The Downstream Emissions Resulting from the Energy East Pipeline: an evaluation considering economic, technical and political risk factors

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Disclaimer

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INFORMATIONS SUR LE DOCUMENT

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Ce document de travail a pour but de stimuler la discussion au sein du milieu de la recherche et parmi les utilisateurs de la recherche, et son contenu peut avoir été soumis ou sera soumis ultérieurement pour publication dans une revue scientifique. Il a été examiné par au moins un arbitre interne avant publication. Les commentaires sont les bienvenus.

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CONTENTS

EXECUTIVE SUMMARY

This paper aims to improve understanding of the potential impact of the Energy East pipeline on global oil consumption and consequent downstream emissions of greenhouse gases responsible for climate change. At a design capacity of 1100 thousand barrels per day (TBD), the Energy East pipeline is expected to take oil from Western Canada through Eastern Canada, largely for export to international markets. If the project proceeds, will this lead to a significant increase in emissions outside of Canada? In this study, we seek an answer to this question by offering an analysis of Energy East's impact on downstream, global emissions that considers economic, technical and political factors.

At the outset, it is important to clarify the distinction between so-called "upstream" emissions, those on Canada's national territory, and "downstream" emissions due to consumption of Canadian oil abroad. Under United Nations accounting rules, countries are only responsible for emissions that occur within a country's national borders (IPCC, 2006b: 1.4; UNFCCC, 2006: para.9). Canada is not responsible for emissions resulting from the combustion of Canadian oil elsewhere. However, it is increasingly recognized that the production and consumption of fossil fuels needs to be significantly scaled back to avoid dangerous climate change (McGlade and Ekins, 2015)—assuming that rapid advancement in carbon sequestration technology is not achieved (see Keith et al., 2006; Preston et al., 2005 for discussion). While upstream emissions associated with Energy East are important, in this study we focus on downstream emissions.

The only other study to consider the downstream emissions associated with Energy East has been led by the Canadian consulting firm Navius (Peters et al., 2015). Navius concludes that, as a result of new oil brought to market by Energy East, the global average price of oil is likely to decline slightly which will lead to increased consumption of refined petroleum products outside of Canada and an associated increase in downstream emissions of 4.7-12.0 megatonnes carbon dioxide equivalent (MtCO2e) per year (Peters et al., 2015: vii). Yet in reaching these results, Navius assumes that oil transport by rail will have expanded to effectively compensate for any lack of pipeline. More specifically, their scenarios modelling the absence of new pipelines in Canada anticipate that oil transport by rail will increase from just under 200 TBD in 2013 to 2400 TBD by 2035—an increase of over 1000% (Peters et al., 2015, 27, 31-33). This quantity of oil is itself equivalent to the functional capacity of all pipelines currently being proposed in Canada. Is this assumption valid? In the current paper, we rigorously assess the substitutability between rail and pipeline transport infrastructure. As our findings show, the choice of oil transport scenario against which Energy East is evaluated—the counterfactual scenario—significantly affects results of the evaluation of the pipeline's effect on downstream global emissions.

First, we review Western Canadian oil supply, including estimates of the amount expected to need exit from Western Canada by 2030. Second, we carefully build seven counterfactual reference scenarios of Western Canadian oil exports from 2015 through 2030 that distinguish between different plausible combinations of pipeline and rail oil transport capacity. Third, at the heart of our paper is a careful appraisal of economic, technical and political risk factors affecting the likelihood of each counterfactual scenario's implementation in the absence of Energy East. Based on our risk analysis, we evaluate in a qualitative manner which oil transport proposals are more likely to proceed than others—including different combinations of new pipeline and rail. The examination of political risk focuses on (i) the presence of institutional veto points that allow various political actors to block an oil transport infrastructure project and (ii) how the risks, interests and resources of strategic actors are influenced by the structure of the policy issue, particularly the jurisdictional separation of risks and benefits. Finally, for each counterfactual scenario, the effect of Energy East on global oil consumption and downstream emissions is estimated using an economic model based on

Erickson and Lazarus (2014) but modified in an important way to more accurately represent global price elasticities for oil supply and demand (see Leach, 2014a; b; Levi, 2014). We submit that an extremely-low to low demand elasticity ($E_d = -0.07$ *to* -0.20) and medium supply elasticity ($E_s = 0.75$) are the most appropriate parameters for assessing the impact of new Energy East oil on global markets. We note that the model we use is not perfect, for which reason complex economic models are often favoured for analyses of this kind. However, to the extent that our results approach those of Navius when using their assumptions about substitutability between rail and pipeline, we have confidence in the results presented here. While many factors are important in determining global oil consumption, long-term price elasticities of global oil supply and demand are amongst the most important factors used in modeling such global dynamics.

Across the seven counterfactual scenarios identified, the relative impact of Energy East on global emissions varies from 3-40 MtCO2e (Table ES1). However, based on our risk analysis, we submit that the most likely and therefore appropriate counterfactual scenario against which to measure the effects of Energy East is Scenario 3 where, by 2030, limited new pipeline is constructed (TransMountain Expansion and Enbridge's Line 3 Replacement projects go ahead while Northern Gateway remains unimplemented) and limited new rail transport capacity is developed up to 660 TBD. While the associated amount of new rail is lower than that found in other studies, it is still a more than 300% increase above 2015 rail movements estimated at 200 TBD. However, while rail is uneconomic at current 2015 oil prices, we do not anticipate the global price of oil to be the limiting factor over the long-term. Rather, the key factors limiting substitutability between rail and pipeline are technical challenges and politics surrounding the prospect of a significant increase in oi transport by rail. Given these technical and political challenges, we maintain that it is highly unlikely that sufficient new rail transport capacity will be constructed to compensate completely for Energy East (990 TBD functional capacity) if the pipeline is not implemented. If a pipeline option is rejected, it does not follow that a politically less-favourable alternative will replace it even if it is economically feasible.

TABLE ES1: ESTIMATES OF THE IMPACT OF ENERGY EAST ON ANNUAL GLOBAL OIL CONSUMPTION AND DOWNSTREAM EMISSIONS USING APPROPRIATE PRICE ELASTICITIES OF GLOBAL SUPPLY AND DEMAND

Scenario	Risk Analysis	Annual Oil Consumption (TBD)	Annual Downstream Emissions (MtCO2e)
1) 2015 Status Quo Pipeline & Rail	Unlikely	78-204	15-40
2) Limited New Pipeline & No New Rail	Unlikely	78-204	15-40
3) Limited New Pipeline & Limited New Rail to 660 TBD	Most Likely	63-165	12-32
4) Limited New Pipeline & Limited New Rail to 400 TBD	Likely	78-204	15-40
5) Limited New Pipeline & Rail Compensates for EE	Unlikely	21-56	4.0-11.0
6) Extensive New Pipeline & Limited New Rail to 660 TBD	Unlikely	26-68	4.8-13.3
7) Navius: Limited New Pipeline & Extensive New Rail	Highly Unlikely	17-46	3.3-9.0

Note: Long-term Price Elasticity of Supply: Medium ($E_s = 0.75$). Long-term Price Elasticity of Demand: Extremely-low ($E_d = -0.072$) and Low ($E_d = -0.20$). EE=Energy East, NG=Northern Gateway.

Based on our Scenario 3, we estimate Energy East to most likely lead to an increase in global annual oil consumption of 63-165 TBD per year and downstream emissions by 12-32 MtCO2e per year (Table ES1). When we consider the impact of Energy East relative to a counterfactual scenario that replicates assumptions about the near perfect substitutability of pipeline and rail, our Scenario 7, Energy East increases downstream emissions by 3-9 MtCO2e per year—a figure close to Navius' own estimate of 4.7-12.0 MtCO2e per year. Put different, our estimate of the downstream emissions resulting from Energy East is more than 2.5 times as large as the only other existing study. We conclude that the feasibility of substituting pipeline with rail has a significant impact on estimates of emissions associated with Energy East and should be scrutinized in any evaluation of the global carbon footprint of Energy East. In light of our scenarios, the difference between downstream emission under scenarios assuming perfect and imperfect substitutability between pipeline and rail stands at 8.7-23 MtCO2e per year.

In Table ES2 below we summarize results of our study and other existing studies of Energy East to arrive at an estimate of total upstream and downstream emissions likely due to this new pipeline. We distinguish between studies that question the perfect substitutability between pipeline and rail, including a study by the Pembina Institute (Flanagan and Demerse, 2014) and this study, as well as the study by Navius which assumes near perfect substitutability. In terms of upstream emissions, the Pembina Institute estimated Energy East would result in 30-32 MtCO2e per year on Canadian territory (Flanagan and Demerse, 2014: 21), but did not consider net upstream effects after accounting for global oil market dynamics. Navius finds that while upstream emissions in Canada increase to between approximately 2-11 MtCO2e in Navius' model, this is offset by reduction in upstream emissions linked to reduced production elsewhere in the world (Peters et al., 2015: x). After accounting for global oil market dynamics, Navius concludes that Energy East will likely increase net global upstream emissions by 0.7-4.3 MtCO2e per year (p. viii-ix). We agree with Navius that it is important to consider global oil market dynamics, which we have also undertaken in our analysis. Using a ratio from Navius' estimate of global upstream emissions and Canadian upstream emissions, we estimate that net global upstream emissions associated with the Pembina study would have been approximately 12-13 MtCO2e per year. To the best of our understanding, the discrepancy between Navius and Pembina's adjusted estimate is due to different treatments of the substitutability of rail and pipeline transport in the analysis.

TABLE ES2: TOTAL GLOBAL EMISSIONS (UPSTREAM AND DOWNSTREAM) ASSOCIATED WITH ENERGY EAST, DIFFERENTIATING BETWEEN IMPERFECT AND PERFECT SUBSTITUTABILITY OF PIPELINE AND RAIL

Emissions	Imperfect Substitutability Between Pipeline and Rail		Perfect Substitutability Between Pipeline and Rail	
	MtCO2e /yr	Reference	MtCO2e /yr	Reference
Upstream Emissions*				
-Global	(12-13)	(See Text)	0.7-4.3	(Peters et al., 2015)
-Canada	30-32	(Flanagan and Demerse, 2014)	2.0-11.0	(Peters et al., 2015)
Downstream Emissions				
-Global	12-32	(This Study)	4.7-12.0	(Peters et al., 2015)
Total Global Emissions	24-45		5.3-17.0	

*Note that we estimate global upstream emissions associated with the Pembina Institute's upstream estimate, which does not consider global oil market dynamics, based on a ratio of global upstream to Canadian upstream emissions in Navius' study. This adjusted Pembina estimate of 12-13 MtCO2 per year is reported in parentheses in this table. See text for details.

In terms of downstream emissions, our estimates in Table ES2 differ significantly between the estimate emanating from our study of 12-32 MtCO2e per year in contrast to the Navius estimate of 4.7-12 MtCO2e per year. Again these differences are explained by the different treatment of the substitutability of pipeline and rail in the analysis. Overall, we estimate that, when taking global oil market dynamics into consideration, the total impact of Energy East varies from 24-45 MtCO2e per year when pipeline and rail are considered imperfectly substitutable to 5.3-17.0 MtCO2e per year where they are deemed perfectly substitutable. Given technical and political challenges to the significant increase in oil transport by rail, we have argued in this paper that pipeline and rail are highly imperfect substitutes for bringing Western Canadian oil to global market and thus that the total effect of Energy East in terms of upstream and downstream emissions is more likely to be 24-45 MtCO2e per year. It is important to consider political risks along with economic and technical factors associated with new oil transport infrastructure in the evaluation of emissions related to new pipelines.

Is our estimate of the 24-45 MtCO2e of total upstream and downstream emissions associated with Energy East in the table above significant? We assert that the significance of these figures will also be political. Energy East is but one small piece of a much larger puzzle; however, this large puzzle is itself made of many small pieces and guided by the international norm of common but differentiated responsibilities (Asselt and Zelli, 2014; Purdon, 2015a; Stone, 2004). Total global greenhouse gas emissions stood at 46,049 MtCO2e in 2012 (WRI, 2016). Relative to this figure, total upstream and downstream emissions resulting from Energy East range from 0.05-0.10%. However, relative to Canadian emissions, total upstream and downstream associated with Energy East range from 3.4 to 6.4% of Canada's 702 MtCO2e emitted in 2011 (Environment Canada, 2013: 15). Finally, using a greenhouse gas equivalency calculator developed by the EPA (2015a), our estimate of the total emissions associated with Energy East is equivalent to adding approximately 5.0-9.5 million cars to the roads of the world. We stress again that under current international accounting rules, Canada is not responsible for downstream emissions resulting from oil consumed outside Canada's borders. However, our findings also contribute to ongoing debates about the appropriate accounting framework for the international climate change regime—consumption or production (Harrison, 2015; Peters and Hertwich, 2008).

While our study is unlikely to be the final word on Energy East, we hope that it helps clarify discussion about new pipelines in Canada and contributes to these important international debates. It also points to a number of recommendations. First, it would be important that more detailed economic modeling is undertaken in conjunction with rigorous vetting of various counterfactual scenarios that includes economic, technical and political factors. Second, it would important to assess the possibility of a significant increase in rail transport implied in counterfactual claims made in reference to Energy East and other pipeline proposals, including effects on safety and congestion. Such recommendations might be incorporated into new rules being developed by the Canadian federal government for the assessment of pipeline proposals (Muise, 2016).

SOMMAIRE

Ce document vise à améliorer la compréhension de l'impact potentiel de l'oléoduc Énergie Est sur la consommation mondiale de pétrole et les émissions en aval associées de gaz à effet de serre (GES) responsables des changements climatiques. D'une capacité nominale de 1100 milliers de barils par jour (kb/j), l'oléoduc Énergie Est transporterait le pétrole de l'Ouest canadien vers l'Est du Canada, en grande partie pour l'exportation vers les marchés internationaux. Si le projet se concrétise, résultera-t-il en une augmentation significative des émissions de GES à l'extérieur du Canada? Dans cette étude, nous cherchons à répondre à cette question à partir d'une analyse de l'impact d'Énergie Est sur les émissions mondiales en aval qui tient compte de facteurs économiques, techniques et politiques.

D'entrée de jeu, il est important de distinguer entre ce qu'on appelle les émissions « en amont », soit celles effectuées sur le territoire national du Canada, des émissions « en aval », dues à la consommation de pétrole canadien à l'étranger. En vertu des règles comptables de l'ONU, un pays n'est responsable que des émissions se produisant à l'intérieur de ses frontières (IPCC, 2006b: 1.4; UNFCCC, 2006: para.9). Selon ces règles, le Canada n'est donc pas responsable des émissions résultant de la combustion du pétrole canadien en dehors de ses frontières. Cependant, il est de plus en plus reconnu que la production et la consommation globale de combustibles fossiles doivent être revues à la baisse de façon considérable afin d'éviter de dangereux changements climatiques (McGlade et Ekins, 2015), en supposant qu'une amélioration rapide de la technologie de séquestration du carbone ne soit pas réalisée (voir Keith et al., 2006; Preston et al., 2005 pour une discussion à ce sujet). Alors que les émissions en amont associées à Énergie Est sont importantes, nous nous concentrons, dans la présente étude, sur les émissions en aval.

La seule autre étude examinant les émissions en aval associées à Énergie Est a été réalisée par la firme de conseil canadienne Navius (Peters et al., 2015). Navius a conclu qu'à la suite de la mise en marché du nouveau pétrole transporté par Énergie Est, le prix moyen mondial du pétrole est susceptible de diminuer légèrement, ce qui conduira à une consommation accrue de produits pétroliers raffinés à l'extérieur du Canada et à une augmentation associée des émissions en aval de 4,7 à 12,0 mégatonnes d'équivalents CO2 (MtéqCO2) par année (Peters et al., 2015: vii). Pour parvenir à ce résultat, Navius a supposé que le transport du pétrole par chemin de fer aura augmenté pour compenser de façon équivalente pour toute absence de transport du pétrole par oléoduc. Plus précisément, leurs scénarios qui modélisent l'absence de nouveaux oléoducs au Canada prévoient que le transport de pétrole par voie ferroviaire augmentera à partir d'un peu moins de 200 kb/j en 2013 jusqu'à 2400 kb/j en 2035, soit une augmentation de plus de 1000% (Peters et al., 2015, 27, 31-33). Cette quantité de pétrole en 2035 est équivalente à la capacité fonctionnelle de tous les nouveaux oléoducs actuellement proposés au Canada. Ce postulat est-il valide? Nous évaluons de façon plus rigoureuse la substituabilité entre les infrastructures de transport de pétrole par chemin de fer et par oléoduc dans le présent document. Comme le démontrent nos résultats, le choix du scénario de transport de pétrole contre lequel Énergie Est est évalué influence de façon significative les résultats de l'évaluation de l'effet de cet oléoduc sur les émissions globales en aval.

Tout d'abord, nous commençons par examiner l'offre canadienne de pétrole de l'Ouest, incluant des estimations quant à la quantité de pétrole supposée devoir sortir de l'Ouest canadien en 2030. Deuxièmement, nous élaborons avec soin sept scénarios contrefactuels de référence quant aux exportations de pétrole de l'Ouest canadien de 2015 à 2030. Ces scénarios se distinguent par différentes combinaisons plausibles de capacités de transport de pétrole par oléoduc ou chemin de fer. Troisièmement, au cœur de notre document se trouve une évaluation minutieuse des facteurs de risques économiques, techniques et politiques qui affectent la probabilité de la mise en œuvre de chaque scénario contrefactuel en l'absence Énergie Est. S'appuyant sur cette analyse de risque, nous évaluons de manière qualitative lesquels des

scénarios de transport de pétrole sont plus susceptibles que d'autres d'aller de l'avant, et ce, en considérant différentes combinaisons de nouvelles capacités de transport de pétrole par oléoduc et par chemin de fer. L'examen des risques politiques se concentre sur (i) l'existence de droits de veto institutionnels et (ii) la façon dont les risques, intérêts et les ressources des acteurs stratégiques sont influencés par la structure de l'enjeu politique, en particulier la séparation juridictionnelle des risques et des avantages. Finalement, pour chaque scénario contrefactuel, l'effet d'Énergie Est sur la consommation mondiale de pétrole et les émissions en aval associées est estimé à l'aide d'un modèle économique simple basé sur Erickson and Lazarus (2014), mais modifié de façon importante afin de représenter de façon plus fidèle les élasticités globales des prix de l'offre et de la demande de pétrole (see Leach, 2014a; b; Levi, 2014). Nous estimons qu'une élasticité des prix de la demande allant de très faible à faible ($E_d = -0{,}07$ *à* $-0{,}20$) et une élasticité des prix de l'offre moyenne ($E_s = 0{,}75$) sont les paramètres les plus appropriés pour évaluer l'impact du nouveau pétrole transporté par Énergie Est sur le marché mondial. Nous notons que le modèle que nous utilisons n'est pas parfait, considérant que des modèles économiques plus complexes sont souvent favorisés pour des analyses de ce genre. Cependant, le fait que nos résultats se rapprochent de ceux de Navius—lorsque nous utilisons leurs hypothèses quant à la substituabilité entre le transport de pétrole par chemin de fer et oléoduc—nous donne confiance quant aux résultats de notre modèle.

Dans les sept scénarios contrefactuels identifiés, l'impact relatif d'Énergie Est sur les émissions mondiales varie entre 3 et 40 MtéqCO2 (Tableau S1). Cependant, sur la base de notre analyse de risques, nous estimons que le scénario contrefactuel le plus probable, et donc le plus approprié pour permettre de mesurer les effets d'Énergie Est, est le Scénario 3, soit celui où, en 2030, une capacité additionnelle limitée d'oléoduc est construite (l'extension du projet TransMountain et le remplacement de la canalisation 3 d'Enbridge vont de l'avant tandis que Northern Gateway (NG) n'est pas construit) et une nouvelle capacité, limitée, de transport de pétrole par chemin de fer est développée jusqu'à atteindre un total de 660 kb/j. Bien que l'augmentation de la capacité de transport par chemin de fer considérée soit inférieure à celle observée dans d'autres études, elle représente tout de même un accroissement de plus de 300% par rapport au transport ferroviaire de 2015 estimé à 200 kb/j. Bien que le transport de pétrole par chemin de fer ne soit pas rentable aux prix du pétrole de 2015, nous ne nous attendons pas à ce que le prix mondial du pétrole soit le facteur limitatif de ce mode de transport à long terme. Les facteurs clés limitant la substituabilité entre le transport par chemin de fer et par oléoduc sont plutôt les défis techniques et les enjeux politiques quant aux risques de sécurité associés à la possibilité d'une augmentation significative du transport du pétrole par voie ferroviaire. Compte tenu de ces défis techniques et politiques, nous maintenons qu'il est très peu probable qu'une quantité suffisante de nouvelles capacités de transport ferroviaire sera construite pour compenser entièrement Énergie Est (d'une capacité fonctionnelle de 990 kb/j) si ce dernier n'est pas construit. Ainsi, si le projet d'oléoduc est rejeté, il ne va pas de soi qu'il sera remplacé par le transport ferroviaire du pétrole, une alternative politique moins favorable, même si ce mode de transport était économiquement viable.

Sur la base de ces éléments, nous estimons qu'Énergie Est, en considérant le scénario le plus probable, Scénario 3, résulterait en une augmentation globale de la consommation annuelle de pétrole de 65 à 165 kb/j et en des émissions de GES en aval associées de 12 à 32 MtéqCO2 par année (Tableau S1). Lorsque l'on considère l'impact d'Énergie Est par rapport à un scénario contrefactuel incluant une hypothèse de substituabilité presque parfaite entre oléoduc et chemin de fer, les émissions en aval associées au transport par oléoduc augmentent plutôt de 3 à 9 MtéqCO2 par an, un résultat du même ordre que l'estimation de Navius de 4.7 à 12.0 MtéqCO2 par an. Autrement dit, notre estimé est plus de 2,5 fois supérieur à celui provenant de la seule autre étude portant sur cette question. Nous concluons que la faisabilité du remplacement du transport de pétrole par oléoduc par le transport ferroviaire a un impact significatif sur les estimations des émissions associées à Énergie Est et devrait être examinée en détail dans toute évaluation de l'empreinte carbone globale d'Énergie Est.

TABLEAU S1: ESTIMATIONS DE L'IMPACT GLOBAL D'ÉNERGIE EST SUR LA CONSOMMATION ANNUELLE DE PÉTROLE ET LES ÉMISSIONS EN AVAL

Scénario	Analyse de risques	Consommation annuelle de pétrole (kb/j)	Émissions annuelles en aval (MtéqCO2)
1) 2015 Statu Quo oléoduc & chemins de fer	Peu probable	78-204	15-40
2) Nouvelle capacité par oléoduc limitée & par chemin de fer nulle	Peu probable	78-204	15-40
3) Nouvelle capacité par oléoduc limitée & par chemin de fer limitée à 660 kb/j	Le plus probable	63-165	12-32
4) Nouvelle capacité par oléoduc limitée & par chemin de fer limitée à 400 kb/j	Probable	78-204	15-40
5) Nouvelle capacité par oléoduc limitée & par chemin de fer compensant pour ÉE	Peu probable	21-56	4,0-11,0
6) Nouvelle capacité par oléoduc importante & par chemin de fer limitée à 660 kb/j	Peu probable	26-68	4,8-13,3
7) Navius: Nouvelle capacité par oléoduc limitée & par chemin de fer importante	Très peu probable	17-46	3,3-9,03

Note: Élasticité à long terme des prix de l'offre: Moyenne ($E_s = 0.75$). Élasticité à long terme des prix de la demande: très faible ($E_d = -0,072$) et faible ($E_d = -0,20$); ÉÉ = Énergie Est, NG = Northern Gateway

Dans le tableau S2 ci-dessous, nous résumons les résultats de notre étude et d'autres études existantes sur Énergie Est afin de déterminer un estimé du total des émissions en amont et en aval susceptibles de résulter de ce nouvel oléoduc. Nous y faisons une distinction entre d'un côté deux études qui remettent en question la substituabilité parfaite entre le transport par oléoduc et par voie ferroviaire, soit celle de l'Institut Pembina (Flanagan et Demerse, 2014) et la présente étude, et de l'autre l'étude de Navius supposant une substituabilité parfaite entre ces deux modes de transport (Peters et al., 2015: x). En termes d'émissions en amont, l'Institut Pembina estime qu'Énergie Est sera responsable de 30-32 MtéqCO2 par année sur le territoire canadien (Flanagan et Demerse, 2014: 21). Ce résultat ne tient par contre pas compte des effets nets en amont dus à la dynamique du marché mondial du pétrole. Navius constate pour sa part que les émissions en amont au Canada estimées à environ 2-11 MtCO2e dans leur modèle sont compensées par la réduction des émissions en amont liées à une réduction de la production ailleurs dans le monde (Peters et al, 2015: x). Considérant la dynamique du marché mondial du pétrole, Navius conclut alors qu'Énergie Est résultera en une augmentation probable des émissions en amont mondiales nettes de 0,7 à 4,3 MtéqCO2 par an (p. viii-ix). Nous sommes d'accord avec Navius qu'il est important de considérer la dynamique du marché mondial du pétrole, ce que nous avons fait dans notre analyse. Utilisant le ratio des émissions en amont mondiales et des émissions en amont canadiennes déterminé à partir de l'étude de Navius, nous estimons, à partir de l'étude de l'Institut Pembina, les émissions mondiales nettes en amont d'Énergie Est à une valeur de 12-13 MtéqCO2 par année. Considérant ceci, nous arrivons alors à un total des émissions globales (amont et aval) de 24-45 MtéqCO2 par année pour l'oléoduc Énergie Est. Au meilleur de notre connaissance, l'écart entre cet estimé et le résultat de Navius est dû à un traitement différent de la substituabilité entre les transports ferroviaires et par oléoduc dans les analyses respectives.

Observant spécifiquement les émissions en aval dans le tableau S2, nous constatons que celles-ci diffèrent de manière significative entre l'estimé émanant de notre étude (12-32 MtéqCO2 par année) et celui déterminé par Navius (4,7-12 MtéqCO2 par année). Cet écart s'explique également par la différence quant au traitement de la substituabilité entre le transport du pétrole par oléoduc et par voie ferroviaire. Dans l'ensemble, nous estimons, prenant en compte la dynamique du marché mondial du pétrole, que l'impact total d'Énergie Est varie de 24 à 45 MtéqCO2 par année lorsque le transport par oléoduc et par voie ferroviaire n'est pas considéré comme parfaitement substituable, et 5,3-17,0 MtéqCO2 lorsque ce dernier est considéré parfaitement substituable. Compte tenu des défis techniques et politiques résultant d'une augmentation significative du transport de pétrole par voie ferroviaire, nous avons fait valoir dans cet article que les transports par oléoduc et par voie ferroviaire sont des substituts imparfaits pour transporter le pétrole de l'Ouest canadien vers le marché mondial, et donc que l'effet total d'Énergie Est en termes d'émissions en amont et en aval est plus susceptible de se situer aux environs de 24 à 45 MtéqCO2 par année. Il est important de tenir compte des risques politiques ainsi que des facteurs économiques et techniques associés à de nouvelles infrastructures de transport de pétrole dans l'évaluation des émissions.

Table S2: Total Global Emissions (Upstream and Downstream) Associated with Energy East, Differentiating Between Imperfect and Perfect Substitutability of Pipeline and Rail

Émissions	**Substituabilité imparfaite entre transport par oléoduc et par voie ferroviaire**		**Substituabilité parfaite entre transport par oléoduc et par voie ferroviaire**	
	MtéqCO2/an	**Réference**	MtéqCO2/an	**Réference**
Émissions en amont*				
-Globales	(12-13)	(Voir le texte)	0,7-4,3	(Peters et al., 2015)
-Canada	30-32	(Flanagan and Demerse, 2014)	2,0-11,0	(Peters et al., 2015)
Émissions en aval				
-Globales	12-32	(Présente étude)	4,7-12,0	(Peters et al., 2015)
Total des émissions mondiales	24-45		5,3-17,0	

*Notons que nous estimons les émissions mondiales en amont à partir de l'estimé des émissions en amont de l'étude de l'Institut Pembina, qui ne considère pas la dynamique du marché mondial du pétrole, en nous basant sur un ratio des émissions en amont mondiales et des émissions en amont canadiennes provenant de l'étude de Navius. Cet estimé de 12-13 MtéqCO2 déterminé à partir de l'étude de Pembina est indiqué entre parenthèses dans le tableau ci-haut (voir le texte pour les détails).

Notre estimé de 24-45 MtéqCO2 quant aux émissions totales (en amont et en aval) associées à Énergie Est rapporté dans le tableau ci-dessus est-il substantiel? Nous affirmons que la portée de ces chiffres sera aussi politique. L'oléoduc Énergie Est constitue une pièce d'un puzzle beaucoup plus grand; cependant, ce grand puzzle est lui-même constitué de nombreuses petites pièces, et régi par la norme internationale de responsabilités communes mais différenciées (Asselt et Zelli, 2014; Purdon, 2015a; Stone, 2004). Le total des émissions mondiales de gaz à effet de serre se chiffrait à 46.049 MtéqCO2 en 2012 (WRI, 2016). Par rapport à ce chiffre, le total des émissions (en amont et en aval) résultant d'Énergie Est représente de 0,05 à 0,10%. Cependant, le total d'émissions en amont et en aval résultant d'Énergie Est représente de 3,4 à 6,4% des 702 MtéqCO2 émises au Canada en 2011 (Environnement Canada, 2013: 15). Enfin, en utilisant un calculateur d'équivalence de gaz à effet de serre mis au point par l'EPA (2015a), notre estimation du total des émissions associées à Énergie Est équivaut à l'ajout d'environ 5,0 à 9,5 millions de voitures sur les routes du monde. Soulignons à nouveau qu'en vertu des règles internationales comptables actuelles, le Canada n'est pas responsable des émissions en aval résultant de la consommation de pétrole à l'extérieur de ses frontières. Cependant, nos résultats contribuent également aux débats en cours quant au cadre comptable le plus approprié à adopter pour le régime international en matière de changement climatique - consommation ou production (Harrison, 2015; Peters et Hertwich, 2008).

Bien que la présente étude ne marquera sans doute pas la fin de la discussion sur Énergie Est, nous espérons qu'elle aidera à clarifier les discussions sur les nouveaux oléoducs au Canada et contribuera à ces débats internationaux importants. Cette étude est aussi assortie de certaines recommandations. Tout d'abord, il serait important qu'une modélisation économique plus détaillée soit effectuée en lien avec une sélection rigoureuse de différents scénarios contrefactuels incluant des facteurs économiques, techniques et politiques. Deuxièmement, il serait important d'évaluer la possibilité d'une augmentation significative du transport de pétrole par voie ferroviaire associée aux revendications contrefactuelle faites en référence à Énergie Est et d'autres oléoducs, y compris les effets sur la sécurité et la congestion. De telles recommandations pourraient être intégrées aux nouvelles règles en cours d'élaboration par le gouvernement fédéral canadien pour l'évaluation des propositions d'oléoducs (Muise, 2016).

1. INTRODUCTION

This paper aims to improve understanding of the potential impact of the Energy East pipeline on global oil consumption and consequent downstream emissions of greenhouse gases responsible for climate change. At a design capacity of 1100 thousand barrels per day (TBD), the Energy East pipeline is expected to take oil from Western Canada through Eastern Canada, largely for export to international markets. If the project proceeds, will this lead to a significant increase in emissions outside of Canada?

At the outset, it is important to clarify the distinction between so-called “upstream” emissions, those on Canada’s national territory, and “downstream” emissions due to consumption of Canadian oil abroad. Under United Nations accounting rules, countries are only responsible for emissions that occur within a country’s national borders (IPCC, 2006b: 1.4; UNFCCC, 2006: para.9). In 2011, Canada’s emissions stood at 702 megatonnes carbon dioxide equivalent, MtCO2e (Environment Canada, 2013: 15). But Canada is not responsible for emissions resulting from the combustion of Canadian oil elsewhere. However, it is increasingly recognized that production and consumption of fossil fuels needs to be significantly scaled back to avoid dangerous climate change (McGlade and Ekins, 2015)—assuming that rapid advancement in carbon sequestration technology is not achieved (see Keith et al., 2006; Preston et al., 2005 for discussion). Canada holds the world’s largest proven oil reserves after Venezuela and Saudi Arabia (CAPP, 2014: 3).

The evaluation of emissions associated with Energy East has proven to be politically sensitive. In November 2014, the governments of Ontario and Quebec required an evaluation of emissions associated with Energy East for their approval (CBC, 2014a; Vendeville, 2014). Yet Alberta’s former premier claimed that such an evaluation was unnecessary because “[t]he market will carry this oil through to market, it will either go by pipeline or by rail or other modes of transport” (Morgan, 2014). In December 2014, the governments of Ontario and Quebec dropped the emissions evaluation of the Energy East project from their conditions for project approval (Shields, 2014a); however Quebec’s *Bureau d'audiences publiques sur l'environnement* (BAPE), or Public Hearings Office, is currently considering them (Shields, 2016a). Similarly, while the National Energy Board (NEB), the federal regulatory body, formerly indicated that it would not evaluate the project’s impact on emissions (Shields, 2014b), the new Canadian government is currently developing new rules for the assessment of new pipelines (Muise, 2016).

Under these conditions, objective studies of the emissions resulting from Energy East are required. A study by Vaillancourt et al. (2015) found oil transport export capacity from Western Canada will be an important driver of oil production in Canada. The Pembina Institute estimated upstream emissions associated with Energy East on Canadian territory at 30-32 MtCO2e per year, largely due to the production and transport of oil (Flanagan and Demerse, 2014: 21). Another study that has considered upstream emissions associated with Energy East was carried-out by the consulting firm Navius (Peters et al., 2015). Their study is noteworthy in that it is based on Navius’ OILTRANS model of the global oil market, which simulates how the global oil market adjusts to the entry of new oil (p. 14-27). Navius concludes that Energy East will likely increase net global upstream emissions by only 0.7-4.3 MtCO2e per year (Peters et al., 2015: viii-ix), much less than that anticipated by Pembina. While upstream emissions in Canada increase to between approximately 2-11 MtCO2e in Navius’ model, this is offset by reduction in upstream emissions linked to reduced production elsewhere in the world (p. x). It is important to note that, under current UN accounting rules, however, Canada would still be responsible for upstream emissions on Canadian territory: 30-32 MtCO2e per year (Pembina Institute estimate) or 2-11 MtCO2e per year (Navius estimate). What explains these different estimates of upstream emissions?

While upstream emissions associated with Energy East are important, in this study we focus on downstream emissions. However, in contrast to the Keystone XL expansion pipeline, which has received considerable attention (Erickson and Lazarus, 2014; Leach, 2014a; b; Levi, 2014; McNutt, 2014; Palen et al., 2014), very few studies have been undertaken of the downstream emissions impact of the Energy East pipeline. The only study to consider the downstream emissions associated with Energy East has been the Navius study mentioned above (Peters et al., 2015). Navius concludes that, as a result of new oil brought to market by Energy East, the global average price of oil is likely to decline slightly which will lead to increased consumption of refined petroleum products outside of Canada and an associated increase in downstream emissions of 4.7-12.0 MtCO2e per year (Peters et al., 2015: vii). Total upstream and downstream emissions are estimated to reach 5.3-17.0 MtCO2e per year (p. x).

Yet in reaching these results, Navius assumes that oil transport by rail will have expanded to effectively compensate for any lack of pipeline. Specifically, their scenarios modelling the absence of new pipelines in Canada anticipate that oil transport by rail will increase from just below 200 TBD in 2013 to 2400 TBD by 2035—an increase of over 1000% (Peters et al., 2015, 27, 31-33). As will be explained, this quantity of oil is itself equivalent to the functional capacity of all pipelines currently being proposed in Canada. Is such an assumption valid? The assumption that pipelines and rail are near perfect substitutes suggests that construction of oil transport infrastructure is driven by international economic demand alone and tends to overlook other technical and political factors. Yet, the choice of oil transport scenario against which Energy East is evaluated—referred to as the reference scenario or counterfactual scenario—significantly affects the evaluation of the pipeline's effect on global emissions.

In this study, we offer an analysis of Energy East's impact on downstream, global emissions that considers economic, technical and political factors. While global oil prices will incentivize Canadian oil production and supply, oil transport capacity is also shaped by technical and political factors that render the substitutability of pipeline and rail imperfect. Consequently, we begin by reviewing Western Canadian oil supply, including estimates of the amount expected to need exit from Western Canada by 2030. Second, we carefully build seven counterfactual reference scenarios of Western Canadian oil exports from 2015 through 2030 that distinguish between different plausible combinations of pipeline and rail oil transport capacity. We note that the year 2015 was an eventful one for Canadian pipelines. The 830 TBD Keystone XL pipeline was rejected by the Obama administration (Koring, 2015); however the Alberta Clipper project quietly added 350 TBD of capacity in 2014 and 2015 (Enbridge, 2015b; e; Marcetic, 2016). Yet uncertainty remains about Energy East as well as three other Canadian pipeline proposals: TransMountain Expansion, Northern Gateway and the Line 3 Replacement of the Canadian Mainline system. An overview of all proposed and existing Canadian pipelines are presented in Table 1 below.

Third, at the heart of our paper is a careful appraisal of economic, technical and political risk factors affecting the likelihood of each counterfactual scenario's implementation, that is, in the absence of Energy East. For political risk analysis we use Hoberg's (2013) framework to evaluate in a qualitative manner which oil transport proposals are more likely to proceed than others—including pipeline and rail. Finally, for each counterfactual scenario, the relative effect of Energy East on global oil consumption and emissions is estimated using a simple economic model based on Erickson and Lazarus (2014) but modified in an important way to more accurately represent global price elasticities for oil supply and demand. As a number of experts have observed, the measure of elasticity of global oil supply used by Erickson and Lazarus is unrealistically inelastic (Leach, 2014a; b; Levi, 2014). In our version of the model, we use more appropriate measures of elasticity. While many factors are important in determining global oil consumption, long-term price elasticities of global oil supply and demand are amongst the most important factors used in modeling such global dynamics.

Across the seven counterfactual scenarios identified, the relative impact of Energy East on global emissions is found to vary from 3-40 MtCO2e per year. However, based on our risk analysis, we submit that the most likely and therefore appropriate counterfactual scenario against which to measure the effects of Energy East is Scenario 3 where, by 2030, limited new pipeline is constructed (TransMountain Expansion and Line 3 Replacement projects go ahead while Northern Gateway remains unimplemented) and limited new rail transport of up to 660 TBD is developed. If Energy East is not implemented, it seems reasonable that a limited amount of new pipeline and rail is constructed in its absence, bringing total oil transport capacity to 4419 TBD by 20130. However, this is still considerably below Navius estimate of 5000 TBD (Peters et al., 2015: 32). As for long-term price elasticities for global oil supply and demand, we submit that an extremely-low to low demand elasticity ($E_d = -0.07$ *to* -0.20) and medium supply elasticity ($E_s = 0.75$) are the most appropriate parameters for assessing the impact of new Energy East oil on global markets. Based on these factors, we estimate that against our most likely Scenario 3 counterfactual scenario, Energy East will lead to an increase in global annual oil consumption by 63-165 TBD and annual downstream emissions by 12-32 MtCO2e. When we consider the impact of Energy East relative to a counterfactual scenario that replicates assumptions about the near perfect substitutability of pipeline and rail, the pipeline increases downstream emissions by only 3-9 MtCO2e per year—a figure close to Navius' own estimate of 4.7-12.0 MtCO2e per year. Put differently, our estimate of the downstream emissions resulting from Energy East is more than 2.5 times as large as the only other existing study. We conclude that the feasibility of substituting pipeline with rail has a significant impact on estimates of emissions associated with Energy East and should be scrutinized in any evaluation of the downstream emissions associated with Energy East.

2. OVERVIEW OF THE ENERGY EAST PIPELINE

A project of TransCanada, Energy East would be the first pipeline to take oil directly from Western Canada to refineries and ports in Eastern Canada (Figure 1). It is one of three other new pipelines currently being proposed in Canada (see Table 1 below). The delivery points for Energy East include three existing refineries in Eastern Canada and, at least initially, two marine terminals (Cacouna, Québec and Saint John, New Brunswick). The terminal in Cacouna, Quebec has recently been withdrawn, largely given concerns about biodiversity, while alternative sites in Quebec are currently being considered (TransCanada, 2015b). TransCanada has anticipated an in-service date for the pipeline of late 2018. The proposed pipeline would have a capacity of 1100 TBD of which 900 TBD is underpinned by firm contracts. It would carry a mix of crudes, with the share of light crude and heavy crude (diluted bitumen) ranging from 20-80% (Flanagan and Demerse, 2014: 18-19).

Based on our review of the available literature, Energy East oil is expected to be largely exported to international markets. First, even after adjusting for functional capacity and diluent recover, the estimated volume of Western crude oil transported by Energy East would exceed the combined capacity of 772 TBD at the three proposed refineries in Québec and New Brunswick (CFA, 2015: 16; Flanagan and Demerse, 2014: 17). Second, Eastern Canadian refineries are not currently equipped to refine oil sands crude and have existing agreements with other foreign crude suppliers which would inhibit immediate uptake of crude oil from Western Canada (Flanagan and Demerse, 2014: 16-17). Upgrading refineries to process oil sands could however have considerable economic advantages over refining foreign light crude, which is marginally more expensive (Deloitte, 2013: 16-17). Yet, third, despite potential upgrading, the supply of Energy East oil would exceed local demand. For example, there is already a new marine export terminal just outside of Montréal, currently supplied by oil transported by train from Western Canada (CBC, 2014b; Gerbet, 2015; Lui, 2014). Furthermore, refineries in Montreal have recently gained access to 300 TBD oil sands crude from the recently completed Line-9 project (Wilson, 2015)—a quantity of oil more than one half of Canada's current international imports. Finally, we note that Quebec is actively seeking options to electrify its transport sector in order to reduce its carbon footprint (MTQ, 2015), which would likely reduce domestic demand for oil in Eastern Canada if successful.

Given these factors, we do not explicitly model a situation where Energy East oil is refined and consumed in Canada. Regardless, because oil consumed in Canada also contributes to global warming, the impact on total emissions is not expected to be significantly different than if Energy East oil is not exported. We note that over the period 2013-2014, total oil consumption in Canada declined slightly from 1622 TBD to 1576 TBD—well below the estimated 1873 TBD capacity at existing Canadian refineries (CFA, 2015: 16).

Figure 1: Map of Proposed Energy East Route

The existing gas pipeline system consists of several individual pipes running in parallel with each other. This project will entail the conversion of just one of those individual pipes.

Source : TransCanada (2015a)

Table 1. Western Canadian Oil Pipeline Capacity

Pipeline	Firm	Design Capacity (TBD)	Functional Capacity* (TBD)	Geography	Federal Regulatory Status	State/Provincial Regulatory Status	Implementation Status
Proposed Pipelines							
1) Energy East	TransCanada	1100	990	Alberta (& SK) to Quebec & NB	Under Consideration	Under Consideration	Not implemented
2) Northern Gateway	Enbridge	525	473	Alberta to BC	Approved 2014	Under Consideration	Construction not started; expected late 2018
3) TransMountain Expansion	Kinder Morgan	590	531	Alberta to BC	Under Consideration	Under Consideration	Construction not started; expected in service 2018
4) Mainline Line 3 Replacement	Enbridge	370	333	Alberta to Wisconsin	Under Consideration	Under Consideration	Some construction started; expected in service late 2017
Total Proposed Pipeline Capacity		2585	2327				
Existing Pipelines (2015)**							
1) Canadian Mainline	Enbridge	2621	1992	Alberta to Wisconsin	Approved	Approved	Operational
2) TransMountain	Kinder Morgan	300	297	Alberta to BC	Approved	Approved	Operational
3) Express	Spectra	280	199	Alberta to Wyoming	Approved	Approved	Operational
4) Keystone	TransCanada	591	520	Alberta to Oklahoma	Approved	Approved	Operational
5) Alberta Clipper Phase II	Enbridge	230	207	Alberta to Wisconsin	Approved	Approved	Operational
6) North Dakota* Pipeline**	Enbridge	-210	-189	North Dakota to Manitoba	Approved	Approved	Operational
7) Bakken Pipeline Project***	Enbridge	-145	-131	North Dakota to Wisconsin	Approved	Approved	Operational
Existing 2015 Pipeline Capacity		3667	2895				
Grand Total (Proposed + Existing Pipeline)		6252	5222				

* Review of throughput versus capacity of various Canadian pipelines indicates that older pipelines like the Canadian Mainline operate considerably below capacity (NEB, 2014: 14-20). It is reasonable to assume that new pipelines operate at approximately 90% capacity.

** Includes Kinder Morgan TransMountain, Spectra Express, original Keystone as well as Canadian Mainline including Phase 2 of Alberta Clipper expansion (CAPP, 2015c; Enbridge, 2015a: 24; 2015b; e; Marcetic, 2016). The two pipelines in North Dakota flow into the Canadian Mainline, currently reducing capacity for transporting Western Canadian oil, for which reason they are subtracted from the final tally.

*** These pipelines from North Dakota flow into the Canadian mainline system, reducing space for Western Canadian oil transport (Enbridge, 2014; 2015c).

3. METHODOLOGICAL APPROACH

3.1. Counterfactual Methods

We construct seven counterfactual scenarios of Western Canadian oil export infrastructure against which the impact of Energy East is evaluated (Table 2). Each scenario details a possible evolution of oil transport capacity over the period 2015-2030. What would the future export of Western Canadian oil be if the Energy East pipeline were not to proceed? We quantify the effect of Energy East by comparing an estimate of global oil consumption and emissions under each counterfactual scenario to the counterfactual scenario plus Energy East. Some scenarios actually compensate for the lack of Energy East, rendering Energy East itself partially unnecessary. We discuss the actual operationalization of our counterfactual analysis, particularly justification of a counterfactual upper limit, in more detail below.

Note that in this study we distinguish between pipeline design capacity and functional capacity. Pipelines rarely operate at full capacity; their capacity is affected by maintenance, pressure reductions as well as the type of product—a pipeline can transport more light crude oil than heavy crude oil (NEB, 2014: 4). Review of throughput versus design capacity of existing Canadian pipelines indicates a range of 71-99% functional capacity (NEB, 2014: 14-20). We assume all new Canadian pipeline will operate at 90% functional capacity.

TABLE 2: SEVEN COUNTERFACTUAL SCENARIOS

Counterfactual Scenario	2030 New Pipeline Design Capacity			2030 New Rail Movements		Total Design Capacity in 2030	Total Functional Capacity in 2030
	North. Gateway (525 TBD)	Line 3 (370 TBD)	TransMountain (590 TBD)	Limited Rail	Extensive Rail	(TBD)	
1) 2015 Status Quo Pipeline & Rail*	-	-	-	-	-	3867	3095
2) Limited New Pipeline & No New Rail	-	✓	✓	-	-	4827	3959
3) Limited New Pipeline & Limited New Rail 660	-	✓	✓	✓ (460 TBD)	-	5287	4419
4) Limited New Pipeline & Limited New Rail 400	-	✓	✓	✓ (200 TBD)	-	5027	4159
5) Limited New Pipeline & Rail Compensates for Energy East	-	✓	✓	-	✓ (990 TBD)	5817	4949
6) Extensive New Pipeline & Limited New Rail	✓	✓	✓	✓ (460 TBD)	-	5812	4892
7) Navius: Limited New Pipeline & Extensive New Rail**	-	✓	-	-	✓ (1400 TBD)	5378	5000

* See Table 1 for 2015 pipeline capacity of 2895 TBD while 2015 rail capacity estimated at 200 TBD. See text for details.

** Assumes that Navius assessment of exports for crude oil and refined petroleum products (Peters et al., 2015: 31-32) of 3400 TBD has been adjusted for pipeline functional capacity. Total rail capacity in 2030 is estimated at 1600 TBD, of which 1400 TBD is new. See text for details.

Counterfactual scenarios are routinely used in climate policy planning and evaluation. They are perhaps best known in carbon offset systems, such as the Clean Development Mechanism (CDM) of the Kyoto Protocol. There has been considerable concern about the appropriate measurement of the CDM's counterfactual emissions scenario because it is against this that carbon credits are awarded (Purdon, 2014; 2015b; Purdon and Lokina, 2014; Wara, 2008; Zhang and Wang, 2011). Counterfactuals have also played an important role in assessing the climate change impact of the Keystone XL pipeline. In a 2014 report, the US State Department concluded that the Keystone project would add 1-27 MtCO2e annually: the pipeline "is unlikely to significantly affect the rate of extraction in oil sands areas (based on expected oil prices, oil-sands supply costs, transport costs, and supply-demand scenarios)" (US Department of State, 2014: ES-9 & ES-15). Relatively high global prices, as they stood in 2014, were expected to make alternative transport options feasible, including new "east-west pipelines" and rail in Canada (US Department of State, 2014: ES-12). However, the State Department also identified a price of $65-$75 USD per barrel to be the critical threshold for such new transport capacity (US Department of State, 2014: ES-12). Many have questioned the State Department's conclusion because the price of oil has dropped significantly (for example, EPA, 2015b). As noted by Levi (2014), the implication of a low price for oil is that it would make rail less competitive, given that it is relatively more costly than pipeline. However, as we argue, political factors are also important in the evaluation of counterfactuals.

3.2. Political Risk Analysis

A major strength of the current paper is that it considers the political risks of non-approval facing Canadian oil infrastructure projects. As Hoberg (2013) explains, the examination of political risk should focus on (i) the presence of institutional veto points and (ii) how the risks, interests and resources of strategic actors are influenced by the structure of the policy problem (p. 373-374). He identifies five variables by which to measure political risk (Table 3). The first three variables relate to veto points, which Hoberg defines as a set of authoritative decisions that can block the approval of an oil transport project. For reasons discussed below, rail has certain characteristics, namely that it relies on existing infrastructure to a larger degree, that reduce opportunities for institutional veto relative to pipeline where new ground needs to be broken. However, we consider rail to carry more risk in terms of Hoberg's second political risk factor, environmental risk and the jurisdictional separation of risk and benefits.

TABLE 3: HOBERG'S FIVE VARIABLES OF POLITICAL RISK

Political Risk Factors	Political Risk Variable	Description
1. Veto Risk	1a. The number of institutional veto points	Institutions vested with direct or indirect authority over the decision-making process
	1b. Whether opposition groups have access to veto points	Political risk is higher when those opposed to a project are in a position of authority and lower when they are not.
	1c. Whether the project can take advantage of existing infrastructure	Projects that are forging a new path will require new easements and other permits. Projects that use or trace the path of existing infrastructure are at less risk of regulatory disapproval
2. Risk Associated with the Structure of the Policy Issue	2a. The salience of place-based, concentrated environmental risks	An oil spill or train derailment will result in concentrated environmental impacts in specific location, often removed from the jurisdiction benefiting.
	2b. The jurisdictional separation of risks and benefits	Most of the oil in question is being developed in Alberta and, to a more limited degree, Saskatchewan while the risks are to be borne by other states and provinces.

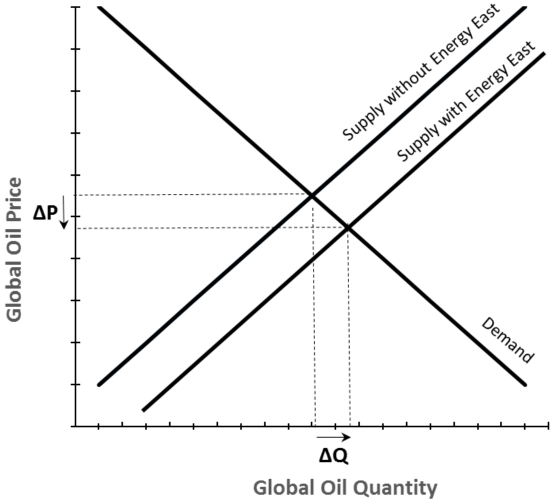
3.3. Economic Model for Estimating the Effect of Energy East on Global Oil Consumption

Simply putting new Western Canadian oil on the global market does not necessarily lead to an increase in oil consumption proportional to the amount of oil brought to market; rather it depends on how responsive global markets are to it. Drawing on Erickson and Lazarus' (2014) study of Keystone XL, we estimate the increase in annual global crude oil consumption per barrel resulting from Energy East oil reaching global markets based on the long-term price elasticities of global oil supply and demand. The ratio of increased global consumption to small increases in global production can be approximated as the long-term price elasticity of demand (E_d) divided by the difference between the long-term price elasticity of demand (E_d) and the long-term price elasticity of supply (E_s). See Equation 1 below. While many factors are important in modeling global oil consumption, long-term price elasticities of global oil supply and demand are amongst the most important.

$$\frac{\Delta\, Consumption}{\Delta\, Production} \cong \frac{E_d}{E_d - E_s} \qquad \text{Equation 1}$$

To summarize our model, greater transport capacity for Western Canadian oil made possible by the Energy East pipeline represents a non-price change in global supply that leads to a shift in the global supply curve (Figure 2).

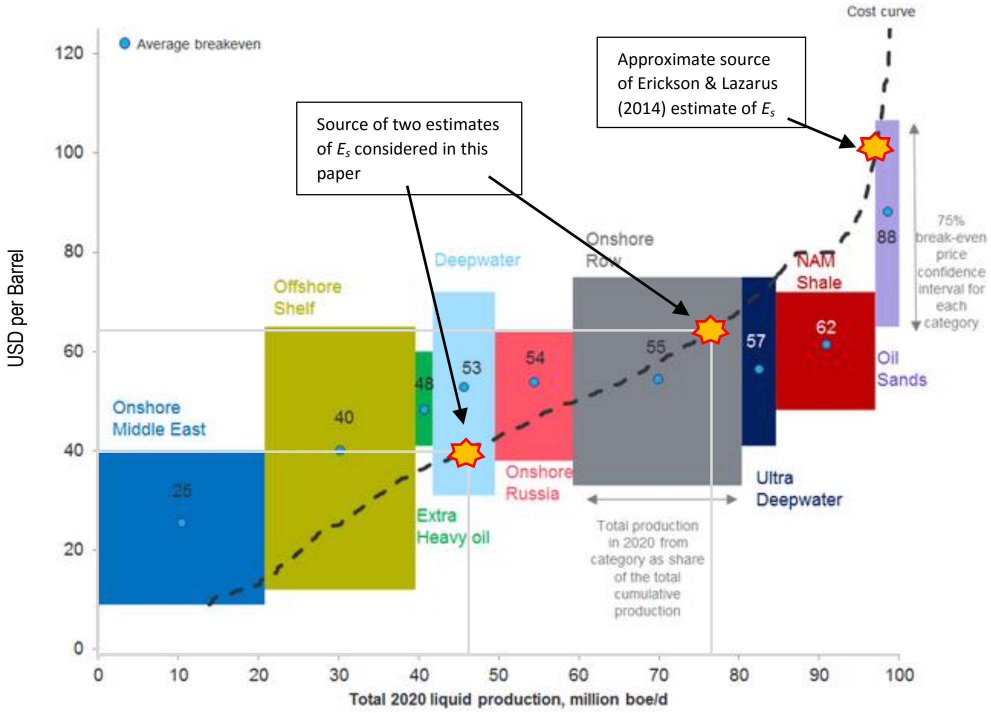
Figure 2: Schematic of the shift in global oil consumption resulting from Energy East



In using Erickson and Lazarus' (2014) simple model in our evaluation of Energy East, we need to confront two major criticisms of it when originally applied to Keystone XL. First, Leach argued that Keystone XL would not have resulted in a shift in the global supply curve because it alone would not affect the marginal supply of oil to global markets (Leach, 2014a; b). Erickson and Lazarus overlooked the fact that alternative, albeit more expensive transportation options for shipping Western Canadian oil sands existed, including the Energy East pipeline and rail. Rather than a shift in the supply curve, Keystone would simply result in a movement up the supply curve—assuming Energy East and/or new rail are constructed.

We argue, however, that the addition of Energy East and/or new rail would result in a slight shift in the global supply curve because the presence or absence of such new transport infrastructure would affect the marginal cost of supplying oil to global markets. Canadian oil sands production is widely considered the most costly oil in the world currently in production (see Figure 3). Furthermore, amongst proposed Canadian pipelines, Energy East is the longest and therefore most expensive pipeline currently be proposed in Canada. As Leach (2014b) observes, only transporting Western Canadian oil by train would be more expensive than using Energy East to get Canadian oil to market. By considering political factors affecting Energy East and new rail, this study addresses non-price factors involved in transporting Western Canadian oil and, consequently, capable of shifting the global supply curve.

FIGURE 3: 2020 COST CURVE OF GLOBAL OIL SUPPLY (USD PER BARREL)



Source: Nysveen (2015)

The second major criticism of Erickson and Lazarus' (2014) model is that it has been incorrectly parameterized with a highly inelastic price elasticity of supply, $E_s = 0.13$, resulting in an exaggeration of the impact of Keystone XL (Leach, 2014a; b; Levi, 2014). The parameters of E_s and E_d in Equation 1 above significantly influence estimates of oil consumption and thus global emissions, perhaps moreso than any other factor considered in this study. Price elasticity is an observable measure of the responsiveness of the quantity of a good supplied (or demanded) to a change in its price (Varian, 2003: 270-271). An inelastic supply (or demand) indicates that the amount of a good supplied (or demanded) is relatively unresponsive to a change in price. An elastic supply (or demand) indicates that the amount of a good supplied (or demanded) changes considerably when its price changes. It is conventional to consider an elasticity value of less than 1 to be inelastic and a value greater than 1 to be elastic. Elasticity of supply is typically a positive measure as higher price is generally an incentive to produce more oil. The elasticity of demand is usually a negative number as increasing price reduces demand.

Erickson and Lazarus obtained their measure of elasticity of global oil supply from a 2020 global oil supply curve assembled by Rystad consultancy (see Figure 3 above), an estimate of 2020 global oil consumption of 96,620 TBD maintained by US Energy Information Administration (US EIA, 2013), and assuming the price of oil would be $101 USD per barrel. Consequently, they conclude that new supply of oil delivered by Keystone XL might lead to a relatively large increase in global emissions, up to 110 MtCO2e per year, because global oil supply would be generally unresponsive to new Keystone XL oil and foreign producers would not curtail their production. But as Levi (2014) argues, the global oil supply is likely to be much more elastic, with producers scaling back production in response to new oil supplied to global markets. This is even more relevant since the global drop in oil prices. Indeed, the significant change in global oil prices makes challenging any study that seeks to evaluate the impact of new oil transport infrastructure projects on global emissions. Prices have fallen from over $100 USD per barrel in mid-2014 to reach $45 USD by October 2015, declining to approximately $32 USD in January 2016 though returning to $40 USD in March 2016 (NASDAQ, 2016). We note also that Western Canadian oil is typically sold at prices below the global price (Bakx, 2015; Williams, 2015).

While retaining the basic model depicted in Equation 1, we agree with the criticism of Erickson and Lazarus' measure of the elasticity of global oil supply and discard it. Instead, we use a more realistic range of measures of E_s and E_d. For reasons explained below, we submit that an extremely-low to low long-term price elasticity of demand ($E_d = -0.07$ *to* -0.20) and medium long-term price elasticity of supply ($E_s = 0.75$) are the most appropriate measures for estimating the effect of new oil on global consumption. That is, each new barrel of oil production reaching global markets leads to an increase in consumption of between 0.09-0.21 barrels (Table 4). We justify the selection of these parameters in the section below.

TABLE 4: DEMAND AND SUPPLY PRICE ELASTICITIES USED IN ESTIMATION OF INCREASE IN ANNUAL CRUDE OIL CONSUMPTION PER BARREL OF NEW OIL REACHING GLOBAL MARKETS

Long-term Price Elasticity of Supply	**Medium Supply Elasticity** $E_s = 0.75$	
Long-term Price Elasticity of Demand	**Extremely Low Demand Elasticity** $E_d = -0.07$	**Low Demand Elasticity** $E_d = -0.20$
Consumption/Increased Production	0.09	0.21

Long-term Price Elasticity of Global Oil Supply

We consider the long-term price elasticity of supply a similar global supply cost curve as Erickson and Lazarus (2014), but using more appropriate price points: $65 USD per barrel ($E_s = 0.75$) and $40 USD per barrel ($E_s = 1.08$). The first price point is the critical threshold price for the viability of rail transport for Western Canadian oil identified by the US State Department, as discussed earlier. A number of observers anticipate global prices recovering to at least this level in the medium-term. For example, the World Bank envisages prices returning to $60-$70 USD per barrel by 2016 and returning to over $100 USD per barrel over the next decade (Baffes et al., 2015: 18 & 42). Recently, OPEC members as well as Russia agreed to freeze oil production at January 2016 levels in a bid to stabilize global prices (Graves, 2016). The second price point indicates relatively high elasticity and approximates current oil prices. In interpreting our results, we believe the value of $E_s = 0.75$ is the more representative estimate of long-term price supply elasticity given that we expect oil prices to recover to the range of US$65-$75 per barrel by 2020, for reasons discussed below. In our economic model, we only use the medium sensitivity price elasticity of global oil supply.

Long-term Price Elasticity of Global Oil Demand

The long-term price elasticity of global oil demand must also be selected with care. However, we observe three short-comings of the studies usually consulted for the long-term price elasticity of oil demand (Cooper, 2003; Dahl and Sterner, 1991; Hamilton, 2009; Javan and Zahran, 2015). First, few are based on recent data and many go back to the 1970s and the effect of the OPEC oil embargo. Second, most studies have historically focused on developed countries of the Organization for Economic Co-operation and Development (OECD), despite the fact that developing countries currently account for most new growth in oil consumption. Third, historical analysis of demand elasticities suggests an important asymmetry depending on the direction of change (Gately, 1993; Gately and Huntington, 2002). When the global price of oil increases, as it did during the 1970s oil embargo, global demand for oil slumped. However, the reverse has not proven trued: when oil prices drop, this has typically not resulted in greater global consumption but rather a continuation at current levels. The implication is that societies become more efficient in their use of oil when prices are high and retain these efficiencies for a not insignificant period of time. As more research into the elasticity of demand has focused on oil price spikes rather than price drops, an over-estimation of elasticity of demand appears likely during periods of declining prices. Altogether, these issues suggest that relatively inelastic measures of global oil demand are more appropriate.

Consequently, we use two relatively inelastic measures of the long-term price elasticity of global demand for oil in this study. First is the key measure of price elasticity of demand by Erickson and Lazarus ($E_d = -0.20$), upon which their claims about the impact of Keystone are based. This measure is at the low end of elasticities reported in Hamilton (2009: 190), from which Erickson and Lazarus derived it.[1] We note that there has been little criticism of Erickson and Lazarus selection of long-term price elasticity of demand. Second, because the survey of Hamilton (2009) is based on relatively old empirical data, we also include a more recent empirical analysis of data collected in developed and developing countries (IMF, 2011: 89-124). The IMF found the elasticity of demand measured from 1990-2009 to be much lower than estimates above: $E_d = -0.072$ for combined developed and developing countries, $E_d = -0.093$ for developed countries and $E_d = -0.035$ for developing themselves (IMF, 2011: 97). Since global oil markets are comprised of developed and developing countries, we use the IMF's $E_d = -0.072$ measure of elasticity of global demand for oil as a second measure. Both measures are relatively inelastic, suggesting that there is currently little substitute for oil as a source of global energy and demand remains relatively stable despite changes in global prices.

A Note on Our Economic Model

A potential criticism of our study is that the model we use is too simple to realistically model global oil markets. As Hamilton (2009: 190) explains, both oil supply and demand in any given year are responding to numerous factors, for which reason complex economic models are often favoured for analyses of this kind. It assumes that the only potential shift in the global supply curve results from the entry of Energy East and also assumes that global supply and demand curves are linear. Our model also ignores the international political economy of the oil trade, where the cartels such as OPEC are recognized to shape the market to their benefit (Smith, 2009). Nonetheless, when parameterized with appropriate supply and demand elasticities, the model we have used does offer a window for estimating emissions associated with Energy East that can be verified with more detailed modeling. While many factors are important in determining

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[1] We note that Navius used a range of long-term price elasticities of demand ranging from -0.26 to -0.84 (Peters et al., 2015: 26), derived from Hamilton (2009). For their key reference scenario, Navius used a measure of elasticity of demand that is of medium sensitivity: $E_d = -0.58$ (Peters et al., 2015: 25-27). However, results using this elasticity of demand in our model were unrealistically high and are not presented.

global oil consumption, long-term price elasticities of global oil supply and demand are amongst the most important factors used in modeling such global dynamics. The advantage of application of our model is that it is used in conjunction with the careful consideration of counterfactual scenarios against which Energy East is evaluated. Furthermore, to the extent that our results approach those of Navius when using their assumptions about substitutability between rail and pipeline, we have confidence in our results.

3.6. Transforming Oil Consumption into Emissions

We transform estimates of additional global oil consumption into emissions using IPCC emission factors. These indicate that tar sands are associated with approximately 46% greater emissions than conventional crude (IPCC, 2006a: 1.23).[2] This is because extracting an upgrading oil sands bitumen currently requires significantly more energy than conventional oil (Flanagan and Demerse, 2014: 18) As we are uncertain of the final mix of crude oil to be shipped, we estimate emissions based on range of two different compositions of pipeline content suggested by the Pembina Institute: 80:20 ratio of light crude oil to bitumen (low bitumen content) and 20:80 (high bitumen content) (Flanagan and Demerse, 2014: 19).

Bitumen requires diluent for pipeline transport (CAPP, 2015c: 9-10; Flanagan and Demerse, 2014: 19). Untreated bitumen has low viscosity, with a consistency similar to peanut butter. Consequently, the high bitumen content scenario needs to account for the volume of diluent that is not exported but rather recovered. Based on CAPP's production versus supply forecast (CAPP, 2015c: 4 and 10), discussed in more detail below, we assume that diluent decreases exports of bitumen by 14% relative to synthetic crude/light crude oil.

4. OIL TRANSPORT CAPACITY AND WESTERN CANADIAN OIL SUPPLY

In order to measure the relative effect of Energy East, we need to carefully review current and anticipated oil transport capacity and supply. Here we make use of trends and forecast reported by the Canadian Association of Petroleum Producers (CAPP) as they evolved from 2013 to 2015—before and after the global price drop (CAPP, 2014; 2015c). We note that CAPP itself does not forecast crude oil prices, rather their trends and forecasts are based on a survey of producers who respond based on their own internal view of long-term oil prices (CAPP, 2014: 1; 2015c: 1). The degree to which technical and political constraints are incorporated into these capacity and supply forests is unclear, though as we shall demonstrate expected 2030 supply of 5341 TBD approximates our estimate of total pipeline functional capacity 5222 TBD that would be achieved if all new proposed Canadian pipelines including Energy East were implemented. Whether it is technically and politically feasible to implement such an amount of new pipeline or other modes of oil transport infrastructure, is at the heart of our analysis.

In relying on CAPP supply forecasts, our study does not explicitly model a relationship between global oil price and Western Canadian production. However, assuming that CAPP administers its surveys in the first quarter, its 2014 report captures producer forecasts associated with a price of $100 USD per barrel price and its 2015 report captures forecasts associated with $50-$60 USD per barrel. We base our model on CAPP's 2015 forecast because prices implicit in this forecast are closer to the price for oil anticipated by

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[2] While there are various estimates, we have opted to use 2006 IPCC default values of 73.3 tCO_2e/TJ (0.430 tCO_2e/barrel) for conventional crude oil and 107 tCO_2e/TJ (0.627 tCO_2e/barrel) for oil sands crude (IPCC, 2006: 1.23).

the World Bank and other observers, as discussed above. Consequently, our analysis results in a conservative estimate of the pipeline's impact should global prices rise to US$65-$75 USD per barrel.

4.1 Recent Trends in Western Canadian Production and Supply

We first consider recent trends in Canadian oil production and supply as well as existing pipeline and rail oil transport capacity as they stood before and after the global price drop. In 2013, when oil prices hovered around $100 USD per barrel, total production of Canadian oil stood at 3529 TBD, of which 93% was derived from Western Canada (CAPP, 2014: 3-4). Canada refines and consumes a sizeable portion of the oil it produces, about 975 TBD in 2013 of which 905 TBD was sourced from Western Canada (CAPP, 2014: 11).[3] Oil for domestic consumption is delivered to Canadian refineries itself by pipeline, though imported oil is generally delivered by ship (Crawford, 2011: 11). The remaining 2378 TBD of Western Canadian oil produced in 2013 was exported, an increase from 1000 TBD in 1993 (CAPP, 2015a; b).[4] Almost all Canadian exported oil is purchased by entities in the US (EIA, 2015a; b). In 2013, the design capacity of pipelines exiting Western Canada stood at 3671 TBD, which includes Kinder Morgan TransMountain, Spectra Express, and the original Keystone (CAPP, 2014: 23). At an estimated functional capacity of 2916 TBD, this is still greater than 2013 export levels of 2378 TBD.

By 2013 the level of crude oil transported by rail in Canada was just under 200 TBD (CAPP, 2014: 31-32), representing a 300% increase relative to 2011 (CAPP, 2014: 30, see Figure 4.2). Marine transport appears to be linked to existing pipeline and rail infrastructure. For example, there is Suncor's new marine terminal on the St. Lawrence River north of Montreal (CBC, 2014b; Gerbet, 2015; Lui, 2014). Western Canadian crude oil is otherwise not currently transported on the Great Lakes St. Lawrence Seaway (GLC, 2014), though oil tankers carrying imported oil have supplied refineries in Saint John, Quebec City and Montreal for decades (Globe and Mail, 2014). While oil is also exported by oil tanker from Burnaby, BC, this itself is reliant on the existing TransMountain pipeline. Consequently, except for just under the 200 TBD transported by rail, 2378 TBD of Western Canadian oil exited the region largely by pipeline in 2013, before the global price drop.

Already in 2015, there has been a considerable increase in pipeline capacity out of Western Canada. The Alberta Clipper pipeline added 230 TBD upon completing Phase II of the project (Enbridge, 2015b; e; Marcetic, 2016), bringing the design capacity of Canadian pipelines to 3667 TBD. It is also important to consider new oil production in the Bakken formation of North Dakota and Montana, which is already feeding into the existing Enbridge Mainline pipeline system (Enbridge, 2014). Inflows from the North Dakota Pipeline and Bakken Pipeline Project occupied 210 TBD and 145 TBD of design capacity, respectively, on the Canadian Mainline system (CAPP, 2015c: 24; Enbridge, 2015c). Accordingly, we subtract these amounts from our assessment of 2015 total pipeline capacity. Pipeline capacity in North

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[3] Canada still imported 642 TBD of oil from foreign sources, with most importation occurring in Eastern Canada (CAPP, 2014: 11).

[4] We note that production, domestic consumption and export due not perfectly align between CAPP (2014) and CAPP (2015a, 2015b). We maintain the 3529 TBD production figure and 2278 TBD export from Western Canada as measured in CAPP (2015a, 2015b).

Dakota has grown from 80 TBD to 355 TBD over the period 2007-2013 and is planned to reach a capacity of 580 TBD in 2017 (Bloomberg, 2015; ND Pipeline Authority, 2015).[5]

However, rail transport has shown slower growth since 2013. Despite important increases in rail movents from 2011-2013, movements levelled off after a peak in 2014 in response to the global price drop (CAPP, 2015c: 32, see Figure 4.2).[6] CAPP observed actual rail movements of 185 TBD in 2014 and estimated 200 TBD in 2015 (CAPP, 2015c: 32). Finally, domestic consumption of Canadian oil increased slightly from 2013 measures, to a total 1034 TBD of which 1000 TBD sourced from Western Canada (CAPP, 2015c: 12).

4.2 Forecasts of Western Canadian Production and Supply

How will Western Canadian oil production evolve into the future? Before the global price drop, CAPP forecast production of 6350 TBD by 2030 (CAPP, 2014: 3). Subsequent to the price drop, many experts have expected the rate of production will decline: CAPP "anticipates that total oil production continues to grow but at a slower pace" (CAPP, 2015c: 1). Relative to its 2014 forecast, CAPP has now projected a 17% reduction in production to 5230 TBD in response to the global price drop (CAPP, 2015c: 4). CAPP still expects growth of 156 TBD/year through 2020, though now expecting growth to decline by nearly half (85 TBD/year) from 2020-2030 due to reduced capital investments (CAPP, 2015c: 5; 2015d).

Why continue Western Canadian production at all given the drop in global prices? A first explanation is that Western Canadian oil producers have sought to retain market share in anticipation of a return to higher global oil prices in the not so distant future (Austen, 2015). As indicated above, we believe that prices will return to US$65-75 per barrel range by at least 2030. Second, despite currently low oil prices, new oil sands projects are still attractive if their construction has already commenced or if they constitute an extension of an existing site (Leach, 2015). Operating costs before the oil price drop have been as low as $34-38 USD per barrel (Leach, 2015). The effect of oil prices is likely to be felt more in terms of transport options, as shipping by rail is generally acknowledge to be more expensive than pipeline—a matter that we discuss in more detail below.

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[5] Looking further ahead, CAPP expects oil production from the US Bakken formation to increase and constitute a potential major new volume of oil transported on Canada's existing pipeline network: from analysis of CAPP figures, we estimate expected new US production at 1542 TBD by 2030 (CAPP, 2015c: 34). This estimate is derived from reading Figure 4.5 in CAPP (2015c: 34), which suggests Western Canadian oil and US Bakken movements stand at a total of 6772 TBD by 2030. Subtracting CAPP's 2030 forecast of Western Canadian production of 5230 TBD (2015c: ii), we arrive at the estimate of 1542 TBD for new oil production from North Dakota to be transported on the pipeline system owned by Canadian companies. Similar analysis drawn from the 2014 CAPP forecast, before the global price drop, suggests a similar amount: 1543 TBD from North Dakota. This is derived from an estimated 7893 TBD total Canadian and North Dakota supply by 2030 minus 6350 TBD Western Canadian only supply (CAPP 2014: i & 34). While a possible bottleneck, it is likely that Enbridge will be able to accommodate this volume of oil through expansion of appropriate sections of the mainline system located in the US. For example, the upgrade of Line 61 as well as a construction of Line 78 and Southern Access Extension Pipeline Project are expected to increase capacity by 1670 TBD and have all become operational in late 2015 (Enbridge, 2015d).

[6] CAPP (2014: 32) anticipates rail movements to increase from 200 TBD in 2013 to a projected 700 TBD in 2016, which suggests 375 TBD in 2014. However, comparison of oil movements in 2014 and 2015 indicates that rail movements peaked in early 2014 and declined slightly into 2015 (compare Figures 4.2 in CAPP (2014) and CAPP (2015)).

How much future oil transport capacity is required to match forecast production? A first factor is to estimate the actual volume that exported oil will occupy on pipelines exiting Western Canada. As discussed above, oil sands bitumen needs to be mixed with diluent in order to be moved by pipeline. This "supply" volume of oil sands crude and diluent takes up more space on the pipeline network. In its forecast before the global price drop, CAPP estimated that Western Canadian oil supply in 2030 would stand at 7450 TBD relative to production of 6350 TBD (CAPP, 2014: 9). Subsequent to global oil price drop, CAPP now estimates that the 5230 TBD of Western Canadian oil produced by 2030 will represent 6058 TBD of supply volume after being mixed with diluent—an increase in volume of approximately 16% (CAPP, 2015c: 10). Second, a portion of Western Canadian oil is consumed domestically and reduces reliance on Western Canadian pipelines exiting the region to international markets. Further complexity arises from the fact that Western Canadian oil consumed in Ontario also depends on pipelines crossing into the US at the Minnesota-North Dakota border before re-entering Canada at the Ontario-Michigan border. Refineries in Ontario that accept Western Canadian oil have a combined capacity of 410 TBD; Western Canada possesses 626 TBD of refining capacity linked to pipeline found in Western Canada (CFA, 2015: 16). Therefore, only the 626 TBD of oil refined in Western Canada would not rely on current oil transport capacity and relieve congestion on the current pipeline system.

In conclusion, we estimate that, based on CAPP's (2015c) forecast, 4604 TBD of future Western Canadian oil production—equivalent to an estimated 5341 TBD of supply—is expected to exit from Western Canada through pipeline or rail by 2030. This supply volume is nearly double 2015 pipeline functional capacity exiting Western Canada, explaining efforts to secure greater oil transport capacity. A similar calculation based on CAPP's (2014) forecast, before the global price drop, suggested 6640 TBD of oil supply (5724 TBD production) would seek exit to international markets. For reasons provided above, we believe CAPP's most recent forecast is more representative of long-term global oil prices, for which reason it is used in our economic model.

5. PIPELINE RISK ANALYSIS

5.1. Overview of Pipeline Political Risk Factors

Recalling our discussion of political risk factors, we first consider opportunities for institutional veto of Canadian pipeline projects. As discussed by Hoberg (2013), when pipelines cross Canadian national or provincial boundaries, they are under the jurisdiction of the Canadian federal government through the authority of the National Energy Board Act (NEBA) and Canadian Environmental Assessment Act (CEAA). Both acts have been substantially revised under the controversial 2012 budget implementation bill, which amended any NEB decision to be a recommendation to the federal cabinet rather than be a final decision; the 2012 budget implementation bill also significantly reduced the scope of the CEAA (Hoberg et al., 2012).

However, given the nature of Canadian federalism, institutional veto are also found outside the federal government. As Hoberg also observes, while provinces do not have direct jurisdictional authority over interprovincial pipelines, due to their authority over provincial lands and resources they still have considerable veto power. An important veto player at the provincial level, albeit one of limited authority, are institutions for environmental impact assessment. In Quebec, the BAPE, or Public Hearings Office, has been an important feature of provincial environmental policy (Gauthier and Simard, 2007; Gauthier et al., 2011). While BAPE recommendations are not binding on government, the institution does play an important role in giving voice to environmental concerns and shapes the legitimacy of environmental decision-making.

Many Canadian municipalities have voiced discontent with pipeline proposals. Recently, Montreal-area municipal governments announced their formal opposition to Energy East (Feith, 2016). Yet as creatures of provincial legislation (Makuch et al., 2004), however, municipal governments are more limited in their veto power over any potential pipeline development. In many parts of Canada, particularly many parts of British Columbia where treaties have not been settled, First Nations have a certain degree of institutional veto power over pipelines. The Canadian Supreme Court has decided that government has an obligation to consult and accommodate First Nations when projects could affect their rights and title, though also explicitly stating that this does not confer veto power to them (Treacy et al., 2006). However, as Hoberg observes, courts clearly have a veto if they believe the government has not effectively accommodated the concerns raised by First Nations.

As for the second group of political risk factors, the risks resulting from the structure of the policy issue, particularly the jurisdictional separation of risks and benefits, looms large in pipeline projects. For example, a 2014 academic poll showed that only 33% of Quebeckers support Energy East while 50% of Albertans do (Shields, 2014c). In a study of Keystone XL's politics, public opinion with regard to the project has been found related to political party affiliation, political ideology as well as proximity (Gravelle and Lachapelle, 2015). The mayor of Montreal explained that Montreal-area municipalities were "against the Energy East pipeline project because it still represents a serious environmental threat, with too little economic benefits for the greater Montreal region" (Feith, 2016).

In what follows, we apply these two dimensions of political risk analysis to the three alternative pipelines also being considered in Canada. See Table 5 for a summary of this evaluation as well as a similar evaluation for new rail, which is itself discussed in the section below.

TABLE 5: SUMMARY OF RISK EVALUATION OF PROPOSED PIPELINES

Political Risk Factors	Proposed Pipelines			New Rail	
	Northern Gateway (525 TBD)	TransMountain (590 TBD)	Line 3 (370 TBD)	Limited (400-660 TBD)	Extensive (990-1400 TBD)
1. Veto Risk	High	High	Low	Medium	High
2. Risk Resulting from Structure of Policy Issue	High	Medium	Low	Medium	High

5.2. Northern Gateway

The Northern Gateway Project of Enbridge would consist of a 525 TBD capacity pipeline connecting Alberta to a marine terminal in Kitimat, British Columbia. In 2014, the federal NEB recommended that the project be approved. Federal approval is contingent on Enbridge satisfying some 209 conditions, more than half of which have to be met before the company can commence construction (Mason, 2014). Perhaps in light of federal approval, CAPP reports that the target in-service date for the project is late 2018 (CAPP, 2014). However, the reality of Canadian federalism is that, despite gaining federal approval, the project faces considerable opposition in BC, which has delayed indefinitely the project.

A number of veto risks present themselves. First Nations have taken legal action as well and a deal without accommodating their interests appears unlikely (Coates, 2014). But most importantly, the BC government announced in 2012 that the project would be subject to five conditions for it to receive provincial approval

(BC Ministry of Environment, 2012a), which are reproduced in Table 6 below. In BC's 2015 Speech from the Throne, the government stated "We will continue to stand up for BC with our Five Conditions on heavy oil pipelines. Not to build walls against development, but to articulate the way we do business in BC" (BC Government, 2015). Most recently, the BC Supreme Court has brought the project to a halt on the grounds that the BC government did not consult First Nations on key aspects of the project and cannot grant sole decision-making authority to the federal government (Morton, 2016). As for the risks resulting from the structure of the Northern Gateway pipeline, these are also high. Environmentalists in BC have raised questions about climate change impact and the risk of inland and coastal oil spills and have been preparing legal challenges (Suzuki, 2014). Indeed, the risk analysis that formed an integral part of the federal governments approval has been heavily criticized by various academics and professional engineers (Chan et al., 2014; CPE, 2014).

Given the continued debate about the Northern Gateway project within BC, there is a certain element of doubt that Enbridge will proceed with its construction. Despite receiving federal approval "things have been mighty quiet on the Northern Gateway front, with no mention of the pipeline in the Q4 earnings, nor in the end of quarter conference call, and only a page dedicated to the project in Enbridge's 75-page year-end information form" (Johnson, 2014). The new federal government has proposed a ban on oil tanker traffic on BC's North Coast in late 2015 (Hage, 2015). With both veto risks and risks resulting from the structure of the policy issue, the political risks confronting Northern Gateway are significant and we conclude that it is unlikely to go forward.

Table 6. BC government's 5 conditions to consider support for the Northern Gateway project

1) Successful completion of the environmental review process. In the case of Enbridge, that would mean a recommendation by the National Energy Board Joint Review Panel that the project proceed;
2) World-leading marine oil spill response, prevention and recovery systems for B.C.'s coastline and ocean to manage and mitigate the risks and costs of heavy oil pipelines and shipments;
3) World-leading practices for land oil spill prevention, response and recovery systems to manage and mitigate the risks and costs of heavy oil pipelines;
4) Legal requirements regarding Aboriginal and treaty rights are addressed, and First Nations are provided with the opportunities, information and resources necessary to participate in and benefit from a heavy-oil project; and
5) British Columbia receives a fair share of the fiscal and economic benefits of a proposed heavy oil project that reflects the level, degree and nature of the risk borne by the province, the environment and taxpayers.

Source: BC Ministry of Environment (2012a)

5.3. TransMountain Expansion

Northern Gateway is not the only new pipeline project being considered to export oil sands crude through BC. In 2013, Kinder Morgan submitted an application to the NEB for an expansion of its existing TransMountain pipeline and maritime terminal in Burnaby, along Vancouver's bay; it would expand export capacity from 300 TBD to 890 TBD (Kinder Morgan, 2015).

If approved and constructed, the TransMountain Expansion would entail construction of two parallel pipelines (Lines 1 and 2) twinning the existing pipeline route (CAPP, 2014: 28; Kinder Morgan, 2015). This Line 1 would consist of existing pipeline segments and could transport 350 TBD of refined petroleum products and light crude or potentially heavy crude oil, but at a loss of capacity. The proposed Line 2 would have a capacity of 540 TBD and would be allocated to the transportation of heavy crude oil. The expansion is underpinned by firm contracts totalling 708 TBD. The BC government observes that this expansion would increase the number of oil tankers in Vancouver's Burrard Inlet to 20-25 per month from the current

4-5 per month (BC Ministry of Environment, 2012b: 2). Most recently, both the BC government and Vancouver have stated their disapproval of the project to the NEB, largely because it is perceived not to include an adequate plan to prevent or respond to an oil spill and, therefore, that the risks of the project outweigh the benefits (CBC News, 2016; Mandel, 2016). As for Northern Gateway, the veto risks for the project are high as provincial and municipal institutions are currently opposed to the project.

In terms of the risks resulting from the structure of the policy issue, the Kinder Morgan expansion project appears less controversial than the Northern Gateway project. We base our reasoning on the fact that the project will largely trace the existing TransMountain pipeline, where right-of-way approvals appear to have already been obtained. While some First Nations have voiced opposition, Kinder Morgan has secured "mutual benefit agreements" along much of the route, though it is still in negotiation with a number (Penner, 2015). Overall, political opposition appears lower in comparison to Northern Gateway. At the same time, current Alberta Premier Notley has been actively supporting the TransMountain Expansion bid though appear to desist from the promotion of Northern Gateway (Canadian Press, 2016; Varcoe, 2016). And the Alberta government has been reported to be resisting overtures from BC to sell its hydroelectricity to the oil rich province, with Alberta's energy minister recently stating "We won't be buying more power if we can't get our resources to market" (Cattaneo, 2016). A high level deal of BC hydropower for at least one Alberta oil pipeline appears possible, with TransMountain Expansion being the more likely candidate.

5.4. Mainline Line 3 Replacement

In addition to Northern Gateway, Enbridge is also currently planning to nearly double the capacity of a key pipeline comprising its existing Canadian Mainline system taking oil from Alberta to Wisconsin and, from there, to the US Gulf Coast and eastern refineries. The Line 3 replacement project will replace pipeline on both sides of the border with a larger capacity pipeline, increasing capacity from 390 TBD to a total of 760 TBD. In contrast to Keystone expansion, the Line 3 expansion project is not under legal obligation to acquire US presidential permit as it is considered a maintenance project and not a new project (Lewis, 2014). Indeed, certain segments of the project have already been constructed (Enbridge, 2015d: 8), including connections to the 145 TBD US Bakken Pipeline project (Enbridge, 2015c) and an expanded border crossing linked to the Alberta Clipper project (Enbridge, 2015b; e; f; Marcetic, 2016).

Both political risk factors are low. Assuming the pipeline project continues to legally be considered a maintenance project and not a new project, it avoids the key veto risk of needing to acquire a US presidential permit. In terms of the risks associated with the structure of the policy issues, there are also low because the project generally expands on existing pipelines rather than constructing entirely new routes. Consequently, we conclude that the mainline Line 3 replacement project seems highly likely.

6. RAIL RISK ANALYSIS

6.1. Risk Factors

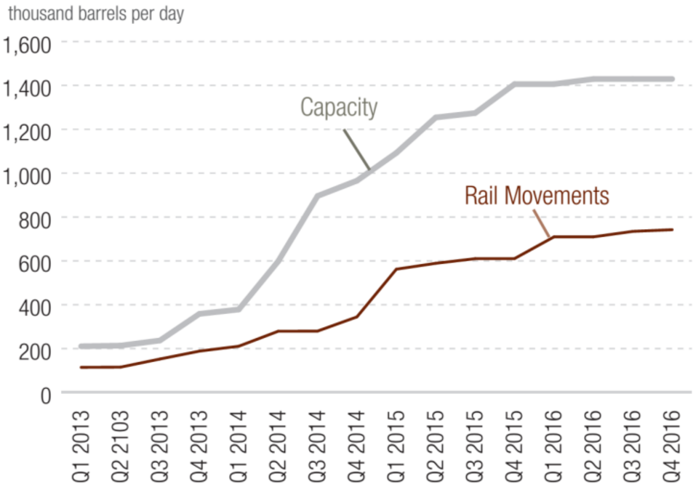
It is true that rail transport has been tapped in recent years to compensate in part for insufficient pipeline infrastructure, but how much further might rail transport expand in North America? Is rail capable of compensating for the absence of Energy East and other pipelines? Recall that built into its reference scenario for evaluating Energy East, Navius assumes an increase in rail transport from 200 TBD to 2400 TBD by 2035 (Peters et al., 2015: 31-33)—more than the functional capacity of Energy East, Northern Gateway, TransMountain Expansion and Line 3 Replacement project combined (2327 TBD).

In our assessment of the prospects for expanding Western Canadian oil transport by rail, we consider economic, technical *and* political factors. While rail is uneconomic at current 2015 prices, we do not anticipate the global price of oil to be the limiting factor over the long-term. Rather, the key factors limiting substitutability between rail and pipeline are technical and political challenges involved in the significant increase in rail transport. After breaking down the risks involved with additional rail transport, it is difficult to avoid the conclusion that sufficient additional rail transport infrastructure to compensate fully for the lack of new pipelines in Canada is highly unlikely. However, some will undoubtedly be constructed if global prices return to the critical $65-$75 threshold.

First we consider the economic risks of oil transport by rail. Relative to pipelines, the costs facing Western Canadian oil producers are greater when shipping by rail (Leach, 2014a; b). Shipping by traditional "manifest" trains to the US Gulf Coast might cost $17-$21 USD per barrel (Hussain, 2014; 2015). Such trains carry a range of goods, not just oil. Dedicated "unit" oil trains, that might stretch over a mile, promise greater economies of scale and the reduction of costs to $13-$17 USD per barrel (Hussain, 2014). The first unit train rolled out of Edmonton in late 2013, at which time a number of players planned investment in such new train systems (Hussain, 2014). In comparison, the cost of shipping from Western Canada to the US Gulf Coast by pipeline is $7-11 USD per barrel (Hussain, 2014; 2015). However, there are some economic advantages to shipping by rail, given that rail networks already run close to many oil facilities, uploading capacity can be more quickly built than pipelines and that oil sands crude can be shipped without costly diluent (Green, 2013: 10). Nonetheless, since the drop in global oil prices, the amount of oil being shipped by train has begun to decline. Recall that rail movements reported by CAPP increased from approximately 50 TBD in 2011 to 185 TBD in 2014, though 2015 data suggested a leveling off around 200 TBD. As prices continue to deteriorate into late 2015-early 2016, there are increasing signs of a decline in oil transport by rail (Atkins, 2015; Wright, 2016).

A second limiting factor is the technical challenges involved in ramping up oil transport by train. Here it is important to distinguish between rail uploading capacity and actual rail movements. Before the global price drop, CAPP estimated that uploading capacity would be 1000 TBD in 2015 and might rise to 1400 TBD by 2016 (CAPP, 2014: 31-32). These uploading capacity forecasts for 2015 and 2016 are important because they were made prior to the effects of the global price drop be felt, and we return to them later. However, CAPP expected 700 TBD to actually be transported in 2016 (Figure 5). That is, rail is only expected to work at 50% efficiency—much poorer than pipelines. CAPP describes a number of factors that reduce actual capacity including supply connections, system bottlenecks, operational inefficiencies, limited hours of operation, and ramp up time required to achieve full utilization (CAPP, 2014: 32). At 50% transport efficiency, Navius' target of transporting 2400 TBD by rail would require a total of 4800 TBD in uploading capacity. As evidence in support of such an increase, Navius refers to a 800 TBD increase in rail export capacity in North Dakota between 2010-2013 (Peters et al., 2015: 33). Is this comparison appropriate? We return later to the question of whether the observed increase in North Dakota is transferable to the Canadian context.

Figure 5: Expected Rail Uploading Capacity and Rail Movements (TBD)



Source: (CAPP, 2014: 32)

For the moment, we observe there are significant technical challenges involved in ramping up rail capacity to compensate for the absence of new pipelines, most importantly including increased congestion. The logistical complexity of Canada's rail network was recognized by Transport Canada in its 2011 review:

> *The rail-based logistics system is complex and involves a range of stakeholders, including shippers, railways, terminal operators, transloaders, ports, shipping lines and trucks. As well, there is a broad range of factors affecting efficient and reliable service, some of which are under the control of railways and others under the control of shippers, receivers/terminals and shipping lines. Problems incurred by any one of these stakeholders can cause system congestion impacting all stakeholders. There are also other factors beyond anyone's control, such as disruptions related to severe weather or accidents. Any of these problems can disrupt the entire system for extended periods of time.*
>
> *The rail portion of the logistics system is, by itself, quite complex. For example, CN and CP operate nearly 1,300 trains a day. These serve hundreds of customers and their work involves the planning, scheduling and management of approximately 2,000 train crews, 3,000 locomotives and 200,000 rail cars. In 2009, there were approximately 28,000 route-miles of track in Canada, about 75 percent of which were owned or leased by CN and CP. CN and CP have to coordinate their operations with other railways, including 49 shortline operators, with whom they interchange approximately 10,000 cars a day. In addition, the railways have to coordinate their activities with other logistics partners, including shippers and receivers, ports, terminals and transloaders (Transport Canada, 2011 : 38).*

We know of no study that has considered the effect on Canada's rail congestion if oil transport by rail were to increase to levels sufficient to replace proposed new pipelines. Surely without proper planning such an increase in rail traffic would risk contributing to rail congestion, making rail transport issues more politically salient than at 200 TBD levels in 2015. For a general analysis of railway fulfillment of shipper demand and transit times in Canada for the period 2006-2008, prior to rise of Canadian oil transport, see QGI Consulting (QGI Consulting, 2010).

Putting aside economic and technical issues, we argue that the politics surrounding oil transport by rail in North Dakota are unlikely to play out in a similar way in most jurisdictions in Canada. Continuing with the

North Dakota example, a key issue is the jurisdictional separation of risks and benefits resulting from the structure of the policy issue. North Dakota produces the oil that is being transported by rail. In pointed contrast, jurisdictions that would take on increased rail oil transport in Canada would only see indirect economic benefits. The asymmetry between risks and benefits is important because of the perceived greater safety risks of trains. Indeed, advocates of pipelines often justify them in terms of safety relative to trains. The Canadian Energy Pipeline Association (CEPA) writes: "While other forms of transportation are available, pipelines provide a safe, economical and constant flow of crude oil, natural gas and petroleum products" (CEPA, 2015). Safety concerns are especially high in Quebec, given the 2013 Lac-Mégantic disaster. Here an unattended 73-car train carrying crude oil from North Dakota derailed, resulting in a fire and explosion that killed 45 people and destroyed almost all of the town's downtown. We conclude that the risks resulting from the structure of the policy are relatively high for rail transport, with these risks increasing with the quantity transported (Table 5).

Are these safety concerns justified? Industry analysts observe that between 2012 and 2014, Canadian pipelines and railways delivered 99.9997% of the gallons they transported without spillage—spilling 729,000 gallons (Oliver Wyman, 2015: 3). Whether this amount of oil is ecologically significant or not is beyond the scope of the present study and we focus on comparing rail and pipeline safety records. Such a comparison is challenging given the use of rail is a relatively recent phenomenon in Canada and data are not readily available before 2012. Comparing spill rates and incidence rates in Canada suggest that pipeline is less dangerous (Table 7a). However, averaging across a ten-year period (2004-2014), one report observes that spill rates and incidence rates for pipeline are considerably higher than rail, respectively. Lacking comparable rail data for the same ten-year period, we do not believe it is possible to make a robust conclusion. The United States has been tracking comparable data in the US for a longer period. Safety records from 1990-2009 from the US indicate that, when compared to pipeline, rail transport averaged lower quantities of oil spilled per barrel-mile transported though was associated with greater fatalities and injuries per barrel-mile transported (Table 7b). Cairns (2015) also suggests the data show safety gains between the periods 1990-2000 and 2000-2009 with regards to oil spills from rail and pipeline, though the data also show increasing fatalities and injuries for rail while little change for pipeline. Longer and more detailed safety records for rail and pipeline would be necessary to allow more sophisticated time series analysis to determine the veracity of these trends. Note that the units in the two sections of Table 6 are different and thus results between Canada and the US not directly comparable.

However, in comparison to pipelines, there appear to be relatively fewer opportunities for institutional veto available for rail. The main reason is that, up until a certain amount of oil is transported, rail does not require breaking new ground, but would mostly use existing track. Similar to pipelines, provinces do not have jurisdiction over interprovincial or international rail, which is regulated by the federal government through Transport Canada and the Canadian Transportation Agency, CTA (Railway Safety Act Review Secretariat, 2007). While it has a limited role in railway safety, the CTA has regulatory powers over economic matters such as licensing, cost apportionment, and competitive access—particularly the power to issue the Certificate of Fitness required to operate a railway and which must specify the termini and route of every railway line to be operated (*Ibid.*: 22). To the extent that increased oil rail transport results in greater traffic on existing lines, the scope for provincial intervention therefore appears more limited than for pipeline.

Table 7: Safety metrics for rail and pipeline in Canada (2012-2014) and US (1990-2009)

A) Spill Rate and Indenc Rates in Canada (2012-2014)				
	Spill Rate Canada		**Incidence Rate Canada**	
	Thousand Gallons Spilled per Billion Gallon-Miles		**Incidents per Billion Gallon-Miles**	
	Rail	**Pipeline**	**Rail**	**Pipeline**
2012	7.0	14.1	0.010	0.010
2013	20.1	2.6	0.011	0.002
2014	7.6	3.7	0.003	0.004
Average	11.6	6.8	0.008	0.005

Source: Oliver Wyman (2015: 4-7)

B) Spill Rates, Fataility Rate and Injury Rate in US (1990-2009)						
	Spill Rate US		**Fatality Rate US**		**Injury Rate US**	
	Barrels Spilled per Billion Barrel-Miles		**Fatalities per Billion Barrel-Miles**		**Injuries per Billion Barrel-Miles**	
	Rail	**Pipeline**	**Rail**	**Pipeline**	**Rail**	**Pipeline**
1990-2000	36.8	35.6	0.0009	0.0005	0.011	0.003
2000-2009	16.5	23.9	0.0013	0.0005	0.017	0.001
Average	25.0	29.8	0.0011	0.0005	0.015	0.002

Source: Cairns (2015: 33-44)

However, while there are relatively fewer institutional veto point for rail than pipeline, this should not be interpreted as implying that there are none. A certain level of new landing infrastructure would need to be constructed at either port facilities or Canadian refineries, particularly if extensive amounts of oil were to be transported. For example, dedicated “unit” trains require railyard of at least 80 ha of relatively flat land (Zielinski, 2013). Any such new development would implicate provincial governments since land-use planning and development is both a provincial and a municipal responsibility (Railway Safety Act Review Secretariat, 2007: 104). Furthermore, increased rail congestion might require construction of new track and alternative railway crossings. Such new construction would also be open to provincial and municipal intervention. Consequently, the veto risks increase with the level of new rail. For a limited level of new rail, the veto risk are medium as provincial and municipal governments might only play a moderate role. For extensive new rail, the veto risks are high as the extensive amount of new rail will very likely affect congestion and require developing new provincial and municipal lands.

Overall, give the separation between jurisdictional risks and benefits and other institutional veto opportunities, we maintain that it is highly unlikely that sufficient new rail transport capacity will be constructed to compensate completely for Energy East if it is not implemented. If a safer transport option (pipelines) is rejected, it does not follow that a politically less-favourable alternative will replace it because this is economically feasible. While a certain degree of new rail infrastructure might complement existing pipelines, a major effort to expand rail infrastructure to compensate for pipelines is far from certain to receive positive endorsement. Put differently, veto risks and the risks resulting from the structure of the policy issue increase with the amount of new rail expected to be transported rail (see Table 5 above). Both these risk are estimated at medium levels for the limited new rail though high for extensive new rail, which we define below. Estimating the actually amount of oil that is represented by these scenarios is the topic of the next section.

6.2. Estimating Feasible New Rail Levels

Our above rail risk analysis suggests that politics will be an important factor limiting the extent of oil transport by rail, in addition to economic and technical constraints. However, neither does our analysis indicate an easy formula for predicting the level of new rail that might be built in the absence of Energy East and other pipelines and . As this is of key importance to our counterfactual analysis, we distinguish between three scenarios pertaining to different levels of new rail: (i) no new rail, (ii) extensive new rail and (iii) limited new rail.

First, it is not impossible but unlikely that rail transport will be frozen at 2015 levels of 200 TBD. In terms of economic and technical factors, such a scenario is unlikely because rail uploading capacity saw considerable growth when oil enjoyed high global prices and new technical solutions such as the move towards more efficient "unit" trains emerged. In terms of politics, despite being a high profile during the 2015 Canadian federal election (Maclean's, 2015), no federal candidate proposed halting oil transport by rail; even oil transport through Lac-Mégantic is slated to resume in 2016 (Feith, 2015).

Yet, secondly, we believe it is also equally unlikely that extensive new rail is built to compensate completely for the lack of new pipeline capacity. To compensate for the functional capacity of Energy East, rail transport movements would need to increase from 200 TBD to 990 TBD by 2030—nearly a 500% increase. If none of the other three remaining proposed Canadian pipelines are implemented, rail transport would need to increase to 1337 TBD—a more than 600% increase. Assuming rail movement efficiency remains 50%, uploading capacity would need to increase to 1980 TBD and 2674 TBD, respectively, for the two scenarios described above. This is considerably more than the 1400 TBD that was expected prior to the global price drop. It is reasonable to conclude that extensive new rail would be highly politically salient and would draw considerably more opposition, making such an expansion appear unlikely. As discussed above, we conclude that both the veto risks and risks associated with the structure of the policy issue to be high for extensive new rail (Table 5).

Identifying a politically feasible amount of rail expansion is challenging, but we believe combining insights from economic, technical and political risk analysis illuminates a pathway to a more appropriate measure. First, if global oil prices return to the critical threshold of $65-$75 USD per barrel over the medium-term as anticipated, we expect the economics of rail transport will become favourable again. However, we think it unlikely to see rail uploading capacity to reach the anticipated high of 1400 TBD observed when prices hovered around $100 USD per barrel. Rather, a return to 1000 TBD in uploading capacity expected by CAPP in 2015 (CAPP, 2014: 31-32) appears reasonable if global oil prices return to the critical threshold level. Second, it is reasonable to expect an increase in rail transport efficiency, particularly if more "unit" trains come into service. Over a fifteen-year period of time, we believe it is reasonable to expect that rail transport efficiency increases from 50% to 66%. Applying this to the 1000 TBD uploading capacity above, by 2030 trains might technically be able to move a total of 660 TBD. Is this really politically feasible? Even 660 TBD represents a 330% increase over 2015 train exports. We note that in a recent public consultation session in Quebec, TransCanada suggested that trains might be able to deliver up to 400 TBD though the basis of this figure is unclear (Shields, 2016b).

In our evaluation of Energy East below, we retain both 400 TBD and 660 TBD as possible levels of total rail movements under the limited rail scenarios. While the structure of the policy issue is similar to the extensive new rail scenario, both veto risks and risk resulting from the structure of the policy are expected at medium levels because not as much oil is being transported relative to the extensive scenario. However, we consider the 660 TBD more likely as we have a means of estimating it, while we are unclear about the justification for the 400 TBD. We emphasize that these are just estimates and further study of rail transport capacity to transport Western Canadian oil in the absence of new pipelines is necessary.

7. EVALUATION OF ENERGY EAST DOWNSTREAM EMISSIONS

In order to discuss the impact of Energy East on global downstream emissions, we independently model its effects relative to each of our seven counterfactual scenarios. Drawing on our risk analysis of new pipeline and rail options in Canada, we assess in a qualitative manner the likelihood of each counterfactual scenario existing in the absence of Energy East. This permits us to identify the most likely and therefore most appropriate counterfactual scenario against which to evaluate the impact of Energy East. We then quantify the effect of new Energy East oil brought to market on global consumption and emissions by comparing each counterfactual scenario to the counterfactual scenario plus Energy East (Table 8). All such evaluations are based on pipeline 2030 functional capacity as estimated in Table 1. For example, we have assumed that Energy East is set at 90% functional capacity meaning that it would effectively be able to transport 990 TBD of fluids. It is the difference between the counterfactual scenario and counterfactual scenario plus Energy East after adjusting for the counterfactual upper limit, discussed below, from which the amount of Energy East oil brought to global markets is estimated. A counterfactual upper limit is important because, relative to different counterfactual scenarios, Energy East oil is likely to crowd out and substitute for less preferable transport options such as rail. We then apply our economic model to determine the additional net global oil consumption associated with new Energy East oil and, finally, transform this into emissions, estimating for both low and high bitumen content (Table 9).

7.1. Counterfactual Upper Limit

When quantifying the relative effect of the Energy East pipeline, it is important to identify a boundary or upper limit to Western Canadian oil transport capacity in order to frame our counterfactual analysis. That is, what is the maximum functional capacity of oil that might be expected to be transported in the future in the absence of Energy East. This counterfactual upper limit is important because we evaluate the impact of Energy East by gauging whether the oil it transports would actually be necessary relative to each counterfactual scenario. Certain counterfactual scenarios represent quantities of oil that approach this counterfactual upper limit in their own right, meaning that, in comparison, the effect of Energy East is only partial. Defining a counterfactual upper limit is important to avoid over-estimating the impact of Energy East in counterfactual scenarios where Energy East, if it were implemented, would replace less preferred oil transport options such as rail.

First, we assert that the counterfactual upper limit should be defined in terms of pipeline. Recall that we have asserted that while global oil prices will incentivize Canadian production and supply, oil transport capacity is also shaped by domestic technical and political factors. Considering economic, technical and political factors together, we have demonstrated that there are grounds to believe that pipelines are a more feasible transport option than rail. Consequently, the counterfactual upper limit is represented by the situation where Energy East, Northern Gateway, TransMountain Expansion and Line 3 Replacement are implemented. The functional capacity of all four new proposed pipelines is 2327 TBD. Following this logic, the maximum functional capacity of oil supply exiting Western Canada in 2030 is estimated to be 5222 TBD: 2895 TBD (2015 pipeline) plus 2327 TBD (all new proposed pipelines). See Table 1.

Second, we think it highly unlikely that rail would be built to surpass the maximum functional capacity represented by new pipelines. If all proposed pipelines were to be implemented, we think it unreasonable to expect that additional new rail be tapped to export beyond the total capacity of 2327 TBD represented by all four proposed pipelines. Because pipelines are the preferred transport option, new rail will only be substituted for pipeline that has not been implemented up to the counterfactual upper limit. Where extensive new rail forms part of the counterfactual scenario, it assumes new rail will compensate for the lack of pipelines up to the upper limit level of 5222 TBD but will not surpass this amount.

We note that our counterfactual upper limit is approximately the same amount of oil expected to be supplied from Western Canada, after accounting for Western Canadian consumption: 5341 TBD. See Section 4.2 above. However, this supply estimate tends to reflect economic demand alone and not other technical and political factors which, as we have argued, are likely to shape oil transport capacity. If the supply of 5341 TBD were set as the counterfactual upper limit, this actually would increase pressure for Western Canadian oil export capacity, indicating that our 5222 TBD counterfactual upper limit is actually conservative for the evaluation of Energy East. Overall, the ultimate limiting factor on oil transported is oil transport infrastructure and not supply.

7.2. Counterfactual Likelihood Assessment

In our status quo scenario where pipeline and rail transport options are frozen at 2015 levels, the absence of Energy East is significant. Functional capacity in 2015 has been estimated at 3095 TBD, of which 2895 TBD is pipeline and another 200 TBD by rail. This is well below the 5222 TBD upper limit level. When considered relative to this counterfactual scenario, the absence of Energy East is significant. The addition of Energy East to this Scenario 1 would total 4085 TBD, which is still below the upper limit level identified. Thus if one were to consider the impact of Energy East relative to the current situation, the pipeline would be found to have considerable impact. However, it is unlikely that the 2015 status quo scenario prevails. Consequently, our other counterfactual scenarios become important.

By 2030, we consider it unlikely that Scenario 2 will come to pass: a limited amount of new pipeline capacity totalling 3759 is constructed, consisting of TransMountain Expansion and Line 3 Replacement, but no new rail is constructed beyond 200 TBD status quo levels. We recognize that TransMountain Expansion project is still a controversial project, but the level of political risk is slightly lower relative to Northern Gateway given that the pipeline is to expand an existing line while Alberta’s Premier Notley appears to be putting her political weight behind it. If Energy East were itself to be rejected, there would be considerable political pressure to see one of these two BC pipelines implemented. Under this scenario, there is no growth in rail transport above 200 TBD which, as discussed above, appears unrealistic especially as international prices return to the critical threshold of $65-$75 USD. However, from the point of view of our counterfactual analysis, results here are little different than Scenario 1. This is because the total functional capacity of this counterfactual Scenario 2, at 3959 TBD, is still well below our upper boundary limit of 5222 TBD. The difference between Scenario 2 and upper boundary limit is 1263 TBD, which is more than Energy East’s 990 TBD functional capacity. Thus, similar to Scenario 1, the absence of Energy East for Scenario 2 is measured in its entirety.

Combining insights from pipeline and rail risk analysis above, we believe the most likely and therefore most appropriate counterfactual scenario against which to measure the effects of Energy East is Scenario 3. In this counterfactual scenario, in the absence of Energy East, only TransMountain Expansion and Line-3 Replacement are constructed, providing 3759 TBD functional capacity. However, economic and technical improvements allow a limited amount of new rail transport to be realized, up to a maximum 660 TBD. Above the rail transport level of 660 TBD, we think that there are strong reasons to believe that the politics of rail transport would become highly contested. Overall, total oil transport functional capacity under this counterfactual scenario stands at 4419 TBD, which is still below our upper boundary limit of 5222 TBD by 803 TBD. Note that this is slightly less than Energy East's functional capacity of 990 TBD. Consequently, the absence of Energy East is slightly less significant relative to this counterfactual scenario, as only 80% of its oil is necessary to reach the upper boundary limit of 5222 TBD. Is it appropriate to consider only a fraction of the Energy East pipeline's impact? We maintain that it is possible because, as pipeline is generally preferred to train, adjustments can readily be made to rail transport if Energy East were to actually be implemented. Here it is helpful to consider what would transpire if Energy East were implemented in addition to the other two pipelines considered in this scenario. Here total pipeline functional capacity would stand at 4749 TBD, meaning that only 473 TBD of rail transport would be necessary—instead of the 660 TBD expected in the absence of Energy East—to approach the total oil transport capacity threshold necessary for future oil supply.

Scenario 4 is very similar to Scenario 3. While also a likely, it is relatively less likely than Scenario 3 because, for reasons explained earlier, we believe that amount of new rail constructed is more likely to reach 660 TBD rather be limited to 400 TBD.

In our Scenario 5, we would also expect that TransMountain Express and Line 3 Replacement projects would go ahead as above; however, we discount political opposition and allow rail export capacity to increase to fully compensate for Energy East. The total rail under this scenario would include the 200 TBD status quo baseline level but add an additional 990 TBD to reach a total of 1190 TBD. Consequently, the total functional capacity of oil transported under this scenario stands at 4949 TBD, which is only 273 TBD below our upper boundary limit of 5222 TBD. The absence of Energy East is therefore less significant relative for this counterfactual scenario compared to others considered thus far, as only 28% of its oil is necessary to reach the upper boundary limit of 5222 TBD. Is this scenario realistic? For reasons described earlier, we believe it unrealistic to expect rail transport to expand above the 660 TBD threshold we have identified.

It is unlikely that Scenario 6 will be implemented, where all three proposed pipelines are brought into service—including TransMountain Expansion, Line 3 Replacement as well as the more controversial Northern Gateway—but only a limited amount of new rail transport of 660 TBD is constructed. Under this scenario, the functional capacity of oil export infrastructure from Western Canada would increase to 4892 TBD by 2030. This is actually less than under Scenario 5 above because Northern Gateway (included in Scenario 4) is not as large a pipeline as Energy East, the equivalent oil of which is transported by train in Scenario 5. The total functional capacity of oil transported under this scenario is only 330 TBD below our upper boundary limit of 5222 TBD and the absence of Energy East is also not very significant relative to our first three scenarios as only 33% of its oil is necessary to reach the upper boundary limit of 5222 TBD.

In our last Scenario 7 we sought to replicate the reference scenario used by Navius in their study. The total capacity of total oil export infrastructure stands at 5000 TBD by 2030, including 1600 TBD of rail and 3400 TBD of pipeline export capacity. The figure of 3400 TBD of pipeline export capacity is difficult to interpret. Does it represent design or functional capacity? We assume 3400 TBD represents the functional capacity for the following reasons. First, the Navius figure suggests 2015 pipeline export capacity of just under 3000 TBD in 2015 though climbing to 3400 by 2020 after which it remains constant through 2035 (Peters et al., 2015: Figure 15). From our review, the design capacity of Canadian pipelines in 2015 stood at 3667 TBD and functional capacity at 2895 TBD—the latter being closer to Navius' estimate. Second, in order to move from 3000 TBD to 3400 TBD, it would appear that Navius assumes that some new pipeline capacity comes online after 2015. From our analysis, the most likely new pipeline is the Line 3 Replacement project, which would bring the total functional capacity to 3228 TBD. While this is not exactly the same 3400 TBD functional capacity as in the Navius model, it is reasonably close. We note that Navius published their study in early 2015 and therefore it is largely based on estimates of new pipeline development in 2014 when there was still considerable uncertainty about the Keystone XL and Alberta Clipper projects.

Table 8: Seven Scenarios of Possible Impact of Energy East on Oil Transport Capacity Exiting Western Canada

Scenario	Risk Analysis	(A)	(B)*	(C)	(D)**
		Functional Capacity Baseline Scenario (TBD)	Conditional EE Functional Capacity* (TBD)	Total Functional Capacity Baseline Scenario + Energy East (TBD)	(Change %)
1) 2015 Status Quo Pipeline & Rail	Unlikely	3095	990	4085	+32%
2) Limited New Pipeline & No New Rail	Unlikely	3959	990	4949	+25%
3) Limited New Pipeline & Limited New Rail 660	Most Likely	4419	803	5222	+18%
4) Limited New Pipeline & Limited New Rail 400	Likely	4159	990	5149	+24%
5) Limited New Pipeline & Rail Compensates for EE	Unlikely	4949	273	5222	+6%
6) Extensive New Pipeline & Limited New Rail 660	Unlikely	4892	330	5222	+7%
7) Navius: Limited New Pipeline & Extensive New Rail	Highly Unlikely	5000	222	5222	+4%

*The amount in Column (B) Conditional Energy East Functional Capacity depends on whether the 990 TBD of Energy East functional capacity would be necessary given the counterfactual upper limit:

-Below Counterfactual Upper Limit: If (A) + 990 TBD < 5222 TBD, then (B) = 990 and (C) = (A) + (B).

-At Counterfactual Upper Limit: If (A) + 990 TBD > 5222 TBD, then (B) = 5222 TBD – (A) and, consequently, (C) = 5222 TBD.

**The amount in Column (D) is derived from (C)/(A).

7.3. Effect on Global Oil Consumption and Emissions

We estimate that new Western Canadian oil that reaches global markets via Energy East would bring down global prices and stimulate consumption when measured against each of our counterfactual scenarios, yet to varying degrees. In Table 9 we report results of our model evaluating the impact of new Energy East oil on global markets.

For the status quo Scenario 1 as well as Scenario 2 and Scenario 4, the full amount of Energy East oil is prevented from reaching global markets. Depending on the ratio of light crude to bitumen circulating in the pipelines, this represents between 881-963 TBD. Therefore, relative to these three counterfactual scenarios, Energy East would result in an increase in annual global consumption of between 78-204 TBD for extremely-low to low demand elasticity. Relative to our most likely Scenario 3, the absence of Energy East would not be felt in its entirety: only 803 TBD of its full functional capacity of 990 TBD. Therefore, the impact of Energy East as measured against this scenario is 63-165 TBD, slightly lower than its full impact as for Scenarios 1, 2 and 4. In Scenario 5, where only two proposed pipelines are implemented but the lack of Energy East is completely compensated by rail, the impact is reduced to between 21-56 TBD. In Scenario 6, where all three other proposed pipelines are implemented but rail expansion is limited, the impact is similar: 26-68 TBD. Finally, in our replication of Navius counterfactual reference scenario in Scenario 7, not all of Energy East's oil would be necessary—only 222 TBD. Annual global oil consumption would increase by 17-46 TBD for extremely-low to low demand elasticity.

TABLE 8: ESTIMATES OF THE IMPACT OF ENERGY EAST ON ANNUAL GLOBAL OIL CONSUMPTION AND DOWNSTREAM EMISSIONS

Extremely-low Price Elasticity of Demand (E_d= *-0.072*)

Scenario	Risk Analysis	Annual Oil Consumption (TBD)	Annual Downstream Emissions (MtCO2e)
1) 2015 Status Quo Pipeline & Rail	Unlikely	78-85	15-17
2) Limited New Pipeline & No New Rail	Unlikely	78-85	15-17
3) Limited New Pipeline & Limited New Rail 660	Most Likely	63-69	12-14
4) Limited New Pipeline & Limited New Rail 400	Likely	78-85	15-17
5) Limited New Pipeline & Rail Compensates for EE	Unlikely	21-23	4.0-4.6
6) Extensive New Pipeline & Limited New Rail 660	Unlikely	26-28	4.8-5.6
7) Navius: Limited New Pipeline & Extensive New Rail	Highly Unlikely	17-19	3.3-3.7

Low Price Elasticity of Demand (E_d= *-0.20*)

Scenario	Risk Analysis	Annual Oil Consumption (TBD)	Annual Downstream Emissions (MtCO2e)
1) 2015 Status Quo Pipeline & Rail	Unlikely	186-204	35-40
2) Limited New Pipeline & No New Rail	Unlikely	186-204	35-40
3) Limited New Pipeline & Limited New Rail 660	Most Likely	151-165	28-32
4) Limited New Pipeline & Limited New Rail 400	Likely	186-204	35-40
5) Limited New Pipeline & Rail Compensates for EE	Unlikely	51-56	9.6-11.0
6) Extensive New Pipeline & Limited New Rail 660	Unlikely	62-68	11.6-13.3
7) Navius: Limited New Pipeline & Extensive New Rail	Highly Unlikely	42-46	7.8-9.0

Note Long-term Price Elasticity of Supply: Medium (E_s = *0.75*); EE = Energy East, NG = Northern Gateway

What about emissions of greenhouse gases? Similar to our estimates of the effect of Energy East on global consumption above, all of the oil transported by Energy East is relevant for Scenarios 1, 2 and 4. Demand elasticities are still important, with emissions resulting from this new oil standing at 15-17 to 35-40 MtCO2e per year for extremely-low to low demand elasticities, respectively. Put differently, against these three counterfactual scenarios, Energy East is expected to lead to an increase in global emissions with a range of 15-40 MtCO2e per year. In the most likely Scenario 3, the range of emissions is diminished slightly relative to the previous two scenarios because the relative impact of Energy East is slightly reduced. Under Scenario 3, the range of impact is 12-32 MtCO2e per year from extremely-low to low demand elasticities. Beginning with Scenario 5, the relative impact of Energy East becomes less important. Emissions associated with Energy East stand at 4-11 MtCO2e per year and 4.8-13.3 MtCO2e per year for Scenario 5 and Scenario 6, respectively. Finally, our estimate simulating Navius' reference scenario in Scenario 8 suggests that the relative impact of Energy East is 3.3-9.0 MtCO2 per year. The result of 3.3-9.0 MtCO2e, where we replace Navius' assumptions about the substitutability of rail and oil, is particularly insightful as it is comparable to the estimation of 5-12 MtCO2e per year impact that Navius estimated (Peters et al., 2015: vii).

Overall, these results indicate that the assumption that oil transport infrastructure is driven almost exclusively by economic factors might lead to an underestimation of the impact of Energy East. Under more realistic assumptions about the limited substitutability of pipeline and rail as well as political risks of new pipelines themselves, represented by our Scenario 3, we find the impact of Energy East to be increased by 8.7-23 MtCO2e per year relative to Scenario 7 where the rail and pipeline are nearly perfectively substitutable.

8. CONCLUSION

We have sought to identify a range of counterfactual scenarios reflecting the potential of Canadian oil exports if the Energy East pipeline project were not to exist and then estimate the effect of Energy East on global consumption of oil and downstream emissions relative to each. These seven scenarios were constructed to reflect a range of economic, technical and political factors surrounding the expansion of Canadian oil transport infrastructure as well as appropriate measures of the long-term price elasticity of global oil supply and demand.

We believe the most likely counterfactual scenario against which to measure the effects of Energy East is Scenario 3 where limited new pipeline (TransMountain Expansion and Line 3 Replacement) and limited new rail transport are realized (660 TBD) are built by 2030. As for key supply and demand price elasticities, we submit that an extremely-low to low long-term price elasticity of demand ($E_d = -0.07$ *to* -0.20) and medium long-term price elasticity of supply ($E_s = 0.75$) are the most appropriate parameters for assessing the impact of new Energy East oil on global markets. Under these conditions, we estimate Energy East to add an additional 12-32 MtCO2e per year to global emissions as a result of 63-165 TBD per year of additional oil being consumed globally. Under the scenario where rail is used extensively in the absence of proposed Canadian pipelines, the relative impact of Energy East drops to 3-9 MtCO2e per year (Scenario 7). We believe such a scenario is unlikely because substitution between pipeline and rail is imperfect for technical and political reasons. Assumptions that 1600 TBD of oil will be transported by rail to fully compensate for the lack of oil pipelines appear, in our view, unrealistic. The difference between our downstream emission scenarios assuming perfect and imperfect substitutability between pipeline and rail stands at 8.7-23 MtCO2e per year. It is important for the public debate on the downstream emissions associated with Energy East that the effect of assumptions about pipeline and rail substitutability are made clear.

Overall, our research points to a need for greater cooperation between economists expert in modeling and those expert in technical and political dimensions of new oil transport infrastructure. While we have sought to include major economic, technical and political factors in our analysis, we have not been able to include everything. Findings from our economic model should be verified by more complex modeling efforts that can handle more parameters. However, such models should be used in conjunction with the counterfactual approach considering economic, technical and political factors that we have outlined here. However, to the extent that our results approach those of Navius when using their assumptions about substitutability between rail and pipeline, we have confidence in the results presented here.

New information could also be incorporated into the analysis. For example, we have not been able to ascertain the impact of new carbon pricing tools adopted in Alberta (Leach et al., 2015). Advanced oil sands extraction technologies might reduce emissions associated with bitumen by 85% relative to current practice (Peters et al., 2015: 46-48). Furthermore, particularly important for the evaluation of the project on global emissions are technical issues surrounding the feasibility of carbon sequestration technology (see Keith et al., 2006; Preston et al., 2005 for discussion). The goal of such carbon sequestration technology is to allow for the continued combustion of fossil fuels but avoiding emissions damage by capturing greenhouse gases and injecting them underground for long-term storage (IPCC, 2005). It is beyond the scope of this study to weigh in on the technical feasibility of this technology nor other emission reduction pathways. To the best of our knowledge, practical implementation of CCS on a scale to appreciably attenuate emissions appears a long way off (Surampalli et al., 2015). Under these circumstances, the continued production and consumption of oil from Canada and elsewhere in the world might be expected to increase global emissions and hence climate change.

In conclusion, in Table 10 below we summarize results of our study and other existing studies of Energy East to arrive at an estimate of total upstream and downstream emissions likely due to this new pipeline. We distinguish between studies that question the perfect substitutability between pipeline and rail, including a study by the Pembina Institute (Flanagan and Demerse, 2014) and this study, as well as the study by Navius which assumes near perfect substitutability. In terms of upstream emissions, the Pembina Institute estimated Energy East would result in 30-32 MtCO2e per year on Canadian territory (Flanagan and Demerse, 2014: 21), but did not consider net upstream effects after accounting for global oil market dynamics. Navius finds that while upstream emissions in Canada increase to between approximately 2-11 MtCO2e in Navius' model, this is offset by reduction in upstream emissions linked to reduced production elsewhere in the world (Peters et al., 2015: x). After accounting for global oil market dynamics, Navius concludes that Energy East will likely increase net global upstream emissions by only 0.7-4.3 MtCO2e per year (p. viii-ix). We agree with Navius that it is important to consider global oil market dynamics, and have striven to do so in this study. Using a ratio from Navius' estimate of global upstream emissions and Canadian upstream emissions, we estimate that net global emissions associated with the Pembina study would have been approximately 12-13 MtCO2e per year. To the best of our understanding, the discrepancy between Navius and Pembina's adjusted estimate is due to different treatments of the substitutability of rail and pipeline transport in the analysis.

Table 10: Total Global Emissions (Upstream and Downstream) Associated with Energy East, Differentiating Between Imperfect and Perfect Substitutability of Pipeline and Rail

Emissions	**Imperfect Substitutability Between Pipeline and Rail**		**Perfect Substitutability Between Pipeline and Rail**	
	MtCO2e /yr	**Reference**	**MtCO2e /yr**	**Reference**
Upstream Emissions*				
-Global	(12-13)	(See Text)	0.7-4.3	(Peters et al., 2015)
-Canada	30-32	(Flanagan and Demerse, 2014)	2.0-11.0	(Peters et al., 2015)
Downstream Emissions				
-Global	12-32	(This Study)	4.7-12.0	(Peters et al., 2015)
Total Global Emissions	24-45		5.3-17.0	

*Note that we estimate global upstream emissions associated with the Pembina Institute's upstream estimate, which does not consider global oil market dynamics, based on a ratio of global upstream to Canadian upstream emissions in Navius' study. This adjusted Pembina estimate of 12-13 MtCO2 per year is reported in parentheses in this table. See text for details.

In terms of downstream emissions in Table 10, these differ significantly between the estimate emanating from our study of 12-32 MtCO2e per year in contrast to the Navius estimate of 4.7-12 MtCO2e per year. Again these differences are explained by the different treatment of the substitutability of pipeline and rail in the analysis. Overall, we estimate that, when taking global oil market dynamics into consideration, the total impact of Energy East varies from 24-45 MtCO2e per year when pipeline and rail are considered imperfectly substitutable to 5.3-17.0 MtCO2e per year where they are deemed perfectly substitutable. Given technical and political challenges to significant increase of rail, we have argued in this paper that pipeline and rail are highly imperfect substitutes for bringing Western Canadian oil to global market and thus that the total effect of Energy East in terms of upstream and downstream emissions is more likely to be 24-45

MtCO2e per year. It is important to consider political risks along with economic and technical factors associated with new oil transport infrastructure in the evaluation of emissions.

Is our estimate of the 24-45 MtCO2e of total upstream and downstream emissions associated with Energy East in the table above significant? We assert that the significance of these figures will also be political. Energy East is but one small piece of a much larger puzzle; however, this large puzzle is itself made of many small pieces and guided by the international norm of common but differentiated responsibilities (Asselt and Zelli, 2014; Purdon, 2015a; Stone, 2004). Total global greenhouse gas emissions stood at 46,049 MtCO2e in 2012 (WRI, 2016). Relative to this figure, total upstream and downstream emissions resulting from Energy East range from 0.05-0.10%. However, relative to Canadian emissions, total upstream and downstream associated with Energy East range from 3.4 to 6.4% of Canada's 702 MtCO2e emitted in 2011 (Environment Canada, 2013: 15). Finally, using a greenhouse gas equivalency calculator developed by the EPA (2015a), our estimate of the total emissions associated with Energy East is equivalent to adding approximately 5.0-9.5 million cars to the roads of the world. We stress again that under current international accounting rules, Canada is not responsible for downstream emissions resulting from oil consumed outside Canada's borders. However, our findings also contribute to ongoing debates about the appropriate accounting framework for the international climate change regime—consumption or production (Harrison, 2015; Peters and Hertwich, 2008).

While our study is unlikely to be the final word on Energy East, we hope that it helps clarify discussion about new pipelines in Canada and contributes to these important international debates. It also points to a number of recommendations. First, it would be important that more detailed economic modeling is undertaken in conjunction with rigorous vetting of various counterfactual scenarios that includes economic, technical and political factors. Second, it would important to assess the possibility of a significant increase in rail transport implied in counterfactual claims made in reference to Energy East and other pipeline proposals, including effects on safety and congestion. Such recommendations might be incorporated into new rules being developed by the Canadian federal government for the assessment of pipeline proposals (Muise, 2016).

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