

# Macro-environmental and Socio-economic Considerations

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# NFAT Terms of Reference

- 1b. Alignment of **Preferred Development Plan** with Clean Energy Strategy and principles of sustainable development as outlined in *The Sustainable Development Act*.
- 2b. Alignment of **Preferred Development Plan** and alternatives to strategy, principles and *Climate Change and Emissions Reduction Act*.
- The socio-economic impacts and benefits of the **Preferred Development Plan** and alternatives to northern and aboriginal communities.
- The macro environmental impact of the **Preferred Development Plan** compared to alternatives.

# Definitions re PUB Order 92/13

- Macro-environmental  
‘A critical analysis of the macro environmental impacts and benefits of Manitoba Hydro’s **Preferred Development Plan** and Alternative Plans. Specifically, this refers to the collective macro-economic (sic) consequences of changes to air, land, water, flora and fauna, including the potential significance of these changes, their equitable distribution within and between present and future generations.’

# Definitions re PUB Order 92/13 cont'

- Socio-economic  
'A critical analysis of the socio-economic impacts and benefits of Manitoba Hydro's **Preferred Development Plan** and alternative Plans. Specifically, a high level summary of potential effects to people in Manitoba, especially Northern and Aboriginal communities, including such things as employment, training and business opportunities; infrastructure and services; personal, family and community life; and resource use.'
- Evidence in the Clean Environment Commission not be filed in the PUB NFAT Review

# Manitoba Hydro Process

- Systematic, progressive analysis considering technical, economic, environmental and social parameters of:
  - Resource technologies
  - Specific resource options
  - Development plans
- Undertake a Multiple Account Benefit-Cost Analysis (MA-BCA)
- Analysis of plans against the provincial principles of sustainable development

# Screening Level Analysis

- Chapter 7 of the NFAT submission
- Also Appendices 7.1 Emerging Energy Technology Review & 7.2. Range of Resource Options
- Monitor wide range of resource supply options
- 16 resource options screened against 15 technical, environmental and socio-economic criteria
- 7 technologies 'screened in' for further consideration

# Range of Resource Options- Appendix 7.2 (376 pages)

- DSM
- Hydro with Storage and Run-of-River Hydro
- Hydroelectric Resources Available to Manitoba Hydro
- On-Shore Wind and In-Lake Wind
- Solar Photovoltaic
- Solar Thermal
- Enhanced Geothermal System
- Simple Cycle Gas Turbines
- Combined Cycle Gas Turbines
- Conventional Pulverized Coal
- Integrated Gasification Combined Cycle
- Nuclear Power Plant
- Biomass Energy
- Contractual Import Agreements
- Hydroelectric Resource Options (16 options)
- Thermal Resource Options (Heavy Duty CCGT, Heavy Duty SCGT, Aeroderivative SCGT, Wood Waste-Fired Generation (15MW & 30MW), Agricultural Crop Residue-Fired Generation (15MW & 30 MW))
- Subcritical Pulverized Coal Generation, Supercritical Pulverized Coal Generation, Integrated Gasification Combined Cycle, Integrated Gasification Combined Cycle & CCS, Nuclear Power Plant)
- Emerging Technology Resource Options (Solar Photovoltaics (Fixed Tilt, Single Axis Tracking, Dual Axis Tracking), Solar Parabolic Trough (No Thermal Storage & 6-hour Thermal Storage), Generic On-Shore Wind (100MW & 65MW), Generic In-Lake Wind, Enhanced Geothermal System Generation)

# Resource Technologies Screening - Chapter 7 Table 7.1

- Additional DSM
- Hydro With Storage
- Run-of-River Hydro
- On-Shore Wind
- In-Lake Wind
- Photovoltaic (Utility Plant Scale)
- Solar Thermal
- Enhanced Geothermal System
- Simple Cycle Gas Turbine
- Combined Cycle Gas Turbine
- Conventional Pulverized Coal Generation
- Integrated Gasification Combined Cycle
- Nuclear Power Plant
- Agricultural Crop Residue
- Wood Based Fuel
- Imports
- In addition to resources listed, also looked at hydro kinetic for instance.



# Resource Options Screened In (Table 7.6)

- Additional DSM
- Hydro resource options
  - Keeyask Generating Station (G.S.)
  - Conawapa Generating Station (G.S.)
- Natural gas-fired resource options
  - Heavy-duty Combined Cycle Gas Turbine (CCGT)
  - Heavy-duty Simple Cycle Gas Turbine (SCGT)
  - Aeroderivative SCGT
- Wind resource option
- Imports

# Table 7.6 Screened-In Resource Supply Options

Resource		DEM	Newark	Connequot	Wind	SR 29A Heavy Duty CCOT	SR 29A Heavy Duty SCOT	SR LR 800PH Aerobic/Anaerobic SCOT	Imports	
Technical	Fuel Type	-	Water	Water	Air	Natural Gas	Natural Gas	Natural Gas	Primarily Thermal	
	Renewable	Yes	Yes	Yes	Yes	No	No	No	No	
	Dispatchability	No	Yes	Yes	No	Yes	Yes	Yes	Yes	
	Mode of Operation	Must Take	Baseload & Peaking	Must Run or Flow	Must Take	Intermediate & Peaking (70-80% capacity factor)	Peaking (20% capacity factor)	Peaking (20% capacity factor)	Flexible	
	Asset Life	Variable	47 years	47 years	20 years	20 years	20 years	20 years	Not Applicable	
	Resource Lead Time	Variable	7 years	10 years	3 years	3 - 5 years	3 - 5 years	3 years	Not Applicable	
	Transmission Length	-	28 Km	7 Km	Avg. 28 Km	0 Km (Feed Plant)	0 Km (Feed Plant)	0 Km (Feed Plant)	0 Km	
	Capacity at Plant	Baseload	-	666 MW	1,860 MW	85 MW	208 MW	220 MW	47 MW	Up to Transmission Interconnector Limits
		Net Winter Peak	-	600 MW	1,000 MW	0 MW	205 MW	220 MW	50 MW	Up to Transmission Interconnector Limits
	Environmental	GHG Emissions Intensity Plant Operations	None	Negligible	Negligible	Negligible	300 t CO2e/MWh	300 t CO2e/MWh	300 t CO2e/MWh	~ 700 t CO2e/MWh
Regional GHG Emissions Intensity Production		+ 750 t CO2e/MWh	+ 50 t CO2e/MWh	+ 750 t CO2e/MWh	+ 750 t CO2e/MWh	+ 400 t CO2e/MWh	+ 240 t CO2e/MWh	+ 240 t CO2e/MWh	-	
NOx Emissions Intensity		-	-	-	-	100 kg NOx/MWh	100 kg NOx/MWh	200 kg NOx/MWh	Not Determined	
Land Impacts		EE Footprint	0 ha	214 ha	154 ha	+ 10 - 20 ha	+ 3 ha	+ 2 ha	+ 1 ha	0 ha
		Flooded Area	0 ha	4,400 ha	307 ha	0 ha	0 ha	0 ha	0 ha	0 ha
		Additional Impacted Area	0 ha	8,000 ha	1,000 ha	+ 800 - 2,000 ha	0 ha	0 ha	0 ha	0 ha
		Total Impacted Area	0 ha	10,670 ha	2,000 ha	+ 1,000 - 3,000 ha	+ 3 ha	+ 2 ha	+ 1 ha	0 ha
Water Impacts		Water Consumption	-	Domestic Needs Only	Domestic Needs Only	Domestic Needs Only	+ 300 m3/GWh	Domestic Needs Only	Domestic Needs Only	-
		Water Quality	-	Boron & Mercury	Negligible	None	Negligible	None	None	-
		Water Rights	-	Regulated Operating Range	Regulated Operating Range	None	Negligible	None	None	-
	Wildlife Impacts of Natural	Aquatic	-	Lake Sturgeon Habitat	Lake Sturgeon Habitat	None	Negligible	None	None	-
		Terrestrial	-	Caribou Habitat	Caribou Habitat	Negligible	Negligible	Negligible	Negligible	-
		Avian	-	Nesting Habitat	Negligible	Bird & Bat Collisions	Negligible	Negligible	Negligible	-
Socio-Economic/Provincial	New Jobs	Peak Construction	-	Very Low	Very Low	Low	Low	Low	-	
		Steady Construction	-	Medium	Medium	Very Low	High	High	-	
	RR Revenue Opportunities (% of total assets in RR)	100%	50%	40%	10%	30%	17%	17%	-	
		Client Contribution	Program Dependent	400 Person-Years	600 Person-Years	20 to 30 Person-Years	20 Person-Years	100 Person-Years	40 Person-Years	-
	Employment	All Northern Work Sites	Program Dependent	24%	24%	0%	0%	0%	0%	-
		Participate in O&M	Minimal	36 FTE	41 FTE	4 to 8 FTE	34 FTE (for 1 to 2 plants at site)	32 FTE (for 1 to 2 plants at site)	32 FTE (for 1 to 2 plants at site)	-
	Programs (from 2014)	All Northern Work Sites	0%	100%	100%	0%	0%	0%	0%	-
		Water Needs	-	\$0.2 Myear	\$12.8 Myear	-	-	-	-	-
		Capital Taxes	Program Dependent	\$17.3 Myear	\$26.8 Myear	\$0.8 Myear	\$2.0 Myear	\$2.8 Myear	\$3.4 Myear	-
		Electricity Fees	Program Dependent	\$27.7 Myear	\$45.8 Myear	Potential for \$1.3 Myear	\$2.2 Myear	\$1.3 Myear	\$2.8 Myear	-
Other		-	-	Grants in lieu of taxes	Land Rental, Grants in lieu of taxes	Grants in lieu of taxes	Grants in lieu of taxes	Grants in lieu of taxes	-	
Nearest Population Centers		-	Five Lake ON, Oshawa, Tawasentah ON, Thompson, War Lake PN, York Factory FN	Five Lake ON, Oshawa, Shawanaga PN, Tawasentah ON, War Lake PN, York Factory FN	Southwest & South-central Manitoba	Brandon, Southern centre near pipeline	Brandon, Southern centre near pipeline	Brandon, Southern centre near pipeline	-	
Economic	Levelized Cost (2014)	Program Dependent	\$80/MWh	\$20/MWh	\$10/MWh	\$75 - \$250/MWh	\$100 - \$200/MWh	\$100 - \$200/MWh	Projected Market Prices	

# Characteristics of Screened-In Resource Supply Options

## Table 7.6

### **Technical:** Fuel Type

Renewable

Dispatchability

Mode of Operation

Asset Life

Resource Lead Time

Transmission Length

Capacity at Plant – Nominal, Net Winter Peak

### **Environmental:**

Air Impacts – GHG Emissions, NOx

Land Impacts – GS Footprint Area, Flooded Area, Other Impacted Area, Total Impacted Area

Water Impacts – Water Consumption, Water Quality, Water Regime

Wildlife Species of Interest – Aquatic, Terrestrial, Avian

### **Socio –Economic / Provincial:**

Generic Tech Rating – Health Concerns, Safety Concerns

Manitoba Business Opportunities

Employment – Direct Construction At Northern Work Sites; Permanent O & M At Northern Work Sites

Royalties / Taxes – Water Rentals, Capital Taxes, Guarantee Fees, Other Nearby Population Centers

**Economic :** Levelized Cost

# Multiple Account Benefit-Cost Analysis

- Chapter 13 of NFAT submission
- Disaggregated form of cost-benefit analysis
  - Recognizes that not all consequences can be monetized
  - Addresses important distributional considerations as well as overall benefits and costs
- Takes broad societal perspective - incorporates benefits and costs not reflected in Manitoba Hydro's revenues and expenditures
- Identifies advantages or disadvantages of the alternatives and key trade-offs for different parties and interests

# The Evaluation Accounts

- Market Valuation Account (incremental revenues and expenditures to MH and its partners)
- Manitoba Hydro Customer Account
- Manitoba Government Account
- Manitoba Economy Account
- Environment Account
- Social Account
- Uncertainty and Risk

# Market Evaluation Account

- **Preferred Development Plan** and Small Interconnection Plan have lowest net cost
- **Preferred Development Plan** has:
  - much higher capital cost
  - much higher firm export sale revenues
  - much higher residual value of assets
  - much lower fuel cost

# Customer Account

- **Preferred Development Plan** results in greatest rate increase in short to medium term
  - Cumulative increase approximately 16 – 18 percentage points higher than other options by 2031/32
- **Preferred Development Plan** results in lowest rate increase in longer term
  - Cumulative increase approximately 34 to 70 percentage points lower than other options by 2061/62
- **Preferred Development Plan** would also provide:
  - greater system reliability
  - significantly lower expected cost of unserved load
  - greater ability to manage extreme drought

# Manitoba Government Account

- Focus on incremental revenues to government not offset by incremental costs or risks
  - Capital taxes and water rentals
- Net benefits greatest with **Preferred Development Plan**
  - \$350 to \$400 million greater than two alternative plans with Keeyask G.S.
  - \$670 million greater than the all-gas plan



# Manitoba Economy Account

- Focus on incremental income or other benefits
- Demand for labour – greatest potential for net benefits
- Greatest benefit with **Preferred Development Plan**
  - \$123 to \$150 million greater than plans with Keeyask G.S. and gas
  - \$260 million greater than all-gas plans
- Large proportion of these benefits in the north where they would be particularly beneficial

# Environment Account

- Greenhouse Gas (GHG) and other air emissions (NO<sub>x</sub> and local Criteria Air Contaminants):
  - **Preferred Development Plan** much more beneficial than plans with gas
  - Multiple Account – Benefit Cost Analysis (MA-BCA) monetizes results

# Environment Account Continued

- Biophysical impacts

- Keeyask G.S. based on high-level description of impacts in the project description (Chapter 2). The environmental effects are currently under review by the Clean Environment Commission; the PUB is not to duplicate the CEC review
- No detailed assessment of other projects at this time
- Manitoba Hydro conclusion re Keeyask G.S. and Conawapa G.S.:
  - With extensive mitigation, environment impacts acceptable (to be determined through regulatory process)
- Impact-related costs internalized with project designs and plans
- Gas turbines: likely located on relatively small industrial (brownfield) sites (N.B. Submission focused on plant impacts and did not include impacts of natural gas production and pipelines)

# Social Account

- Project partners
  - Largest benefits with **Preferred Development Plan**
  - Significant benefits also with Keeyask G.S. / gas plans
  - No similar opportunities with non-hydro plans
- Local and regional communities
  - Full range of positive and negative impacts
  - For the most part, adverse impacts minimized or offset
  - Nevertheless, some negative residual effects for some individuals and families
- Manitobans as a whole
  - Large bequest value for future generations with **Preferred Development Plan**

# Summary of Multiple Accounts Analysis

## (Reference Scenario - Real Discount rate = 6.0%)

	Preferred Development Plan	K19/G24/250 MW	K22/Gas	All Gas
Market Valuation	--	17.0	(270.5)	(654.1)
Government Transfers	--	(353.5)	(359.9)	(674.2)
Manitoba Economy	--	(123.7)	(150.0)	(260.3)
Environment		(217.2)	(181.4)	(333.3)
<b>Overall Monetized Net Benefit (Cost)</b>	<b>--</b>	<b>(677.4)</b>	<b>(997.4)</b>	<b>(1922.2)</b>

# Conclusions

- Developing Keeyask G.S. to meet domestic load offers significant benefits relative to the all-gas plan for Manitoba Hydro and society as a whole
  - Tax, employment, air emissions, and social benefits (including Northern and Aboriginal people)
- Plans with a new interconnection offer significant benefits
- **Preferred Development Plan** versus a 250 MW interconnection with Keeyask G.S. but no Conawapa G.S.:
  - Similar net benefit to Manitoba Hydro and its partners
  - Higher short to medium term rate increase
  - Lower long term rate increase
  - Greater long-term legacy value and upside potential
  - Greater long-term rate, customer reliability, tax, employment and social benefits, as well as greenhouse gas benefits

# Sustainable Development Principles

- *The Sustainable Development Act* contains 7 principles and 6 guidelines
- Today's presentation: restrict discussion to the principles
  - Submission deals with all principles and guidelines

# Integration of Environmental and Economic Decisions

- Manitoba Hydro applies thorough, systematic process integrating environmental and economic considerations, beginning with initial screening of options
- MA-BCA extends evaluation
- Comprehensive environmental impact assessment with CEC review and recommendations
- Needs For and Alternative To submission with PUB review and recommendations
- Government of Manitoba (elected by citizens of Manitoba)  
– final arbiter of accounting of economic, environmental, human health and social consequences



# Stewardship

- **Preferred Development Plan** offers:
  - lowest long-term rates and most reliable supply
  - largest amount of new government revenue
  - most employment
    - accentuated especially in the North
  - the fewest greenhouse gases and largely avoids NOx and CAC
  - minimizes and compensates for adverse effects
  - potential for significant benefits to project partners

# Shared Responsibility and Understanding

- **Preferred Development Plan** offers greatest opportunity for engaging public
  - Process with local Cree Nations began in 1990s and expanded in first decade of this century
  - Joint Keeyask Development Agreement establishes partnership, including project governance
  - KCNs, NCN, MKO and MMF partners with governments and Manitoba Hydro in the Hydro Northern Training and Employment Initiative
  - Aboriginal traditional knowledge and Cree worldview embedded in project plans and environmental assessment
- Experience with Brandon gas turbine project: little public interest

# Prevention

- Keeyask G.S. and Conawapa G.S.
  - Concentrating new projects on rivers previously affected and currently managed
  - Reduction in size of Keeyask G.S. and Conawapa G.S.
  - Adverse effects agreements with local Cree Nations
  - Mitigation to protect water quality, key fish species and important ecosystem functions
  - Benefits also enhanced:
    - Keeyask Hydropower Limited Partnership
    - Employment and contract preferences
    - Hydro Northern Training and Employment Initiative
    - Stocking and enhancement program to establish long-term, sustainable population of lake sturgeon

# Prevention Continued

- Gas turbines:
  - Located in existing industrial areas with almost negligible effects on local residents and natural environment
  - Environmental issues of air emissions and water usage managed at technical level with provincial regulators

# Conservation and Enhancement

- Keeyask G.S. and Conawapa G.S.:
  - Stocking program to establish long-term, sustainable population of lake sturgeon
  - Populations of other key fish species will remain stable or increase over long term
  - Terrestrial ecosystem diversity expected to remain stable
  - Tataskweyak and War Lake developing fish and moose harvest sustainability plans
- Gas turbine plants:
  - Not likely to directly affect ecological processes, biological diversity or environmental life-support systems
  - Emissions of greenhouse gases will contribute to climate change, which will cause environmental effects
  - Magnitude of effects from one gas-fueled GS would be nominal, but incremental

# Rehabilitation and Reclamation

- Keeyask G.S. and Conawapa G.S.
  - Infrastructure no longer required will be rehabilitated
  - Hydroelectric generating stations may operate 100+ years
    - Decommissioning according the legislation and agreements
    - TCN 1992 Implementation Agreement: maintain existing water regime at that time
- Gas
  - Industrial site could be restored for other industrial developments

# Global Responsibility

- Keeyask G.S. and Conawapa G.S.
  - Substantial reduction in greenhouse gases by displacing fossil-fuel electricity generation
  - Keeyask G.S. fewer GHGs in a century than CCGT in 183 days (half a year)
  - Conawapa G.S. fewer GHGs in a century than CCGT in 100 days

# Questions

