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Synthesis Paper - Final

A RENEWABLE ENERGY STRATEGY FOR NOVA SCOTIA

Presented to the

Nova Scotia Renewable Energy Consultation

by

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1. Mandate

This Synthesis Paper has been commissioned by the Nova Scotia Renewable Energy Consultation (NSREC); it is a component of a comprehensive process to recommend a renewable energy strategy to the Government of Nova Scotia.

The mandate for this paper is as follows:

- Receive and absorb the outputs of the NSREC process so far, especially the commissioned papers (Economic[1], Social[2] and Environment[3]) and the outputs of the stakeholder consultations[4];
- Suggest 2-3 candidate favourable scenarios for Nova Scotia to meet its short term and long term renewable energy strategy, in consideration of economic, social, technological and environmental factors;
- Describe the candidate scenarios in terms of relative costs, benefits and risks based on international experience and particular circumstances of NS and Atlantic Canada; and,
- Identify enablers and barriers for favourable options and timescales involved.

Following the presentation of a summary of the renewable energy opportunities for Nova Scotia, the paper builds on the main, recurring elements identified in the stakeholder consultation to identify guiding principles for the definition of the renewable energy scenarios to meet the short term and long term renewable energy targets of Nova Scotia. These scenarios are then presented and discussed to give a broad overview of their main issues.

The paper does not attempt to assess the environmental impacts of specific energy sources, whether they are greenhouse gas emitters or not. Rather, the report is based on the postulate that society will evolve from fossil fuel based economies to economies that rely on renewable energy. Despite the current lack of a comprehensive international agreement on climate change, with clear targets for reductions in greenhouse gas emissions, jurisdictions are nonetheless diversifying their energy portfolio towards renewable energy sources. The jurisdictions that are moving away from the rhetoric and passing to actions should benefit in the transition phase from non-regulated carbon economies to regulated economies regarding greenhouse gas emissions.

Finally, due to time constraint in the consultation process, this paper is not meant to provide all the details and arguments to substantiate the recommendations; rather, it is meant to provide a general context for renewable energy scenarios to stimulate the debate and to provide options for the stakeholder consultation process.

This final Synthesis Paper integrates most of the comments received following the publication and the presentation of the initial Synthesis Paper. Comments related to other models or that pertain to disagreements with the elements of the Synthesis Paper are not integrated; rather, these types of comments should be considered in the definition of the final Renewable Energy Strategy of Nova Scotia.

[1] Gardner M., 2009, "Economic Implications of Renewable Energy in Nova Scotia", Nova Scotia Renewable Energy Consultation, 14 p.
[2] Haley B., 2009, "Social Implications of Nova Scotia Renewable Energy Scenarios", Nova Scotia Renewable Energy Consultation, 21 p.
[3] Rod J., 2009, "Environmental Implications – Renewable Energy Scenarios in Nova Scotia", Nova Scotia Renewable Energy Consultation, 14 p.
[4] "Nova Scotia Renewable Energy Strategy – Scenarios and Policy Options", Nova Scotia Renewable Energy Consultation, September 10, 2009, 20 p.

2. METHODOLOGY

The methodology used to define the potential scenarios for the renewable energy strategy is based on a multitude of sources of information. The main sources used in this work are the outputs of the NSREC process so far, especially the commissioned papers (Economic, Social and Environment) and the outputs of the stakeholder consultations. A particular attention is placed on the four conceptual scenarios identified by the stakeholder group.

This information is then validated by the best practices in other jurisdictions, both national and international, along with the work done by the research group of the author on renewable energy policies.

The potential scenarios are based on energy requirements to meet the short term and the long term targets indentified in the renewable energy strategy of Nova Scotia. For sake of general knowledge, a power capacity of an electricity generation source is expressed in kilowatts (kW) for small scale systems, and in megawatts (MW) for large scale systems. The energy generated is measured in kilowatt-hr (kWh); a house with electric heating typically consumes approximately 20,000 kWh per year.

For large scale generators, the amount of energy generated is measured in terawatt-hours (TWh) or gigawatt-hours (GWh), where one TWh is equal to 1,000 GWh, while one GWh is equal to one million kWh. One gigawatt-hours, which corresponds to one million kilowatt-hours (1,000,000 kWh), thus satisfy the annual electricity needs of approximately 50 homes (with electric heating) in Nova Scotia.

This paper is based on the energy requirements identified in the NSREC, and is summarized in Table 1. As determined in the stakeholder consultation, the estimates in the energy requirement take into consideration a reduction in consumption due to Demand Side Management (DSM), while it does not take into consideration the additional wind projects contracted, i.e. 50 MW by end of 2009 and 200 MW for 2010. Regarding the projections for 2020, a constant energy demand is assumed, representing a reasonable estimate of the incremental renewable energy requirements.

Table 1

Energy requirements to meet the renewable energy (RE) targets in Nova Scotia

Year	Energy Demand with DSM (GWh)	Total Energy Generation by Renewable Sources (%)	Total Energy Generation by Renewable Sources (GWh)	Current RE Generation (GWh)	Incremental RE Generation (GWh)
2015	12,000	25	3,000	1,200	1,800
2020	12,000	40	4,800	1,200	3,600

Source: Nova Scotia Renewable Energy Strategy – Scenarios and Policy Options, Nova Scotia Renewable Energy Consultation, September 10, 2009.

Sources of energy generation are characterized by an availability factor, which corresponds to the proportion of time that the unit is available to generate electricity when it is not down for various reasons, such as maintenance, breakdowns or availability of the fuel. Regarding wind energy, a capacity factor is normally used to measure the annual power production in comparison to the nameplate capacity of the wind turbine or the wind farm; the capacity factor thus takes into consideration both the availability factor and the effect due to the intermittency of the wind. Solar energy for electricity generation using photovoltaic cells also refers to a capacity factor, which corresponds to the proportion of the energy generated in comparison to the nameplate capacity of the system due to the diurnal cycle and the cloud cover. Table 2 presents the availability factors or capacity factors, along with the estimated costs of installation, used to develop the potential scenarios.

Table 2

Availability or capacity factors for various energy sources used in the potential scenarios

Renewable Energy Source		Availability / Capacity Factor (%)	Costs per Installed MW (M$)
Wind Energy[5]	Utility Scale	36	2.0
	Community-Based	36	2.4
Biomass[6]		80	3.0
Solar[7]	Utility Scale	15	5.0
	Residential Systems	15	8.0
Tidal Power[8]		40	4.0 – 5.0

[5] The 36% average capacity factor for wind farms in Canada is documented through the ecoEnergy Fund of the federal government (Knox N., Royer J., 2008, “Overview of the Performance of Wind Farms Funded Under Federal Renewable Energy Programs”, NRCan, CanWEA Annual Conference, October 21, 2008); this capacity factor is determined from a diversified portfolio of wind farms benefiting from federal funds, with almost half of the wind farms being under 15 MW of nameplate capacity. The costs for utility scale wind farms is taken from Gagnon Y., Leclerc A., Landry M., 2009, “Economic Impact Assessment of a 100 MW Wind Farm Project in New Brunswick”, Université de Moncton, and are based on the actual cost of real wind farms built in Eastern Canada since 2005; the cost for the community-based wind energy project is taken from Gagnon Y. and Landry M., 2009, “A Community Wind Energy Program for New Brunswick”, NB Department of Energy.

[6] For biomass, the capacity factor is estimated for an efficient cogeneration plant with a constant supply of biomass. The 3 M$/MW cost, taken from the NSREC document “NSPI’s Collected Comments on Three Expert Papers”, represents the cost for new facilities. The same document mentions that retrofitting existing coal fired plants to burn biomass would cost approximately 50 k$/MW.

[7] Alex Pavlovski, Green Power Lab, Dartmouth, Nova Scotia, personal communication. These capacity factors and costs correspond to generally accepted figures for photovoltaic solar energy generation. For the residential costs, the figure presented corresponds to the cost for small residential systems (i.e. $8 per watt).

[8] Nova Scotia Power.

In the short term (25% by 2015), it appears important to capitalize on technology that is currently available and that is economically viable. For the longer term target (40% by 2020), Nova Scotia should work to position itself to become a leader in emerging technologies where the province has a distinct differential advantage in comparison to other jurisdictions. The best example in this regards is ocean based energy, with a particular emphasis on in-stream tidal power rather than wave energy, where Nova Scotia has a distinct advantage because of the important resource in the Bay of Fundy. On the other hand, smart grid technologies are not constrained by a natural resource; the technology is thus being developed in numerous jurisdictions. Nova Scotia should thus concentrate on the integration of smart grid technologies rather than implementing an aggressive technology development strategy for smart grid technologies.

Financial projections are made to estimate the installation costs of the potential scenarios and their impacts on the rate of electricity in the province of Nova Scotia. Table 3 provides a summary of the financial data used to do the financial projections.

Table 3

Financial data used in the financial projections on the installation costs and the impacts on the electricity rates in Nova Scotia

Number of customers[9]	483,000	customers
Average cost of generation[10]		
Without transmission and distribution	0.067	$ / kWh (6.7 cents/kWh)
With transmission and distribution	0.086	$ / kWh (8.6 cents/kWh)
Residential rate for electricity[11]	0.118	$ / kWh (11.8 cents/kWh)

Based on the documents provided, it appears that the stakeholder group had extensive discussions on the impact of demand side management, smart grid technologies and energy efficiencies to determine the amount of incremental renewable energy generation needed to meet the short term (2015) and long term (2020) targets in Nova Scotia. While it is indeed an important issue in relative terms, it may not be relevant when one considers the absolute numbers. Indeed, there is a strong probability that the transportation industry will migrate towards more efficient electricity-powered vehicles, which will be developed in parallel to the development of smart grid technologies. In consequence, there is a good probability that the electricity demand in Nova Scotia will increase, while the implementation of energy efficiency policies and Demand Side Management will decrease consumption. It is thus felt that the total incremental energy generation from renewable sources identified by the stakeholder group (1,800 GWh in 2015 and 3,600 GWh in 2020) represents good and realistic estimates for the targets to achieve.

[9] Nova Scotia Power, http://www.nspower.ca/en/home/aboutnspi/nspfacts/default.aspx
[10] Sources: Emera, “Opportunity”, 2008 Annual Financial Report, taken from Gardner M., 2009, “Economic Implications of Renewable Energy in Nova Scotia”, Nova Scotia Renewable Energy Consultation, 14 p.; confirmed by email communications by Nova Scotia Power.
[11] Nova Scotia Power, http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetariff.aspx

3. Summary of Renewable Energy Opportunities for Nova Scotia

The stakeholder group has identified seven different technologies to harness the renewable energy resources available in Nova Scotia, namely wind energy, forest biomass, non-forest biomass, solar, ocean technologies, energy imports, along with other technologies and displacement. While the group decided not to consider domestic hydro since there are few opportunities for hydro expansion in the province, the author feels that the concept of micro and small scale hydro should be considered, notably in regards to the emerging concept of electricity generation using run-of-the-river hydro systems.

While not necessarily complete, the following provides a general overview, based on the consultation process and the research work of the author, for each of the technology solutions in regards to meeting the short term and long term targets for the Nova Scotia Renewable Energy Strategy.

Wind Energy

Benefits

- The technology is readily available
- The technology is reliable and proven
- Suited for large scale projects and community-based projects
- Rapid deployment

Enablers

- Nova Scotia has an exceptional wind resource
- Low density of population is conducive for the installation of large wind farms
- Very easy to install and operate
- Scalable, i.e. more capacity can easily be added
- Storage technologies could be developed, notably through pumped hydro storage
- Model by-laws for Nova Scotia municipalities and documents on best practices for community acceptance are available
- Possibility to install large wind farms (50-100 MW) and community-based wind energy projects (usually up to 15 MW)
- Distributing the wind farms over a large territory reduces the grid balancing costs
- Builds on previous experiences and existing initiatives (Nova Scotia Wind Atlas, Model Wind Turbine By-Laws, etc.)
- With the current recession and the emergence of several new wind turbine manufacturers, the supply of wind turbines should not be a concern in the next few years

Risks

- Low technology risks
- Low financial risks
- Low operational risks

Barriers

- Wind farms can have impacts on the landscape
- Need other energy sources to balance the grid due to the intermittency of the wind

- Various forms of opposition if not built according to best-practice principles and without community engagement
- Depending on where wind energy is developed, there could be a need for upgrades in the transmission capacity
- Wind energy can't be dispatched
- Depending on the ownership model, wind energy development could require new public policies (notably for community-based renewable energy projects with Feed-In Tariff approaches)
- Wind farms can have impacts on avian species (birds and bats) if not well sited
- Offshore wind energy is more costly
- The ecological impact of offshore wind energy is not well documented

Costs

- Onshore wind energy is economically viable
- The installation costs are relatively well know
- The operation and maintenance costs are relatively well know

FOREST BIOMASS

Benefits

- The technology is available and proven
- Can be installed as a Combined Heat and Power (CHP) system
- Suited for large scale and small scale projects
- Carbon neutral energy (without consideration to the harvesting of the biomass)

Enablers

- Can generate economic development in rural areas
- The biomass is available in various forms, and distributed throughout the territory
- Efficient CHP systems could reduce heating costs or offer new economic development opportunities
- Possibility of retrofitting coal fired plants; however this means that large plants would be retrofitted, thus requiring important quantities of biomass, which could have adverse ecological and environmental impacts
- Possibility of using a portion (e.g. 10%) of biomass in current coal fired plants

Risks

- Low technology risks
- Low financial risks
- Dependant on the availability and supply of the biomass

Barriers

- Perceived as an emitter of greenhouse gas
- Burning biomass induces air pollution
- Various forms of opposition if not operated according to best-practice principles, notably in regards to the harvesting of the biomass
- The harvesting of the biomass can be detrimental to the environment, in terms of impact on the biodiversity, loss of ecosystem services, landscape and greenhouse gas emissions
- Large generation units need important quantities of biomass, thus increasing the carbon footprint of the harvesting of the biomass

- The sustainable availability of the biomass is unknown

Costs

- The installation costs are relatively well know
- The operation and maintenance costs are relatively well know
- The cost of the biomass can grow as the supply of biomass expands over the territory
- The cost for the externalities can be very high

NON-FOREST BIOMASS

Benefits

- The technology is available and proven
- Can be installed as a Combined Heat and Power (CHP) system
- Suited for large scale and small scale projects

Enablers

- Can generate economic development in rural areas
- The experience of the City of Charlottetown can provide good information regarding the use of municipal waste, along with wood biomass, in CHP systems
- The biomass is available and distributed throughout the territory
- Many sources of non-forest biomass: manure, municipal waste, switch grass, algae, waste animal rendering, fish oil and various crops

Risks

- Low technology risks
- Low financial risks
- Dependant on the availability and supply of the biomass

Barriers

- Various forms of opposition if not operated according to best-practice principles, notably in regards to the harvesting of the biomass
- Perceived as an emitter of greenhouse gas
- Large generation units need important quantities of biomass, thus increasing the carbon footprint of the harvesting of the biomass
- Depending on the feedstock, burning non-forest biomass can degrade the value of the biomass (notably for municipal waste)

Costs

- The installation costs are relatively well know
- The operation and maintenance costs are relatively well know
- The cost of the biomass can grow as the supply of biomass expands over the territory

SOLAR ENERGY

Benefits

- Rapid deployment once the technology will be economically viable
- Suited for community-based and residential projects

Enablers

- Low density of population is conducive for the installation of large solar energy systems
- Very easy to install and operate
- Scalable, i.e. more capacity can easily be added
- Large areas are available to install solar energy systems
- Solar heating systems (air or water) for residences offer interesting opportunities for Nova Scotia

Risks

- High costs
- The technology is not mature

Barriers

- While being available, the technology for electricity generation from solar photovoltaic cells is not economically viable
- The solar resource is modest in Nova Scotia
- Solar energy can't be dispatched
- Because of snow, the winter season could affect negatively the performance of solar systems, if not well maintained

Costs

- Solar energy for electricity generation is not economically viable
- Solar heating systems (air or water) for residences is accessible and economically feasible

OCEAN TECHNOLOGIES

Benefits

- Suited for large scale projects and community-based projects
- Nova Scotia can be a leader in the ocean power sector (integration and manufacturing)

Enablers

- Nova Scotia is characterized by important ocean energy resources, notably in the Bay of Fundy
- Scalable, i.e. more capacity can easily be added
- Being an early adopter, Nova Scotia could be well positioned to develop an ocean energy manufacturing sector

Risks

- Currently, high technology risks
- Currently, high financial risks
- High operational risks
- Ecological and environmental impacts not well known

Barriers

- Many unknowns regarding the impact on the marine environment
- The technology is only in its early phase of development
- Depending on where ocean energy technologies are developed, there could be a need for upgrades in the transmission capacity
- Ocean energy can't be dispatched
- Subject to various forms of opposition, notably because of the potential ecological and environmental impacts (which are not well documented)

Costs

- The total cost structure of ocean energy technologies is not well known

ENERGY IMPORTS

Benefits

- No need to install generation capacities in Nova Scotia
- Increased regional cooperation in the energy sector
- Purchasing hydroelectricity, with appropriate long term agreements, could provide short term low cost energy

Enablers

- Larger balancing area is more conducive to integrate intermittent renewable energy sources
- Upgrading transmission interconnections may lead to greater flexibility to both import and export renewable energy as market conditions evolve

Risks

- Low technology risks
- Without long term purchase agreements, the cost can become excessively high
- Can have important financial risks; this risk is increased if Hydro Quebec proceeds with the purchase of NB Power (concentration in a single electricity supplier, through acquisition, of the electricity sector in Eastern Canada)
- Become dependent on external energy sources

Barriers

- Could have a need to upgrade the transmission capacities of the interconnections
- Does not provide opportunities for economic development in Nova Scotia

Costs

- The costs of the imported electricity will be variable and will depend on the type of contract (firm power purchase agreement, price based on the market supply and demand of electricity at specific periods, etc.)
- The need to upgrade interconnection capacities would induce costs

OTHER TECHNOLOGIES AND DISPLACEMENT

Benefits

- Displacement can be achieved through demand side management or energy efficiencies
- Smart grid technologies have the property of reducing the peak load demand; it does not necessarily reduce the consumption of electricity

Enablers

- Plan for the long term development of the electricity grid
- Engage in pilot projects to integrate smart grid technologies

Risks

- The technology for efficient demand side management, e.g. smart grids, is not mature
- Low financial risks

Barriers

- The technology for smart grids is still in development phase

Costs

- The costs to integrate smart grid technologies is not well known

MICRO AND SMALL HYDRO

Benefits

- Suited for large scale projects and community-based projects
- Run-of-the-river hydro is considered a renewable energy source (because of the low emissions of methane in comparison to large hydroelectric dams)

Enablers

- Can generate rural economic development, notably during the construction phase
- Scalable, i.e. more capacity can easily be added
- Nova Scotia should engage in a project to assess the micro and small hydro potential in the province

Risks

- Moderate technology risks
- Moderate financial risks

Barriers

- Can have an impact of the aquatic wildlife, notably in regards to the passage of fish
- The quality, and quantity, of the resource is unknown

Costs

- The installation costs are not well know
- The operation and maintenance costs are not well know

4. Guiding Principles for the Development of Scenarios

Based on the positions expressed in the consultation process and the technologies available, the potential scenarios for the development of the renewable energy sector in Nova Scotia presented in this report are based on the following guiding principles:

- The renewable energy sector is developed in order to maximize the economic and social benefits of Nova Scotia, while minimizing the environmental impacts in the province;
- The renewable energy sector is developed to contribute to low cost electricity and the long term stability of electricity rates in Nova Scotia;
- The energy portfolio should be based on a diversified mix of renewable energy sources;
- The energy portfolio should have a judicious combination of large scale and small scale energy generation units;
- The energy portfolio is developed with a short term vision (25% target before 2015) and a long term strategy (40% target before 2020);
- The short term target should be met by renewable energy sources with technologies that are currently available and that are economically viable;
- The longer term target should consider emerging renewable energy sources; and,
- Infrastructure development should be initiated to meet the long term target and to position Nova Scotia as a leader in emerging renewable energy sources.

5. Models of Development of Renewable Energy Sources

5.1 Large Wind Farms

In Canada, wind energy has mostly been developed through Request for Proposals approaches where private developers bid to obtain Power Purchase Agreements. This approach is a consequence of a trend towards neoliberal public policies, where governments reduce their interventions in the economy, and the deregulation of the electricity sector. On the other hand, as seen in Europe, the wind energy sector can be developed through community-based approaches where smaller wind farms are locally owned through local initiatives. Finally, the traditional approach to the development of electricity generation facilities in Canada is through the ownership by Crown Corporations.

The wind energy sector is thus characterized by three main models of ownership of wind farms, namely:

- Wind farms owned by private developers through Requests for Proposals;
- Wind farms owned by Crown Corporations; and,
- Community-based wind farms with local ownership normally developed through Feed-In Tariffs.

Typically, wind farms that are privately owned or owned by a Crown Corporation are large wind farms (50 to 100 MW, 100 to 200 M$ to build), while community-based wind farms are smaller wind farms (up to 15 MW, up to 36 M$ to build).

There are essentially three revenue streams in the operational aspects of the wind energy sector:

- Development and installation of the wind farm;
- Operation and maintenance of the wind farm; and
- Profits generated from the wind farm.

A study by Gagnon et al.[12] on the economic impact of a 100 MW wind farm clearly shows that the revenue streams from the development and installation phase, and the operation and maintenance of the wind farm, have relatively small economic impacts in comparison to the profits generated by the project. However, benefiting from the profits of the wind farm also implies financial obligations and risks in the project. Since the province is in a relatively early stage of development of the wind energy sector, the Government of Nova Scotia will have to decide on the most appropriate ownership model to develop the large wind energy projects to achieve the short and long term targets for renewable energy integration.

Irrespective of the ownership model, wind energy can be developed with large and community-based projects in view of maximizing the community acceptance of wind energy. This will be possible by following best practices and by engaging in community consultations in the early phase of projects.

On the principle, it is better to install the wind farms in various regions. Not only will this minimize the costs of balancing the grid and minimize transmission losses, it will allow to distribute the revenues and the wealth in various regions of the province.

[12] Gagnon Y., Leclerc A., Landry M., 2009, "Economic Impact Assessment of a 100 MW Wind Farm Project in New Brunswick", Université de Moncton, 27 p.

This being said, for certain areas, the development of wind farms can generate a lot of opposition, notably if the wind farms have an impact on landscapes that are important for the surrounding communities. A good practice that has been applied in other jurisdictions is to define Designated Areas and/or Exclusion Zones for the development of large wind farms. Since Nova Scotia has an exceptional wind resource, and considering the relatively small absolute quantity of wind energy that can be integrated in the province (because of the relatively small electricity system), it should be relatively easy to identify sufficient locations to install wind farms that will minimize the negative impacts in communities.

Regarding the workforce needed to construct, install and operate wind farms, the model of the PEI Energy Corporation has shown that it is possible to train local people for such work, and thus to maximize the hiring of local people and contractors in a wind farm project. Indeed, the development, design, installation and operation of the wind farms in North Cape (10 MW) and East Point (30 MW) have been mostly done using PEI workforce resources.

Finally, offshore wind energy can be interesting when the onshore potential is constrained, e.g. when the population density is high, such as in Europe, and where land availability is constrained by other usage. While benefiting from a better wind regime, offshore wind energy is also characterized by higher installation and operation costs. Finally, offshore wind energy presents higher technology and environmental risks. Therefore, offshore wind energy does not appear to be a necessary model for Nova Scotia.

5.2 COMMUNITY WIND FARMS OR RENEWABLE ENERGY PROJECTS

Community approaches to renewable energy has been widely used in Europe in the development of the wind energy sector, notably in Denmark and Germany. The concept is gaining popularity in a growing number of jurisdictions, including in Ontario and British Columbia in Canada. While this section refers mostly to community-based wind energy projects, the concept can be extended to other renewable energy sources.

Normally classified as wind energy projects of approximately 10 to 15 MW, and often connected to the distribution system of the electricity grid, community wind energy projects are locally developed, owned and operated by a municipality, community group or cooperative. While being a source of electricity generation that contributes to the global supply of renewable energy in a jurisdiction, community wind energy projects also have the following advantages:

- Greater impacts on local economies than projects owned by external developers;
- Increased local energy independence;
- Delayed need for new transmission capacity;
- Easier integration of small, community based wind farms in the landscape;
- Greater acceptance of wind energy projects;
- Develop citizen and community engagement in the sustainable development of their region;
- Develop community entrepreneurship and stronger rural communities; and,
- Allows for opportunities for collaboration between communities in the development, installation and operation phases of community wind energy projects.

Standard Offer Contracts (SOC) are recognized as successful mechanisms to stimulate the growth of renewable energy in a jurisdiction. Essentially, SOC, or Feed-In Tariffs (FIT), specify the rate paid for electricity generated from renewable sources by Independent Power Producers in a jurisdiction. The rate can be at a fixed price per kWh, or as a percentage of the retail price of electricity. When SOC or FIT are used, the Power Purchase Agreements are thus not solely awarded on the basis of the price of electricity, but rather on other attributes that will maximize benefits or will allow to attain other policy objectives of the jurisdiction.

Standard Offer Contracts and Feed-In Tariff mechanisms are thus designed as long term policies to allow guaranteed prices for the electricity and to allow for a reasonable rate of return for the proponent and owner of the community wind farm. Fundamentally, the policy objectives of Standard Offer Contracts is to increase the local and community participation in renewable and wind energy projects, and thus to maximize the economic and social benefits of this new economic sector. On the other hand, the higher price paid for the electricity must not induce excessive increases in the price of electricity for the ratepayers.

The concept of Feed-In Tariffs offers various approaches to set the price of electricity paid to community-based wind energy projects[13]. For a comprehensive analysis of the price structure for Feed-In Tariffs, see Couture and Gagnon[14].

Community renewable energy projects, by definition, involve communities and citizens. Such projects, while being branded as small scale projects in the energy sector, are nonetheless important initiatives involving technical and financial issues that are not necessarily available in a community group. Furthermore, with a vision of having several community-based energy projects in the province, it would be important to make sure that the projects are not developed in isolation, but rather that there is a forum or a structure for the exchange of ideas and best practices, along with making agreement on the purchase of technology (technology integration) and the operation (sharing of expertise) of the community energy projects. In this regards, the model of a Resource Center for Community Renewable Energy appears to be an appropriate vehicle to reach this objective. This Resource Center could be created to assist in the development of community-based renewable energy projects, along with working on awareness activities for renewable energy in the general public.

The report by Gagnon and Landry[15] presents a list of recommendations and a model for a community wind energy program in New Brunswick. The recently announced Green Energy Act in Ontario is structured along the model presented in the report of Gagnon and Landry. Using this model, a 15 MW community-based wind energy project can generate, on average, approximately one million dollars of net revenues (profits) per year, over the life cycle of the project.

5.3 Biomass – Forest and Non-Forest

Once a major source of energy for societies, biomass is re-emerging as an energy source, despite the perception that burning biomass is an important source of greenhouse gas emissions. However, when the life cycle of the biomass is considered, it is indeed a carbon neutral generation of electricity. On the other hand, the harvesting of biomass is not carbon neutral, and it can have an important carbon footprint, notably when the source of biomass is distributed over

[13] See the recent book by Miguel Mendonça, "Feed-In Tariffs – Accelerating the Deployment of Renewable Energy", World Future Council, 2007, for a detailed description of the Feed-In Tariff concept.

[14] Couture T. and Gagnon Y., 2009, "An Analysis of Feed-In Tariff Remuneration Models: Implications for Renewable Energy", Energy Policy, 38, pp.955-965.

[15] Gagnon Y., Landry M., 2009, "A Community Wind Energy Program for New Brunswick", New Brunswick Department of Energy, available at http://www.gnb.ca/0085/Renewable-e.asp#wind .

a large territory. Also, the harvesting can have other environmental and ecological impacts, as mentioned in section 3. Therefore, the utilization of biomass for large scale energy generation is not necessarily a panacea; it should thus be developed with a particular attention to its drawbacks.

Various data show that the capital costs for biomass systems are in the order of 2.5 M$ to 6 M$ per MW of installed capacity; we have used an estimate of 3 M$ (see Table 2). The wide range of estimates for the capital costs is an indication that a rigorous planning process must be engaged before engaging in large scale biomass developments.

Efficient biomass based energy systems can be used to generate electricity and heat; such systems are referred to as Combined Heat and Power (CHP) systems. The energy efficiency for CHP systems can reach 80%. It thus appears important to try to develop CHP systems, when possible.

Another interesting possibility for Nova Scotia is to use biomass for the co-firing of coal plants. Indeed, up to 10% to 20% of biomass can be used as a fuel for coal fired plants, thus reducing the need to purchase foreign coal, while generating economic activities in the province through the harvesting of the biomass. Such system is also less capital intensive than building new biomass generation plants.

The feedstock of biomass is however a main concern when large scale biomass energy systems are developed. As presented earlier, the concerns relate to the availability of the biomass, the method of harvesting, the ecological impact of harvesting biomass, etc. Before engaging in a large scale development of biomass based energy systems, it appears important to engage in a systematic study on the availability of the resource and the impact of using this resource for energy generation projects.

The consultation process has addressed the concept of biomass utilization as an energy source for Nova Scotia. The stakeholder consultation has shown that the usage of biomass for electricity generation raises a lot of interest; but on the other hand, many question the environmental sustainability of burning large quantities of biomass (forest and non-forest) for electricity generation. It thus appears that further knowledge is needed to better assess the potential of biomass as a source of energy for electricity generation in Nova Scotia. This could be done through a specific study on the potential of biomass for electricity generation in Nova Scotia. The study could allow to assess the interest and to gain a better understanding of the potential of this sector for Nova Scotia. Besides measuring the interest for biomass energy projects in the province, the study should try to obtain information on the sustainable supply of biomass from each interested participants and the level of interest for community based biomass energy projects. From these results, the province would be in a better position to define a strategy regarding the usage of biomass as an energy source in the province.

Finally, any biomass policy should address issues regarding the sustainable harvesting of biomass and the long term effect of harvesting biomass for large scale energy generation.

5.4 Renewable Energy Investment Fund (REIF)

A Renewable Energy Investment Fund (REIF) is a financial product that can be used to develop community-based renewable energy projects, such as community wind farms. Essentially, a REIF is a capital pool formed through the sale of units or shares, eligible to persons living in a specific jurisdiction or community. The REIF would invest its funds in specific renewable energy projects such as a community wind energy project. Investors can receive tax credits (RRSP and/or provincial tax credits) for their investments while the REIF allows for the local capital and dividends to remain in the region. Details on a model for a Renewable Energy Investment Fund can be found in Gagnon and Landry[16].

Prince Edward Island has used this mechanism to raise money to install the 30 MW East Point wind farm; the program had the following characteristics:

- Exclusively reserved to PEI residents (possession of a provincial Medicare number);
- Minimum one time investment of $500 and a maximum annual investment of $10 000; invested in bonds guaranteed by the Government of PEI;
- Interest rate of 5 %;
- Investments locked for a period of 5 years; and,
- Monies invested exclusively in the East Point wind farm.

Nova Scotia also has a series of Community Economic Development Investment Funds (CEDIF)[17] in various areas of the province. Implemented to reduce the amount of capital that left the province to mutual funds administered elsewhere in Canada, the Government of Nova Scotia created the concept of CEDIFs to pool the capital of persons living within a defined community for investments in local businesses. While the Nova Scotia CEDIFs can invest in any business ventures within the community, the concept could be structured so that the investments are specifically within a single industry, such as community-based wind energy projects.

A Nova Scotia Renewable Energy Investment Fund (REIF) could be structured along the following concepts:

- Open to Nova Scotia citizens (need to pay income tax in Nova Scotia to be able to invest in the REIF);
- Minimum of $500 (one time investment), maximum of 10 k$ per year;
- Investment for a minimum period of 5 years;
- Investors obtain RRSP deductions and an investment tax credit; and,
- Interest rate based on the Canadian prime rate.

Initially, the Renewable Energy Investment Fund would invest in community-based wind energy projects, while on the longer term, it could invest in other renewable energy opportunities.

5.5 Renewable Energy Credits (REC)

Electricity generated from renewable sources comprises two distinct commodities: electricity and green attributes related to the environmental benefits of generating electricity from renewable sources.

With regulations on reduction of greenhouse gas (GHG) emissions being implemented in a growing number of jurisdictions, the reductions can be met by effectively reducing the amount of GHG emissions or by buying Renewable Energy Credits (REC). RECs are unbundled from the electricity generated and are tradable units. Carbon markets are thus being established where RECs are being traded between entities that have reduced their GHG emissions and entities that have the obligation to reduce their GHG but are not capable at the present time. In Canada, the

[16] Gagnon and Landry, 2009, "A Community Wind Energy Program for New Brunswick" New Brunswick Department of Energy, available at http://www.gnb.ca/0085/Renewable-e.asp#wind .
[17] See www.gov.ns.ca/econ/cedif for details.

Montréal Stock Exchange has signified its intention to become the organization to manage the carbon exchange in the country through the trading of RECs.

The stakeholder consultation does not appear to have addressed the issue of REC for the renewable energy strategy of Nova Scotia. Normally, the province retains the environmental attributes of renewable energy projects. In its current Request for Proposals[18] of large wind energy projects, the province of Prince Edward Island offers an innovative approach regarding RECs. Essentially, selected proponents of wind farms may acquire the environmental attributes for the export market through the payment of a development fee to the province (a base amount of 15 k$ per megawatt of installed capacity, plus 10% of incremental gross revenues when the gross revenues of the facility are between 11 cents/kWh and 13 cents/kWh or 50% of incremental gross revenues when the gross revenues are above 13 cents/kWh).

The Nova Scotia Renewable Energy Strategy should have clear provisions in regards to the Renewable Energy Credits obtained with the generation of electricity from renewable sources.

5.6 ABORIGINAL COMMUNITIES

Beyond the obligations of the duty to consult and to accomodate Aboriginal communities where Crown Lands are used to develop renewable energy projects, Aboriginal communities can be an important component of a renewable energy strategy. Indeed, Aboriginal communities must be duly consulted when projects concern their rights, but they could also be consulted as potential partners, notably in community-based renewable energy projects.

Beyond their potential participation in community-based projects, specific programs to increase Aboriginal participation in renewable energy could be established by the Government of Nova Scotia, in partnership with the federal government. Experiences in other jurisdiction include:

- Aboriginal loan guarantee program to support Aboriginal participation in renewable energy projects;
- Financial support for Aboriginal communities to do feasibility studies on renewable energy projects;
- Program to provide a production subsidy for Aboriginal community renewable energy projects;
- Etc.

Various possibilities do exist to increase Aboriginal community participation in renewable energy projects, thus providing opportunities for these communities to benefit economically, and socially, from this emerging economic sector. A specific initiative could be engaged by the Government of Nova Scotia to establish policies, programs or enablers to increase the participation of Aboriginal communities in the collective goals of the Nova Scotia Renewable Energy Strategy.

[18] Maritime Electric Company, 2009, “Request for Proposals 2009-20 – Renewable Energy Supply”.

6. Potential Scenarios for Renewable Energy Development in Nova Scotia

6.1 Short Term Target - 2015

The short term target, to be attained in 2015, is to provide 25% of the energy consumption through renewable energy sources, corresponding to 1,800 GWh of energy on an annual basis. The scenarios presented are based on the capacity or availability factors, the costs and the financial data presented in section 2.

Common to All Short-Term Scenarios

Net metering Policy

Characteristics

- Implement a net metering Feed-In Tariff: Pay excess power at a preferential rate; at the minimum, the price paid should be the retail price of electricity
- Maximum individual installation of 10 kW
- Maximum allocation of 5 MW (total installed capacity) for the province; aim for 500 to 1,000 systems before 2015 (ambitious, mostly since small residential systems are not cost efficient)
- Admissible technologies: micro wind energy, solar photovoltaic, micro-hydro
- The pricing structure for electricity generated from small, residential renewable energy system varies greatly, ranging from policies that do not pay for the excess energy put on the grid, to programs that pay a premium for renewable energy put on the grid; in the latter case, such premium is tied to other policy objectives such as developing a manufacturing industry in the jurisdiction; by providing incentives to install such systems, manufacturers of the product could decide to install a manufacturing plant in the jurisdiction; for example, Ontario is pursuing this strategy by offering $0.802/kWh for electricity generated from residential solar photovoltaic systems of less than 10 kW

Advantages

- Develop citizen participation in the generation of renewable energy
- At a 20% capacity factor, this policy would add, once fully subscribed, approximately 8 GWh of energy to the grid on an annual basis; because of its relatively small size, this energy is neglected in the achievement of the renewable energy targets

Costs

- The cost for the electricity generation units in this program would be paid by citizens or businesses that would have made a voluntary decision to install a small renewable energy system for their electricity consumption

Impact on the electricity rates in Nova Scotia

- With a capacity factor of 20% and with the electricity paid at retail price, and considering only the excess energy to the grid, the incremental generation cost of electricity would be approximately 190 k$ on an annual basis, or approximately $0.40 (less than a half dollar) per year for every customer of Nova Scotia Power in the province
- For every penny paid above the retail price of electricity, the total incremental cost for the generation of electricity would be approximately 40 k$ per year, or approximately $0.10 (one dime) for every customers of Nova Scotia Power in the province

Calendar

- Implement the earliest possible (2010)

EMBEDDED GENERATION POLICY

Characteristics

- An embedded generation policy is geared towards small and medium size enterprises who could install an electricity generation unit to provide its own electricity, or to sell electricity to the grid (the excess electricity not consumed or all the electricity generated)
- Maximum individual installation of 2 MW
- Maximum allocation of 20 MW (total installed capacity) for the province; aim for 10 to 15 systems before 2015
- Implement an embedded generation Feed-In Tariff; e.g. pay the excess power at the retail price of electricity, less a fixed connection service fee per kWh
- Admissible technologies: wind energy, solar photovoltaic, micro-hydro, biomass

Advantages

- Allows the possibility to exploit a small, localised source of renewable energy
- Diversifies the revenues of small and medium enterprises
- Can provide a competitive advantage to enterprises who could brand that their operations are supplied by renewable energy
- At a 20% capacity factor, this policy would add, once fully subscribed, approximately 35 GWh of energy on an annual basis; because of its relatively small size, this energy is neglected in the achievement of the renewable energy targets

Costs

- The cost for the electricity generation units in this program would be paid by citizens or businesses that would have made a voluntary decision to install an embedded generation renewable energy system for electricity generation

Impact on the electricity rates in Nova Scotia

- Assuming a price corresponding to 90% of the retail price of electricity and a capacity factor of 20%, the incremental generation cost of electricity would be approximately 3.7 M$ on an annual basis, or approximately $8 per year for every customer of Nova Scotia Power in the province
- For every penny paid above the retail price of electricity, the incremental generation cost of electricity would be approximately 300 k$ per year, or approximately $0.65 for every customers of Nova Scotia Power in the province

Calendar
- Implement the earliest possible (2010)

RENEWABLE ENERGY BASED HEATING PROGRAM

Characteristics
- Provide an incentive for the installation of renewable energy based heating systems in residential, commercial and industrial settings
- The financial incentive could take the form of: subsidy at the time of purchase, HST tax credit, refundable or non-refundable income tax credit
- Admissible technologies: solar air heating (air or water based systems), solar water heaters, geothermal systems or heat pumps (reduces energy consumption)

Advantages
- Reduces the energy demand in the province
- Recognizes the contributions of citizens in reducing greenhouse gas emissions
- Contributes in developing a specialized industry sector in renewable energy based heating systems (wholesale, retail and installation)

Costs
- The cost for the units in this program would be paid by citizens or businesses that would have made a voluntary decision to install a renewable energy based heating system
- Indicative cost of the program: For a typical system of $2,000 and with 1,000 units installed every year, an HST rebate would have an annual cost of 260 k$ for the government, or approximately one quarter for every citizens in the province

Impact on the electricity rates in Nova Scotia
- Such program would be paid by the taxpayers and would thus not have an impact on the electricity rates in Nova Scotia

Calendar
- Implement the earliest possible (2010)

WIND ENERGY STORAGE PILOT PROJECT

Characteristics
- Currently, the intermittency of the generation of electricity from wind energy is mitigated by limiting the wind energy penetration at 20-25% of total capacity on a utility grid, and by balancing the grid with other sources of energy; as the wind energy penetration will increase, the storage of wind energy will become more important, along with innovative grid management
- Nova Scotia should engage in medium term projects of studying wind energy storage solutions; an initial step could be to engage in a pilot project on pumped hydro storage, where water is pumped upstream of an hydroelectric dam and used to generate electricity in time of peak demand; alternatively, Nova Scotia could engage in a demonstration project on hydrogen storage, similar to the work currently being done at the PEI Energy Corporation
- If a pumped hydro storage pilot project goes forward, it would ideally use an existing hydroelectric dam in Nova Scotia

- Other storage technologies could be considered for a storage pilot project, if these can benefit from a competitive advantage in Nova Scotia

Advantages

- Positions Nova Scotia for a large penetration of wind energy using energy storage systems

Costs

- Models of pumped hydro storage or hydrogen as an energy vector should be studied to identify the options for Nova Scotia, and to establish the costs for such projects

Impact on the electricity rates in Nova Scotia

- If a pilot project is funded by the Government of Nova Scotia or a federal program, the cost would be incurred by the taxpayers (rather than the ratepayers); there would thus not be an impact on the electricity rates in Nova Scotia

Calendar

- 2010: Assess the work done in other jurisdictions on wind energy storage; identify options for Nova Scotia
- 2011: Decide on a specific project for Nova Scotia; secure financing
- 2012 +: Engage in the project

OCEAN POWER RESEARCH AND INNOVATION STRATEGY

Characteristics

- Engage into a long term strategy for Nova Scotia to be a leader in the technology development and integration of in-stream tidal and wave power, with the objective of developing an ocean power manufacturing sector in the province
- Nova Scotia should engage in a study to assess the work done and the positions taken by Scotland and Ireland in this sector (both jurisdictions have similar objectives)
- Initially, Nova Scotia should develop a clear vision and objectives in regards to ocean power; this vision should address the positioning of the province in this emerging energy sector, notably to decide if it wants to develop a manufacturing industry or if it simply wants to be ready to integrate this new technology as it will become economically viable and environmentally sustainable; a partnership with other jurisdictions could also be considered
- In parallel to the existing study on the in-stream energy resource in the Bay of Fundy, Nova Scotia could engage in a project to assess the wave energy around the province

Advantages

- Benefits from a relatively abundant resource accessible by Nova Scotia (in-stream tidal energy and wave energy)
- Build on a similar approach in Denmark who, as an early adopter of wind energy, has developed an important wind turbine manufacturing sector in the country[19]

[19] Recent numbers suggest that the wind turbine manufacturing industry in Denmark provides over 21,000 direct jobs (Copenhagen Environment and Energy Office, 2008).

Costs

- Initially, Nova Scotia should engage in a strategic planning exercise to determine the positioning it wants to take in the tidal power sector
- The long term costs would evidently be determined by the objectives and goals that would have been determined by the province

Impact on the electricity rates in Nova Scotia

- The cost of a strategic planning exercise would normally be incurred by the Government of Nova Scotia, and thus paid by the taxpayers (rather than the ratepayers); there would thus not be an impact on the electricity rates in Nova Scotia
- The federal government has numerous funding programs for technology development[20]; Nova Scotia could thus benefit from those programs and leverage its own funds to develop the technology; the cost to develop the tidal power sector would thus be incurred by the taxpayers (rather than the ratepayers); there would thus not be an impact on the electricity rates in Nova Scotia

Calendar

- 2010: Assess the work done in the development of the tidal power technology; engage in a strategic planning exercise to identify options and the positioning of Nova Scotia
- 2011: Secure financing to implement the strategic plan in regards to tidal power
- 2012 +: Engage in the project

SMART GRID PILOT PROJECT

Characteristics

- Engage in a pilot projects to start the integration of smart grids in Nova Scotia
- Build on the experiences of other jurisdictions where projects have been done to integrate smart grid technologies for specific consumers (municipality, isolated community, island, etc.)

Advantages

- Positions Nova Scotia as an early adopter of smart grid technologies
- Since smart grid technologies is a global technology, applicable irrespective of an energy source, smart grid technologies will be the object of development in numerous jurisdictions; therefore, Nova Scotia should concentrate on the integration of this technology rather than in the development of the technology
- Being an early adopter in the integration of smart grid technologies, Nova Scotia could have economic and environmental benefits by integrating smart grid technologies in its economy

Costs

- Models of smart grid pilot projects should be studied to identify the options for Nova Scotia, and to establish the costs for such projects

[20] Notably through the Atlantic Innovation Fund (AIF), the Natural Sciences and Engineering Research Council (NSERC), Sustainable Development Technology Canada (SDTC), etc.

Impact on the electricity rates in Nova Scotia

- o If pilot projects are funded by the Government of Nova Scotia or a federal program, the cost would be incurred by the taxpayers (rather than the ratepayers); there would thus not be an impact on the electricity rates in Nova Scotia

Calendar

- o 2010: Assess the work done in smart grid pilot projects; identify options for Nova Scotia
- o 2011: Decide on specific projects for Nova Scotia; secure financing
- o 2012 +: Engage in the project

SCENARIO ST1 (SHORT TERM 1) – LARGE WIND ENERGY PORTFOLIO

Energy Source	Installed Capacity (MW)	Effective Capacity (MW)	Annual Energy Generation (GWh)
Large wind farms	570	205	1,800
Total		205	1,800

Characteristics:

- Set a limit on the maximum allowable size of individual large wind farms (60 MW; 20 to 40 turbines; 120 M$ to build); aim for approximately 10 wind farms distributed in all regions of the province where the wind resource is sufficient[21]
  - o While being large, 60 MW wind farms are nonetheless relatively small utility scale wind farms and therefore are easier to integrate of the landscape
  - o Distributes the wealth in many regions of the province
- Ownership of the large wind farms:
  - o The ownership model of the large wind farms should have the objective of maximizing the economic and social benefits for Nova Scotia
- Grid integration:
  - o The addition of 570 MW of wind energy capacity to the grid is possible since the wind energy capacity would be between 20% (no phasing out and no reduction of production of existing generation units; thus the total generation capacity would be 2,870 MW) and 25% (phasing out or reduction of production of existing units to maintain a 2,300 MW total generation capacity in the province) of the total generating capacity of Nova Scotia; the Nova Scotia Wind Integration Study has shown that this wind energy capacity could be installed with only minor grid upgrades and operational changes[22]
- Because of the relatively small total capacity that could be installed in Nova Scotia, and because of a systematic lack of regional cooperation in the energy sector in the Maritimes, and considering the concentration of the wind energy manufacturing

[21] The Wind Atlas of Nova Scotia (www.nswindatlas.ca) can be used to identify the most appropriate regions for the integration of large wind farms. The identification of regions should also consider the Designated Areas and the Exclusions Zones, if appropriate.
[22] Hatch, 2008, "Nova Scotia Wind Integration Study", available at http://www.gov.ns.ca/energy/resources/EM/Wind/NS-Wind-Integration-Study-FINAL.pdf

sector in the USA Midwest, Nova Scotia should not expect to attract significant wind energy manufacturing facilities with a 570 MW wind energy strategy

Advantages:

- Depending on the ownership model, a large wind farm strategy could generate important economic, social and environmental benefit for the province
- For a 570 MW installed capacity, the potential annual net revenues would be between 40 and 50 M$, averaged over the 25 year life cycle of the wind farms, for a total net revenue (profit) of over one billion dollars over the life cycle of the project[23]

Costs:

- 570 MW of wind energy installed capacity involves an investment of approximately one billion dollars
- Typically, wind farms are financed with 20% equity and 80% debt, thus the equity needed to develop 570 MW of wind energy is approximately 200 M$, the rest (800 M$) being financed through debt

Impact on the electricity rates in Nova Scotia:

- Since it has no fuel and that the cost structure has relatively low financial risks, wind energy has the property to stabilize rates of electricity
- Since most of the wind energy projects in the region have been built through Request for Proposals and thus are privately owned, the price paid for electricity generated from large wind farms is not published; however, it is common knowledge that the cost of generating electricity from large wind farms is of the same order of magnitude as generating electricity from a diversified energy portfolio and that the cost is lower than the retail cost of electricity; integrating 570 MW of wind energy should thus not incur an increase in the electricity rates in Nova Scotia
- In the case where the cost to generate electricity from the wind is higher than the current average cost of generation (0.067 $/kWh) and for a total wind capacity of 570 MW, every penny above the current generation cost incurs an annual incremental cost of 18 M$ for the generation of electricity in Nova Scotia, or $37 for every customer of Nova Scotia Power

Calendar:

- Integrate the large wind farms in two stages, i.e. a first stage of 300MW the earliest possible (2011), followed by an integration of the reminder in the latter part of the period (2014 or 2015)

[23] Gagnon Y., Leclerc A., Landry M., 2009, "Economic Impact Assessment of a 100 MW Wind Farm Project in New Brunswick", Université de Moncton, 27 p.

SCENARIO ST2 (SHORT TERM 2) – DIVERSIFIED WIND ENERGY PORTFOLIO

Energy Source		Installed Capacity (MW)	Effective Capacity (MW)	Annual Energy Generation (GWh)	
Large wind farms		400	144	1,261	(70%)
Community wind farms	Phase I	100	36	315	(18%)
	Phase II	70	25	221	(12%)
Total			205	1,800	

Characteristics:

- Maximum allowable size of individual wind farms
  - Large wind farms
    - Set a limit on the maximum allowable size of individual large wind farms (60 MW; 20 to 40 turbines; 120 M$ to build); aim for approximately 7 wind farms distributed in all regions of the province
  - Community wind farms[24]
    - Set a limit on the maximum allowable size of individual community wind farms (15 MW; 5 to 10 turbines; 36 M$ to build); aim to install 10 to 14 community wind farms distributed in all regions of the province
- Ownership
  - Large wind farms:
    - The ownership model of the large wind farms should have the objective of maximizing the economic and social benefits for Nova Scotia
  - Community wind farms:
    - The ownership of community wind energy projects should be limited to community groups (municipalities, cooperatives, community groups, institutions), with the possibility of limited participation by private citizens and Nova Scotia based private corporations
    - The Power Purchase Agreements for the community wind farm projects should be Standard Offer Contracts with a Feed-In Tariff for the price of electricity
    - Proceeds of an eventual Renewable Energy Investment Fund could be used for the financing of community-based projects, notably as an equity partner in the projects

[24] A model program for community wind energy can be found in Gagnon Y. and Landry M., 2009, "A Community Wind Energy Program for New Brunswick" New Brunswick Department of Energy, available at http://www.gnb.ca/0085/Renewable-e.asp#wind

Advantages:

- Modular strategy, i.e. scenario based on various size of projects
- Includes community-based projects
- Scalable, i.e. other components can be scaled up if a particular component can't be developed within the time frame specified
- Depending on the ownership model, a large wind farm strategy could generate important economic, social and environmental benefit for the province
- For a 400 MW installed capacity, the potential annual net revenues would be between 30 and 35 M$, averaged over the 25 year life cycle of the wind farms, for a total net revenue (profit) of approximately 750 million dollars over the life cycle of the project[25]
- Instead of owning and operating individual electricity generation system at their residences, citizens could own a small portion of a renewable energy, community-based electricity generation plant, whether through their municipality, a cooperative, a community group or an eventual Renewable Energy Investment Fund; models in Denmark show that, typically, families invest in such initiatives up to a level of ownership that corresponds to the power capacity for their level of electricity consumption

Costs:

- 400 MW of large wind farms involves an investment of approximately 800 M$, while 170 MW of community-based wind farms involves an investment of approximately 400 M$
- At 20% equity and 80% debt, the financing needed to develop 400 MW of large wind farms is approximately 160 M$ and 640 M$ of debt; while 170 MW of community-based wind farms needs approximately 70 M$ of equity and 330 M$ of debt financing

Impact on the electricity rates in Nova Scotia:

- Since it has no fuel and that the cost structure has relatively low financial risks, wind energy has the property to stabilize rates of electricity
- As mentioned in scenario ST1, integrating 400 MW of large wind farms in Nova Scotia should not incur an increase in the electricity rates in Nova Scotia
- In the case where the cost to generate electricity from the wind is higher than the current average cost of generation (0.067 $/kWh) and for a total wind capacity of 400 MW, every penny above the current generation cost incurs an annual incremental cost of 12 M$ for the generation of electricity in Nova Scotia, or $26 for every customer of Nova Scotia Power
- For the community wind energy component, every penny paid above the average generation price of electricity in Nova Scotia would incur one time rate increase as follows for the two phases of the implementation:
  - Phase I, 100 MW: Total cost of 3.2 M$; one time rate increase of 0.3% (three tenths of one percent)
  - Phase II, 70 MW: Total cost of 2.2 M$; one time rate increase of 0.2% (two tenths of one percent)

[25] Gagnon Y., Leclerc A., Landry M., 2009, "Economic Impact Assessment of a 100 MW Wind Farm Project in New Brunswick", Université de Moncton, 27 p.

Calendar:

- Large wind farms
  - Initiate the process in 2010; install when the projects have obtained all necessary approvals
- Community wind energy
  - Initiate Phase I in 2010; install when the projects have obtained all necessary approvals
  - In 2013, initiate Phase II. However, if the target for Phase I is not achieved, develop the remaining community capacity using large scale wind farms

SCENARIO ST3 (SHORT TERM 3) – DIVERSIFIED RENEWABLE ENERGY PORTFOLIO

Energy Source	Installed Capacity (MW)	Effective Capacity (MW)	Annual Energy Generation (GWh)	
Large wind farms	300	108	950	(53%)
Community wind farms	100	36	314	(17%)
Biomass	75	60	526	(30%)
Total		204	1,800	

Characteristics:

- Maximum allowable size of individual wind farms
  - Large wind farms
    - Set a limit on the maximum allowable size of individual large wind farms (60 MW; 20 to 40 turbines; 120 M$ to build); aim for 5 to 6 large wind farms distributed in all regions of the province
  - Community wind farms
    - Set a limit on the maximum allowable size of individual community wind farms (15 MW; 5 to 10 turbines; 36 M$ to build); aim to install 6 to 8 community wind farms distributed in all regions of the province
  - Biomass
    - Set a limit on the maximum allowable size of individual biomass projects (50 MW; 150 M$ to build); aim for 4 to 5 biomass projects in different regions of the province
    - Alternatively, this allocation could partly be satisfied by transforming existing coal fired plants to burn 10% to 20% of biomass

- Ownership
  - Large wind farms:
    - The ownership model of the large wind farms should have the objective of maximizing the economic and social benefits for Nova Scotia
  - Community wind farms:
    - The ownership of community wind energy projects should be limited to community groups (municipalities, cooperatives,

community groups, institutions), with the possibility of limited participation by private citizens and Nova Scotia based private corporations
    - The Power Purchase Agreements for the community wind farm projects should be Standard Offer Contracts with a Feed-In Tariff for the price of electricity
    - Proceeds of an eventual Renewable Energy Investment Fund could be used for the financing of community-based projects, notably as an equity partner in the projects
  - Biomass:
    - Since a 50 MW biomass plant is a major initiative to undertake, both technically and financially, these plants would normally be built by large corporation (NS Power, private energy developers, large Nova Scotia based corporation, renewable energy Crown Corporation of Nova Scotia); however, a community-based approach could be considered; in that case, a Feed-In Tariff approach should be developed explicitly for community-based biomass projects

Advantages:

- Modular strategy, i.e. scenario based on various renewable energy sources and size of projects
- Includes community-based projects
- Scalable, i.e. other sources can be scaled up if a particular renewable energy source can’t be developed within the time frame specified
- Alternative sources if one component is not successful
- Depending on the ownership model, a large wind farm strategy could generate important economic, social and environmental benefit for the province
- For a 300 MW installed capacity, the potential annual net revenues would be approximately 25 M$, averaged over the 25 year life cycle of the wind farms, for a total net revenue (profit) of 600 million dollars over the life cycle of the project[26]
- Instead of owning and operating individual electricity generation system at their residences, citizens could own a small portion of a renewable energy, community-based electricity generation plant, whether through their municipality, a cooperative, a community group or an eventual Renewable Energy Investment Fund; models in Denmark show that, typically, families invest in such initiatives up to a level of ownership that corresponds to the power capacity for their level of electricity consumption
- Can be positive for the forest industry

[26] Gagnon Y., Leclerc A., Landry M., 2009, “Economic Impact Assessment of a 100 MW Wind Farm Project in New Brunswick”, Université de Moncton, 27 p.

Costs:

- 300 MW of large wind farms involves an investment of approximately 600 M$, while 100 MW of community-based wind farms involves an investment of approximately 240 M$
- At 20% equity and 80% debt, the financing needed to develop 300 MW of large wind farms is approximately 120 M$ and 480 M$ of debt; while 100 MW of community-based wind farms needs approximately 50 M$ of equity and 190 M$ of debt financing
- 75 MW of biomass-based generation plants involves an investment of approximately 225 M$

Impact on the electricity rates in Nova Scotia:

- Since it has no fuel and that the cost structure has relatively low financial risks, wind energy has the property to stabilize rates of electricity
- As mentioned in scenario ST1, integrating 300 MW of large wind farms in Nova Scotia should not incur an increase in the electricity rates in Nova Scotia
- In the case where the cost to generate electricity from the wind is higher than the current average cost of generation (0.067 $/kWh) and for a total wind capacity of 300 MW, every penny above the current generation cost incurs an annual incremental cost of 10 M$ for the generation of electricity in Nova Scotia, or $20 for every customer of Nova Scotia Power
- For the community wind energy component, every penny paid above the average generation price of electricity in Nova Scotia would incur one time rate increase as follows for the two phases of the implementation:
    - 100 MW: Total cost of 3.2 M$; one time rate increase of 0.3% (three tenths of one percent)
- Since there are no information in regards to the costs of operating a biomass plant, the impact on the electricity rates can't be determined; however, since this option does not rely on imported fuel subject to price volatility and international markets, the impact of the electricity rates should be relatively well known once the cost structure of biomass-based generation is established for each projects

Calendar:

- Large wind farms
    - Initiate the process in 2010; install when the projects have obtained all necessary approvals
- Community wind energy
    - Initiate the process in 2010; install when the projects have obtained all necessary approvals
- Biomass
    - Initiate, in 2010, an Expression of Interest for biomass projects in the province
    - Depending on the results of the Expression of Interest, develop a strategy for biomass integration in order to meet the 2015 target
- In 2013, assess the level of development of each technology solution; adjust the deployment using successful technologies and models to achieve the 2015 target

SCENARIO ST4 (SHORT TERM 4) – BIOMASS ENERGY PORTFOLIO

Energy Source	Installed Capacity (MW)	Effective Capacity (MW)	Annual Energy Generation (GWh)
Biomass – Forest and non-forest	260	210	1,840
Total		210	1,840

Characteristics:

- Set a limit on the maximum allowable size of individual biomass projects (50 MW; 150 M$ to build); aim for 5 to 10 biomass projects in different regions of the province
- Alternatively, this allocation could partly be satisfied by transforming existing coal fired plants to burn 10% to 20% of biomass
- Since a 50 MW biomass plant is a major initiative to undertake, both technically and financially, these plants would normally be built by large corporation (NS Power, private energy developers, large Nova Scotia based corporation, renewable energy Crown Corporation of Nova Scotia); however, depending on the Expression of Interest for biomass projects, a community-based approach could be considered; in that case, a Feed-In Tariff approach should be developed explicitly for community-based biomass projects

Advantages:

- Scalable, i.e. projects can be built in sequence and thus benefit from the experience gained as the generation plants are developed and installed
- Can be positive for the forest industry

Costs:

- 700 MW involves an investment of over two billion dollars

Impact on the electricity rates in Nova Scotia:

- Since there are no information in regards to the costs of operating a biomass plant, the impact on the price of electricity can’t be determined; however, since this option does not rely on imported fuel subject to price volatility and international markets, the impact of the electricity rates should be relatively well known once the cost structure of biomass-based generation is established for each projects

Calendar:

- Integrate the biomass projects in sequence, adjust the projects on the basis of the knowledge gained
- Initiate the earliest possible the development of a strategy to integrate biomass projects in the energy portfolio of the province, with the first biomass plants installed once all necessary approvals will have been obtained

6.2 LONGER TERM TARGET – 2020

The longer term target, to be attained in 2020, is to provide 40% of the energy consumption through renewable energy sources, corresponding to 3,600 GWh of energy, or an increment of 1,800 GWh after 2015, on an annual basis. The scenarios presented are based on the capacity or availability factors, the costs and the financial data presented in section 2.

The long term scenario (Scenario Longer Term 1, LT1) is presented as an indicative model for the renewable energy portfolio of Nova Scotia in 2020. Its objective is to show the coherence between the portfolio developed to reach the short term target and a possible portfolio to reach the long term target. Essentially, the long term scenario builds on the experience and the success of the technologies used in the short term scenario, and it integrates emerging renewable energy technologies once they will have become economically viable and technologically efficient and reliable.

Scenario LT1 (Longer Term 1) – Diversified Renewable Energy Portfolio

Energy Source	Installed Capacity (MW)	Effective Capacity (MW)	Annual Energy Generation (GWh)
Large wind farms	300	108	950
Community wind farms	75	27	230
Biomass projects	40	30	260
Ocean power	100	40	350
Net-metering projects	5	1	10
Embedded generation	20	4	30
Solar (large scale energy generation)	?	?	?
Micro and small hydro	?	?	?
Total		210	1,830

Characteristics:

- The experience gained in achieving the short term target (25% by 2015) will assist in determining the best scenario possible to reach the long term target (40% by 2020)
- Continue the strategy to have a diversified portfolio of energy generation
- Continue to distribute the energy projects in various regions of the province
- Engaging in the pilot projects presented in the short term strategy will better position Nova Scotia to achieve its long term target
- The allocation for each technology stream should be adjusted as a function of the cost to install and the cost to operate the various generation units
- Regarding ocean power, it is assumed that, until 2015, testing and demonstration projects will validate to efficiency and the reliability of in-stream tidal power; the projection of 100 MW is thus a possible level of integration (estimated capacity factor of 40%), presented for discussion only
- Regarding the emerging technologies, i.e. solar energy and micro and small hydro, the pilot projects and an assessment of these technologies regarding their economic viability and technical efficiency in the coming years will provide indications in

regards to the potential for these forms of energy to contribute to the renewable energy portfolio of Nova Scotia in the long term

Advantages:

- Defining the strategy for the long term target on the basis of the short term results will allow for a more robust and better adapted development of renewable energy in Nova Scotia
- Defining the strategy for the long term target on the basis of the short term results reduces the long term risks for the province

Costs:

- The cost structure is similar to the short term scenarios
- The decision regarding the long term renewable energy portfolio will consider the projected costs to install and operate the facilities

Impact on the electricity rates in Nova Scotia:

- The potential scenario to achieve the long term objectives should consider the impact on the electricity rates in Nova Scotia

Calendar:

- In 2013, assess the results obtained in the deployment of the technologies and projects to reach the short term target (25% by 2015), and determine what is the best scenario for the deployment of projects to reach the longer term target (40% by 2020)