

Canada's Carbon Liabilities

The Implications of Stranded
Fossil Fuel Assets for Financial
Markets and Pension Funds

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CCPA
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Summary

MOUNTING EVIDENCE OF climate change impacts worldwide will inevitably lead to a new global consensus on climate action. Based on recent research, between two-thirds and four-fifths of known fossil fuel reserves have been deemed to be *unburnable carbon* — that cannot safely be combusted.

This is of profound importance to Canada, a nation making fossil fuel development and expansion the centrepiece of its industrial strategy. This study looks at the implications of unburnable carbon for the Canadian fossil fuel industry and in particular for financial markets and pension funds. We argue that Canada is experiencing a *carbon bubble* that must be strategically deflated in the move to a clean energy economy.

Doing the Math

A *carbon budget* is the maximum amount of CO₂ that can be emitted in the future, based on scientifically-estimated probabilities of staying below 2°C of global warming, above which would lead to catastrophic or “runaway” climate change beyond humanity’s capacity to manage. The world’s carbon budget is now approximately 500 billion tonnes (Gt) of carbon dioxide, an amount that would provide an 80% chance at staying under 2°C.

Canada’s share of that global carbon budget would be just under 9 Gt based on its share of world GDP, and 2.4 Gt based on share of world population. An internationally negotiated carbon budget for Canada could go

up depending on export arrangements with other countries, or down if larger historical emissions mean disproportionate reductions from rich countries. A plausible carbon budget for Canada would almost certainly fall between 2 and 20 Gt.

Canada's reserves of fossil fuels are significantly larger than Canada's fair share of a global carbon budget:

- Canada's proven reserves of oil, bitumen, gas and coal are equivalent to 91 Gt of CO₂, or 18% of the global carbon budget.
- Adding in probable reserves boosts this figure to 174 Gt, or 35% of the global carbon budget.
- A final, more speculative category including all possible reserves is 1,192 Gt – more than double the world's carbon budget.

This means that business as usual for the fossil fuel industry is incompatible with action to address climate change that keeps global temperature increase to 2°C or less. Even at the high end of a 20 Gt carbon budget, this would imply that 78% of Canada's proven reserves, and 89% of proven-plus-probable reserves, would need to remain underground.

Carbon Liabilities, Stranded Assets

The Toronto Stock Exchange (TSX) is highly weighted towards the fossil fuel sector. At the end of 2011, the TSX had 405 listed oil and gas companies with a total market capitalization of over \$379 billion. When coal producers are added this number rises further.

To assess the implications of Canada's carbon bubble, we developed a database of 114 fossil fuel companies operating in Canada – 103 listed on the TSX (assets greater than \$70M for oil and gas, and \$50M for coal), and 11 foreign-owned subsidiaries. For each we compiled financial data on revenue, assets and market capitalization. Then we added data on fossil fuel reserves (proven and probable), which we converted into potential CO₂ emissions. We develop an estimated range of their *carbon liabilities* by applying a carbon price, representing the estimated damages from emitting a tonne of carbon (known as the *social cost of carbon*, or SCC, based on recent literature).

For the Canadian-listed companies:

- Our low estimate considers a \$50 per tonne SCC applied only to the proven reserves category, and amounts to \$844 billion in carbon lia-

bilities — more than two and a half times the market capitalization and nearly double the assets of those companies.

- Our high estimate of \$200 per tonne SCC applied to their proved-plus-probable reserves yields a figure just under \$5.7 trillion, an amount 17 times larger than market capitalization and 13 times assets.
- For 12 companies in our database included in the S&P/TSX 60 index, total carbon liabilities are between \$0.5 and \$3.5 trillion. Even the low estimate of carbon liabilities exceeds both assets and market capitalization.

For foreign companies, the estimated carbon liability of their Canadian fossil fuel reserves is between \$0.3 and \$1.2 trillion. The latter amount, incredibly, is larger than the full market capitalization of foreign companies, and 81% of their assets, even though market capitalization and assets are based on global operations.

This situation is exacerbated by the predominance of bitumen and coal in the reserve mix because these particular fuel types are far more GHG-intensive than other fossil fuel products, and are much more likely to be regulated earlier under a global climate action framework.

- Bitumen and coal account for more than three-fifths of both the proved and proved-plus-probable potential emissions in our database.
- If synthetic oil is added, which is crude oil produced from oil sands bitumen, the proportions jump to more than four-fifths for both categories of reserves.

An important consideration is that Canada's oil and gas sector has a very high degree of foreign ownership.

- Foreign corporations owned 35% of the sector's \$518 billion in assets in 2010, and received roughly half of the sector's revenues and profits in 2010.
- US corporations have been the principal foreign investors, although their share has declined in recent years from 79% in 2001 to 64% in 2010. Recent takeovers of oil and gas assets by China's CNOOC and Malaysia's Petronas in late 2012 — deals worth \$21 billion combined — have increased the foreign-owned share.

Canada has a unique role in the global economy with regard to fossil fuels. Some 80% of the world's oil reserves are held by state-owned companies;

that is, countries who have made public ownership of this strategic asset a top priority. Of the remaining global oil reserves, two-thirds are found in Canada, making the country a top destination for private investments.

As foreign capital flows in, so it may flow out. External drivers such as international, regional or national rules that shrink Canada's export markets for fossil fuels, or successful divestment campaigns in other jurisdictions could have a spillover effect that could trigger a withdrawal of capital from Canada. This is an additional source of instability or external shock that could lead to a bursting carbon bubble.

Pension Funds and Climate Risk

The recent experience of high-tech and housing bubbles should serve as a stern warning to policy makers. In 2008, the collapse of a housing bubble (in particular, in the United States and Europe) threatened the global financial system as a whole. The fallout from the housing crash affected a broad segment of society because housing is the most important asset for middle-class households.

Next to home ownership, the right to future income through employer pension plans is the second-most important asset for a wide swath of middle-class households. Registered pension plans cover more than 6 million members in Canada, and the total market value of trustee pension funds in 2012 was over \$1.1 trillion, of which almost one-third was held in stocks.

At a system-wide level, however, it is difficult to ascertain the exposure of Canadian pension funds and other investment types to the carbon bubble.

- More than half of Canada's pension system is in the form of employer pension funds (55%), followed by RRSP assets holdings (35%), and the Canada Quebec Pension Plans (under 10%).
- In the US, pension funds alone owned almost one-third of oil company stocks in 2011.
- About one-third of the assets of the Canada Pension Plan are invested in publicly traded equities, representing \$13 billion in Canadian equities and \$43 billion in foreign equities, as of the end of 2012.

Addressing risk is inherent to financial market investment, which routinely must account for risks due to inflation, currency movements, regulatory changes, political turmoil and general economic conditions. However, there has been a general failure to account for climate risks, and a tendency to view

any screening for environmental purposes to be detrimental to financial performance. Our analysis turns this on its head: by not accounting for climate risk, large amounts of invested capital are vulnerable to the carbon bubble.

There is an important inter-generational equity argument built into the management of pension funds. While pension funds have to generate maximum current return value for existing (and soon-to-be) pensioners, at the same time they are legally obligated to ensure the long-term sustainability of the fund. That is, funds must equally represent the interests of young workers for their eventual retirements.

Deflating the Carbon Bubble

Pension funds and other institutional investors need to be part of the solution. Other private savings vehicles, such as RRSPs, and public investments through the Canada Pension Plan, are also in need of a “managed retreat” from fossil fuel investments. We recommend the following to green Canada’s financial markets.

- *Establish a National Carbon Budget* — In order to do their job properly, and contribute to achieving a zero-carbon Canada (and world), financial markets need a clear and credible long-run climate action commitment that provides investment security and certainty. In addition to credible emission targets, Canada needs to establish a *national carbon budget* to manage its fossil fuel resources for wind-down. A corollary to this is that the federal government must acknowledge that a large share of proven and potential reserves is indeed “unburnable carbon.” These reserves should be effectively taken out of circulation, leaving only Canada’s fair share of the remaining global carbon budget.
- *Make Market Prices Tell the Truth about Carbon* — Shifting the terrain towards clean or renewable sources of energy from fossil fuels requires policies that make sure the costs of greenhouse gas emissions are reflected in market prices. Broad framework policies to level the playing field for clean energy alternatives and internalize costs include: carbon pricing; removal of subsidies to fossil fuel producers; regulations and standards; and public investments.
- *Develop Green Bonds* — Pension funds and other investors divesting from fossil fuel companies need an alternative place to put their money,

and one major transitional support could be the development of a national green bonds program (along with complementary provincial programs). The long-run investment horizons of pension funds align nicely with long-term bond issues, and the need to invest in public infrastructure for climate action. While carbon taxes are an ideal source for funding climate action it will take time for those revenues to ramp up with a rising carbon tax. Green bonds can bridge this gap by essentially borrowing against future carbon tax revenues.

- *Public Sector Leadership* —The government of Canada should direct the Canada Pension Plan Investment Board to divest from fossil fuel companies. If pension plans on behalf of public sector retirees and employees (or their relevant investment management boards) join this effort, this would provide a powerful signal to other pension funds. Outside of pensions, divestment is broadly applicable to other related investment funds, such as university endowments or investments held by municipalities and Crown corporations. The federal government should also make changes to private savings vehicles, such as Registered Retirement Savings Plans (RRSP) and Tax Free Savings Accounts (TFSA) by restricting preferential tax treatment to funds or investments that meet certain green economy criteria.
- *Mandate Carbon Stress Tests* — Canadian financial markets need a mandatory system of *climate stress tests* for new financing commitments and for outstanding portfolios. Disclosure of climate change information must be standardized to provide high-quality and comparable information (ideally, internationally comparable) about climate change policies and assessment of risks. The federal government could lead in developing selection criteria to be used in the screening of investment opportunities, and in requiring ratings agencies to report on climate risk and the implications of unburnable carbon in their evaluations. Securities and accounting oversight bodies should be involved in developing a harmonized Canadian approach to climate risk.

Our suggested reforms would go a long way to providing the foundation necessary for taking Canada's economy towards a cleaner future. A coherent and credible action plan led by the federal government that includes action to better regulate financial markets will make it much easier for investors to account for climate change in their risk-return assessments. Our hope is

that these actions can steadily reduce the exposure of Canadian pension funds and other investors, and the Canadian economy as a whole, by deflating the carbon bubble.

Until such time as our governments take decisive action, we should rightly see an expansion of divestment efforts by civil society groups — on campuses, within churches, by credit unions, and by other community-based organizations seeking to influence the investment choices of major institutions. Such efforts are encouraging — they signal an early understanding that a managed retreat is preferable to a financial meltdown.

Introduction: Unburnable Carbon

INVESTMENTS IN THE fossil fuel industry have become a hot topic on American university campuses, energized by environmentalist Bill McKibben's 2012 popular article, "Global Warming's Terrifying New Math", in *Rolling Stone* magazine. Similar to the South Africa divestment campaigns of the 1980s, students are calling on their administrations to remove coal, oil and gas stocks from university endowment funds.¹ Beyond the moral arguments on university campuses for divestment, pension funds and other institutional investors are beginning to question whether owning fossil fuel stocks is a wise financial move in light of climate change.

The problem is the disconnect that exists between the desire to maximize investment returns, which has historically involved investing in fossil fuels, and the need to reduce atmospheric greenhouse gas concentrations. In McKibben's words:

We have five times as much oil and coal and gas on the books as climate scientists think is safe to burn. ... Yes, this coal and gas and oil is still technically in the soil. But it's already economically aboveground — it's figured into share prices, companies are borrowing money against it, nations are basing their budgets on the presumed returns from their patrimony. ... The numbers aren't exact, of course, but that carbon bubble makes the housing bubble look small by comparison.²

This reality of *unburnable carbon* is of profound importance to Canada, a nation making fossil fuel development and expansion the centrepiece of its industrial strategy — in particular with the recent push for new bitumen and natural gas pipelines, and expansion of coal port facilities on the West Coast.³ While Canada ostensibly has targets for GHG emission reductions as part of the 2009 Copenhagen Accord — a 17% reduction in emissions by 2020 relative to 2005 levels — its actions suggest an ever-greater reliance on fossil fuel extraction with little regard for climate consequences.

We argue that mounting evidence of climate change impacts worldwide will inevitably lead to a new global consensus that keeps unburnable carbon underground. Extreme drought and Hurricane Sandy put climate change back on the radar for the United States, and impacts around the world are almost impossible to ignore. Canada may be dragged kicking and screaming into a new global climate treaty — and the longer the delay the more aggressive the terms of that treaty will need to be — but a new treaty is surely coming. All that remains in doubt is the timing.

In other parts of the world, such as the United Kingdom, there is a growing awareness that the value of fossil fuel companies is vastly overstated because of unburnable carbon. In January 2012, a group of finance and pension organizations wrote to then-Bank of England governor, Mervyn King, of concerns that “the UK’s exposure to high carbon investments might pose a systemic risk to our financial system ... [and] the depth and breadth of our collective financial exposure to high carbon, extractive and environmentally unsustainable investments could become a major problem as we transition to a low carbon economy.”⁴ Oxford University recently announced a new research program into the potential for climate action to lead to “stranded assets.”⁵ Stranded assets refer to financial assets whose value under certain circumstances or policy scenarios, such as a reasonable price on carbon, have the potential to be reduced significantly.⁶

In Canada, fossil fuel extraction and production is the second-largest contributor (after the financial sector itself) to the market capitalization of Canada’s stock market, representing approximately 24% of the total market capitalization of the S&P/TSX 60.⁷ The core business model, and share prices, of fossil fuel companies are premised on their ability to convert fossil fuel reserve assets into marketable products and cash-flow. Yet, these companies, and Canada’s financial sector as a whole, have, to date, largely ignored the realities of climate change. Global bank, HSBC, garnered major headlines for its analysis that major oil companies could lose 40–60% of their value if the world was to meet existing Copenhagen

Accord targets, with expensive projects like Alberta's oil sands among the first to be shelved.⁸

South of the border, the fossil fuel divestment campaign by 350.org (of which Bill McKibben is a founder) on university campuses is beginning to show some early success (4 divestments as of the time of writing, and active campaigns on more than 300 campuses). The divestment campaign has spread north, through Fossil Free Canada, targeting Canadian university endowments. Moreover, divestment concerns are spreading from university campuses, drawing on both moral and financial arguments. The Cities of Seattle and San Francisco are reviewing investments in fossil fuels, including pension funds.⁹ US churches are considering similar actions, such as the United Church of Christ, a 1.2 million-member church, who will be holding a national vote in June on divestment.¹⁰

This report considers Canada's growing petro-state and reviews the case for a carbon bubble in Canadian financial markets, with a closer look at the relative contributions of Canada's largest fossil fuel companies. This analysis suggests significant potential consequences for Canada's financial markets, in particular pension fund assets upon which many middle-class households are relying for their retirement. The report also looks at how Canada can implement institutional and policy reforms to transition from carbon-intensive investments to green investments that transition to a zero-carbon economy. In concert with a coherent climate policy framework, the capital of public and private pension funds, university endowments and private savings vehicles could be levered to accelerate the low-carbon transition.

Doing the Math: Implications for Canada

WORLDWIDE, EXTREME WEATHER events from drought and floods to powerful storms and record-breaking temperatures are making a powerful statement that climate change can no longer be denied. Calls for action to change course are no longer coming solely from climate scientists and environmental groups. For example, in a landmark November 2012 report the World Bank concluded we are headed for a 4°C warmer world, “one of unprecedented heat waves, severe drought, and major floods in many regions, with serious impacts on ecosystems and associated services.”¹¹ The Managing Director of the International Monetary Fund, Christine Lagarde, was even more frank at the January 2013 meetings of the World Economic Forum: “Unless we take action on climate change, future generations will be roasted, toasted, fried and grilled.”¹²

There is international agreement that global temperature increase should be kept below 2°C (above pre-industrial levels) in order to avert the worst climate impacts. Beyond this threshold there is a very high likelihood of “runaway climate change” that is beyond humanity’s capacity to manage. Already, global temperature has risen 0.8°C, and even if greenhouse gas emissions were cut to zero overnight the inertia of emissions over the past few decades would still cause additional warming of 0.5 to 1.0°C.¹³ A number of participating countries in international negotiations, those from small island states and less developed countries, have called for a lower lim-

it of 1.5°C, given existing climate impacts and the need for prudence in the face of uncertainty about where tipping points in the global climate system may actually lie.

How much space exists for further emissions before climate change becomes irreversible is uncertain. Atmospheric carbon dioxide (CO₂, the most significant greenhouse gas) levels were stable at approximately 280 parts per million (ppm) from the end of the last ice age approximately 10,000 years ago up to the beginning of the industrial revolution.¹⁴ As of February 2013, atmospheric concentrations of CO₂ had reached 397 ppm, with annual emissions growing by approximately 2.1 ppm per year over the past decade (though this includes the 2008–10 recession).¹⁵

Stabilizing emissions at 450 parts per million has been cited as a target in international negotiations, and would still provide a roughly 50/50 chance of overshooting the 2°C target.¹⁶ This amounts to about twenty years of emissions at current levels, less if annual emissions continue to rise. NASA climate scientist James Hansen’s analysis of previous transitions between climatic regimes concludes that a CO₂ level of 450 ppm or larger, if long maintained, would push Earth towards an ice-free state. Although the pace of climate change would initially be limited by ocean and ice-sheet inertia, “such a CO₂ level likely would cause the passing of climate tipping points and initiate dynamic responses that could be out of humanity’s control.”¹⁷

Hansen and others have supported 350 ppm as a long-term target that would provide a high probability of not exceeding 2°C. That is, not only must emissions peak soon and then begin to fall steadily over subsequent decades — which means phasing out fossil fuels and tackling other sources of GHG emissions — but the existing stock of atmospheric CO₂ must be reduced in absolute terms through aggressive tree planting and perhaps other measures to sequester carbon underground.

The concept of a *carbon budget* — a maximum amount of CO₂ that can be emitted in the future — has been developed over the past decade. In 2009, researchers with the Potsdam Institute conducted a probabilistic analysis aimed at quantifying emission budgets for the period 2000 to 2050 that would limit global warming to less than 2°C. Their analysis concludes that a “carbon budget” of no more than 886 billion tonnes (gigatonnes, or Gt) of CO₂ can be released into the atmosphere if we are to have a 80% chance of staying under the 2°C limit, and no more than 1,437 Gt CO₂ for a 50% chance.¹⁸

The “inconvenient truth” of this exercise is that the trajectory of the world’s emissions is far in excess of this carbon budget. A 2011 report from the Carbon Tracker Initiative (CTI) was the first to point out that this rep-

The 3 Ps of Fossil Fuel Reserves

According to the *Canadian Oil and Gas Evaluation Handbook*, based upon current technology and economic circumstances:

Proven (P) – “Proved [or proven] reserves are those reserves that can be estimated with a high degree of certainty to be recoverable. It is likely that the actual remaining quantities recovered will exceed the estimated proved reserves.”

Proven + Probable (2P) – “Probable reserves are those additional reserves that are less certain to be recovered than proved reserves. It is equally likely that the actual remaining quantities recovered will be greater or less than the sum of the estimated proved + probable reserves.”

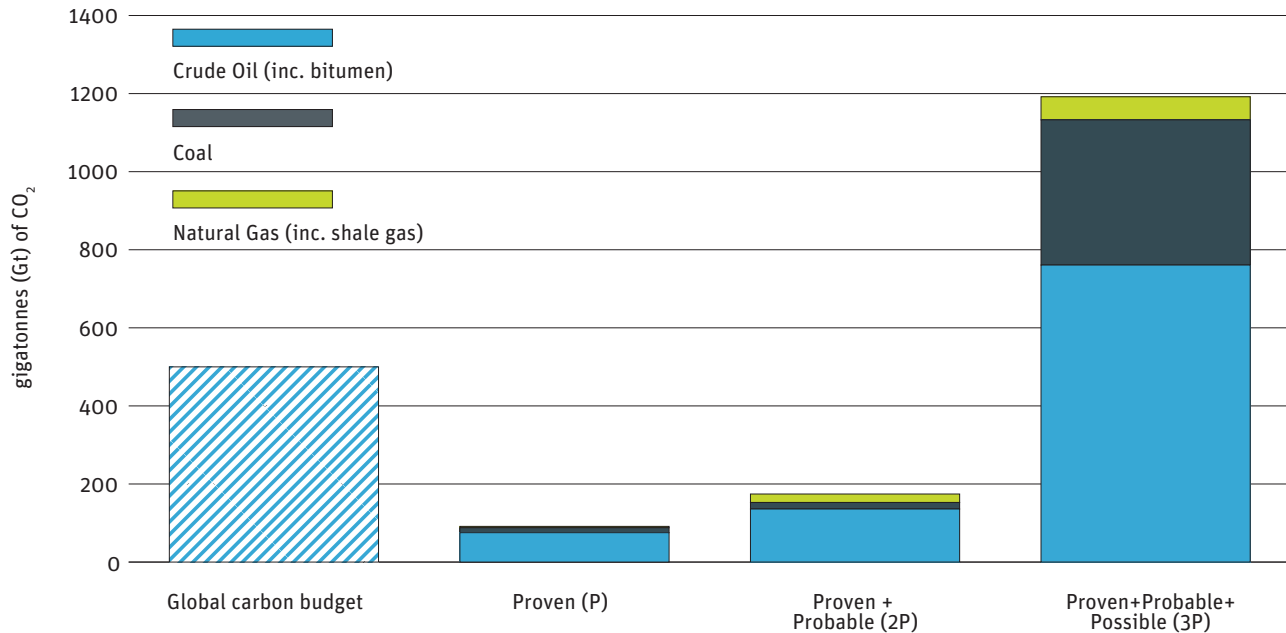
Proven + Probable + Possible (3P) – “Possible reserves are those additional reserves that are less certain to be recovered than probable reserves. It is unlikely that the actual remaining quantities recovered will exceed the sum of the estimated proved + probable + possible reserves.”

resents a *carbon bubble*. Based on the 886 Gt carbon budget from the Potsdam Institute study, CTI estimated the world’s remaining carbon budget of 565 Gt, due to emissions up to the end of 2010. It also calculated the emissions potential of the world’s proven oil and gas and coal reserves at 2,795 Gt CO₂ — that is, five times the estimated carbon budget.¹⁹ A similar conclusion was reached by the International Energy Agency, although their analysis was based upon the larger carbon budget representing a 50% chance of staying below 2°C.²⁰ Nonetheless, the IEA concludes: “No more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2°C goal, unless carbon capture and storage technology is widely deployed.”²¹

Approximately 360 Gt CO₂ of the world’s carbon budget has already been used up between 2000 and 2012, due to emissions from fossil fuel combustion alone.²² In addition, we must also account for emissions from industrial (non-combustion) emissions, agriculture, waste, and land use changes. Thus, conservatively, the world’s carbon budget is now closer to 500 Gt for an 80% chance at staying under 2°C of warming, and 1,000 Gt for a 50% chance. Because of the risks associated with the latter carbon budget, we only consider the 500 Gt carbon budget in the remainder of this paper.

What is perhaps most troubling about these studies is that they only examined “proven” reserves, those that are already close to development. Fossil fuel companies also have control over territories with “probable” and “possible” recoverable reserves, which add considerably to the reserve and

FIGURE 1 Canada's Fossil Fuel Reserves vs Global Carbon Budget



Notes (i) The “proven” (P) scenario refers to established reserves that are currently economically and technologically viable for extraction. (ii) The “proven + probable (2P)” scenario includes amounts from the ultimate potential measure for resources that industry expects to be discovered and developed in the future. (iii) The “proven+probable+possible (3P)” 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 All reserve data for 2009, summarized in M Lee and A Card, *Peddling GHGs: What is the Carbon Footprint of Canada’s Fossil Fuel Exports?*, Behind the Numbers, November 2011, Canadian Centre for Policy Alternatives. 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*.

potential CO₂ totals (see sidebar).²³ Of particular relevance for Canada, the CTI report comments that oil and gas reserve estimates may be artificially low due to accounting practices for the oil sands and shale gas deposits that only count reserves when their production is deemed to be “imminent”.²⁴

Converted into potential emissions, Canada’s proven reserves of oil, bitumen, gas and coal are equivalent to 91.4 Gt of CO₂, an amount that is about three times global CO₂ emissions of 30.6 Gt in 2010. Adding in probable reserves (2P) boosts this figure to 174.3 Gt CO₂, almost six times annual global emissions. As Figure 1 shows, these reserves amount to 18% and 35% of a global carbon budget of 500 Gt, respectively. The final category including possible reserves (3P) is more speculative, based on total estimated volumes in place, with extraction hinging on more favourable economics and technology. Nonetheless, it is estimated at a total of 1,192 Gt CO₂ — more than double the world’s carbon budget.²⁵

Yet, Canada's share of a 500 Gt CO₂ global carbon budget would be just under 9 Gt based on share of world GDP,²⁶ and 2.4 Gt based on world population. An internationally negotiated carbon budget for Canada could go up depending on export arrangements with other countries, or down if larger historical emissions mean disproportionate reductions from rich countries. Still, with a plausible carbon budget almost certainly falling between 2 and 20 Gt, the conclusion is inescapable: business as usual for the fossil fuel industry is incompatible with action to address climate change that keeps global temperature increase to 2°C or less. Even at the high end of a 20 Gt carbon budget, this would imply that 78% of proven reserves, and 89% of proven-plus-probable reserves, would need to remain underground. When (if) the necessary policy action is taken to constrain the amount of carbon dioxide humanity is sending into the atmosphere, those reserves must become stranded assets.

A separate issue is that climate change itself will have adverse economic impacts for different industries and regions of Canada. These include costs arising from significant sea level rise, increased likelihood of floods, droughts and shocks associated with more intense storms.²⁷ Such events will have significant economic impacts for both Canada and the world. Canada's National Round Table on the Environment and the Economy (NRTEE) has modelled the 2°C scenario and indicated that costs to Canada's economy would rise from approximately \$5 billion per year in 2020 to \$21–43 billion per year by the 2050s, with a 5% chance that the costs could be as high as \$91 billion per year, depending on worldwide emissions pathways and Canada's own economic and population growth trajectories.²⁸ While this reflects a long-term challenge for different types of infrastructure and industries, we do not consider the impacts of climate change for financial markets in the remainder of this paper; instead, we focus on the carbon bubble arising from the need for international mitigation efforts.

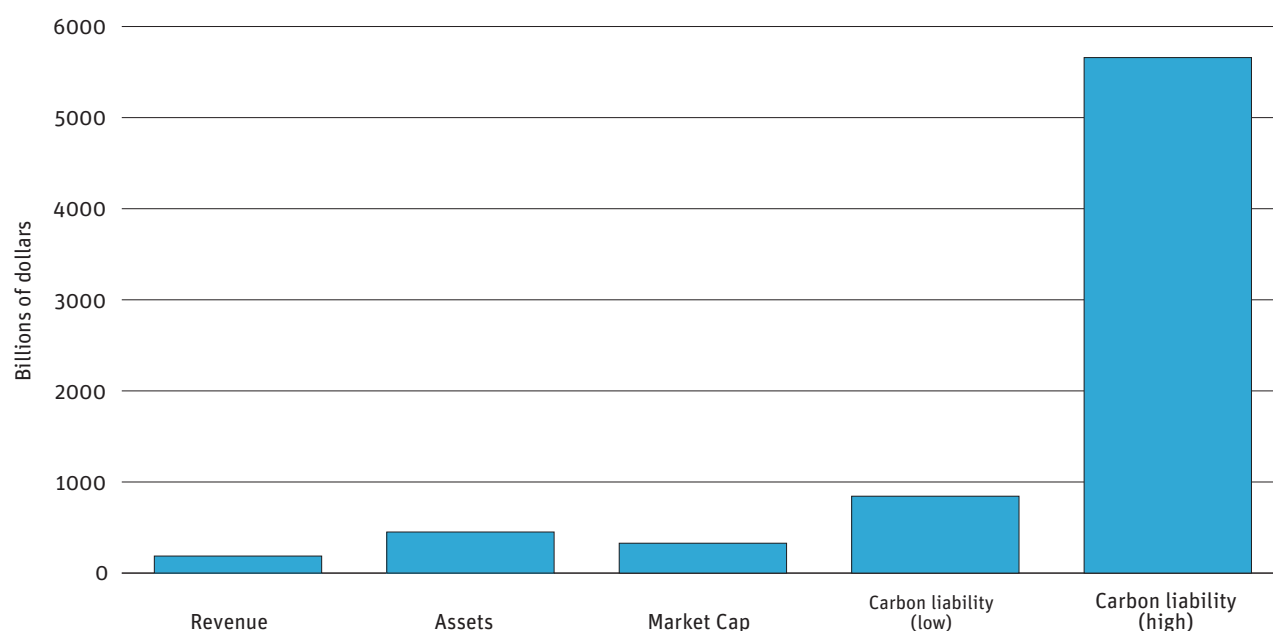
Carbon Liabilities, Stranded Assets

THE TORONTO STOCK Exchange (TSX) is highly weighted towards the fossil fuel sector, and has been called “the world’s leading capital market for natural resource companies.”²⁹ For institutional investors like pension funds, it is difficult to hold a diversified portfolio constructed from Canadian securities without holding fossil fuel company stock. At the end of 2011, the TSX had 405 listed oil and gas companies with a total market capitalization of over \$379 billion.³⁰ When coal producers are added this number rises further.

In this section we look at the intersection between Canadian fossil fuel companies and their vulnerability to becoming stranded assets. A database of 114 top fossil fuel companies operating in Canada was developed, including oil and gas, and coal. Of these, 103 companies are Canadian publicly-traded corporations, while another 11 are foreign-owned subsidiaries.³¹ The minimum asset base for inclusion was \$70 million for oil and gas and \$55 million for coal. Private companies are not included in our sample, nor are foreign companies for which we were unable to clearly differentiate Canadian reserve holdings. The full table of 114 companies is available in the Appendix, along with more detail on how data was gathered and estimates derived.

Financial data was collected on assets, revenues, and market capitalization. Canadian-listed companies in the sample had total revenues of \$187 billion, assets of \$451 billion, and market capitalization of \$328 billion. For foreign-owned companies with subsidiaries holding fossil fuel reserves in

FIGURE 2 Summary for Canadian-listed Companies



Notes Figure includes 103 Canadian-listed companies with more than \$70 million in assets in the oil and gas industry and more than \$55 million for the coal industry. Carbon liability (low) estimated as CO₂-equivalent proven reserves times \$50 per tonne social cost of carbon (scc). Carbon liability (high) estimated as CO₂-equivalent proven+probable (2P) reserves times \$200 per tonne scc. See Technical Appendix for additional details on methodology.

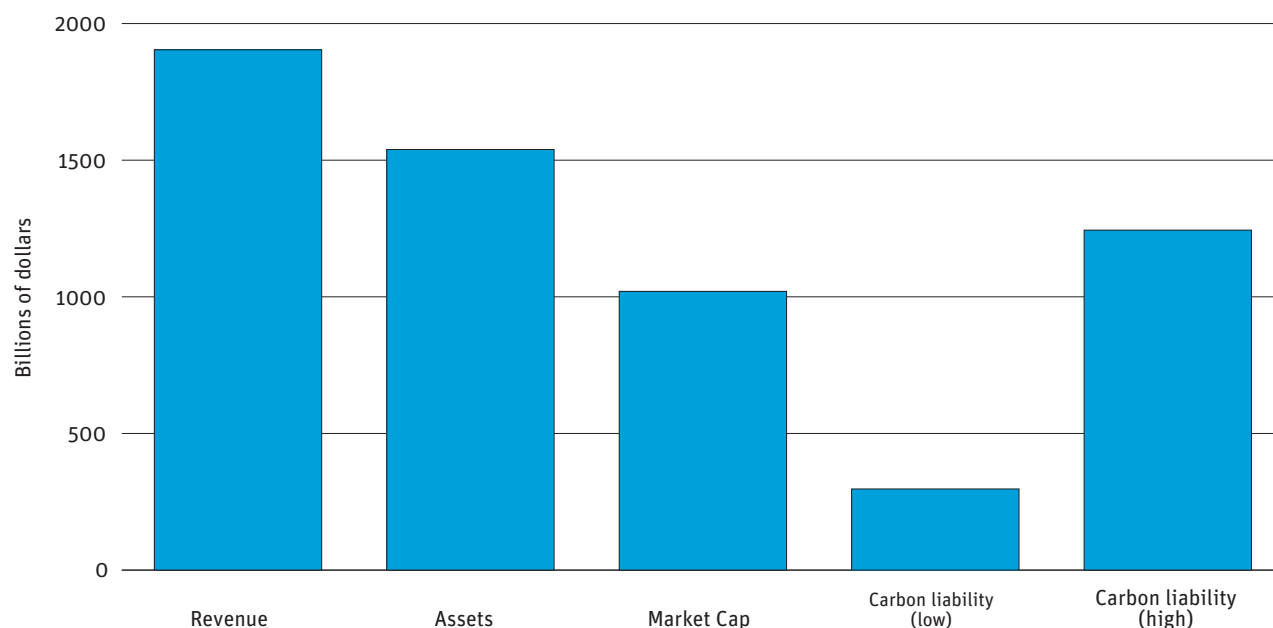
Sources Authors' calculations based on 2011 annual financial reports.

Canada, total global revenues were \$1.9 trillion, \$1.5 trillion in assets and market capitalization of \$1 trillion. To put this information into perspective, Canada's GDP was about \$1.7 trillion in 2011.

Next, we gathered data from annual financial reports on companies' fossil fuel reserves (proven and potential) in Canada. Using standard conversion factors, these reserves were converted into potential emissions of carbon dioxide. Total potential CO₂ equivalent emissions attributable to the proven reserves of the 114 companies in our sample amount to 23 billion tonnes (23 Gt) — an amount larger than the high end of a plausible carbon budget for Canada (see previous section). Adding proven plus probable reserves, these companies have reserves equivalent to 35 Gt.³² The broader category of possible reserves was not estimated, as these numbers are not consistently reported.³³

We compare this data on potential emissions to assets and market capitalization by estimating the associated “carbon liability” from burning fossil fuel reserves. Carbon emissions are a classic example of external costs (or “externalities”) that are not captured in market prices, and thus are

FIGURE 3 Summary for Foreign Companies with Canadian Subsidiaries



Notes Figure includes data from 11 foreign companies operating in Canada. Revenues, assets and market capitalization are for global operations, while estimated carbon liabilities are based only on fossil fuel reserves in Canada. Carbon liability (low) estimated as CO₂-equivalent proven reserves times \$50 per tonne social cost of carbon (SCC). Carbon liability (high) estimated as CO₂-equivalent proven+probable (2P) reserves times \$200 per tonne SCC. See Technical Appendix for additional details on methodology.

Sources Authors' calculations based on 2011 annual financial reports.

imposed on third parties, in other parts of the world and into the future. That is, there is a “social cost of carbon” (SCC), defined as either the damage done by a tonne of carbon or, conversely, the benefits derived from reducing a tonne of carbon.

Estimates of the social cost of carbon tend to be biased towards costs that can be measured, and are biased towards impacts on human populations. They also tend to be conservative, based on cautious modeling of future climate impacts. Nonetheless, numerous researchers have calculated this figure to understand how high carbon prices eventually need to be in order to reduce carbon emissions. Frank Ackerman and Elizabeth Stanton estimate a range for the SCC, for the year 2010, between \$118 and \$893.³⁴ Mark Jaccard and Associates estimate that a 2°C pathway would require a carbon price of \$50 per tonne of CO₂ in 2010, rising to \$200 in 2020.³⁵

We present a range of results to illustrate the relationship between carbon liabilities, assets and market capitalization. Our low estimate considers a \$50 per tonne SCC applied only to the proven reserves category, and amounts to \$844 billion in carbon liabilities for the Canadian-listed com-

TABLE 1 Fossil Fuel Companies Featured on the S&P/TSX 60 Composite Index

Company Name	Assets	Market Cap	Proven Reserves	Proven+ Probable Reserves	Carbon Liability (Low)	Carbon Liability (High)
	millions of dollars			Mt CO ₂ e		millions of dollars
ARC Resources LTD	5,324	6,506	136.6	215.0	6,830	43,004
Canadian Natural Resources Ltd.	47,278	30,287	2,077.9	3,286.4	103,897	657,277
Canadian Oil Sands Ltd	8,620	9,729	386.7	803.5	19,334	160,691
Cenovus Energy Inc.	22,194	25,223	1,042.6	1,423.0	52,132	284,590
Encana Corporation	33,918	15,278	455.9	642.0	22,794	128,408
Enerplus Corporation	5,723	2,637	68	93.1	3,393.1	18,616
Husky Energy Inc.	32,426	25,355	500.7	1,410.4	25,034	282,082
Imperial Oil Limited	25,429	36,311	2,043.7	3,126.4	102,187	625,288
Penn West Petroleum Ltd.	15,584	6,758	205.2	295.8	10,261	59,161
Suncor Energy Inc.	74,777	47,401	1,745.0	3,116.8	87,248	623,363
Talisman Energy Inc.	24,226	12,030	101.5	137.1	5,077	27,430
Teck Resources Limited	34,219	19,312	1,206.3	2,850.0	60,317	570,003
Totals	329,718	236,827	9,970	17,400	498,504	3,479,911

Notes Assets and reserves data are as of December 31, 2011; market capitalization as of July 5, 2012. Nexen was taken over by the China National Offshore Oil Corporation in February 2013, and is no longer included in the S&P/TSX 60.

Source Authors' calculations based on 2011 annual financial reports.

panies, a figure more than two and a half times the market capitalization and nearly double the assets of those companies. The high estimate applies a \$200 SCC to the proved plus probable reserves, and yields a figure just under \$5.7 trillion, an amount 17 times larger than market capitalization and 13 times assets.

For Canadian subsidiaries of foreign companies, the estimated carbon liability is between \$297 billion and \$1.2 trillion. The latter amount, incredibly, is larger than the full market capitalization of foreign companies, and equal to 81% of their assets, even though market capitalization and assets are based on global operations.

Table 1 shows more detailed results for fossil fuel companies included in the Toronto Stock Exchange's benchmark index, the S&P/TSX 60 (the full list of 114 companies is in the Appendix). The index includes 12 of the companies featured in our database, which together account for a market capitalization of \$237 billion — nearly one-quarter of the index's total value (as of July 5, 2012) — and assets of \$330 billion. Total carbon liabilities are between \$0.5 and \$3.5 trillion for the 12 companies, and account for three-fifths of the carbon liabilities in our database of Canadian-listed companies.

TABLE 2 Top 20 Canadian-Listed Companies Ranked by Carbon Liability

Company Name	Assets	Carbon liability (low)		Carbon liability (high)	
		millions of dollars	ratio to assets	millions of dollars	ratio to assets
Sherritt International Corp.	6,498	137,858	21.2	619,937	95.4
Canadian Natural Resources Ltd.	47,278	103,897	2.2	657,277	13.9
Imperial Oil Limited	25,429	102,187	4.0	625,288	24.6
Suncor Energy Inc.	74,777	87,248	1.2	623,363	8.3
Teck Resources Limited	34,219	60,317	1.8	570,003	16.7
Cenovus Energy Inc.	22,194	52,132	2.3	284,590	12.8
Coalspur Mines Limited	160	51,013	318.8	229,089	1431.4
Husky Energy Inc.	32,426	25,034	0.8	282,082	8.7
Encana Corporation	33,918	22,794	0.7	128,408	3.8
MEG Energy Corp.	6,201	20,264	3.3	235,811	38.0
Canadian Oil Sands Ltd	8,620	19,334	2.2	160,691	18.6
Nexen Inc	20,068	16,236	0.8	175,619	8.8
Cardero Resource Corp.	121	13,875	114.4	55,500	457.4
Fortune Minerals Ltd.	156	12,214	78.3	58,052	372.0
Cline Mining Corporation	251	12,106	48.2	78,996	314.8
Penn West Petroleum Ltd.	15,584	10,261	0.7	59,161	3.8
ARC Resources LTD	5,324	6,830	1.3	43,004	8.1
Erdene Resources Corp.	56	5,874	104.9	93,985	1678.5
Crescent Point Energy Corp	8,734	5,872	0.7	35,386	4.1
Talisman Energy Inc.	24,226	5,077	0.2	27,430	1.1
Top 20 Totals	366,240	770,423	2.1	5,043,669	13.8

Source Authors' calculations based on 2011 annual financial reports.

While there is a range of outcomes for different companies, even the low estimate of carbon liabilities exceeds both assets and market capitalization.

Table 2 contains a list of the top 20 Canadian-listed companies in our sample, ranked by carbon liability (low estimate). This sub-group includes 90% of the carbon liabilities in our database of Canadian-listed companies, and they would be the most vulnerable to carbon budget constraints. This includes most of the companies in Table 1, but in Table 2 we also consider the ratio between estimated carbon liability and assets. The relationship between assets and carbon liabilities is more relevant to understanding Canada's carbon bubble, since market capitalization will be a function of assets as well as holdings of fossil fuel reserves. The table shows some

Carbon-Intensity of Fossil Fuel Reserves

Bitumen is a thick, sticky form of crude oil that is so heavy and viscous that it will not flow unless it is heated or diluted with lighter hydrocarbons. At room temperature, bitumen looks much like cold molasses and at 11°C it can be as hard as a hockey puck. It typically contains more sulphur, metals and heavy hydrocarbons than conventional crude oil.

Synthetic Crude Oil is created by heating the bitumen to extremely high temperatures, which breaks up or “cracks” the large complex bitumen hydrocarbon molecules into smaller hydrocarbon chains. This material then goes through a secondary upgrading process where hydrogen is added to stabilize the remaining hydrocarbon molecules and impurities like sulphur and nitrogen are removed.

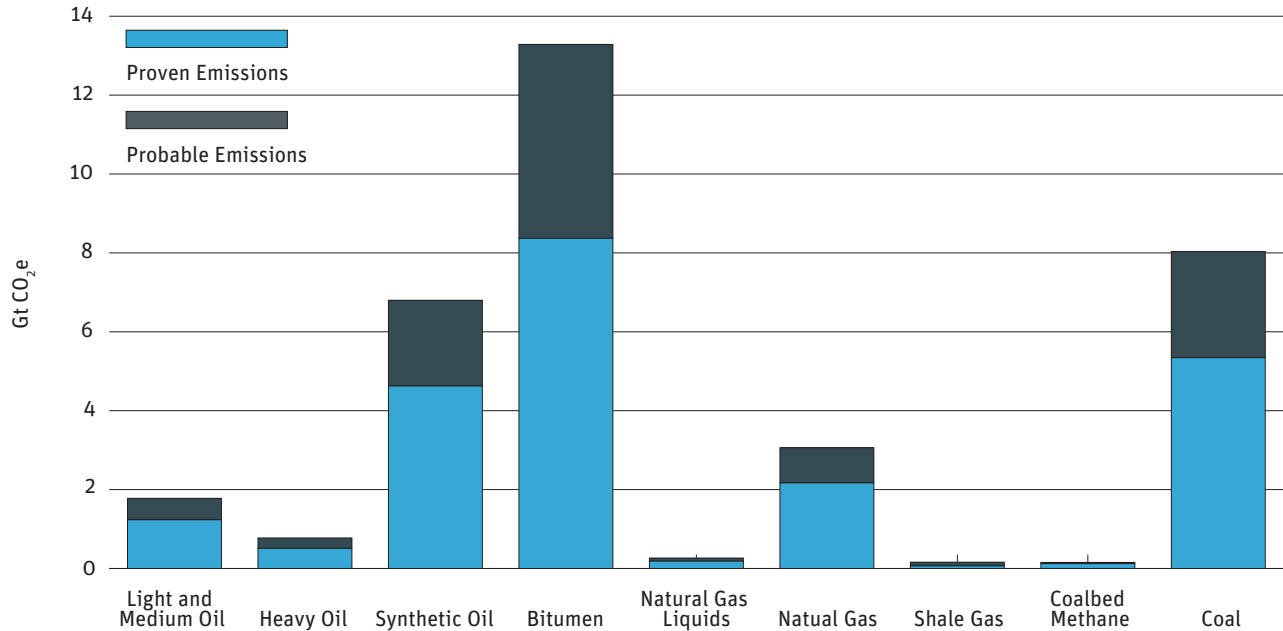
extreme outcomes, where carbon liability dramatically exceeds the assets of the company.

While it is clear that a very large portion of the reserves of Canadian fossil fuel companies would be rendered unburnable as a result of international climate action, this situation is exacerbated by the predominance of bitumen and coal in the reserve mix. These particular fuel types are far more GHG-intensive than other fossil fuel products. Figure 4 shows the emissions potential of proven and probable reserves by fossil fuel type. Together, these two products account for nearly two-thirds of both the proven (61%) and proved plus probable (62%) emissions in our sample. If synthetic oil, which is the crude oil produced from oil sands bitumen,³⁶ is added, more than four-fifths (81% of proven and 82% of proven-plus-probable emissions) come from the fossil fuels that are the dirtiest from a carbon perspective.

The oil sands industry is, on average, three to four times more carbon-intensive than the conventional oil industry when producing a barrel of oil.³⁷ Even on a lifecycle (or “well-to-wheels”) approach, emissions from fuel produced from oil sands are 8 to 37% higher than conventional sources. These estimates do not take into account new findings that a by-product of bitumen refining, petroleum coke (or petcoke), if used as a fuel, emits 5–10% more CO₂ than coal per unit of energy produced. And it is estimated that the proved reserves of Canada’s oil sands would yield 5 billion tonnes of petcoke.³⁸

For Canada’s other main fossil fuel resource, coal, the problem is just as evident. Coal is generally regarded as being the dirtiest of the fossil fuels. According to the United Nations Intergovernmental Panel on Climate Change, coal’s carbon content per unit of energy produced is, on average, 20 percent higher than crude oil and approximately 40 percent higher than natural gas.³⁹

FIGURE 4 Emissions Potential of Reserves



Note This figure only includes estimates of reserves from the 114 companies in our database.

Source Authors' calculations based on 2011 annual reports.

While unconventional natural gas does not figure prominently into the carbon liabilities of the companies in our database, we note that extensive new reserves (beyond those in Figure 1) of shale gas, tight gas and coalbed methane might also be off-limits in a carbon-constrained world. Recent research has questioned whether gas extraction through hydraulic fracturing, or fracking, is superior to coal per unit of energy. Field tests in the United States have shown high methane leakage rates, large enough to offset any advantage relative to coal. There is a lack of independent research on methane leaks in fracking operations in Canada. Planned export of liquified natural gas (LNG) to Asia would require additional energy-intensive pipeline and gas compression infrastructure.⁴⁰

This reality places Canada's energy reserves, and the companies exploiting them, in conflict with any meaningful international treaty intended to combat climate change. While our analysis looks only at fossil fuel producers, this type of analysis would be relevant to pipeline companies like Enbridge and TransCanada, and to supplier industries, neither of which have holdings of reserves per se but whose business model is also based on the

exploitation of unburnable carbon. This type of analysis is also relevant across the broader economy, particularly for companies whose business model is heavily reliant on fossil fuels as an input, and for which there are no or few known alternatives. Technological advances and shifts to renewable power sources could mitigate such concerns, depending on the industry. Certain transportation industries, for example, such as air travel would be hard pressed to move off of fossil fuels, at least in the short- to medium-term. This type of analysis would be a logical extension of our research but we do not consider those impacts further in this paper.

Canada's Fossil Fuel Investments in Global Context

From a purely financial perspective, high market valuations are justified because the oil and gas industry is the most profitable in the world. The Big 5 global oil and gas companies earned a combined \$119 billion in profits in 2012.⁴¹ A review of the 50 most profitable Canadian corporations in 2010 found that finance (12 corporations) and resources (17 corporations) were dominant, with two-thirds of the total profits of the top 50. The top 50 in turn captured 80% of the total profits of the top 1000 corporations.⁴²

Defence of profit streams has led companies to fund climate change denial, and entrench political influence through extensive lobbying. Yet, as noted above, a major cost of their operations — greenhouse gas emissions — are not included in market prices, nor do they form part of their financial statements. Profits in the industry come at the expense of people living today and into the future who have not benefitted from consuming or producing fossil fuels but whose livelihoods are adversely affected by droughts, floods and extreme weather events arising from climate change. These costs are piling up, with one recent estimate of \$1.2 trillion per year in global damages from climate change (impacts such as extreme weather, US\$696 billion), and from a carbon-intensive economy (related environmental disasters and impacts, US\$542 billion).⁴³

An important consideration is that Canada's oil and gas sector has a very high degree of foreign ownership (including both foreign ownership stakes in Canadian-listed companies and foreign-owned subsidiaries). Foreign corporations owned 35% of the sector's \$518 billion in assets in 2010, and received roughly half of the sector's revenues and profits in 2010.⁴⁴ US corporations have been the principal foreign investors, although their share has declined in recent years from 79% in 2001 to 64% in 2010. Recent takeovers of oil and gas assets by China's CNOOC and Malaysia's Petronas in

late 2012 — deals worth \$21 billion combined — have increased the foreign-owned share.

Canada has a unique role in the global economy with regard to fossil fuels.⁴⁵ Some 80% of the world's oil reserves are held by state-owned companies; that is, countries who have made public ownership of this strategic asset a top priority. Of the remaining global oil reserves, two-thirds are found in Canada, making the country a top destination for private investments.⁴⁶ Indeed, while Canada does not have a state-owned oil company at all, state-owned companies from other countries are investing in Canadian oil. Technically speaking, the public owns fossil fuel reserves, which are then leased to private companies, who only own the resources once extracted and a royalty reflecting public ownership is paid.

As foreign capital flows in, so it may flow out. This is a lesson learned by many countries, from Thailand to Argentina to Russia to Greece, over the past couple decades. While those concerns pertain more to flows of short-term “hot money”, there is an analogue to Canada due to the particularly large role of oil and gas in the Canadian stock market. Foreign investment in Canada may not be vulnerable to a “rush for the exits” but external drivers such as international, regional or national rules that shrink Canada's export markets for fossil fuels, or successful divestment campaigns in other jurisdictions could have a spillover effect that could trigger a withdrawal of capital from Canada. This is an additional source of instability or external shock that could lead to a bursting carbon bubble.

Pension Funds and Climate Risk

THE RECENT EXPERIENCE of high-tech and housing bubbles should serve as a stern warning to policy makers. In 2008, the collapse of a housing bubble (in particular, in the United States and Europe) threatened the global financial system as a whole. Massive bailouts to private banks, near-zero interest rates from central banks, and large government deficits have been invoked to prevent a market meltdown and minimize harm from a recession. The immediate financial crisis has passed, but the lingering effects of deleveraging and devaluing of assets (also known as “depression economics”) can be seen in ongoing economic difficulties in key European nations (compounded by the adoption of austerity policies) and sluggish economic performance in North America.

Despite warnings about a housing bubble as early as 2004, financial markets served to inflate it, and as long as everyone was making money, engaging in denial was easy. En route, fund managers and bankers lavished themselves with billions of dollars in compensation. And after a brief period of remorse, once bailouts had been made the return to outlandish salaries and bonuses came all too quickly (in the United States, where impacts were most severe, this occurred even as, or perhaps because, families lost their homes and life savings). It also affected pension funds and other financial investors left holding supposedly AAA-rated mortgage securities that were proven to be toxic assets. Investment banks helped to inflate the bubble by

creating and selling mortgage-backed securities, then bet against the buyers to profit from the bust. Sadly, those who created and profited from the housing bubble have paid no price for bringing the global economy to its knees.

The fallout from the housing crash affected a broad segment of society because housing is the most important asset for middle-class households (and anxiety about not owning property was part of the bubble's psychology). Next to home ownership, the right to future income through employer pension plans is the second-most important asset for a wide swath of middle-class households. Registered pension plans in Canada cover more than 6 million members.⁴⁷ As of 2012, the total market value of trustee pension funds in Canada was over \$1.1 trillion, of which almost one-third was held in stocks.⁴⁸ In most cases, workers have little to say about how these funds are invested on their behalf. But if pension funds are systemically ignoring climate risk, a popping carbon bubble could have an adverse impact on the retirement prospects of millions of workers and their families.

As noted earlier, the collapse of a carbon bubble would be disproportionately felt in Canada due to our emphasis on fossil fuel development. For example, public sector pension funds through the BC Investment Management Corp held \$406 million in Enbridge stock as of early 2013, even as public sentiment in BC is hostile to Enbridge's proposed Northern Gateway Pipeline.⁴⁹ BCIMC represents the pension interests of 500,000 members, with over \$92 billion in assets. It has billions invested in other oil and gas companies, leaving public sector workers and existing retirees vulnerable to the destruction of value that would occur in the event that the carbon bubble pops.

At a system-wide level, however, it is difficult to ascertain the exposure of Canadian pension funds and other investment types. Three key pools of capital comprise Canada's pension system: a majority (55%) is in the form of employer pension funds, another 35% in RRSP assets holdings, and less than 10% in the Canada Pension Plan (and Quebec Pension Plan) as of 2005.⁵⁰ In the US, pension funds alone owned almost one-third of oil company stocks in 2011, according to the American Petroleum Institute; ownership breaks down as 31% pension funds, 21% individual investors, 21% asset management companies (including mutual funds), 18% IRAs (US version of RRSPs), 7% other institutional investors, and 3% corporate management of oil companies.⁵¹

About one-third of the assets of the Canada Pension Plan are invested in publicly-traded equities, representing \$13 billion in Canadian equities and \$43 billion in foreign equities, as of the end of 2012.⁵² Compared to our

database, there are 56 companies that are held by the CPP, with a total market value of \$2.2 billion.⁵³ Another \$684 million in market value is held in energy companies not listed on our database (including pipeline companies). In addition, the CPP holds stocks of foreign companies, with all but one of the companies in our dataset in its portfolio, with total market value of \$2.4 billion. Another large portion of CPP holdings are in private equities, which are more difficult to discern with regard to fossil fuel exposure.

Pension funds in Canada may have a greater share of ownership in oil and gas, as there are fewer alternative industries in which to buy and hold assets. Although diversification strategies would include holding foreign equities, there tends to be a home bias in financial investment. The key point is that pension plans need to reassess their vulnerability to a bursting carbon bubble, and the risk associated with being left holding stranded financial assets.

Ignoring Climate Risk

Addressing risk is inherent to financial market investment, which routinely must account for risks due to inflation, currency movements, regulatory changes, political turmoil and general economic conditions. However, there has been a general failure to account for climate risks of the sort we discuss above, a remarkable parallel to the failure of financial analysts and rating agencies to see the housing bubble while it was growing. Some positive first steps have emerged around “environmental, corporate and social governance” (ESG) issues and carbon disclosure reporting (more on these below), but so far these efforts have fallen short of diffusing the carbon bubble.

Research from the United Nations Environment Programme Finance Initiative and the World Business Council for Sustainable Development found that many financial investors only think about climate change in very narrow terms; being primarily concerned with how it affects corporate reputation and brand issues or perhaps corporate governance.⁵⁴ Furthermore, in a survey of asset managers conducted by CERES (a global investor network concerned about sustainability), 71% responded that they did not conduct a comprehensive assessment of climate risks as part of their due diligence process.⁵⁵

We argue that there is no longer any excuse for fund managers to plead ignorance about climate risk. It is well understood that pension fund managers and other institutional investors have a “fiduciary responsibility”

to work in the long-term best interest of their members or asset owners. A number of behavioural standards, rules, and constraints have developed to ensure that fiduciaries “act prudently and not invest in a specific asset or adopt particular investment styles or preferences if this involves foregoing return opportunities on a systematic basis.”⁵⁶ If a fiduciary does not uphold this convention of prudent behaviour, they may be liable to the asset owners for financial losses incurred.⁵⁷

Historically, applying any type of non-financial screen or criteria, such as an environmental performance measure, in the evaluation of the performance of a security has been perceived as preventing optimal diversification and the generation of maximum return value.⁵⁸ That is, a fossil fuel screen would negatively affect the long-run performance of a fund. Herd behaviour is also a problem, as investment managers are incited to reduce their own liability risk by following the behaviour of others. Some 75% of a typical portfolio’s return comes from general market exposure (this also signals vulnerability to systemic risk).⁵⁹

A contributing factor is the short-term nature of the financial industry, and more broadly the business world, which is set up to report performance over periods from 3 to 12 months. This means that managers inevitably focus much of their attention on shorter-term rather than longer-term value drivers.⁶⁰ Reinforcing this trend are compensation schemes that fail to hold investment managers and corporate executives responsible for their decisions over the long-term.⁶¹

While pension funds have to generate maximum current return value for existing (and soon-to-be) pensioners, at the same time they are legally obligated to ensure the long-term sustainability of the fund. That is, funds must equally represent the interests of young workers for their eventual retirements.⁶² Quantifying and accounting for climate risk is thus necessary to achieve inter-generational equity.⁶³ Moreover, over a longer time horizon, pension funds are particularly exposed to the widespread and growing costs of environmental damage caused by companies. An investor in the fossil fuel industry may ultimately be undermining the long-term value of assets held in other sectors, such as forestry, which Canada’s NRTEE has highlighted as being under particular threat from climate change.⁶⁴

For investors with long-term interests, this means that climate and ecosystem health and integrity should be of primary importance. If pension fund managers adopt this precautionary mandate they will also find that climate change, and the policy environment within which it will take place, will provide significant investment opportunities. This is particularly the

case because low-carbon investments, which can be used as a hedge against emerging liabilities, often have economic lifespans that align nicely with the long-term perspectives of pension funds. For example, wind and solar farms have high upfront capital costs, low operating costs, and are generally able to produce stable long-term revenue streams that are attractive to lower-risk investors.⁶⁵

Coming Clean on Dirty Energy

Efforts to date to consider environmental risks have clearly failed to make an impact on financial investors. The Canadian Securities Administrators (CSA) have set out five key disclosure requirements regarding environmental risk management for public companies: environmental risks; trends and uncertainties; environmental liabilities; asset retirement obligations; and, financial and operational protection requirements.⁶⁶ In theory, these categories should provide enough information for investors to adequately account for climate change risks in their valuations. Unfortunately, due to a poor understanding of climate change related risks in the financial community, poor disclosure practices by businesses, lack of enforcement by oversight bodies, and governments' failure to create the policy structures that would promote more sustainable investing practices, this reality has failed to materialize.

The main problem with the current reporting requirements is that they only require the disclosure of company information that is of “material” interest to investors, whereas environmental, social, and corporate governance (ESG) issues are perceived to be secondary. But as Goldman Sachs has pointed out, “some companies do not view ESG impacts as sufficiently material to company performance to warrant quantification and public disclosure and therefore do not publish (ESG) performance indicators.”⁶⁷ This criticism has been repeated internationally by numerous non-governmental organizations, as well as nationally by the Ontario Securities Commission, all of which found major discrepancies between the ESG information that investors deemed material and that which was provided by companies.⁶⁸ A report issued jointly by CERES and the Environmental Defense Fund concluded that there was “an alarming pattern of non-disclosure by corporations regarding climate risks.”⁶⁹

In addition to concerns over materiality, the Canadian Institute of Chartered Accountants (CICA) reports that there is very little consistency in terms of units and chart formatting by firms. Even when information is provid-

ed, investors report concerns regarding the lack of standardized, comparable and sector specific metrics that would help with the interpretation of ESG information.⁷⁰

This information gap suggests that the current oversight provided by the Canadian Securities Administrators and Canada's professional accounting associations is inadequate. For example, as part of its governing mandate, the General Accountants Association of Canada (CGA) requires its members to "safeguard and advance the interests of society" and indicates that they "should not be associated with information which the member knows, or should know, to be false or misleading, whether by statement or omission."⁷¹ To comply with its ethical mandate, the CGA must require of its members a higher standard of carbon disclosure.

Some progress has been made in Canada regarding sustainable investment practices. For example:

- Organizations like Ethical Funds have screened for investments in military and tobacco, and, in November 2012, divested from Enbridge (based on First Nations opposition). But to date, fossil fuel producers have not been included in investment screens.
- The Caisse de dépôt et placement du Québec was the first institution in Canada to adopt a policy on responsible investment and has been an advocate for shareholder engagement and integration of ESG criteria in investment analysis and decision-making. In particular, the Caisse actively promotes its participation in the Carbon Disclosure Project and the Extractive Industries Transparency Initiative.⁷²
- The Ontario Teacher's Pension Plan (OTPP) has not made a specific commitment to green investing but it does consult with research providers to analyze ESG risks, is a signatory to the Carbon Disclosure Project, and participates in the Sustainable Forests Initiative.⁷³ With regard to climate change risks, the OTPP's 2011 Annual Report indicates that when "it is deemed that a material investment risk exists, we seek to quantify that risk and to understand management's plan for meeting any strategic challenges posed by it."⁷⁴

Still, in an economy increasingly wedded to fossil fuel extraction and export, such initiatives have been marginal at best. Action by governments is needed to create the context for a transformational shift of investor behaviour that is part of the solution not the problem. Some large global institutional investors have now added their voices to the call for action. In

November 2012, groups representing large global institutional investors, representing \$22.5 trillion in assets, issued an open letter to governments of the world calling for climate leadership, including timelines and targets for GHG emission reductions, and shifts in incentives towards low-carbon investment. They note:

Current policies are insufficient to avert serious and dangerous impacts from climate change. Further delay in implementing adequately ambitious climate and clean energy policy will increase investment risk for institutional investors and jeopardise the investments and retirement savings of millions of citizens.⁷⁵

Deflating the Carbon Bubble

HOW THEN CAN pension funds and other institutional investors be part of the solution? We have articulated a case that implies divestment is a rational choice, not just for moral reasons, but due to the core financial problem of unburnable carbon. As we noted above, a major drop in asset values for fossil fuel stocks could drive an economic downturn in Canada, and is a systemic concern given the large volume of funds workers have invested through private pension funds. Other private savings vehicles, such as RRSPs, and public investments through the Canada Pension Plan, are also in need of a “managed retreat” from fossil fuel investments. Ideally, long-term savings vehicles in the Canadian economy would be strongly aligned with the need for climate action and low-carbon economic transition.

Establish a National Carbon Budget

In order to do their job properly, and contribute to achieving a zero-carbon Canada (and world), financial markets need a clear and credible long-run climate action commitment that provides investment security and certainty. Canada’s record to date has been to set GHG targets and timelines, and then fail to meet them. This makes financial market analysts cynical about climate action, and less willing to consider climate risk in their decision-

making. In addition to credible emission targets, Canada needs to establish a *national carbon budget* to manage its fossil fuel resources for wind-down.

A corollary to this is that the federal government must acknowledge that a large share of proven and potential reserves is indeed “unburnable carbon.” These reserves should be effectively taken out of circulation, leaving only Canada’s fair share of the remaining global carbon budget. This would be subject to international negotiation, but, as noted above, Canada’s share of a 500 Gt global carbon budget would be 9 Gt based on share of world GDP,⁷⁶ and just over 2 Gt based on world population. And, while Canada may have some short-term role in exporting fossil fuels to other jurisdictions, this would not dramatically increase what Canada will realistically be permitted to extract. Clearly, any realistic budget will be much smaller than Canada’s available fossil fuel reserves. The key point is that a clear signal to the financial markets must be sent that vast amounts of known carbon reserves are off limits.

Make Market Prices Tell the Truth About Carbon

Shifting the terrain towards clean or renewable sources of energy from fossil fuels requires policies that make sure the costs of greenhouse gas emissions are reflecting in market prices. Broad framework policies advanced by the Climate Justice Project and many others to level the playing field for clean energy alternatives and internalize costs include:

- Carbon pricing that increasingly internalizes costs of GHG emissions into market prices;
- Removal of public subsidies to fossil fuel development;
- Regulations and standards that drive up energy efficiency and restrict expansion of carbon-intensive modes of economic activity;
- A conscious policy decision not to make large new infrastructure investments that expand the transportation and export of fossil fuels;
- Public investments and subsidies to build new infrastructure and accelerate the transition to a zero-carbon economy; and,
- Commitments to renewable energy supplies that displace fossil fuels.

The United Kingdom has recently established a Green Investment Bank in November 2012, capitalized by £3 billion (\$4.6 billion) in public expenditure.

The bank will make commercial investments in several priority areas like offshore wind, waste management, energy efficiency and bioenergy. While this is a very new initiative, and is arguably a small one given the scope of change in a country the size of the UK, it is notable that the banks is explicitly targeting market failures, such as the lack of a carbon price, information gaps, and risks for large renewable energy projects.⁷⁷

Develop Green Bonds

Pension funds and other investors divesting from fossil fuel companies need an alternative place to put their money, and one major transitional support could be the development of a national green bonds program (along with complementary provincial programs). The long-run investment horizons of pension funds align nicely with long-term bond issues, and the need to invest in public infrastructure for climate action. While carbon taxes are an ideal source for funding climate action it will take time for those revenues to ramp up with a rising carbon tax. Green bonds can bridge this gap by essentially borrowing against future carbon tax revenues.

Pioneered by the European Investment Bank (EIB), green bonds are a simple variant of general bonds wherein the issuer guarantees to use the funds raised through the bond for some specific environmental purpose. Sustainable Prosperity reports that narrowly-defined green bonds worldwide were valued at over \$7 billion, but the broader universe of climate-related bonds was as much as \$174 billion.⁷⁸ While still a drop in the bucket compared to the US\$95 trillion global bond market, this shows significant progress.⁷⁹ In addition, the UK Treasury has also considered using green bonds to raise capital for green infrastructure projects and the US House of Representatives is currently evaluating a “Clean Energy Victory Bond” in committee.⁸⁰

There appears to be widespread support for government-sponsored green bonds initiatives.⁸¹ According to a Nanos Research poll, 82% of Canadians support the idea of green bonds and 62% stated that they would purchase them if they had interest rates similar to traditional Canada Savings Bonds.⁸² Due to their longer timeframe and investment security, the Green European Foundation reports that green bonds have been quite attractive to institutional investors. A number of new and innovative green bond designs, such as asset-backed green bonds, have been successful at funding large infrastructure projects like wind farms and other green projects with high upfront costs and consistent returns.⁸³

Public Sector Leadership

Federal and provincial governments can likewise provide leadership on divestment and transition. The Government of Canada should direct the Canada Pension Plan Investment Board to divest from fossil fuel companies. If pension plans on behalf of public sector retirees and employees (or their relevant investment management boards) join this effort, this would provide a powerful signal to other pension funds. Outside of pensions, divestment is broadly applicable to other related investment funds, such as university endowments or investments held by municipalities and Crown corporations.

The federal government should also make changes to private savings vehicles, such as Registered Retirement Savings Plans (RRSP) and Tax Free Savings Accounts (TFSA) by restricting preferential tax treatment to funds or investments that met certain green economy criteria. Currently, Canada's RRSP system amounts to approximately \$33 billion per year invested in financial markets.⁸⁴ By the end of 2011, total contributions to TFSAs were valued at over \$62 billion.⁸⁵

Some key concepts to shape this transition include:

- **Green Funds:** Green index funds are generally classified as being thematic indices, best in class indices, or conventional indices that give companies weights according to their environmental performance. These options provide investors with different priorities (risk appetite, environmental performance, economic performance, etc.) a range of options to meet their specific needs. The main benefits of indices are that they can provide diversification potential (specifically away from the traditional dirty sectors), screening, and therefore quality control based on a number of performance criteria, and aggregation of small environmentally-friendly investment opportunities into larger ones.⁸⁶
- **Green Securitisation:** Securitization involves the pooling of small bonds and loans (debt) into a special purpose investment vehicle (the security) that can be purchased by investors. The principal and interest on the debt, underlying the security, is then paid back to investors as investment gains. The Green European Foundation has indicated that this type of investment vehicle is particularly relevant for green investing because “many green investments, particularly those in energy efficiency measures and in local generation, are quite

small compared to the “normal” market size for transactions.”⁸⁷ Consequently, bundling investment opportunities in this manner can dramatically reduce the transaction costs associated with financing at this scale making them more attractive for institutional investors.

- **Green Savings Accounts (GSA):** The general target for these accounts are individuals and institutions that either do not want their money to be lent to environmentally unsustainable companies or projects or that believe there are significant financial gains to be made in the green sector. A report on Canada’s largest banks, commissioned by the Rainforest Action Network, indicated that simply moving savings from a bank with a high carbon footprint, such as Scotiabank, to a more climate-friendly financial institution, like Van-city Credit Union, could significantly reduce the GHG emissions attributable to those savings.⁸⁸

Mandate Carbon Stress Tests

Canadian financial markets need a mandatory system of climate stress tests for new financing commitments and for outstanding portfolios. Disclosure of climate change information must be standardized to provide high-quality and comparable information (ideally, internationally comparable) about climate change policies and assessment of risks.⁸⁹ The federal government could lead in developing selection criteria to be used in the screening of investment opportunities, and in requiring ratings agencies to report on climate risk and the implications of unburnable carbon in their evaluations. Our estimates of carbon liabilities and the ratio to assets comprise one set of possible indicators.

To this end, the Canadian Institute of Chartered Accountants has recommended the Canadian Securities Administrators (CSA) provide stronger enforcement, make available better interpretive guidance, and develop new disclosure requirements. Canada’s accounting standards setting bodies, the CICA and the CGA, also need to fulfill their ethical responsibilities to society by ensuring that their professional members understand the real risks posed by climate change and the necessity to have that information appear in firms’ financial statements. Of particular importance for financial investors is ensuring that businesses are reporting Environmental, Social and Governance material regularly in Annual Reports, Annual Information Forms, and Management Discussion and Analysis reports.

In February 2010, after being petitioned by a group of institutional investors, the US Securities and Exchange Commission became the first regulator in the world to clarify the meaning of “materiality” to account for the new realities of climate change and offer disclosure guidance to businesses on climate risks. A common approach that has been suggested is to require integrated ESG, specifically GHG emissions data, and financial reporting.⁹⁰ In their entirety, these new disclosure requirements should unify the disparate sources of ESG information that investors need to properly determine the risk-return ratios required to appropriately value companies.⁹¹

On the investor side, there are also policy improvements that can and should be made regarding disclosure. In the Spring of 2011, the Ontario government proposed legislation under its Pension Benefits Act that would require registered pension plans to disclose on their Statements of Investment Policies and Procedures (SIP&Ps) whether or not their SIP&Ps address ESG factors. Similar legislation exists in a host of European countries. If this proposed legislation becomes law, Ontario will be the first jurisdiction in Canada to specifically require pension plan managers to disclose this kind of information.⁹²

In addition to the securities and accounting bodies, the Canadian Pension Supervisor Authorities (CAPSA) also has a role to play in advancing the transition to the low-carbon economy. CAPSA’s mandate is to develop best practice guidelines for pension management and develop harmonized solutions to address emerging issues.⁹³ Consequently, CAPSA should issue guidance clarifying that trustees have an obligation to take environmental and social considerations into account when setting and implementing investment policy and conducting investment analysis. Finally, CAPSA needs to issue specific guidance for pension trustees on how to address climate change in investment policy. Both reforms should improve fund governance processes and transparency.

Conclusion: Getting these Reforms Right

THERE IS AN alternative path to what we have laid out above: humanity continues on a business-as-usual trajectory, ignoring climate change up to the point where perpetual adaptation is the norm. That course takes us into uncharted territory, and we have good reason to believe that economic costs will pile up quickly. For example, Trucost and the UN Principles of Responsible Investment (PRI) association have calculated climate change's potential cost to the global economy at US\$21 trillion per year by 2050.⁹⁴

Alternatively, the Stern review indicates that the worldwide economic costs of climate change are likely to be between 5 and 20% of GDP per year depending on the range of risks and impacts that are taken into account.⁹⁵ Moreover, the Stern Review indicates that the “costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly.” If significant steps are taken now, stabilizing emission levels in the range associated with the 2°C scenario would cost approximately 1% of global GDP annually.

The author, former World Bank Chief Economist Nicholas Stern, recently noted his report was too conservative: “Looking back, I underestimated the risks. The planet and the atmosphere seem to be absorbing less carbon than we expected, and emissions are rising pretty strongly. Some of the effects are coming through more quickly than we thought then.” New World Bank president, Jim Yong Kim, has issued a global call to action on climate

change, pointing to the severe risk of conflicts over natural resources in a 4°C warmer world: “There will be water and food fights everywhere.”⁹⁶

We believe that the attention of leading global institutions and growing evidence of climate change will push the world into a strict new climate change regime, hopefully sooner rather than later. This will have major impacts on Canada, and companies with claims on Canadian fossil fuel reserves. The operational business model of Canada’s fossil fuel exploration and production sector simply cannot continue. Reserves held by Canadian fossil fuel and extraction companies, primarily in Alberta’s oil sands, have high carbon intensities relative to more conventional fuel types, and will be most challenged by a new carbon regime.

Because public valuation of companies largely ignores big picture climate realities, there is a systemic risk inherent in the fossil fuel extraction and production industry. Our analysis finds that Canadian financial markets have failed to consider climate risk. The shock associated with coming global efforts to manage carbon could leave key sectors such as pension funds vulnerable. Canada’s carbon bubble has three interrelated drivers: the historical exclusion of systemic risk factors from investment decision-making processes; the failure of governments to put a price on carbon and force the accounting of the liability associated with carbon in the fossil fuel companies’ financial statements; and, inadequate disclosure processes and enforcement of existing regulations in the business and financial sectors.

Our suggested reforms would go a long way to providing the foundation necessary for taking Canada’s economy towards a cleaner future. A coherent and credible action plan led by the federal government that includes action to better regulate financial markets will make it much easier for investors to account for climate change in their risk-return assessments. Our hope is that these actions can steadily reduce the exposure of Canadian pension funds and other investors, and the Canadian economy as a whole, by deflating the carbon bubble.

Until such time as our governments take decisive action, we should rightly see an expansion of divestment efforts by civil society groups — on campuses, within churches, by credit unions, and by other community-based organizations seeking to influence the investment choices of major institutions. Such efforts are encouraging — they signal an early understanding that a managed retreat is preferable to a financial meltdown.

Technical Appendix

TO BE INCLUDED in the study, companies had to be publicly-traded and have fossil fuel reserve holdings in Canada. In addition, to ensure that the database being created would be relatively comprehensive without becoming overly burdensome to generate, it was decided that only companies reaching a certain size, as measured by their total assets, would be included. For the oil and gas industry, this threshold was set at \$70 million. To compensate for the greater emissions potential of coal resources, relative to oil and gas, the asset threshold for coal companies was set at \$55 million.

The list of companies was then constructed by applying the established criteria to the operational data of the fossil fuel extraction and production companies listed on www.fpinfomart.ca. The use of this website allowed the capture of all of the Canadian companies meeting the criteria. In order to include the Canadian operations of international companies, the membership lists of the Canadian Association of Petroleum Producers and the Coal Association of Canada were consulted as well as the Oil Sands Company and Property Database available at oilsands.infomine.com. The result of this process was a list of 114 companies.

The specific resource reserve holdings and accompanying financial information for each company were determined by examining each company's 2011 year-end financial reports: 2011 Annual Reports, 2011 Annual Information Forms, and 2011 oil and gas activity disclosure forms. It must be noted however that, due to different reporting practices and requirements around the world, there were some gaps in the data collected. For example, the

United States Securities and Exchange Committee (SEC) only requires the explicit disclosure of proven reserves and not probable reserves, therefore the probable reserves data documented in this report underestimates the actual potential held by the companies included in this study.

In addition, a few large international companies were excluded from the database as a result of those companies failing to adequately differentiate their Canadian reserves from those held in other jurisdictions. Finally, due to their limited ability to affect Canadian investments as well as the inaccessibility of their operational and financial data, no privately held companies with Canadian operations were included in the dataset. The list of those excluded includes some of the world's leading fossil fuel companies such as Sword Energy, Value Creation Inc, Apache Canada, CNOOC, JACOS, Laracina, KNOC, JX Oil and Energy, Canadian Dehua International Mines Group, Centerpoint Resources Inc., Grande Cache Coal, and Statoil. The result of these exclusions means that the potential CO₂e emissions attributable to companies in our dataset are not comprehensive of carbon liabilities associated with Canadian fossil fuel reserves.

Potential CO₂e emissions for the companies were calculated based on the specific products produced, reported in annual securities filings. The product categories are coal (types of coal were not disaggregated), the conventional oil and gas fuels, which include light and medium oil, heavy oil, natural gas liquids, and natural gas and the non-conventional oil and gas fuels which include bitumen, synthetic oil, shale gas, and coal bed methane.⁹⁷ To determine the specific emissions for each company, the reported reserves were multiplied by the net calorific values for each of the product types.⁹⁸ Potential coal emissions were calculated based on the average calorific value of coal types produced in Canada.⁹⁹ The energy potential was then multiplied by standard emissions factors as provided by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories to determine each fuel's CO₂ emissions and by the 2007 IPCC Global Warming Potentials to determine the CO₂e of the other significant greenhouse gases, CH₄ and N₂O, released during combustion.¹⁰⁰

Our estimates of CO₂ potential are conservative for a few reasons. Because the amount of CH₄ and N₂O produced during combustion is highly technology dependent, this study utilized the lowest emissions factors available, those associated with combustion in the energy industry. Potential coal emissions were calculated based on the average calorific value of coal types produced in Canada. Finally, our estimates do not account for more recent research that suggests much higher lifecycle leakage rates for natur-

al gas produced from hydraulic fracturing, or additional emissions from the combustion of petroleum coke, a by-product of bitumen processing not typically counted in estimates of emissions potential from Canada's oil sands.

APPENDIX TABLE Part 1

Company Name	Revenue	Assets	Market Cap	Proven reserves	Proven+ Probable reserves	Carbon liability (low)	Carbon liability (high)
	Millions of Canadian dollars			Mt CO ₂ e	Millions of Canadian dollars		
Advantage Oil Gas Ltd.	302	1,973	562	59.7	95.1	2,987	19,019
Anderson Energy	107	460	59	7.7	12.6	385	2,530
Angle Energy Inc.	150	596	279	12.3	23.9	617	4,782
ARC Resources LTD	1,278	5,324	6,506	136.6	215.0	6,830	43,004
Arcan Resources Ltd.	39	290	195	9.2	17.4	458	3,486
Arsenal Energy Inc.	36	114	78	1.6	2.6	81	515
Artek Exploration Ltd.	23	148	78	4.9	8.0	243	1,598
Athabasca Oil Corporation	N/A	2,557	4,750	55.5	478.4	2,777	95,672
AvenEx Energy Corp	1,009	491	165	4.2	6.0	210	1,201
Baytex Energy Trust	1,079	2,417	5,205	63.1	103.7	3,154	20,734
Bellatrix Exploration Ltd	161	580	362	15.3	24.6	763	4,923
Birchcliff Energy Ltd	235	1,225	857	57.9	102.0	2,896	20,393
BlackPearl Resources Inc.	134	607	913	7.5	17.6	376	3,521
Bonavista Energy Trust	888	3,924	2,791	80.6	117.9	4,030	23,589
Bonterra Energy Corp.	145	364	908	11.5	16.7	573	3,345
Canada Energy Partners Inc.	N/A	92	14	0.5	2.5	26	502
Canadian Natural Resources Ltd.	13,792	47,278	30,287	2,077.9	3,286.4	103,897	657,277
Canadian Oil Sands Ltd	3,875	8,620	9,729	386.7	803.5	19,334	160,691
Canadian Spirit Resources Inc.	N/A	89	28	0.2	0.6	8	130
Cardero Resource Corp.	- 25	121	83	277.5	277.5	13,875	55,500
Cequence Energy Ltd.	87	491	232	12.7	24.5	637	4,895
Celtic Exploration Ltd.	199	1,080	1,449	27.1	47.3	1,353	9,466
Cenovus Energy Inc.	15,696	22,194	25,223	1,042.6	1,423.0	52,132	284,590
Charger Energy Corp.	31	146	40	1.8	3.2	90	647
Chinook Energy Inc.	211	745	268	9.3	14.4	467	2,882
Cline Mining Corporation	N/A	251	134	242.1	395.0	12,106	78,996
Coalspur Mines Limited	N/A	160	459	1,020.3	1,145.4	51,013	229,089
Compton Petroleum	131	673	32	18.1	27.0	904	5,408
Condor Petroleum Inc.	3	206	121	0.1	0.2	7	39
Connacher Oil & Gas Ltd.	873	1,606	216	101.0	287.7	5,048	57,550

APPENDIX TABLE Part 2

Company Name	Revenue	Assets	Market Cap	Proven reserves	Proven+ Probable reserves	Carbon liability (low)	Carbon liability (high)
	Millions of Canadian dollars			Mt CO ₂ e	Millions of Canadian dollars		
Corridor Resources Inc.	23	204	65	3.6	6.5	182	1,306
Crescent Point Energy Corp	1,729	8,734	12,505	117.4	176.9	5,872	35,386
Crew Energy Inc.	288	1,843	778	28.0	50.6	1,401	10,129
Crocotta Energy Inc.	30	214	225	6.1	10.3	305	2,069
DeeThree Exploration Ltd.	27	213	239	2.9	3.8	144	758
Delphi Energy	108	447	172	8.7	14.0	437	2,796
Dundee Energy Ltd.	36	187	61	4.8	6.1	240	1,214
Encana Corporation	8,374	33,918	15,278	455.9	642.0	22,794	128,408
Enerplus Corporation	1,091	5,723	2,637	67.9	93.1	3,393	18,616
Epsilon Energy Ltd.	10	129	104	0.02	0.02	1	4
Equal Energy Ltd.	136	467	94	1.7	2.4	84	489
Erdene Resources Corp.	1	56	22	117.5	469.9	5,874	93,985
Exall Energy Corporation	25	95	49	0.9	2.0	44	393
Fairborne Energy Ltd.	185	918	172	15.9	23.0	793	4,598
Fortune Minerals Ltd.	N/A	156	73	244.3	290.3	12,214	58,052
Falcon Oil & Gas Ltd	N/A	116	90	3.4	5.6	171	1,112
Freehold Royalties Ltd.	154	4,223	1,204	1.5	2.4	73	488
Guide Exploration Ltd	182	671	180	9.2	15.0	459	3,003
Husky Energy Inc.	23,364	32,426	25,355	500.7	1,410.4	25,034	282,082
Imperial Oil Limited	30,474	25,429	36,311	2,043.7	3,126.4	102,187	625,288
Insignia Energy Ltd	44	161	40	2.7	5.6	134	1,114
Ivanhoe Energy Inc.	37	414	206	-	100.5	-	20,108
Legacy Oil + Gas Inc.	301	2,301	856	20.9	35.5	1,043	7,102
Lone Pine Resources Inc.	191	992	230	25.3	43.4	1,266	8,683
Marquee Energy Ltd.	4	111	55	2.0	4.2	98	832
MEG Energy Corp.	1,033	6,201	7,231	405.3	1,179.1	20,264	235,811
NAL Energy Corporation	442	1,561	997	25.1	39.4	1,256	7,890
Nexen Inc	6,341	20,068	9,230	324.7	878.1	16,236	175,619
Novus Energy Inc.	17	134	128	3.7	6.2	187	1,230
NuVista Energy Ltd	305	1,374	427	25.3	39.8	1,267	7,955

APPENDIX TABLE Part 3

Company Name	Revenue	Assets	Market Cap	Proven reserves	Proven+ Probable reserves	Carbon liability (low)	Carbon liability (high)
	Millions of Canadian dollars			Mt CO ₂ e	Millions of Canadian dollars		
Open Range Energy Corp.	41	351	103	5.1	9.1	256	1,826
Pace Oil and Gas Ltd.	194	739	151	17.9	27.8	895	5,558
Painted Pony Petroleum Ltd.	51	234	558	11.3	48.5	564	9,695
Pan Orient ¹⁰¹	73	371	219	-	-	-	-
Paramount Resources Ltd.	218	1,726	2,139	11.7	17.5	583	3,508
Pengrowth Energy Corporation	1,136	5,665	2,409	91.8	128.8	4,590	25,767
Penn West Petroleum Ltd.	2,951	15,584	6,758	205.2	295.8	10,261	59,161
Perpetual Energy Inc	230	1,018	151	14.1	29.1	703	5,830
Petrobakken Energy Ltd	1,017	6,477	2,172	49.4	83.9	2,472	16,784
Petrobank Energy and Resources ¹⁰²	1,017	6,918	1,205	49.4	137.5	2,472	27,509
Peyto Exploration Corp.	383	1,800	2,777	76.9	110.4	3,843	22,089
Pinecrest Energy Inc.	2	185	418	2.3	3.6	115	726
Progress Energy Resources Corp.	408	2,646	4,712	66.9	114.5	3,345	22,904
Questerre Energy Corporation	17	258	171	0.7	1.1	37	223
Renegade Petroleum Ltd.	24	204	248	3.6	5.5	182	1,095
RMP Energy Inc.	45	198	162	5.5	8.8	276	1,765
Rock Energy Inc.	55	189	39	3.9	8.2	194	1,647
Second Wave Petroleum Inc.	22	167	85	2.8	4.7	140	937
Sherritt International Corp.	1,978	6,498	1,493	2,757.2	3,099.7	137,858	619,937
Skopec Energy Inc	15	145	2	3.5	4.2	173	834
Sonde Resources Corp.	35	187	110	2.3	3.5	115	709
Southern Pacific Resource Corp.	79	871	444	68.4	102.6	3,422	20,510
Spartan Oil Corp.	15	126	300	6.1	8.8	305	1,769
Sprott Resource Corp.	86	529	444	2.3	12.3	116	2,466
Storm Resources Ltd.	6	109	104	1.4	3.0	68	602
Strategic Oil & Gas Limited	19	118	118	1.4	2.2	68	445
Suncor Energy Inc.	39,619	74,777	47,401	1,745.0	3,116.8	87,248	623,363
Sure Energy Inc.	23	81	32	1.6	2.4	81	488
Surge Energy Inc.	50	378	524	8.2	12.9	412	2,575
Talisman Energy Inc.	8,104	24,226	12,030	101.5	137.1	5,077	27,430

APPENDIX TABLE Part 4

Company Name	Revenue	Assets	Market Cap	Proven reserves	Proven+ Probable reserves	Carbon liability (low)	Carbon liability (high)
	Millions of Canadian dollars			Mt CO ₂ e	Millions of Canadian dollars		
Teck Resources Limited	11,514	34,219	19,312	1,206.3	2,850.0	60,317	570,003
Terra Energy Corp.	62	296	38	6.2	12.1	312	2,424
Tourmaline Oil Corp.	340	2,711	4,355	53.3	96.5	2,665	19,294
TriOil Resources Ltd	17	196	54	2.3	4.0	114	804
Triology Energy	336	1,260	2,736	22.8	31.9	1,141	6,375
Twin Butte Energy Ltd.	85	338	460	8.4	14.8	420	2,963
Vermilion Energy Inc	977	2,735	4,506	14.9	24.9	743	4,989
Vero Energy Inc.	112	385	87	1.8	3.6	91	713
Waldron Energy Corporation	22	92	19	2.0	3.9	102	780
Westfire Energy Ltd	121	666	365	10.9	16.6	546	3,319
Whitecap Resources Inc.	21	207	889	10.6	15.9	529	3,183
Yoho Resources Inc.	27	140	77	2.7	4.8	133	961
Zargon Oil & Gas Ltd.	154	471	251	7.8	13.3	390	2,653
Canadian-listed Total	187,111	450,799	327,660	16,882.0	28,295.5	844,101	5,659,101
Canadian-listed average	1,949	4,377	3,181	163.9	274.7	8,195	54,943
Subsidiaries of foreign companies							
Anglo American	31,100	73,674	44,112	288.1	316.2	14,406	63,249
BP PLC	381,901	298,050	127,735	106.0	106.0	5,299	21,196
ConocoPhillips Canada	248,975	155,835	70,407	988.0	988.0	49,398	197,591
Devon Energy	11,649	41,816	23,544	300.7	300.7	15,034	60,135
Exxon Mobil	474,968	336,680	403,281	2,172.8	2,172.8	108,640	434,561
Marathon Oil	14,912	31,904	17,899	284.1	284.1	14,204	56,816
Murphy Oil Company Ltd.	28,217	14,378	9,916	114.1	114.1	5,703	22,814
Royal Dutch Shell	478,164	351,126	216,296	930.4	930.4	46,521	186,082
Sunshine Oilsands Ltd	N/A	379	1,699	1.2	239.1	59	47,812
Total SA	231,838	228,356	102,219	563.1	563.1	28,156	112,623
Walter Energy Inc.	2,562	6,812	3,016	197.4	205.2	9,871	41,034
Foreign subsidiaries total	1,904,286	1,539,011	1,020,123	5,945.8	6,219.6	297,290	1,243,913
Foreign subsidiaries average	190,429	139,910	92,738	540.5	565.4	27,026	113,083
Totals	2,091,397	1,989,810	1,347,783	22,828	34,515	1,141,392	6,903,014

Notes

- 1 Gillis, Justin. “To Stop Climate Change, Students Aim at College Portfolios”, in *The New York Times*, December 4, 2012. http://www.nytimes.com/2012/12/05/business/energy-environment/to-fight-climate-change-college-students-take-aim-at-the-endowment-portfolio.html?pagewanted=1&_r=4&hpw&
- 2 B McKibben, “Global Warming’s Terrifying New Math” in *Rolling Stone*, August 2, 2012, <http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719>
- 3 M Lee and A Card, *A Green Industrial Revolution Climate Justice, Green Jobs and Sustainable Production in Canada*, Canadian Centre for Policy Alternatives, April 2012. Also see Lee and Card, *Peddling Greenhouse Gases: What is the Carbon Footprint of Canada’s Fossil Fuel Exports?*, Canadian Centre for Policy Alternatives, November 2011.
- 4 Letter to Mervyn King, <http://www.climatechangecapital.com/media/256968/letter%20to%20bank%20of%20england%20financial%20policy%20committee%20-%2019th%20january%202012%20-%20final.pdf>
- 5 Oxford University, “Smith School launches Futures Programme on Asset Stranding,” media release, <http://www.smithschool.ox.ac.uk/smith-school-launches-futures-programme-on-asset-stranding/>
- 6 Generation Investment Management, *Sustainable Capitalism* (London: Generation Investment Management LLP, 2012). <http://www.generationim.com/media/pdf-generation-sustainable-capitalism-v1.pdf>
- 7 The TSX 60 index is constructed to reflect real sector weights as they exist on the TSX. For further discussion see Canadian Capitalist, *Sector Breakdown of Diversified Portfolios*, <http://www.canadiancapitalist.com/sector-breakdown-of-diversified-portfolios/>
- 8 W Nichols, “HSBC: Oil majors at risk from ‘unburnable’ reserves” in *Business Green*, Jan 29, 2013, <http://www.businessgreen.com/bg/news/2239778/hsbc-oil-majors-at-risk-from-unburnable-reserves>
- 9 Financial Times, “US pension fund eyes selling oil holdings,” Jan 30, 2013, <http://www.ft.com/intl/cms/s/0/73fedbf2-6af2-11e2-9871-00144feab49a.html#axzz2Jn24Ghge>, and M Green, “Burst-

ing the carbon bubble” in *The Age*, February 15, 2013, <http://m.theage.com.au/business/carbon-economy/bursting-the-carbon-bubble-20130214-2efob.html>

10 K Bagley, “Climate Change Divestment Campaign Spreads to America’s Churches” in *Inside Climate News*, Jan 10, 2013, <http://insideclimatenews.org/news/20130109/fossil-fuel-divestment-movement-climate-change-global-warming-bill-mckibben-american-churches-oil-coal-natural-gas>

11 World Bank, *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided*, November 2012, http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf

12 D Runnals, “‘Roasted, toasted, fried and grilled’: climate-change talk from an unlikely source” in *The Globe and Mail*, February 1, 2013, <http://www.theglobeandmail.com/commentary/roasted-toasted-fried-and-grilled-climate-change-talk-from-an-unlikely-source/article8077946/>

13 This is a conservative range. Hansen et al. argue that the currently accepted wisdom that an additional 0.6 °C warming is ‘in the pipeline’ ignores slow feedbacks and is therefore an underestimate. They believe that current atmospheric GHG concentrations commit us to an additional 1.4 °C increase. J Hansen et al. 2008. “Target Atmospheric CO₂: Where Should Humanity Aim?” in *The Open Atmospheric Science Journal*, 2: 217-31.

14 Copenhagen, University of. 2009. “Synthesis Report.” *Climate Change: Global Risks, Challenges & Decisions*. Copenhagen, 10-12 March 2009.

15 Earth’s CO₂ Home Page, based on preliminary NOAA data dated March 5, 2013 from Mauna Loa Observatory: Scripps Institution of Oceanography, <http://co2now.org/>

16 See discussion in K Anderson and A Bows. 2008. “Reframing the Climate Change Challenge in Light of Post-2000 Emission Trends.” *Phil. Trans. R. Soc. A* doi:10.1098/rsta.2008.0138, <http://rsta.royalsocietypublishing.org/content/366/1882/3863.full.pdf>

17 Hansen, James et al. 2008. “Target Atmospheric CO₂: Where Should Humanity Aim?” *The Open Atmospheric Science Journal*.2: 217-31.

18 M Meinshausen et al, “Greenhouse-gas emission targets for limiting global warming to 2C” in *Nature*, April 30, 2009, p. 1158, <http://www.iac.ethz.ch/people/knuttir/papers/meinshausen09nat.pdf>

19 J Leaton, *Unburnable Carbon: Are the world’s financial markets carrying a carbon bubble?*, The Carbon Tracker Initiative, 2011, p. 2, <http://www.carbontracker.org/carbonbubble>

20 J Leaton, “Sizing the Carbon Bubble”, in *China Dialogue*, March 21, 2012, <http://www.chinadialogue.net/article/show/single/en/4818>

21 International Energy Agency. *World Energy Outlook 2012*. <http://www.iea.org/publications/freepublications/publication/English.pdf>

22 Data from the International Energy Agency put CO₂ emissions from combustion of fossil fuels at 327 Gt between 2000 and 2011, and 2012 emissions will be approx 32-33 Gt. <http://www.iea.org/publications/freepublications/publication/name,32870,en.html>

23 Reporting definitions are slightly different for oil and gas and minerals in Canada. Minerals (i.e. coal) reserves are reported as measured, indicated, or inferred. For simplicity, in this analysis the terms proven, probable and possible are used as substitutes. For further information on the reserves definitions see Society of Petroleum Evaluation Engineers. *Section 5 of volume 1 of the Canadian Oil and Gas Evaluation Handbook (COGEH)*. <http://www.albertasecurities.com/securitieslaw/Regulatory%20Instruments/5/2232/COGEHs.5DefinitionsOfOilandGasResourcesandReserves.pdf>. Also see Woodside, Clare. *Lifting the Veil: Exploring the Transparency of Canadian Companies* (Ottawa: Publish What You Pay Canada, 2009).

- 24** Leaton, 2011 *supra* note 19. p. 12.
- 25** See notes in Figure 1. Emissions estimates are based on government reserves data, as summarized in M Lee and A Card, *Peddling GHGs: What is the Carbon Footprint of Canada's Fossil Fuel Exports?*, Behind the Numbers, November 2011, Canadian Centre for Policy Alternatives, <http://www.policyalternatives.ca/publications/reports/peddling-greenhouse-gases>
- 26** Canada's economy is 1.79% of world GDP as measured at purchasing power parities. Global Finance, Canada Country Report, <http://www.gfmag.com/gdp-data-country-reports/304-canada-gdp-country-report.html>
- 27** For further discussion of these issues see for example, Great Britain Treasury. *Stern review on the economics of climate change: Stern review final report* (HM Treasury: 2006). http://web.archive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/stern_review_report.htm. Also see Generation Investment Management LLP. *Sustainable Capitalism*. (London U.K.: Generation Investment Management LLP, 2012). <http://www.generationim.com/media/pdf-generation-sustainable-capitalism-v1.pdf>. and National Roundtable on the Environment and the Economy. *Paying The Price: The Economic Impacts of Climate Change For Canada* (Ottawa: NRTEE, 2011). <http://nrtee-trnee.ca/wp-content/uploads/2011/09/paying-the-price.pdf>
- 28** National Roundtable on the Environment and the Economy, *Paying The Price: The Economic Impacts of Climate Change For Canada*, 2011, <http://nrtee-trnee.ca/wp-content/uploads/2011/09/paying-the-price.pdf>, pp. 15-17.
- 29** Blakes Canadian Lawyers, *Accessing the Canadian Capital Markets: Legal Advice for Non-Canadian Mining and Oil and Gas Companies*, http://www.blakes.com/english/legal_updates/reference_guides/AccessingCdnCapitalMarketsMining.pdf
- 30** TMX Group, *A Capital Opportunity: A Global Market for Oil and Gas Companies*. (2012) p. 26. http://www.tmx.com/en/pdf/OilGas_Presentation.pdf.
- 31** This analysis was conducted before the takeover of Nexen by the China National Offshore Oil Corporation, as of February 2013, so Nexen is included in our database as a Canadian-listed company. Because CNOOC has other asset holdings in Canada, and was otherwise excluded from our database to lack of data availability, we have left Nexen among our Canadian-listed companies for information purposes.
- 32** It should be noted that the reserves reporting requirements in Canada are different for companies operating in the oil and gas extraction and production sector and mineral extraction and production sector (ie coal). In effect, this means that the timelines associated with coal development are more long-term than for oil and gas. This fact implies that the specific liabilities associated with coal reserves and oil and gas reserves are not directly comparable. For further discussion of the reporting requirements in Canada see Woodside, Claire, *Lifting the Veil: Exploring the Transparency of Canadian Companies* (Ottawa: Publish What You Pay Canada, 2009). http://www.pacweb.org/Documents/PWYP/Lifting_the_veil-Nov2009.pdf
- 33** These estimates are conservative for a number of reasons. See the Technical Appendix for more details.
- 34** F Ackerman and E Stanton, *Climate Risks and Carbon Prices: Revising the Social Cost of Carbon*, Economics for Equity and Environment, 2011, p. 2. http://sei-us.org/Publications_PDF/SEI-Climate-Risks-Carbon-Prices-2011-full.pdf
- 35** Modelling by Mark Jaccard and Associates for M Bramley, P Sadik and D Marshall, *Climate Leadership, Economic Prosperity: Final report on an economic study of greenhouse gas targets and policies for Canada* (David Suzuki Foundation and the Pembina Institute, 2009), <http://www.pembina.org/pub/1909>
- 36** Canadian Oil Sands Limited. *Annual Information Form*, 2011, p. 4. <http://www.cdnoilsands.com/Theme/COS/files/FinancialReports/AnnualReport2011/AIF%20English.pdf>

- 37** Summary from Pembina Institute, *Oil Sands: Climate Impacts*, Oil Sands 1010 website, <http://www.pembina.org/oil-sands/os101/climate>. Also, National Defence Research Council, *GHG Emission Factors for High Carbon Intensity Crude Oils*, September 2010, http://docs.nrdc.org/energy/files/ene_10070101a.pdf.
- 38** L Stockman, *Petroleum Coke: The Coal Hiding in the Tar Sands*, Oil Change International, January 2013, <http://priceofoil.org/2013/01/17/petroleum-coke-the-coal-hiding-in-the-tar-sands/>
- 39** Garg, Amit, Kazunari, Kainou and Pulles, Tinus, 2006 *IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy*. 2006. p. 1.4.2.1. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html> / p. 1.4.2.1.
- 40** For a discussion of natural gas, see CCPA Climate Justice Project reports by M Lee, *BC's Legislated Greenhouse Gas Targets vs Natural Gas Development: The Good, The Bad and the Ugly*, October 2012, <http://www.policyalternatives.ca/natural-gas-ghgs>, and B Parfitt, *Fracking Up Our Water, Hydro Power and Climate: BC's reckless pursuit of shale gas*, November 2011, <http://www.policyalternatives.ca/fracking>.
- 41** J Weidman, "BP Rakes In \$11.6 Billion In Profits For 2012," in *Think Progress* blog, <http://thinkprogress.org/climate/2013/02/05/1542701/bp-rakes-in-116-billion-in-profits-for-2012/>
- 42** J Stanford, "A July 1 Portrait of Corporate Canada" in *Relentlessly Progressive Economics* blog, June 29, 2011, <http://www.progressive-economics.ca/2011/06/29/a-july-1-portrait-of-corporate-canada/> Analysis based on Globe and Mail's Report on Business Top 1000 rankings.
- 43** DARA and the Climate Vulnerable Forum, *Climate Vulnerability Monitor 2nd Edition: A Guide to the Cold Calculus of a Hot Planet*, September 2012, <http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/>
- 44** Statistics Canada, Corporations Returns Act, Table 2: Oil and gas extraction and support activities, released June 22, 2012, <http://www.statcan.gc.ca/pub/61-220-x/2010000/to31-eng.htm>. Data are not broken out for coal mining, but the category of "mining and quarrying (except oil and gas)" shows about one-third of assets are foreign-owned, and about two-thirds of revenues and profits (Table 3).
- 45** Another CCPA report goes into detail about the perverse macroeconomic impacts of bitumen development in Canada. See J Stanford et al, *The Bitumen Cliff: Lessons and Challenges of Bitumen Mega-Developments for Canada's Economy in an Age of Climate Change*, CCPA and Polaris Institute, February 2013.
- 46** Y Hussain, "Oil explorers' new challenges" in *Financial Post*, May 3, 2012, http://business.financialpost.com/2012/05/03/oil-explorers-face-new-challenges/?__lsa=05f2-7329
- 47** Statistics Canada, *Pension Plans in Canada, as of January 1, 2011*, Table 1: Registered pension plan membership, by sector and type of plan, The Daily, May 25, 2012, <http://www.statcan.gc.ca/daily-quotidien/120525/t120525a001-eng.htm>
- 48** Statistics Canada, Employer pension plans (trusteed pension funds), second quarter 2012, Table 1: Trusteed pension funds: Market value of assets by type, The Daily, December 12, 2012, <http://www.statcan.gc.ca/daily-quotidien/121212/t121212c001-eng.htm>
- 49** L Pynn, "B.C.'s public-sector pension invests millions in Enbridge, tobacco stock" in *Vancouver Sun*, Jan 10, 2013, <http://www.vancouversun.com/business/public+sector+pension+invests+millions+Enbridge+tobacco+stock/7804127/story.html>
- 50** D Dodge, *Economic and Financial Efficiency: The Importance of Pension Plans*, Remarks by David Dodge, Governor of the Bank of Canada, to l'Association des MBA du Québec (AMBAQ), 9 November 2005, <http://www.bankofcanada.ca/wp-content/uploads/2010/02/sp05-14.pdf>
- 51** American Petroleum Institute, *Putting Earnings into Perspective: Facts for Addressing Energy Policy*, January 2012, http://www.api.org/statistics/earnings/upload/earnings_perspective.pdf

- 52** Canada Pension Plan Investment Board, *Equities*, <http://www.cppib.ca/Investments/Equities/default.html>
- 53** As of March 31, 2012. CPP Investment Board, *List of Canadian publicly-traded equity holdings*, http://www.cppib.ca/files/F2012_-_YE/Publicly-Traded_Equity_Holdings_-_CDN_-_March_31_2012_-_Eng.pdf
- 54** Canadian Institute of Chartered Accountants, *Environmental, Social, and Governance Issues in Institutional Investor Decision Making*. (Toronto: CICA, 2010). pp. 3-4. <http://www.cica.ca/publications/list-of-publications/manual/item41881.pdf>
- 55** S Kapoor, L Oksnes and R Hogarth, *Funding the Green New Deal: Building a Green Financial System* (Brussels, BEL: Green European Foundation, 2011). p. 16. <http://re-define.org/sites/default/files/GEF-Funding%20the%20GND%20web.pdf>
- 56** O Sorensen and S Pfeifer, "Climate Change Issues in Fund Investment Practices" in *International Social Security Review*, Vol 64, April 2011, p. 65.
- 57** Institutional Investors Group on Climate Change, *Global Investor Statement on Climate Change: reducing Risks, Seizing Opportunities & Closing the Climate Investment Gap*. (London, UK: IIGCC, 2010). p. 1. Also see J Hawley, K Johnson and Waitzer, Ed, "Reclaiming Fiduciary Duty Balance" in *Rotman International Journal of Pension Management*, Vol. 4, Fall 2011. p. 5.
- 58** G Yaron, *The Responsible Pension Trustee: Reinterpreting the Principles of Prudence and Loyalty in the Context of Socially Responsible Investing*. (Vancouver: Canadian Shareholder Association for Research and Education). pp. 36-37.
- 59** J Hawley et al, 2011 *supra* note 57. p. 5.
- 60** Sorensen and Pfeifer, 2011 *supra* note 56. p. 67.
- 61** A Gore and D Blood, *A Manifesto for Sustainable Capitalism: How businesses can embrace environmental, social and governance metrics*. December 14, 2011. <http://www.scribd.com/doc/77004188/PDF-Wsj-Manifesto-Sustainable-Capitalism-14-12-11>
- 62** R Bauer, *Climate Change and Pension Funds: Risks, Opportunity or Distraction?* Rotman ICPM, 2010, p. 14. http://www.rijpm.com/admin/article_files/1_ICPM_Case_4_Climate_Change_and_Pension_Funds_FINAL_September_24_2010.pdf
- 63** K Ambachtsheer, *Wealth Across Generations: Can Pension Funds Shape the Future of Capitalism*, Rotman Centre for Pension Management, 2011, p. 1. And Guardian Ethical Management Inc, *Sustainable Investing Handbook for Mission-Based Organizations*, p. 36. http://corostrandberg.com/wp-content/uploads/files/Sustainable_Investing_for_Mission-Based_Organizations.pdf
- 64** For this and other examples see National Roundtable on the Environment and the Economy, 2011 *supra* note 28. pp. 15-17.
- 65** Bauer, 2010 *supra* note 62, pp. 14-18. Also see Della Croce, R., C. Kaminker and F. Stewart, *The Role of Pension Funds in Financing Green Growth Initiatives*, OECD Publishing, 2011, pp. 11-17.
- 66** Canadian Securities Administrators, *CSA Staff Notice 51-333 Environmental Reporting Guidance*. 2010. p. 8. http://www.osc.gov.on.ca/documents/en/Securities-Category5/csa_20101027_51-333_environmental-reporting.pdf
- 67** Canadian Institute of Chartered Accountants, 2010 *supra* note 54. p. 4.
- 68** Some of the NGOs that have made this observation include the UNEP FI, the World Business Council for Sustainable Development, CERES, and the Environmental Defense Fund. See J Desjardins and A Willis, *Climate Change Briefing: Questions for Directors to Ask*, Canadian Institute of Chartered Accountants, 2009, p. 9.

- 69** Canadian Institute of Chartered Accountants, *Environmental, Social, and Governance Issues in Institutional Investor Decision Making*, 2010, <http://www.cica.ca/publications/list-of-publications/manual/item41881.pdf>, p. 21.
- 70** Canadian Institute of Chartered Accountants, 2010 *supra* note 54. pp. 12-13.
- 71** Certified General Accountants Association of British Columbia, *Code of Ethical Principles and Rules of Conduct*, September 24, 2011.
- 72** The Caisse de dépôt et placement du Québec, *Responsible Investment*, <http://www.lacaisse.com/en/investments/responsible-investment>. Also see The Caisse de dépôt et placement du Québec, Policy on Responsible Investment. December 17, 2012. pp. 1-6. http://www.lacaisse.com/sites/all/files/medias/en/gouvernance/documents/politique_investissement_responsable_en.pdf
- 73** Ontario Teacher's Pension Plan, *Responsible Investing: Environmental and Social Considerations*, September 2011, http://www.otpp.com/wps/wcm/connect/otpp_en/Home/Responsible+Investing/Environmental%2C+Social+Issues/.
- 74** Ontario Teachers' Pension Plan. *Leading the Way: 2011 Annual Report*. (Toronto: OTPP, 2012). p. 34. http://docs.otpp.com/annual_report/PDF2012/AnnualReport2011.pdf
- 75** Letter From Global Investor Networks To The Governments Of The World's Largest Economies, November 20, 2012, <http://www.ceres.org/files/investor-files/2012-global-policy-letter>
- 76** Global Finance, *Canada Country Report*, <http://www.gfmag.com/gdp-data-country-reports/304-canada-gdp-country-report.html>
- 77** Green Investment Bank, *Our Investment Approach*, <http://www.greeninvestmentbank.com/userfiles/files/Our-Investment-Approach.pdf>
- 78** Sustainable Prosperity, *Green Bonds*, Policy Brief, June 2012, p. 2. <http://www.sustainableprosperity.ca/dl854&display>
- 79** R Della Croce, C Kaminker and F Stewart. The Role of Pension Funds in Financing Green Growth Initiatives, OECD Publishing, 2011, p. 38 <http://www.oecd.org/finance/privatepensions/49016671.pdf>
- 80** R Scheer and D Moss, "Clean Energy "Victory" Bonds Seek to Recapture Spirit of U.S WWII Investment Drive" *Scientific American*, website, December 18, 2012, <http://www.scientificamerican.com/article.cfm?id=clean-energy-victory-bonds>
- 81** Sustainable Prosperity, 2012. *supra* note 78. p. 10.
- 82** B Fine et al., *Green Bonds: A Public Policy Proposal* (Action Canada, 2008). p. 2. <http://www.actioncanada.ca/en/wp-content/uploads/2008/10/teamgreenbondsprojectenglish.pdf>
- 83** Kapoor, Oksnes and Hogarth, 2011. *supra* note 55. p. 89.
- 84** RBC Economics, "Backing in the Future: Canada's Declining RRSP Contribution Rates" in *Current Analysis*, February 2012. p. 1. <http://www.rbc.com/economics/market/pdf/rrsp2012.pdf>
- 85** Finance Canada. "Tax-Free Savings Accounts: A Profile Of Account Holders" In *Tax Expenditures And Evaluations 2012. Part 2—Tax Evaluations And Research Reports*, released February 2013, <http://www.fin.gc.ca/taxexp-depfisc/2012/taxexp1202-eng.asp#toc346014054>
- 86** T Nash, *A Critical Look at Canada's Green Funds*, SocialFinance.ca, January 11, 2011, <http://socialfinance.ca/blog/post/a-critical-look-at-canadas-green-funds>. And Kapoor, Oksnes and Hogarth, 2011. *supra* note 55. pp. 87-88.
- 87** *Ibid*, p. 89.

- 88** Kapoor, Oksnes and Hogarth, 2011. *supra* note 55. p. 90. Disclosure: Please note that Vancity is a funder and supporter of the CCPA and the Climate Justice Project.
- 89** Green European Foundation, *Funding the Green New Deal: Building a Green Financial System*, Green New Deal series vol. 6, http://gef.eu/uploads/media/Funding_the_Green_New_Deal.pdf
- 90** Gore and Blood, 2011 *supra* note 61. A new report from Promethian Carbon and the Carbon Disclosure Standards Board, a project of the Carbon Disclosure Project, provides a good discussion of what “material” items related to climate change should be part of integrated reporting frameworks. *Climate Change: Your Journey to Integrated Reporting*, February 2013, <http://www.promethium.co.za/wp-content/uploads/2013/02/2013-02-25-BROCHURE-FINAL2.pdf>
- 91** Canadian Institute of Chartered Accountants, 2010 *supra* note 54. p. 27.
- 92** J Ambachtsheer, “Potential ESG Disclosure Requirements in Ontario” *Mercer Web Site*, July 11, 2012. <http://www.mercer.com/articles/ESG-disclosure-requirement-Ontario>.
- 93** Canadian Association of Pension Supervisory Authorities, “Role and Mandate of the Canadian Association of Pension Supervisory Authorities (CAPSA)” CAPSA Web Site. [Online] June, 2012. [Cited: Nov. 19, 2012.] <http://www.capsa-acor.org/en/about/Role%20and%20Mandate%20of%20CAPSA%20Final%20-%20June%202012.pdf>
- 94** PRI Association; UNEP FI; Trucost, *Universal Ownership: Why Environmental Externalities Matter to Institutional Investors*, PRI Association; UNEP FI, 2011, p. 4, http://www.unepfi.org/fileadmin/documents/universal_ownership_full.pdf
- 95** N Stern and Great Britain Treasury, *The Economics of Climate Change: The Stern Review*, Cambridge University Publishers, 2006, p. vi.
- 96** H Stewart and L Elliott, “Nicholas Stern: ‘I got it wrong on climate change – it’s far, far worse’: Author of 2006 review speaks out on danger to economies as planet absorbs less carbon and is ‘on track’ for 4C rise” in *The Observer*, Saturday 26 January 2013, <http://www.guardian.co.uk/environment/2013/jan/27/nicholas-stern-climate-change-davos>
- 97** Canadian Securities Administrators, 2010 *supra* note 66, p. 4.
- 98** The net calorific values for each fuel type were assembled from a number of different reports. These included, Statistics Canada, *Report on Energy Supply and Demand in Canada: 2009 Preliminary*. (Ottawa: Statistics Canada, 2011). pp. 124-125. <http://www.statcan.gc.ca/pub/57-003-x/57-003-x2009000-eng.htm> and Garg, Kazunari, and Pulles, 2006 *IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy*. 2006. p. 1.4.2.1. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html>/ p. 1.4.2.1, and Boundy, Bob, et al, *Biomass Energy Data Book: Edition 4* (Washington D.C.: U.S. Department of Energy, 2011). p. Appendix A: Lower and Higher Heating Values of Gas, Liquid and Solid Fuels. http://cta.ornl.gov/bedb/pdf/BEDB4_Full_Doc.pdf
- 99** Environment Canada, “Fossil Fuels: Coal” [Online] May 26, 2010. [Cited: June 13, 2012.] <https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=1357A041-1>
- 100** Garg, Amit, Kazunari, Kainou and Pulles, Tinus, 2006 *supra* note 98. pp. Tables 1.3, 1.4, 2.2, 2.4. and Environment Canada, “Global Warming Potentials”, <http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=AC2B7641-1>.
- 101** Pan Orient is included in our database because they disclose large possible reserves (equivalent to 65,5 Mt CO₂e) but not proven or probable reserves.
- 102** Note, Petrobank Energy Resources is majority owner of Petrobakken Energy and includes Petrobakken Energy’s reserves in its reserve calculations.



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