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Contested Knowledges in Hydroelectric Project Assessment: The Case of Canada's Site C Project

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Abstract: This paper analyzes contestation over aspects of the Site C Project on the Peace River in northeastern British Columbia, Canada. The $10.7 billion project, which is now under construction, has been vigorously debated for over 30 years. Initially proposed in the 1980s, project approval was not granted following review by the BC Utilities Commission, as the need for the project was not established. In 2010, the provincial government enacted legislation to exempt the project from future review by the BC Utilities Commission; an environmental assessment was initiated in 2012 and a constrained review by the Commission was undertaken in 2017, after construction had commenced. The paper explores key examples of contested knowledge regimes within the review process, focusing on debates over cumulative effects and greenhouse gas emissions. The analysis provides technical examples of the ways in which differing societal values are deployed and co-produced within regulatory processes.

Keywords: hydroelectric development; hydropower; dam; indigenous peoples; first nations; Canada; Site C; British Columbia; environmental impacts; socio-economic impacts

1. Introduction

Over recent decades, large-scale hydropower projects have sparked significant debates around the world [1]. Proponents and opponents differ on whether the benefits (e.g., flood control, expansion of irrigated land, improved drinking water supply, and hydropower production) outweigh the costs (environmental impacts, cost over-runs, and displacement (particularly of Indigenous peoples)). The World Commission on Dams emphasized these concerns over a decade ago, and many countries and international organizations (such as the World Bank) overhauled their hydropower policies as a result [2]. Some experts even called for a new post-dam era; in the United, States, a leader in building big dams in the 20th century, considerable attention has now been refocused on dam decommissioning and environmental restoration [3–5].

In Canada, recent large-scale hydropower projects have raised substantive concerns: significant adverse environmental effects, potential health effects due to methylmercury bioaccumulation and exposure (particularly through fish consumption), infringement on First Nations' Aboriginal and Treaty rights, questionable economics (due to construction cost overruns, declining cost of alternatives and low export market prices for surplus electricity), and constrained regulatory processes, which do not adequately consider many of the key issues [6–10]. The Site C Project, currently under construction on the Peace River in northern British Columbia, exemplifies many of these concerns, and similar issues have arisen in relation to two other major hydropower projects currently under construction in Canada: the Keeyask Generating Station in Manitoba and the Muskrat Falls Project in Labrador.

The issues arising from Site C, as from these other two projects, raise questions respecting the role of large hydropower in Canada's energy future, as well as the regulatory processes for approval of these projects, given what World Bank evaluator Besant-Jones has termed "pervasive appraisal optimism" [11,12] (p. 61)). Such optimism typically entails under-estimating risk by relying on overly positive assessments of future gains and benefits, while under-estimating and/or externalizing environmental and socio-cultural costs [2,12–17]. Mega projects, such as large dams, are also typically plagued by rent-seeking provoked by the enormous investments required, as well as principal-agent problems—in which the state makes decisions that may benefit certain actors, but negatively impact others with less political power [18,19]. In the regulatory decision-making process, multiple contestations over knowledge production arise between proponents and opponents. In this paper, we focus on contestations over knowledge regarding data sources, analytical methods, and underlying assumptions deployed in the technical assessment process.

Our analysis is based on a series of research papers that specifically addressed environmental, economic, and socio-legal issues that were not adequately studied during the regulatory review process due to governmental circumvention of comprehensive environmental assessment and economic evaluation of Site C [20–30]. All raw data was obtained from published sources, most of which were provided by the proponent, British Columbia Hydro and Power Authority (BC Hydro), the BC Utilities Commission (the utility board responsible for regulating BC Hydro), the federal government of Canada, or the provincial government of British Columbia. In our analysis, we found that Site C poses greater environmental risk, has equal or higher greenhouse gas emissions, and generates fewer jobs compared to the cost-comparable alternative portfolios of resources available for meeting needs (including wind generation, upgrades to existing hydroelectric facilities and additional conservation and demand management). Our research was submitted to the BC Utilities Commission during its review of the economic aspects of Site C, and our findings were cited more often than those of any other intervenor [31]. However, our focus in this paper is not on the technical details of the analysis, but rather on the knowledge regimes contested during the regulatory process.

The following section of the paper provides a brief overview of our conceptual framework underlying our presentation of the contested production of knowledge via the regulatory process. Section 3 discusses the historical and regulatory context of the Site C Project. Section 4 provides examples of the regulatory shortcomings and gaps in the assessment and review process. Section 5 concludes with reflections on further research into the technical dimensions of the contestation of knowledge in the evaluation of major hydroelectric projects.

2. Contested Knowledges: Conceptual Discussion

The focus of this paper is the contestation of knowledge within regulatory review processes of resource development. However, what do we mean by resource regulation? To begin with, we are referring to regulation in a practical sense: the rules and procedures whereby different orders of government (in this case, the federal government of Canada and the provincial government of British Columbia) conduct reviews of proposed resource projects, consult with stakeholders, and issue approvals or rejections. A study of resource regulation must include an analysis of the different arguments mobilized by specific stakeholders: the project proponent, government agencies, and affected constituents, including Indigenous communities and local landowners, some of whom may be opposed to a proposed project. In short, our definition of regulation refers to the set of rules for project evaluation, together with procedures for application and enforcement of these rules.

Our analysis is, however, more expansive than this procedural definition of regulation. Social scientists studying resource management often argue that formal rules are only a subset of the *institutions*—understood as 'norms, rules, and customs' [32]—governing resource decision-making. These institutions are relatively coherent albeit dynamic, and embedded within broader political economic processes. Resource regulation is, from this perspective, a socio-political practice of negotiating resource allocation. Within contested processes of regulatory review of hydroelectric

projects, regulation is thus a strategic terrain, or what Jessop terms a 'site of struggle': An object and generator of strategies as well as the product of past political struggles [33]. As a 'key site in the strategic codification of power relations' [33] (p. 248), regulation is a deeply socio-political process in which competing interests are advanced and defended. Moreover, regulatory approval processes are also key sites of epistemological production. Regulatory decision-making is both analytical and representational: an act of interpretation as well as adjudication, involving categorization and assessment of analytical procedures, data, and outcomes. In other words, the production of knowledge in decision-making processes—such as those for large utility projects—combines an analysis of socio-environmental issues together with contestation over the underlying knowledge regimes at stake [33–35]. Resource regulation is thus inherently (but by no means solely) a socio-political practice, insofar as the institutional framework for conducting regulatory reviews includes rules that define knowledge and legitimize authority. This socio-political practice is enacted by individuals, or groups of individuals, who share common 'storylines'—sets of (often contested) ideas that unite people in particular ways of communicating and producing knowledge about a problem, issue, or event [36]. Regulation is thus inevitably inscribed within ideological allegiances, as well as political alliances. Defining regulation as the social negotiation of the exploitation of a dynamic resource landscape thus requires an analysis of both the discursive and the technical dimensions of regulatory decision-making. In other words, at the heart of the regulatory process is a contestation over knowledge which is simultaneously technical, sociopolitical, and discursive [37,38].

Within this conceptual framework, our specific goal in this paper is to provide examples of knowledge contestation concerning two critical environmental knowledge domains—cumulative effects and greenhouse gas emissions—that were at the core of debates over Site C; these issues are also highly relevant to international discourse over hydroelectric projects. In undertaking this analysis, our paper directly addresses some of the key questions posed in this special issue [39]. We provide examples of how these two knowledge domains were rigidly interpreted in favor of some stakeholders over others during the regulatory review process. Underlying this analysis is a split between distinct "epistemic communities" (BC Hydro on the one hand, and a coalition of environmental groups and Indigenous communities on the other). We explore how one dominant epistemic community successfully claimed legitimacy and authority, and how these dominant epistemologies were linked to norms, beliefs, and values about impacts and benefits of hydroelectric development. To frame this analysis, the next section provides a brief overview of the historical and regulatory context of the Site C Project.

3. Historical and Regulatory Context of British Columbia's Site C Project

Canada emerged from the Second World War as a hydroelectric superpower; only the United States generated more hydropower than Canada, and only Norway generated more per capita [40–42]. The majority of this hydropower development occurred in northern Canada, far from densely populated regions in the south, but often with significant impacts on local Indigenous communities; these impacts on Indigenous communities were politically controversial but relatively under-studied, in a pattern characterized as "Hydraulic Imperialism" [43]. The Canadian provinces of Quebec, Ontario, Manitoba and British Columbia emerged as hydropower leaders. Significant hydropower development took place from the 1930s onwards, creating disputes with Indigenous peoples across Canada due to negative effects from displacement, flooding of traditional hunting and harvesting territories, and infringement of Treaty rights [44–47]. In British Columbia (as in western Canada more generally), postwar debates over resource extraction and development intensified over the second half of the 20th century as Indigenous peoples gained recognition of their rights in the courts [48–51].

Site C is among the costliest infrastructure projects ever undertaken by the province of British Columbia: originally budgeted in 2011 at C$7.9 billion, the project cost is now estimated at C$10.7 billion, a real dollar increase of more than 25%, with a potential for further cost increases. The Project is currently under construction on the Peace River in northeastern British Columbia and

is designed to provide 1145 MW of capacity and 5286 GWh/year of energy, starting in late 2024. Supporters of the project—notably BC Hydro, the provincial Crown corporation developing the project—have promoted it as "clean energy."

The genesis for the Site C Project lies in a policy first formulated more than a half-century ago, in the 1950s. The Two Rivers Policy was conceived by the then Premier of British Columbia, William Andrew Cecil (W.A.C.) Bennett, and called for large-scale hydroelectric development on both the Peace River and Columbia River watersheds. The result of the Two Rivers Policy was the development on the Peace River of the W.A.C. Bennett Dam and GM Shrum Generating Station in 1968 (2730 MW) and the Peace Canyon Dam and Generating Station in 1980 (694 MW) (see Figure 1). This enabled the creation of a large electricity supply that powered industrial growth, served growing demand in the rapidly developing southern part of the province of British Columbia, and provided revenues from export of electricity surpluses.

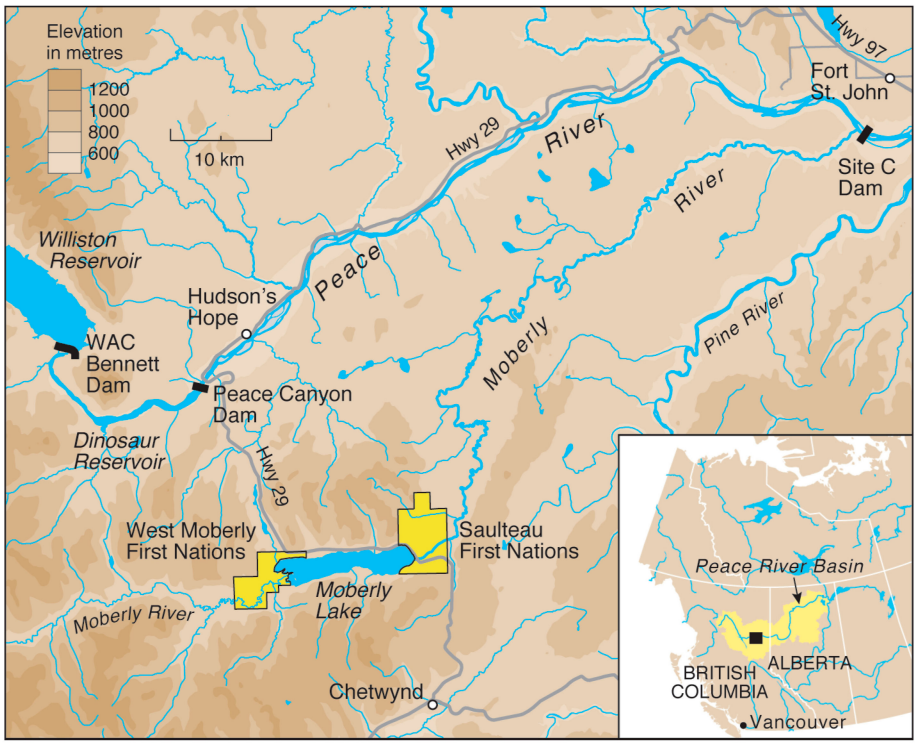

Figure 1. Hydroelectric developments on the Peace River [52].

By the early 1980s, BC Hydro was planning to move forward with its third hydroelectric facility on the Peace River, the Site C Project. The BC Utilities Commission was tasked with reviewing the project's justification, design, impacts and other relevant matters, and recommending whether and under what conditions to issue an Energy Project Certificate, which encompassed the issuance of a Certificate of Public Convenience and Necessity [53]. At that time, BC Hydro's original and final submissions to the Commission based the need for the Site C Project on the electricity requirements identified in its load forecasts [53]. BC Hydro's 1981 "probable" or "mid load" forecast was for BC Hydro system-wide energy demand to increase to 59,700 GWh/year by 1992–1993 [53]. Upon review, the Commission raised several "major issues" respecting the demand forecasts, as detailed in its report, including: forecast methodology, the role and forecast of key underlying variables, specific factors such as industrial sector growth, technological change, fuel shifting, conservation and self-generation, and prospects and potential in the export market.

Though the Commission's report was written over 30 years ago, the major issues raised at that time remain salient. The Commission concluded that: "Hydro's 'probable' load forecast should be considered as optimistic" [53] (p. 85) and recommended as follows:

> *The Commission recommends that Cabinet defer issuing an Energy Project Certificate for Site C until an acceptable load forecast demonstrates that construction of Site C must begin immediately in order to avoid supply deficiencies, and a comparison of alternative system plans demonstrates that Site C is the best project to meet the anticipated shortfalls [53] (p. 23).*

The conclusions reached by the Commission would prove to be illustrative of the value for the public interest of thorough, evidence-based consideration of proposed large-scale resource projects. The acceptance of the Commission's recommendations by the Government of the day would also prove to be prudent: as of 2017–2018, the system-wide energy demand forecasted in 1981 by BC Hydro for the year 1992–1993 has only just materialized, over 25 years later than initially forecast by BC Hydro [54].

The Site C Project was shelved for over two decades. However, in the mid-2000s, the Two Rivers Policy was revived when BC Hydro announced its intentions to reconsider developing Site C. This time, the provincial government was extremely supportive.

With the enactment of the *Clean Energy Act* in 2010, BC Hydro was no longer required to obtain a Certificate of Public Convenience and Necessity for the Site C Project, the legislation having exempted it from review and approval by the BC Utilities Commission. This exemption fast-tracked project development, despite the lack of growth in domestic electricity demand in British Columbia over the past decade [55], declines on the order of 60% in export market prices over that same period [56], and substantial reductions in the cost of alternative resources for meeting the electrical energy [57] and capacity [58] requirements of BC Hydro—all of which pointed to a need for policy reconsideration.

Site C was required to undergo a joint federal and provincial environmental assessment by an independent Joint Review Panel (relevant legislation includes the *Canadian Environmental Assessment Act* and the British Columbia *Environmental Assessment Act*) [59]. In February 2012, the federal and provincial Ministers of Environment finalized a Panel Agreement to conduct a cooperative environmental assessment, including the terms of reference for a Joint Review Panel (JRP), and guidelines for an environmental impact statement [60]. The assessment included an 8-month Joint Review Panel phase, in which the Panel was expected to: review nearly 30,000 pages of documentation; issue and review responses to information requests; determine the sufficiency of the proponent's environmental impact statement; consult with the public and Indigenous groups; hold public hearings; and prepare its final report and recommendations to government. The Panel's final report was issued in May 2014 and, following additional consultation with Indigenous groups concerning conditions for approval, environmental assessment approvals were granted in October 2014. These approvals were given despite recommendations from the Joint Review Panel that key matters related to the economic evaluation of Site C, including project costs and future electricity requirements, be referred to the BC Utilities Commission for further review prior to construction [61]. The provincial government rejected these recommendations and, as the shareholder for BC Hydro, issued a final investment decision in December 2014. By July 2015, construction commenced on the Site C Project on what was estimated at that time to be a 9-year construction period.

However, in May 2017, a new provincial government was elected and initiated the BC Utilities Commission Inquiry Respecting Site C. Pursuant to part 5 of the British Columbia *Utilities Commission Act*, the new government asked the Utilities Commission to inquire into Site C and advise on the implications of completing the project as scheduled, suspending the project, or terminating construction and remediating the site. The Inquiry focused on the Site C Project expenditures to that date, the likelihood of achieving the proposed budget, the implications to ratepayers of suspending or continuing the project, and the potential for an alternative portfolio of resources to meet BC Hydro's forecasted future requirements at a similar or lower cost [62]. The BC Utilities Commission Inquiry final report, issued in November 2017, provided a detailed analysis, determined that the project was unlikely to remain on schedule or on budget, and identified an alternative portfolio capable of meeting BC Hydro's needs at a similar cost to ratepayers [31]. Nonetheless, the provincial government decided

to continue with construction of the project, with planned completion in 2025 (delaying the original schedule by one year).

4. Contesting Environmental Knowledge in Regulatory Decision-Making: Cumulative Effects and Greenhouse Gas Emissions

This section explores technical dimensions of the contestation of knowledge with respect to cumulative effects and greenhouse gas emissions within the regulatory decision-making process for the Site C Project. Prior to presenting this analysis, some context is necessary. The Panel Agreement between the federal and provincial governments concerning the environmental assessment of the Site C Project scoped the assessment to include environmental, economic, social, health and heritage effects, and included consideration of alternatives to the Project [60]. However, the Agreement imposed several time and resource constraints on the work of the three-person Panel, and left open to interpretation several pivotal aspects of the assessment, including in relation to cumulative effects and greenhouse gas emissions. With respect to time and resource constraints, while it is not unusual for environmental assessments to include large volumes of material, it *is* unusual (at least in the Canadian context) to limit a review of a large-scale hydroelectric project by an independent panel to be completed within 225 days, or less than eight months [60]. In contrast to the Site C process, the four-person Clean Environment Commission reviewing Manitoba's 695 MW Keeyask Hydroelectric Project was provided a total of 18 months, and the five-member Manitoba Public Utilities Board was provided an additional 14 months. The Lower Churchill Hydroelectric Generation Project in Labrador was reviewed by a five-person environmental assessment panel over 32 months, followed by a review over a nine-month period by the four-person Newfoundland and Labrador Utilities Board.

The implications of the Panel's time and resource constraints are evident in its findings related to Site C's cost—a central consideration in evaluating it relative to the available alternatives—a key mandate and responsibility of the Panel:

> *The Panel cannot conclude on the likely accuracy of Project cost estimates because it does not have the information, time, or resources. This affects all further calculations of unit costs, revenue requirements, and rates [61].*

The decision to impose significant constraints on the environmental assessment created a situation in which a comprehensive analysis of the relevant information could not be undertaken. Future environmental reviews of similar project proposals should be provided time and resources in order to ensure that the evidence can be properly gathered and analyzed in order to provide robust, evidence-based and defensible recommendations and conclusions to decision-makers.

4.1. Cumulative Effects

The first example of the contestation of knowledge that we present is that of "cumulative effects", defined by the federal government's Canadian Environmental Assessment (CEA) Agency as "changes to the environment that are caused by an action in combination with other past, present and future human actions" [63]. The question of cumulative effects became one of the focal points of the contestation of knowledge between BC Hydro and interveners in the regulatory process for Site C. The treatment of the effects of prior development within the region surrounding the project is of critical importance in this case, since development has been extensive [64], and includes the existing WAC Bennett Dam with the large Williston Reservoir, and Peace Canyon Dam with the Dinosaur Reservoir. These projects inundated more than half the length of the Peace River in British Columbia.

The Panel Agreement between the federal and provincial governments concerning the environmental assessment of the Site C Project scoped the assessment to include cumulative effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out [60]. According to the CEA Agency, a cumulative effects assessment includes a study area that is large enough to allow for the assessment of effects of the project or action being

proposed, as well as identification of other projects or actions that have occurred, exist, or may yet occur and that may also affect the valued components of the ecosystem that are under study [63]. The cumulative effects assessment should address the incremental additive effects of the proposed action and the other actions, including against thresholds or policies. Following the consideration of proposed mitigation measures, the significance of residual effects is clearly stated and defended [63]. The CEA Agency guidance outlines the following options for scoping the temporal boundaries for the cumulative effects assessment, each of which progresses further back in time: (i) when impacts associated with the proposed action first occurred; (ii) existing conditions; (iii) the time at which a certain land use designation was made (e.g., lease of crown land for the action, establishment of a park); (iv) the point in time at which effects similar to those of concern first occurred; or (v) a past point in time representative of desired regional land use conditions or pre-disturbance conditions (i.e., the "historical baseline"), especially if the assessment includes determining to what degree later actions have affected the environment [63].

In preparing the draft guidelines for the preparation of the environmental impact statement (EIS) for the Site C Project, BC Hydro proposed a methodology for evaluating cumulative effects using a temporal baseline based on *existing* conditions, including the effects the two existing hydroelectric project and other prior development in its baseline case [65].

In contrast to the BC Hydro methodology, during the review of the draft guidelines, several First Nations suggested an alternative approach based on the last of the five options contained in the CEA Agency guidance.

> *We also noted in our comments on the EIS Guidelines that in order to assess the cumulative environmental effects of the proposed Project and the cumulative implications for [Constitution Act] Section 35(1) rights, the initial case for consideration or the "baseline case" must include the historical circumstances, since these circumstances are essential to the understanding of the seriousness of the potential impacts on established Treaty rights, and which circumstances would include the WAC Bennett Dam, Peace Canyon Dam and the Peace Project Water Use Plan [66].*

Parks Canada, a federal government department, raised concerns similar to those of the First Nations in its comments on the draft guidelines:

> *BC Hydro's approach to cumulative effects assessment for the Site C project is based on accepting the present state of the Peace River and the Peace Athabasca Delta as the baseline condition upon which to add the incremental impacts from construction and operation of the Site C dam. This approach does not fully consider the cumulative impact from all BC Hydro's flow management operations against an unregulated, undammed river. The point here is that the WAC Bennett dam was proposed, and constructed, in a time when no environmental assessment legislation or process was in place. If the Bennett dam project was proposed today it is very unlikely that such dramatic regulation of the flow regime on the Peace River would be found to be justifiable in the circumstances. The project would then either be modified to limit the scope of the impact to the hydrology of the Peace River, or the project would be cancelled. Using the existing conditions as the baseline, conveniently incorporates the extensive impacts from the WAC Bennett Dam into the baseline, and avoids looking holistically at the collective impacts of all BC Hydro's flow management upon the flows and ecology of the Peace River downstream of the dams. The usual argument for not doing this in cumulative effects assessments is that it is unfair to saddle the current proponent or project with the responsibility to cumulatively assess the impacts of all relevant projects and activities on the receiving environment. This argument often succeeds and hence cumulative effects assessment typically becomes more an exercise in assessing incremental effects of the proposed project, than a comprehensive assessment of cumulative effects. The current circumstances before us are unique in that BC Hydro presently manages two dams on the Peace River and, in the event of the Site C project being approved, would manage all three dams on the Peace River. This provides a compelling argument for BC Hydro to assess the full impact of its operations on the Peace River. The WAC Bennett Dam damage is done and no one is going to ask for*

> *that dam to be decommissioned. Given that is the case, the tolerance for accepting Site C incremental impacts to downstream environments should be correspondingly low [67].*

BC Hydro responded to these concerns by noting that the reliability of the environmental assessment would be compromised by, in its view, the lack of available data concerning historical baseline conditions.

> *BC Hydro also believes that a pre-development case would be inherently unreliable. There are two methods by which a pre-development case could be developed. Firstly, if direct, reliable data about the pre-development state is available, that information could be used. BC Hydro is not aware of data from the pre-development era. Secondly, in the absence of data from the pre-development era, a model would have to be built based on various assumptions in order to emulate pre-development conditions. The longer the period of time between current conditions and the pre-development era, the greater the uncertainty would be [68].*

BC Hydro's approach to the baseline case is identical to that used for the environmental assessment of Nalcor Energy's Lower Churchill Hydroelectric Generation Project. In that instance, the Joint Review Panel raised concerns about this approach that would have been known to the government agencies approving the guidelines for the Site C environmental impact statement, particularly the Canadian Environmental Assessment (CEA) Agency:

> *The Panel concluded that Nalcor's approach to cumulative effects assessment was less than comprehensive and that participants had raised valid concerns that contributed to a broader understanding of the potential cumulative effects of the Project. The Panel recognized the challenges involved, including limited information about past projects such as the Churchill Falls project, and the built-in disincentive for proponents to identify adverse cumulative effects when they are perceived as a potential threat to project approval [69].*

In a critical review prepared in relation to Manitoba Hydro's Bipole III transmission line, Gunn and Noble argue the importance of this retrospective analysis, or the "historical circumstances" referred to above:

> *The development of a baseline for evaluation of cumulative effects is more than a description of current conditions, which alone can discount the effects of past changes as simply the 'new normal.' Baseline development requires a retrospective analysis of how VEC conditions have changed over time and whether that change is significant in terms of the sustainability of the VEC [70].*

In finalizing the guidelines for the Site C Project, the CEA Agency and the British Columbia Environmental Assessment Office accepted BC Hydro's position concerning the temporal boundaries for the cumulative effects assessment, based on BC Hydro's position that there was insufficient data to prepare a pre-development baseline. As a compromise, the CEA Agency added the following requirement pertaining to previous developments:

> *The EIS will include a narrative discussion of existing hydro-electric generation projects on the Peace River (W.A.C. Bennett Dam and the Peace Canyon Dam). The narrative will include the description of any existing studies of changes to the environment resulting from those projects that are similar to potential changes resulting from the project, including any mitigation measures that were implemented, and any long term monitoring or follow up program that were conducted. The effectiveness of those mitigation measures and key results of monitoring or follow-up programs would be described. This narrative discussion should include historical data, where available and applicable, to assist interested parties to understand the potential effects of the Project and how they may be addressed [60].*

BC Hydro tabled its environmental impact statement based on the approved guidelines. The Joint Review Panel, which was struck only after the impact statement was tabled, reviewed the documents and during the public hearings issued several requests for additional information related to cumulative effects, including to local, Indigenous and government participants in the environmental assessment process. During those hearings, the Panel queried BC Hydro concerning its approach to the temporal baseline in conducting the cumulative effects assessment:

> *I'd like to know more about the arguments that you've used and managed; they must be magical. In addition, managed to convince the agency and environmental assessment office of the Province to go ahead and exclude the two dams. Because even if there is a narrative, it does not preclude the proponent to do a cumulative effect assessment, especially if in the narrative you acknowledge that the previous dams had effects.*
>
> ...
>
> *Do I understand that the major argument was that you did not have the data? I mean, the Peace Canyon Dam had the Environmental Impact Assessment done. The Bennett Dam—when you build a dam, you have data. I mean, even if it is 1957, you would have data [71].*

Upon receipt of the additional information from participants, and completion of the hearing, the Panel prepared its final report, which provided specific conclusions and recommendations regarding the environmental effects of the Site C Project. Table 1 presents a comparison of the number of significant environmental effects determined by the Joint Review Panel for the Site C Project compared to other projects assessed as having significant environmental effects under the *Canadian Environmental Assessment Act*. The table demonstrates that Site C was predicted to have more significant environmental effects than any project ever assessed under the *Act* [22,25,62]. This finding may seem surprising, and arises from the extensive biodiversity of the Peace River valley, which plays a key role in the ecology of the northeastern part of British Columbia, as well as being vital to the exercise of First Nations rights, including hunting, fishing and gathering.

Table 1. Significant environmental effects arising from projects assessed under the *Canadian Environmental Assessment Act* (1992–2017).

Projects Assessed under the Canadian Environmental Assessment Act	Number of Significant Environmental Effects
Site C Project	20
New Prosperity Gold and Copper Mine Project	5
Lower Churchill Hydroelectric Generation Project	5
Jackpine Mine Expansion Project	5
Pacific Northwest LNG	3
Encana Shallow Gas Infill Development Project	2
Cheviot Coal Project	2
Kemess North	2
Northern Gateway Project	1
White Pines Quarry	1
LNG Canada	1
Labrador-Island Transmission Link	1

Data source: CEA Agency, Environment and Climate Change Canada.

Of the numerous significant environmental effects identified by the Panel, many were cumulative effects, including on fish, vegetation and ecological communities, several wildlife species, heritage resources, and the current use of lands and resources for traditional purposes by Indigenous peoples. In addition to conclusions regarding the significance of the cumulative effects of the Site C Project, the Panel also drew more general conclusions respecting the cumulative effects assessment for the Site C Project.

> *While the Panel understands that, according to the CEA Agency Operational Policy Statement, past or existing physical activities may be helpful in predicting the effects of a designated project, it is not the sole intent of assessing past or existing projects. The Panel believes that providing a narrative with no analysis or conclusions on the cumulative effects of the existing hydroelectric facilities does not suit the needs of a cumulative effects assessment [61] (p. 259).*
>
> ...
>
> The Panel disagrees with BC Hydro's assertion that there was limited information available to conduct a cumulative effects assessment, particularly given the information from participants. The Panel received numerous testimonies from Aboriginal and non-Aboriginal participants about the effects of the Bennett and Peace Canyon Dams. This information was provided first-hand (by people who were alive at that time) or second-hand (by participants who learned of the effects from previous generations). The Panel understands that there is existing information in various formats such as air photos, environmental impact studies, research from various provincial and independent bodies, and historic maps of changing land tenure [61] (p. 259).
>
> *The Panel concludes that, whether the Project proceeds or not, there is a need for a government-led regional environmental assessment including a baseline study and the establishment of environmental thresholds for use in evaluating the effects of multiple, projects in a rapidly developing region [61] (p. 261).*
>
> ...
>
> *Because of the importance of cumulative effects assessment, the Panel concludes that there is a need to improve and standardize cumulative effects assessment methods [61] (p. 262).*

In summary, while the Panel was able to gather information to support its determinations respecting the significance of the cumulative effects of the Site C Project, this information was prepared and made available very late in the assessment process. As the Panel observed, additional information existed that was not made available to the Panel to support its assessment. In this instance, the contestation of knowledge could have been resolved by early provision of available knowledge, which would have supported a more comprehensive analysis. However, given that this analysis would have required scoping guidelines for the environmental impact assessment in a manner unfavorable for the proponent, the exclusion of this data by BC Hydro is perhaps unsurprising.

4.2. Greenhouse Gas Emissions

The second example of the contestation of knowledge pertains to greenhouse gas (GHG) emissions. The guidelines for the preparation of the environmental impact statement required: an estimate of the multi-year GHG emissions profile associated with the construction and ongoing operations of the Project; an estimate of the net change in GHG emissions from current conditions to post-inundation scenarios; and a comparison of the GHG profile of the Project with other electricity supply options [60].

The Site C Project was promoted, in part, for its purported reductions in GHG emissions relative to the available alternative portfolios of resources for meeting the energy and capacity requirements of BC Hydro [72]. While the generation of hydroelectricity results in no GHG emissions, the construction activities and reservoir creation for the Site C Project do result in meaningful emissions. In preparing its GHG emissions estimate, BC Hydro considered both "likely" (lower emission) and "conservative" (higher emission) scenarios.

Construction emissions from Site C result from fuel and electricity use associated with the dam and generating station, spillways, quarried and excavated materials, transmission lines, access roads, highway realignment and worker accommodation facilities. GHG emissions embedded in construction materials are also included in BC Hydro's analysis based on a life cycle assessment. The conservative

scenario during construction assumes 15% greater fuel emissions and greater life-cycle emissions for construction materials than in the likely scenario [73].

Operations emissions from Site C result from the decomposition of flooded biomass within the reservoir, increasing emissions of both CO_2 and CH_4 over baseline conditions. The conservative scenario for operations assumes no storage of carbon (i.e., harvested timber stored as building materials for the construction industry) and no burial of biomass, while the likely scenario assumes that merchantable timber is converted entirely into stored carbon and that 30% of non-merchantable timber cleared would be buried (and therefore indefinitely stored) [73].

As presented in Table 2, the construction of the Site C Project and the inundation of biomass resulting from reservoir creation generate greenhouse gas emissions, estimated by BC Hydro at between 5.3 and 7.3 million metric tons of CO_2e over the first 100 years of project operations [74]. Both the likely and conservative estimates assume that the reservoir emissions occur mostly in the early years following inundation, and eventually decline to resemble emissions prior to reservoir creation.

Table 2. BC Hydro estimates of GHG emissions—Site C Project [74].

Activity	GHG Emissions Estimates	
	Conservative	Likely
	(tonnes CO_2e)	(tonnes CO_2e)
Construction (8 years)	1,483,708	997,225
Operations (100 years)	5,824,820	4,343,633
TOTAL (108 years)	7,308,528	5,340,858

During the environmental assessment of the Site C Project, BC Hydro developed an alternative portfolio of resources for meeting the energy and capacity needs of BC Hydro without the use of fossil fuels. This alternative "clean" portfolio consisted of available resources for meeting needs considering regulatory, planning and technical constraints, including the requirements of the *Clean Energy Act*. These resources included upgrades to existing hydroelectric facilities, municipal solid waste (MSW) generation, pumped storage hydroelectric, and wind.

Of potential concern in light of the *Clean Energy Act*, particularly the requirement to generate at least 93% of electricity from non-emitting sources, is that the MSW generation included in the alternative portfolio emits carbon dioxide at levels on par with diesel generation [74]. The analysis presented by BC Hydro during the environmental assessment did not seek to minimize the GHG emissions in this alternative portfolio by optimizing the selection and operation of the available resources. Our subsequent research illustrated that several options were available to optimize the greenhouse gas emissions of the alternative portfolios, including replacing the MSW generation with lower emitting resources [24].

During the Site C Joint Review Panel hearings, minimal attention was paid to the issue of GHG emissions. Over the course of the 25 days of hearings, the JRP dedicated one afternoon session to atmospheric and air quality issues, of which GHG emissions was one of five sub-topics [75]. No technical evidence concerning GHG emission estimates of Site C and the alternative portfolios was presented to the Panel during the hearings, other than by BC Hydro. The JRP undertook no independent analysis of the findings of BC Hydro, and solicited no additional evidence through undertakings by BC Hydro or other interveners. Yet, in its final report to the Ministers, the JRP reached the conclusion that the Site C Project "would produce a vastly smaller burden of greenhouse gases than any alternative save nuclear power, which B.C. has prohibited" [61].

In response to an information request from the JRP to estimate the GHG emissions that would be avoided by the Site C Project, inclusive of export of surplus electricity, BC Hydro provided the following table (Table 3), which it subsequently presented in its submission to the BC Utilities Commission Inquiry Respecting Site C. Table 3 presents the avoided GHG emissions of the Site C Project over 100

years compared to the alternative clean portfolio, as well as the additional avoided GHG emissions resulting from exporting the surplus energy created by Site C.

Table 3. BC Hydro's comparative GHG benefits of the Site C Project (2024–2124) [76].

Attribute	Units	Site C Energy Used in BC	Site C Surplus Energy Exported	Total
Generation (100 years)	(GWh)	476,300	33,700	510,000
Avoided GHGs—alternative "clean" portfolio	(Mt CO_2e)	19	15	34

BC Hydro then drew the following conclusions:

> *The portfolio including the Project has lower operational GHG emissions than both portfolios not including the Project. The Clean Generation portfolio selects a municipal solid waste resource option, which includes GHG emissions from fuel combustion [77].*

In arriving at the conclusion that the Site C Project avoids 19 Mt relative to the alternative portfolio in relation to electricity used in BC, BC Hydro omits a key consideration. The MSW generation developed by BC Hydro and included in the alternative clean portfolio used in the Site C Project environmental impact statement was not ultimately selected in any of BC Hydro's portfolios developed for its submission to the BCUC Inquiry Respecting Site C. With the removal of MSW generation from the alternative clean portfolio, the GHG emission advantage of the Site C Project in terms of electricity sold in BC disappears entirely.

Secondly, as our research illustrated, the total energy surplus from Site C based on information presented by BC Hydro during the BCUC Inquiry Respecting Site C is approximately 20,400 GWh, much less than the 33,700 GWh reported in Table 3 [29]. With respect to the emissions avoided through the export of surplus electricity from the Site C Project, BC Hydro incorrectly compared electricity from Site C to the potential emissions from existing electricity resources rather than from other *new* resources that could also be developed to replace existing higher-emitting resources.

Finally, while Table 3 excludes construction phase emissions from Site C and the alternative portfolio, it also omits entirely the GHG emissions from the operations phase of the Site C Project, which were estimated at from 4.3 to 5.8 Mt, as shown in Table 2.

In summary, the alternative portfolio of clean resources produces fewer greenhouse gas emissions than the Site C Project, even after considering the emissions reductions resulting from the export of the energy surplus resulting from Site C. While the GHG emissions from both the Site C Project and the alternative portfolio are low compared to emissions from a natural gas facility of comparable capacity and energy production, our findings illustrate that there is no greenhouse gas emissions advantage to the Site C Project compared to alternative clean portfolios [29].

Indeed, in its terms of reference for the BCUC Inquiry respecting Site C, the provincial government included a requirement for the Commission to identify an alternative portfolio that could provide similar benefits to the Site C Project at similar or lower costs with "maintenance or reduction of 2016-2017 greenhouse gas emission levels" [31]. In preparing these terms of reference, the Provincial Government seemed unaware of the actual emissions profile of the Site C Project. In its final report, the Commission observed that while the alternative portfolio satisfied this requirement, the Site C Project did not [31].

In this instance, the underlying assumption that the Site C Project produces lower GHG emissions than the available and cost-comparable alternative portfolios resulted in a failure to properly contest the evidence during the environmental assessment. Time constraints on the regulatory process reduced the potential for the Joint Review Panel to undertake or solicit an independent review of BC Hydro's GHG emissions analysis. Based on our subsequent research, the findings of such an analysis would

have contradicted the prevailing narrative surrounding the justification for proceeding with the Site C Project, including the incorrect postulate that Site C reduces GHG emissions more than the available alternatives.

5. Conclusions

Despite the deteriorating economic case for continuing with Site C, the provincial government rendered its decision in December 2017 to carry on with the project. In making this decision, the government acknowledged unresolved Treaty rights and economic risks but indicated that in the government's view, the project was too far advanced to halt [78]. The academic research conducted on Site C—including the project's implications for Treaty rights, significant adverse environmental effects, lack of greenhouse gas emissions reduction benefits, and lower employment benefits compared to the alternatives—was not referenced in the government's public announcement. In early 2018, an application for an injunction was launched by affected First Nations, which was later dismissed by the court [79–82].

Why was the Site C Project advanced to construction despite the numerous shortcomings? Additionally, why did the project continue despite the (albeit belated) BC Utilities Commission review challenging the "pervasive appraisal optimism" of the evidence offered by the proponent, BC Hydro? At first glance, the answer is simple: with the enactment of the *Clean Energy Act*, the government exempted the project from regulatory review by the Commission, and then—as publicly promised—pushed the project "past the point of no return" prior to the (belated and limited) review [83]. This was compounded by systemic shortcomings in the regulatory process for Site C, including a failure to consider the evolving framework of Indigenous rights (an important topic beyond the scope of this paper), and an overly constrained environmental assessment process.

The Site C Project is an example of what Boelens, Shah and Bruins term in the introductory article to this special issue [39] as "manufactured ignorance" via the exclusion of specific questions, analyses, data, and analytical methods from consideration. In the case of Site C, this "manufactured ignorance" was criticized by a wide range of stakeholders, including affected Indigenous communities, a previous CEO of BC Hydro, the former Chair of the Joint Review Panel (a former senior federal civil servant), and a federal government department [69,84–86]. Of course, this contestation of knowledge occurs in the context of uncertainties and unpredictability of planning mega-projects such as large dams, which inevitably understates the challenges and difficulties which arise in such projects. It is also important to emphasize the point made above that Indigenous treaty rights issues, while beyond the scope of this paper, are significant in the context of Canada's Truth and Reconciliation Commission, and its recent commitment to implementing the UN Declaration on the Rights of Indigenous peoples [87–90]. Nonetheless, our analysis reveals that the choices made by the government and BC Hydro regarding the evaluation of cumulative effects and GHG emissions favored a specific outcome: developing the Site C Project. The question thus arises: what forms of regulatory review could reduce the possibility for "manufacturing ignorance" in the future? How might legal, policy, and procedural changes create the space for more accurate, comprehensive, and inclusive evaluation? Our hope is that our analysis of the Site C case provides lessons for the future on these crucially important questions.

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Appendix A

All reports published by the Program on Water Governance (including those submitted to the BC Utilities Commission) are available online at www.watergovernance.ca/projects/sitec.

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