Manitoba Hydro's Needs For and Alternatives to (NFAT)
Review of Keeyask and Conawapa Generating Stations

Macro Environmental Impact Assessment Guidance

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OUTLINE

Scope, objectives & approach

Macro environmental impact assessment

Impacts and benefits of power supply options

Guidance for the Panel

Scope, objectives & approach

Scope

- Provides a high-level overview of the potential macro environmental impacts and benefits of power technologies associated with Manitoba Hydro's preferred development plan and its main alternatives including:
  - hydro-electric
  - natural gas
  - wind
  - solar
  - demand-side management

Intent is to set the stage for the Panel to engage in a thoughtful, strategic discussion of the options from a macro-environmental perspective

Objectives

- Facilitate comparative analysis of the macro environmental impacts of the various technologies associated with the Plan and its alternatives, and what they involve

- Offer guidance to the Manitoba Public Utilities Board (PUB) Needs for and Alternatives To (NFAT) review panel (the Panel) on how to critically assess the macro environmental strengths and weaknesses of the Plan and its alternatives, and their implications

- Is *not* a technical analysis; does *not* attempt to provide the level of insight or detail that some of the other specialized reports in the NFAT review have. It is *not* a critical assessment of the MB Hydro filing

- Does *not* attempt to assess the best development option, or draw conclusions about the needs for or alternatives to the Plan

Approach

Consulted international peer-reviewed scholarly literature:

Sources from leading international journals such as *Impact Assessment and Project Appraisal*, *Environmental Impact Assessment Policy and Management*, and *Environmental Impact Assessment Review*. The academic literature was supplemented by publically available professional reports and information provided on government and non-government websites.

Examples of other documents consulted:

Dunsky, P. (2014) The role and value of demand-side management in Manitoba hydro's resource planning process. A Testimony submitted to Manitoba Public Utilities Board, February 3.

Manitoba Innovation, Energy, and Mines (Energy Division). (2012) Focused on What Matters Most: Manitoba's Clean Energy Strategy. Government of Manitoba: Winnipeg, MB.

MNP. (2014) NFAT Review: A Review of Manitoba Hydro's Macro Environmental Considerations. On behalf of the Manitoba Public Utilities Board: Winnipeg, MB.

LaCapra Associates, Inc. (2014) Needs for and Alternatives to (NFAT) Review of Manitoba Hydro's Proposal for the Keeyask and Conawapa Generating Stations, Technical Appendix 4. Manitoba Public Utilities Board: Winnipeg, MB.

Noble, B. and Gunn, J. (2013) Review of KHLP's Approach to the Keeyask Generation Project Cumulative Effects Assessment. Public Interest Law Centre: Winnipeg, Manitoba.

Gaudreau, K. and Gibson, R. (2014) Framework for Sustainability-based Assessment for the Public Utilities Board's Needs For and Alternatives To (NFAT) Assessment of Manitoba Hydro's Preferred Development Plan and Alternatives.

Manitoba Hydro (2013) Chapter 13: Integrated Comparisons of Development Plans – Multiple Account Analysis Conclusions. Needs For and Alternatives To. Winnipeg, MB.

Relevant Information Requests and responses

Macro environmental assessment

Thinking about 'macro environmental assessment'

The PUB requested a "macro environmental impact assessment" (2013: 13) be done:

"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 consequences of changes to air, land, water, flora, and fauna, including the potential significance of these changes, and their equitable distribution within and between present and future generations."

Thinking about 'macro environmental assessment'

Bond et al. (2013) – list 40 types of environmental assessment
Vanclay (2004) – list 142 types of environmental assessment

- The term macro environmental assessment is absent from the scholarly literature
- Lack of established academic definition, or principles and procedures.

What are the core characteristics of 'macro environmental impact assessment' as defined by the PUB, and what does this mean to the Panel?

Thinking about 'macro environmental assessment'

(i) It is '**strategic**' by nature

The Manitoba Hydro NFAT review process will result in the choice of a preferred future energy development path from a range of alternatives.

This will ultimately have profound implications for the province's biophysical environment and its communities for many decades to come.

Thinking about ‘macro environmental assessment’

(ii) It is ‘**regional**’ in scale

This is readily apparent from the features of the Plan and its alternatives, which include large-scale development projects such as hydro-electric and natural-gas fuelled generating stations, transmission lines, and various other infrastructure; all of which potentially have regional-scale impacts.

Thinking about 'macro environmental assessment'

(iii) It is 'collective' or '**cumulative**' in scope

The PUB asks for information about the macro/collective/cumulative effects of the Plan and its alternatives.

Arguably, there could not be any real examination of macro environmental impacts of the Plan and its alternatives without consideration of their potential cumulative effects on regions affected by development.

It is a mistake to simply 'compare' the impacts of one development to another. One can always find the 'lowest impact alternative'. The purpose of cumulative effects assessment is to focus foremost on the TOTAL environmental effects of all development,
and then the marginal cost of adding one more.

Thinking about 'macro environmental assessment'

(iv) It is an '**appraisal**' of the preferred plan and its alternatives

A form of SEA known as 'policy appraisal' is often used to select among competing policy options when there is a need to determine which is most desirable, rather than to predict with accuracy the physical impacts of subsequent development projects (Therivel 1993).

The general approach is to appraise the strengths and weaknesses of various policy options by evaluating how well they measure up to key performance indicators (which reflect values or vision).

What are the 'right' performance indicators?

- those adopted by the Proponent?
- the sustainability assessment criteria suggested by Gaudreau and Gibson (2014)?
- something else?

Thinking about ‘macro environmental assessment’

The point of thinking about macro environmental impact assessment in these ways is to remind the Panel about the kinds of high-level, strategic questions it can and should be asking in the NFAT review.

Thinking about 'macro environmental assessment'

The challenge for the Panel given the intensely technical nature of the NFAT review is:

…to **avoid a reductionist mind-set**, and instead focus on "identifying possible futures and the means to shape sustainable regional outcomes" (Gunn and Noble 2009: 262).

"…the complex nature of environmental systems precludes a reductionist approach…yet we still tend (in strategic decision-making) to frame CEA problems in this manner" (Gunn and Noble 2011: 157).

Impacts and benefits of power supply options

Hydro electric power generation (renewable)

Impacts	Benefits
Environmental: • disruption of natural variation in river flow patterns[2,9,11,14] • impact on fisheries & fish migration[1,9,10,11,12,14,15] • deterioration of freshwater ecosystems – scouring of river beds and loss of riverbanks[3,10,11] • reduced biodiversity and conversion of surrounding ecosystem; from terrestrial to aquatic[3,8,9,11,14] • potential to cause earthquakes[10,13] *Socioeconomic:* • inundation of agricultural areas[1,7,12,13] • resettlement needs and problems[1,3,5,7,8,12,13] • social and cultural disruption[1,5,7,12,13] • impact on indigenous people[1,12,13] • effects on biodiversity[1] • danger of waterborne diseases[1,12,13]	*Environmental:* • renewable[1,3,6,8,9] • helps to combat climate change – comparatively lower GHG emission factor[1,3,6,8] • simpler decommissioning process and no hazardous waste[6] *Socioeconomic:* • relatively low cost long term option[1,8,9] • eliminates the cost of fuel; does not require imported fuel[3] • flood control[3,8,9,11] • fast response time – capacity to generate electricity practically instantly[8] • can be integrated within multipurpose developments e.g. provision of irrigation water[8,12] • proven and well-advanced technology[8] • water supply is generally stable and not subject to fluctuation in market conditions[8] • accelerated rural development[1,7,8,11]

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Natural gas-fuelled power generation (non-renewable)

Impacts	Benefits
Environmental: • high greenhouse effect[2,3] • resource depletion[2] • risk of contamination (for surface water, groundwater, air, and surface media)[5] • linked to seismic activity due to hydraulic fracking[5] *Socioeconomic:* • high cost of pipeline construction[1] • health concerns due to pollution and potential earthquakes[5] • migration of contaminant and its effects on agricultural and livestock farms[5]	*Environmental:* • lower emission than coal[2,3] • high grade waste heat[4] • lower weight per unit power[4] • dual fuel capability[4] • low vibration levels[4] *Socioeconomic:* • low maintenance cost[4] • low capital cost[4] • short delivery time[4] • high flexibility and reliability[4] • fast starting time[4] • lower manpower[4]

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Wind turbine power generation (renewable)

Impacts	Benefits
Environmental: • birds mortality / impacts on bats (fairly recent) [2,3,4,5,6] • habitat loss, disturbance, and fragmentation, and effects on wildlife [2,5,6,7] • less efficient in comparison to hydro or fossil fuel alternatives [1] • energy generated sometimes restricted to local use [1] • broken ice formed around the blades could be thrown up to 250 metres [2] *Socioeconomic:* • visual impact problem [1,3] • noise problems from rotating blades [1,3] • shadow flicker effects [2,3] • less reliable – intermittent and does not always blow when electricity is needed [1,3] • relatively high cost of production [1]	*Environmental:* • extremely low carbon emissions, no emissions directly associated [2,3,4] • not land intensive / minimal land clearing required [3,4] • wind turbines materials are recyclable [2] • more environmentally friendly decommissioning process [2] • less damaging to wildlife populations [2] • do not produce any kind of hazardous/ toxic or radioactive waste [3] • no resource extraction or transportation [3] • no water required for installation [3] *Socioeconomic:* • no evidence of significant health effects [2]

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Solar photovoltaic power generation

Impacts	Benefits
Environmental: • land use: large areas are required for central systems[4,5,6] • fragmentation of the countryside[5] • plant degradation[5] • interference with fauna and flora[5,6] • microclimate change[5] • glare – temporary loss of vision or reduction in the ability to see the details of the human eye as a result of the reflection of the sunlight by the surface of the photovoltaic module[5] *Socioeconomic:* • relatively higher costs of production (from PV sunlight-to-electricity conversion efficiency and manufacturing yield), although in rapid transition [2,3,7,8] • relatively high payback period although in transition[3,8] • visual intrusion/visual impact on the landscape[1,5] • potential danger of electrocution from the direct current produced by systems[1] • large amounts of rare materials required[7,8] • highly skilled and expensive construction personnel required to build and operate[7] • reduction of cultivable land[5]	*Environmental:* • no chemical pollutants during normal[1] operation • PV cells help the increase of soil humidity[1] • reclamation of degraded land – improves flora formation in dry/arid areas[1] • landscape modification limited to construction phase[1,4] • low to reduced emissions[1,6] • reduction of the required transmission lines of the electricity grids[4] *Socioeconomic:* • does not generate noise[1,7] • cost benefits of cladding materials serving dual purposes[1] • low maintenance required[3,7] • little or no transmission cost[1] • wide range of domestic and industrial applications[7]

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Demand-side management

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Sustainability and equity perspectives

Evans et al. (2009) found that “electricity production from wind is the most sustainable followed by hydropower” (p. 1086).

	Photovoltaic	Wind	Hydro	Geothermal
Price	4	3	1	2
$CO_{2\text{-}e}$ Emissions	3	1	2	4
Availability and limitations	4	2	1	3
Efficiency	4	2	1	3
Land use	1	3	4	2
Water consumption	2	1	3	4
Social impacts	2	1	4	3
Total	20	13	16	21

Sustainability and equity perspectives

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The ‘dual sustainability’ of wind energy – both from environmental and financial points of view – suggests it is time to re-evaluate public policy towards wind energy production.

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It is possible that solar PV power will similarly enter this discussion in the next decade (given apparently materially changing economics).

Sustainability and equity perspectives

Inter-generational equity – requires that exploitation rates of renewable energy resources do not excess their regeneration rates (assumes a shift away from non-renewable energy resources) in the long term

Some considerations for inter-generational equity:

- investment in new technology and resilient, flexible systems
- not foreclosing the options for future generations through further depletion of non-renewables
- equitable distribution of long-term positives and negatives, and risks
- setting aside part of current net profits (and other strategies) to help shift to more sustainable options in the long-term

Sustainability and equity perspectives

Intra-generational equity – requires consideration of the distributional consequences of near-term costs, benefits and risks

Some considerations for intra-generational equity:

- resource access gaps between upper and lower income segments of the population
- strategies for redistribution of costs, benefits, risks among various populations (quality of life considerations)
- responsibility for the externalization and internalization of costs, benefits and risks among investors, suppliers, consumers, and governments
- who wins and who loses among suppliers and consumer groups

Sustainability and equity perspectives

There have been arguments and counter-arguments on the ‘best’ source of power. The is no right answer because the answer is context specific.

> e.g. China: best option is natural gas, but in Malaysia, solar and biomass energy alternatives preferred over hydropower and wind.

The selection of a preferred energy development package ultimately comes down to what is most desirable given the development context (what is available, costs to develop, etc.) and the question of ‘trade-offs’, i.e. choices about what purposes to serve or what alternatives to favour (Gibson 2013).

Sustainability and equity perspectives

Nelson River Sub-watershed development context:

1. Significant stress already experienced by the Nelson River sub-watershed and its communities due to 55+ years of hydro-electric development

- habitat degradation, fragmentation, and total loss; aquatic ecosystem disturbance; and a variety of socio-economic impacts (see for e.g., Gunn and Noble 2012; Noble and Gunn 2013; G&P Resource Services 2013; Peake 2013; Schaefer 2013).
- widespread agreement that the region has already been 'substantially altered'

2. Ongoing regulatory processes including the regional cumulative effects assessment flowing from the CEC Bipole III recommendations

- net positive benefits to the region?

Sustainability and equity perspectives

Ultimately:

What are the values of the Manitoba public and project stakeholders… today?

What are the values of the Panel in its decision-making…right now?

What is the best alternative given the state of the Nelson River sub-watershed…in the future?

Guidance to the Panel

Kornov and Theisen (2000: 191) caution that strategic decision- and policy-making is too often based on an assumption that:

"the provision of rational information will help improve decision-making…but the literature points to other characteristics of real decision-making processes, including cognitive limitations, behavioural biases, ambiguity and variability of preferences and norms…" etc.

In other words, a rational procedure will not automatically lead to a rational choice.

It is therefore recommended that the Panel ensure that it has in mind a strong vision of the future at the outset of its deliberations, and carefully weigh and clearly understand the implications of the choices at hand at a high-level before entering into the fray of technical reports and debates.

In this regard, four questions may be of use to the Panel:

1. While hydro-electric power has been the power generation source of choice in the past in Manitoba, it may not be preferred in the future. **What is the preferred future direction for long-term energy infrastructure investment in Manitoba?**

2. The Nelson sub-watershed has already been substantially altered by hydroelectric development, and it is agreed past alterations have been cumulatively significant. **What is the vision for the Nelson sub-watershed region, and can or should it sustain further development?**

3. The NFAT review represents a strategic policy decision. **What are the values and/or performance indicators against which the Plan and its alternatives are being assessed?**

4. All of the power supply options will have profound potential impacts on the environment, and that trade-offs among them are complex. **What are the likely macro or cumulative environmental impacts of the Plan and each alternative and how well does each perform with respect to the broad vision, values and performance indicators that have been identified?**

Manitoba Hydro's Needs For and Alternatives to (NFAT)
Review of Keeyask and Conawapa Generating Stations

Macro Environmental Impact Assessment Guidance

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