% per year is stated explicitly in the province's renewable energy policy.[57] The intention of energy policy is to accept power price increases in the near term, during the switch over to renewables, to save the province from the prospect of rising costs of oil, gas, and coal in the long term.

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[55] Institute of Electrical and Electronics Engineers ("IEEE"). *Integrating Distributed Generation into the Smarter Grid*. December 2013. <http://smartgrid.ieee.org/december-2013/1013-integrating-distributed-generation-into-the-smarter-grid>.

[56] State of California. *Distributed Generation Integration Cost Study*. 2014. http://www.pjm.com/~/media/committees-groups/committees/pc/20140530-advance/20140530-distributed-generation-integration-cost-study-by-navigant-consulting.ashx.

[57] Nova Scotia. *Renewable Electricity Plan*. April 2010.



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In terms of employment, there will be winners and losers. Closing power plants such as the two coal units at Lingan will result in loss of jobs.[58] On the other hand, much of the spending on renewable energy, both large-scale and small–scale could occur within Nova Scotia, as long as wind equipment can be manufactured in the province. The construction of wind turbines has begun to take place in the province. Depending on the expansion of the local service manufacturing industry, Nova Scotia estimates employment of 5,000-7,500 person-years inside the province (across construction, supply, manufacturing and maintenance areas) to meet renewable targets.[59] And the province is offering the COMFIT program to small renewable projects despite those projects' higher costs than large renewables, to encourage rural economic development.[60]

[58] Mining Connection. "Nova Scotia Power to Retire Two Coal-Fired Generators by 2019."January 3, 2013. http://www.miningconnection.com/coal_prep/news/article/nova_scotia_power_to_retire_two_coal-fired_generators_by_2019/.

[59] Nova Scotia. *Renewable Electricity Plan.* April 2010.

[60] Nova Scotia. *Renewable Electricity Plan.* April 2010.

# 5 Strengths, Weaknesses, Opportunities and Threats ("SWOT") analysis

Nova Scotia has a unique combination of strengths related to its power sector, including diverse potential fuel supplies and open and transparent policy-making, regulatory processes, and governance structure (see Figure 21). Weaknesses in the power sector and in governance structure mainly stem from the relatively small size of the Nova Scotia power system.

**Figure 21. SWOT analysis of Nova Scotia's electric power system**

| Strengths | Weaknesses |
|---|---|
| ▪ Fuel diversity and availability of natural gas<br>▪ Favorable geology, which can allow for construction of natural gas storage facilities<br>▪ Potential tidal power resources that have only begun to be developed | ▪ System operator, NSPSO, not independent of the major utility, NSPI<br>▪ NSPI owner may have priorities other than minimizing NS ratepayer costs<br>▪ Lack of a spot wholesale power market<br>▪ Reliance on traditional cost of service ratemaking |
| **Opportunities** | **Threats** |
| ▪ Commercial opportunities and lower power costs owing to potential natural gas storage<br>▪ Re-powering coal units with gas or biomass<br>▪ Tidal potential estimated at about 332 MW at 8 potential sites | ▪ Stranded costs and rising costs of capital that could lead to higher customer rates<br>▪ Oil, gas, and coal prices could rise in long term<br>▪ Capital for utility investment is set to become more expensive |

## 5.1 Strengths

The governance of the Nova Scotia power sector has a number of strengths. The UARB is an independent body, with its board appointed by the lieutenant governor. The review process for rate filings and fuel adjustments is public. The rules governing wholesale power are transparent. The creation of the independent entity ENSC to run efficiency programs (rather than efficiency programs run by the utility) is also a strength - it ensures that there is an incentive for energy efficiency. Also, because NSPI is a private-sector utility, there are no implicit power subsidies.

The main strength of the power system itself is its fuel diversity. The near-term availability of natural gas (for perhaps the next 5-7 years, until the decline of Deep Panuke tightens gas supplies again) will help the province transition away from coal. The power system is also quite compact - generation is close to load.

Nova Scotia also has geology in its favor - it contains underground salt formations, which can allow for construction of natural gas storage facilities such as the Alton project currently under way.[61] Salt cavern storage, known as high-deliverability storage, allows gas to be injected and withdrawn over the course of days or hours. This is in contrast to seasonal storage, which utilizes depleted oil or gas fields, or aquifers with a much slower injection and withdrawal period (weeks and months). High-deliverability storage is ideal for meeting the fluctuating demand for gas by power generators.

Nova Scotia has potential tidal power resources that have only begun to be developed. There is only one small facility, the 20 MW (nameplate capacity) Annapolis Royal plant, currently in operation. The province plans to continue to invest in tidal energy research and development.[62] Opportunities around tidal power are discussed in Section 5.3.3.

### 5.2 Weaknesses

A weak point in the governance of the power system is that the system operator is not entirely independent of the major utility. Although NSPSO operates independently, it is not an independent entity—it is owned by its main user, NSPI. Likewise, NBSO is a fully integrated part of NBPC. In a large and complex liberalized power system, such as ISO-New England, it makes sense from an operational and cost perspective to have the system operator fully independent of individual utilities and other generation owners. Such independence and separate ownership might not be practical for a smaller system such as Nova Scotia's. However, because the utilities in Nova Scotia and New Brunswick both operate the system, it is possible that decisions are made that benefit the parent company and not necessarily other users of the system.

Another possible weakness is the ownership structure of NSPI. Its parent company, Emera, owns power assets in neighboring provinces, as well as gas infrastructure in the region. It is possible that Emera policies and strategies could influence decisions made by NSPI to benefit other parts of Emera. While market testing requirements can be reviewed, it is notable that NSPI files an Annual Capital Expenditure ("ACE") plan that details all of its major capital investment proposals, which is subject to the approval of the UARB. In addition, for large-scale

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[61] Nova Scotia. *Environmental Assessment, Alton Underground Natural Gas Storage Facility*. June 14, 2007. <https://www.novascotia.ca/nse/ea/Alton/Section5-9.pdf >.

[62] Nova Scotia. *Marine Renewable Energy Strategy.* May 2012. http://energy.novascotia.ca/sites/default/files/Nova-Scotia-Marine-Renewable-Energy-Strategy-May-2012.pdf.

renewable energy projects, a competitive bidding process is enforced and overseen by the Renewable Electricity Administrator to ensure all projects are cost-competitive.

Lack of a spot wholesale power market could be considered a weakness. However, in a system as small as Nova Scotia's with only a few players, it may not make sense to create a wholesale market. Administrative costs would add to the cost of power, while the number of participants would likely be too small to support effective competition.

The reliance on traditional cost of service ratemaking could become a weakness, as NSPI is faced with slow load growth and the potential for stranded assets. Customers would likely object to paying for assets that are no longer in use.

### 5.3 Opportunities

The changes under way in Nova Scotia present a number of opportunities for the gas and power systems.

#### 5.3.1 Natural gas storage and potential for new resources

Nova Scotia has the ideal geology and geography to serve not only its own peak season gas needs, but those of New England as well, as discussed in Section 5.1). A local gas utility, or even a gas trader, could contract for storage capacity in Alton, buy gas in the summer (supplied perhaps from Deep Panuke, or from a reversal of the M&NP) when gas is less expensive, then provide it to NSPI or other gas users, including in New England, in the winter. New England has zero underground gas storage (its geology is not favorable) and it is in the same gas-capacity constrained situation as Nova Scotia in the winter. New England might find it more economical to contract for gas from Nova Scotia storage than to contract for firm capacity on pipelines, especially because the gas is only needed in the winter. Alternatively, New England and Nova Scotia could cooperate and contract for firm pipeline capacity to support expansion of capacity from the Marcellus shale. New England generators would use the gas in the winter; Nova Scotia would take the gas in the summer, store it, then use it locally and/or sell it to New England generators in the winter. Not every salt formation in Nova Scotia is suitable for gas storage, but the potential size of the Alton project itself, at 20 Bcf, could serve a market larger than just Nova Scotia.

As mentioned previously, Nova Scotia has shale gas resources in place that may prove to be cost effective to develop. Also, there is some deep water exploration under way that may prove to be successful.

#### 5.3.2 Re-powering coal

NSPI might consider replacing an existing coal unit with a completely new CCGT in some circumstances. The on-site infrastructure such as cooling equipment and transmission connections could be reused. NSPI might wish to examine whether conversions such as this could be cost-effective.

Similarly, repowering with biomass or co-firing with biomass could be an opportunity. There is one biomass plant in operation currently, the 60 MW Port Hawkesbury plant at Point Tupper.

### 5.3.3 Expanded use of tidal power

Tidal potential for Nova Scotia has been estimated at about 332 MW at eight specific potential sites.[63] These estimates account for environmental issues, maritime infrastructure, grid interconnection, and other factors. The largest of these are in the Minas Passage (166 MW) and the Minas Channel (131 MW). These two are potentially large enough to interconnect to the transmission grid; other potential sites (all 1-10 MW in size) would have to be connected to the distribution grid. Challenges include the care that needs to be taken to minimize environmental impacts, as well as technical challenges in installing and maintaining turbines and infrastructure. Nova Scotia's COMFIT program incorporates a tariff supporting small tidal projects connected to the distribution grid. There is also a separate feed in tariff ("FIT") covering large tidal arrays in the developmental stage, to be connected to the distribution or transmission grid.[64]

### 5.3.4 Transmission and distribution

NSPI may find ongoing opportunities for investment in transmission rather than generation, and in upgrades to the distribution system to better integrate the renewable power being added under COMFIT program. Potential retirement of coal assets and additions of renewables could require re-configuring the transmission grid, and associated new investment. Renewables are relatively more capital intensive and less fuel-intensive, and that increases rate base per unit of power production, which can help support NSPI revenues. Of course this would require approval by the UARB.

### 5.3.5 Smart grid technology investment

The term "smart grid" is not well-defined, but broadly speaking, smart grid technology equips the power grid with advanced capabilities for operating the system and interacting with customers. The key elements of this technology include a backbone two-way communication network coupled with advanced sensors, meters, monitors, and control devices. Behind the worldwide drive to deploy smart grid technologies is the widespread need to upgrade transmission and distribution ("T&D") equipment, as well as improve system planning, operations, and reliability, while coping with new sources of power and new ways to use power. For example, smart grid technology allows for integration of distributed resources

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[63] Electric Power Research Institute. *Nova Scotia Tidal In-stream Energy Conversion (TISEC): Survey and Characteristics of Potential projects Sit*es. 2006. <http://oceanenergy.epri.com/attachments/streamenergy/reports/Tidal_003_NS_Site_Survey_Report_REV_2.pdf>.

[64] Nova Scotia. *Renewable Electricity Plan*. April 2010.

(supporting integration of small-scale renewable power), integration of demand-side resources (supporting demand response programs) and electricity storage.

On the end-user side, smart grid technology enables advanced metering infrastructure ("AMI"). AMI allows for communications and automation which support time-of-use and other pricing regimes designed to promote conservation. AMI also supports automated meter-reading, which can be a source of substantial cost-savings to a distribution utility. Smart grid technology also allows a utility to enter new business lines, for example, delivering voice and data service to customers. Revenue from new communications businesses can subsidize smart grid investment in the power system.[65] For a utility in Chattanooga, TN, its fiber-optic business combined with the benefits of its smart grid investments drove an upgrade of its bond rating.[66]

Currently, several municipal utilities in Nova Scotia have invested in smart grid technologies. NSPI is implementing an Advanced Distribution Management System ("ADMS") as an integrated smart grid solution to improve operational efficiencies and outage management response and restoration. The utility also has a smart meter pilot program under way.

### 5.3.6 Rate re-design

There may be opportunities to re-design customer rates (to expose customers to costs closer to the true cost of providing power) by more widespread use of time of day prices or time of use prices. Smart meters could help customers understand and manage their own power consumption. Power price increases are the likely outcome of the many challenges facing the Nova Scotia power system, so the utilities and UARB might wish to offer customers options to change their behavior, to mitigate some of these increases.

## 5.4 Threats

The largest threat to the power system seems to be the combination of challenges ahead for the major utility, NSPI. In a worst-case scenario, it could be faced with stranded costs, as well as rising costs of capital. These cost pressures would point to need for higher customer rates.

The potential for long-term increases in oil, gas, and coal prices is also a threat to NSPI, as well as to power customers and the Nova Scotia economy generally. NSPI would likely only be allowed to recover fuel cost increases with a lag, so as to minimize rate shock. High energy costs, especially if those costs are for imported fuel, drain purchasing power from the provincial economy and make it more expensive for industry and commercial businesses to operate, and increase the cost of living for homeowners and renters. Finally, climate change or more severe weather could pose challenges to the power system, impacting reliability and cost.

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[65] EPB. Annual Report. 2013. And Times Free Press. "Grid upgrades put EPB in national spotlight." January 22, 2011. http://www.timesfreepress.com/news/2011/jan/22/grid-upgrades-put-epb-in-national-spotlight/>.

[66] EPB. "Standard & Poor's Upgrades EPB's Bond Rating to 'AA+'." October 20, 2012. https://www.epb.net/news/news-archive/standard-poors-upgrades-epbs-bond-rating-to-aa/>.

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# 7 Appendix B - List of acronyms

| | |
|---|---|
| ACE | Annual Capital Expenditure |
| ADMS | Advanced Distribution Management Systems |
| AMI | Advanced Metering Infrastructure |
| AUC | Alberta Utilities Commission |
| Bcf | Billion cubic feet |
| Bcf/d | Billion cubic feet per day |
| BCUC | British Columbia Utilities Commission |
| CAIDI | Customer Average Interruption Duration Index |
| CAIFI | Customer Average Interruption Frequency Index |
| CAPEX | Capital Expenditures |
| CCGT | Combined cycle gas turbine |
| CCS | Carbon Capture and Sequestration |
| CEPA | Canadian Environmental Protection Act |
| COMFIT | Community Feed-in Tariff |
| COS | Cost of Service |
| CPG | Certificate of Public Good |
| DG | Distributed Generation |
| DOE | Department of Energy (Nova Scotia) |
| DSM | Demand-side Management |
| ENSC | Efficiency Nova Scotia Corporation |
| FAM | Fuel Adjustment Mechanism |
| FERC | Federal Energy Regulatory Commission |
| FIT | Feed-in Tariff |
| GDP | Gross Domestic Product |
| GHG | Greenhouse gas |
| GRA | General Rate Application |
| GWh | Gigawatt hours |

| | |
|---|---|
| Hg | Mercury |
| HVDC | High voltage direct current |
| IPP | Independent Power Producer |
| IRP | Integrated Resource Plan |
| ISO | Independent System Operator |
| kWh | Kilowatt Hour |
| LEI | London Economics International LLC |
| LNG | Liquefied natural gas |
| M&NP | Maritimes and Northeast Pipeline |
| MEUNS | Municipal Electric Utilities of Nova Scotia |
| MMBtu | Million British Thermal Units |
| MMcf | Million cubic feet |
| MMcf/d | Million cubic feet per day |
| MW | Megawatt |
| MWh | Megawatt hours |
| NB | New Brunswick |
| NBPC | New Brunswick Power Corporation |
| NBSO | New Brunswick System Operator |
| NEB | National Energy Board |
| NERC | North American Electric Reliability Corporation |
| NOx | Nitrogen oxide |
| NPCC | Northeast Power Coordinating Council |
| NS | Nova Scotia |
| NSPI | Nova Scotia Power, Inc. |
| NSPSO | Nova Scotia Power System Operator |
| OASIS | Open Access Same time Information System |
| OATT | Open Access Transmission Tariff |
| OEB | Ontario Energy Board |
| REA | Renewable Energy Administrator |

| | |
|---|---|
| RFP | Request for Proposal |
| ROE | Return on Equity |
| RPS | Renewable Portfolio Standards |
| RTO | Regional Transmission Organization |
| S&P | Standard & Poor's |
| SAIDI | System Average Interruption Duration Index |
| SAIFI | System Average Interruption Frequency Index |
| $SO_2$ | Sulfur dioxide |
| SOC | Standards of Conduct |
| SOEP | Sable Island Offshore Energy Project |
| T&D | Transmission and Distribution |
| Tcf | Trillion cubic feet |
| UARB | Nova Scotia Utility and Review Board |