ATLANTIC INSTITUTE FOR MARKET STUDIES

Policy Paper

Gas Opportunities for Atlantic Canada

Andrew Pickford

Halifax, Nova Scotia

February 2016

The Atlantic Institute for Market Studies (AIMS)

AIMS is a Canadian non-profit, non-partisan think tank that provides a distinctive Atlantic Canadian perspective on economic, political, and social issues. The Institute sets the benchmark on public policy by drawing together the most innovative thinking available from some of the world's foremost experts and applying that thinking to the challenges facing Canadians.

AIMS was incorporated as a non-profit corporation under Part II of the *Canada Corporations Act* and was granted charitable registration by Revenue Canada as of 3 October 1994. It received US charitable recognition under 501(c)(3), effective the same date.

287 Lacewood Drive, Suite 204,
Halifax, Nova Scotia, Canada B3M 3Y7

Telephone: (902) 429-1143

Email: aims@AIMS.ca

Website: www.AIMS.ca

Gas Opportunities for Atlantic Canada

By Andrew Pickford[1]

Table of Contents

About the Author

Andrew Pickford works in Perth, Australia, and Mont-Tremblant, Canada, in the areas of strategy, economic analysis and natural resources for a number of organizations, both private and public. He has expertise with electricity utilities, commodity trends, industry-driven applied research and the reform and transformation of businesses and governments during periods of turbulence. Mr Pickford maintains a mix of appointments and engagements in both Australia and North America, working with decision-makers in corporate, government, academic and civil society settings.

Halifax, Nova Scotia

February 2016

Executive Summary

Restricting the expansion of natural gas in Atlantic Canada could make electricity more expensive, less clean and increasingly subject to decisions and events outside the region. By optimizing their natural gas resources with the view to export, the four provinces will benefit from both the major changes in the energy market that are occurring in North America and the increasing uses of natural gas. The current, narrow debate over some forms of gas extraction needs expanding so that jobs, clean energy and opportunities for communities across Atlantic Canada are included.

Introduction

Over the past decade, the natural gas sector has seen rapid development. Technological advances in extraction have enabled firms and governments to reassess what were previously regarded as uncommercial, costly projects. The development of floating liquefied natural gas (FLNG) vessels led to a reduction in the costs of exploiting offshore gas deposits that were once too far away or too small for conventional extraction and processing, and rapid innovations in hydraulic fracturing have led to a boom in the exploitation of shale gas resources in the United States. As a result, natural gas has become an increasingly viable and abundant resource just waiting to be utilized.

The case for natural gas to be utilized in preference to coal has resulted in it being defined as a transition fuel on the path to decarbonisation.

This is good news for Atlantic Canada — a region rich with natural gas. The only questions remaining are will Atlantic Canadians decide to develop this resource and if so, how?

Certainly, some will call for doing nothing with this resource and argue that it is best left in the ground. This is a valid choice. However, by choosing to do nothing, citizens in each of the four provinces will miss many benefits. For example, on August 28, 2014, the Report of the Nova Scotia Independent Review Panel on Hydraulic Fracturing highlighted the potential economic benefits of using hydraulic fracturing in developing shale gas deposits in Nova Scotia. It estimated that in a “lower medium case scenario” (a development of 4,000 gas wells) an estimated 1,500 direct jobs and annual investments of $1-billion could be secured. Furthermore, if Nova Scotia and New Brunswick developed their Marcellus Shale gas deposits at the same rate as Pennsylvania did, they could potentially mitigate both power rates and home heating costs for gas customers.

Given these and other potential benefits, the purposes of this paper are to: 1) review the energy mix in Atlantic Canada from a clean sheet perspective; 2) consider the impact of restricting new gas developments; 3) take into account existing and planned infrastructure, and; 4) propose policy recommendations aimed toward allowing markets to satisfy energy demand. The paper will also examine the role of natural gas in the energy mix, noting the interaction between gas and electricity markets and the critical role natural gas plays in supporting wind power.

When looking at the future of Atlantic Canada, it is important to consider what the region will be like in 2020. By the end of the decade, electricity interconnections will link the four provinces, facilitating an expansion of hydro-generated electricity. The shale gas revolution in the United States will likely continue to influence electricity and gas markets across the continent. It is in this context that the Atlantic energy framework will be analyzed.

Defining energy

Before analyzing the energy landscape in Atlantic Canada, it is important to discuss what "energy" means. For many people, energy generally means gasoline for cars and power or natural gas for heating. For the sake of clarity and comparison, this paper classifies energy into two types: stationary energy (electricity that is generally generated by large power plants and distributed via a grid) and transport energy (liquid fuel used in vehicles, such as gasoline and diesel). The reason for making this distinction is stationary and transport energy are not easily substitutable. In other words, electricity cannot be used in lieu of transport fuels and vice versa.[2]

Energy policy

Like the term "energy," the phrase "energy policy" has a range of meanings. Within the Canadian context, energy policy and political decisions concerning it occur at all three levels of government. Historically, they have been some of the most politically contentious.[3] In Atlantic Canada, elected officials and policy-makers face difficult energy choices while managing small systems that cover dispersed and isolated populations. Making their roles more problematic is the public's aversion to service disruptions and its extreme sensitivity to price movement, especially relating to heating costs. Decisions made by government affect the direct and indirect cost of energy that citizens pay. Setting the policy framework for a system with assets lasting decades and operating on a second-by-second basis is challenging. Nonetheless, residents of Atlantic Canada can reasonably expect that their energy is cheap, clean and reliable.

For this reason, all options should be on the table and subject to a rigorous cost-benefit analysis and evidence-based policy. Accordingly, those wishing to immediately convert to 100 per cent renewable electricity need to argue the merits of such a change, including its effect on the poorest members of the community and its technical feasibility. In reality and in general, there will always be a mix of energy types; some will be more or less popular over time. A CBC News series that looked at these trends succinctly summarized successive transitions: "The first half-century of electrification in Canada was all about the country's hydro power. Then came coal, oil and nuclear. The future is written in wind and natural gas."[4]

In Atlantic Canada, the last vigorous debate on energy was in the 1970s and early 1980s following the OPEC oil shocks. In 1982, Formac along with Acadia University Institute published a book from a series of conferences and workshops titled *Energy Options for Atlantic Canada: The Potential — and the Problems — of Oil, Coal, Tidal, Nuclear and Hydro,* which captures the main themes of these debates. At that time, there was an open discussion about the types of fuel sources that could be utilized. Importantly, there was a realisation that in order to attract large capital investments, there needs to be consistent and clear policy frameworks. Options that lead to major projects that would change the energy landscape were considered. Looking at all fuel options without narrowly focusing on current controversies is a useful starting point when considering choices for Atlantic Canada in 2016.

An overview of natural gas

Natural gas is an energy source that has developed over millions of years from the carbon and hydrogen molecules of organic matter that are trapped in sandstone, coal seams, shale and oil deposits. It is primarily methane gas but can include ethane, propane, butane, pentanes and other associated hydrocarbons. Natural gas is not extracted in its pure form; rather, it is processed and converted into a low-emission fuel and associated by-products. Natural gas can be extracted from:

1) **Conventional Sources:** This natural gas is located in multiple small porous areas that naturally occur in geological formations such as carbonates, sandstones and siltstones. Due to the ability to cost effectively drill and produce from these sources, it has been the initial focus of extraction efforts and was traditionally the mainstay of the gas industry.

2) **Unconventional Sources:** This natural gas is found in large volumes in geological formations and requires specific technologies or processes to extract quantities that are economically viable. Examples include shale gas, coal seam gas, tight gas and gas hydrates. It is extracted via newer technologies such as hydraulic fracturing, although it should be noted that hydraulic fracturing has been used for

a number of decades.

While a number of regions may have gas reserves, they are generally categorized into different classifications that are based on how well each reservoir or field is mapped and the extent to which gas can be commercially extracted with the available technology. Caution about potential reserves is important, as the ability of private enterprise to economically convert this into aboveground supplies is not always evident.

The Maritime Electricity Premium

Natural gas is used to produce electricity in Atlantic Canada. The price of natural gas is one cost driver of the end costs for power and heating. Considering the sector more broadly, it is worth comparing the price of power across a number of provinces and jurisdictions in North America. The high cost of power in Atlantic Canada is illustrated each year when Hydro-Québec releases its annual Comparison of Electricity Prices in Major North American Cities. In this analysis of electricity prices in 21 major North American cities, cities in Atlantic Canada tend to be near the top of the list. An indication of how this resonates in Nova Scotia is the article in *The Chronicle Herald* that was based on its calculations and published in 2013 titled “Power Fairly Pricey in N.S.” It estimated that electricity prices in Winnipeg and Ottawa were 46 per cent and 13.5 per cent lower than Nova Scotia’s.[5]

A number of historical reasons and specific attributes of Atlantic electricity systems contribute to the higher average prices for this service. However, the premium need not be as high as it is currently, and it is time that a new lexicon is used to capture the problem. So that policies applied to the broader energy sector can be placed in context, it is time that the higher cost of power is referred to as the “Maritime Electricity Premium.” This phrase can help define the benefit, or cost, of new initiatives by governments across the region. For example, if a fuel source or the extraction process for a new technology is banned or limited, the general benefits must then be weighed against the cost or the impact they will have on the Maritime Electricity Premium. This is important because too often many anti-development advocates portray their actions as if they benefit everyone, without any cost. While in some cases there may be some limited environmental advantages, the overall cost or lost opportunities need to be quantified, tested and articulated.

If Atlantic Canada can effectively utilize its natural gas resources, it could enter a period of economic development. Natural gas has many applications in areas such as electricity generation, transportation and the petrochemical industry. However, such opportunities can only occur if there is smart and effective government regulation of the industry as well as the utilization of all natural gas deposits. Such a use involves the development of conventional and unconventional sources of natural gas.

To optimize unconventional sources of natural gas, a variety of technologies and processes are required. One such technology is hydraulic fracturing, which is the pumping of fracturing fluid under high pressure into a shale or coal seam to extract natural gas. This process is highly controversial in the region due to its perceived negative environmental impact. As a result, each province in the region has dealt with the use of hydraulic fracturing differently:

Nova Scotia

Nova Scotia prohibited high-volume hydraulic fracturing for onshore gas deposits in November 2014 in response to the formal, independent review into hydraulic fracturing. The review, led by Dr. David Wheeler from Cape Breton University, recommended that fracturing not be allowed in Nova Scotia until more research is completed and that local communities should have input into future decisions.

Newfoundland and Labrador

Newfoundland and Labrador does not have a formal moratorium on hydraulic fracturing. However, it has stopped accepting applications from companies that want to use fracturing processes to exploit oil and gas.[6] The government did this so it could undertake an internal review of the extraction process.[7] The review did not provide sufficient information to make a final decision about fracking in the province. This resulted in an external review with an appointed panel that would undertake a more detailed analysis of the issue and seek input from the public.[8] Public consultations took place throughout 2015 and with the last round held in October 2015.

New Brunswick

In New Brunswick, a moratorium on all forms of hydraulic fracturing was put in place by the newly elected Liberal government in December 2014. This moratorium applies to all types of hydraulic fracturing, regardless of whether the process uses water, propane or another substance to extract natural gas from shale rock beneath the Earth's surface. As there was no grandfathering of projects already underway, it has created considerable investor uncertainty with some firms signalling their intention to leave the province. In March 2015 the New Brunswick government appointed a commission to report to cabinet whether the government's conditions for shale gas development can be met. The report is due by March 2016 when it will reconsider the ban.[9]

Prince Edward Island

There is no moratorium on hydraulic fracturing, and there have been a few exploratory leases given to oil and gas companies. However, there are currently no active leases or hydraulic fracturing operations in the province.

The differences in each province's method highlight one factor that impedes further natural gas development: a consistent regional approach. This requires that the four provincial governments come together to outline a harmonized regulatory approach to all forms of natural gas development. Doing this will give oil and gas companies greater certainty, entice them to explore, to invest and, ultimately, to develop a vibrant natural gas industry in the region.

Regional Benefits

Increasing the development of natural gas in Atlantic Canada provides several benefits. Additional investment creates jobs, localized spending and flows on to additional tax receipts for the government. Accelerating the transition to natural gas for power can reduce dependence on heavier forms of fossil fuels that have higher emissions. More investment in gas can put downward pressure on gas prices through higher availability and more supply options. This can also cause a flow on effect and lower electricity prices. With the increasing use of gas as a transport fuel, this may also influence costs in this sector. Indigenous gas reserves would provide a stable local energy source that could become especially important for Nova Scotia and Newfoundland, as part of their electricity will be derived from Muskrat Falls hydroelectricity in Labrador.[10]

Through 2014 and 2015, it became evident that Muskrat Falls had cost overruns, and the achievement of power in 2017 is in question.[11] Any additional costs will likely be borne by electricity consumers in Nova Scotia and taxpayers in Newfoundland. Newfoundland electricity consumers are particularly exposed. Memorial University economist Professor James Feehan notes that under amendments to the *Electric Power Control Act, 1994,* and subject to cost overruns from Muskrat Falls, "Island ratepayers, with no access to outside markets or alternate on-Island suppliers, will be trapped in a highly monopolized market with little choice but to pay."[12] With this in mind, local gas usage should be seriously assessed as a key energy source for electricity generation.

The electricity sector in Atlantic Canada: past, present and future

Atlantic Canada was amongst the first Canadian regions to start electrification. Historically, electricity plants were private ventures based near industrial enterprises such as paper and pulp mills and generally part of an integrated, single company. The result was a number of legacy systems that were fragmented and quite different from the rest of the country's.

Some economic historians think the dominance of private electricity plants restricted development and hastened industrial decline in the Maritimes.[13] This claim is questionable on economic grounds, as power generated by central government authorities also comes at a cost (whether it is direct as in tariffs or indirect through taxes, fees or other forms of revenue).

During the 1950s and 1960s, each province developed its own central electricity service provider that connected consumers across the province to strategically located generation plants. However, as Atlantic Canada is sparsely populated, there remained small communities that continued (and continue to this day) to rely primarily on diesel generators.

During the 20th century, governments began to take a more active role in providing electricity. This often meant getting involved in the development and extraction of new energy sources. A recent example of this is the Muskrat Falls hydroelectric dam, which produces hydroelectricity exported from Labrador, via Newfoundland, to Nova Scotia and the United States.

Megaprojects such as Churchill Falls and Muskrat Falls have historically captured the imagination of visionaries and various premiers. These are often sold under the banner of economic development and job creation, although empirical data supporting these claims are generally not presented in any meaningful manner. It should be noted that there are some benefits derived from government facilitating a large infrastructure project, outside of the ability of the private sector to finance. Nevertheless, it is important to remember that this approach places the risk associated with investing in megaprojects, successful or otherwise, on to electricity users and taxpayers.

Four provinces, many systems

After World War II, electricity utilities were structured as provincially owned commissions and Crown corporations — a pattern largely unbroken until the 1970s. Interconnection was usually done within towns near the capital and then spread out to the periphery of the province. The first interprovincial electricity connection in the Maritimes was between Nova Scotia and New Brunswick in 1960.

Globally, a trend of disaggregation started in the 1980s and 1990s followed by varying levels of privatization. This involved separating the generation, transmission, distribution and retail components of the original commissions, followed to some degree by privatization. In Atlantic Canada, due to small systems, difficulty creating competitive tension within the market, and political sensitivities, only partial privatization of electricity assets occurred.

Electricity assets in the Maritimes remain owned by a mix of private and public sector operators. Among those that are private, the most prominent are Nova Scotia Power (owned by Emera) and Newfoundland Power (owned by Fortis). Other than these and a few independent power producers, provincial or municipal governments own the remaining electricity assets.

Government decision-makers are focused on so-called “green policies” that favour low-carbon generation and energy efficiency and contain the end costs for consumers given the sensitivity of voters to the increases in the price of power (especially in cold winters). While producing localized benefits (usually financial for those who site wind farms on their land), green policies and renewable generation have brought about a number of problematic issues. Included are problems for the electricity grid due to intermittency, frequency control, load following[14] and dispatch[15] of conventional plants. There is also the budget pressures of small scale renewable policies which can result in challenges if these subsidies are withdrawn. For example, in August 2015 Nova Scotia ended its “community feed-in-tariff” for the stated reason that adding additional capacity would “negatively impact rates.”[16]

Table 1, page 13, provides a snapshot of the status of the Atlantic electricity system. This is for illustrative purposes only and does not include some independent power producers and other smaller municipal generators such as wind farms and off-grid, independent diesel generators.

TABLE 1

Overview of Atlantic Electricity System (As at Sept. 2015)

	Nova Scotia[17]	New Brunswick[18]
Main Utility	Nova Scotia Power (Emera) The private, integrated utility provides "95 per cent of the generation, transmission and distribution of electricity in Nova Scotia, and serve[s] 500,000 residential, commercial and industrial customers across the province."	New Brunswick Power (Crown) A Crown-owned, integrated utility serving "391,191 direct and indirect New Brunswick homes, businesses and facilities." Also "exports electricity to New England, Quebec, Nova Scotia and Prince Edward Island."
Generation mix	Hydro, tidal, wind, coal, oil, biomass and natural gas	Hydro, coal, oil, diesel, wind and nuclear
Installed megawatts	2,435 MW	2,853 MW
Transmission and distribution lines	Transmission: 5,300 km Distribution: 26,500 km	Transmission: 6,849 km Distribution: 20,815 km
Maritime interconnections	N.B.: 350 MW[23]	N.S.: 300 MW Quebec: import 1,080 MW, export 785 MW New England, Northern Maine PEI: 200 MW
Notable attributes	A diverse set of generation sources that is transitioning away from fossil fuels. The Muskrat Falls project will transform the energy mix.	Host to only nuclear reactor in the Maritimes.
	Prince Edward Island[19]	Newfoundland and Labrador[20]
Main Utility	Maritime Electric (Fortis) A private company that "supplies electricity to customers across [Prince Edward Island]. This electricity is mainly purchased from off-Island sources and supplied via two submarine transmission cables under the Northumberland Strait. Maritime Electric also purchases up to 52 Megawatts (MW) of wind generation."	Newfoundland Power (NP) (Fortis) Private distributor on island portion of province. **Newfoundland and Labrador Hydro (Hydro) (Crown)** "Hydro is a provincial Crown corporation, with the mandate to generate and transmit electricity in the province, and to provide distribution and retail services to customers in Labrador and in areas of the island of Newfoundland not serviced by NP." The two utilities serve about 280,000 customers.[21]
Generation mix	Diesel, oil, and wind	Hydro, oil, diesel, natural gas and wind
Installed megawatts	149 MW	Newfoundland: 1,966 MW Labrador: 5,428 MW[22]
Transmission and distribution lines	Transmission: 600 km Distribution: 4,400 km	Transmission: 3,742 km Distribution: 3,334 km
Maritime interconnections	N.B.: 200 MW	N/A (exports electricity to Quebec from Churchill Falls)
Notable attributes	Two submarine cables from New Brunswick provide approximately 80 per cent of the provincial load.	Muskrat Falls will transform the energy mix of Newfoundland and open new opportunities as the island is interconnected with Labrador and Nova Scotia.

Muskrat Falls

The Muskrat Falls project will significantly transform the electricity systems of Newfoundland and Nova Scotia. This project involves the construction of an 824-megawatt hydro project in Labrador and transmission lines to Churchill Falls (to link with the Quebec grid) and a series of transmission lines to connect Labrador, Newfoundland and Nova Scotia (via the $1.52-billion Maritime Link).[24] This $7.7-billion megaproject has attracted a great deal of debate, controversy and interprovincial tension. The project was approved despite issues with the economics, cost pressures and its long-term impact. If construction costs change, the cost parameters for electricity delivered to Newfoundland and Nova Scotia (sometime post 2017) will change. This paper assumes the project will proceed, and electricity from Labrador will reach Nova Scotia in or soon after 2017.

Interconnections

As recently as a decade ago, it was possible to look at each provincial electrical system as relatively autonomous (aside from the links between New Brunswick and Prince Edward Island and the limited connections between Nova Scotia and New Brunswick).[25] The organic development of electricity systems places New Brunswick at the heart of Maritime electricity. The Maritime Link, connecting Labrador, Newfoundland and Nova Scotia, will change New Brunswick's central role insofar as the regional electricity system will align Nova Scotia and Newfoundland more closely. Muskrat Falls will provide a consistent base-load service to both Newfoundland and Nova Scotia that will reduce the need for some of the oldest conventional power plants, particularly oil plants in Newfoundland and coal plants in Nova Scotia.

On the natural gas side of the equation is the Maritimes & Northeast Pipeline, the Brunswick Pipeline and the Canaport receiving and regasification terminal in Saint John, New Brunswick. The shift to natural gas for power generation (and access to natural gas on the pipeline route) has significantly changed the generation mix in Nova Scotia and New Brunswick. The next section covers this in more detail.

New realities

Along with the change in domestic energy infrastructure that has altered the nature of the electricity generation and mix, the energy revolution in the United States has disrupted the existing patterns of generation and the movement of electricity across the continent. The rapid expansion of U.S. shale gas has changed the economics and availability of gas in North America. Ports originally intended for the importation of LNG are being considered for exporting purposes. Canaport is one such example. This has made gas and power relatively cheaper although there remain many regional pricing variances. The Western Canadian oil and gas sector continues to expand, which has national implications for the transit of petroleum products. For example, the use of railways to export oil and the proposed reversal of the Line 9 Enbridge pipeline show how developments in the West can have an effect across Canada.

Evolution of consumer expectations and demand

Over the past decade, a subtle change in consumer preferences and expectations around electricity and heating has occurred. Quite understandably, Canadians are sensitive about continual access to reasonably priced heating. This can be a life or death matter in the depths of winter. Communities are generally resilient, as evidenced in the Newfoundland blackouts in early 2014. There is a broad consensus among consumers that energy should be clean and of minimal harm to the environment. While not necessarily using the language of experts or economists, electricity customers are aware of the environmental, economic and market forces that contribute to their power prices. Nonetheless, there is little tolerance for breaks in service, more demand for clean energy and an extreme aversion to price increases that can be crucial during an election cycle.

Legacy systems and infrastructure

In short, the Maritimes has a range of legacy electrical systems and infrastructure. The shift to gas and the connection of Muskrat Falls will significantly change the generation mix and electricity flows. With the adoption of significant new intermittent renewable generators and a shift to natural gas, the difference between the gas market and electricity market is blurrier than ever. The next section looks at how the two markets are increasingly influencing one another.

Interaction between electricity and gas markets

Traditionally, electricity and natural gas markets were viewed as separate systems. However, over the past decade, there has been a steady increase in the use of natural gas for electricity (in addition to its traditional role for heating). This can be attributed to the lower carbon emissions of natural gas compared with coal or oil and its status as a transition fuel in the general shift toward a low-carbon economy. Due to the low cost of gas, a number of households in Atlantic Canada have switched to natural gas for heating.

A shift to gas

In 2011, the International Energy Agency published a report titled “Are We Entering a Golden Age of Gas?,” which outlined the long-term outlook for natural gas. The report presents a scenario in which the global use of gas rises by more than 50 per cent from 2010 levels and accounts for more than one-quarter of global energy demand by 2035. In addition to having lower carbon emissions than coal does, gas is becoming increasingly favoured within electricity markets for a number of other reasons. Not only are gas power plants cheaper on a per unit basis than coal power plants, gas tends to be the preferred option for base-load and peaking plants due to the increasing restrictions (and effective bans) on new coal power plants in some jurisdictions and the unavailability of hydro or nuclear in others.

The Maritimes experience

The Maritimes has also experienced a natural gas revolution over the past decade. While this transition has been part of a global trend of a larger proportion of natural gas in the energy mix, some local factors were also at play. In the Maritimes, as in many jurisdictions, the OPEC shocks of the 1970s forced a revaluation of the dependence on oil for power generation. This prompted a review of energy options[26] including extraction of local resources. Another long-term impact of the debate over energy was a focus on attracting large investments from international energy companies to unlock some of the reserves in and around Atlantic Canada.

One of the best illustrations for the move to gas is the Sable Island project. Sable Island is the natural gas complex off the coast of Nova Scotia that came online on December 31, 1999. The business case for the $3-billion project and associated $2-billion Maritime & North East Pipeline was based on supplying natural gas to the Boston and New England markets. During the early 2000s, more than 90 per cent of the natural gas reached the intended U.S. market as that region progressively shut down coal plants and shifted to natural gas. From about 2002, the bulk export of gas to the United States began to change. Nova Scotia and New Brunswick consumed more gas, as various businesses — such as refining, pulp and paper, mining and power generation — shifted to this fuel. This occurred as production on Sable Island began to decline. Although the Deep Panuke offshore project achieved peak production of 300,000,000 cubic feet of natural gas in December 2013, there will be a gradual decline of domestic production from existing conventional sources in the coming decade. There are often seasonal supply shortages of natural gas for power and heating purposes. To deal with these temporary shortages, at times LNG is sometimes imported. The Saint John, New Brunswick, Canaport LNG facility was built to receive natural gas and has received shipments during winter peaks for the local market, although the volumes of imported LNG have decreased year on year.

The transition to natural gas for industrial and power purposes in New Brunswick and Nova Scotia, along with the declining economics of new, large offshore oil and gas projects like Sable Island, has created some surprising, unforeseen results. In the early 2000s there was a debate over the Maritimes being a LNG import hub servicing North-East US markets. It is quite possible that by the 2020s there could be an LNG industry, but one which is based on exports, and not imports as was once envisaged. By September 2015 three projects on the east coast had received approval from the National Energy Board to export LNG.

TABLE 2

LNG Export Projects Approved by the National Energy Board (As at Sept. 2015)

Project	Province	Company
Bear Head LNG	Nova Scotia	LNG Ltd.
Saint John LNG Development Canada	New Brunswick	Repsol
Goldboro LNG	Nova Scotia	Pieridae Energy Ltd.

While not all these projects will necessarily proceed, it is entirely possible that the first LNG Canadian exporting terminal will be built in the Maritimes. To become a reality, these projects must go through the Final Investment Decision process, which is an industry term referring to approval to invest and proceed. The proposed sources of the gas for these projects vary, but would likely involve a reversal of the Maritime & North East Pipeline to facilitate exporting of shale gas from the U.S. Marcellus basin.

An evolving gas market

While natural gas prices have generally declined, there are seasonal variances in prices. While there has been a shift toward gas overall, during specific times of the year, some users reduce their consumption, effectively being able to arbitrage between different energy markets. Demand for natural gas during winter is traditionally very high compared with the rest of the year. Approximately 48 per cent of Canadian homes use natural gas for heating, and the use of natural gas by industry and power plants is expanding. A colder than average winter in January and February 2014 saw a spike in natural gas markets, sometimes quadrupling prices throughout New Brunswick.[27] The high prices for natural gas also had an effect on the electricity generation mix in Nova Scotia near the end of 2013.[28] These extra costs will flow through to consumers, albeit in a more indirect manner. By November 30, 2013, Nova Scotia Power generated 12 per cent of electricity from burning gas. The original forecast, based on June 2012 projections, was 27 per cent. This large gap was filled with more-expensive, less-clean forms of fuel.

Convergence

With heating, power and other industrial processes relying on natural gas as a competitive fuel source, electricity and gas markets should be viewed as part of a larger energy market. When the price and availability of natural gas change, so do choices for generators. If the cost of gas increases, so will the cost of electricity. Gas is an important part of the energy mix, a mix that includes both renewable and non-renewable sources. As a stable energy source, natural gas is important in this context, given it can help accommodate fluctuations in the supply of wind power on to the grid. As more wind generation is incorporated into the grid, the demands on gas may increase, further exposing the electricity sector to the vagaries of the wind and the variances in the market price of natural gas.

Lessons from other jurisdictions

Another issue in the convergence of electricity and gas markets is that as gas generation increases, pipeline capacity and availability become critical. Western Australia has had a convergence of gas and electricity markets. The dependence on gas for electricity (above 60 per cent of the generation capacity) means that electricity generators are beholden to the production of gas thousands of kilometres away. When this gas supply was disrupted in 2008[29] because of a pipeline explosion, expensive diesel generators and power rationing kept the system functioning. The estimated economic cost of the disruption was approximately $3-billion.[30] Even when the gas supply and the pipeline were working, drawing on remote gas without having storage options meant gas (and electricity) became more expensive. Accordingly, efforts have accelerated to source unconventional gas closer to power generation and industrial consumers.

When Western Australia experienced this supply disruption, mainstream political parties considered all options as part of the public debate. From this debate emerged a general policy consensus on the need for more natural gas storage, additional pipeline capacity, export options and new domestic production. These changes would place downward pressure on gas prices and provide redundancies in the system to guard against future disruptions.

Western Australia and Atlantic Canada share some similarities. Both have a small, dispersed population; major offshore oil and gas projects; a need to transport electricity and gas a long way to reach consumers; and a generation mix that exposes electricity consumers to the fluctuations in global gas markets. The Western Australian experience in 2008 transformed the role of shale gas in the energy mix. As with Atlantic Canada, there was a growing reliance on natural gas for electricity, and traditional suppliers were forecast to struggle to meet demand.

Because of the major disruption in natural gas, there was a determination to apply high standards to shale gas extractions and to allay public concern by explaining how hydraulic fracturing has been used extensively in the conventional industry for decades.[31] Efforts to promote a balanced discussion about hydraulic fracturing went beyond defending this process from its many critics, some of whom are fundamentally opposed to any use or extraction of any fossil fuel. Western Australia Department of Mines and Petroleum Minister Bill Marmion said in response to a report by the Australian Council of Learned Academies on the fledgling industry that illustrated great potential for shale gas: "The obvious examples of the direct benefits include the increasing investments in Western Australian operations by petroleum companies; local employment through exploration, construction and production and related services; and the flow-on benefits for the Western Australian community from royalties from future operations."[32]

Prices and the true cost of renewables and government intervention

This section will review the difference between the price of power and the additional costs of renewables and government intervention. It will highlight the true cost of energy policies and how consumers pay for them, either directly or indirectly.

When considering energy policy, it is important to be aware that its primary purpose is to provide cheap, clean and reliable energy to consumers, who are often forgotten in energy policy discussions. This is problematic, as it is individuals who have to deal with large electricity bills and higher taxes when energy policies do not work.

Cost and prices

Electricity has a cost and a price, and they are not always the same. The cost represents the sum of the economic processes required to transport electricity to the consumer. It is the fuel, wages and infrastructure (and a number of other inputs) that an electricity provider needs to buy to meet consumer demand. Price, on the other hand, is the amount of money the consumer pays for the product. In the private sector, the cost must be less than the price. The difference is profit.

The price paid by consumers for their electricity is the result of a regulatory or political process that determines the end customer charges. This means that unlike gasoline used for cars, which fluctuates based on market prices, electricity prices for households tends to be at a set rate regardless of the cost of the fuel. At times, the cost of power is more than the price paid by consumers. This can be through a direct subsidy by government — that is, from implicit or explicit debt guarantees to lower the cost of capital for utilities — or from more-complex regulatory mechanisms that involve some form of taxpayer transfer to the producers of electricity. In economic terms, it is more efficient for the cost and price of electricity to be closely aligned, ideally with a profit component to attract and encourage investors.

Some commentators will advocate self-generation of electricity and independence from the grid. However, even with the best solar-wind-battery combination, it is not economically viable for households to go without some form of backup for the grid. Therefore, there is still a debate as to whether electricity is a commodity or a service. Part of the problem arises from the fact that many people want it to be delivered like a service but priced like a commodity. Commodities tend to be generic, cheap and available everywhere. Services tend to be time sensitive, responsive to customers' needs and require reliable support and a quick reaction to disruptions in the product's provision.

The restriction of new energy sources also influences the cost of power. A case in point is the restrictions put in place in the extraction of shale gas in Atlantic Canada. If the region had followed a pathway similar to Pennsylvania's in its development of the Marcellus Shale,[33] it could have mitigated the rising cost of electricity and heating for consumers. Pennsylvania, in utilizing the gas deposits in the Marcellus Shale, has seen increased availability and supply of gas. This has placed downward pressure on gas prices, resulting in reduced electricity prices for consumers and businesses.[34] Therefore, in deciding to ban shale gas development, Atlantic Canada should take into account the positive economic benefits seen in Pennsylvania — not just the environmental concerns raised by activist groups. After all, it costs the government nothing to respond to calls made by activist groups; it does, however, cost electricity users and taxpayers if shale gas restrictions continue.

New and emerging uses for gas and related fuels

The traditional view is that natural gas is used solely for large generating stations and heating homes. This has changed in recent years, as new technologies and transport options unlock new uses for this transition fuel. Natural gas is used for powering air conditioners; as a chemical feedstock; as a substitute for petrol or diesel, especially for trucks (compressed natural gas: CNG); and as an alternative to oil for heating via a virtual pipeline.

There are a range of applications for Atlantic Canada which include:

Electricity generation

Virtual Gas Pipeline: One example of a new use for natural gas is the virtual pipeline created by trucking CNG to places where it can be used as an alternative to oil for heating. Acadia University, located in the Annapolis Valley of Nova Scotia, made the transition to CNG-transported gas to save money and reduce emissions.[35] This transition to CNG is occurring across the Maritimes and New England, with a number of large energy consumers opting to use natural gas. There is potential for the virtual pipeline to be extended to most parts of the region that are large consumers of energy. The traditional geographic requirement to be close to a pipeline to access natural gas is now removed.

Microgrids: Microgrids can provide a stable and consistent source of electricity generation for the remote parts of the Atlantic region. Microgrids are small-scale power networks that operate independently of the main electricity grid and utilize two or more sources of energy to provide electricity. They are often a mix of renewable and non-renewable resources such as a combination of natural gas-powered microturbines and solar-voltaic cells. In fact, Nova Scotia Community College recently received a $2.3-million grant from the Natural Sciences and Engineering Research Council of Canada to develop and build a micropower grid. The College, in a partnership with industry, will use this microgrid to develop smart electric systems that can effectively utilize renewable energy sources, develop energy storage systems and gain a greater understanding of the impact.[36]

Microturbines: These small electricity-generating units use gaseous or liquid fuel to spin a turbine to generate electricity. They are capable of producing electricity and heat; often both capabilities are used. This is cogeneration, the simultaneous generation of electricity and thermal energy. Microturbines can produce between 25 kW and 500 kW of energy. These generators can operate on natural gas, waste gases, diesel, gasoline, kerosene and waste gases from industrial processes. As this is a relatively new technology, there are relatively few commercial or residential applications. However, it is predicted that there will be a widespread adoption of this technology in the near future due to its portability, low cost, low emissions and flexibility in electricity load requirements.[37] This technology provides a cost-effective option, especially where electricity prices are high compared with the cost of natural gas.[38]

Fuel Cells: A fuel cell produces electricity through a chemical reaction. Pushing a fuel source (such as natural gas) through a membrane produces this reaction. As long as there is a consistent supply of fuel, these cells can run indefinitely, constantly producing electricity. Fuel cells have many uses including electricity generation and powering vehicles. Internationally, Canada is recognized as the global hub for hydrogen and fuel cell research, development and early-stage commercialization of the technology.[39] Despite this, due to high costs, fuel cell technology has yet to be deployed.

Gas Storage: Storage will expand the use of natural gas, which, according to a study commissioned by the government of Nova Scotia, is being considered under the banner of the Atlantic Energy Gateway initiative.[40] Taking its cues from this study, Alton Natural Gas Storage LP recently developed plans for a gas storage facility. It proposed developing an underground natural gas storage facility out of naturally occurring salt formations, and it has environmental approval.[41] The ultimate aim of such a project is to reduce the impact and severity of seasonal consumption peaks, allowing natural gas storage permits consistent production levels and pipeline volumes throughout the year. There will be supply to meet seasonal swings in demand. This option lets the Maritimes improve the attractiveness for gas in the region and allows year-round access to competitively priced product.

Transportation

LNG/CNG-Fuelled Vehicles: Two forms of natural gas are used in vehicles: CNG and LNG. CNG is produced by compressing the natural gas to less than 1 per cent of its volume at standard atmospheric pressure. It is used in light- medium- and heavy-duty transportation applications. For instance, in long-haul driving and trucking applications, conversion to CNG is already paying dividends, as the initial costs are recouped over a short time, and ongoing energy unit costs are less than diesel's. As the distribution network for long-haul trucks is extended and people become more familiar with this technology, its popularity could increase. One question that remains unanswered is whether CNG cars will become a serious alternative to gasoline and diesel options. The economics will change once purpose-built CNG cars and fuelling options become more commonplace. The only CNG car available in Canada is the CNG Honda Civic.[42] An alternative to CNG is LNG, which is produced by purifying natural gas and then supercooling it until it turns into a liquid. As LNG is denser than CNG (LNG is a liquid rather than a gas), more of it can be stored by volume, making this a good option for long-haul transportation. However, one drawback is that LNG must be kept cold in a pressurized and well-insulated vessel.

Chemicals

Chemical Feedstock: Natural gas can be utilized as a chemical feedstock, as it consists of various hydrocarbons, with the majority being methane. Methane is the main chemical feedstock in widely used chemicals such as ammonia and methanol. In addition to methane, other naturally occurring elements are cooled to form liquids (otherwise known as Natural Gas Liquids (NGLs)). NGLs form the basis of many everyday products such as plastics, antifreeze and detergent and are a fuel source (propane is a good example). Nationally, the $47-billion petrochemical industry has a strong presence in Ontario, Alberta and Quebec.[43]

Synthetic fuels

Coal to Liquids Technology (CTL): In the longer term, if carbon sequestration becomes economically viable and the environmental concerns regarding emissions are dealt with, there could be a return to other forms of traditional fuel. Examples of this are coal to liquids and coal to gas[44] technologies that in essence convert gas and coal into a liquid fuel that can be used for traditional transportation purposes. Products derived from CTL include ultra-clean petroleum and diesel, synthetic waxes, lubricants, chemical feedstocks and alternative liquid fuels such as methanol.

Whilst there are no CTL technologies in Canada, such technologies have been used since 1955 to produce coal-derived fuels in South Africa.[45] China is also developing this technology as seen in the estimated 325 million tce[46] of coal conversion projects awaiting development.[47] CTL could help unlock existing coal reserves, especially in Nova Scotia. Once these processes can meet the requisite environmental conditions, they would provide further options for Atlantic Canada.

Technical developments

Floating LNG (FLNG): Offshore projects such as Sable Island and Deep Panuke remain an important component of the energy mix in Nova Scotia and New Brunswick. Now, the economics of new, large, capital-intensive offshore projects is less attractive due to the expansion of shale gas. This will not necessarily be permanent. Technologies such as FLNG can negate the need for expensive subsea pipelines and increase the potential for the exploitation of smaller and uneconomical fields. FLNG plants allows for extraction and processing of gas offshore, as well as transferring of the gas to LNG carriers while at sea before the carriers travel directly to market.

However, as FLNG is a new technology, it is difficult to identify what developments will be suitable because every potential gas development is different in terms of the relative technical, economic, environmental and social parameters. In addition, the FLNG market is young and uncertain. There remain technical as well as commercial issues that need to be resolved before the wide-scale viability of the technology is established. Despite being cheaper to construct (compare a $12-billion FLNG project[48] to a $55-billion onshore liquefaction plant[49]), there is still a requirement of significant capital investment. As such, the viability of FLNG hinges on competitive global gas prices and ensuring that the increased supplies of natural gas resulting from shale gas developments do not detrimentally affect those prices. FLNG development, similar to the shale gas revolution, has the potential to change the landscape in the offshore natural gas industry. Such a technology is one of many that will allow new and unexpected energy sources to be unlocked.

Gas opportunities for Atlantic Canada

We are witnessing a major energy transformation across Atlantic Canada. Not since the 1970s and the OPEC-driven switch away from imported oil has there been such dynamism in the sector and from government policy-making circles. This change is due to Muskrat Falls and the general transition to natural gas for electricity, industrial processes, heating and transport. This creates new opportunities for Atlantic Canada. To realize its full potential, policies that are restricting the extraction of natural gas must be reviewed. As well, new consumer technologies must be allowed into the market.

The following recommendations would allow the four provinces to benefit from the transition to natural gas and position them for new, unforeseen opportunities.

Benefits of an LNG industry

The major changes to the natural gas markets in North America has meant that the region could be host to a number of LNG exporting plants. While three projects have received approval to export natural gas as LNG to world markets, none of these projects has been sanctioned. The British Columbia experience of counting (and taxing) the benefits of the industry before it was established provides a cautionary tale.

Recommendation: To facilitate greater levels of investment, there should be an effort to create a bipartisan, consensus view on fundamental aspects of the LNG industry.

Unexpected offshore prospects

For those in the energy business, constant flux is a given. However, events, technologies and political changes rarely unfold as expected. Most energy forecasts more than a decade old show how frequently incorrect even senior forecasters can be in their predictions. As shale gas has focused most attention onshore, it would be wrong to write off new forms of offshore extraction. When FLNG technology becomes more commonplace and costs decrease, there may be more opportunities in this area.

Recommendation: In the shift to new onshore natural gas opportunities, new offshore opportunities such as FLNG should not be forgotten, especially with regard to regulatory settings and policy frameworks.

Shale gas: local or imported?

Some forms of natural gas extraction have been the subject of fierce debate in New Brunswick and Nova Scotia. Naturally, there is concern about new technologies and an extraction method that has had a lot of publicity. However, hydraulic fracturing is not that new, and it was practised in the province without issue or concern prior to the violent protests in late 2013. Due to the evolving international energy matrix and the transition to electrical and transport systems that increasingly rely on natural gas, it is inevitable that there will be more shale gas entering and being used in the region. The key question for those in Atlantic Canada will be does this shale gas originate in the United States, or is it unconventional gas that is extracted locally? The discussion over natural gas has been framed for too long as a choice between natural gas and other options. This is a false choice. Natural gas is already part of the mix.

Recommendation: As natural gas is already playing a critical and growing role in Atlantic Canada, it is necessary to quantify the cost of importing an energy source that can be extracted locally. There are prospective onshore shale gas fields in Nova Scotia and Newfoundland. While each province may opt for its own regulatory framework, agreement on minimal or harmonized Atlantic Canadian standards for extraction of shale gas is recommended.

Quantify the Maritime Electricity Premium

Maritime electrical systems are becoming more reliant on natural gas. Electricity and natural gas markets are becoming intertwined, and policies in one area can affect another area. By restricting some forms of natural gas extraction, there is a cost impact on consumers and taxpayers. The Maritime Electricity Premium, already high by national standards, has the potential to increase even further. Hydraulic fracturing can be easily demonized in an election campaign due to misinformation and activist groups that promote fear and hysteria. Despite those who rush to condemn hydraulic fracturing, there is a group of people who argue that electricity costs should be higher.

Recommendation: All efforts should be made to reduce the Maritime Electricity Premium, especially in terms of new natural gas options and the effect the cost would have on households if they are not developed.

New technologies

Just as CNG has changed the landscape for gas heating for those not close to a pipeline, it is likely there will be other new technologies that use natural gas.

Recommendation: Atlantic governments should monitor international technology developments relating to natural gas products for consumers, so they can review and approve products and processes in a timely manner.

Look beyond celebrities and the favoured comparisons

Atlantic Canada is not the only jurisdiction that has faced energy challenges and debates over new fuel sources. Thus far, those who are fundamentally opposed to the extraction, use and even the existence of natural gas extraction have framed the debate. Some activists are also against the widespread use of energy and favour a vast reduction in its consumption. While this group has captured the terms and tone of the energy debate, it is time to look beyond celebrity-endorsed campaigns that are often inspired by similar activities in the United States. Many other sub-national jurisdictions have had to deal with pending gas shortages and have had broader debates incorporating the views of taxpayers, community leaders, small business and landowners.

Recommendation: It is time to look to other jurisdictions, such as Western Australia, that have faced gas shortages and price increases and turned to shale gas as an alternative in order to expand investments, jobs and royalty revenue.

Endnotes

1. The author would like to thank research assistants Samuel Kitchen and Sunita Sebastian for their assistance with this paper as well as the various energy and resource experts from Atlantic Canada who provided feedback and suggestions.
2. There are, of course, exceptions such as electric vehicles.
3. Consider, for instance, Pierre Trudeau's New Energy Policy, the nationalization of Quebec's hydro industry and the contemporary expansion of oil sands transportation infrastructure.
4. Zach Dubinsky, "Major Changes in Works for Canada's Electrical Grid," *CBC News,* March 30, 2011, http://www.cbc.ca/news/canada/major-changes-in-works-for-canada-s-electrical-grid-1.1067041 (accessed June 1, 2014).
5. Joann Alberstat, "Power Fairly Pricey in N.S.," *The Chronicle Herald,* April 22, 2013, http://thechronicleherald.ca/business/1124673-power-fairly-pricey-in-ns (accessed March 3, 2014).
6. "Moratorium on Fracking Announced by Newfoundland Government," *The Telegram,* November 4, 2013, http://www.thetelegram.com/News/Local/2013-11-04/article-3465585/Moratorium-announced-on-fracking/1 (accessed June 1, 2014).
7. This will include a review of the rules in other regions, an assessment of the process's geological impact on Western Newfoundland and the undertaking of public consultations: James Mahony, "Regulatory Picture for Fracturing Coming into Focus Across Canada," *Daily Oil Bulletin,* March 11, 2014, http://www.csur.com/images/press/March%2011_2014_DOB_Regulatory.pdf (accessed June 1, 2014).
8. Information on the Newfoundland and Labrador Hydraulic Fracturing Review Panel can be found on the official website: http://nlhfrp.ca/.
9. CBC News, "Fracking commission appointed to study shale gas conditions," *CBC News,* March 24, 2015, http://www.cbc.ca/news/canada/new-brunswick/fracking-commission-appointed-to-study-shale-gas-conditions-1.3006938 (accessed September 23, 2015).
10. Electricity consumption in Nova Scotia and Newfoundland and Labrador, respectively, is 11 TWh and 8 GWh: "Market Trends for the Supply & Demand of Electricity in Nova Scotia," *ICF International,* May 30, 2014, submission to the Nova Scotia Department of Energy, http://energy.novascotia.ca/sites/default/files/files/Electricity-Review-NS-DOE-Market-Trends-Report.pdf; "Newfoundland and Labrador – Statistics (2011-2012)," Canadian Centre for Energy, http://www.centreforenergy.com/FactsStats/Statistics.asp?Template=5,10. The Muskrat Falls project has the potential to provide at least 5 TWh: "Submission to the Joint Committee on Telecommunications, Utilities and Energy, Bill H-3968, *An Act Relative to Clean Energy Resources,*" April 22, 2014.
11. "Muskrat Falls Costs Rising, Power May Be Delayed: Nalcor CEO," *The Globe and Mail,* April 15, 2014, http://www.theglobeandmail.com/news/national/muskrat-falls-costs-rising-power-may-be-delayed-nalcor-ceo/article18005738/; Pat Bates, "Muskrat Falls Hydro-Project Costs Ballooning," *Cape Breton Post,* August 9, 2014; *CBC News,* "Muskrat Falls behind schedule; delays with pouring concrete highlighted," *CBC News,* July 3, 2015, http://www.cbc.ca/news/canada/newfoundland-labrador/muskrat-falls-behind-schedule-delays-with-pouring-concrete-highlighted-1.3137222 (accessed September 23, 2015).
12. James Feehan, "Electricity Market Integration: Newfoundland Chooses Monopoly and Protectionism," Commentary, Atlantic Institute of Market Studies, November 2013.
13. Peter J. Wylie, "When Markets Fail: Electrification and Maritime Industrial Decline in the 1920s," *Acadiensis* Vol. 17, Autumn 1987, pp. 74-96.
14. Load following refers to the process in which power plant increases or decreases power output in responses to fluctuating energy demand. This is to keep the system in balance and avoid brownouts and other related issues.
15. Dispatch refers to process regarding the sequence and timing for power plants to generate electricity to the grid. This is generally done on based on system demand and cost of generation, however, it is made more complicated as some plants may take some time to commence generating electricity compared to the instantaneous changes in wind condition.

16. Richard Blackwell, "Britain, Nova Scotia cut subsidies to green energy over cost concerns," *The Globe and Mail,* September 6, 2015, http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/britain-nova-scotia-cut-subsidies-to-green-energy-over-cost-concerns/article26240381/ (accessed September 23, 2015).

17. Information from Nova Scotia Power Web site (https://www.nspower.ca).

18. Information from New Brunswick Power Web site (http://www.nbpower.com).

19. Information from Maritime Electric Web site (http://www.maritimeelectric.com).

20. Information from Newfoundland and Labrador Department of Natural Resources Web site (http://www.nr.gov.nl.ca/nr/energy/electricity/).

21. The majority of customers are served by the island's interconnected system. In Labrador, customers on the Labrador interconnected system are served by Hydro with power from the Churchill Falls Hydroelectric Generating Station. Customers on 21 isolated systems on the coasts of Newfoundland and Labrador receive their power from diesel generators operated by Hydro.

22. This is the Churchill Falls Hydroelectric Generating Station. Most of the electricity produced by its 11 turbines is sold to Hydro-Québec through a long-term power purchase arrangement that is due to expire in 2041.

23. As per the Nova Scotia Power Web site: "A 350 MW capacity transmission line connects Nova Scotia with New Brunswick, enabling limited importing and exporting of electricity with neighbouring jurisdictions." It is also noted: "Typically, imports account for less than 5% of the electricity used in Nova Scotia in a year." However, this will change when Muskrat Falls comes online.

24. The Emera Web site noted, "When the generating facility is operational, approximately 40% of the power generated at Muskrat Falls will be used to meet the island's electricity needs. For 20% of the project cost, Emera Inc. will purchase 20% of the power from Muskrat Falls for use in Nova Scotia. The remaining 40% of the power may be exported into Atlantic Canadian and New England markets or retained for our own use as needed. The province is projected to need 80% of Muskrat Falls' power by 2036, or earlier as additional industrial growth occurs." https://muskratfalls.nalcorenergy.com/project-overview/.

25. New Brunswick has interconnections with Quebec and limited links with New England.

26. These debates are in Marshall Conley and Graham Daborn (eds.), *Energy Options for Atlantic Canada: The Potential – and the Problems – of Oil, Coal, Tidal, Nuclear and Hydro Power,* 1982 Formac Publishing Company Limited, Halifax.

27. "'Shocking' Natural Gas Prices Expected to Continue to Rise," *CBC News,* February 2, 2014, http://www.cbc.ca/news/canada/new-brunswick/shocking-natural-gas-prices-expected-to-continue-to-rise-1.2520381 (accessed March 3, 2014).

28. Joann Alberstat, "NSP Cuts Use of Natural Gas Due to Prices," *The Chronicle Herald,* December 20, 2013, http://thechronicleherald.ca/business/1175313-nsp-cuts-use-of-natural-gas-due-to-prices (accessed March 3, 2014).

29. Elizabeth Gosch, "WA Gas Supply Cut 30pc by Blast at Varanus Island," *The Australian,* June 7, 2008, http://www.theaustralian.com.au/news/nation/wa-gas-supply-cut-30pc-by-blast/story-e6frg6pf-1111116564482 (accessed August 18, 2015).

30. Kathryn Diss, "The Cost of Securing WA's Energy Future," ABC, May 13, 2013, http://www.abc.net.au/news/2013-05-17/the-cost-of-securing-wa27s-energy-future/4697136 (accessed March 3, 2014).

31. Paul Garvey, "Monitoring Shows No Risk in Fracking for Shale Gas: Agency," *The Australian,* June 11, 2013.

32. Saskia Pickles, "Shale Gas to Secure WA's Energy Future: Marmion," *Business News,* June 6, 2013, http://www.businessnews.com.au/article/Shale-gas-to-secure-WAs-energy-future-Marmion (accessed March 3, 2014).

33. The Marcellus Shale is a shale gas deposit that underlies a large part of Pennsylvania and is the second-largest natural gas shale formation in the world.

34. For instance, in 2011, as per a Public Utility Commission calculation, the lower natural gas prices saw Pennsylvania energy consumers save $13-billion over a two-year period: Donald Gilliland, "Marcellus Shale Natural Gas Boom Alters Pa.'s Economy," Penn Live, December 11, 2011, http://www.pennlive.com/midstate/index.ssf/2011/12/marcellus_shale_natural_gas_bo.html, (accessed September 7, 2014).

35. Nova Scotia, "Acadia University Gets Innovation Fund Boost," March 28, 2013, http://novascotia.ca/news/release/?id=20130328009 (accessed March 4, 2014).

36. Nova Scotia Community College, Media Release, "$2.3 Million Injection to Fund Energy Research Innovation at NSCC," April 17 2014, http://www.nscc.ca/about_nscc/media/2014/04-17-14-00.asp (accessed May 31, 2014).

37. Canadian Industrial Energy End-use Data and Analysis Centre, "Cogeneration Facilities in Canada, 2014," March 2014, http://www2.cieedac.sfu.ca/media/publications/Cogeneration_Report_2014_Final.pdf (accessed May 25, 2014).

38. *Ibid.*

39. Industry Canada, Hydrogen and Fuel Cells, April 3, 2013, http://www.ic.gc.ca/eic/site/hfc-hpc.nsf/eng/home (accessed May 25, 2014).

40. Joann Alberstat, "N.S. Looks at Maritime Partnership for Buying Natural Gas," *The Chronicle Herald,* February 5, 2014, http://thechronicleherald.ca/business/1184889-ns-looks-at-maritime-partnership-for-buying-natural-gas (accessed March 4, 2014).

41. Minister of Environment, Nova Scotia, "Alton Natural Gas Pipeline," May 21, 2013, http://www.novascotia.ca/nse/ea/alton-natural-gas-pipeline-project.asp (accessed June 3, 2014).

42. Michael Vaughan, "Will Natural Gas Work for Your Car?," *The Globe and Mail,* August 29, 2013, http://www.theglobeandmail.com/globe-drive/culture/technology/will-natural-gas-work-for-your-car/article13999009/ (accessed March 4, 2014).

43. Chemical Industry Association of Canada, About Our Industry, http://www.canadianchemistry.ca/index.php/en/industry-overview (accessed June 3, 2014).

44. Coal gasification turns coal and coke into synthesis gas (syngas), which is a mixture of hydrogen and carbon monoxide that burns as cleanly as natural gas. It creates useful by-products: fly ash for the cement industry, sulphur for fertilizer manufacture and chemical applications, and slag for building materials and roads. Due to its similarity to natural gas, it can be used in electricity production.

45. World Coal Association, "Coal to Liquids," http://www.worldcoal.org/coal/uses-of-coal/coal-to-liquids/ (accessed September 23, 2015).

46. The Tonne for Coal Equivalent is a unit that signifies the amount of energy generated by burning one metric ton of coal.

47. Aleksandra Tomczak, "The Coal Industry and Asia in 2014," *World Coal,* May 28, 2014, http://www.worldcoal.com/news/special-reports/articles/The_coal_industry_and_Asia_in_2014_coal889.aspx (accessed June 3, 2014).

48. The Shell Prelude FLNG project, which will be extracting, producing and exporting gas and associated condensates from the Browse Basin in Australia, is estimated to cost as much as $12-billion AUD: "The Biggest Vessel Ever Sent to Sea is Coming to Australia," *The Sydney Morning Herald,* December 13, 2013, http://www.smh.com.au/business/mining-and-resources/the-biggest-vessel-ever-sent-to-sea-is-coming-to-australia-20131213-2zchn.html (accessed June 3, 2014).

49. Pangea LNG CEO Kathleen Eisbrenner "noted that perhaps only three companies in the world can afford $55 billion-type land-based LNG liquefaction plants," Velda Addison, in "Wave of FLNG Projects Could Emerge," *E&P Magazine,* May 17, 2013, http://www.epmag.com/Production-Field-Development/Wave-FLNG-Projects-Emerge_116499 (accessed June 1, 2014).

AIMS
ATLANTIC INSTITUTE FOR MARKET STUDIES

Making a Donation

AIMS is a registered charity that operates with the financial support of foundations, corporations and individuals and offers tax receipts for donations. AIMS does not receive government funding nor does it contract itself for specific research projects thereby enhancing the Institute's ability to think freely, to hold decision-makers accountable for the choices they make, and maintain its professional integrity and intellectual independence.

Cost of Research: Each research project has its own parameters with respect to the amount and quality of the information available, the level of expertise required by the researcher and the amount of time that it takes to complete the paper. The total cost tends to range between $10,000 - $20,000+ which includes the author's fee, oversight and guidance by our Director of Research, proofreading, time, peer review, formatting, communications, radio ads, and media relations.

AIMS would like to invite you to join our group of valued supporters by filling in the form below. AIMS has been an influential voice in Canada for 20 years and those who support our mission and believe in moving it forward are integral to AIMS' continued success.

Name: ____________________

Organization: ____________________

Address: ____________________

Telephone: ____________________

Email: ____________________

Payment Method: Visa ☐ Mastercard ☐ Cheque ☐

$250 ☐ $500 ☐ $1,000 ☐ Other ____________

Card Number: ____________ Expiry Date: ____________

Card Holder: ____________ Signature: ____________

Please mail this form to:

287 Lacewood Drive,
Suite 204, Halifax, NS
B3M 3Y7

Or you may email it to aims@aims.ca.

If you wish to donate using our online portal, go to the Support Us page on our website:
http://www.aims.ca/en/home/supportus/default.aspx