Competing in Clean Energy

Capitalizing on Canadian innovation in a $3 trillion economy

Dan Woynillowicz,
Penelope Comette,
Ed Whittingham

Foreward by David McLaughlin

January 2013

PEMBINA institute

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Competing in Clean Energy: Capitalizing on Canadian innovation in a $3 trillion economy

Editor: Roberta Franchuk
Communications and Production Management: Kevin Sauvé
Contributors: Devika Shah, Katie Laufenberg, P.J. Partington, Tim Weis, Matt Horne, Graham Haines, Matt McCulloch

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The Pembina Institute
Box 7558
Drayton Valley, Alberta
Canada T7A 1S7
Phone: 780-542-6272
Email: info@pembina.org

Additional copies of this publication may be downloaded from the Pembina Institute website, www.pembina.org, and from the Pembina Foundation website, www.pembinafoundation.org.

About the Pembina Institute

The Pembina Institute is a national non-profit think tank that advances clean energy solutions through research, education, consulting and advocacy. Having spent close to three decades working to reduce the environmental impacts of energy production and use in Canada, the Pembina Institute's work includes:

- Driving down energy demand by encouraging energy efficiency and transportation powered with cleaner energy sources.
- Promoting pragmatic policy approaches for governments to avoid dangerous climate change, such as increasing the amount of renewable energy plugged into our electricity grids.
- Recognizing that the transition to clean energy will include fossil fuels for some time, we advocate for responsible development of Canada's oilsands and shale gas resources.

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About the Pembina Foundation

The Pembina Foundation for Environmental Research and Education is a federally registered charitable organization. The foundation supports innovative environmental research and education initiatives that help people understand the way we produce and consume energy, the impact of energy generation and use on the environment and human communities, and options for more sustainable use of natural resources. The Pembina Foundation has contracted the environmental research experts at the Pembina Institute to deliver on this work. For more information about the Pembina Foundation, visit www.pembinafoundation.org.

About the Authors

Dan Woynillowicz (Alumni) — Passionate about energy policy and politics, Dan joined the Institute in 2001 as a policy analyst, led the Institute's oilsands program from 2003 through 2007 and managed the organization's strategy and communications from 2010 to 2012. He has authored or contributed to numerous reports on environmental, climate change and economic policy related to oilsands development, including the Institute's groundbreaking 2005 report, *Oilsands Fever: The environmental implications of Canada's oilsands rush.*

In December 2012, Dan joined Clean Energy Canada at Tides Canada as director of policy and partnerships, where he engages in policy analysis and advocacy and convenes diverse stakeholders in support of clean energy.

Dan holds a master's degree in environment and management from Royal Roads University, where he conducted research on corporate climate change strategy as a Social Science and Humanities Research Council scholar. He also holds a bachelor of science in environmental science from the University of Calgary.

Penelope Comette — Penelope is the Institute's associate director of Corporate Consulting and is responsible for leading teams engaged in delivering strategic projects that advance sustainable energy solutions. Penelope is an experienced management consultant with a passion for sustainability and over 10 years of experience managing projects and developing strategies across a wide range of industries including insurance, high tech, and health care. Her expertise lies in managing and mentoring project teams, change management, and strategic development.

Prior to joining the Pembina Institute, Penelope was an Associate of Canadian Business for Social Responsibility (CBSR). She also created an independent consultancy focused on strategically managing change for clients such as Vancouver Coastal Health Authority (VCHA) and Manulife Financial Corporation. Penelope is also a former manager in the eBusiness Advisory Services division for PriceWaterhouseCoopers LLP and a strategist with Razorfish Inc.

Penelope holds an MBA (in marketing and finance) from the University of British Columbia, a bachelor of arts (Honours) in political science from the University of Western Ontario and has her Six Sigma green belt from PriceWaterhouse Coopers LLP.

Ed Whittingham — Since January 2011 Ed has been Pembina's executive director, through which he directs the Institute's strategic approach and research projects. In September of that year, Ed was named to "Canada's 2012 Clean 50" list, which honours 50 outstanding contributors to sustainable development and clean capitalism in Canada.

Through his work, Ed serves in an advisory capacity to companies, industry associations, government bodies and research networks on clean energy solutions. Ed is a faculty member of leadership development at the Banff Centre, a board member of Carbon Management Canada, and an advisory council member of the Network for Business Sustainability (Richard Ivey School of Business, University of Western Ontario), the Centre of Excellence in Responsible Business (Schulich School of Business, York University) and the Alberta–Canada Collaboratory in Cleaner Oil Sands Development.

Ed holds an International MBA from York University's Schulich School of Business. During his graduate studies he was a Social Sciences and Humanities Research Council of Canada scholar, an Export Development Canada scholar and a visiting researcher at the United Nations Environment Programme's Japan branch. From 2007-2008 he served as an Alcoa Foundation Conservation and Sustainability Practitioner Fellow for his research into the U.S. Climate Action Partnership.

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DISCLAIMER: The views, conclusions and recommendations within this report represent those of the authors and not necessarily those of the interviewees or reviewers.

Foreword

Few organizations have been as relentless and as articulate in making the case for a clean energy transformation for Canada as the Pembina Institute. This new paper is another timely and useful contribution to this increasingly important debate for our country. It begins with one word in the title — *Competing* — because that's what Canada has to come to grips with: what must we do to compete and win our market share in this valuable and inevitable economic sector? No abstract environmentalism here; just the unsparing logic of marketplace realities.

Follow that logic for a moment. Pembina begins with a global assessment of what other countries are *already* doing and how Canada compares. Drawing on solid national and international analysis, the report paints a compelling picture of where we are, and how far we need to go. Next, it goes to the industry and business levels to identify the challenges clean energy entrepreneurs face. A stable public policy framework and access to capital top that list. Finally, it lays out clear, realistic, and doable policy conditions to move us ahead.

This examination is helpful on its own merits. But what I like most about this paper is how Pembina brings in the voices of actual business leaders and entrepreneurs. Targeted interviews with over a dozen recognized 'doers' sheds new light and force on what Canada must do. They lend important weight and credence to the arguments and analysis throughout the paper. From those 'in the business' to decision-makers who must pay attention to how we 'grow that business', we feel the optimism they share in the opportunity this presents for Canada and Canadians.

Canada's abundant energy reserves make us not just a supplier of choice but a leader by necessity. Competing in the inevitable clean energy transformation taking root around the world is both smart and unavoidable. It is not either, or; it is not about fossil fuels versus clean energy. It is about how we use both in the right way. It is about how we transition to more clean energy production and use, so our economy remains competitive and new jobs emerge. Betting the house on one form of energy over another when we have an exceptional diversity of literally all forms of energy sources right here at home makes no sense.

At no time in our past has energy and environment combined to forecast our economic destiny as it does today. Energy is a central driver of both our current and our future growth and prosperity. Yet, producing and exporting that energy under optimal environmental conditions is increasingly expected. It is fast becoming a market access issue, through and through. There is no business-as-usual anymore. Canada needs to come to grips with this new reality in a way that serves our nation's economic and social interests. Competing in clean energy will help us do just that.

The Pembina prescription is a realistic response to a real opportunity. *Competing in Clean Energy* is a positive assessment grounded in the realities we face.

Canada *can* compete and Canada *can* win in the clean energy transformation.

But we need a roadmap to do so. Pembina has helpfully set one out for us.

David McLaughlin
Former President & CEO, The National Round Table on the Environment and the Economy

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Executive summary

With more than 700 companies, the cleantech sector has emerged as a major driver of innovation and employment growth in Canada,[1] investing almost $2 billion in research and development and seeing an 11 per cent increase in employment between 2008 and 2010.[2] Yet, Analytica Advisors notes that Canada currently captures just one per cent of the $1 trillion global clean technology industry.[3] It estimates that, as this industry grows to a projected $3 trillion by 2020, Canadian clean technology companies have the potential to increase their market share from today's $9 billion to $60 billion.[4]

Numerous studies and reports have explored the opportunity for Canada to compete in clean energy, but none have been based on the actual experiences — both positive and negative — of Canadian clean energy entrepreneurs. Drawing on published research and one-on-one interviews, Pembina's research explores how Canada is faring in the global clean energy race, identifies challenges faced by clean energy businesses, and suggests public policy options that would help create winning conditions for Canadian clean energy entrepreneurs. (For a list of our interviewees, see Table 1 below.)

How is Canada faring in the global clean energy race?

While Canada is one of the top energy research and development (ER&D) funders in the world, this funding tends to be both short term and thinly distributed across multiple, uncoordinated programs.[5] Further, public ER&D funding in Canada is presently less than its peak in 1984 (measured as a percentage of GDP), and funding has been volatile, cycling through booms and busts.[6] ER&D funding is also concentrated in supply-side technologies, accounting for more than two-thirds of funding, which risks shortchanging the crucial demand side of the energy system.[7]

Despite ER&D investments, Canada places fifth in clean energy inventions, with its companies securing only two per cent of clean energy patents granted in the United States since 2002 (compared to Korea's five per cent, Germany's seven per cent, Japan's 26 per cent and the United States' 49 per cent).[8]

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[1] Analytica Advisors, *Spotlight on Cleantech*, Issue No.3 (2012). http://www.analytica-advisors.com/sites/default/files/Spotlight%20on%20Cleantech%20No.3.pdf

[2] Ian Philip, Jordan Isenberg, Jean-Frédéric Légaré-Tremblay and Remzi Cej, *Launching Cleantech: Ensuring Canada's place in the new global market* (Action Canada, 2012), 9.

[3] *Spotlight on Cleantech*.

[4] Ibid.

[5] Tatiana Khanberg and Robert Joshi, *Smarter and Stronger: Taking charge of Canada's energy technology future* (The Mowat Centre, 2012), 9. http://mowatcentre.ca/research-topic-mowat.php?mowatResearchID=67

[6] Ibid, 39.

[7] Ibid, 40.

[8] Ibid, 9.

Several studies have ranked Canada's clean energy performance lower than that of other countries. A 2010 report by the National Roundtable on the Environment and the Economy (NRTEE) benchmarked Canada's performance relative to other G8 countries using a Low-carbon Performance Index, and found that Canada placed sixth.[9] In the 2011 edition of its *Who's Winning the Clean Energy Race?* report, Pew Charitable Trusts ranked Canada's finance and investment in clean energy eleventh in the G-20,[10] a drop from eighth place in the 2009 edition.[11] These findings are consistent with the perspectives gathered from our interviewees, all of whom felt that there was tremendous opportunity for Canada both to compete globally in clean energy and to improve on our performance to date.

What challenges do Canadian clean energy entrepreneurs and businesses face?

Our research identified two main challenges to clean energy entrepreneurship in Canada: the lack of stable, long-term government policy and difficulty accessing capital.

Prospective clean energy developers face a patchwork of policies and initiatives intended to support clean energy development across the country. In addition, conventional fossil fuel sources of energy (and associated technologies) benefit from more than a century of incumbency and competition that has driven their costs downward while being supported by infrastructure, market rules, and favorable tax treatment that predispose markets in their favour.[12] As a result, numerous interviewees suggested that the federal government has a necessary role to play in driving demand for clean energy through policy measures such as clean energy targets, green procurement policies and carbon pricing systems.

In an export-oriented economy like Canada's, significant growth in the clean technology sector will require looking to international markets. To date, the federal government has made some effort to support access to international markets for clean energy technology;[13] however, export market support for clean energy pales in comparison to the federal support being offered to diversify markets for oil and gas exports.[14]

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[9] National Roundtable on the Environment and the Economy, *Measuring up: Benchmarking Canada's competitiveness in a low-carbon world* (2010), 15. http://nrtee-trnee.ca/wp-content/uploads/2011/08/benchmarking-eng.pdf

[10] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2011 Edition,* (2012), 37. http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/FINAL_forweb_WhoIsWinningTheCleanEnergyRace-REPORT-2012.pdf

[11] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race?* (2010), 25. http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Global_warming/G-20%20Report.pdf

[12] Jesse Jenkins and Sara Mansur, *Bridging the Clean Energy Valleys of Death: Helping American entrepreneurs meet the nation's energy innovation imperative* (The Breakthrough Institute, 2011), 9. http://thebreakthrough.org/blog/Valleys_of_Death.pdf

[13] For example, several clean energy research partnerships between Chinese and Canadian firms arose out of Prime Minister Harper's February 2012 trip to China; see Ari Altstedter, "Green dreams for Canada and China in clean energy deals," *Capital News Online,* March 2, 2012. http://www.capitalnews.ca/index.php/news/canadian-and-chinese-firms-partner-for-clean-energy

[14] For example, see:

Interviewees expressed a difficulty in accessing capital. One of the primary reasons for this is these types of technology companies fall into a "hole" between traditional asset classes. They have a venture capital risk profile, but require infrastructure-type capital (i.e. debt financing) — that is, they are both high risk and have high capital needs. Compounding the challenge of accessing capital is the decline in venture capital investment, particularly from large institutional investors. With this in mind, many highlighted Sustainable Development Technology Canada's (SDTC) Tech Fund and NextGen Biofuels Fund as bright lights on the investment landscape. Our interviewees noted that these funds fill critical gaps in the innovation cycle that risk leaving cleantech startups crippled.

What public policy options could be applied to these challenges?

Our research uncovered three main opportunities for the federal government to better support clean energy entrepreneurship in Canada:

1. Develop a set of specific federal financial tools to encourage clean energy entrepreneurship. As with other sectors of the Canadian economy, targeted and customized support will help enable the clean energy sector to fulfill its potential. A toolbox of financial instruments is needed to support clean energy technologies and ensure that those with market potential successfully cross both "valleys of death" (technological and commercial) that researchers have identified. For example, there is growing support for green bonds, broadly defined as "fixed-income securities that raise capital for a project with specific environmental benefits."[15] There is also a need to continue to provide support to approaches that are already proving successful. SDTC has played a critical role in supporting clean energy technologies. We suggest the federal government begin recapitalizing SDTC at a rate of $100 million per year for the next five years, beginning in Budget 2013.

2. Engage in the development of a national energy strategy. A Canadian energy strategy would provide long-term guidance to federal, provincial and municipal policymakers, as well as the private sector. While provincial governments are pursuing such a strategy through the Council of the Federation, the federal government to date has been less active. A national energy strategy could be complemented by long-term ER&D targets and effective funding for "...priorities set by long-term policy and organized in a diversified portfolio that cuts across the energy system and stages of investment."[16] Many of our interviewees suggested that Canada's abundance of resource wealth should be leveraged to support a transition to clean energy.

Nathan Vanderklippe, "Canada goes on offensive in pipeline PR war," *Globe and Mail*, October 10, 2011. http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/canada-goes- on-offensive-in-pipeline-pr-war/article557163/

Jason Fekete, "Oil sales, human rights (and pandas) on Stephen Harper's China agenda," *Postmedia News*, February 7, 2012. http://news.nationalpost.com/2012/02/07/oil-sales-human-rights-on-stephen-harpers-agenda-in-china/

Chris Sorenson, "Enbridge has a best friend in Ottawa," *Macleans*, July 4, 2012. http://www2.macleans.ca/2012/07/04/power-corp/

[15] Sustainable Prosperity, *Green Bonds: Policy Brief* (2012), 2. http://www.sustainableprosperity.ca/article2810

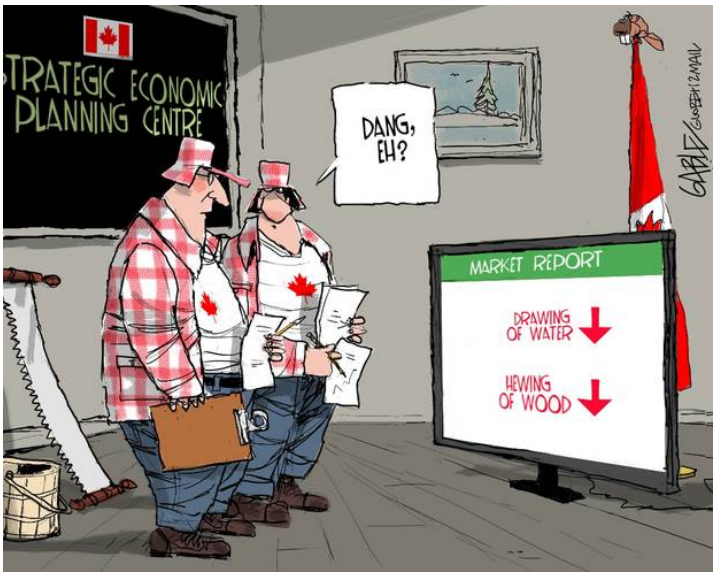
[16] *Smarter and Stronger*, 10.

3. Send the right price signals. As with the recommendation above, provincial governments also have an important role to play here. However, the federal government can help send the right price signals for clean energy entrepreneurship by accelerating efforts to phase out the remaining fossil fuel subsidies. In addition, the majority of our interviewees identified a federal approach to carbon pricing as a critical step in encouraging the domestic transition to clean energy technologies and services. That domestic transition would then help establish the conditions for Canadian entrepreneurs and businesses to compete successfully abroad.

1. Introduction

The clean energy opportunity

> *"The future is low carbon. Economies the world over are making the transition. Canada's actions today on climate, energy, trade, innovation, and skills will shape its economic prosperity for decades to come."*
>
> — National Round Table on the Environment and the Economy[17]



In recent years, much has been made about the prospect of Canada emerging as an "energy superpower," and every so often the descriptor "clean" is added for good measure.[18] Yet much of the focus of leaders in government and business has been on Canada's abundance of raw fossil fuel commodities — from oilsands to shale gas and coal — and the opportunity to generate prosperity by exporting these resources. In contrast, relatively scant public and political attention has been paid to the efforts required for Canada to seize the opportunity to compete and prosper in the development and export of low-carbon, clean energy technologies and services.

PriceWaterhouseCoopers LLP recently noted that in order for the world to have a 50 per cent chance of limiting global warming to two degrees Celsius, as Canada and other governments committed in the Copenhagen Accord,[19] the global economy now needs to cut its carbon intensity by 5.1 per cent every year from now to 2050.[20] In Canada, this annual cut in carbon

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[17] National Roundtable on the Environment and the Economy, *Framing the Future: Embracing the low-carbon economy* (2012), 15. http://nrtee-trnee.ca/wp-content/uploads/2012/10/framing-the-future-report-eng.pdf

[18] For example, in a 2009 speech Prime Minister Harper stated, "As I have told audiences around the world, Canada is an emerging energy superpower. But, as you all well know, the only way we are going to stay competitive in the global energy market of the future, is if we are also a clean energy superpower. We must develop new, clean sources of energy, and we must develop technologies that make cleaner use of conventional energy." Stephen Harper, "Clean Energy for Tomorrow: Investing in Carbon Capture and Storage in Alberta," speech, Wabamun, Alberta, October 14, 2009. Available at: http://www.pm.gc.ca/eng/media.asp?id=2888

[19] UNFCCC, Copenhagen Accord (2009). http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf

[20] PriceWaterhouseCoopers LLP, *Too late for two degrees? Low-carbon economy index 2012* (2012), 2. http://preview.thenewsmarket.com/Previews/PWC/DocumentAssets/261179_v2.pdf

intensity is slightly greater at 5.3 per cent per year.[21] Similarly, the International Energy Agency's 2012 World Energy Outlook includes a 450 Scenario — premised upon limiting warming to two degrees Celsius — that is highly dependent upon achieving emission reductions through energy efficiency (more than half of all reductions), renewable energy (21 per cent), carbon capture and storage (12 per cent) and nuclear (eight per cent).[22] As both of these reports make clear, there will be an incredible opportunity both domestically and internationally for businesses providing low-carbon technologies and services if countries around the world fulfill their commitment to decarbonize their energy systems.

> *"…we need to be innovative using the excellent entrepreneurial skill and technology that we have and convert this into products and demonstrate their use here so that we can then show and sell it to the world. That takes long-term vision and it takes tenacity on the part of governments."*
>
> — Mossadiq Umedaly, Enecsys Limited and Wellington Partners

The Alberta Premier's Council on Economic Strategy noted in 2011 that, "…we must plan for the eventuality that oil sands production will almost certainly be displaced at some point in the future by lower-cost and/or lower-emission alternatives. We may have heavy oil to sell, but few or no profitable markets wishing to buy."[23] The global shift toward a low-carbon future is "unmistakable" and "…most of the world's major economies are shifting their spending and policies to prepare for it."[24]

Accompanying this shift is a new way of thinking about energy. Rather than thinking about energy as a "commodity," we must now think about energy in terms of the technologies and services that enable its responsible production and consumption. As markets diversify their focus from energy commodities to energy technologies, significant opportunities will be available for "jurisdictions that develop the next generation of energy technologies."[25] As a recent report by the University of Toronto's Mowat Centre noted, "…becoming an energy superpower requires more than just taking things out of the ground and selling them around the world…what is missing is energy technology."[26]

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[21] Ibid., 5.

[22] International Energy Agency, *World Energy Outlook 2012* (2012), 241.

[23] Government of Alberta, *Shaping Alberta's Future: Report of the Premier's Council for Economic Strategy* (2011), 6. http://alberta.ca/AlbertaCode/images/ShapingABFuture_Report.pdf

[24] Stewart Elgie and Alex Wood, "Building a Low-Carbon, High Octane Canadian Economy," in *The Canada We Want in 2020: Towards a strategic policy roadmap for the federal government*, (Canada 2020, 2011), 20. http://www.canada2020.ca/files/canada-we-want-2020-e.pdf

[25] Tatiana Khanberg and Robert Joshi, *Smarter and Stronger: Taking charge of Canada's energy technology future* (The Mowat Centre, 2012), 7.

[26] Ibid.

Defining clean energy

The term "clean energy" spans energy production, infrastructure and conservation, and involves technologies and services that promote, enhance or advance: diversity of supply sources and distribution/transmission, efficiency in use, and reduced negative environmental effects such as greenhouse gas emissions.[27]

For the purpose of this report, clean energy entrepreneurs are those individuals and companies that design, develop and manufacture clean energy technologies and/or provide supporting services.

Canada is well positioned to compete in the field of clean energy technology, creating jobs and economic prosperity across the country. It was recently noted that "Canada's skilled workforce, innovation clusters, research excellence and stable investment climate make it an ideal growth environment for cleantech firms."[28] Research by Analytica Advisors shows that, with more than 700 companies, the cleantech sector has emerged as a major driver of innovation and employment growth in Canada,[29] investing almost $2 billion in research and development and 11 per cent employment growth between 2008 and 2010.[30] Yet it has noted that today the Canadian clean technology industry captures just one per cent of the $1 trillion global industry.[31] However, Analytica Advisors estimates that as this industry grows to a projected $3 trillion by 2020, Canadian clean technology companies have the potential to increase their market share from today's $9 billion to $60 billion.[32]

Clean energy opportunities across Canada

As we documented in our report *Shadow of the Boom: How oilsands development is re-shaping Canada's economy*,[33] there is a growing tension between regions of Canada arising from the rapid growth of fossil fuel development (largely in Western Canada) and associated macroeconomic changes. In contrast, Canada has clean energy opportunities across the country, including low-carbon electricity resources, a highly educated workforce, significant research and development capacity and advanced manufacturing capacity, as illustrated in Figure 1.[34] Cleantech economic activity is well distributed, tracking closely with population. For example, Ontario, British Columbia, Quebec and Alberta are home to 85 per cent of the population and 88 per cent of the Canadian cleantech market.[35]

[27] MIT Clean Energy Prize, "Clean Energy Definition." http://mitceep.com/2009/competition/clean-energy-definition.html

[28] Ian Philip, Jordan Isenberg, Jean-Frédéric Légaré-Tremblay and Remzi Cej, *Launching Cleantech: Ensuring Canada's place in the new global market*, (Action Canada, 2012), 9.

[29] Analytica Advisors, *Spotlight on Cleantech*, Issue No.3 (January 2012). http://www.analytica-advisors.com/sites/default/files/Spotlight%20on%20Cleantech%20No.3.pdf

[30] *Launching Cleantech: Ensuring Canada's place in the new global market*, 9.

[31] *Spotlight on Cleantech*.

[32] Ibid.

[33] To download a copy of the report visit: http://www.pembina.org/pub/2345

[34] *Framing the Future*, 27.

[35] *Launching Cleantech*, 9.

Figure 1. Canada's low-carbon strengths and opportunities

Source: National Roundtable on the Environment and the Economy[36]

Recent literature and media commentary have noted that the Canadian clean energy sector faces challenges in fulfilling its potential. In order to identify and characterize these challenges — and potential public policy solutions — our researchers conducted both a review of recent literature and one-on-one interviews with clean energy leaders in Canada, as described in the following section.

Research approach

Numerous studies and reports have explored the opportunity for Canada to compete in clean energy, but none have been based on the actual experiences — both positive and negative — of Canadian clean energy entrepreneurs. The purpose of this report is to explore how Canada is faring in the global clean energy race, identify challenges faced by clean energy entrepreneurs

[36] *Framing the Future*, 50.

and businesses, and suggest public policy options that would help create winning conditions for Canadian clean energy entrepreneurs.

Building upon recent literature, we engaged in one-on-one interviews with leading entrepreneurs, academics and executives across Canada (Table 1) to better understand their first-hand experience. Interviewees were selected with the aim of building a representative sample that would balance sectors, company size, vantage point within a company and region.

Through a review of recent literature and one-on-one interviews this report explores three principal questions:

1. How is Canada faring in the global clean energy race? (Section 2)
2. What challenges do Canadian clean energy entrepreneurs and business face? (Section 3)
3. What public policy options could be applied to address these challenges? (Section 4)

The report also draws conclusions (Section 5) and suggests next steps for both additional research and immediate action. By answering these principal questions and identifying policy options, we hope this report can serve as a useful tool for policymakers, entrepreneurs, and academics as they work together to create winning conditions for Canada's clean energy businesses and entrepreneurs.

Table 1. Interviewees

Name	Position	Company
Dan Balaban	Founder and CEO	Greengate Power Corporation
Frances Bowen	Chair in Innovation Studies	Queen Mary University of London & University of Calgary
Mike Brown	Co-founder and Chairman of the Board	Chrysalix Energy Ventures
Karen Clarke-Whistler	Chief Environment Officer	TD Bank Group
John Coyne	VP, General Counsel & Corporate Secretary	Unilever Canada
David Demers	CEO	Westport Innovations
Dawn Farrell	CEO	TransAlta
Jeremy Hall	Professor, Beedie School of Economics; Fellow of The Centre of Innovation Studies (THECIS)	Simon Fraser University
Andrew Heintzman	Co-founder, President and CEO; Chair of Premier's Climate Change Advisory Panel for the Province of Ontario	Investeco Capital Corp.
Tom Heintzman	Co-founder and President	Bullfrog Power
Guy Holborn	Associate Professor, Business, Economics and Public Policy; Director, Ivey Energy Policy and Management Centre; and Suncor Chair in Energy	University of Western Ontario

	Policy	
Ross Hornby and Kim Warburton	VP, Government Relations and Policy; VP, Communications	GE Canada
Jatin Nathwani	Professor and Ontario Research Chair in Public Policy and Sustainable Energy Management, Faculty of Engineering and the Faculty of Environment; Executive Director WISE	University of Waterloo
Nick Parker	Executive Chairman	Cleantech Group
Tom Rand	Managing Partner, MaRS Cleantech Fund	MaRS Discovery District
John Ruffolo	CEO	OMERS Ventures
Bill Smith	Senior VP, Energy Sector	Siemens Canada
Mike Scott	President and CEO	Nexterra
Bill Tharp	CEO	Climate Change Infrastructure
Mossadiq Umedaly	Executive Chairman; Venture Partner	Enecsys Limited; Wellington Partners
Dianne Zimmerman	Manager, Strategic Relations	Suncor Energy

2. How is Canada faring in the global clean energy race?

The global race to compete in the burgeoning clean energy marketplace is well underway, and countries around the world — both developed and developing — are assessing how best to position themselves to compete. A recent paper by Sustainable Prosperity found that countries' approaches typically fall into one of three groups:[37]

> **Go fast** — betting on a faster-than-expected shift to a low-carbon economy (e.g. Norway, South Korea, Germany and Denmark).
>
> **Go slow** — betting on a slower emergence of a low-carbon economy, and a reluctance to impose additional costs on domestic industries/consumers to address a global problem (climate change) (e.g. United States and Canada).[38]
>
> **Go smart** — assuming that a low-carbon transition will happen but traditional sectors will remain important for many years; therefore hedging their bets by taking modest, cost-effective steps to foster low-carbon options (e.g. Australia, parts of Europe and China).

While some might argue that "go slow" is easier and safer in the short run, it risks leaving the country "dangerously ill-prepared" in the medium term, hampering the future competiveness of many Canadian sectors through a failure to spur innovation and efficiencies.[39] This "go slow" approach is reflected in Canada's weak record on energy technology, which risks "…lost market opportunities, strategic disadvantages within the rapidly changing global economy, and higher costs of mitigating climate change."[40]

This section explores the clean energy innovation cycle, trends in Canadian energy research and development, and rankings of Canada's relative performance in the clean energy economy in recent years relative to our international peers.

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[37] "Building a Low-Carbon, High-Octane Canadian Economy," 21. http://www.canada2020.ca/files/canada-we-want-2020-e.pdf

[38] While Canada is going slow nationally/federally, there are several provinces (B.C., Ontario and Quebec) in the "go fast" or "go smart" camps. Ibid.

[39] Ibid., 22.

[40] *Smarter and Stronger*, 8.

The clean energy innovation cycle

An increasing amount of attention is being paid to Canada's innovation performance relative to other countries,[41] the "innovation imperative,"[42] and federal policy options to support research and development and encourage business innovation.[43] Across the board, these assessments have found Canada's innovation experience to be lacking, and when it comes to innovation in energy technology, Canada's performance has been similarly described as "…unremarkable, despite energy superpower aspirations."[44]

> *"I find it difficult to not be acerbic or negative when it comes to how Canada ranks in the clean energy race. I call it a race because it is a race. It's a race in two senses of the word. One, it's a race against time vis-à-vis climate change. And two, it's a race vis-à-vis the competition to create the jobs and the wealth that come with being part of the solution."*
>
> — Nick Parker, Cleantech Group

So what does it take to use innovation to drive success in the marketplace of clean energy technology? Given the imperative to both drive and harness innovation, a useful starting point for answering this question is to look at the clean energy innovation cycle (Figure 2) and understand how it differs from other sectors. The innovation cycle flows through five stages as an idea moves from "basic science to a fully developed business."[45]

[41] Science, Technology and Innovation Council, *Imagination to Innovation: Building Canadian paths to prosperity: State of the Nation 2010* (2011). http://www.stic-csti.ca/eic/site/stic-csti.nsf/eng/h_00038.html

[42] For example, see Institute for Competitiveness and Prosperity, *Canada's Innovation Imperative* (2011). http://www.competeprosper.ca/download.php?file=Report_on_Canada_2011_FINAL.pdf

[43] Independent Panel on Federal Support to Research and Development, *Innovation Canada: A call to action,* (2012). http://rd-review.ca/eic/site/033.nsf/vwapj/R-D_InnovationCanada_Final-eng.pdf/$FILE/R-D_InnovationCanada_Final-eng.pdf

[44] *Smarter and Stronger*, 4.

[45] Jesse Jenkins and Sara Mansur, *Bridging the Clean Energy Valleys of Death: Helping American entrepreneurs meet the nation's energy innovation imperative* (The Breakthrough Institute, 2011), 5. http://thebreakthrough.org/blog/Valleys_of_Death.pdf

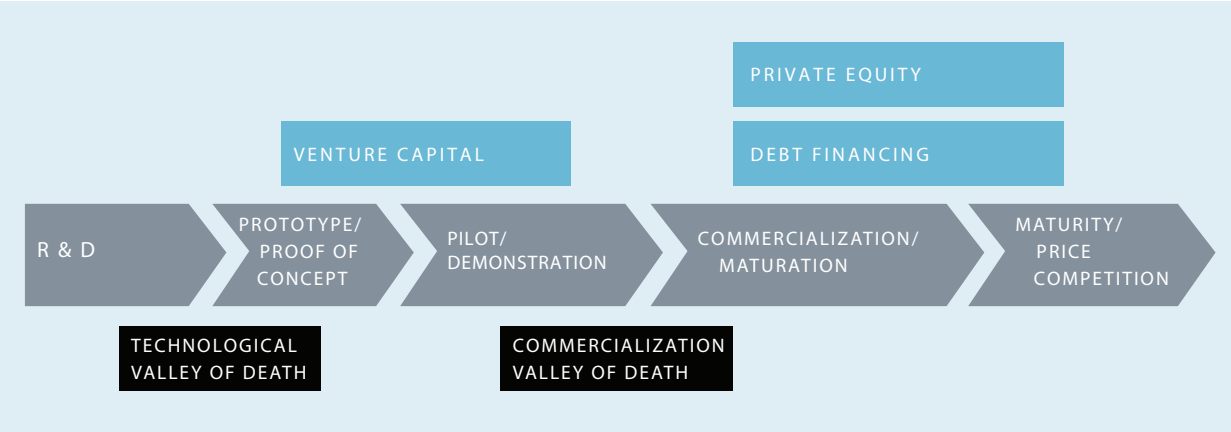

Figure 2. The clean energy innovation cycle

Source: Jenkins and Mansur[46]

As identified in Figure 2, the first step in the clean energy innovation cycle is research and development. While Canada is one of the top energy research and development (ER&D) funders in the world (tied with Japan for second in investment intensity — measured as ER&D spending as a share of GDP — among International Energy Agency peers), this funding tends to be both short term and thinly distributed across multiple, uncoordinated programs.[47] Further, public ER&D funding in Canada is presently less than its peak in 1984 (measured as a percentage of GDP), and funding has been volatile, cycling through booms and busts as illustrated in Figure 3 below.[48] The boom-and-bust funding cycle is also closely correlated with the price of oil, creating a lack of predictability and an inefficient use of both public and private funds.[49] Lastly, it is clear that funding is disproportionately concentrated in supply-side technologies (more than two-thirds of funding), which downplays the crucial demand-side of the energy system,[50] despite the wide range of socioeconomic benefits (beyond simply energy conservation) that can arise from energy efficiency.[51]

[46] *Bridging the Clean Energy Valleys of Death*, 5.

[47] *Smarter and Stronger*, 9.

[48] Ibid., 39.

[49] Ibid., 39-40.

[50] Ibid., 40.

[51] Lisa Ryan and Nina Campbell, *Spreading the Net: the multiple benefits of energy efficiency improvements* (International Energy Agency, 2012), 3-6. http://www.iea.org/publications/insights/ee_improvements.pdf

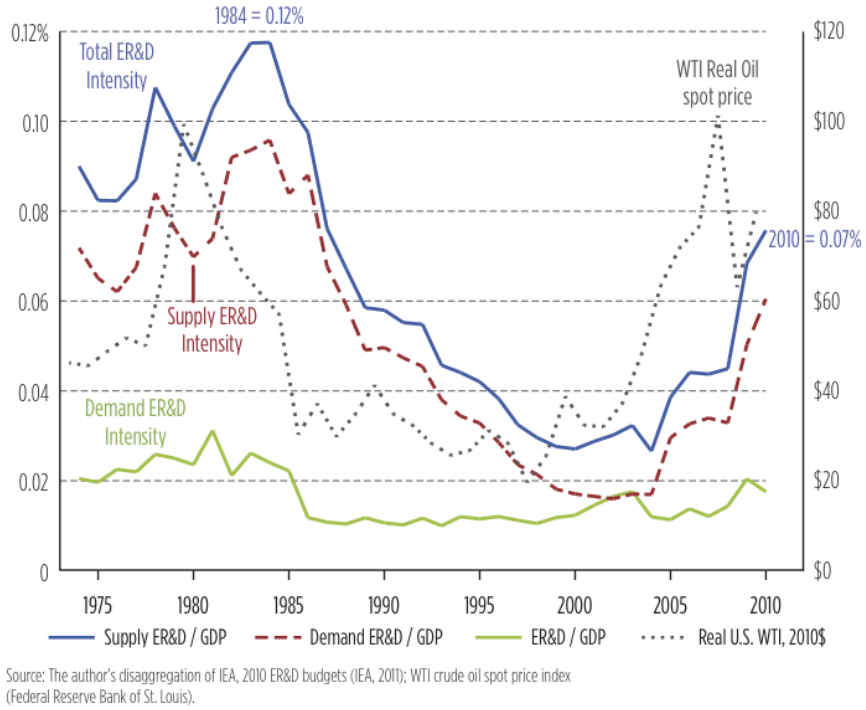

Figure 3. Canada's ER&D funding: Boom and bust

Source: Khanberg and Joshi[52]

This sub-optimal approach to ER&D is reflected in Canada's "clean energy" technologies innovation output, as measured by patent filings (as published in the Clean Energy Patent Growth Index[53]). Despite the ER&D investments by the federal and provincial governments, Canada places fifth in clean energy inventions, with Canadian companies securing only two per cent of clean energy patents granted in the United States since 2002 (compared to Korea's five per cent, Germany's seven per cent, Japan's 26 per cent, and the United States' 49 per cent).[54]

> *"The federal government should be very clear that we favour clean sources of energy in this country to dirty sources of energy."*
>
> — Dan Balaban, Greengate Power Corporation

Once a new technology has been developed through ER&D, two "valleys of death" must be crossed to achieve commercial success, but successfully crossing these valleys is particularly challenging for energy technologies. The first, the "technological valley of death," involves developing a product and proving market viability.[55] The second, "commercialization valley of death," involves securing capital to fund demonstration or first-of-a-kind commercial-scale projects or manufacturing facilities.[56]

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[52] *Smarter and Stronger*, 39.

[53] Heslin Rothenberg Farley & Mesiti P.C. Cleantech Group, *Clean Energy Patent Growth Index*. http://cepgi.typepad.com/

[54] *Smarter and Stronger*, 9.

[55] *Bridging the Clean Energy Valleys of Death*, 5.

[56] Ibid.

> *"...in order to dramatically catalyze the development and deployment of clean energy technologies and seize this economic opportunity, innovative public policy must be employed. Here, the public sector's role is to overcome certain persistent market barriers and help bridge often-fatal gaps in the innovation cycle."*
>
> — The Breakthrough Institute (2011)[57]

These valleys arise from a "a perception of risk and a scarcity of appropriately matched risk capital in the energy technology market."[58] Relative to other sectors — such as pharmaceuticals, software and information technology — energy technology is faced with challenging conditions (Table 2) that serve as barriers to successful innovation (from idea to commercial success).

Table 2. Innovation conditions in various sectors

	PHARMACEUTICAL	SOFTWARE & IT	ENERGY
Time Required to Innovate	10-15 years	1-5 years	10-15 years
Capital Required to Innovate	Medium to High	Low to Medium	High
New Products Primarily Differentiated By	Function/Performance	Function/Performance	Cost
Actors Responsible for Innovation	Large Firms Reinvesting in R&D; Biotech startups, often VC & govt. funded; Govt. (NIH, NSF)	Dynamic Startups, often VC-funded; Large Firms Reinvesting in R&D	Various: Utilities, Oil & Gas Co.s, Power Tech Co.s, Startups, Govt.
Typical Industry Risk Tolerance	High	High	Low
Innovation Intensity	High	High	Low
Intellectual Property Rights	Strong	Modest	Modest

Source: Jenkins and Mansur[59]

Clearly, succeeding in the field of clean energy innovation requires overcoming some daunting obstacles. However, given the growing opportunity and demand for clean energy technologies and services, countries around the world are taking steps to ensure they are competitive in the clean energy race. The next section explores how Canada stacks up relative to other countries in creating the conditions for clean energy success.

[57] Ibid., 18.

[58] Ibid., 6.

[59] *Bridging the Clean Energy Valleys of Death*, 8.

Ranking Canada's clean energy performance

> *"...it's clear Canada's developed, over the past decade, a good global reputation as a green innovator, which comes as a huge surprise to a lot of Canadians. But if you go to China or India or Europe, Canada is recognized as a green innovator."*
>
> — David Demers, Westport Innovations

A 2010 report by the National Roundtable on the Environment and the Economy (NRTEE) benchmarked Canada's performance relative to other G8 countries using a Low-Carbon Performance Index (LCPI), and found that Canada placed sixth.[60] The report concluded that:

> Canada's overall ranking is principally a function of an economy that is based on high-carbon energy emissions and of the weak performance in the policy and institutions category. Canada scores highest on skills and shows better than average scores on investment and innovation. While clearly not a leading low-carbon performer, the LCPI does show Canada positioned to do better relative to some of its main competitors, particularly the United States, if actions are taken to reduce our energy emissions profile and institute low-carbon growth plans and policies.[61]

More recent studies have similarly found Canada's performance to be in the middle of the pack. In its 2011 edition of its *Who's Winning the Clean Energy Race?* report, Pew Charitable Trusts ranked Canada's finance and investment in clean energy eleventh in the G-20,[62] a drop from eighth place in the 2009 edition.[63] Between the 2009 and 2011 editions, the five-year growth rate in finance and investment in clean energy in Canada dropped from 70.2 per cent to 22 per cent.[64,65]

[60] National Roundtable on the Environment and the Economy, *Measuring up: Benchmarking Canada's competitiveness in a low-carbon world* (2010), 15. http://nrtee-trnee.ca/wp-content/uploads/2011/08/benchmarking-eng.pdf

[61] Ibid., 16.

[62] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2011 edition,* (2012), 37. http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/FINAL_forweb_WhoIsWinningTheCleanEnergyRace-REPORT-2012.pdf

[63] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race?* (2010), 25. http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Global_warming/G-20%20Report.pdf

[64] Ibid.

[65] *Who's Winning the Clean Energy Race? 2011 edition*, 37.

> *"So [Canada's] role in the international clean tech economy is not to produce the cheapest solar panels. That's what China's going to do. Ours is going to be providing innovation, developing the next generation of solar panels and storage devices and energy management systems and software and so on. We will find our niches. We're a small country. We're looking at value-added jobs. We're looking at high tech jobs…I don't see any problem with China having first mover advantage on low-cost production. That's what they do. We just have to react and play to our strength: It's innovation."*
>
> — Tom Rand, MaRS Discovery District

Looking at cleantech[66] innovation more broadly, in February 2012 the Cleantech Group LLC and WWF published a study on global cleantech[67] innovation, which indexed 38 countries based on their "…potential to produce entrepreneurial cleantech start-up companies which will commercialise clean technology innovations over the next 10 years."[68] The analysis was based on scoring across four factors, each of which comprised multiple sub-factors that were weighted and contributed to a cumulative score for each factor (Figure 4).

[66] While this report is focused on clean energy, we have also drawn on studies that have evaluated the broader cleantech sector, of which clean energy is a subset. Therefore, findings at the sector level may or may not pertain more specifically to clean energy. This report is intended to begin a more specific assessment of the clean energy sub-sector, and we encourage further research at the sub-sector level to better understand trends, challenges and opportunities, and solutions.

[67] The study described cleantech as a term that "embraces a wide range of innovative products and services that contribute both financial returns and positive environmental impacts and outcomes. A large proportion of cleantech is made up of energy-related technologies — 77% of total cleantech VC investment in 2010 — though the definition also includes a broader range of sustainable technologies in such areas as water, agriculture, waste and materials." Vince Knowles, Stefan Henningsson, Richard Youngman and Amanda Faulkner, *Coming Clean: The global cleantech innovation index 2012* (Cleantech Group LLC and WWF), 10. http://awsassets.panda.org/downloads/coming_clean_2012.pdf

[68] Ibid., 8.

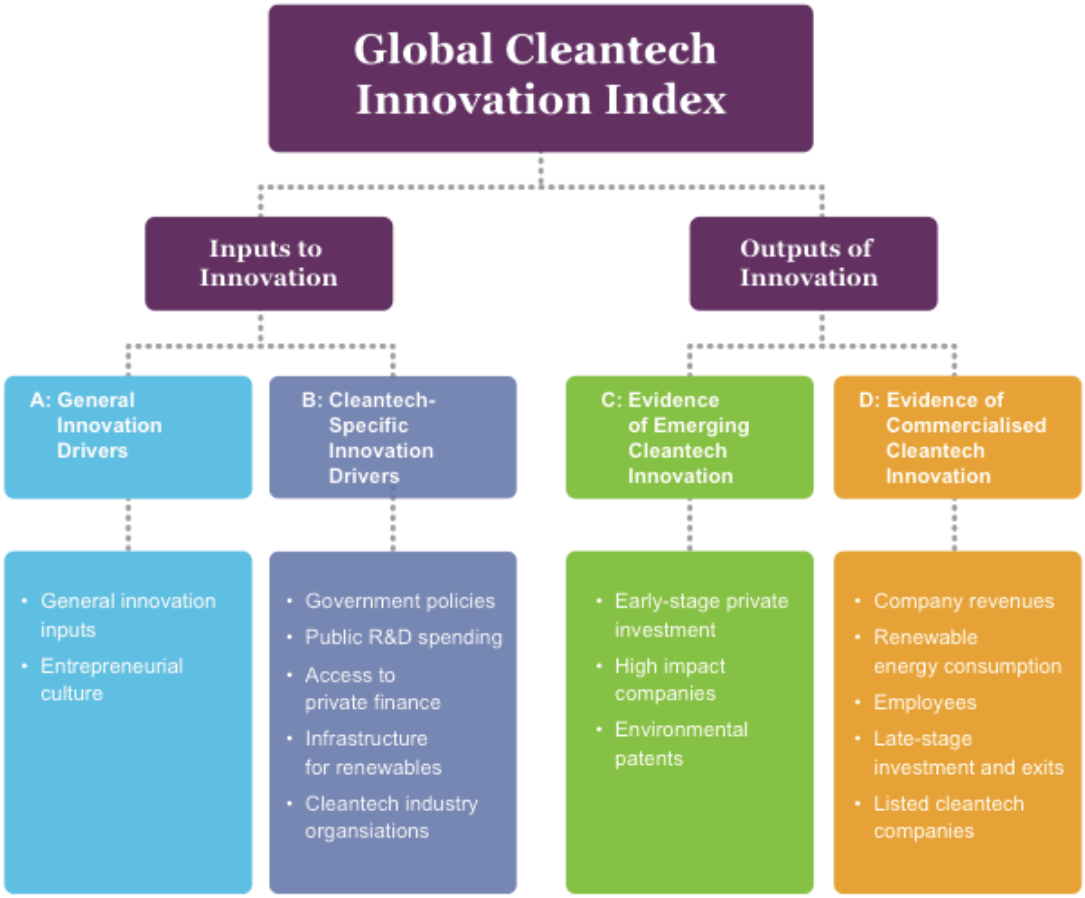

Figure 4. Cleantech innovation index
Source: Knowles et al[69]

Canada placed seventh out of 38 countries assessed (Table 2), scoring "…surprisingly well given their lack of reputation for cleantech innovation and indeed, in Canada's case, a poor reputation at a federal level for political leadership on climate change."[70] The top five countries in the index were Denmark, Israel, Sweden, Finland and the U.S.[71]

[69] *Coming Clean*, 14.
[70] Ibid., 18.
[71] Ibid., 16.

Table 2. Canada's cleantech innovation performance

Profile: Canada scores in the top 10 for both general innovation drivers a commercialised cleantech innovation, but falls below average on cleantech specific drivers. The country has very strong general innovation inputs but lacks strong government policies as well as public R&D funding in support of cleantech innovation. The country has seen strong VC investment, along with a good number of private equity and M&A deals, coupled with good density of public cleantech companies. On the downside, the country's commercialised cleantech score is held back by below average renewable energy consumption. Canada scores below its immediate neighbour the U.S.[72]		
Factors	**Canada's rank (out of 38 countries)**	**First place country**
General innovation drivers[73]	5th	U.S.
Cleantech-specific innovation drivers[74]	24th	Denmark
Emerging cleantech innovation[75]	9th	Israel
Commercialized cleantech innovation[76]	6th	Denmark

These findings are consistent with the perspectives gathered from our interviewees, all of whom felt that there was tremendous opportunity for Canada to compete globally in clean energy and improve on performance to date. Despite a "go slow" federal approach to clean energy and suboptimal ER&D, efforts at the provincial level have allowed Canada to remain relatively competitive with other countries. However, our current performance and recent trends suggest that Canada risks falling behind.

Based on both the literature and our interviews, it's clear that Canada has significant potential to compete in clean energy, but doing so will require that we overcome challenges currently facing clean energy entrepreneurs and businesses, as identified and discussed in the next section.

[72] Ibid., 32.
[73] Ibid., 19.
[74] Ibid., 20.
[75] Ibid., 22.
[76] Ibid., 24.

3. What challenges do Canadian clean energy entrepreneurs and businesses face?

If Canada is to compete in clean energy, we need to both understand and overcome the challenges facing Canadian clean energy entrepreneurs and businesses. While there was relatively little literature premised upon first-hand experience, the interviews we conducted with clean energy entrepreneurs and businesses provided us with excellent insight. While many challenges were identified, it was possible to aggregate challenges based upon a higher-order theme. The challenges most often described in both the literature and interviews can be captured within two key themes:

1. A lack of stable, long-term government policy; and
2. Difficulty accessing capital.

This section describes these thematic challenges, providing examples from both the literature and the first-hand experience of our interviewees.

Lack of stable, long-term government policy

In both the literature and our interviews, one of the most commonly cited challenges identified for clean energy entrepreneurs and businesses in Canada is the lack of stable and supportive government policy. This challenge was broken down into three sub-challenges, each of which will be described in this section:

1. The absence of a national approach to clean energy.
2. The need to secure access to and compete in international markets.
3. The artificial advantage offered to fossil fuel-based energy through unpriced environmental externalities.

A provincial patchwork approach to clean energy

In Canada, the federal, provincial and municipal governments each have areas of responsibility and influence, sometimes overlapping, regarding how energy is both produced and consumed. This presents opportunities, but also challenges.

A commonly cited challenge arises from the absence of a national approach to clean energy production. In 2008, the federal government established an objective that “90 per cent of

Canada's electricity needs be provided by non-emitting sources such as hydro, nuclear, clean coal or wind power by 2020."[77] Yet decisions about specific electricity generating projects are made at the provincial level, and the federal government has taken few steps (i.e. legislation, policy, program) to ensure this objective is achieved. As a result, when it comes to various policies meant to support clean energy development, prospective developers face a policy patchwork across the country.

> *"That's one of the complications with renewable power — we really do have 10 if not 13 different regimes for renewable power, and some of them would compare very favourably to what goes on in the United States or in Europe, and others less favourably… It's in all of our best interests that developers be able to get economies of scale and it makes it difficult when you're operating on a province-by-province basis."*
>
> — Tom Heintzman, Bullfrog Power

As a result, numerous interviewees suggested that the federal government has a necessary role to play in driving demand for clean energy. For example, Dianne Zimmerman (Manager, Strategic Relations, Suncor Energy) stated, "In some jurisdictions, where there is a very strong commitment from the provincial government, commitment and vision, the establishment of targets to support renewable energy, you do have that longer-term policy support… I believe that at the federal level, there is an opportunity to create a commitment that would establish a vision of where the federal government would like to see Canada going. Having that very strong vision would help to provide some of the certainty that we're all looking for."

Beyond targets, governments can also introduce policy measures that create a "demand pull" — such as carbon cap-and-trade systems, renewable portfolio standards and feed-in tariffs[78] — effectively increasing market demand. While some of these mechanisms have been adopted at the provincial level in Canada, such as Ontario's successful feed-in tariff,[79] the federal government has implemented relatively few approaches (e.g. the Wind Power Production Incentive, which was discontinued in 2007), and approaches vary from province to province. Further, where such policy measures have been introduced, their longevity (e.g. Ontario's feed-in tariff program) or stability (e.g. the federal government has overhauled its approach to carbon emissions multiple times) is often in question, creating challenging conditions for would-be investors. Dan Balaban (CEO, Greengate Power) highlighted this as a challenge: "I'm a believer in the free market and using market forces to find the most efficient way to satisfy demand, but the government's responsibility, in my view, as the policy leader, is to create that demand. So I believe the challenge we have in Canada is that we don't have any policy-driven demand for clean energy. I think it's absolutely in our strategic interest."

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[77] The Right Honourable Michaëlle Jean, Speech from the Throne, November 19, 2008. Available at http://www.sft-ddt.gc.ca/eng/media.asp?id=1364

[78] Emmanuel Guérin and Joseph Schiavo, "Pushing and Pulling: The bumpy road to effective renewable energy policy," *Bridges Trade BioRes* 5, no. 1 (2011). http://ictsd.org/i/news/bioresreview/103559/

[79] Ontario Ministry of Energy, "Feed-in Tariff Program Two Year Review" (, 2012), http://www.energy.gov.on.ca/en/fit-and-microfit-program/2-year-fit-review/

As it will be discussed in the following section, creating domestic demand in Canada (particularly when it is in only one province) is unlikely to be sufficient to support growth of companies to a significant size. To truly compete, Canadian companies will need to tap into international markets.

Limited support for accessing international markets

While there are opportunities to encourage and expand the domestic market for clean energy technology and services, as described in the preceding section, for Canadian clean energy entrepreneurs and businesses to grow more significantly, they must look to international markets.

In fact, a 2010 survey of cleantech companies by SDTC found that "with few exceptions, early-adopter markets for Canadian companies are located outside of Canada."[80] Within the clean energy sub-sectors, this trend was quite pronounced for transportation (Figure 5) and process efficiency and abatement (Figure 6), but less so for energy efficiency (Figure 7).

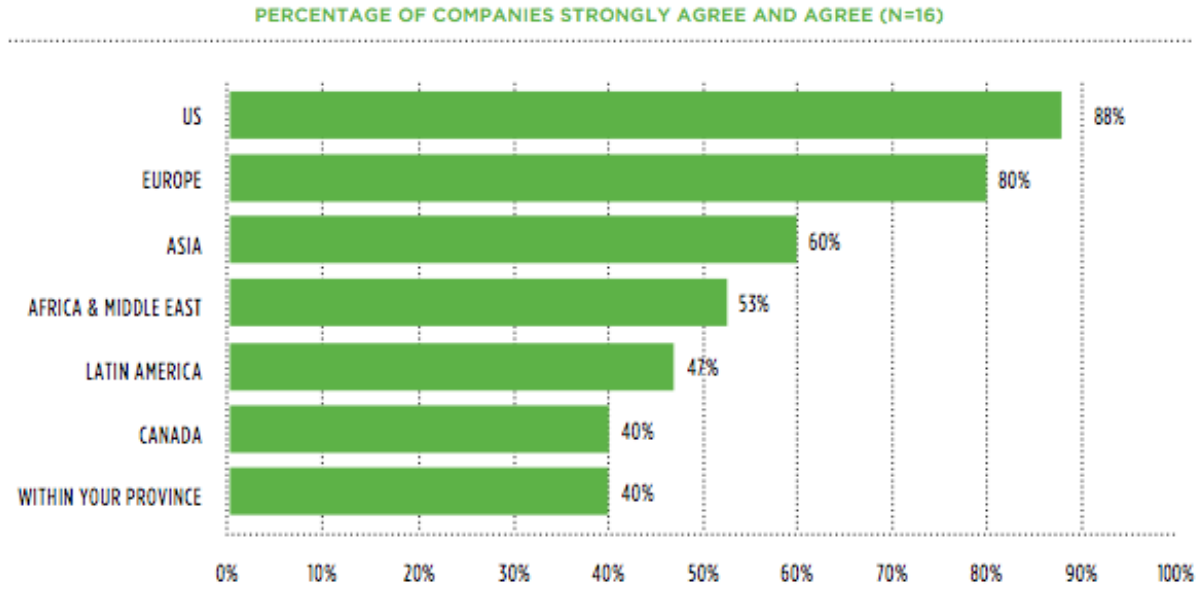

Figure 5. Location of early adopters markets — Transportation

Source: Sustainable Development Technology Canada and Russ Mitchell Group[81]

[80] Sustainable Development Technology Canada and Russ Mitchell Group, *The 2010 SDTC Cleantech Growth and Go-to-market Report* (2010), 72. http://www.sdtc.ca/uploads/documents/en/CLEANTECH%20REPORT.pdf

[81] Ibid., 73.

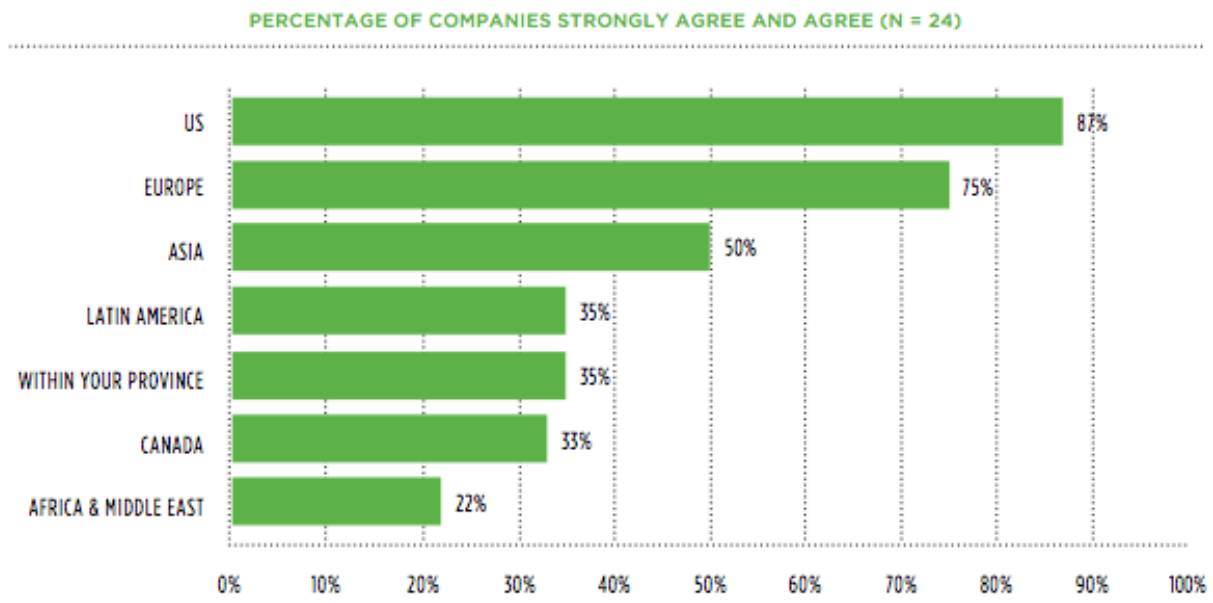

Figure 6. Location of early adopters market — Process Efficiency & Abatement

Source: Sustainable Development Technology Canada and Russ Mitchell Group[82]

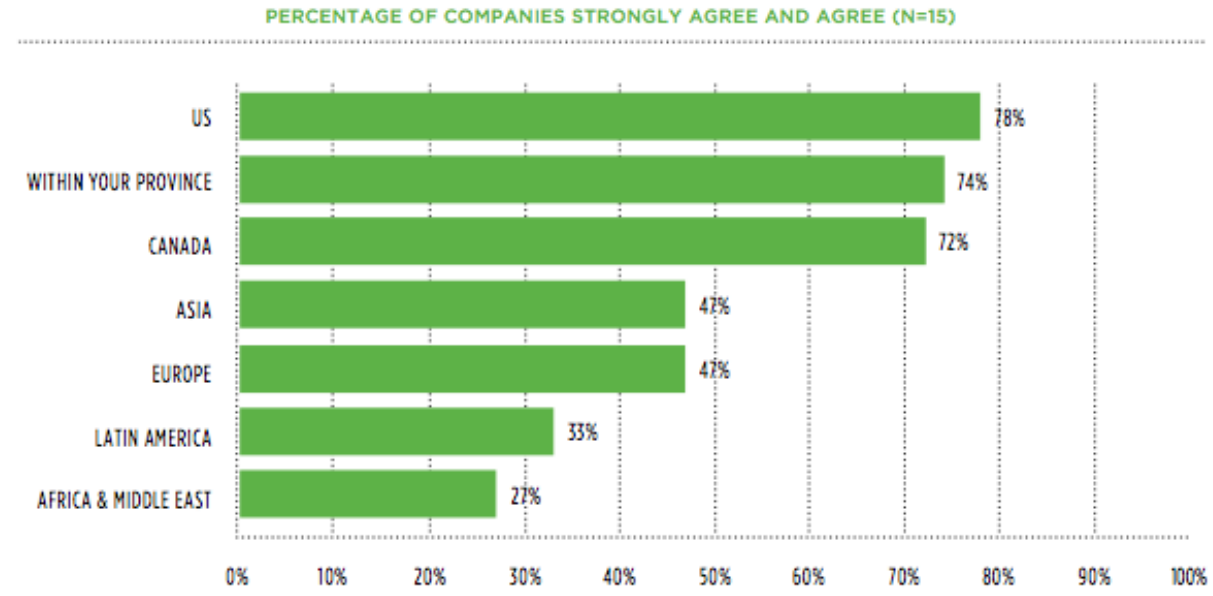

Figure 7. Location of early adopters market — Energy Efficiency

Source: Sustainable Development Technology Canada and Russ Mitchell Group[83]

These results were mirrored in our interviews. For example, Mossadiq Umedaly (Enecsys Limited, Wellington Partners) said, "On our own, we are not a big market; we are a nation with a small population and demand, so what we have to do… is be nimble and effective in taking

[82] Ibid.

[83] Ibid., 74.

entrepreneurial skill and technology that we have and convert it to products that the market wants, demonstrating their efficacy here. Then bring the world here to see what we can do to meet their real needs and export this. Canada is essentially an exporting country, and that will be true for clean tech products as well."

To date the federal government has made some effort to support access to international markets for clean energy technology;[84] however, it pales in comparison to the support being offered to diversify markets for oil and gas exports.[85] There are signs, though, that this might be changing — as evidenced by a recent collaborative agreement between Sustainable Development Technology Canada and Export Development Canada.[86]

> *"...if we're going to have clean tech winners and leaders that are based here in Canada, I think we have to take a more global and international mindset, and that's very much what we're trying to do."*
>
> — Mike Scott, Nexterra

While the patchwork approach to clean energy across the country and a limited domestic market are challenges in and of themselves, they also contribute to a significant and growth-limiting challenge: access to capital throughout the energy innovation cycle (see Figure 2, Section 2), which is explored in the following section.

Fossil fuels' artificial advantage: externalities and subsidies

> *"...the first barrier that clean-energy entrepreneurs are facing is the costing of externalities...it's hard to compete when your competitors are being subsidized...by society."*
>
> — Andrew Heintzman, Investeco Capital Corp.

Conventional fossil fuel sources of energy (and associated technologies) benefit from more than a century of incumbency and competition that has driven their costs downward.[87] These

[84] For example, several clean energy research partnerships between Chinese and Canadian firms arose out of Prime Minister Harper's February 2012 trip to China - see Ari Altstedter, "Green dreams for Canada and China in clean energy deals," *Capital News Online,* March 2, 2012. http://www.capitalnews.ca/index.php/news/canadian-and-chinese-firms-partner-for-clean-energy

[85] For example, see:

Nathan Vanderklippe, "Canada goes on offensive in pipeline PR war," *Globe and Mail*, October 10, 2011. http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/canada-goes- on-offensive-in-pipeline-pr-war/article557163/

Jason Fekete, "Oil sales, human rights (and pandas) on Stephen Harper's China agenda," *Postmedia News*, February 7, 2012. http://news.nationalpost.com/2012/02/07/oil-sales-human-rights-on-stephen-harpers-agenda-in-china/

Chris Sorenson, "Enbridge has a best friend in Ottawa," *Macleans*, July 4, 2012. http://www2.macleans.ca/2012/07/04/power-corp/

[86] Export Development Canada and Sustainable Development Technology Canada, "EDC and SDTC join forces to help commercialize Canada's clean technologies," news release, October 5, 2012. http://www.edc.ca/EN/About-Us/News-Room/News-Releases/Pages/sdtc-edc.aspx

[87] *Bridging the Clean Energy Valleys of Death*, 9.

incumbent technologies are also supported by incumbent infrastructure and market rules, while "…persistent subsidies and favorable tax rules continue to skew markets"[88] in their favour.

> *"Low-carbon growth requires a reorientation of the economy over the long term to take into consideration existing externalities."*
>
> — National Roundtable on the Environment and the Economy[89]

In addition, carbon-based sources of energy have benefited from an artificial price advantage — artificial in the sense that the costs from associated impacts, notably greenhouse gas pollution, but also emissions of other air and water pollution, are externalized — a view echoed by a majority of interviewees. For example, an independent cost-benefit analysis[90] produced for the Government of Ontario found that coal-fired power generation costs $4.4 billion annually when factoring in health and environmental costs — costs that don't hit the balance sheet of polluters. As John Ruffolo said, "the world, including Canada, generally does not factor in the cost of carbon in emissions, and there is no price transparency on the alternative to renewables so that we are constantly getting subsidized as consumers at a very low, artificial rate."

While the challenges that flow from a lack of stable, long-term government policy may seem daunting on their own, they also exacerbate another key challenge: the difficulty many clean entrepreneurs and businesses face in accessing the capital they need to grow.

Difficulty accessing capital

The challenge of securing capital — of different types and at different stages of the innovation cycle (i.e. the two "valleys of death" illustrated in Figure 2, Section 2) — were repeatedly raised in our interviews. As David Demers (Westport Innovations) noted, "there aren't many venture capitalists in Canada who look at early stage technology, and there aren't many who have successfully done it." He also suggested that this was, in part, due to Canada's historic economic focus on natural resources versus technology development: "…people are quite comfortable with investing in…a new drilling program. Or, we have a geological asset we want to turn into a mine. We know that process, and we know it takes X months or years, and we know it takes this kind of money. Where people get very confused in our capital markets, is how do you get a new technology product out to market?" Several interviewees noted that this confusion can result from a lack of understanding of the clean energy sector on the part of the financial markets and/or a lack of understanding of financial markets on the part of clean energy entrepreneurs and businesses.

Andrew Heintzman (Investeco Capital Corp.) similarly highlighted the decline in venture capital investment, particularly from large institutional investors: "In Canada, our venture capital investment has declined from around $3.3 billion in 2000 to less than $1 billion this year. We're just simply not funding early-stage companies, and there's a whole raft of reasons for this. One I

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[88] Ibid.

[89] *Framing the Future*, 83.

[90] DSS Management Consultants Inc. and RWDI Air Inc., *Cost Benefit Analysis: Replacing Ontario's coal-fired electricity generation*, prepared for Ontario Ministry of Energy, 2005, ii. http://www.energy.gov.on.ca/docs/en/coal_cost_benefit_analysis_april2005.pdf

will point to is that many of our large institutional investors or pension funds that hold so much of our wealth have basically moved out of the venture and early-stage investing game. So it's extremely difficult for new entrepreneurs in this country to find start-up capital… I don't think, as a country, we can let this go very much longer, where we massively underinvest in our early-stage businesses."

There was, however, a bright light on the investment front that was highlighted by numerous interviewees: Sustainable Development Technology Canada (SDTC)[91] and its Tech Fund and NextGen Biofuels Fund, both of which fill critical gaps in the innovation cycle (Figure 8).

[91] Sustainable Development Technology Canada is "a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians." It is funded by the Government of Canada and its chief aim is "to de-risk clean technologies in a way that will ultimately attract downstream private-sector investment and open up opportunities for commercial success. We do this by employing a stringent due diligence process when selecting technologies to support, and by actively strengthening project consortia—requiring every project to involve representatives from the entire supply chain: researchers, product developers, manufacturers, distributors, retailers and end customers. In all, 80 percent of our consortia are industry-led." See http://www.sdtc.ca/index.php?page=sdtc-profile

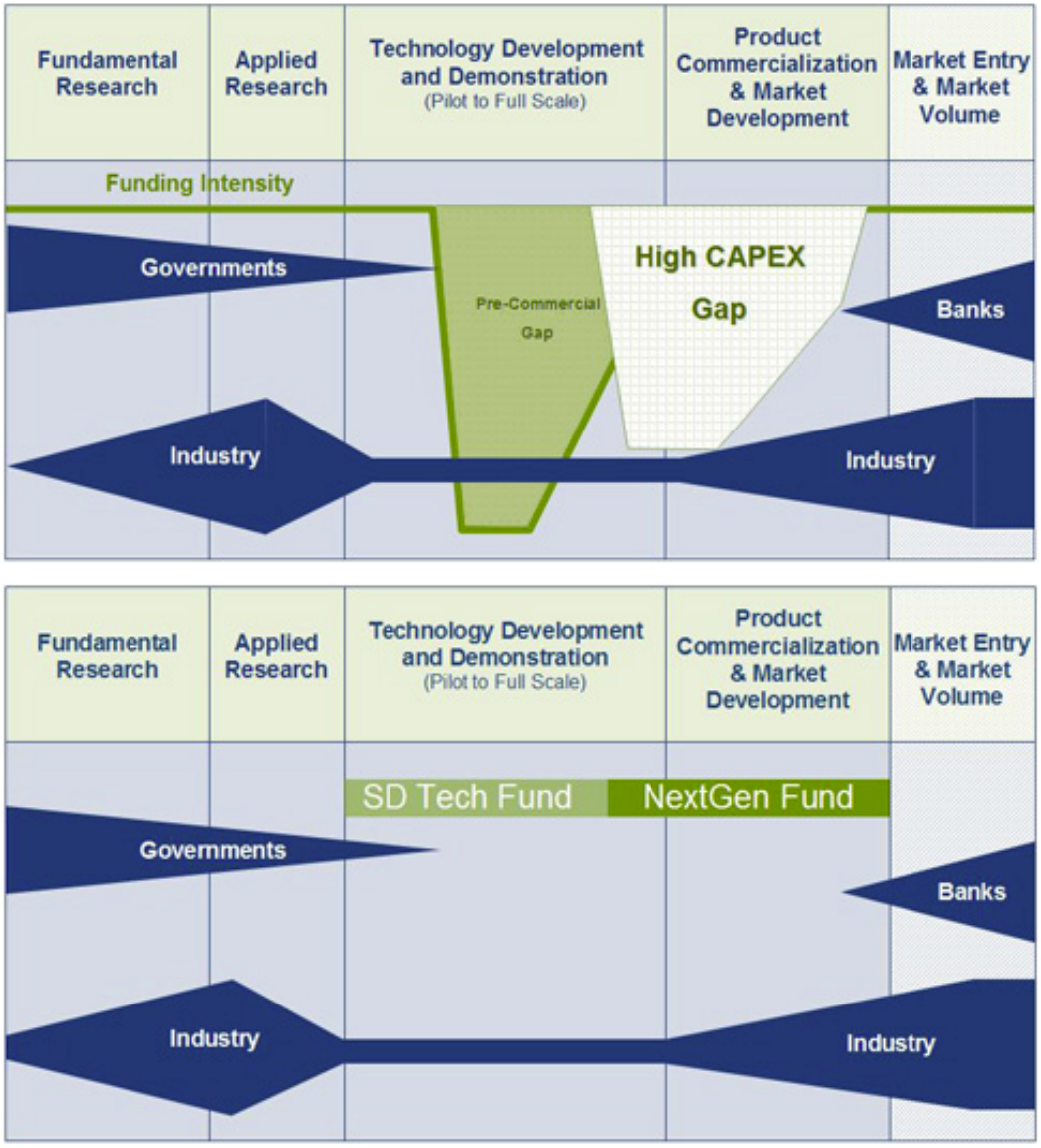

Figure 8. SDTC Tech Fund and NextGen Biofuels Fund support in the innovation cycle

Source: Sustainable Development Technology Canada[92]

The SDTC Tech Fund supports "the late-stage development and pre-commercial demonstration of clean technology solutions: products and processes that contribute to clean air, clean water and clean land, that address climate change and improve the productivity and the global competitiveness of the Canadian industry."[93] The NextGen Biofuels Fund supports "the establishment of first-of-kind commercial scale demonstration facilities for the production of next-generation renewable fuels and co-products" that "…are capital equipment intensive, are not progressing to market because they present too great a risk for the debt finance community.

[92] Sustainable Development Technology Canada, "About Our Funds." http://www.sdtc.ca/index.php?page=about-our-funds&hl=en_CA

[93] Ibid.

Equity financing is not consistently available and has been difficult to source in Canada at sufficiently attractive rates of return."[94]

> *"I think that SDTC has more to do with the advancement of clean tech in those spaces, in Canada, than any other single body."*
>
> — Mike Brown, Chrysalix Energy Ventures

John Ruffolo (OMERS) provided an insightful view into the challenge for clean energy companies raising equity financing as these companies tend to fall into the "hole" between traditional asset classes. He noted that the technology class of the cleantech sector was similar to information technology — small start-ups, higher risk, developing intellectual property — and so is a more conventional fit for traditional venture capital. However, the clean energy class of cleantech is comprised of projects that are "spinning" (or about to), and fit into an infrastructure asset class — with a lower return but much more of a guarantee (i.e. lower risk). The "hole" between these asset classes includes those technologies/projects that have a venture capital risk profile, but require infrastructure-type capital (i.e. debt financing) — that is, they are both high risk and have high capital needs. Compounding the challenging conditions for energy technology innovation (see Table 2 above) is the absence of private sector actors or institutions that align with the "high risk" and "high capital" characteristics of innovative energy technologies (Table 3).[95] In light of these conditions and barriers, the energy sector "…is among the most difficult for innovative technologies to navigate, providing substantial obstacles for deployment of clean and affordable advanced energy technologies."[96]

> *"In the clean tech I think they've [SDTC] been a hugely important piece of the success of the industry, and I think without that support we certainly wouldn't be where we are today."*
>
> — Mike Scott, Nexterra

[94] Ibid.

[95] *Bridging the Clean Energy Valleys of Death*, 6.

[96] Ibid.

Table 3. Private sector actors in the energy innovation cycle

	SEED FINANCING	ANGEL INVESTORS	VENTURE CAPITAL	DEBT FINANCING	PRIVATE EQUITY	UTILITIES
Typical Investment Amount	Small	Small	Small-medium	Any size	Any size	Large
Technology Financing Stage	R&D, Prototype	R&D, Prototype	Prototype, Commercial-ization	Commercial-ization, Deployment	Commercial-Ization, Deployment	Deployment
Expected Time for ROI	Long-term	Long-medium-term	Short-medium-term	Medium-long-term	Medium-long-term	Long-term
Risk Tolerance	High	High	High	Low	Low	Low

Source: Jenkins and Mansur[97]

According to Ruffolo, the types of investor that often fills this "hole" are consortia of strategic corporate investors: "...whereby if there's a binary bet, even if the bet is wrong, typically there has been a lot of great research and technology developed that a strategic investor might be able to utilize…in some other area of their business."

The challenges identified in this section are not insignificant; however, both the literature and our interviews provide numerous options for overcoming them, as described in the following section.

[97] *Bridging the Clean Energy Valleys of Death*, 8.

4. What public policy options could be applied to these challenges?

Our research uncovered three main opportunities for the federal government to better support clean energy entrepreneurship in Canada:

1. Develop a toolbox of financial instruments and recapitalize Sustainable Development Technology Canada.
2. Provide focused and long-term national support for clean energy through a national energy strategy.
3. Send the right price signals with a price on carbon pollution.

These opportunities are outlined in more detail below.

Develop a toolbox of financial instruments and recapitalize Sustainable Development Technology Canada

Challenges

The twin "valleys of death:" Insufficient access to capital throughout the energy technology innovation cycle.

Solutions

- Develop and deploy a toolbox of financial instruments custom designed for the unique challenges of the clean energy technology sector.
- Recapitalize SDTC at a rate of $100 million per year over the next five years, starting in Budget 2013.

As the Canadian Clean Technology Coalition has noted, it's critical that federal policy in support of clean technology be based on a sound understanding of financial markets specific to clean technology: "The market works. However, government must understand the dynamics of financial markets for equity, debt, export and buyer finance for a sector with significant domestic and export growth potential."[98]

[98] Canadian Clean Technology Coalition, *2012 Finance Submission*, 4. http://www.canadiancleantechnologycoalition.ca/media/docs/2012_Finance_Submission_Canadian_Clean_Technology_Coalition.pdf

As with other sectors of the Canadian economy, targeted and customized support is required to truly enable the clean energy sector to fulfill its potential. A toolbox of financial instruments is needed to support clean energy technologies and ensure that those with market potential successfully cross both "valleys of death." As Karen Clarke-Whistler (TD Bank Group) noted, "…from a banking perspective, there are a couple of things that always make financial institutions feel comfortable — whether it's cleantech or anything else. One is sovereign debt. So that's loan guarantees, government-backed loan guarantees. You know, if you're going to actually support something out there, you should be prepared to guarantee it…"

The second thing Clarke-Whistler suggested is putting a bond together, given bonds are "very, very, safe…. Those are things that make banks comfortable." There has been growing support for green bonds, broadly defined as "fixed-income securities that raise capital for a project with specific environmental benefits."[99] The think tank Sustainable Prosperity has noted that "if the federal government could provide the right support and enabling environment, the market for green bonds could grow,"[100] and points to examples of progress elsewhere such as the U.K.'s new Green Investment Bank.[101] As John Ruffolo (OMERS Ventures) and several others noted, this challenge isn't unique to clean energy, but was historically faced (and overcome) by the oil and gas and mining sectors in Canada through the support of targeted financial tools (e.g. flow-through shares), which may serve as useful examples.

In addition to developing a toolbox of financial instruments, there is also a need to continue to provide support to approaches that are already proving successful. As described in Section 3, Sustainable Development Technology Canada (SDTC) has played a critical role in supporting clean energy technologies. It has "…a clear mandate to develop the most promising pre-commercial clean technologies, an independent governance structure, and operates arms-length from the government,"[102] while its national scope "is a strong advantage giving it a unique perspective and awareness of diverse regional capabilities and existing projects, thereby avoiding duplication."[103]

One of the recommendations made by the recent expert panel on federal support for research and development in Canada was to "help high growth innovative firms access the risk capital they need through the establishment of new funds where the gaps exist."[104] In the area of clean technology SDTC has been fulfilling this role, a contribution recently praised by both the Standing Senate Committee on Energy, the Environment and Natural Resources[105] and the public policy think tank the Mowat Centre.[106]

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[99] Sustainable Prosperity, *Green Bonds: Policy Brief* (2012), 2, http://www.sustainableprosperity.ca/article2810

[100] Ibid.

[101] Ibid., 8.

[102] *Smarter and Stronger*, 42.

[103] Ibid.

[104] *Innovation Canada.*

[105] The Standing Committee on Energy, the Environment and Natural Resources, "Now or Never: Canada must act urgently to seize its place in the new energy world order" (Senate of Canada, 2012). http://www.parl.gc.ca/Content/SEN/Committee/411/enev/rep/rep04jul12-e.pdf

[106] *Smarter and Stronger*, 42.

While some further funding has been provided following its original capitalization, the federal government's 2012 budget did not recapitalize SDTC.[107] The SD Tech Fund will be fully allocated by the end of 2012 with the NextGen Biofuels Fund on track to be fully allocated by early 2014.[108] We suggest the federal government begin recapitalizing SDTC at a rate of $100 million per year for the next five years, beginning in Budget 2013.

Provide focused and long-term national support for clean energy through a national energy strategy

Challenges

A patchwork approach to clean energy policy domestically and difficulty accessing international markets.

Solutions

- Develop a Canadian energy strategy and accompanying policy framework that leverages the value of our fossil fuel resources to support clean energy technology development and deployment domestically and enhances international export opportunities.

There is growing agreement across sectors and provinces that Canada needs some form of a national sustainable energy strategy to ensure responsible decisions are made regarding how we produce and consume energy. Alberta Premier Alison Redford has made the establishment of a "Canadian energy strategy" a key priority, and intends to build support within the Council of the Federation.[109]

Support for a national approach to energy was also reflected in our interviews; for example, Dan Balaban (Greengate Power Corporation) said, "…we need to come back to creating policy-driven demand. I think we need to put in place a clean electricity standard, ideally at the federal level to encourage clean electricity across the nation. It would come from the top. It would be policy-driven demand by the federal government."

This sentiment was similarly reflected in interviews conducted for another recent study, which noted, "The clearest message from the interview process is that a national energy strategy, with an energy technology policy as its centerpiece, is essential."[110] Further, it found that "Many stakeholders believe that the lack of a pan-Canadian energy policy results in major uncertainties about future policy directions, which is debilitating to their ability to manage ER&D and make investment decisions."[111]

A Canadian energy strategy would provide long-term guidance to federal, provincial and municipal policymakers — as well as the private sector — and could be complimented with

[107] Ibid.

[108] SDTC email correspondence with Tim Weis (Pembina Institute), 21 September 2012.

[109] "Canadian energy strategy key to Alberta's future: Redford," *Edmonton Journal*, January 16, 2012.

[110] *Smarter and Stronger*, 52.

[111] Ibid., 46.

"long-term ER&D targets"[112] and effective funding for "…priorities set by long-term policy and organized in a diversified portfolio that cuts across the energy system and stages of investment."[113]

> *"…looking at the future industrial strategy of this country, we're going to have to make bets, and we've already made a bet, whether we like it or not, that energy is one of our key strengths in this country. So my view is if we're so strong on energy, it forms the platform for us to be so strong in renewable energies. And what will have to happen is the massive profits that this country is making from carbon-based energies are needed to fund the future bets on renewable energies. And right now we're not doing that. We're taking those massive profits funding historical deficits and not reinvesting that back into the future."*
>
> — John Ruffolo, OMERS Ventures

Many of our interviewees suggested that Canada's abundance of resource wealth should be leveraged to support a transition to clean energy. For example, Tom Heintzman (Bullfrog Power) said, "we should be … looking forward in a very farsighted way to be able to use this wealth that we've been bequeathed to transform our economy. And you do see a lot of the Middle East, the progressive Middle Eastern states using oil money to help finance cleantech and finance that conversation. So we were lucky, but I think we owe it to ourselves and to the world to use a reasonable portion of that wealth in order to help transition to what will be the next energy economy." But this approach need not only apply to the public sector, as Dianne Zimmerman (Suncor Energy) noted, "For companies like Suncor, the ability to use the revenues generated from other parts of our business to advance our efforts in the renewable energy field, provides us with a great advantage."

Recognizing that Canada has a significant but ultimately limited domestic market, clean energy entrepreneurs and businesses would also benefit from greater support in accessing international markets. The Canadian Clean Technology Coalition has noted that, "Canada's clean technology companies are increasingly at a competitive disadvantage. Several countries including the U.S., China, Japan, Germany and Korea are integrating trade, investment, international development and economic policies to support their domestic industries."[114]

> *"In the cleantech area, the challenges seem to be that the technology's here, but the real growth markets are in the developing world or in Asia….Where do you go? Do you go to Philadelphia or Halifax, or do you get off the plane in Ho Chi Minh or Cairo or Shanghai? Our markets are growing at one per cent. Those markets are growing at 10 per cent, 20 per cent, even 30 per cent."*
>
> — Nick Parker, Cleantech Group

The recent announcement by SDTC and Export Development Canada is a step in the right direction. As EDC President Stephen Poloz noted in announcing the collaboration, "Clean-tech

[112] Ibid., 10.

[113] Ibid.

[114] Canadian Clean Technology Coalition, *2012 Finance Submission*, 1.

companies need to scale up and go global, which provides a natural fit for EDC and SDTC to work together to help put Canadian companies at the forefront of the industry."[115] However, there is much more that the federal government could do, both politically and practically, to enhance the efforts of clean energy entrepreneurs and businesses. For example, the Canadian Clean Technology Coalition has recommended that Canada "play a leadership role in the development of a private-sector debt fund that would be complementary to an [International Finance Corporation] IFC equity investment fund"[116] that would ensure developing countries can secure the financing they need to move ahead with sustainable infrastructure investments, a significant potential market for Canadian clean technology companies.

Send the right price signals with a price on carbon pollution

Challenges

Fossil fuel energy continues to benefit from government subsidies and the externalization of costs associated with its greenhouse gas pollution.

Solutions

- Eliminate preferential tax treatment for fossil fuel production.
- Establish a national carbon price (via a tax or cap-and-trade system) to internalize the cost of greenhouse gas pollution.

The OECD and International Energy Agency have recommended that countries remove inefficient fossil fuel subsidies,[117] and in 2009 G20 countries, including Canada, agreed to phase out fossil fuel subsidies over the medium term.[118] While the federal government has begun to phase out some subsidies, the OECD has noted that several tax measures that support energy production remain in place, including "accelerated depreciation for physical assets in mines (including coal mines, but not oil sands mines) and for successful oil, gas and mineral exploration expenses; flow-through shares, which allow a corporation to transfer unused exploration and development expenses to their shareholders; and the ability for small oil and gas companies to reclassify some development expenses as exploration expenses under the flow-through share scheme."[119] The OECD further notes that, "Alberta offers several royalty-reduction programmes that target specific types of oil and gas projects."[120]

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[115] "EDC and SDTC join forces to help commercialize Canada's clean technologies."

[116] Canadian Clean Technology Coalition, *International Finance for Exports Submission*, NO DATE, 3. http://www.canadiancleantechnologycoalition.ca/media/docs/Canadian_Clean_Technology_Coalition_Finance_Query_IFIs-1.pdf

[117] OECD, "OECD and IEA recommend reforming fossil-fuel subsidies to improve the economy and the environment," media release, October 4, 2011. http://www.oecd.org/document/35/0,3746,en_21571361_44315115_48804623_1_1_1_1,00.html

[118] Jeff Mason and Darren Ennis, "G20 agrees on phase-out of fossil fuel subsidies," *Reuters*, September 25, 2009. http://www.reuters.com/article/2009/09/26/us-g20-energy-idUSTRE58O18U20090926

[119] OECD, *Canada: Inventory of estimated budgetary support and tax expenditures for fossil fuels* (2011), 2. http://www.oecd.org/site/tadffss/48785246.pdf

[120] Ibid.

The federal and provincial governments should accelerate efforts to phase out remaining fossil fuel subsidies.

More importantly, however, is the increasing number of diverse voices advocating for federal action to establish a price on carbon pollution. Carbon pricing was identified as a key policy solution by the majority of our interviewees as a critical step in encouraging the domestic transition to a clean energy technologies and services, and in doing so establish the conditions for Canadian entrepreneurs and businesses to compete abroad.

> *"I'm an economist. I do not believe that you will ever make the right and most efficient decisions on how to do carbon without a price on carbon. If society agrees that the use of the atmosphere for taking up CO_2 is a scarce resource, then we know that pricing resources minimizes their use. We have proven over and over that when resources become expensive, we find innovative ways to minimize their use. That is at the heart of competition! So pricing the use of the environment will encourage all of us to find the most cost effective way to minimize its use."*
>
> — Dawn Farrell, TransAlta

> *"A price on carbon is about market pull. It's about creating demand in that jurisdiction for low-carbon infrastructure. It's about changing the investing climate for large-scale energy infrastructure…it's often said that Canada couldn't possibly go it alone with a carbon price, that we would put ourselves at an economic disadvantage to our southern neighbours. We're so tightly integrated with them we can't act independently. This is a common refrain. I would argue that there is so much pent-up demand internationally for low-carbon-risk infrastructure that the jurisdiction that moved first to say, "'I'm putting in a clear, concise, long-term signal on my carbon price. I'm taking that risk off the table and I'm quantifying it," I think you would get first mover advantage in having a lot of that funding coming into your sector."*
>
> — Tom Rand, MaRS Discovery District

> *"…the first barrier that clean-energy entrepreneurs are facing is the costing of externalities…it's hard to compete when your competitors are being subsidized, basically, by society… So I think one of the greatest things that the federal government could do to build up early-stage entrepreneurship in this country would be to have a carbon price."*
>
> Andrew Heintzman, Investeco Capital Corp.

> *"If you were to ask me what is the one silver bullet to get clean energy projects off the ground…I think that it's a fundamental issue associated with carbon…the world, including Canada, generally does not factor in the cost of carbon emissions, and there is no price transparency on the alternative to renewables so that we are constantly getting subsidized as consumers at a very low, artificial*

rate. So if you completely remove the subsidies and you add a carbon tax, the ROI on these investments shoot up through the roof, and all of a sudden the math starts to work."

John Ruffolo, OMERS Ventures

"The single most meaningful thing that could be done very quickly in this country that would make a material difference in the performance of this country from an environmental point of view and immediately get the attention and the commitment of the citizens of this country is a carbon tax. There's absolutely nothing else. You talk about designing it. People know how to design taxes. They could do it on the back of an envelope in 48 hours for a carbon tax. The only question is, how much would it be? There's no question that design would be absolutely simple. What the government is counting on, and what all governments count on, is the ability to do nothing until a sufficient groundswell of noise exists which forces them to do something."

John Coyne, Unilever

"…there's the vexed question of a price for carbon. Some jurisdictions around the world have adopted a carbon price either through a cap and trade system or through a carbon tax, and GE has been very supportive of those systems, both in Europe and Australia. In the absence of a price for carbon, there are emission standards that need to be adopted for various industries, and we're moving in that direction in Canada."

Ross Hornby, General Electric

Similar results arose from the interviews conducted by the Mowat Centre on energy research and development, which found that "Price signals are important for pulling in private investment. A comprehensive carbon price, for example, would incent investments into low-carbon technologies."[121] While a recent paper by the Institute for Research on Public Policy (IRPP) downplayed the role of carbon pricing as a means to induce the development of new energy technologies, it nonetheless recommended the use of a modest carbon tax to raise funds that would be distributed for R&D by a low-carbon energy research council.[122]

Most recently, the Canada International Council's report *The Nine Habits of Highly Effective Resource Economies* recommended that:

> Canada should bring in a national, revenue-neutral carbon tax. We should not wait for the United States to act, but move ahead with a plan that includes border measures to ensure Canadian companies are not put at a competitive disadvantage. This will not only create more certainty for Canadian businesses but will give them the incentive they need to develop the greener products and processes that are increasingly in demand in much of the rest of the

[121] *Smarter and Stronger*, 51.

[122] Isabel Galiana, Jeremy Leonard and Christopher Green, *A Technology-Led Climate Change Policy for Canada,* IRPP Study No. 40 (Institute for Research on Public Policy, 2012), 21. http://www.irpp.org/pubs/IRPPstudy/IRPP_Study_no34.pdf

world. This should be done in consultation and co-operation with business and the provinces.[123]

Support for carbon pricing is both broad and deep, garnering strong support from the business community,[124] environmental community and economists.[125] While a number of provinces have embarked upon carbon pricing policies — including B.C., Alberta and Quebec — a national approach would prove far more effective and provide consistency and certainty to Canadian businesses and consumers alike.

[123] Canada International Council, *The Nine Habits of Effective Resource Economies: Lessons for Canada* (2012), 45. http://www.opencanada.org/wp-content/uploads/2012/10/CIC-9-Habits-of-Highly-Effective-Resource-Economies.pdf

[124] For an overview of business association preferences, see Sustainable Prosperity, *Canadian Business Preference on Carbon Pricing* (2011), 4. http://www.sustainableprosperity.ca/dl329&display

[125] For example, during the 2008 federal election more than 200 Canadian economics professors signed an open letter on climate change that noted "Pricing carbon is the best approach from an economic perspective." See http://worthwhile.typepad.com/worthwhile_canadian_initi/2008/10/an-open-letter-to-the-leaders-of-canadas-federal-political-parties-from-economists-teaching-in-canadian-colleges-and-unive.html

5. Conclusions

> *"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."*
>
> — Stewart Elgie and Alex Wood, Sustainable Prosperity[126]

We believe this report provides a unique contribution toward informed policy decisions aimed at unleashing Canada's clean energy entrepreneurs and businesses and supporting their success. Its survey of the literature and comprehensive interviews of leading entrepreneurs, academics and executives across Canada offers a deeper understanding of the actual experiences — both positive and negative — of Canadian clean energy entrepreneurs and businesses.

It explored three principal questions in a novel and timely way:

1. How is Canada faring in the global clean energy race? (Section 2)
2. What challenges do Canadian clean energy entrepreneurs and business face? (Section 3)
3. What public policy options could be applied to address these challenges? (Section 4)

We found that Canada is well positioned to compete in the field of clean energy technology, creating jobs and economic prosperity across the country. The growth potential is significant, and despite a "go slow" federal approach to clean energy and suboptimal ER&D, efforts at the provincial level have allowed Canada to remain relatively competitive with other countries. Canada has a significant opportunity to generate jobs and prosperity by effectively competing in the clean energy race. To date, Canada's performance is in the middle of the pack — we are falling short of fulfilling the potential of our clean energy entrepreneurs and businesses. As has been noted, "…being an energy superpower—and being able to capture more benefits from growing world energy markets—means more than just figuring out how to boost resource export revenues. It means taking advantage of existing opportunities in technology to meet the challenges of the 21st century and expanding Canada's energy leadership to knowledge-intensive components and ER&D services. It means becoming a global leader in a lucrative and rapidly growing market for new energy solutions, which includes, but is not limited to, our natural resources."[127]

As Sustainable Development Technology Canada (SDTC) has concluded, "Unless more Canadian technology — including clean technology — companies become more effective at commercialization and grow revenues at rates equal to or greater than global competitors, many companies with attractive technologies will be susceptible to acquisition by foreign firms that may have little interest in maintaining large operations in Canada. Smaller, slower-growth companies will still continue to operate as independent businesses. Both outcomes fall short of the industry's potential to create large numbers of high-value jobs, generate wealth for

[126] "Building a Low-Carbon, High-Octane Canadian Economy," 22.

[127] *Smarter and Stronger*, 56.

Canadians, and deliver products and services that contribute to a sustainable economy and healthier environment."[128]

The challenges facing Canadian clean energy entrepreneurs and businesses fall within two key themes:

1. A lack of stable, long-term government policy; and
2. Difficulty accessing capital.

In both the literature and our interviews, one of the most commonly cited challenges identified for clean energy entrepreneurs and businesses in Canada is the lack of stable and supportive government policy. This challenge was broken down into three sub-challenges:

1. The absence of a national approach to clean energy.
2. The need to secure access to and compete in international markets.
3. The artificial advantage offered to fossil fuel-based energy through unpriced environmental externalities.

> *"Compared with most of the great energy exporting nations, we [Canada] have a great ability to diversify our economy — we have a well educated work-force, healthy immigration levels to build our population and well developed infrastructure. The question for Canada should not be limited to: How can we develop energy resources? Instead, we should ask: How can our energy resources best help us to build a competitive economy and a great society for generations to come?"*
>
> — Bob Elton, former CEO of BC Hydro[129]

As identified in this report, there are policy options available that will enable Canada to continue to take steps toward becoming more competitive in the global clean energy marketplace. First, a toolbox of financial instruments customized for the clean energy sector is needed, and the success of SDTC should be built upon through its recapitalization. Second, focused and long-term national support for the clean energy sector is required, starting with the implementation of a national sustainable energy strategy and the implementation of a price on carbon pollution. Finally, the federal and provincial governments should accelerate efforts to phase out remaining fossil fuel subsidies, and establish a price on carbon pollution.

Developing, implementing and exporting the clean energy technologies and services that will see our production and consumption of energy services align with the need to reduce greenhouse gas pollution and avoid the worst impacts of climate change offers Canada a win-win opportunity to play a leading role in the global transition to a low-carbon economy. It's our hope that this report sheds some light on the policy solutions that might help Canada fulfill this opportunity.

[128] *The 2010 SDTC Cleantech Growth and Go-to-market Report*, 38.

[129] Bob Elton, "How can Canada develop its energy riches to build a great future?" *National Post*, April 23, 2012.