



# Innovation in **CLEANTECH**

How Canada can become  
a global leader

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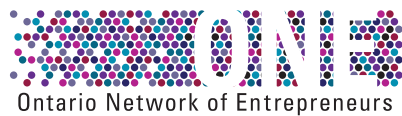
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Innovation Data Partnership Ontario

## ABOUT MaRS

MaRS Discovery District is a not-for-profit innovation hub dedicated to driving economic and social prosperity by harnessing the full potential of innovation. MaRS works with entrepreneurs and investors to launch and grow companies that have broad economic and societal impact, and convenes governments and industry stakeholders to enable widespread adoption in complex markets and systems, including energy. For more information, please visit [marsdd.com](http://marsdd.com).

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CLEAN TECHNOLOGIES ARE **MOVING BEYOND ENERGY** AND TAKING ROOT ACROSS THE ECONOMY. THEY ARE HELPING TO MAKE CITIES SMARTER, PROTECT WATER AND FOOD SUPPLIES, CREATE NEW MATERIALS AND REDUCE WASTE.

Cleantech companies are creating ways for cities to manage traffic and public transit in real time, cutting emissions and saving fuel

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IMAGE: ISTOCKPHOTO

# EXECUTIVE SUMMARY

The global market for clean technologies is expected to expand rapidly in the next decade as countries seek ways to grow their economies while meeting international obligations on greenhouse gas emissions.

Canada's ability to compete for a slice of this market will depend on its ability to rapidly commercialize breakthroughs and grow companies from small startups into significant players on the global stage.

This report examines data compiled by MaRS Discovery District and the Ontario Network of Entrepreneurs on more than 300 companies that are actively innovating and developing clean technologies. It is an analysis of the factors affecting the growth of early stage companies working on the next generation of clean technologies. **It does not encapsulate the entire cleantech sector in Canada or Ontario, which are considerably larger.**

The data suggests that Canadian cleantech is poised for significant growth, led by a cohort of companies reaching the scaling stage together. However, when compared internationally, Canadian cleantech companies grow more slowly and raise less capital than their competitors in countries such as the United States.

Canada should adopt a multi-faceted strategy that seeks to both accelerate the development of innovative startups and remove barriers to the adoption of their technologies domestically and outside Canada.

Key steps include increasing the supply of angel and venture capital and providing greater support for exports. ■

## KEY FINDINGS



### MANY COMPANIES ARE AT THE SCALING UP PHASE

These companies will likely expand their operations rapidly during the next five to 10 years and deploy their technologies at scale.



### CLEANTECH IS A HIGH PERFORMING SECTOR

Cleantech compares well against other innovation-driven sectors on key measures such as capital raised, revenues generated and people employed.



### CLEANTECH STARTUPS ARE GLOBALLY FOCUSED

Export markets are crucial. The sector derives 62% of revenues from outside Canada.



### CLEANTECH HAS EXPERIENCED FOUNDERS

70% of cleantech firms have at least one founder who has started another company.

# ABOUT THIS PAPER

The next generation of clean technologies will be brought to market by companies that are actively innovating and developing new products today. The future health of Canada's cleantech sector rests on the success of these firms.

Company growth depends on a mix of factors, key among which are access to capital and talent, ability to secure intellectual property protections and how soon the firm can start winning customers and generating revenues. The goal of this paper is to determine how these factors affect early stage cleantech companies.

MaRS Data Catalyst has directly surveyed 324 companies drawn from clients of the MaRS Discovery District in Toronto and the Ontario Network of Entrepreneurs.

We have included in this report only companies that meet the following definition:

**A company that is focused on the creation of intellectual property, new products and services that protect and/or increase efficient utilization of land, energy, water or natural resources.**

The majority of these companies are in Ontario, but firms based in Alberta, Nova Scotia and British Columbia are also included. The data reflects the 2014 and 2015 calendar years. Because of the intermittent nature of events such as funding rounds, we report combined totals for the two years together.

To put the data into context, we have selected four other technology-driven sectors to compare cleantech against. These are financial technology (fintech), advanced healthcare, education, and information and communications technology (ICT).

**IMPORTANT NOTE:** This is not a general market-sizing report. We do not include companies that are mainly involved in applying existing clean technologies or multinational organizations, whose activities are captured in other reports. As such, the figures contained here represent only a section of the market and should not be compared to data from general market-sizing reports, which will likely contain significantly larger numbers.

Due to rounding, not all percentages sum to 100%.

See appendix for detailed methodology.

# 01/ THE SHIFT TO CLEAN GROWTH

Across the world, a rush for clean technologies is under way. Canada must prepare its companies to compete.

The global clean technology industry is at a defining moment. The Paris Agreement on climate change, which entered into legal force in October 2016, has established an international commitment to develop a carbon-neutral global economy by the middle of the century.

There's renewed focus for cities and countries to find ways to grow their economies while using fewer resources and creating less pollution and waste.

At the same time, many clean technologies are becoming more economical than ever before. Since 2008, the cost of utility-scale solar electricity has dropped by 64% and land-based wind prices have come down 41%.<sup>1</sup>

There is now a powerful set of economic and policy drivers aligning to create sustained demand for clean technologies across the world.

Consider China and India. They have a combined population of 2.5 billion people and their rapidly growing middle classes are creating an unprecedented demand for energy. With rivers and air clogged by pollution, they need cleaner ways to power production and to transport people and goods. They are turning to clean technologies. China, which already accounts for 40% of renewable capacity increases, will invest 2.5 trillion yuan (\$484 billion Cdn.) into



renewables in the next five years. Chinese cities are also making major investments in emission-free urban transit. In India, the government expects nearly 60% of the country's generating capacity to come from non-fossil fuels within 10 years.

South America is urbanizing rapidly and the region's electricity consumption is expected to double by 2030. More than \$38 billion is expected to be invested in smart grid technologies there in the next decade.

Meanwhile, the world's most advanced economies are also moving towards cleaner technologies. In Europe, the European Union's climate change plan demands a 20% cut in greenhouse gas emissions (from 1990 levels) by 2020. In Canada, the federal and provincial governments have agreed a clean growth framework that includes introducing carbon pricing and measures to increase

Currently, two wind turbines are installed every hour around the world, according to the International Energy Agency

<sup>1</sup> U.S. Dept. of Energy: Revolution Now, 2016.

IMAGE: ISTOCKPHOTO

### FIG. 1.1: CLEANTECH AT WORK

Canadian clean technologies are reducing emissions and saving resources globally. Here are three leading startups that are helping create a cleaner economy.



#### ECOBEE Toronto

Founded in 2007, Ecobee produces smart thermostats with multiple room sensors to reduce energy consumption. They can cut annual heating and cooling costs by up to 23%. Ecobee has proven popular with consumers and is currently growing at 100% a year.

#### HYDROGENICS Toronto

Hydrogenics is a global leader in designing and building commercial hydrogen systems. Its hydrogen generation systems are used for industrial hydrogen production, energy storage and fuelling vehicles. Its fuel cells are used in stationary and vehicle applications, such as buses and trains.

#### GREENMANTRA Brantford

GreenMantra uses a proprietary process to de-polymerize hard-to-recycle plastics and turn them into high-value synthetic waxes that have applications including asphalt for roads and roofing, adhesives, emulsions and inks.

adoption of low-emission transportation and energy-efficiency technologies in buildings.

At the time of writing the United States government appears intent on pulling back from efforts to curb climate change, including the Paris accord, but action at the state level seems likely to continue. For example, California, the world's fifth largest economy in its own right, has pledged to continue efforts to transition away from fossil fuels.

The global demand for clean technologies is there. These technologies are already winning market share from traditional sources of energy and, as costs decline further, their use will continue to increase.

Canada can play a major role in meeting this demand. And it is well positioned to do so.

### POISED FOR GROWTH

Canada already has a well-established cleantech sector with next-generation technologies that can compete in global markets. From the outset, Canada's cleantech firms have to think globally. The nature of

many cleantech problems – such as how to store clean energy, cut pollution from cargo shipping or reduce energy use from street lighting – means that these firms' client bases are likely to be large industrial businesses, municipalities, utilities or public transit operators. In a mid-size economy like Canada's, there are only so many of those clients to go around. So Canadian companies have to look beyond our borders for growth.

As we shall see later, Canada has a relatively large cohort of cleantech companies that are hitting the "scaling" stage of their development together.

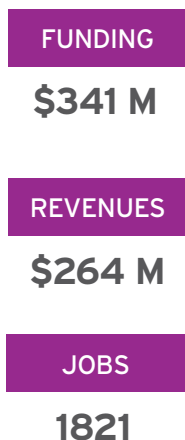
After years of product development, these companies have proven technologies and are set to grow rapidly. Firms at this stage are major drivers of job and wealth creation and are well placed to benefit from increased global demand for clean technologies.

However, competition is intensifying. Conscious of the sustainable well-paid jobs cleantech businesses create, governments in many countries are actively trying to grow their own sectors and Canada has been

IMAGE: ECOBEE

**FIG. 1.2: KEY FIGURES**

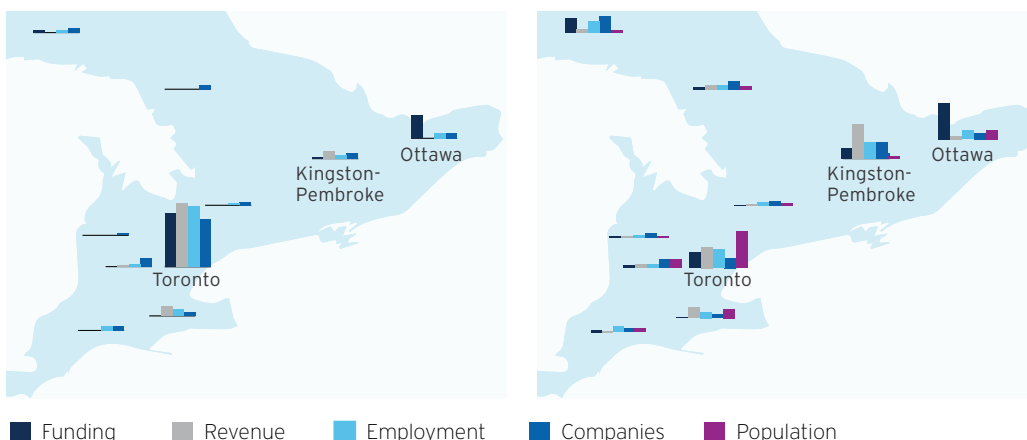
Total funding, revenues and jobs reported by our sample of firms in 2014 & 2015



Data represents only Canadian firms captured in the MaRS survey. Total sector size is larger.

**FIG. 1.3: POWERHOUSE TORONTO**

Toronto has the largest single cleantech cluster in Ontario (left). However, when the data is normalized by population (right), companies are more evenly spread throughout the province, with Kingston-Pembroke and Ottawa punching above their weight.



Data represents only Ontario firms captured in the MaRS survey. Total capital=\$287M, revenue=\$222M, employment=1,375, companies=189. The data in our sample do not permit geographical breakdowns for other provinces.

losing ground. According to a report from Analytica Advisors,<sup>2</sup> Canada's share of the international market shrank from 2.2% in 2005 to 1.3 per cent in 2014.

To reverse this trend over the long term and truly capitalize on the potential of the cleantech sector, Canada must get better at bridging the gap between research breakthrough and commercially successful product.

Canada's academic institutions perform well in turning out original research, but the startups founded here to commercialize these discoveries grow more slowly than their European and American counterparts.

Although the overall supply of venture capital has increased markedly in Canada in the last decade, accessing sufficient funding remains an issue for large parts of the innovation economy. It is a particular concern for cleantech companies, which often

have high funding requirements but long product development times that exceed the time horizons of traditional venture capital investors.

A 2016 study from Cycle Capital Management and Sustainable Development Technology Canada found that, on a per capita basis, venture capital investment in Canadian cleantech is about half the level seen in the United States.<sup>3</sup> Since 2010, only five Canadian cleantech companies have raised more than US\$50 million in venture capital, against 183 companies in the U.S.

The global market for clean technologies is evolving rapidly. Canada can claim a significant slice of that market, if it can swiftly commercialize discoveries and grow startups to scale.

Canada has a good base to build from, now it needs to take the next steps to fully realize its potential to become a cleantech leader. ■

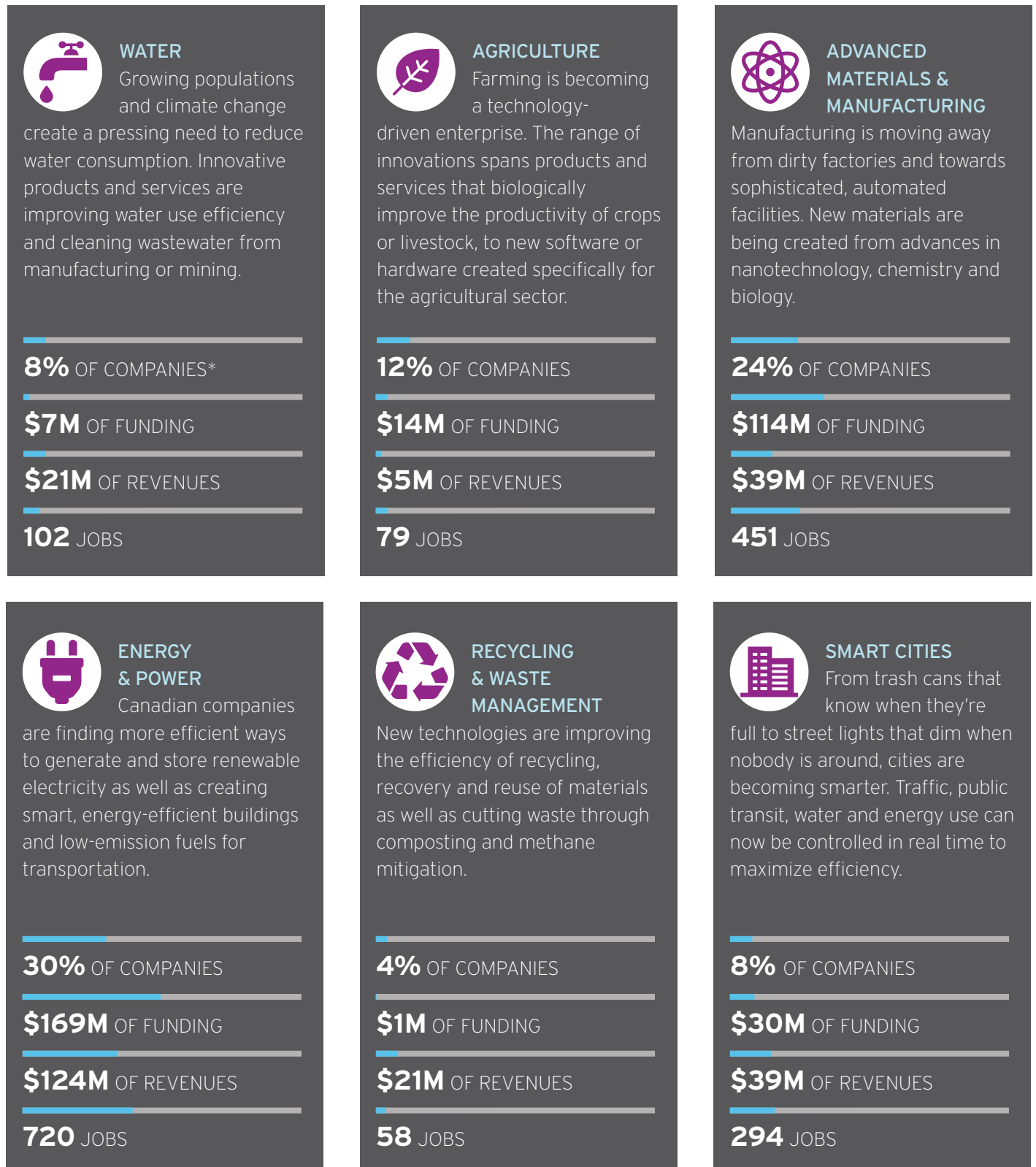
2. Analytica Advisors: 2016 Canadian Clean Technology Industry report.

3. Giles Duruflé, Louis Carboneau: Forging a Cleaner and More Innovative Economy in Canada, 2016



**FIG. 1.4: BEYOND WIND TURBINES & SOLAR PANELS**

Today's companies are innovating across the economy



\* Data from 324 companies in MaRS survey and are combined totals for 2014 and 2015. 15% do not fall into any of these categories and are recorded as "other."

# 02/ STARTUPS & SCALEUPS

A relatively small group of later-stage companies makes an out-sized contribution, creating new products, jobs and revenues.

Cleantech innovation in Canada is a tale of two types of company.

The first is the leading firms that are the country's next cleantech champions. These are at or close to the scaling stage of development where they can grow rapidly, generating revenues, profits and employment.

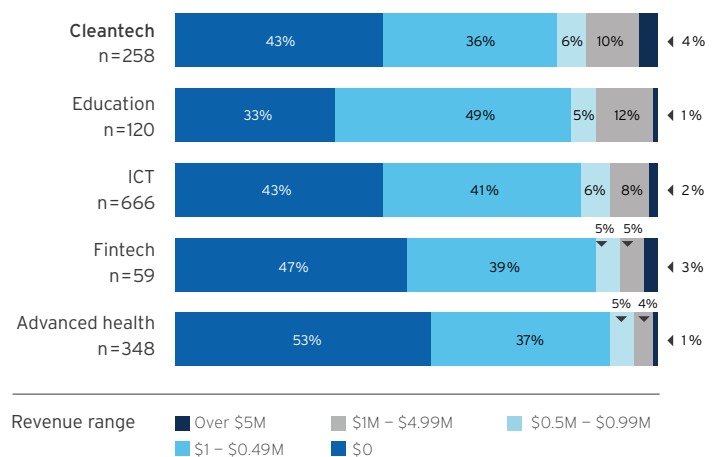
After years of painstaking product development - sometimes as long as a decade - they have technologies that are tested and in the market. These firms are relatively well capitalized, have a customer base and, led by success in markets outside of Canada, have annual revenues that exceed the \$5-million benchmark.

These firms account for 4% of the companies in the sector. Although this number may seem small, it compares well to the number of firms that generally become growth companies in the Canadian economy (see Fig. 2.1).

The second group is composed of firms that want to join the 4%. These are companies that are at much earlier stages of development. They may be startups that are newly out of the gate and have the backing of an angel investor. Or they may be firms that are refining and validating their technologies. Some of these companies may have reached the stage where they've started generating revenue, but their focus largely remains

FIG. 2.1: REVENUE DISTRIBUTION BY SECTOR

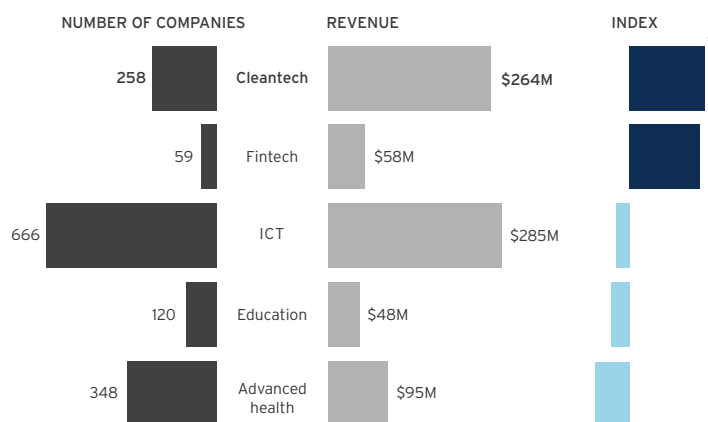
4% of cleantech companies generate more than \$5 million in revenue, the largest percentage of any sector studied



Index values represent the difference between the mean for that category and the mean for all categories combined

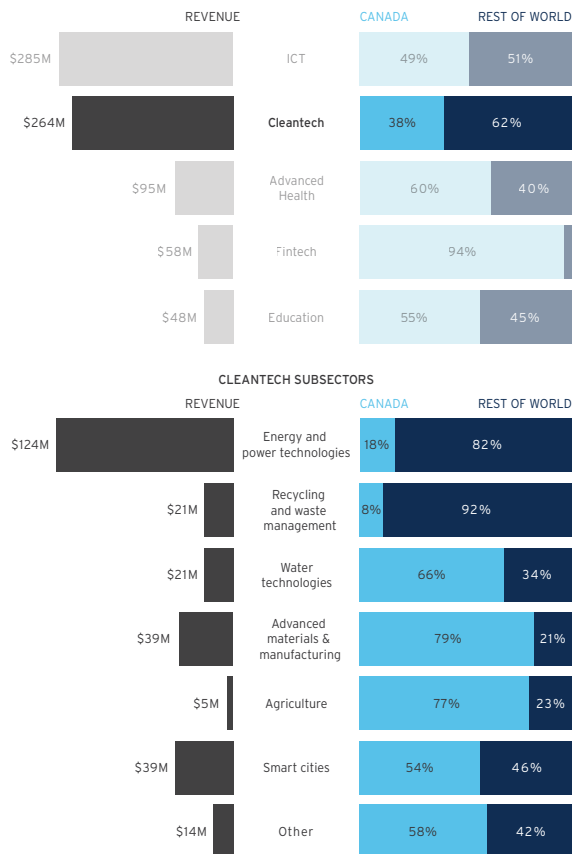
FIG. 2.2: REVENUE

Cleantech firms have the highest revenue per company



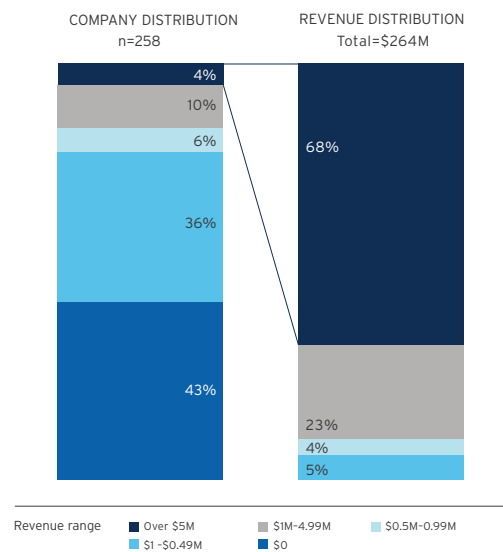
**FIG. 2.3: REVENUE SOURCE**

Cleantech performs strongly in total revenues and exports



**FIG. 2.4: REVENUE DISTRIBUTION**

4% of firms make 68% of the revenue.



on product development. While this 96% of companies accounts for the majority of cleantech firms in Canada, they are out-weighted in revenue, capital and jobs created by the scaling firms. However, they are the pipeline of companies for the future.

The outsize contribution of a relatively small number of firms is a recurring theme in much of the data that follows.

**REVENUES**

During the period covered by our data (2014 and 2015), the firms in our sample generated a total of \$264 million in revenues (see Fig. 2.2). In both absolute terms and revenue per company, cleantech performs strongly in comparison with similar sectors. But it is in exports that cleantech truly shows

itself to be a powerhouse (see Fig. 2.3). Cleantech firms derive 62% of their sales from outside Canada, well ahead of those in the ICT (51%) and advanced health (40%) sectors.

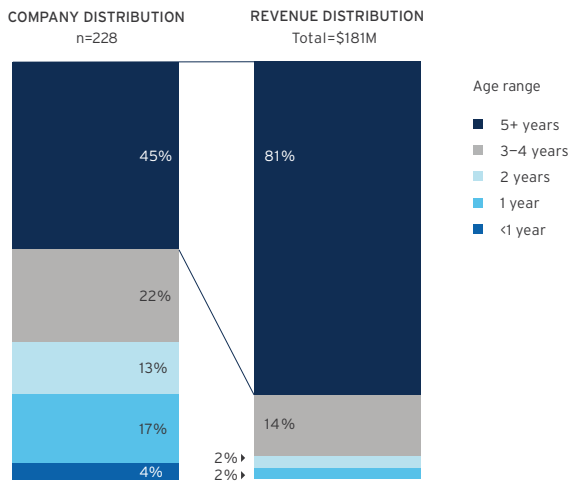
In exports, as elsewhere, cleantech is not a monolith and there is wide variation among the various branches of the cleantech family in their international outlook.

Firms working in the energy and recycling sectors have penetrated furthest into global markets, making more than 80% of their revenues outside Canada on average. For companies working in agriculture and advanced materials, the situation is reversed, with approximately 80% of their revenues coming from the domestic market.

The healthy revenues are likely due to the

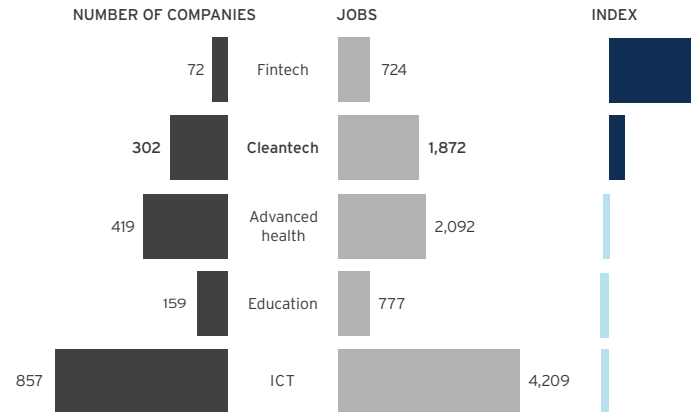
**FIG. 2.5: REVENUE DISTRIBUTION BY COMPANY AGE**

Revenues grow strongly once companies have made it through the technology development stages in their early years



**FIG. 2.6: JOBS BY SECTOR**

Cleantech startups have relatively high headcounts, likely due to the need for large engineering teams



comparatively large number of later-stage companies in the sector. The top 4% of cleantech companies accounted for 68% of the sector’s revenues (see Fig. 2.4). It seems that once firms make it through the development stages, they are able to access high-value export markets – for instance, those associated with large-scale infrastructure projects – and generate strong revenues to fuel further growth (see Fig. 2.5).

That strong export base is a solid foundation on which the industry can grow. But export assistance will likely be critical.

The barriers to adopting new technologies – particularly those developed overseas – vary from country to country, but they are invariably systematic and often complex.

For Canadian firms to continue to succeed, they need both financial support, like federal underwriting for large infrastructure projects abroad, and connections to subsector-specific networks and regional expertise. Partnering with local businesses, such as utility companies or manufacturers of public transit equipment, can be key to developing complete end-to-end solutions, gaining market entry and unlocking sales.

The government could also indirectly support Canadian exports by encouraging adoption of these technologies at home. Strong home market sales are a trust signal potential purchasers often look for when considering buying from a foreign firm.

### EMPLOYMENT

The relative growth and maturity of the cleantech sector is translating into stable, well-paid jobs. At the end of 2015, the firms surveyed by MaRS together employed 1,872 people (see Fig. 2.6). On average, cleantech firms employ more people and have higher payrolls than companies in any other sector, with the exception of fintech. This is likely a reflection of cleantech companies’ need for large and highly skilled teams to tackle complex engineering challenges and the fact that these companies tend to keep development in house to retain intellectual property.

Cleantech firms compete fiercely for talent. The average company payroll is \$120,000, which compares well with similar tech-based industries (see Fig. 2.7). However, it is substantially behind fintech, where the average company payroll is \$200,000

(although that sector was an outlier in our data).

The investment in people appears to be paying off, as revenue per employee (a gauge of productivity and efficiency) is very high. There is also a strong correlation between employment and raising capital, with firms raising \$156,447 in capital for every extra employee hired.

In our data, 15% of firms accounted for 69% of the total employee headcount. As might be expected, there is a strong correlation between revenue and number of staff employed (see Fig. 2.8).

Employment is also not evenly distributed among the various subsectors that make up the cleantech industry. Firms working in the smart cities, energy and power technologies, and advanced materials and manufacturing subsectors employed 80% of all workers (see Fig. 2.9). ■

FIG. 2.7: TOTAL COMPANY PAYROLL

Cleantech payroll compares well with that of similar sectors

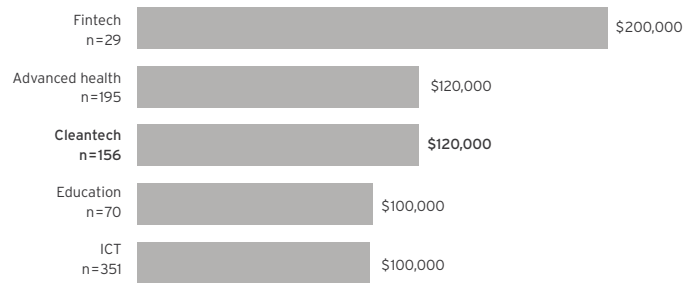


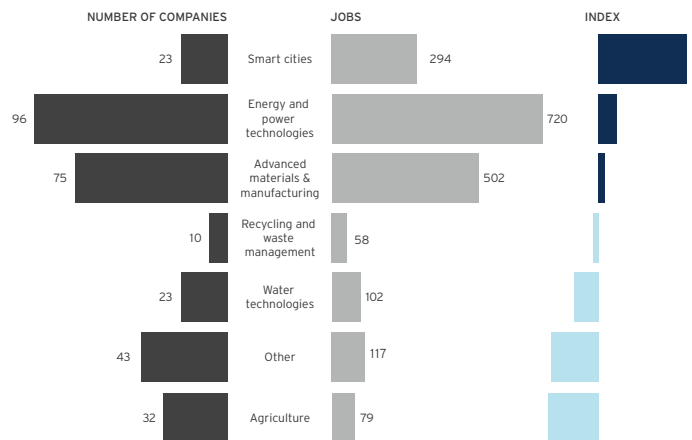
FIG. 2.8: REVENUES AND EMPLOYMENT

There is a strong positive correlation between the two



FIG. 2.9: EMPLOYMENT BY SUB-SECTOR

Smart city companies have surprisingly large workforces



# 03/ DRIVERS OF INNOVATION

It takes a mix of talent, investment, time and ideas to grow cleantech companies. How those factors interact is complex, but crucial for success.

The picture that emerges from the data is of a sector that punches above its weight and has high potential for further growth.

The challenge now is to support the scaling firms as they compete in international markets and to move more startups swiftly along the pipeline. There is, however, much work to do on the latter. Cleantech Group, an industry analyst, reports that scaling firms in Canada's cleantech sector are older than those of other leading countries.<sup>4</sup> They average 10.2 years in Canada, but 9.9 years in the United Kingdom, 8.9 years in the United States and 8.6 years in France and Germany. This suggests it takes longer for Canadian companies to reach the scaling stage.

If Canada is to realize the full potential of its cleantech sector, it must find answers to two critical questions:

- How should financing and support be structured to get more firms to the point of scaling and avoid getting stuck in product demonstration and validation?
- What growth financing or export assistance should be provided to help Canadian firms compete on the global stage?

This section explores how talent, capital and intellectual property protection contribute to the sector's growth. This information provides indicators about where to strategically direct support.

## TALENT: DIVERSITY MATTERS

Few factors are as critical to the success of a tech startup as the quality of its founding team.

At the level of the individual, it is impossible to capture in a dataset the personality traits that make successful entrepreneurs and business leaders. If there were, innovation would be a much more predictable endeavor. However, when founding teams are looked at as a whole, two traits emerge that appear to be important for success: experience and demographic diversity. In general, founding teams that have experience and diversity on their side do better at attracting investment capital than those that do not.

In terms of experience, cleantech firms are standouts among startups. Nearly 70% of the surveyed companies have at least one person on their founding team with previous experience building a new company. These experienced voices help startups avoid common pitfalls that waste time and money, and can also be essential in helping a firm pivot if its engineering or economics do not pan out as expected.

The large percentage of experienced founders is likely a reflection of both the growing pool of serial entrepreneurs in Canada and the sophistication with which cleantech companies must operate from

<sup>4</sup> Troy Ault, Todd Allmendinger, Cleantech Group: Benchmarking the Canadian Cleantech Ecosystem, 2016.

the beginning. These firms set out to solve complex engineering challenges and it can be expected that most company founders would understand the value of partnering with an experienced entrepreneur in navigating the long route to market.

When it comes to demographic diversity, the picture is a mixed one. Canada's cleantech sector is a place where minds from across the world meet. More than half of the surveyed companies have at least one foreign-born person on their founding team and 27% of them have co-founders who were all born outside of Canada (see Fig. 3.1). This likely brings advantages such as a global outlook, familiarity with other markets and the ability to speak multiple languages, which are all helpful in an export-focused sector.

Although Canada's cleantech founders are diverse in their ethnic and cultural origins, they are remarkably homogeneous in another important respect: almost all of them are male.

Just under 80% of the surveyed companies were founded by all-male teams. Only 17% can count at least one woman among their founders, and just 4% were founded by women only (see Fig. 3.2). Of our comparison sectors, only fintech had less female representation.

This gender skew may be because cleantech firms are often founded by engineers, a profession that is still heavily male dominated. Canada has a long way to go before it achieves anything close to gender balance in cleantech, so action on this front is urgently needed.

### CAPITAL: INVESTORS SHOW STRONG INTEREST IN CLEANTECH

Risk capital is the lifeblood of a startup company. From seed-stage funding by angel investors to government support and venture

FIG. 3.1: FOUNDER ORIGINS

Cleantech companies have ethnically and culturally diverse founding teams

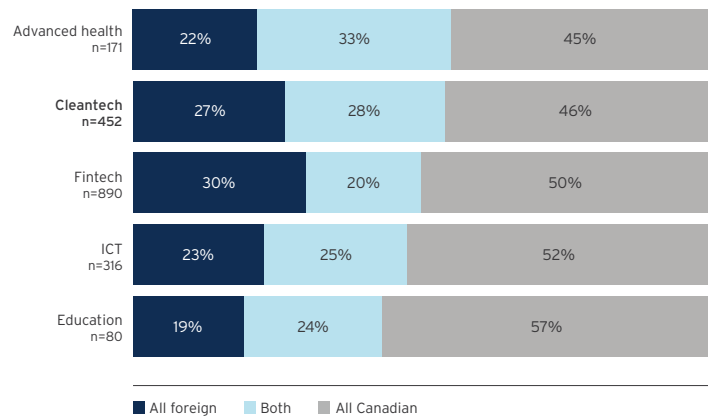


FIG. 3.2: FOUNDER GENDER

Women are under-represented among cleantech founders

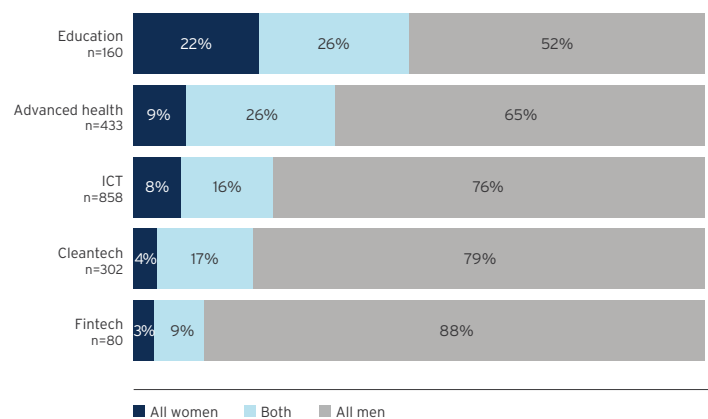
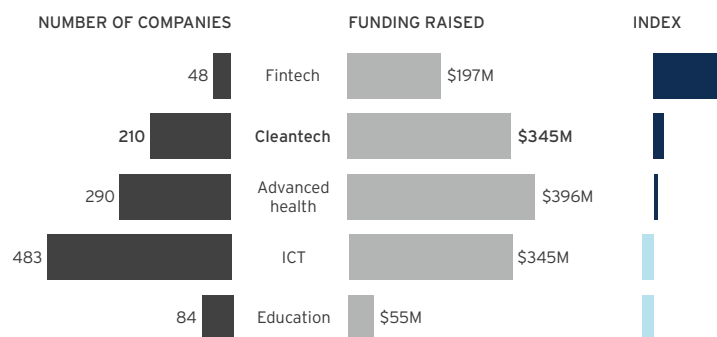


FIG. 3.3: CAPITAL RAISED PER VENTURE

Cleantech is the second most successful sector at raising funding



capital in fundraising rounds, all early-stage companies require regular injections of risk capital to propel their growth. The ability to secure investment is far from a guarantee of success – especially in a company’s very early stages – but it is a prerequisite for it.

Patient capital is especially important for a sector like cleantech, where companies may need to put in years of expensive product development and market building.

### Investors tilt towards later-stage deals

Overall, cleantech is an attractive sector for investors, with only fintech attracting more capital per venture (see Fig. 3.3). As with revenues, investment is dominated by a relatively small number of leading firms: 41% of all capital raised in the sector went into just 4% of the firms (see Fig. 3.4).

In recent years, these later-stage companies have raised increasingly large rounds of venture capital, creating an overall shift away from seed-stage financing to later-stage growth financing (see Fig. 3.5). As a result, the imbalance between later and earlier stage funding is more pronounced in cleantech than it is in any other sector. Cleantech companies aged five or more years raised \$215 million, while all other younger cleantech companies combined raised \$130 million.

Another sign of the growing maturity of the sector is its ability to convert investment into revenue. Overall, cleantech performs reasonably well, generating \$0.86 in revenue each year for every \$1 of investment. However, both the ICT and education sectors perform better (see Fig. 3.6).

There are also some indications that later-stage companies are starting to become less reliant on venture capital as they generate their own revenues. By tracking individual companies, our analysis shows that for every \$1 in revenue a venture generated in Canada in 2014, they raised \$1.37 less in

FIG. 3.4: CAPITAL DISTRIBUTION

The top 14% of companies in our sample raised more than half the capital

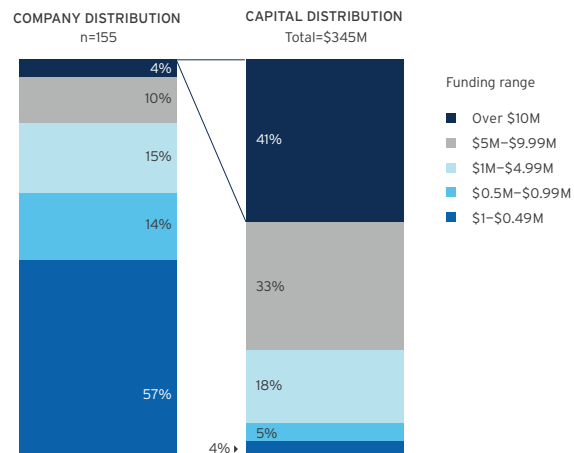


FIG. 3.5: CAPITAL RAISED BY SECTOR AND COMPANY AGE

Capital is particularly concentrated in later-stage ventures in cleantech. (Colours are only comparable within rows, not between them.)

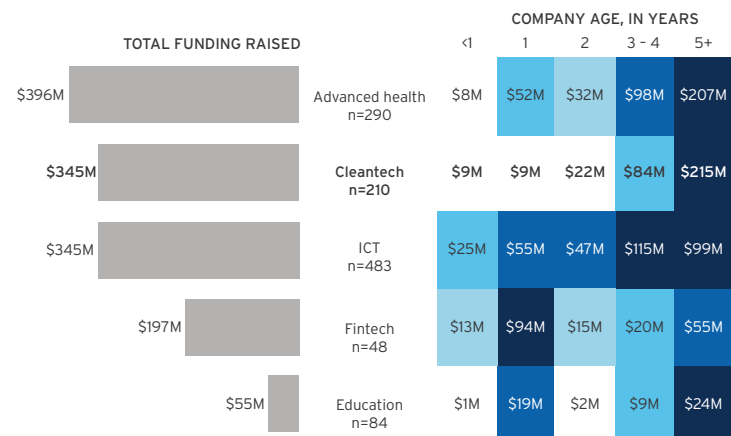
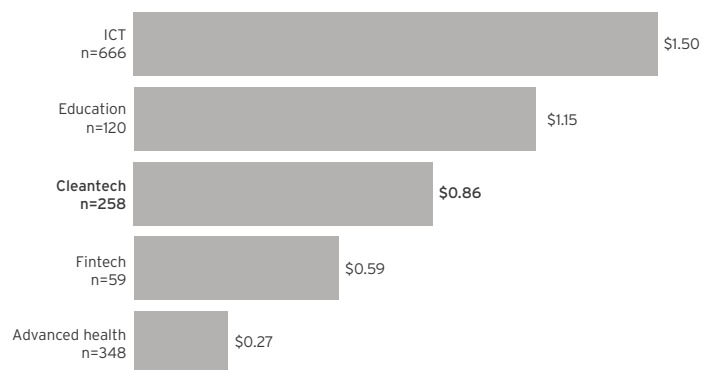


FIG. 3.6: ANNUAL REVENUE GENERATED PER \$1 OF CAPITAL RAISED

Cleantech performs reasonably well at turning investment into revenue





**TABLE 3.1: SOURCES OF CAPITAL**

Venture capital is the biggest single source of investment, but most companies in our sample also received some capital from the public sector

	Funding source	Amount	% amount	Median amount	# companies
Private	Venture Capital	\$159M	46%	\$1,175,000	36
	Angel	\$31M	9%	\$300,000	42
	Other Private	\$46M	13%	\$200,000	70
Public	Federal	\$53M	15%	\$95,000	83
	Provincial	\$23M	7%	\$50,000	52
Other	Undisclosed	\$34M	10%	\$150,672	25
Overall		\$345M	100%	\$200,000	155

funding in 2015. (We see a smaller effect for revenues earned outside Canada, which decreased funding by \$0.43 for every \$1). Although these are only two years of data, a likely explanation is that these firms are increasingly able to finance themselves from their own sales.

Although cleantech performs well against other Canadian sectors in attracting capital, if we look for comparisons beyond our borders, the picture is not as heartening. Canadian cleantech firms have to get by with much less capital than their international competitors. Data from Cleantech Group indicates that deals in the United States are approximately twice as large as they are in Canada. In addition, Canadian firms are more reliant on capital from overseas investors than their peers in the U.S., Germany, France and the U.K. This is likely at least part of the explanation for why it takes longer for a company to reach growth stage in Canada than in these other developed economies.

**Government support stimulates private investment**

Addressing this funding gap will not be easy. Although data from the Canadian Venture Capital and Private Equity Association indicate the country’s overall venture capital

market has grown for seven straight years, between 2013 and 2015 (the most recent year for which numbers are available) investments in cleantech firms declined.<sup>5</sup>

Our analysis suggests that the federal government can make a major contribution to stimulating investments. Ottawa funds a number of grant and loan programs (as do provinces and territories) to support cleantech businesses. Although this funding is not especially large in dollar terms – the median amount firms received from the federal government was \$95,000 – it seems to have an outsize effect in helping companies unlock private investment (see Table 3.1).

The majority of cleantech firms that raised money (53%), did so with the assistance of federal government programs, suggesting that government financing acts as a catalyst for co-investments by venture capital.

For every \$1 of government funding received in 2014, those same companies were able to raise a further \$0.86 in private funding in 2015. However, further research is required to better understand the interplay between public and private sectors, as public money is often linked to pre-existing product validation and the ability to raise match funding. The relationship between public and private funding is, therefore, a complex one.

<sup>5</sup> Canadian Venture Capital and Private Equity Association: Venture Capital Sneak Peek: 2016 Year-in-Review

Additionally, government can build on the significant investments in mature firms led by venture capital, through non-equity or debt financing in the form of export security and financing for deployment of large-scale projects. These will likely be more important for cleantech firms than many other emerging technology sectors, given the high level of working capital needed to support project deployment by customers overseas.

### Angels dominate at early stages

To get going at their earliest stages, cleantech companies are reliant on angel investors (see Fig. 3.7), who are the largest single source of funding for startups in the first two years of their existence. Typically, angels bring more than money to the table: they have expert knowledge on evaluating risks and help guide startups through their critical early days. However, there are a finite number of angels making these investments, creating a funding bottleneck that limits the development of very-early-stage firms.

Public sources of funding do not address this problem, as government financing largely follows these earlier investments rather than stimulating them. Directing more public funding to ventures at the seed stage could help motivate co-investment from angels, essentially de-risking new technology where only a few investors have expertise.

Because the time to growth capital is longer and the size of capital greater than most other sectors, there is a need to create networks of investors and public funders to sustain that pathway over multiple years. Strong executive networks are also important to make expertise from a comparatively experienced founder base more widely accessible to startups. This could increase success rates for new entrepreneurs, female founders and those from outside Canada, who all raise significantly lower than average amounts of capital.

FIG. 3.7: INVESTMENT TIMING

The supply of angel investment is critical to seed-stage companies. (Colours are only comparable within rows, not between them.)

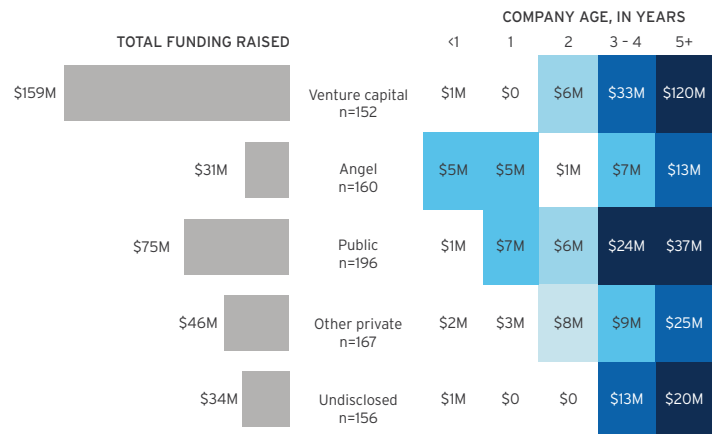
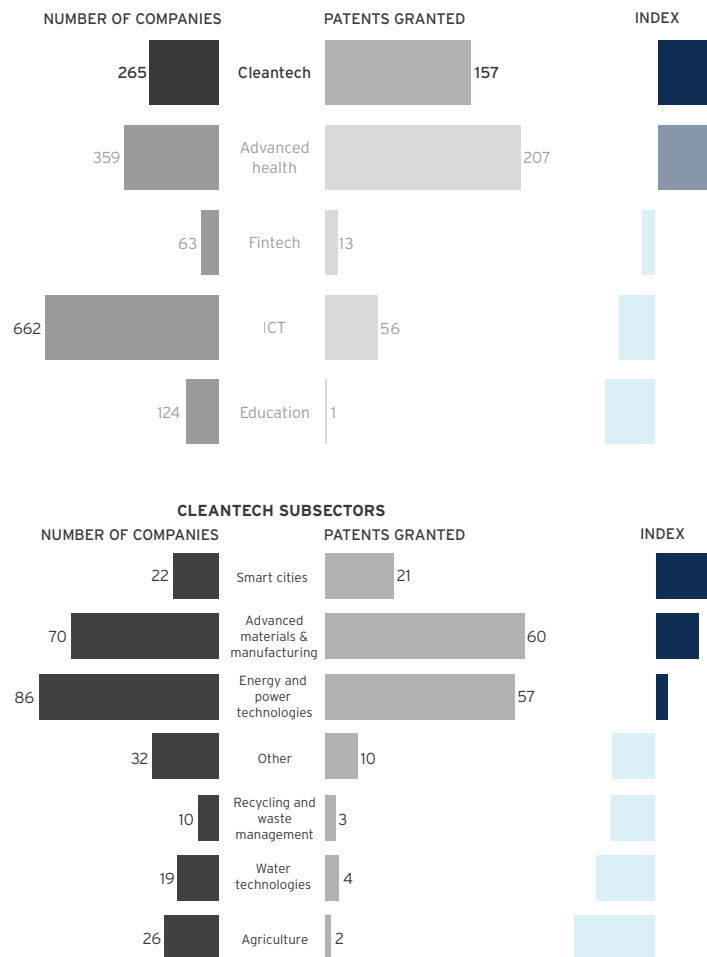


FIG. 3.8: PATENTS GRANTED

Cleantech is ahead of all comparison sectors on patents-per-company (index value) and second by absolute number of patents. ICT fares particularly badly in this comparison as it is notably harder to obtain intellectual property protections for software.



## INTELLECTUAL PROPERTY AND PRODUCT INNOVATION

Cleantech ventures compete on the strength of their technological innovations. The problems these companies are working on often involve the creation of new materials, physical devices or large-scale engineering works. As a result, cleantech companies are more likely than those in any other sectors to introduce new products. They're also the least likely to introduce new services (though most of the products they sell are complemented by installation and lifetime support services, which help drive overall revenues).

Given this focus on product creation, it is little surprise that cleantech excels at generating intellectual property, filing more patents per venture than any other sector (see Fig. 3.8).

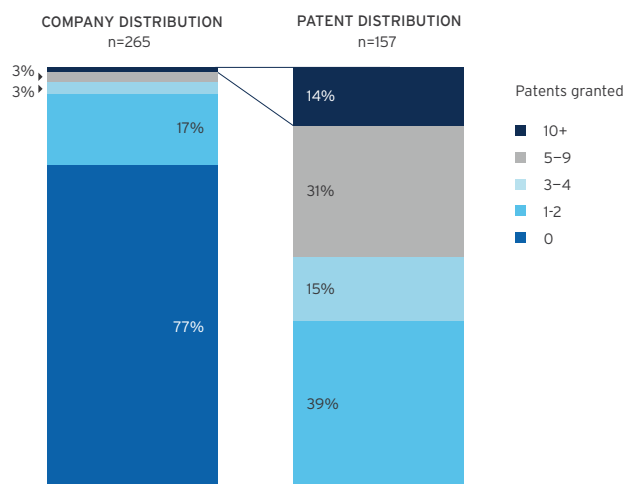
A company's ability to file patents and bring products to market is a key signal that investors look for. Our statistical analysis reveals just how potent these factors can be:

- Companies that filed patents in 2014 were more likely to raise funding the following year than those that did not.
- For every patent that a company filed in 2014, it was able to raise \$1,171,078 more in funding in 2015.
- For every new product a venture launched in 2014, it was able to raise \$1,043,987 more in funding in 2015.

As with other measures of success, patenting activity is highly concentrated in the top firms. During the two years of this study, only 23% of cleantech firms filed any patents, and a handful of top performers each accounted for five or more patents (see Fig. 3.9). It is important to note, however, that only patents filed in 2014 or 2015 are captured in this data - the total number of companies holding patents is likely to be significantly higher.

FIG. 3.9: PATENT CONCENTRATION

Patent filing activity in 2014 and 2015 was concentrated in a small number of firms



Continued creation and protection of intellectual property is crucial. While cleantech has a pipeline of patents that would be the envy of other Canadian sectors, when compared with the U.S., the picture is much less positive. Data from the Cleantech Group shows that on a per capita basis, the U.S. cranks out roughly twice as many cleantech patents as Canada.<sup>4</sup>

If we're to close this gap, Canadian institutions must maintain their strength in original research and continue their efforts to smooth the path to commercializing technologies and adequately protecting them with patent law.

The concentration of patents in a relatively small number of firms should give pause for thought. Given the strong correlation between patents and the ability to attract future investment, steps should be taken to ensure that startup founders appreciate the importance of protecting their intellectual property from the outset. ■

<sup>4</sup>. Troy Ault, Todd Allmendinger, Cleantech Group: Benchmarking the Canadian Cleantech Ecosystem, 2016.

# 04/ GROWING THE SECTOR

Innovative cleantech companies reduce our environmental impact and provide high-quality jobs and exports. Growing these firms should continue to be a priority.

Early-stage cleantech companies are already performing well against their counterparts in other sectors. Given the rapidly enlarging global market for clean technologies, the sector could become a major economic driver in the future. Supporting cleantech innovation should continue to be a focus for economic development in Canada.

While cleantech firms themselves are highly specialized, it's apparent from the data that the factors determining their success are broadly similar to those in other sectors (see **Fig. 4.1**). The general needs are:

- Smart and patient capital that can support companies through all stages of development.
- Introductions to partners and customers who can test, deploy and scale these technologies in global markets.
- Diverse and experienced founding teams, and access to a highly skilled workforce.
- Protection for intellectual property.

Where cleantech companies have an acute need for support is in clearing systemic barriers that prevent their technologies being adopted. Cleantech firms often work in tightly regulated markets, go up against large utility companies or face procurement



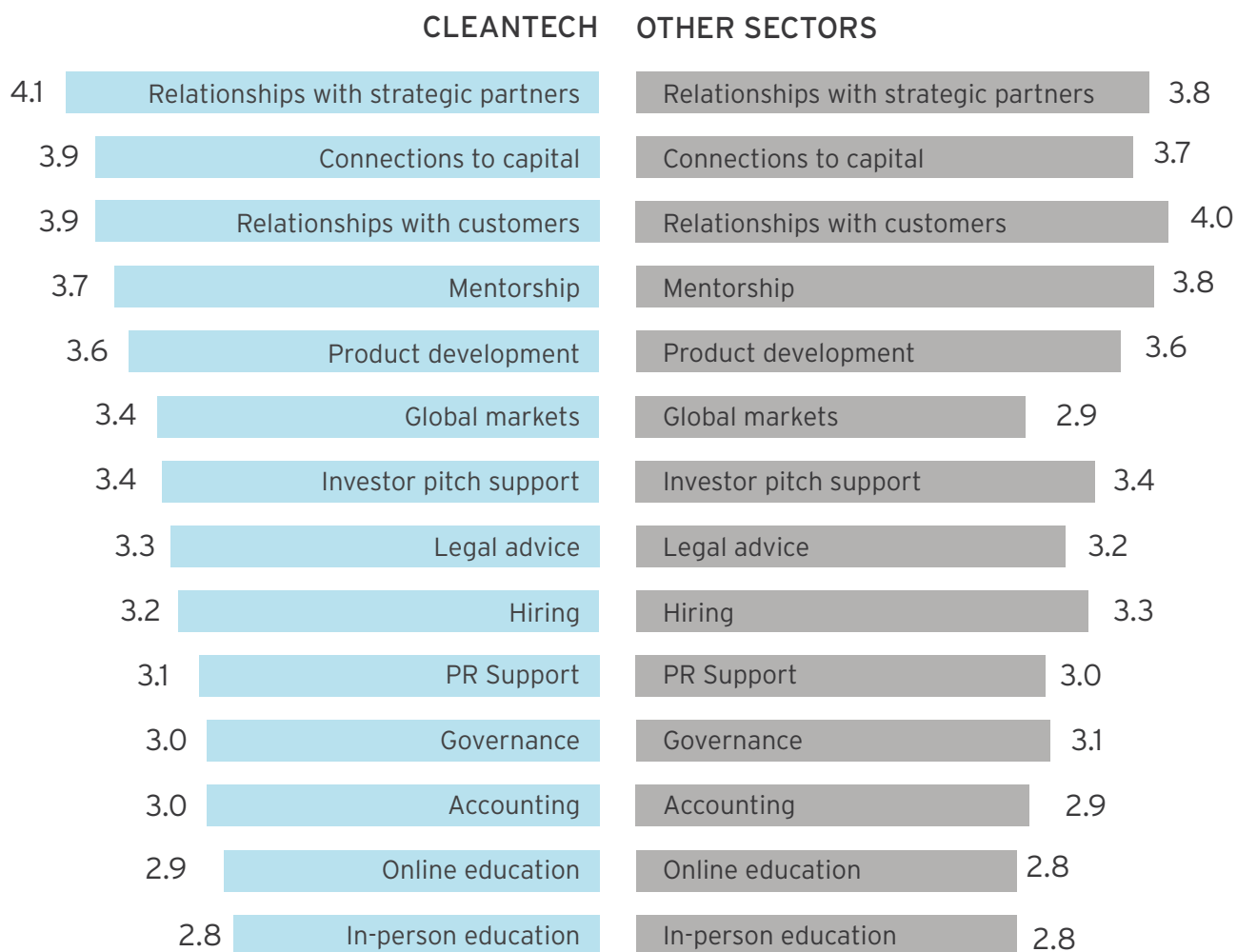
systems that are slow to embrace new technologies and favour the status quo. Without addressing these issues, it will be impossible to reap the full economic and environmental benefits of these emerging technologies. Cleantech industry leaders, stakeholders, investors and governments should commit to a two-prong approach that focuses on enabling cleantech firms to grow (the supply side of innovation, if you will) and also clearing barriers to adopting these technologies in global markets (stoking the demand side of the equation).

Tight regulation in electricity markets often creates powerful incentives to favour existing technologies over new innovations

IMAGE: ISTOCKPHOTO

**FIG. 4.1: FACTORS FOR SUCCESS**

Cleantech companies value connections to global markets more highly than firms in other sectors, likely because they are export focused



# 05/ RECOMMENDATIONS

Canada can be a leader in clean technologies, but our startups need help breaking into markets – overseas and at home.

Our data illustrate the complex network of factors that influence the growth of cleantech companies. There is no magic bullet that can accelerate this process. Instead, action must be taken simultaneously on a number of fronts to ensure firms have access to the support and resources they need at each stage of their development. The greatest dividends will come from a strategy that seeks to support company development with strategic investments, and increase adoption of clean technologies in Canada and overseas to grow the potential market size.

## ACCELERATE COMPANY DEVELOPMENT

- **Grow the talent supply.** Canada's strong foundations in science, research and education translate into a highly skilled workforce. This needs to be complemented by efforts to better connect the industry across Canada to share best practices and foster the spread of leadership expertise. The federal government should also ensure that immigration policies do not create unnecessary obstacles for highly skilled cleantech professionals seeking to come to Canada.
- **Step up support for companies competing on the global stage.** The federal government should commit to regularly reviewing, based on sector data, both its financial commitment (what instruments it offers and at what stage of company development) and the expertise it makes available (can we connect companies to buyers or build partnerships between firms to enable scaling?). At the top end, financial assistance need not be solely equity or debt based – the market will likely provide that – but could also take the form of securing export contracts or underwriting new plants and installations overseas.
- **Give angels their wings.** The limited supply of angel investment is a significant factor holding back the creation and growth of startups. The situation may improve as investors start to exit from later-stage companies and recycle capital back into the sector. However, ensuring an adequate supply of angel capital is essential and angels should be provided with access to expertise that will help them perform due diligence – for example through connections with academic experts, innovation hubs or government programs – to attract more non-cleantech angels to the sector.
- **Give firms time to grow.** Cleantech firms need access to patient capital to fund their lengthy development cycles. Venture capital funds that have longer

time horizons are needed to support these companies. Federal programs can help this – and, to an extent, are doing so already – by making strategic co-investments that stimulate further private-sector financing. Going forward, fund-of-fund, shared due-diligence and strategic investment partnerships between major funds could be important ways of ensuring that sufficient capital is channelled into the top-performing firms.

### ENABLE TECHNOLOGY ADOPTION

- **Grow export networks.** Fostering strong specialist export networks and implementation partnerships will help Canadian firms determine market opportunities, secure sales and clarify their knowledge of local regulatory conditions for technology adoption. Canada's network of innovation hubs are rapidly developing their international partnerships and will play a vital role in this.
- **Encourage efficient buildings.** Ease adoption of clean power and energy- and water-saving technologies. This can be done through developing incentives for the private sector to invest in such technologies and adjusting reporting standards for large building performance to encourage their use. Governments of all levels should also use these technologies to improve the performance of their own extensive building stocks.
- **Encourage clean public sector procurement.** Governments at all levels should reconsider their procurement models to ensure they accurately capture both the environmental and economic impact of clean technologies. Full life-cycle costing is essential. Although clean

technologies can require higher initial outlay than existing solutions, in many cases once ongoing savings (such as in energy or water consumption) are factored into the calculations they are comparable or more cost effective.

- **Regulatory reform.** Most of the sectors cleantech focuses on are strongly regulated and have significant public entities involved, such as utilities and municipalities. Barriers to adoption in these sectors need to be addressed.
- **Promote a cluster strategy to create industry convergence.** Advanced materials and manufacturing is a prime example of convergence where clean technology is applied across new sectors (quantum materials or artificial intelligence in manufacturing, for example). Cluster development policy needs to move from a traditional industry sector focus toward a transformative technology focus, enabling the local convergence of firms and supply chains across traditional sectors.

### COLLECT DATA

- **Bigger data yields better results.** This study highlights the need to collect detailed industry data over time. To build a true picture of what is going on in the cleantech sector, we need to be able to delve into its subsectors and take the temperature of companies at various stages of development. The national cleantech data strategy being developed by the federal government is an essential foundation to understanding firm growth dynamics at a national level and taking steps to support the sector in a timely manner. ■

## APPENDIX/ METHODOLOGY

Data for this study comes from an annual survey of the venture clients of the 17 Regional Innovation Centres in Ontario.

The survey is conducted over a 3.5-week period starting at the end of March each year. The survey is administered by MaRS Data Catalyst, a distinct and separate business unit within MaRS. To adhere to provincial auditing guidelines, MaRS Data Catalyst sent surveys directly to all ventures and received responses directly from them. The survey data was collected using FluidSurveys. MaRS Data Catalyst ensured that survey methodology best practices were adhered to. Financing data from the survey is supplemented with data from third-party sources such as CVCA, Crunchbase and Thomson Reuters.

For this report, we used data from the 2015 and 2016 annual surveys, which measured venture client performance in the calendar years 2014 and 2015, respectively. The annual survey collects data from ventures working in a wide range of sectors. From this, we extracted information on companies that are working in cleantech, as defined by MaRS and the Ontario Network of Entrepreneurs.

In figures where index values are presented, they were calculated by comparing the mean values for a sector with the mean value across all sectors.

The age of ventures is calculated as of December 31 of each year. ■



