

Oct 28/12

MHI'S WIND REPORT

(8)

Executive Summary p. 3-5

p. 3 - MHI Study goals

- ① Complete due diligence review of studies provided by Nolon to determine if study goals have been met
- ② Utilizing info provided by Nolon: "Can an isolated, island power, aka sufficient wind be developed to replace Hologood Thermal generating station and meet future demand? Is this a technically feasible & economic alternative to MF?"

- 2 reports reviewed → Hologood and Nolon
- "Both reports are technically sound, meet their study goals and were performed in accordance of good utility practice."
- In MHI's opinion, Nolon has incorporated maximum amount of wind generation
- To meet 2nd MHI study goal — two theorized options for replacement of Hologood w/ large-scale wind development

- p. 4 - generation must be backed up by firm dispatchable energy sources
- deployment of low capital but high-energy cost backing CT generation
 - deployment of massive 6 TWh battery bank

C/L - MF - \$ 8.37

Hologood → 10.78

(\$2.46)

Wind + Thermal - \$ 11.86 B

(\$3.58)

Wind + Battery - \$ 17.43 B

(\$9.06)

KEY - only 10% or so integrated into system → large-scale wind does not meet good utility practice

- MHI does not recommend that wind options beyond a 10% penetration level, as recommended by 2012 Hatch study, has prevailed at this time
- Wind penetration threshold is still largely a thermal generation reserve plan since Hydrogen is replaced
- scenario and mode of wind operation threshold in this study has not been demonstrated elsewhere in the world for an isolated island grid
- MHI finds that large-scale wind development is not a least cost option and does not represent good utility practice at this time

~~Wind As A Replacement For Hydrogen~~ - p. 17

Review of EXISTING work - p. 9

- p. 9 - 10% wind penetration based on capacity in an isolated scenario for Island
- p. 10 - reference to N.Z. and Hawaii
- p. 11 - Hatch report - 10% maximum recommended in 2035
 - uncertainty of technical and economic impacts on higher penetration rates which are yet to be tested under isolated system conditions.
- p. 12 - MHI concludes that Hatch report was developed following good utility practices
 - Netco 2012 Technical Wind Integration Study →
- p. 15 - confirms to good utility practice
- p. 15 - Wind experience in Orkney → 22.6% in August/12 → linked to electricity grids of Northern Orkney, Shetland and Great Britain

WIND AS REPLACEMENT for HONGKONG - p.17

- p.18 - high-level desktop study - should only influence decision whether or not to spend more time and effort
- estimated cost of theoretical scenarios more likely to increase than decrease

- wind potential in NE may be best in the country

p.19 - in order to replace Hongkong 1000 MW of wind required

- p.21 - 2 wind farms - 500 in Avon and 600 in Western region
- wind farms have typical useful life of 20 years - significant transmission infrastructure development required

p.22-23 - synchronous generators

p.24 - wind integration costs

p.25 - wind turbine technology

p.27 - Capacity Credit of Wind

Notes - 2066 MW of capacity credit of 18% (375 MW)

- Capacity credit allocated to wind power is 0 -> cannot be assumed to have any of its capacity available during peak demand periods

p.28 - Lithium-ion batteries

p.29 - Hydro as backup

p.30 - Combustion turbines as backup

p.36 - Batteries as backup

→ amount of installed wind capacity increases from 54 MW in 2012 to maximum of 1319 MW in 2035 (p.32 and p.37)

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CLW ANALYSIS - p. 38

p. 40	Interconnected Isled (MF)	- \$ 8.37 B	
	Isolated Isled (Hulgrud)	- \$ 10.78 B	(\$ 2.4 B)
	Wind : Thermal	- \$ 11.86 B	(\$ 3.5 B)
	Wind : Battery	- \$ 17.43 B	(\$ 9.0 B)

MHI's conclusions - p. 44

- 100% penetration level
- MF provides a firm supply and an opportunity to monetize excess energy prior to interconnection is made
- Wind scenarios do not provide new value for \$ 11.86 or \$ 17.43 B
- Wind scenarios theorized as that largely a thermal generation resource plan
- MHI finds that large-scale wind development, as a replacement for Hulgrud, is at least a least cost option and does not represent good utility practice at this time.

NATURAL GAS
JPK's Summary of Natural Gas

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Critics have argued that natural gas issues were not thoroughly explored. Government retained Ziff Energy of Calgary to review the LNG option (importation of natural gas and Grand Banks pipeline option).

In Wade Locke's presentation at the Harris Center in March 2012 Dr. Locke indicated that for LNG to be viable, gas would have to come in at less than \$5.75 mbtu.

Critics argued that because of the shale gas revolution in the US, cheap natural gas would be available to use at Holyrood and that it would be cheaper than Muskrat Falls. Today shale gas is selling at 3.70 Mcf Henry Hub in the US and has gone as low as \$1.85 in April of this year.

LNG Option

The LNG Option Ziff concludes:

- the Henry Hub price is not the price the province would pay. In fact because of low volume of natural gas required it would be required to pay world prices (approximate - natural gas in Europe costs \$9 Mcf and Asia costs \$15 Mcf)
- Added to base Henry Hub price one has to add 15% premium, toll fees and registration costs.
- Locke did not take into account the cost of building regasification facility.
- World gas markets are primarily linked to world oil prices - 80-90% of Brent Crude
- Firm contracts would be required to ensure security of supply.
- Delivered to NL at \$18.35 Mcf

- Regasification facility would cost \$800m
- Full LNG Supply cost would be \$27.15 mcf

To help people understand cost and to allow a comparison of apples to apples, Nalcor, using the CPW methodology utilized by MHI in both reports, concluded the following:

Muskrat Falls	- \$8.4B
Isolated Island	- \$10.8B
LNG	- \$10.7 - \$11.1B
Pipeline (FPSO) (Bruneau)	- \$12.8B
Pipeline Standalone	- \$15.0B

Shale tied to the volatility of fossil fuels – simply one fuel with another.

GRAND BANKS PIPELINE

On the Grand Banks pipeline option, Ziff concluded that:

- While natural gas is available, there is no viable commercial market to develop and produce the gas
- Companies have looked at this opportunity for a number of years and they have yet to find a commercial solution
- If oil companies in the NL offshore could be making money on natural gas, they'd be producing and selling it now.
- The amount of gas required to generate electricity at Holyrood is small. When you put this up against the high capital and operating costs to develop and produce gas from the Grand Banks, the cost to consumers would be greater

than the costs they currently pay for electricity from Holyrood.

- Delivered gas from the Grand Banks would cost between \$27 Mcf to \$33 Mcf depending on the development option.
- When converted to a CPW equivalent, the costs range from \$12.5 billion to \$15.0 billion. The CPW for Muskrat falls is \$8.4 billion.