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Corporate Risk and Climate Impacts to Critical Energy Infrastructure in Canada

Recent climate events such as Hurricane Harvey in Texas foreshadow the dangers that could result from critical energy infrastructure failure in Canada due to physical impacts caused by climate change. This article examines the types of climate impacts that could affect critical energy infrastructure in Canada. The article argues that these impacts translate into three types of corporate risk to the owners and operators of the critical asset: economic risks to the infrastructure asset; management and operational risks to the corporation; and risks arising from corporate disclosure obligations. Applying the theoretical approach of "risk management," the article concludes that, on this approach, any effects of climate impacts on the critical infrastructure asset will be limited to a narrow corporate risk. By contrast, the paper argues that by applying an expanded understanding of the critical energy infrastructure asset's context, one where the critical infrastructure asset is viewed as existing within its broader economic, social, and environmental geography, a climate impact on the infrastructure asset is thus also a climate impact on the infrastructure's environment. On this broader understanding, the risk of a climate impact may not fall solely upon the corporation, and the public and governments may seek to expand their influence over what adaptive measures are required to ensure resilience of the asset. It can be anticipated that increased public interest in the adaptation of critical energy infrastructure will result in uncertainty and potential resistance by corporations. A new corporate risk is likely to emerge.

Des événements climatiques récents comme l'ouragan Harvey, au Texas, laissent présager les dangers qui pourraient résulter d'une défaillance des infrastructures énergétiques essentielles au Canada en raison des impacts physiques causés par les changements climatiques. Le présent article examine les types d'impacts climatiques qui pourraient affecter les infrastructures énergétiques essentielles au Canada. L'article fait valoir que ces répercussions se traduisent par trois types de risques pour les propriétaires et les exploitants des infrastructures essentielles : les risques économiques liés aux infrastructures, les risques opérationnels et de gestion pour les sociétés et les risques découlant des obligations d'information qu'ont les sociétés. En appliquant l'approche théorique de la « gestion des risques », l'article conclut que, selon cette approche, les effets des impacts climatiques sur les infrastructures essentielles seront limités à un risque limité pour les sociétés. En revanche, l'article soutient qu'en appliquant une compréhension élargie du contexte des infrastructures énergétiques essentielles, c'est-à-dire un contexte dans lequel ces infrastructures sont considérées comme faisant partie d'un ensemble économique, social et environnemental plus large, les impacts climatiques sur les infrastructures sont donc également des impacts climatiques sur l'environnement des infrastructures. Dans cette optique plus large, le risque d'un impact climatique peut ne pas incomber uniquement à la société, et le public et les gouvernements peuvent chercher à étendre leur influence sur les mesures d'adaptation nécessaires pour assurer la résilience de l'actif. On peut s'attendre à ce que l'intérêt accru du public pour l'adaptation des infrastructures énergétiques essentielles entraîne de l'incertitude et une résistance potentielle de la part des entreprises. Un nouveau risque d'entreprise est susceptible d'apparaître.

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Introduction

Consider the role of infrastructure in the following climate event: when Hurricane Harvey made landfall in Texas on 25 August 2017, little attention was paid to the "500 chemical plants, 10 refineries and more than 6,670 miles of intertwined oil, gas and chemical pipelines [that] line the nation's largest energy corridor."[1] Harris County, home to Houston, also "hosts more than two dozen current and former toxic waste sites designated under the federal Superfund program. At least 14 of these sites—whose grounds are contaminated with dioxins, lead, arsenic, benzene or other compounds from industrial activities—were flooded or damaged by Hurricane

1. Associated Press, "Hurricane Harvey's Toxic Impact Deeper Than Public Told," *Associated Press* (23 March 2018), online: <www.apnews.com/e0ceae76d5894734b0041210a902218d> [perma.cc/S5AJ-NQXX]; See also United States Environmental Protection Agency, News Release, "PA/TCEQ Harvey Update: Air Quality Improving, More Water Systems Operational" (6 September 2017), online: <https://www.epa.gov/newsreleases/epatceq-harvey-update-air-quality-improving-more-water-systems-operational> [perma.cc/N4L6-TTJK].

Harvey."[2] This catastrophic incident foreshadows the significant dangers that could result from infrastructure failure due to physical impacts caused by climate change, which this article terms "climate impacts."

Canada's 2009 National Strategy for Critical Infrastructure considers infrastructure as critical where the asset is essential to the "health, safety, security or economic well-being of Canadians."[3] Examples of such assets, which this paper terms "critical energy infrastructure," include electricity generation and transmission infrastructure, oil and gas industry infrastructure, maritime ports related to the energy sector, and railway infrastructure. All of these classes of assets are vulnerable to the anticipated and unanticipated effects of climate change.

This article examines climate impacts to critical energy infrastructure assets in Canada from a corporate risk perspective. It breaks ground by examining climate impacts on any one of these assets as an outright corporate risk, which has the potential to manifest itself as follows. Climate change events may not only cause *direct* impacts to a critical infrastructure asset, resulting in a direct corporate risk, but also *indirect* impacts, where the economic, social, and environmental systems dependent on the critical asset are affected by a climate event on the asset. The article explores the implications of these direct and indirect impacts from the perspective of the owners and operators of the critical assets and translates these climate impacts into three corporate risks: economic risks; management and operational risks; and risks arising from corporate disclosure obligations.

Economic risks are perhaps the most overt risks to the owners and operators of the critical infrastructure asset. Here, a climate impact has the potential to cause damage to the asset and reduce its operability and resultant profits to the corporation. In addition, a climate impact may require the asset to be rebuilt and may expose the corporation to liabilities for environmental spills and potential contamination. Management and operational risks from climate impacts pose challenges to the directors

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2. Hiroko Tabuchi & Sheila Kaplan, "A Sea of Health and Environmental Hazards in Houston's Floodwaters," *The New York Times* (31 August 2017), online: <www.nytimes.com/2017/08/31/us/houston-contaminated-floodwaters.html> [perma.cc/7H7H-K4XY].

3. Canada, Public Safety Canada, *National Strategy for Critical Infrastructure, 2009*, online: <www.publicsafety.gc.ca/cnt/rsrcs/pblctns/srtg-crtcl-nfrstrctr/index-en.aspx> [perma.cc/BT7X-JCSH] [*National Strategy for Critical Infrastructure*]; for a current definition of "climate adaptation" see also Danny Bednar, Jonathan Raikes & Gordon McBean, "The Governance of Climate Change Adaptation in Canada" (February 2018) ICLR Research Paper Series—number 60, online (pdf): *Institute for Catastrophic Loss Reduction* <www.iclr.org/wp-content/uploads/2018/04/cca-climate-change-report-2018.pdf > [perma.cc/8K76-ANEE] which considers climate adaptation as "a complex process of preparing for actual or projected changes in climate averages and extremes. This process generally takes place in five stages. These stages overlap with the responsibilities and interests of a multitude of actors, making the adaptation process complex" (*ibid* at 7).

and officers of the corporation, whereby a corporate risk may arise from regulatory obligations to operate safe and reliable assets in the energy infrastructure sector. Risks arising from corporate governance and disclosure obligations may expose directors and officers of the corporation to strict penalties for inadequate or defective corporate disclosure.

Overall, these three corporate risks could expose directors and officers to corporate liability and may significantly affect the profitability of the corporation. This, in turn, will likely negatively affect the value of the critical asset and the overall corporation. Further, the article argues that when the *indirect* effects of a climate impact are factored into a corporate risk analysis, a climate event has the potential to increase the overall exposure of the owner or operator of the critical infrastructure asset to what this paper calls a "new corporate risk." This new risk could arise due to greater public and governmental scrutiny in the management and regulation of the critical infrastructure asset.

To address this corporate risk, the article focuses on the importance of undertaking climate adaptation, "a process of adjustment in natural and human systems to actual or expected climatic stimuli and their effects,"[4] to critical energy infrastructure in Canada. Despite its importance, adaptation has not received the necessary attention in the global climate change debate,[5] which has predominantly focused on mitigation efforts,[6] disaster response to climate event risks,[7] and climate change and insurance law.[8] Encouragingly, climate adaptation as a corporate risk is gaining attention in the literature,[9] although the discussion remains somewhat limited,

4. Intergovernmental Panel on Climate Change, Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Summary for Policymakers*, (Toronto: Intergovernmental Panel on Climate Change, 2014), online (pdf): <www.ipcc.ch/site/assets/uploads/2018/03/ar5_wgII_spm_en-1.pdf> [perma.cc/N732-GBXF] at 5.

5. Edna Sussman et al, "Climate Change Adaptation: Fostering Progress through Law and Regulation," 18:1 NYU Envtl LJ, 55 at 57.

6. International Bar Association, IBA Climate Change Justice and Human Rights Task Force, *Achieving Justice and Human Rights in an Era of Climate Disruption* (London: International Bar Association, 2014), online: <www.ibanet.org/PresidentialTaskForceClimateChangeJustice2014Report.aspx> [perma.cc/B9RZ-LCSX] at 87.

7. Kevin Quigley, Ben Bisset & Bryan Mills, *Too Critical to Fail: How Canada Manages Threats to Critical Infrastructure* (Montreal: McGill-Queen's University Press, 2017). See also Jocelyn Stacey, "Vulnerability, Disaster Law and 'the Beast'" (2018) 55:4 Alta L Rev 853.

8. Howard Kunreuther & Erwann Michel-Kerjan, "Encouraging Adaptation to Climate Change: Long-Term Flood Insurance" (2009) Resources for the Future Issue Brief 09-13, online (pdf): <media.rff.org/documents/RFF-IB-09-13.pdf> [perma.cc/2V93-KFED] at 2.

9. Lee Godden et al, "Law, Governance and Risk: Deconstructing the Public-Private Divide in Climate Change Adaptation" (2013) 36:1 UNSWLJ 224 ("In key private law areas, there have already been moves to include climate change risk considerations within the scope of critical decision-making domains such as directors' duties." at 236).

focusing primarily on corporate disclosure requirements[10] and corporate law disputes grounded in climate adaptation.[11]

The overall objective of this article is to contribute to the active resilience and climate adaptation debate[12] by developing the argument that direct *and* indirect climate impacts on critical infrastructure translate into corporate risk to the owners and operators of the asset. The article examines the influence of corporate governance considerations in establishing a framework for managing the physical impacts of climate change on critical infrastructure in the energy industry and proceeds on the understanding that "resilience to the physical impacts of climate change… is vital for the long-term sustainable growth of a business."[13]

The article is structured as follows. Part I explores the types of climate impacts that are anticipated in relation to critical energy infrastructure in Canada. Part II examines the concept of "critical infrastructure" and defines it for purposes of this article. Part III translates potential climate impacts to critical energy infrastructure into three types of corporate risk: economic risks to the infrastructure asset; management and operational risks to the corporation; and risks arising from corporate disclosure obligations.

In Part IV, the article argues for a broad understanding of climate impacts on critical energy infrastructure. First, it considers the theoretical approach of "risk management," which tends to view the critical energy infrastructure asset as a narrow corporate interest, and concludes that on this approach, any effects of climate impacts on the asset are limited to a

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10. Nina Hart, "Legal Tools for Climate Adaptation Advocacy: Securities Law" (2015) Sabin Center for Climate Change Law, Columbia Law School White Papers, online: <academiccommons.columbia.edu/doi/10.7916/D83R0S2Z> [perma.cc/737D-DF8Y].

11. JB Ruhl, "A Summary of Present and Future Climate Adaptation Law" (2013) Vanderbilt Public Law Research Paper No 13-4, online: *Social Sciences Research Network* <ssrn.com/abstract=2214001> [perma.cc/S5H9-VGSP] at 3.

12. Brian Chaffin, Hannah Gosnell & Barbara Cosens, "A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions" (2014) 19:3 Ecology and Society article 56; Thomas Dietz et al, "The Struggle to Govern the Commons" (2003) 302:3652 Science 1907; Robin Kundis Craig, "Trickster Law: Promoting Resilience and Adaptive Governance by Allowing Other Perspectives on Natural Resources Management" (27 January 2019), Ariz J Envtl L & Pol'y, [forthcoming], online: *Social Sciences Research Network* <ssrn.com/abstract=3323945> [perma.cc/BQ88-6QE6]; for a timely discussion of risk and resilience in the Canadian context, see also Quigley, *supra* note 7.

13. Australian Government, Department of Environment and Energy, *National Climate Resilience and Adaptation Strategy*, (2015) at 7, online: <www.environment.gov.au/climate-change/adaptation/publications/national-climate-resilience-and-adaptation-strategy> [perma.cc/9T5M-F2V3]. To this end, this article does not directly address critical energy infrastructure in the context of climate mitigation, or the risk of failed adaptation, so-called maladaptation. On maladaptation, see Jon Barnett & Saffron O'Neill, "Minimising the Risk of Maladaptation: A Framework for Analysis" in Jean Palutikof et al, eds, *Climate Adaptation Futures* (Hoboken: John Wiley & Sons, 2013).

narrow corporate risk. The paper then argues for an expanded understanding of the critical energy infrastructure asset's context, one where the asset is viewed as existing within a broader economic, social, and environmental geography. On this understanding, a climate impact on critical energy infrastructure is also a climate impact on the infrastructure's environment, thereby broadening and increasing corporate risk.

Part V of the article explores adaptation and resilience of the corporate asset in this expanded context and discusses what those terms mean when viewed through the lense of the theory of "risk management" and when a broader geographical context is applied to the asset. Part VI develops the argument that once the critical infrastructure asset is viewed in a broader geographical context, the discussion of climate impacts has the potential to take on a mixed private and public focus, due to the social and ecological interconnections between the asset and its environment. This broader interpretation will influence decisions on how an infrastructure asset is determined to be "critical," as well as decisions on how future adaptation responsibilities are to be allocated between private and public interests. It can be anticipated that the increased public interest in the adaptation of critical energy infrastructure will result in uncertainty and potential resistance by corporations. A new corporate risk, resulting from direct and indirect climate impacts to critical energy infrastructure, is therefore likely to emerge. The article concludes with a call for leadership by the federal government on climate adaptation to assist corporations in navigating this new risk.

I. *Anticipated climate impacts on Canadian energy infrastructure*

Extreme weather and climate events will impact each region of Canada differently. Climate change will also impact corporate operations in the energy sector in different ways, specifically the value of corporate assets and their productivity. The literature distinguishes between "first-order impacts," namely acute climate hazards that *directly* affect corporate operations, including physical impacts, and "second-order impacts," which have *broader* economic, human and natural impacts within which the corporation operates.[14]

Climate impacts will result in increases in temperatures and correspondingly, in increased rates of evaporation of water sources. Changes to the availability of water as a result of climate impacts are critical

14. European Bank for Reconstruction and Development and Global Centre of Excellence on Climate Adaptation, "Advancing TCFD Guidance on Physical Climate Risks and Opportunities" (2018), online (pdf): <427mt.com/wp-content/uploads/2018/05/EBRD-GCECA_final_report.pdf> [perma.cc/4TSJ-D9MZ] [*TCFD Guidance*].

to the energy infrastructure sector, where the generation of electricity is dependent on the availability of cooling water[15] or water supplies are instrumental to industrial processes such as refining operations. In the event of anticipated droughts, power plants may therefore have to secure alternative water supplies or undertake expensive conversion from wet cooling[16] to dry cooling.[17] The opposite problem may also cause impacts on critical energy infrastructure. As electricity generation infrastructure is usually located near water, there is an increased risk of flooding. Excess water from flooding can also affect the operations of other critical energy infrastructure.[18] For example, substations, which reduce high-voltage transmission electricity into lower-voltage power for distribution, are vulnerable to structural and operational damage caused by flooding.[19] Flooding can also disrupt critical transmission lines by flooding tunnels and destroying line support structures as well as natural gas and petroleum supply systems. Hydroelectric power plants may be damaged or rendered inoperable by the availability of too little or too much water, with dam infrastructure damaged as a result of excess pressure on concrete dams. Outdated flood-risk projects may also no longer be accurate due to a changing climate. Given the location in Canada of energy infrastructure in coastal regions, such as the anticipated mega-projects on the Pacific coastline to support Canada's LNG industry, climate change may pose serious challenges to the safe and reliable operation of that infrastructure.

Increased temperatures can have adverse effects on electricity generation and transmission, and decrease generation efficiency in thermoelectric power plants.[20] Higher temperatures increase power line resistance, thereby reducing efficiency, compounded by increased electricity demand during periods of excess heat, which only increases operational power line temperatures further.[21] Increasing ambient temperatures are also causing

15. Marco Braun & Elyse Fournier, "Cooling for Thermal and Nuclear Power Generation in a Warmer Climate" in *Adaptation Case Studies in the Energy Sector: Overcoming Barriers to Adaptation* (2016) at 77, online (pdf): <www.ouranos.ca/publication-scientifique/ReportCaseStudies-EN.pdf> [perma.cc/7JR4-4NWG] (report presented to Climate Change Impacts and Adaptation Division, Natural Resources Canada) [*Ouranos Report*].
16. *Ibid* at Case Study 03.
17. *Ibid* at 34; see also *ibid* at Case Study 08.
18. Justin Gundlach & Romany Webb, "Climate Change Impacts on the Bulk Power System: Assessing Vulnerabilities and Planning for Resilience" (2018) Sabin Center for Climate Change Law, Columbia Law School at 10, online: *Social Sciences Research Network* <papers.ssrn.com/sol3/papers.cfm?abstract_id=3128971> [perma.cc/FG77-EFKK].
19. *Ouranos Report*, *supra* note 15 at 13. For example, the 2013 floods in southern Alberta completely destroyed an AltaLink substation.
20. Gundlach, *supra* note 18 at 7.
21. *Ibid* at 11.

permafrost degradation in Canada's Northern region. This has adverse effects on critical infrastructure as the structures rely on permafrost for stability, for example to support power lines, oil and gas pipelines or water lines, resulting in potential snagging of the infrastructure. Rising air temperatures are also contributing to increased forest fire risk, particularly critical for Alberta's oil sands industry which is surrounded by forests.[22] Critical infrastructure assets such as pipelines and transmission lines, but also railway tracks, pass through forested areas and hydroelectric plants are often located in remote and forested areas.[23]

Erratic weather severity and frequency will also have notable impacts on Canada's critical energy infrastructure. High winds, anticipated to be of particular concern to the Western and Atlantic regions,[24] have the potential to damage overhead power transmission lines. Heavy rainfall events can cause washouts of power line and pipeline infrastructure foundations and destroy ancillary infrastructure such as road and rail systems.[25]

Another major effect of climate change is relative sea level change. Both the Atlantic and Pacific regions are facing risks associated with sea level rise,[26] which is often associated with coastal flooding and storm surges.[27] For example, during Superstorm Sandy in New York State, critical infrastructure assets were destroyed and damaged.[28] Sea level rise also increases the risk of coastal erosion, for example rendering port infrastructure ineffective. Canada's largest port, the Port of Metro Vancouver, has been identified as critically vulnerable to the effects of sea level rises.[29]

II. *The concept of "critical infrastructure"*

As illustrated in Part I above, the anticipated effects of climate impacts on Canada's energy infrastructure will vary widely and also have the potential

22. For a general discussion of the emergency response to the Fort McMurray fires see Stacey, *supra* note 7.
23. Gundlach, *supra* note 18 at 6, 12.
24. Natural Resources Canada, *Climate Risks & Adaptation Practices—For the Canadian Transportation Sector 2016*, by Kathy Palko & Donald Lemmen (Ottawa: Government of Canada, 2017), online (pdf): <www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2016/ClimatRisk-E-ACCESSIBLE.pdf> [perma.cc/9WZZ-YSHM] at 68, 220.
25. *Ibid* at 68. ("Extreme precipitation events are a major concern in the Western region.")
26. *Ibid*.
27. *Ibid* at 9.
28. *City of New York v BP PLC,* 325 F Supp (3d) 466 (NY State Ct 2018) (leave to appeal to 2nd Cir granted) brief for appellant, online (pdf): <blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20181109_docket-18-2188_brief.pdf> [perma.cc/BVX8-ZWDC]).
29. Adolf K Y Ng, Jason Monios & Huiying Zhang, "Climate Adaptation Management and Institutional Erosion: Insights From A Major Canadian Port" (2018) 62:4 J Envtl Plan & Mgmt 586.

to overlap. For example, severe droughts may affect both the operative efficiency of an electricity power plant and also increase the risk of fires. In addition, climate impacts on Canada's energy infrastructure expose not only the owners and operators of the critical asset, but have the potential to impact and disrupt those depending on the critical asset, for example for the purposes of generating and transmitting electricity or transferring oil and gas by way of pipeline infrastructure. Defining what constitutes "critical" infrastructure is therefore important for understanding the climate impacts examined in Part I.

As a starting position, there is little consensus in the literature on how to identify and determine an infrastructure asset as "critical." A good starting point, however, is Canada's 2009 National Strategy for Critical Infrastructure,[30] which uses the following broad definition:

> Critical infrastructure refers to processes, systems, facilities, technologies, networks, assets and services essential to the health, safety, security or economic well-being of Canadians and the effective functioning of government. Critical infrastructure can be stand-alone or interconnected and interdependent within and across provinces, territories and national borders. Disruptions of critical infrastructure could result in catastrophic loss of life, adverse economic effects, and significant harm to public confidence.

The strategy places the emphasis on economic *and* social interests, an approach that is also reflected in the action plans to implement the National Strategy. The most recent plan, the National Cross Sector Forum 2018–2020 Action Plan for Critical Infrastructure,[31] predominantly focuses on the convergence between the existing built infrastructure and the increased evolution of cyber security risks.[32] The plan also identifies Canada's aging infrastructure as an "emerging risk" which has the potential to result in "increased risk of disruption"[33] and "significant impacts of infrastructure failure."[34] It is apparent that there is a strong public interest focus set out in the federal government's National Strategy.

In contrast to a broader economic and social approach to critical infrastructure, it may also be possible to identify infrastructure as

30. *National Strategy for Critical Infrastructure*, *supra* note 3.
31. Public Safety Canada, National Cross Sector Forum, *2018–2020 Action Plan for Critical Infrastructure* (Ottawa: Government of Canada, 2018) at 1, online (pdf): <publications.gc.ca/collections/collection_2018/sp-ps/PS4-66-2018-eng.pdf> [perma.cc/TE7Z-GPEN] [*2018-2020 Action Plan for Critical Infrastructure*].
32. *Ibid* at 5.
33. *Ibid* at 6.
34. *Ibid*.

"critical" based on a "sector-specific" analysis. For example, the designation of an energy infrastructure asset as "critical" may be found in relevant legislation related to a specific sector strategic to the Canadian economy, such as the *Emergency Management Act*,[35] the *Energy Supplies Emergency Act*[36] and the *Marine Transportation Security Regulations*[37] at the federal level. At a provincial level, the Alberta *Electric Utilities Act*[38] sets out a list of infrastructure assets designated as "critical transmission infrastructure." In addition, the provincial mechanism implementing the *Emergency Management Act* framework in Alberta includes a list of critical infrastructure, which includes assets in the upstream petroleum sector.[39]

An alternative to the prescriptive legislative approach is a risk-based approach. This process applies a "risk assessment" mechanism, drawing on a broader evaluation based on a number of pre-determined factors, which in turn rank infrastructure in order of critical importance. The advantages of this approach is that it is highly subjective, that it may be undertaken at different stages of the asset's life-cycle assessment (for example during scheduled maintenance), and that it can be fully integrated in corporate management practices.[40] For example, the Canadian Electricity Association has prepared a sophisticated risk assessment and management process for climate adaptation risks that anchors climate risks within business and strategic planning practices.[41] Central to this mechanism is a clear prioritisation of risks and the continued monitoring and evaluating of the effectiveness of risk mitigation efforts.[42]

For the purposes of our discussion, this article will proceed on the understanding of critical infrastructure as set out in the National Strategy for Critical Infrastructure. The strategy includes a broad definition of "critical" infrastructure, one which focuses on assets and systems that are essential to the functioning of the Canadian economy and society.

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35. *Emergency Management Act*, SC 2007, c 15, s 6 (requires federal Ministers to identify risks related to critical infrastructure within their areas of responsibility and to prepare emergency management plans in respect of those risks).
36. *Energy Supplies Emergency Act*, RSC 1985, c E-9, s 15 (gives the federal Cabinet the power to implement mandatory allocation of petroleum products in case of real or anticipated shortages).
37. *Marine Transportation Security Regulations*, SOR/2004-144, s 329(d) (refers to critical marine infrastructure).
38. *Electric Utilities Act*, RSA 2003, c E-5.1.
39. *Security Management Regulation*, Alta Reg 230/2012; *Security Management for Critical Upstream Petroleum and Coal Mining Infrastructure*, Alta Reg 91/2013.
40. Canadian Electricity Association, "Adapting to Climate Change: A Risk Management Guide for Utilities" (2017) at 13, online (pdf): <electricity.ca/wp-content/uploads/2017/11/Adapting_to_Climate_Change-A_Risk_Management_Guide_for_Utilities.pdf > [perma.cc/XM5A-2TTB] [*Risk Management Guide*].
41. *Ibid* at 14.
42. *Ibid* at 16-18.

The strategy therefore applies an expanded understanding of the asset's relevant context, which is discussed further in Part IV below.

III. *Translating climate impacts into corporate risk*

On a narrow interpretation of critical energy infrastructure, climate impacts may appear to be localized and relatively containable, both from an environmental and economic perspective. This is not the case, however, in the highly networked and integrated energy infrastructure sector. In integrated business models, a localized climate event can result in broader service interruptions that may affect business operations beyond the affected location.[43] A recent report prepared for the Canadian electricity generation and transmission sectors on climate change action identified the sectors as priority areas for climate change adaptation, driven largely by an understanding of economic, management and operational risks[44] to the supply and distribution of electricity.[45] The vulnerability of a corporation "to climate impacts goes well beyond the physical exposure of its facilities. It includes supply chains, distribution networks, customers and markets."[46] For example, a shut-down of pipeline infrastructure in Canada as a result of a climate event causing the rupture of a pipeline asset would have the potential to result in significant environmental and economic harm well beyond the physical location of the event. To this effect, Canada's National Strategy for Critical Infrastructure confirms that infrastructure owners and operators possess the key expertise and information on their assets and have primary responsibility "for protecting their assets and services."[47] The statement serves to establish a clear linkage between climate impacts on an asset and the myriad services related to it and dependent on it.

Climate impacts on critical infrastructure raise serious challenges for a corporation and its officers. Failure to effectively manage assets has been identified as a potential material risk in light of climate change.[48] A climate impact may result in the full scope of social and environmental

43. Daniel A Farber, "Climate Adaptation and Federalism: Mapping the Issues" (2009) 1 San Diego J Climate & Energy L 259 at 267.

44. Laura Zizzo, Travis Allan & Joanna Kyriazis, "Understanding Canadian Electricity Generation and Transmission Sectors' Action and Awareness on Climate Change and the Need to Adapt" (2014) at 10, online (pdf): <uwaterloo.ca/school-environment-enterprise-development/sites/ca.school-environment-enterprise-development/files/uploads/files/understanding_canada_electricity_generation.pdf> [perma.cc/24J6-LBFJ].

45. *Risk Management Guide*, *supra* note 40 at 5.

46. *TCFD Guidance*, *supra* note 15 at 15.

47. *2018–2020 Action Plan for Critical Infrastructure*, *supra* note 31 at 1.

48. Sophie Marjanac & Lindene Patton, "Extreme weather event attribution science and climate change litigation: an essential step in the causal chain?" (2018) 36:3 J Energy & Nat Resources L 265 at 294.

social costs, as well as corporate costs in the shape of loss or damage to the critical asset. Failure to adequately take climate adaptation risks into consideration at a corporate level, or to undertake appropriate adaptation to the infrastructure asset, could significantly expose the corporation. One example of potential corporate liability could be grounded in a failure to adequately consider "foreseeable risk to the interests of the company."[49] In addition, "failure to adequately disclose climate related risks or the withholding of certain information from the market"[50] may raise legal issues for corporate officers by way of corporate disclosure obligations and securities fraud.

Corporations and their officers should also be mindful of the linkages between energy infrastructure assets and the wider climate change liability debate. To date, climate change litigation has mostly focused on arguments of climate change *mitigation* and tort liabilities arising from a failure to undertake adequate mitigation efforts, including: (a) the failure of corporations to adequately disclose knowledge of climate risks arising from the burning of fossil fuels; (b) the failure to divest of fossil fuel-based assets; and (c) questions of liability and attribution of corporate liability for the effects of global climate change.[51] Liability arising from a failure to adequately *adapt* critical infrastructure assets against the actual and anticipated effects of climate change has not yet been the focus of targeted litigation against corporations. But as discussed below, this may change, and corporate officers should remain vigilant as to the disclosure of future climate adaptation risks resulting from actual or anticipated climate impacts to their critical infrastructure assets.

The potential climate impacts to critical energy infrastructure can be translated into corporate risk in three ways: (a) economic risks to the infrastructure asset; (b) management and operational risks to the corporation; and (c) risks arising from corporate disclosure obligations. Each are discussed below.

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49. *Ibid* at 295, referring to the expert legal opinion on Australian corporate law by Noel Hutley SC & Sebastian Hartford-Davis, "Climate Change and Directors' Duties" (7 October 2016), online: *Minter Ellison Solicitors/Centre for Policy Development and the Future Business Council* <cpd.org.au/wp-content/uploads/2016/10/Legal-Opinion-on-Climate-Change-and-Directors-Duties.pdf> [perma.cc/DN4H-BH4R].

50. See the discussion on the New York *Martin Act* and ongoing litigation related to ExxonMobil regarding disclosure obligations of material information discussed in Marjanac, *supra* note 48 at 295-296.

51. For a current overview of US and Non-US climate change litigation, see further the Climate Change Chart of databases maintained by the Sabin Center for Climate Change Law at Columbia Law School and Arnold & Porter, online: <climatecasechart.com/about/> [perma.cc/DQ2M-BJC2].

1. *Economic risks*

The actual and anticipated impacts of climate change on critical energy infrastructure include economic risks ranging from damage to the infrastructure itself as a result of a climate event, to loss of productivity and profitability, and to increases in risks related to the failure of the infrastructure resulting in potential environmental contamination and liabilities.[52] The ability of critical infrastructure to adapt is directly influenced by the age, composition and design of the asset.[53]

Thus, with infrastructure ageing, climate vulnerabilities will correspondingly increase, requiring strategic investments in infrastructure that may not have been anticipated in the economic calculations for the life-cycle of the asset. Adaptation works should be prioritized and physical resilience incorporated into scheduled maintenance works, upgrades and retrofits of critical assets. This will minimize the risk of potential economic impacts to the corporation resulting from damage to the asset or the need to remove the asset from service due to climate impacts "ahead of schedule.[54] For example, it is estimated that $300 billion will be invested in Canada's electricity infrastructure by 2030, a portion of which should be allocated to adaptation works.[55]

2. *Corporate management and operational risks*

Directors and officers must manage the business and affairs of the corporation. Their duties include an obligation to exercise a duty of care, to exercise sound business judgment, and to avoid conflicts of interest. Directors and officers also owe fiduciary duties to the corporation.[56] In a 2016 study, a lack of a clear understanding of climate change was identified as a key reason for why the energy industry had not yet adequately invested in climate adaptation.[57] A failure to anticipate and manage climate impacts to critical energy infrastructure could amount to a breach of the obligations owed by directors and officers to the corporation.

In addition, corporate management and operational oversight of critical energy infrastructure assets are subject to a detailed regulatory environment. The electricity sector serves as a good example of how climate adaptation may impose specific management and operational obligations

52. Zizzo, *supra* note 44 at 10.
53. Jessica Boyle, Maxime Cunningham & Julie Dekens, "Climate Change Adaptation and Canadian Infrastructure—A review of the literature" (2013) at 15, online: *International Institute of Sustainable Development* <www.iisd.org/pdf/2013/adaptation_can_infrastructure.pdf> [perma.cc/X2SQ-RT7A].
54. *Ibid* at 11.
55. *Ibid* at 12.
56. See e.g. *Canada Business Corporations Act*, RSC 1985, c C-44, Part X.
57. *Ouranos Report*, *supra* note 15 at 110.

upon the owners and operators of critical infrastructure. For example, the *Electric Utilities Act* of Alberta provides that an owner of a transmission facility must operate and maintain the facility "consistent with the safe, reliable and economic operation of the interconnected electric system."[58] Statutory provisions impose obligations of due diligence and reasonable care upon electricity utilities, obligations which will increase as climate events become more frequent and as the critical infrastructure ages.[59] For example, failure to properly anticipate, prepare for or adapt to the effects of climate change has been the subject of a number of lawsuits in the United States against the federal government, including those following the Hurricane Katrina catastrophe.[60] It can be anticipated that similar claims may be brought against the owners and operators of critical energy infrastructure, namely on grounds of a failure to adequately comply with the obligation to operate safe and reliable energy infrastructure. As Ruhl correctly notes, "the topic of climate change adaptation and the law is largely prospective…there is good reason to believe that the number of measures meeting the "but for" test for identifying climate change adaptation law will grow over time."[61] As such, a private law response based on grounds of a "failure to adequately adapt," for example in the form of litigation against corporations for failing to undertake anticipatory adaptation works, should be anticipated. Corporations and their officers should therefore be mindful of the inevitable risks posed by their corporate decision making in relation to the operation of their critical energy infrastructure assets.

3. *Risks arising from corporate disclosure obligations*

Current discussions on corporate disclosure obligations in the climate change context are predominantly focused on holding corporations accountable for their (in)actions on climate change *mitigation*. This accountability forms the central focus of ongoing climate change litigation and corporate shareholder activism efforts related to the corporation's failure to undertake adequate mitigation efforts.[62]

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58. *Electric Utilities Act*, SA 2003, c E-5.1, s39(1). There is no caselaw or guidance on s 39 from the Alberta Utilities Commission (AUC) charged with oversight of the statutory provision.
59. Zizzo, *supra* note 44 at 12.
60. Ruhl, *supra* note 11: "Nothing could more pointedly suggest this is a potential issue for climate change adaptation law than the litigation against the U.S. Army Corps of Engineers following the Hurricane Katrina levee failures" (*ibid*, at 26); See also Marjanac, *supra* note 48, "In the US, lawsuits have already been filed seeking to hold governments responsible for damages resulting from failure to adapt crucial infrastructure to shifting flood risks" (*ibid* at 289).
61. Ruhl, *supra* note 11 at 20.
62. Marjanac, *supra* note 48 at 293, citing Sarah Barker, "Directors' Duties in the Anthropocene: Liability for Corporate Harm Due to Inaction on Climate Change" (2013), online (pdf): *Responsible*

For example, as illustrated by a 2014 shareholder action to require ExxonMobil to report on its corporate climate change and carbon asset risks, investors are aggressively seeking disclosure of critical information on companies' climate risks related to their assets for purposes of investment decisions and determining shareholder value.[63] In the United Kingdom, two energy companies were the subject of a complaint to the Financial Reporting Council pursuant to disclosure obligations in the *Companies Act* 2006. The complaint by ClientEarth[64] alleged that Cairn Energy and SOCO International failed to adequately disclose risks to the companies' business operations and energy assets as a result of global climate mitigation efforts to transition to a lower carbon-intensive economy. Following the complaint, both companies made the disclosure voluntarily.[65] However, the Financial Reporting Council has not yet released the results of the complaints or updated its guidance on climate risk reporting obligations.[66]

Increasingly, disclosure of climate *adaptation* risks, within broader corporate disclosure documentation, is gaining the requisite attention. In the adaptation context, disclosure is rightly considered "an important tool for investigating or assessing corporations' adaptation measures."[67] Guidance on this may be found in the Canadian Securities Administrators (CSA) disclosure obligations on environmental matters.

Disclosure requirements on environmental-related matters are set out in Environmental Reporting Guidance CSA 51-333.[68] Relevant to a discussion of climate impacts on physical assets are the provisions on

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Investment Banking <responsible-investmentbanking.com/wp-content/uploads/2014/11/Directors-Duties-in-the-Anthropocene-December-2013.pdf > [perma.cc/4J2W-89YX].

63. Marjanac, *supra* note 48 at 295.

64. See ClientEarth, "ClientEarth complaint prompts transformed climate reporting from oil and gas companies" (27 April 2017), online: <www.clientearth.org/clientearth-complaint-prompts-transformed-climate-reporting-oil-gas-firms/> [perma.cc/4QFC-8QBN] [*ClientEarth*].

65. SOCO International plc, "Annual Report and Accounts 2016" (2016), online (pdf): *SOCO International* <www.socointernational.com/private/downloads/qOaacpfBIv-J5lMBnHdUUQ/SOCO_ARA16_DL_.pdf> [perma.cc/N972-9UZZ]: "global transition to a lower carbon intensity economy in response to climate change could result in reduced demand and increased operating cost, capital cost, regulation and taxation. Accordingly, it is a factor that impacts many of the Group's principal risks set out herein, including those associated with commodity price, reserves, operations, political, stakeholder and reputational" (*ibid* at 30).

66. *ClientEarth*, *supra* note 64: the ClientEarth report notes that "despite explicit reference by Cairn in its 2016 report to the FRC's intervention, the regulator has yet to disclose the results of its investigation, or to provide guidance to companies clarifying that climate risk reporting is required under the law. ClientEarth has pressed the FRC to make its efforts more public…[the] two major companies have updated their disclosure practices as a direct result of ClientEarth's complaint to the FRC."

67. Hart, *supra* note 10 at 2.

68. Canadian Securities Administrators, *Staff Notice 51-333, Environmental Reporting Guidance*, (27 October 2010), online (pdf): *Ontario Securities Commission* <www.osc.gov.on.ca/documents/en/Securities-Category5/csa_20101027_51-333_environmental-reporting.pdf> [perma.cc/4TCP-MFEU].

physical risks, for which "material disclosure" may have to be made. Material disclosure may include details on "environmental matters, such as the impacts of industrial contamination, changing weather patterns and water availability."[69]

In March 2017, the CSA announced that it would undertake a project on "climate change-related risks and opportunities that impact an issuer and its business."[70] The CSA project focused on physical assets, the changing regulatory environment, and risks to existing business models in light of climate change in Canada.[71] The project included a strong emphasis on adaptation as it excluded the effect an issuer has or may have on climate change mitigation, from its scope. The CSA project report identified a number of encouraging findings. Of the 78 issuers selected from the S&P/TSX Composite Index for the report, 56 per cent reported that they made specific climate change-related disclosures.[72] Those issuers not disclosing climate change-related risks identified that they did not consider these risks to rise to the level of materiality or probability of anticipated magnitude of impacts.[73] The report also noted that the oil and gas industry is "generally more likely to include climate change-related disclosure in their regulatory filings compared to other industries, especially with respect to regulatory risks."[74]

One of the more challenging findings of the CSA report is the observation that "substantially all users expressed general dissatisfaction with the current state of climate change-related disclosure."[75] One would have expected the CSA to clarify the regulatory disclosure requirements in the context of specific climate change risks to the business, but such an update is not presently anticipated. This leaves open the question of how accurate a disclosure of "material information" on environmental risks and management is, in the absence of more stringent reporting requirements on climate change risks. For example, it would seem unclear whether a disclosure pursuant to CSA 51-333 would require a corporation to report on the risk of a corporate asset becoming a "stranded asset" because of climate mitigation efforts (as reported voluntarily by Cairn Energy and

69. *Ibid* at 9.
70. Canadian Securities Administrators, *Staff Notice 51-354*, *Report on Climate change-related Disclosure Project* (5 April 2018), online (pdf): *Ontario Securities Commission* <www.osc.gov.on.ca/documents/en/Securities-Category5/csa_20180405_climate-change-related-disclosure-project.pdf> [perma.cc/EFS8-H9WZ] [*CSA Climate Risk Report*]
71. *Ibid* at 6.
72. *Ibid* at 12.
73. *Ibid* at 14.
74. *Ibid* at 15.
75. *Ibid* at 18.

SOCO International in the United Kingdom). Without direction from the regulator, we do not know.

It will be of interest to see if the CSA revisits climate change-related disclosure obligations in light of ongoing efforts at an international level to standardize assessment methods and disclosure obligations of climate-related risks through the Task Force on Climate-Related Disclosure.[76]

IV. *Climate impacts as direct and indirect risks to the corporation*

To date, the energy industry has predominantly considered the intersection of climate change, infrastructure assets, and corporate risk from the perspective of so-called "stranded assets." Assets are "considered stranded when they were prudently acquired but have lost economic value as a direct result of an unforeseeable regulatory or legislative change specific to the industry in question."[77] As further developed below, the energy infrastructure asset would become obsolete or "stranded" within a carbon-constrained economy that is focused on avoiding the worst impacts of climate change through concerted *mitigation* efforts.[78]

For the purposes of our discussion, the argument may also be made that, based on increased risks of climate impacts as examined in Part I above, the critical energy infrastructure asset may become obsolete or "stranded" as a result of damage from a climate impact, rendering the asset inoperable or economically obsolete. This type of expanded "stranded asset" risk could be termed the *adaptation* risk inherent in a lack of progress on climate adaptation of the critical asset. This section will therefore briefly draw upon existing examples of the risk of "stranded assets" in the climate mitigation context so as to develop the argument that a broader perception of corporate risk of stranded assets, in the adaptation context, is necessary. What unites the discussion on both "stranded asset" risks is that climate impacts on the critical energy infrastructure asset are essentially *direct* risks to the critical asset. This will be contrasted with a discussion below on *indirect* risks to the critical asset, where the asset is viewed through an expanded understanding of the asset's context to

76. Task Force on Climate-Related Disclose, "Final Report: Recommendations of the Task Force on Climate-related Financial Disclosure" (June 2017), online: <www.fsb-tcfd.org/publications/final-recommendations-report/> [perma.cc/2LMV-ZLAQ].

77. Robert D Cairns, "Stranded Oil of Erewhon" (2018) 121 Energy Policy 248 at 249, citing Michael A Crew & Paul R Kleindorfer, "Stranded Assets in Network Industries in Transition" in Michael A Crew, ed, *Regulation Under Increased Competition* (Boston: Kluwer, 1999) at 64.

78. For a helpful overview on the question of stranded assets and "unburnable carbon" investments in Canada, see Marc Lee & Ellis Brock, *Canada's Carbon Liabilities the Implications of Stranded Fossil Fuel Assets for Financial Markets and Pension Funds* (Ottawa: Canadian Centre for Policy Alternatives, 2013) at 20.

include broader social and environmental systems that may be affected by the asset's failure or damage beyond repair.

1. *Climate impacts as a direct corporate risk*

To date, from the perspective of corporations in the energy industry, the focus has been on the risk of "stranded assets" as a result of global climate *mitigation* efforts to transition to a low-carbon economy. This discussion views climate *mitigation* efforts as essentially hostile to existing business models and as posing a corporate risk. For example, as discussed further below, Chevron, Exxon and Shell have reported on "climate change risks" and the potential impact of climate change mitigation efforts on the corporation's business case, including its assets. Similarly, both Cairn Energy and SOCO International voluntarily disclosed their corporate risk of "stranded assets" as a result of climate change mitigation efforts.[79] This Part will build upon this discussion to broaden the concept of corporate risk in the context of a lack of climate *adaptation*. As developed below, the potential damage to critical energy infrastructure assets as a result of climate impacts requires an expanded risk awareness, one which places adaptation as the central objective in any corporate risk management response to climate change. Essentially, a broader concept of corporate risk is needed to include the risk of physical climate impacts.

To support the argument for a broader understanding of corporate risk, one which includes climate impacts, the theoretical approach of "risk management," based on Miller's integrated risk management framework, is examined.[80] Here, the asset, and the management of climate impacts on the asset, are viewed from a narrow corporate risk perspective. The focus is on strategic management responses by the corporation alone. In contrast, by applying an expanded understanding of the asset's relevant context, one where the critical infrastructure asset is viewed as one existing *within* a social and environmental geography, the effects of climate impacts translate into a broader corporate, and potentially public, risk. Responses

79. *ClientEarth*, *supra* note 64.

80. Kent D Miller, "A Framework for Integrated Risk Management in International Business" (1992) 23:2 J Intl Bus Stud 311. See also Benno Rothstein et al, "Impacts of Climate Change on the Electricity Sector and Possible Adaptation Measures" in Ralf Antes & Bernd Hansjürgens, eds, *Economics and Management of Climate Change Risks, Mitigation and Adaptation* (New York: Springer, 2008) 231: "Climate change is becoming an increasingly relevant factor in the planning processes of electricity companies since it affects all areas of the electricity sector, from production via distribution to consumption. It is of paramount importance for electricity companies to define adaptation measures in this new context so as to limit their risks and financial losses" (*ibid* at 239). See also Ans Kolk, "Developments in Corporate Responses to Climate Change Within the Past Decade," *ibid* at 221.

to climate impacts in this broader context may therefore extend beyond those of the corporation.

2. Integrated risk management and direct corporate risk

Miller's starting position is that the development of a strategy for the management of corporate risks is one of the primary objectives of any corporation.[81] Historically, corporate risks were interpreted in isolation in the literature but any corporate perspective on risk should give "explicit consideration to numerous uncertainties."[82] On this basis, Miller developed an "integrated risk management framework" which provides a risk assessment framework for "identifying and assessing the many types of uncertainties relevant to strategy formulation."[83] There are three groups of risks faced by corporations which form part of Miller's framework.[84] Although reference is also made to social and natural uncertainties,[85] the focus is inherently narrow and is limited to the interests of the corporation alone. This narrow focus can be seen by considering the current approach to "stranded assets" in the critical energy infrastructure context.

The Alberta Court of Appeal, albeit in the context of determining divestments of infrastructure assets for utility rate calculations, has interpreted a "stranded asset" as an asset that "has lost its usefulness before the end of its expected economic life. In other words, the asset has not yet been fully depreciated but is no longer capable of being used."[86] Although public utilities are not, strictly speaking, akin to corporate owners of infrastructure assets, two notable decisions of the Alberta Utilities Commission (AUC) may be of interest to our discussion of the theory of risk management in the climate change context. Interestingly, the AUC reached contrasting decisions on the issue of the recovery of undepreciated costs of damaged infrastructure assets as a result of climate impacts. In a decision arising from the 2011 wildfires in the Slave Lake region[87] and their effects on electric distribution infrastructure, the AUC

81. Miller, s*upra* note 80 at 312.
82. *Ibid* at 312.
83. *Ibid* at 328.
84. *Ibid*, these are "environmental uncertainties" (factors that affect the business context across industries); "industry uncertainties" (related to market uncertainty, product uncertainty, and competitive uncertainty); and "firm uncertainty" (firm-specific factors).
85. *Ibid* at 314, "natural uncertainties" include variations in rainfall, hurricanes and other natural disasters.
86. *FortisAlberta Inc v Alberta (Utilities Commission)*, 2015 ABCA 295, at para 20.
87. *Re ATCO Electric Ltd: 2012 Distribution Deferral Accounts and Annual Filing for Adjustment Balances* (29 October 2014), 2014-297, online: *Alberta Utilities Commission* <www.auc.ab.ca/regulatory_documents/ProceedingDocuments/2014/2014-297_Errata.pdf> [perma.cc/8Y2K-3YL2].

ruled that these costs could not be recovered.[88] By contrast, costs arising from the impacts of the 2013 Southern Alberta flood[89] on gas distribution infrastructure could be recovered.[90] These divergent results have recently been revisited in academic commentary, which has criticized the AUC's outcomes as arbitrary based on its reasoning that a utility "can recover stranded asset costs where the assets are stranded by a mechanism or event of a type and magnitude that the utility has experienced in the past."[91] It will interesting to observe if the AUC, albeit within the narrow field of utility cost recovery, will change its stance on stranded assets in light of the increasing recognition and evidence of the now predictable nature of climate impacts in Canada.

Further, in the narrow context of managing corporate risks of stranded assets, it is noteworthy that in 2018, a number of international energy companies published reports addressing "climate change risks" to their operations as a result of global climate change *mitigation* efforts. The reports highlight the corporation's response to climate change risks and efforts to maintain corporate "resilience." For our discussion, these documents provide helpful insight into current corporate perceptions of global climate mitigation efforts as a corporate risk, and the assessment of the risk of stranded assets.

Chevron's "Climate Change Resilience" report discusses that "some assets may become "stranded" as unproduced reserves become uneconomical due to potential future regulations"[92] arising from climate

88. *Ibid* at para 66: "In the Commission's view it is the characteristics of the event that are relevant to the determination of whether the event had been contemplated or anticipated by a prior depreciation study. If the characteristics of the Slave Lake fires event are sufficiently different to distinguish the Slave Lake fires from the events considered in the previous depreciation study such that the characteristics of the Slave Lake fires cannot be said to have been reasonably contemplated or anticipated in the determination of the depreciation parameters in that study, then the Commission would consider the event to give rise to an extraordinary retirement and the $400,000 notional net book value of the destroyed assets would be for the account of the shareholders."

89. *Re ATCO Gas and Pipelines Ltd: Z Factor Application for Recovery of 2013 Southern Alberta Flood Costs* (16 March 2016), 2738-D01-2016, online: Alberta Utilities Commission <www.auc.ab.ca/regulatory_documents/ProceedingDocuments/2016/2738-D01-2016.pdf> [https://perma.cc/YRC7-M9EU].

90. *Ibid* at para 93: "The characteristics of the 2013 flood event are of a similar nature to the 2005 flood event that was incorporated in the 2009 depreciation study. Relying on this finding of fact, the Commission concludes that the 2013 flood does not give rise to an extraordinary retirement of the destroyed assets and therefore the undepreciated net book value of $496,747 will continue to be recovered from ratepayers".

91. *Lou Cusano et at,* "Prudence, Stranded Assets, And the Regulation Of Utilities: A Review of Alberta Utility Regulatory Principles in a Post-Stores Block Era" (2018) 56:2 Alta L Rev 403 at 433.

92. Chevron Corporation, "Climate Change Resilience—A Framework for Decision Making" (2018) at 25, online (pdf): <www.chevron.com/-/media/shared-media/documents/climate-change-resilience.pdf> [perma.cc/GR97-BKGD].

change mitigation efforts. The report confirms, however, that although there is the possibility that "not all oil and gas assets will get produced,"[93] Chevron takes "carbon pricing into account where appropriate in our business planning to avoid having stranded assets."[94] Shell's "Energy Transition Report" sees the risk of stranded assets in its current portfolio of assets as low,[95] in part due to Shell's strategy of producing 80 per cent of current proven oil and gas reserves by 2030. Shell's active diversification of its investments, including into electricity generation from renewable sources such as wind and solar contributes to a low-risk of stranded assets and "the risk of having assets that are uneconomic to operate, or oil and gas reserves that are uneconomic to produce because of changes in demand or CO2 regulations."[96] ExxonMobil's "Energy & Carbon Summary: Positioning for a Lower-Carbon Energy Future" does not explicitly refer to stranded assets but notes that under oil and gas demand projections to 2040, which include a 2-degree scenarios average, "it is possible that some higher-cost assets, which could be impacted by many factors including future climate-related policy, may not be developed."[97]

As set out above, these key energy corporations view climate risks as narrow risks which may affect business continuity as a result of climate mitigation efforts. The focus on climate risks is thus limited to stranded assets, in response to the risk of changing climate policy parameters, including the cost of carbon. No reference is made to risks arising to critical energy infrastructure from physical climate impacts on corporate assets.

3. *Climate impacts as an indirect corporate and social risk*

In the 2017 Shell Annual Report, in a section entitled "Our Strategy on Climate Change," Shell refers to physical risk as a "potential impact on our facilities and *the communities* in which we operate due to changing physical conditions."[98] This statement illustrates the fact that it is likely necessary to apply a broader understanding to the question of physical

93. *Ibid.*
94. *Ibid.*
95. Shell plc, "Energy Transition Report" (April 2018) at 37, online (pdf): <https://www.shell.com/energy-and-innovation/the-energy-future/shell-energy-transition-report/_jcr_content/par/toptasks.stream/1524757699226/3f2ad7f01e2181c302cdc453c5642c77acb48ca3/web-shell-energy-transition-report.pdf> [perma.cc/6GCX-3CSU].
96. *Ibid* at 30.
97. ExxonMobil Corporation, "Energy & Carbon Summary: Positioning for a Lower-Carbon Energy Future" (February 2018) at 14, online (pdf): <corporate.exxonmobil.com/-/media/Global/Files/energy-and-carbon-summary/Energy-and-carbon-summary.pdf> [perma.cc/XSZ7-S2TM].
98. Shell plc, "Annual Report and Form 20F 2017" (2017) at 65, online: <reports.shell.com/annual-report/2017/?accept=1> [perma.cc/LTP2-PBA5] [emphasis added].

climate impacts on critical energy infrastructure, one which considers the critical energy infrastructure *within* its broader geographical context.

To develop such an expanded understanding of the asset's context, this section builds upon Ottaviano's broader discussion of the role of infrastructure in affecting economic geography[99] and the risk regulation regime framework developed by Hood et al, which argues that context shapes the manner in which risk is regulated.[100] An expanded understanding of the asset's context as advocated in this paper necessarily focuses on the critical energy infrastructure asset *as it co-exists* with its geographical environment. Such a broader context allows for a discussion of corporate risk arising from climate impacts in a manner that goes beyond a strict economic interest in the corporate asset. For example, any climate impact on the asset is also an impact on its geographical environment, including its economic and social aspects. A good example to return to is Hurricane Harvey in Houston in 2017. The hurricane resulted not only in physical impacts on Houston's critical energy infrastructure, but also caused, and continues to cause, widespread economic, social and environmental impacts beyond the assets involved. This example illustrates that the risks associated with climate impacts can extend beyond the corporation to the geographical system within which the asset is located.

By examining the critical infrastructure asset within its broader geographical location and context, a different emphasis is placed on the role of the infrastructure asset. In contrast to the theory of risk management, this broader understanding of the critical infrastructure asset's context does not view the asset as solely a private corporate asset. Instead, the asset is viewed as having a public dimension. This is because the public depends upon the existence of the critical infrastructure asset. As set out in Canada's National Strategy for Critical Infrastructure, critical energy infrastructure contributes to achieving a functioning society and economy.[101] Moreover, the critical infrastructure asset may support the geographic location, for example by connecting it to critical energy supplies and resources and by way of economic contributions. In the event that the asset suffers a climate impact, the geographical context within

99. Gianmarco Ottaviano, "Infrastructure and Economic Geography: An Overview of Theory and Evidence" (2008) 13:2 Eur Investment Bank Papers 8.

100. Christopher Hood, Henry Rothstein & Robert Baldwin, *The Governance of Risk: Understanding Risk Regulation Regime* (Oxford: Oxford University Press 2001), discussed in detail in Quigley, *supra* note 7 at 49.

101. *National Strategy for Critical Infrastructure*, *supra* note 3, which defines critical infrastructure as the "processes, systems, facilities, technologies, networks, assets and services essential to the health, safety, security or economic well-being of Canadians and the effective functioning of government" (*ibid* at 2).

which it is located may suffer economically and socially. An analogy can be drawn with the historical coal mining towns of Alberta and their economic, social and environmental transition in light of Alberta's phase-out of coal production.[102] The infrastructure asset is now defunct, and the geography within which the asset is located, correspondingly affected.

On this reasoning, a restrictive economic risk management theory is replaced by a broader focus, one where private and public interests in the critical infrastructure asset are potentially aligned to address the *direct* and *indirect* effects of a climate impact. This approach recognizes that a climate impact on critical energy infrastructure is likely to affect the infrastructure's economic, social, and environmental context. On such an expanded approach, the physical resilience of the critical infrastructure asset to climate impacts will include social and ecological resilience, which Adger terms "fair adaptation."[103]

V. *Expanding the concept of adaptation*

Although there is no universal definition of "climate adaptation," Article 7 of the Paris Agreement provides guidance by setting out a global goal of "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in the context of the temperature goal of the Agreement."[104] In addition, the definition of "critical infrastructure" from Canada's National Strategy for Critical Infrastructure of 2009 examined above emphasizes that the objective of climate adaptation is to achieve resilience of the infrastructure in an economic *and* ecological context.[105]

What do we mean by "resilience" and how does this objective manifest itself within climate adaptation? As a starting position, formulating a strategy for adaptation to climate impacts "requires a specific meaning to be given to resilience by defining the public interest."[106] For this, we can borrow the definition of "resilience" from the United States Federal Energy Regulatory Commission as "[t]he ability to withstand and reduce

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102. Alberta, "Phasing out Coal Pollution," online: <www.alberta.ca/climate-coal-electricity.aspx> [perma.cc/8QKZ-B3WG]. See also, Lauren Vriens, "The End of Coal: Alberta coal phase-out, 2015," online (pdf): *International Institute of Sustainable Development* <www.iisd.org/sites/default/files/publications/alberta-coal-phase-out.pdf> [perma.cc/9QQC-2AKA].

103. W Neil Adger, "Emerging Dimensions of Fair Process For Adaptation Decision-Making" in Jean Palutikof et al, eds, *Climate Adaptation Futures* (Hoboken: John Wiley & Sons, 2013). See also Nilufar Matin, John Forrester & Jonathan Ensor "What Is Equitable Resilience?" (2018) 109 World Development 197.

104. *Paris Agreement*, 12 December 2015, FCCC/CP/2015/L.9/Rev.1 (entered into force 4 November 2016), online: <unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf> [perma.cc/N3EM-ZSTN].

105. *National Strategy for Critical Infrastructure*, *supra* note 3.

106. Andrea Keessen et al, "The Concept of Resilience from a Normative Perspective: Examples from Dutch Adaptation Strategies" (2013) 18:2 Ecology & Soc'y 45, at 45.

the magnitude and/or duration or disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event."[107]

On such an understanding of resilience, physical resilience would be achieved by decreasing the vulnerability of the asset to climate impacts. The critical question, from the perspective of the corporation, is *what type of resilience* adaptation should achieve. For example, should adaptation aim to offer protection against the direct physical effects of climate impacts on the critical infrastructure asset only (i.e., limit adaptation to *direct* climate impacts on the asset)? Or, should the strategy focus on achieving a *broader* adaptation goal to achieve social and environmental resilience? From the perspective of the corporation, this is the core question for purposes of developing an appropriate adaptation strategy and assessing corporate risk.

1. *Divergent approaches to risk: corporate versus socio-ecological*

As introduced in Part IV above, if the adaptation strategy adheres to a narrow theory of corporate risk management, the focus is limited to the interests of the corporation only. The corporation as owner and operator of the critical infrastructure asset will pursue a focused strategy of resilience to protect the asset against climate impacts. The scope of resilience is therefore narrow, with a strong emphasis on the private aspect of the asset. This translates into an adaptation strategy that is limited to the self-interest of the corporation in its protection of the corporate asset and reduction of corporate risk. Correspondingly, there is limited scope for public concerns to be reflected in the adaptation strategy.

When the objective of achieving resilience of critical infrastructure is broadened pursuant to an expanded understanding of the critical infrastructure asset's context as developed in Part IV above, the focus of the adaptation strategy is correspondingly widened in scope. The overall resilience potential is increased. Any discussion of protection of the asset against climate impacts will now include the socio- and environmental aspects of the geographical context which supports the asset. The adaptive response is therefore localised in the geography; it is "context-specific, place-based, grounded in local structures and situations."[108] Important socio-environmental components that would otherwise be excluded are now included.

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107. Gundlach, *supra* note 18 at 1.

108. Jana-Axinja Paschen & Ray Ison, "Narrative Research in Climate Change Adaptation—Exploring a Complementary Paradigm for Research and Governance" (2014) 43:6 Research Pol'y 1083 at 1085.

The distinction between the two approaches is critical to the overall risk of corporations arising from climate impacts to their critical energy infrastructure assets. The more expansive the adaptation focus, the greater the *public* involvement in the adaptation discussion becomes. But how do we demarcate the geographical context that will be considered? Guidance may be found in the literature of adaptive management.

2. *Lessons from adaptive management*

Applying a broader concept of corporate risk, one where climate impacts on the critical infrastructure asset are viewed as an indirect corporate risk, necessarily invites a comparison with ecology and the adaptive management of ecosystems. As a starting position, there must be a recognition that the critical infrastructure asset is a component of a wider "social–ecological system…in which people depend on resources and services provided by ecosystems, and ecosystem dynamics are influenced, to varying degrees, by human activities."[109]

The *Convention on Biological Diversity* sets out a mechanism for an "ecosystem approach" which promotes the conservation and sustainable use of ecosystems.[110] The ecosystem approach, in turn, is dependent on a system of "adaptive management" to "deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning."[111] Applying an adaptive management mechanism to the question of climate adaptation, it can be argued that the uncertainties of climate impacts on critical infrastructure should require a similar emphasis on flexibility to respond to changing social and ecological conditions, as is set out in Principle 9 of the ecosystem approach.[112] Furthermore, adaptive management includes a strong monitoring mechanism of both socio-economic and ecological factors. It is this emphasis on flexibility, and on a mechanism to respond to changing ecological conditions through monitoring, which suggests that adaptive management could act as a model for future climate adaptation mechanisms. In his work, Olszynski has examined the practice of adaptive management in Alberta's energy resources sector in relation to coal and

109. F Stuart Chapin III et al, *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World*, 1st ed (New York: Springer, 2009) at chapter 1.
110. *Convention on Biological Diversity*, 5 June 1992, 1760 UNTS 79; 31 ILM 818 (entered into force 29 December 1993) [*CBD*].
111. Secretariat of the Convention on Biological Diversity, "The Ecosystem Approach" (2004) at 6, online (pdf): *Convention on Biological Diversity* <https://www.cbd.int/doc/publications/ea-text-en.pdf> [perma.cc/X3FT-EDKC].
112. *CBD*, *supra* note 110, Principle 9.

oil sands mining projects, and in situ oil sands operations.[113] These studies may assist in providing the rationale for, and delineating the scope of impacts to be included in climate adaptation efforts.[114]

This discussion of adaptive management confirms that a broader approach to climate adaptation will not only capture direct private corporate interests, but will also allow for indirect public interests (such as social and environmental considerations) to form part of any adaptation discussion. Essentially, the key question is how to demarcate the extent of the corporate risk arising from climate impacts to the critical infrastructure asset within its geographic location; it is a question of scale. The greater the scale of the geographic context, the broader the corporate risk will be.

A broader theoretical treatment of the infrastructure asset will also influence the questions of whether the asset is considered "critical" and, if so, critical to whom? This may expose the corporation to greater *public* scrutiny over the company's infrastructure assets and adaptation responses. Such an enhanced public scrutiny has the potential to create a new corporate risk.

VI. *A new corporate risk*

To date, corporate risk arising from physical climate impacts to energy infrastructure has largely been limited to direct impacts to the critical asset, as seen when the theory of risk management is applied to the asset. But when the critical energy infrastructure asset is viewed within a broader social and environmental context, the risk of a climate impact may therefore not be limited to the corporation. Because of the public dimension involved, governments and public interest groups may want to expand their role in influencing how critical energy infrastructure is adapted. From the perspective of the corporation, this may manifest itself in a new corporate risk, one where the corporation will have to navigate climate adaptation objectives that pursue both private and public interests.

1. *Private and public adaptation objectives*

Consider the new corporate risk in the following example. An inter-provincial pipeline may not be a critical asset *to the corporation* owning the asset if it does not connect into a transmission network. In turn, a

113. See Martin Olszynski, "Failed Experiments: An Empirical Assessment of Adaptive Management in Alberta's Energy Resources Sector," (2017) 50:3 UBC L Rev 657; see also Arlene Kwasniak, "Use and Abuse of Adaptive Management In Environmental Assessment Law And Practice: A Canadian Example and General Lessons," (2010) 12:4 J Envtl Assessment Pol'y & Mgmt 425.

114. See e.g. *ibid* at 733-734 where the author discusses the proposed adaptive management mechanism for the Shell Canada Jackpine Oilsands mine, which included a broad scope of surface and groundwater management; climate change impacts; fish and fish habitat; socioeconomic and health issues; and reclamation obligations.

smaller energy infrastructure project may be critical *to a remote local community* if it is the only electricity transmission infrastructure that connects the community to a central electricity grid. Any discussion of "critical" must therefore distinguish between a classic "ownership" approach and a broader "social" approach. In addition, the question of "critical to whom?" may be influenced by the fact that segments of the infrastructure may be owned by different parties, especially when dealing with networked or linear infrastructure projects. The potential for both private and public adaptation objectives is apparent.

Given these objectives, the allocation of responsibilities for undertaking climate adaptation to critical energy infrastructure will be challenging. From the perspective of the corporation, managing risks from climate impacts may not be a new challenge, but rather, "an extension of existing risk management."[115] This supports a strong corporate autonomy argument for any climate adaptation response. In principle, responsibility for managing climate risks should lie with the private owners and operators of the critical infrastructure asset, as the party "best placed to manage them."[116] Without adaptation, the energy industry runs a risk of significant losses. As a result, the owners and operators of critical infrastructure assets have a vested interest to manage this risk and adaptation must be "initiated in advance, as a precautionary measure."[117] In the National Cross Sector Forum 2018–2020 Action Plan for Critical Infrastructure, the federal government allocated the responsibility to "collaboratively manage risks related to…critical infrastructure"[118] to the owners and operators of critical assets. Responsibilities placed upon the private sector include identifying critical infrastructure assets,[119] providing data and projections, and developing and promoting industry standards.[120]

The private sector may, however, push back on assuming sole responsibility for undertaking climate adaptation measures. Owners and operators of critical infrastructure may invoke the "public good" nature of their assets to resist responsibility for undertaking adaptation. With respect to regulation, the energy industry may view any climate

115. National Climate Change Adaptation Research Facility, "Roles and Responsibilities for Climate Change Adaptation in Australia" (2012) at 1, online: <www.nccarf.edu.au/sites/default/files/18-dccee-2012.pdf> [perma.cc/28GC-ZBTA].
116. *Ibid* at 3.
117. Tina Schneider, "Responsibility for private sector adaptation to climate change" (2014) 19:2 Ecology 8.
118. *2018–2020 Action Plan for Critical Infrastructure*, *supra* note 31 at Appendix A: Roles and Responsibilities.
119. *Ibid*.
120. Bednar, *supra* note 4 at 51-52.

adaptation requirements with potential hostility, given that adaptation will mean expenditure on risk management that is still, largely, perceived as "indeterminate."[121] There are also strong market dynamics and competition aspects to adaptation.[122] Competitive concerns may act as a disincentive to collaborate on adaptation or may be prohibited by competition law at the risk of market dominance or illegal collusion.

The anticipated scale of climate impacts will mean that inevitably, corporate interests in the critical infrastructure asset will intersect with the public domain, especially on the key issues of responsibility for undertaking adaptation and who should pay for the adaptation. Critical questions related to the jurisdictional divide between the federal and provincial governments in Canada over climate adaptation are far from clear.[123] They form part of the broader jurisdictional complexities related to energy and environmental matters.[124] The question of jurisdiction over climate adaptation is therefore both a legal and political one, where demarcations between the federal and provincial governments remain unclear.[125] Given these uncertainties, the federal government to date has not assumed a central role in leading adaptation policy in Canada.[126]

In the 2016 Federal Adaptation Policy Framework, the federal government described its role as that of advisor only. It stated that its role is not to "prescribe how or when to adapt but to facilitate others' actions."[127] On review, the Office of the Auditor General of Canada (OAG) in 2017 concluded that the federal government's action on climate adaptation was "insufficient."[128] The OAG found that Environment and

121. Quigley, *supra* note 7 at 61.
122. *Ibid* at 57.
123. Canadian Climate Change Adaptation Platform, Infrastructure and Buildings Working Group, "Adaptation State of Play Report" (March 2017) at 48, online: *Canadian Risks and Hazards Network* <www.crhnet.ca/sites/default/files/library/IBWG_SoP_Final.pdf> [perma.cc/836A-6MU7] [*Adaptation State of Play Report*].
124. In the context of developing oil and gas pipelines in Canada, see Nigel Bankes, "Pipelines and the Constitution: A Special Issue of the *Review of Constitutional Studies*" (2018) 23:1 Rev Const Stud 1; George Hoberg, "Pipelines and the Politics of Structure: Constitutional Conflicts in the Canadian Oil Sector" (2018) 23:1 Rev Const Stud 53.
125. *Adaptation State of Play Report*, *supra* note 123 at 49.
126. Bednar, *supra* note 4 at 46-49.
127. Canada, Environment Canada, *Federal Adaptation Policy Framework* (Ottawa: Environment Canada, 2016) at 1-2, online: <www.canada.ca/content/dam/eccc/migration/cc/content/2/b/2/2b2a953e-756b-4e8c-a2ba-3fbdc3324dba/4214_federal-20adaptation-20policy-20framework_en.pdf> [perma.cc/W2W3-PVL6].
128. Canada, Office of the Auditor General of Canada, *Reports of the Commissioner of the Environmental and Sustainable Development to the Parliament of Canada: Report 2—Adapting to the Impacts of Climate Change* (Ottawa: Office of the Auditor General of Canada, 2017) at 27, online: <http://publications.gc.ca/collections/collection_2017/bvg-oag/FA1-26-2017-1-2-eng.pdf> [perma.cc/Q77E-NAB5].

Climate Change Canada had not integrated adaptation measures into its own policies and programs. Moreover, it had not provided satisfactory leadership or resources to other agencies on adaptation. This was the case despite the Department's stated policy to facilitate adaptation and to provide leadership by example.[129]

Although some provincial governments have attempted to fill the void left by the federal government's inaction on climate change,[130] a further OAG report in 2018 identified the inadequate preparation by the provinces to the challenge of climate adaptation.[131] To date, only Nova Scotia has assessed the potential impacts of climate change and has developed the requisite adaptation requirements.[132] By contrast, several provinces have limited their engagement with climate adaptation to performing adaptation assessments on isolated sectors of their economy.[133] Others have launched more general adaptation strategies, such as British Columbia's 2010 Climate Adaptation Strategy, where the focus is on building knowledge and implementing adaptation into general government planning.[134] Given that the provinces are well-placed to undertake and to support corporations in their climate adaptation efforts, one would expect more guidance. For example, many provinces supply public utilities through Crown corporations, thereby holding valuable practical knowledge relevant to climate adaptation of critical energy infrastructure.[135]

This lack of action on the part of both levels of government means that climate adaptation has not yet arrived at the forefront of governmental

129. *Ibid* at 5.

130. Brendan Boyd, "Working Together on Climate Change: Policy Transfer and Convergence in Four Canadian Provinces" (2017) 47:4 Publius: J Federalism 546.

131. Canada, Office of the Auditor General of Canada, *Perspectives on Climate Change Action in Canada Collaborative Report from Auditors General: Perspectives on Climate Change Action in Canada* (2018) at Exhibit 5, online: <www.oag-bvg.gc.ca/internet/English/parl_otp_201803_e_42883.html#> [perma.cc/MFW6-N5UU].

132. *Ibid* at Exhibit 6, which notes in the context of Nova Scotia that "the government had not reviewed the assessment since 2005 to see whether changes to risk ratings were needed, and not all departments were involved in the adaptation planning process."

133. *Ibid* at Exhibit 6. For example, the British Columbia government assessed climate risks to the mining and agriculture sectors. As of 2019, the British Columbia Ministry of Transportation and Infrastructure requires new projects to consider future climate projections and to include adaptation mechanisms: British Columbia, Technical Circular T-04/19, "Resilient Infrastructure Engineering Design - Adaptation to the Impacts of Climate Change and Weather Extremes" (27 March 2019).

134. British Columbia, Ministry of Environment, *Preparing for Climate Change: British Columbia's Adaptation Strategy* (February 2010), online (pdf): <www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/adaptation_strategy.pdf> [perma.cc/AY3S-2GRP]. The strategy concentrates on observing and forecasting changes and supporting scientific research into ongoing effects of climate change.

135. Ouranos Report, *supra* note 15 at 85-86, discussing BC Hydro's use of real-time thermal rating monitors on its transmission and distribution networks to monitor heat sag.

awareness, making it difficult for corporations to anticipate possible regulatory responses. This uncertainty is yet another dimension of what this article has identified as a new corporate risk.

Conclusion

This article has outlined the implications of climate change impacts on critical energy infrastructure in Canada and has concluded that climate change poses significant risks for the owners and operators of the critical infrastructure. As discussed, corporate risks in this context can take the form of either direct risks to the critical asset and to the corporation, or indirect risks when the critical asset is viewed within its broader economic, ecological and social geography. Once these indirect risks are included in a risk analysis, an expanded understanding of climate impacts follows, resulting in what this article has termed a new corporate risk. How can corporations navigate such an expanded category of corporate risk?

In the first instance, corporations must recognize that the direct and indirect impacts of climate change on their operations pose serious risks to business activities and business continuity. The pressing questions then become who should be responsible for leading, implementing and paying for climate adaptation? On a strict risk management approach, climate adaptation falls exclusively within the domain of the corporation as owner and operator of the infrastructure. The corporation alone should decide how best to achieve physical resilience of its assets and to undertake "responses to maintain business as usual."[136] However, as this article has argued, when the critical energy infrastructure asset is viewed within an expanded understanding of the asset's relevant geographical context, i.e., within its broader economic, social, and environmental context, climate adaptation inevitably becomes both a private and public matter. Governmental presence will therefore likely occur, including in the form of regulation, and the question of climate adaptation may also become politicised.

This potential for private and public interests in climate adaptation can be illustrated by the question of costs, which has been identified as the most significant barrier to adaptation.[137] To date, corporations have

136. European Commission, Climate Action, "Financial Institutions, Insurance and Private Sector" (accessed 15 August 2019), online: <ec.europa.eu/clima/policies/adaptation/financing/others_en> [perma.cc/AG8T-KYVZ].

137. Julia Berry & Lisa Danielson, "Paying for Urban Infrastructure Adaptation in Canada: An Analysis of Existing and Potential Economic Instruments for Local Governments" (June 2015) at 49, online: *Simon Fraser University* <summit.sfu.ca/item/17659> [perma.cc/V2S3-U3PH]; See also Martin Parry et al, "Assessing the costs of adaptation to climate change: A review of the UNFCCC and other recent estimates" (2009), online (pdf): *International Institute for Environment and Development*

typically restricted their perception of costs in the context of climate impacts to those related to damages arising from those impacts. They have not yet fully embraced the actual cost of undertaking climate adaptation.[138] Furthermore, in recognition of the fact that their critical energy infrastructure assets provide a public good, corporations may be reluctant to internalize the full costs of adaptation. They may look to the public for a sharing of these costs, which will make the discussion on costs a political one.

Another potential area for the corporation to navigate in regard to the new corporate risk set out in the article is the question of responsibility and leadership on climate adaptation. A factor contributing to the new corporate risk is the fact that currently there is fundamental uncertainty related to the allocation of responsibility on leadership and implementation of climate adaptation in Canada. Given the public dimension of climate adaptation, governmental leadership may in fact be necessary and welcomed from the point of view of corporation. Leadership in this area may not necessarily entail regulation, but could consist of strong policy direction. Either way, this would assist in providing some guidance and certainty to corporations in regard to the allocation of climate adaptation responsibilities.

As noted above, to date, neither the federal nor provincial governments have demonstrated leadership on climate adaptation in the context of critical energy infrastructure. In light of the national importance of this infrastructure to Canadian economic and social well-being, it would appear logical for the federal government to take the lead on adaptation. Given the urgency of climate change generally, and the need to adequately prepare Canada for the effects of climate change, it would be prudent for the federal government to assume an active role on climate adaptation. Clarity on climate adaptation leadership will be an important first step to allow corporations to manage and navigate the new corporate risk.

Ultimately, the key starting point for corporations is to view climate change and the potential for impacts to critical energy infrastructure as a new corporate risk as outlined in this article. To do so, corporations must view the infrastructure asset within its geography. Viewing the asset in this broader context widens the risk analysis and adaptation responses of the corporation. In this way, corporations can best plan for and manage anticipated and unanticipated climate impacts on their assets.

<pubs.iied.org/pdfs/11501IIED.pdf> [perma.cc/9WNW-9PG6].

138. See generally Boyle, *supra* note 53.