

The Time for Action is Now: Examining Renewable Energy Developments in Canada

Emily Bishop

“The economy of the future is likely to reward companies (and countries) that are energy efficient, low polluting, and use scarce natural resources efficiently. Rather than seeing this shift as a threat, and resisting change, Canada should view it as an opportunity.”

— Woynillowicz et al, 2013¹

Canada is very rich in natural resources and much of the country's economic wealth is derived from these sources. However, the manner in which the country is developing these resources is unsustainable and demands amendments. Energy insecurity and climate change are important topics on the global stage, and while many countries are working towards a renewable energy reality, the Government of Canada has proven to be unyielding on this issue. Thus, the aim of this paper is to examine Canada's energy and climate policies and make recommendations as to how the country could begin to transition towards more sustainable methods of development.

1.0 CANADA'S ENERGY POLICY

1.1 CANADIAN RESOURCE MANAGEMENT

Energy and climate policies are extremely interrelated. Energy policies that encourage fossil fuel production often conflict with climate policies that aim to reduce greenhouse gas (GHG) emissions. In Canada, this situation is further complicated due to differing interests between provinces. Thus, in order to understand how energy and climate policies are governed in Canada, it is necessary to examine how the country manages its

resources. Firstly, it is important to note that there is no integrated national energy strategy within Canada, instead, as outlined in Canada's constitution, jurisdiction over energy is divided between the federal and provincial government.² Due to the uneven distribution of resources within the country, the constitution stipulates provincial governments have control over their underground resources, with the exception of those found in aboriginal lands and certain federal lands.³ Thus, the provinces are responsible for the regulation, protection, distribution, and planning of their own resources, essentially giving each provincial government substantial control over the nature and pace of resource development in their province.

Conversely, the federal government is in charge of managing resources in national parks, northern territories and offshore waters. The federal government is also responsible for managing international and inter-provincial trade, and efforts to coordinate provincial policies. Additionally, the government is responsible for preserving national interests, such as environmental protection and climate policy.⁴ Thus, Canadian energy and climate policies are constrained by the constitutional division of powers between the federal and provincial governments. Although the federal government establishes objectives for the entire country, it cannot force regions to reduce their emissions using tools that fall under provincial legislation.⁵ For instance, the federal government cannot impose electricity tariffs that encourage renewable sources, because tariff regulations fall under provincial legislation. However, the Canadian federal government has tools to confront these issues, through national regulations or taxation, such as a carbon tax, or through environmental or health regulation. In order to develop a meaningful national energy or climate policy, coordination is needed at many levels. Nonetheless, achieving this has proven difficult due to the differing regional economic interests. As noted below, this has impeded Canada's transition away from fossil fuels and towards a green energy economy.

¹ Woynillowicz, D., Comette, P., Whittingham, E. “Competing in Clean Energy: Capitalizing on Canadian Innovation in a \$3 Trillion Economy.” *Pembina Institute* (2013).

² Bernstein, S., J. Brunnee, D. Duff, A. *A Globally Integrated Climate Policy for Canada*. (Toronto: University of Toronto Press. 2008).

³ Fertel, C., Bahn, O., Vaillancourt, K., Waaub, J.P. “Canadian Energy and Climate Policies: A SWOT Analysis in Search of Federal/ Provincial Coherence,” *Energy Policy*. No. 63 (2013)

⁴ Campbell, B. “The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth”. *Canadian Centre for Policy Alternatives* (2013).

⁵ Ibid

1.2 HISTORY OF ENERGY POLICY IN CANADA

Renewable energy first entered into the discourse of politics during the energy crisis on the 1970s. This turning point demonstrated how vulnerable the world was on fossil fuels and sent states scrambling to come up with 'alternative' energy sources. However, once the crisis had subsided and oil prices were back down, the need to develop alternatives receded as well.⁶ Throughout the past four decades, the issues of climate change, environmentalism and energy security have ebbed and flowed in political relevance, reflecting the economic situation at the time and the position of powerful heads of states. Canada, compared to other industrial nations, has never been at the forefront of developing renewable energy technology or implementing energy efficiency policies nationally. This is partly due to constitutional barriers and differing ideals provincially.

Since the 1980s, Canadian heads of state have taken varied positions in combatting climate change and encouraging environmental protection. While some prime ministers have taken progressive stances, instead, the majority of Canadian leaders have supported fossil fuel extraction and the protection of the economy. In general, political leaders, the public and the media are historically less attentive to environmental matters, while, economic issues such as unemployment, job loss and inflation have taken centre stage.⁷ In the 1980s and 1990s environmental causes began to see political support internationally. At the time, this 'second wave' of environmentalism fit within Canada's wider political agenda and many

"The majority of Canadian leaders have supported fossil fuel extraction and the protection of the economy."

commitments were undertaken. Unfortunately however, many of the landmarks that were achieved have been abandoned and Canada is now considered a "rogue state" in terms of climate change, and is "accelerating the global tragedy."⁸

As a result of his efforts, Prime Minister Mulroney was acknowledged as an early leader on the issue of climate change.⁹ Under Mulroney, Canada initiated the Green Plan, and an acid precipitation treaty with the US, as well as successful programs targeting solid waste reduction, recycling and energy efficiency.¹⁰ Moreover, economic-environmental roundtables were developed at the federal, provincial and municipal levels. One such landmark was the National Round Table on the Environment and the Economy, a federal advisory panel with a mandate to bring together business and environmental interest. Amongst other things, the panel predicted that doing nothing about climate change could cost the Canadian economy up to \$43 billion in losses per year by 2050 due to impacts of global warming, which was essentially a call for action from the Canadian government.¹¹ Furthermore, in 1988, Mulroney heralded the era of global climate governance with a high-profile opening address at the International Conference on the Changing Atmosphere in Toronto.¹² As well, in 1992 Mulroney pressed for the adoption of the UN Framework Convention on Climate Change in Rio de Janeiro, and was one of the first countries to ratify the convention.¹³

In 1993 the Liberal government, led by Jean Chrétien, was elected on a strong environmental platform. However, the government's willingness to implement this objective was faced with strong resistance from the oil and gas industries, and the province of Alberta - who would be adversely affected by rising energy prices and regulatory requirements. Unfortunately, the proposed

⁶ Turner, C., *The Geography of Hope: A Tour of the World We Need*. (Random House of Canada, 2008).

⁷ Paehlke, R. "Environmentalism in One Country: Canadian Environmental Policy in an Era of Globalization" *Policy Studies Journal*. Vol. 28, (2000)

⁸ Panetta, A. "Mark Jaccard, Ex-Harper Appointee, Calls Canada a 'Rogue State' on Environment". *Huffington Post Canada*. December 2, 2013. http://www.huffingtonpost.ca/2013/12/02/mark-jaccard-canada-environment_n_4373266.html

⁹ Smith, H. "Political Parties and Canadian Climate Change Policy". *International Journal*. No. 64 (2009): 48

¹⁰ Paehlke, R. "Environmentalism in One Country: Canadian Environmental Policy in an Era of Globalization."

¹¹ De Souza, M. "Stephen Harper's Environment Minister Casts Doubt on Climate Change". *Morgan Leslie, MP*. October 4, 2013. <http://meganleslie.ndp.ca/stephen-harper-s-environment-minister-casts-doubt-on-climate-change>

¹² Rabe, B. "The Absence of Governance: Climate Change in Canada and The United States." *Canadian-American Public Policy*. No. 73 (2008)

¹³ Macdonald, D. "Explaining the Failure of Canadian Climate Policy" (pp. 223-240). In Compston H., Bailey I., *Turning Down the Heat: The Politics of Climate Policy in Affluent Democracies*. (London, UK: Palgrave Macmillan 2008).

implementation of a carbon tax was abandoned due to Alberta's lobbying.¹⁴ In 1998 and 1999, the federal and provincial governments engaged in extensive consultations, and unsurprisingly, environmental groups recommended a different kind of large scale change. They argued that emissions could be cut to near half of 1990s levels through comprehensive building retrofits, a tripling of vehicle fuel efficiency, curbing urban sprawl, and the introduction of energy-efficiency and emission-reduction strategies into architecture, engineering design and urban planning.¹⁵ However, no such vision was incorporated into national policy. Instead the federal government's programs relied primarily upon voluntary action, and informational and educational methods. Voluntary measures such as the 2002 Climate Change Plan for Canada and the Voluntary Challenge Registry for Industries Program had little effect on GHG emissions and thus they continued to rise.¹⁶

In 2002 Chrétien ratified the Kyoto Protocol. The imposed target was to reduce Canada's 1990 greenhouse gas (GHG) levels by 6% by 2012.¹⁷ This decision went through despite the absence of the United States in the agreement, as well as opposition within Canada. The oil and gas industry and the province of Alberta engaged in nation-wide advertising campaigns with the intention of convincing Canadians that ratification would cause major job losses.¹⁸ These actions demonstrate the differing views of certain provinces, the political influence of certain industries, and the importance of economic prosperity for many Canadians. With the Kyoto Protocol, the government announced it was abandoning voluntarism and would be using law-based instruments to regulate emissions. However, this would be short lived and Chrétien, to assure the worried industry, noted that costs above \$15 per ton on emissions would be paid by the federal government.¹⁹ The policy of capping industry costs would be reiterated under Harper's policy.

Although Prime Minister Paul Martin's time in office was short-lived (2003-2006), he took a progressive stand on environmental issues. This can be seen when he proposed Project Green, a strategy that relied heavily on government funding and included such initiatives as a cap-and-trade system for large emitters, and a Carbon Fund, which would finance the purchase of emission credits domestically and internationally.²⁰ This was a very innovative plan and would have placed Canada on the right path towards climate change action. However, it was never implemented as Stephen Harper came into power in 2006. Prime Minister Harper made it evident from the beginning of his time in office that his priorities did not lie in environmental protection and combating climate change. Instead, his party was almost exclusively concerned with economic concerns. This was demonstrated in his government's policy package, which was introduced in the fall of 2006, as he bundled together climate change and all other air pollution issues, and essentially returned to voluntarism in emissions control.²¹ As he is from Calgary, much of Harper's political support is concentrated in the West. From his actions he has demonstrated that he is more than willing to appease the province of Alberta, and the oil and gas industries within Canada and abroad.

Instead of promoting a meaningful climate policy, Harper has pushed for the accelerated expansion of the Alberta tar sands and the emergence of Canada as an 'energy superpower'. In less than eight years, his actions have essentially reneged Canada's position as a pioneer in combating climate change, and according to Green Party Leader Elizabeth May, Harper has brought nothing but "shame" to Canada over climate change because of the unwillingness to take global warming seriously.²² This is evident with Harper's 2011 decision to withdraw from the Kyoto Protocol, effectively making Canada the first country to do so. Instead, the federal government is now promoting a 'made in Canada' solution that is premised on view that any regulation of GHGs had to be attentive to

¹⁴ Ibid

¹⁵ Ibid

¹⁶ Bernstein et al., *A Globally Integrated Climate Policy for Canada*

¹⁷ Fertel et al. "Canadian Energy and Climate Policies: A SWOT Analysis in Search of Federal/Provincial Coherence."

¹⁸ Macdonald, D. "Explaining the Failure of Canadian Climate Policy".

¹⁹ Ibid

²⁰ Bernstein et al., *A Globally Integrated Climate Policy for Canada*

²¹ Macdonald, D. "Explaining the Failure of Canadian Climate Policy".

²² Brennan, R. "May Slams PM, Outlines Green Platform" *The Toronto Star*. October 16, 2007. http://www.thestar.com/news/2007/10/16may_slams_pm_outlines_green_platform.html

economic and social realities in Canada.²³ Furthermore, Harper has clearly stated that there will be no federal carbon tax. Conversely, he has cancelled cap-and-trade systems for large emitters and is promoting voluntary agreements instead. In 2006, the Federal Commissioner of the Environment and Sustainable Development concluded “that the federal government’s response to climate change has been a story of ‘inadequate leadership, planning and performance’ which ‘lacked foresight and direction and has created confusion and uncertainty for those who are trying to deal with it.’”²⁴ Harper has agreed to commit to the 2009 Copenhagen Accord, with the target of stabilizing the concentration of GHGs in the atmosphere at a level no higher than 450 parts per million. The federal government has now chosen sector-by-sector regulations as its main tool to work towards its national GHG reduction target.²⁵

Canada is one of the largest per-capita consumers of primary energy and electricity in the world. The customary explanations for this include Canada’s cold climate, low population density - which requires long distance travel - and high quality of life, coupled with the concentration of highly energy-intensive sectors.²⁶ The country’s population is concentrated along the border with the United States and can be divided into four distinct districts: British Columbia on the Pacific coast; the West; the industrial heartland of Ontario and Quebec; and Atlantic Canada.²⁷ These regions all have very different incentives in respect to energy and climate change. For instance, Alberta and Saskatchewan dominate oil and gas production in Canada, while the majority of energy demands come from the manufacturing centres of Ontario and Quebec. Furthermore, energy consumption within Canada is increasing at a rate of 1.4% per year (See Figure 1). This does not seem like a large increase, but when compared to 2004 levels, Canada’s energy consumption in 2025 will be 34% higher, and predicted GHG emissions will grow by 33-45%.²⁸ A large part of this increase is a consequence of Canada’s fossil fuel industry and

without proper policies and clear commitments; this will bring devastating results to both Canada and the world at large.

1.3 CANADA’S FOSSIL FUEL INDUSTRY AND THE RELATED IMPLICATIONS

Traditionally, Canadian energy policy has been devoted to the development of Canada’s large oil, gas and coal resources. Canada is a very energy-intensive country - the energy sector is one of the most important parts of Canada’s economy in terms of investment, trade, income generation and employment. Canada is ranked second globally, after Saudi Arabia, for its proven reserves of crude oil.²⁹ However, this lucrative resource is unevenly distributed across the country, with more than 95% of the reserves located in Alberta in the form of tar sands, and the remaining reserves consisting of conventional oil, located mainly off the coast of Newfoundland.³⁰ The main tar sands deposits in Alberta are located in Peace River, Cold Lake and Athabasca. Tar sands oil consists of a mixture of silica sand, minerals, clay and crude bitumen and due to the highly dispersed nature of the oil, the process of converting one barrel of bitumen requires three barrels of fresh water and two tonnes of earth for open-pit mining. Canada is currently exporting roughly one million barrels of tar sands bitumen a day to the US.³¹ As noted below, due to the country’s reliance on foreign ownership and foreign markets, Canada’s energy policy is quite vulnerable and thus, requires vast improvements.

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As described in the Canadian constitution, each province has the legal authority to develop their resources as they please. With this, Western provinces have wished to maximize their powers associated with the control of natural resources,

²³ Bernstein et al., *A Globally Integrated Climate Policy for Canada*.

²⁴ Bernstein et al., *A Globally Integrated Climate Policy for Canada*, 10.

²⁵ Demerse, C. “Getting on Track for Canada’s Climate Target: Designing a Technology Fund That Works for 2020”. *Pembina Institute*. (2013).

²⁶ Fertel et al. “Canadian Energy and Climate Policies: A SWOT Analysis in Search of Federal/Provincial Coherence.”

²⁷ Macdonald, D. “Explaining the Failure of Canadian Climate Policy”.

²⁸ Hofman, K., Li, X. “Canada’s Energy Perspectives and Policies for Sustainable Development.” *Applied Energy*. No. 86. (2009): 407-415

²⁹ Fertel et al. “Canadian Energy and Climate Policies: A SWOT Analysis in Search of Federal/Provincial Coherence.”

³⁰ Ibid

³¹ Suzuki, D and Hanington, 1, *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet* (Vancouver: Greystone Books, 2012)

and consequently, since the energy crisis in the 1970s, there have been strong tensions between the federal government and the governments of Alberta.³² In the wake of the 1970s oil price shocks, in order to effectively manage the tar sands, the federal government created Petro-Canada and the National Energy Program (NEP) to increase Canadian ownership of the petroleum industry by 50%. This was meant to ensure Canadian energy security, and to appropriate a greater share of the petroleum wealth.³³ This was to be done through a system of taxes and other fiscal incentives. This program created severe tensions in federal-provincial relations, ultimately leading Alberta to briefly shut off oil shipments to other provinces.³⁴ As well, it encountered fierce resistance from the foreign-controlled oil industry and the US government. Due to the 1981-82 global recession, oil prices reached worldwide lows, and the Alberta government was quick to blame the NEP and proceeded to push for its elimination. This pressure influenced Mulroney in his decision to scrap the NEP and begin to slowly sell-off Petro-Canada. Since then, each subsequent federal government has played a passive role in restructuring the petroleum sector, although reforms are necessary in order to benefit the future of all Canadians.

The government of Alberta and the Federal Government of Canada have been actively promoting foreign ownership in the fossil fuel industries and have enacted several policies to do so. This is reflected in the government of Alberta's strategy, which "has been to create a favourable investment climate, through large subsidies including low taxes and royalties, a variety of tax breaks, and direct financial assistance" as well as "minimal labour market and environmental regulation has also helped to spur rapid oil exploitation."³⁵ Unsurprisingly, 71% of all tar sands production is currently owned by non-Canadian shareholders, translating into foreign firms procuring 47% of the profits.³⁶ These actions severely contrast the role of other petro-states, such as Norway, who participates and, even

controls, energy production. Norway owns 80% of oil and gas production and thus, has appropriated roughly 85% of the net revenues. In 1996, the Norwegian government began making deposits into a petroleum fund, or the Government Pension Fund Global. This fund receives all petroleum revenues and invests them. Now it is the largest sovereign wealth fund in the world with over \$664 billion. Conversely, in Alberta, the Heritage Savings Fund was created in 1976 with similar goals but with different methods and today, the fund contains only \$16 billion.³⁷ When comparing oil management in Norway to that of Canada, it is strikingly clear that Canada could be managing its resources in a far more productive way. However, due to the manner the provincial-federal division of resource management in Canada, and because the government of Alberta has their own economic interests in mind, this has proven to be very difficult to achieve. Thus, a serious conversation needs to be had at the federal and provincial level about implementing a national energy strategy in order to benefit all Canadians now and into the future.

For economists, the natural resource boom in Alberta translates into increased demand for Canada's products in international markets. This should have improved Canada's terms of trade and brought benefits to all Canadians. However, this has not proven to be the case: the OECD noted in 2008 that tar sands development is "generating large regional disparities, especially because some provinces are affected by negative externalities through the currency appreciation and have questioned the appropriateness of current inter-provincial redistribution mechanisms."³⁸ Numerous experts and politicians, including the leader of the New Democratic Party (NDP), Thomas Mulcair, are speculating that the Canadian economy is beginning to show signs of Dutch Disease, which causes the appreciation of a country's exchange rate and reduces the competitiveness of other export industries.³⁹ As well, the Alberta tar sands are creating significant

³² Paehlke, R. "Environmentalism in One Country: Canadian Environmental Policy in an Era of Globalization."

³³ Campbell, B. "The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth". *Canadian Centre for Policy Alternatives* (2013).

³⁴ Ibid

³⁵ Campbell, B. "The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth". *Canadian Centre for Policy Alternatives* (2013): 21

³⁶ Ibid

³⁷ Ibid

³⁸ Dobson, S., Lemphers, N., Guilbeault, S. "Booms, Busts and Bitumen: The Economic Implications of Canadian Oilsands Development". *The Pembina Institute* (2013): 20

³⁹ Ibid

regional imbalances with respect to GDP growth, employment and tax revenue, and other economic sectors are being adversely affected. This is evident in the manufacturing sector in Ontario and Quebec. Recent statistics are showing that the manufacturing sector is declining. In fact, between 2002-2011, 531,000 manufacturing jobs were lost in Canada.⁴⁰ The tar sands are not bringing equal benefits to all Canadians, but instead, the country's reliance on the fossil fuel industry is exacerbating numerous environmental issues, as well as causing economic and political fragility.

Harper and his environmental minister, Peter Kent, refer to tar sands oil as 'ethical oil' despite the fact that it accounts for 5% of Canada's GHG emissions, has disturbed 600 km² of boreal forest as of 2011, and is directly polluting the Athabasca River.⁴¹ In regards to GHG emissions, oil and gas industries are responsible for following Alberta's Specified Gas Emitters Regulation, which has been in place since 2007. The regulation is a partial carbon-tax, and stipulates that emitters who do not meet government emissions intensity targets are required to pay a \$15 per ton levy.⁴² This regulation is designed to give companies a very high degree of flexibility in attaining its targets and with this, "emitters in Alberta have historically taken full advantage of that flexibility, with the majority of firms' compliance with the regulation coming from the purchase of offset credits and technology fund payments rather than physical emission reductions in their facilities."⁴³ Conversely, Norway requires heavy emitters to pay a \$66 per ton levy.⁴⁴ Due to lenient environmental regulations and high tax subsidies, the Government of Canada and the provincial government of Alberta are essentially paying foreign oil companies to take the country's

resource wealth and increase GHG levels. This is unacceptable and requires vast alterations.

Carbon capture and storage (CCS) is another ineffective incentive to reduce GHG levels that is being actively promoted in Canada. CCS is expected to account for 60% of the carbon reduction commitments in Alberta, as outlined in the province's Climate Plan.⁴⁵ Little is known about the repercussions of CCS as it is a very new method, therefore, it could have numerous environmental side-effects. The Alberta government created a \$2 billion fund for CCS projects, and the federal government has committed a further \$526 million.⁴⁶ Moreover "this massive infusion of public funds into helping hugely profitable petroleum companies develop CCS technology is not even remotely matched by support for conservation, renewable energy, or energy efficiency."⁴⁷ This demonstrates that Canada's environmental regulation processes and institutions favour rapid oil development and do not meaningfully restrain the resulting environmental impacts. This strategy is simply an out-of-sight, out-of-mind approach, and essentially, the oil driven mentality in Canada

"Canada's environmental regulation processes and institutions favour rapid oil development and do not meaningfully restrain the resulting environmental impacts."

has created the concern that the economy comes first. The economic potential of alternative energy has proven successful elsewhere in the world but unfortunately, this has not been tried in Canada.

This position is compounded by the government and oil industries' advertisement campaigns. The federal government is spending millions of dollars publicizing the supposed benefits of tar sands development in Canada and internationally. This is evident in the current bid to undermine the European Union's Fuel Quality Directive, as well as California's Low Carbon Fuel Standard, and Section 526 of the US Energy Security and Independence Act, which effectively forbids

⁴⁰ Ibid

⁴¹ Suzuki, D et al., *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet*

⁴² Macdonald, D. "Explaining the Failure of Canadian Climate Policy".

⁴³ Partington, P.J., Demerse, C. "Context for Climate Action in Canada - Backgrounder". *Pembina Institute* (2013): 8

⁴⁴ Campbell, B. "The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth". *Canadian Centre for Policy Alternatives* (2013).

⁴⁵ Ibid

⁴⁶ Ibid

⁴⁷ Campbell, B. "The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth". *Canadian Centre for Policy Alternatives* (2013): 60

government agencies from buying oil with a high carbon footprint.⁴⁸ Furthermore, Prime Minister Harper's "approach to climate may be summed up as: delay, defer, obfuscate, and attack climate critics as anti-Canadian."⁴⁹ This is demonstrated with the numerous cutbacks to environmental protection as outlined in the 2012 budget and omnibus legislation. In this legislation almost 3,000 environmental reviews were cancelled, funding was cut to the National Round Table on the Environment and the Economy, as well as to the Experimental Lakes Area, which is one of the world's leading research centres on freshwater, and has done groundbreaking work on acid rain, and household pollutants, amongst other things.⁵⁰ Additionally, Harper has rejected or ignored scientific studies showing environmental damage from the tar sands, and has been accused of 'muzzling' scientists.⁵¹ Furthermore, it is not only Canadians who are taking note of the Harper government's lack of environmental protection and continued promotion of the tar sands, this inaction has also garnered international attention. While Canada was once seen as an environmental leader, the country has now received the 'Colossal Fossil' award for the past five years, which is given out by hundreds of environmental groups to the nation that has done the most to undermine progress on climate change prevention.⁵²

Despite public opposition, emphasis is still being placed on developing fossil fuels in Canada. This past year there have been numerous public demonstrations across the country, one of such was the 'Defend Our Climate' protests that took place in over 130 communities across the country in November.⁵³ As well, in New Brunswick, heavy opposition against shale gas development echoed across the province this fall. The province's Premier, David Alward, is highly in favour of hydraulic fracturing or 'fracking', noting the economic advantages it would bring to the province. To access shale gas, large amounts of water, sand and chemicals are blasted into wells to

fracture the underground shale and release natural gas. Leaks, blowouts, water contamination, and emissions of methane are some of the possible consequences.⁵⁴ Since the discovery of shale gas in the province there has been strong opposition, mainly from First Nations groups, whose concerns, amongst other things, are about the effects fracking would have on the province's water. This opposition exploded this past fall with numerous arrests taking place. Despite numerous attempts at dialogue and reconciliation, Alward has continued to push for exploration. It is evident that Canada needs to reconsider the country's energy uses and sources. We need slower and wiser development of our resources and we need to ensure that the wealth is used for the benefit of all citizens.

Fertel *et al.* (2013) describe Canada's contemporary situation appropriately, noting: "the lack of coordination between energy and climate policies, the lack of cooperation between federal and regional governments, and the short-term funding and overall poor performance of the Canada energy R&D strategy explains the observed tendency to exploit non-renewable resources in a short-term way without considering the long-term impact and public benefits."⁵⁵ Thus, re-evaluation is greatly needed. This could be done by implementing a full cost-benefit analysis, one that considers the short-term and long-term economic and environmental implications of tar sands development at the local, provincial and national level. It is evident that a shift is needed from high-carbon sources to more renewable types of energy, in order for this to happen, however, government support is a requisite.

2.0 CLIMATE POLICY

2.1 RENEWABLE ENERGY POTENTIAL IN CANADA

Sustainable development has been defined by the Brundtland Commission as "development that meets the needs of the present without compromising the ability of future generations to

⁴⁸ Engler, Y. "Will Harper Ever Pay for His Climate Crimes?" *The Huffington Post Canada*. November 18, 2013 http://www.huffingtonpost.ca/yves-engler/harpers-climate-crimes_b_4293661.html

⁴⁹ Campbell, B. "The Petro-Path Not Taken: Comparing Norway with Canada and Alberta's Management of Petroleum Wealth". *Canadian Centre for Policy Alternatives* (2013): 58

⁵⁰ Ibid

⁵¹ Suzuki, D et al., *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet*

⁵² Engler, Y. "Will Harper Ever Pay for His Climate Crimes?" *The Huffington Post Canada*. November 18, 2013 http://www.huffingtonpost.ca/yves-engler/harpers-climate-crimes_b_4293661.html

⁵³ Anonymous Author. "Climate change rallies staged across Canada". *CBC News*, November 16, 2013, <http://www.cbc.ca/news/canada/british-columbia/climate-change-rallies-staged-across-canada-1.2428825>

⁵⁴ Suzuki et al., *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet*

⁵⁵ Fertel et al. "Canadian Energy and Climate Policies: A SWOT Analysis in Search of Federal/Provincial Coherence," 1148.

meet their own needs.”⁵⁶ Given this definition and the current trends in the energy sector as described above, it is evident that the manner in which Canada is currently developing cannot be considered sustainable. Therefore, essential steps must be taken in order to ensure that Canada begins transitioning towards a sustainable model. This transition should include both the diversification and localization of energy systems in the country. It is necessary to note that diversification of energy systems is key, as one solution will not be found to confront the current energy issue. As well, diversification and localization leads to a more secure energy policy within Canada, as the country will be less reliant on fluctuations in foreign markets.

Canada’s abundance of resource wealth should be used to influence a transition to clean energy. Renewable energy technology has advantages over non-renewable energy, including oil independence, pollution free generation, and low energy costs, once initial capital costs are paid off. However, as technology improves, these costs will dramatically reduce. In general, there are three ways to effectively manage energy systems: energy efficiency, energy conservation, and switching to renewable energy sources. Energy efficiency relates to the ways and means of reducing energy in generation and distribution, while conservation deals with the implementation of methods and applications of reducing the amount of energy that is used to provide goods and services.⁵⁷

Renewable energy sources can be defined as the electricity generated from renewable sources such as wind, solar, hydro, and geothermal, etc. It is necessary to note that “humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century.”

know-how to solve the carbon and climate problem for the next half-century.”⁵⁸ Now, it is up to the policy makers to implement this know-how. Some of the main alternative energy sources that are being developed in Canada are solar, wind, hydro and tidal.

Solar energy systems can be divided into two main categories: photovoltaics (PV) and solar thermal. Solar PV uses semi-conductor materials to convert sunlight into electricity and arrays can be mounted on rooftops, integrated with buildings, or mounted on the ground. The electricity they produce can be dispatched to a utility or can be used in local buildings or commercial operations. The cost of producing electricity from PV systems lies almost exclusively in the initial capital costs. This cost includes: the PV modules, and the racks, inverters, controls and instrumentation, as well as labour cost for installation.⁵⁹ The cost of solar energy technologies are dropping dramatically and academic observers predict the ongoing decline in solar costs will make it hit grid parity — the price at which solar becomes competitive with traditional supply without any subsidies — in both North America and Europe within the next five to 10 years.⁶⁰ As well, compared to other renewable energy sources, solar installations do not mar the skyline, kill bats or birds, make noise or interfere with fisheries. Solar panel manufacturing creates chemical pollution; however, this can be controlled with proper treatment systems. As well, PV systems can present challenges to the management of the supply-demand balance in traditional grids. A combination of increased storage, smart grid applications, and automated control of demand and supply will be needed to accommodate the larger role for these new technologies should be incorporated into new energy policies in the future.

Solar thermal heating systems use collectors that convert sunlight into heat in order to warm water for domestic use. In Canadian residential, commercial, institutional and public administration 60-80% of the total energy

⁵⁶ Suzuki et al., *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet*, 89

⁵⁷ Jagoda et al., “Development and Commercialization of Renewable Energy Technologies in Canada: An Innovation System Perspective”.

⁵⁸ Pacala, S., Socolow, R. “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies.” *Science*. Vol. 305. (2004): 968

⁵⁹ Torrie, R., Bryant, T., Beer M., Anderson B., Marshall D., Kadowaki R., Whitmore J. “An Inventory of Low-Carbon Energy for Canada”. *Trottier Energy Futures Project* (2013).

⁶⁰ Weis, T., Stensil, S.P., Harti, J. “Renewable is Doable: Affordable and Flexible Options for Ontario’s Long-Term Energy Plan.” *Pembina Institute* (2013).

consumed is used for space and water heating.⁶¹ The advantages to solar hot water and solar thermal is that these technologies are able to be retrofitted to existing housing and apartment units. Other benefits include decreased energy consumption, stabilized or reduced energy costs, quick pay-back and energy security going to individual citizens rather than large producers. As solar hot water units are manufactured in Nova Scotia, and solar thermal units are manufactured in Newfoundland, the manufacturing, installation and maintenance of these units would all contribute to the Maritime economy.⁶² In conclusion, although the initial cost for PV systems and solar thermal, solar energy systems are easily installed, require the least amount of technical, financial and regulatory work and has the maximum potential for distribution and long-lasting individual ownership and benefit.

Wind power is the generation of electricity from the kinetic energy of wind. As wind passes through wind turbine blades, it turns a shaft coupled with a generator for the production of electricity.⁶³ Currently, it is the world's fastest growing source of energy. On average, wind turbines in Canada generate electricity 70-80% of the time - electricity is generated when wind speeds exceed 13 kilometers per hour and most large wind mills shut down for safety reasons when wind exceeds 90 kilometers per hour.⁶⁴ Opponents to wind farms have noted the variety of health and environmental concerns that have arisen over the years with the increased use of wind turbines. Issues such as noise, electromagnetic interference, loss of property values, aesthetics, and bird and bat fatalities. However, reports note that "the number of birds killed in wind developments is substantially lower relative to estimated annual bird casualty rates from a variety of other anthropogenic factors, including vehicles, buildings and windows, power transmission lines, communication towers, toxic chemicals including pesticides."⁶⁵ People also report nausea, headaches, depression, anxiety and sleeplessness.

Furthermore, fossil fuels and other materials are consumed and emitted in the process of manufacturing windmills.⁶⁶ Another factor that will affect the overall contribution of wind to the electricity supply is curtailment, the term for non-dispatchable electricity that cannot be used due to limited transmission capacity, or because the electricity cannot be used or stored when it is generated. Although there are several barriers to implementation and design, energy storage is the largest technological hurdle for solar and wind energy today.⁶⁷ However, storage technologies are advancing rapidly and, in the foreseeable future, will enable greater penetration of renewable energy into the grid system.

Hydropower is generally divided into two categories: large-scale, with a generating capacity of more than 50 MW and energy storage capabilities, and small-scale, which produces less than 50 MW and has limited storage. Hydroelectricity is produced and used widely throughout Canada, accounting for 11% of Canada's primary energy supply, and produces few GHG emissions in the production of electricity.⁶⁸ The majority of this hydroelectricity comes from large projects, and amongst all the renewable energy technologies large hydropower projects are associated with the significant controversies due to social and environmental impacts caused by inundation of large areas. In comparison to other green technologies, that can provide reliable sources of electricity within a short and flexible time frame, due to the size of these dams, it takes several years to develop from the planning to the implementation stages, and large financial contributions are necessary. This is being experienced currently in New Brunswick as the Mactaquac dam is nearing the end of its life expectancy and experts are contemplating rebuilding it or removing it.⁶⁹ Conversely, small hydro dams do not carry the same social, environmental or economic costs, albeit they do not have the same generating capacity.

⁶¹ Jagoda et al., "Development and Commercialization of Renewable Energy Technologies in Canada: An Innovation System Perspective".

⁶² Interview with Peggy Cameron, November 4, 2013

⁶³ Interview with John Ereaux, November 15, 2013

⁶⁴ Torrie et al. "An Inventory of Low-Carbon Energy for Canada". *Trottier Energy Futures Project* (2013).

⁶⁵ Suzuki et al., *Everything Under the Sun: Toward a Brighter Future on a Small Blue Planet*, 66

⁶⁶ Suzuki, D., Dressel, H. *More Good News: Real Solutions to the Global Eco-Crisis*. (Vancouver: D&M Publishers Inc, 2010).

⁶⁷ Interview with Woody Thompson, November 6, 2013

⁶⁸ Islam, M., Fartaj, A., Ting, D. "Current Utilization and Future Prospects of Emerging Renewable Energy Applications in Canada". *Renewable and Sustainable Energy Reviews*. No. 8 (2004)

⁶⁹ Anonymous Author. "NB Power invests \$2.3M to study Mactaquac Dam", *CBC News*, October 8, 2013. <http://www.cbc.ca/news/canada/new-brunswick/nb-power-invests-2-3m-to-study-mactaquac-dam-1.1930342>.

Tidal and wave power have much potential worldwide for generating electricity, however, due to financial and mechanical limitations, its implementation has been slow. Advantages include the predictability of tides and waves, it is generally more predictable than wind and solar power. Energy can be harnessed in two ways: using the change in height of the tides or waves (potential); and using the flow of the water (kinetic). The most common technology of tidal power include: In-Stream Devices, Barrages, and Tidal Lagoons. There is large potential for tidal and wave power on the east coast of Canada, for example, roughly 300 MW of capacity can be developed in the Minas Passage of Nova Scotia.⁷⁰ However, this technology has proven to be very problematic to implement, complications include financial and mechanical obstacles. Due to the power of the tides, the technology is very vulnerable; storms destroy structures, salt water corrodes the equipment and the marine power installation can disrupt migratory patterns of species like whales, birds, fish and seals.⁷¹ Although the potential for tidal power is evident, there are numerous barriers to entry for the technology.

Nuclear energy is a contested topic. Although considered a non-emitting source, there are numerous other considerations. Currently, 3% of Canada's primary energy comes from nuclear generation⁷² and because Canada is the largest producer of uranium in the world, Harper is actively promoting nuclear energy (Suzuki, 2012). Concerns with nuclear energy include the finite limitations of uranium, and the necessary construction of large-scale nuclear plants. As well, the generation of nuclear electricity is exceptionally precarious, which is evident in the nuclear disasters in Chernobyl and Fukushima. Furthermore, there is high degree of challenge in safely disposing radioactive waste over a long period of time.⁷³ In conclusion, nuclear energy is a very volatile means of producing energy and should not be given priority in Canada.

2.2 EVOLVING POLICY OBJECTIVES

Under the evolving policy objectives of “energy self-reliance”, “security of energy supplies”, “energy diversity”, “sustainable development”, “clean air” and “climate change” initiatives, Canadian governments introduced many programs over the last few decades in support of renewable energy.⁷⁴ These programs took the form of cost-sharing research, development and demonstrations for new energy technologies and, in some cases, fiscal measures that provided tax incentives or grants to encourage the broad market penetration of renewable energy. Other related activities included informing the public about the merits of renewable energy, facilitating the development of standards and training tools, and streamlining regulations. Initiatives included: the 1996 Renewable Energy Strategy, 1998 Renewable Energy Deployment Initiative, Action Plan 2000 on Climate Change, and the 2002 Climate Change Plan.⁷⁵ In the past the federal government has encouraged investments in renewable energy through direct grants under a Renewable Energy Deployment Initiative. This was terminated in 2007 and replaced by ecoENERGY Renewable Power Program which supported the deployment of 4,000 MW of renewable energy. This too expired in 2011 and there have been no new plans signed since ecoENERGY.⁷⁶ While there was some funding available, many of these strategies lacked a clear timeline and limited budget to accomplish their goals, when compared to the massive and continuous subsidies provided to the fossil fuel industry. These former federal initiatives have demonstrated a lack of political will and are in desperate need of clear, integrated, and comprehensive strategy framework for sustainable energy use in Canada.

“Most strategy measures for developing and implementing renewable energy sources are voluntary. This strategy has proven to be detrimental.”

In Canada, most strategy measures for developing and implementing renewable energy sources are voluntary. This strategy has proven to be detrimental and now, in comparison to other industrial nations, Canada is falling behind in

⁷⁰ Interview with Mary McPhee, October 10, 2013

⁷¹ Suzuki et al., *More Good News: Real Solutions to the Global Eco-Crisis*

⁷² Torrie et al. “An Inventory of Low-Carbon Energy for Canada”. *Trottier Energy Futures Project* (2013).

⁷³ Ibid

⁷⁴ Islam et al., “Current Utilization and Future Prospects of Emerging Renewable Energy Applications in Canada”

⁷⁵ Liming, H., Haque, E., Barg, S. “Public Policy Discourse, Planning and Measures Toward Sustainable Energy Strategies in Canada”. *Renewable and Sustainable Energy Reviews*. No. 12. (2008)

⁷⁶ CanWEA, Wind Energy in Nova Scotia at a Glance. http://www.canwea.ca/wind-energy/windfacts_e.php (2013).

renewable energy deployment. In 2004, Canada's installed wind power capacity was 341 MW while Germany's installed wind capacity was 13,407 MW.⁷⁷ Several initiatives including Feed-In Tariffs (FITs), Net Metering, Renewable Portfolio Standards and Requests for Proposals have proven to be very beneficial in encouraging individuals to invest in renewable energy technology. FITs are widely used in Europe and are the most cost-effective policies for ensuring rapid transition to a more sustainable energy system. It is a fiscal incentive that establishes the price paid for renewable energy and requires that producers to pay a fixed above-market price for all alternative energy produced. Ontario is a champion in renewable energy and the majority of Canadian solar panels are produced in the province, which is a direct result of the FIT.⁷⁸ Net Metering has proven to be popular at the homeowner level. Renewable Portfolio Standards are also important in encouraging renewable energy. This system requires that consumers or distributors of electricity purchase a fixed amount of energy from renewable sources. In Canada, provincial governments have issued Requests for Proposals, which invite private generators to submit competitive bids to supply specified quantities of electricity under long-term contracts (Bernstein et al., 2008). Other fiscal incentives include tax deductions. According to numerous entrepreneurs, the largest hurdle in implementing renewable energy technology is the financial limitations, including the limited duration of incentive programs.

2.3 BENEFITS OF A GREEN ECONOMY

As outlined in the recent report from the Intergovernmental Panel on Climate Change (IPCC), it is evident that a transition is needed internationally from fossil fuel sources to low-emitting carbon sources.⁷⁹ Investments in renewable energy have been increasing rapidly around the world in recent decades and while

Prime Minister Harper is quick to promote his "jobs-versus-the-environment dichotomy", this sentiment is becoming increasingly anachronistic.⁸⁰ There is an abundance of economic opportunities within the renewable energy technology. This is evident in Figure 2. Furthermore the National Round Table on the Environment and the Economy, which was recently dismissed under Harper, noted that governments could find economic opportunities by promoting a shift away from fossil fuels to clean energy as part of an emerging green economy sector, estimated to be worth about \$3 trillion by 2020.⁸¹ Many academics are quick to mention that if Canada does not join in, the country will soon fall behind in green technologies. "Current federal and provincial policies around oil sands expansion show a lack of economic foresight that may ultimately limit the long-term competitiveness of Canada in a lower-carbon global economy."⁸²

Clean energy jobs include those in the manufacturing, installation and operation of renewable energy technologies. The majority, 70%, of the labour required for solar and wind projects is in the manufacturing of the parts, therefore countries that manufacture the inputs capture the majority of the jobs created. It also includes jobs in such sectors as designing and building electric cars, retro-fitting buildings, and designing and building new green buildings.⁸³ "Innovation is the engine of economic development and has been considered as a major source of creating new employment and improving skill base [...] It may not only create local market for renewable technologies but also export markets".⁸⁴ Strong action to reduce GHG emissions provides opportunities for 'green growth', there will be an increase in jobs, profits, and tax revenues domestically. As well, investing in this technology offers Canada with other economic advantages, such as a comparative advantage internationally.

⁷⁷ Liming et al., Public Policy Discourse, Planning and Measures Toward Sustainable Energy Strategies in Canada"

⁷⁸ Interview with Woody Thompson, November 6, 2013

⁷⁹ Simpson, J. "Climate Deniers in their Own Universe". *The Globe and Mail*. October 2, 2013. <http://www.theglobeandmail.com/globe-debate/climate-deniers-in-their-own-universe/article14639865/#dashboard/follows>.

⁸⁰ Nugent, J.P. "Changing the Climate: Ecoliberalism, Green New Dealism, and the Struggle over Green Jobs in Canada". *Labor Studies Journal*. Vol. 36. No. 58. (2010)

⁸¹ De Souza, M. "Stephen Harper's Environment Minister Casts Doubt on Climate Change". *Morgan Leslie, MP*. October 4, 2013. <http://meganleslie.ndp.ca/stephen-harper-s-environment-minister-casts-doubt-on-climate-change>

⁸² Dobson, S., Lemphers, N., Guilbeault, S. "Booms, Busts and Bitumen: The Economic Implications of Canadian Oilsands Development". *The Pembina Institute* (2013): 7

⁸³ McEachern, G., Campbell, C., Price, M. "Falling Behind: Canada's Lost Clean Energy Jobs". *Blue Green Canada* (2010).

⁸⁴ Jagoda, K., Lonseth, R., Lonseth, A., Jackman, T. "Development and Commercialization of Renewable Energy Technologies in Canada: An Innovation System Perspective". *Renewable Energy*. No. 36. (2011): 1267

Due to the Canadian government's fixation with the tar sands, the government has ignored the clean energy boom now underway. "In 2008, Canada ranked 31st out of 42 countries for clean energy sales relative to GDP, barely ahead of Tunisia, Indonesia, Malaysia and Egypt."⁸⁵ Canada is well positioned to compete in the field of clean energy technology, creating jobs and economic prosperity across the country. However, there are currently numerous barriers to entry, including the lack of stable, long-term government policy, the absence of a national approach to clean energy, and the artificial advantage that is offered to fossil-fuel industries. In an export-oriented economy like Canada's, growth in the clean technology sector will require an outward look to international markets. The federal government has made some efforts to support access to international markets for clean energy technology; however, export market support for clean energy pales in comparison to the federal support being offered to diversify markets for oil and gas exports. The global shift to a low-carbon economy is unmistakable and many of the world's major economies are currently shifting their policies to adapt. It is necessary that the Canadian government begin pushing Canada's economy in the right direction.

3.0 RECOMMENDATIONS

The two main challenges to clean energy entrepreneurship in Canada are the lack of a stable, long-term government policy, and difficulty accessing capital. Currently the federal government does not provide the right incentives or energy regulations to promote the implementation of renewable energy technology in the country. What is needed is an integrated climate and energy policy, one that takes the 'real' cost of energy into account. In Canada, fossil fuels have benefited for decades from an artificial price advantage. Artificial in the sense that costs from associated impacts, notably GHGs emissions, toxic waste, local air pollutants, watershed impacts and human health impacts, are externalized. The most significant barrier to entry for renewable energy sources is the lack of pricing for these

environmental and human health 'externalities'. Without 'real' price signals, energy projects that have severe environmental impacts are being subsidized while low-impact renewable sources are denied financial support for their environmental benefits. This needs to change and the 'real' cost of energy needs to be accounted for.

Rather than sticking to the status quo, the world must move towards adopting renewable energy technologies in a way that offers maximum advantages to Canadian citizens. There is a great need for mandatory policies as it is evident that voluntary measures are not producing the necessary results. For "as long as the current energy source is doing the job (at a very low price), there will be a resistance to change by Canadian inhabitants and companies, especially when it takes time, money and effort."⁸⁶ A complete reliance on voluntary programs will not be effective. The preoccupation with 'low-cost' fuel and electricity has blinded policy makers to opportunities for our economy and energy, and our social, environmental and cultural sustainability.

According to the Canadian Association for Renewable Energies (CARE), Canada desperately needs a new agency to promote renewable energy developments. This agency would include federal and provincial departments, utilities, local municipalities, and industry to work collaboratively to promote the opportunities offered by renewable energy sources. Although Canada has formulated

various strategy measures to accelerate the development of energy efficiency systems and renewable energy technologies since the 1970s, there is still no comprehensive strategy framework for sustainable energy use in Canada. The tasks of managing strategies for sustainable energy development have been divided

into various departments, including Natural Resources Canada, The Ministry of the Environment, Industry Canada and Canada Mortgage and Housing. In coordinating between all these different departments, various problems emerge, including overlapping functions, multi-management, decentralized funds and divided

⁸⁵ McEachern et al. "Falling Behind: Canada's Lost Clean Energy Jobs". *Blue Green Canada* (2010):6

⁸⁶ Hofman, K., Li, X. "Canada's Energy Perspectives and Policies for Sustainable Development." *Applied Energy*. No. 86. (2009): 408

policies, to name a few.⁸⁷ This has weakened the ability of national intervention in the development and implementation of renewable energy technologies in Canada. In order to improve management, there is a clear need for a coordinated approach and a national strategy.

Numerous academics cite that the government has a necessary role in assisting the demand for clean energy through policy measures such as clean energy targets, green procurement policies and carbon pricing systems.⁸⁸ The federal government could initiate several policy measures, such as carbon pricing and Feed-In Tariffs. This could help spur Canada's transition towards a competitive, low-carbon economy. It is worth repeating that "humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century,"⁸⁹ thus, it falls on political will. As the policy leader, it is the federal governments' responsibility to create this transition. With this, it is clear that "moving to a less energy-intensive economy, by adopting more renewable energy and reduce energy demand, and at the same time ensuring continued growth is a big economic and political challenge for Canadian energy policy in the coming years."⁹⁰ However, it is a necessary transition that requires immediate action.

CONCLUSION

Canada's greatest strength in terms of energy and climate policies is the country's rich endowment of energy resources, both fossil and renewable. However, in order for Canada to move forward sustainably, a unified, coherent Canadian energy policy is necessary. Because no such policy exists currently, the federal government needs to make meaningful reforms to encourage the development of renewable energy sources, while also transitioning away from the country's economic reliance on the fossil fuel industry. The federal government keeps reiterating that the continued development of the oil and gas sector is the only viable economic option in Canada. However, the alternative energy economy also offers economic and employment generation opportunities to the country, and furthermore, with the coming climatic

challenges, this option will be far less risky. Due to numerous financial barriers, it is evident that voluntary measures will be insufficient in transitioning Canada towards the new global energy reality. Thus, mandatory regulations are key. The rest of the world is starting the transformation, now it is Canada's turn.

⁸⁷ Liming et al., Public Policy Discourse, Planning and Measures Toward Sustainable Energy Strategies in Canada"

⁸⁸ Woynillowicz et al. "Competing in Clean Energy: Capitalizing on Canadian Innovation in a \$3 Trillion Economy." *Pembina Institute* (2013).

⁸⁹ Pacala, S., Socolow, R. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." *Science*. Vol. 305. (2004): 968

⁹⁰ Hofman, K., Li, X. "Canada's Energy Perspectives and Policies for Sustainable Development." *Applied Energy*. No. 86. (2009): 414