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15 April 2022

Environment and Climate Change Canada

By email to: ECD-DEC@ec.gc.ca

Re: A Clean Electricity Standard in support of a net-zero electricity sector – Discussion Paper

Dear Sirs:

The Ontario Rivers Alliance (ORA) is a not-for-profit grassroots organization with a mission to protect, conserve and restore riverine ecosystems in Ontario. ORA advocates for effective policy and legislation to ensure that development affecting Ontario rivers is environmentally and socially sustainable.

The government of Canada is seeking input regarding the federal regulatory actions that should be taken to support net-zero generation by 2035. The ORA's comments are mainly focused on the inclusion of hydroelectric as it is referred to in the Clean Electricity Standard Discussion Paper (CES); however, our answers to the Key questions appear at the end of the submission.

When people refer to hydroelectric as clean, it's usually in the context of GHG emissions; however, governments and utilities often use the term categorically and without caveat or qualification. Using the word "clean" in this context is misleading. Just because hydroelectric facilities are not spewing out smoke does not mean they are clean or renewable. In fact, waterpower has resulted in significant and ongoing impacts on water quality, water quantity, ecological processes, fish and wildlife populations and habitat, and to aboriginal communities. Hydroelectric also makes a significant daily contribution to the earth's accumulation of greenhouse gases (GHG) in our atmosphere.

A very high environmental and socio-economic price has been paid in the past in terms of losses to other valued natural resources due to the installation of dams and waterpower facilities. However, the socio-economic costs of these losses are generally ignored[1],[2] and rarely reported to the public.

**Non-emitting Generation:**

Environment and Climate Change Canada (ECCC) purports to be taking further action to reduce GHG emissions from electricity generation to achieve a net-zero electricity supply by 2035. This can only be achieved if integrity and accountability are embedded into all aspects of the CES.

Instead, ECCC has presented an ineffective and misleading CES that has only created a façade of doing something. The transition to a net-zero electricity supply by 2035 will be transformational only if we in fact reach net-zero by 2035.

[1] *Wang, G., Fang, Q., Zhang, L., Chen, W., Chen, Z., Hong, H. 2010. Valuing the effects of hydropower development on watershed ecosystem services: Case studies in the Jiulong River Watershed, Fujian Province, China, Estuarine Coastal and Shelf Science. 86.3*
[2] *Institute for Fisheries Resources.1996. Cost of Doing Nothing: The economic burden of salmon declines in the Columbia River basin. Report No. 1 of 3. Online: https://pcffa.org/wp-content/uploads/2016/10/CDNReport-Columbia.pdf*

The CES makes it appear to be a way to reach net-zero, but this sleight of hand won't fool our failing planet. It isn't enough to only appear to take adequate actions to reduce GHG emissions; it is imperative that legislation, policy, and the CES guidelines properly recognize all sources of GHG emissions and lay the groundwork for a meaningful, measurable, and accountable process. If you don't accurately count or measure the sources of GHG emissions, this government will only send us deeper into climate peril.

For instance, in the Glossary, the following definition is not based on science and is egregiously wrong:

> "*Non-Emitting Generation means electricity produced in a manner that does not directly release any greenhouse gases (GHGs) as a result of fuel combustion. Non-emitting generation sources include hydro, wind, photovoltaic solar, concentrated solar-thermal, geothermal, and nuclear, among others. While non-emitting sources can produce lifecycle GHG emissions from activities other than fuel combustion (for example, hydro reservoirs can release methane over time), attributing these emissions to electricity still results in a relatively low lifecycle emissions intensity."*

This definition designates hydro as "*Non-Emitting*" yet admits that "*hydro reservoirs can release methane over time*". This is an oxymoron – double-speak, and it is not congruent with the facts.

The definition also states that "*attributing these emissions to electricity still results in a relatively low lifecycle emissions intensity"* but it is an admission to emissions and provides no independent study or reference to back up its "low lifecycle emissions intensity" statement,

Table 3 of the CES also wrongly indicates that hydro reservoirs and run-of-river hydro have 0.0 direct emissions of $CO_2$/GWh, and methane ($CH_4$) is not even mentioned in this chart.

"Low-Emitting Generation" would also fall short of adequately describing the GHG emissions released from hydroelectric reservoirs. It would be interesting to know why there aren't Medium and High-Emitting Generation categories so the electricity industry can work towards a cleaner label or a gold star?

The CES totally dismisses the methane coming from hydro reservoirs and gives it a high pass as a "non-emitter" when it couldn't be further from the truth. There are hundreds of independent peer-reviewed studies refuting these "*non-emitting*" and "*low lifecycle emissions*" claims in describing hydro generation, including a 2004 Environment Canada report that states (underlining is for emphasis only):

> *In contrast to the widespread assumption (e.g., in Intergovernmental Panel on Climate Change scenarios) that GHGs emitted from reservoirs are negligible, measurements made in boreal and tropical regions indicate they can be substantial*.[3]

It's no wonder Canada doesn't want to admit that they should place a moratorium on these high emitters and should be measuring the GHG emissions coming from hydro reservoirs. Canada relies heavily on hydroelectric power generation at 59.5% of its energy mix and is the second-largest producer in the world. The provinces are also well invested in hydropower, with Ontario at

[3] *Environment Canada. 2004. Threats to Water Availability in Canada. National Water Research Institute, Burlington, Ontario. NWRI Scientific Assessment Report Series No. 3 and ACSD Science Assessment Series No. 1. 32-150 p.*

23%, BC at 91%, Manitoba at 97%, Saskatchewan at 20%, New Brunswick at 21%, and Quebec at 95% of the electricity mix.

The CES must be grounded in truth and integrity. For example, if an electricity generation facility emits GHGs, it must be labeled and measured as an emitter. A non-emitter should mean that it does not generate any emissions due to the facility and its operation.

**Hydroelectric and GHG Emissions:**

A 2016 Washington State University study examined 100 recent studies from 267 reservoirs worldwide and calls into question the wisdom of building more hydroelectric dams. The study found that decaying vegetation and nutrient run-off into the water means that the dams emit about a billion tonnes of greenhouse gases every year. This is not "*low life-cycle emissions intensity*". This represents 1.3% of total annual anthropogenic (human-caused) global emissions. When considered over a 100-year timescale, dams produce more methane than rice plantations and biomass burning. Emily Stanley, a professor in limnology and marine science at the University of Wisconsin-Madison, said that the study is "very relevant" because it delivers the best available information about greenhouse gas emissions from dams. It shows that high methane emissions are not linked to the location or antiquity of the reservoirs but to the quantity of organic material.[4],[5]

Methane is generated in reservoirs from bacteria living in oxygen-starved environments. *"These microbes eat organic carbon from plants for energy, just like people and other animals, but instead of breathing out carbon dioxide, they breathe out methane."*[6]

River networks with high nutrient and sediment loading from agricultural or wastewater effluent provide microbial communities with a more significant source of nutrients that can deplete sediment oxygen and fuel methane production. Algal blooms and upstream wastewater treatment facilities can result in excessive nutrient loading and further enrich reservoir sediments to fuel methane.[7] So methane production can vary significantly from location to location and is very site-specific.

Methane [$CH_4$] is a potent greenhouse gas with a heat-trapping capacity 28 to 34 times greater than carbon dioxide [$CO_2$] over a 100-year time scale and measured over a 20-year time period, that ratio grows to 84 to 86 times.[8]

Methane only stays in the atmosphere for 9 to 12 years; however, carbon dioxide remains in the atmosphere for 1,000s of years.

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[4] *Deemer, Bridget R.; Harrison, John A.; Li, Siyue; Beaulier, Jake J.; DelSontro, Tonya; Barros, Nathan; Bezerra-Neto, Jose F.; Powers, Stephen M.; dos Santos, Marco A.; Vonk, J. Arie. Greenhouse Gas Emissions from Reservoir Water Surfaces: A New global Synthesis.*

[5] *Hydroelectric dams emit a billion tonnes of greenhouse gases a year, study finds, 14 November 2016, by The Guardian.*

[6] *Beaulieu, J.J.; Smolenski, R. L.; Nietch, C.T.; Townsend-Small, A.; and Elovitz, M.S. 2014. High Methane Emissions from a Midlatitude Reservoir Draining an Agricultural Watershed. United States Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, Ohio 45268, United States*

[7] *West, W.E.; Coloso, J.J.; Jones, S.E. Effects of algal and terrestrial carbon on methane production rates and methanogen community structure in a temperate lake sediment. Freshw. Biol. 2012, 57 (5), 949−955.*
*Online: https://www3.nd.edu/~sjones20/ewExternalFiles/Westetal2012_FWB.pdf*

[8] *Myhre, G., Shindell, D, Breon, F.-M., Collins, W., Fuglestvedt, J., Huang, J., Koch, D., Lamarque, J.F., Lee, D., Mendoza, B., Nakajima, T., Robock, A., Stephens, G., Takemura, T., Zhang, H., Anthropogenic and natural radiative forcing. In Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 8, Table 8.7; Stocker, T. F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Bex, V., Midgely, P. M., Eds.; Cambridge University Press: Cambridge, U.K. and New York, U.S.A., 2013.*

Coincidentally, the IPPC reports that we have approximately 9 years to dramatically reduce our emissions if we are to avoid the worst effects of climate change, so it is extremely evident that methane emissions are the low-hanging fruit. For instance,

- Cutting methane is the most powerful opportunity we will have to reduce GHG emissions and slow the rate of global warming in the shortest amount of time.
- Cutting methane would have strong and immediate climate benefits, as it is the only greenhouse gas for which emission reductions could quickly cool the planet.

So, why would we want to build more hydroelectric reservoirs that will continually spew out megatons of methane into the atmosphere for the 100-year life cycle of the plant? There already have plenty that is continually adding to the GHG problem all across Canada.

Indeed, dams and their associated waterpower facilities harm the environment. Flooding landscapes to create reservoirs causes flooded vegetation and soils to decompose and sediment to accumulate behind the dam, producing carbon dioxide and methane for a century or more.[9],[10].[11],[12]

The hydroelectric industry frequently claims its facilities will generate power for 100 years or more. For instance, a Swiss study of a temperate hydropower reservoir indicates that "*the total methane emissions coming from Lake Wohlen, was on average > 150 mg $CH_4$ $m^{-2}$ $d^{-1}$, which is the highest ever documented for a midlatitude reservoir. The substantial temperature-dependent methane emissions discovered in this 90-year-old reservoir indicate that temperate water bodies in older headponds can be an important but overlooked methane source"*.[13]

If the ECCC does not recognize the substantial amount of GHG emissions generated by hydroelectric reservoirs in the CES, it will be ignoring a multitude of independent studies concluding that GHG emissions from hydroelectric reservoirs are significant. In addition, this government will be going in the total opposite direction with the reduction of GHG emissions, and its CES objectives will fail. The government has no time to waste to get it right. It must introduce effective and meaningful CES guidelines if it is to save our Country, our world, and our civilization from destruction.

Hydroelectric must be labeled and measured as an emitter. The greater the volume of emissions emanating from the headpond and immediately downstream, the greater the category of emissions. Hydroelectric facilities cannot be pegged on masse because each facility is very site-specific. GHG emissions must be considered under each facility's unique development conditions and location. Therefore, there should be no desk-top formula allowed to estimate or average out GHG emissions. Instead, GHG emissions must be measured daily because they are also impacted by water quality, quantity, temperature, debris from stormwater run-off, and sediment build-up behind the dam.

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[9] *Venkiteswaran, J.J., Schiff, S.L., St. Louis,V.L., Matthews, C.J.D., Boudreau, N.M., Joyce, E.M., Beaty, K.G., and Bodaly, R.A.(2013), Processes affecting greenhouse gas production in experimental boreal reservoirs, Global Biogeochem. Cycles, 27, Online: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/gbc.20046*

[10] *Maeck, A., DelSontro, T., McGinnis, D.F, Fischer, H., Flury, S., Schmidt, M., Fietzek, P. and Lorke, A., 2013. Sediment Trapping by Dams Creates Methane Emission Hot Spots, Environmental Science and Technology, 8130-8137, Online: http://www.dx.doi.org/10.1021/es4003907*

[11] *Venkiteswaran, J.J., Schiff, S.L., St. Louis,V.L., Matthews, C.J.D., Boudreau, N.M., Joyce, E.M., Beaty, K.G., and Bodaly, R.A.(2013), Processes affecting greenhouse gas production in experimental boreal reservoirs, Global Biogeochem. Cycles, 27, doi:10.1002/gbc.20046*

[12] *Maeck, A., DelSontro, T., McGinnis, D.F, Fischer, H., Flury, S., Schmidt, M., Fietzek, P. and Lorke, A., 2013. Sediment Trapping by Dams Creates Methane Emission Hot Spots, Environmental Science and Technology, 8130-8137, Online: http://www.dx.doi.org/10.1021/es4003907*

[13] *DelSontro, Tonya, McGinnis, Daniel F., Sobek, Sebastian, Ostrovsky, Ilia, Wehrli, Bernhard, 2010, Extreme Methane Emissions from a Swiss Hydropower Reservoir: Contribution from Bubbling Sediments. Online: https://pubs.acs.org/doi/full/10.1021/es9031369*

**The Trouble with Small Hydropower:**

Small hydro is often thought to be clean and carry fewer impacts. This is understood in most circles to mean that it does no harm to the environment and does not emit GHGs. However, "*With the "clean" reputation of large hydroelectric dams already in question, scientists are reporting that millions of smaller dams on rivers around the world make an important contribution to the greenhouse gases linked to global climate change*. *Their study, showing that more methane than previously believed bubbles out of the water behind small dams.*" They describe the methane released from water impounded behind six small dams on a European River. "*Our results suggest that sedimentation-driven methane emissions from dammed river hot spots can potentially increase global freshwater emissions by up to 7 percent".* [14]

With smaller dams, storage becomes increasingly important. Reservoirs silting up or becoming overloaded with nutrients are common problems with major reservoirs. They are at least as serious where shallower bodies of water are created – the shallower a water body, the more easily eutrophic it can become. Likewise, methane generation occurs largely where water and sediment meet. This means that a shallower water body is likely to release more methane per unit area than a deeper water body. Shallow reservoirs are not unlike paddy fields and biomass generation, which are known to contribute substantially to methane emissions.[15]

It is also important to consider that creating a hydroelectric reservoir on a previously untamed riverine ecosystem can transform a healthy ecosystem from a GHG sink to a relatively large source of emissions into the atmosphere.[16]

New reservoir flooding also accelerates the bioaccumulation of methylmercury in fish tissue, and these effects can persist for 20 to 30 years or more.[17],[18] This can remove fish as a primary source of food from Indigenous and other stakeholder communities.

The hydropower industry has been lobbying hard for a new renaissance in hydroelectric because capacity additions of hydropower have been declining since 2013, due not only to the falling costs of competing technologies but also to a broader set of challenges, including high-profile cancellations, growing hydrological risks, cost and schedule over-runs, technical challenges, and increasing social resistance.

**Run of River Hydropower:**

The only lower-impact type of hydroelectric power generation is run-of-river, but it has no storage capacity. In fact, building a true run-of-river facility is often not cost-effective on smaller rivers because of the high cost of construction and the small amount of power that would be produced as a result of low and unreliable flows – as low as 15 to 30% of Installed Capacity[19].

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[14] *Phys.org. Sediment trapped behind dams makes them 'hot spots' for greenhouse gas emissions. July 31, 2013. Online: http://phys.org/news/2013-07-sediment-hot-greenhouse-gas-emissions.html*
[15] *Abbasi, T. and Abbasi, S.A. 2011b. Small hydro could add up to big damage. SciDev.Net 20/06/11. Online: http://www.scidev.net/global/water/opinion/small-hydro-could-add-up-to-big-damage-1.html*
[16] *St. Louis, V.L., Kelly, C.A., Duchemin, E., Rudd, J.W.M., Rosenberg, D.M. 2000. Reservoir Surfaces as sources of greenhouse gases to the atmosphere: a global estimate. BioScience 50(9): 766-775. Online: https://academic.oup.com/bioscience/article/50/9/766/269391*
[17] *Rosenberg, D.M., et al. 1997. Large-scale impacts of hydroelectric development. Environmental Reviews. 5: 27-54.*
[18] *World Commission on Dams. 2000. In Dams and development: A new framework for decision-making; Earthscan Publications: London.*
[19] *North of Dryden Integrated Regional Resource Plan – January 27, 2015, by OPA/IESO. P-56 & 124. Online: http://www.noma.on.ca/upload/documents/north-of-dryden-report-2015-01-27.pdf*

The daily, seasonal and annual variations of small hydro operations are intermittent and unreliable. This is because generation peaks during the high flows of spring when power is in low demand and produces at its lowest during the hot summer months when consumption and demand are highest. During the low flow season of summer or during drought conditions, many true run-of-river and even some peaking (storage) facilities, especially on smaller rivers, cannot operate efficiently and must be shut down.

To further highlight this point, in 2014 an analysis was conducted by the Independent Electricity Systems Operator (IESO) to determine the best means of connection to remote First Nation communities and to enable forecasted growth of the Ring of Fire. The analysis concluded that "*Northern hydroelectric generation is an energy limited resource known to have significantly reduced output and availability during drought conditions of the river system supplying these generating units.*[20] In fact, the recommendation of this report was to not build any new hydroelectric facilities, but primarily build new transmission lines. A cost/benefit analysis should be required to determine whether these types of projects are environmentally and/or economically viable.

Run-of-river dams can still accumulate sediment and litter behind the dam and generate GHG emissions.

There are numerous old mill dams in Ontario that have been in place for 100 years or more, and the upstream headpond inevitably turns into a wetland because of sediment build-up behind the dam. If the government is serious about getting to net-zero by 2035, then it would do well to incentivize dam owners and environmental groups to remove these old and unsafe dams. It would have a massive impact on GHG emission reductions.

**Wrong Climate for Damming Rivers:**

Climate change is altering hydrological cycles, meaning that historical data may no longer be a reliable predictor of future hydrological patterns.

"*Climate warming will adversely affect water quality and water quantity, as well as the magnitude and timing of river flows, lake levels and water renewal times."* [21] Drought conditions could make many waterpower projects uneconomical, while more extreme rainfall will heighten the risk of dam failures and rapid release of high volumes of water. "*Climate will interact with overexploitation, dams and diversions, habitat destruction, non-native species, and pollution to destroy native freshwater fisheries.*"[22]

Sustainable management of natural resources such as forests, soils, water, and fisheries are at the heart of conservation, and these resources are the building blocks for green cities, energy production, agriculture, and water supply and sanitation systems. Relatively stable ecosystems and species dynamics are indicative of sustainable resource use, and conservation science has been broadening this knowledge to buffer ecosystems and species from negative climate change

[20] *North of Dryden Integrated Regional Resource Plan – January 27, 2015, by OPA/IESO. P-56 & 124. Online: http://www.noma.on.ca/upload/documents/north-of-dryden-report-2015-01-27.pdf*
[21] *Schindler, D.W., 2001. The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium. Canadian Journal of Fisheries and Aquatic Sciences. 58: 18-29.*
[22] *Schindler, D.W., 2001. The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium. Canadian Journal of Fisheries and Aquatic Sciences. 58: 18-29.*

impacts.[23],[24] The loss of wetlands and climate change impacts should be part of a full cost accounting of the impact a proposed waterpower facility will have on climate change and GHG emissions.

Healthy and resilient rivers and wetlands are the key to successful adaptation to the extremes of climate change.

**Closed-loop off-river Pumped Storage:**

If this government intends to achieve net-zero by 2035, it is imperative that energy projects are truly "non-emitting," but as referenced above, in-river hydroelectric generation is responsible for substantial amounts of carbon dioxide and methane being released into the atmosphere.

Instead, limit hydro generation to clean closed-loop pumped storage. *"Creating 'closed-loop' or 'off-river' PHES [Pumped Hydro Energy Storage] systems that uses pairs of … reservoirs instead of rivers would bypass the need for new dams, with little additional land demand except for transmission lines. A pair of 250-acre, 20m-deep reservoirs with an altitude difference of 600m can store 24GWh of energy, meaning the system could supply 1GW of power for 24 hours, enough for a city of a million people. In addition, evaporation suppressors – small objects floating on the water to trap humid air – can help reduce water evaporation. On average, the water required for an off-river PHES system equates to about three litres per person per day, equivalent to 20 seconds of a morning shower or one-tenth of the water evaporated per person per day in the cooling systems of US fossil fuel power stations."*[25]

Net-zero emissions will require a massive scale-up and investment in solar, wind, off-river closed-loop pumped hydro, nuclear, and geothermal, as well as investment and innovation into green hydrogen and other potential energy resources. Secure, reliable, affordable, and clean energy supplies are fundamental to economic and social stability and development.

**ORA strongly recommends the following:**

1. A moratorium is placed on all new in-river hydroelectric facilities.
2. All existing hydroelectric facilities must be required to effectively account for the GHG emissions being released into the atmosphere from each operation.
3. Accurate, effective, and useful CES categories (high, medium, low and non-emitting) based on volumes of GHG emissions from each facility.
4. Incentivise off-river closed-loop pumped storage hydropower generation to achieve net-zero by 2035.
5. Hydroelectric power generation units are required to purchase carbon offset credits.
6. Hydroelectric not be allowed to sell carbon offset credits.
7. Incentivise the removal of unnecessary and unsafe dams throughout the Country.
8. Make healthy and resilient lakes, rivers, wetlands, and forests a priority.

[23] *Millennium Ecosystem Assessment. 2005. Ecosystem and Human Well-Being: Wetland and Water Synthesis. World Resources Institute, Washington, D.C. Sec1: ii*
[24] *Parmesan C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology and Evolution 37: 637-669.*
[25] *Pumped hydro resurfaces as a net-zero stalwart, Energy Monitor.*

**ORA Comments on Key Questions:**

1. The CES regulation framework should ensure effective built-in accountability for both the ECCC and the subject electricity emitters. The more guidance and progress monitoring, the better chance we have to reach our 2035 goals of no GHG emissions by 2035.

2. To minimize or avoid stranded capital assets, place a moratorium on new hydroelectric facilities, as we cannot actually reach zero emissions with carbon and methane spewing out its reservoirs.

   An effective strategy in reducing GHG emissions is to channel government dollars and energies into removing unnecessary and unsafe dams to reduce the amount of methane and carbon dioxide bubbling up from these shallow warming headponds.

3. End-point emissions intensity standards must ensure effectiveness and accountability in significantly reducing GHG intensity.

4. No. comment.

5. The CES should offer no compliance flexibilities as we have a long way to go over the next decade if we are to avoid an unstoppable climate catastrophe. We must not comprise the end goal of net-zero or our future.

6. For an effective carbon offset program, federal and provincial/territorial governments must incentivize tree planting and the protection of forests. Forest-carbon offset projects would have a legitimate and lasting impact on the climate.

   Offset credits must not be issued by the hydroelectric industry as it is a significant emitter. Instead, the hydropower industry must be required to purchase GHG offset credits for their contribution to climate change. However, offsets only work in the real world if there is integrity in the offset program. Governments must ensure the delivery of emission reductions promised. Carbon offset programs have a long history of overpromising and under-delivering. Consequently, monitoring and compliance must be an essential component of the program.

   If hydropower generation is allowed to continue to spew out carbon dioxide and methane into the atmosphere while selling offset credits – the entire Clean Energy Standard is a total sham, and our children and grandchildren are doomed.

7. So far, the technology has not lived up to its promises. This year, two carbon capture facilities in Canada were found to be underperforming, with one facility capturing just half of the carbon advertised, while the other facility supposed to be creating clean hydrogen was actually emitting the equivalent of 1.2 million cars. Negative emission technologies are unproven and should not be part of a Clean Energy Standard. This government has caved to the climate deniers and those provinces that are merely trying to escape meaningful GHG reduction measures.

8. We are on a very tight timeline; therefore, compliance should be assessed annually to be assured the program is working as planned.

9. Hydroelectric must be recognized for its significant and ongoing contribution to our climate predicament. There must be a moratorium on all new hydroelectric developments and efforts made by existing facilities to reduce the amount of carbon dioxide and methane being released into the atmosphere. There should be no offset credits issued by the hydroelectric industry. Electricity projects must undergo rigorous, effective, and strict monitoring and compliance rules around carbon emissions and offsets.

10. No comment.

11. Natural gas must not be part of a net-zero electricity sector because of the methane emissions leaking from a multitude of gas wells, pipelines, storage tanks, and pipelines. The processes involved in fracking, drilling, and producing natural gas are fraught with environmental impacts and GHG emissions and must be avoided.

12. Natural gas should be phased out as soon as possible and only used in emergencies. In addition, there must be much better monitoring and regulation of the natural gas industry. There should be no role for natural gas past 2030.

13. The CES should not allow electricity generated by cogeneration of fossil fuels now or in the future. If we are talking about cogeneration using biomass, this would involve cutting down the forests we rely on to sequester the carbon.

14. The CES should be applied to industrial generation units in a timely fashion – we don't have much time to reach our goals.

15. Governments must prioritize clean energy resources for remote, northern, and Indigenous communities.

16. Distributed energy technologies should be used and even incentivized, as long as they are clean, efficient, and feasible.

17. The full life cycle GHG emissions from biomass combustion or any other energy source must be counted if we are to have a legitimate and meaningful CES. Biomass combustion is not clean since it is the 4$^{th}$ highest emitter of GHGs of all fuel types. Therefore, biomass generation should be required to purchase carbon credits to account for its emissions.

18. Biomass generation must take into account its full life cycle carbon footprint and be replaced by solar, wind, geothermal, nuclear, and any new clean technologies, such as green hydrogen.

19. All power generation sources must accurately report on and comply with the CES. Healthy and abundant forests are one of the most beneficial ways of preventing and getting us out of this climate crisis we find ourselves in, so cutting healthy trees to use in biomass generation should be banned.

20. Investments into new and emerging power generation technologies and innovation must be a top priority for the federal government now and into the future. As well, we must ensure that electricity is truly clean, reliable, and affordable for all Canadians.

21. Conservation and efficiencies should be another top priority in transitioning to net-zero by 2035.

22. Place a moratorium on new hydroelectric developments, as they do nothing to reduce GHG emissions and will only add significantly to our climate crisis. It is crucial that hydroelectric be recognized for the significant and ongoing carbon and methane emissions they generate and are required to purchase carbon credits for their GHG emissions.

Hydroelectric "*threatens the ability of the water cycle in the Canadian boreal forest to maintain freshwater biodiversity and may have unpredictable effects on ecosystem functioning. Climate change coupled with human impacts on watersheds is expected to further strain global water resources, causing greater discharge and water stress within altered watersheds. Protecting large-scale intact aquatic and forest ecosystems will maintain abundant migratory and inland water fish populations and aquatic biodiversity, intact headwaters, intact hydrologic and nutrient cycles, and carbon storage and sequestration in forested and non-forested peatland ecosystems".*[26]

Thank you for this opportunity to comment!

Respectfully,

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(705) 866-1677

[26] *PEW Environment Group. 2011. A Forest of Blue: Canada's Boreal. Online: https://www.pewtrusts.org/-/media/assets/2011/03/a_forest_of_blue_canadas_boreal.pdf*