WHITE PAPER

Stranded Oil and Gas Assets—Is the Wolf at the Door or Waiting in the Forest?

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Executive Summary

Corporate boards, shareholders, and the broader public have growing concerns about stranded oil and gas assets. This white paper explores the risk of fossil fuel reserves becoming stranded assets as governments move to mitigate greenhouse gas emissions and shift to a low-carbon economy. Stakeholders such as institutional investors are increasingly pushing for oil and gas companies to identify, consider, quantify, and report risks associated with stranded assets.

Given the current state of global climate policy, stranded assets may not be perceived as an imminent threat. However, some institutional investors have committed to divesting to reduce exposure to fossil fuels. Publicly traded oil and gas companies have provided responses to address increased requests for disclosure.

The risk of government carbon policies, regulations, and other environmental drivers that lead to reduced reliance on fossil fuels and stranded assets is expected only to increase. Therefore, understanding the potential risks of these assets becoming stranded along with the resource specific mitigation measures is becoming even more important. Such understanding, in a rhetoric-charged space, is essential to truly quantify asset and investor risk and to mitigate and manage potential risks accordingly and in parallel.

During the past 20 years, ICF International has earned an international reputation in the field of climate change consulting. ICF is known for analytical rigor, in-depth market expertise, and technical integrity through scores of climate change-related assignments. Our expertise is exemplified by the receipt of a gold award from the *Climate Change Business Journal®* in the category of Consulting & Engineering: Climate Risk Management & Adaptation. In this paper, ICF discusses the potential threat of stranded assets and identifies the key issues. Our team of climate change experts can address these topics in a company-specific manner.

Introduction

As evidenced by majors such as Shell and Exxon, publicly traded oil and gas companies have been responding to investor and broader public concerns regarding the valuation of proven fossil fuel reserves and the potential liability resulting directly from the forward constraints on carbon dioxide (CO_2) emissions. Institutional investors such as Norway's Storebrand and Dutch multinational Rabobank have made public announcements on their intentions to divest broadly in the fossil fuel sector or not loan to certain energy extraction process such as shale gas and oil sands. Much of the basic logic is well defined in The Carbon Tracker Initiative's Unburnable Carbon—are the world's financial markets carrying a carbon bubble? (Carbon Tracker, 2014).

The recently released Fifth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) holds that the global temperature rise attributed to anthropogenic greenhouse gas (GHG) emissions will exceed 2°C[1] unless cumulative global emissions are held below 3,670 gigatonnes of CO_2e[2] since the period 1861 to 1880. This threshold is commonly known as the "carbon budget." As of 2011, more than half of this global budget has been used.

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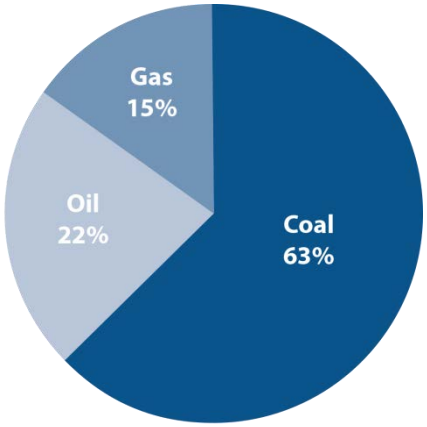
[1] Established as a global target at the Copenhagen Convention, the increase in global temperature (relative to pre-industrial levels) should be below 2°C to stabilize GHG concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

[2] Carbon-dioxide equivalent (CO_2e) emission is the amount of CO_2 emission that would cause the same time-integrated radiative forcing, during a given time horizon, as a given mixture of CO_2 and other forcing components. The CO_2 e emission is obtained by multiplying the emission of a greenhouse gas by its global warming potential for a given time horizon.

Figure 1. Potential CO_2 Emissions from Proven Fossil-Fuel Reserves



Source: International Energy Agency, 2012[3]

Similarly, the International Energy Agency's (IEA's) "450 scenario,"[4] (based on past trends and modified by known policy actions) deliberately selects a plausible energy pathway consistent with a 50 percent chance of staying within the carbon budget. Under a scenario based on the potential CO_2 emissions from proven fossil-fuel reserves and to stay within the carbon budget, no more than one-third of these reserves can be consumed prior to 2050. The carbon budget and findings of the 450 scenario raise concerns about fossil fuel reserves becoming stranded assets. These assets represent proven resources that could suffer from premature write-downs, devaluations, or conversion to liabilities caused by any number of environmental drivers. Energy extraction processes broadly defined as "unconventional"—such as shale gas—and specific resources such as Canadian oil sands have been the focus of much of this attention. The risk of regulation impacts production economics as well as stakeholder push back against transportation infrastructure and import. An assessment and discussion of global reserves and specifically Canada's oil and gas reserves is provided in the following sections.

Allocating Greenhouse Gas Emissions—Lifecycle Analysis

Global fossil fuel reserves include coal, oil, and natural gas. As illustrated in Figure 1 above, potential CO_2 emissions from coal account for 63 percent of proven fossil fuel reserves. Oil and gas combined account for the remaining 37 percent. Coal, oil, and natural gas are intrinsically tied as fossil fuels. However, they represent separate and distinct risks of becoming stranded assets as a result of their differing end uses: coal and natural gas are used primarily for electricity production, and oil for transportation fuel making.

The current proven petroleum reserves published by the U.S. Energy Information Administration (EIA) and Canadian Association of Petroleum Producers (CAPP) are shown in Figure 2 below. An estimated 500 kilograms of CO_2 are generated per barrel of refined product on a lifecycle basis, with variability depending on the crude source (Government of Canada, 2013). Based on these values, an estimated 763 $GtCO_2$, or 43 percent of the remaining carbon budget, would be consumed by the production and combustion (on a well-to-wheel basis) of all 2012 proven crude oil global reserves alone.

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[3] http://www.pjm.com/~/media/documents/reports/20140109-january-2014-cold-weather-peaks-and-generator-outages.ashx. Published Monday Jan 13, 2014

4 A scenario presented in the World Energy Outlook which sets out an energy pathway consistent with the 2°C target by limiting the concentration of greenhouse gases in the atmosphere to around 450 parts per million (ppm) of CO_2.

Figure 2. Potential CO_2 Emissions from Proven Fossil-Fuel Reserves

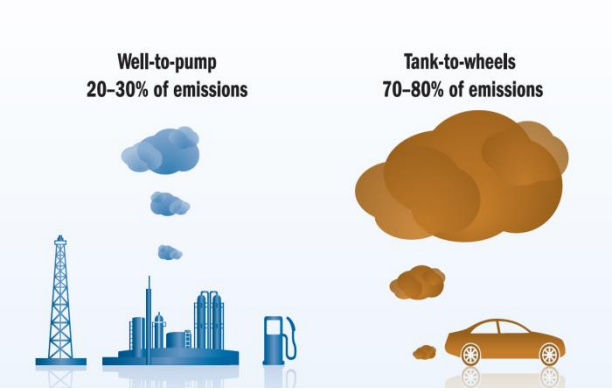
	2012 Crude Oil Proven Reserves (Billion Barrels)	Lifecycle GHG Emissions ($kgCO_2$/barrel)	GHG Emissions Equivalent ($GtCO_2e$)	Percent of Remaining Carbon Budget
Canada	172[5]	525	100	5 percent
World	1,525	500	763	43 percent

Source: U.S. Energy Information Administration and Canadian Association of Petroleum Producers

In general, reductions in GHG emissions can be achieved in two ways: (1) improving the efficiency of the economy's consumption of energy (energy consumed per unit of gross domestic product) and (2) reducing the CO_2 intensity of the fuel source. Low-carbon fuel standards (such as those introduced in California, British Columbia, and the European Union) focus on GHG emissions produced (per unit of fuel) during the entire lifecycle of the transportation fuel, including production, refining, transportation, and combustion. Energy-efficiency approaches are being applied through emissions performance standards for vehicles, such as those dictated by California's *Advanced Clean Cars Program* and Environment Canada's *On-Road Vehicle and Engine Emissions Regulations* (SOR/2003-2).

For governments in the pursuit of overall emissions reductions, targeting fuel production through GHG emissions caps or reduction regulations alone may prove less fruitful ambition than targeting downstream users through efficiency and fuel standards. In terms of lifecycle GHG emissions that include those associated with production (well) through to combustion emissions from vehicle engines (wheel), not all sources are equal. "Well to retail pump" emissions account for approximately 25 percent of crude oil's lifecycle emissions; with the remaining 75 percent accounted for by "tank to wheels" emissions (see Figure 3). Although reduction of emissions at any source will aid efforts to reduce overall emissions, the relative contribution of the targeted sector will dictate the effectiveness of carbon policy.

Figure 3. Lifecycle Emissions



Source: Government of Canada

Allocating Responsibility—Ownership of Reserves

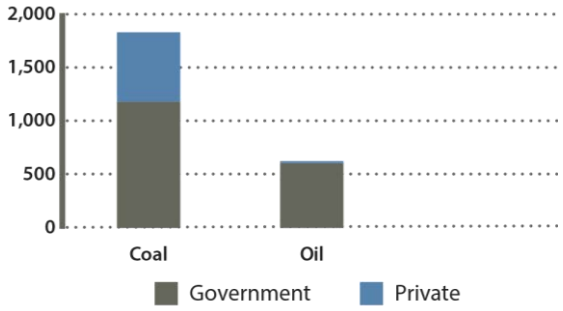
The "tragedy of the commons" describes a situation in which individuals acting independently and rationally behaves according to their own self-interest and contrary to the best interest of the group by depleting a resource under common ownership. In the case of the carbon budget, the atmosphere is a resource under common ownership. The absence of clear and enforceable liability rules allows each GHG emissions source to "use up" the remaining budget. Allocating responsibility through a global policy to all contributors to work toward management of the atmosphere as a resource becomes an essential but challenging task.

The discussion related to investor concerns and requirements of publicly traded companies and to the allocation of emissions (broad asset level) must include crude oil, national oil companies (NOCs). These companies control approximately 90 percent of the world's oil reserves and 75 percent of production

[5] CAPP 2012 Crude Oil and Oil Sands Statistics—4,118 million barrels in conventional oil reserves, 33 billion barrels in mining reserves, and 135 billion barrels in in-situ bitumen reserves (2011 yearend).

(similar numbers apply to natural gas) as well as many of the major oil and gas infrastructure systems. Of the top 25 oil and gas reserves holders and producers, 18 are NOCs (World Bank, 2011). Therefore, private companies are not alone in reducing GHG emissions associated with oil production. Despite the fiduciary duty of institutional investors to focus on private companies, NOCs also must be recognized as large contributors with a role to play in reducing GHG emissions.

Figure 4. Potential Embedded CO_2 in Reserves (Gt)



Source: HSBC

An assessment of the risk of a defined asset (rather than a broad asset) becoming stranded requires understanding of the fundamental economics and emissions associated with NOCs assets. However, NOCs tend to be less transparent than publicly traded oil and gas companies (not only on emissions reporting but also on reserves and cost to produce). Further, they are driven to make reserve deployment decisions based on very different outcomes. With the large majority of oil and gas reserves in the hands of NOCs, one of the main threats to the world's biggest oil companies will come from the behavior of governments, especially OPEC states (HSBC, 2013).

Stranded Assets

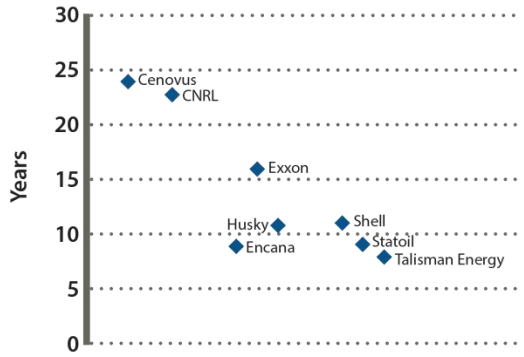
In a carbon-constrained global economy, projects that would be deferred or cancelled by the major oil and gas companies would be those with the highest costs and tightest margins. A recent analysis by HSBC (2013) concluded that capital-intensive, high-cost projects such as heavy oil and oil sands are most at risk of becoming stranded assets. The IPCC (2014) Fifth Assessment Report supports these findings with high confidence. The report indicates that GHG mitigation policy could devalue fossil fuel assets and reduce revenues for fossil fuel exporters, with differences between regions and fuels. However, the carbon-constrained economy in these scenarios defines a globally consistent carbon policy—a reality that does not appear imminent. As previously discussed, dramatic changes to environmental regulations that drive stranded assets are unlikely to occur suddenly without a strong demand side shift. What also matters is the availability of resource- and asset-specific abatement technology and of broadly applicable technology such as carbon-capture and sequestration. Such availability could reduce the adverse effect of mitigation on the value of fossil fuel assets and need to be better understood with regard to cost and applicability.

Conclusion

The concept of the carbon budget as described by IPCC and IEA provides a straightforward global level emissions cap. Clearly, the world's current proven reserves of fossil fuels cannot be fully deployed if the 450 ppm or 2°C target is to be met. Changes must be made to the GHG intensity of the fuel we fire as well as to the intensity with which the current global economy consumes energy. Otherwise, reserves will be deployed at a pace that results in exceeding the emissions threshold well before 2050. Work by IPCC, IEA, and entities like The Carbon Initiative shows that without a globally consistent carbon policy we will be unable to reduce our emissions and consumption intensity to stay within the global carbon budget.

Although a globally consistent carbon policy appears far from imminent, much discussion is taking place. Institutional investors and other stakeholders for oil and gas companies will increasingly push to identify, consider, quantify, and report risks associated with stranded assets. Although the wolf still may be lurking in the forest, the threat of its presence is being felt with an increasing intensity. The probability of an aggressive path, led by government policy and regulations, to stranded assets in the near future seems unlikely, given the lack of urgency in recent history with respect to global-oriented carbon policies. Most publicly traded oil and gas majors report reserve life indices of 8 to 20 years (Figure 5). In our professional opinion, even a significant impact on earnings in the latter half of that time frame is largely discounted (and considered a low financial risk). However, the development of future reserves beyond this time period has less certainty. As exemplified by the International Monetary Fund's[6] endorsement of an increased price on carbon, the push for a carbon-constrained economy is not subsiding.

Figure 5. Reported Reserve Life Index



Source: ICF

Further understanding and evaluation of the risks associated with the carbon budget and stranded assets may take form in several ways:

1. Publicly traded oil and gas companies may want to consider the risk of stranded assets from the production side and operational energy efficiency and ensure that shareholders' concerns are addressed.
2. Institutional investors such as pension funds and insurance companies may be concerned with understanding both the risks associated with investing in publicly traded oil and gas companies and the carbon policies that impact demand.
3. Governments and policymakers may want to develop an enhanced understanding of the implications of carbon pricing or GHG regulations.

Many questions are open for consideration by producers. What alternative low-carbon pathways may be considered more economic in future operation decisions? At what point in production life or well decline does an added cost of carbon merit resource abandonment? How should lost assets be evaluated practically? Although stranded assets may not be perceived as an immediate threat, understanding of the potential risks and mitigation measures of stranded assets is becoming increasingly important. ICF has much experience working with oil and gas producers as well as institutional investors and relevant expertise in assessing and quantifying risk at the resource, company, or asset level to contribute to that understanding. The risk of government policies and regulations as well as other environmental drivers leading to stranded assets is expected only to increase.

[6] International Monetary Fund, 2014. Getting Energy Prices Right: From Principle to Practice. July 2014. Retrieved August 12, 2014, from http://www.imf.org/external/np/fad/environ/.

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Duncan Rotherham supports ICF International's Canadian operations within energy and carbon markets. He has 14 years' experience providing a wide range of services to the North American and international oil and gas, electricity and gas utility, aluminum and metals, forest products, manufacturing, and chemical sectors. Mr. Rotherham has worked with more than 40 companies to assess current emissions management systems, identify gaps, develop robust inventories, and implement transparent operating procedures and tools. He has assessed emission abatement options, developed coordinated multipollutant emission reduction strategies, supported the development of marginal abatement cost curves, and quantified risk.

James D. Brown has more than 30 years of experience within the broader oil and gas sector, including oil refining, petrochemicals, and oil sands. He has worked in process and project engineering, operations, account and business management, business development, divestitures, strategy and enterprise risk management, public policy, and government relations. Mr. Brown is an analytical thinker who assesses situations objectively and critically. He uses cognitive ability and draws from his broad background of experience and skills to formulate a logical approach to exploit opportunities and solve problems.

Jennifer Suke has more than five years of technical and supervisory experience in the environmental sector. She holds a master's degree in Sustainable Energy Development from the University of Calgary. She has been the lead verifier on third-party assurance assignments for compliance and offset projects under Alberta's Specified Gas Emitters Regulation in addition to offset projects under the Clean Development Mechanism. Greenhouse gas verification projects have included bitumen extraction facilities in Alberta's oil sands, refineries, upgraders, natural gas processing plants, wind electricity generation, acid gas injection, energy efficiency, and landfill gas utilization.

About ICF International

ICF International delivers objective, credible guidance and comprehensive support to clients working in energy, energy efficiency, and climate change. ICF's operations in Canada are backed up by global resources. Through 4,500 employees in more than 70 offices around the world, ICF partners with government and commercial clients to deliver professional services and technology solutions in 13 markets, including energy, environment, and infrastructure; health, social programs, and consumer and financial; and public safety and defense. ICF's website is http://www.icfi.com/canada.