Canada's GHG Cap Imposed on the Oil and Gas Industry is All Pain With No Gain

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Executive Summary

In 2021, the Government of Canada enacted the Canadian Net-Zero Emissions Accountability Act, more commonly discussed as "Net-Zero Emissions 2050." The goal of this Act is to ensure that in the year 2050, Canada's emissions of greenhouse gases to the atmosphere are balanced by actions within Canada that pull greenhouse gases back out of the atmosphere, or at least, prevent some from entering that would otherwise have done so.

Pursuant to that, Canada enacted an interim plan, the 2030 Emissions Reduction Plan, which has a specific sub-component dealing with the greenhouse gas emissions that come from Canada's oil and gas sector, a sector mostly found in Western Canada. This subcomponent would require "emission reductions [from the oil and gas sector] to 31% below 2005 levels in 2030 (or to 42% below 2019 levels)", which would build a pathway to net-zero emissions by 2050.

This essay provides a rough estimate of the environmental benefits associated with imposing the GHG cap on the oil and gas industry. We show that eliminating all GHG emissions from the oil and gas sector in 2030 would reduce Canada's projected GHG emissions by 29 percent. This is not a trivial number, as an absolute value, even for a single sector of Canada's emitting industries.

However, when seen in a global context, even if Canada eliminated all of its GHG emissions expected in the year 2030 as a result of the new greenhouse gas caps implemented by the current government (187 Mt), the emission reduction would equal four-tenths of one percent of global emissions, a reduction unlikely to have any impact on the trajectory of the climate in any detectable manner, and hence, to offer only equally undetectable environmental, health, or safety benefits.

The calculated environmental benefits in this essay are even overestimated due to the risk of carbon leakage: studies have shown that greenhouse gas emissions are quite fungible meaning that they move from place to place where regulations allow. A recent study of the issue suggests that nearly 30 percent of any reductions made in Canada with regard to greenhouse gas emissions would simply be emitted elsewhere, as the emitting activity moved to more permissive jurisdictions.

In addition, the essay shows that the GHG cap imposed on the sector will inevitably curtail the production of oil and gas in the coming years and thereby result in negative economic impacts due to reduced production and exports. Recent estimates suggest the GHG cap will result in at least $45 billion in revenue losses for the industry in 2030 alone, which would imply a significant drop in government resource royalty and tax revenue.

But Canada does more with oil and gas than simply using it for heat, fuel, mobility, and so on. Canada's oil and gas sector provides feedstocks into a very promising part of Canada's economy, which is its growing petrochemical sector. This sector makes

products such as plastics, solvents, and hundreds of other intermediate and end-user goods, many of which are not easily substitutable. Canada's petrochemical industry in 2020 was responsible for creating some 4,800 jobs; exports were worth nearly $6 billion dollars. The resins, rubbers, and fibres sub-sector of Canada's economy, again in 2020, employed nearly 5 million workers, and produced exports worth $7.8 billion.

Overall, the GHG cap imposed on the oil and gas industry will result in significant economic losses without generating material environmental benefits. This cap, which will inevitably curtail oil and gas production in Canada, will likely harm the petrochemical and plastics sectors, which use petroleum as a feedstock for producing their products.

Introduction

In 2021, the Government of Canada enacted the Canadian Net-Zero Emissions Accountability Act (NetZero), which enshrines in legislation Canada's commitment to achieve net-zero greenhouse gas emissions by 2050: [1]

> The purpose of this Act is to require the setting of national targets for the reduction of greenhouse gas emissions based on the best scientific information available and to promote transparency, accountability and immediate and ambitious action in relation to achieving those targets, in support of achieving net-zero emissions in Canada by 2050 and Canada's international commitments in respect of mitigating climate change. (Canada, 2022: 3–4)

In 2022, government followed up on NetZero with the *2030 Emissions Reduction Plan* (ECCC, 2022a) which, according to Minister Stephen Guilbeault, "charts a credible path to emissions that are 40 percent lower than 2005 levels by 2030" (p. 6). That plan "includes a projected contribution from the oil and gas sector of emission reductions to 31% below 2005 levels in 2030 (or to 42% below 2019 levels)." Following consultations, the plan proposes that the greenhouse gas emissions cap will be designed to lower emissions at a pace and scale needed to achieve net-zero by 2050. The government's plan is also intended to reduce oil and gas methane emissions by at least 75 percent by 2030; support clean technologies to further decarbonize the sector; and work to create sustainable jobs (p. 8).

On July 22, 2022, government released *Options to Cap and Cut Oil and Gas Sector Greenhouse Gas Emissions to Achieve 2030 Goals and Net-Zero by 2050* (ECCC, 2022b; hereafter "Options"), which "... invites input on the design and implementation of an approach to cap and cut emissions from the sector."

The Options document seeks input on two potential regulatory approaches:

1. The development of a new cap-and-trade system under the Canadian Environmental Protection Act, 1999 (CEPA); and
2. The modification of existing carbon pollution pricing systems under the Greenhouse Gas Pollution Pricing Act (GGPPA).

[1] Greenhouse gases include carbon dioxide, methane, nitrous oxide, and an evolving class of fluorinated gases. Emissions of these gases as a class are expressed in units of carbon dioxide equivalent, or carbon equivalents.

The Options document includes several important "policy design considerations":

- ... the [GHG emissions] cap should include broad coverage of upstream facilities;
- The emission reduction trajectory set by the cap should ensure emissions do not increase from current levels, should account for the "expected contribution" of the sector identified in Canada's 2030 Emissions Reduction Plan, and should ensure that the sector achieves net zero emissions by 2050 in alignment with Canada's commitment under the Canadian Net-Zero Emissions Accountability Act;
- The cap will need to take into consideration the technological readiness of key mitigation solutions and the timelines for their deployment;
- The cap will also need to consider how best to encourage continued investment to abate emissions; and lastly,
- ... the design of the cap and its trajectory will also need to take into consideration energy security and affordability. (ECCC, 2022b)

Government is contemplating one of two approaches for implementing this new cap, one being the creation of a new cap-and-trade system under the Canadian Environmental Protection Act of 1999, the other being to weave an additional oil-and-gas-sector pricing scheme into the existing Greenhouse Gas Pollution Price Act of 2018 (ECCC, 2022b).

The Options document concludes with a lengthy list of "discussion questions" for interested parties (some 22 questions in all), spanning questions involving the scope of coverage, emission cap trajectory, competitiveness and carbon linkage, policy coherence and coordination across jurisdictions, and implementation. There is, refreshingly, one economic question right up front: "What potential short or long-term socio-economic impacts do you foresee or anticipate for particular regions or population groups resulting from an oil and gas emissions cap in general, and more specifically, the two proposed regulatory options?"

The introduction of what is essentially a fixed-quantity rationing system for emissions control atop the layers of regulation and taxation approaches already on the country's books is announced with little fanfare, although, as we (and others) have written elsewhere, further layering of control measures one atop another, and the use of control measures inappropriate for the control of particular target emissions (such as cap-and-trade) ought surely to have been a larger part of the discussion in options.

However, the question, "can this policy be justified based on its costs and benefits" was conspicuously missing from the list of questions raised by government. But government's question about potential short or long-term socio-economic impacts, which might be foreseen or anticipated as a result of implementing either of government's two potential new layers of greenhouse gas control on the oil and gas sector, is an excellent one, worth considering.

And that is the question that we will consider, first with some newly released analysis courtesy of the Canadian Energy Centre (2022), produced by Rystad Energy, "an independent energy research and business intelligence company providing data, analytics, and consultancy services to clients exposed to the energy industry across the globe."

The Rystad analysis is complex, and the financial terminology is daunting to the non-financier, but in summary, [2] Rystad compared two scenarios regarding the Net Present Value (NPV) of Canada's oil and gas economic sector as government's Net-Zero 2050 plan moves forward. The two scenarios are labeled the OPEC scenario, and the Net-Zero 2050 scenario planned by government, which show different speeds of energy transition.

In the *OPEC scenario*, "global oil demand increases by 17.6 million barrels per day (mbpd) between 2020 and 2045, rising from 90.6 mbpd in 2020 to 108.2 mbpd in 2045."

In the *Net-Zero 2050 scenario* (or the IEA NZE scenario), Rystad sees the global energy sector attain net zero emissions by 2050. Global temperatures rise by 1.5 degrees C. Oil demand peaks at 91 mbpd in 2021 and then falls to 21 mbpd by 2050. This scenario is based on the projections for the global oil and gas sector as laid out in an IEA Report, Net Zero by 2050, released in May 2021 (CEC, 2022).

Net Present Value, CEC explains, "is the difference between the present value of cash inflows for the oil sands and the present value of cash outflows over a period of time." They further explain that with a *positive* net present value, inflows exceed outflows, and, in theory, a sector experiencing that state should be attractive to investment. If the net present value is *negative* then cash is essentially flowing out of that sector, making it more unattractive to investment.

The different impact on Canada's oil and gas sector valuation under the Rystad analysis is stark: "Under the OPEC scenario, the NPV for the oil sands sector is over $300.9 billion. Under the NZE scenario, the NPV for the oil sand sector falls to negative $54.7 billion."

In plain English then, the government's Net-Zero 2050 plan would appear poised to essentially wipe out the net present value of Canada's oil and gas holdings (at least in the oil sands) completely, and in fact, leave Canada's oil and gas sector in something of a negative cash flow situation pertaining to those resources.

The government's "take" also declines precipitously under a Net-Zero 2050 scenario: "Under the OPEC scenario, Canadian oil sands sector government take grows from $29.4 billion (USD, real) in 2022 to $46.7 billion in 2050. On the other hand, under the IEA NZE scenario, Canadian oil sands government take falls from $29.4 billion in 2022 to negative $1.6 billion in 2050. On a cumulative basis, between 2022 and 2050, $727.6 billion of Canadian oil sands sector government take is at risk under the IEA NZE scenario."

[2] The author, who is not an economist by training, has tried to render the Rystad report into plain English that should be understandable to the moderately educated reader. For more details, see the CEC report summarizing the Rystad findings. All errors of translation are the author's.

Capping Oil and Gas GHG Emissions: To What Benefit?

In *Canada's Greenhouse Gas and Air Pollutant Emissions Projections 2021*, without implementation of an emissions cap, Environment and Climate Change Canada project Canada's greenhouse gas emissions by the Oil and Gas sector to increase from 179 Mt of CO_2 eq (under their 2005–2030 reference case), to 187 Mt of CO_2 eq by 2030, an increase of 8 Mt of CO_2 eq. [3] Canada's projected total greenhouse gas emissions in 2030 is projected to be 648 Mt CO_2 eq in 2030 (ECCC, 2021).

Eliminating all GHG emissions from the oil and gas sector in 2030 would reduce Canada's projected GHG emissions by 187/648 = .29, or 29 percent. **Table 1** shows the GHG emission forecasts for Canada, under the ECCC "reference case" by economic sector, should the reader wish to do some comparative analysis of their own.

A nearly 30 percent reduction in Canada's emissions from 2020 to 2030 from curtailing oil and gas sector emissions may seem significant (and indeed it is, as a matter of *national* emissions) but any environmental, health, or safety benefits of that reduction (which are the raison d'être of climate policy) have to be evaluated in light of the *global* total greenhouse gas emissions, which as a freely-mixed component of the Earth's atmosphere, regulate (to a certain extent) global atmospheric temperature levels, climatic conditions, and ultimately, weather conditions as experienced by humans.

According to the United Nations Intergovernmental Panel on Climate Change, expected global emissions in 2030 (in an optimistic projection that assumes all government policies adopted to the date of the report (2022) will actually be implemented in coming years), will be 50 Gt (gigatons) of CO_2 eq/yr (IPCC, 2022). Thus, even if Canada eliminated all of its GHG emissions expected in the year 2030 as a result of the new greenhouse gas caps implemented by the current government (187 Mt), the emission reduction would be 187e6/50e9 = .00374, or four-tenths of one percent of global emissions, a reduction unlikely to have any impact on the trajectory of the climate in any detectable manner, and hence, to offer only equally undetectable environmental, health, or safety benefits.

[3] Government's emission projections are cited here in order to contextualize the relative effect of suppressing emissions from the oil and gas sector. It should be noted that the author of this essay places little to no faith in modeled projections of the future—any modeled projections of any potential future—from any source. Projecting something as complex as GHG emissions over a span of years is fraught with uncertainty, and as we have seen from recent developments in the world (Europe's return to coal generation for electricity), the best laid "projections" of climate prognosticators can come undone in a matter of weeks, unpredictably, at any point forward in the projection.

Table 1: GHG emissions by Economic Sector (Mt CO_2 eq) under the Reference Case (2005 to 2030), including Land Use, Land-Use Change, and Forestry

	Historical				*Projected*		*Change 2005 to 2030*
	2005	2010	2015	2019	2020	2030	
Oil and Gas	160	166	190	191	179	187	27
Electricity	118	95	79	61	52	28	-90
Transport	160	167	172	186	165	170	10
Heavy Industry	87	75	77	77	69	75	-13
Buildings	84	80	83	91	85	76	-9
Agriculture	72	68	71	73	72	74	2
Waste & Others	57	52	50	51	51	50	-11
LULUCF	n.a.	10	-4	-87	-10	-11	n.a.
Total (excl. LULUCF)	739	703	723	730	675	659	-79
Total (incl. LULUCF)	739	713	719	723	665	648	-90

Note: Numbers may not sum due to rounding (original). n.a. = not available.

Source: ECCC, 2022c.

The Matter of Leakage

One common consequence of unilateral carbon regulation by individual countries is the exporting of carbon-emitting activities to other countries, in some cases, countries that may actually be less carbon-efficient in their manufacturing processes, not to mention less environmentally and socially responsible in their manufacturing as well. In other work, I've likened this to a game of "whack-a-mole". Another way to think about it is to consider a film stretched over a container of water. Press down on the film in one area, and you will cause a bulge to form somewhere else.

A recent study published by the International Monetary Fund (2021) took a good look at the rates of carbon leakage across countries for the first time. The working paper, *Revisiting Carbon Leakage*, by researchers Florian Misch and Phillipe Wingender, explains that carbon leakage is "potentially of significant concern for policymakers and a key parameter for the international climate policy discussion" (Misch and Wingender, 2021). First, carbon leakage undermines the effectiveness of unilateral environmental policies. Second, carbon leakage can reflect a loss of domestic economic competitiveness and global market share if production costs increase, thereby inducing production to shift to other countries alongside emissions. If domestically produced goods and services become relatively more expensive as a result of say an increase in the carbon price, consumers, both domestically and abroad, can switch to foreign goods and services. Third, carbon leakage provides the rationale for border carbon adjustment mechanisms which continue to be debated.

Misch and Wingender's country-specific leakage estimates show that carbon leakage is significant across 38 countries which had sufficient data to include in their analysis, and more so among smaller countries that have open economies and trade policies, such as Canada. Misch and Wiegender's leakage estimation is surprisingly large: the average leakage rate across all countries in their sample was 0.25. As Misch and Wigender observe, "[t]his implies that a reduction of 100 tons of carbon emissions domestically would be accompanied by an increase of 25 tons abroad." The specific leakage rate for Canada estimated by Misch and Wiegender was 0.284, or 28.4 percent.

Thus, based on the Misch and Wiegender leakage model, *we would expect a reduction of carbon emissions achieved in Canada via the NetZero regulations to be negated by about 30 percent by increased emissions elsewhere around the world*. That is assuming an average performance on the Misch and Wingender index. So, whatever small share of global greenhouse gas emissions that Canada might emit less of directly would be offset by about a third, as those emissions "leak" to other jurisdictions around the world.

The immaterial environmental benefit resulting from the GHG cap imposed on the oil and gas industry will come with high economic costs. A recent study conducted by researchers at the Montreal Economic Institute (MEI) examined the economic impact of applying a carbon emissions cap to the oil and gas industry and found that the cap

will reduce oil and gas production and cut the revenue of the companies in the sector (Tremblay and Rancourt, 2022). Specifically, the authors developed three scenarios based on three different assumptions about GHG intensity per barrel produced. The first scenario assumes that the industry will not succeed in improving its GHG intensity by 2030. The second scenario assumes that the GHG emissions from the sector will be reduced by 22 Mt by 2030—this is the goal already announced by Pathways Alliance, which makes up Canada's six largest oil sands producers. The third scenario assumes that the industry will improve its GHG intensity by 12 percent by 2030, in addition to the Pathways Alliance's 22 Mt of emission reductions.

The study estimated that the GHG cap will reduce oil and gas production in 2030 by 789 to 1,397 million barrels of oil equivalent. The cap will result in significant revenue losses for the oil and gas industry ranging from a loss of $44.8 billion under Scenario 3 to a loss of $79.3 billion under Scenario 1 just for the year 2030. As the study points out, "considerable additional economic losses could occur before 2030, depending on the speed at which the cap is lowered" (Tremblay and Rancourt, 2022: 4). The significant drop in the industry's revenue would imply a significant drop in government resource royalty and tax revenue.

Threatening Canada's Oil and Gas By-product and Derivative Markets

The impacts of government's Net-Zero 2050 plan, and its derivative Net-Zero plan for the Oil and Gas sector, will have obvious economic impacts as discussed above.

But the impact of going with net-zero greenhouse gas emissions in the oil and gas sector, since this will effectively shut down all petroleum extraction, will have serious impacts on less well-understood knock-on markets in Canada that turn outputs from the oil and gas sector into inputs for the petrochemical and plastics sectors. This knock-on aspect of the Net-Zero framework has not received nearly as much attention as the obvious first-order economic impacts of reducing emissions directly from oil and gas production. A better understanding of these knock-on effects is needed in order to fully understand the Net-Zero Emissions plan in a fuller perspective.

Canada has robust and highly promising petrochemical and plastics sectors, as well as other manufacturing and agricultural sectors that demand oil and gas by-products and derivatives. This sector is more complex, and diverse, than many people will realize.

The Chemistry Industry Association of Canada published, in 2021, an *Economic Review of Chemistry* in Canada (CIA, 2021) which offers the latest snapshots of the two knock-on economic sectors likely to be constricted under the forthcoming "carbon cap" on the oil and gas sector, with diverse data sets compiled by Statistics Canada.

Two summary tables, in particular, are of relevance for this discussion. **Table 2** offers a snapshot of the Petrochemical and Organic Chemicals sector in Canada (2016–2020), while **table 3** offers a snapshot of Canada's synthetic resins, rubbers, and fibers manufacturing sector. Note the section on "Shipments" of petrochemicals and organic chemicals in row 2 of table 2.

In addition to the raw bitumen, conventional oil, natural gas, and commonly consumed fuel oils, lubricating oils, heating oils, and cooking gases that most Canadians will be familiar with, the Canadian Oil and Gas sector generates significant streams of chemical by-products as well. Those chemicals, which flow downstream from Canada's oil and gas producers into secondary markets, include two broad classes of hydrocarbons: aromatic liquids (such as benzene and toluene), and plastic-precursor chemicals such as ethylene and propylene.

Farther down the production chain, ethylene and propylene, in turn, are used to produce polyethylene, polypropylene, polyvinyl chloride, and eventually, the plastic bottles, bags, and films Canadians are more intimately familiar with. [4]

[4] For more details, see CERI (2015). Any errors involved in this colloquial discussion are the author's, and not to be blamed on the detailed chemistry of the CERI report.

Table 2: Principal Statistics for Petrochemicals and Other Organic Chemical Production, Canada: Shipments, Imports, Exports, and Related Employment

	2016	2017	2018	2019	2020
Establishments					
Petrochemicals	28	27	16	29	29
Other Organic Chemicals	133	150	92	145	134
Shipments, $M					
Petrochemicals	5,597	6,747	7,008	5,945	5,138
Other Organic Chemicals	3,402	4,820	6,181	5,6011	4,716
Employment					
Petrochemicals	1,859	2,205	1,963	1,835	1,730
Other Organic Chemicals	2,367	3,543	3,555	3,263	3,046
Exports, $M					
Petrochemicals	1,556	1,880	2,488	2,061	1,641
Other Organic Chemicals	3,924	4,138	4,390	4,041	4,219
Imports, $M					
Petrochemicals	894	966	1,067	817	610
Other Organic Chemicals	6,022	6,292	6,609	6,476	6,462

Source: CIA, 2021.

Table 3: Principal Statistics for Synthetic Resins, Rubbers, and Fibre Production, Canada: Shipment, Imports, Exports, and Related Employment

	2016	2017	2018	2019	2020
Establishments					
Synthetic resins and rubbers	117	119	91	112	108
Synthetic fibres	25	28	17	32	30
Shipments, $M	9,710	9,161	10,571	9,597	8,333
Employment	4,920	4,484	5,215	5,373	5,193
Exports, $M					
Synthetic resins and rubbers	7,849	7,626	8,514	7,712	7,023
Synthetic fibres	347	291	273	283	233
Imports, $M					
Synthetic resins and rubbers	8,033	8,734	9,249	8,620	7,735
Synthetic fibres	583	601	597	528	430

Source: CIA, 2021.

As CERI (the Canadian Energy Research Institute) documents in *Examining the Expansion Potential of the Petrochemical Industry in Canada*, oil and gas by-products in Canada are used to produce a broad range of consumer products (CERI, 2015: figure 1.1, p. 2):

- Synthetic fibers and plastic bottles
- Plastic bags and films
- Cables and diapers
- Windows and pipes
- Carpets, car parts, and bank notes
- Food packaging, CD cases, and disposable utensils
- Gasoline
- Solvents

Some of these products are certainly substitutable—we could, after all, revert to using glass jars and metal cans for more food packaging; more metal pipe in lieu of plastic piping; cloth diapers in lieu of disposable synthetic diapers; and cardboard sleeves for compact disks. But several of these products evolved within a universe of plastics and are much less satisfactorily substitutable. Transparent films? These are essentially the definition of plastic. Cable coverings? Returning to cloth or clay would be rather difficult, given current safety standards. And of course, synthetic materials such as nylon, rayon, polyester, etc., simply did not exist prior to a world of freely available plastics technology. Returning to fur parkas would probably be unacceptable for a number of reasons.

Breaking down Canada's oil and gas by-product production by geographic region, per CERI (p. 9):

- *Alberta*: Alberta's production of oil and gas by-products is primarily in the production of olefins (the plastic precursor chemicals) at 92 percent. Another 8 percent is aromatic production (solvents and light-weight hydrocarbons);
- *Ontario*: Ontario's oil and gas by-product production is split more evenly, at about 60 percent plastic precursors to 40 percent aromatic hydrocarbons;
- *Quebec* produces only aromatic hydrocarbons as a byproduct of its oil and gas production (they only produce natural gas in Quebec); and
- For *Canada* as a whole, the split is 75 percent olefins (plastic precursors), and 25 percent aromatics/solvents.

The omnipresence and criticality of oil and gas by-products to the maintenance of Canada's technological society is generally under-appreciated by the average person; much is taken for granted. Consider plastics made from the oil and gas derivatives and by-products discussed above, alone. As is now the norm in developed societies, plastic materials in Canada are virtually omnipresent: it is difficult, if not impossible, to look around oneself in an indoor environment without seeing innumerable objects that are

partially composed of plastic materials. Some of those plastics, in fact, make up the structural elements of the rooms we inhabit, up to and including some of the structural materials that form the entire indoor environment itself. Some of them are inside our bodies themselves, or may compose the thin film of a contact lens on the front of your eyes.

As Vaclav Smil, Canada's world-renowned expert on all things related to energy and materials use, observes in a recent article for *Time*, plastics have become, in their very short span of invention, development, and adoption, one of the "four pillar" materials on which the modern world depends (Smil, 2022a). (The other three are concrete, steel, and ammonia (for fertilizer).)

Plastics, Smil explains, "are a large group of synthetic organic materials whose common quality is that they can be molded into desired shapes—and they are now everywhere. As I type this, the keys of my Dell laptop and a wireless mouse under my right palm are made of acrylonitrile butadiene styrene, I sit on a swivel chair upholstered in a polyester fabric, and its nylon wheels rest on a polycarbonate carpet protection mat that covers a polyester carpet."

But as Smil points out in his most recent book (he's authored over 40!) *How the World Really Works*, it is in the biomedical world where the contributions of plastics to modern civilizations stand out:

> But plastics have found their most indispensable roles in health care in general and in the hospital treatment of infectious diseases in particular. Modern life now begins (in maternity wards) and ends (in intensive care units) surrounded by plastic items. And those people who had no prior understanding of plastics' role in modern health care got their lesson thanks to COVID-19. The pandemic has taught us this in often drastic ways, as doctors and nurses in North America and Europe ran out of personal protective equipment (PPE)—disposable gloves, masks, shields, hats, gowns, and booties—and as governments outbid each other in order to airlift limited (and highly overpriced) supplies from China, to which the Western producers of PPE, obsessed with cutting costs, had relocated most of their production lines, creating dangerous yet entirely avoidable supply shortages. Plastic items in hospitals are made above all from different kinds of PVC: flexible tubes (used for feeding patients, delivering oxygen, and monitoring blood pressure), catheters, intravenous containers, blood bags, sterile packaging, assorted trays and basins, bedpans and bed rails, thermal blankets, and countless pieces of labware. PVC is now the primary component in more than a quarter of all health-care products, and in modern homes it is present in wall and roof membranes, window frames, blinds, hoses, cable insulation, electronic components, a still-growing array of office supplies, and toys—and as credit cards used to purchase all of the above. (Smil, 2022b)

If those chemical names—acrylonitrile, butadiene styrene, PVC—look familiar, it will be because they are the same chemicals being produced in Canada's oil and gas by-product and petrochemical sectors.

And, Smil concludes (2022a), "[m]ore plastics will be needed for expanding medical (aging populations) and infrastructural (pipes) uses and in transportation (see the interior of airplanes and high-speed trains)." He also observes that more plastics will be needed if the world is to continue its pursuit of more renewable energy resources, such as wind and solar power generation, both of which rely heavily on plastics, as well as the other "pillar" materials of steel and concrete. Canada's policy trajectory, however, has to be seen as on a collision course with Smil's call for expanded production and use of plastics: the impact of government's net-zero greenhouse gas emission plans from the oil and gas sector will be met by a reduction in production.

One key assumption will guide our considerations here, which is that emission reductions in the oil and gas sector (and among the downstream users of oil and gas or its by-products) pursuant to the cap will not be met to any significant extent by improvements in what is commonly called the "greenhouse gas intensity" of oil and gas production, or downstream use of by-products, via new technologies that allow greater productivity with lower carbon emissions. The justification for this assumption can be seen by examining the history of efforts to lower the carbon-emission intensity of the oil and gas sector over the last 20 years.

While there is no gainsaying the fact that improvements in greenhouse gas emission intensity have been achieved since serious pursuit of that endeavor accelerated around the year 2000 (particularly in the early years shortly thereafter), decreases in GHG intensity in Canada as a whole, and in the Mining, Quarrying, Oil and Gas Extraction Sector, have been occurring only slowly and unevenly for the last 10 years or more. This slow decline has occurred even as the political and regulatory climate internationally, nationally, and provincially has grown ever more intense, even to the point of becoming a central issue in Canadian elections at the federal and provincial levels. After initial progress from 2000 to 2010, progress toward reducing greenhouse gas emissions per unit of economic activity produced, or energy consumed, has advanced but haltingly.

Hence the assumption in this analysis, that if GHG emissions from the oil and gas sector are to be brought down, it will likely not be via significant near-term improvements in GHG emissions intensity of oil and gas production. *It is much more likely that achieving lower GHG emissions from the oil and gas sector will require shutting down some level of oil and gas production, and/or shutting down some level of downstream uses of oil and gas that leads to GHG emissions (which would be virtually all of them)*.

Given that probable reality, government's current call for a greenhouse gas emission reduction of "31% below 2005 levels in 2030 (or to 42% below 2019 levels) by equal division over the next 10 years" suggests that *oil and gas production in Canada (sui generis) will have to be curtailed (if done so in a linear fashion over the selected timeframe) by about 4 percent per year from 2020 to 2030*.

Further, we can conservatively assume an equivalent curtailment of the production of Canada's oil and gas by-products, with knock-on effects along the chain of production from raw chemical by-products of oil and gas production, to finished plastic products, fuels, and solvents to be used in Canadian production of consumer products.

Policy Discussion

Canada's plan to institute a hard cap on greenhouse gas emissions from the oil and gas sector is deeply problematic. First, given the limitations of technology, achieving greenhouse gas reductions from the oil and gas sector in Canada is likely to be achieved primarily by curtailing production of oil and gas in Canada, with all of the negative economic and social impacts such reduction has had in the past, when natural fluctuations in world markets for oil and gas led to reduced production, export, and sale of Canadian oil and gas. Inflicting such pain on Canada's economy voluntarily would seem to fall into the category of "shooting oneself in the foot." Second, the amount of emission reductions to be achieved by Canada's greenhouse gas emission caps is insignificant on the global scale of greenhouse gas concentrations, which are the only thing that matters when it comes to potentially limiting climate change, and the environmental impacts that we fear from it. Third, capping Canada's greenhouse gas emissions of the oil and gas sector will have impacts that transcend just that sector, harming Canada's nascent and growing petrochemical and plastics manufacturing sectors, which are located across Canada in Alberta, Ontario, and Quebec. Finally, there is the reality that anything which Canada does unilaterally to stem greenhouse gas emissions domestically is likely to be at least partially offset by the "leakage" of greenhouse generating activities to other jurisdictions around the world, that may in fact have far worse environmental, health, and safety regulatory regimes than does Canada.

Canada's political class would be better off considering "scrapping of the capping," and consider, instead, a policy reform effort to rationalize Canada's increasing crazy-quilt of greenhouse gas control policies and taxes that, in addition to being expensive and insufficient to have Canada on course to meet existing greenhouse gas emission reduction commitments, might well be mutually self-negating, and through leakage, might simply transfer Canada's greenhouse gas emissions to other countries, where they will be accompanied by still greater environmental despoilation due to lower environmental standards abroad.

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Kenneth P. Green is a Fraser Institute senior fellow and author of over 800 essays and articles on public policy, published by think tanks, major newspapers, and technical and trade journals in North America. Mr. Green holds a doctoral degree in environmental science and engineering from UCLA, a master's degree in molecular genetics from San Diego State University, and a bachelors degree in general biology from UCLA. Mr. Green's policy analysis has centered on evaluating the pros and cons of government management of environmental, health, and safety risk. More often than not, his research has shown that governments are poor managers of risk, promulgating policies that often do more harm than good both socially and individually, are wasteful of limited regulatory resources, often benefit special interests (in government and industry) at the expense of the general public, and are almost universally violative of individual rights and personal autonomy. Mr. Green has also focused on government's misuse of probabilistic risk models in the defining and regulating of EHS risks, ranging from air pollution to chemical exposure, to climate change, and most recently, to biological threats such as COVID-19. Mr. Green's longer publications include two supplementary text books on environmental science issues, numerous studies of environment, health, ands afety policies and regulations across North America, as well as a broad range of derivative articles and opinion columns. Mr. Green has appeared frequently in major media and has testified before legislative bodies in both the United States and Canada.

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