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# Peddling GHGs
## What is the Carbon Footprint of Canada's Fossil Fuel Exports?

*By Marc Lee and Amanda Card*

### *Key Findings*

- Greenhouse gas emissions from Canadian exports of fossil fuels (crude oil, refined oil products, coal and natural gas) in 2009 were 15% greater than the emissions from *all* fossil fuel combustion within Canada, and almost four times the emissions from extracting and processing fossil fuels in Canada.

- Canada's *confirmed* reserves of coal, natural gas and crude oil in the ground, both conventional and nonconventional (bitumen and shale gas), are equivalent to more than three years of global $CO_2$ emissions. Total *possible* reserves (given changes in technology and economic conditions) are much higher, equivalent to 40 years of global emissions at current levels.

- Canada cannot meet its Copenhagen commitment to a 17% reduction in GHG emissions by 2020 (over 2005 levels) under status quo conditions. To provide climate leadership, Canada needs to keep its stores of fossil fuels underground.

### *Introduction*

The key driver of global climate change is the use of fossil fuels for energy. By removing carbon from underground and putting it into the atmosphere, an ever-thicker blanket of carbon dioxide is warming the planet. Relative to population, Canada is one of the worst offenders. In 2008, Canada ranked fourth in the world for highest greenhouse gas (GHG) emissions per capita, with 22 tonnes of carbon dioxide equivalent ($CO_2e$) emitted per person. Our per capita emissions were only slightly less than the United States, which emitted 22.8 tonnes per person that year.[1]

Canada burns a significant amount of fossil fuels for transportation, electricity generation, and industrial use. In 2009, these accounted for 505 million tonnes of carbon dioxide equivalent (Mt $CO_2e$) out of a total inventory of 690 Mt $CO_2e$.[2] While some provinces generate electricity from renewable hydro resources (notably, Quebec, Manitoba and BC), a number of provinces rely on coal, the most GHG-intensive energy source, as well as natural gas and other resources, for electricity generation (98 Mt). Altogether, Canadians use a significant amount of fossil fuels to heat homes (41 Mt) and other buildings (36 Mt), and to move people and freight (190 Mt).

In addition to utilizing fossil fuels for energy services, Canada is also a major producer of them. The extraction and processing of fossil fuels (oil, natural gas and coal) led to 162 Mt of emissions in 2009, almost one-quarter of Canada's total emissions (23.5%). But the footprint of Canada's fossil fuel production is actually even larger because official inventories only count emissions released *within the borders* of a jurisdiction. The combustion of exported coal, oil and gas outside of Canada in export markets is counted in

the inventories of the importing nations. As a result, emissions attributable to export-oriented fossil fuel industries in Canada's official GHG inventory are vastly understated.

This brief reviews emissions from Canada's export of fossil fuels, a key economic plank for the Conservative government, but one clearly at odds with climate action. Looking forward, Canada's massive fossil fuel reserves (still in the ground) represent major emissions potential. The oil sands are the third largest reserve of oil in the world, and estimates of Canada's shale gas potential are considerable. If Canada is serious about mitigating the effects of climate change, both domestically and internationally, it needs to not only reduce domestic consumption of fossil fuels, but also to stop peddling fossil fuels in export markets.

### *Fossil Fuels and Canada's Climate Policy*

For the past decade, Canada's GHG emission targets were framed by the Kyoto Protocol, in which Canada committed to a 6% reduction in emissions by 2012 relative to 1990 levels. In spite of signing this treaty and its ratification through Parliament in 2002, Canada has continued to increase emissions. In 2009, Canada's 690 million tonnes of carbon dioxide equivalent (Mt $CO_2e$) emissions were 17% higher than 1990 levels (the impact of the recession is notable, as 2008 emissions were 24% higher).[3]

Having failed on Kyoto, Canada's new climate change commitment, set in Copenhagen in 2009, is to reduce GHG emissions to 17% below 2005 levels by 2020 (a target emissions level of 607 Mt). Currently there is a wide gap between this commitment and emissions reduction planning from federal and provincial governments. According to Environment Canada, existing government actions are expected to reduce GHG emissions, relative to a business-as-usual trajectory, by 65 Mt by 2020, or about one-quarter of the reductions in GHG emissions needed to meet the 2020 target.[4]

Canada cannot achieve its Copenhagen commitment until it takes on the oil and gas industry and compels emission reductions. The Environment Canada report anticipates that the oil and gas industry will account for 46 Mt (86%) of Canada's anticipated increase in emissions between 2005 and 2020. It also shows the rise of the oil sands as a source of GHG emissions. Emissions from the oil sands are anticipated to triple to 92 Mt in 2020 relative to 30 Mt in 2005 (this is somewhat offset by a drop in conventional oil production).

But the carbon footprint of the industry is even worse because conventional accounting only counts in Canada's inventory the domestic emissions associated with getting fuels out of the ground and to market. Canada is the seventh-largest oil producer in the world, and is a significant exporter of coal and natural gas. Emissions related to the actual combustion of those fossil fuel exports represent large GHG emissions counted in the inventories of other nations (primarily the U.S.).

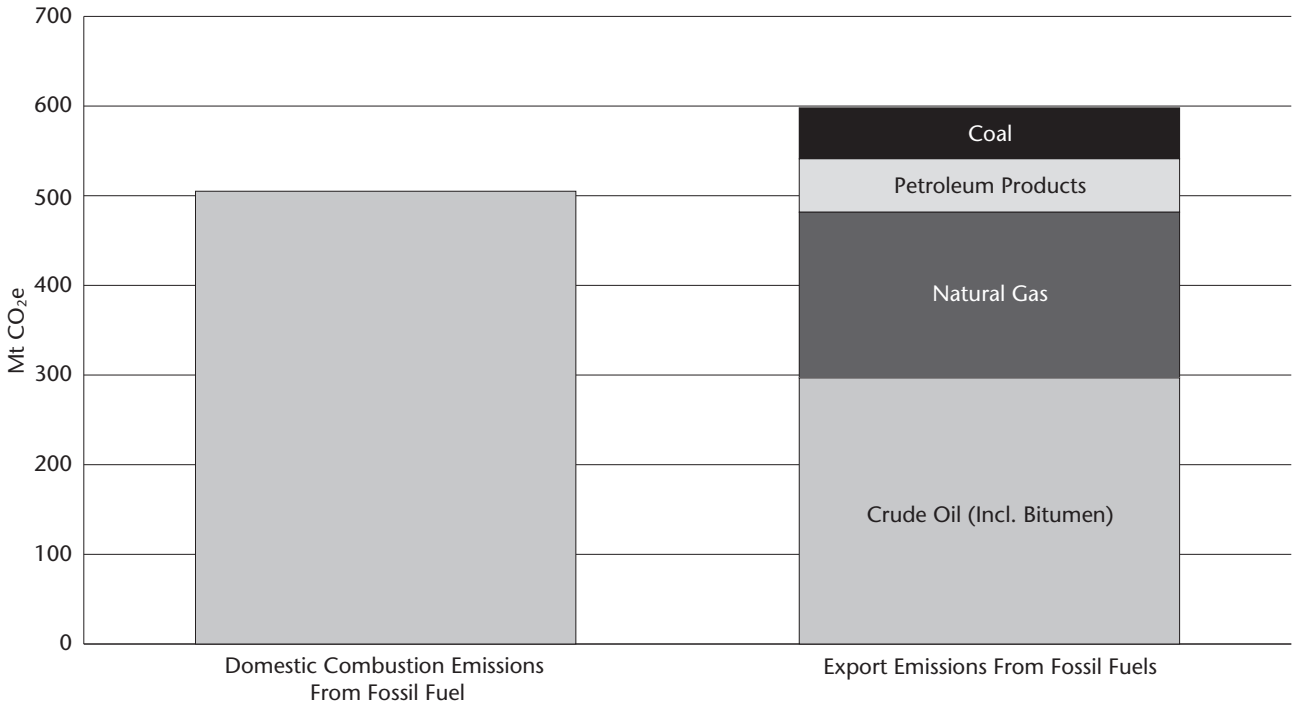
As a significant source of export revenues and royalties, fossil fuel industries have a disproportionate influence in Ottawa, as well as provincial capitals. Exports of crude oil, natural gas and petroleum products accounted for 21% of all Canadian exports in 2009.[5] Despite the recession's effect on demand, crude oil exports reached almost $43 billion, natural gas exports were $16 billion, refined petroleum products $15 billion, and coal $5 billion.[6]

Emissions associated with fossil fuel exports can be estimated by multiplying export volumes by the emission factors in Canada's GHG inventory report.[7]

- In 2009, Canada exported 109 million cubic metres of crude oil, including conventional and synthetic crude as well as crude bitumen. Converted to tonnes of carbon dioxide, Canadian crude oil exports totaled 297 Mt $CO_2e$.
- Exports of 94 billion cubic metres of natural gas represent 185 Mt of emissions combusted across the border.
- Refined petroleum product exports of 24 million cubic metres are equivalent to 60 Mt of exported emissions.
- More than 27 million tonnes of coal left Canada in 2009, leading to another 57 Mt of $CO_2$ emissions in export markets.

Combined, Canada's GHG exports were 598 Mt $CO_2e$ in 2009. As Figure 1 shows, exports of these commodities led to emissions elsewhere amounting

*Figure 1: Canada's Domestic Emissions vs Exported Emissions*




**Note:** Export emissions are generated from fuel combustion emissions factors.
**Sources:** Environment Canada, Canada's Greenhouse Gas Inventory, www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=DDCA72D0-1; Statistics Canada, Energy Statistics Handbook; CANSIM tables 126-0001 (crude oil), 134-0004 (petroleum products) 131-0001 (natural gas) and 135-0002 (coal). All data for 2009, last available data year. Farrell and Sperling (2007), A Low-Carbon Fuel Standard for California. Emissions factor for crude oil is from U.S. Energy Information Administration, www.eia.doe.gov/oiaf/1605/ coefficients.html. Combustion emissions for crude bitumen are equivalent to crude oil.UC Berkley and UC Davis. www.energy.ca.gov/low_carbon_fuel_standard/UC_LCFS_study_Part_1-FINAL.pdf

to equivalent to 115% of the emissions from fossil fuel combustion within Canada, and 3.7 times the domestic emissions generated in extracting and processing those fossil fuels.

## *Fossil Fuel Reserves and GHG Emissions*

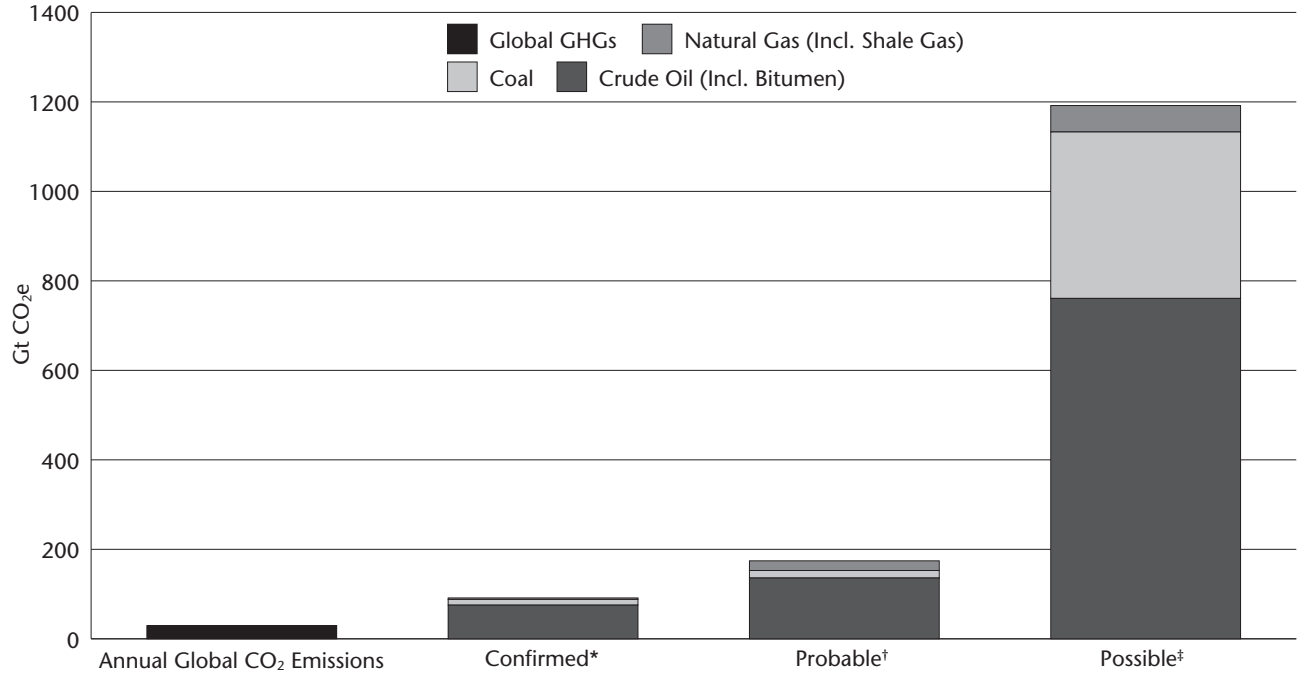
Canada is endowed with significant fossil fuel reserves. Proved reserves of traditional fossil fuels, including conventional crude oil, natural gas and coal, represent 18 billion tonnes, or gigatonnes (Gt), of potential $CO_2$ emissions. This amount is equivalent to 26 years of Canada's annual GHG emissions, and almost half of annual global emissions. Based on current extraction and production technologies, current proved reserves of conventional crude oil and natural gas will be entirely depleted in one decade, while coal reserves could last almost six decades.[8]

Although most conventional fossil fuel sources are dwindling, instead of working aggressively to curb our addiction to fossil fuels, Canada and other nations have shifted to an even dirtier path of developing unconventional fossil fuel sources that are much more difficult to extract and that result in higher production emissions. Canada's major unconventional reserves include crude bitumen (from the oil sands) and shale gas, both of which represent extraordinary potential for production as well as global emissions.

Canada also continues to increase development and production of the dirtiest of fossil fuels, coal. Significant reserves remain, and 193 billion tonnes of coal resources have been identified. Although these latter resources are not immediately recoverable under current conditions, they represent 372 Gt of $CO_2$-equivalent emission, or almost thirteen years worth of annual global emissions.[9]

Largely due to Alberta's oil sands, Canada's proven oil reserves are now the 3rd largest in the world (after Saudi Arabia and Venezuela) with over 27

*Figure 2: Global $CO_2$ Emissions vs Canadian Reserve Scenarios*




**Note:** * The "confirmed" scenario refers to established reserves that are currently economically and technologically viable for extraction. † The "probable" scenario includes amounts from the ultimate potential measure for resources that industry expects to be discovered and developed in the future. ‡ The "possible" scenario includes all the volume in-place that has not been extracted; while there is not currently technology or economic incentive to extract this volume, this scenario measure the emissions effect if we were able to get all of Canada's fossil fuel resources out of the ground.
**Sources:** Global $CO_2$ emissions are for 2010, from International Energy Agency, "Prospect of Limiting the Global Increase in Temperature to 2°C is getting Bleaker," http://iea.org/index_info.asp?id=1959. All reserve data for 2009. Reserve data for crude bitumen: NRC, Canadian Crude Oil, Natural Gas and Petroleum Products: Review of 2009 & Outlook to 2030, May 2011. Conventional crude: CAPP, Statistical Handbook for Canada's Upstream Petroleum Industry, Aug 2011. Natural/shale gas: EIA, World Shale Gas Resources, Apr 2011; NEB, Energy Brief: Understanding Canadian Shale Gas, Nov 2009. Coal: NRC, Canadian Mineral Yearbook 2009.

billion cubic metres of established crude bitumen reserves. Converted into emissions, these reserves would contribute 75 Gt of $CO_2$ equivalent emissions if combusted. And this amount only represents bitumen that can be recovered by current means; depending of future technology and economics, there is the potential that several times more crude bitumen could be extracted.[10]

The practice of exploiting shale gas has been the source of speculation and controversy across the country. BC is going ahead with major projects such as the Horn River Basin, while Quebec has put a temporary moratorium on shale gas exploration.[12] A 2009 Energy brief from the National Energy Board indicates that Canada potentially holds 30 *trillion* cubic metres of shale gas, and that might be a conservative estimate.[13] It is anticipated that almost 11 trillion cubic metres are technically recoverable; this represents 21.7 Gt (billion tonnes) of $CO_2$ that would be released through combustion.[14]

Figure 2 puts the impact of Canadian reserves into global perspective. Confirmed reserves are equivalent to 91.4 Gt $CO_2$ emissions, about three times annual global CO2 emissions of 30.6 Gt CO2 in 2010. Estimates of probable reserves to be extracted represent 174.3 Gt $CO_2$ emissions, almost six times annual global emissions. The most staggering picture, though, comes in the unlikely but possible event that all Canadian fossil fuel resources might one day be extracted, and put into the atmosphere. Potential emissions from all remaining fossil fuels (1,192 Gt $CO_2$ e) are equivalent to almost 40 times current global emissions.

Canada's reserves are significantly made up of unconventional sources, such as crude bitumen (oil

sands) and shale gas. Bitumen makes up 97% of Canada's proved crude oil emissions, while crude oil and natural gas reserves in the probable and possible categories are almost exclusively crude bitumen and shale gas, respectively.

Notably, the emissions in Figure 2 only count the carbon content of the fuels themselves, and do not include domestic production emissions associated with getting these unconventional sources out of the ground, which are much higher than for conventional fossil fuels. Recent analysis indicates that shale gas may in fact have a greater GHG footprint than either conventional gas or coal.[15] Analysis for bitumen reveals emissions at least 10% and perhaps as much as 40% higher than conventional production.[16]

The potential effect of such reserves is put into perspective when gauged against the world's *carbon budget*, an estimate of the total stock of emissions that can be emitted between now and 2050, worldwide, consistent with a reasonable probability of keeping global temperature increase under 2 degrees Celsius above pre-industrial levels. Above 2 degrees Celsius, it is widely believed that humans lose the ability to stop climate change, and runaway global warming could be the result.

Estimates of the global carbon budget are based on probabilities of reaching 2 degrees. With a 25% probability of exceeding 2 degrees, the global carbon budget is 1 trillion tonnes of $CO_2$ equivalent; at a 50% probability the budget is 1.44 trillion tonnes.[17] This available budget has already been depleted by emissions between 2000 and 2009 of 282 Gt $CO_2e$,[18] leaving a remaining budget of 728 Gt between 2010 and 2050 (at the 25% probability).

This means a very large share of global reserves of fossil fuels represent "unburnable carbon"—about 80% of total reserves and perhaps higher.[19] Canada's confirmed fossil fuel reserves are thus equivalent to one-eighth of the world's remaining carbon budget; probable reserves would take a quarter of the remaining carbon budget. Putting this carbon into the atmosphere would represent a climate catastrophe.

### *Burying the Evidence?*

Recent attempts by the fossil fuel industry to decrease GHG impacts associated with their sector have centred on plans to bury emissions back underground. Carbon capture and storage (CCS) technology is based on separating out $CO_2$ from fossil fuels during processing or combustion, and pumping it deep underground where it will stay, forever.

At a technology and engineering level, CCS is plausible but limited to large-scale electric power generation

### *A Note About Reserves*

While "fossil fuel reserves" might appear to be a straightforward concept, in practice there are different definitions that are categorized according to the likelihood of recovery. Those resources that are most expensive to extract and produce will not necessarily be accessed until technology improves or fossil fuel prices rise to make extraction economically worthwhile.

The most firm reserve statistic is the "established" or "proved" reserves, which sum up the reserves that are recoverable with presently available technology that would be profitable at current/future oil prices. Essentially these amounts will almost certainly be extracted.

Established reserves, however, are only a fraction of "initial volume in-place", the total amount of fossil fuels estimated to be in the ground. Currently, we are only able to extract a fraction of this total volume. To provide some estimate of reserves not yet established, the fossil fuel industry also reports the "ultimate potential" of a fossil fuel resource. Ultimate potential includes total production that has already taken place, established reserves that remain, and estimates of future discoveries and developments.[11] This statistic is most important for more recent non-conventional fossil fuels.

For example, current statistics from the Energy Resources Conservation Board for crude bitumen put the initial volume in place at 286.6 billion cubic metres. This has a total ultimate potential of 50.0 billion cubic metres, of which 26.9 billion cubic metres are the remaining established reserves.

using gas and coal, and even in these cases about 85–90% of $CO_2$ is captured.[20] CCS is not applicable small-scale end-use emissions from cars, trucks and homes. There are also long-term risks associated with sequestration. For example, concerns about leaks from Canada's largest CCS demonstration site in Weyburn, Saskatchewan challenge the viability of this solution.[21] Meanwhile, other major CCS projects continue to move ahead, including Shell's Quest plant near Edmonton, which has received $850 million in federal and provincial funding, as well as a proposal from Spectra Energy for Fort Nelson, BC.

Even if we are generous about the potential of CCS as a technology, we are left with some big and dirty challenges en route to a low-carbon economy. Developing CCS is terribly expensive with significant risks involved. The industry is actively seeking funding from federal and provincial governments to implement CCS projects. As governments are being asked by the industry to pick up the tab in the short- to medium-term, a less costly and less risky option would be to spearhead aggressive conservation efforts, and to shift towards truly renewable sources of energy.

Given the sheer urgency of getting over our addiction to fossil fuels, this inevitably means a moratorium on new oil and gas development is needed, with the existing industry phased out. Unless CCS will provide a trustworthy method for sequestering 100% of lifecycle emissions, those resources must be left in the ground.

### *The Challenge of Getting to Zero*

Future oil and gas development represents a substantial barrier to reducing Canadian GHG emissions. The federal campaign to increase oil sands exports is demonstrated in the campaign for U.S. approval of the 2,673 km Keystone XL pipeline. This expansion will connect Hardisty, Alberta through Saskatchewan, Montana, South Dakota and Nebraska to terminals in Nederland, Texas on the Gulf of Mexico.[22] A decision on Keystone XL has been delayed until 2013, but if approved would increase export capacity by 510,000 barrels a day, equivalent to 80 Mt $CO_2$ annually.[23] If not approved, the federal government has proposed expanding pipeline capacity to the British Columbia coast for shipping to Asia.

Data identifying the growing impact of the oil sands on Canada's emissions were not included in the most recent National Inventory Report submitted to the United Nations Framework Convention on Climate Change. The omitted information would have noted a substantial increase in emissions from Canada's oil sands industry, accounting for 6.5% of total national emissions. This is up from 5% in 2008, and highlights growth of almost 300% since 1990. [24] While this is not the only source of fossil fuel emissions and exports in Canada, it could be one of the most impacting for the world in years to come.

An important social justice concern in shifting away from fossil fuel extraction is the negative impact on many workers in these industries, and the communities they live in. Fossil fuel production contributed 81,000 jobs to the Canadian economy in 2008, or about 0.6% of Canadian employment.[25] While this is a relatively small share of the total and there is a strong case to be made for new green jobs to be created in renewable energy, the promise of green jobs in the future is not the same as a good high-income job today.

The transition away from fossil fuels must happen in a way that minimizes impacts on resource-dependent communities and that commits to "just transition" strategies for affected workers. These include income supports, retraining provisions and mobility allowances as part of a "green social contract" that ensures that no groups bear disproportionate costs of adjustment to a carbon neutral economy. Further research along the lines of Denmark's "flexicurity" model, which provides extensive income support and education and training for displaced workers, is needed to better define what an ideal package would look like.[26]

Confronting GHG emissions from the oil and gas sector is necessary for Canada to come anywhere near meeting its climate change commitment to drop to 17% below 2005 emissions levels by 2020. In order to be part of the climate change solution, we need to work at not only reducing our emissions nationally, but to limit our international GHG contribution. These challenges, and the social justice transitional issues that accompany them, must be addressed if Canada is to hit its emissions targets and finally become a world leader in climate action. As part of the global commons, our future depends on it.

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