Final Report

Impact on GHG Emissions and Climate Targets of the Trans Mountain Expansion Project

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Introduction

The Trans Mountain Expansion Project (TMEP) would provide additional transport capacity of 590,000 barrels per day (bd) for oil produced in western Canada to access offshore markets. The City of Vancouver is concerned with the direct risks from spills and other accidents when transporting oil by pipeline and tanker. It is also concerned with the contribution of the project to greenhouse gas (GHG)[1] emissions in Canada and abroad since the city will be significantly impacted by climate change and ocean acidification.

In this report, we focus on the contribution of the TMEP to GHG emissions by (1) estimating the GHG emissions it causes, and (2) calculating their effect on the Canadian government's promise to reduce GHG emissions significantly by 2020. If national governments such as Canada's are not committed to achieving GHG abatement promises, the best-available independent assessments – Intergovernmental Panel on Climate Change, Canada's National Roundtable on the Environment and the Economy – predict severe economic, ecological and social impacts to coastal cities such as Vancouver.

Greenhouse gas emissions from the TMEP

The effect of the TMEP on Alberta bitumen production

The key effect of the TMEP is to increase the production of bitumen in Alberta's oil sands. For the following reasons, we assume that it will have negligible incremental effect in western Canada on the rates of production of conventional crude oil, synthetic crude oil or refined petroleum products.

In the case of conventional crude oil, its future rate of production will be determined primarily by the rate at which this declining resource is depleted. The TMEP does not change that. In the case of synthetic crude oil, decisions to produce it by upgrading bitumen (instead of transporting diluted bitumen) will depend on a host of market conditions, which are largely independent of the TMEP. Finally, refinery investments in Alberta (to produce more refined petroleum products) will also depend on a host of market conditions for which the TMEP should have negligible effect.

Thus, while the TMEP would probably transport some mix of diluted bitumen, synthetic crude oil and refined petroleum products, it is a mistake to equate the actual mix of

[1] CO_2 is the most important GHG, especially from fossil fuel production and use, but methane and other emissions are also significant. We follow here the convention of sometimes using CO_2e (e = equivalent) to show when we refer to all GHGs together in terms of their equivalent global warming potential.

products carried by the pipeline with its incremental effect on oil production and processing in Alberta. Its primary incremental effect would be to increase the production of bitumen (expanded exploitation of the oil sands), which one can assume would be transported as diluted bitumen from Alberta to the coast via the TMEP.[2]

In estimating this incremental effect, however, we must recognize that one barrel of additional pipeline capacity of the TMEP does not equate to one barrel of additional bitumen production in Alberta. First, maintenance and other operating considerations prevent the TMEP from being used at 100% of capacity. Second, the addition of condensate in order to convert bitumen into diluted bitumen for transport by pipeline reduces capacity for pure bitumen transport. These two factors must be included in estimating the incremental effect of the TMEP on Alberta bitumen production.

To convert the 590,000 bd of the TMEP capacity into Alberta bitumen production, we assume 95% for pipeline capacity utilization[3] and 28:72 for the ratio of condensate to bitumen.[4] The 590,000 bd of TMEP capacity must therefore be multiplied by .95 and then .72, which yields, all else being equal, an incremental increase of 403,560 bd of Alberta bitumen production resulting from the TMEP – a 21% expansion relative to 2012.[5]

Alberta bitumen production and GHG emissions

Each stage in the production and consumption of fossil fuels is associated with CO_2 and other GHG emissions. All of these emissions together – through the entire chain from initial land disturbance to production to transport to final consumption – are referred to as the full-cycle or well-to-wheel emissions. The following diagram depicts all of the stages entailed in calculating well-to-wheel emissions, as well as the stages involved in calculating only well-to-refinery and well-to-tank.

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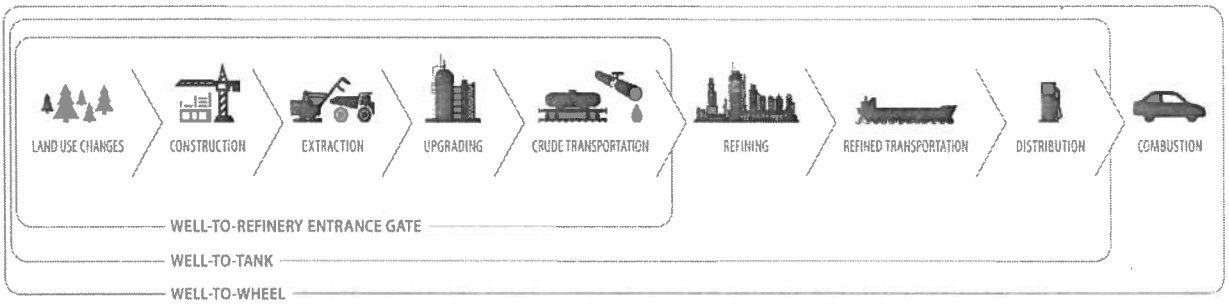
[2] The spurious argument is sometimes offered that a given pipeline from the oil sands has no effect on bitumen production because if it were not built another pipeline would be built instead. If one applied this logic to each proposed pipeline, and on that basis decided not to build each one (since it would have no product to transport), then no pipelines would be built – and the current level of Alberta bitumen production would somehow occur with zero pipeline capacity to transport it to market. As one would expect, growth in the production of bitumen is strongly correlated with growth in pipeline capacity connected to the oil sands.

[3] Dinara Millington and Jon Rozhon, *Pacific Access: Part I – Linking Oil Sand Supply to New and Exisiting Markets,* Study No. 129 – Part I, Canadian Energy Research Institute, 2012, 11-15.

[4] IHS CERA, *Oil Sands, Greenhouse Gases, and U.S. Oil Supply: Getting the Numbers Right - 2012 Update*, Special Report, 2012.

[5] Alberta oil sands production in 2012 was approximately 1.9 million barrels per day according to the Energy Resources Conservation Board, *ST98-2013: Alberta's Energy Reserves 2012 and Supply/Demand Outlook 2013–2022*, 2013.

Figure 1. Boundaries of full-cycle GHG assessments[6]



Given the complexity of so many stages, the task of estimating GHG emissions can seem daunting. But emissions from most of the stages are relatively small, enabling us to focus on production, processing (including upgrading and refining), transport and consumption, this latter being the most important.[7] While emissions caused during transport – truck, rail, ship, pipeline – constitute a smaller percentage, they can be important, depending on the focus of analysis.

For the TMEP, we focus on emissions caused by the conversion of oil sands to bitumen and their transport to points of export. These "upstream emissions" will occur in Canada and are therefore directly relevant to our examination of the relationship between the TMEP, the Alberta oil sands and Canada's GHG commitments.

The Canadian Association of Petroleum Producers estimates that 74% of growth in oil sands production to 2030 will be from *in situ* projects, which involve injecting steam into deep oil sands deposits in order to release the oil without having to mine it.[8] (Only about 20% of remaining oil sands reserves are likely to be recoverable by mining, which has been the dominant process thus far.) We therefore used a ratio of 74:26 to allocate the growth in bitumen production caused by the TMEP between the *in situ* and the mining production processes. Multiplying this by the average production emissions from each of these processes yields average emissions for incremental bitumen production of 52.4 kg CO_2e per barrel.[9]

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[6] Flanagan, E. and C. Demerse, *Climate Implications of the Proposed Energy East Pipeline: A Preliminary Assessment*. The Pembina Institute, 2014.

[7] Emission caused by the actual construction of facilities, such as oil sands processing plants, refineries, and pipelines like the TMEP, which are relatively small, are excluded from this analysis.

[8] Canadian Association of Petroleum Producers, *2013 Crude Oil Forecast, Markets & Transportation* 2013. i. http://www.capp.ca/getdoc.aspx?DocId=227308&DT=NTV

[9] Industry-average production GHG emission factor values were provided by E. Flanagan of the Pembina Institute using the GHGenius model v3.02.

When this value is multiplied by 403,560 bd, and by 365 days per year, it equates to bitumen production emissions caused by the TMEP of 7.7 MT CO_2e. When these emissions are combined with the 1.1 MT CO_2e annual emissions from operating the TMEP[10] – pump stations, tanks, and marine terminal – the total upstream emissions attributable to the TMEP are 8.8 MT CO_2e per year, as shown in Table 1. This is equivalent to adding 2.2 million average emission cars to Canada's existing vehicle stock.

Table 1. Canadian emission impact of the TMEP proposal (Million tonnes of CO2e)

Annual bitumen production emissions	Annual TMEP operation emissions	Total annual upstream emissions caused by TMEP	Millions of cars to produce equivalent annual emissions
7.7	1.1	8.8	2.2

Since we do not assume that the TMEP would trigger the construction of more bitumen upgrading or oil refining capacity in Alberta, we assume that these particular sources of upstream emissions will be zero in Canada. And since the objective of the TMEP is to provide access to export markets for Alberta bitumen, we assume that all of the unaccounted for emissions, whether from further processing and refining, overseas transport, or final consumption, will occur outside of Canada.

These unaccounted for emissions are, however, important in terms of estimating the global effect of expanding oil sands production. The values in Table 2 show all the unaccounted annual emissions from the production and consumption of Alberta bitumen associated with the TMEP.

Table 2. Unaccounted annual emissions (refining, distribution, combustion) from incremental bitumen production related to the TMEP (Million tonnes of CO2e).

Annual refining and distribution emissions[11]	Annual combustion emissions[12]	Total unaccounted emissions
17.3	53.8	71.1

[10] The TMEP Environmental Effects Assessment for application to the National Energy Board submitted December 2013 and available at http://application.transmountain.com/facilities-application.

[11] Industry-average refining and distribution GHG emission factor values were provided by E. Flanagan of the Pembina Institute using the GHGenius model v3.02

[12] Combustion emissions factor of 72.6 g CO_2e/ MJ from Richard K. R.K. Lattanzio, *Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions.* Congressional Research Office. 2013.

The argument is sometimes made that these downstream emissions would occur even in the absence of the TMP. The reason is that much of the time oil is an easily traded, mobile commodity. A reduction in supply from one source is unlikely to have implications for market prices or the level of consumption, since there are many alternative suppliers.[13] Indeed, Alberta bitumen is one of the highest cost sources of oil in global markets, and current levels of market demand could be met by increased output from competitive alternatives.

But there is a case in which we would avoid the emissions in Table 2 by not building the TMEP. This is the case in which countries are acting to reduce GHG emissions in line with the targets they committed to in 2009 at the Copenhagen meeting of the Conference of the Parties to the Framework Convention on Climate Change. At that meeting, Canada and other major countries reconfirmed and strengthened national targets for the years 2020 and 2050 as part of a commitment to prevent global temperatures from rising more than 2° C from pre-industrial levels by 2100.

With those commitments, global demand for oil would not be growing as it is today and this would especially reduce demand for high-cost oil from Alberta bitumen production. One of the world's leading research institutes on energy-economy modeling, the Institute for the Science and Policy of Global Change at MIT, recently modeled a global effort to reduce GHG emissions that was actually less ambitious than what Canada and other countries committed to at Copenhagen (it would allow temperatures to rise by more than 2° C by 2100, although not by as much as they would if no actions were taken).

According to their analysis, even this more modest effort at mitigating climate change would reduce the global demand for oil to the extent that oil sands expansion, and associated new pipelines like the TMEP, would not occur. Instead, there would be a gradual decline in production from the oil sands over the next decades. The authors noted in conclusion, "The niche for the oil sands industry is fairly narrow and mostly involves hoping that climate policy will fail."[14]

The implications are clear. The demand for the TMEP depends on global climate policy failure. And in such a case, the TMEP will contribute, along with other investments that expand carbon pollution, to the imposition of significant costs to a coastal city such as Vancouver. If, however, global climate policy succeeds in preventing a greater-than 2° C rise in temperatures by 2100, then there will be no demand for the TMEP. As a regulated energy investment, it will not be "used and useful" – a key criterion by which the NEB determines whether to approve a given investment.

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[13] Economists therefore refer to a product like oil as a "fungible" commodity.

[14] Chan, G., Reilly, J., Paltsev, S. and H. Chen, *Canada's Bitumen Industry Under CO2 Constraints*, Report No.183, Science and Policy of Global Change Institute, MIT, 2010.

Canada's emissions targets and oil sands expansion

Global warming and ocean acidification are caused primarily by the expansion of fossil fuel production and consumption. This occurs via investments in the extraction, processing, transport and consumption of coal, oil and natural gas. When these investments are allowed to occur, carbon pollution increases. This is why the world's leading independent experts, like the researchers at MIT, know that these investments would decline where policies are in place to cause GHG emissions to decline. And they know that this would be immediately the case for the higher emitting fossil fuels, namely coal and unconventional oil such as bitumen.

Where governments are allowing an increase in any of the stages of fossil fuel production and consumption, analysts can assess the relationship between this expansion and their GHG emission reduction promises.

Canada's emissions targets and its efforts to reduce GHG emissions

In 2007, the government of Canada committed to reduce national emissions 20% from their 2006 levels by 2020 and 65% by 2050.[15] In 2009, the government revised its 2020 target to a 17% reduction from 2005 levels. It justified this weakening of the target by noting that this aligned Canada's target with that of the US in percentage terms.

While there are multiple ways by which humans cause CO2 and other GHG emissions, the actions to reduce them can be grouped into a few major categories. This is especially the case with CO2 from burning fossil fuels, an activity which is responsible for 60-70% of human-produced GHGs. To reduce CO2 from burning fossil fuels, the options are: (1) reducing energy use by lifestyle changes and by adopting more efficient technologies, buildings, infrastructure and urban design, (2) switching from fossil fuels to non-emitting energy sources like biomass, solar, wind, hydropower, geothermal and nuclear, and (3) capturing and storing carbon emissions to prevent them from reaching the atmosphere.

The only policies that can cause these actions are: (1) regulations on technologies, fuels, or sectors of the economy, (2) GHG emissions pricing via a carbon tax, and (3) GHG emissions pricing via a cap-and-trade program. In 2006, the Canadian government stated it would achieve its 2020 and 2050 commitments without GHG emissions pricing, instead applying regulations to individual sectors of the economy, such as electricity generation, transport, oil and gas production, buildings, steel production, aviation, shipping,

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[15] Government of Canada, *Turning the Corner*, 2008, p.1. "The Government of Canada has set a national goal of reducing greenhouse gas emissions, relative to 2006 levels, by 20 per cent by 2020, and by 60 to 70 per cent by 2050."

agriculture, forestry, and municipal solid waste. To this end, in 2007, it launched its *Turning the Corner* policy initiative, focused on the 2020 timeframe.[16]

Also in 2007, the Canadian government directed the National Roundtable on the Environment and the Economy to provide a blueprint for achieving the government's commitment to reduce national GHG emissions 65% by 2050. In its two reports, *Getting to 2050* and *Achieving 2050*, the roundtable showed that success with the 2050 target required the immediate implementation of regulations and/or GHG emissions pricing, which would reduce emissions in all sectors, including bitumen production.[17]

Between 2008 and 2011, the longstanding growth trend in Canadian GHG emissions abated slightly. But this was equally the case for all industrial economies as the global community grappled with a severe economic downturn. In Canada, the decline in emissions from certain industries, like steel and cement, was coupled with a major initiative of the Ontario government to phase out coal-fired power plants and replace these with a combination of nuclear power, renewables and natural gas. Other policies, like BC's carbon tax and Quebec's introduction of cap-and-trade, have started a small downward effect on emissions in some sectors.

In its report, *Canada's Emissions Trends 2013*, Environment Canada combined these historical developments with emissions forecasts for all sectors, given projected growth rates in population and the economy, as well as the impacts of already-implemented GHG policies of Canadian federal and provincial governments.[18] Figure 2 shows the overwhelming role of emissions from growing bitumen production in reversing the 2008-2011 decline, and thus in preventing Canada from achieving its 2020 target. With Canada's annual GHG emissions at 702 MT CO_2e in 2011, Environment Canada estimated that Canada would miss its 2020 target by 122 MT.[19]

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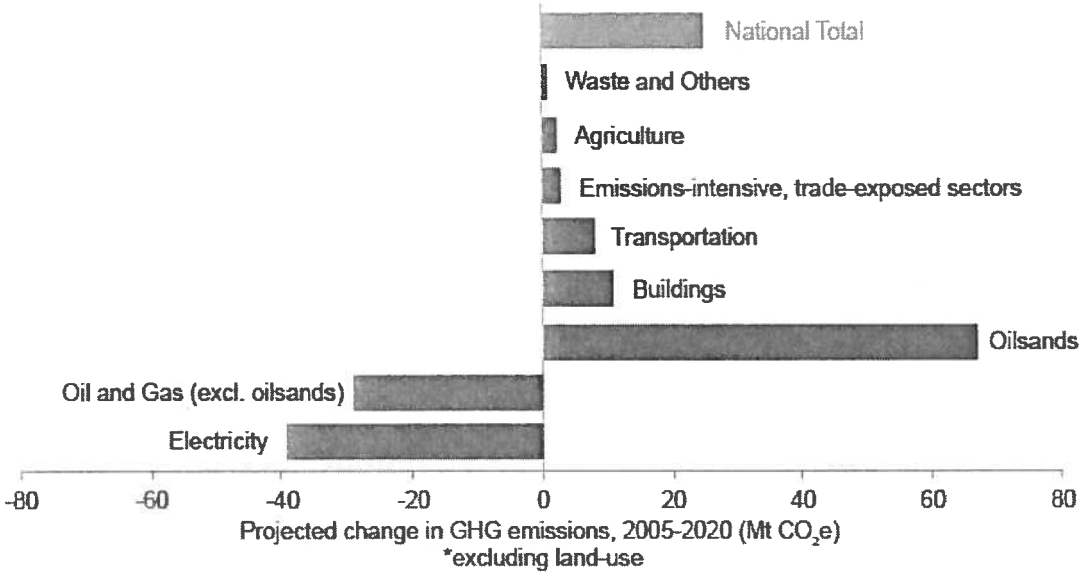
[16] Government of Canada, *Turning the Corner*, 2008.

[17] NRTEE, *Getting to 2050*, 2007 and NRTEE, *Achieving 2050*, 2009.

[18] Environment Canada, *Emission Trends 2013*.

[19] 2011 was the latest date for which emissions data were available at the time of the Environment Canada report.

Figure 2 Historical and forecasted change in GHG emissions by sector, 2005-2020[20]



In fulfilling its mandate of reporting on the effectiveness of government's policies to meet its goals, the Auditor General of Canada's commissioner on environment and sustainability released a report in 2012 called *Meeting Canada's 2020 Climate Change Commitments*. The report noted that because the government had done little in terms of implementing its promised regulatory policies, such as regulations on oil and gas, "it is unlikely that enough time is left to develop and establish greenhouse gas regulations … to meet the 2020 target." The report echoed Environment Canada's own analysis in concluding that Canada is on a path to be "7.4 percent above its 2005 level instead of the targeted 17 percent below."[21]

Oil sands expansion's impacts on Canada's emissions targets

Figure 2 presents a combination of historical emissions (2005-2011) and projected emissions (2012-2020). In both periods, it is growth in emissions from bitumen production that plays the dominant role in preventing Canada from meeting its climate commitments. In the historical period, between 2005 and 2011, bitumen production

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[20] Flanagan, E. and C. Demerse, *Climate Implications of the Proposed Energy East Pipeline: A Preliminary Assessment*. The Pembina Institute, 2014. Based on data from Environment Canada, *Canada's Emissions Trends 2013*, 2013.

[21] Auditor General of Canada, Commissioner on Environment and Sustainability, *Meeting Canada's 2020 Climate Change Commitments*, 2012.

increased by 64% and GHG emissions from the oil sector increased by 62%.[22] In the forecast period, 2012-2020, the Environment Canada analysts expect that bitumen production and its emissions will grow another 60-70%.

This Environment Canada forecast for bitumen production is consistent with the industry forecast. The Canadian Association of Petroleum Producers (CAPP) expects output to grow from 1.9 million bd in 2012 to 3.2 million bd in 2020.[23] CAPP notes, however, that this growth in bitumen production cannot occur without transportation infrastructure, such as the TMEP and other proposed pipelines. "Western Canadian supplies are essentially landlocked and will need additional transportation infrastructure to bring this growing oil supply to markets."[24] In the same report, moreover, CAPP states, "pipelines will remain the preferred mode of transportation for crude oil."

In other words, the projected massive expansion of bitumen production in Alberta requires a host of new pipelines to enable the land-locked oil sands to reach export markets. Current pipeline proposals include Northern Gateway, Keystone XL, Line 9B Reversal, Energy East, and the TMEP. If each of these pipelines is incrementally seen as not causing Canada to miss its climate commitments, then all will proceed – with obvious cumulative effect.

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[22] Flanagan, E. and C. Demerse, *Climate Implications of the Proposed Energy East Pipeline: A Preliminary Assessment*. The Pembina Institute, 2014.

[23] Canadian Association of Petroleum Producers, *2013 Crude Oil Forecast, Markets & Transportation* 2013. http://www.capp.ca/getdoc.aspx?DocId=227308&DT=NTV

[24] Canadian Association of Petroleum Producers, *2013 Crude Oil Forecast, Markets & Transportation* 2013. http://www.capp.ca/getdoc.aspx?DocId=227308&DT=NTV