Oral Presentation to British Columbia Utilities Commission
by Chris Aikman
Nanaimo, October 10, 2017

Explanatory Note:
BCUC held a series of Community Input Sessions between September 23 and October 11 to gather public feedback for the Site C Inquiry. The Nanaimo session was held on October 10. Presenters had 5 minutes each to address the commission, and spoke in the order they had registered for the event. The first four presenters spoke in favour of the project, then all but two of the remaining ~29 presenters spoke against it.

What follows is an outline of what I presented, but it is not an oral transcript. Because of the 5 minute limit, some aspects included below were skipped or greatly compressed.

1. Introduction

I would like to thank the Commission for this opportunity to speak on the important issue of the Site C project. I believe the last time I was in this room was in 2005 when the BCUC sought public input on the proposal to build a major gas-fired electrical generation plant at Duke Point. Fortunately, that generating station was never built.

I have made a written submission on the Site C project, number F56-1 in your posted list of Submissions & Comments. The full text can also be found on my website DreamGreen.ca, along with some related supporting documents.

I was an astrophysicist/astrochemist with National Research Council of Canada for three decades. My views on energy choices were influenced by that experience in a number of ways, some of which are reflected here and on the DreamGreen.ca website.

2. Electrical Demand

The demand for the electrical power Site C would provide has been a contentious issue, with many speakers dismissing the need for such additional electricity.

In the Commission's preliminary report, it is stunning that no mention is made of the Paris Agreement. The terms given in the Order-in-Council of August 2, 2017, Section 3(c)(ii) specifically require that the Commission look for "other factors that could reasonably be expected to influence demand". Any forecast for electrical demand that does not consider our climate obligations should not really be considered.

The Preliminary Report does mention 'climate change' in a number places, but usually in a perverse way, suggesting it as a 'disruptor' or 'risk' in forecasting hydro capacity. A more rational view is the opposite one, namely that hydro generation in support of intermittent electricity from sun and wind offers our best chance to decarbonize our energy and reduce CO2 emissions.

Climate change has totally dominated the news this summer. In British Columbia, a record 1.2 million hectares of wildfires burned for week after week. Similar drought sparked wildfires throughout the American west, while the eastern and southeastern parts of North America experienced unimagined floods and hurricanes. As Al Gore has said: "We are entering a period of consequences".

The Preliminary Report did hint "Deloitte considers that electric vehicle uptake in BC could be greater than BC Hydro has estimated in its load forecast." In the two months since the Commission began this hearing, the prospects for electric vehicles has totally changed. Consider these announcements in recent weeks:

- China, which currently accounts for about 40% of the global electric vehicle (EV) market, is on the path to eliminating carbon-fuelled vehicles. This will make electric vehicles more price-competitive everywhere.
- Sales of carbon-fuelled vehicles will be banned in Netherlands by 2025, in Norway before 2030, in India by 2030 (partial ban), in UK and France by 2040. Paris plans to ban all but electric vehicles from the city by 2030.

- This week Ford and General Motors both revealed plans to make electric vehicles the major part of their production.
- BMW expects to sell 100,000 electric vehicles in Europe this year.

By all accounts, the transition to electric vehicles will be substantially fulfilled around the time Site C should reach completion. Is British Columbia ready for the coming electric vehicle revolution?

All forms of land transportation including buses and rail can be electrified. Rail systems in Europe, and even the Trans-Siberian railway, have been electrified for decades, with considerable cost efficiency. Electric locomotion is twice as energy-efficient as diesel-electric locomotion.

In 2016, about 7 billion litres of gasoline and diesel fuel were retailed in British Columbia.This represents an energy content of 70,000 Gwh (gigawatt-hours). For comparison, BC Hydro sold 57,652 Gwh of energy in the year ending March 31, 2017.This means electrical production must double if we are to meet the demands of electric vehicles. That figure is mitigated by the greater efficiency of electric motors. Of course, Site C cannot and need not supply that much energy. But the Peace triple-reservoir will be essential to maintain load balance.

Land transportation is not the only market where demand for electricity will grow. In British Columbia's climate, all buildings can be heated by electrically pumped heat from a 0 celsius (or warmer) source, such as liquid water. Adoption of heat pumps for all buildings will substantially increase electrical demand.

Electrification of land transportation and building heat, taken together, would reduce our carbon emissions to one-third their current levels. This can be achieved within a decade or two, if our electrical supply is tripled from current production.

All the claims that demand for Site C power won't materialize must be recognized as inherently ludicrous. The notion that BC Hydro will face certain economic loss in selling this power should likewise be dismissed.

How did we ever manage to get so misled? One clue might be that BC's Climate Leadership Plan was largely written by the fossil fuel industry. **None of the recommendations** put forward by the Government's own team were fully adopted.

3. Electrical Supply

If British Columbia installed the same area density of photovoltaic generation that Germany already has, achieved at this early stage, *we would have 100,000 GWh of energy annually from this source alone*. There is no doubt that solarPV will become a dominant electrical supply.

Critics of Site C point out that SolarPV and wind generation have now become the cheapest source of new electrical energy. That is true as far as it goes, but we all know these sources are intermittent, and typically produce only a fraction of their nominal capacity much of the time. Solar panels produce no power half the time (at night), even though they perform wonderfully when the sun is high in a clear sky.

There's enough wind and solar power available to meet the energy needs of modern civilisation many times over, but not necessarily at the times when it's needed. In order to match demand robustly in real time, we will require storage capacity comparable to the power levels we build for interruptable power. In other words, you can't run a modern society on solar and wind energy alone, without a huge amount of backup storage.

How can we store energy on a societal scale, in a dispatchable form? Apart from hydrocarbons, stored hydro is the only efficient and practical way, for rather simple reasons

As we all learned and know, energy exists in many forms, is transformed between them, is never destroyed, but often becomes unavailable to us. Practically speaking, energy becomes available in three forms: chemical, nuclear, and gravitational:

- chemical energy is the energy of life forms, and fossil life forms. Overwhelming, these chemical sources of energy involve carbon, the most versatile and strongest bonding element because of its unique electron shell structure. Nothing compares with hydrocarbons in terms of specific energy density. That's

why the human body (and all animals) is 93% composed of only three elements: oxygen,hydrogen and carbon.

- Nuclear energy powers the interior heating of the Earth through element fission, and the power of the Sun by nuclear fusion of hydrogen to helium. The Earth's interior heat is challenging to access, but the Sun's radiated energy constantly floods one side of the planet ~10,000 faster than all human activity could consume it. Every ten days, sunlight gives the Earth more solar energy than is contained in all the fossil energy reserves known to exist on the planet. In other words, we have more solar energy than we could ever use, but the trick is to store it for use during nighttime.
- Gravity is the largest reserve of energy in the universe, forming stars and galaxies. At the end of its life, a star releases more energy undergoing gravitational collapse that it produce in millions and billions of years by nuclear fusion. On Earth, energy is stored as water at elevation: it's gravitational energy can be harvested as hydro.

We need to clarify a misunderstood point: many people expect that by storing the sun's energy in batteries we will be able to power our cities through the times of dark and calm, but that's almost impossible. Consider this: it takes 50 to 100 kg of lithium batteries to contain the same chemical energy as 1 kg of gasoline. And there's not that much lithium on the planet: lithium was created in the Big Bang, but mostly destroyed at stellar temperatures. There's probably enough recoverable lithium on Earth to power a billion electric vehicles. There's not enough to power all the cities of the world through darkness.

So the reality is this: to be powered dominantly by the sun and wind, we will absolutely need stored hydro to buffer their intermittency of supply. Other non-carbon sources of energy (such as tides, waves, geothermal) will be consigned to playing minor roles, for a host of practical reasons.

In the face of all the current controversy over where to source our energy, perhaps we should reflect on famous '*serenity prayer'*. It is also known as the 'alcoholic's prayer', which is fitting because we are addicted to fossil fuels, even though we know they are hurting us and everything we love:

> *"G*rant me the **serenity** to accept the things I cannot change;
>
> courage to change the things I can;
>
> and wisdom to know the difference.*"*

We cannot change the laws of physics and chemistry, but we can change how we use them to supply energy. The wise choice is to select what we know works.

4. Conclusion

The Commission is tasked to recommend one of three choices for the Site C project: cancellation, suspension or completion.

- Suspension or delay achieves nothing except to increase the total cost of the project. The Keyaask project by Manitoba Hydro stands as an example of cost escalation when each successive government reverses the position of the previous government. This option should be be considered.
- Cancellation would indicate that we have abandoned any hope of solving the climate crisis. Canada has yet to meet a single climate target it has set for itself in the last 25 years. Quite simply, neither governments nor individuals will trust an electrical supply that does not have a reserve of dispatchable power, so investment in solar and wind generation will be minimal, and the economy will fizzle.

- Completing Site C as close to schedule and budget as may be possible will be a strong step towards a sustainable future. Householders in BC will feel secure investing in their own solar generation systems without fear of being left powerless. The economic benefits will be immense.

It doesn't get any better than this: A huge watershed straddling the Rockies with three successive reservoirs holding successively 2 years of river flow, then 2 days worth, then 22 days of supply. That's Site A, B and C respectively. Together, their electrical generation can be orchestrated to need demand on timescales of minutes to months.

Climate change is basically an energy problem. But it's also an environmental, ecosystem, economic, poverty, hunger and health problem. It's also a social justice, empowerment, community resource and innovation problem.

However it is only by addressing it as an energy problem that can we stabilize climate. Let us not forfeit our future, but instead complete Site C and secure the path to a better future.