SYNOPSIS

2017 CANADIAN CLEAN TECHNOLOGY INDUSTRY REPORT

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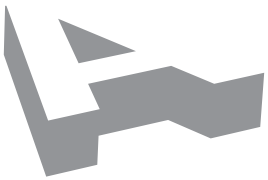

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Canada's Low-Carbon Economy, Clean Growth and the Canadian Clean Technology Industry

On its surface, Canada appears to be undergoing something of a clean-growth Renaissance.

In March 2016, the federal government launched a joint federal-provincial-territorial Working Group on Clean Technology, Innovation and Jobs. Across the span of six months, the group engaged with a wide range of stakeholders in the clean-technology ecosystem—from companies, to accelerators, to investors, to provincial-territorial and federal agencies and departments focused on innovation and climate change. The team's findings informed the *Pan Canadian Framework on Clean Growth and Climate Change*, and yielded a number of commitments in the 2017 budget. Chiefly, Ottawa allocated $1.8 billion of scarce federal policy dollars over three years for equity investment, debt financing for working capital, venture capital, and large-project finance focused on clean technology.

In addition to this direct support, in recent months Ottawa has introduced new or expanded regulations to address greenhouse gases in the transportation, built environment, and electricity sectors. These regulations will not only reduce emissions, they will also help to level the playing field by correcting market failures, improving the viability of clean-technology enterprises. Meanwhile, provincial governments and cities across the country are taking stock and establishing policies to achieve climate objectives by prioritizing low carbon infrastructure, pricing carbon, and investing in economic diversification in areas such as clean technology, agriculture, and artificial intelligence.

Canada's clean-technology industry is the nation's first new industry of the 21st Century. It directly employs more than 55,000 people in more than 800 firms that use market forces to advance social and environmental goals. It is a highly competitive, innovation-led industry that is committed to exporting and investing heavily in global-scale commercialization.

Canada's clean technology companies are working to build out competitive positions in fast-growing global markets. In lieu of dividends, share buy-backs, or executive bonuses, they are investing in talent. They are creating and commercializing intellectual property and solutions that protect or repair ecosystems while growing *and* diversifying our economy. They are enabling economic renewal.

The Canadian clean technology industry can play a key role in the global race to fight climate change and help Canada meet its 2020 commitments under the *Paris Agreement*. And it can employ many Canadians in good jobs with good futures, putting to work some of our brightest and best, and building the knowledge-based economy that Canadians hope and strive for.

And yet, despite this impressive progress, our detailed analysis of the industry finds much reason for concern today and into the medium term.

In short, Canada's clean-technology industry is awash in red ink. Its firms, and the know-how and intellectual property (IP) they hold, are vulnerable to foreign takeovers. Despite unprecedented interest and engagement from provincial and federal governments, Canada's low-carbon Renaissance is very much on the ropes. The sector needs smart new policy from the public sector and engagement from Bay Street to build markets for low-carbon solutions, unlock private finance, and secure the prosperity that should accrue from investment in low-carbon innovation.

2017 Canadian Clean Technology Industry Report

The *2017 Canadian Clean Technology Industry Report*, compiled and published by Analytica Advisors, concerns itself with the people working in the growing number of businesses that make up this industry.

The 2017 Report builds on seven years of research conducted at the firm level, this year on a national cohort of over 800 clean technology companies. At the core of this annual report, and the five that preceded it, are the companies that participate in the research.

This year 148 companies—18 public and 130 private firms—shared their confidential financial information and plans with Analytica Advisors to benchmark themselves against their peers. We conducted the research for this edition between August and November of 2016, with companies reporting their results for 2015 and their plans for 2016 and 2017.

Over the past six years, 341 companies—or 40 percent of the industry—have participated in the research. We would like to thank each of these firms. It takes courage to both report on achievements and reflect on hard choices. But the primary research to which these companies have added, and which is communicated in this report, represents a unique contribution globally to the academic, private and public domains. Through this sharing and benchmarking, we can draw lessons on how to build new IP-based industries in the 21st century.

We have once again offered an analysis of Canada's global market share ranking among the top 25 exporters of manufactured Environmental Goods, based on global trade reports. This year, we have organized this analysis according to two time periods. The first begins in 2001, the year China joined the World Trade Organization, and ends with the global financial crisis in 2008. The second period spans 2008 to 2015. It includes an analysis and ranking of the change in global market share for these exporters during these periods.

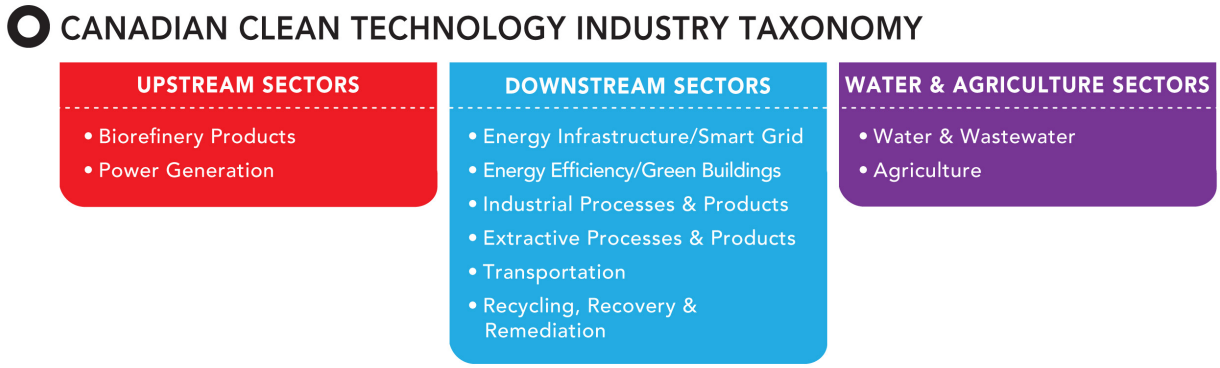
In an effort to provide a more robust picture of Canadian innovation, this year we've also included an analysis of Canada's global rank with respect to patent applications. This analysis builds on a report by Cycle Capital and Sustainable Development Technology Canada and was performed using public data from the World Intellectual Property Organization (WIPO) for the period from 2011 to 2015.

As always, we prepare this report for the clean-technology companies that participated in our research; elected officials and their advisors with responsibility for finance, innovation, infrastructure, procurement, trade, energy, and environment and climate change; as well as our private- and public-sector subscribers.

What is clean technology and what is a clean technology company?

Clean technology does much more than produce renewable energy. In Canada alone, the innovation-based firms that make up the industry reported more than $13 billion in revenues and operate in one of ten sectors. These sectors form the basis of the *2017 Canadian Clean Technology Industry Report*. They fall under three broad market segments: Upstream, Downstream, and Water & Agriculture.

We define a clean technology company as one with proprietary technology or know-how that addresses one or more of the following markets:



Clean technology: re-imagining our society

In the coming decades, Canadian entrepenurs will harness digital and clean technologies to reinvent almost all aspects of contemporary life—how we live, work, learn, play, get around… the works. The climate challenge, and widespread degradation of air, water, and land, as well as Canada's exposure to climate-related financial risk, demands we make sweeping changes to "business as usual."

In the next 35 to 85 years, we will transition to a world in which we no longer burn fossil fuels to meet our energy needs. At the moment, fossil-fuel exports represent 20 percent of all Canadian exports. Eventually, we will need to replace this export revenue with other globally competitive goods and services. Doing so will require Canadian leadership on global technology standards that deliver environmental benefits, so that Canadian intellectual property can form the basis of our future prosperity, just as non-renewable natural resources have in the past. Canadians support both climate action and economic diversification. Clean technology offers the chance to do both; it is not one or the other.

Though they are not yet widely known, innovators are creating new systems to address climate change, and clean technology is playing a major part in this effort. Without much fanfare, more than 55,000 people now work for Canadian clean technology companies. So why haven't more Canadians heard of them? Spreading the word is part of how we will re-imagine society, the environment and the economy.

The good news

Canada's clean-technology industry now boasts more than 850 technology companies, including many small and medium sized enterprises, operating in ten sectors and in every region of the country. To place this in context, 700 firms comprise Canada's aerospace sector, and the automotive sector boasts 450.

With respect to revenue, employment, and exports, the clean-tech industry remains a significant contributor to the economy.

In 2015, industry revenue clocked in at an estimated $13.27 billion (up 8 percent from $11.63 billion in 2014, on par with the year-on-year growth rate for the global market in manufactured Environmental

Goods. Clean technology companies directly employed 55,200 people.

At $6.7 billion, export revenues from these innovation-based firms exceeded the halfway mark in 2015, with 18 percent of sales originating with non-U.S. markets.

Seventy-eight percent of Canadian clean-technology companies export goods and services; 93 percent anticipate doing so by 2017.

In response to market forces, companies are accelerating the move away from one-time sales business models and continue to move towards recurring-revenue models. Sales originating with one-time sales fell from 54 percent of sales in 2013, to 47 percent in 2015, suggesting growth in more capital-intensive business models.

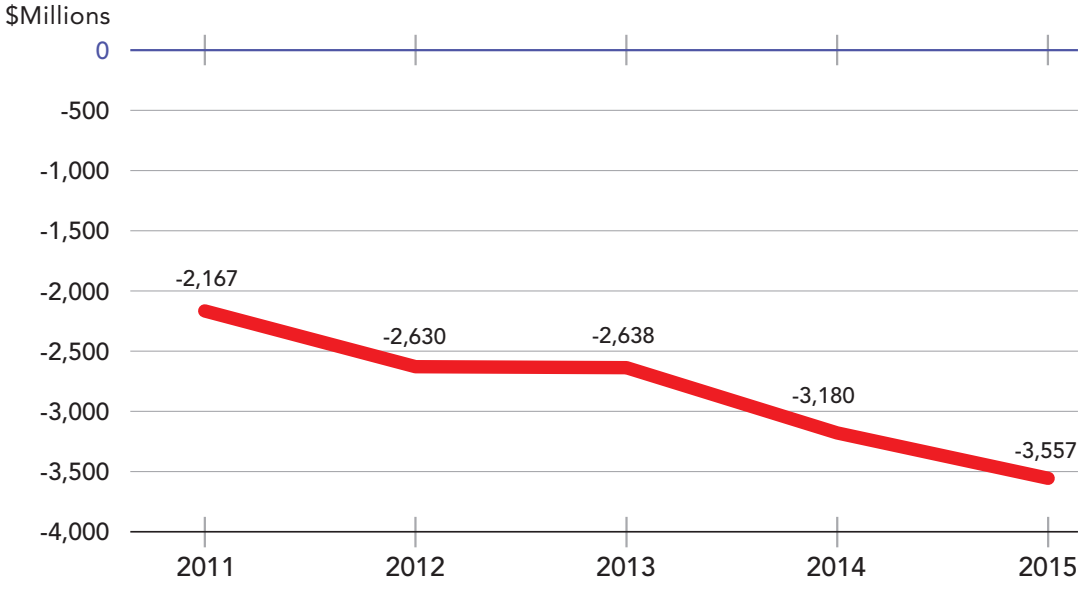
The same companies are investing in innovation, spending more than $1.5 billion in R&D in 2015, and $8.2 billion cumulatively between 2009 and 2015. The lion's share of the latter total, $6.1 billion, originated with firms logging less than $50 million in revenue.

The bad news

The industry continues to benefit from significant government investment; the public sector provides more than a quarter of R&D investments. But overall, the industry is awash in red ink and shareholder returns are negative.

Retained earnings for the industry have declined each year for the past five years. The rate of decline moderated very slightly between 2014 and 2015, but the trend remains decidedly negative. Deeper analysis suggests that markets for low-carbon innovation have yet to emerge.

RETAINED EARNINGS, CANADIAN CLEAN TECHNOLOGY FIRMS, 2011-2015



Source: Statistics Canada. **N=713**

Our analysis of firm-level financial extracts reveals a negative return on sales since 2011. While the rate of negative returns did decrease in 2014 and 2015 for the cohort of firms as a whole, most operate in unprofitable markets. To us, this suggests that the federal investments in working capital, large project finance, and equity and venture capital, must be deployed urgently with a clear mandate to address market failures.

Our research finds that aggregate losses are diminishing for late-stage firms (e.g., Product Commercialization & Market Development, and Market Entry & Market Volume) and appear to be on a steadily improving trajectory, but returns to shareholders even for mature firms remain below those of the lowest-risk investments in the economy. While early-stage firms (e.g., Research & Development and Technology Development & Demonstration) are not expected to be profitable, their profitability actually decreased from 2011 to 2015.

All but one sector have experienced five consecutive years of negative returns on sales. We note that those sectors with steadily negative, or barely positive, returns deliver products and services that will be critical for the low-carbon economy. All fall under provincial and territorial jurisdictions.

In particular, the Energy Infrastructure/SmartGrid sector—vital to the clean-energy transition and squarely within provincial jurisdiction—has operated in the red for five straight years. Similarly, Canada will not likely meet its *Paris Agreement* objectives without a healthy low-carbon Transportation sector — a global high growth sector — yet this sector has also seen five years of negative returns. The same holds true for sectors with blended provincial and federal responsibilities, such as Biorefinery, which holds the promise of coverting biomass into high-value products. We also logged losses in Water & Wastewater, Agriculture, Industrial & Extractive Technologies. The Energy Efficiency/Green Buildings sector nearly broke even over the study period, suggesting that markets for improved building efficiency are finally forming.

The Power Generation sector offers the exception to these persistently negative returns—the only sector with positive returns on sales from 2011 to 2015. This suggests that a strong domestic and global policy environment providing investor certainty has made a difference for innovation-based firms that provide solutions to global renewable-energy developers.

At a time of negative return on sales and weak investor returns, demand on capital is high, and likely to grow. Market dynamics between clean-tech buyers and sellers have led to an increase in the proportion of firms providing turnkey solutions, as opposed to those that license technology through joint ventures or one-time sales. Between 2013 and 2015, we witnessed a marked increase in the number of firms with business models that required them to finance turnkey solutions. This points to market conditions that require investors to “double down” on their investment. Is it wise for them to do so? Return on Capital Employed (ROCE) ratios for the industry compared to returns for the aggregate of Canada’s non-banking firms would suggest not. This highlights another fundamental challenge for clean-tech firms seeking capital: Investors can generate better returns elsewhere.

ROCE is the “great equalizer” of financial ratios. It shows returns on shareholder investments, excluding short-term assets that do not carry interest. Here, again, findings point to market failures. For 2015, Statistics Canada published a ROCE of 4.4 percent for the aggregate of all Canadian firms excluding the financial sector. This is higher than most clean-technology firms making investments in intellectual property with the expectation that returns would be superior to the aggregate of the Canadian economy. Excluding the financial sector, the ROCE of clean-tech firms engaged in commercialization was barely higher than that of Canadian firms overall.

The picture does not improve when viewed under the lens of highest-growth companies. In 2015, first-quartile firms by revenue growth showed negative 25 percent ROCE. Meanwhile, firms with first-quartile employment growth reported negative 15 percent ROCE. Early-stage firms are managing their capital tightly with relatively better ROCE at negative 9 percent, having markedly improved returns since a low of negative 33 percent in 2013.

Help wanted; millennials encouraged to apply

Canada's clean-technology sector continues to prove itself a pillar of the country's clean-growth foundation, where skilled employees are paid well. At a time when growth in high-value, full-time jobs remains patchy, clean technology employees do well.

Direct employment in this industry declined slightly from 2014 to 2015, to just above 55,000. The industry has continued to put young Canadian problem solvers to work. People aged 30 years or under now represent 23 percent of all employees, up from 20 percent last year. If anything, the industry is getting younger. That means that more than 12,700 young people already feel right at home. They are investing their time and talent, and building strong careers.

Currently, engineers constitute 23 percent of the people working in Canadian clean technology—up from 20 percent last year—but many other roles are represented. Skills gaps remain in international business development, international sales, and capital raising. Companies could drive higher industry growth by mentoring young people keen to hone their chops in these areas.

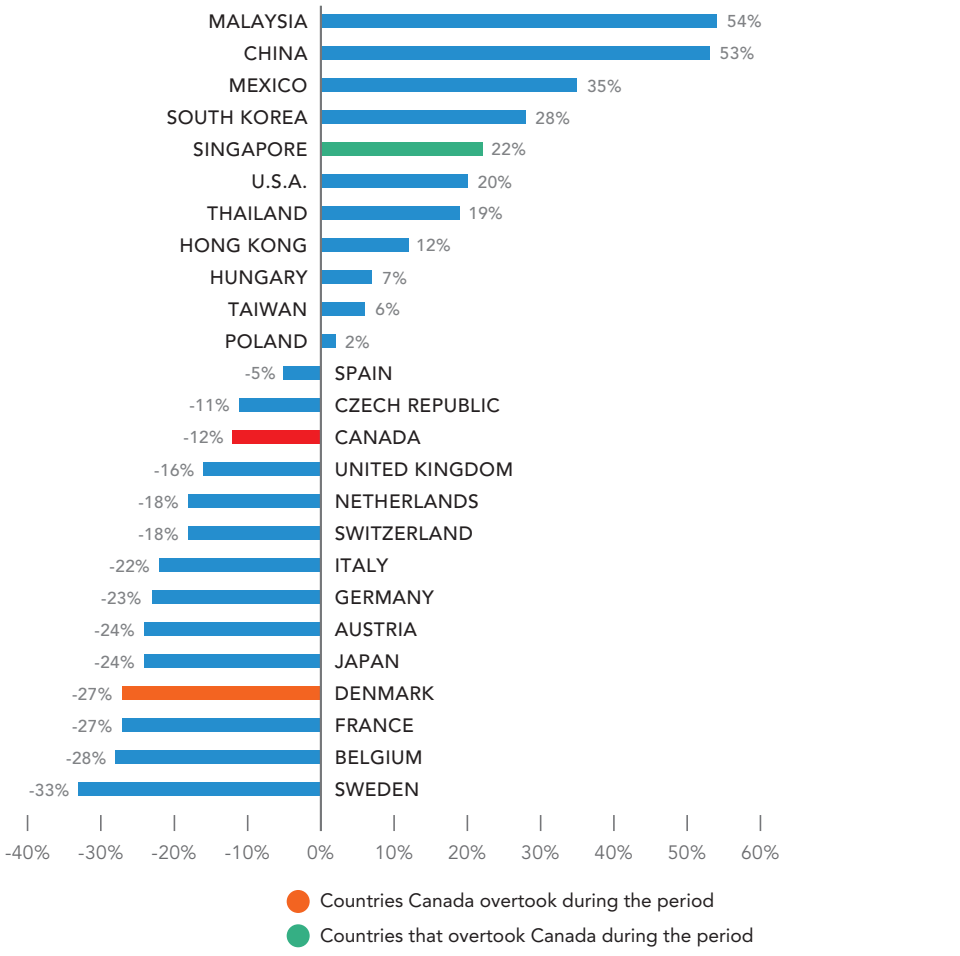
Canada has begun to stem its losses in a trillion-dollar global market

With a CAGR of 4 percent from 2008 to 2015, global trade in clean technology as measured by exports doubled during this period, to more than $1.15 trillion. But Canada's market share of clean technology goods declined by 12 percent, from 1.6 percent to 1.4 percent. Among the top 25 exporters, our global ranking held steady at 16th place.

Canada is not alone in feeling the heat. The figure below depicts recent changes in global market share of clean-technology manufactured goods exports. At current growth rates, the United States will soon overtake Germany as the world's second-largest exporter of clean-technology goods. Top-ranked China continues to dominate, with 21 percent of exports versus second-ranked Germany, with 11 percent, and the third-ranked United States at 10 percent.

During the study period, Canada overtook Denmark in market share, but was surpassed by Singapore.

CHANGE IN GLOBAL MARKET SHARE, MANUFATURED ENVIRONMENTAL GOODS EXPORTS, 2008-2015



Data Source: World Trade Atlas. Source: Analytica Advisors.
Reporting total includes 187 countries. Results from the top 25 exporters reported.

Investments in innovation for the low carbon and digitized economy are at risk if they follow trends for Canada's patent applications

In addition to their leadership of global clean-technology exports, United States, Japan, China, Germany and Korea also hold the top five slots in the world in patent generation for all fields, which suggests that in addition to terms of trade and market-based policies, intellectual property plays a key role in global competitiveness.

With a CAGR of 4.5 percent between 2011 and 2015, global patent applications grew to more than 217,000. But just as Canada dropped in global clean-technology exports, our share of patent applications fell from 1.6 percent to 1.3 percent—a 19 percent decline. Among the top 20 applicants, our global ranking fell from 11th to 12th place, and we were the 4th biggest loser of share. China, the Republic of Korea, and the Netherlands all gained market share, with the United States and Israel only slightly losing ground.

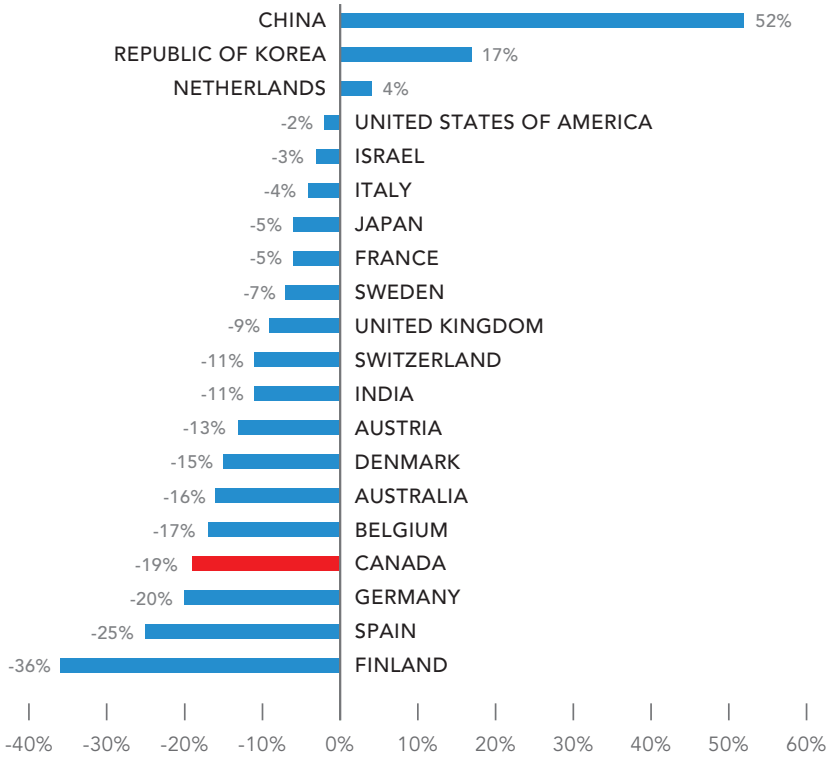
GLOBAL TOP RANKING COUNTRIES FOR PATENT APPLICANTIONS, 2011 & 2015

2011				2015			
2011 Rank	Country	2011 Patent Applications	2011 % of Total	2015 Rank	Country	2015 Patent Applications	2015 % of Total
	2011 Total: 182,112				2015 Total: 217,229		
1	United States of America	48,896	26.85%	1	United States of America	57,121	26.30%
2	Japan	38,873	21.35%	2	Japan	44,053	20.28%
3	Germany	18,846	10.35%	3	China	29,837	13.74%
4	China	16,403	9.01%	4	Germany	18,003	8.29%
5	Republic of Korea	10,446	5.74%	5	Republic of Korea	14,564	6.70%
6	France	7,436	4.08%	6	France	8,421	3.88%
7	United Kingdom	4,848	2.66%	7	United Kingdom	5,290	2.44%
8	Switzerland	4,007	2.20%	8	Netherlands	4,334	2.00%
9	Netherlands	3,502	1.92%	9	Switzerland	4,265	1.96%
10	Sweden	3,462	1.90%	10	Sweden	3,842	1.77%
11	Canada	2,922	1.60%	11	Italy	3,072	1.41%
12	Italy	2,695	1.48%	12	Canada	2,820	1.30%
13	Finland	2,079	1.14%	13	Australia	1,741	0.80%
14	Australia	1,739	0.95%	14	Israel	1,685	0.78%
15	Spain	1,728	0.95%	15	Finland	1,584	0.73%
16	Israel	1,452	0.80%	16	Spain	1,530	0.70%
17	Austria	1,346	0.74%	17	India	1,412	0.65%
18	India	1,329	0.73%	18	Austria	1,399	0.64%
19	Denmark	1,314	0.72%	19	Denmark	1,327	0.61%
20	Belgium	1,191	0.65%	20	Belgium	1,180	0.54%

NOTE: *China's patent applications are estimated to be 43,168 for 2016.*

Source: World Intellectual Property Organization.

CHANGE IN MARKET SHARE BY COUNTRY, PATENT APPLICATIONS, 2011 TO 2015



Source: World Intellectual Property Organization.

Key findings and challenges from the 2017 Report

Is the party over? No, but it's time for a reality check

In previous editions of the report, we highlighted industry growth of four times that of the overall Canadian economy. This growth coincided with declining global GDP and declining Canadian GDP in 2015. The mood and the numbers have since changed; the competitive environment is getting tougher. Between 2013 and 2015, the industry's CAGR was 3 percent.

Although Canada's clean-technology industry still demonstrated strong resilience in fiscal 2015, the headwinds we anticipated in previous editions manifested as low return on capital employed.

The Canadian clean-technology industry is now moving to the slowest of the three growth scenarios that we first published in 2011. Under the slow-growth scenario, we project 2022 revenues at $18 billion. This is a long way from the "$50 billion industry by 2022" goal that we proposed under a high growth scenario in the 2013, 2014, and 2015 editions of this report.

The widespread adoption of an increasing price on carbon will help to begin reversing this trajectory. But it will take much more to establish a sustainable industry. Government must begin the rapid phase-out of fossil-fuel subsidies. It must also develop a strategy to enable firms engaged in emerging technology markets to actively participate in global standards, so they can secure restricted access to markets for their innovation. Provincial and municipal procurement should play a key role in the inclusion of lower cost, low-carbon innovation in infrastructure projects. Equally important, Bay Street needs to come to the table; asset owners must require reporting on material carbon emissions and monitoring of leading indicators of carbon reductions, such as investments in innovation to deliver reduced emissions. Realigning financial flows in Canada's financial sector with climate goals should support the growth of companies delivering solutions to climate change—including those with high capital requirements.

Despite this news, the industry remains a source of sustainable and growing exports as commodity-led industries face lower demand and international competition. And the clean-technology industry continues to step up. Revenues from recurring-revenue business models have grown. To sustain these, firms will require rapid access to significantly higher amounts of debt in the form of project finance as proposed in the 2017 Federal Budget.

As the industry takes on bigger turnkey projects, and as firms scale up, companies will find themselves constrained by a lack of debt financing. Debt markets have been very slow to form in Canada and our firms have increasingly looked to venture-debt providers, foreign banks, and international financial institutions. Budget 2017 proposed a BDC working capital fund as well as EDC large project finance funds. All need to be up and running as soon as possible with clear mandates to address market failures.

As part of its Innovation Agenda, the federal government is now reviewing its considerable array of innovation policies and programs. Past programs have produced know-how supporting clean technologies with the potential to deliver broader environmental and economic benefits. If government sets a course to embed Canadian intellectual property at the core of international standards, climate and environmental regulation, infrastructure, and public procurement policies, then we expect healthy

shareholder profits will follow, along with an increase in foreign direct investment—which will boost the economy overall.

If policy makers can smoothly hand off of the baton from the domain of innovation to that of standards, regulation, and infrastructure, Canada might reverse negative productivity indicators and regain patent application market share. Central to that hand-off will be policies that translate public investments in innovation into prosperity and benefits for society—at a time when demand for hydrocarbons must inevitably decline and markets for other natural resources may decline due to carbon prices on energy used for global shipping. Should government drop that baton, clean technology will go the way of other leading Canadian innovation-based industries that scaled up elsewhere.

The federal budget included $1.8 billion in funding for venture capital, working capital, equity and large project finance. These funds will need to begin flowing immediately. A supporting suite of policies to secure Canada's clean innovation in the form of standards and regulation must follow suit very quickly.

More well-paid, export-driven middle-class jobs, but missed opportunities

This sector continues to prove itself a clean-growth engine, and it continues to support Canadian families. These are the kinds of jobs that Canada needs to re-invigorate its middle-class home-buyers, consumers, and future generations of savers.

Between 2014 and 2015, direct employment in the Canadian clean technology industry declined slightly by 400 jobs, to 55,200 jobs. Still, employment in the clean technology industry exceeds direct employment in the forestry and logging industries, as well as sectors such as pharmaceuticals and medical devices.

If the industry regains the momentum that delivered 11 percent employment growth in the 2011–2013 period and achieves an 8 percent mid-growth scenario, the industry will directly employ 95,000 people before 2022.

Further, rich potential exists for indirect job creation. Canadian clean-technology companies manufacture a full 51 percent of their own bill of materials and source another 31 percent domestically. This will change over time, and materials sourced globally will likely grow, but if properly established through global standards bodies and domestic rules and regulations, this innovation-driven global industry could continue to deliver dividends from intellectual property for some time to come.

Should the industry's employment growth not bounce back in the coming years, the 4 percent low-growth scenario for industry employment suggests that the industry would employ 72,000 people directly by 2022. That is 42,000 fewer jobs than the high-growth predictions of previous years. That's 42,000 middle-class, high-value jobs that Canada needs, but may never see.

Canadian financial institutions missing an opportunity?

Financing remains a dominant concern for clean-technology companies in Canada and elsewhere. Previous reports have highlighted the opportunity to increase equity investment in Canadian innovation-based industries. Regrettably, the situation remains the same and, if anything, has worsened in the area of debt financing.

Debt financing is now an increasingly important aspect of the growth of the Canadian clean-technology industry. The market demands deployment of know-how and intellectual property via turnkey service contracts, including financing. As companies scale up these operations, access to debt will play an important role in their ability to grow and export.

And there's the rub. This year's report highlights a growing problem: Canadian banks and financial institutions are not engaged with the sector. There is increasing evidence that international institutions, which have become familiar enough with the sector to build underwriting capacity, are stepping into the gap left by Canada's private-sector banks.

These market developments may present both challenges and opportunities for Canadian firms. Internationally, banking regulators are assessing the potential impact of climate on lending portfolios. In China, for example, policy makers are also considering how best to review capital ratios, to loosen credit requirements for carbon-reduction project loans—and by extension reduce the carbon exposure of lending portfolios.

This may be a way to break the log jam for Canadian firms needing access to debt that will outstrip the working capital fund and large project fund provided for in Budget 2017. In the meantime, it is worth bearing in mind:

- The average interest rate paid by Canadian clean technology companies on working capital loans increased from 6.8 percent in 2013 to 8.5 percent in 2015.

- Growth Capital remains the top-listed barrier for Canadian clean technology companies, followed by Capital Raising Talent and Venture Capital Series seed, A, B. Forty-three percent of companies surveyed sought venture capital in 2015, and 45 percent of those secured it. Fifty-two percent of venture capital investors were based in Canada, 28 percent in the US, 9 percent in the EU, 7 percent in Asia, and the remaining 4 percent were from elsewhere.

Still globally ambitious, but not out to rule the world

Our research revealed that many clean-technology companies are refocusing their attention away from dominating global markets. This reflects intense pressure on margins as described above.

Between 2009 and 2015, Canadian firms focused less on dominating global markets, and more on uncovering and exploiting niche opportunities. Our research finds that the number of Canadian firms that have done so has nearly doubled—from 16 percent in 2009 to 31 percent in 2015. But Canadian clean-technology firms are less interested in becoming mere suppliers in global value chains and building to specification. They instead remain focused on developing and delivering complete solutions based on intellectual property and know-how—albeit with a greater focus on niche markets. Accessing global value chains is a legitimate priority of SMEs in emerging markets.

To better support the ambitions of Canadian firms, federal and provincial governments will need to more effectively integrate policy. Joint infrastructure-investment initiatives must consider the role of newly commercialized solutions. For example, the federal government must duly consider value for money in evaluating new investments in water and wastewater and transportation infrastructure innovation.

For example, consideration of both capital expenditures, operating expenditures and a price on carbon can provide a more equal playing field for innovation as part of infrastructure procurement. From a trade perspective, we should be aware of key policies for our trading partners when it comes to procurement. Since 1958, the United States has had legislation that requires consideration of small and medium sized companies in all public procurement—as well as all procurement by firms receiving significant public contracts. Canada must consider U.S. approaches in its NAFTA II negotiation strategy.

Still an export-fuelled industry with lots of untapped growth potential

For the second year in a row, exports exceeded domestic revenues—reaching $6.7 billion, or 51 percent of revenues. Eighteen percent of sales went to non-U.S. markets. The industry expects that exports will grow from 51 percent of all industry revenues in 2015, to 57 percent in 2017.

The proportion of companies actively exporting grew to 78 percent during 2015, up from 68 percent during 2013 but down from 2014. This finding reflects the lower value of the Canadian dollar in 2015. The industry has an ambitious forecast for the next two years. Fully 93 percent of companies expect to be actively exporting this year. It will be interesting to note if the industry achieves this goal, given the Canada-E.U. Trade Agreement, growing U.S. "Buy America" sentiment and the renegotiation of NAFTA, the impact of Brexit on foreign direct investment flows, and currency fluctuations.

Clearly, Canadian clean-technology companies are accomplished exporters. It is less clear that they will have access to domestic-market opportunities and debt finance as a springboard to build strong international credentials in the delivery of complete solutions. To accomplish this feat, government will need to modernize regulation and pursue financial innovation that reflects international best practices on climate-related financial risk disclosure for banks and other financial intermediaries. Asset owners such as pension funds and insurance companies may examine how asset managers monitor investment in climate-related innovation aimed to make material reductions in carbon emissions. This may provide a leading indicator of carbon-risk reduction.

With no sign of a global clean-technology slowdown, and an acceleration of policy and investment in the wake of the *Paris Agreement*, the choices made by private sector leaders will have an impact on the sector's potential. In the low-growth scenario, exporting 70 percent of industry revenues would represent $13 billion in exports by 2022. A mid-growth scenario would unlock exports on the order of $19 billion.

Declining market share in Canadian clean-technology exports would suggest the mid-growth scenario goal may now be out of reach. We remain convinced that with smart private and public sector policy, Canada can turn this ship around, grow market share, and once again attain its fair slice of global trade in clean technology.

Will others benefit from Canada's R & D investment?

As noted above, between 2009 and 2015 the industry logged a cumulative $8.2 billion in R&D. Firms with less than $50 million in annual revenues comprised $6.1 billion of this total. To us, this situation suggests that many firms are making themselves targets for acquisition by foreign companies.

Innovation-based firms invest in intellectual property rather than fixed assets, which will impact their access to asset-based lending and therefore their ability to deliver fully financed turnkey systems. But if all the financing goes into turn-key systems, what's left over to finance R&D and IP? Without a serious strategy to protect IP through patents embedded in global standards, there is cause for concern.

In the absence of coordinated policies to spur IP generation and protection as well as new market-mechanisms for finance, push-based policies that focus on invention—without a strategy to generate prosperity from ideas—risk creating an R&D bubble. And as more R&D is invested in the industry, we expect companies lacking a solid base in the Canadian domestic market, especially those with strong IP protection strategies, will be sold or acquired.

Countries such as China, the Korean Republic and the Netherlands are moving smartly to deploy policies for the low carbon and digital economy, to generate and protect IP. China and the Korean Republic have achieved competitive results with their investments in innovation policy. It's high time Canada took note.

Conclusion

Canada can apply numerous powerful policy levers to significantly grow the nation's clean-tech sector. We can and should build a significant economic sector, relevant across the country.

Our nation accounts for 2 percent of the global economy. With the decline of Canada's global market share in Environmental Goods, Canada should aim to achieve an equivalent global market share in clean technology.

If we were to achive 2 percent, Canada could create a $50 billion industry by 2022, to the immense benefit of our economy and society. To build this globally competitive, multi-billion dollar industry, we would need to nurture dozens of Canadian clean-technology companies to enable them to reach the $100 million revenue threshold. This was our clarion call seven years ago, when we completed the first edition of this research. It remains our goal today.

The clean-technology sector has made a powerful beginning and set an ambitious goal. But we are suffering a setback. The sector is swimming in red ink and returns don't reflect unstinting public investments. At the same time, conditions have never been riper for the sector to grow wings and take flight. It is time to take the necessary steps to capitalize on our know-how, get back to the black, and realize this once-in-a-generation opportunity.

2017 Recommendations

Context for the 2017 Canadian Clean Technology Report Recommendations:

• Canadians understand the imperative to move to a low-carbon economy;

• Canada is the world's fourth most GHG-intensive economy per GDP and the most GHG-intensive economy per capita. Mitigating and adapting to climate change requires changes to existing systems;

• Canada has many firms producing innovative goods and services to protect the air, water and land. The shareholders of these firms are experiencing the effect of low prices on negative externalities and other market failures due to asymmetric information and lack of transparency in capital markets;

• Canada remains committed to multilateralism via participation in processes such as the UN Framework on Climate Change and the 2030 Agenda for Sustainable Development.

To these ends, we recommend policy makers:

Translate Canada's Paris Agreement commitments across the economy:

A. Finance Canada and their provincial counterparts should establish a formal consultation with the Canadian financial industry on the degree to which financial flows are consistent with Canada's Paris Climate Agreement commitments, including the potential impact of climate-related innovation to reduce climate-related financial risk

B. Finance Canada and Natural Resources Canada and the provinces and territories should establish a formal consultation with the Canadian energy sector on how to unwind $3.3 billion in fiscal subsidies to the fossil fuel industry and a consultation with stakeholders on global best practices for the redeployment of savings from the unwinding of fossil fuel subsidies.

C. Environment and Climate Change Canada should engage provincial counterparts in a formal consultation on the UN 2030 Sustainable Development Goals to establish data requirements to assess current achievements at the provincial and municipal level and establish future goals.

D. Environment and Climate Change Canada should formally consult on the role and impact that innovation will play in Canada's effort to meet UN 2030 Sustainable Development Goals and implement the *Pan-Canadian Framework on Clean Growth and Climate Change*. The department could do so in conjuction with with provincial counterparts, and employ a similar format and methodology as the consultations conducted with emissions-intensive, trade-exposed sectors.

E. Global Affairs Canada shoud instruct Export Development Canada to hold consultations on how best to redirect $3 billion in publically financed working capital loans that are currently extended to international petroleum companies.

F. Infrastructure Canada should identify global best practices in assessing the sustainability of infrastructure projects to inform project proposals. Criteria may be identified through the G20 Infrastructure Hub. Examples of project evaluation criterial include a rising price on carbon for the life of the infrastructure as well as alignment with 2030 Agenda for Sustainable Development.

G. Innovation, Science and Economic Development with their provincial counterparts should engage in formal consutations on the impact of market failures for emerging clean technology markets on the ability of Canadian firms to finance patent applications, patent maintenance and the ability to participate in global standards bodies.

Establish reporting and accountability mechanisms to make resource productivity a driver of private-sector innovation investment:

H. Provincial and federal auditors general should include resource efficiency indicators in their climate-change accountability framework.

I. Natural Resources Canada should conduct a consultation with private-sector stakeholders to establish a baseline for timely reporting on resource productivity compared to OECD peers. Scope would include indicators such as water, and all forms of energy, including electricity, liquid fuels, and other minerals such as rare earths. An assessment of patents associated with these productivity areas should be conducted.

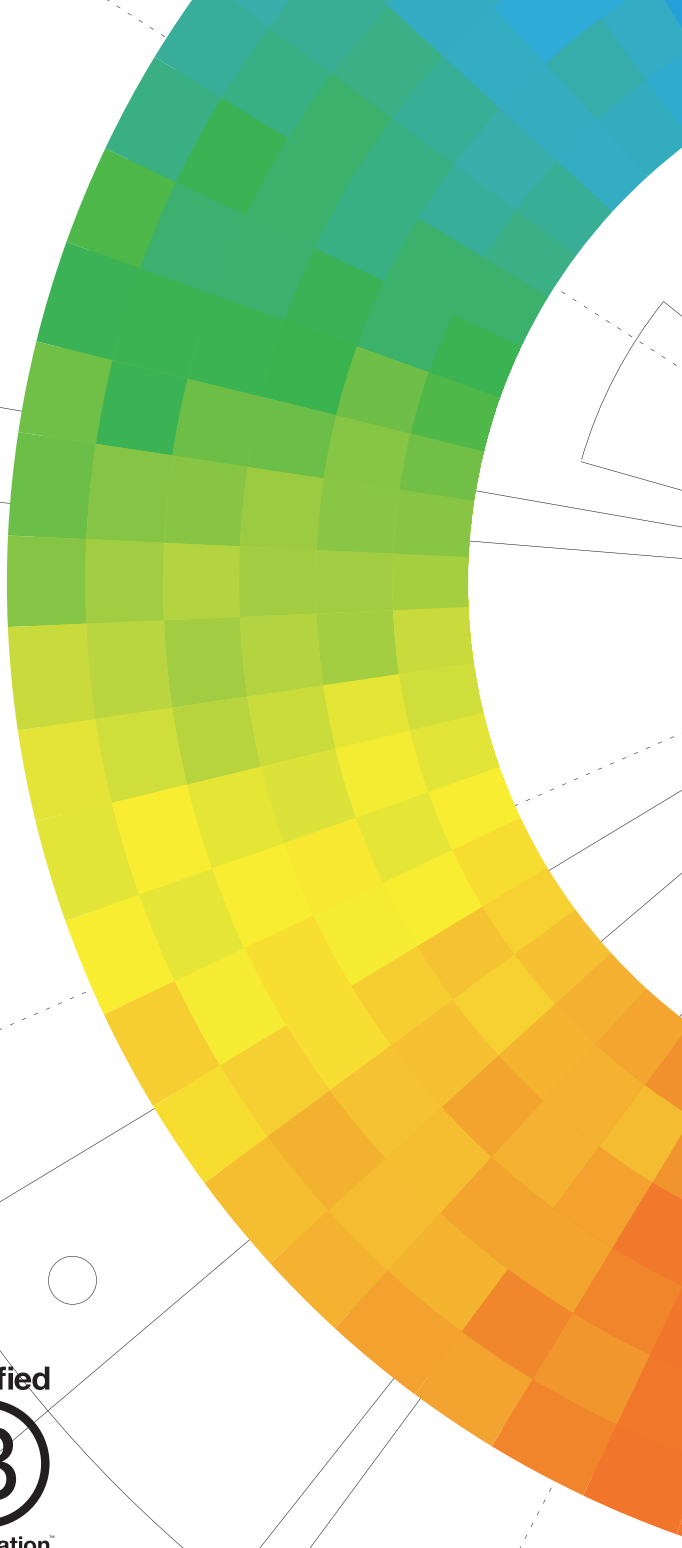
J. At the G7 and G20, Canada should promote the development of tools to build the foundations of productivity, including assessments of the impact of structural economic barriers to investment in innovation. These baselines would subsequently inform innovation policy investments at Innovation, Science and Economic Development Canada.

Invest in multilateral processes to improve the business environment for private-sector investment through reduced policy risk:

K. Environment and Climate Change Canada should participate in peer reviews for eliminating fossil-fuel subsidies, UN 2030 Sustainable Development Goals, and the UNFCC's Facilitative Dialogue. Wherever private sector consultations are part of these processes, the department should include representatives from clean-technology firms and their shareholders.

L. Natural Resources Canada should assume leadership on multilateral energy-efficiency and resource productivity/circular-economy initiatives, including through the G20 platforms.

Note: We originally published the above recommendations on Environment & Climate Change Canada's "Let's Talk Climate" consultation website. In January 2017, the Centre for International Governance Innovation (CIGI) published a policy paper containing recommendations to ensure public spill-over benefits from low-carbon innovation. That paper, "Policy Paper 114: Generating Growth from Innovation for the Low-carbon Economy: Exploring Safeguards in Finance and Regulation," is available on the CIGI website.



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