World-Class Regulatory Oversight:

Scientific knowledge and evidence-based decision-making

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IISD Experimental Lakes Area (IISD-ELA) has been granted intervenors status in the Energy East review as a result of its proximity to the proposed pipeline route.

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1.0 Setting the Context

The National Energy Board (NEB), established in 1959, is the federal regulatory body that oversees energy projects that fall within the purview of the Government of Canada. These include energy transmission projects that cross jurisdictional boundaries (including oil and gas pipelines as well as electricity transmission lines), import and export of such energy products, and associated tariffs. It is responsible for overseeing environmental assessments of projects and, through the Minister of Natural Resources, it reports to Parliament. NEB also has a role in producing energy-related information.

This research paper looks at how scientific evidence can be best incorporated into the regulatory decision-making process. By examining the evolution of NEB reform and relevant lessons from other approaches, it proposes a number of recommendations to advance evidence-based decision-making within the NEB.

Energy is essential in lifting people out of poverty and improving quality of life. Canada's energy sector has been an integral part of the economy, contributing to growth and meeting the country's energy demand. However, it is important to meet today's and tomorrow's energy needs in a sustainable manner. Fossil fuel-based energy production and consumption contributes to carbon pollution, which is rapidly changing the planet's climate.

In a world that is becoming increasingly carbon constrained and in light of our commitments under the Paris Agreement, it is critical for regulatory bodies to assess whether a project has a lock-in effect, either in its direct or cumulative impacts, in contributing to climate change. In addition to climate impacts, it is also important to take into account the effects of energy projects on human health, air quality, water, biodiversity and other key issues as highlighted in the Sustainable Development Goals. Projects overseen by the NEB can have direct environmental impacts. They can also enable upstream production and downstream consumption with their own local environmental and global climate impacts. These impacts require complex analysis of evidence.

Science-informed and evidence-based decision-making supports the principle of providing options based on assessment of facts. When regulatory decisions are supported by scientific evidence, weighed in an objective and transparent manner, public trust can be improved and decision-making can be enhanced. The result should be the disclosure of findings in a transparent and public manner, from which decision-makers can make a final determination.

2.0 Key Considerations

Concerns that have been raised about the current NEB process include:

a) Some stakeholders have expressed concerns about the relationship between the NEB and companies that it regulates. It is not unreasonable for regulators to interact with regulatees, for example, to seek information in project review and for enforcement. However, when such interaction occurs behind closed doors and when there is lack of disclosure of the interaction, public trust in the regulator could be affected.

   In reviewing scientific information, the perception of conflict of interest can impact how results of the review are perceived by external stakeholders. Irrespective of whether there is a conflict, the onus is on the reviewer of the scientific information to demonstrate that no interference has taken place to undermine the integrity of the review and its conclusions.

b) There have also been concerns that the NEB relies primarily on highly technical information provided by the companies that it regulates. This raises the question of whether information provided to decision-makers is comprehensive in nature or if there is overreliance on the regulatees' submission. There is an important role for external analysis that involves multidisciplinary collaboration. See Box 1 for an example.

Box 1. Developing Scientific Studies Specifically to Inform Policy: An IISD-Experimental Lakes Area Approach

With continued use and transportation of oil and gas there is the potential for accidents and spills of petroleum products into the environment. Environmental impacts of oil spills are a major concern for the Canadian public. There is also uncertainty on the part of regulators, spill responders and the scientific community regarding the fate, behaviour and potential effects of spilled oil, and debate over which methods are best to employ when cleaning up spills in different environments. In response to a request from the Canadian Energy Pipeline Association and the Canadian Association of Petroleum Producers, the Royal Society of Canada (RSC) recently produced an expert panel review regarding the state of knowledge of spilled oil in the aquatic environment (RSC, 2015). The RSC also identified urgent data gaps requiring scientific input in order to increase understanding of oil in the environment. In fact, how proponents will address these knowledge gaps has even become embedded in regulatory permit conditions for recently approved pipeline projects (NEB, 2103; Natural Resources Canada, 2016).

The IISD-Experimental Lakes Area has embarked on a comprehensive program of study to examine the fate, behaviour and potential impacts of spilled crude oil in the freshwater aquatic environment. Examining strategies to enhance recovery of spilled oil in affected freshwater ecosystems also comprises a major component of the program. The studies have been specifically designed to address data gaps identified by the RSC, and have been developed in simultaneous consultation with academia, industry, federal and First Nations governments, as well as public interest groups. The deliberate approach of including representation from each of these sectors has been applied to build transparency in the scientific process and validate the results across political and social boundaries. Finally, so that the results may more readily facilitate policy and regulatory changes, study designs have been reviewed early and updated with regular reviews from regulatory agencies, including the NEB.

The potential for conflict of interest can be amplified when additional responsibilities related to environmental assessment are delegated to the regulator. Prior to 2012, environmental assessments (EAs) were governed by the Canadian Environmental Assessment Act, S.C. 1992, c. 37 (CEAA, 1992). With the introduction of Bill C-38, responsibility for environmental assessment was shifted. The NEB was delegated the Responsible Authority for projects that were within its regulatory purview. Canadian Environmental Assessment Agency has extensive experience in environmental assessments, while other department and agencies hold in-house expertise on rules and regulations

for which they are responsible. As an energy regulator, NEB does not necessarily have the expertise, and while it could expand its expertise in every area of environmental law and environmental assessment, this is not the most efficient or effective approach.

There is also a concern on the principle focus of EAs being on specific, rather than broader cumulative environmental impacts of a project. CEAA notes that EAs must take into account, "any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out" (CEAA, 2012, p. 13). As Duinker and Greig (2006) have argued, "cumulative effects are the only real effects worth assessing in most [environmental impact assessments]." However, the goal of EAs is often not aligned with this objective and is principally focused on attaining project approval and not, as it should be, the protection of the environment.

c) External stakeholders have also raised concerns that they have not been able to adequately provide third-party perspective or meaningfully cross-examine information. Broad public participation is essential to a comprehensive understanding of key issues. More restrictive timelines have also hindered meaningful public participation. An EA by agency must be completed within 12 months and includes a series of 20- and 30-day public comment periods. An EA by review panel must be completed within 24 months and public comment periods range from 20 to 45 days (Office of the Auditor General of Canada, 2014). Given the complexity of issues to be addressed and the high level of interest, meaningful participation may be difficult under current timelines.

With a lack of consideration of cumulative impacts, perception of conflict of interest, and concerns on EA expertise and independence, a number of stakeholders have expressed a loss of public trust in the NEB and its ability to review and approve projects. Question have been raised about the appropriate principles and tools that can be used in ensuring the independence and objectivity of regulatory decision-making processes.

3.0 Other Regulatory Bodies

In light of concerns about the decision-making process, other domestic and international approaches can provide lessons regarding principles and tools to be considered in NEB modernization. This section includes relevant examples from Canada, California and the United Kingdom of policies and regulations incorporating science. In all examples, scientific knowledge remains a central pillar of evidence-based decision-making.

3.1 Species at Risk Act

Section 14 of Canada's Species at Risk Act (SARA) established the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which acts as an implementation body for parts of the act's provisions (Species at Risk Act, S.C. 2002). COSEWIC's functions, as outlined by Section 15 of the act, include assessing the status of species at risk and classifying them into three different categories: (i) extinct, extirpated, endangered, threatened or of special concern; (ii) insufficient information to classify; or (iii) not currently at risk. COSEWIC is required by law to conduct its functions based on different types of information and knowledge, including scientific knowledge (Subsection 15(2)). This applies to COSEWIC's drafting of status reports as well. SARA's preamble also emphasizes a precautionary principle in conserving biological diversity, stating that "cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty."

COSEWIC's most recent guidelines to assess and determine whether or not a species is at risk, adopted in 2015 (Committee on the Status of Endangered Wildlife in Canada, 2015), instruct the committee to conduct a three-step process, whereby it: (i) assesses which species should be considered for assessment; (ii) gathers the available information into a status report for the identified species; and (iii) assesses the available information and knowledge, based on which COSEWIC will determine whether or not to designate a species as now being at risk. Each step is further broken down into prerequisite actions (Committee on the Status of Endangered Wildlife in Canada, 2015).

3.1.1 Assessing Candidate Wildlife Species

For COSEWIC to assess the status of a species, it is first identified as potentially at risk by either the Species Specialist Subcommittees (SSCs) or by the Aboriginal Traditional Knowledge Subcommittee (ATK SC) (Committee on the Status of Endangered Wildlife in Canada, 2015). Subcommittees review their respective lists of species that may be at risk annually and submit their analysis to COSEWIC's attention. SSCs and COSEWIC's work can be informed by a number of sources, namely:

- The May Be At Risk list in the Monitoring the General Status of Wild Species in Canada Program
- Multi-jurisdiction monitoring
- Jurisdictional and international assessment processes (e.g. International Union for Conservation of Nature and Association for Biodiversity Information)
- Published ranking systems in the scientific literature

Once a species is identified by COSEWIC as being of interest, it is added to its Candidate List. The committee then drafts a status report on the species as an "up-to-date compilation and analysis of all relevant, available, and credible biological information concerning a wildlife species and its status in Canada" (Committee on the Status of Endangered Wildlife in Canada, 2015: 3). The status report also

delves into information about "distribution, extent of occurrence, area of occupancy, abundance (including population estimates or number of occurrences, where available), population and habitat trends, and factors or threats limiting the wildlife species" (COSEWIC, 2015, p. 3).

The status reports are commissioned by COSEWIC externally. The report will result in an interim status report after initial internal review, at which point it will be distributed to relevant Wildlife Management Boards at the provincial and territorial levels and sometimes to external reviewers (both inside and outside of government agencies). This last step of the process lasts at least six months, after which the content of a report is reviewed during a Wildlife Species Assessment Meeting.

Finally, during an Assessment Meeting, COSEWIC is required to consider the content of a report through a lens that answers the following questions sequentially, before making a decision (Committee on the Status of Endangered Wildlife in Canada, 2015):

1. Is there sufficient information presented in the report to determine wildlife species eligibility?
2. Given sufficient information, is the wildlife species eligible for assessment?
3. Is the status report adequate and acceptable for assessment purposes?
4. What status is suggested by application of approved COSEWIC quantitative assessment criteria and guidelines (i.e., rescue effect)?
5. Does the suggested status conform to the COSEWIC definition for the proposed status category?"

3.1.2 Recovery Planning

Depending on the status of a species that is determined by COSEWIC, several government agencies or departments are required to take specific actions. These are: Parks Canada, Fisheries and Oceans Canada, and Environment Canada (Commissioner of the Environment and Sustainable Development, 2013). For species that are listed as extirpated, endangered or threatened, recovery strategies should be drafted and action plans implemented. For species of special concern, management plans should be implemented. Overall, COSEWIC is first responsible to determine the status of wildlife in Canada and base its assessments on scientific knowledge, among other criteria. Once species are listed by the government as necessitating intervention, processes are in place in a number of governmental organizations to implement COSEWIC's recommendations.

However, in 2013, the Commissioner of the Environment and Sustainable Development (CESD) found that out of 360 species at risk, recovery strategies were lacking for 40.5 per cent of them. More than half of these pending strategies were more than three years behind schedule. Of the recovery strategies that were drafted, the CESD found that just over half of these were accompanied by an action plan in place, and that only 7 per cent of those plans were completed. In terms of management plans for species listed as being of concern, the CESD found that just short of 60 per cent of the plans were completed. Of the pending plans, 60 per cent were more than three years behind schedule.

Lessons Learned

- By its very nature, there can always be an element of uncertainty in scientific conclusions but this should not prevent action. COSEWIC is authorized to scale the likelihood of a threat to a species or the risk of it eventually arising.

- SARA's precautionary approach is strong in the absence of certainty over the extent of risks posed by a project. The lack of certainty on social, environmental and economical risks should not prevent a regulator from considering the scientific evidence at hand in its decision-making process.
- Governments must be legislated to give due consideration to scientific evidence provided and implement mitigative measures in a timely manner.

3.2 Canadian Environmental Protection Act

3.2.1 Toxic Substances

The Government of Canada adopted the Canadian Environmental Protection Act (CEPA) in 1999 (Canadian Environmental Protection Act, S.C. 1999). Section 64 of the Act defines the class of toxic substances that are required to be regulated in Canada. Subsection 6(1) also requires that a National Advisory Committee composed of federal, provincial and territorial officials be appointed to provide guidance on the management of toxic substances (Government of Canada, 2013), whereas Subsection 44(1) mandates the government to conduct research on toxic substances that are naturally present in the environment. Finally, as per Section 68 of CEPA, the government is required to "collect or generate data and conduct investigations respecting any matter in relation to a substance, including, without limiting the generality of the foregoing." That led the government to create, in 2006, the Chemicals Management Plan (CMP) under the helm of Environment and Climate Change Canada, and Health Canada (Government of Canada, 2014).

At the time of creating the CMP, the government conducted a review of approximately 23,000 substances that had been used commercially over the past 20 years or so in Canada, and identified 4,300 critical substances that warranted further analysis and assessment (Government of Canada, 2014). Of these, just under 3,000 have been assessed and the rest are part of the current iteration of the CMP, launched in 2016, with the intention of addressing the remainder of the initially identified substances by 2020 (Government of Canada, 2016a). Decisions to prohibit toxic substances are based on the scientific evaluation of two main types of risks: (i) the hazardous properties of a substance and (ii) the potential of exposure both for the population and the environment (Government of Canada, 2016b).

The existing measures underwent an assessment process that involved a review of the relevant scientific literature, of databases either published or not, of stakeholders submissions, and of similar assessments done in the past both by national and international agencies, and by government researchers. It is also based on the various available sources of monitoring (Government of Canada, 2016b). Once an assessment is completed, a report is drafted by Environment and Climate Change Canada and/or Health Canada and is open to external review during a 60-day period. Along with releasing a first CMP in 2006, the government identified 200 substances that it considered being of highest priority for action (Government of Canada, 2011a).

As part of this process, the Prohibition of Certain Toxic Substances Regulations, 2012 was adopted to prohibit new substances, including the benzenamine, *N*-phenyl-, Reaction Products with Styrene and 2,4,4-Trimethylpentene (BNST). A full screening assessment of the substance was conducted in 2009 by Environment Canada and Health Canada (Government of Canada, 2010), which found that, based on the scientific information assessed, BNST was present in the environment in concentrations or conditions that could harm the environment or biological diversity. Provided that paragraph 76.1 of CEPA requires that evidence be considered alongside the precautionary principle, BNST was prohibited in Canada as part of the 2012 regulations.

Similarly and more recently, the Regulations Amending the Prohibition of Certain Toxic Substances Regulations, 2012 were adopted in 2016 to prohibit five new substances as of January 1, 2017, namely hexabromocyclododecane (HBCD) (Government of Canada, 2011b), perfluorooctanoic acid (PFOA) (Government of Canada, 2012a), long-chain (C_9-C_{20}) perfluorocarboxylic acids (LC-PFCAs) (Government of Canada, 2012b), perfluorooctane sulfonate (PFOS) (Government of Canada, 2006a; Government of Canada, 2006b) and polybrominated diphenyl ethers (PBDEs) (Government of Canada, 2006c; Government of Canada, 2004), all of which underwent extensive review and assessment processes by both Environment Canada and Health Canada. Since 2013, Environment and Climate Change Canada and Health Canada have created a CMP Science Committee to provide support in the assessment of substances (Government of Canada, 2017). The expertise sought by the government for this committee ranges from human health and ecological risk assessment experts to modelling and emerging technologies experts.

Lessons Learned

- Under CEPA, Environment and Climate Change Canada and Health Canada are ultimately in charge of decision-making with regards to regulating toxic substances. The departments inform their decisions through external scientific advice coming from across the country. Initially, a thorough exercise of reviewing the available data on 23,000 substances was conducted internally in order to select a specific set of substances of interest, even though less than a quarter eventually warranted further review. This thorough review led to a first roadmap in the form of a plan that is now regularly reiterated. External expert committees can be an effective way of assessing scientific evidence.

3.3 California Air Resources Board

California's Air Resources Board (CARB) was created in 1967 through the adoption of the Mulford-Carrell Act (CARB, 2009a). CARB's work involves research and regulation enforcement on a wide array of issues related to air pollution, from emission standards for motor vehicles, fuels and consumer products, to controlling the state's climate change emissions, to setting standards for air quality that are health-based, or for low-carbon fuels that are based on the best available science. The CARB then conducts monitoring operations as well, and is directed to conduct scientific research as part of its mandate.

CARB is composed of 11 members, including the chairperson, six of which are experts appointed from diverse fields such as medicine, chemistry, physics, meteorology, engineering, business and law (CARB, 2014a), whereas the other half are elected representatives of five different regions across California. It conducts research, sets standards, and monitors and enforces compliance with these standards on a number of distinct issues. It is subdivided into scientific committees that have the necessary expertise to address specific issue areas, and is by legislation required to commission external scientific peer review of any policies it wishes to adopt (California Department of Toxic Substances Control, 1997). We explore below one internal CARB committee, the Scientific Review Panel on Toxic Air Contaminants, and one external review process that took place more recently, the peer review of California's Proposed Low Carbon Fuel Standard.

3.3.1 Scientific Review Panel on Toxic Air Contaminants (SRPTAC)

Part of the SRPTAC mandate is to consider the submission from outside expertise regarding new toxic air contaminants and potentially make a recommendation to CARB's chairperson to expand California's list of toxic air contaminants (CARB, 1989). The SRPTAC, as of November 10, 2014, was composed of nine scientists in the fields of pathology, oncology, occupational medicine and biochemistry to name a few (CARB, 2014b). The work of the panel is first submitted to a screening process by which CARB and California's Department of Health Services (DHS) staff review any new submittal to the panel that suggests new scientific evidence exists and warrants attention (CARB, 1989).

Any submittal is expected to include evidence of how a new compound can have health effects, how the new evidence shows that current CARB thresholds of a substance concentration in the environment should be revised and how the potency of the compound has evolved from previous standards. The onus to demonstrate that the evidence is based on scientific data and that the results were peer reviewed falls on the submitters. If these criteria are met, the DHS reviews the submittal and determines whether or not it should be passed on to the panel's attention. Only then would the panel conduct its own review of the data, with the chairperson assigning a lead person to review the DHS's work and conduct any other relevant consultation process. The lead person will then submit their evaluation to the chairperson so that the full panel can review the findings, at which stage the panel could elect whether or not to update or review the CARB's initial risk assessment of toxic air contaminants.

3.3.2 Peer Review of California's Proposed Low Carbon Fuel Standard

Section 57004 of California's Health and Safety Code mandates any agencies under its legislation to conduct a scientific external peer review of any policies it wishes to adopt (California Department of Toxic Substances Control, 1997):

> (b) The agency, or a board, department, or office within the agency, shall enter into an agreement with the National Academy of Sciences, the University of California, the California State University, or any similar scientific institution of higher learning, any combination of those entities, or with a scientist or group of scientists of comparable stature and qualifications that is recommended by the President of the University of California, to conduct an external scientific peer review of the scientific basis for any rule proposed for adoption by any board, department, or office within the agency.

In that regard, CARB, before adopting its Low Carbon Fuel Standard in 2009, had its policy peer reviewed by four university experts (CARB, 2009b). The four peer reviewers submitted a total of 35 pages, commenting on aspects such as greenhouse gas (GHG) and land-use modelling settings in the policy, economic impacts, environmental and multimedia impacts, and credit trading. When CARB updated its policy in 2015, three staff reports on scientific methodologies to calculate Fuel Carbon Intensities and GHG emissions were submitted again to four external university experts for peer review before adoption (CARB, 2015).

Lessons Learned

- CARB is required to staff its board with members that have expertise in different fields on which CARB is authorized to make decisions, from medicine, chemistry, physics, meteorology, engineering, business and law. Having scientists with knowledge in different environmental and policy spheres means the board has a better grasp on the recommendations that are put in front of it in order to make decisions. Further, to ensure that the diverse population of California is well represented, the

state is divided into five geographical areas that all have representatives sitting on the board, which allows them to be part of the decision-making process.

- CARB is also required to go through a multistage process whereby updated scientific data can frequently be reviewed by staff or by other state governments' bodies that also have scientific expertise. Further, by being required to have its internal work externally reviewed by university experts, CARB's processes include a crucial layer of independent and critical oversight in its decision-making procedures. External experts' input can potentially foster additional debate and discussions within CARB, ultimately improving on draft policies by including very recent scientific data that might not have been available at the early stages of drafting a new policy or regulation.

3.4 California State Water Resources Control Board

California created the State Water Resources Control Board (SWRCB) in 1967 (California Environmental Protection Agency, 2011) and adopted in 1969 the Porter-Cologne Water Quality Control Act (California State Water Resources Control Board, 2017) with the purpose of sustainably managing groundwater resources "for long-term reliability and multiple economic, social, and environmental benefits for current and future beneficial uses," and emphasizing that policies adopted under the act should by done by taking into account the "best available science." Under the act, by July 1, 1991, the board was required to adopt a work plan on toxic pollutants, in which it was mandated to consult with a number of stakeholders, including research scientists and organizations for the protection of natural resources and the environment. Following the identification of toxic hot spots, the SWRCB was required to submit a toxic hot spots cleanup plan by June 30, 1999 to California's legislature.

In 1998, the Water Quality Control Policy for Guidance on Development of Regional Toxic Hot Spot Cleanup Plans was adopted (State Water Resources Control Board, 1998). Before adopting the policy, the SWRCB made sure to comply with the Porter-Cologne Act's general provision of science-based evidence by having the policy peer reviewed by University of California scientists (California Department of Toxic Substances Control, 1997). In defining potential toxic hot spots, the SWRCB included a wide array of outside organizations' criteria, including the National Academy of Sciences' (NAS) toxic pollutant thresholds for the protection of human health or wildlife (State Water Resources Control Board, 1998).

More recently, California's Department of Water Resources, also pursuant to the Porter-Cologne Act, was required to convene an expert panel on uniform water recycling by February 15, 2014, partially to be advised on public health issues and scientific and technical matters (California State Water Resources Control Board, 2017). The criteria to convene the panel included the following:

> (2) The expert panel shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years' experience in wastewater treatment, an engineer licensed in the state with at least three years' experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist.

Lessons Learned

- Just as CARB is required to do, the SWRCB needs to have any regulation or policy that it adopts reviewed externally by one of the following independent, external bodies: National Academy of Sciences, the University of California or the California State University (California Department of Toxic Substances Control, 1997). This practice ensures that the SWRCB can constantly integrate the best, up-to-date scientific knowledge in its decision-making processes.

- Additionally, the same practice can facilitate the SWRCB's policy process by allowing it to integrate the academic findings and work of such external institutions within its own regulations and policies. For instance, when it adopted its Water Quality Control Policy for Guidance on Development of Regional Toxic Hot Spot Cleanup Plans, the SWRCB integrated the criteria of other scientific bodies such as the Office of Environmental Health Hazard Assessment or the Department of Health Services into its own definition of toxic hot spot. As such, the policy states that when a health advisory has already been issued on an organism by these bodies, the site where it is present is automatically classified as a "candidate" toxic hot spot (State Water Resources Control Board, 1998).

3.5 United Kingdom Committee on Climate Change

The United Kingdom (U.K.) created the Committee on Climate Change under the Climate Change Act 2008 (Committee on Climate Change, n.d.a). The committee's role is primarily to advise the various organizations that manage and implement the Climate Change Act 2008 (Government of the United Kingdom, 2010). It is required to provide advice on the U.K.'s 2020 and 2050 GHG emission reductions targets through the assessment of carbon budgets for the country, which are drafted by the U.K.'s Secretary of State for five-year periods starting in 2008 (Government of the United Kingdom, 2017). This advisory role can take into consideration a number of items that can contribute to the budget:

- Domestic emission reductions
- Emission credits purchased overseas
- Contributions from sectors of the economy whose emissions fall under the European Union emissions trading system (EU-ETS)
- Contributions from sectors of the economy whose emissions do not fall under the EU-ETS
- Contributions from sectors of the economy in which the committee can find particular opportunities for emissions reductions

The committee is also competent in reviewing and assessing the U.K.'s progress towards meeting each of its carbon budgets and its 2050 targets through the submission of an annual progress report. It is also required to review the implementation of each budget in the second year after a budget has ended. To complete its mandate, the committee is permitted to develop its own models and to review government organizations' models, from global damage costs, macroeconomic costs and burden-sharing modelling to the U.K. Air Passenger Demand & CO_2 Forecasting Framework (Government of the United Kingdom, 2010). The committee is currently composed of eight members. Its current chairman is the former, and longest serving, Secretary of State for the Environment in the U.K. (Committee on Climate Change, n.d.b). It is composed of seven additional members that are experts in such fields as behavioural science, economics and policy, meteorology, engineering, climate change science and energy.

However, the committee's powers are limited to an advisory and assessment role. The U.K.'s Secretary of State is responsible for setting the country's carbon budgets. In drafting each budget, the Secretary of State is expected to take the following into consideration (Government of the United Kingdom, 2017):

(a) scientific knowledge about climate change;

(b) technology relevant to climate change;

(c) economic circumstances, and in particular the likely impact of the decision on the economy and the competitiveness of particular sectors of the economy;

(d) fiscal circumstances, and in particular the likely impact of the decision on taxation, public spending and public borrowing;

(e) social circumstances, and in particular the likely impact of the decision on fuel poverty;

(f) energy policy, and in particular the likely impact of the decision on energy supplies and the carbon and energy intensity of the economy;

(g) differences in circumstances between England, Wales, Scotland and Northern Ireland;

(h) circumstances at European and international level;

(i) the estimated amount of reportable emissions from international aviation and international shipping for the budgetary period or periods in question. (Government of the United Kingdom, 2017)

Lessons Learned

- The UK's Committee on Climate Change model is different from the other bodies reviewed. Its role is more of a watchdog of government's legislation, policies and commitments in one specific issue area in order to make sure that it is working towards achieving its own targets. However, it provides a model for assessing whether or not a project is aligned with the government's environmental policy objectives. Ideas can be drawn from the U.K.'s Committee on Climate Change powers, including economic, social and environmental modelling. Such impact modelling could be set as a part of the EA process, undertaken by third parties or by the regulator itself, with the objective of stress testing a project against climate objectives.

4.0 Recommendations

The lessons identified in Section 3 reveal a number of principles, tools and approaches to improve how scientific knowledge can be enhanced in the NEB toward evidence-based decision-making. The cases provided highlight the importance of external review and expertise, transparency and accountability, and using the precautionary principle in the face of uncertainty. Operationalizing these principles through a reformed federal EA body that undertakes comprehensive assessments can enhance the scientific integrity of the decision-making framework of the NEB and contribute to improved public trust of the regulatory body.

1. Develop a Reformed Federal EA Body

The responsibility for conducting full EAs of energy projects should be undertaken by a reformed federal EA body. As part of the EA process, this body should:

- **Undertake life-cycle cumulative impacts analysis and sustainability assessment[1]:** At the centre of the EA process should be cumulative impacts, which apply a life-cycle approach and include upstream and downstream impacts. An effective EA should assess the sustainability of projects, including their social, economic and environmental impacts. For example, regulations under the National Energy Board Act requires the collection of information on environmental and social impacts of imports and exports. This could be expanded both in scope and application. The regulator could assess the sustainability of imports and exports as a central pillar of its decision-making process. Similar approach could be applied to the assessment of energy-transmission projects.
- **Use a Climate test:** Given the urgent need to combat climate change and the lock-in effect of infrastructure projects, the regulator can play a critical role in assessing projects against climate objectives. Direct and upstream emissions from projects should be considered within Canada's overall commitments under the Paris Agreement. A comprehensive test would go beyond looking at just the project's specific impacts and instead stress test the project against climate objectives, providing full cost-and-benefits accounting for society at large.
- **Use the precautionary principle:** In the face of any uncertainty, the NEB should be guided by the precautionary principle. This means that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (United Nations, 1992).

2. Conduct External Scientific Review

The overreliance on evidence submitted by a proponent can undermine the integrity of the decision-making process. Third party and expert reviews can enhance the review of evidence and improve information available for decision-makers. A scientific panel approach or assessment by respected academics in fields relevant to the review could be devised. To this end, the Scientific Review Panel on Toxic Air Contaminants under CARB provides a good example. The team of scientists could be approached on an ad hoc basis as project reviews emerge. In addition, it could follow the Canadian Species at Risk Act model of having an external review body that reviews emerging science to inform ongoing projects. Irrespective of whether one or both tools are used, a chief scientist within the regulatory body could be appointed as the point of contact between the regulator and external review bodies. It is also critical for regulatory bodies to ensure the process incorporates valuable traditional knowledge and meaningful engagement with Canada's Indigenous peoples.

[1] For more information, please see Pembina 2017, CEGN 2016, Ecojustice 2017.

3. Ensure Transparency

To ensure integrity of scientific review is maintained and public trust in the regulator is upheld, it is critical that the review of evidence be made public, and that the decision-making process and findings are both transparent. Decision-makers should be held to more stringent requirements to explain final EA decisions in light of scientific evidence. It would be helpful for Cabinet to publicly defend its decisions after the fact in a more structured manner. This approach not only opens the black box of the regulatory decision-making process, but would also increase public engagement by allowing stakeholders to review evidence, which can ultimately improve public trust in the decision-making process.

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