



**INTACT CENTRE**  
ON CLIMATE ADAPTATION

**CLIMATE RISK MATRIX**

# **FACTORING CLIMATE RISK INTO FINANCIAL VALUATION**

GENEROUSLY SUPPORTED BY:



**Scotiabank®**



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The Intact Centre on Climate Adaptation (Intact Centre) is an applied research centre at the University of Waterloo. The Intact Centre was founded in 2015 with a gift from Intact Financial Corporation, Canada's largest property and casualty insurer. The Intact Centre helps homeowners, communities and businesses to reduce risks associated with climate change and extreme weather events. For additional information, visit: [www.intactcentreclimateadaptation.ca](http://www.intactcentreclimateadaptation.ca)

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*“ The framework presented in this report provides a solid and practical way to assess and value physical climate risks, supporting improved disclosure and better pricing of climate risks.”*

**Tiff Macklem**

Chair, Expert Panel on Sustainable Finance

# EXECUTIVE SUMMARY

The Task Force on Climate-Related Financial Disclosures (TCFD), and the Expert Panel on Sustainable Finance (EPSF), both advised that climate change and extreme weather risk should factor into institutional portfolio management. *This paper offers a practical means to execute on that advice, that conforms well with the risk management protocols that have become convention since the financial crisis (2008).*

Climate Risk Matrices, presented herein for two industry sectors, identify the top 1-2 physical climate risk impacts that portfolio managers should prioritize as most material to affect performance of companies within a given sector. These 1-2 impacts reflect the expert advice of operations officers or similarly experienced subject matter experts within industry sectors – based on their collective experience, these practitioners are best positioned to identify a short list of material means by which flood, drought, fire, wind, etc., may convey risk to companies within a specific sector. Within this paper, climate risk reflects the magnitude of an impact, juxtaposed to its probability of occurrence (which includes tail risk). Prioritized impacts presented within Climate Risk Matrices provide standardized guidance to portfolio managers, in user-friendly language, which can be used to determine if, and how, issuers are mitigating climate change and extreme weather risk satisfactorily.

Two Climate Risk Matrices – Electricity Transmission & Distribution (T&D), and Commercial Real Estate (CRE) – presented in this paper, illustrate the user-friendly and interpretable information that a portfolio manager would receive. The protocols used to develop both the T&D and CRE Climate Risk Matrices are transferable to any industry sector.

Guidance is presented to help ensure that issuers profile climate risk data, relative to each industry sector, in a manner that is readily predisposed to five common financial valuation methods: (1) Ratio Analysis, (2) Discounted Cash Flow, (3) Rules of Thumb Valuation,

(4) Economic Value Added (EVA®), and (5) Option Pricing Models. Utilizing these methods, a quantitative case study is presented whereby climate risk impact on share price is presented for a publicly traded issuer, thus illustrating that so-called “non-financial” measures of performance are predisposed to valuation.

Relative to next steps, all major industry sectors were reviewed (utilizing publicly available climate risk/ ESG reports) to determine which offer the greatest predisposition to develop additional industry-specific Climate Risk Matrices going forward. Those sectors were determined to include (1) Materials, (2) Energy, (3) Utilities, (4) Industrials, and (5) Real Estate (See Appendix 1).

Although the utility of Climate Risk Matrices discussed herein focuses on institutional investors, the matrices offer value to securities commissions (to guide expectations on climate risk related disclosure), credit rating agencies (to identify a borrower’s key climate risk liabilities) and Boards of Directors (to set a framework for Board members to ask appropriate climate risk related questions of management).

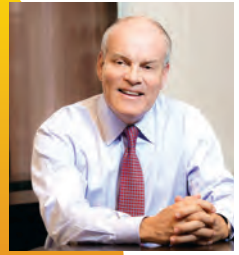
*Time is not a luxury in reference to applying climate risk to portfolio management. The development of industry-specific Climate Risk Matrices offers an immediately executable and practical means to incorporate climate risk into portfolio management now, which in turn will drive **GLOBAL** preparedness to arrest the future impact of irreversible and largely debilitating climate change.*

# INTRODUCTION

*“Climate change and extreme weather risks can represent challenges for capital markets. This report provides practical guidance that will help the financial sector to better incorporate climate risk into financial valuation.”*

**Brian Porter**

President and Chief Executive Officer, Scotiabank



A warming climate (IPCC 2019) and associated extreme weather risks (e.g., flood, drought, fire, hail, wind, extreme heat, storm surge/sea level rise, permafrost loss) will be more challenging across Canada, and globally, as described in Canada’s Changing Climate report (ECCC 2019):

“There is overwhelming evidence that the Earth has warmed during the Industrial Era

and that the main cause of this warming is human influence. The observed warming and other climate changes cannot be explained by natural factors, either internal variations within the climate system or natural external factors such as changes in the sun’s brightness or volcanic eruptions. Only when human influences on climate are accounted for... can these observed changes in climate be explained.

**This warming is effectively  
*irreversible.”***



In response to irreversible climate change, global warming, and exacerbated extreme weather events, many companies spanning most (if not all) industry sectors will suffer disruptions to the continuity of their operations due to physical climate change induced impacts (Krueger et al. 2019, Roman 2019, Macklem et al. 2019, TCFD 2018). When these disruptions are material – for example, if an extreme weather event resulted in flooding that truncated supply chain, which subsequently impacted a company’s long-term cash flow – fiduciary duty would require that this information be disclosed, as it could affect the decision of an investor to buy/hold/sell stock in the company (Bank of Canada 2019, Giuzio et al. 2019, Tooze 2019).

The fiduciary logic of the above scenario is straightforward – however, there are practical limitations that prohibit corporations, spanning virtually all industry sectors, from disclosing climate-related risk that may be material to an investor. As articulated by Macklem et al. (2019) and CSA (2019), the challenge is this:

“Institutional investors are dissatisfied with the state of corporate climate-related reporting in Canada, noting a general inability to determine whether non-disclosure reflects legitimate immateriality or a lack of internal focus. Investors are turning to third-party providers that face the same information barriers, making assurance difficult.”

Building on this observation, Krueger et al. (2019) highlight that despite growing empirical evidence that investors should consider climate stress, integrating climate risk into investment management can prove to be challenging, as investment tools and best practices are not yet well established. However, a few studies are beginning to record the direct financial impacts of extreme weather on valuation – for example, Addoum et al. (2019) have shown that extreme temperatures can adversely affect corporate earnings, and Kruttli et al. (2019) document that extreme weather can be reflected in stock and option market prices.

The primary purpose of this paper is to present a protocol and framework that, if applied across

industry sectors, will alleviate the dissatisfaction felt by institutional investors regarding reporting relative to climate risks. The framework prioritizes the top 1-2 means by which each category of extreme weather (e.g., flood, fire, wind, etc.) may negatively impact each industry sector, while simultaneously identifying the action that an investor could expect a company to take to mitigate prioritized risks (including probable risk and tail risk). The framework of risk prioritization is profiled in an easily interpretable industry-specific Climate Risk Matrix. Furthermore, by way of a case study, the translation of extreme weather risk into impact on share price is calculated using standard financial valuation methods.

Although the target audience for the Climate Risk Matrix is institutional investors, the matrix will also be of value to securities commissions calling for material climate risk disclosure by issuers (e.g., CSA Staff Notice 51-358 2019). In Canada, it is within the mandate of corporations to disclose climate risk, as directed by the Canadian Securities Administrators, beginning with CSA Staff Notice 51-333, Environmental Reporting Guidance (2010). Until the release of the Phase I Report of the Task Force on Climate-Related Financial Disclosures (TCFD 2016), this notice did not draw appropriate attention by issuers across Canada.

The Climate Risk Matrix also offers utility to credit rating agencies, under circumstances where extreme weather events might impact the capacity of a borrower to repay a loan. As suggested by Tigue (2019):

“Credit ratings, much like individual credit scores, assess how likely it is that a borrower will repay debt. Those ratings can affect how much governments and companies are able to borrow and how much it will cost them. Just the threat of a lower credit rating can pressure cities and companies to be more proactive in taking steps to mitigate risks, and now those risks are starting to include climate change.”

In sum, a concise encapsulation of industry-specific climate change and extreme weather risks, presented in standardized user-friendly form, would be of primary benefit to aforementioned institutional investors, secondarily to securities commissions and credit rating agencies, and to a growing extent Boards of Directors that need concise guidance on the physical manifestation of climate change risk.



In this study, two industry sectors – Electricity Transmission & Distribution (“T&D”) and Commercial Real Estate (“CRE”) – are profiled to illustrate how climate change and extreme weather risk can be incorporated into portfolio management by institutional investors. T&D and CRE were appropriate to serve as “model sectors”, based on three requisite criteria (TCFD 2019):

- **Operational Impacts:** T&D and CRE are experiencing substantial impacts due to climate change and extreme weather events (e.g., Bienert 2016, Burillo 2018);
- **Mitigation Actions:** relative to T&D and CRE, means to mitigate climate change and extreme weather risks are reasonably well understood (e.g., CSA 2019, BOMA 2019); and
- **Geographical Range:** climate change and extreme weather risks (e.g., flood, fire and wind) can impact T&D and CRE in virtually any populated region of Canada.

Before describing the framework to establish the Climate Risk Matrix, it is necessary to first describe how climate risk will continue to become more severe, and thus of greater relevance to institutional investors and more broadly the capital markets.

## → GROWING COST OF CLIMATE CHANGE

The term “new normal” is often used to describe weather that today is more extreme than was commonplace prior to 2010 (Moore 2019) – however, caution should be exercised relative to this terminology, as it can instill a sense of complacency with institutional investors that could unintentionally add risk to their investment decisions. Extreme weather, driven in concert with a changing climate, will continue to evolve and become increasingly severe over time, thus generally rendering greater costs across industry sectors. Otherwise stated, there will be nothing normal about the weather of the future (GCA 2019). Investors must, therefore, be vigilant and cognizant of the increasing potential for severe weather to impact investments over time.

There is no better witness to the financial costs associated with extreme weather than the Property and Casualty (“P&C”) insurance sector, where the impacts of a flood, fire, wind, etc., can be tallied almost instantly (Moudrak et al. 2017). Recognizing that the impact of extreme

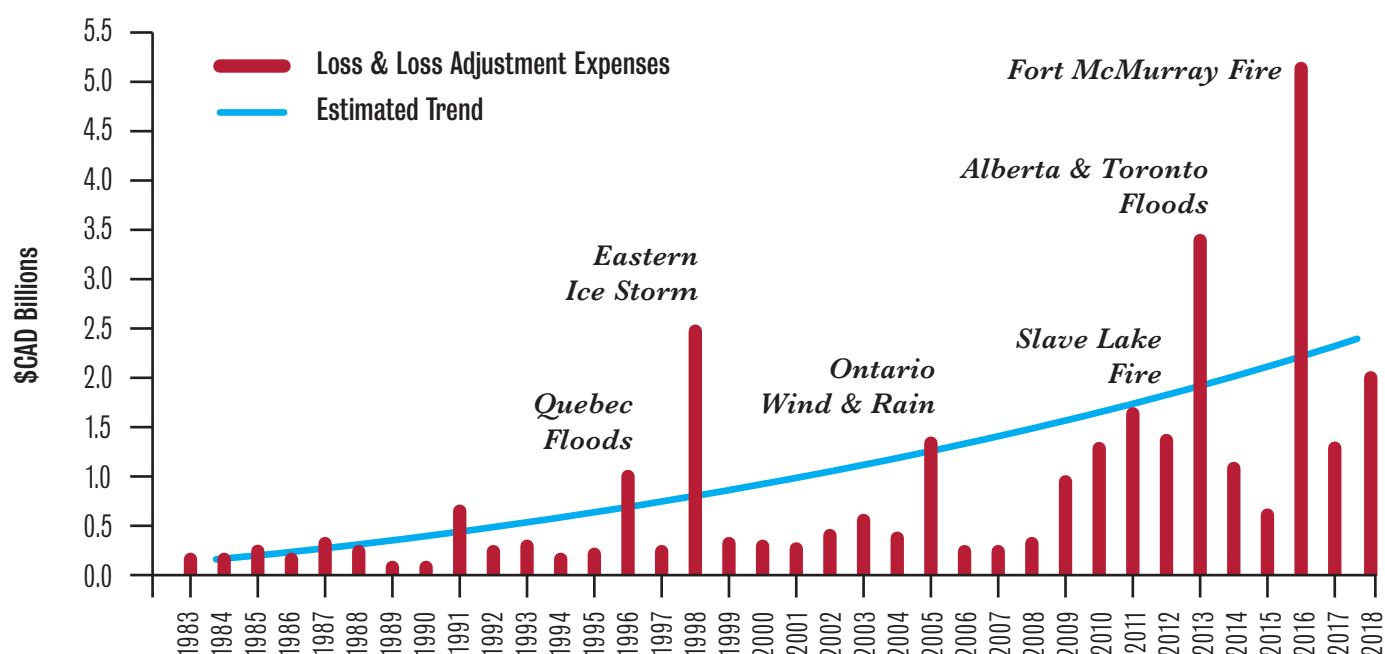


weather would not be restricted to one area of business (Bloomberg 2014), **the P&C sector should be viewed as a proxy for the growing cost of climate change that will impact, to varying degrees, most if not all industry sectors going forward.**

In Figure 1, which profiles annual catastrophic insurable loss claims for Canada (i.e., a “cat loss” is any event such as a flood, fire, hail storm, etc., that triggers \$25

million or more in insurable losses), there is a discernable upward trend in losses since 1983. Note that the losses presented in the figure are normalized for inflation to \$2018, and for per capita wealth accumulation – thus the horizontal axis presents a comparison of “apples to apples.” The trend of increasing costs associated with extreme weather events should concern any investor as a predictor of growth in climate change risk that is pervasive across industry sectors.

**Figure 1: Catastrophic Insured Losses in Canada (1983 – 2018)**



*Source: IBC Facts Book, PCS, CatIQ, Swiss Re, Munich Re & Deloitte. Values in \$2018 CAN; total losses are normalized by inflation and per-capita wealth accumulation*

As a cautionary note, the upward claims trend in Figure 1 is not solely due to escalations in extreme weather events. For example, compounding factors that can affect flood claims include loss of permeable areas and natural habitats due to development (i.e., the loss of the natural “sponge” capacity of wetlands and green spaces to absorb water/reduce flooding), aging municipal infrastructure and housing construction practices that did not incorporate flood-resilience considerations adequately in the past (Moudrak and Feltmate 2019).

Further evidence of the growing costs associated with extreme weather is evident in escalating Disaster

Financial Assistance Arrangements (DFAA) payments made by the Federal Government of Canada – these are funds that are transferred from the federal to provincial or territorial governments, principally to provide relief when the costs associated with natural catastrophes are exceptional. According to Public Safety Canada, the number of natural disasters for which provinces and territories were granted assistance under DFAA increased nearly tenfold from 2005 – 2014 as compared to the previous decade. Going forward, the annual costs borne by DFAA will average \$902 million, with \$673 million attributable to flood relief. The \$902 million

projection is substantially in excess of the nominal DFAA program budget of \$100 million (PBOC 2016).

Escalating insurance claims, combined with substantial increases in DFAA transfer payments, presage the growing risk that climate change and extreme weather will present to institutional investors. The discussion now turns to a practical means to prioritize risks in user-friendly format that managers may factor into portfolio management.



## METHOD: DEVELOPING CLIMATE RISK MATRICES

The method to construct Climate Risk Matrices, for both electricity T&D and CRE, is described below. Where the protocol applied to T&D vs. CRE varies, such differences are described. The protocol applied to establish climate risk for T&D and CRE would be applicable to virtually all industry sectors.

The method to establish a Climate Risk Matrix was based on two axioms. First, that insight to identify and prioritize climate change and extreme weather risk resides within the collective intelligence and consensus of operating officers, or similarly experienced senior persons, who have worked in specific industry sectors for an extended period of time (i.e., which in this study was deemed to be > 20 years of service). Second, that six-to-eight “subject matter experts”, each with at least 20 years of experience, thus representing total “person years of experience” of 120 - 160 years, would have collective insight to identify and prioritize physical climate change risks, if any, relative to their respective industry sectors.

In this paper, there is also an assumption that the manifestation of extreme weather would be in the direction of risk to an issuer, more so than benefit.

Based on the above criteria, subject matter experts, with at least one representative drawn from eastern, central,

western and northern regions of Canada, were engaged in the following generalized protocol to help create a Climate Risk Matrix for each of T&D and CRE:

- 1) each expert was asked to identify physical climate change risks/hazards they deemed to be most material to their business operation (e.g., flood, fire, wind, etc.);
- 2) each expert was asked to describe up to 5 ways in which their operations could be impacted by each of the identified hazards (e.g., service disruption, power outage, equipment damage, etc.); and
- 3) experts were brought together for an in-person meeting to determine the most material hazards and associated operational challenges impacting industry as a whole (accomplished vis-à-vis a voting exercise, where only 2-3 operational challenges were allowed to be kept per hazard).

Once the climate change and extreme weather concerns were established, subject matter experts performed three additional tasks:

- 1) identify what action, if any, could be reasonably taken to limit the identified risk/hazard;
- 2) provide a question the portfolio manager could present to a company or issuer to determine if the issuer was aware of the risk; and
- 3) provide direction as to what would constitute an “excellent response” or “good response” by the issuer in reference to risk mitigation.

Following the generalized protocol profiled above, Climate Risk Matrices were completed for the T&D and CRE sectors.

In addition to subject matter input received from experts in T&D, information was also drawn from *NRC – CSA Group Canadian Electrical Code* (CE Code), *Climate Change Adaptation Project* (CSA Group 2019), and additional insight was received from Ernest Wiebe (*Innovative Solutions Engineering Inc., personal communication, 2019*). Similarly, input into CRE drew upon expert advice from members of the Building Owners Management Association (BOMA Canada), Real Property Association of Canada (REALPAC), and Moudrak and Feltmate (2019).



# RESULTS

Material presented below has not been field tested for ease of use/user-friendliness by multiple portfolio managers – accordingly, direction in the tables is not final, but rather penultimate (practitioner feedback would fine tune future versions).

Table 1 considers climate risk from the perspective of electricity T&D.



**Table 1: Climate Risk Matrix - Electricity Transmission and Distribution** (material highlighted in red reflects prioritized areas of focus applied to portfolio management)

|  | Flood  | Fire  | Wind Storm  | Ice and Snow Loading   | Thawing Permafrost   |
|--|--|---|---|--|--|
| <b>Key Climate Risk Impacts</b>                                      | Flood-induced high water levels result in inadequate electrical clearances below lines that are hazardous to the public                              | Fire along transmission corridors can cause outages if corridors are not adequately clear of brush<br><br><b>Vegetation/tree contacts with transmission lines can cause arcing, fires and outages</b> | Vegetation/tree branches can fall onto T&D lines causing outages<br><br>T&D lines can be brought down by wind forces  | <b>T&amp;D lines and structures can collapse under heavy ice loading</b>   | Thawing/discontinuous permafrost can displace transmission tower foundations, causing structural collapses and outages   |
| <b>Mitigation Measures</b>   | Ensure structures are tall enough for safe clearance under foreseeable flood levels, or lines are installed underground                              | Conduct patrols (visual inspection of utility equipment and structures) in fire prone areas<br><br><b>Clear vegetation along transmission corridors</b>   | Clear vegetation along transmission corridors<br><br>Install anti-galloping devices on conductors and ensure structures are designed to withstand winds                 | <b>Install visual monitors to detect ice loading. Before ice loads build, boost current to melt ice (i.e., short the line)</b> | Modify structure/ designs to readily permit adjustment of towers when line patrols identify permafrost thaw displacement                                       |
| <b>Key Questions to Determine Readiness to Mitigate Climate Risk</b> | What percentage of T&D lines in flood-prone areas have sufficient clearance to safely accommodate a 1:200 year flood without de-energizing the line? | <b>What percentage of total length of overhead transmission lines in wildfire-possible areas are closer than 10 metres horizontally to tree branches?</b>   | What percentage of total length overhead Transmission lines in treed areas are closer than 10 metres horizontally to tree branches that are higher than the conductors? | <b>Are overhead lines that are susceptible to icing monitored by cameras that observe icing on the conductors?</b>             | Are your transmission structures, in discontinuous permafrost areas, of a design where the structured footings can be adjusted without de-energizing the line? |
| <b>Excellent Answer</b>  | > 75%  | None  | < 5%  | Yes  | Yes  |
| <b>Good Answer</b>   | 50% or higher  | < 10%   | < 25%   |  | Yes, the most recent ones  |

Table 2 considers climate risk from the perspective of CRE.

**Table 2: Climate Risk Matrix – Commercial Real Estate** (material highlighted in **red** reflects prioritized areas of focus applied to portfolio management)

|  | <b>Flood</b>   | <b>Fire</b>  | <b>Wind Storm</b>   | <b>Ice and Snow Loading</b>   | <b>Thawing Permafrost</b>   |
|--|--|--|---|---|---|
| <b>Key Climate Risk Impacts</b>                                      | <p>Flooding can lead to property damage, potential for life loss and business disruption</p> <p><b>Property damage and business continuity disruptions increase if critical equipment is damaged or rendered unworkable</b></p>  | <p>Wildfire can lead to property damage, potential for life loss and business disruption</p> <p>Smoke from wildfires contains fine particulate matter and gases such as carbon monoxide and carbon dioxide, which when concentrated impact respiratory health and may aggravate pre-existing heart and lung conditions</p> | <p><b>High winds can loosen the perimeter flashing of the roof leading to roof detachment or “peel off”</b></p> <p>Windborne debris can shatter windows</p>                     | <p><b>Snow and ice can accumulate on flat roofs, increasing the risk of roof collapses</b></p> <p>As snow and ice melt on the roof, leaks can cause water damage and mould</p> <p>Outdoor pipes and pipes in unheated areas such as basements, garages and crawl spaces can burst under extreme cold</p>                                    | <p>Thawing permafrost can lead to structural building collapses</p>   |
| <b>Mitigation Measures</b>   | <p>Emergency Management Plan, including flood procedures, is tested annually with operations staff and tenants</p> <p>Elevators are equipped with water sensors to automatically return to higher floors if water is in the basement or the underground parking</p> <p><b>Critical equipment such as HVAC, electrical and communication systems and server rooms are elevated above expected flood levels. If not feasible to elevate, these systems are wet flood-proofed</b></p> | <p>“Fire-resistant zone” is established within 10 metre perimeter of property</p> <p>Roofs and gutters kept free of combustible materials, and openings and vents are equipped with non-combustible screen mesh</p> <p>HEPA/Activated Carbon filters are installed on HVAC system to cleanse air from wildfire smoke</p>   | <p><b>Roof is reinforced and additional fasteners are applied at the perimeter and corners</b></p> <p>Impact-resistant glass is installed to prevent shattering from debris</p> | <p><b>Snow and ice is proactively removed from roofs</b></p> <p>Snow removal items are available (e.g., heating cables and chemical deicers) and snow/ice removal contractors are secured</p> <p>Thermal imaging cameras are installed to detect leaks and prevent mould</p> <p>Outdoor pipes and pipes in unheated areas are insulated</p> | <p>Building foundations are strengthened with piles, backfilled with coarse-grained soil under the foundation</p> |
| <b>Key Questions to Determine Readiness to Mitigate Climate Risk</b> | <b>Are HVAC, electrical, communication systems and server rooms elevated or otherwise flood protected?</b>   | Does HVAC system have capacity to cleanse air from smoke?  | <b>Is roof reinforced for severe wind around upper perimeter and corners?</b>   | <b>Is snow and ice proactively removed from roofs?</b>  | Are measures present to limit damage where permafrost loss may affect structural integrity?                       |
| <b>Excellent Answer</b>  | Yes  | Yes  | Yes   | Yes   | Yes   |
| <b>Good Answer</b>   | > 50% of facilities  |  |   | > 50% of facilities in high snowfall regions  |   |



As is evident based on a review of Tables 1 and 2, interpretation of climate change and extreme weather risks does not require depth of technical expertise.

**Almost any large cap portfolio manager – with or without expertise in T&D and CRE – could utilize the information presented in both tables.**

In addition to the non-technical nature of information in Tables 1 and 2, the short time-frame within which a portfolio manager could review the table would be advantageous. Under conditions whereby many portfolio managers are addressing climate risk analytics for the first time, a readily accessible review would engage them more than a dense/time consuming process.

Once portfolio managers and analysts appreciate the risks associated with climate change and extreme weather risks, the next point for consideration is how that risk translates to impact financial valuation and share price performance – key considerations in this regard follow below.

## **CLIMATE CHANGE, EXTREME WEATHER RISK AND FINANCIAL VALUATION**

Once climate change and extreme weather risks have been identified, the question to consider from the perspective of financial valuation is this – can these non-financial measures be translated into impact on share price? The short answer is yes, as illustrated in this section and the next. However, there are some precautionary steps to be taken to maximize translation of risk into valuation.

More specifically, recognizing that Climate Risk Matrix data will increasingly become available to investors by corporations, either within Annual Reports, Annual Information Form (AIF) filings, and/or voluntary Environmental, Social and Corporate Governance (ESG) Reports, it is critical to establish guidance now to ensure

that such data will be of value to financial analysts going forward (Economist 2015). There is an important lesson of admonishment in this regard, drawn from the area of ESG and sustainability reporting which began in earnest starting about 2000, but that nonetheless remains problematic for financial analysts today (Paisley and Nelson 2019).

Amongst the first reports to document limitations in sustainability reporting was the sdEffect™ (NRTEE 2006), which focused on calculating sustainability valuation utilizing such tools as Ratio Analysis, Discounted Cash Flow (DCF), “Rules of Thumb” valuations, Economic Value Added (EVA®) (Ehrbar 1998), and Option Pricing Models (OPM). The problem in applying these various analyses was lack of data – reporting on sustainability practices by issuers tended to be anecdotal and non-quantitative. When data was available, it frequently lacked key information related to such simple measures as the timeframe over which data applied, or the geographic range of operations under consideration (WBCSD 2018).

To help ensure that climate change and extreme weather data appear in industry specific reports in a form readily predisposed to financial valuation, Table 3 provides high-level guidance to issuers.



**Table 3: Guidance to Issuers, to Optimize the Utility of Climate Risk Reporting Relative to Five Financial Valuation Methods**

|                                   | Description of Financial Valuation Method  | For Consideration by Issuers – Key Climate Specific Information Applicable to Valuation Method  |
|-----------------------------------|--|---|
| <b>Ratio Analysis</b>             | <p>Valuation of a company's common equity price or the entire enterprise value is established as a ratio of measurable factors in a company's operations such as:</p> <ul style="list-style-type: none"> <li>• Price/Earnings</li> <li>• Price/Cash Flow</li> <li>• Price/Book Value of Equity</li> </ul> <p>Ratios are compared to peers to determine relative valuation and likelihood that the company is over or undervalued.</p> <p>These techniques are useful to establish relative valuation, but less so to establish absolute valuation.</p> | <ul style="list-style-type: none"> <li>• Have earnings/cash flow been impacted by a climate event – e.g., flood, fire, shoreline impact?</li> <li>• What was the financial impact on earnings/cash flow that year/quarter?</li> <li>• What is the probability of repeat impact (low, medium, high) over the next 5 years?</li> </ul> <p><b>Sectors Predisposed to Ratio Analysis</b></p> <ul style="list-style-type: none"> <li>• Mining, Forestry, Petroleum, Utilities, Telecommunications, Auto</li> </ul> <p><b>Sectors Less Predisposed to Ratio Analysis</b></p> <ul style="list-style-type: none"> <li>• Financials, Legal, Life &amp; Health</li> </ul>   |
| <b>Discounted Cash Flow (DCF)</b> | <p>Absolute valuation of a company is achieved through a DCF analysis. DCF starts with a forecast of a company's future after-tax cash flows. These are adjusted to reflect capital expenditures necessary to sustain the business. This stream of cash flows is then discounted back to the present time using a discount rate which reflects the risk adjusted weighted average cost of capital of the company. The result is an estimate of the total enterprise value of a company.</p>  | <ul style="list-style-type: none"> <li>• Have future cash flow projections been impacted (negatively or positively), relative to initial value, by a climate change/extreme weather event?</li> <li>• Is \$ spread between current and future values increasing or decreasing since climate event?</li> <li>• Have appropriate discount rates been selected – accounting for risk of return – i.e., what is the likelihood of repeat impact to risk variables?</li> </ul> <p><b>Sectors Predisposed to DCF</b></p> <ul style="list-style-type: none"> <li>• Well established companies with steady growth and consistent levels of capital expenditures</li> <li>• Defensive Industries: Utilities, Oil, Gas, Banking, Telecommunications</li> </ul> <p><b>Sectors Less Predisposed to DCF</b></p> <ul style="list-style-type: none"> <li>• Small/start-up companies exposed to economic cycle</li> <li>• Cyclical Industries: Raw Materials, Consumer Discretionary</li> </ul> |
| <b>Rules of Thumb Valuation</b>   | <p>Many industries are valued using “rules of thumb” specific to their business. For example, in the electricity sector, the frequency and duration of electricity outages is an industry comparable.</p>  | <ul style="list-style-type: none"> <li>• Did business realize climate related impacts more/less than peers?</li> <li>• Relative to peer group (industry association) what precautions will ensure continuity of business operations?</li> <li>• What aspects of operations are vulnerable to business disruption relative to peers?</li> </ul>  |



**Table 3** *Continued*

|                                    | Description of Financial Valuation Method   | For Consideration by Issuers – Key Climate Specific Information Applicable to Valuation Method   |
|------------------------------------|---|--|
| <b>Economic Value Added (EVA®)</b> | EVA® is the difference between a company's net operating profits and its total cost of invested capital over a given time period. The capital charge is necessary to compensate providers of debt and equity for use of their capital, at a rate adequate for the risk incurred. If EVA® is positive, the company has created value. The market value of a company is equivalent to its invested capital plus the sum of all future EVA®. From this relationship, a company's enterprise value can be determined from a forecast of its EVA®. | <ul style="list-style-type: none"> <li>• Were positive returns realized following an extreme weather event?</li> <li>• Have liabilities increased since the extreme weather event? – higher operating costs, lower profits?</li> <li>• Has debt/equity ratio increased/decreased for companies that implemented adaptation measures?</li> <li>• Was average rate of return higher/lower compared to peers after climate event?</li> </ul> <p><b>Sectors Predisposed to EVA®</b></p> <ul style="list-style-type: none"> <li>• Applies to asset-intensive companies/ industries that are generally stable</li> <li>• Utilities, Mining, Industrials</li> </ul> <p><b>Sectors Less Predisposed to EVA®</b></p> <ul style="list-style-type: none"> <li>• Applies to those with intangible assets</li> <li>• Information Technology</li> </ul>  |
| <b>Option Pricing Models (OPM)</b> | Certain business activities create value for companies by providing alternatives or choices for the future. These choices or “options” do not necessarily have discrete cash flows but do provide tangible value for a company. Option pricing methods can be applied to these situations to provide a quantitative way to estimate and communicate the economic value of these choices. The technique is also useful when uncertainty of outcomes exists and more than one result is possible.   | <ul style="list-style-type: none"> <li>• Have underlying assets been impacted due to an extreme weather event?</li> <li>• Has intrinsic value increased/decreased due to an extreme weather event – i.e., is the strike price “in the money”?</li> <li>• After an extreme weather event, does extrinsic value (time value) exceed intrinsic value (financial advantage of exercising option)?</li> </ul> <p><b>Sectors Predisposed to OPM</b></p> <ul style="list-style-type: none"> <li>• High Option Value companies - high time values produce significant stock price movements – i.e., high volatility potentially generates higher returns</li> <li>• Information Technology</li> </ul> <p><b>Sectors Less Predisposed to OPM</b></p> <ul style="list-style-type: none"> <li>• Low Option Value companies - falling time values produce less movement in stock price - i.e., low volatility/ beta generate lower premiums</li> <li>• Utilities, Energy, Banking</li> </ul> |

From the perspective of portfolio management, there is no doubt that climate change and extreme weather risks can and should factor into business valuation. The rate at which these risks are included in financial analyses will be affected by ongoing and more severe weather impacting businesses spanning multiple industry sectors.

As climate risks transition from short to longer-term adjustments on stock price, presumably the capital markets will continue to pay increasing attention (TCFD 2019). The irreversibility of climate change effectively guarantees this realization (ECCC 2019) – i.e., it is not a matter of “if,” but rather “when”.

# CASE STUDY:

## Extreme Weather Impacts Applied to Financial Valuation

Climate risks can impact revenues, costs and risk profiles of companies, generally in a negative direction, causing earnings and cash flow to vary from expectations with growing regularity.

In 2017, just over 15% of S&P 500 companies disclosed an impact on earnings from an unforeseen weather effect, but only 4% quantified the effect – for those that did, the impact on earnings averaged 6% (S&P Global 2018). As argued by TCFD and the EPSF, the impact of these variances should be identified, quantified and factored into corporate valuation, or simply, stock price.

The value of a company is ultimately the present value of the stream of cash flows that can be produced in the future. In this regard, the three pertinent factors that are relevant are the **size** of the cash flows, the **timing** of the cash flows and the **risk** associated with achieving those cash flows. Extreme weather – and preparation to limit risk through the operationalization of adaptation – would have a direct impact on all three factors.

As mentioned, the impacts of climate risks are being recognized by a small but growing number of companies spanning a range of industry sectors (see Appendix 1), with disclosure in public documents improving to a level that translation of risk to stock valuations is possible.

To demonstrate how climate risk can be valued as part of overall stock price analysis, reference is made to TransAlta Corporation (an electricity power generator and wholesale marketing company headquartered in Calgary, Alberta, Canada) public disclosure material from 2018 and 2019. **TransAlta is on the leading edge of disclosure and provides detailed reviews of its operations and exposure to climate/weather risks.** It is not surprising that TransAlta focuses on these risks, as its production of electricity from coal, gas and wind in Canada, USA and Australia is predisposed to extreme weather events.

In 2018, the Climate Disclosure Program (CDP) – an international not-for-profit that documents information for investors, companies, cities, provinces, states and regions – completed an in-depth survey of TransAlta's operations relative to climate change. In this survey, TransAlta disclosed that climate related impacts were evaluated on a “six-month or more frequent” basis, future impacts were projected beyond six years, and such impacts “are discussed at every quarterly board meeting”. For TransAlta, climate related risks are substantive financial risks as they have a direct and measurable impact on the expected production and distribution of electricity from their various facilities. In particular, “where we are unable to produce sufficient quantities of output in relation to contractually specified volumes, we may be required to pay penalties or purchase replacement power in the market (TransAlta 2018).”

In Example 1 (below), the impact on financial valuation caused by incremental capital costs and expenses to adapt to extreme weather is calculated. TransAlta prepared for the likely impact that the increased severity of weather events would have on their facilities, particularly from cyclones and floods, by increasing “sustaining and productivity capital” by \$214 million in 2017.\* These expenditures are required on a sustaining and routine basis and thus have been assumed to continue each year for 5 years (although each year's capital budget for this unique category will vary).

\* Note: all TransAlta sustaining capital and productivity capital would not be directed towards climate resilience.



# EXAMPLE 1: VALUE OF SUSTAINING CAPITAL EXPENDITURES FOR EXTREME WEATHER PREPAREDNESS/CLIMATE RESILIENCE

**Event:** Capital expenditures related to ensuring plants and operating facilities are available to meet market demand and are prepared for extreme weather elements. These expenditures are pro-active and can-be-planned.

**Translation:** Additional capital investment and expenses = \$214 million per year commencing in 2017

*Valuation:*

Discounted Cash Flow

- i) Cost of Capital – 7.65% (Jarvi and Primak 2019)
- ii) Cash Flow to be value = -\$214 million/year over 5 years (forecast)
- iii) Present Value =  $PMT \times [(1 - (1/(1+r)^n))/r]$

*Where:*

PMT = the annual costs of Climate Resilience expenditures

r = the discount rate

n = the number of periods the costs will be incurred (5 years)

Present Value = \$862 million

- iv) Convert to Per Share Valuation

Shares outstanding in 2017 = 288 million

Per share valuation impact =  $\frac{\$862 \text{ million}}{288 \text{ million}}$   
= \$3.00 per share (rounded)

- v) **Conclusion:** The capital expenditures and costs associated with extreme weather preparedness has up to a \$3.00 per share negative impact on stock price. Furthermore, even if the expenditures incurred in 2017 were “one-time” only, the impact would be \$0.74 per share.

TransAlta has provided guidance regarding the impact of lost production on net earnings (CDP 2018). They

indicate that “a 1% increase or decrease in production (MWh) has an approximate impact on net earnings of (+/-) \$12 million.” In 2018, total net earnings at TransAlta was negative \$90 million, indicating that a 1% variance in power production would have a 13% impact on earnings. Although the valuation of specific extreme weather events will come later, the general impact of any event causing a 1% impact on production is calculable.

# EXAMPLE 2: VALUE OF AN EXTREME WEATHER EVENT THAT IMPACTS PRODUCTION BY 1%

**Event:** Any extreme weather event causing a 1% loss in production

**Translation:** The impact of a 1% production loss is +/- \$12 million in net earnings

*Valuation:*

Price/Cash Flow multiple

- a) Given that TransAlta was not profitable in 2018, assume that impacts on net earnings are effectively equivalent to a direct cash flow impact.
- b) Price/Cash Flow (2018) = 6.5 X (Jarvi and Primak 2019)
- c) Convert to Per Share valuation impact

Price impact =  $6.5 \times \$12 \text{ million/shares outstanding}$   
= \$72 million/287 million  
= \$0.25 per share

**Conclusion:** A 1% variance in production can impact the share price valuation by \$0.25 per share. Given that the average price of TransAlta stock in 2018 was \$6.98, this translates to a 3.6% impact on stock value.

Extreme weather impacts on TransAlta are acutely impactful on electricity production and pricing when they occur unexpectedly. For example, in 2019, Canadian coal and wind assets “benefited from higher power prices...reflecting the impact of extreme cold weather during the first quarter of 2019.”

For the first half of 2019, average electricity prices increased to \$63 per MWh from \$45 per MWh in 2018.\*

The positive impact on earnings before interest, tax, depreciation and amortization (EBITDA) from this increased pricing was estimated at approximately \$100 million. Using the methodology of Example 2, it can be estimated that the extreme cold of 2019 impacted TransAlta by over \$2.00 per share.

The extreme cold of the winter of 2019, however, did not just provide an opportunity for elevated electricity pricing. TransAlta's US Coal team experienced "a tail event" due to "cold weather and strong demand in the Pacific Northwest from extremely high natural gas prices" (caused by pipeline constraints in part linked to extreme weather). "The Company incurred cash losses of \$25 million on its day ahead hedging position (TransAlta 2019)."

The "tail event" resulted in EBITDA being down \$35 million compared to 2018. Combining all impacts (positive and negative) of the extreme cold, the first half of 2019 produced free cash flow that was "\$33 million lower ... for six months ending June 30, 2019 ... compared with the same period in 2018" (TransAlta 2019).



\* Note: higher power prices in 2019 vs. H1 2018 may have been affected by cold weather and additional factors

### EXAMPLE 3: VALUE OF UNEXPECTED EXTREME COLD WEATHER IN THE FIRST HALF OF 2019

**Event:** Extreme cold weather in North America in 2019

**Translation:** The net effect of positive and negative cash flow impacts estimated by the company at -\$33 million.

*Valuation:*

Price/Cash Flow multiple

- a) Price/Cash Flow (2019) = 7.0 X (Jarvi and Primak 2019)
- b) Convert to Per Share valuation impact

$$\begin{aligned}\text{Price impact} &= 7.0 \text{ X } -\$33 \text{ million/shares} \\ &\text{outstanding} \\ &= -\$231 \text{ million}/282 \text{ million} \\ &= \$0.82 \text{ per share}\end{aligned}$$

**Conclusion:** The extreme cold weather of 2019 has had an impact on share price valuation of \$0.82 per share – relative to a share price of TransAlta (November 2019) of \$8.49, this is equivalent to a 10% impact on share valuation.

Overall, extreme weather has impacted TransAlta's share price through both predictable preparedness costs and through volatility caused by operational disruptions – as illustrated, each of these isolated effects can be valued individually using conventional valuation methods.

In the previous examples, we demonstrated numerically how investment in extreme weather preparedness, or response to extreme weather events, has direct and measurable impact on share valuation. Even more meaningful is recognizing that not only is climate change altering the current risk profile of entire business operations, but it will continue to do so in the future. In other words, the predictability of future cash flows will have diminished and increasing volatility that should be valued into the overall investment merits of companies.

The increase in risk has a large and quantifiable impact on the value of future cash flows. The Discounted Cash Flow ("DCF") method calculates present value of future cash flows that a business produces. This is based upon a discount rate determined from cost of capital inputs and risk profile of the company.

Previous examples demonstrate that individual extreme weather events can impact share valuation by 5-10% on a case-by-case basis. Therefore it is reasonable to assume that Beta, cash flow volatility compared to the overall market or a diversified portfolio, should likely be increased by 5-10% to represent a recognition of the new risk profile.

## EXAMPLE 4: VALUATION IMPACT ON TRANSALTA'S OVERALL BUSINESS DUE TO INCREASED RISK

**Event:** Overall current and future occurrences of extreme weather on cash flows.

**Translation:** The impact of a 7.5% increase in Beta (mid-point of 5-10%) of TransAlta's overall DCF calculation.

Valuation: a) Adjust Cost of Equity to reflect increased risk

$$\text{Cost of Equity} = R_f + \beta (R_m - R_f)$$

$$R_f = \text{Risk free rate} = 3.50\%$$

$$(R_m - R_f) = \text{Market risk premium} = 7.00\%$$

$$\beta = \text{unsystematic risk} = 1.0 \text{ (current)}$$

(all values from Jarvi and Primak 2019)

$$\beta_{\text{new}} = \text{unsystematic risk with extreme weather adjustment}$$

$$\beta_{\text{new}} = 1.0 * (1.075)$$

$$\beta_{\text{new}} = 1.075$$

$$\text{Cost of Equity (current)} = 10.50\%$$

$$\begin{aligned} \text{Cost of Equity (new)} &= 3.5\% + 1.075 (7.0\%) \\ &= 11.03\% \end{aligned}$$

- b) Calculate new Weighted Average Cost of Capital with new Cost of Equity

$$\begin{aligned} \text{WACC new} &= \text{Cost of Equity new} \times \text{Equity Weight} + \\ &\text{Cost of Debt} \times \text{Debt Weight} + \text{Cost of Preferred Shares} \\ &\times \text{Preferred Share Weight} \end{aligned}$$

$$\text{WACC new} = 11.03\% \times 52\% + 5.75\% \times 38\% + 5.75\% \times 10\%$$

$$\text{WACC new} = 8.50\%$$

- c) Calculate DCF Valuation for increased WACC

i.  $\text{PV of 10 Years Cash Flows new} = \$3,827 \text{ million}$

ii.  $\text{PV of Terminal Value new}$

$$= \frac{[\text{FCF 10th year} \times (1 + g)]}{(1 + \text{WACC new})^{10}}$$

where;

$$\text{FCF 10th year} = \text{final year cash flow from step i)}$$

$$g = \text{terminal growth rate} = 0.83\%$$

$$\text{PV of Terminal Value new} = \$3,254$$

$$\text{DCF Valuation new} = \text{value from i)} + \text{value from ii)}$$

$$= \$3,827 \text{ million} + \$3,254 \text{ million}$$

$$= \$7,081 \text{ million}$$

- 1) Calculate Share Price

$$\text{NPV to Common Equity} = \text{DCF} - \text{Debt} - \text{Pref} - \text{Minority Interest}$$

$$\text{NPV to Common Equity} = \$7,081 - 2,669 - 942 - 1,610$$

$$\text{Common Equity} = \$1,860 \text{ million}$$

$$\text{Per Share Value new} = \$6.62$$

$$\text{Previous DCF Share value} = \$9.64$$

**Conclusion:** The overall inclusion of extreme weather risk in the DCF Valuation of TransAlta reduces the stock value estimate from \$9.64 per share to \$6.62 per share.

The discussion now turns to the need to identify climate change and extreme weather impacts that may affect financial valuation, as informed by industry specific subject matter experts.





## ROLE OF SUBJECT MATTER EXPERTS

Subject matter experts, **who generally reside within industry associations**, are key to advancing the inclusion of climate change and extreme weather risk into institutional portfolio management. Material risks are best identified by industry members with “on the ground” experience – these are professionals with decades of field experience on an individual basis, and hundreds of years of experience collectively. Subject matter experts, although not infallible, can draw upon their experience, with insight unmatched through any other means, to identify material expressions of how flood, fire, ice loading, wind, etc. affect business operations/continuity.

As climate change continues to affect virtually all business sectors, it would be prudent for industry associations to engage their membership to develop Climate Risk Matrices – subsequently, as this information becomes available, financial analysts could utilize this information. Subject matter experts from across industry sectors must work hand-in-hand with the capital markets/financial

analysts if recommendations by TCFD (2019) and Macklem et al. (2019) are to become commonplace. It is in the interest of industry sectors to contribute their expertise to risk identification, as financial specialists, left on their own with limited operational experience, can easily end up chasing the wrong “climate risk rabbit”.

There is a fortuitous predisposition within industry sectors that could lead to the creation of Climate Risk Matrices with relative ease. When industry associations meet, annually or bi-annually, they could create “climate risk committees” to create Climate Risk Matrices similar to Tables 1 and 2 (see pages 9 and 10).

Within many industry sectors, climate related information is publicly available through industry associations and/or professional associations. For those sectors that have a high percentage of associations reporting on climate change, they may be prime candidates to pursue the creation of Climate Risk Matrices (e.g., as per Appendix 1, these include: Materials – 100%; Energy – 100%; Utilities – 87%; Industrials – 67%; Real Estate – 63%).

A solid foundation for industry sectors to develop Climate Risk Matrices has been established in some spheres: for example, the chemical sector (WBCSD – Chemical 2019) and electric utilities (WBCSD – Electric 2019).







# BENEFICIARIES OF CLIMATE RISK MATRICES

Beyond the utility that Climate Risk Matrices would convey to institutional investors, other stakeholders would also benefit from climate change and extreme weather risk guidance.

**Securities Commissions:** Relative to enforcement of a “comply-or-explain” mandate for issuers reporting on climate risk (sensu Macklem et al. 2019), securities commissions have limited guidance as to what would constitute acceptable disclosure, per industry sector, relative to multiple forms of climate impact (Evain et al. 2018).

Climate Risk Matrices would provide securities commissions with a prioritized baseline of acceptable industry-specific climate risk disclosure – i.e., the “explain” part of comply-or-explain – that would help to empower commissions to enforce their mandate.

**Credit Rating Agencies:** The impacts of climate change and extreme weather risk could affect a borrower’s capacity to repay a lender (Moody’s 2017, Tigue 2019). As such, credit rating agencies should incorporate climate risk into credit rating assignments. Growing recognition of the importance of climate risk to credit rating agencies is reflected in Moody’s Corporation purchasing a controlling stake in Four Twenty Seven, a California-based company that measures a range of hazards, including extreme rainfall, hurricanes, heat stress and sea level rise, and tracks their impact on 2,000 companies and 196 countries (Flavelle

2019). This acquisition signifies a meaningful step toward financial institutions committing to the realization that climate risk should enter into any evaluation of the financial strength of any government or company and their ability to repay debt.

Access to Climate Risk Matrices would help inform credit rating agencies such as Moody’s, Standard & Poor’s, DBRS and Fitch Ratings (Tigue 2019).

**Boards of Directors:** From the perspective of fiduciary oversight, it is incumbent upon Boards to ensure that management is directing appropriate attention to climate change and extreme weather risk (CPA 2017, Wylnco and Musulin 2019, Geneva Association 2019). Upon recognition of risk that may be material, a Board must be satisfied that management is appropriately engaged to address that risk. The difficulty for Boards in executing on this direction may be a combination of (a) the appropriate expertise may not exist amongst Board members to assess climate-related risk, and/or (b) Boards not having appropriate guidance that would enable them to ask the appropriate questions of management in reference to climate related risk. Boards could hire expertise to gain insight into risk, but even that expertise may be nascent or poorly informed (Tooze 2019, Geretto and Jacques-Brissette 2019).

Climate Risk Matrices could fill this risk awareness void by concisely conveying to Board members, in user-friendly format, material risks pertaining to climate change and extreme weather that could inform a dialogue with management. By simply asking well informed questions to management on the subject of climate risk, Boards would signal that they attach importance to the issue, and they would demonstrate due diligence that could serve them well if a material risk were to manifest itself (Wylnko and Musulin 2019).

“

**Climate Risk Matrices could fill a risk awareness void by concisely conveying to Board members, in user-friendly format, material risks pertaining to climate change and extreme weather that could inform a dialogue with management.”**



## → NEXT STEPS

Time is not on the side of institutional investors regarding irreversible climate change (ECCC 2019), as the magnitude of extreme weather risks guarantees to challenge all industry sectors going forward. Accordingly, institutional investors, securities commissions and credit rating agencies must adapt their businesses to this unrelenting risk.

The capital markets must acknowledge that there is no such thing as “not deciding” relative to climate risk – deciding to ignore climate risk is effectively a decision to select for the status quo (i.e., business as usual), whereas incorporating climate risk into financial valuation is adaptive management that will limit future beta/risk (Economist 2015).

The development of Climate Risk Matrices offers a practical, accessible, cost-effective and user-friendly standardized method to incorporate physical climate change risk into institutional portfolio management. Climate risks are predisposed to translation to impact on valuation and share price, using a variety of standardized financial valuation methods, as demonstrated in this report.

Future incarnations may see climate risk calculated using such sophisticated means as artificial intelligence, machine language or similarly advanced technologies – however, for the present, Climate Risk Matrices offer a viable **early stage solution** to incorporate climate risk into portfolio management almost immediately.

The next step to create Climate Risk Matrices requires major institutional investors reaching out to subject matter experts, who would be most easily accessed and assembled into working groups through industry associations – by combining the skill sets of investors and subject matter experts (neither can succeed alone), the scaled production of Climate Risk Matrices, across sectors, can begin. Sectors best positioned for Climate Risk Matrix development, based on self-reported and readily available climate change data, are **Materials, Energy, Utilities, Industrials and Real Estate**.

In sum, financial value is at increasing risk due to the irreversibility of climate change. Recognizing the enormity of this risk, Mark Carney admonished that “climate disclosure must become comprehensive, climate risk management be transformed, and sustainable investing must go mainstream” (Green 2019). **Climate Risk Matrices offer a readily deployable means to act on Carney’s admonition, NOW.**

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**Appendix 1: Industry Sector Disclosure/Non-Disclosure on Climate Change\*, Available Publicly Through Industry Associations and Professional Organizations (\* includes any aspect of climate change discussion. Source: Intact Centre review of public documents as of 12/23/19.)**

| Sector/Subsector   | Industry Associations  | Publicly Available Climate Information – Disclosed/Not Disclosed   |
|--|--|--|
| <b>Sector:</b><br>Communication Services<br><br><b>Subsectors:</b><br>Telecommunication Services, Media & Entertainment<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 23.5%                                   | <b>Sector Associations:</b><br>1) Canadian Communication Association<br>2) Canadian Communication Systems Alliance (CCSA)<br><br><b>Subsector Associations:</b><br>3) Canadian Wireless Telecommunications Association<br>4) Canadian Media Producers Association<br>5) News Media Canada<br>6) Travel Media Association of Canada<br>7) Canadian Association of Journalists<br>8) Canadian Ethnic Media Association<br>9) Women in Communications and Technology<br>10) Association of Canadian Advertisers<br>11) Association of Canadian Publishers<br>12) Canadian Association of Broadcasters<br>13) Canadian Public Relations Society Inc.<br>14) Canadian Authors' Association<br>15) Canadian Digital Media Network<br>16) Entertainment Software Association of Canada<br>17) Motion Picture Association of Canada  | 1) Not Disclosed<br>2) Not Disclosed<br><br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) Not Disclosed<br>6) Not Disclosed<br>7) <b>Disclosed</b><br>8) Articles on CC<br>9) Not Disclosed<br>10) Not Disclosed<br>11) Not Disclosed<br>12) Not Disclosed<br>13) Not Disclosed<br>14) Not Disclosed<br>15) Articles on CC<br>16) Not Disclosed<br>17) <b>Disclosed</b>   |
| <b>Sector:</b><br>Consumer Discretionary<br><br><b>Subsectors:</b><br>Automobiles & Components, Consumer Services, Consumer Durables & Apparel, Retailing<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 54.2% | <b>Sector Associations</b><br>1) Consumers' Association of Canada<br><br><b>Subsector Associations</b><br>2) Auto Parts Manufacturers Association<br>3) Automotive Industries Association of Canada<br>4) Automotive Parts Manufacturers' Association<br>5) Canadian Automobile Dealers Association<br>6) Canadian Automotive Partnership Council<br>7) Canadian Manufacturers and Exporters<br>8) Canadian Vehicle Manufacturers' Association<br>9) Global Automakers of Canada<br>10) Japan Automobile Manufacturers' Association of Canada<br>11) North American Automobile Trade Association<br>12) The Association for the Work Truck Industry (NTEA)<br>13) Used Car Dealers Association of Ontario<br>14) Atlantic Marine Trades Association (AMTA)<br>15) Boating BC Association (BBA)<br>16) National Marine Manufacturers Association (NMMA)<br>17) Apparel Connexion (formerly known as the Apparel Human Resources Council)<br>18) CTT Group<br>19) The Canadian Apparel Federation (CAF)<br>20) Canadian Sporting Goods Association<br>21) The Canadian Home Furnishings Alliance (CHFA)<br>22) Canadian Kitchen Cabinet Association (CKCA)<br>23) The Quebec Furniture Manufacturers Association (QFMA)<br>24) Canadian Printing Industries Association (CPIA) | 1) <b>Disclosed</b><br><br>2) Articles on CC<br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b><br>7) <b>Disclosed</b><br>8) <b>Disclosed</b><br>9) <b>Disclosed</b><br>10) Articles on CC<br>11) Not disclosed<br>12) <b>Disclosed</b><br>13) Not Disclosed<br>14) Not Disclosed<br>15) <b>Disclosed</b><br>16) <b>Disclosed</b><br>17) Not Disclosed<br><br>18) <b>Disclosed</b><br>19) Not Disclosed<br>20) Not Disclosed<br>21) Not Disclosed<br>22) <b>Disclosed</b><br>23) Not Disclosed<br>24) Not Disclosed |

| Sector/Subsector  | Industry Associations   | Publicly Available Climate Information – Disclosed/Not Disclosed  |
|---|---|---|
| <b>Sector:</b><br>Energy<br><br><b>Subsectors:</b><br>Energy Services<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 100%   | <b>Sector Associations</b><br>1) Energy Services Association of Canada<br>2) Ontario Energy Association<br>3) Community Energy Association<br>4) Ontario Energy Board<br><br><b>Energy/Utilities</b><br>5) Canadian Energy Pipeline Association<br>6) Ontario Sustainable Energy Association  | 1) <b>Disclosed</b><br>2) <b>Disclosed</b><br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b>  |
| <b>Sector:</b><br>Financials<br><br><b>Subsectors:</b><br>Insurance, Banks, Diversified Financials<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 47.8%   | <b>Sector Associations</b><br>1) Canadian Consumer Finance Association<br>2) The Canadian Association of Financial Institutions in Insurance<br>3) Canadian Bankers Association<br>4) Investment Industry Association of Canada<br>5) Investment Industry Regulatory Organization of Canada (IIROC)<br><br>6) The Financial Advisors Association of Canada<br>7) Canadian Finance and Leasing Association of Canada<br>8) The Association for Financial Professionals<br>9) CFA Society Canada<br>10) Insurance Brokers Association of Canada<br>11) Insurance Bureau of Canada<br>12) Financial Services Commission of Ontario<br>13) Insurance Brokers Association of Ontario<br>14) Registered Insurance Brokers of Ontario<br>15) Alberta Insurance Council<br>16) Insurers Brokers Association of Alberta<br>17) New Brunswick Insurance Board<br>18) Insurance Brokers Association of New Brunswick<br>19) Consumer Advocate for Insurance<br>20) Insurance Brokers Association of Newfoundland<br>21) Insurance Brokers Association of Nova Scotia<br>22) Financial Executives International Canada<br>23) Sustainable Investment Organization | 1) Not Disclosed<br>2) <b>Disclosed</b><br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) Letter from SIO regarding KYC and ESG guidelines<br>6) Not Disclosed<br>7) Not Disclosed<br>8) Articles on CC<br>9) Articles on CC<br>10) <b>Disclosed</b><br>11) <b>Disclosed</b><br>12) Articles on CC<br>13) <b>Disclosed</b><br>14) Not Disclosed<br>15) Not Disclosed<br>16) Not Disclosed<br>17) Not Disclosed<br>18) <b>Disclosed</b><br>19) Not Disclosed<br>20) <b>Disclosed</b><br>21) <b>Disclosed</b><br>22) <b>Disclosed</b><br>23) <b>Disclosed</b> |
| <b>Sector:</b><br>Health Care<br><br><b>Subsector:</b><br>Health Care Equipment & Services, Pharmaceuticals, Biotechnology & Life Sciences<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 51.3% | <b>Sector Associations</b><br>1) Canadian Institute for Health Information<br>2) BC Health Information Management Professionals Society<br>3) Canadian College of Health Leaders<br>4) The Canadian Coalition for Green Health Care<br>5) Canadian Cancer Society<br>6) Canadian Health Information Management Association<br>7) Canadian Home Care Association<br>8) Canadian Medical Association<br>9) Canadian Medical Protective Association<br>10) Canadian Mental Health Association<br>11) Canadian Nurses Association<br>12) Canadian Patient Safety Institute<br>13) Canadian College of Health Leaders<br>14) Canadian Pharmacists Association<br>15) Digital Health Canada<br>16) Heart and Stroke Foundation<br>17) Institute for Safe Medication Practices Canada (ISMP Canada)  | 1) <b>Disclosed</b><br>2) Not Disclosed<br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b><br>7) Not Disclosed<br>8) <b>Disclosed</b><br>9) Not Disclosed<br>10) Not Disclosed<br>11) <b>Disclosed</b><br>12) <b>Disclosed</b><br>13) <b>Disclosed</b><br>14) <b>Disclosed</b><br>15) Not Disclosed<br>16) Articles on CC<br>17) Articles on weather and health  |

| Sector/Subsector   | Industry Associations   | Publicly Available Climate Information – Disclosed/Not Disclosed  |
|--|---|---|
| <b>Sector:</b><br>Health Care<br>(Continued)   | 18) ITAC Health – Information Technology Association of Canada<br>19) JDRF<br>20) MedicAlert Foundation Canada<br>21) Ontario Telemedicine Network<br>22) Patients Canada<br>23) Patients for Patient Safety Canada<br>24) The Lung Association (Ontario)<br>25) BIOTEC Canada<br>26) Canadian Generic Pharmaceutical Association<br>27) Innovative Medicines Canada<br>28) Consumer Health Products Canada<br>29) LifeSciences British Columbia<br>30) BioAlberta<br>31) Life Science Association of Manitoba<br>32) Ontario Bioscience Innovation Organization<br>33) Life Sciences Ontario<br>34) BIOQuébec (French only)<br>35) BioNova<br>36) PEI BioAlliance<br>37) Newfoundland and Labrador Association of Technology Industries<br>38) Association of Cooperative Counselling Therapists of Canada<br>39) HealthCareCAN  | <b>18) Disclosed</b><br>19) Articles on weather and health<br>20) Not Disclosed<br>21) Not Disclosed<br>22) Not Disclosed<br>23) Not Disclosed<br><b>24) Disclosed</b><br><b>25) Disclosed</b><br>26) Not Disclosed<br>27) Not Disclosed<br>28) Articles on CC<br>29) Not Disclosed<br><b>30) Disclosed</b><br><b>31) Disclosed</b><br>32) Not Disclosed<br><b>33) Disclosed</b><br>34) Not Disclosed<br><b>35) Disclosed</b><br><b>36) Disclosed</b><br><b>37) Disclosed</b><br>38) Not Disclosed<br><b>39) Disclosed</b>                      |
| <b>Sector:</b><br>Industrials<br><br><b>Subsector:</b><br>Commercial & Professional Services, Transportation, Capital Goods<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 66.7% | <b>Sector Associations</b><br>1) Transportation Association of Canada<br>2) Canadian Transportation Equipment Association<br>3) Canadian Urban Transit Association<br>4) Alberta Transportation<br>5) Department of Transportation and Works (NB)<br>6) Transportation and Infrastructure Renewal (NFL)<br>7) Department of Transportation, Infrastructure and Energy (PEI)<br>8) Canadian Manufacturing Coalition<br><br>9) Canadian Trucking Alliance<br>10) Canadian International Freight Forwarding Association<br><br>11) Ontario Trucking Association<br>12) Association of Professional Canadian Consultants<br>13) Canadian Bar Association<br>14) Association of Canadian Advertisers<br>15) Ontario Association of Architects<br>16) Chartered Professional Accountants Canada<br>17) Professional Engineers Ontario<br><br>18) Canadian Association of Management Consultants | <b>1) Disclosed</b><br><b>2) Disclosed</b><br><b>3) Disclosed</b><br><b>4) Disclosed</b><br><b>5) Disclosed</b><br><b>6) Disclosed</b><br><b>7) Disclosed</b><br>8) Articles on CC – redirects to members that disclose<br><b>9) Disclosed</b><br>10) Not Disclosed – redirects to government websites<br>11) Articles – same as #9<br>12) Not Disclosed<br><b>13) Disclosed</b><br>14) Not Disclosed<br><b>15) Disclosed</b><br><b>16) Disclosed</b><br><b>17) Disclosed</b> – Environmental Site Assessment Subcommittee<br>18) Not Disclosed |

| Sector/Subsector   | Industry Associations  | Publicly Available Climate Information – Disclosed/Not Disclosed  |
|--|--|---|
| <b>Sector:</b><br>Information Technology<br><br><b>Subsector:</b><br>Technology Hardware & Equipment, Semiconductors & Semiconductor Equipment, Software & Services<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 16.7% | <b>Sector Associations</b><br>1) Information Technology Association of Canada<br><br><b>Subsector Associations</b><br>2) Canada's Association of I.T. Professionals<br>3) Information and Communications Technology Council<br>4) Canadian Information Processing Society<br>5) Canadian Technology Immigration Network<br>6) Alliance of Technology and Science Specialists of Toronto Inc. (ATSS)  | 1) <b>Disclosed</b><br><br>2) Articles on CC<br>3) Not Disclosed<br>4) Not Disclosed<br>5) Not Disclosed<br>6) Not Disclosed – redirects to sustainable members   |
| <b>Sector:</b><br>Materials<br><br><b>Subsectors:</b><br>Materials<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 100%   | <b>Sector Associations</b><br>1) Canadian Plastics Industry Association<br>2) Natural Resource Canada<br>3) Tire and Rubber Association of Canada<br>4) Canadian Association of Recycling Industries<br>5) Grain Growers of Canada (consumer staples?)<br>6) Forest Products Association<br>7) APA-The Engineered Wood Association<br>8) The Mining Association of Canada  | 1) <b>Disclosed</b><br>2) <b>Disclosed</b><br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b><br>7) <b>Disclosed</b><br>8) <b>Disclosed</b>  |
| <b>Sector:</b><br>Real Estate<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 62.5%   | <b>Sector Associations</b><br>1) Canadian Real Estate Association<br>2) Real Estate Institute of Canada<br>3) Ontario Real Estate Association<br>4) REALPAC<br>5) British Columbia Real Estate Association<br>6) New Brunswick Real Estate Association<br>7) Manitoba Real Estate Association<br>8) Canadian National Association of Real Estate Appraisers  | 1) <b>Disclosed</b><br>2) Not Disclosed<br>3) <b>Disclosed</b><br>4) <b>Disclosed</b><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b><br>7) Articles on CC<br>8) Not Disclosed  |
| <b>Sector:</b><br>Utilities<br><br><b>Subsectors:</b><br>Electrical, Oil, Gas<br><br><b>Total % of listed Sector/Subsectors that disclose:</b> 86.8%   | <b>Sector Associations</b><br>1) Canadian Electricity Association<br>2) Canadian Gas Association<br>3) Canadian Heavy Oil Association<br><br>4) Canadian Association of Petroleum Producers<br>5) Canadian Propane Association<br>6) Canadian Water & Wastewater Association<br>7) Newfoundland & Labrador Public Utilities Board<br>8) Nova Scotia Utility and Review Board<br>9) Clean Energy Association of Canada<br>10) Canadian Council on Renewal Electricity<br>11) Canadian Wind Association<br>12) Independent Electricity Systems Operator<br>13) BC Hydro<br>14) SaskPower<br>15) Nova Scotia Power<br>16) Toronto Hydro | 1) <b>Disclosed</b><br>2) <b>Disclosed</b><br>3) Not Disclosed – members are environmental specialists<br>4) <b>Disclosed</b><br>5) <b>Disclosed</b><br>6) <b>Disclosed</b><br>7) <b>Disclosed</b><br>8) <b>Fire Disclosed</b><br>9) <b>Disclosed</b><br>10) <b>Disclosed</b><br>11) <b>Disclosed</b><br>12) <b>Disclosed</b><br>13) <b>Disclosed</b><br>14) <b>Disclosed</b><br>15) <b>Disclosed</b><br>16) <b>Disclosed</b> |



| Sector/Subsector  | Industry Associations   | Publicly Available Climate Information – Disclosed/Not Disclosed   |
|---|---|--|
| <b>Sector:</b><br>Utilities<br>(Continued)  | 17) Maritime Electric<br>18) PEMBINA<br>19) Electro-Federation Canada (EFC)<br>20) Canadian Energy and Utility Regulations<br>21) Canadian Communication Systems Alliance<br>22) The Heating, Refrigeration and AC Institute of Canada<br>23) Alberta Land Surveyor's Association<br>24) Canadian Association Geophysical Contractors (CAGC)<br>25) Canadian Association of Oilwell Drilling Contractors (CAODC)<br>26) Canadian Association of Petroleum Landmen<br>27) Canadian Energy Pipeline Association<br>28) Canadian Fuels Association<br>29) Canadian Global Exploration Forum<br><br>30) Canadian Society of Exploration Geophysicists<br>31) Canadian Society of Petroleum Geologists<br>32) Canadian Society for Unconventional Resources (CSUR)<br>33) Canadian Well Logging Society<br>34) Clean Resource Innovation Network (CRIN)<br>35) Explorers and Producers Association of Canada (EPAC)<br><br>36) Gas Processing Association Canada<br>37) Petroleum Technology Alliance of Canada (PTAC)<br>38) Society of Petroleum Engineers – Canada Region | 17) <b>Disclosed</b><br>18) <b>Disclosed</b><br>19) <b>Disclosed</b><br>20) <b>Disclosed</b><br>21) Not Disclosed<br>22) <b>Disclosed</b><br>23) <b>Disclosed</b><br>24) <b>Disclosed</b><br>25) <b>Disclosed</b><br>26) <b>Disclosed</b><br>27) <b>Disclosed</b><br>28) <b>Disclosed</b><br>29) Case studies – must be a member to view<br>30) <b>Disclosed</b><br>31) <b>Disclosed</b><br>32) <b>Disclosed</b><br>33) Not Disclosed<br>34) <b>Disclosed</b><br>35) Articles on CC and/or redirects to government website<br>36) <b>Disclosed</b><br>37) <b>Disclosed</b><br>38) <b>Disclosed</b> |
| <b>Sector:</b><br>Consumer Staples<br><br><b>Subsectors:</b><br>Food & Staples<br>Retailing, Household & Personal Products, Food<br>Beverage & Tobacco<br><br><b>Total % of listed Sector/Subsectors that disclose: 53.3%</b> | <b>Sector Associations</b><br>1) Consumers' Association of Canada<br>2) Canadian Health Food Association<br>3) Food & Consumer Products of Canada<br>4) Food & Beverage Canada<br>5) Imperial Tobacco Canada<br>6) Baking Association of Canada<br>7) Consumer Health Products Canada<br><br>8) Cosmetic Alliance Canada<br><br>9) Canadian Natural Products Association<br>10) Canadian National Millers Association<br>11) Canadian Pasta Manufactures Association<br>12) Canadian Pastry Chefs Guild<br>13) Beer Canada<br>14) Canadian Beverage Association<br>15) Canadian Bottled Water Association   | 1) <b>Disclosed</b><br>2) <b>Disclosed</b><br>3) <b>Disclosed</b><br>4) Not Disclosed<br>5) Not Disclosed<br>6) Not Disclosed<br>7) <b>Disclosed</b> – Plastic action plan<br>8) Articles on CC but must be member to login<br>9) Not Disclosed<br>10) <b>Disclosed</b><br>11) Not Disclosed<br>12) Not Disclosed<br>13) <b>Disclosed</b><br>14) <b>Disclosed</b><br>15) <b>Disclosed</b>  |



**“The framework presented in this report provides a solid and practical way to assess and value physical climate risks, supporting improved disclosure and better pricing of climate risks.”**

**Tiff Macklem**, Chair, Expert Panel on Sustainable Finance

**“Climate change and extreme weather risks can represent challenges for capital markets. This report provides practical guidance that will help the financial sector to better incorporate climate risk into financial valuation.”**

**Brian Porter**, President and Chief Executive Officer, Scotiabank

**“Understanding the financial impacts of climate change necessitates the building of new data bridges between asset owners and the companies they invest in. This framework demonstrates how we can use new climate-related data about company risks with existing valuation models to get decision-ready results.”**

**Sonia Baxendale**, President and CEO, Global Risk Institute

**“We need to better understand the impacts of climate change on the financial performance of companies. This report provides a practical framework for how businesses should disclose, and how investors should evaluate physical climate risks to help us build a more prosperous and resilient society.”**

**Charles Brindamour**, Chief Executive Officer, Intact Financial Corporation

**“The climate related tools in this report conform well with the risk management protocols that have become convention since the financial crisis.”**

**Mike Pedersen**, Chair of the Board of Business Development Bank of Canada

**“This report establishes a framework for institutional investors to ask issuers industry-specific questions regarding their vulnerability to climate change induced risk.”**

**Marcia Moffat**, Managing Director, BlackRock Canada

**“Identification of industry-specific physical climate risks, through the process presented in this report, may provide practical input to assist credit rating agencies.”**

**Douglas Turnbull**, Vice-Chairman, Country Head, Canada, DBRS

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**“Climate change is a global challenge that has presented—and will continue to present—risks for businesses and communities around the world.”**

**Jamie Dimon**, Chairman and CEO, JPMorgan Chase & Co.

**“WHEN THE WELL’S DRY, WE KNOW THE WORTH OF WATER.”**

**Benjamin Franklin**



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