Name: Oskar T. Sigvaldason

Date: September 28, 2017

Subject: BCUC Site C Inquiry; Submission re; "Climate Change Considerations with Respect to Site C Hydro-electric Project"

Dear Mr. Patrick Wruck
Commission Secretary
British Columbia Utilities Commission

We are grateful for the opportunity of forwarding our submission on the Site C Inquiry, which is attached. The submission contains our expressed concern about the lack of attention to climate change considerations, as committed by the Governments of Canada and British Columbia. There are associated major needs for greatly increased electrification, including increased generation supply from non-greenhouse gas emitting sources.

We are available to provide additional information which your Commission may require, as part of its ongoing inquiry process. I can be contacted directly at my home office ([redacted]) or on my mobile ([redacted])

Respectfully submitted
On behalf of Oskar Sigvaldason, Jim Burpee and Ken Ogilvie.

Climate Change Considerations with respect to Site C Hydro-electric Project

Submitted by Oskar Sigvaldason, Jim Burpee and Ken Ogilvie

Context:

Construction of the Site C hydro-electric Project on the Peace River in British Columbia was initiated in 2015, with project completion scheduled for 2024. This Project is planned for 1,100 MW of generating capacity, and for generating 5,100 GW-h of electrical energy annually.

Currently, a review of the Project is being carried out by the British Columbia Utilities Commission. The options being assessed include: completing the project as planned; suspending the Project; or terminating the Project.

We have reviewed recent documentation related to this review, especially two reports prepared By Deloitte LLP, both dated September 8, 2017[1], and a Preliminary Report prepared by the British Columbia Utilities Commission, dated September 20, 2017[2].

We wish to express our concern that this review has not addressed major commitments and associated obligations by Canada, and by the provincial jurisdictions, including British Columbia, on climate change and related greenhouse gas (GHG) emissions mitigation. As described below, the dominant strategy for achieving progress on climate change is to replace the use of fossil fuels and its derivatives (gasoline, diesel, natural gas, etc.) with energy from non-emitting energy sources. This involves large-scale electrification, with electricity supplied primarily from renewable generating sources, such as hydro, wind, and solar.

Our position is based on results of the most comprehensive and analytically rigorous study (Trottier Energy Futures Project (TEFP)) undertaken to date in Canada, for defining minimum cost strategies for GHG mitigation for Canada, and for each of its thirteen jurisdictions[3]. The primary goal of the TEFP was to meet reductions in GHG emissions of up to 80% for Canada by 2050, relative to 1990. This Project was carried out by a team of a dozen experts from across Canada, covering the full range of expertise required for such a complex undertaking. Two mathematical models were used: a formal optimization model based on the TIMES-MARKAL formulation, and a simulation model. The use of the TIMES-MARKAL formulation for deriving minimum cost solutions for energy-GHG mitigation is coordinated globally by the International Energy Agency. Results of the Project were subject to extensive peer review, including a specially appointed Expert Review Panel. The Final Report was presented at a special event at

[1] Deloitte LLP; Site C – Alternative Resource Options and Load Forecast Assessment; and Site C Construction Review; September 8, 2017.
[2] British Columbia Utilities Commission; BCUC Inquiry Respecting Site C – Preliminary Report; September 20, 2017
[3] Trottier Energy Futures Project; Canada's Challenge and Opportunity: Transformations for Major Reductions in GHG Emissions; April, 2016.

the Trottier Energy Institute in Montreal in April, 2016, and is publically accessible on its website.

It is important to appreciate that results of other studies for achieving ambitious GHG mitigation targets, have also clearly demonstrated the importance of large scale electrification, with generation supply from renewable generating sources. For example, extensive work has been carried out by Navius Research, and at Simon Fraser University, including a study in 2013 for the United Nations' Deep Decarbonisation Pathways Project, for Canada as one of sixteen major GHG emitting countries around the world. There have also been comparable assessments by the National Round Table on the Environment and the Economy, up to 2013.

The magnitude of the transformation required to meet committed emissions reduction targets is enormous. Demand for electricity in Canada could increase three-fold within a 30 to 40-year timeframe. This places emphasis on ensuring that the demand forecast for electricity in British Columbia reflect the need for wide-scale electrification, in response to major transformations away from the use of fossil fuels in the transportation, buildings (residential and commercial), industrial, forestry and agricultural sectors. It also needs to reflect progressive decarbonizing of the fossil fuel "supply chain", including extraction, refining, transport, and delivery.

The potential role and associated timing of projects, such as the Site C hydro-electric Project, also need to be assessed within the context of a comprehensive integrated planning framework. Such planning needs to combine the minimizing of overall cost for GHG mitigation, with associated major transformations of the energy systems.

Existing Climate Change Obligations and Commitments:

Canadian commitments to GHG emissions mitigation include;

1. Signatory to the Paris Accord (COP 21), signed on December 12, 2015, in which Canada committed to reduce its GHG emissions by 30% below the 2005 level, by 2030.
2. On March 3, 2016, First Ministers issued a joint communique in the Vancouver Declaration on clean growth and climate change. This communique builds on existing commitments and actions by the Provinces and Territories, as well as the momentum from COP 21, for clean growth and climate change. This commitment includes meeting or exceeding Canada's international emissions targets, and transitioning Canada to a low carbon economy.
3. On October 3, 2016, the Government of Canada formally ratified the Paris Accord, which came into force on November 4, 2016.
4. On November 18, 2016, Canada presented its "Mid-Century Long-Term Low-Greenhouse Gas Development Strategy" at the COP 22 meeting in Marrakech, Morocco.

In this Report, Canada defined its overall strategy for achieving 70 to 90% reductions in GHG emissions by 2050, relative to 2005.

5. British Columbia has demonstrated strong leadership in Canada, and globally, in implementing climate change legislation. In 2007, it passed the Greenhouse Gas Reductions Target Act, with the goal of reducing GHG emissions by 33% by 2020, and by 80% by 2050, relative to 2007. In 2008, it passed the revenue-neutral Carbon Tax Act.

Results of Canadian Studies for GHG Mitigation:

From the studies noted above, there are several important observations, which are directly relevant to any decision concerning the future status of major hydro-electric projects:

- There are significant opportunities to reduce energy intensity (i.e., the ratio of primary energy to each unit of GDP), while continuing to meet energy-based demands, through energy efficiency and energy conservation programs. Energy intensity in Canada can be reduced by as much as 50%, with the implementation of cost-effective efficiency and conservation programs.
- The dominant strategy for reducing GHG emissions is to reduce the use of fossil fuels and its derivatives from the current 74% of energy demand to less than 25%. To accomplish this, the use of electricity needs to increase from the current 22% of energy demand to more than 60% - a three-fold increase. There would also be an increase in dependence on biomass and biofuels from the current 4% of demand to more than 15%. These massive changes need to occur in a 30 to 40-year period.
- There is a corresponding need for massive increase in electricity supply infrastructure. From the TEFP, Canada's electricity supply infrastructure would need to increase from its current 135,000 MW, to more than 400,000 MW, in the same 30 to 40-year period.
- Minimum-cost solutions for GHG mitigation result in the rapid decarbonisation of electricity supply systems in Canada. This begins with having coal-fired generation plants taken out of service, or refurbishing such facilities with carbon capture and storage (CCS). This would be quickly followed by reducing dependence on natural gas for electricity generation, through combinations of combined cycle-cogeneration-CCS, or limiting natural gas-fired generating facilities dominantly to peaking and/or stand-by operation.
- The optimum composition for generation supply systems for jurisdictions that are richly endowed with access to "dispatchable" hydro (i.e., hydro with upstream storage) as well as other renewable generating sources (such as wind and solar) is to place emphasis on developing such systems for increasing electricity supply, while

achieving major progress in reducing GHG emissions. The electricity supply system in British Columbia is an excellent example of a jurisdiction having this potential.

- "Dispatchable" hydro developments play a key role, and merit special consideration, including:
  - Virtually all dependable capacity (guaranteed availability at maximum system demand) for the system comes from installed generating capacity at such hydro generating facilities. This arises as other renewable generating sources (wind, solar, in-stream generation, tidal, run-of-river hydro, etc.) provide little dependable capacity contribution for grid supply. (As an aside, there are potential dependable capacity contributions from other electricity supply sources, such as geothermal, nuclear, bioenergy, and thermal generating facilities);
  - Hydro-power provides valuable operating support, which enhance the value of electricity production from intermittent renewable generating facilities. These include load following and fast system response capability, which facilitate immediate system responses to major short-term variations in generation. Hydro-power also provides other important system operating benefits, including voltage control, system stability, and emergency support;
  - Special system dispatch problems can occur when total generating capacity from intermittent renewable generating sources exceeds minimum system demand. In such cases, excess electricity production needs to be disposed of. Disposal of excess electricity normally requires transfer to neighbouring utilities (which may be based on "pay to take" arrangements), or absorbing such energy in energy storage facilities, such as grid scale pumped storage; and
  - A consequence of this "system dispatch" consideration, is that there is a practical upper limit to the total amount of electricity generation from intermittent renewable generating sources that can be readily absorbed in a large-scale grid supply system. There have been numerous assessments of this challenge, with variations dependent on overall composition of the supply system, arrangements with neighboring utilities to take excess generation, availability of grid scale energy storage (dominantly pumped storage), and/or high voltage transmission capacity. For systems dominated by generation from renewable generating sources, such as the B.C Hydro system, the upper limit for generation from intermittent renewable generating sources, collectively, would be expected to be in the general range of 30% of total system demand, based on existing technologies. It follows that the remaining 70% of electricity generation for such a supply system would need to come from dispatchable hydro generation.

- From TEFP, one of the important observations was that the "implicit value" of large-scale hydro for providing both dependable capacity and electricity generation to meet rapidly expanding electricity demands, primarily to achieve ambitious GHG mitigation targets, was extremely high. This reflected a very high unit benefit value for any action that results in reducing CO_2 emissions, or for the retention and storage of carbon.

Summary:

The authors of this brief again reinforce their concern that the review of the Site C Hydro-electric Project needs to be carried out with full consideration for meeting climate change commitments and obligations made by the Governments in Canada, including those made by British Columbia and other jurisdictions. Major increases expected in the demand for electricity will be dominated by the pressing need for rapid reductions in the use of fossil fuels and its derivatives to meet energy demands.

We emphasize the importance also of ensuring that there is a comprehensive planning process that combines the selection of cost-effective GHG mitigation strategies, with major transformation of the energy system in British Columbia. This includes long term planning for major expansion of electricity supply with low- and non-GHG-emitting electricity generation. This process should serve as the fundamental basis for selecting and developing electricity generating supply facilities in the Province.

Respectfully submitted

Oskar Sigvaldason (1), Jim Burpee (2), and Ken Ogilvie (3)

1. Oskar Sigvaldason worked with Acres International; Consulting Engineers, for 38 years, including nine years as President. His career has included managing preparation of national investment and strategic development plans for the energy sector in various countries, with funding provided from multilateral and bilateral funding agencies. He served as Project Manager for the TEFP.
2. Jim Burpee has worked in the electricity sector for 40 years, including working as a senior executive for Ontario Hydro and Ontario Power Generation, CEO of Bridge Renewable Energy Technologies, and President and CEO of the Canadian Electricity Association (CEA). On behalf of CEA, he carried out in-depth reviews of the TEFP Working Paper "Electricity Supply and Delivery". He continues to consult, write and speak on issues relating to electricity and climate change.
3. Ken Ogilvie has worked in a variety of roles in the environmental field, including holding positions with three governments in Canada (Federal, Manitoba and Ontario) and serving as

Executive Director of Pollution Probe, one of Canada's longest-standing environmental groups. He was a Member of the TEFP Expert Review Panel, and subsequently, co-authored the Executive and Project Summary Reports. He remains active as a policy consultant on energy and climate change.