

An Economic Analysis of New Upstream Emissions Requirements for Pipeline Approvals

EXECUTIVE SUMMARY

- New regulations announced by the federal government require the National Energy Board (NEB) to consider the quantity of direct and upstream greenhouse gas emissions when evaluating pipeline projects.
- Estimates of the total emissions attributable to a given project are highly uncertain for three reasons: the capacity of alternative modes of transport is unknown; it is unclear which source of foreign oil Western Canadian crude will displace; and, there is fundamental uncertainty about future global oil demand.
- Uncertainty introduces important policy implications when trading-off the merits of quantity- and price-based greenhouse gas policies; this trade-off depends on comparing the benefits from extracting and consuming oil to the global harm caused by emissions.
- Due to the inherent uncertainty associated with the capacity of Canada's rail system to transport oil sands crude and future global oil demand, carbon taxes such as those in British Columbia and Alberta—and not emissions quantity limits on pipeline projects—are the best instrument to control overall sector emissions and to achieve both economic and environmental goals.

INTRODUCTION

On January 27, 2016, the Government of Canada announced that “direct and upstream greenhouse gas emissions” would factor into the regulatory review process for proposed pipeline projects.¹ The new standard aims to address claims that new pipelines will induce greater expansion of Canada's oil sands, producing more greenhouse gas (GHG) emissions. Specific details were not provided in the government's initial press release but both the TransMountain Expansion and Energy East projects, which are already under regulatory review, will be subject to the new standards. The inclusion of carbon dioxide-equivalent (CO₂e) emissions in the pipeline approval process marks a shift in the regulatory landscape, giving climate policy a more prominent position.

As expected, the government's announcement attracted substantial attention. Many environmental non-governmental organizations (ENGOS) viewed it as a positive step towards achieving Canada's commitments under

¹ “Government of Canada Moves to Restore Trust in Environmental Assessment,” press release available at <http://news.gc.ca/web/article-en.do?mthd=index&ctr.page=1&nid=1029999>.

global climate change agreements.² Energy and pipeline executives, on the other hand, argued that the new requirements are unnecessary, stating that pipelines “are already subject to vigorous regulation”.³

Before the final regulations are announced, it is useful to consider some economic principles that help frame the consequences of the government’s announced policy. An important conclusion from economic analysis is that, given the uncertainty in future emissions, it is possible that the government can achieve improved economic *and* environmental outcomes by imposing a tax on carbon dioxide and other emissions and then by decoupling pipeline approvals from associated emissions. The logic underlying this claim is more subtle than the conventional tax versus cap-and-trade debate. Instead, it relies on an idea that is colloquially referred to as ‘prices versus quantities’. Prices versus quantities places the inherent uncertainty of future emissions at the center of the policy problem. Given the fundamental uncertainty of global oil markets, prices versus quantities asks: accounting for both the costs and benefits to Canada’s economy *and* the global climate, what is the best regulatory framework for managing CO₂e emissions? The relationship between policy and uncertainty has been overlooked in most of the Canadian energy policy discussions, when it should be foremost in any regulatory framework.⁴

PIPELINES AND UNCERTAIN FUTURE EMISSIONS: THE CASE OF ENERGY EAST

A concern about new pipeline projects is that they might induce increased GHG emissions. However, it is unclear how many additional tonnes of CO₂e might actually be released if, for example, TransCanada’s Energy East Pipeline is approved. Only two studies—a 2015 paper by Navius Research⁵ and an April 2016 report released by IQCarbone (the Quebec Carbon Institute)⁶—have estimated the emissions implications of this project. Navius Research uses their OILTRANS model to establish their estimate. This is a detailed model of global energy markets that accounts for a wide range of market and technological factors that would arise in a series of counterfactual scenarios.⁷ The IQCarbone study adopts a more qualitative approach, emphasizing vital domestic political dimensions of Canada’s economic and regulatory environment.

Table 1 summarizes several key details about Energy East including the estimated emissions from Navius and IQCarbone. Energy East, a project that will span from Alberta to Saint John, New Brunswick, is expected to cost \$11.3 billion and have a maximum capacity of 1.1 million barrels per day. Yet, simply because the pipeline has a 1.1 million barrel per day capacity does not mean that the oil sands will produce an additional 1.1 million barrels per day. Output could be greater if rail expands to supplement pipelines. Alternatively, global oil markets may be weak and there may be excess capacity.

² Leahy, Derek, January 27, 2016. “Feds Announce Upstream Emissions Will be ‘Factor’ In Pipeline Decisions.” <http://www.desmog.ca/2016/01/27/feds-announce-upstream-ghg-will-be-factor-their-decisions-pipelines> (accessed April 4, 2016).

³ Bicks, Ian and Dan Healing, April 28, 2016. “CEOs of TransCanada, Imperial Oil say new emission rules not necessary.” <http://www.calgaryherald.com/business/ceos+transcanada+imperial+emission+rules+necessary/11886813/story.html> (accessed April 28, 2016).

⁴ The CD Howe’s Grant Bishop and Benjamin Dachis also responded to the government’s announcement. They question the federal government’s authority to regulate provincially-sourced emissions and state that “blocking pipelines, as opposed to putting a price on emitting greenhouse gases, would hinder, rather than help, Canada to achieve promised emissions reductions at the lowest cost”. Based on uncontroversial characteristics of climate change and pipelines, this statement is economically true. The third section (as well as the Online Technical Appendix) presents some long-standing and overlooked economic results supporting this statement. When the future of the oil and gas sector is uncertain, pricing on carbon unambiguously leads to a lower “deadweight losses” or social costs for society than does restricting pipeline construction based on emissions.

The two rightmost columns of **Table 1** present the estimated emissions from the project. Navius estimates that Energy East will lead to additional emissions of 3.3-9.0 million tonnes (Mt) CO₂e per year by 2035. IQCarbone forecasts a higher and wider range for the pipeline's induced emissions, 12.0 - 32.0 Mt CO₂e per year. Both the Navius and IQCarbone's estimates total upstream plus downstream emissions, while the new NEB rules cover upstream emissions exclusively.⁸ IQCarbone estimates that Energy East will yield an increase of 0.05%-0.10% in global emissions and an increase of 3.4-6.4% in Canadian emissions.

Table 1: Energy East Pipeline Emissions Predictions

| | Capacity ('000 bpd) | Projected Cost | Emissions ^a (Mt CO ₂ e/year) | |
|--------------------|---------------------|----------------|--|------------------------|
| | | | Navius Research | IQCarbone ^b |
| Energy East | 1,100 | \$11.3bn | 3.3-9.0 | 12.0-32.0 |

a – Estimates reflect combined up- and downstream emissions in 2035 for Navius estimate and 2030 for IQCarbone.
b – Values are IQCarbone's "most likely" estimates.

The disparity between the Navius and IQCarbone estimates is primarily attributable to differing assumptions about three sources of uncertainty: (1) the capacity of Canada's rail system to transport oil in the future, (2) the source of oil that Western Canadian crude will displace, and (3) fundamental uncertainty about future global oil demand. IQCarbone projects that trains will transport 660 thousand barrels per day by 2030, while Navius allows for much greater pipe-rail substitutability. Trains are more expensive than pipes per barrel transported. So this additional cost influences the development of new production. In general, however, there are few reliable estimates of the scalability of rail. Next, and along similar lines, Western Canadian bitumen is relatively GHG-intensive under current extraction technologies. Each barrel of heavy Alberta crude generates 0.11tCO₂e, two thirds of which is due to fugitive emissions and flaring. For comparison, the estimated per barrel emissions from Middle Eastern conventional oil equals 0.03tCO₂e, while Venezuelan extra heavy has an emissions profile roughly comparable to Alberta's oil sands. If Venezuelan sources are displaced, the additional emissions from producing in Canada are much smaller than if Middle Eastern crude is curtailed. Finally, there is substantial uncertainty about the future global demand for fossil fuels.

Combined, these three uncertainties imply that it is virtually impossible to precisely attribute a specific estimate of future emissions to a pipeline project. It also means that any regulatory framework should incorporate this uncertainty into its design.

⁵ Peters, Jotham, Nicholas Rivers and Michael Wollinetz, 2015. "Linking pipelines infrastructure and global GHG emissions."

⁶ Purdon, Mark and Simon-Philippe Breton, 2016. Energy East Pipeline: an evaluation considering economic, technical and political risk factors. Climate Policy Working Paper No.2, Quebec Carbon Institute. https://www.dropbox.com/s/ixdsf2zjxsnj7a7/IQCarbone_EnergyEast_PurdonBreton_F5_27avril2016_Complet.pdf?dl=0.

⁷ Peters, Jotham, Nicholas Rivers and Michael Wollinetz, 2015. "Linking pipelines infrastructure and global GHG emissions."

⁸ Under the United Nations Framework Convention on Climate Change, countries are solely responsible for emissions released within national borders. This means that Canada is responsible for CO₂e released during production and construction phases. Despite this, as mentioned by IQCarbone, downstream emissions are politically salient and are likely to be important in the political discussion. See UNFCCC, 2006 (2013). "Decision 24/CP.19." http://unfccc.int/documentation/advanced_search/items/6911.php?preref=600007789 (accessed May 5, 2016).

PRICES VERSUS QUANTITIES: THE ECONOMIC RATIONALE FOR A CARBON TAX IN THE PIPELINES DEBATE

Two scenarios emerge from the government's January announcement that pipeline approvals will consider greenhouse gas emissions. It is unlikely that the NEB will adopt either of these scenarios. Rather the probable outcome is somewhere between the two.⁹ Nonetheless, these two scenarios bound the prospective implications of NEB decisions and emphasize that the NEB should be careful when prescribing conditions.¹⁰ While the NEB is likely to adopt policies that do not perfectly mimic these, the qualitative implications remain for a very wide range of regulatory policies that fall within the boundaries of these scenarios.¹¹

The first scenario is that while the NEB will formally consider upstream emissions attributable to a pipeline project, the standard it applies will be equivalent to not having a standard. Essentially, the government will establish a "rejection threshold"—i.e., a level of induced emissions whereby the NEB will reject the project—that is so high that it is irrelevant. The second scenario is that the NEB will establish a CO₂e emissions rejection threshold that binds. A pipeline that induces emissions above this threshold then faces the real prospect of denial. A rejected pipeline must either find a method to abate a pre-determined quantity of CO₂e to bring emissions below the threshold or it will not receive an NEB certificate.¹²

Both of these scenarios pose challenges for interested parties such as ENGOs and energy firms. Scenario one means that Canada is less likely to achieve its emissions targets, an undesirable outcome to many environmental groups, whereas scenario two may lead to foregone economic benefits and weaker economic performance. Of course, this situation is not unique: any climate change policy faces a similar trade-off. What is distinctive about the new standard laid out in the government's statement is what happens when there is uncertainty about the level of future emissions.

From an economic perspective, tying pipeline approvals to emissions is equivalent to imposing a quantity restriction on the GHG emissions from the oil sands.¹³ Under scenario one the constraint is non-binding and of no importance. However, there are meaningful consequences under scenario two.

The policy problem of pipeline-induced emissions can be reduced to two decisions. First, the government must target a level of emission reductions from the energy sector. The second decision involves choosing the policy instrument to achieve this target. In general, two types of regulation are used to manage CO₂e emissions: carbon

⁹ For example, the NEB may require TransCanada to purchase carbon offsets for some share of the upstream emissions. This policy does not change the conclusions of this analysis provided that there is an increasing marginal cost to offsets. An offset policy would reduce the slope of the marginal surplus curve, but not by enough to make it flatter than the marginal social damage curve.

¹⁰ It should be noted that the NEB does not necessarily need to adopt pure price versus quantities approaches and that several "hybrid" policies are available. Many of these designs can get more complex and depend on the precise policy objective of the regulator.

¹¹ It is worth noting that there are several sophisticated policy designs that can avoid the issues highlighted in this brief. However, these policies are often complex, face a distinct set of challenges and require careful design.

¹² For example, the developer may be required to purchase offsets (whose costs are uncertain), either from domestic or international sources.

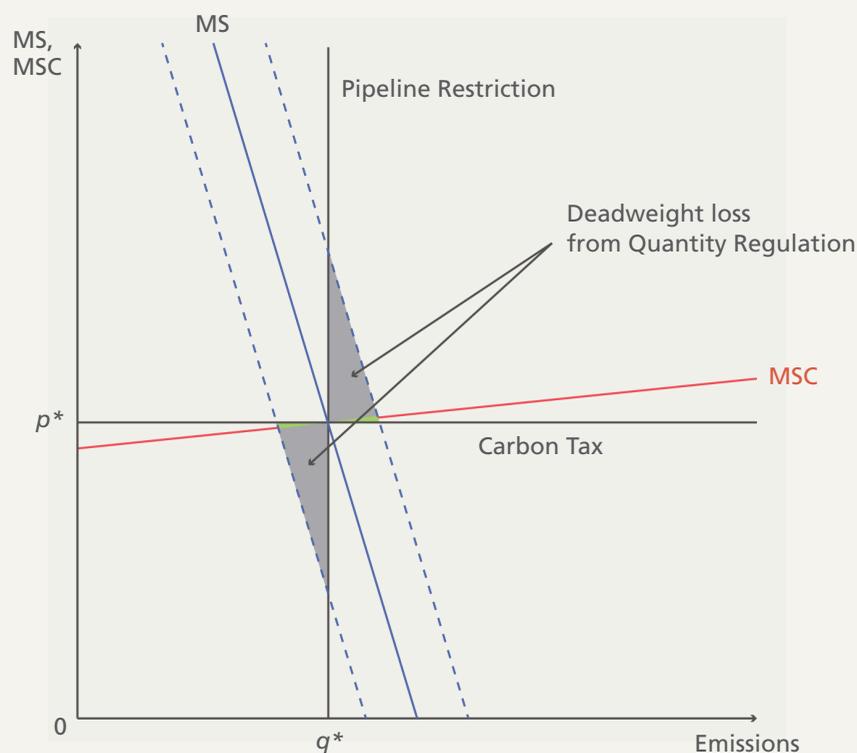
¹³ In their submission to the Standing Senate Committee on Transport and Communications, Grant Bishop and Benjamin Dachis of the CD Howe Institute were the first to note this equivalency between pipeline approvals and quantity based regulation. They also emphasized that conditioning pipeline approvals on emissions is inefficient. See Bishop, Grant and Benjamin Dachis, 2016. "The National Energy Board's Limits in Assessing Upstream Greenhouse Gas Emissions. Submission to the Standing Senate Committee on Transportation and Communications. www.parl.gc.ca/content/sen/committee/421/TRCM/Briefs/TRCM_2016-04-19_BrieffromBenjaminDachis_e.pdf (accessed May 6, 2016).

taxes, constituting a fee on emissions, and quantity restrictions, which are rules governing the maximum number of tonnes that can be emitted. Quantity restrictions are implicit in the government’s new conditions on pipeline approvals since projects may be rejected if they induce too many emissions.¹⁴

In a world with perfect certainty, economists have demonstrated that carbon taxes and quantity regulations produce identical outcomes. When future emissions cannot be predicted perfectly, however, large differences between price and quantity restrictions may materialize.

Figure 1 demonstrates why carbon taxes are the preferred method to manage CO₂e emissions in Canada. The figure hinges on comparing the benefits from extracting and consuming oil to the global damage caused by emissions. The vertical axis represents the per tonne abatement cost for CO₂e. This is the cost to prevent a tonne of GHG from being emitted into the atmosphere. Along the horizontal axis are total tonnes emitted per period. If future Canadian capacity of rail, the source of displaced oil, and future energy demands are all known with perfect certainty, the government could pick either a carbon tax at p^* or a quantity restriction at q^* and obtain an identical outcome. These policies— p^* and q^* —also reflect the government’s best guess about the future. The quantity restriction is illustrated using the black vertical line, while the carbon tax is represented by the solid horizontal line.

Figure 1: Implications of Quantity and Price Regulation of Emissions



¹⁴ It is worth mentioning that a quantity restriction does not preclude the NEB from conditioning pipeline approvals on a range of alternative factors. For example, they may require developers to purchase offsets, employ specific GHG-reducing technologies, or offer a “safety valves” to firms in an effort to avoid sunk costs. Still, each of these must be evaluated based on some quantity or price standard.

As emissions increase—i.e., we move from left to right in the figure—the damage from climate change also increases. This relationship is shown by the red marginal social cost (MSC) curve. The MSC captures the world-wide damage caused by emitting the marginal tonne of CO₂e. The MSC curve is relatively flat since carbon dioxide is a stock pollutant, remaining in the atmosphere for a very long time after it is emitted. In fact, between 20-35% remains in the atmosphere for between 200 and 2,000 years after being initially released.¹⁵ But this also means—on the margin—reducing emissions by one tonne has little effect on the damages caused by existing atmospheric stock. Even though abatement in the current period endures into the distant future, any emissions reductions in the current period have only a small effect on the total stock of CO₂e in the atmosphere.¹⁶ It is this stock pollutant characteristic that implies that the MSC curve is flat. As a result, the benefits from reducing CO₂e are essentially constant at any point in time.

The blue curve in **Figure 1** represents the marginal market surplus (MS) of extracting and consuming oil—i.e., from building a pipeline in this context. This includes all of the profits earned by producers and the entire surplus that consumers obtain from using oil and gas (i.e., the surplus of all participants in the energy market). The MS curve is *relatively* steep because producers and consumers receive diminishing marginal benefit from the next barrel of oil.¹⁷ If there are no restrictions on emissions, then firms will produce fossil fuels and release CO₂e at the point where the MS curve intersects the horizontal axis. This is the business-as-usual scenario that exists in most of the world—people and businesses are free to emit as much as they choose. The precise location of the MS curve is uncertain, however, since no one knows precisely how many emissions a new pipeline will induce.¹⁸ As a result, two additional, dashed MS curves are drawn. These reflect underlying uncertainty. The left curve can be considered one where there is low global demand for oil or, alternatively, where there is a rapid transition to a low carbon economy. The right curve then illustrates the opposite. It is the high oil demand, slow transition scenario.

The left curve is a situation where the future demand for hydrocarbons is low and where the government overestimates Western Canadian oil production. Under this scenario, it is possible to show that carbon taxes are superior to government's proposed quantity restriction. Consider what happens when the government establishes a quantity regulation, q^* , versus using a price, p^* . The intersection of the carbon tax line and the dashed MS curve is to the left of the intersection of the quantity line and the dashed MS curve. Hence, emissions are greater under the quantity restriction, yielding more environmental damage than under a carbon tax.

The grey triangle represents what economists call “deadweight loss”, the economic cost to society from making an inefficient choice. It is a lost gain or surplus that no one—not consumers, producers or the environment—obtains. Whenever the government misses a policy target, there will be deadweight loss. So the government's objective should be to shrink the triangles—i.e., shrink the deadweight loss—to the greatest extent possible. Consequently, in the low MS case it would be more beneficial to the global climate if the government simply levied a carbon tax rather than imposing a quantity control. Of course, fundamental uncertainty implies that there is still deadweight

¹⁵ Archer et al., 2009. “Atmospheric Lifetime of Fossil Fuel Carbon Dioxide.” *Annual Review of Earth and Planetary Sciences*. 37:117–34.

¹⁶ Pizer, William A., 1997. “Prices vs. Quantities Revisited: The Case of Climate Change.” *Resources for the Future Discussion Paper* 98-02.

¹⁷ The blue MS curve in Figure 1 is drawn as quite steep. This is for illustrative purposes only. The only condition required for all of the policy implications to persist is that the MS is steeper than the MSC curve. This is almost certainly the case as: (i) consumer surplus is diminishing at the margin, (ii) producers profits are facing increasing marginal costs due to both the resource availability and scarce inputs and (iii) the MSC curve is virtually flat at a given point in time.

¹⁸ There may also be uncertainty in the costs of climate change. Weitzman (1974), however, shows that uncertainty in the MSC has no effect on instrument choice. (Weitzman, Martin. (1974). *Prices vs. Quantities*. *The Review of Economic Studies*, 41(4), 477–491.)

loss from imposing a carbon tax. This is represented by the much smaller green triangle and summarizes the foregone economic benefits attributable to the disincentive effects of the tax. A similar story unfolds for the higher than expected oil demand scenario as characterized by the right MS curve. Here the grey triangle represents foregone economic benefits that are missed due to rejecting a pipeline based on emissions, whereas the green triangle represents the additional environmental damage due to uncertainty.

In **Figure 1**, it is clear that the green triangles associated with carbon taxes are much smaller than the grey ones associated with emissions quantity regulation (for the mathematically-inclined, an Online Technical Appendix accompanies this Policy Brief and provides a more formal presentation of the results). This result arises because there is fundamental uncertainty about the level of emissions that pipelines will induce *and* because of the nature of the damage caused by CO₂e emissions.

CONCLUSION

The government has signaled that upstream emissions will factor into the national energy regulator's reviews of pipeline proposals. However, precisely estimating the emissions associated with pipeline projects is challenging. The ranges are wide and highly uncertain. It is difficult to determine today what will be the future capacity of rail, which source of foreign oil Western Canadian crude will displace, or what future energy demand will be. As a result of this uncertainty, there are likely to be significantly larger costs for society, both economic and environmental, from regulating the quantity of emissions rather than the price of emissions. Thus, based on the characteristics of climate change and pipeline projects, carbon taxes or price-based policies should be strongly preferred to emissions quantity restrictions when appraising new pipeline proposals.

AUTHOR

Brandon Schaufele, Assistant Professor and Ivey Energy Consortium Fellow, Ivey Business School

The findings and opinions contained in this report reflect solely those of the author(s). The Ivey Energy Policy and Management Centre submits reports for external review by academic and policy experts and energy sector stakeholders. The Centre gratefully acknowledges support from organizations and individuals listed on the Centre's website: <https://www.ivey.uwo.ca/energycentre/about-us/supporters>

ABOUT THE IVEY ENERGY POLICY AND MANAGEMENT CENTRE

The Ivey Energy Policy and Management Centre is the centre of expertise at the Ivey Business School focused on national energy business issues and public policies. It conducts and disseminates first class research on energy policy; and promotes informed debate on public policy in the sector through supporting conferences and workshops that bring together industry, government, academia and other stakeholders in a neutral forum. The Centre draws on leading edge research by Ivey faculty as well as by faculty within Western University.

More information is available at www.ivey.ca/energy