OUTLINE OF PROPOSED EVIDENCE

Introduction 5

1. Oil sands production: evidence of growth to 2030 5
2. Oil sands emissions: evidence of increase to 2030 6
3. Evidence about the capability of technology to reduce oil sands emissions 8
   - Carbon intensity 9
   - Carbon capture and storage technology 10
4. Evidence about Alberta's 100 Mt cap on oil sands emissions 11
5. Evidence on the growth of oil and gas sector emissions to 2030 12
   - Methane emissions 13
   - Promised additional measures for the oil and gas sector 14
6. Evidence about Alberta's emissions to 2030 15
   - Government of Canada's projections 15
   - Province of Alberta's projections 16
   - Alberta Climate Leadership Report 17
7. Evidence about Canada's emissions to 2030 18
8. National Energy Board (NEB) inquiry report (May 19, 2016) 19
9. Trans Mountain upstream emissions report (November 25, 2016) 21
   - The report unequivocally endorses the expansion of oil sands production to 2040 21
   - The report confirms that oil sands emissions will continue to grow to 2030 22
   - Does not answer whether oil sands emissions growth is consistent with the 2030 target 22
   - The report finds that incremental emissions from the project will be "minimal" 24
   - The Trans Mountain upstream emissions assessment was a closed process 25
10. The Ministerial Panel on the Trans Mountain Pipeline (November 1, 2016) 26
11. The Order in Council (November 29, 2016) 26
    - The Order cites the upstream emissions assessment report 27
    - The reference to Alberta's 100 Mt cap 28
    - The claim that "incremental emissions are unlikely" 28
    - Reference to the Ministerial Panel report 30
12. *Pan-Canadian Framework on Climate Change* (December 9, 2016) 30

Additional measures 31
Purchase of carbon credits: 59 Mt 32
The other promised 66 Mt of future reductions 32
Carbon pricing 33
The plan is dependent on uncertain future action by provincial governments 34
The plan excludes proposed LNG development in B.C. 34
13. Global oil consumption to 2040 35
14. Evidence about global CO_2 emissions 36
Regional trends 38
Economic growth and carbon emissions 39
Increased CO_2 emissions in 2017 40
15. Evidence about the atmospheric carbon concentration level 41
16. Evidence about mitigation scenarios 44
Global emissions reductions must begin by about 2020 44
Baseline scenarios 45
Mitigation scenarios 47
The problem of time 48
Oil accounts for 34% of global CO_2 emissions 49
Accumulation of CO_2 in the oceans 49
The economic constraints on rapid emissions reductions 50
17. The global emissions gap and the significance of Canada's commitment 50
The UN Emissions Gap Report 52
The emissions gap and the 1.5°C pathway 55
The IPCC Special Report on Global Warming of 1.5°C 55
18. Evidence about the consequences of climate change 57
Evidence about warming (rising global mean surface temperature) 57
Evidence about warming in particular regions: the case of South Asia 60
Evidence about increase of extreme weather events 60
Evidence about glacier loss and consequential impacts 61
British Columbia: the loss so far 62
Glaciers in South Asia 62
Evidence about sea level rise 63
Impact of rising temperature on the hydrological cycle 64
Acidification of the oceans 64

Additional serious risks 64
APPENDICES: ADDITIONAL DETAILS OF PROPOSED EVIDENCE 65
A. The Government of Canada's emissions projections to 2030 65
The National Inventory Report (April 17, 2018) 66
B. The Government of Canada's commitments 69
C. Technology and the carbon intensity of oil sands extraction 71
The background of CCS technology 73
The abandonment of CCS in Alberta 74
The fate of CCS in the oil sands 75
D. Alberta's 100 Mt oil sands emissions "cap" 78
December 2013: Canada's Sixth National Report on Climate Change 78
February 2016: Canada's Second Biennial Report on Climate Change 78
January 2017: Canada's 2016 Greenhouse Gas Emissions Reference Case 79
December 29, 2017: *3rd Biennial Report* 79
E. Reduction of methane emissions 80
F. Meeting the 2030 target of 517 Mt 81
G. The methodology (*Canada Gazette*, March 19, 2016) 82
H. The Trans Mountain upstream emissions assessment 84
I. The *Pan-Canadian Framework* (December 9, 2016) 85
Transportation 88
Heavy industry 89
J. Report of the Auditors General (March 27, 2018) 90
K. Carbon pricing 91
L. British Columbia and its planned LNG industry 92
No assessment of impacts on emissions reduction targets for 2030 93
LNG exports to Asia 94
B.C. Government consultation: July 2018 95
Existing emissions intensity benchmarks for LNG in B.C. 96
The scope of the LNG emissions problem 97
M. Global oil consumption and the 2°C limit 97
N. The Trans Mountain upstream emissions report and the 2°C limit 99
O. The Ministerial Panel report and the 2°C limit 101
P. Oil sands expansion and the 2°C limit: additional proposed evidence 103
Q. Federal Court of Appeal decision (August 30, 2018) 105

R. Climate sensitivity: warming and the level of atmospheric carbon 107
S. Additional evidence on mitigation scenarios 109
The IPCC Report: September 27, 2013 110
"Business-as-usual" approach: RCP8.5 111
Delay cuts until 2040-2060: RCP6.0 and RCP4.5 111
Start cuts in 2020: RCP2.6 112
T. The global emissions gap and Canada's commitment 112
U. Evidence about glacier loss and impacts on human settlement 115
Measurement of glacier loss 116
Response of glaciers to temperature change 116
The high mountains of Asia 117
Water supply: the example of Chinese Central Asia 117
Outcome 119

David Gooderham
November 21, 2018

Introduction

The economic rationale underlying the approval of the Trans Mountain pipeline project is the planned expansion of Canada's oil sands production from the 2015 level of 2.5 million barrels per day to 4.5 million by 2040.

The evidence at trial will show that, between now and 2030, technological innovation cannot lower carbon intensity per barrel fast enough to alter the existing trend, in which emissions continue to increase in step with rising production. The Government of Canada's most recent numbers (*Canada's 3rd Biennial Report*, December 29, 2017) tell the story:

Figure i: Oil sands emissions and production figures from *Canada's 3rd Biennial Report*

	2005	2015	2020	2030	change 2015-2030
Emissions	35	71	89	115	**+44 Mt CO_2eq**
Production	1.065	2.526	3.361	4.236	**+1.719 million bpd**

Source: *Canada's 3rd Biennial Report to UNFCCC* (December 29, 2017), Table 5.9

If we continue to expand oil sands output as currently projected, annual greenhouse gas (GHG) emissions in that industry will be about 44 million tonnes (Mt) higher by 2030 than they were in 2015.

The question is whether this 44 Mt increase can be reconciled with Canada's commitment under the December 2015 Paris Agreement to reduce our total emissions 30% by 2030 below the 2005 level, down to 517 Mt. Under current policies, the total is expected to be 722 Mt by 2030. To meet the target, cuts of 200 Mt will have to be achieved within the next decade.

→ **Appendix A provides an outline of the evidence that will be presented at trial about Canada's current emissions, and projected emissions to 2030. Appendix B outlines the evidence about the emissions reduction commitments made by Canada.**

1. Oil sands production: evidence of growth to 2030

1.1 The economic foundation for the continued expansion of Canada's oil sands production is explained in a report published by the National Energy Board (NEB) on January 27, 2016, *Canada's Energy Future 2016*: *Energy Supply and Demand Projections to 2040.* The NEB concluded that global oil consumption, especially in Asia, would likely continue to grow for at least another twenty-five years. Based on that projection of increasing oil demand worldwide for several more decades, the NEB forecast that Canada's oil sands production would increase from the 2014 level of 2.4 million barrels per day (bpd) to 4.8 million bpd by 2040 – a doubling of production.

1.2 In October 2016, the NEB published an update (titled *Canada's Energy Future 2016 Update*) that lowered the NEB's projections due to uncertainty about future oil prices. The *Update* forecast that oil sands production would reach 4.3 million bpd (instead of 4.8) by 2040, which is nevertheless a 72% increase above the 2015 level of 2.5 million bpd. Taking into account an additional 1.4 million bpd of conventional oil production, the *Update* projected that Canada's total crude oil output would reach 5.7 million bpd by 2040, up from 4.0 million bpd in 2015. The October 2016 *Update* report estimated that oil sand production would reach 3.967 million bpd by 2030.

1.3 The final version of the "upstream emissions assessment" for the Trans Mountain pipeline released on November 25, 2016 (*Review of Related Greenhouse Gas Emissions Estimates for the Trans Mountain Expansion Project*) adopted the NEB's October 2016 *Update* forecast that oil sands production will increase from the 2014 level of 2.3 million bpd to 3.967 million bpd by 2030, and to 4.3 million bpd by 2040: see *Report*, November 25, 2016, s. B.2.1 at p. 21, "Canadian Oil Supply Growth."

1.4 In October 2017, the NEB released a new set of oil supply and demand projections, *Canada's Energy Future 2017*, projecting that oil sands production is expected to grow a bit more rapidly, reaching 4.180 million bpd by 2030, and 4.5 million by 2040: https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2017/2017nrgftr-eng.pdf .

1.5 The Government of Canada's most recent emissions projections to 2030 (the *3rd Biennial Report* released on December 29, 2017) are based on the assumption that oil sands production will reach 4.236 million bpd by 2030 (see Figure i above).

2. Oil sands emissions: evidence of increase to 2030

2.1 The annual level of oil sands emissions has more than doubled since 2005. Figure ii is taken from the *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada*, published April 17, 2018:

Figure ii: Oil sands emissions 2005 to 2016 (Mt CO_2eq)

	2005	2011	2012	2013	2014	2015	2016
Oil sands	35	55	55	59	63	68	72

Source: *National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada (April 17, 2018), Table 2-12.

2.2 The oil sands sub-sector is by far the largest source of emissions growth in the Canadian economy. In comparison, since 2005 the entire transportation sector has increased by only 11 Mt. Emissions data for all economic sectors, including projections to 2030, are found in Appendix A.

2.3 The only part of the Canadian economy that has achieved substantial *emissions reductions* during the past eleven years is the electricity sector. Between 2005 and 2016

the electricity sector cut its emissions by 41 Mt, mainly by shutting down coal-fired electricity generation in Ontario. Almost all of the emissions reductions accomplished by reducing coal consumption in Canada have been offset by the emissions growth from expanding oil sands production.

2.4 At trial, the defendant will call evidence showing that oil sands emissions are projected to increase by another 44 Mt between 2015 and 2030. The defendant will refer to *Canada's 7th national Communication and 3rd Biennial Report*, published by Environment and Climate Change Canada on December 29, 2017.

2.5 The defendant will show that, within the next decade, there are no policy measures or technological solutions that offer any realistic prospect that this projected 44 Mt increase can be avoided, if we proceed with plans to increase bitumen production to about 4.3 million bpd by 2030, as shown in Figure i. Particulars of the proposed evidence on technology are set out in Part 3 and in Appendix C. An outline of the evidence about Alberta's 100 Mt cap on oil sands emissions is found in Part 4 and in Appendix D.

2.6 The unanswered question is whether this further growth of oil sands emissions by about 44 Mt can be reconciled with Canada's commitment to cut its total emissions to 517 Mt by 2030.

2.7 At trial, the defendant will show that prior to the Order in Council dated November 29, 2016, no inquiry process had answered the question of whether our projected oil sands expansion to 2030 is consistent with our commitments under the Paris Agreement of December 2015 to reduce Canada's total emissions to 517 Mt. On that point, the defendant will refer to two reports.

2.8 The first report is the National Energy Board (NEB) released on May 19, 2016 recommending approval of the Trans Mountain expansion project, after a lengthy inquiry through 2014 and 2015. The NEB inquiry was a public hearing process and it had full powers to hear evidence and make findings. However, the NEB took the view that "upstream emissions" released into the atmosphere at oil sands production sites in Alberta did not fall within the scope of its inquiry. Accordingly, the NEB inquiry excluded all evidence about the expected future growth of greenhouse gas emissions related to expanding oil sands production. Particulars of the evidence about the NEB inquiry process are set out in Part 8.

2.9 The second report is the *Review of Related Greenhouse Gas Emissions Estimates for the Trans Mountain Expansion Project*. The Government of Canada announced on January 27, 2016 that it would create a separate "upstream emissions assessment" procedure. It promised that the new procedure would examine *"the potential impact [of the pipeline projects] on Canadian and global emissions."*

2.10 The "upstream emissions assessment" for the Trans Mountain pipeline was publicly released on May 19, 2016 in draft form. The final version of the report was released on November 25, 2016. The document adopted the NEB's forecast that oil sands production will increase from the 2014 level of 2.3 million bpd to 4.3 million bpd by 2040: see the

Trans Mountain emissions report, November 25, 2016, section B.2.1 at p. 21, "Canadian Oil Supply Growth" (http://ceaa-acee.gc.ca/050/documents/p80061/116524E.pdf).

2.11 The report found that the Trans Mountain expansion, if built, would increase the existing capacity from 300,000 bpd to 890,000 bpd, adding 590,000 bpd of new shipping capacity (about 25% of the total projected expansion of oil sands production between 2015 and 2040). The report found that the emissions associated with the expanded volume of oil sands production transported by this additional shipping capacity would be 13 Mt to15 Mt of CO_2eq per year. It acknowledged that oil sands emissions will continue to increase to 2030, and they will be the main driver of Canada's total emissions:

> *The growth in emissions to 2030 is driven largely by growth in the upstream oil and gas sector and, in particular, from the oil sands. ECCC [Environment and Climate Change Canada] projections indicate that GHG emissions from the oil sands could increase from 62 Mt in 2013, to 90 Mt in 2020 and up to 116 Mt in 2030.*
>
> — Trans Mountain emissions report, November 25, 2016, section B.2.2, p. 22 (emphasis added)

2.12 The Trans Mountain assessment, however, did not consider whether oil sands growth could be reconciled with Canada's commitment to reduce its total emissions to 517 Mt by 2030. It did not ask that question.

→ **A summary of the proposed evidence about the methodology followed by the Trans Mountain upstream emissions assessment is provided in Appendix G. A detailed outline of the evidence related to the limited scope of the findings in the upstream emissions assessment is found in Part 9 below.**

3. Evidence about the capability of technology to reduce oil sands emissions

3.1 At trial, in order to establish that the trend of oil sands emissions will continue to rise to 2030, the defendant will call expert evidence showing that no substantial reductions in carbon intensity per barrel are expected to occur over the next twelve years in the oil sands industry, with the result that total oil sands emissions will continue to increase in step with growing production levels. In outline, the evidence will cover these points:

3.2 The oil sands consist of immense formations of clay, silt, and sand particles coated with an outer layer of tar-like bitumen. A unique feature of extracting bitumen from the oil sands, in comparison to recovering crude oil in the form it is found in most other places in the world, is that the process requires massive amounts of heat and steam to separate the bitumen from the sand and clay in which it is embedded. Bitumen in its natural state in the earth has a *high viscosity*. Heat must be used to make it melt – to make it flow.

3.3 Most of the oil sands formations in Alberta are located too deep underground for surface mining. Surface mining is gradually declining in relative importance, although its vast open pits and tailings ponds remain the most visible symbol of the industry. The most common extraction method being developed now, called "in situ", involves drilling into

deep deposits of oil sands, perhaps 400 to 600 feet underground, and then drilling a series of horizontal wells which may extend a kilometer or more in length through the bitumen saturated deposit. In the in situ process, high-pressure steam is injected underground for lengthy periods, eventually causing the bitumen to soften and separate from the granular sand and clay in which it is embedded and drain through the earth into the lower well from which it is pumped to the surface.

3.4 That natural-gas-driven process explains the high level of CO_2 emissions for each barrel of bitumen produced.

3.5 The Government of Canada's *National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada* (released April 13, 2017), provides this succinct description of the SAGD process, which is the main method of in situ extraction:

> *The steam-assisted gravity drainage (SAGD) process used to extract crude bitumen involves injecting large amounts of steam into the producing formation, where the heat from the steam allows the crude bitumen to flow and be extracted. The steam is generally produced by combusting natural gas, resulting in emissions. Since 2005, total natural gas consumption in this subcategory has increased over 75% (Statistics Canada 1990-2016), and SAGD production has increased over 900% (AER 2016).*
>
> — *National Inventory Report 1990-2015*, p. 57

Carbon intensity

3.6 Improvements in technology and advances in extraction method over the past twenty-five years have achieved some success in lowering the amount of energy (fossil fuel burned) that is required to extract each barrel of bitumen. Those gains are spoken of as improvements in *carbon intensity*. A much-cited figure is that over the initial fifteen years between 1990 and 2005, emissions intensity per barrel dropped by 26%, from 122 kg CO_2eq per barrel to 90 Kg CO_2eq per barrel. Notwithstanding that documented improvement in carbon intensity per barrel, total oil sands emissions in Alberta more than quadrupled between 1990 and 2015, from 15 Mt to 71 Mt.

3.7 The problem is that the comparatively small "gain" in the reduction of the amount of CO_2 per barrel (26% over that 15-years period) was more than offset by the huge increase in the number of barrels produced. Between 1990 and 2005, production quadrupled from less than 400,000 bpd to 1.7 million.

3.8 The average carbon intensity of all oil sands operations in 2015 (including in situ, mining, and upgrading) was 79 kg CO_2eq per barrel. But if we look at the period between 2005 and 2015, the annual level of oil sands emissions doubled – from 35 Mt to 71 Mt.

3.9 The Government's *3rd Biennial Report* acknowledges that emissions in the oil sands industry will continue to rise more or less in step with production up to 2030. Reductions in carbon intensity will be offset by other factors:

> *In the forecast, several factors could lead to increasing intensity in the oil sands subsector, such as declining reservoir quality, aging of existing facilities, and shifts from mining operations to more emissions-intensive in situ extraction processes. On the other hand, clean technology deployment could lead to significant emissions intensity reductions in the subsector. Considering the uncertainties associated with these counterbalancing trends in oil sands emissions intensities, the projections keep the emissions intensities of new oil sands productions at the level of existing technologies.*
>
> — *3rd Biennial Report*, p. 139 (emphasis added)

Carbon capture and storage technology

3.10 At present, the only existing technology that has the capability to separate and remove industrial CO_2 gas and prevent it from entering the atmosphere – although at enormous cost – is carbon capture and storage (CCS). In 2008, Alberta announced an ambitious plan to deploy CCS technology on a very large scale. The promise was that by 2020 the installation of CCS would avoid any further increase in the absolute level of oil sands emissions. Indeed, the plan declared that total emissions from Alberta were expected to begin to decline after 2020. To fulfill those promises, dozens of CCS installations would have had to be built in Alberta.

3.11 In fact, only two CCS installations were ever completed in Alberta. One, which became operational in November 2015, is located at Shell Canada's Scotford Upgrader near Edmonton. It cost $1.35 billion – two-thirds of which was paid for by the Canadian and Alberta governments. It is designed to capture and inject underground 1.2 Mt of CO_2 every year, about 35% of the total CO_2 emitted annually from the part of the facility where it is deployed.

3.12 In 2014, the Alberta government abandoned the entire CCS strategy. The technology was not economically viable for the oil sands industry. No other CCS projects are planned for the province.

3.13 Although rarely mentioned in the public discussion, the abandonment in 2014 of the CCS technology strategy for the oil sands industry in Alberta was an enormous set back in efforts to manage Canada's total emissions. The oil sands is the largest source of emissions growth in Canada, and no alternative technological solution is available to curb that growth over the next decade.

→ **Appendix C outlines particulars of the evidence that will be called at trial about the failure of Alberta's CCS strategy and other evidence affirming that over the next twelve years there is no realistic prospect that technological innovation can lower the currently projected increase in the absolute level of oil sands emissions.**

4. Evidence about Alberta's 100 Mt cap on oil sands emissions

4.1 The defendant will call evidence to show that while Alberta has legislated a "cap" that purports to limit the growth of oil sands emissions, the cap will do nothing to curb the 44 Mt increase in oil sands emissions that is expected to occur between 2015 and 2030.

4.2 In November 2015, Alberta announced it was imposing a 100 Mt cap on oil sands emissions. In order to assess whether this cap will make any contribution to limiting Canada's GHG emissions by 2030, it is helpful to start by noting that the actual level of oil sands industry emissions in 2015 was 71 Mt (as shown in Figure i) and that the government's most recent projections released December 29, 2017 show the level will rise to 115 Mt by 2030.

4.3 Alberta's cap, while it is called a "100 Mt cap", is set at a high enough level that it will allow oil sands emissions to freely increase from 71 Mt in 2015 to 115 Mt by 2030, because of the way the cap limit is defined by the Province of Alberta.

4.4 This feature of the "100 Mt limit" was explicitly acknowledged by the Federal Government almost two years ago, when it published an earlier set of emissions projections: *Canada's 2016 Greenhouse Gas Emissions Reference Case*, January 5, 2017). At that time, the government projected that oil sands emissions would reach 108 Mt by 2030. The *Reference Case* document explained that this 108 Mt of oil sands emissions would in fact be well *below* the cap. The reason for that is that the 100 Mt cap limit excludes some kinds of oil sands-related emissions:

> *Based on the Alberta Government's announcement, Alberta's 100 Mt cap on oil sands emissions excludes emissions from cogeneration of electricity and new upgrading. When taking these into account, total emissions from oil sands is 93 Mt in 2030 under the reference case scenario, below the 100 Mt cap.*
>
> — *Reference Case*, section 2 "Emissions projections by sector", note 4, p.7.

4.5 Although it is not commonly understood, the 100 Mt cap does not apply to, or restrict, the growth of additional emissions generated by "new upgrading" in Alberta. Upgrading is a highly emissions-intensive process that converts raw bitumen into a higher-value crude oil before it is shipped to foreign refineries for further processing. The cap also exempts additional emissions attributed to cogeneration. Therefore, under Alberta's cap, total oil sands emissions will be allowed to rise to about 116 Mt before they exceed the cap.

4.6 Therefore, the cap – in reality – is 116 Mt.

4.7 This feature of the cap was again confirmed when Canada released its most recent emissions report, the *3rd Biennial Report* (December 29, 2017). The new projections show that oil sands production is now expected to rise to 4.236 million bpd by 2030 (up from the previous estimate of 3.967 million bpd), and that oil sands emissions (according to the Government of Canada's methods of calculation) are now projected to reach 115

Mt by 2030. The new report explains that the projected increase of oil sands emissions to 115 Mt by 2030 will still be within the cap limit, and that under Alberta's definition the increased figure is equivalent to only 99 Mt (*3rd Biennial Report*, notes g and h, at pp.138-139.

→ **A detailed outline of the proposed evidence about Alberta's 100 Mt cap is found in Appendix D.**

5. Evidence on the growth of oil and gas sector emissions to 2030

5.1 The evidence at trial will show that based on the currently projected expansion of oil sands production in Alberta (which is the rationale for the Trans Mountain and Line 3* expansions) the annual level of emissions in the oil sands industry will rise to 115 Mt by 2030, an increase of 44 Mt above the 2015 level. Technological innovation over the next twelve years does not offer any assurance that this substantial emissions increase can be avoided. Nor will Alberta's 100 Mt cap do anything to curb that 44 Mt increase.

5.2 Figure iii, based on Table 5.8 in the *3rd Biennial Report*, shows emissions projections for the entire oil and gas sector. Oil and gas is Canada's largest emitting sector, accounting for 26% of our total emissions. The oil sands sub-sector accounts for all of the expected emissions growth in the oil and gas sector over the next decade.

Figure iii: Oil and gas sector emissions by production type (Mt CO_2eq)

	2005	2010	2015	2020	2030	Change 2005-2030
Natural Gas Production and Processing	57	49	56	50	45	**-12 Mt**
Conventional Production	30	27	31	26	23	**-8 Mt**
Oil Sands	35	53	71	89	115	**+80 Mt**
Oil and Natural Gas Transmission	12	7	10	9	9	**-3 Mt**

* A second pipeline expansion project, called Line 3, was also given final approval on November 29, 2016, the same day as the Kinder Morgan approval. It adds 370,000 bpd of new capacity. Line 3 is routed from Alberta to Superior, Wisconsin. The emissions assessment report for Line 3 found that the additional emissions associated with the increased volume of production carried by Line 3 would be approximately 10 Mt to 13 Mt of CO_2eq per year: http://www.ceaa.gc.ca/050/documents/p80091/114134E.pdf. Therefore, the combined new capacity of both Kinder Morgan and Line 3 (960,000 bpd) will generate between 22 Mt and 28 Mt of additional GHG emissions per year.

Petroleum Products (Refining)	22	22	21	22	22	**0**
Natural Gas Distribution	1	1	1	1	1	**0**
Total	**158**	**160**	**189**	**197**	**215**	**+57 Mt**

Source: *Canada's 3rd Biennial Report* (December 2017), Table 5.8. The report notes that numbers may not sum due to rounding.

5.3 The oil sands industry, which involves more emissions-intensive production methods compared to conventional oil, is the dominant driver of emissions growth in Canada's oil and gas sector. Conventional oil emissions are declining as conventional fields are gradually depleted. But that decline (and some decline in emissions from natural gas production and processing) has been offset by the rapid growth of oil sands emissions.

5.4 The emissions projections to 2030 shown in Figure iii are based on current policies, which means, in the case of the *3rd Biennial Report*, they take into account all provincial and federal emissions reduction measures in place up to November 2017.

Methane emissions

5.5 The evidence at trial will show that the only proposed new policy that could (if fully implemented) significantly reduce GHG emissions in the oil and gas sector between now and 2030 is regulation of methane emissions.

5.6 Based on the Government of Canada's *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada* (April 17, 2018), methane emissions from all sources in Canada in 2016 were 96 Mt CO_2eq (representing 14% of Canada's total emissions). Of that amount, 44% (about 42 Mt per year) is generated by the oil and gas sector, mostly in Alberta and B.C., where it is associated mainly with natural gas extraction and processing activities. A large proportion is caused by the *deliberate flaring or venting of natural gas into the atmosphere* and by "fugitive" leaks during natural gas production, transmission, storage, and processing. Methane emissions are not a significant factor in the oil sands industry. The proposed regulations – if enacted – will not significantly slow down the growth of oil sands emissions.

5.7 The Liberal Government promised in 2016 that it would enact regulations to reduce methane gas emissions in the oil and gas industry by 40-45% below 2012 levels by 2025, following an announcement June 29, 2016 of a joint strategy by the U.S., Canada, and Mexico to reduce methane emission to meet that goal by 2025.

5.8 At present, both the Federal Government and Alberta are drafting their own methane regulations. Alberta's *Climate Leadership Plan Progress Report* (December 2017)

estimates that the regulations will achieve a 14 Mt reduction of methane emissions by 2025, in Alberta. In the recent *3rd Biennial Report*, the Federal Government claims that, for Canada as a whole (including Alberta), methane regulations will reduce the annual level of oil and gas emissions 22 Mt during the next decade. But methane regulations are not yet adopted in any jurisdiction in Canada, and will not be fully implemented until about 2023.

→ **Appendix E outlines further particulars of proposed evidence about methane regulation in the oil and gas sector.**

Promised additional measures for the oil and gas sector

5.9 In its *3rd Biennial Report* (December 29, 2017) the Government of Canada published an Emissions Forecast (Table 5.28 at p. 153), showing expected emissions in each of Canada's seven economic sectors, based on the assumption that all the "additional measures" promised in the government's "climate plan" are in fact adopted. Here are the numbers provided by the government showing its forecast for total oil and gas sector emissions by 2030, taking into account "additional measures" for that sector:

Figure iv: 2030 emissions forecast (Mt CO_2eq) including promised additional measures

	2015	2020	2030	
			Current Measures	Additional Measures
Oil and Gas sector	189	197	215	192

Source: *Canada's 3rd Biennial Report* (December 29, 2017), Table 5.28. and 5.9

5.10 This confirms that even with the benefit of promised "additional measures" (which in the case of the oil and gas sector means the promised methane regulations) total oil and gas sector emissions will still reach 192 Mt by 2030.

5.11 The significance of that number is evident if we compare it to the government's most recent projection showing the expected level of oil and gas sector emissions by 2020: 197 Mt (*3rd Biennial Report*, Table 5.6, at p 137). Even with the benefit of the methane regulations, oil and gas sector emissions will decline only 5 Mt between 2020 and 2030.

5.12 Canada's total emissions are projected to reach 722 Mt by 2020. Out emissions reduction target for 2030 is 517 Mt. To meet our target, absolute cuts of about 200 Mt will have to be achieved within the next decade.

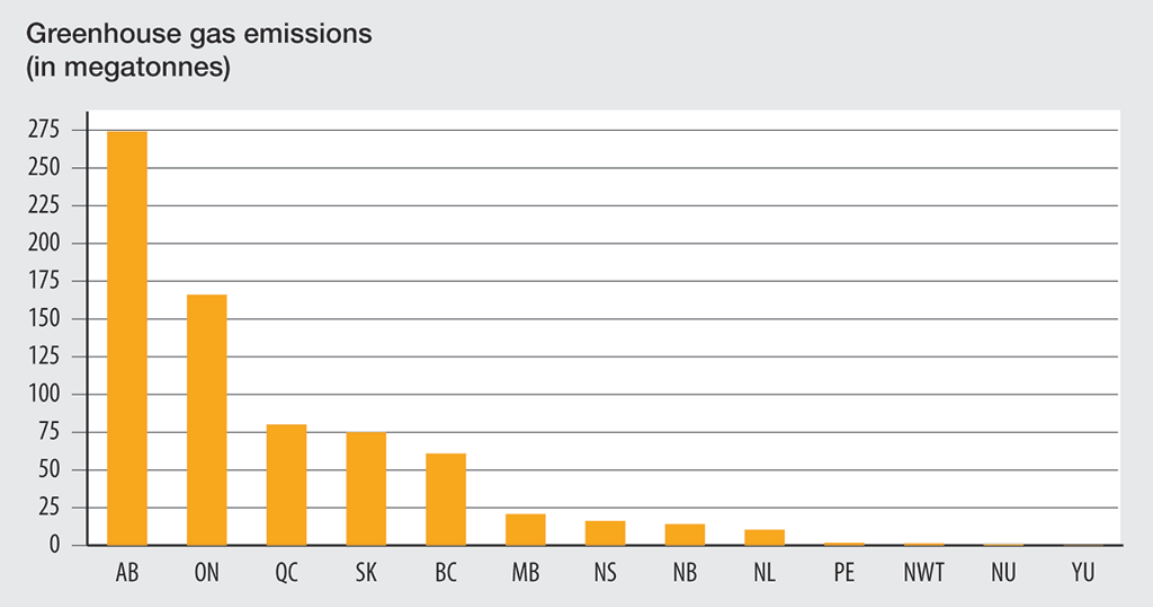
5.13 The oil and gas sector, which is Canada's largest emitting sector (26% of the national total), will be *unable to contribute any share of the needed reductions – because it will still be increasing*. Even if promised new regulations to cut methane emissions (mainly in the natural gas industry) are fully implemented in the next decade, the entire oil and gas sector will achieve a net reduction of only 5 Mt by 2030, below the 2020 level.

6. Evidence about Alberta's emissions to 2030

6.1 Part 6 provides a summary of the proposed evidence about the expected annual level of Alberta's emissions by 2030, taking into account the impact of promised emissions reduction policies over the next decade.

6.2 At present, Alberta accounts for about 37% of Canada's total emission, due to the dominant role of the emissions-intensive oil and gas industry in that province. Figure v represents provincial emissions levels in 2015. The question is whether, over the next twelve years, Alberta can contribute any substantial share of the deep reduction needed to meet Canada's emissions target by 2030.

Figure v: Provincial and Territorial GHG Emissions



Source: *National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada, 2017. This graph published in *Perspectives on Climate Change Action in Canada – A Collaboration Report from Auditors General* (March 27, 2018).

6.3 The evidence will show that carbon reduction policies recently adopted or promised in Alberta will not be sufficient to make any substantial contribution to the cuts we need. The problem is that the growth of oil sands emissions between 2015 and 2030 will cancel out most of the reductions promised by Alberta over the next decade. Here is an outline of the proposed evidence on that issue:

Government of Canada's projections

6.4 The Government of Canada's *3rd Biennial Report*, which will be put into evidence at trial, gives this estimate of the Alberta's total emissions to 2030:

Figure vi: Province of Alberta – Federal emissions projections to 2020 and 2030 (Mt CO_2eq)

	2005	2015	2020	2030
Alberta	233	274	278	287

Source: *Canada's 3rd Biennial Report* (December 29, 2017), Table 5.27.

6.5 The above projection is based on current measures: it takes into account the future benefit of all major new carbon-reduction policies put in place up to September 2017 by Alberta and by the Federal Government. It does not include the impact of promised regulations to reduce methane reductions in the oil and gas industry – because the methane regulations have not yet been implemented. It does include the shutdown of all coal-fired electricity generation in the province by 2030.

Province of Alberta's projections

6.6 The Government of Alberta's *Climate Leadership Plan Progress Report*, released in December 2017, provides us with a more optimistic projection about the expected impact of Alberta's new policies by 2030. It includes the benefit of policies not yet implemented. It assumes *full implementation of all future measures* promised in Alberta's Climate Leadership Plan (CLP):

Figure vii: Province of Alberta – emissions projections to 2020 and 2030 (Mt CO_2eq)

	2015	2020	2030
Alberta	274	270	254

Source: *Alberta Climate Leadership Plan Progress Report*, 2017 Policy and Economic Expectations ("with CLP and federal climate policies"), (December 29, 2017), Table 1.

6.7 The *Progress Report* takes into account a promised 14 CO_2eq cut of methane emissions below the business-as-usual level in Alberta by 2030. It also takes into account the promised phase-out of coal-fired electricity in Alberta (which will provide a 17 Mt reduction over the next decade). It includes 7 Mt of additional future reductions based on the government's promise that when Alberta's existing coal-fired electricity plants are replaced (mainly with natural gas), 30% of the replacement will be renewable energy sources. It counts the future benefits of Alberta's carbon tax.

6.8 Assuming that Alberta's total emissions could decline to 254 Mt by 2030, that is only a 20 Mt cut below the 2015 level – and still 20 Mt *above* the province's 2005 level. Canada's national commitment is 30% below the 2005 level. To meet that target, Alberta would need to reduce its emissions to 163 Mt by 2030.

6.9 But there is no possibility that Alberta can do that. The expected 44 Mt increase in oil sands emissions between 2015 and 2030 will cancel out most of the promised reductions over the next decade in Alberta's other economic sectors.

6.10 At present, Alberta accounts for about 37% of Canada's total emissions, due to the dominant role of the emissions-intensive oil and gas industry in that province. Assuming that Alberta fulfills all its promises and meets its 254 Mt estimate – and even if the other provinces could achieve all the needed additional cuts required to meet Canada's 517 Mt target – Alberta's economy will account for an astonishing 48% of Canada's total emissions by 2030.

6.11 Alberta's *Progress Report* (Table 2 at p. 9) acknowledges that, under this forecast, the oil and gas sector in Alberta will account for 145 Mt of the province's total 254 Mt emissions by 2030 – about 57% of the province's total. Emissions from the expanding oil sands industry will account for most of the oil and gas sector share in Alberta.

6.12 The *Progress Report* also includes a more ambitious scenario, which proposes that Alberta's total emissions could fall as low as 222 Mt by 2030 (Table 1 p.8). However, that outcome is not supported by quantified or detailed policies showing how that additional 32 Mt of reductions might be achieved. This scenario is described as based on Alberta's Climate Leadership Plan (the same policy package that supports the 254 Mt forecast), but with the added words: "plus Potential Reductions from Innovations". It is dependent on unspecified future technological innovations.

Alberta Climate Leadership Report

6.13 The Alberta Climate Advisory Panel's *Climate Leadership: Report to Minister*, dated November 20, 2015, conceded that the proposed new measures in the province's Climate Leadership Plan would have only a limited impact on the province's total emissions:

> *Many will look at these emissions reductions and claim that our policies will not place Alberta on a trajectory consistent with global 2° goals, and in some sense this is true – the policies proposed for Alberta in this document would not, if applied in all jurisdictions in the world, lead to global goals being accomplished.*
>
> — *Report to Minister*, "Outcomes and Impacts", p. 11 (emphasis added)

6.14 The panel concluded that more aggressive policies to substantially reduce oil sands emissions (i.e., a higher carbon price to induce more rapid technological changes to reduce emissions intensity) are "not tenable", because they would raise production costs for Alberta producers and make the industry uncompetitive against lower-cost oil production in other jurisdictions:

> *However, more stringent policies in Alberta would come at significant cost to the province due to lost competitiveness, with negligible impaction on global emissions due to carbon leakage. As a panel, we have looked at this challenge and concluded that while we do not have an architecture that, in the short-term,*

> *will be consistent with meeting global goals, the approach we are proposing will position Alberta to make a meaningful contribution in the longer-term. In the meantime, imposing policies in Alberta that are more stringent than what we have suggested is not tenable, until our peers and competitor jurisdictions adopt policies that would have a comparable impact on their industrial sectors.*
>
> — *Report to Minister*, "Outcomes and Impacts", p. 11 (emphasis added)

6.15 "Carbon leakage" means that if Alberta were to adopt more stringent policies aimed to eliminate or substantially cut the projected growth of oil sands emissions, the additional costs (incurred by producers to adopt required new technologies to lower emissions per barrel) would make Alberta's bitumen production more expensive, and therefore uncompetitive. Alberta's production and exports would as a result decline – but crude oil producers in the U.S., or in Saudi Arabia or elsewhere, would increase their output.

6.16 According to the Alberta panel's report, the choice for the province is to pursue the economic benefits of continued expansion of its oil sands output, or, in the alternative, adopt more stringent carbon prices and tougher performance standards that would achieve deeper reductions in emissions per barrel – but it cannot do both, according to the panel.

6.17 The Alberta panel recommended the path of continued expansion, on the grounds that imposing more stringent emissions reduction in the oil sands would result in "sacrificing wealth and prosperity" in Canada (i.e., lower production levels) while other countries increase their crude oil output to replace our exports.

7. Evidence about Canada's emissions to 2030

7.1 The issue is whether a 44 Mt increase in oil sands emissions between 2015 and 2030 can be reconciled with Canada's commitment to reduce our total emissions 30% by 2030 below the 2005 level, down to 517 Mt. Under current policies, the total is expected to be 722 Mt by 2030. To meet the target, cuts of 200 Mt will have to be achieved within the next decade.

7.2 Even if all of Alberta's new carbon reduction policies (including its carbon price) are fully implemented, by 2030 its total emissions will be at about the same level as they are today – or possibly reduced about 20 Mt to around 254 Mt – *but still well above the 2005 level*. The problem is that growth of oil sands emissions between 2015 and 2030 will cancel out most of the reductions promised by Alberta over the next decade. In consequence, the entire burden of making deep cuts below the 2005 level will fall on the other provinces.

7.3 Second, the oil and gas sector, Canada's largest emitting sector (26% of the national total) will be unable to contribute any share of the needed reductions – because it will still be increasing. Even if promised new regulations to cut methane emissions (mainly in

the natural gas industry) are fully implemented in the next decade, the entire oil and gas sector will achieve a net reduction of only 5 Mt by 2030, below the 2020 level.

7.4 That means four key sectors of our economy (transportation, buildings, heavy industry, and electricity) which together are expected to account for 410 Mt of Canada's total emissions in 2020, will have to cut their combined emissions by about 50% within ten years – if we are going to meet the target.

→ **Appendix F outlines in more detail the proposed expert evidence at trial, which will show that if oil sands production continues to expand to 2030 as currently projected, emissions in Canada's other four main economic sectors would have to be reduced by about 50%, as indicated above, in order to comply with our commitments under the Paris Agreement.**

7.5 No government assessment or inquiry process has shown that is feasible: see Parts 8, 9, and 10 below.

7.6 Based on "current measures", the *3rd Biennial Report* confirms that only 29 Mt of net reductions are expected between 2020 and 2030 in those four sectors – a fraction of the cuts needed over the next twelve years.

7.7 "Current measures" is a key term in government projections of future emissions. It means carbon-reduction policies that have already been adopted by the Federal Government and by provincial governments, up to September 2017. We can have a degree of certainty that these policies will be funded and implemented. They offer some real assurance that the promised emissions reductions will actually occur between now and 2030.

7.8 The question is whether other future policies, which have not yet been implemented (and which in many cases have not even been developed), will have the capability to achieve the massive reductions needed to meet Canada's 517 Mt target by 2030. Those kinds of promised future policies, not yet adopted, are referred to as "additional policies".

7.9 When the Government of Canada announced the approval of two major pipeline expansion projects (Trans Mountain and Line 3) on November 29, 2016, no public inquiry process had assessed whether the expected expansion of oil sands production up to 2030 facilitated by those projects could be reconciled with our commitment to reduce Canada's total emissions to 517 Mt by 2030.

7.10 Canada is now embarked on a plan to build two new pipelines to facilitate the expansion of oil sands production. But we have no reasonable assurance that the other provinces can achieve the deep emissions reductions needed to meet Canada's 517 Mt target by 2030.

8. National Energy Board (NEB) inquiry report (May 19, 2016)

8.1 On May 19, 2016, the NEB issued its report recommending approval of the Trans Mountain expansion project, following a lengthy inquiry through 2014 and 2015. It was a public hearing process and it had full powers to call evidence. However, the NEB took

the view that "upstream emissions" released into the atmosphere at oil sands production sites in Alberta did not fall within the scope of the inquiry. Accordingly, the inquiry excluded all evidence about greenhouse gas emissions in Alberta – and excluded all scientific evidence about the impact of emissions on the climate system.

8.2 Two years earlier, on April 2, 2014, when it issued the Hearing Order for the Project which included the List of Issues, the NEB expressly excluded from the List of Issues the environmental effects associated with upstream activities and development of the oil sands, including greenhouse gas emissions. The City of Vancouver at that time applied for an order expanding the List to include those issues. Other intervenors made submissions supporting the City of Vancouver's motion.

8.3 The NEB panel in a ruling on July 23, 2014 (NEB Ruling 25) rejected the application by the City of Vancouver to expand the List of Issues, which would have permitted intervenors to call expert evidence about emissions and climate change. The substance of the ruling is that environmental impacts of that kind are not "directly related" to the Project:

> *The Project does not include upstream production and is not dependent on any particular upstream development and, therefore, any link to environmental changes caused by such upstream production is indirect and not necessarily incidental to Project approval.*
>
> — NEB Ruling 25, July 23, 2014, p. 3

8.4 On October 16, 2014, the Federal Court of Appeal (FCA) dismissed an application by the City of Vancouver for leave to appeal NEB Ruling 25.

8.5 Also, on May 6, 2016, a group of eight individuals and Forest Ethics Advocacy Association made an application to the NEB panel alleging that the Board's exclusion of emissions and climate issues from the List of Issues violated their Charter freedom of expression rights under the Charter. The panel dismissed the application on October 2, 2014 (NEB Ruling 34). The FCA on January 25, 2015 dismissed the applicants' motion for leave to appeal that ruling.

8.6 On October 11, 2014, the FCA issued Reasons for Judgment in *Forest Ethics Advocacy Association v. The National Energy Board*, dismissing an application raising virtually identical issues in the NEB inquiry relating to the Line 9B Project (a pipeline routed through eastern Canada to carry oil sands bitumen). The applicant had sought an order in that case to include climate change and emissions issues, but the application was denied.

8.7 All lawful avenues to raise questions concerning the emissions and climate implications of the proposed Trans Mountain expansion project by participating in the NEB inquiry process were effectively foreclosed by reason of the above rulings and orders

8.8 When the NEB recommended approval of the project on May 19, 2016, not one sentence in the report discussed emissions or climate.

→ **Appendix Q notes that on August 30, 2018, the Federal Court of Appeal quashed the Order in Council that approved the Trans Mountain project, finding a number of shortcomings in the NEB inquiry process. However, the decision of the Federal Court of Appeal in its August 30, 2018, judgment did not address any matters relating to emissions or climate.**

9. Trans Mountain upstream emissions report (November 25, 2016)

9.1 The second process was the so-called "upstream emissions assessment" for the Trans Mountain pipeline expansion (also known as the Trans Mountain pipeline), the process officially called the *Review of Related Greenhouse Gas Emissions Estimates for the Trans Mountain Expansion Project*. The new emissions assessment procedure was briefly described in a January 2016 announcement, in these few words:

> *Assess the upstream greenhouse gas emissions associated with this project and make this information public.*
>
> — *Interim Measures for Pipeline Reviews*, January 27, 2016

9.2 On March 19, 2016, the Liberal Government quietly published details of the emissions assessment procedure. A notice published in the *Canada Gazette* explained the new procedure:

> *The assessment of upstream GHGs will consist of two parts: (A) a quantitative estimation of the GHG emissions released as a result of upstream production associated with the project, and (B) a discussion of the project's potential impact on Canadian and global emissions.*
>
> — "Estimating upstream GHG emissions", *Canada Gazette*, March 19, 2016. (http://www.gazette.gc.ca/rp-pr/p1/2016/2016-03-19/html/notice-avis-eng.php#nl4)

9.3 The March 19, 2016 notice prescribed the "methodology" governing how an assessment should calculate the emissions impact of a new project. Details of the methodology are set out in Appendix G.

9.4 About two months later, on May 19, 2016, the government published its draft report. The final version of the report was released on November 25, 2016.

9.5 Unfortunately, the report did not answer the important question, which is whether Canada can successfully reduce our total emissions by 2030 if emissions from expanding oil sands production keep growing. Here is a summary of the main findings of the Trans Mountain assessment, and a list of what the report did not discuss:

The report unequivocally endorses the expansion of oil sands production to 2040

9.6 The report affirms that oil sands production will continue to grow between now and 2040. It has adopted the NEB's view that global oil consumption will continue to increase for

at least another twenty-five years. Based on that forecast of growing global oil demand, the report adopts the NEB's forecast that *oil sands production will increase from the 2014 level of 2.3 million bpd to 4.3 million bpd by 2040*: see *Report*, November 25, 2016, section B.2.1 at p. 21, "Canada's Oil Supply Growth."

9.7 The Trans Mountain pipeline expansion, if built, will have the capacity to transport an additional 590,000 bpd, which is 25% of the proposed total expansion of oil sands production increase between now and 2040. The project will increase the capacity of the existing line from 300,000 to 890,000 bpd.

The report confirms that oil sands emissions will continue to grow to 2030

9.8 The report finds that the volume of new production shipped by the Trans Mountain expansion will add 13 to 15 Mt of new emissions to Canada's annual total (adding 20%-25% more to Canada's annual oil sands emissions): *Report*, November 25, 2016, section A.5, "Estimated Upstream GHG Emissions", p. 14.

9.9 A second pipeline expansion project, called Line 3, was also given final approval on November 29, 2016, the same day as the Trans Mountain approval. Line 3 adds 370,000 bpd of new capacity. The emissions assessment report for Line 3 found that the additional emissions associated with the increased volume of production carried by Line 3 would be approximately 10 Mt to 13 Mt of CO_2eq per year.

9.10 The Trans Mountain and the Line 3 projects will together add 960.000 bpd of new shipping capacity. The volume of new production represented by the combined capacity of just those two projects will generate between 23 Mt and 30 Mt of GHG emissions per year.

9.11 The Trans Mountain upstream emissions report concedes that oil sands emissions will continue to increase, and they will be the main driver of growth in Canada's total emissions:

> *The growth in emissions to 2030 is driven largely by growth in the upstream oil and gas sector and, in particular, from the oil sands. ECCC projections indicate that GHG emissions from the oil sands are expected to increase from 62 Mt in 2013, to 90 Mt in 2020, and up to 116 Mt in 2030.*
>
> — *Report*, November 25, 2016, section B.2.2, Canada's GHG Projections, p.22 (emphasis added)

Does not answer whether oil sands emissions growth is consistent with the 2030 target

9.12 The report does not answer the question of whether oil sands emissions growth of that kind can be reconciled with our commitment to reduce Canada's total emissions to 517 Mt by 2030. It is silent about whether we can make large enough reductions from other

economic sectors to obtain the deep cuts we need – and to offset the continued increases in oil sands emissions. The Trans Mountain report provides no data or analysis to demonstrate that we can obtain the needed emissions reductions from other sectors, to get to 524 Mt by 2030.

9.13 The report acknowledges that the most recent emissions projections available at that time, the Government of Canada's *Second Biennial Report* published in February 2016, showed that total emissions for all economic sectors were expected rise to 815 Mt by 2030, based on current policies.

9.14 The only answer the report provides to that evidence – which shows continued growth of Canada's total emissions to 2030 – is to claim that "recently announced provincial government policies", which refers to measures promised since September 2015, will be able to improve the outcome by 2030: the report says that these new provincial government policies "will have an impact on Canadian GHG emissions" (i.e., will lower the projected number below 815 Mt). The report says that the impact of these new provincial polices "were not reflected in *Canada's Second Biennial Report* as the details of these policies were not available at the time of publication" (*Report*, November 25, 2016, section A.6, GHG Forecast Approach, p 15-16).

9.15 Beyond the vague assertion that new provincial policies "will have an impact", the report offers no quantified estimates to substantiate its claim that the recently announced provincial policies will be able to substantially reduce emissions below the then projected 815 Mt level by 2030.

9.16 In the case of Alberta, the Trans Mountain upstream emissions report points to that province's new plan to "cap" oil sands emissions at a maximum annual level of 100 Mt. It also refers to Alberta's declared new policy to reduce methane emissions from oil and gas operations, and to set new standards for large industrial emitters. But the report offers no analysis or projections to demonstrate whether, or by how much, these new measures can contribute to lowering Canada's emissions level by 2030, below the current level.

9.17 In fact, if we look at the Alberta government's own documents (in particular *Climate Leadership: Report to Minister*, November 20, 2015) we find that the new Alberta policies, if fully implemented, are expected during the next decade to bring Alberta's total emissions down to about 254 Mt by 2030, which is only 20 Mt less than they were in 2015: see Part 6 above. They will still be well above Alberta's 2005 level (233 Mt).

9.18 Based on the evidence available and cited in the report, all the expected emissions reductions from Alberta's recently announced policies would be offset by continued emissions increases between 2015 and 2030 from expanding oil sands production. Alberta will contribute nothing to the cuts we need to make below the 2005 level.

9.19 As for the promise of future cuts by other provinces, the report merely says this:

> *On March 3, 2016, First Ministers adopted the Vancouver Declaration on Clean Growth and Climate Change, in which they commit to develop a concrete plan to*

achieve Canada's international climate commitments and become a leader in the global clean growth economy."

— *Report*, section A.6, p.16

9.20 But the commitment in the Vancouver Declaration, cited in the report, was just 'a promise to develop a plan'. There is no analysis in the Trans Mountain upstream emissions report of what these future cuts might be – their scale or when they will start, or whether they can be sufficient to offset the rise of oil sands emissions and meet our 517 Mt target. Indeed, the report acknowledges that it contains no analysis of the impact of these promised future measures, some of which have been announced and other said to be "under development":

> *While this analysis focuses on policies implemented as of September 2015 and does not reflect the impact of additional federal, provincial, or territorial measures announced or under development, it is recognized that future improved practices will mitigate emissions. As measures to meet targets are implemented, they will be incorporated into future emissions projections and future upstream GHG reviews.*

— *Report*, section A.6, p. 16

9.21 Therefore, the Trans Mountain report simply informed Canadians that when the promised measures are implemented they will be incorporated into future emissions projections. The November 25, 2016 report provides no quantified estimate of the promised future emissions reductions.

→ **The defendant at trial will refer in detail to section A.6 of the Trans Mountain emissions assessment report, particulars of which are set out in Appendix H.**

The report finds that incremental emissions from the project will be "minimal"

9.22 The report acknowledged that the annual level of oil sands emissions will rise from 90 Mt in 2020 to 116 Mt by 2030, and accepted that the expanded capacity of the Trans Mountain project will account for 13 Mt to 15 Mt of that growth.

9.23 Yet the report stated that provided long-term oil prices reach US$80 or higher in the post-2020 period, any "incremental GHG emissions" attributed to the pipeline expansion will be "minimal".

9.24 That seemingly contradictory finding is explained by the methodology that governed the upstream emissions assessment. The methodology was prescribed in the five-page notice published in the *Canada Gazette* on March 19, 1016: details of the evidence about the methodology and how it determined the assessment findings are found in Appendix G.

9.25 The methodology stipulated that the upstream emissions assessment must evaluate whether "alternate modes of transport" (i.e., rail shipping) could provide an economically viable alternative if a proposed pipeline were not built. In this case, the assessment

determined that the cost of rail transport would be $10 more per barrel than shipping by pipeline. The report concluded that if long-term oil prices post-2020 are US$80 or higher, rail transport, although more expensive, would be a viable alternate method to move the increased production to market – if the pipeline were not built. It accepted evidence from the NEB forecasting that long-term oil prices will reach US$78 by 2020, and will rise to US$102 by 2030. At those prices, rail transport would be an economically viable alternative.

9.26 Following the methodology, and accepting the evidence about future oil prices, the assessment was obliged to decide, as it did, that the increased production that will be carried by the proposed pipeline *will be produced anyway, even if the pipeline were not built*. The rationale is that the new pipeline would not make emissions any worse – because the increased production would still occur even if the new pipeline were not approved. Accordingly, the assessment decided that building the pipeline will not "cause" any "incremental" emissions."

9.27 In truth, the accumulating concentration of CO_2 emissions in the atmosphere is the problem we are trying to solve. In light of that problem, the distinction between pipelines and rail transport is meaningless. If we are going to increase production by another 1.0 million barrel per day between 2020 and 2030, as this report acknowledges we plan to do, Canada's total emissions will increase by about 26 Mt – whether the increased output is shipped by pipeline or shipped by rail.

The Trans Mountain upstream emissions assessment was a closed process

9.28 The assessment was a closed process. It was not a public inquiry. It provided no opportunity for cross-examination or any public questioning. There was no public or media access. There is no record.

9.29 There were no witnesses on the stand, just written reports, many of them written by Government of Canada's own agencies – most importantly, by the NEB, the same agency that in July 2014 excluded all evidence about climate impacts during its own inquiry process. No members of the public were in the room when the methodology was decided on.

9.30 The government also controlled the evidence. The March 19, 2016 notice in the *Canada Gazette* explained what evidence could be relied on in the assessment procedure: it stated that *"publicly available date provided by the proponent will be used"* in the assessment. The "proponent" was the pipeline company. No representatives of the public were present to demand the right to call evidence.

9.31 Canada's leading climate scientists could have testified about the rapidly rising level of atmospheric carbon and whether the planned expansion of oil sands production in Alberta to 2030 could possibly be consistent with Canada's emissions reduction commitments – but they were not called. The assessment was controlled by government employees, taking direction from the politicians and their staff members.

9.32 There was no lawful avenue for a Canadian citizen to challenge the evidence, the process, or the findings.

10. The Ministerial Panel on the Trans Mountain Pipeline (November 1, 2016)

10.1 There was a third process. The Ministerial Panel was an unusual kind of public consultation, appointed by the Federal Minister of Natural Resources in May 2016. It did not have powers to call evidence, or make findings, or draw conclusions. The Ministerial Panel's only mandate was to listen to members of the public – including some of Canada's leading experts on emissions who volunteered to make submissions. People were permitted to attend a series of public meetings in Alberta and British Columbia to express their concerns about what issues and evidence had been overlooked, or inadequately dealt with, during the previous two processes.

10.2 The panel was not allowed to make "recommendations". But it found a way to make what are, in effect, a series of highly significant findings – findings that identify crucial questions that have not yet been answered. The panel says at page 46 of their report:

> *Our role was not to propose solutions, but to identify important questions that, in the circumstances, remain unanswered.*

10.3 The first "high-level question" that "remains unanswered", according to the three panel members, is whether the growth of emissions that will result from building the Trans Mountain pipeline can be reconciled with Canada's climate change commitment, which includes our 2030 emissions reduction target. The panel states the question this way:

> *Can construction of a new Trans Mountain Pipeline be reconciled with Canada's climate change commitments?*
>
> — *Ministerial Panel Report*, November 1, 2016, p. 46
> https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/files/pdf/16-011_TMX%20Full%20Report-en_nov2-11-30am.pdf

10.4 The panel unanimously concluded that this is one of the important questions that "remain unanswered".

10.5 The Ministerial Panel's report was delivered to the government on November 1, 2016. The government did not respond. Four weeks later, the cabinet announced its decision approving the two pipelines – without any public comment on the unanswered question.

11. The Order in Council (November 29, 2016)

11.1 The final step in the approval of the Trans Mountain expansion project was a decision by the cabinet – collectively the thirty members of the Trudeau Government – announced on November 29, 2016.

11.2 The discussions and information considered by the cabinet in making that decision is secret, protected by cabinet confidentiality – although we know, from the Order in Council, that the cabinet considered the NEB report of May 19, 2016, the Trans Mountain upstream assessment report of November 25, 2016, and the Ministerial Panel's report of November 1, 2016. The only public record we have of the cabinet's decision, and the justifications for it, is the formal Order in Council document released on that date, which recites, in a few short paragraphs, the grounds relied on. The Order is one page in length, supplemented by a nineteen-page "Explanatory Note": http://www.gazette.gc.ca/rp-pr/p1/2016/2016-12-10/html/sup1-eng.html

11.3 In reciting the reasons for the government's decision, the Order states that it "accepts" the NEB's recommendation that the Project is "required" (i.e., it accepts the NEB's findings about the economic benefits and need for the additional pipeline capacity) and that it "will not likely cause significant adverse environmental effects under the *Canadian Environmental Assessment Act, 2012*." The Order thus assures us that the NEB report contained evidence and findings that supported and justified the government's crucial decision that the project "will not likely cause significant adverse environmental effects".

11.4 However, the NEB report did not discuss emissions or climate. The NEB inquiry had excluded any evidence about greenhouse gas emissions in Alberta – and excluded all scientific evidence about the impact of emissions on the climate system. So clearly the cabinet had not obtained any analysis, or indeed any information at all, about the emissions implications of oil sands expansion from the NEB report.

The Order cites the upstream emissions assessment report

11.5 The next short paragraph in the Order in Council cites the Trans Mountain upstream emissions assessment report, which had been released on November 25, 2016:

> *Whereas the Governor in Council, having considered upstream greenhouse gas emissions associated with the Project and identified in Environment Canada's report entitled* Trans Mountain Pipeline ULC – Trans Mountain Expansion Project Review of Related Upstream Greenhouse Gas Emissions*, and the Government of Alberta's* Climate Leadership Plan *commitment to cap oil sands emissions at 100 megatonnes of carbon dioxide equivalent per year, is satisfied that the project is consistent with Canada's commitments in relation to the Paris Agreement on Climate Change.*
>
> — Order in Council, November 29, 2016 (emphasis added)

11.6 The Trans Mountain report found that the upstream emissions "associated with" the volume of bitumen that could be carried by expanded capacity of the pipeline would amount to 13 to 15 Mt of CO_2eq on an annual basis.

11.7 But the Trans Mountain upstream emissions assessment did not address whether oil sands growth could be reconciled with Canada's commitment to reduce its total

emissions to 517 Mt by 2030. The report was silent about whether we can make large enough emissions reductions from other economic sectors in Canada to obtain the deep cuts we need – and to offset the continued increases in oil sands emissions. The cabinet could not have obtained any analysis or guidance from the November 25, 2016 Trans Mountain report to satisfy itself that the expected emissions growth from the expansion of oil sands production between 2015 and 2030 can be consistent with our 517 Mt target.

11.8 The text of the Order stated that "the project is consistent with" Canada's Paris commitments. There is nothing in the Trans Mountain upstream assessment report that could support that conclusion.

The reference to Alberta's 100 Mt cap

11.9 The Order in Council makes the claim that Alberta's commitment to cap oil sands emissions at 100 Mt per year provides additional support for the cabinet to have reached the conclusion (to be "satisfied") that the Trans Mountain project is "consistent with Canada's commitment" under the Paris Agreement.

11.10 Canada made two major commitments under the Paris Agreement. One is to reduce our total emissions to 517 Mt by 2030. The other is to hold the increase in global average temperature "*to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C*."

11.11 Alberta's 100 Mt cap will still allow oil sands emissions to rise from an annual level of 70 Mt in 2015 to as much as 116 Mt before the cap takes effect: see Part 4 above and Appendix D. Accordingly, the cap will do nothing to prevent the 44 Mt increase in oil sands emissions currently projected to occur between 2015 and 2030.

11.12 The cap will prevent oil sands emissions from eventually rising to more than 115 Mt per year, but based on the current production forecasts, that will not occur until after 2030.

11.13 The 100 Mt cap provides no assurance at all that the expected 44 Mt increase in oil sands emissions between 2015 and 2030 can be reconciled with our commitment to reduce our total emissions to 517 Mt.

The claim that "incremental emissions are unlikely"

11.14 The Order in Council is one page in length, supplemented by a nine-page "Explanatory Note."

11.15 The "Explanatory Note" appended to the November 29, 2016 Order contains a brief paragraph entitled "Climate Change". This paragraph includes what purports to be a summary of the findings of the Trans Mountain upstream assessment report, regarding the impact of the pipeline on Canada's total emissions:

> *The assessment indicated that <u>incremental emissions are unlikely</u> to be expected as oil production is expected to grow by more than the capacity of the expanded line regardless of whether the line is built.*
>
> — Order in Council, Explanatory Note, "Climate Change", p. 9 (emphasis added)

11.16 To any Canadian unfamiliar with the details of the methodology recited in the March 29, 2016 notice published in the *Canada Gazette*, the above sentence appears to tell us that the Trans Mountain assessment concluded it is "unlikely" that the Trans Mountain project will cause any growth in oil sands emissions.

11.17 But the upstream assessment report did not make that finding at all. It found that the emissions associated with the expanded shipping capacity of the Trans Mountain project would amount to 13 Mt to 15 Mt. A separate upstream assessment report, released for the Line 3 pipeline expansion project, found that the emissions associated with Line 3 would be in the range of 10 to 13 MT of CO_2 per year – so that the two projects together will account for between 22 Mt and 28 Mt of additional GHG emissions per year. The Trans Mountain assessment report acknowledges that total oil sands emissions were projected to rise to 116 Mt per year by 2030, up from 68 Mt in 2014 – a 48 Mt increase based on the then available data.

11.18 Why then did the "Explanatory Note" make the claim that incremental emissions would be unlikely? The answer lies in the details of the methodology adopted by the Trans Mountain assessment, and the definition of "incremental emissions".

11.19 The finding in the Trans Mountain assessment that "incremental emissions are unlikely" was based on the proposition that building new pipeline capacity is deemed to cause no emissions growth if the same amount of increased oil sands production would still occur if the pipeline were not built. The assessment made a finding that, provided oil prices reach US$80 per barrel by 2020 and remain above that level, rail would be an economically viable alternate mode of transport – so that, if the pipeline were not built, the same production growth would still occur. Therefore, following that method of analysis, a decision to build a new pipeline would not "cause" any increase in production, or in emissions. The same increase would occur if the pipeline were not built.

→ **A detailed outline of the evidence on the assessment methodology is in Appendix G.**

11.20 Notwithstanding the claim recited in the Explanatory Note, the evidence is incontrovertible that the Trans Mountain and Line 3 pipeline expansion projects together will facilitate more than 50% of the projected expansion of oil sands production between 2015 and 2030, and will account for more than half of the 44 Mt increase in the annual level of oil sands emissions over that period of time.

11.21 The Explanatory Note therefore provides no support for the statement contained in the Order in Council that the Trans Mountain project "is consistent with Canada's commitments in relation to the Paris Agreement on Climate Change". The claim is untenable, based on the evidence or findings in the Trans Mountain assessment.

Reference to the Ministerial Panel report

11.22 A third paragraph of the Order in Council acknowledges that the cabinet had also considered the report of the Ministerial Panel:

> *Whereas the Governor in Council has considered the Ministerial Panel's report on the Project entitled* Report from the Ministerial Panel for the Trans Mountain Expansion Project, *dated November 1, 2016.*

11.23 But the Ministerial Panel report did not provide the cabinet with any evidence to support a conclusion that the project is consistent with our Paris Agreement commitments. On the contrary, the panel had advised the government that the question remains unanswered.

11.24 Therefore, none of the three sources cited in the Order could have provided the cabinet with grounds to believe that projected emissions increases from the planned expansion of oil sands production between 2015 and 2030 are "consistent with Canada's commitments in relation to the Paris Agreement on Climate Change". None of these three processes conducted an inquiry into that question.

12. *Pan-Canadian Framework on Climate Change* (December 9, 2016)

12.1 The *Pan-Canadian Framework on Climate Change*, described as our "national climate plan", was publicly released on December 9, 2016 – a week *after* the government approved the pipeline projects. It was never subjected to any kind of scrutiny by a public inquiry process.

12.2 At that time, the most recent publicly available projection of Canada's emissions to 2030 was a report called *Canada's Second Biennial Report*, published by Environment Canada in February 2016. It showed Canada's total emissions reaching 815 Mt by 2030. On January 5, 2017, Environment Canada released an updated report, showing that total emissions by 2030 would be 742 Mt by 2030 (*Canada's 2016 Greenhouse Gas Emissions Reference Case*). That 742 Mt number was based on "current policies", indicating measures that had been implemented or announced by November 2016.

12.3 The government's most recent projections show total emissions reduced to 722 Mt by 2030, based on current policies as of September 2017: *Canada's 3rd Biennial Report*, released December 29, 2017. See Appendix A.

12.4 The *Framework* document made the claim that taking into account promised policies, Canada's total emissions would be reduced to meet the 517 Mt target by 2030.

12.5 The Framework provided a long list of promises about future emissions reduction policies. The *Framework* claimed that, based on these future policies, not yet implemented and mostly highly uncertain – *many of them not identified or developed at all* – Canada would be able to cut its total emissions down to 567 Mt by 2030, and that other unspecified future measures (e.g., "green infrastructure") would achieve an additional 44 Mt of cuts.

Additional measures

12.6 One of the major differences between the *Framework* document and the projections shown in Appendix A is that the former incorporates what it calls "additional measures" – which are promised future carbon reduction policies which have not yet been implemented, and which in many cases had not even been developed when the plan was published on December 9, 2016.

12.7 Since its initial public release on December 9, 2016, the *Framework* plan has been revised, and the new version was released on December 29, 2017, when it was published as part of *Canada's 3rd Biennial Report*. Figure viii incorporates the emissions data published on December 29, 2017 in the *3rd Biennial Report* (found in Table 5.28) showing the emissions reductions the government promises will be achieved by the "additional measures" described in the *Pan-Canadian Framework* plan:

Figure viii: Canadian 2030 GHG Emissions Forecasts (Mt CO_2eq) under different scenarios

	Current Projections to 2020	Projections to 2030		
		Current Measures	Additional Measures	Difference
Electricity	71	46	21	**-25 Mt**
Transportation	168	155	143	**-12 Mt**
Oil and Gas	197	215	192	**-23 Mt**
Heavy Industry	83	97	93	**-4 Mt**
Buildings	88	83	71	**-12 Mt**
Agriculture	71	72	71	**-1 Mt**
Waste and Others	50	53	51	**-2 Mt**
Total	**728**	**722**	**642**	**-79 Mt**

Source: emissions data from *Canada's 7th National Communication and 3rd Biennial Report* (December 29, 2017), Environment and Climate Change Canada, Table 5.28. The column on the left for 2030 shows the Government of Canada's emissions projections to 2030 based on current policies. The column on the right for 2030 shows forecast emissions by 2030 assuming that certain "additional policies" are all fully implemented and achieve the results promised by the government.

12.8 Additional measures are policies not yet implemented, and which in many cases are not even developed. Proposed methane regulations in the oil and gas industry are one example of an "additional policy". Some of the promised additional measures are within provincial jurisdiction and depend on future provincial action.

12.9 Assuming all of these "additional measures" are fully implemented, they will comprise 79 Mt of the total of approximately 200 Mt of future reductions needed to meet Canada's target by 2030. But the additional reductions by themselves can only bring the total down to 642 Mt.

12.10 This still leaves an emissions "gap" of 125 Mt if we are going to meet Canada's 517 Mt target. The promised 79 Mt of "additional measures" cover less than 50% of the reductions needed.

Purchase of carbon credits: 59 Mt

12.11 According to the government's *Framework* plan, another 59 Mt of reductions will be accounted for by the purchase of "international allowances" under the Western Climate Initiative.

12.12 Industrial emitters who are unwilling or unable to cut their own emissions in Canada will instead be able to purchase credits from California (where the reductions will occur) — allowing them to continue to emit CO_2 and other GHGs into the atmosphere unabated using their existing emissions-intensive technologies. They will be able to delay until after 2030 the kinds of technological innovation needed to reduce emissions.

12.13 This is not really a plan to reduce Canada's emissions. It is a scheme to *defer* almost one third of our needed cuts until some time after 2030. Canada has agreed with other leading industrial economies that we must achieve an 80% reduction of our total emissions by 2050. Assuming we successfully meet our nominal target by 2030, we will still require another deep round of cuts between 2030 and 2040, and more after that. We are simply shifting the burden of making this 59 Mt reduction to the people in charge after 2030 (our children) – but it will be, for them, an additional 59 Mt burden, on top of the all the other reductions they will have to make. The *Pan-Canadian Framework* contains no "plan" for what happens after 2030.

12.14 In the original version of the plan published December 9, 2016, carbon credits accounted for 55 Mt of the promised "reductions". The new version increases the carbon credits to 59 Mt of the total amount.

12.15 Based on Table 5.28 in the *3rd Biennial Report*, the combined "additional measures" (79 Mt) plus the "international allowances" (59) Mt will reduce Canada's total emissions down to a nominal 583 Mt by 2030 (from the currently projected 2030 level of 722 Mt). That still leaves a shortfall of 66 Mt.

The other promised 66 Mt of future reductions

12.16 In the context of what must be achieved in the next twelve years, 66 Mt is a huge number. The evidence at trial will show that, in the case of the transportation sector (Canada's second largest emitting sector), even assuming all of the above promised "additional measures" are fully implemented and successful, total transportation emissions between

2015 and 2030 will be reduced from 173 Mt down to a 143 – a total cut of only 30 Mt over fifteen years.

12.17 This claim that we can find a further reduction of 66 Mt is covered, in part, by promises that over the next decade we will lower the carbon-intensity of fossil fuels used in Canada – an ambitious plan called the "low carbon fuel standard", which is supposed to account for 30 Mt of the amount. The balance is covered by vague assurances about "investing in public transit, clean technology, and innovation…" (*Report,* Figure 5.6, p. 153), which means future policies that do not yet exist.

Carbon pricing

12.18 According to the *Pan-Canadian Framework* document, a carbon price (by means of a carbon tax or a cap-and–trade system) is one of the "four pillars" of what it calls a comprehensive plan (see *Framework* document, section 1.2, "Pillars of the Framework", p. 2).

12.19 The evidence at trial will show that the key factor in determining the effectiveness of any carbon pricing scheme is the *stringency* of the price: the cost of emitting CO_2 must be set high enough to ensure that businesses and consumers are motivated to switch away from carbon-intensive technology, products, and services – and to do that quickly enough to meet our emissions reduction target by 2030.

12.20 In the December 9, 2016 document, the Federal Government announced a benchmark for carbon pricing requiring that the carbon price for all jurisdictions in Canada will start at a minimum of $10 per tonne in 2018 and rise by $10 per year, to $50 per tonne by 2022. The scheme, summarized in the *Framework* document, provides that any further increase in the carbon price will not be decided until "early 2022":

> *The overall approach will be reviewed by early 2022 to confirm the path forward, including continued increases in stringency. The review will account for progress and the actions of the countries in response to carbon pricing, as well as recognition of permits or credits imported from other countries.*
>
> — *Pan-Canadian Framework,* p. 49

12.21 Therefore, there does not yet exist any agreed carbon pricing plan for Canada that ensures prices will rise above $50 after 2022. We do not know what the carbon price might be during the seven years after that, up to 2030 – or indeed whether it will increase at all.

12.22 Energy economists in Canada have warned that if we are going to rely on carbon pricing as a principal policy to achieve our emissions reduction target by 2030, the carbon price during the next decade will need to rise very substantially over the next decade – to as much as $150 or $200 per tonne of CO_2. At trial, the defendant will call expert evidence to show that a national carbon price rising to $50 per tonne by 2022 falls far short of the required stringency.

→ **Particulars of the proposed evidence about the incomplete and inadequate character of Canada's proposed carbon price are set out in Appendix K.**

The plan is dependent on uncertain future action by provincial governments

12.23 Further, the promised outcomes under the *Pan-Canadian Framework* plan depend heavily on the policy implementation by the provinces. A March 27, 2018 report by the Auditor General of Canada and by the auditors general of all provinces and territories (except Quebec) found that "most governments in Canada were not on track to meet their commitments to reducing greenhouse gas emissions…".

12.24 Most provinces do not have an emissions target for 2030. The report finds that provincial plans for the most part consisted of "high-level goals, with little guidance on how to implement actions. Details often missing from the plans included timelines, estimates of the reductions expected from individual action items, and information about funding."

→ **See Appendix J, Report of the Auditors General, March 27, 2018.**

12.25 The contingent nature of the *Framework* plan and its dependency on uncommitted provincial action was made painfully clear when the Ontario government recently abandoned that province's cap-and-trade program. The newly elected provincial government on July 25, 2018 tabled Bill 4, the *Cap and Trade Cancellation Act*, which repeals the entire carbon price scheme that came into force in Ontario on January 1, 2017. Ontario, Canada's second largest emitting jurisdiction and our biggest major industrial region, now has no carbon price at all. The Ontario scheme had set "caps" on greenhouse gas emissions for companies and certain industries, including manufacturing, electricity and fuel distribution.

12.26 The Ontario government says it will develop a new climate change plan; however, it rejects the view that the Federal Government has any constitutional power to impose its own carbon tax on Ontario. The province of Saskatchewan has also rejected the Federal government's authority to impose a national carbon price. At present there is no national agreement on establishing the promised carbon-pricing scheme, even at the $50 per tonne price level.

The plan excludes proposed LNG development in B.C.

12.27 On October 2, 2018, the owners of LNG Canada, a major liquid natural gas (LNG) liquefaction facility long planned for B.C.'s north coast, announced their decision to proceed with the construction of their project. When completed, the coastal facility and related natural gas production and processing activities will add 8.6 to 9.6 $MtCO_2eq$ to Canada's annual emissions.

12.28 The original *Framework* document released on December 9, 2016, applauded the efforts of the B.C. government to develop an LNG industry. It claimed that LNG "will play a critical role in transitioning the world … off of high carbon fuels." But it completely

omitted any discussion or analysis of the substantial growth of emissions that would result at the production and processing sites in B.C.

12.29 It has been known for the past five years at least that a single LNG plant (including upstream emissions from increased natural gas extraction and processing that will supply the liquefaction plant) will *increase* the annual level of Canada's total emissions by about 10 Mt. A joint federal-provincial environmental assessment report three years ago gave final environmental approval to the LNG Canada project. It acknowledged at that time that the liquefaction plant alone would generate 3.6 $MtCO_2eq$ of emissions annually. At trial, evidence will show that an additional 5.0 to 6.0 $MtCO_2eq$ will be released by the related upstream natural gas production and processing activities.

12.30 But that significant potential growth was not mentioned in the recent *3rd Biennial Report* (December 29, 2017), which incorporates updated projections for future cuts under the government's *Pan-Canadian Framework* plan. That update included no provision at all for any emissions increase in the oil and gas sector from LNG development. Instead, it contains this note acknowledging that prospective LNG emissions are excluded:

> *Consistent with the most recent NEB projections, this report does not include the construction of any liquefied natural gas production projects nor emissions from that sector over the projection period.*
>
> — *3rd Biennial Report*, Section 5.3.6.1 "Oil and Gas", p. 139

→ **Particulars of the evidence about the emissions impact of LNG development in B.C. are set out in Appendix L.**

13. Global oil consumption to 2040

13.1 Another deep contradiction, unanswered, lies at the heart of our national policy.

13.2 The economic benefits of the Trans Mountain pipeline expansion have been much discussed by the National Energy Board (NEB) and by the Government of Canada and the Province of Alberta.

13.3 The foundations of the economic case were set out in the NEB's January 27, 2016 report, *Canada's Energy Future 2016*: *Energy Supply and Demand Projections to 2040.* The NEB concluded in its analysis that growth in global oil consumption, especially in Asia, will remain strong for another twenty-five years. Based on that projection of increasing oil demand worldwide for several more decades, the NEB forecast that Canada's oil sands production would increase from the 2014 level of 2.4 million bpd to 4.8 million bpd by 2040 – a doubling of production. Later, in October 2016, the NEB published an update (titled *Canada's Energy Future 2016 Update*) that lowered the NEB's projections due to uncertainty about future oil prices. The *Update* projected that oil sands production will reach 4.3 million bpd (instead of 4.8) by 2040.

13.4 The two projects now approved (Trans Mountain and Line 3) will add enough new capacity to transport an additional 960,000 bpd, which will accommodate almost 50% of the industry's total planned expansion to 2040. The economic viability of this plan – building new pipelines and a near doubling of oil sands production by 2040 – is based on the expectation that *the global appetite for oil will continue to grow for at least another twenty-five years.* That is the key assumption underlying the economic case.

13.5 However, the International Energy Agency (IEA) has stated unequivocally that current "business-as-usual" projections showing continued growth of global crude oil production to 2040 are inconsistent with the goal of limiting the long-term rise of average global temperature to 2°C – a climate policy commitment affirmed by all signatory countries (including Canada) under the 2015 Paris Agreement.

13.6 The IEA's "450 Scenario" is a mitigation scenario designed to meet that goal. It calls on all countries to adopt carbon-reduction policies that will achieve significant reductions of global oil consumption – absolute reductions starting by 2020 – that are deep enough to meet the 2°C target. The key strategy under the 450 Scenario is a gradual decline of global oil consumption, starting in 2020, to achieve about a 20% cut in worldwide oil demand by 2040, compared to the 2014 level.

13.7 The *Pan-Canadian Framework* plan is completely silent about whether the planned expansion of oil sands production to 2040 is consistent with the 2°C commitment.

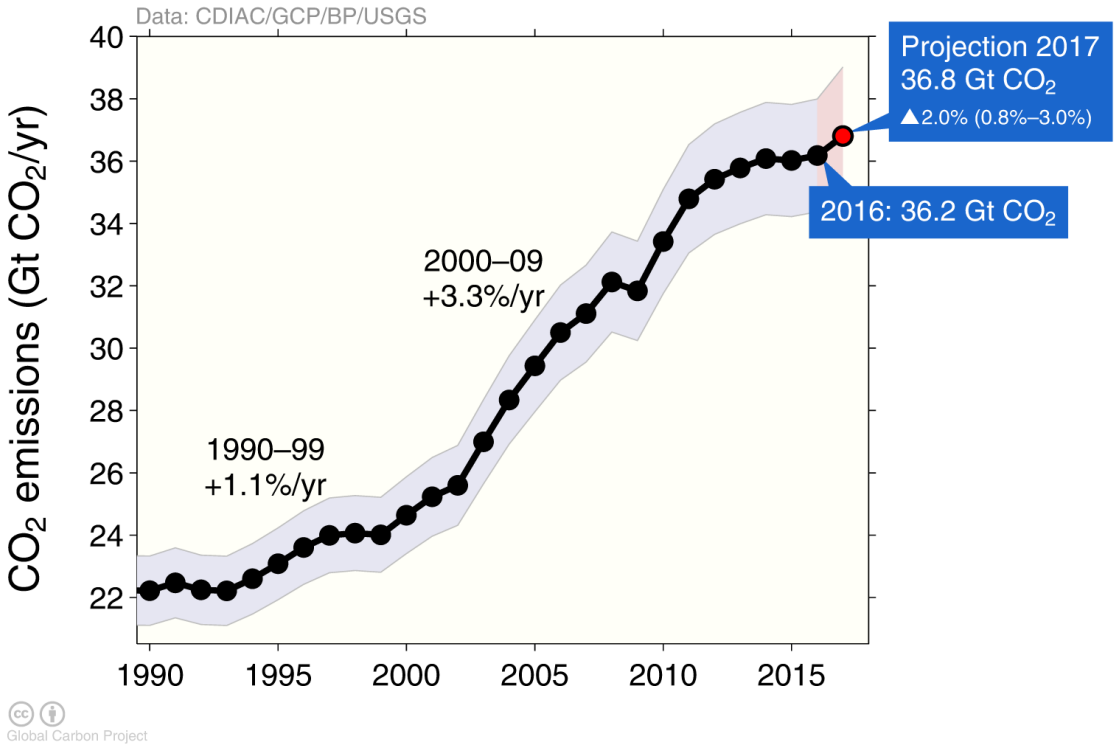
→ **A more detailed outline of the evidence that the accused intends to call at trial on this issue is set out in Appendices M, N, O, and P.**

14. Evidence about global CO_2 emissions

14.1 The annual level of global CO_2 emissions is still increasing.

14.2 The graph below is reproduced from a report called the *Global Carbon Budget 2017* published on November 13, 2017. It shows the trend of global CO_2 emissions over the past twenty-seven years.

Figure ix: Fossil fuel burning and cement production – global CO_2 emissions in 2016



Source: Global Carbon Project

14.3 Between 1990 and 1999, the average annual increase in global CO_2 emissions was 1% per year. From 2000 to 2009 the average annual growth rate was 3.3% per year. Prior to 2014, the only recent period in which global emissions stopped their rapid annual growth – and when they briefly declined in absolute terms – was in 2008-2009 when the global financial crisis and resulting recession dramatically reduced economic output.

14.4 As the world economy emerged from the recession in 2010, the level of global emissions began to increase again, and we experienced three more years of substantial emissions growth, driven by economic expansion.

14.5 In 2014, for the first time, the annual rise of CO_2 emissions slowed down during a period of robust growth in the world economy. That positive trend continued through 2015 and in 2016, with a small increase to 36.2 billion tonnes

14.6 However, preliminary figures project that the annual level for 2017 increased to 36.8 billion tonnes of CO_2, a 2% increase above the 2016 level.

14.7 The 36.2 billion tonnes (Gt) of CO_2 emissions for 2016 shown in Figure ix covers only emissions from burning fossil fuels (coal, oil, and natural gas) as well as emissions from cement production. It *does not include* CO_2 emissions from deforestation, forest fires, and other land use changes (referred to as "LULUCF" emissions). Nor does it include

non-CO_2 GHG emissions, the most important of which are methane (CH_4) and nitrous oxide (N_2O).

* Apart from emissions from burning fossil fuels and cement production, the second major source of anthropogenic CO_2 emissions to the atmosphere is caused by changes in land use (mainly deforestation which causes globally a net reduction in land carbon storage). Land use, land-use changes, and forestry emissions add another estimated 4.3 Gt CO_2 to the global total of carbon dioxide emissions: see *Trends in global CO_2 and total greenhouse gas* emissions, 2017 report, PBL Netherlands Environmental Assessment Agency, The Hague, 2017 http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-trends-in-global-co2-and-total-greenhouse-gas-emissons-2017-report_2674.pdf.

* Estimates of land use CO_2 emissions vary slightly, but are generally estimated to add another 10% to carbon emissions released from fossil fuel burning and cement production. Taking into account land use CO_2 emissions, the recent report of the IPCC concludes that "the carbon budget is being depleted by 42±3 $GtCO_2$ per year" (*IPCC 2018,* SPM at C1.3).

14.8 If we take into account as well all non-CO_2 GHGs, overall GHG emissions in 2016 are estimated to have reached 53.4 billion tonnes (Gt) in CO_2 equivalent (CO_2eq): see 2017 report, PBL Netherlands Environmental Assessment Agency. Globally, about 25% of all methane emissions are released during oil and gas production and processing, about 25% from cattle, and 10% from rice cultivation. An outline of the evidence about the significance of methane emissions in Canada is found in Appendix E. The main sources of nitrous oxide emissions are in agriculture, such as animal manure and the use of fertilizers.

* The defendants will also cite the analysis reported in *The Emissions Gap Report 2017*, United Nations Emissions Program, which estimates that total global GHG emissions, including non-CO_2 and land use emissions, reached 51.9 $GtCO_2$eq in 2016.

14.10 Coal burning is the source of 40% of all CO_2 from fossil fuel burning and cement production, oil accounts for 34%, natural gas 19%, cement 6%, and gas flaring 1%. Out of the global total of 36.2 $GtCO_2$ emissions in 2016, oil accounted for 12.5 $GtCO_2$; see below Part 16, para.16.30. Coal has traditionally been the dominant fuel for electrical generation. There is a shift now to a growing share of natural gas use in the electricity sector, with the result that natural gas use is rising.

Regional trends

14.11 Four political jurisdictions dominate the world's emissions: they make up almost 60% of the global total. The list below, taken from the *Global Carbon Budget 2017*, sets out the percentage share of each, and shows the growth rate of their emissions in 2016, and their per capita emissions:

Figure x: Global CO_2 emissions in 2016: top four emitters

	Share	Emissions Growth 2015-2016	Per Capita Emissions
China	28%	-0.3%	7.2 tCO_2
USA	15%	-2.1%	16.5 tCO_2
EU	10%	-0.3%	7.0 tCO_2
India	7%	4.5%	1.8 tCO_2

Sources of data: Global Carbon Project

14.12 The rise in per capita emissions in fast developing economies in Asia (especially in China and India) has been a major cause of the rising global trend in recent years.

Economic growth and carbon emissions

14.13 The evidence will show that the main driver of the rate of a*nnual increases* in the level of CO_2 emissions is the rate of economic growth. In advanced western industrialized economies, and now in the developing countries in East Asia, it has been usual to see national economies grow by 3.5% or more every year, measured by GDP.

14.14 The use of carbon-based energy is integral to almost every kind of economic activity (as fuel in all forms of transportation, in electrical production, industrial processes, and heating). When the size of an economy grows, say at 3.5% a year, the annual consumption of coal, oil, and natural gas and the resulting annual level of CO_2 emissions also all substantially increase – but usually at a lower percentage rate, because of what is called the *declining carbon intensity* of economic activity.

14.15 Over long periods of time, advances in technology and improved efficiencies in industrial economies allow producers of goods and services to *use less fossil fuel energy to produce the same amount of output*. Economists call this the declining carbon intensity of production.

14.16 In *The Climate Casino: Risk, Uncertainty, and Economics for a Warming World* (2013), the American economist William Nordhaus provides a clear introduction to the relationship between economic growth and carbon emissions. He summarizes the historic economic evidence. In the case of the United States, over the past 80 years real output has grown at an average rate of 3.4% per year, while during the same period carbon intensity has declined at 1.8% per year. Therefore, over that 80-year period, U.S. economic growth has been accompanied by 1.6 % of growth in CO_2 emissions every year, on average.

14.17 In contrast, less-developed economies do not have the same capacity to reduce their carbon intensity, at least not at anything comparable to the U.S. historic average of 1.8% per year. Poorer countries have less capital available for investing in advanced technologies, and as a result they are slower to improve efficiencies in energy use. They also have traditionally have had abundant supplies of low-paid labour, which is a disincentive to invest in expensive technology. When a country like India experiences rapid economic growth – as it expands its industries, electricity generating systems, and transportation systems – its annual carbon emissions rise at a faster rate than for comparative growth in a highly industrialized western economy.

14.18 As long as the global energy system is overwhelmingly dependent on carbon-based fuels and until we make changes that begin to *shift us away from that dependence in a substantial way*, all annual economic growth – a phenomenon we generally welcome – will be accompanied by the growth of CO_2 emissions. William Nordhaus summarizes our dilemma in the astringent language of an economist:

> *Rapid climate change is the unintended by product of rapid economic growth with no abatement policies.*

Increased CO_2 emissions in 2017

14.19 The evidence will show that global emissions are not yet close to "peaking." That conclusion, if well founded, has the most serious implications for any expectation that we can keep the rise in average surface temperature to less than 2°C.

14.20 The Global Carbon Budget report, referred to above, has warned that after three years of stabilized emissions (through 2014, 2015, and 2016), based on preliminary data, global emissions are projected to rise 2% to 36.8 Gt CO_2.

14.21 The defendant will also call other evidence showing that global CO_2 emissions in 2017 not only resumed their previous rising trend, but that the underlying factors driving that emissions growth show that we are very far from achieving the kind of transition in energy systems that will allow deep reductions at any early date. Specifically, the defendant will call expert evidence confirming the findings set out in the International Energy Agency's (IEA) March 2018 report, *Global Energy and C0₂ Status Report 2017*, found at https://www.iea.org/publications/freepublications/publication/GECO2017.pdf

14.22 The IEA report finds that global energy-related CO_2 emissions grew by 1.4% in 2017 (slightly less than the Global Carbon Budget projection). What is significant are the underlying trends which explain that growth.

14.23 First, according to the IEA report, in 2017 global energy demand increased by 2.1%. That reflects strong economic growth in the world economy. The IEA reports economic growth was 3.7% in 2017 - by itself a positive development.

14.24 But what should concern us is that *72% of that rise in energy demand was met by an increase in fossil fuels consumption*, 25% by renewables, and the remainder by nuclear.

14.25 The evidence will show that, on a global basis, strong annual economic growth is still driving up carbon emissions. This significant growth in fossil fuel demand in 2017 occurred despite continued rapid expansion of renewable energy:

> *Renewable saw the highest growth rate of any energy source in 2017, meeting a quarter of global energy demand growth last year. China and the United States led this unprecedented growth, contributing around 50% of the increase in renewables electricity generation, followed by the European Union, India, and Japan. Wind power accounted for 36% of the growth in renewables".*
>
> — IEA, *Global Energy and CO_2 Status Report 2017*

14.26 Despite strong growth in renewables, however, the overall share of fossil fuels in the world's total energy supply has remained at about 81%, a level virtually unchanged over the past three decades.

14.27 In 2017, global oil demand rose by 1.6% (an additional 1.5 million bpd). That growth was much higher than the annual average of 1% seen over the last decade. The IEA report identifies two principal factors driving that growth: "An increasing share of sport-utility vehicles and light trucks in major economies and demand from the petrochemical sector bolstered that growth'". It observes that "there are no signs of a peak in demand anytime soon", a conclusion confirmed by the fact that the IEA's New Policies Scenario projects rising global oil consumption until 2040.

14.28 Natural gas demand grew by 3%.

14.29 Even coal demand increased, by 1% in 2017, "almost entirely driven by an increase in coal-fired electricity generation". That compares to a 2.3% decline in coal use in 2015 and a 2.1% decline in 2016.

14.30 As long as this pronounced fossil-fuel dependence of the energy system remains unaltered, rapid economic growth will inevitably mean more emissions. The 1.5 % rise in global emissions in 2017 amounted to an additional 460 million tonnes (Mt) of CO_2 – almost equivalent to Canada's entire annual emissions. The global increase in 2017 occurred despite reductions by some countries: the United States achieved a 0.5% cut, or 25 Mt; the United Kingdom a 3.8% cut, or 15 Mt. In Japan, emissions fell by 0.5%. But emissions growth in other regions offset those gains. China's emissions grew by 1.7%, or 150 Mt.

15. Evidence about the atmospheric carbon concentration level

15.1 The accumulating concentration of CO_2 is measured in parts per million (ppm), indicating the number of CO_2 molecules per million molecules of other gases in the atmosphere.

15.2 The carbon concentration level reached an annual average of 405.0 ppm in 2017.

15.3 An atmospheric carbon concentration level of 450 ppm is broadly equivalent to a 2°C increase in global average temperature. That conclusion is based on the correlation, supported by the scientific evidence, between increases in the CO_2 concentration level and warming of the earth.

→ **Appendix R, "Climate sensitivity: warming and the level of atmospheric carbon", provides further details of the proposed evidence about the relationship between the CO_2 concentration level and warming.**

15.4 Human activities are estimated to have caused approximately 1.0°C of global warming above the pre-industrial level (the pre-industrial level is taken to be the average over the period 1850-1900). Estimated anthropogenic global warming is currently increasing at 0.20°C per decade (IPCC 2018, SPM-4)

15.5 Two-thirds of the total surface warming has occurred since 1970. Further particulars of the proposed evidence on surface warming are set out in Part 18.

15.6 Between 2016 and 2017, the atmospheric carbon concentration level rose by 2.2 ppm, which was slightly less than the increase between 2015 and 2016 (3.0 ppm). The rate of increase has been accelerating, reflecting the persistent growth in the annual level of global emissions from burning coal, oil, natural gas, and cement production. In the 1960s, the global growth rate of atmospheric carbon dioxide was about 0.6 ppm per year. The rise in the global atmospheric CO_2 concentration since 2000 is about 20 ppm per decade (IPCC 2018, Chapter 1 at 1-8).

15.7 An unusual characteristic of CO_2, unlike methane for example, is that once the gas is released into the upper atmosphere it does not break down. It has an effective atmospheric residence time of centuries to millennia (IPCC 2018 Chapter 1 at 1-23). It is only removed from the atmosphere when it is absorbed by the earth's surface – by dissolving into the upper ocean (and slowly into the deep ocean) or by biological uptake into forests and plants. The problem is that we keep releasing more CO_2 into the atmosphere every year. Once we stop massive fossil fuel burning, the incremental increases in the atmospheric concentration will stop. After emissions cease, atmospheric CO_2 will begin to decline, albeit very slowly – only over decades and centuries. From the perspective of the time frame that concerns us, slowing the rise in the concentration level to 2030 and 2035 is crucial.

15.8 A comprehensive review of the long-term record of atmospheric carbon levels is found in *Climate Change 2013: The Physical Science Basis*, which is the first part of the Fifth Assessment Report (AR5) prepared by the Intergovernmental Panel on Climate Change (IPCC). The study was prepared by a group of leading climate scientists who assessed the most recent available findings about physical changes in the global climate system, including measurements of atmospheric gases.

> *The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels <u>unprecedented in at least the last 800,000 years</u>. Carbon dioxide concentrations have <u>increased by 40% since pre-industrial times</u>, primarily from fossil-fuel emissions and secondarily from net land use change*

emissions. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification.

— *IPCC, 2013*: *Summary for Policymakers*, B.5 at page 11 (# 3)

15.9 Since before the beginning of human life on earth and up to the start of industrialization in about 1780, the CO_2 concentration level was never *higher* than 300 ppm. During the past 12,000 years, from the end of the last Ice Age until the advent of the industrial age, it was stable at about 280 ppm. By 1958, it was 315 ppm. Since then, the level has risen by another 90 ppm.

15.10 Half of all human-caused carbon emissions have occurred after1970: IPCC, 2014, *Summary for Policymakers*, SPM.3, p.7.

15.11 Each year the atmospheric CO_2 concentration follows a cycle. April and May are the high point of the cycle, September the low. *But the annual average is moving up every year.* The monthly averages in April and May 2018 exceeded 410 ppm: see National Oceanic Atmospheric Administration (NOAA), Earth System Research Laboratory, Global Monitoring Division website, https://www.esrl.noaa.gov/gmd/ccgg/trends/index.html

15.12 In monitoring these issues, scientists add together the warming effect of all the GHGs, principally carbon dioxide, methane, and nitrous oxide. The combined concentration is measured as "CO_2 equivalent" (CO_2eq). The most recent comprehensive studies indicate that if we do nothing, the combined concentration level will exceed 450 ppm CO_2eq by 2030:

Baseline scenarios (scenarios without explicit additional efforts to constrain emissions) exceed 450 parts per million (ppm) CO_2eq by 2030 and reach CO_2eq concentrations between 750 and more than 1300 ppm CO_2eq in 2100.

— IPCC, 2014, *Summary for Policymakers*, SPM 3, p. 8 (emphasis added)

15.13 Baseline scenarios ("business-as-usual" scenarios) are studies that calculate future levels of accumulated GHGs in the atmosphere, based on the assumption that countries around the world *do not act to substantially reduce current patterns of coal, oil, and natural gas consumption.* If we continue on the present path, we will likely exceed the 450 CO_2eq level by 2030.

15.14 The above quotes are taken from the *Summary for Policymakers* that is included in each volume of the IPCC report. The Government of Canada approved the language of both documents, in late 2013 and April 2014, respectively. The above statements therefore summarize the key findings of science that have already been acknowledged by our government – and they indicate the nature of the scientific evidence that we would expect to see addressed in any proper environmental assessment that concerns the proposed expansion of oil sands production over decades.

15.15 What we do in the next twelve years is of enormous importance. We have to move very quickly to diminish those incremental increases in the atmospheric concentration of CO_2 and other GHGs.

15.16 Canada's leading climate scientists could have been called to testify at the National Energy Board (NEB) inquiry about the rising level of atmospheric carbon and the implications of failing to meet our emissions reduction target by 2030 – but all evidence of that kind was excluded. The Trans Mountain upstream emissions assessment report was also silent about the narrowing time frame we have to arrest the rapid accumulation of CO_2 and other gases in the atmosphere.

16. Evidence about mitigation scenarios

16.1 The evidence at trial will show that the annual level of global emissions is still increasing (see the proposed evidence outlined in Part 14). The projected level for 2017, 36.8 $GtCO_2$, will be a new high record. The increase in the atmospheric carbon concentration level in 2017 to 405 ppm is a new high, an increase of 2.2 ppm above 2016.

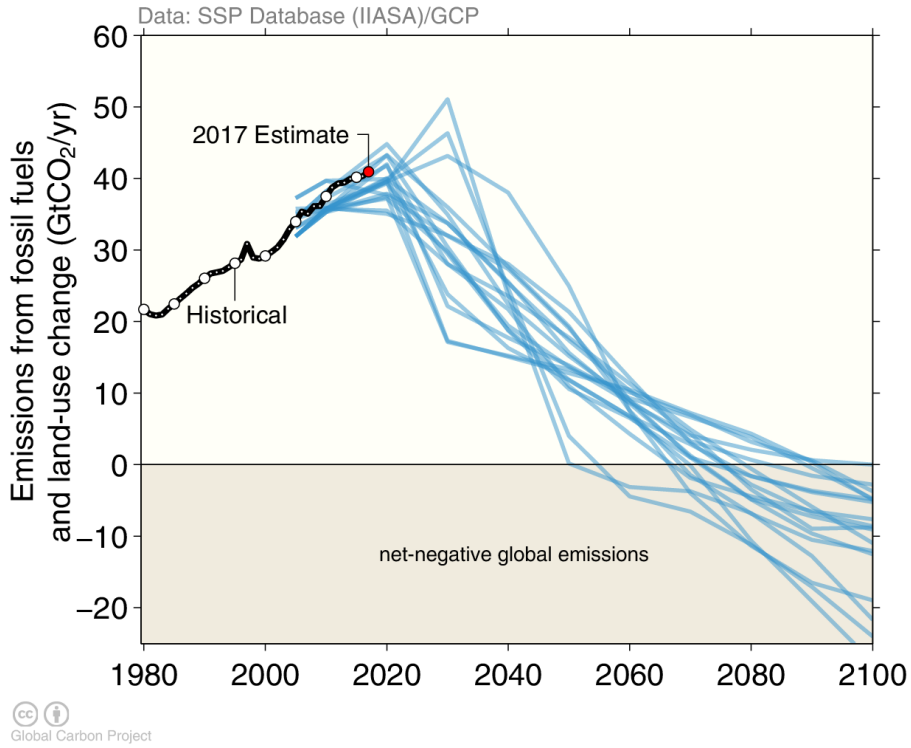
16.2 At trial, the defendant will call expert evidence to show there is broad agreement among climate scientists that atmospheric carbon concentration levels exceeding 450 ppm are not consistent with keeping global average surface warming within 2°C.

16.3 The evidence will also show that in order to keep within 450 ppm, reductions to global emissions levels must be implemented by 2020.

Global emissions reductions must begin by about 2020

16.4 Key evidence at trial will refer to mitigation scenarios, which are studies that examine the magnitude of emissions reductions that will be required over the next forty-years to ensure that warming can be kept "to well below 2°C", the commitment made by Canada under the terms of the Paris Agreement in December 2015. The evidence will show that virtually all emissions reduction scenarios capable of meeting the 2°C target require that deep cuts must begin by about 2020.

Figure xi: Pathways that avoid 2°C of warming



Source: Global Carbon Project

16.5 Figure xi reproduces a graph depicting a recent series of mitigations scenarios, called the Shared Socioeconomic Pathways (SSP).

16.6 All of the SSP scenarios are consistent with avoiding 2°C of warming. All of the depicted scenarios begin with deep cuts by about 2020, with the exception of three – two of which show continuing strong emissions growth until 2030, after which (in order to stay within the warming threshold) they would need to initiate extremely rapid reductions. It can also be seen that, to stay within the limit, all of these scenarios require future deployment of technologies after about 2060 that will have the capability to *remove* CO_2 from the atmosphere – technologies that do not yet exist.

Baseline scenarios

16.7 The defendant's expert evidence will cite *Climate Change 2014: Mitigation of Climate Change*, released on April 12, 2014, the third in a series of reports issued by the Intergovernmental Panel on Climate Change (IPCC), prepared by Working Group 3 (referred to as "WC3"). That working group is a panel of scientists who are specifically concerned with research and policy about mitigation.

16.8 A starting point for understanding Working Group 3's approach to assessing the impact of future CO_2 emissions trends is the concept of "baseline scenarios". Baseline calculations begin with current emissions levels and calculate future trajectories, for

example, up to the year 2100, taking into account expected trends of economic growth, future population growth, changes in energy demand, and future technology. They work out what the pathway of the increasing annual emissions level will be at various stages along the way, i.e. in 2040, 2070, and so on. These studies provide a "baseline" of what will happen if no robust carbon-reduction measures (usually referred to as "mitigation" measures) are adopted.

16.9 The IPCC does not conduct its own primary research. Working Group 3 was composed of a panel of scientists who over several years gathered together and assessed the most recent research from government bodies, independent research institutes, and universities. In this case they looked at 300 different baseline scenarios projecting the trajectory of emissions levels to the year 2100 or after. They also examined 900 "mitigation" scenarios, which are considered below.

16.10 The wide range of "baseline" projections vary in their final outcomes because the various studies make very different assumptions about how rapidly economies will grow in different regions of the world, how much the carbon intensity of production will decline (even without special policies aimed to cut emissions), and how much technological change will improve energy efficiency.

16.11 The IPCC's large-scale assessment of recent baseline scenarios of CO_2 emissions therefore provides a composite picture of the conclusions reached by multiple scientists and researchers about how CO_2 emissions will continue to rise to the end of the 21st century based on many different projections of how the global economy will perform. It also gives an overview of the conclusions reached by hundreds of researchers who have calculated how rising annual emissions will alter the CO_2 concentration level in the atmosphere (405.0 parts per million in 2017) and the likely impact of that on warming and other changes to the climate system.

16.12 Here is a summary of the conclusions reached by Working Group 3 based on its assessment of these baseline scenarios:

> *Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities. Baseline scenarios, those without additional mitigation, result in global mean surface temperature increase in 2100 from 3.7°C to 4.8°C compared to pre-industrial levels (median values: the range is 2.5°C to 7.8°C when including climate uncertainty, see table SPM.1) (high confidence)*
>
> — *IPCC WG3 Summary for Policymakers* SPM-3

16.13 By the year 2100, all of the baseline scenarios show that the atmospheric concentration of CO_2eq *will increase to between 750 ppm and more than 1300 ppm CO_2eq*: that finding is discussed in Chapter 6 of the IPCC WG3 report at page 19. Taking into account that 450 ppm is the high end of the CO_2eq concentration level consistent with staying within the 2°C threshold, the conclusion based on baseline scenarios is that our current

emissions pathway, in the absence of significant new policies that dramatically cut emissions, will take us well above 2°C.

16.14 The baseline scenarios also show that even by 2040 – 2050 the concentration level will exceed 550 CO_2eq.

16.15 Data showing the *annual level of emissions* are important indicators of what is happening. But it is the *atmospheric CO_2 level* (which in 2017 increased by 2.2 ppm to 405 ppm) that is driving the impact on the climate system.

16.16 The evidence at trial will show that the atmospheric carbon concentration level reached an annual average of 405 ppm in 2017. The monthly average through April and May 2018 exceeded 410 ppm. Daily records in April and May have reached 412 ppm.

16.17 The baseline scenarios tell us that unless we substantially alter and reduce the trajectory of the present global emissions pathway the CO_2eq concentration level will exceed 550 ppm in 2040-2050 and will be *more than 750 ppm by 2100.*

16.18 CO_2eq concentration levels that exceed 750 ppm will lead to a projected rise of global surface temperature by 3.7 to 4.8°C above the pre-industrial level. That is the conclusion reported by Working Group 3 based on multiple studies.

Mitigation scenarios

16.19 Working Group 3 examined 900 "mitigation scenarios" developed by scientists in different countries. *Mitigation scenarios* involve making assumptions about future economic growth, population growth, and energy demand, but they also include additional assumptions about *future shifts to renewable energy (and low-carbon energy) and about how long it will be before those changes take place*; the availability of new technologies; improvements in energy efficiency (amounts of energy per unit of production) and carbon efficiency (amounts of CO_2 per unity of energy). Mitigation scenarios consider, for example, the impact of possible large-scale shifts to electric vehicles, the adoption of carbon capture and storage (CSS), how fast coal-fired electrical generation is curtailed, and so on.

16.20 One key objective, reported in Chapter 6 of Working Group 3's report, was to calculate which mitigation scenarios would be consistent with keeping warming below the 2°C threshold.

16.21 On the question of the 2°C threshold, here is the answer provided by Working Group 3:

> *Mitigation scenarios in which it is likely that the temperature change caused by anthropogenic GHG emissions can be kept to less than 2°C relative to pre-industrial levels are characterized by atmospheric concentrations in 2100 of about 450 ppm CO_2eq (high confidence).*
>
> *— IPCC WG3 Summary for Policymakers, SPM.4.1*

16.22 That is the key finding. It allows us to see in a direct way the correlation between the accumulating level of CO_2eq in the atmosphere and climate disruption. The next few sentences in that summary are highly relevant, because they vividly convey in the sober language of science the thin margin we have to avoid the most serious climate disruption:

> *Mitigation scenarios reaching concentration levels of about 500 ppm CO_2eq by 2100 are more likely than not to limit temperature change to less than 2°C relative to pre-industrial levels, unless they temporarily 'overshoot' concentration levels of roughly 530 ppm CO_2eq before 2100, in which case they are about as likely as not to achieve that goal. Scenarios that reach 530 to 650 ppm CO_2eq concentrations by 2100 are more unlikely than likely to keep temperature change below 2°C relative to pre-industrial levels. Scenarios that exceed about 650 ppm CO_2 eq by 2100 are unlikely to limit temperature change to below 2°C relative to pre-industrial levels.*

16.23 Therefore, 450 ppm is the upper end of the range for the atmospheric concentration of CO_2eq within which we can "likely" (66% chance or better) keep warming from exceeding the 2°C. If the concentration level rises to 500 ppm, or "temporarily" as high as 530 ppm, the chance moves closer to 50-50.

→ **Appendix S outlines additional details of the evidence about mitigation scenarios that will be called by the defendant at trial.**

The problem of time

16.24 Working Group 3 explains that under *all baseline projections* the CO_2eq concentration level by 2040-2050 exceeds 550 ppm. That is well above the crucial level of 450 ppm beyond which we lose any "likely" chance to keep warming under 2°C.

16.25 Even if all *further increase* in the annual level of global CO_2 emissions is halted, for example, by 2020 – so that annual release of emissions worldwide is stabilized and starts to decline in absolute terms after 2020 – the atmospheric CO_2eq level will still continue to rise for many years into the future, because substantial additional amounts of CO_2 will continue to be released into the atmosphere every year (although we can hope the future annual increases will begin to decline in magnitude). Therefore, the existing accumulation already in the atmosphere will continue to rise.

16.26 At present, our current volume of global CO_2 emissions is increasing the atmospheric carbon concentration level by about 2.3 ppm every year. Even after deep annual cuts begin, the atmospheric concentration level will continue to rise by significant annual increments, which will only gradually diminish as total emissions are reduced.

16.27 The evidence based on mitigation scenarios demonstrates that it will take more than forty years to substantially complete the transformation of the world's energy system away from reliance on carbon-based fuels, and bring an end to large-scale releases of CO_2 into the atmosphere.

16.28 The immediate challenge is how we can most effectively *slow down, or delay, the rise from 410 ppm to 450 ppm*.

Oil accounts for 34% of global CO_2 emissions

16.29 In this context, the defendant at trial will call evidence to show that the required deep reductions to stay within the 2°C warming threshold cannot be achieved if oil consumption continues to increase after about 2020: see Appendices M, N, and O.

16.30 Oil consumption accounted for 12.5 billion tonnes (34%) of the total 36.2 billion tonnes ($GtCO_2$) of emissions from burning fossil fuels globally in 2016. Oil use is currently increasing. In 2017, global oil demand increased by 1.5%. Under the IEA's New Policies Scenario, demand *is projected to continue to rise for another twenty years*.

16.31 Although emissions from coal burning (40% of the global total) are beginning to decline, emissions from natural gas (currently 19%) are increasing – and are expected to continue to increase for another decade or two. Natural gas is being substituted for coal in electricity generation. Natural gas produces only about 50% of the emissions to generate the same amount of electricity. But the shift to natural gas is offsetting some of the gains from the shutdown of coal plants.

16.32 While coal is rapidly declining in the EU and in the United States (and in Canada) – and coal use in China has now peaked – the move away from coal in many poorer countries around the world will occur slowly.

16.33 The International Energy Agency's (IEA) 450 Scenario has unequivocally concluded that global oil consumption must begin to decline by 2020 to give the world even a 50-50 chance of keeping warming within the 2°C threshold.

→ **An outline of the evidence relating to the 450 Scenario is found in Appendix M.**

Accumulation of CO_2 in the oceans

16.34 The relationship between the annual level of emissions and the rising accumulation in the atmosphere is complicated by the fact that not all of the additional volume of CO_2 released annually by human activities at the earth's surface ends up in the atmosphere.

16.35 According to recent estimates published by the Global Carbon Project, between 2007 and 2016, on average, 23% of total CO_2 emissions (8.7 $GtCO_2$ per year) was absorbed into the ocean every year; about 30% (11.2 $GtCO_2$ per year) was absorbed into the land. Scientists speak of the ocean "sink" and the land "sink", describing in that way a natural process that effectively removes from the atmosphere every year a substantial share of the additional human-caused CO_2 emissions. Thanks to the land and ocean sinks, about 53% of total emissions over that period did not remain in the atmosphere. *But the other*

47 % of emissions (17.3 $GtCO_2$ per year on average) *did remain in the atmosphere*, and those amounts were added to the already existing carbon accumulation.

16.36 That amount added to the atmosphere every year (averaging 17.3 $GtCO_2$ per year in the recent period) accounted for the incremental increase in the *atmospheric carbon concentration level*.

16.37 The evidence will show that the proportionate distribution of GHG emissions in specific years between the atmosphere, the land, and the ocean can vary due to other factors, such as natural variation in climate conditions on the earth's surface. For example, during a year of unusually warm, dry conditions in tropical land areas (as in the El Niño year of 2016), the ability of land areas to absorb CO_2 can weaken, leading to larger releases of CO_2 into the atmosphere. Thus in 2016 the atmospheric concentration increased to 3.0 ppm (a significantly larger increase than the 2.3 ppm increase in 2015), even though the total level of human-caused CO_2 emissions in 2016 was more or less the same as in 2015.

16.38 The ocean is absorbing about 8.7 billion tonnes of CO_2 every year, which would otherwise have been added to the accumulation in the atmosphere. But the addition of vast amounts of carbon dioxide into the ocean is causing other problems, principally the increasing acidification of the ocean that is impairing the growth of coral reefs and other forms of marine life. The pH of ocean surface water has decreased by 0.1 since the beginning of the industrial age.

The economic constraints on rapid emissions reductions

16.39 Economic analyses from many sources indicate that for any modern industrial economy that is dependent on fossil fuels as its dominant energy source, annual emissions cuts that are substantially greater than about 5% to 6% per year will cause undue economic disruption. There are limits on how quickly a complex economy can transition away from its reliance on carbon-based energy. Annual cuts that are substantially larger will not be viable over a long period.

16.40 The IEA, for example, adopted 3% as the proposed level of annual cuts in CO_2 emissions in its 450 Scenario.

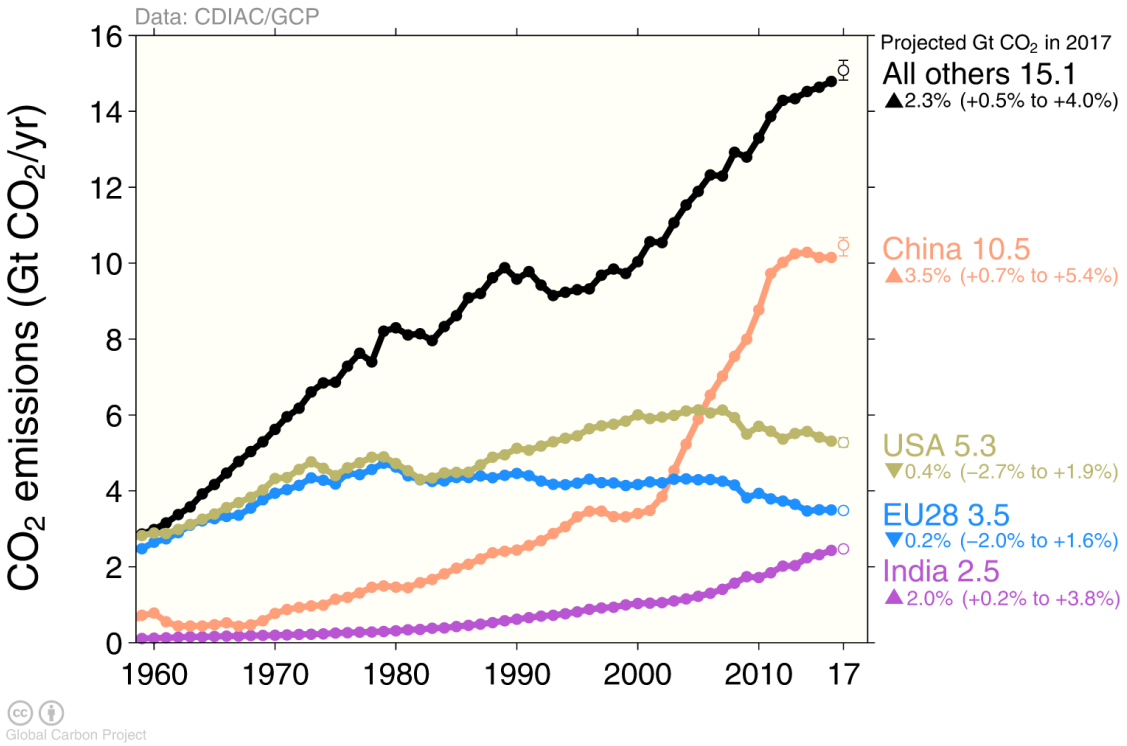
16.41 The longer we delay before starting to make absolute reductions, the deeper and more disruptive, and more costly, the cuts will eventually have to be – when we attempt to make them at a later date. That is evident in Figure xi. If we wait too long, the size of the annual reductions required will be so large that they will be beyond our ability.

17. The global emissions gap and the significance of Canada's commitment

17.1 The graph below is reproduced from *Global Carbon Budget 2017* published on November 13, 2017. It shows along the top line the trend of total global CO_2 emissions attributed to "all others", which means all countries with the exception of the four big

emitters (China, USA the EU, and India). At trial the defendant will call expert evidence confirming these trends.

Figure xii: Emissions projections to 2017 (showing other countries)



Source: Global Carbon Budget 2017, published November 13, 2017

17.2 The numbers shown in Figure xii do not include all greenhouse gas emissions. They cover only CO_2 emissions from fuel combustion, cement production, and other industrial processes, which reached a global total of 36.2 $GtCO_2$ in 2016 and are projected to have reached 36.8 Gt CO_2 in 2017. The big four emitters account for about 60% of the total.

17.3 The evidence will show that it is far beyond the capability of the four big emitters alone to achieve all the massive reductions needed over the next twelve years to keep the rise in the atmospheric carbon concentration level from exceeding 450 ppm.

17.4 Assuming, for example, that a 20% to 30% reduction of global emissions by 2030 below the 2016 level (36.2 $GtCO_2$) would be sufficient to meet that goal, that would require an absolute reduction of about 7 to 11 $GtCO_2$ over the next twelve years. However, a reduction in that range would only be sufficient provided *none of the other countries continue to increase their emissions during the next decade*.

17.5 But the evidence will show that India's emissions will *continue to increase* at least to 2030. Unfortunately, numerous other countries are also projected to continue increasing their emissions up to 2030. No significant reduction in the annual level of China's emissions is likely to occur before 2030.

17.6 The combined emissions of the United States and the EU, as large as they are, are only about 8.8 Gt. Those two entities cannot possibly deliver all of the needed cuts over the next decade. Even if they were to achieve an astonishing 40% reduction of their emissions, combined they would contribute a 3.5 $GtCO_2$ cut in the annual global level by 2030. But that is a fraction of the reduction needed to meet the global target for 2030, even if annual emissions from all other countries were immediately stabilized and stopped rising above their 2016 levels.

17.7 The evidence at trial will show that the shortfall is very much larger because during the next twelve years emissions in some countries will continue to rise.

17.8 To meet the target, the full participation of the limited number of countries that have the technological capacity to make rapid and deep reductions will be essential.

17.9 There is a group of advanced industrial economies, like Canada, that do have the capacity to achieve deep emissions reductions over the next decade. The evidence at trial will show that the needed deep cuts, over the next decade at least, will have to come from the most technologically advanced economies – which possess the technological resources to rapidly transform their energy systems.

17.10 Canada is the world's 10th largest emitter. After the big four emitters, Canada ranks just after the next five: Russia (1.63 $GtCO_2$), Japan (1.21 $GtCO_2$), Iran (0.66 $GtCO_2$), Saudi Arabia (0.63 $GtCO_2$), and South Korea (0.60 $GtCO_2$). Brazil (0.53 $GtCO_2$) ranks after Canada. Combined, this group of seven of the world's middle-range emitters accounts for about 5.5 Gt CO_2 of the world's annual emissions – about the same as the US's total.

17.11 But several of these seven economies will contribute little or nothing to the deep cuts needed in the next decade: Saudi Arabia is almost entirely dependent on its emissions-intensive oil and gas industry and petro-chemicals. The Russian Federation has not yet ratified the Paris Agreement, and in any case its own declared NDC (Nationally Determined Contribution) allows it to *increase* its emissions by 2030 above the 2015 level.

17.12 Therefore, in addition to expected deep cuts in the US and EU, looking ahead over the next decade the technologically advanced economies of Japan, South Korea and Canada offer the next-best chance we have to obtain a substantial portion of the deep reductions needed by 2030. To add to that short list, we can identify other mid-size and smaller emitters who may be able to substantially increase their reductions.

The UN Emissions Gap Report

17.13 At trial, the defendant will refer to a recent report that examines the "gap" that currently exists between the emissions reductions that will be needed by 2030 to stay within the 2°C target and the actual commitments so far made by individual countries. See UNEP (2017): *The Emissions Gap Report* 2017, United Nations Emissions Program, found at https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf?isAllowed=y&sequence=1

17.14 The evidence will show that, at present, after counting all emissions reductions commitments given by the United States, the EU, and all other countries (including Canada) that have agreed to make cuts under the Paris Agreement, the shortfall is substantial. *The Emission Gap Report 2017* concludes that existing commitments under the Paris Agreement, known as the Nationally Determined Contributions (NDCs), "cover only approximately one-third of the emissions reductions needed to be on a least-cost pathway for the goal of staying well below 2°C ": Executive Summary, p. xiv (emphasis added}.

17.15 The adoption of the Paris Agreement at the 2015 Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) established a framework for global emissions reduction. In advance, Canada and other countries declared their Intended Nationally Determined Contributions (INDCs). Each country voluntarily announced the magnitude of the reductions that they were prepared to achieve by 2030. Canada's promise was a 30% reduction by 2030, below the 2005 level. As of October 15, 2016, 168 of the 197 Parties to the Convention had ratified the Agreement, which entered into force on November 4, 2016. When the Agreement came into force, the cuts promised by individual countries thereby became their Nationally Determined Contributions (NDCs). Most of these NDCs are "unconditional," although some are "conditional."

17.16 Unfortunately, the UN *Emissions Gap Report 2017* demonstrates that the combined NDCs fall far short of the reductions needed by 2030:

17.17 The report takes into account all GHG emissions, not just carbon dioxide. It relies on 35.8 $GtCO_2$ as the measure of global CO_2 emissions in 2016 (slightly less than the Global Carbon Budget's figure of 36.2 $GtCO_2$). It adds to that all other other greenhouse gases (methane, nitrous oxide, etc.) and additional emissions from land use, land use change and forests (i.e., deforestation and land clearing). The UN report calculates that overall emissions reached 51.9 $GtCO_2eq$ in 2016.

17.18 The UN *Emissions Gap Report 2017* concludes that, based on *current policies*, total emissions will increase to 58.9 $GtCO_2eq$ by 2030. That is the projected outcome for 2030, without subtracting the promised emissions reductions under the NDCs.

17.19 The problem is that even assuming all of the existing unconditional NDCs are fully implemented over the next decade (including Canada's promise 30% reduction), total global emissions in 2016 (51.9 $GtCO_2eq$) are nevertheless projected to rise to 55.2 $GtCO_2eq$ by 2030, according the UN Report. Implementation of all the NDCs by some countries will not be enough to offset the continued growth of emissions in other countries. That is the evidence the defendant will call at trial, based on the UN Report and other sources.

17.20 That troubling estimate is confirmed in a comprehensive new study, the Special Report published by the Intergovernmental Panel on Climate Change on October 7, 2018 (IPCC 2018). It reports that estimates of the global emissions outcome based on currently nationally stated mitigation ambitions (i.e. the NDCs) submitted under the Paris

Agreement would lead global GHG emissions in 2030 of 52-58 $GtCO_2eq$: IPCC 2018, SPM-24, D1.

17.21 The UN analysis concludes that total GHG emissions from all human-induced sources must not exceed 41.8 $GtCO_2eq$ by 2030, if the 2°C target is to be attained with higher than a 66 percent chance of success. The 41.8 $GtCO_2eq$ figure is therefore the global "target" for 2030 to stay within the 2°C pathway.

17.22 In other words, in order to meet the 2030 target, the world's leading economies would need to find an *additional* 13.4 $GtCO_2eq$ of reductions – over and above the NDCs already committed. That is a massive amount of additional reductions. There exists an additional 3.0 $GtCO_2eq$ of "conditional NDCs" which, if fully implemented, would narrow the gap to about 11 Gt.

17.23 Although scenarios and theoretical plans exist that explain the kinds of global-scale policy changes needed to close the "emissions gap" by 2030 (the IEAs 450 Scenario is an example), the evidence at trial will show that individual countries have not yet adopted policies or made the additional reduction commitments required to meet the target.

17.24 The UN report explains the crucial importance of what happens in the next twelve years:

> *Looking beyond 2030, it is clear that if the emissions gap is not closed by 2030, it is extremely unlikely that the goal of keeping warming to well below 2°C can still be reached. Even if the current NDCs are fully implemented, the carbon budget for limiting global warming to below 2°C will be about 80% depleted by 2030. Given currently available carbon budget estimates, the available carbon budget for 1.5°C warming will already be well depleted by 2030.*
>
> — *The Emissions Gap Report 2017*, Executive Summary, p. xiv (emphasis added)

17.25 The Emissions Gap Report 2017 leaves no doubt that the full implementation of all the unconditional and unconditional NDCs by 2030 is insufficient to put the world on an emissions pathway consistent with keeping warming "well below 2°C." The NDCs are not enough:

> *Full implementation of the unconditional NDCs and comparable action afterwards is consistent with a temperature increase of about 3.2°C by 2100 relative to pre-industrial levels. Full implementation of the conditional NDCs would lower the projection by about 0.2°C.*
>
> — *The Emissions Gap Report 2017,* Executive Summary, p. xviii (emphasis added)

The emissions gap and the 1.5°C pathway

17.26 Under the Paris Agreement, Canada has committed to "holding the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C." (emphasis added)

17.27 To assess the additional emissions reductions needed on a global basis to stay within the 1.5°C threshold, the *Emissions Gap Report 2017* explains that it uses scenarios that are consistent with a 50% to 66% probability of meeting that target, which is a lower probability than the 66% used in its 2°C scenarios. A higher probability would require larger reductions than those developed in this 1.5°C scenario.

17.28 The report concludes that to have a 50-60% chance of meeting the 1.5°C pathway, total global emissions by 2030 would need to be reduced to 36.5 $GTCO_2eq$ (*Emissions Gap Report 2017*, Chapter 3 "The emissions gap and its Implications", Table 3.1, p. 13).

17.29 In comparison, staying within the 2°C pathway requires that global emission be reduced to 41.8 $GTCO_2eq$ by 2030, according to the *Emissions Gap Report 2017*.

17.30 The difference between the existing reduction commitments (NDCs) and the very substantial additional reductions needed to meet the 1.5°C target is 16-19 $GtCO_2eq$, based on the 50-66% probability.

The IPCC Special Report on Global Warming of 1.5°C

17.31 The evidence at trial will also refer to the findings of the IPCC *Special Report on Global Warming to 1.5°C*, released on October 7, 2018. The report was prepared by the IPCC at the request of the Conference of the Parties of the UN Framework Convention on Climate Change, a request contained in the decision to adopt the Paris Agreement. It was under the terms of the Paris Agreement in December 2015 that countries, including Canada, formally committed to *"pursue efforts to limit the temperature increase to 1.5°C"*.

17.32 One main purpose of the report was to assess the expected impacts of global warming of 1.5°C above pre-industrial levels, and to develop comparisons between the impacts at 1.5°C and 2°C. The evidence will show that at the time of the Paris Agreement two years ago, there had been relatively little detailed research about impacts at 1.5°C. Global average surface warming has already increased by 1.0°C. Part of the significance of this report is that, for the first time, it provides a comprehensive picture of the substantial differences in the outcomes for human and natural systems as warming increases from the current level to 1.0°C to 1.5°C, and the further adverse impacts to 2°C.

17.33 The other main purpose of the report is to examine and report on the most recent research on mitigation scenarios that offer a 66% chance or better of keeping warming from exceeding 1.5°C, referred to as "greenhouse gas emissions pathways" consistent with 1.5°C.

17.34 The report finds that in pathways for limiting global warming to 1.5°C, global anthropogenic emissions must decline by about 45% from 2010 levels by 2030 [IPCC 2018, SPM-15, C1.

17.35 In contrast, for limiting warming to below 2°C, CO_2 emissions must decline by about 20% by 2030 below 2010 level. The IPCC's estimate of a 20% reduction to stay below 2°C is consistent with the UN *Emissions Gap Report 2017*, which concludes that total GHG emissions would have to fall from its current estimate of 51.9 $GtCO_2eq$ to 41.8 $GtCO_2eq$ (see above, paragraphs 17.17 and 17.19).

17.36 In the IPCC's review of pathways that limit global warming to 1.5°C, all but one show a decline in global greenhouse gas emissions to below 35 $GtCO_2eq$, and half of the available pathways fall within the range of 25-30 $GTCO_2eq$ per year (IPCC 2018, SPM-24, D1.1). To put that in context, it is helpful to keep in mind that the UN *Emissions Gap Report 2017* projects that, based on current policies, total global GHG emissions are projected to reach 58.9 $GtCO_2eq$ by 2030 – and even if all NDCs under the Paris Agreement are fully implemented, they are still projected to rise to 55.2 $GtCO_2eq$.

17.37 Total GHG emissions in 2016 reached 51.9, based on the UN *Emissions Gap Report 2017* (paragraph 17.17). The needed reductions of global emissions over the next twelve years to limit warming to 1.5°C is therefore in the range of 16.9 to 26.9 $GtCO_2eq$. At the high end of the range, that would require a 50% cut of all GHG emissions worldwide

17.38 Not even the world's most technologically advanced industrial economies (of which Canada is an example) project cuts remotely approaching that magnitude. Many large emitting countries (i.e., India) do not have the economic or technological capacity to achieve a fraction of a 50% reduction.

17.39 The IPCC 2018 report does not address the feasibility of achieving the massive reductions needed to meet the 1.5°C. Its purpose was to examine the pathways and calculate the size of the cuts that would be required to achieve that goal.

17.40 With respect to the existing commitments by Canada and other signatories to the Paris Agreement, the new IPCC report released on October 7, 2018, finds that even if all the NDCs are fully implemented the level of global greenhouse gas emissions will reach 52-58 $GtCO_2eq$ by 2030: IPCC 2018 SPM-24, D1. That confirms the finding on that point reported in the UN *Emissions Gap Report 2017*, which gives an estimate of 55.2 $GTCO_2eq$ [paragraph 17.20]. The evidence at trial will show that the existing LDCs fall far short of the 2°C target, and are remote from the 1.5°C pathway.

17.41 Further, the IPCC 2018 report finds that emissions pathways that reflect the existing LDC commitments to 2030 (assuming Canada and all the other signatories fully implement their obligations) would not limit warming to 1.5°C, *"even if supplemented by very challenging increases in the scale and ambition of emissions reductions after 2030."* In other words, if we fail between now and 2030 to substantially augment the existing LDCs, no amount of deep reductions undertaken *after* 2030 will restore any chance we

have to keep warming below 1.5°C. We have only the next twelve years to do what we can to stay within the 1.5°C limit, and then that opportunity will be gone.

17.42 Particulars of the proposed evidence based on the findings of the IPCC 2018 report relating to the impacts of warming at 1.0°C, at 1.5°C, and at 2°C – and the substantial differences in the impacts as warming increases through that range – are set out in Part 18.

→ **Additional particulars of the proposed evidence about the global emissions gap and *The Emissions Gap Report 2017* are found in Appendix T.**

18. Evidence about the consequences of climate change

18.1 At trial, the defendant will call evidence about changes in the global climate that are degrading the natural systems that support human flourishing and economic security. The evidence will identify (i) the impacts that have already occurred (and which are well documented); (ii) impacts that have not yet occurred but to which we are irrevocably committed because of the long-term consequences of changes already affecting the atmosphere and oceans, and (iii) projected future impacts that are expected if the rising carbon concentration level is not curbed.

18.2 One indicator of "global warming" is an increase in the global mean surface (air) temperature, measured against the pre-industrial level. A more accurate way of describing the broader changes in the climate system is global heating, which includes the transfer of heat into the ocean, including the deep ocean; the melting of arctic sea ice; the melting of glaciers and the Greenland and Antarctic ice shelves; rising sea levels; accelerated rates of evaporation, rising level of humidity, and increased frequency of extreme weather events including hear waves, droughts, and flooding.

Evidence about warming (rising global mean surface temperature)

18.3 At the time of the IPCC report in 2013-2014, the documented rise in global mean surface temperature was 0.85°C above the pre-industrial level, which was based on records up to 2012. The more recent IPCC report released on October 7, 2018, concludes that global surface temperature has increased 1.0°C above the pre-industrial level (the pre-industrial level is taken to be the average over the period 1850-1900). Estimated anthropogenic global warming is currently increasing at 0.20°C per decade (IPCC 2018, SPM-4).

18.4 At trial, the defendant will provide expert evidence to confirm both the IPCC findings and the recent trend, showing that the rise in global mean surface temperature has now reached 1.0°C – meaning that we are half way to the nominal 2°C threshold.

18.5 More than two-thirds of the total surface warming has occurred since 1970. The most marked changes are therefore very recent.

18.6 The recent warming is consistent with the disproportionately large share of all CO_2 emissions from fossil fuel burning that have occurred in the past fifty years. Half of all human-caused carbon emissions have occurred since 1970: IPCC, 2014, Summary for Policymakers, SPM.3

18.7 The evidence will show a correlation between the rapid increase in the atmospheric carbon concentration level and the recent increase in global mean surface temperature. In 1958, when measurements began at the top of Mauna Loa in Hawaii, the value was 317 ppm – which, after a hundred years of industrialization, was still only 40 ppm above the pre-industrial level (280 ppm). Since 1958 – sixty years ago – the carbon concentration level has increased from 317 ppm to 405 ppm, an increase of 88 pp.

18.8 The evidence will explain that the 1.0°C of warming so far – which might at first sight seem too small to make much difference – *is the average increase for the entire surface of the globe*, including over the surface of the oceans (where air temperature is cooler than over land surfaces in most places). The temperature increases that have already occurred vary in scale, depending on the region. Increases over land areas are more pronounced than over the oceans, with larger absolute increases in northern latitudes.

18.9 As an example of an already profound regional impact, climate stations in Canada's Western and Central Arctic have recorded average increases ranging from 0.7 to 1.2°C per decade in mean annual temperature between 1981 and 2010 – an increase of about *3°C increase in air temperature within three decades* – a massive change seen in the loss of seasonal sea ice cover in the Arctic Sea. Most of the sea ice loss has happened in a short time, since about 1990.These changes in Canada's north are unprecedented, given their rapidity and scale. A regional impact study that examines climate change in the Canadian Arctic is Gary Stern and Ashley Gaden, *From Science to Policy in the Western and Central Canadian Arctic: An Integrated Regional Impact Study (IRIS) of Climate Change and Modernization*, Arctic Net, Quebec City. Temperature increase and sea ice loss are discussed in Chapter 2, Lauren Candlish and David Barber, "Climate Variability and Projections".

18.10 Warming on a similar scale has already occurred in parts of South Asia, and on other continents. In western Afghanistan and southwestern Pakistan annual average temperatures have already risen by 1.0°C to 3.0°C over the period from 1950 to 2010. Southeastern India, Sri Lanka, and northern Pakistan have experienced increases in their annual average temperature in the range of 1.0°C to 1.5°C over the same period. The average temperatures in these inland regions are 25°C to 30°C, so these recent increases are already pushing warming to limits that adversely affect agricultural productivity, the drying out of soils, and human health.

18.11 The impact of the above *average temperature* increases in these already hot regions has been exacerbated by a related feature of the changing climate, which is the more frequent occurrence of *extreme weather events* – in particular heat waves.

18.12 Multiple studies have found that a temperature increase of more than 2°C will bring severe climate system disruptions to many parts of the world (extreme changes in rainfall

patterns, droughts, crop yields, temperature levels). Some areas will no longer be able to support human life, for reasons of heat, loss of adequate water supply, crop failure, and flooding. In many other places the changes will impoverish human life.

18.13 The recently released IPCC *Special Report on Global Warming to 1.5°C* provides a comprehensive picture of the substantial differences in the outcomes for human and natural systems as warming increases from the current level of 1.0°C to 1.5°C, and the worsening adverse impacts to 2°C. The impacts will be marked and significant as warming move above 1.5°C and approaches 2°C.

18.14 The degradation of living conditions around the world is not just something that will happen in the future. At trial, the evidence will show that the destructive impacts are already occurring. Therefore, delay or failure to limit large-scale increases in carbon emissions will aggravate these losses, which are irrevocable.

18.15 At trial, the defendant will call evidence showing the expected future increases of global surface temperature over the balance of this century and explaining the huge differences in the projected outcomes depending on how rapidly Canada and other industrial economies reduce the annual level of their CO_2 emissions.

→ **At trial the defendant will call expert evidence showing the projected rise of surface temperature by 2045-2065 and by 2081-2100 under three mitigation scenarios (RCP8.5, RCP4.5, and RCP 2.5) presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), September 27, 2013. An outline of that evidence is found in Appendix S: Additional evidence on mitigation scenarios.**

18.16 The evidence will show that, if we follow the current "business-as-usual path," CO_2eq concentration levels that exceed 750 ppm will lead to a projected rise of global surface temperature by 3.7 to 4.8°C above the pre-industrial level. That is the conclusion reported by Working Group 3 based on multiple studies.

18.17 The evidence will show that if a major global effort is eventually undertaken to achieve deep emissions reductions, but if the inception of deep cuts is delayed so that global emissions do not "peak" until about 2040, by 2081-2100 the increase of average surface warming will likely be in the range of *1.7°C to 3.2°C* above the pre-industrial level. That is the outcome projected under the RCP4.5 scenario. Under that scenario, the likely average increase in temperature by 2045-2065 will already be 1.5 to 2.6°C above the pre-industrial level. The full unfolding of the expected warming under that scenario (up to as much as 3.2°C on average across the entire earth's surface) will not occur until later in the century, but it will be irreversible.

18.18 The defendant will also present evidence showing projected outcomes under the most optimistic mitigation scenario, which assumes that emitting countries – immediately or within the next two years or so – adopt stringent policies to limit emissions. Under this scenario (referred to as RCP2.5), the annual global level of CO_2 emissions reaches its maximum by about 2020 and then begins to decline annually.

18.19 Under RCP2.6 the global mean surface temperature by 2081-2100 will likely be 0.3°C to 1.7°C warmer than 1986-2005. The average temperature in 1986-2005 was already 0.6°C warmer than the pre-industrial level. So this projection shows that warming by 2081-2100 is likely to be about 0.9°C to 2.1°C warmer than the pre-industrial level. Under this scenario, which assumes absolute reductions to the global level CO_2 emissions will start as early as 2020, it is possible to avoid, or almost entirely avoid, the risk that warming will exceed the 2°C threshold.

Evidence about warming in particular regions: the case of South Asia

18.20 The evidence will show that the consequences of delay are measurable and will be especially dire in regions that are already vulnerable, due to existing climate conditions (high temperatures, scarce water), poverty, heavy dependence on agriculture, lack of education and vocational skills, and poor access to roads.

18.21 In South Asia, under the business-as-usual scenario (RCP8.5) annual average temperatures by 2050 are projected to increase another 2.2°C (the range is 1.5°C to 3.1°C) above the 1981-2010 average. Under the more pro-active scenario (RCP4.5) which also delays cuts but eventually sees global emissions begin to decline after 2040, the annual average temperature increase is 1.6°C (1.0°C to 2.3°C) by 2050, above the 1981-2010 average.

18.22 A study published by the World Bank in July 2018 examines the impacts of the changes expected under these two scenarios in South Asia: *South Asia's Hotspots: The Impacts of Temperature and Precipitation Changes on Living Standards*. The study identifies climate "hot spots" defined as geographical areas where living standards will be most adversely impacted by changes in average weather. Poor agricultural areas are most exposed. Rising temperatures can reduce crop yields, lower worker productivity, and increase vector-borne and other infectious diseases.

18.23 The projected 2.2°C of warming under the RCP8.5 scenario by 2050 is expected to reduce income by 14.4 percent in the most severely affected parts of Bangladesh, 9.8 percent in the most severely affected parts of India, and 10 percent in Sri Lanka.

18.24 Under the RCP8.5 scenario, about 45 percent of the present population of South Asia will be living in moderate or severe hotspots – that is, 800 million people experiencing markedly reduced incomes (people who have low incomes to begin with) because of warming. Under the RCP4.5 scenario, which assumes deep cuts in global emissions do not start until about 2040, the share of South Asia's population experiencing moderate to severely reduced living standards by 2050 is expected to be 375 million people.

Evidence about increase of extreme weather events

18.25 In assessing the impact of changing climate, both changes in the average weather and increases in the *frequency of extreme events* are important.

18.26 Tables of "temperature distribution" show the most probable temperature for a particular region, based on past records. "Extreme events" are the comparatively infrequent occurrences of extreme cold, depicted on one side of a graph, or extreme heat, depicted on the other. The graph flattens toward the sides, confirming that the most "extreme" events are rare.

18.27 Evidence at trial will show that, for particular regions in Canada (and globally), the entire temperature distribution is "shifting", reflecting the fact that weather statistics for specific regions are showing not only higher average temperatures, but *more frequent occurrences* of heatwaves and other extreme events.

18.28 The evidence will show, in the case of South Asia, *more frequent, longer, and more intense* heatwaves.

18.29 The World Bank report explains the consequences of this increased likelihood of extreme high temperatures:

> *Any rise in the average temperature could thus potentially lead to a rise in the number of days that are extremely hot. This increase in heat has repercussions for a myriad of sectors, including health, farming, and energy systems. More extreme heat raises the risk of heat-related illnesses, such as heat exhaustion, and allows insects to move into new areas, potentially increasing the spread of vector-borne diseases. It could also stress crops accustomed to milder climate and worsen drought conditions. In addition, extreme heat is associated with air stagnation, which could trap pollutants and worsen respiratory illnesses such as asthma. Similarly, shifting the average of the precipitation distribution would mean a greater likelihood of no precipitation or extreme precipitation, corresponding to an increased likelihood of droughts or flooding, respectively.*

18.30 The evidence will explain that when weather records show a change in the *frequency* of those very hot days every year over a period of years we are seeing a change in the "probability of occurrence". Climate scientists have concluded that these increasingly common changes in the frequency of extreme weather events are evidence of long-term changes in the underlying climate.

18.31 Similar kinds of patterns are emerging, in many regions, for drought, heavy rainfall, and for winds.

Evidence about glacier loss and consequential impacts

18.32 There are estimated to be 170,000 to 200,000 glaciers on the earth's surface. In Central Asia alone there are 30,200.

18.33 Glacier studies emphasize the individual distinctiveness of every glacier, the natural course of each influenced by altitude, local precipitation patterns, by unique micro-climates, by the particular steepness of the terrain, by the shade cast by adjacent peaks and ridges, and even the effects of debris and soot.

British Columbia: the loss so far

18.34 An assessment conducted by the Pacific Climate Impacts Consortium based on research conducted at the University of Northern British Columbia compared glacier area changes between 1985 and 2005 in seven ecological regions of B.C. The three vast large northern and interior regions of the province – the Northern Boreal Mountains, Sub-Boreal Interior, and Southern Interior Mountains – lost 15.5%, 16%, and 15.4% respectively of their total ice coverage. The losses in the Central and Southern Interior were about 12% in each. The most westerly Coastal Mountain region was only 6.4%.

18.35 In the region called the Georgia Depression, the small zone covering either side of Georgia Straight on Vancouver Island and the immediate mountainous areas along the coast north of the city of Vancouver, the glacier loss was 34.1% within that period of twenty years.

18.36 The influences of glacier on the wider natural environment are subtle. In British Columbia cold glacial melt-water in the warm summer months helps cool small mountain streams and tributaries of the great salmon rivers, where young salmon, in the hottest season, cannot survive if the water temperature is too much warmed by the sun.

Glaciers in South Asia

18.37 A comprehensive analysis of the phenomenon of glacier loss in the high mountains of Asia is found in a report published in 2010, *High Mountain Glaciers and climate chaos – challenge to human livelihood and adaptation*, Katleborn, B.P., Nelleman, C., and Vistney, I.I. United Nations Environment Programme. The authors look at the region of the Hindu Kush-Himalayas and Central Asia, which includes China's Xinjiang province. The majority of glaciers in the Hindu Kush-Himalayas and the Tibetan plateau are receding, a process that increased beginning in the 1980s. The overall rate of mass loss has increased in the last decade.

18.38 The UN report notes that over half of the world's population lives in watersheds of major rivers that originate in mountains with glaciers and snow. One of the largest of the great rivers is the Indus, the core water system of Pakistan. Part of the Indus River flow is provided by glacial melt from the Himalayan Mountains.

18.39 Projections of water flow in Pakistan show expected increases during the next few decades as shrinking glacier mass releases greater-than-normal melt water. After that the water supply will decline through the entire Indus River irrigation system.

18.40 After these sources of glacier melt-water disappear, or when they are greatly reduced, the flow-rate of rivers will then be limited by the pattern of local precipitation (seasonal rain and in some places seasonal snow at high altitudes). The rivers will provide little or no runoff during the dry season, especially in arid or semi-arid places.

18.41 The only recourse now in the semi-arid regions of Asia (and elsewhere) is to build dams and reservoirs to capture and store water, and build new irrigation systems to distribute

whatever water supply remains available. But even those measures, expensive as they are to the inhabitants, are only palliative steps in view of the long-run outcome.

18.42 Looking ahead, the 2010 UN report states that glaciers in the region will largely disappear by 2100, although some will continue to exist in reduced form. The pace of destruction depends on the rate of temperature increase over the next 80 years. If we see an increase in global surface temperature by as much as 4°C by 2100 (a decadal increase of 0.04°C) then glaciers will be largely gone by 2100. [UN report]

→ **A detailed outline of the evidence on the measurement of glacier loss and its impacts on human settlements is found in Appendix U.**

Evidence about sea level rise

18.43 Between 1901 and 2010 the level of the sea rose by 19 cm (about 7 ½ inches). The average rise in the sea level over that entire period is 1.7 mm per year. The rate is increasing: from 1993 to 2010 the sea level rose by 3.2 mm per year. The most conservative projection in the IPCC report is that by 2100 the sea level will be 40 cm (about 15 ¾ inches) above the 1986-2005 level. That projection of further sea level rise (in the scenario called RCP2.6) assumes that very stringent policies will be implemented after 2020 to cut CO_2 emissions.

18.44 In fact, a number of authoritative analyses have projected much more than 15 inches of rising sea level. An expert panel of the U.S. National Ocean and Atmospheric Administration has cautioned that sea rise could be 6.6 feet.

18.45 Even a rise of another 24 inches (instead of just another 15 ¾ inches) above the 7½ inches that have already happened will have massively destructive effects. Along coastal regions salt water begins to contaminate fresh water supplies that lie in the ground close to sea level. In low lying countries like Bangladesh and in the river delta region at the mouth of the Mekong, incremental sea level rise this century will destroy productive crop land.

18.46 But as destructive as those direct impacts are, for our immediate purposes a significant implication of rising sea level is what it tells us about what is happening in the climate system.

18.47 About 38% of rising sea level is caused by *thermal expansion of the ocean*: water volume increases as it warms. The mere fact that we are observing sea level rise – and indeed the fact that the rate of sea level rise is increasing – shows that thermal expansion of the ocean is taking place. That thermal expansion is reliable evidence that the ocean, or at least the upper levels of the ocean, are getting warmer.

18.48 The rest of the increase in sea level comes from the melting of ice on land: glaciers in the mountain ranges, as well as melting of the Greenland and Antarctic ice sheets – also evidence of warming. So the rising sea level is reliable evidence of the warming of the earth, quite apart from what air temperature measurements tell us.

Impact of rising temperature on the hydrological cycle

18.49 Evidence at trial will explain that higher average temperatures at the earth's surface affect the hydrological cycle. Warmer temperatures bring more rapid drying out of soil moisture, warmer air permits much higher levels of humidity in the air, which (with other changes in climate) means shifting rainfall patterns (less rain in some areas, more rain in others), heavier downfall of rains compared to past experience, which in turn cause flooding and devastation, and also extended periods of drought, and greater intensity of drought.

Acidification of the oceans

18.50 Part 16 at paragraphs 16.34 to 16.38 ("Accumulation of CO_2 in the oceans") outlines the evidence about the magnitude of the share of global carbon emissions absorbed into the oceans every year. Evidence at trial will explain the problem of ocean acidification, and its impact on shellfish and the food chain that supports commercial fisheries, and its broader threats to marine ecosystems.

Additional serious risks

18.51 Evidence at trial will explain other extremely consequential risks: methane release in Arctic region due to thawing permafrost; loss of the earth's albedo (the capacity of the reflective white surfaces of the artic sea ice and extensive snow cover to reflect heat energy away from the earth's surface; the risk of accelerated melting of the large ice sheets in Antarctica and Greenland, which potentially would contribute to massive sea level rise.

APPENDICES: ADDITIONAL DETAILS OF PROPOSED EVIDENCE

A. The Government of Canada's emissions projections to 2030

A.1 On December 29, 2017, the Government of Canada published *Canada's 7th National Communication and 3rd Biennial Report to UNFCCC*, which provides emissions projections up to 2020 and 2030. The full report can be found online at: http://unfccc.int/files/national_reports/national_communications_and_biennial_reports/application/pdf/82051493_canada-nc7-br3-1-5108_eccc_can7thncomm3rdbi-report_en_04_web.pdf.

A.2 The *3rd Biennial Report* projections for all seven economic sectors are shown in Figure xiii:

Figure xiii: Emissions projections to 2020 and 2030 (Mt CO_2eq)

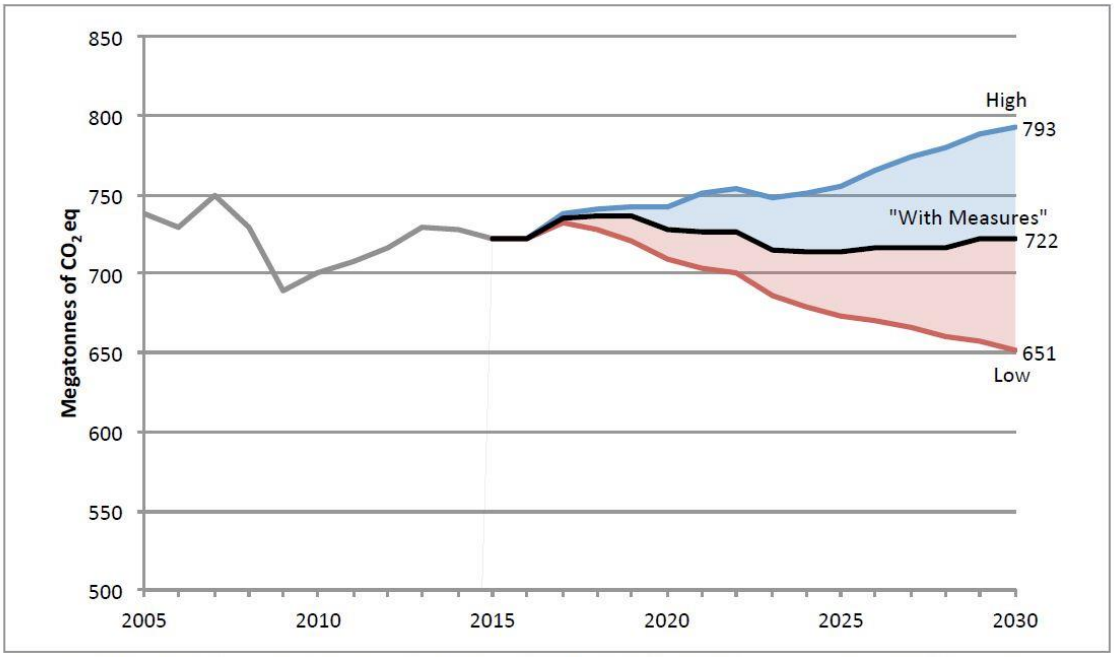
	2005	2010	2015	2020	2030	Change 2005-2030
Oil and Gas	158	160	189	197	215	**+57 Mt**
Electricity	117	96	79	71	46	**-70 Mt**
Transportation	163	171	173	168	155	**-8 Mt**
Heavy Industry	86	73	75	83	97	**+11 Mt**
Buildings	85	81	86	88	83	**-2 Mt**
Agriculture	74	70	73	71	72	**-3 Mt**
Waste and Others	54	50	48	50	53	**-2 Mt**
Total	**738**	**701**	**722**	**728**	**722**	**-16 Mt**

Source: *Canada's 7th National Communication and 3rd Biennial Report to UNFCCC* (December 2017), Table 5.6. The report notes that numbers may not sum due to rounding.

A.3 The record shows that, between 2005 and 2015, the electricity sector was by far the largest source (and the only substantial source) of emissions reductions in the Canadian economy. However, that remarkable 38 Mt cut in electricity sector emissions over ten years was to a large extent offset by a 31 Mt increase in oil and gas emissions. Based on the *3rd Biennial Report* projections, the same pattern is going to continue: between 2015 and 2030, electricity emissions are expected to decline by another 33 Mt, but oil and gas sector emissions (almost entirely driven by oil sands expansion) will grow by 26 Mt. Apart from a very modest expected cut in transportation emissions (18 Mt), no other economic sector is projected to show any meaningful reduction between 2015 and 2030.

A.4 Figure xiv, reproduced from the *3rd Biennial Report*, provides a convenient picture of our current situation:

Figure xiv: Canada's domestic emissions projections in 2020 and 2030 (Mt CO_2eq)



Source: *Canada's 7th National Communication and 3rd Biennial Report to UNFCCC* (December 2017).

A.5 The middle line is the "reference case" projection of Canada's total emissions to 2030. The other tracks indicate two other possible emissions paths, depending on the future rate of economic growth, long-term oil prices, etc. Strong growth could push the projected level up to 793 Mt. The Government of Canada's declared target for 2030 (a commitment made at the Paris Climate Conference in 2015) is 517 Mt.

A.6 We see a sharp break in the emissions trend between 2007 and 2010. Canada's annual CO_2 emissions peaked at 750 Mt in 2007 according to the data reported in the *3rd Biennial Report* (according to the revised data cited below, emissions peaked at 745 Mt in 2007). The numbers fell in 2008-2009 as a result of the 2008 financial collapse. Most of that unprecedented drop had nothing to do with any policy by governments to manage carbon emissions. The numbers fell mainly because economic activity collapsed. The low point was 689 Mt in 2009 according to the *3rd Biennial Report* (according to the revised data cited below, the low point was 682 Mt in that year). The total drop was as much as 68 Mt, an extraordinary reduction of emissions within the space of two years.

The National Inventory Report (April 17, 2018)

A.7 On April 17, 2018, the government published a new report covering emissions data up to 2016: the *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada*. The *Executive Summary* is available at https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/emissions-

inventories-reporting/nir-executive-summary/National%20Inventory%20Report%20Executive%20Summary%202018.pdf. The *National Inventory Report* does not include projections to 2020 or 2030. It is limited to providing reported emissions up to 2016, and includes some adjustments or revisions to previously reported results for 2015 and earlier years. Figure xv shows the updated emissions for all sectors:

Figure xv: Canada's GHG emissions by economic sector 2005-2016 (Mt CO_2eq)

	2005	2011	2012	2013	2014	2015	2016
Oil and Gas	158	161	172	180	187	184	183
Electricity	120	88	85	82	79	81	79
Transportation	162	171	173	176	173	174	173
Heavy Industry	86	79	73	77	77	76	75
Buildings	86	87	85	86	88	85	81
Agriculture	73	69	70	73	71	72	72
Waste & Others	48	44	43	43	41	42	41
National GHG Total	**732**	**700**	**707**	**716**	**716**	**714**	**704**

Source: *National Inventory Report 1990-2016, April 17, 2018* Table S-3 p. 10. A more detailed breakdown of this data, showing emissions for sub-sectors and specific industries, is found in Table 2-12 of the report, at p. 62.

A.8 The April 2018 report contains adjusted emissions results for the year 2015, which differ from the 2015 emissions numbers reported in the December 2017 *3rd Biennial Report.*

A.9 These revisions reduce the overall total for 2015 down to 714 Mt, from the previously reported total of 722 Mt. But a close look at these adjustments indicates that, for most sectors, the main trend of emissions over the period 2005-2015 remains basically unchanged. Transportation emissions for the year 2015 are now reported as 174 Mt, up from the 173 Mt figure given in the *3rd Biennial Report*. Electricity emissions for 2015 have been adjusted up by 2 Mt. Heavy industry has been adjusted upwards by 1 Mt, and agriculture down by 1 Mt.

A.10 There is a 5 Mt reduction to the waste sector, which for the year 2015 is now reduced to 43 Mt, down from 48 Mt – a substantial adjustment in relation to the size of that sector. This revision applies to all previous years for the waste sector, going back to 2005 (indicating a pattern of consistent over-reporting of waste sector emissions, which has now been corrected.)

A.11 Mainly as a result of that correction, the annual totals for previous years have been revised downwards. The annual level of Canada's total emissions in 2005 is now given as 732 Mt, down from the previous figure of 738 Mt – which is the base year used to calculate our 30% reduction commitment under the Paris Agreement. Using the corrected 2005 figure, our target for 2030 is now 517 Mt.

A.12 But for the purpose of understanding the future outlook, the recent adjustments do not indicate any sudden downtrend of emissions. The new April 2018 report confirms the persisting trend: electricity is the only sector showing a substantial decline in emissions.

A.13 For the oil and gas sector, the emissions total is now reported as 184 Mt, reduced from the previously reported 189 Mt for that year.

A.14 The April 2018 report confirms, however, that emissions from the oil sands sub-sector continued to increase during the reported period:

Figure xvi: Oil sands emissions 2005 to 2015 (Mt CO_2eq)

	2005	2011	2012	2013	2014	2015	2016
Oil sands	35	55	59	63	68	70	72

Source: *National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada*, Environment and Climate Change Canada (April 17, 2018), Table 2-12, p. 62

A.15 The continued rise of emissions in the oil sands sub-sector in 2015 and 2016 was offset by a substantial drop of emissions in other more traditional parts of the oil and gas industry: in the two years following 2014, the annual level of emissions from conventional oil production fell by 6 Mt. Over the same two years, emissions from natural gas production and processing declined by 2 Mt.

A.16 The explanation for those reductions was the massive decline in global oil prices that started in July 2014, which by 2015 had begun to slow the level of conventional oil and gas activity in Alberta and in other provinces, reducing emissions in those sub-sectors. Those events accounted for an 8 Mt decline of emissions in these traditional activities, which offset the 4 Mt increase in oil sands emissions during this two-year period.

A.17 That explains why total oil and gas sector emissions dropped from 187 Mt to 183 Mt over the two most recent reported years.

A.18 Further, the above numbers disguise the continued robust growth of emissions from expanding oil sands *production*. During 2015 and 2016, the annual level of emissions from oil sands in situ production rose by a remarkable 7 Mt (emissions from open pit mining operations remained constant), which continued the pattern of previous years in which oil sands emissions increased by almost 4 Mt every year. But after the oil price collapse in mid-2014, there was a significant slowdown in oil sands upgrading (a preliminary kind of bitumen refining) which caused upgrading emissions to fall from 20 Mt in 2014 to 17 Mt in 2016. That 3 Mt decline in upgrading emissions offsets the 7 Mt

increase in production emissions. Therefore, in 2015-2016 oil sands emissions are reported to rise by only 4 Mt.

A.19 The evidence at trial will show that the flattening out of emissions growth in the oil and gas sector in 2015 and 2016 was unrelated to any advances in Canada's emissions policy, or to any technological improvements in production methods in the oil sands industry. It was due to low oil prices.

B. The Government of Canada's commitments

B.1 At trial, the defendant will call evidence about the international commitments made by the Federal Government to reduce the annual level of Canada's GHG emissions:

B.2 The Liberal government of Jean Chretien made an ambitious commitment under the Kyoto Protocol (signed in 1997 and solemnly ratified in 2002) to reduce Canada's total emissions 6% below the 1990 level by 2012. That would have required cuts to an annual total of about 580 Mt. The Liberals left office in 2006. By 2005, Canada's total emissions were 732 Mt, rising to a peak of 745 Mt in 2007. The Conservative Government under Stephen Harper formally abandoned the Kyoto target. By that time, the target was beyond reach.

B.3 After it assumed power in 2006, the Conservative government made a series of promises and declarations about how it would deal with carbon emissions. On April 25, 2007, Environment Minister John Baird made a significant speech. "The climate is changing," he declared:

> *After 13 years of inaction by the Liberal government, Canada is going in the wrong direction on the environment. Since the Liberals promised to reduce greenhouse gases in 1997, they have only gone up. They promised to meet Kyoto, but went in the opposite direction … Now we need to turn things around. On behalf of all Canadians, in particular our youngest citizens, we need to find a better way. Instead of greenhouse gases going up, we believe they should go down. Instead of putting more carbon in the air, we believe we should put less.*
>
> — speech, John Baird (emphasis added)

The text of John Baird's speech made on April 25, 2007 is not available on any Government of Canada site, but can be found on sqwalk.com: http://www.sqwalk.com/blog2007/001027.html#baird_globe

B.4 Baird announced a new climate action plan called *Turning the Corner*. It set a goal of reducing Canada's GHG emissions by 20% below 2006 levels by 2020, and a reduction of 60 to 70% below 2006 levels by 2050. The rising level of emissions from Alberta's expanding oil sands industry had become the largest source of emissions growth in the Canadian economy. Baird promised to develop regulations to address rising emissions in the oil sands industry.

B.5 In March 2008, the government unveiled proposed regulations explicitly aimed to curb CO_2 emissions from oil sands extraction and processing: see Environment Canada, March 10, 2008 (http://www.marketwired.com/press-release/government-delivers-details-of-greenhouse-gas-regulatory-framework-830605.htm) and *National Post*, March 11, 2008 (http://www.nationalpost.com/news/canada/pickton/baird+talks+tough+emitters/365981/story.html). The draft regulations, however, were never enacted.

B.6 The result is that over the past ten years (and currently) there has been no Federal Government regulatory control over the growth of oil sands emissions.

B.7 In December 2009, the Conservative government made a new commitment to achieve, by 2020, a 17% reduction below the 2005 level, which would be 613 Mt.

B.8 A year later, in December 2010, the Conservative Government became a signatory to the Cancun Agreements, acknowledging in writing that there is a safe upper limit for the earth's surface temperature, and agreeing that the 2°C warming threshold is based on scientific evidence. Here is the wording of the key decision approved at the Conference:

> *The Conference of the Parties … recognizes that deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, with a view to reducing global greenhouse gas emissions so as to hold the increase in global temperature below 2°C above pre-industrial levels, and that the Parties should take urgent action to meet this long-term goal, consistent with science and on the basis of equity.* (emphasis added)

B.9 In the Cancun Agreements, Canada committed to limit the increase in average global temperature below 2°C. Canada and other countries formally agreed that "deep cuts in global emissions are required" in order to meet that goal. When the Cancun Agreements were signed in 2010, they did not specify the size of the "deep cuts" that each country would be obliged to make. But previously, under the Copenhagen Accord signed in 2009, Canada had already agreed to reduce its annual emission 17% by 2020, below the 2005 level.

B.10 Canada's total emissions in 2005 were 732 Mt. A 17% reduction would lower the annual emissions level to 613 Mt by 2020. The Government of Canada's most recent projections published in *Canada's 3rd Biennial Report* (December 29, 2017) show the projected level will be 728 Mt – a reduction of less than 1% in ten years.

B.11 In 2015, Canada agreed to reduce our national emissions (that is, *all* emissions caused by activities within our borders) 30% by 2030, below the 2005 level. That pledge was formally made by the Conservative Government on May 15, 2015, and was re-affirmed by the Liberal Government at the climate conference in Paris in December 2015. The 2005 level was 732 Mt. The target is 517 Mt.

B.12 All parties to the United Nations Framework Convention on Climate Change (UNFCCC) were obligated to submit their reductions targets in advance of the Paris Conference

scheduled for December 2015. The May 2015 target submitted by Canada was described as our "Nationally Determined Contribution" under the terms of the Convention, which means it is our formal commitment to make reductions between now and 2030. Under the Paris Agreement, Canada has now committed to "*holding the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C*".

C. Technology and the carbon intensity of oil sands extraction

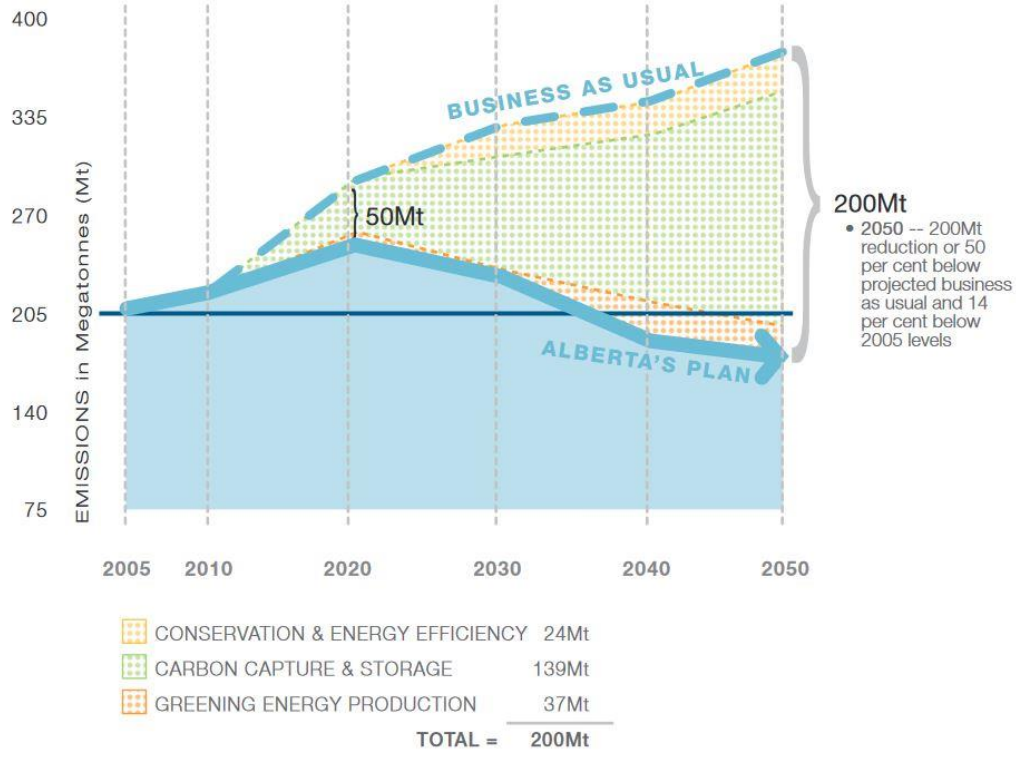
C.1 At trial, the defendant will call expert evidence to establish that no substantial reductions in carbon intensity per barrel are expected to occur over the next twelve years in the oil sands industry, with the result that total oil sands emissions will continue to increase in step with growing production levels.

C.2 At present, the only existing technology that can separate and remove industrial CO_2 gas and prevent it from entering the atmosphere, albeit at enormous cost, is carbon capture and storage (CCS).

C.3 In the case of the oil sands, CCS would capture CO_2 emissions from the flue gases where the fuel for the extraction process is combusted (at the bitumen sites and at processing facilities where natural gas is burned to generate heat and steam) and thus prevent the gases from being released into the atmosphere. The captured CO_2 would be compressed into an almost liquid form, then transported by pipeline and injected deep underground for permanent storage. The technology has its detractors: it is very costly, and some people point to the risk that the CO_2 will later escape into the atmosphere.

C.4 Figure xvii reproduces a graph published in 2008 by the Province of Alberta in a document called *Alberta's 2008 Climate Change Strategy*, when the province launched what it described as the renewal of its climate change policy. At the core of that ambitious new plan was a commitment to deploy CCS technology on a large scale. The premise of the plan was that bitumen production would be able to continue to expand without increasing emissions.

Figure xvii: Graph representing Alberta's 2008 emissions reduction plan



Source: *Alberta's 2008 Climate Change Strategy*, p.24.

C.5 By 2005, Alberta's total emissions, including emissions from its growing oil sands industry, were already at 233 million tonnes (Mt) of CO_2eq. The province's share of Canada's total emissions was then about 31%, reaching 37% by 2014. By 2008, the fast expanding oil sands industry had already become the largest source of emissions growth in the Canadian economy.

C.6 The dotted top line on the graph (Figure xvii) represents the pathway of Alberta's "business as usual" emissions: that line depicts the projected level of CO_2 emissions that, according to the Alberta government, would be produced in the province in the absence of any new carbon-reduction policies. In the 2008 plan, the projection for Alberta's 2050 "business as usual" emissions was about 384 Mt: that estimate of the annual emissions level by 2050 was largely driven by the continued expansion of oil sands production up to 2050.

C.7 The bottom line on the graph shows that under the 2008 plan, total emissions by 2050 were anticipated to be only 194 Mt – an astonishing 200 Mt less than the business-as-usual outcome. Most significantly, the graph shows that by 2050, *139 Mt of that reduction* of CO_2 emissions would be achieved by the large-scale implementation of CCS.

C.8 At the heart of Alberta's 2008 plan was the ambition to continue rapid oil sands production, with the declared expectation that by 2020 the installation of CCS would

avoid any further increase in the absolute level of emissions. Indeed, the graph shows total emissions in Alberta were expected to begin to decline after 2020 (see the distinct bend downwards in the bottom line on the graph, just above the year 2020).

C.9 The plan also promised a 50 Mt cut below the baseline projection by 2020, of which *more than 30 Mt was supposed to be achieved by new CCS technology installations*.

The background of CCS technology

C.10 By 2008, when Alberta announced its new climate policy, CCS was already broadly recognized as the most advanced technology in the world available to reduce CO_2 emissions at large "fixed-site" operations. It was not a speculative technology.

C.11 Long before that, basic CCS technology had been used for many years in the U.S. and elsewhere for enhanced oil recovery (EOR) in semi-depleted oil fields. In that application, CO_2 is injected underground into declining oil fields, where the pressure of the injected CO_2 drives the remaining crude oil through existing wells to the surface. There have been many years of successful commercial experience in separating CO_2 at industrial plants, and long experience in the transfer of the gas by pipeline and its injection into semi-depleted oil fields. The technology used for EOR is virtually identical to what is required for CCS, although it was widely acknowledged that a successful application of CCS to sequestering CO_2 at large fixed-site emitters like power plants would require a huge scaling up of the technology.

C.12 In a comprehensive study of CCS called the *Special Report on Carbon Capture and Storage* (2005) a team of 100 specialists under the auspices of the Intergovernmental Panel on Climate Change (IPCC) examined the state of technical knowledge available about the separation of CO_2 in industrial settings. The report, written between 2003 and 2005, looked at the existing level of experience worldwide in transporting CO_2 by pipeline, methods of injection for underground storage, the availability of suitable geological locations for secure underground storage, risks and safety, and costs.

C.13 The International Energy Agency (IEA) has also long identified CCS as the essential technology that will be relied upon to capture CO_2 emissions from coal-fired electricity generation plants and other large industrial emitters. In its annual *World Energy Outlook* reports, the IEA has been advocating CCS as the "key abatement option" to achieve large emissions savings at industrial sites. The IEA called for starting large-scale deployment of CCS by 2020, which it regarded at the time as technically feasible. In a special report published in June 2013, entitled *Redrawing the Energy-Climate Map*, the IEA summarized the current state of CCS technology, with particular reference to its availability for installation in coal-fired generating plants:

> *"While the technology is available today, projects need to be scaled-up significantly from existing levels in order to demonstrate carbon capture and storage from a typical coal-fired power plant. Experience gained from large demonstration projects will be essential, both to perfecting technical solutions and driving down costs".*

— IEA, *Redrawing the Energy Climate Map*, June 2013, p. 25-26
(emphasis added)

C.14 The IEA concluded that two conditions must be met before we will see widespread adoption of CCS on a global scale. First, innovation and demonstration projects need to lower the per-tonne cost of capturing CO_2. Secondly, governments must adopt a carbon tax that is *higher* per tonne than the cost of capturing emissions, so as to create an economic incentive for industrial emitters to install this relatively expensive technology.

The abandonment of CCS in Alberta

C.15 In 2014, the government of Alberta quietly abandoned its entire CCS strategy. By then, seven years had passed since the Alberta plan was unveiled. Four carbon capture projects in Alberta were originally announced. Two were later cancelled. No further government funding has ever been committed to support additional projects.

C.16 On July 18, 2014, *The Globe and Mail* published an article headlined "Alberta leadership hopeful Prentice lets carbon capture go". Jim Prentice, a former federal cabinet minister then campaigning to become the new leader of Alberta's governing Conservative Party, was quoted as follows:

> *"I don't believe carbon capture and storage is the panacea," he said. "It's not capable of achieving the reductions in emissions that are required, and it is expensive, and in certain contexts, it's quite unproven."*
>
> — *The Globe and Mail*, July 18, 2014 (emphasis added)

C.17 Prentice described CCS as a "science experiment." He declared that if he became premier of Alberta, his government would discontinue any further financial support for CCS. This was an extraordinary and far-reaching change of policy. At the time, Mr. Prentice held no elected office. There had been no prior discussion in the Alberta legislature and there was no explanation from the provincial government. CCS technology was the sole foundation for achieving 70% of Alberta's planned carbon reductions over the next 35 years. In his media interview, Prentice declared that CCS technology was not capable of making the required reductions.

C.18 In September 2014, Prentice became premier of Alberta. He confirmed that CCS technology no longer had government support in Alberta.

C.19 Soon after, Premier Prentice called a provincial election, which was held in May 2015. By that time, the provincial economy in Alberta had been badly weakened by the deep fall in world oil prices, which began in July 2014. A new NDP majority government took power, under Premier Rachel Notley. During the provincial election campaign the NDP promised to end the government's "costly and ineffective carbon capture experiment" and reinvest the funding in public transit. In Alberta there was no political support for CCS. After its electoral victory, the new government confirmed that no other government funding was planned to support development of the technology, although it agreed to continue funding the two existing CCS projects.

C.20 Today in the oil sands there are only two existing CCS projects. One is the "Quest Project", located at Shell Canada's Scotford Upgrader near Edmonton. Designed to capture and inject underground 1.2 Mt of CO_2 every year, it became operational in November 2015. That amount represents 35% of the total CO_2 emitted annually from the upgrader's steam methane units, which produce hydrogen for upgrading bitumen. The capital cost was about $1.35 billion, two-thirds of which was paid for by the Canadian and Alberta governments.

C.21 To place the Quest Project in context, currently the level of emissions in the oil sands is increasing by about 4 Mt per year. To halt those regular annual increases, Canada would need to complete more than 3 Quest-sized CCS installations every year. Alberta's goal, announced in 2008, was to install enough CCS to achieve a 30 Mt cut in the province's annual level of emissions by 2020 (a target that applied to all kinds of large-scale emitting sources in Alberta, including oil sands facilities). To meet that goal, the province would have needed to complete about 25 Quest-sized installations, all by 2020.

C.22 The only other CCS project is the Alberta Carbon Trunk Line, a 240-km pipeline that will transport CO_2 from a fertilizer plant and a bitumen refinery located near Edmonton. The pipeline will transport the CO_2 south to semi-depleted oil fields, where the gas will be injected underground and used for EOR.

C.23 In July of 2014, just a week before Mr. Prentice made his announcement, Alberta's Auditor-General issued a scathing report confirming that the province's bold plan to install CCS in the oil sands would not meet any of the goals set for 2020. Although the plan was originally announced in 2008, virtually nothing had been done to carry the scheme into effect, according to the findings of the Auditor-General. The report confirmed that apart from the two projects then nearing completion, no other CCS installations were under construction or even planned.

C.24 Under *Alberta's 2008 Climate Change Strategy*, CCS technology was supposed to lower the province's emissions level 30 Mt below the "business as usual" level by 2020. The magnitude of that promised cut was equivalent to almost the entire increase of oil sands emissions that in fact occurred over the nine-year period between 2005 and 2014 (when oil sands emissions grew from 34 Mt to 68 Mt). The two completed CCS projects will together cut the annual emissions level by 2.67 Mt, less than 10% of the promised reduction, by 2020. No further reductions by CCS technology are projected after that.

The fate of CCS in the oil sands

C.25 Not long after Alberta confirmed that it was dropping support for CCS, a panel of experts on technological innovation in the oil sands industry completed a major report called *Technological Prospects for Reducing the Environmental Footprint of Canadian Oil Sands* (referred to below as "*Technological Prospects*"). The study was originally commissioned by Natural Resources Canada, with the support of Environment Canada. A panel of twelve leading engineers and other experts, the majority of them from Alberta and experienced in oil sands extraction and processing, were appointed to examine

whether technological innovation has the potential to significantly reduce the environmental footprint of oil sands development.

C.26 The resulting report, which was released on May 26, 2015, reviews the entire range of carbon reduction technologies currently available or under development, including technologies still at the experimental stage that may become commercially available within the next 15 years. The panel explained the scope of their review:

> *Technologies at an early stage of development (i.e., biologically assisted processes) are noted but not necessarily emphasized due to a lack of information and uncertainty about their potential performance. The technologies reviewed include those deemed by the Panel to be commercial in the near to midterm (about 15 years) as well as those that could become viable over the longer term (beyond 15 years).*
>
> — *Technological Prospects*, Introduction, p. 9 (emphasis added)

C.27 One section of the report (section 6.2) deals specifically with CCS. It identifies *the high cost of carbon capture technology* as the principal barrier to any large-scale adoption of the technology in the near future.

C.28 The panel's overall conclusion is significant: the report explains that if oil sands production continues to expand in line with the industry's growth forecasts outlined in 2014, *it will not be possible to achieve any significant reductions in carbon emissions until some time after 2025 or 2030*. In other words, if oil sands production levels continue to grow at a substantial rate, so will emissions. According to the panel, none of the existing or emerging technologies (including CCS) have the capability to substantially lower CO_2 emissions per barrel in oil sands production, at least not for another ten or fifteen years.

C.29 In the specific case of CCS, the *Technological Prospects* report concludes that CCS technology will likely have a very limited role in future efforts to reduce emissions in the oil sands.

C.30 The panel's broad conclusion is that CCS is too expensive to be adopted during the next ten to fifteen years in the oil sands. Due to the huge capital investment needed for a single CCS installation, the technology is most promising for very large industrial sites (e.g., coal-fired electrical generating plants) that generate high volumes of concentrated CO_2 at a single location. The report explains that, in the oil sands, the most likely future use of CCS will be in applications that capture emissions from hydrogen production in upgraders – a specialized high-emitting industrial activity connected to processing bitumen at open-pit mining operations. But upgraders are a relatively small part of the oil sands emissions problem in Alberta.

C.31 In comparison, the fastest expanding area of bitumen production – and therefore the fastest growing source of emissions – is in situ (underground extraction) operations, which are smaller in scale. The panel was not optimistic about the prospect that CCS can

ever become an affordable technology at these smaller-scale in situ sites, because they do not offer the needed high volume of emissions to justify the cost:

> *More expensive would be the capture of CO_2 from in situ projects because these represent smaller and geographically dispersed sources of emissions.*
>
> — *Technological Prospects*, p. 130 (emphasis added)

C.32 Even after the expensive technology is installed, operating expenses are substantial. The "capture" stage, which involves compressing huge volumes of separated CO_2 gas, is a highly energy-intensive process; that process consumes a lot of natural gas, which adds to costs (and ironically also adds to carbon emissions at the site).

C.33 The failure of Alberta's 2008 plan based on CCS technology was a matter of enormous consequence. CSS was assumed to be the means of achieving 70% of Alberta's entire carbon reduction objective up to 2050. It was the technological solution that was going to allow bitumen production to continue to expand after 2020, while *simultaneously achieving absolute reductions* in CO_2 emissions.

C.34 The Alberta government released a new Climate Leadership Plan on November 20, 2015. A 90-page report, entitled *Climate Leadership: Report to Minister*, was prepared by an Advisory Panel, chaired by economist Andrew Leach. It can be accessed at: http://www.alberta.ca/documents/climate/climate-leadership-report-to-minister.pdf.

C.35 The November 20, 2015 report candidly discusses the failure of *Alberta's 2008 Climate Change Strategy*. It concludes that the 2008 plan's ambitious target that oil sands emissions would begin to decline by 2020 was never supported by sufficiently stringent carbon prices and regulations to achieve the promised results:

> *… these targets were based on a computer model under the assumption that Alberta's policies would include "… a strict regulation that all large, new industrial facilities are required to incorporate carbon capture and storage by 2015 wherever possible". The latter of those assumptions, a requirement to adopt carbon capture and storage in industrial facilities, was supposed to have led to the lion's share of reductions posited in the target by 2050 but neither these regulations nor the modeled carbon price were imposed.*
>
> — *Climate Leadership,* November 20, 2015, p. 25 (emphasis added)

C.36 The deep emissions reductions promised by Alberta's 2008 plan were based on the assumption that the government would enact a mandatory regulation requiring oil sands producers to *incorporate carbon capture and storage by 2015*. But no mandatory regulation was ever adopted. Alberta's Auditor General had warned – in an October 2008 report – that the necessary regulation had not been put in place (http://www.oag.ab.ca/webfiles/reports/Oct_2008_Report.pdf: see "Alberta's response to climate change", in particular pp. 98-99 of that 2008 document).

D. Alberta's 100 Mt oil sands emissions "cap"

D.1 The proposed evidence will establish that while Alberta has legislated a "cap" that purports to limit the growth of oil sands emissions, the cap will do nothing to curb the 44 Mt increase in oil sands emissions that is projected to occur between 2015 and 2030. Oil sands production and emissions data published by the Government of Canada will br referred to:

December 2013: Canada's Sixth National Report on Climate Change

D.2 At the end of December 2013, the last year before the collapse of world oil prices (which began in July 2014), *Canada's Sixth National Report on Climate Change* projected that oil sands production would reach 4.567 million barrels per day (bpd) by 2030, and that emissions from the oil sands industry would rise to 137 Mt. That was the Government of Canada's projection at a time when global oil prices were at their height, and when the long-term future growth of the oil sands industry appeared to be assured.

D.3 The oil and gas industry's own projections in June 2014 (just before the start of the steep decline in world oil prices began) showed oil sands production rising to 4.81 million bpd by 2030, a more ambitious outlook than Canada's official projections (Source: CAPP, *Crude Oil: Forecast, Markets & Transportation*, June 2014).

D.4 By early 2015, oil prices had fallen 50%. By the time CAPP released its June 2015 forecast, it had reduced its own estimate for 2030 oil sands production down to 3.50 million bpd (CAPP did not provide any forecast of emissions levels). Because the cost of production per barrel for oil from Canada's oil sands is among the highest in the world, future oil sands production levels are driven by future world oil prices. As future long-term oil prices declined, so did oil sands production forecasts.

February 2016: Canada's Second Biennial Report on Climate Change

D.5 The rapid fall in forecasted oil sands production accounted for a large reduction in the projected level of oil sands emissions. This fall in the expected emissions level had nothing to do with the Alberta's 100 Mt cap – which did not even exist in June 2015, when CAPP published its revised production forecast.

D.6 When the Federal Government published its revised projections of oil sands output to 2030 (*Canada's Second Biennial Report on Climate Change)* in February 2016, its projection of oil sands production to 2030 had been lowered to 4.258 million bpd, with projected annual emissions of 116 Mt (down from the 137 Mt figure projected in December 2013). That reduction was largely driven by the reduced oil sands production level, which in turn reflected the decline in global oil prices. It was also the result of lowered expectations about the future volume of oil sands upgrading, which accounted for 5 Mt of that reduction.

January 2017: Canada's 2016 Greenhouse Gas Emissions Reference Case

D.7 In January 2017, the Government of Canada's projected oil sands production level for 2030 was again lowered, down to 3.967 million bpd, and projected emissions were reduced to 108 Mt (*Canada's 2016 Greenhouse Gas Emissions Reference Case,* January 5, 2017, *Table A7).* That again had nothing to do with the cap. That revised projection of the future path of Canada's oil sands production to 2030 was based on forecasts done by the National Energy Board (NEB). It reflected a further 300,000 bpd reduction in the expected level of oil sands production by 2030. The NEB's forecast was based on calculations about the future growth of global oil demand – closely tracking similar projections done by the International Energy Agency (IEA).

December 29, 2017: *3rd Biennial Report*

D.8 In the Government of Canada's most recent projections, released on December 29, 2017 (*3rd Biennial Report*), the expected level of oil sands production in 2030 has now been revised upwards again to 4.2 million bpd, with the projected annual level of oil sands emissions now expected to reach 115 Mt by 2030.

D.9 Overall, during the past four years, the expected level of oil sands emissions by 2030 has been lowered from a high point of 137 Mt (given in the 2013 report) down to 115 Mt.

D.10 That revision has been entirely driven by the sharp decline of world oil prices since July 2014 – and the resulting reductions in the expected oil sands production level by 2030 as well as some reduction in upgrading.

D.11 None of that 22 Mt reduction in the expected level of oil sands emissions by 2030 has any connection with Alberta's 100 Mt "cap'' announced in November 2015.

D.12 Furthermore, Alberta's cap, while it is called a "100 Mt cap", is set at a high enough level that it will allow oil sands emissions to freely increase from 71 Mt in 2015 to 115 Mt by 2030, because of the way the cap limit is defined by the Province of Alberta.

D.13 Despite its name, the Alberta cap will in fact allow total emissions in the oil sands industry to grow to as much as 115 Mt before they exceed the upper limit. The *Reference Case* document (January 5, 2017) explained that the 108 Mt of oil sands emissions (the level of oil sands emissions projected at that time for 2030) would in fact be well *below* the cap. The reason for that is that the 100 Mt cap limit excludes some kinds of oil sands-related emissions:

> *Based on the Alberta Government's announcement, Alberta's 100 Mt cap on oil sands emissions excludes emissions from cogeneration of electricity and new upgrading. When taking these into account, total emissions from oil sands is 93 Mt in 2030 under the reference case scenario, below the 100 Mt cap.*
>
> — *Reference Case*, section 2 "Emissions projections by sector", note 4, p.7.

D.14 Although it is not commonly understood, the 100 Mt cap does not apply to, or restrict, the growth of additional emissions generated by "new upgrading" in Alberta. Upgrading is a highly emissions-intensive process that converts raw bitumen into a higher-value crude oil before it is shipped to foreign refineries for further processing. The cap also exempts additional emissions attributed to cogeneration. Therefore, under Alberta's cap, total oil sands emissions will be allowed to rise to about 115 Mt before they exceed the cap.The cap, in reality, is 116 Mt.

D.15 This limitation of the cap was again confirmed when Canada released its most recent emissions report, the *3rd Biennial Report* (December 29, 2017). The new projections show that oil sands production is now expected to rise to 4.236 million bpd by 2030 (up from the previous estimate of 3.967 million bpd), and that oil sands emissions (according to the Government of Canada's methods of calculation) are now projected to reach 115 Mt by 2030. The new report explains that the projected increase of oil sands emissions to 115 Mt by 2030 will still be within the cap limit, and that under Alberta's definition the increased figure is equivalent to only 99 Mt (*3rd Biennial Report*, notes g and h, at pp.138-139).

E. Reduction of methane emissions

E.1 In 2016, about 45 Mt CO_2eq of methane was generated by the oil and gas sector (*3rd Biennial Report*, Table 5.22, p. 148) mostly in Alberta and B.C., where it is associated mainly with natural gas extraction and processing. The promised methane reductions are cited in the "additional measures scenario" set out in the *3rd Biennial Report*, which estimates that methane regulations, if implemented, would allow an estimated 22 Mt CO_2eq of future emissions reductions in the oil and gas sector, taking into account the impact in all provinces, including Alberta. See: *3rd Biennial Report*, Chapter 5 "Projections and the Total Effect of Policies and Measures" sec.5.3.6.1, p.137

E.2 At present, both the Federal Government and Alberta are drafting their own methane regulations. Alberta's *Climate Leadership Plan Progress Report* (December 2017) estimates that the regulations will achieve a 14 Mt reduction of methane emissions by 2030, in Alberta.

E.3 Methane emissions in the oil and gas sector are broadly acknowledged to be a compelling opportunity for reductions. A large proportion is caused by the *deliberate flaring or venting of natural gas into the atmosphere* and by "fugitive" leaks during natural gas production, transmission, storage, and processing. Technologies to monitor and reduce leaks are available and economically viable. For a detailed discussion, see *Economic Analysis of Methane Emission Reduction Opportunities in the Canadian Oil and Natural Gas Industries*, Environmental Defence Fund, October 2015, https://www.pembina.org/reports/edf-icf-methane-opportunities.pdf .

E.4 There is some uncertainty about the future of the proposed regulations. On June 29, 2016, Canada, the U.S., and Mexico announced a joint strategy to reduce methane emissions 40-45% by 2025. But after the inauguration of the Trump administration, the U.S. announced that it was going to back away from the proposed scheme. The industry in

Canada has since raised concerns it will become "uncompetitive" if it is forced to comply with methane regulations when foreign competitors are not.

F. Meeting the 2030 target of 517 Mt

F.1 *Canada's Third Biennial Report* (December 29, 2018) Table 5.6 at p.137 shows the expected cuts with "current measures". Table 5.28 at page 153 takes into account the impact of promised "additional measures".

F.2 As for the oil and gas sector, under current measures total emissions (including oil sands) are expected to reach 215 Mt by 2030. According to the *3rd Biennial Report*, methane regulations, if fully implemented, could achieve 22 Mt CO_2eq of reductions across Canada by 2030 (discussed at p. 139 of the report). Table 5.28, under "additional measures", shows total oil and gas sector emissions reduced to 192 Mt by 2030, if the promised methane regulations are adopted.

F.3 Two other economic sectors (waste and agriculture) show no potential reduction at all between 2020 and 2030. Therefore, Canada's ability to meet its emissions reduction target by 2030 depends almost entirely on our capacity to achieve very deep emissions cuts in the other four sectors (i.e., transportation, buildings, heavy industry, and electricity):

Figure xviii: Cuts needed in the other four sectors to meet the 30% reduction target (Mt CO_2eq)

	2020	2030	Change 2020-2030
Oil and gas sector emissions	197	192	**- 5 Mt**
Combined agriculture and waste sectors	121	122	**+1 Mt**
Other four economic sectors	410	203	**-207 Mt**
Total emissions in 2020	**728**		
Total emissions in 2030 (if target achieved)		**517 Mt**	

Source: All of the emissions projections shown in Figure xviii for 2020 and 2030 are taken from *Canada's 3rd Biennial Report* (December 29, 2017), with the exception of 209 Mt in the second line, which represents the upper limit for the combined emissions from the other four economic sectors if Canada's total emissions by 2030 are not to exceed the 517 Mt target.

F.4 Of the four sectors, only electricity is currently projected to achieve deep reductions between 2020 and 2030: Appendix A, Figure xiii. Based on current measures, the electricity sector reduction is 25 Mt. If we include promised "additional measures", the total reduction of electricity emissions between 2020 and 2030 is a remarkable 50 Mt (see *3rd Biennial Report*, Table 5.28).

F.5 However, the other three sectors in this group will provide only modest reductions. Transportation offers only 25 Mt of cuts between 2020 and 2030, even if we take into account the promised "additional measures"; the buildings sector, 17 Mt (including the benefit of "additional measures"); and heavy industry sector emissions *increase* by 10 Mt. (*3rd Biennial Report*, Table 5.28). Therefore, these four sectors combined offer a combined net reduction of only 82 Mt between 2020 and 2030.

F.6 In summary, we need to find in total about 200 Mt of cuts in these four sectors between 2020 and 2030 to meet the 517 Mt target. The shortfall is about 120 Mt. That is why the *Pan-Canadian Framework* plan, in its most recent version, is obliged to promise Canadians that we will purchase 59 Mt of "international cap-and-trade credits" or so-called "international allowances" (*3rd Biennial Report*, Table 5.28, p. 153). Even then, there remains a "gap" of 60 Mt, which the government says can be covered by "investing in public transit, clean technologies, and innovation" (*3rd Biennial Report*, Figure 5.1, p. 129). But we are not provided with any details showing specific policies and estimates of the future reductions that could be achieved by these generic solutions.

F.7 The problem is that if we continue to expand oil and gas production in Canada in line with current forecasts, we cannot meet our 2030 target without extraordinarily deep cuts in the other sectors – cuts that appear to be far beyond anything we have the capacity to achieve. For a detailed analysis that examines this basic problem, see David Hughes, *Can Canada Expand Oil and Gas Production, Build Pipelines and Keep its Climate Change Commitments?* (June 2016, Canadian Centre for Policy Alternatives: https://www.policyalternatives.ca/authors/david-hughes). Hughes explains that if we follow current plans to develop oil and gas resources, the other sectors will be required to reduce their emissions between 47% and 59% below 2014 levels by 2030 to meet our 517 Mt target by that year. The high estimate includes the impact of LNG development.

G. The methodology (*Canada Gazette*, March 19, 2016)

G.1 It is relevant to examine details of the methodology adopted by the *Trans Mountain Expansion Project Review* when it conducted its assessment of "the potential impact [of the pipeline projects] on Canadian and global emissions".

G.2 The final report of the upstream emissions assessment was publicly released on November 25, 2016. The Trans Mountain project was given final approval by the government four days later. The Order in Council of November 29, 2016, includes a brief summary of the upstream assessment report regarding the impact of the pipeline on Canada's total emissions.

> *The assessment indicated that incremental emissions are unlikely to be expected as oil production is expected to grow by more than the capacity of the expanded line regardless of whether the line is built.*
>
> — Order in Council, Explanatory Note, "Climate Change", p. 9 (emphasis added)

G.3 This appears to be an assurance that pipeline expansion will not cause higher emissions. In order to understand what it really means, we need to examine the procedure that governed how the assessment was done. On March 19, 2016, the Liberal Government released details of the Interim Measures to assess emissions associated with pipeline projects. A notice published in the *Canada Gazette* explained the procedure:

> *The assessment of upstream GHG's will consist of two parts: (A) a quantitative estimation of the GHG emissions released as a result of upstream production associated with the project, and (B) a discussion of the project's potential impact on Canadian and global emissions.*
>
> — "Estimating upstream GHG emissions", *Canada Gazette*, March 19, 2016 (http://www.gazette.gc.ca/rp-pr/p1/2016/2016-03-19/html/notice-avis-eng.php#nl4)

G.4 The document described the procedure as "the methodology". Part A of the assessment was not complicated. The first step was to calculate the "estimated throughput" (i.e., how much diluted bitumen would be carried by the project). Part A of the assessment would calculate the total GHG emissions "associated with the project" – i.e., the volume of emissions generated every year in the course of producing the amount of bitumen that *could* be transported to markets by the new pipeline, if it were built. Part B of the assessment promised to provide Canadians with "a discussion of the project's potential impact on Canadian and global emissions". But if we read the notice in full, we can see that the "methodology" designed for Part B is formulated in a particular way, which significantly limits the scope of the inquiry:

> *The second part of the analysis discusses the conditions under which the Canadian upstream emissions estimated in Part A could be expected to occur even if the project were not built.*
>
> — *Canada Gazette*, March 19, 2016

G.5 The above wording means that in looking at the impact of "the Project", the assessment must ask this question: will the future increase in oil sands production (and therefore the future increase of emissions) made possible by the additional transport capacity of this pipeline occur *even if the pipeline is not built*? Clear guidance is given on what steps the assessment must follow to answer that question:

> *The second step involves evaluating the technical and economic potential for alternate modes of transportation to be used in the absence of the proposed project.*

G.6 Rail transport is the alternative. The assessment is therefore required to evaluate whether rail transport would be an economically viable method to transport the increased bitumen production to market, and must look at the "economic and technical potential" of the alternate mode of transport. Rail transport is more expensive than pipelines (about US$10 more per barrel, according to the assessment). The crucial question is whether long-term oil prices will be high enough to cover the extra cost of rail "in the absence of

the proposed project." The Trans Mountain report found that oil prices at about $80 per barrel or higher would make rail transport viable.

G.7 The March 18, 2016 notice was absolutely clear on how the assessment should proceed:

> *As an example, when considering whether Canadian GHG emissions would increase as a result of a crude oil pipeline project, the primary factor will be the potential increase in Canadian upstream oil production that would be expected to occur if the pipeline were not built.*

G.8 Therefore, if rail transport is an economically viable alternative, then the assessment is obliged to decide that the increased production that will be carried in the proposed pipeline *would be produced anyway, even if the pipeline were not built*. In that case, the new pipeline would not make emissions any worse – because the increased production would still occur even if the new pipeline were not approved. In that case, the pipeline will not "cause" any "incremental" emissions, according to the terminology.

G.9 Of course, in reality, emissions will increase if production grows. The assessment found that the amount of increased bitumen production carried by expanded pipeline capacity would account for an additional 13 Mt to 15 Mt of greenhouse gas emissions per year (which would represent about a 20% increase of the industry's total emissions, based on the 2015 level) – a significant increase in our total emissions.

G.10 However, in line with the methodology, the Trans Mountain assessment was able to show that the amount of "incremental" emissions caused by the pipeline expansion will be "minimal": (see *Report*, Table 8, p. 39). Evidence was available to establish that long-term oil prices will increase to about US$78 per barrel by 2020, and will continue to rise gradually to US$102 by 2040. The assessment therefore concluded that the pipeline would cause only minimal "incremental" emissions, because the same amount of production increase (and the same emissions growth) would occur if the pipeline were not built – because rail transport would be viable as an alternate form of transport.

G.11 On the basis of that reasoning, the November 25, 2016 report to the government advised that incremental emissions from building the pipeline would be "minimal".

G.12 In truth, the accumulating concentration of CO_2 emissions in the atmosphere is the problem we are trying to solve. In light of that problem, the distinction between pipelines and rail transport is meaningless. If we increase production by 590,000 bpd (the increased capacity added by the Trans Mountain expansion), Canada's total emissions will increase by 13 Mt to 15 Mt – whether the increased output is shipped by pipeline or shipped by rail.

H. The Trans Mountain upstream emissions assessment

H.1 The "upstream emissions assessment" for the Trans Mountain pipeline was publicly released on May 19, 2016 in draft form (the report was officially titled the *Review of Related Greenhouse Gas Emissions Estimates for the Trans Mountain Expansion*

Project). It was 43-pages in length. A period for submitting public comments was open until June 20, 2016. A link to the draft report is found at https://www.ceaa-acee.gc.ca/050/documents/p80061/114550E.pdf .

H.2 The final version of the report was publicly released on November 25, 2016. The final version is 47 pages in length, and is substantially identical to the draft version. The defendant will produce a copy of the final report at trial. It can be found at: http://ceaa-acee.gc.ca/050/documents/p80061/116524E.pdf.

H.3 The report, in a section entitled "GHG Forecast Approach", states that "a number of recently announced provincial government policies" will "have an impact" on Canadian GHG emissions. In that regard, it refers to Alberta's *Climate Leadership Plan*, to Alberta's "commitment to cap emissions at 100 Mt in any year," and to proposed regulations to limit methane emissions in the oil and gas industry. But it offers no analysis to show whether, or to what extent, these measures will reduce Canada's total emissions by 2030.

H.4 The same section of the report also cites the planned carbon-pricing scheme:

> *On October 3, 2016, the Government of Canada proposed its Pan-Canadian approach to pricing carbon pollution. Under the new plan, all Canadian jurisdictions will have carbon pricing in place by 2018. In order to accomplish this, Canada will set a benchmark for pricing carbon emissions – set at a level that will help Canada meet its greenhouse gas emissions targets … Provinces and territories will have flexibility in deciding how they implement carbon pricing: they can put a direct price on carbon or they can adopt a cap-and-trade system. The government proposes … the price should start at a minimum of $10 per tonne in 2018, rising by $10 each year to $50 per tonne by 2022.*
>
> — *Report*, A.6 GHG Forecast Approach, p. 16

H.5 The report, however, contains no analysis at all of whether this proposed carbon pricing scheme, rising to $50 per tonne by 2022, would be stringent enough to achieve the deep emissions reductions needed by 2030.

H.6 Nor does the report disclose, or discuss, the implications of the fact that, under this plan, the proposed carbon price will not be levied at the full rate on a number of major "emissions-intensive" industries, because of concerns that those industries would become uncompetitive against foreign suppliers.

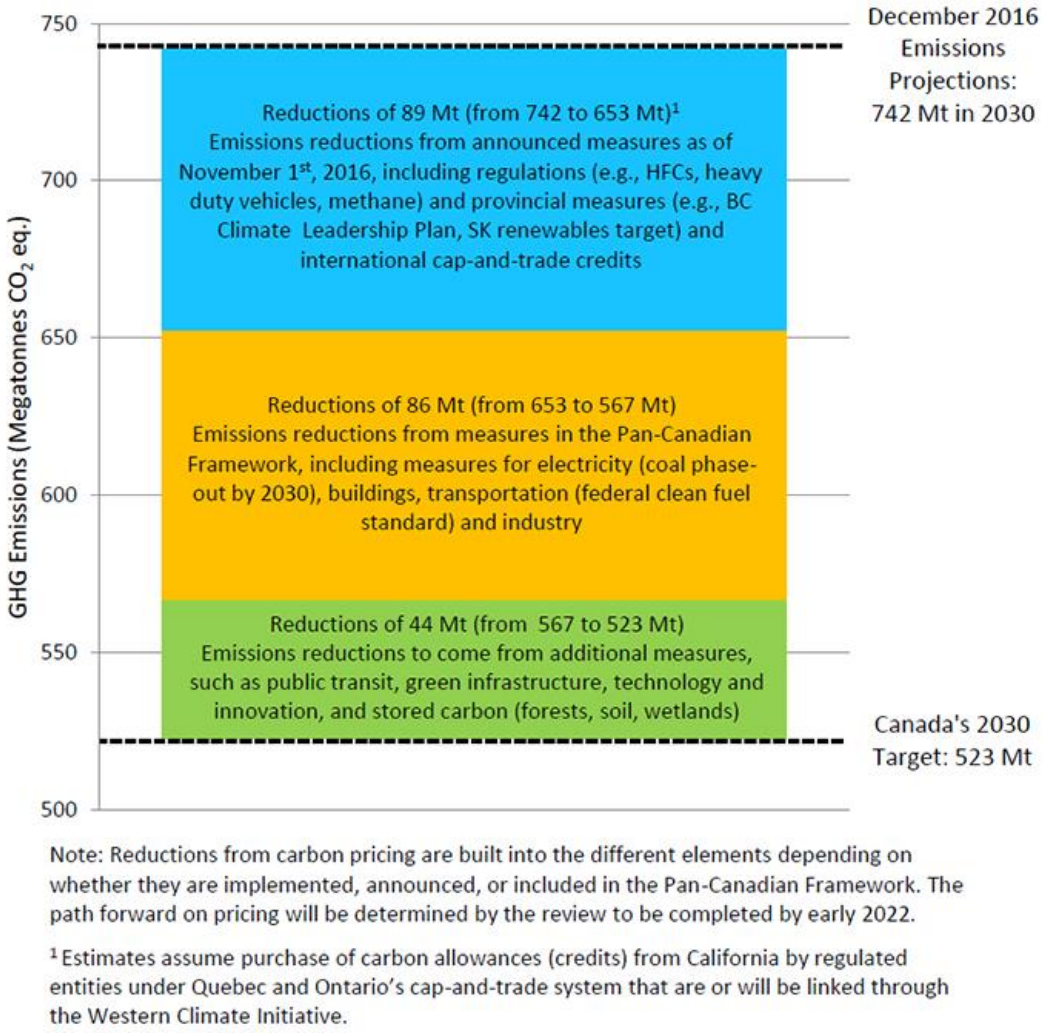
I. The *Pan-Canadian Framework* (December 9, 2016)

I.1 The *Pan-Canadian Framework* document, described as the "national climate plan", was publicly released on December 9, 2016 – a week *after* the government approved the pipeline projects. The *Pan-Canadian Framework* plan had never been subjected to any kind of scrutiny by a public inquiry process.

I.2 The document is publicly available and can be found at: https://www.canada.ca/content/dam/themes/environment/documents/weather1/20170125-en.pdf

I.3 The *Framework* document released on December 9, 2016, consisted of a long list of promises and generic strategies about future measures that provincial governments and the federal government say they will implement to reduce emissions. The *Framework* assured Canadians that based on these future policies, not yet implemented and mostly highly uncertain – *many of them not identified or developed at all* – Canada would be able cut its total emissions down to 567 Mt by 2030, and that other unspecified future measures (e.g., "green infrastructure") can get us to the 517 Mt target.[†]

Figure xix: Pan-Canadian Framework – the promised reductions



Note: Reductions from carbon pricing are built into the different elements depending on whether they are implemented, announced, or included in the Pan-Canadian Framework. The path forward on pricing will be determined by the review to be completed by early 2022.

[1] Estimates assume purchase of carbon allowances (credits) from California by regulated entities under Quebec and Ontario's cap-and-trade system that are or will be linked through the Western Climate Initiative.

Source: Pan-Canadian Framework on Clean Growth and Climate Change, page 44.

[†] Canada's target for 2030 is now set at 517 Mt, following a recent adjustment to the historical emissions data for 2005. At the time the Pan-Canadian Framework was publicly released on December 9, 2012, Canada's total emissions for 2005 were given as 738 Mt.

I.4 With the exception of a single graph on page 44 (designated "Pathway to Meeting Canada's 2030 Target", reproduced in Figure xix), the *Pan-Canadian Framework* document published on December 9, 2016, did not provide any detailed quantified analysis about future emissions reductions.

I.5 The graph published in the December 9, 2016 document showed a horizontal baseline representing the most recent projection of Canada's total emissions for 2030 – indicating an annual level of 742 Mt (that number was the then-available estimate for the 2030 emissions level). From that total, the scheme deducts three broad categories of future emissions reductions, grouped in tranches of 89, 86, and 44 Mt – optimistically indicating by these aggregate numbers that additional deep cuts will be achieved below the projected 2030 level. The promised cuts total 219 Mt. But those large numbers are not broken down or attributed to any specific policy, or to any specific sector.

I.6 The first category promises 89 Mt of future reductions. We are told this category comprises measures already announced by all levels of government as of November 1, 2016, *"but which do not yet have sufficient certainty to be included in the reference case"*: Government of Canada, "Modeling of greenhouse gas emissions," December 12, 2016 https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/modelling-ghg-projections.html. So while the promised reductions do not have "sufficient certainty" to be counted in the *Reference Case*, we are led to believe that they are so close to being implemented that we can count on them.

I.7 A closer look at the graph, however, reveals that *55 Mt of these promised reductions* (out of the entire 89 Mt in the first category) will be obtained by the purchase of carbon allowances ("credits"). Industrial emitters who are unwilling or unable to cut their own emissions in Canada will instead be able to purchase credits from California — and continue to emit CO_2 and other GHGs into the atmosphere unabated using their existing emissions-intensive technologies. They will be able to delay the kinds of technological innovation needed to reduce emissions.

I.8 The second category, which promises an additional 86 Mt of future reductions by 2030, claims that substantial cuts will come from *"measures in the Pan-Canadian Framework … including measures for … buildings, transportation … and industry".* But the "measures" identified in the *Pan-Canadian Framework* document are so lacking specifics that it is impossible to assess whether the proposed future carbon-reductions are viable, whether they will be funded, whether they will be politically acceptable in the various provinces, or if they will be implemented at all.

I.9 The third category in Figure xix is so vague as to be meaningless. It promises 44 Mt of future reductions, but says only that they will come from "additional measures" – which are simply identified as "green technology" and "technology and innovation". This tells Canadians nothing about the feasibility of achieving future reductions on that scale.

I.10 An additional five-page document released on the government's website on December 22, 2016 provides a more detailed breakdown for 120 Mt of the promised reductions (out of

the total 219 Mt) that it claims can be achieved by 2030, listed in a table entitled "Sectoral Reductions":

Figure xx: Sectoral reductions information published December 22, 2016

Sectoral Reductions [1]

Sector [2]	Reductions from December 2016 Reference Case to Pan-Canadian Framework (742 Mt to 567 Mt in 2030)
Electricity	17 Mt (from 34 to 17 Mt)
Buildings	28 Mt (from 94 to 66 Mt)
Transportation	15 Mt (from 157 to 142 Mt)
Heavy Industry (including oil and gas)	56 Mt (from 330 to 274 Mt)
Agriculture, Waste and Others	4 Mt (from 127 to 123 Mt)
Purchase of WCI Allowances (Ontario and Quebec)	55 Mt

[1] Reductions in this table correspond to federal, provincial and territorial announced measures as of November 1, 2016 (blue bar) and measures contained in the Pan-Canadian Framework on Clean Growth and Climate Change (yellow bar).

[2] Sectors as defined in Canada's 2016 Greenhouse Gas Emissions Reference Case

Source: *Modelling of Greenhouse Gas Projections*, Government of Canada, December 22, 2016 (https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/modelling-ghg-projections.html)

I.11 Figure xx purported to show how the promised future cuts would be divided between the seven economic sectors. It confirmed that 55 Mt of the total needed reductions will be accounted for by carbon credits (that estimate is now increased to 60 Mt in the recent *Biennial Report*). The table does not mention the other 44 Mt of cuts needed to meet the 517 Mt target. It is helpful to look carefully at how this table treats each sector. I consider two examples:

Transportation

I.12 Figure xx tells us that total transportation sector emissions (Canada's second largest emitting sector) are projected to decline to 157 Mt by 2030, under carbon-reduction policies already in place (called "current measures"). It claims they will be cut by a further 15 Mt, down to 142 Mt, based on future policies not yet implemented (referred to as "additional measures"). But even cutting transportation emissions to 142 Mt by 2030 would represent only a 15% cut below the projected 2020 level.

I.13 To meet the Paris target of 517 Mt, we would need much deeper reductions of transportation emissions between 2020 and 2030 – as much as a 50% reduction.

I.14 The *3rd Biennial Report* (December 29, 2017) updates that data, but there is no improvement. The new information tells us that, under "current measures", transportation emissions will decline to 155 Mt by 2030, and that "additional measures" will reduce the number to 143 Mt (see *3rd Biennial Report*, Table 5.28 at p. 153).

Heavy industry

I.15 An unusual feature of the original *Pan-Canadian Framework* material published on December 22, 2016 was that, in an unprecedented step, it combined two of Canada's major economic sectors – the heavy industry sector and the oil and gas sector – treating them as if they are one composite "industry" sector. In Figure xx, see the description: "Heavy industry (including oil and gas)". As a result, the original document did not disclose any separate emissions data for the oil and gas sector. It simply identified a composite sector that under current policies was projected to reach total emissions of 330 Mt by 2030. It claimed that "additional policies" under the new plan would reduce that total to 274 Mt by 2030 – a promised 56 Mt reduction.

I.16 The recent *3rd Biennial Report*, which includes an updated version of the *Framework* plan, treats these two major sectors separately. In the case of oil and gas, it shows that with the benefit of future "additional policies" (i.e., the promised methane regulations), oil and gas sector emissions between 2020 and 2030 will decline from 197 Mt to 193 Mt (Table 5.28, at p. 128).

I.17 In the case of heavy industry, it reports that based on "current measures," emissions in the heavy industry sector will rise from 75 Mt in 2015 to 83 Mt by 2020, *and will rise again to 97 Mt by 2030.* Under promised future "additional measures" (not laid out in any detail), it claims that heavy industry emissions will decline slightly to 93 Mt by 2030 (see *Biennial Report*, Table 5.28 at p.153). But that outcome, even assuming it is feasible, would still provide no cuts at all below the 2020 level. In fact, it represents a *10 Mt increase above the 2020 level*.

I.18 In the updated December 29, 2017 version of the *Pan-Canadian Framework*, the combined emissions for these two large sectors (heavy industry plus oil and gas), after taking into account the benefit of all promised "additional measures", will be 286 Mt in 2030 – 12 Mt *higher* than the combined total given a year earlier in Figure xx. This includes the benefit of the promised 22 Mt of methane reductions for the oil and gas sector.

I.19 Deep emissions cuts will need to be made in heavy industry emissions, well below the 2020 level, if we are going to meet Canada's 517 Mt target by 2030. No specific policies are disclosed to explain how substantial cuts can be achieved in the heavy industry sector, which includes chemicals and fertilizers, iron and steel, cement, and other emissions-intensive economic activities. We are not provided with any quantified estimates of

future reductions for each industry. We are being asked to trust that "innovation" and future increases in the "carbon price" will provide a solution.

I.20 If Canadians are going to be told that the expected growth of emissions from Canada's expanding oil sands industry "fits within our national climate plan," the evidence and analysis relied on to support that claim must be disclosed and tested by an open inquiry.

I.21 A proper inquiry process must be *public* – because that is our guarantee that the evidence will not be pre-selected, or exaggerated, and that contrary evidence will not be brushed aside. The integrity of the process must also be protected by the basic principles of judicial independence, so we can be confident that the authors of the report, whoever they may be, are not being influenced by pressures, discussions, or other sources of information that have not been tested in the hearing room, in public view.

J. Report of the Auditors General (March 27, 2018)

J.1 On March 27, 2018 the Auditor General of Canada in collaboration with the auditors general of all ten provinces (except Quebec) issued a joint report entitled *Perspectives on Climate Change in Canada: A Collaborative Report from Auditors General*. Under the heading "Key issues identified in audits of climate change action in Canada", the 28-page report states (emphasis added):

> *Canada's auditors general found that most governments in Canada were not on track to meet their commitments to reducing greenhouse gas emissions. … Meeting Canada's 2030 target will require substantial effort and actions beyond those currently planned or in place.* (p. 4)

J.2 The usual purpose of an auditor general's report is not to second-guess the wisdom or merits of a government's chosen policy objectives, but rather to examine whether governments have actually implemented the kind of detailed planning, funding, development of regulations, and actions needed to ensure that objectives can be achieved:

> *For the most part, auditors found that governments' plans to reduce greenhouse gas emissions consisted of high-level goals, with little guidance on how to implement actions. Details often missing from the plans included timelines, estimates of the reductions expected from individual action items, and information about funding.* (p. 4)

J.3 The auditors general emphasize that "broad goals" are not sufficient:

> *It is unclear how Canada will meet this target. Although it is important for governments to set broad goals around climate change, they must also provide detailed timelines and interim steps for achieving those goals (*page 18).

J.4 The report confirms that most provinces (including Alberta, Saskatchewan, and B.C.) have no 2030 emissions target, and Saskatchewan has not signed the *Pan-Canadian*

Framework. It also acknowledges that Canada will fail to meet its 2020 Copenhagen target, a commitment made in 2009 by the Conservative Government to reduce emissions 17% by 2020, below the 2005 level. The target is 613 Mt. The *3rd Biennial Report* shows that Canada's emissions will reach 728 Mt by 2020 – just 1.4% below the 2005 level.

K. Carbon pricing

K.1 According to the *Pan-Canadian Framework* document, a carbon price (by means of a carbon tax or a cap-and–trade system) is one of the "four pillars" of what it calls a comprehensive plan (see section 1.2, "Pillars of the Framework", p. 2).

K.2 But the existing agreement between the Federal Government and the provinces promises only that the carbon price for all jurisdictions in Canada will start at a minimum of $10 per tonne in 2018 and rise by $10 per year, to $50 per tonne by 2022. The scheme, summarized in the *Framework* document, provides that any further increase in the carbon price will not be decided until "early 2022". There does not yet exist any agreed carbon pricing plan for Canada that ensures prices will rise above $50 after 2022. We do not know what the carbon price might be during the seven years after that, up to 2030 – or indeed whether it will increase at all.

K.3 The promised future emission reductions depend on the stringency of a carbon-pricing scheme that remains unknown for the crucial seven-year period after 2022. Energy economists in Canada have warned that if we are going to rely on carbon pricing as a principal policy to achieve our emissions reduction target by 2030, the carbon price during the next decade will need to rise very substantially over the next decade – to as much as $150 or $200 per tonne of CO_2.

K.4 About future carbon price levels needed to meet Canada's 2030 emissions reduction target: see *"Is Win-Win Possible?"* Marc Jaccard, Mikela Hein, Tiffany Vas (September 20, 2016): http://rem-main.rem.sfu.ca/papers/jaccard/Jaccard-Hein-Vass%20CdnClimatePol%20EMRG-REM-SFU%20Sep%2020%202016.pdf. This paper concludes that if Canada chooses to rely principally on carbon pricing to achieve its carbon-reduction goals, the price would need to increase to about $200 per tonne by 2030. Marc Jaccard is an energy economist at the School of Resources and Environmental Management at Simon Fraser University.

K.5 A broad discussion of the carbon pricing scheme in the Pan-Canadian Framework is found in "Putting a price on carbon pollution across Canada: Taking stock of progress, challenges, and opportunities as Canada prepares its national carbon pricing benchmark", Pembina Institute (May 2017): http://www.pembina.org/reports/carbon-pollution-pricing-2017.pdf . This Pembina Institute paper is clear that substantial increases in the carbon price post-2022 will be necessary. It does not specify the future carbon price level required, but cites a study proposing a national carbon price floor of $150 per tonne by 2030.

L. British Columbia and its planned LNG industry

L.1 This Appendix provides details of the defendant's proposed evidence relating to the emissions implications of the development of an LNG industry in B.C.

L.2 On October 2, 2018, the owners of LNG Canada, a major LNG liquefaction facility long planned for B.C.'s north coast, announced their decision to proceed with the construction of their project, which had received final environmental approval in 2015. When completed, the coastal facility and related and natural gas production and processing activities will add 8.6 to 9.6 $MtCO_2eq$ to Canada's annual emissions level.

L.3 The impact of future emissions growth from B.C.'s planned LNG industry is not included in the projections set out in the *3rd Biennial Report*. The explanation appears to be that, notwithstanding multiple proposed LNG projects during the past five years, at the time the *3rd Biennial Report* was published, no LNG investor had made a final decision to build a plant. Investment decisions had been delayed, primarily due to low LNG prices in Asia. Potential emissions increases from LNG development were therefore excluded from the report.

L.4 A single project will significantly increase the annual level of Canada's oil and gas sector emissions. Even without LNG development, the most recent projection for B.C. (December 29, 2017) shows no significant cuts in the province's total emissions between now and 2030, based on current measures:

Figure xxi: British Columbia – emissions projections to 2020 and 2030 (Mt CO_2eq)

	2005	2015	2020	2030
British Columbia	64	61	59	58

Source: *Canada's 3rd Biennial Report* (December 29, 2017), Table 5.27.

L.5 The evidence at trial will show that, based on current policies, B.C.'s emissions are not projected to decline at all by 2030. Total emissions in B.C. in 2016 were 61 Mt, according to the most recently published Federal data (*Canada's National Inventory report 1990-2016*, April 17, 2018, Table 5-4).

L.6 The above numbers are more or less consistent with the outlook in the former B.C. government's *Climate Leadership Plan*, released on August 19, 2016. That plan indicated total emissions in B.C. by 2030 will be about the same as they were in 2015, around 61 Mt, *with no absolute cuts beginning until after 2030*. The B.C. plan listed a number of policies, it claimed, would eventually cut the province's annual emissions, but not in the next decade (*B.C. Climate Leadership Plan*, Annex I, p. 47).

L.7 The current B.C. government, which took office in July 2017, promised to develop a new climate plan. On May 17, 2018, the government passed the *Greenhouse Gas Reduction Targets Amendment Act 2018*. The new legislation repealed the province's previous commitment to reduce emissions, which promised a 33% cut by 2020 below the 2007

level. The 2007 level was 64.7 Mt. The province's 2020 target, now abandoned, was 43.5 Mt. It is obviously clearly unattainable.

L.8 No new target has been set for 2020. Instead, for 2030, the new statutory commitment is a 40% reduction below the 2007 level. The new provincial target is 38.8 Mt. This, therefore, raises another unanswered question: whether LNG development in B.C. can be reconciled with the substantial emissions reductions required by 2030, having regard to both Canada's national commitment and B.C. new provincial target.

L.9 The LNG Canada project, which has now announced it will proceed with construction, received government approval under a joint federal-provincial environmental assessment released May 6, 2015: https://www.ceaa-acee.gc.ca/050/documents/p80038/101852E.pdf. The proposed evidence at trial will show that this project, when it is completed, will generate 3.6 Mt CO_2eq of emissions annually at the terminal, and an additional 5.0 Mt from the associated upstream natural gas production and processing operations – for an annual total of 8.6 Mt, rising to 9.6 Mt by 2050 (Pembina Institute, "Liquified natural gas, carbon pollution, and British Columbia in 2017: an overview of B.C. LNG issues in the context of climate change", August 2017: http://www.pembina.org/reports/lng-carbon-pollution-bc-2017.pdf).

L.10 Other detailed information is available about the potential emissions impact of LNG development. In September 2016, the Federal Government gave conditional approval to a proposed LNG operation known as Pacific NorthWest LNG (the owners subsequently announced on July 25, 2017 that they would not proceed with that project). CEAA had previously released a Draft Environmental Assessment Report for that project, which found that emissions from the liquefaction facility, together with the associated emissions from processing the natural gas to supply the facility, would generate *11.4 Mt to 14.0 Mt of CO_2 every year for 30 years*: http://www.ceaa.gc.ca/050/document-eng.cfm?document=104785. Of that amount, 5.28 Mt would be released by the liquefaction facility itself and another 6.5 to 8.7 Mt would be generated by upstream production and processing. The Federal Government's approval included conditions that would have limited emissions *at the liquefaction facility* to 4.3 Mt. But the annual total, including upstream emissions, would still have been in the order of 10 Mt.

L.11 A third LNG facility called Woodfibre LNG, smaller in scale, has also been approved. If construction proceeds, it will add about 1 Mt to 1.5 Mt to B.C.'s annual emissions.

No assessment of impacts on emissions reduction targets for 2030

L.12 Notwithstanding the significant negative implications of planned LNG development on Canada's total emissions level, there was only one mention of LNG in the entire *Pan-Canadian Framework* document when it was originally released on December 9, 2016. The mention of LNG is found in a three-page section devoted to British Columbia, included in Annex II, which extols "provincial and territorial accomplishments in reducing greenhouse gas emissions and accelerating clean growth":

> *"B.C. has an abundance of natural gas, which is a lower carbon fuel that will play a critical role in transitioning the world economy off of high carbon fuels such as coal. B.C.is developing the resource responsibly, and provincial legislation will make the emerging LNG sector the cleanest in the world."*
>
> — *Pan-Canadian Framework* (December 9, 2016), p. 52

L.13 The document applauds the efforts of the B.C. government (under then Premier Christie Clark) to develop the LNG industry. It claims that LNG "will play a critical role in transitioning the world … off of high carbon fuels." But it is completely silent about the growth of emissions that will result at the production and processing sites in B.C.

L.14 The recent *3rd Biennial Report* (December 29, 2017), which incorporates updated projections for future cuts under the government's *Pan-Canadian Framework* plan, includes no provision at all for any emissions increase in the oil and gas sector from LNG development. Instead, it contains this bland note:

> *Consistent with the most recent NEB projections, this report does not include the construction of any liquefied natural gas production projects nor emissions from that sector over the projection period.*
>
> — *3rd Biennial Report*, Section 5.3.6.1 "Oil and Gas", p. 139

L.15 Therefore, the evidence at trial will show that the Government of Canada's most recent emissions projections to 2030 (published December 29, 2017), which purport to provide Canadians with what is supposed to be a reliable assessment of Canada's emissions trend to 2030 based on current policies, completely leaves out of account the impact of developing an LNG industry in B.C. The substantial growth of emissions that will result from proceeding with LNG in B.C. is not mentioned.

L.16 Nor is the potential impact of LNG emissions to 2030 taken into account, or mentioned at all, in the updated version of the *Pan-Canadian Framework* plan, which is incorporated into the *3rd Biennial Report*: see Chapter 5 "Projections and the Total Effects of Policies and Measures." The projected oil and gas sector emissions to 2030, set out in Table 5.28 at p. 153, which take into account the benefit of all the promised "additional measures" that are supposed to *reduce* emissions (e.g., the promised methane regulations), are absolutely silent about the potential impact of LNG emissions.

LNG exports to Asia

L.17 In a press conference on March 22, 2018, B.C. Premier Horgan declared that by producing LNG, B.C. will be "contributing to the reduction of global carbon emissions":

> *B.C. could help displace coal in Asia with cleaner LNG, said Horgan, echoing an argument Clark's Liberals had long trumpeted and the NDP had once belittled.*
>
> — *Vancouver Sun*, March 23, 2018

L.18 The point underlying that claim is that once natural gas is delivered to an electricity generating plant, power can be produced with about 50% less emissions than by coal-fired generation. Energy resource scientist J. David Hughes has explained the point this way: "if one looks at burner-tip emissions only (meaning GHG emissions at the point of combustion), natural gas has roughly half the CO_2 emissions of coal" (*A Clear Look at BC LNG*, May 2015). But, as Hughes explains, that calculation does not take into account the energy-intensive LNG production process "upstream", before the fuel reaches its destination in China. Large amounts of natural gas would be consumed at the liquefaction facility in B.C. in order to liquefy the gas for marine transport; transport across the Pacific consumes energy, and so does regasification in China – all of which generates emissions. Natural gas extraction and natural gas processing in B.C. also generate substantial emissions. Natural gas venting and methane leakage add to those emissions.

L.19 Hughes explains that in studies that compare burning coal in China versus burning imported LNG, the outcomes vary depending on assumptions about the volume of upstream methane leakage during natural gas production, and the technology and efficiency of the coal plants in China. The benefits of shipping LNG to Asia to replace coal-fired electricity are not as certain as the *Framework* claims. Depending on the actual circumstances, the substitution of B.C. LNG for coal could be more emissions-intensive (https://www.policyalternatives.ca/sites/default/files/uploads/publications/BC%20Office/2015/05/CCPA-BC-Clear-Look-LNG-final_0_0.pdf).

L.20 Even if claims about the emissions-reducing benefits of shipping LNG to China are true, Canada's commitment under the December 2015 Paris Treaty is to reduce emissions in Canada to 517 Mt by 2030. The *Pan-Canadian Framework* report of December 9, 2016 failed us in two ways. It made claims about the global benefits of LNG that are unsupported by any evidence or analysis, and it omits any account of the emissions growth we will see in in B.C., if the development of the industry proceeds.

L.21 The failure to address the impact of planned LNG development on Canada's ability to meet its commitments under the Paris Agreement discredits not just the *Pan-Canadian Framework* plan, but points to the recklessness of the Government of Canada's entire approach in dealing with the grave question of whether continued expansion of oil and gas production is consistent with our climate commitments.

B.C. Government consultation: July 2018

L.22 Nor has the B.C. government provided people with any candid analysis of whether LNG development is consistent with the province's new 38.8 Mt target for 2030.

L.23 On July 20, 2018, the B.C. government announced that it is inviting "public input" on a new "responsible climate strategy", which is to include "a clean-growth program for industry". The material released to the public included documents entitled "Intentions Paper: A Clean Growth Program for Industry" and "Toward a Clean Growth Future for B.C.: Introduction".

L.24 Yet none of the publicly released material contains any mention of LNG. The subject of LNG development and the potential emissions impact of that industry are entirely omitted from the public consultation documents.

L.25 The consultation documents state that B.C.is going to produce and export "the cleanest natural resources in the world", and that our resource industries will be "reducing the carbon intensity of their operations" – and that B.C. will adopt "world leading emissions benchmarks". The Industry Intentions Paper says new policies will apply to "natural gas operations and refineries", to pulp and paper mills, and large mines. The consultation documents offer broad assurances that our natural resource industries (even when they involve carbon emissions in the production process) can continue to grow in a way that is consistent with our climate goals.

L.26 The crucial question is, will any of these promised strategies to reduce "emissions intensity" appreciably lower the expected volume of emissions generated by LNG, below the estimates we already have? The evidence at trial will show there is no realistic prospect that the numbers will improve. One reason is that the "emissions benchmark" for the LNG Canada liquefaction facility has already been established, and is already incorporated into the existing estimates and accepted, over three years ago, by the joint federal-provincial environmental assessment.

Existing emissions intensity benchmarks for LNG in B.C.

L.27 Existing B.C. polices that apply to the planned LNG industry in B.C. already follow an "intensity-based" performance standard approach. They are based on a performance standard that, in the case of LNG in B.C., has already been fixed at an "intensity benchmark" of 0.16 tonnes of carbon dioxide equivalent for every one tonne of LNG produced. The LNG Canada project will meet that standard. It will have a GHG intensity of 0.15 tonne of CO_2eq per tonne of LNG. The LNG Canada facility will produce 26 million tonnes per annum once it is operating at full capacity. That is why we already know that it will generate 3.6 Mt of CO_2eq per year. We already know what the outcome is going to be for that project.

L.28 That intensity benchmark for the LNG industry was established in November 2014, when the B.C. Liberal government passed the *GHG Industrial Reporting and Control Act*. It is widely acknowledged that the B.C. benchmark (0.16 tonnes of CO_2eq) ranks among the lowest in the world.

L.29 The LNG Canada liquefaction facility will produce 3.6 Mt of CO_2eq per year for the next thirty years. In addition, the *upstream emissions* released by the natural gas production and processing operations in B.C. that will supply that facility will add another 5.0 Mt per year. Marginal reductions in upstream emissions, vaguely promised by the declared strategy of improving "emissions intensity," will not significantly lower that 5.0 Mt number within the next twelve years. Total emissions will be 8.6 Mt per annum, rising to 9.6 Mt over the next decade. The Woodfibre LNG plant will boost the numbers by another 1.0 Mt to 1.5 Mt per annum.

The scope of the LNG emissions problem

L.30 If we proceed with even a single large LNG project in B.C. over the next decade, as we are now committed to doing, the emissions growth from that project will be about 10 Mt. In the absence of emissions reductions in other sectors, B.C.'s total emissions will rise to an annual level of about 70 Mt by 2030. To meet the 38.8 Mt target, we will need to cut more than 30 Mt of emissions from other economic sectors in B.C. – while LNG emissions grow by 10 Mt.

L.31 This means that, in order to meet our 38.8 Mt target by 2030 and at the same time allow the development of LNG, non-LNG emissions in B.C. will have to be cut by 50%.

L.32 No advanced industrial economy in the world has ever achieved deep cuts on that scale, and certainly not within the space of ten years (between 2005 and 2016, the total reduction of B.C.'s emissions was 4.7%).

M. Global oil consumption and the 2°C limit

M.1 The *Pan-Canadian Framework* plan is silent about whether the planned expansion of oil sands production to 2040 is consistent with Canada's other major climate policy commitment. Under the Paris Agreement signed in December 2015, Canada committed to "*holding the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C*" (emphasis added). We are bound to ask if Canada's ambition to continue expanding the level of our oil sands production up to 2040 is compatible with keeping the increase in global average temperature to well below 2°C above pre-industrial levels.

M.2 The International Energy Agency (IEA) has developed a series of scenarios, each of which provides us with a different view of the expected future level of global oil production up to 2040. My comments here are based on the IEA's 2015 report.

M.3 The first is the "Current Policies Scenario". It calculates the future path of global oil consumption, assuming no significant new carbon reduction policies (measures designed to curb the future use of crude oil) are going to be adopted by the world's major industrial economies over the next few decades, beyond existing measures already in place. The Current Policies Scenario represents the expected trend of crude oil production if the world economy continues its current pattern of oil use (a "business-as-usual" scenario). It is a pessimistic scenario, from the perspective of climate. It is not compatible with a 2°C world. With oil demand unconstrained by carbon-reduction policies, the Current Policies Scenario projects that global oil production will increase to 117.1 million bpd by 2040, up from 90.6 million in 2014.

Figure xxii: IEA oil production scenarios: projections (in millions bpd)

	2014	2020	2040
Current Policies Scenario	90.6	97.5	117.1

New Policies Scenario	90.6	95.9	103.5
450 Scenario		93.7	74.1

Source: *World Energy Outlook 2015*, Table 3.1, p. 114 and Annex A pp.582-583.

M.4 Under the Current Policies projection, global oil consumption continues to grow because of expected future economic growth and population growth, and the absence of additional carbon reduction policies that reduce oil use.

M.5 A second IEA scenario, the "New Policies Scenario", is also a business-as-usual projection, but slightly more optimistic. It incorporates carbon reduction measures already adopted as of mid-2015 in countries around the world – but it also takes into account "other relevant intentions that have been announced, even when the precise implementation measures have yet to be fully defined" (World Energy Outlook 2015, p. 34). The New Policies Scenario therefore projects a more substantial curbing of future oil consumption, with global consumption rising to only 103.5 million bpd by 2040. But even the New Policies Scenario is not consistent with keeping average global warming below 2°C, as the IEA has made absolutely clear.

M.6 The IEA's "450 Scenario" is a *mitigation* scenario. It is based on the assumption that countries will soon adopt carbon-reduction policies that will achieve significant reductions of global oil consumption – absolute reductions starting by 2020 – that are large enough to bring about gradually declining GHG emissions from the energy sector consistent with the goal of limiting the long-term rise of average global temperature to 2°C. One of the essential strategies under the 450 Scenario is to gradually reduce global oil production and consumption, starting in 2020 – in order to achieve a total reduction of about 20% between 2020 and 2040.

M.7 If global oil production must begin to decline by 2020, what are the implications for Canada? We hold the world's second largest oil reserves, some 170 billion barrels, second only to Saudi Arabia (third largest if we count Venezuela's heavy oil deposits). According to the IEA's projections (under its business-as-usual New Policies Scenario), Canada will see its oil sands output rise from 2.2 million bpd in 2014 to 4.5 million bpd in 2040: see *World Energy Outlook 2015*, Table 3.6 at p. 135. The magnitude of that increase is more or less identical to the projection developed by Canada's own NEB, which forecasts (in *Canada's Energy Future 2016 Update*) that Canada's oil sands output by 2040 will increase 2.0 million bpd above the 2014 level. Both of these estimates are business-as-usual projections.

M.8 Based on the IEA's 2015 projections, Canada's net increase of oil production over the next twenty-five years will be the *third largest in the world*, after Iraq (4.5 million) and Brazil (3.0 million). According to the IEA, six major oil producing countries have large enough oil reserves to substantially increase their own production over that period – the other three are Iran (1.9 million), Saudi Arabia (1.8 million) and Venezuela (1.1 million): see *World Energy Outlook 2015*, Chapter 3, Tables 3.6, 3.7, and 3.12. Combined, these

six countries under the New Policies Scenario were projected to add 14.7 million bpd of new production by 2040, more than enough to satisfy all of the expected 12.9 million bpd net increase in global consumption – and enough extra new production to offset declining oil production in some other countries where the oil fields are gradually depleting.

M.9 In the IEA's most recent *World Energy Outlook 2017*, published on November 14, 2017, future global oil production numbers are revised, but the substance of the picture is unchanged. In the 2017 edition, the global oil supply under the New Policies Scenario rises to 104.9 million bpd by 2040 (compared to 103.5 million bpd). The U.S. is now expected, during the 2016-2040 period, to increase the annual level of its output by 2.4 million bpd, joining the group of top suppliers. Brazil's production is now projected to increase by 2.6 million bpd, Iraq by 2.5 million bpd, and Canada by 1.7 million bpd.

M.10 However, in a significant change, *World Energy Outlook 2017* discontinued publishing the 450 Scenario, which had appeared in every edition since 2009. The 450 Scenario had long been presented by the IEA as an "alternative" scenario to show a future path of global oil production consistent with limiting warming to 2°C. But in recent years, the 450 Scenario has been subjected to serious criticism. A key shortcoming is that the 450 Scenario is only consistent with a 50% probability of keeping warming below 2°C. Higher odds, say 66%, would require much deeper production cuts by 2040.

M.11 Moreover, by 2015, in advance of the Paris Conference, many scientists had reached the conclusion that even 2°C of warming could be considered excessively dangerous. Reflecting that assessment, the Paris Agreement in December 2015 adopted a more stringent goal of keeping warming "to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C". In the 2017 edition, the IEA offered a new scenario, called the "Sustainable Development Scenario". Its target for reduced oil consumption by 2040 is substantially identical to the 450 Scenario, but it makes no claim to be consistent with the 2°C target. See *Off Track: How the International Energy Agency Guides Energy Decisions Towards Fossil Fuel Dependence and Climate Change*, Oil Change International and Institute of Energy Economics and Financial Analysis, April 2018 (http://priceofoil.org/2018/04/04/off-track-the-iea-and-climate-change/).

M.12 Canada's plan to continue increasing oil sands production provides the economic rationale for the Trudeau Government's pipeline approval decisions on November 29, 2016. We are embarking on a bold path of expanding crude oil production that, if followed by the other six or seven big suppliers, would take the world above the 2°C threshold, according to the IEA's analysis.

N. The Trans Mountain upstream emissions report and the 2°C limit

N.1 The Trans Mountain report provided no answer to the question of whether continued growth of oil sands production to 2040 is compatible with a policy committed to keeping warming within the 2°C limit, although that question is briefly considered: see Trans Mountain report, November 25, 2016, B.2.6, "Canadian Climate Change Commitments and Oil Sands Production" pp. 28-29. The report did refer to the IEA's 450 Scenario:

> *In the IEA's 450 Scenario, in which the world has a 50% chance of limiting the long-term increase in average global temperature to no more than 2°C, global oil demand peaks by 2020 at 93.7 MMbbl/d and declines 18% from 2014 levels to 74.1 MMbbl/d in 2040.*
>
> — *Trans Mountain Report*, sec. B.2.3 "Global Crude Oil Outlook", p. 23 (emphasis added)

N.2 But the report does not explicitly agree – or disagree – with the IEA's conclusion that global oil consumption must begin to decline by 2020 or soon after, to meet the 2°C commitment. About the future trend of global oil production, the report says only this:

> *"However, a common result of modelling efforts to analyze a 2°C world is that overall global crude oil consumption declines relative to the status quo."*
>
> — *Trans Mountain Report*, sec. B.2.6, page 28

N.3 That single sentence is the only acknowledgment in the report that multiple studies by climate scientists (described only as "modeling efforts") have concluded that absolute cuts in the annual level of global oil production are essential to avoid an irreversible commitment to warming above the 2°C limit. The report offers no comment on the time frame for when global oil consumption must peak and begin to decline (the 450 Scenario says by about 2020) and does not discuss the magnitude of the cuts needed by 2040.

N.4 The report says that, in some studies, scenarios show that "oil sands production is not fully consistent with a world in which global warming is limited to 2°C." It claims, however, that "other projections" show that "oil sands production could continue to expand from current levels while still limiting warming to 2°C" (emphasis added). The report summarizes what appeared to be the conflicting evidence:

> *A number of studies have considered scenarios where global warming is limited to 2°C. However, these scenarios utilize different modelling frameworks and can have vastly different assumptions around technology and economic progress. The role of technological innovation, policy design … and business behaviour … can have significant implications on Canadian oil sands production in these scenarios. As a result of the differing treatment of these variables, conclusions across scenarios are not uniform, and the impact on Canadian oil sands production is not clear. However, a common result of modeling efforts to analyze a 2°C world is that overall global crude oil consumption declines relative to the status quo.*
>
> — *Trans Mountain Report*, sec. B.2.6, p. 28 (emphasis added)

N.5 Therefore, according to the report, it "is not clear" whether Canada's ambitions to continue expanding our oil sands production to 2040 is consistent with a world in which global warming is limited to 2°C.

O. The Ministerial Panel report and the 2°C limit

O.1 The Ministerial Panel, appointed by the Minister of Natural Resources on May 17, 2016, lacked any power or capacity to make "findings" or draw any conclusions, and it was not allowed to make any recommendations. Members of the public were permitted to attend a series of meetings held by the panel in British Columbia and Alberta express their concerns or objections to (or express support for) the Trans Mountain pipeline project – and speak about what they felt had been overlooked, or inadequately dealt with, during the previous two processes. Where it was faced with conflicting information or contradictory opinions, the panel was not permitted to adjudicate which view should be accepted. All it could do is report the conflicting information to the Minister in Ottawa.

O.2 After two months of public meetings, the panel released its report on November 1, 2016.

O.3 One of the most significant divergences the Ministerial Panel identified in its report was a fundamental difference between two visions about the future trend of global oil demand.

O.4 The panel summarized the views of presenters in Alberta (people who attended and made submissions to the panel were called "presenters"; this was not a judicial hearing). The panel recounts submissions during the hearings in Alberta of the future of global oil demand:

> *There was no campaign of denial. At the same time, presenters pointed to domestic and international energy industry projections that show a rising need for hydrocarbon-based sources during a period of transition to renewable forms of energy. The question, they said, is … how quickly that conversion can occur. The presenters who appeared before us in Calgary suggested a transitional timeline in the order of 30 to 50 years. And if you accept that timeline as realistic, they said that Canada should be prepared in the meantime to compete … for international market share; Canada should not restrain its energy production at the expense of its energy potential …*
>
> — *Ministerial Panel Report*, p. 10

O.5 In direct contradiction to that view, the report quotes several leading climate researchers who, in their submissions to the panel, explained the consequences of allowing Canadian oil and gas production to grow as presently planned. They explained that our present energy resource expansion plans are incompatible with our overriding commitment to keep warming below 2°C.

O.6 The panel quotes political scientist Kathryn Harrison, who has researched and published widely on energy policy and the efficacy of Canada's emissions reduction efforts:

> *To embrace the economic viability of this project is to self-consciously make an economic bet on a world of catastrophic climate change that the Government of Canada itself explicitly committed to avoid.*
>
> — *Ministerial Panel Report*, p. 32

O.7 Harrison's point is that the future economic viability of the Trans Mountain project depends on the world experiencing continued growth of global oil demand over the next twenty-five years, to 2040. Canada's oil sands industry is a high-cost producer, compared to other major suppliers of conventional crude oil around the world. The industry requires relatively high long-term oil prices to cover its comparatively high production costs. The NEB's forecast expansion of oil sands production from 2.3 million in 2014 to 4.3 million in 2040 – which is the economic rationale for the Trans Mountain project – is based on the assumption that we will see *two or three more decades of increasing global oil consumption*.

O.8 But continued growth of global oil consumption for twenty-five more years is incompatible with keeping warming within the 2°C limit.

O.9 In a 2015 report, Harrison explained her basic analysis:

> *The International Energy Agency (IEA) has modeled national and global emissions consistent with limiting climate change to the internationally agreed target of 2C, which would entail peaking CO_2 concentration in the atmosphere at 450ppm. Underscoring the potential impacts of international action on Canada's exports, this "450 Scenario" finds that global oil consumption would need to peak as early as 2020 and decline thereafter, with projected demand in 2035 13% lower than in 2011.*
>
> — Kathryn Harrison, *Review of Destination Country Policies with Potential to Impact Demand for Canadian Oil Exports*, May 2015 (emphasis added)

O.10 On that point, it is relevant to recall that the atmospheric CO_2 concentration level is currently on track to exceed 450 ppm by about 2030, based on existing trends of global emissions.

O.11 Harrison warned that a "transitional period" of rising oil demand for another 30 years is *"an economic bet on a w*orld of catastrophic climate change".

O.12 U.B.C. climate scientist Simon Donner, in his submission to the Ministerial Panel, addressed the same concern. He focused on the assumption (accepted by the Trans Mountain report) that global oil production will continue to increase up to 2040. He specifically criticized the conclusion in the Trans Mountain report that even if Canada were to curb the expansion of its oil sands production, "*investment would be made in other jurisdictions and global oil consumption would be materially unchanged in the long term"* (Trans Mountain report, section B.4.3.4, p. 33, cited above).

O.13 I quote here the Ministerial Panel's summary of Simon Donner's answer:

> *Donner described this as typical of the tragedy-of-the-commons analysis in which, if everyone in the world decides that the impact of their contribution is irrelevant in a global context, then everyone will continue to expand. As Donner says, "In sum, the analysis in the Environment and Climate Change Canada*

review [the Trans Mountain emissions assessment report of May 19, 2016] is mathematically inconsistent if applied broadly".

— *Ministerial Panel Report*, November 1, 2016, page 33 (emphasis added)

O.14 If all of the world's major oil producing countries that have large enough oil reserves to substantially increase their production levels during the next twenty-five years decide to do so (there are about six big producers, including Canada, that have the capability to do that), the world will have no chance of keeping the increase in global temperature below the 2°C threshold.

O.15 But, unfortunately, the Ministerial Panel had no power to make findings of fact or to draw any conclusions based on scientific evidence. It had no authority to adjudicate between the views of the Alberta presenters (that we can safely keep increasing global oil consumption for another 30 to 50 years) and the evidence of climate scientists (that further growth of global oil production must begin to decline after 2020). All the panel could do was make a list of what Harrison and other people told the panel, and transmit their concerns to Ottawa. The panel members were without authority to make recommendations. They could only conclude their November 1, 2016 report by stating that important questions "remain unanswered".

O.16 The panel was correct. The question – about whether Canada's projected expansion of oil sands production to 2040 can be reconciled with a 2°C world – has never been answered. The NEB inquiry refused to accept or consider any evidence about the impact of increasing oil sands emissions or the climate system. The Trans Mountain emissions assessment accepted without question (and without cross-examination or scrutiny) that Canada's oil sands production would continue to expand up to 2040 in accord with the NEB's "business-as-usual" projection.

P. Oil sands expansion and the 2°C limit: additional proposed evidence

P.1 The proposed evidence at trial will show, unequivocally, that in order to stay within the 2°C pathway, global oil consumption must decline substantially from the current level of 90 million bpd. The IEA's 450 Scenario requires a reduction to 74.1 million bpd by 2040, but that scenario offers only a 50-50 probability of meeting the 2°C target. One very recent study ("Global carbon budgets and the viability of new fossil fuel projects", *Climate Change*, Mark Jaccard, James Hoeffle, and Torsten Jaccard, May 2018) shows global demand declining to 85 million bpd by 2025, to 79 million bpd by 2035, and to 69 million bpd by 2045. Other scenarios show global oil demand falling to 60 million bpd by 2050.

P.2 The question is whether Canada's oil sands output can continue to rise while global demand falls. The Jaccard, Hoeffle, Jaccard study concludes there is a very low probability that oil sands production could be economically viable over the next three decades under these circumstances. It follows an analysis that can be summarized as follows:

P.3 To begin, this anticipated reduction of global oil consumption will only happen if emissions reduction policies (carbon taxes, or cap-and-trade) are adopted that make emitting costlier, whether when consuming gasoline (an oil product) or when producing oil.

P.4 These policies will have the effect of increasing oil production costs, and will especially increase the cost of oil sands production, because it is a relatively emissions-intensive form of oil extraction. In the case of the oil sands, it would require the adoption of expensive technologies to reduce or sequester emissions during the production process.

P.5 The global reduction in global oil demand will also cause a fall in world oil prices.

P.6 At the same time, Canada's oil sands industry has one of the highest production costs per barrel, compared to other suppliers.

P.7 This combination of (1) already relatively high production costs in the oil sands, (2) relatively faster production cost increases for oil sands because of policies that make emissions expensive, and (3) the declining world price of oil, means that the oil sands has an extremely low likelihood of being able to be profitable and expand in a 450 Scenario. The study concludes that there is a less than 5% probability that oil sands investments, and therefore new pipelines, would be economically viable over the next three decades under the 2°C carbon budget.

P.8 The report of the *Review of Relate Greenhouse Gas Emissions Estimates for the Trans Mountain Expansion Project* (November 25, 2016) concluded that the answer "is not clear" whether the continued growth of the oil sands industry was consistent with scenarios where global warming is limited to 2°C (see Appendix N at para. N.4). It refers in particular to four studies. One of the studies (McGlade C, and Ekins P 2014) found that Canadian bitumen production could increase to 4.1 million bpd in 2035 and be consistent with a 2°C target, "but only with rapid deployment of and scale-up of carbon capture and storage (CCS) technology from 2020 and decarbonization of energy inputs" (*Review*, p. 23).

P.9 A second study done a year later by the same authors, also cited by the upstream emissions assessment report, concluded that if the world moves seriously to adopt policies to keep warming within the 2°C threshold, oil sands production would have to be curtailed by 2040. Even in the intervening decades, the ability of the industry to operate will require large-scale adoption of CCS technology:

> *In a 2015 study with a longer timeframe for analysis, the same authors found that, even with widespread CCS deployment from 2025, Canadian oil sands production would be significantly curtailed. The author concluded that 74% of Canadian crude oil reserve would have to remain unexploited, to be consistent with a 2°C target and estimated that without CCS, all bitumen production in Canada would have to cease by 2040 to be consistent with a 2°C target.*

— *Review*, p. 23: referring to McGlade C, and Ekins P (2015): "The geographical distribution of fossil fuels unused when limiting global warming to 2°C", *Nature*, 517: 187-190.

P. 10 One of the central points addressed in the May 2018 Jaccard, Hoeffle, Jaccard article is that large scale adoption of carbon reduction technology in the oil sands industry (for example, CCS technology), if that were to occur on the scale indicated in the McGlade study, would significantly increase costs of production in that industry. Appendix C provides an outline of proposed evidence about the failure of earlier plans in Alberta between 2008 and 2014 to adopt CCS technology in the oil sands. That plan was abandoned by the Government of Alberta in 2014 because the technology proved to be prohibitively expensive.

Q. Federal Court of Appeal decision (August 30, 2018)

Q.1 On August 30, 2018 the Federal Court of Appeal found that the Government of Canada had failed to adequately discharge its duty of consultation with Aboriginal applicants who had brought judicial review applications raising serious issues about the adverse impacts of the project on their interests.

Q.2 The court also found that the NEB erred in failing to conduct an environmental assessment pursuant to the Canadian Environmental Assessment Act (CEAA) in relation to marine shipping risks. The NEB had declined to do so on the ground that marine shipping was, in its view, not an activity "incidental" to the pipeline project. The August 30, 2018, decision quashed the Order in Council dated November 29, 2016 authorizing the Trans Mountain project.

Q.3 The project has been remitted to the NEB to conduct a further hearing on the marine shipping issues. The court also ordered that the Government of Canada conduct further consultations with the Aboriginal parties. In due course, the NEB will issue a new report with its recommendations to the cabinet – and the Crown, after completing further consultations, will decide whether infringements on Aboriginal interests are justified. It will be open to the government to then issue a new Order in Council authorizing the project.

Q.4 The issues of upstream emissions and climate, however, were not before the court. Those issues are not mentioned in the Federal Court of Appeal's 250-page judgment. The NEB had refused to consider any evidence about upstream emissions or any scientific evidence about the climate implications of rising emissions levels.

Q.5 As outlined in Part 8, on July 23, 2014, the NEB had issued a ruling (Ruling 25) rejecting an application by the City of Vancouver to expand the List of Issues to include the emissions implications of pipeline expansion and to consider scientific evidence about the impact of emissions on the climate system. On October 16, 2014, the Federal Court of Appeal dismissed an application by the City of Vancouver to appeal NEB Ruling 25 (see Part 8, paragraphs 8.2 to 8.8).

Q.6 At the NEB inquiry the City of Vancouver had raised a second issue, contending that in determining whether the proposed Trans Mountain expansion was "required by the present and future public convenience and necessity" the NEB was obliged to consider whether projections of rising oil sands production to 2040, which justified the economic necessity for the project, would in fact occur if oil consuming countries worldwide adopt policies consistent with keeping global surface warming within the 2°C limit.

Q.7 When the City of Vancouver filed its judicial review application on June 17, 2016, (after the NEB recommended that Tran Mountain be approved) the City's Notice of Application included a claim that the NEB had erred, by:

> *i. failing to conduct a lawful assessment of whether the project is required by the present and future public convenience and necessity;*
>
> *ii. failing to take into account consideration the applicant City of Vancouver's evidence of regulatory measures and market influences impacting long-term supply and markets for the volume of oil to be delivered by the Project and the economic feasibility of the Project; (my emphasis added)*
>
> — Notice of Application, City of Vancouver, Federal Court of Appeal

Q.8 The City's Notice of Application provided further particulars of this claim in paragraph 20 (c) and at paragraph 35-38.

Q.9 The City's Memorandum of Facts and Law, filed August 4, 2017, included submissions on this issue, in particular at paragraph 5 on page 2 (and note # 13, which cites reports by two independent experts, Kathryn Harrison and Marc Jaccard). The Memorandum also addresses the "markets influences" issue in Part 2, B (page 5-6), and paras. 36-38 (page 15).

Q.10 The substance of the City's case, supported by the expert evidence filed in support, was that if global oil consumption declines over the next two decades to the extent required to keep warming from exceeding 2°C, the currently projected expansion of oil sands production to 2040 (which provides the economic rationale for building the pipeline) will not be economically viable. Declining global oil consumption will be accompanied by lower oil prices. Canada's oil sands is a relatively high cost producer. See Part 13, and Appendix M.

Q.11 However, the Federal Court of Appeal (FCA) court ruled that, for procedural reasons, it would not allow the City to challenge the pipeline decision.

Q.12 The Court of Appeal deals with the dismissal of the application by the City of Vancouver for procedural reason at paragraphs170 to 203 (pages 55 to 66). The basic point is that the "decision maker is the Governor-General" (not the NEB). This result turns on changes that had been made some years ago to the NEB's role in the pipeline approval process. Formerly the NEB was "the decision maker". But the NEB's role was altered, so that it simply makes a "recommendation" to the cabinet. The decision maker is the

cabinet. This result follows an earlier decision dealing with the identical procedural question by the Federal Court of Appeal in *Gitxaala v. Canada* (June 21, 2016).

Q.13 In the August 30, 2018, judgment the FCA court ruled that the City of Vancouver's case should be dismissed for this reason:

> *As the City of Vancouver did not seek and obtain leave to challenge the Order in Council, it follows that the City is precluded from challenging the Order in Council.* (paragraph 203)

Q.14 The oral hearing of the judicial review applications was held on October 2-5, 10, 12-13, 2017, in Vancouver. The time allotted to each party for oral argument was limited. In the case of the City of Vancouver, near the end of its oral submission, the City's lawyer advised the court that, due to the shortness of the available time, counsel would not be able to deal with the market influences issue in the oral argument.

Q.15 That lack of opportunity to raise a particular issue in oral argument due to constraints on the allowed time often happens. Where that occurs, the court is still expected to consider the issue – especially where, as in this case, the issue was clearly raised in the City's Memorandum filed two months before the hearing. An issue of this importance would normally be dealt with in the Reasons for Judgment, even if it is only briefly considered and rejected. In this case, the market influences issue is not mentioned in the 240-page August 30, 2018 decision. Presumably that silence on the issue is because the court had decided to altogether dismiss the City application for procedural reasons.

Q.16 As a result, the Federal Court of Appeal decision offers the public no comment on the emissions implications of this project, and no answer to the important question whether the projected expansion of oil sands production facilitated by the Trans Mountain project (and the pipeline itself) can be economically viable in a world that adopts carbon reduction policies stringent enough to keep global warming below 2°C.

R. Climate sensitivity: warming and the level of atmospheric carbon

R.1 At trial, the defendant will call evidence that an atmospheric carbon concentration level of 450 ppm is broadly recognized by science as the level at which average global surface temperature will have risen 2°C above the pre-industrial level.

R.2 The evidence will show that a key relationship in estimating the expected degree of warming as a result of a given rise in the atmospheric carbon concentration is *climate sensitivity*. Climate sensitivity tells us how much the global average temperature is likely to increase *if the level of atmospheric carbon is doubled from the pre-industrial level, from 280 ppm to 560 ppm*. The calculation of climate sensitivity is a complex field of science, which draws on multiples sources of evidence, including observed changes recorded during the past 60 years.

R.3 The evidence of the defendant will cite the IPCC's Fifth Assessment Report (AR5) released in September 2013, which provides an authoritative estimate of climate

sensitivity based on a comprehensive review of research around the world. This quote from the report summarizes the findings:

> *Estimates of the equilibrium climate sensitivity (ECS) based on observed climate change, climate models and feedback analysis, as well as paleoclimate evidence indicates that ECS is likely in the range 1.5 to 4.5°C with high confidence, extremely unlikely less than 1°C (high confidence) and very unlikely greater than 6°C (medium confidence).*
>
> — *IPCC Fifth Assessment Report (2013),* Chapter 12, page 1033 (emphasis added)

R.4 This means that if the atmospheric CO_2 concentration rises to 560 ppm, the expected warming could be as little as 1.5°C and as much as 4.5°C. The science gives us a "low" and a "high". If we rely on the mid-range number, at 560 ppm the expected temperature increase is 3°C. We cannot know if the actual warming will be at the higher end of the range, or at the lower end – or somewhere between. As a convenient way of speaking, and taking a cautious approach, we can expect that at 560 ppm we will experience 3°C of warming.

R.5 Therefore, in looking at the prospect that the carbon concentration level will rise to 450 ppm, scientists take 2°C as a measure of the expected temperature increase. The actual outcome could be slightly higher, or lower.

R.6 For all the above reasons, most serious carbon reduction plans accept that the CO_2 concentration level must be kept within 450 ppm. As we have seen, the Government of Canada signed an international commitment in 2010 agreeing that deep cuts must be made to keep temperature increase under 2°C. Canada's representatives also approved the wording of the Summary for Policymakers of the IPCC report in September 2013, which indicates that our government accepted the Panel's scientific findings on climate sensitivity, or at least did not publicly dispute those findings. In fact, seven Canadian scientists participated in writing the chapter of the IPCC report that reviewed the most recent evidence on climate sensitivity.

R.7 These are obviously complex projections, beyond any non-specialist's ability to assess, using computers and many kinds of data, including data from recent decades tracking CO_2 concentration levels and observed changes in global temperature.

R.8 The IPCC is not a body that conducts its own research: it operates by appointing working groups of leading scientists who review and compare the results of recent research done by scholars at research institutes and universities in Europe, the U.S., and in numerous other countries. On important issues, like climate sensitivity, the IPCC uses findings from different studies to come up with an "expert judgment" that takes into account all available evidence.

R.9 The IPCC, in its most recent report in 2013, slightly revised its previous (2007) assessment of climate sensitivity. In its 2007 report, the IPCC had concluded that climate sensitivity is *in the range of 2°C to 4.5°C*, with a *"best estimate of 3°C"*. The change is

that the recent report provides a range of 1.5°C to 4.5°C, thus reducing the low-end of the range to 1.5°C.

R.10 This estimate of climate sensitivity is based on several different kinds of evidence. It takes into account, firstly, observations of the rise in global temperature measured over the past century. It also relies on climate models. In addition, it considers the record of long-ago climate change ("paleoclimate evidence"), including the glaciation cycles (for example, physical evidence from the period 10,000 to 23,000 years ago at the end of the last glaciation) and other warming events that happened up to 55 million years ago. Physical evidence allows estimates to be made about changes at that time in the CO_2 level and associated changes in sea level, glaciation, and the flourishing or extinction of different kinds of animal and plant life.

R.11 The term *"equilibrium climate sensitivity"* describes the estimated change that will happen to global temperature over the long-term, recognizing that it takes a long time for the CO_2 that is released now to have its full effect on the world's temperature level. For one thing, a very large proportion (around 90%) of heat energy is absorbed into the world's oceans where it is stored, warming both the sea surface and the deep ocean. Over much longer periods of time a large part of that stored heat will be gradually transferred to the atmosphere, and when that happens surface air temperature will be further increased.

R.12 Normally when these reports speak of "climate sensitivity" they are referring to long-term equilibrium climate sensitivity, which may take a hundred years or several hundred years to fully impact on the earth's climate system.

R.13 Because that "long-term" calculation cannot tell us what will happen in a short time-frame, say within the lives of our children, there is another estimate called *"transient climate response"* which gives a measure of the expected warming we will see in the short-term if a doubling of the atmospheric concentration of CO_2 happens, for example, within the next 30 to 70 years. The" transient climate response" is given as 1.0°C to 2.5°C. There is a "time lag" between the increasing concentration of CO_2 in the atmosphere and the full unfolding of the warming and other climate disturbance that will flow from that.

R.14 Even though the atmospheric carbon concentration level has now reached 405 ppm, and it is perhaps 15 years away from exceeding 450 ppm, marked disruptions to the climate system are already happening. We are already seeing, for example, changes in rainfall patterns in many parts of the world, the drying out of agricultural lands in some regions, increases in extreme weather events, and the melting of glaciers and the rapid loss of the Arctic ice sheet.

S. Additional evidence on mitigation scenarios

S.1 At trial, the defendant will refer to additional evidence-based mitigation scenarios, which have examined the relationship between the rising level of CO_2 emissions and the increase in global average surface temperature.

S.2 Six years ago, two prominent studies warned that then existing carbon-reduction policies, including pledges by governments, were not sufficient to keep future warming within the 2°C threshold.

S.3 In November 2012, the World Bank published a report by a team of scientists from the Potsdam Institute for Climate Impact Research and Climate Analytics entitled *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided*. It begins with this summary:

> *While the global community has committed itself to holding warming below 2°C to prevent "dangerous" climate change, the sum total of current policies – in place and pledges – will very likely lead to warming far in excess of this level. Indeed, present emissions trends put the world plausibly on a path toward 4°C warming within this century.*
>
> *Levels greater than 4°C warming could be possible within this century should climate sensitivity be higher, or the carbon cycle and other climate system feedbacks more positive, than anticipated. Current scientific evidence suggests that even with the current commitments and pledges fully implemented, there is roughly 20 percent likelihood of exceeding 4°C by 2100, and a 10 percent chance of 4°C being exceeded as early as the 2070s.*
>
> — *Turn Down the Heat*, page 1 (emphasis added)

S.4 The International Energy Agency (IEA) has concluded that to stay within the 2°C threshold the world's total level of emissions by 2020 must start to decline by 2% to 3 % every year, and that total coal consumption must start to decline by 3.5% annually, and oil consumption by 0.5% annually:

> *Despite the insufficiency of global action to date, limiting the global temperature rise to 2°C remains still technically feasible, though it is extremely challenging. To achieve our 450 Scenario, which is consistent with a 50% chance of keeping to 2°C, the growth in global energy-related CO_2 emissions needs to halt and start to reverse within the current decade.*
>
> — *IEA, Redrawing the Energy-Climate Map*

The IPCC Report: September 27, 2013

S.5 On September 27, 2013, the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report (AR5) published the results of four related scenarios, referred to as the Representative Pathways. Each study makes different assumptions about the future path that emissions will follow over the rest of this century. They examine the relationship between the rising level of CO_2 emissions and the increase in global average surface temperature.

S.6 Groups of scientists developed these four scenarios, all of which start from our current, actual level of global CO_2 emissions. Each scenario looks at what will happen to our

climate system (air surface temperature, ocean temperature, rainfall patterns, melting of glaciers and ice fields etc.) over the periods 2046-2065 and 2081-2100 based on different assumptions about the level of carbon-based energy use. The scenarios are described by numerical names e.g. "RCP8.5", "RCP4.5" etc. RCP8.5 is the scenario with the highest level of CO_2 emissions.

"Business-as-usual" approach: RCP8.5

S.7 The scenario that produces the largest cumulative CO_2 emissions (referred to as RCP8.5) assumes that we continue to expand the use of coal, oil, and natural gas in a "business as usual way". It also takes into account the impact of relatively high world population increase and high economic growth, both of which accentuate higher levels of energy use.

S.8 The high-emissions pathway (RCP8.5) shows that by 2081-2100 global mean surface temperature will likely be 2.6 to 4.8°C above the 1986-2005 average. If we add to that the additional 0.6°C temperature increase already experienced up to 1986-2005 (from the pre-industrial level c.1880), the projected increase to the end of the 21st century is *3.2 to 5.5°C above the pre-industrial level.*

S.9 Even by the nearer period of 2046-2065, well within the working lives of children now in high school, the mean surface temperature will be 1.4 to 2.6°C warmer than the 1986-2005 level – *equivalent to 2.0 to 3.2°C above the pre-industrial level.* And that is just the global mean surface temperature, which is an average that takes into account all land and sea surfaces. The global average does not tell us what happens over warmer inland regions, in large urban areas, and during heat waves.

Delay cuts until 2040-2060: RCP6.0 and RCP4.5

S.10 The two mid-range scenarios (RPC6.0 and RPC4.5) assume that carbon-reduction policies are eventually adopted which substantially reduce fossil-fuel use, but both assume that the actual implementation of those policies is delayed so that CO_2 emissions do not "peak" (do not hit their maximum level of annual emissions) until about 2040 – 2060. After that emissions start to decline.

S.11 RCP4.0, which assumes that global emissions do not "peak" until about 2040, shows by 2081-2100 an increase of warming in the range of 1.1°C to 2.6°C above the 1986-2005 average: if we add to that the 0.6°C warming that had already occurred by 1986-2005 the projected rise for the last two decades of the 21st century is between *1.7°C and 3.2°C.* That range of variation in the estimated amount of warming reflects some uncertainty, acknowledged by these studies, about exactly how much increase in the global mean surface temperature will be caused by a particular rise in the accumulated level of CO_2 in the atmosphere.

S.12 In the short term, if we follow the RCP4.5 pathway by 2045-2065 the likely increase in warming above the 1986-2005 level will be 1.5°C to 2.6°C above the pre-industrial level.

S.13 RCP6.0 assumes that serious policies are eventually adopted to cut CO_2 emissions, but the implementation of cuts is delayed until after 2040 and is more gradual. The warming

that happens by 2046-2065 is about the same as in RCP4.5, but the additional delay results in appreciably higher warming later. Under RCP6.0 the warming by 2081-2100 is projected to be 2.0 to 3.7°C above the pre-industrial level.

Start cuts in 2020: RCP2.6

S.14 The pathway with the lowest cumulative CO_2 emissions, referred to as RCP2.6, assumes that industrial countries soon adopt stringent policies to limit emissions. Under this scenario the annual global level of CO_2 emissions reaches its maximum about 2020 and then begins to decline annually.

S.15 Under the lowest-emissions pathway (RCP2.6) the global mean surface temperature by 2081-2100 will likely be 0.3°C to 1.7°C warmer than 1986-2005. We need to again keep in mind that average temperature in 1986-2005 was already 0.6°C warmer than the pre-industrial level (1880-1900). So this projection shows that warming by 2081-2100 is likely to be about 0.9 to 2.1°C warmer than the pre-industrial level. In other words, under the scenario that assumes absolute cuts to CO_2 emissions starting as early as 2020 it is possible to avoid, or almost entirely avoid, the risk that warming will exceed the 2°C threshold.

S.16 RCP2.6 is the only scenario that indicates warming will likely stay under 2°C by the end of the 21st century. And it is the only scenario that provides assurance that additional further warming will not continue in the centuries after that.

S.17 The results given by the four IPCC scenarios are substantially in accord with the IEA and the World Bank in their projections of temperature increase over the next 40 to 60 years. If we continue the "business as usual" approach global mean surface temperature increase will easily exceed 3°C, and could exceed 4°C, within the next sixty-five years.

T. The global emissions gap and Canada's commitment

T.1 The evidence the defendant proposes to call at trial to establish the size and seriousness of the global emissions gap will refer to recent data published in *The Emissions Gap Report* 2017, United Nations Emissions Program, found at https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf?isAllowed=y&sequence=1. The defendant will also refer to the IPCC special report published on October 7, 2018, titled *Global Warming of 1.5°C*.

T.2 Figure xxiii below shows the annual level of global emissions in 2016 and projected total emissions to 2030, based on different scenarios. References to paragraph numbers are included adjacent to these numbers, indicating where the discussion of these projections is located in Parts 14 and 17. The numbers given in Lines a, b, and c represent only CO2 emissions, and do not include other GHGs. All the other numbers shown include both CO2 and other GHGs, and also include emissions from land use and deforestation.

Figure xxiii: Global CO_2 emissions in 2016 and projected total GHG emissions to 2030

		Global Carbon Project	PBL Netherlands Report	UN Emissions Gap 2017 Report	IPCC 2018 Report
a	**Current global CO_2 emissions 2016 fossil fuels/cement**	36.2 $GtCO_2$ [14.5, 17.2]	35.8 $GTCO_2$ [17.17]		
b	**Global CO_2 emissions 2017 fossil fuels/cement (preliminary)**	36.8 $GtCO_2$ [14.6, 16.1, 17.2]			
c	**Global CO_2 2016 including land use**				42±3 $GtCO_2$ [14.*]
d	**Global emissions all GHGs including land use 2016**		53.4 $GtCO_2eq$ [14.9]	51.9 $GtCO_2eq$ [17.17]	
e	**Projected global emissions all GHGs including land use 2030**			58.9 $GtCO_2eq$ [17.18]	
f	**Assuming all current NDCs are fully implemented, projected global emissions to 2030**			55.2 $GtCO_2eq$ [17.19]	52-58 $GtCO_2eq$ [17.20]
g	**Projected level of all global emissions by 2030 consistent with 2°C pathway**			41.8 $GtCO_2eq$ [17.21]	
h	**Projected consistent with 1.5°C pathway**				25-30, 35 $GTCO_2eq$ [17.28]

Sources: global emissions data and projections taken from *Global Carbon Project 2017*, PBL Netherlands, UN *Emissions Gap 2017* report, and IPCC 2018.

T.3 Lines *a*, *c*, and *d* of Figure xxiii depict global emissions in 2016. Each line provides a different measure of what kinds of emissions are included. Line *a* represents only CO_2 emissions from burning fossil fuels and cement manufacturing. CO_2 emissions generally represent about 70% of total annual emissions. This line provides numbers from two different sources, which give slightly different measures.

T.4 Line *d* represents total GHG emissions in 2016, comprising CO_2 emissions and all other greenhouse gases (i.e. methane, nitrous oxide, and others) as well as all emissions from land use, deforestation, and land clearance. Two sources are provided which give slightly different totals.

T.5 Line *e* represents projected total global emissions by 2030, including CO_2 emissions and all other GHG emissions plus land use emissions. This number, 58.9 $GtCO_2eq$, is the expected total based on current policies.

T.6 Line *f* represents the projected global emissions total by 2030, but assumes that all countries that have made emissions reduction commitments (LDCs) under the Paris Agreement fully implement their promised reductions. According to the source, UN *Emissions Gap Report 2017,* if all countries (including Canada) meet their reduction commitments the total by 2030 will be 55.2 $GtCO_2eq$.

T.7 Line *g* depicts that projected annual level of total global emissions by 2030 that would be consistent with keeping warming below 2°C. The level is 41.8 GtCO2eq. It can be seen that cutting global emissions to meet the 2 degrees C pathway would require achieving a further 13.4 $GtCO_2eq$ reduction within the next twelve years, in addition to the LDCs already promised by signatories to the Paris Agreement (compare line *g* and line *f*).

T.8 Line *h* depicts the projected annual level of total emissions by 2030 that would be consistent with keeping warming within the 1.5 degrees C pathway. The IPCC 2018 report explains that one available study shows that an annual level of 35 $GtCO_2eq$ would achieve that goal, but other studies indicate that the number would have to be as low as 25 to 30 $GtCO_2eq$.

T.9 There was nothing qualitatively new in the UN *Emissions Gap Report 2017* in its estimation of the emissions gap. Almost two years ago, on November 3, 2016, the UN *Emissions Gap Report 2016* published its Seventh Edition with an almost identical conclusion. It warned at that time that the shortfall in the commitments by signatories to the Paris Agreement to cut emissions enough by 2030 to keep warming to "well below 2°C" was 12 to 14 $GTCO_2eq$. The November 2016 report concluded that even with the benefit of full implementation of all unconditional and conditional NDCs by 2030, we would be on a pathway leading to temperature increases of 3.2°C by 2100. That was three weeks before the Government of Canada approved the Order in Council authorizing the Trans Mountain expansion project.

T.10 The calculation of the "gap" is based on the assumption that all countries that have already made commitments (i.e., Canada's promised 30% reduction below its 2005 emissions level) fully discharge their obligations over the next twelve years. The gap

represents the *additional reductions* that will be required globally to keep warming within the 2°C threshold.

T.11 The Government of Canada (the Conservative government of Stephan Harper) announced on May 14, 2105 that Canada's Intended Nationally Determined Contribution would be a 30% reduction by 2030, below the 2005 level. That commitment was formally submitted under the Framework Treaty, six months before the start of the Paris Conference in December 2015. The new Liberal Government, elected in October 2015, adopted that commitment. Based on Canada's most recent emissions data, that commitment obligates us to reduce our total emissions to 517 Mt by 2030. The currently projected level in 2020 is 722 Mt. The needed reduction over the next decade is therefore about 200 Mt (0.2 $GtCO_2eq$).

T.12 The Paris Agreement, signed in December 2015 by Canada's current government, recognized that the NDCs committed by the signatories fell far short of the total reductions needed by 2030 to close the emissions gap. The Agreement provides a mechanism for individual parties to review their NDCs and raise their commitments. The 2017 report provides this summary of the procedure:

> *Recognizing this significant gap and the urgent need to bridge it, Article 4 of the Paris Agreement specifies that "Each Party shall communicate a nationally determined contribution every five years" and furthermore that "Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition.*
>
> — *Emissions Gap Report 2017*, p. 1

T.13 The *Pan-Canadian Framework* document, published by the Federal Government on December 9, 2016 – which set out Canada's plan to meet it 2030 target (then given as 523 Mt based on the available data about the emissions level in 2005) – included no discussion of this obligation or whether Canada would be increasing its NDC in 2020, or whether the various promised future carbon-reduction policies might be able to accommodate a more ambitious target. The recently revised version of the *Pan-Canadian Framework* plan, published December 29, 2017 as part of the *3rd Biennial Repor*t, includes no discussion of a more ambitious target.

U. Evidence about glacier loss and impacts on human settlement

U.1 At trial, the defendant will call evidence to show that glacier retreat worldwide and the documented loss of glacier area and mass that has already occurred (especially the loss since about 1970) provide powerful confirmation of the rate of change in the world's climate system.

U.2 The IPCC's AR5 report provides detailed estimates of the total mass loss for the world's glaciers.

Measurement of glacier loss

U.3 Studies of glacier loss generally measure shrinkage by "gigatonnes" of ice loss: a single gigatonne is equal to *one cubic kilometre* of freshwater.

U.4 To represent the scale of ice loss involved, we can be guided by an example given in the report: 362.5 gigatones (Gt) of ice removed from land (in the form of melt-water from glaciers or ice sheets) when it enters the ocean will cause roughly 1 mm of global sea level rise.

U.5 The IPCC gives an estimate of the current rate of sea level rise: from 1993 to 2010 the sea level rose 3.2 mm per year. The total sea level rise that has already occurred in the period between 1901 and 2010 is 19 centimetres (about 7 ½ inches). The rate is accelerating.

U.6 Looking at the period 1971 – 2009, the annual mass loss from glaciers (excluding the mass loss from the Antarctic and Greenland ice sheets) was "very likely" 226±135 Gt. This comparatively large range in the "error bar" reflects the uncertainties in the measurement of glacier mass due to the technical limitations that, until very recently, have made it impossible to accurately measure the depth of glacier ice. Nevertheless, that number gives us a range of 90 – 360 Gt, which represents the average glacier mass loss, every year, over that 40-year period.

U.7 The estimate for annual glacier mass loss in the more recent period 1993-2009 is 140-410 Gt, indicating an increase in the rate of loss: compare to 90-360 Gt over the 1971-2009 period. For the period 2005-2009 the IPCC estimate is a range of 166-436 Gt. Taking the mid-point for the recent five-years period, the annual contribution of glacier mass loss to *sea level rise* has been 301 Gt, which is a little less than 1 mm each year.

U.8 Until recently, due to limitations in calculating with accuracy the thickness of individual glaciers, which vary enormously in their specific characteristics, global estimates of glacier retreat have had large 'margins of error'. Now new satellite imaging techniques have expanded scientists' ability to measure glacier mass on a worldwide scale.

Response of glaciers to temperature change

U.9 How glaciers respond to incremental warming is explained in the IPCC's Fifth Assessment Report. Accumulation of snow over many years turns into ice. Under the force of gravity the ice flows downwards, with the advancing front of the glacier finding its way to lower elevations, where air temperatures are warmer.

U.10 During centuries of stabilized temperatures, and assuming a more or less constant pattern of precipitation, there is equilibrium in the overall mass of the glacier: the annual accumulation of snow will be balanced by *ablation* (the term used to describe melting and evaporation that reduce the mass). Melting takes place in the lower altitude zone, called the "ablation area", which lies below the "equilibrium line altitude". Below that altitude, which is defined by a temperature gradient, loss of glacier mass caused by melting will exceed accumulation from new snow.

U.11 An increase in atmospheric temperature changes the position of the equilibrium line. For each 1°C of warming (at any particular glacier location) the "equilibrium line altitude" moves up about 150 metres. A shift upward in the "equilibrium line altitude" means that the zone of melting expands, following the glacier up the mountain.

U.12 A rise in the elevation of the melting zone does not just take place at a single glacier: a similar expansion, slightly different to reflect local conditions, will be happening more or less simultaneously at tens of thousands of glaciers all over the world.

The high mountains of Asia

U.13 In 2013, the IPCC reported on the results of four scenarios called the Representative Concentration Pathways (RCP), each of which examined the impact on the accumulating level of atmospheric greenhouse gases of different trajectories of future global emissions.

U.14 The most ambitious pathway, RCP2.6, assumes that global emissions peak during the period 2010-2020 and then start to decline. Various paths within this group were found to be capable of keeping the future rise of the carbon concentration level to less than 450 ppm – and thus within the 2°C threshold.

U.15 A recent study identified the more limited group of pathways that could keep warming to 1.4 – 1.6°C. This study calculated the impact of that amount of warming on the glaciers in the high mountains of Asia. With a global warming average of 1.5°C, the amount of warming in the regions affecting glaciers in Asia would be 2.1°C. The results vary within the high mountain region: the study projects that the Hindu Kush would experience 2.3°C of warming (even if the global average is kept to 1.5°C). See: Kraaijenbrink, P.D.A, Bierkens, M.F.P., Lutz, A.F. & Immerzeel, W.W. *Nature* 549, 257-260 (2017).

U.16 The study calculated that assuming the global average temperature increase is limited to 1.5°C, about *one-third of the present-day mass of glaciers in the high mountains of Asia will be lost by the end of this century.* The study shows that about two-thirds of ice stored in the high Asian glaciers will be lost by 2071-2100 if no further effort is made to curb emissions.

U.17 Given the extreme effort that would be required to keep future emissions within the RCP2.6 (requiring deep cuts in global emissions starting now), we must regard this projected one-third loss of all high mountain glaciers in Asia as effectively unavoidable – and the question is how much worse it is going to be.

Water supply: the example of Chinese Central Asia

U.18 The glacier-covered Tian Shan range at altitudes of more than 10,000 feet runs for a thousand miles south-west to north-east, a mountain barrier that marks the boundary between Chinese territory and the former Russian republics to the north, Kyrgyzstan and Kazakhstan. Khan Tengri at 23,620 feet is the highest peak in the Tian Shan.

U.19 Melting snowfields and glaciers in the Tian Shan feed rivers that find their way down into the desert, watering the oases on their way.

U.20 In 2007, James A. Millward, a leading American scholar on Chinese Central Asia, published a book titled *Eurasian Crossroads*, a history of Xinjiang and examination of its current difficulties. He described the common threats to living conditions that hang over wide areas of dry continental Central Asia. Soil erosion, salinification, wind-blown encroachment of desert sands, and the deforestation of mountain slopes all accelerate the loss of food-producing land. But the most profound threat derives from the changing condition of the glaciers caused by warming:

> *But the unprecedented warming seems to have speeded the melting of the snowcaps and glaciers in the Tianshan and Kunlun ranges over the past few decades, so that the average annual Tarim River discharge was some 10 percent higher in 1976-86 than it was in the decade 1954-64. Xinjiang's twentieth century development has, therefore, drawn upon water reserves banked in the past; the most recent major deposits occurred during 1400-1900, when temperatures were markedly cooler than today; and especially during the global and local climate minimums of that era, from 1420 to 1520, 1570 to 1690, and 1770 to 1890, when precipitation in the mountains peaked."*

U.21 Millward explains that the major tributaries of the Tarim River (the main river in Xinjiang which gathers most of the smaller rivers that come down out of the Tian Shan) obtain 41% to 58% of their total volume from glacial melt-water. The eventual decline of the volume of glacial melt-water will have especially severe consequences where those rivers flow into semi-arid areas – into areas where there is little or no annual rainfall.

U.22 Millward cites the conclusions of a 2004 study by an international research team [Yao Tandong et al] that the glaciers in the high Tibetan massive, which includes the Kunlun range (the mountains on the southern rim of the Taklamakan Desert) are melting at an annual rate equivalent to the total amount of water discharged by the Yellow River in a single year.

U.23 The Yao study cited by Millward gives an account of the recent history of glacier retreat in Northwest China. From the 1950s to the late 1960s, there was large-scale retreat, followed by a period of slowdown, which then accelerated in the 1990s. Yao rules out declining precipitation as a cause of glacier shrinkage. The problem is not less snow and rainfall. The cause of glacier retreat is warming. Yao calculates that generally in High Asia China, glacier melt has on average increased river flow by 5.5%, and in the specific area of the Tarim Basin has increased by 13%. The Tarim Basin is the geographical name for the area that encloses the Taklamakan Desert and its oasis cities and foothills, including the area around Kuqa and Kizil.

U.24 Yao's study notes that this shrinking of glaciers in China affects not just Xinjiang, but also two adjacent Chinese provinces heavily dependent on glacier-fed rivers, Qinghai and Gansu. The glaciers in the Tian Shan also provide an important part of the freshwater supply during the summer to Kyrgyzstan, Kazakhstan, and Uzbekistan, the former Soviet republics that lie north from Xinjiang. The mountains straddle the international boundaries.

U.25 Some scientific studies use the disturbing but descriptive phrase “deglaciation discharge dividend” to describe this recent increase in river-water flow caused by the declining mass of glaciers. The increased flow gives a short-term gain but masks the ultimate decline of the water supply.

Outcome

U.26 In Xinjiang, the average temperature since the 1980s has already risen by 1.6°C. We must keep in mind that when we speak, for example, of 0.85 or 1.0°C increase in *global average surface temperature*, we are greatly underestimating the warming that has *already* occurred in different parts of the world.

U.27 In Chinese Central Asia, the greatest impact of temperature increase on the glaciers has been in the outer ranges (the furthest north) known as the Western and Northern Tian Shan. In the mid-19th century the total area of the glaciers in the outer ranges was 50% to 90% greater than it is now. The area loss of glaciers on the inner ranges, which have higher altitudes, is less pronounced. Glaciers at high altitudes above 5,500 metres are more protected.

U.28 At the current rate of glacier loss, many glaciers in the outer range of the Tian Shan will have lost 50% of their surface area by 2050.