MR. SPEAKER: The hon. the Minister of Natural Resources.

SOME HON. MEMBERS: Hear, hear!

MR. KENNEDY: Thank you, Mr. Speaker.

I had indicated last week that during the Budget debate I would have three opportunities to speak for twenty minutes at a time and I was going to use those timeframes to speak about Muskrat Falls.

I spoke last week about the need for power. Tonight I am going to speak about options and alternatives, and next week, Mr. Speaker, if I get a chance to speak again, I will talk about the effect of Muskrat Falls on electricity rates. I will talk about environmental economic benefits, debt, cost overruns, and things like that.

Mr. Speaker, last week I prefaced my comments with the two basic questions: Do we need the power? If so, what is the best way to deal with the issue for the need for power? What is the lowest cost option?

Mr. Speaker, in terms of the options, what are the options once we determine we need power? One is to develop Muskrat Falls for the Labrador-Island link; that is the interconnected option. The second is to refurbish Holyrood with a combination of small hydro and wind which would be referred to as the Isolated Island option; to develop Gull Island; to use natural gas. Number five, Mr. Speaker, would be to use wind; number six would be to recall power from the Upper Churchill; number seven would be to import power from Quebec; or to do nothing. Mr. Speaker, to do nothing is not an option because we need the power. We have heard other members in this House over the last week or so concede that point, that we need the power.

Mr. Speaker, while we would all like to develop Gull Island, which is approximately 2,000 megawatts of power, it is not an option at present because we cannot get transmission access across Quebec. Four decades of Newfoundland and Labrador politicians, Mr. Speaker, have tried to negotiate with Quebec to resolve this issue, all without success. With all due respect to the member of the Opposition last week who said it does not matter to him whether he deals with Nova Scotia or Quebec, there is no difference – well, Mr. Speaker, there is a significant historical difference in dealing with Quebec. There is no dealing with Quebec on the issue of hydro-electricity power in Labrador.

This all begins, Mr. Speaker, in 1927, with the decision of the Judicial Privy Council defining the Labrador boundary and giving Labrador to Newfoundland. Quebec has never forgiven us for that. At some point in this House over the next few weeks, I hope to talk about the Upper Churchill; I will trace to 1927, along with documents that were relied upon in the 1960s, along with quotes from the Premier of Quebec and the Premier of Newfoundland at the time, Mr. Speaker, and René Lévesque, the Minister of Energy in Quebec at the time.

It is what is referred to, Mr. Speaker – I think it was a journalist in Quebec who coined the phrase, it was the revenge of geography, that the Upper Churchill had nowhere to go and we were back to that 1927 decision. In fact, we will still see maps from Quebec that show the border as it used to be still to this day, Mr. Speaker.

What we do have at present, Mr. Speaker, is a reservation to export 265 megawatts of power on Quebec transmission lines. We are currently in legal wrangling in Quebec in the courts with their Régie, or equivalent of their PUB, on obtaining open access.

We need to develop Gull Island. The most that we can export at present on the Quebec lines is 265 megawatts of power. Gull Island is not an option at present. As I think I said last week, Gull Island, there is a market for that power, certainly in Ontario.

We have all heard Nalcor has concluded that Muskrat Falls has a cumulative present worth of $2.2 billion, or is $2.2 billion cheaper than the Holyrood option, Mr. Speaker. MHI, the company hired by the Public Utilities Board, has also accepted that conclusion. We have a $6.2 billion project at present, subject to the Decision Gate 3 numbers, which break down as follows, in terms of cost to our Province: $2.9 billion for the generating station and $2.1 billion for the Labrador Link.

Mr. Speaker, last week I talked about the price of oil and why Holyrood becomes so expensive, when at peak it burns 18,000 barrels of oil a day. It only currently operates at 15 per cent to 25 per cent. What we have to plan for, what utilities plan for, is that coldest day in the winter when you need the most energy.

Last week I talked about PIRA and why the price of oil will continue to rise, at least in their opinion, Mr. Speaker. It has to do with the factors such as the activities in the Middle East, supply and demand, growth in China, growth in the middle class, and the issue of security of supply.

Interestingly enough, Manitoba Hydro International did a sensitivity analysis where even if oil went to $40 a barrel – we can say never say never, but the likelihood of that happening is minimal, Mr. Speaker – Muskrat Falls would still be cheaper than the isolated option by $120 million.

I think we heard this the other day: why don't we continue to use Holyrood till 2041? Mr. Speaker, Holyrood will not last until 2041. We heard the Minister of Transportation talk the other day on the environmental impacts of Holyrood, where closing down Holyrood would be the equivalent of taking 300,000 cars off the road. That is why we use the experts. That is why we use Nalcor, Mr. Speaker. We look at inherent risk and uncertainties; whatever project we do will have risks and uncertainties. Anytime you are looking into that crystal ball, in the future there are going to be risks and uncertainties. What we have to try to do is minimize those risks and identify the uncertainties, because if we need the power, we have to do something. It is that simple.

Now, Mr. Speaker, natural gas has been put forward as an option. There are two ways that natural gas could be utilized. The first would be the importation of natural gas where we would buy gas from, for example, the United States. The price of natural gas is currently less than $3 per million cubic feet, Mr. Speaker. That is not the cost, though, to deliver that to Holyrood, because what you have is a situation where you have to add liquefaction costs, transport costs, regasification costs. So the Henry Hub price, or the price of which gas is measured, is not the delivered price to Holyrood. Beyond the cost of building a terminal, Mr. Speaker, an LNG or liquefied natural gas terminal, you have to get your gas.

It would have to be, according to Dr. Wade Locke, at least $2.2 billion cheaper than Muskrat Falls. According to Dr. Locke's calculations, Mr. Speaker, natural gas would have to cost less than $5.75 delivered to be cheaper than Muskrat Falls. The spot prices that are currently being paid in Europe and in Asia are $13 and $16; we cannot compete. The amount of gas needed for Holyrood – we are not going to be burning natural gas here in our Province; we are not set up for that, Mr. Speaker, in terms of our homes.

That cost will continue to rise. The experts predict that it is only going to go to $6 for a million BTU in the next decade, but the delivered cost, what you pay will be much greater to have it delivered. We would be competing with China and Europe. We would be a very small player in a very big market, and vulnerable to a volatile market, because we cannot compete with these countries. Why would any company sell gas to Newfoundland and Labrador for such a small amount when they can obtain higher prices in the European and Asian markets? Mr. Speaker, we would still be dependent on volatility of fuel prices.

Mr. Speaker, even if natural gas was an option, it does not do anything for these mining projects in Labrador. What is it that we are going to do: change Holyrood to natural gas to provide power for the Island which we need, and then develop Muskrat Falls? Muskrat Falls is the only option, Mr. Speaker, which can deal with the needs in Labrador and the needs on the Island.

We have met with independent experts, market analysts, and industry representatives; we have heard from Dr. Locke, Mr. Speaker, and those are the numbers that we have today. The other option that has been put forward is to build a 350 kilometre to 600 kilometre pipeline from the Grand Banks. Mr. Speaker, that is a capital cost of a minimum $1 billion to $2 billion, but then, how do you get the gas?

There is a very practical issue of who owns the gas. According to the Atlantic Accord, it is governed by both the federal and provincial governments in terms of the C-NLOPB, so the Province cannot force the oil companies to develop. I have met with the oil companies, Mr. Speaker. The Atlantic Accord provides for joint management of the offshore and requires federal and provincial concurrence to development decisions or amendments.

We do not have any legislative authority, Mr. Speaker, to order an existing project to deliver gas to the Province, so the low price of gas at present is a deterrent to development. I think it went below $2 per million cubic feet in the last month. What we are told by the oil companies is that the price needed to develop it would be a minimum $10 to $12 per million BTU. The price in the next decade, we are told, will stay around $6. Natural gas, Mr. Speaker, is part of our energy plan, but there is no pressing present need to develop it. The reason that no proposal has been received to develop the gas and build the pipelines is because it is not economically viable.

Mr. Speaker, the best way I can describe it was one oil executive who said: We are in the business of making money. If we could make money we would do it.

What we have decided to do, Mr. Speaker – I am just outlining the facts as I understand them today; what we are willing to do is to obtain a report that will outline these options, that will examine the options of both the importation of natural gas, and also the building of the pipeline. A company out of Calgary has been commissioned to prepare a report and when that report is prepared, Mr. Speaker, it will be provided to the public and to members of this hon. House, so essentially it will be exact.

Mr. Speaker, Nalcor's position, supported by MHI, is that wind is an important component in our Energy Plan, but at present only a small amount of wind can be integrated into the system as it exists. We cannot operate on wind only, even though we have the best wind in North America. Contrary to what the Member for St. Barbe said the other day, it only generates electricity 40 per cent of the time. Mr. Speaker, the development of the Maritime Link allows for the development of more wind to use as export.

We have a number of small hydro projects, Mr. Speaker, that amount to about seventy-seven megawatts of power. We have Round Pond with eighteen megawatts, Portland Creek with twenty-three megawatts, and Island Pond with thirty megawatts. It is MHI's conclusion, in the PUB setting, that Nalcor's estimate of the cost was reasonable, but the price would be more than what Nalcor has forecast.

Another issue or option being suggested, Mr. Speaker, is to recall power from Quebec. There is approximately 5,400 megawatts of power produced by the Upper Churchill. We receive two blocks of energy; one is what is referred to as the TwinCo block or 225 megawatts, which was a result of Twin Falls either closing down or being flooded and the power then being provided to IOC and Wabush Mines at a very low price, Mr. Speaker. Then we have a 300-megawatt recall block which goes to heat Labrador in the winter time where approximately 200 to 220 megawatts of energy is required. We can export excess power on the Quebec transmission lines where we have that 265 megawatt booking. We can export up to 265 megawatts, Mr. Speaker. That excess power was sold a couple of years ago in New Brunswick or it can be sold on the spot markets in New York or the North Eastern United States, Mr. Speaker, at prices that can range anywhere from $25 to $100 per megawatt hour.

The question then is: why don't we recall more power? Mr. Speaker, in the mid-1980s one of the cases that went to the Supreme Court of Canada was the issue of whether or not, under the contract, we could access more power, the power contract, for our own use. However, the Supreme Court of Canada concluded that the law of the contract, the power contract, was governed by the law of Quebec, and also there was no demonstrated need for power at that time. 92A of the Constitution was subsequently enacted, Mr. Speaker, and we have obtained legal opinions from leading jurists that we can potentially recall the power constitutionally, but because the contract is governed by the law of Quebec, we would be subject to a breach of contract action in Quebec.

So, Mr. Speaker, there would be no economic advantage, we would be tied up in the courts for years, and that certainty we are looking for, in terms of being able to provide power to the island and to the companies in Labrador, would not be there. So, this issue has been explored.

Another issue is sourcing power from Quebec; why do we not buy power from Quebec? Well, let me tell you how this would work, Mr. Speaker. We sell power under the power contract to Quebec at $2.50 a megawatt hour, or a quarter cent power. So, we say to Quebec: Will you sell us power? Now, there are issues of transmission lines, but that same power that is produced in the Upper Churchill could be sold back to us for thirty to forty times what they paid for it. Now, is that the kind of contract that people want to enter into? Did we not do that once, Mr. Speaker, in 1969?

So, what we have to look at, we would still be potentially held captive by Quebec: subject to Quebec prices, subject to the whim of their political masters, and subject to Hydro-Québec. Now, Mr. Speaker, that is not the way to go, because they are going to sell at the best price they can get, and that would be, I would suggest to you, the cost of electricity at Holyrood. So we could be

buying power from Quebec that is generated in Labrador. There is something immoral about that, but unfortunately, as the power contract currently exists, it is not illegal. We need power for the island, so we buy power back from Quebec, if we could; we would have to build our transmission lines anyway to get the power to the island. What you are running into, Mr. Speaker, is that same issue of building transmission lines if you need the power.

When you compare that option to Muskrat Falls, there is not that same price certainty over forty to fifty years. I will talk about prices next week, Mr. Speaker, and hopefully illustrate the potential impact for people, people every day who wonder: what is going to happen to my power rates? Well, hopefully I will be able to give some help next week.

To date, Mr. Speaker, we have supplied 100 per cent of the power that we need in this Province. We cannot afford to become dependent on a supply of energy from Hydro-Québec. So, Mr. Speaker, that is the issue of sourcing power from Quebec. It is just not feasible.

The PUB report, Mr. Speaker, there was more than $2 billion spent. What came out of this report, Mr. Speaker, is something I would suggest to you is very positive; nothing they said in the report, but what we have done as a government as a result of their failure to answer the question that was put to them. MHI has been hired by the government to review the Decision Gate 3 numbers. Mr. Speaker, they will outline the costs and the potential overruns. There will be more certainty to the process.

As I have indicated, Ziff Energy of Calgary has been retained to provide reports on natural gas. We will have a study prepared on wind, Mr. Speaker, or a report prepared on wind. There will be full debate in this House of Assembly and a vote on the project. There will be full discussion. These reports will be provided to the public and to the Opposition in plenty of time so there will be informed debate. Then there is still the issue of the loan guarantee that has to be finalized, the issue of the Emera agreement and, most importantly, we will have our final Decision Gate 3 numbers.

Mr. Speaker, over the last week we have heard the endorsement of the federal Leader of the NDP, Thomas Mulcair; very significantly his Quebec caucus is supporting Muskrat Falls. As my colleague pointed out last night, you do not support the loan guarantee unless you support the project. The Liberals accept, Mr. Speaker, that we need the power.

I want to refer you to a couple of comments of Jim Prentice, a former federal Environment Minister, in a speech he gave, Mr. Speaker, on April 27, 2012. Mr. Prentice stated: "First and foremost, I believe that Premier Dunderdale has charted a wise and entirely reasonable course of action."

SOME HON. MEMBERS: Hear, hear!

MR. KENNEDY: Secondly, Mr. Speaker, Mr. Prentice described Muskrat Falls as "a transformational project for Atlantic Canada".

SOME HON. MEMBERS: Hear, hear!

MR. KENNEDY: Very significantly, Mr. Speaker, he stated that Muskrat Falls is "a game-changing regional energy plan for the 21st century".

SOME HON. MEMBERS: Hear, hear!

MR. KENNEDY: Mr. Speaker, I will end on those words. Next week I will be back for part three to talk about electricity rates and other aspects of Muskrat Falls.

Thank you, Mr. Speaker.

Options and Alternatives

- Thank you Mr. Speaker.
- 3 opportunities to speak during budget debate for 20 minutes at a time.
- Spoke last week about the need for power; today will speak about options and alternatives. Next week I will talk about the effect of Muskrat Falls on rates and other issues eg economic and environmental benefits.

- Two questions:
  1. Do we need the power?
  2. What is the lowest cost option?

- What are the options?
  1. Develop MF with LIL (Interconnected Island);
  2. Refurbish Holyrood with small hydro and wind (Isolated Island);
  3. Develop Gull Island;
  4. Natural Gas;
  5. Wind;
  6. Recall Power from Upper Churchill – 92A;
  7. Import power from Quebec; or
  8. Do nothing.

Kennedy - Options and Alternatives (May 15, 2012)

- While we would all like to develop Gull Island, it is not an option at present without transmission access across Quebec. Four decades of NL politicians have attempted to resolve this issue, without success. Begins in 1927 with the decision on the Labrador boundary. Fascinating ~~really~~ reading. "Revenge of geography." At present we have a reservation to export 265 MW of power on Quebec transmission lines and are currently in legal wrangling in Quebec trying to gain open access.

- To do nothing is not an option because we need the power.
- Nalcor has concluded that Muskrat Falls is $2.2B cheaper than the Isolated Island Option.
- ~~Muskrat Falls (CPW $6.6B (2017-2067))~~ MHI agreed with this position and PWC concluded that they would not make a decision based on the information ~~at hand~~ before it.

- $2.9B for generating station
- $2.1B for LIL

- $6B in oil ~~& money~~ that instead of going to big oil companies can be kept in this province.
- ~~Holyrood / small hydro / wind - $8.8B ($2.2B difference in CPW).~~
- Holyrood is so expensive because the cost of oil continues to rise – meetings with PIRA / other analysts in New York over the last few months
  - Not enough supply to meet demand (90mmbls/day)
  - Continued growth in China
  - Activities in Middle East
  - Global middle class population growing by 80M people each year
  - Security of supply
- MHI's sensitivity analysis says even if $40 barrel – MF still cheaper than isolated Island by $120M.
- Holyrood may not last until 2041 – MF may be the only option.
- Inherent risks and uncertainties – but risks and uncertainties will exist no matter what way we proceed – will exist in any major project.
- Why we use experts and why Nalcor uses the gated process – try to identify and reduce uncertainties.
- If we need the power, we need to do something. It is that simple.

Natural Gas

A number of people argue that we have not examined the use of Natural Gas to run Holyrood. They maintain that (1) we can build a pipeline from the Grand Banks or (2) import natural gas from the United States.

I became Minister of Natural Resources on November 1, 2011. Since then I have traveled to New York twice where I met with PIRA, a leading oil-forecasting company and Wood MacKenzie, a worldwide energy advisor. During the meetings we discussed

extensively the effects of shale gas on present and future pricing of natural gas, the impact of shale gas on North American energy markets and the worldwide market for natural gas.

I have met with industry representatives who have explored and continue to explore developing our offshore natural gas. I am told that there are no plans to develop natural gas in the short term as it is not practical or feasible. Now, Mr. Speaker, oil companies are in the business of making money – today. Will anyone honestly think that these oil companies would not be developing natural gas today if it could be done?

So, let's examine the suggestions:

Natural Gas – two scenarios

1. **Build 350-600 km pipeline from Grand Banks and other capital cost – minimum $1.0-$2.0B.**

- Practical issue of who owns the natural gas – province cannot force oil companies to develop/Atlantic Accord provides for joint management of the NL offshore and requires federal and provincial concurrence on development decisions. Further, the Atlantic Accord does not provide government with any legislative authority to order an existing project to deliver gas to the province for the generation of energy.
- Low price of natural gas at present a deterrent to development.
- Natural gas currently selling for less than $3.00 mbtu.
- Price needed to make development viable, more than $10.00 - $12.00 mtbu – experts tell us that the price in the next decade will stay around $6.00.
- Natural gas is part of our Energy Plan but not a pressing present need to develop and we cannot force the oil companies to develop.
- No proposal received because it is not economically viable.

2. **Import Natural Gas – lower capital cost than Muskrat Falls but operating cost high**

- Cost of building LNG terminal - $1-$2B.
- Henry Hub price ($3.00) versus delivered price to Holyrood.
- Not the same – add liquefaction, transport, and re-gasification.
- Would have to be at least $2.2B cheaper than MF.
- Dr. Wade Locke's review – natural gas would have to cost less than $5.75 mbtu delivered to be cheaper than Muskrat Falls.
- Spot prices being paid in Europe and Asia ($13-$16) – we cannot compete.
- U.S. now exporting natural gas but can recall it for their own energy needs.
- Small amount needed in Holyrood which makes us a very small player and vulnerable to a volatile market in the future because we cannot compete with China and Europe. Why would a company sell gas to NL when they can obtain higher prices in the European and Asian markets?
- Still dependent on volatile fuel prices.
- Even if natural gas was an option it does nothing to provide power for the mining developments of Labrador whereas Muskrat Falls meets the Island needs and provides power for mining developments. How are we to satisfy Labrador mining needs with natural gas, or should we use natural gas for Holyrood and develop Muskrat Falls for mining in Labrador?

We have met with independent experts, market analysts and industry representatives. We have heard from Dr Wade Locke. But we will have these options examined – Ziff Energy out of Calgary.

- **Wind** – Nalcor's position supported by MHI
    - Wind is an important component in NL's future as outlined in our Energy Plan but cannot rely solely on wind
    - Have to integrate into NL system

- Cannot operate on wind only – best wind in North America but only generates electricity 40% of the time
- MHI found that Nalcor's plan to incorporate 80MW into the system by 2025 reasonable and appropriate
- Maritime Link allows for development of more wind to use as export

- **Small Hydro** – 77 mw of power (Round Pond – 18 mw, Portland Creek – 23 mw, Island Pond – 30 mw) - MHI's conclusion than Nalcor's estimates of cost reasonable but price would be more than what Nalcor has forecast

- So I say to the critics, what are these other options they have been talking about and that we have not examined?

Insert 5A

Sourcing Power from Quebec

- An alternative to sourcing our power from within the province would be to import power from another jurisdiction; possibly Quebec.

- The cost of this power would be set by the market, but most likely if we were buying from Quebec, they would try to set the price near the cost of our next best alternative. That being the cost of electricity at Holyrood which is based on the price of oil.

- This would mean that there is a possibility that we would be buying power from Quebec that was in all likelihood generated in Labrador. The price of this power would be 30-40 times (or more) than the price that we sold it to Hydro Quebec.

→ need the power for the Island

- In addition to the cost of electricity, we would still have to build the Link to get power to the island and upgrade transmission in Labrador. There is also a possibility that that if we bought power from outside Quebec, then its likely that

(5A)

Recall power from Quebec

- Upper Churchill produces approximately 5400 MW of energy
- NL Receives - 225 in Twin Co Block (TQC and Wabush Mines)
  - Closure of Twin Falls - ~~same price as Quebec power~~
  - ~~got back in April 2009 which previously sold to Quebec~~

300 MW Recall Block - 220 in Winter time needed in Labrador
- Export excess power on Quebec transmission lines where Nalcor has 265 MW booking
- excess power sold in NB or on the spot markets in New York, NE US

- why don't we recall more power? - 92A Constitution
- in 1980's tried this in Court but did not have industrial/commercial need
- 92A subsequently enacted

[redacted]

- tied up in Courts for years → we need certainty

Hydro Quebec would attempt to limit our access through Quebec back into Labrador and also make us pay for upgrades on Quebec's transmission system.

- When compared to Muskrat Falls this option does not provide the same price certainly over the next 40 -50 years; nor does is offer the same assurance of security of supply.

- To-date, we have generated and supplied 100% of our electricity in this province. This option would see us becoming increasingly dependent on the supply of electricity from Hydro Quebec. We would be captive to both the supply and price of electricity from Hydro Quebec while we have our own source that would continue flowing water to the sea.

PUB Report

- More than $2.0M spent and yet could not offer any answer on the question posed to them
- What has come from the failed PUB process
- MHI has been hired by government to review DG3 numbers – will outline costs and potential returns
- Ziff Energy out of Calgary has been retained to provide report on natural gas
    1. Importation of natural gas
    2. Building of a pipeline from the Grand Banks
- Will have a study prepared on wind
- Full debate in the House of Assembly and a vote on the project

Decision on Sanction

- Information/reports will be made public and provided to the opposition
- Loan guarantee and deal with Emera have to be finalized
- Additional information / reports on natural gas / wind

- Final Decision Gate 3 numbers - review by MHI
- Debate in the HOA during the Fall

- Endorsement of federal leader of the NDP, Thomas Mulcair, in his Quebec [illegible]
- Liberals accept that we need the power
- Comments of Jim Prentice, former federal Environment Minister, in speech on April 27, 2012

Jim PRENTICE ② "transformational project for Atlantic Canada"

③ "game-changing regional energy play for 21st century"

① "First and foremost, I believe that Premier D. has charted a wise and entirely reasonable course of action"

4.2.8 Wind

Wind energy (or wind power) refers to the process by which wind turbines convert the movement of wind into electricity. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind energy is harnessed through the use of wind turbines. Wind turbines have three aerodynamically designed blades which spin on a shaft which connects to a generator that produces electricity. Wind passes over the blades, creating lift (just like an aircraft wing) which causes the rotor to turn[27]. Stronger winds will produce more energy. Wind turbines can operate across a wide range of wind speeds - generally from 10 up to 90 km/h[28]. Wind turbines are mounted on a tower to capture the most energy. At 30 metres or more above ground, they can take advantage of faster and less turbulent wind.

Figure 12 below shows a typical wind turbine.

The majority of current turbine models make best use of the constant variations in the wind by changing the angle of the blades through "pitch control", by turning or "yawing" the entire rotor as wind direction shifts and by operating at variable speed. Operation at variable speed enables the turbine to adapt to varying wind speeds. Sophisticated control systems enable fine tuning of the turbine's performance and electricity output. Modern wind technology is able to operate effectively at a wide range of sites – with low and high wind speeds, in the desert and in freezing arctic climates[29].

In a wind farm, individual turbines are interconnected with a power collection system and a communications network. The power is then transferred to the electricity grid.

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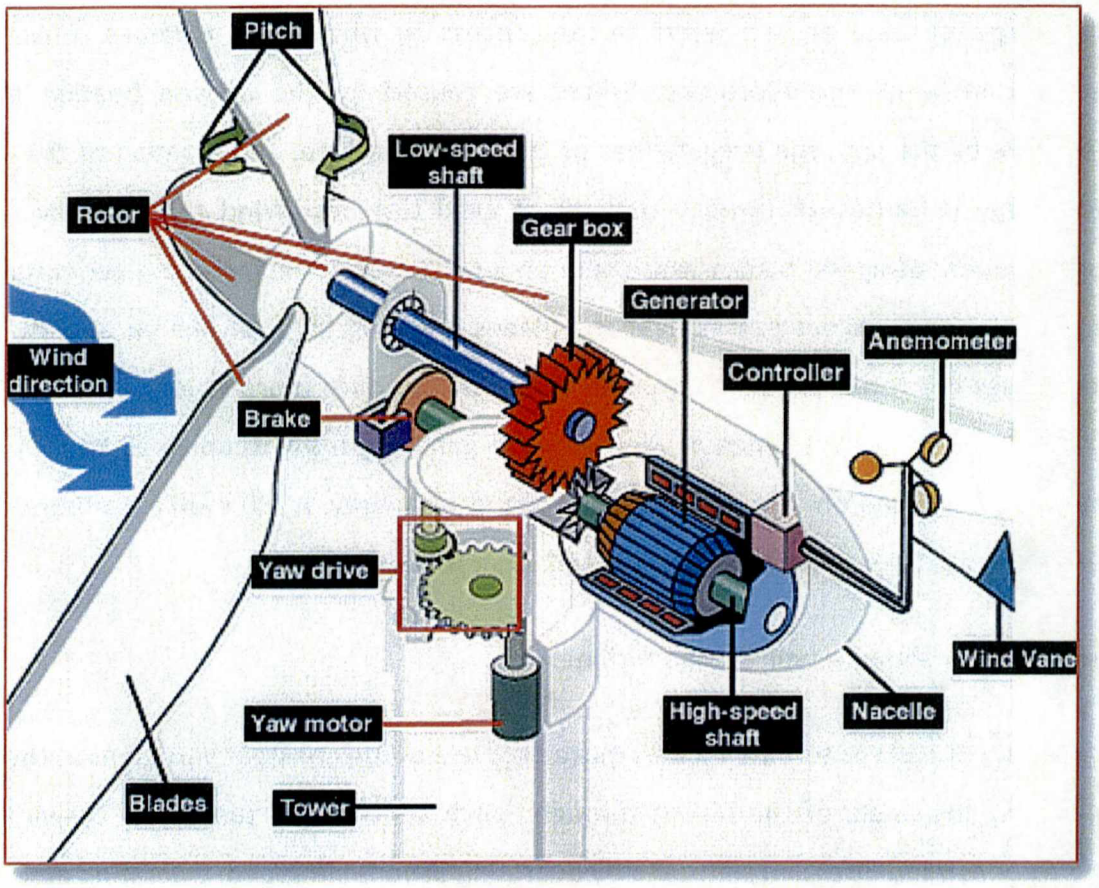
[27] The European Wind Energy Association, *How a Wind Turbine Works*, webpage, 2011 http://www.ewea.org/index.php?id=1922

[28] Global Wind Energy Council, *Wind energy technology,* webpage, 2011 http://www.gwec.net/index.php?id=31

[29] Global Wind Energy Council, *Wind energy technology,* webpage, 2011 http://www.gwec.net/index.php?id=31

Figure 12: Components of a Typical Wind Turbine



Source: Government of the United States, Department of Energy, *How Wind Turbines Work*, webpage, 2011 http://www1.eere.energy.gov/wind/wind_how.html#inside

There are obvious benefits to wind energy. Wind energy is fueled by the wind, so it's a clean fuel source. Wind energy does not generate air pollution or produce atmospheric emissions that cause acid rain or GHGs.

Electricity generated from wind power can be highly variable at several different timescales: from hour to hour, daily, and seasonally: annual variation also exists. Related to variability is the short-term (hourly or daily) predictability of wind plant output. Wind power forecasting methods are used, but predictability of wind plant output remains low for short-term operation. Because instantaneous electrical generation and consumption must remain in balance to maintain grid stability and ensure the electricity is available when the customer needs it, this variability can present substantial challenges to incorporating large amounts of wind power into the Isolated System.

Good wind sites are often located in remote locations, far from places where the electricity is needed. Transmission lines must be built to bring the electricity from the wind farm to the places of high demand.

Newfoundland and Labrador has an excellent wind resource. However, for the Isolated Island setting, the amount of wind power that can be integrated into the island grid is limited. The 2004 NLH study *An Assessment of Limitations For Non-Dispatchable Generation On the Newfoundland Island System*[30] established two limits regarding the possible level of wind generation integration on the Isolated Island system, an economic limit and a maximum technical limit. The study determined that for wind generation in excess of 80 MW there would be a significant increase in the risk of spill at the hydroelectric reservoirs. This would occur when Hydro's reservoir levels were high and system loads were such that the system operator had to decide between curtailing wind generation and allowing water to spill over the dam. Either way, the economic advantage of the wind would be diminished. The study further determined that for wind generation above 130 MW it would not always be possible to maintain system stability particularly during periods of light load and during these periods wind generation would have to be curtailed, again, reducing the economic benefit of the additional wind generation.

The limits identified in the 2004 study are still applicable today. However, as load grows, the Isolated Island system should be able to accommodate additional wind generation. It has been suggested that the system should be able to accommodate an additional 100 MW of wind in the 2025 timeframe and a further 100 MW around 2035[31]. NLH will study this prior to Decision Gate 3 (DG3). As well, as a result of system constraints, and recognizing the inherently intermittent nature of the wind resource, the use of a large-scale wind farm to replace the firm continuous supply capability of the Holyrood generating plant is not operationally feasible and therefore was not considered in the generation expansion analysis.

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[30] NLH, *An Assessment of Limitations for Non-Dispatchable Generation on the Newfoundland Island System*, 2004 (Exhibit 61)

[31] Navigant Consulting Ltd., *Independent Supply Decision Review*, 2011 (Exhibit 101)

NLH has not completed an analysis to establish the level of wind generation that could be sustained in the Muskrat Falls LIL high voltage direct current (HVDC) option. However, given that this option will include at least one interconnection to the North American electrical grid, and that there will be considerable hydroelectric capacity both in Labrador and on the island to provide backup, it would be reasonable to consider the addition of up to 400 MW of wind generation on the system.

Onshore wind power typically costs 8–12 ¢/kWh, depending largely on how windy the site is and how far it is from existing power transmission lines[32]. Good wind sites on the island are at the lower end of this cost range. The estimated average cost incorporates the cost of construction of the turbine and transmission facilities, borrowed funds, return to investors (including cost of risk), estimated annual production, and other components, averaged over the projected service life of the equipment, which is typically around twenty years. Costs associated with any bulk system transmission upgrades that may be required because of the size and/ or location of the wind farm are not included in the estimated generation costs.

Wind power has a place in the electricity generation mix on the island and due to its low environmental footprint, it will be incorporated whenever economically viable. However, technical and operational considerations limit the amount of wind generation that can be operated on the system.

4.2.9 Biomass

Biomass energy is derived from many different types of recently living organic matter (feedstock). However, in the context of producing large-scale energy, it is likely that the focus would be on harvesting forestry products as fuel for the biomass generator. Biomass works similar to many other thermally-based generators in that wood or other biomass products are harvested, treated and then transported to the generation plant to be used in place of other solid fuels such as coal to generate heat. The heat is then used to produce steam. The steam is in turn fed into a turbine that turns a generator to produce electricity.

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[32] The Pembina Institute, *Wind Power Realities*
http://www.pembina.org/docs/re/web-eng-wind-factsheet.pdf