



Solar Ship is one of hundreds of cleantech startups proving Canada's innovation tradition. Read about it on page 55.

The State of Cleantech



Great at innovation, Canada is rich with clean technology startups. But companies struggle after taking the public plunge. What's up with that?

BY TYLER HAMILTON

Canada's cleantech sector, by all measures, is doing remarkably well.

The latest research from Analytica Advisors, which on October 30 released its 2013 Canadian Clean Technology Industry Report, shows that sector revenues were \$10.6 billion in 2011, up 17 per cent from \$9.1 billion a year earlier.

Employment grew by 18 per cent. Investment in research and development was up by 7 per cent, surpassing \$1 billion for the first time. Employment grew by 18 per cent. The average number of employees per company climbed to 64 from 62, and the number of companies grew 6 per cent to 712.

All of this, the report notes, happened against the backdrop of nasty debt crises in the United States and European Union. "The big part of this is a jump in general market demand," said Celine Bak, a founding partner with the Ottawa-based research consultancy. "But some areas are growing faster than others."

The biorefinery and industrial products markets both grew by more than 40 per cent year over year, with the latter seeing about 95 per cent of revenues driven by exports.

Bak said more companies, particularly those in the extractives industry, are beginning to think seriously about the role of technology in sustainability, and about the importance of resource efficiency. "They're not doing it just from a corporate social responsibility perspective, but from a bottom line perspective, which is ultimately good for Canada's productivity.

"It's also to maintain a social licence to operate," she added.

The cleantech sector is more than happy to help them out, and small and medium-sized businesses are clearly the driving force when it comes to developing and supplying the required innovation.

Nearly three-quarters of Canadian cleantech companies employed fewer

than 50 employees in 2011, according to the report. If we narrow that criteria, 40 per cent of companies employed between six and 20 staff. (Indeed, only 24 companies in the space have more than 500 people and can be considered a "large" enterprise.)

They may be small, but they're having a big impact. It's why each year for the past five years, *Corporate Knights* has recognized the Top 10 up-and-comers in the Canadian cleantech sector (see Cleantech Next 10, page 50).

These startups have tremendous potential and much to offer – be it making concrete less carbon-intensive, helping utilities store surplus energy or providing a non-toxic way for farmers to keep pests from damaging their crops.

But it would be a mistake to say that all in cleantech is rosy in Canada. Rafael Coven, managing director of the Cleantech Group's market-leading indices, said the sector is increasingly becoming a game for bigger players.

There may be strength in numbers, but there are also major limits to small. This becomes increasingly clear when companies decide to shed their privately held status and expose themselves to the rough-and-tumble world of the public markets.

Most Canadian cleantech companies that go the publicly traded route find much of their time is soaked up complying with regulations and trying to raise capital. Few financial analysts show interest, and this makes it difficult to raise money for growth.

"Most of Canada's publicly traded cleantech companies should have never gone public," said Coven. "A lot of these companies are very speculative. If you look at the track record of most of them, it's about a 90 per cent failure rate. The point is, if any of these catch fire, they'll simply be acquired."

That's exactly what happened to Vaughan, Ont.-based RuggedCom, a

maker of ruggedized network equipment for the smart grid. A profitable, growing company at the centre of a bidding war, RuggedCom was eventually scooped up in March by German industrial giant Siemens for \$440 million, representing a share-price premium of 50 per cent.

Zenon Environmental, a Canadian gem in the water treatment space that was purchased by General Electric, and Xantrex, a maker of electronics for renewable energy systems acquired by Schneider, both followed a similar path.

But for every RuggedCom, Zenon or Xantrex, there are 10 companies like Railpower Technologies, a promising maker of hybrid locomotives that failed to be the little train that could.

It is with this caveat that Coven created the 2012 Clean 10 list for *Corporate Knights*. This list recognizes the most promising and successful cleantech companies that are traded on the Toronto Stock Exchange or its junior venture exchange.

Coven, comparing what he sees in Canada to the giants of cleantech that exist in the United States, is frank discussing the list. "I'm sorry, but there are just not a lot of great ones out there. I'm scraping the bottom of the barrel in Canada."

He does highlight pipeline inspection provider Pure Technologies, developer Brookfield Renewable Energy Partners, and TS03, a maker of eco-friendly sterilization equipment for medical devices as among his favourites.

But he makes clear they're unlikely to become standalone giants. Canadians will likely never see a Nortel, Research In Motion or Bombardier of clean technology, simply because the good eventually get gobbled up.

The open question is whether Canada needs a few big players to be recognized as a market leader. Can our collective smallness make a meaningful global impact in a world that desperately needs to clean up its act?

Cleantech

CORPORATE KNIGHTS 2012
6th Annual Report

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The 10 most promising
cleantech companies
publicly traded on a
Canadian exchange.

Brookfield Renewable Energy

Developer and owner of mostly hydropower and wind farm projects across Canada, the United States and Brazil. TSX:BEPUN (Ontario)

Carmanah Technologies

Maker of industrial solar LED lighting systems for aviation, marine, traffic management, and outdoor lighting. TSX:CMH (British Columbia)

Electrovaya

Developer/manufacturer of advanced lithium-ion battery systems for transportation and stationary storage markets. TSX:EFL (Ontario)

Pure Technologies

Developer of a number of sensor devices that inspect and monitor the condition of pipelines, buildings, and bridges. TSX:PUR (Alberta)

WaterFurnace Renewable Energy

Maker of ground- and water-source heat pump systems that efficiently supply heating and cooling to homes and buildings. TSX:WFI (Indiana)

BlueScout Technologies

Developer of advanced sensors that allow wind turbines to predict the speed and direction of approaching wind. TSX-V:SCT (Virginia)

EcoSynthetix

Applies green chemistry to make biomaterials that can displace the use of petroleum-based chemicals in a variety of products. TSX:ECO (Ontario)

Innergex Renewable Energy

Owner and operator of more than two dozen run-of-river, wind, and solar projects amounting to 500-plus megawatts, and growing. TSX:INE (Quebec)

TS03

Maker of low-temperature equipment that uses an environmentally safe ozone-based process for sterilizing medical instruments. TSX:TOS (Quebec)

Westport Innovations

Provider of clean-burning natural gas engines for trucks and other heavy-duty vehicles that would otherwise use diesel. TSX:WPT (British Columbia)

Estimated Cleantech Employment (Source: Analytica Advisors)

| | |
|--|--|
| Water + Wastewater 6,375 | Industrial Processes 7,736 |
| Biorefinery Products 4,313 | Recycling + Recovery 7,703 |
| Power Generation 5,673 | Remediation + Soil Treatment 949 |
| Energy Infrastructure / Smart Grid 1,455 | Transportation 7,652 |
| Energy Efficiency 10,511 | Agriculture 205 |

Estimated Cleantech Revenue (\$ millions) (Source: Analytica Advisors)

| | |
|--|--|
| Water + Wastewater \$1,331 | Industrial Processes \$1,933 |
| Biorefinery Products \$1,175 | Recycling + Recovery \$1,364 |
| Power Generation \$1,025 | Remediation + Soil Treatment \$195 |
| Energy Infrastructure / Smart Grid \$345 | Transportation \$1,451 |
| Energy Efficiency \$1,756 | Agriculture \$45 |

The 10
most
promising
startups

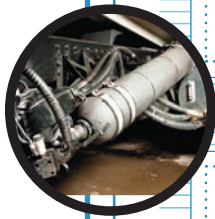
Cleantech Next

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CarbonCure Technologies

Developer of a process that injects CO₂ into precast concrete during manufacturing, creating a building product with a low-carbon footprint. (Nova Scotia)



Effenco

Supplier of hydraulic hybrid systems for trucks that can reduce fuel consumption by up to 25 per cent and significantly extend brake life. (Quebec)



Etalim

Developer of a new high-efficiency "thermal acoustic" engine that converts any low-carbon fuel or heat source into electricity. (British Columbia)



MineSense Technologies

Provider of sensor technology that helps miners reduce waste, water and energy by detecting ore concentrations worthy of processing. (British Columbia)

Switchable Solutions

Based on research of Philip Jessop at Queen's University, company markets a non-volatile, eco-friendly solvent for industrial use. (Ontario)

Carnot Refrigeration

Supplier of cold production systems that use CO₂ as a refrigerant. CO₂ is non-toxic and a far less potent GHG compared to synthetic refrigerants. (Quebec)

Enbala Power Networks

Developer of a smart-grid platform that helps regulate supply and demand on the electricity system by continually adjusting power loads. (Ontario)

Hydrostor

Developer of a unique and low-cost underwater compressed-air energy storage system that can be deployed in any deep body of water. (Ontario)



Quadrogen Power Systems

Builds and installs modular systems that purify renewable fuels from any source. Can handle land-fill gas, digester gas, or syngas. (British Columbia)

Vive Crop Protection

Developer of an eco-friendly pesticide delivery nanotechnology that greatly reduces the amount of chemicals required to protect farm crops. (Ontario)



Cleantech 10 Methodology

The Cleantech 10 list was created by Rafael Coven, managing director and index manager of The Cleantech Index (CTIUS; cleantechindex.com). It underlies several Index-based funds such as the PowerShares Cleantech ETF, and covers a broad array of industries. Coven sought out technology-driven growth companies that have big impacts on resource efficiency and the environment. Screening criteria applied to TSX companies is the same used for The Cleantech Index, but applied with some leniency to create a rounded Top 10 list.



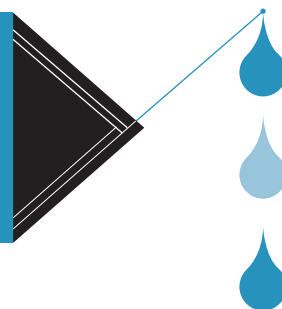
Cleantech Next 10 Selection Panel

The Next 10 are selected by an advisory panel consisting of seven of Canada's foremost authorities on cleantech: Vicky Sharpe, CEO of Sustainable Development Technology Canada; Greg Kiessling, founder of Up Capital and co-founder of Bullfrog Power; Thomas Rankin, investment director with Innovacorp; Michael Brown, chairman of Chrysalix Energy Venture Capital; Salil Munjal, partner with Yaletown Venture Partners; Denis Leclerc, president and CEO of Ecotech Quebec; Tyler Hamilton, editor-in-chief of Corporate Knights.



A Clear Need for Water

New technologies are making it easier and less expensive to clean, manage, protect and waste less of a life-giving liquid we take for granted.



BY KERRY FREEK

Natural resources, agriculture and manufacturing. Many of North America's strongest industries are also its most water intensive. Increased awareness around risks – water scarcity, for example – brings fear into the heart of many a manufacturer. But where they see failure, David Henderson sees opportunity.

"We get a dual benefit by investing in water innovation," says the managing director of water investment firm XPV Capital. "It will increase the productivity of our key sectors and, at the same time, create a whole new generation of companies that can export their water solutions around the world."

Laura Shenkar of the San Francisco-based Artemis Project agrees. She says that water technologies represent the next wave (no pun intended) of high-growth tech investments.

The Artemis Top 50 Water Tech Listing began as an initiative to prove to the investment community that there is a critical mass of water companies worthy of venture capital investments, Shenkar explains. The sector is bolstered by reports that project these disruptive technologies and business models will yield profits as revenues in the water industry approach US\$1 trillion by 2020.

Shenkar and Henderson believe that many successful next-generation technologies exist to refine traditional systems and solutions. The real game-changers are often relatively simple ideas that make tweaks for added efficiency – adding a sensor to collect data here, developing a less energy-intensive filtration membrane there. Here are examples of how new tech is tackling some of the world's biggest water challenges with just a few small adjustments.

At its most basic level of human use,

water needs to be drinkable. Much of North America's large supply of freshwater is teeming with biological and chemical contaminants from a wide range of sources, such as urban and agricultural runoff, industrial effluent, and human and animal waste. To get water to a potable point, we need to identify potentially harmful ingredients. But traditional testing methods are slow and sometimes fussy. Before we can determine what to remove from a water supply, samples must go through incubation periods and specific temperatures.

Researchers like University of Waterloo's Janusz Pawliszyn recognize the need for faster, more accurate samples. His team developed the solid-phase microextraction (SPME) technology, which skips a lengthy phase of sample preparation and allows field researchers to monitor and analyze samples on site. Working with Canadian environmental laboratory Maxxam Analytics, Pawliszyn's team is striving to make the process more cost-effective, which could open the technology to developing countries with large populations that suffer from waterborne disease.

Public health risk, however, doesn't stop at the treatment plant. In North America, aging or poorly maintained drinking water systems lose millions of gallons of treated water every year. Not only are the systems leaking – some estimates say that Montreal loses up to 40 per cent of its drinking water en route to taps – they're opening the door to contamination and infrastructure catastrophes.

Limited municipal budgets are just one reason we're having more frequent sinkholes. In many cases, the real problem is that cities don't have a clue where and when they're leaking. The problem

is data deficiency, and the solution is better intelligence.

Automation and data-gathering technologies are the way forward, says Dave Woollums of Mueller Co. The company's recent acquisitions – such as Ontario's Echologics, which uses acoustic technology to detect leaks and assess the condition of water pipes without breaking ground – focus on these areas.

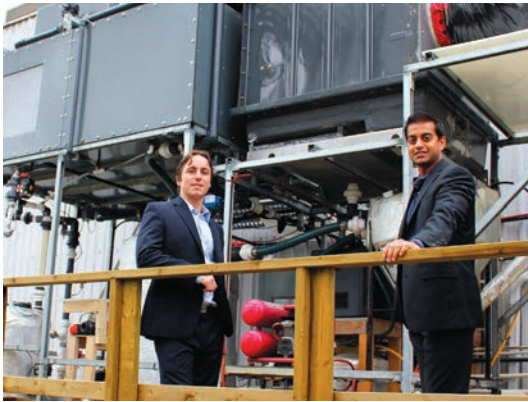
"We're working on embedding intelligence into devices that have, in the past, been dumb mechanical products," says Woollums, Mueller's vice-president of research, development and engineering. "By placing pressure sensors in strategic valves in a system, for instance, we can reduce energy consumption and leakage, and extend the time before utilities have to repair leaks in pipelines."

Combined with sensors, robust GIS systems can help municipalities capture and predict the state of their water infrastructure assets, layering collected data with adjacent infrastructure, environmentally sensitive areas, and other datasets that can help them make better decisions.

"GIS is like a crystal ball, but better," says Karen Stewart, ESRI Canada's public works industry manager. "Every time you track conditions, you can finetune your analysis and more accurately extrapolate future performance."

The more you measure the system, the better you can manage it.

It's a good thing we're fixing those pipes, because the planet is about to get thirstier. Research from McKinsey & Company projects that, with population growth, water demand will outstrip supply by 40 per cent by 2030. Throw climate change – especially extended periods of regional drought – into the mix



Saltworks Technologies' desalination system uses less energy that rival reverse osmosis systems.



Ostara extracts phosphorus and other nutrients from wastewater to create a high-grade fertilizer.

and you've got a significant challenge.

Over the past few decades, water-scarce regions have turned to the sea for a viable alternative to surface and groundwater supplies. According to its Ministry of Environmental Protection, Israel's mammoth desalination operations are projected to create some 600 million cubic metres per year by 2013 – a quantity equal to about half the freshwater that is pumped in the country on average each year – making desalination its main source.

While relieving the demand for freshwater, however, the early days of desalination proved it can be an energy-intensive, and therefore costly, process.

Today, water-tech entrepreneurs will tell you otherwise. California's NanoH2O, which earlier this year secured financing from BASF, Total Energy and Keytone Ventures, has developed a more economical, more energy-efficient reverse osmosis membrane. Vancouver's Saltworks Technologies harnesses low-temperature heat from solar energy and waste heat from power generation to reduce the amount of mechanical or electrical energy required for the process.

These technologies work for drinking wa-

Advertisement

BANU ÖRMECİ IS TESTING THE WATERS

Banu Örmeci studies the fundamental processes involved in wastewater treatment to see what happens to pathogens and chemicals during and beyond treatment processes. Her research on ultraviolet disinfection, real-time water monitoring systems, and sludge treatment is resulting in new and innovative wastewater treatment technologies that protect public health.

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Banu Örmeci
Associate Professor,
Department of Civil and Environmental Engineering
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Wastewater Treatment Engineering



ter, but they can have several other useful applications. NanoH₂O's membrane, for instance, could also help water-using industries preserve equipment from salt corrosion, which results from using saline groundwater, rather than depleting surface-water supplies.

Multiple applications give these technologies their staying power, says Shenkar. "Companies are identifying niche areas where they can provide dramatic benefit, and finding success."

Not surprisingly, oil and gas is proving to be a popular "niche" sector. Increasingly expensive and limited water supplies that steam-assisted gravity drainage (SAGD) operations in Canada's oil sands demand, for instance, are attracting and driving innovation. Developers have the funds to take risks


that municipalities can't afford, and Shenkar says that makes this sector one of the major areas of opportunity.

If you need to ensure a stable water supply, why not reuse what you've already got? Texas-based 212 Resources looked at the costs of handling water, from sourcing to disposal, in the hydraulic fracturing process that helps extract natural gas from shale. The company's process treats "frac" water – often high in salt and other contaminants – to take it to a level high enough for safe discharge back into natural waterscapes, which also makes it possible to reuse the water for subsequent hydraulic fracturing of shale rock.

Reuse possibilities extend to wastewater byproducts. 212's process also separates concentrated brine from frac fluid, which has applications in other on-site drilling activities. New Sky

Energy in Colorado converts salt and carbon dioxide from wastewater into valuable chemicals using a proprietary electrochemical-chemical cycle. Vancouver's Ostara Nutrient Recovery Technologies designs, builds and sells water treatment systems that recover nutrients from wastewater, which it then uses to make an eco-friendly fertilizer.

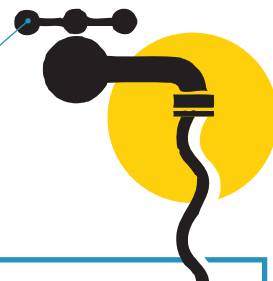
These technologies in particular are indicators of a growing trend – and for good reason. They're creating new revenue streams that can encourage even the risk-averse, cash-strapped municipal sector to more seriously consider innovative options for water management.

Technology that tweaks existing systems, makes processes more efficient, and generates revenue? If the investment community is right about emerging water tech, it's going to be a profitable run to 2020. 

Top Water Productive Companies in Canada

CORPORATE KNIGHTS 2012

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| | Company | Sector | Score |
|-------|-----------------------|----------------------------|---------|
| 1 | HSBC Bank Canada | Financials | 14.9 |
| 2 | Co-operators Group | Financials | 18.1 |
| 3 | Stantec Inc | Industrials | 19.8 |
| 4 | TELUS Corp | Telecommunication Services | 25.7 |
| 5 | Gildan Activewear Inc | Consumer Discretionary | 408.4 |
| 6 | Eldorado Gold Corp | Materials | 984.7 |
| 7 | Talisman Energy Inc | Energy | 1080.0 |
| 8 | Nexen Inc | Energy | 1340.1 |
| 9 | Agrium Inc | Materials | 1418.9 |
| 10 | Barrick Gold Corp | Materials | 3635.5 |
| <hr/> | | | |
| 1 | Talisman Energy Inc | Energy | 1080.0 |
| 2 | HSBC Bank Canada | Financials | 14.9 |
| 3 | Eldorado Gold Corp | Materials | 984.7 |
| 4 | Hydro-Quebec | Utilities | 31555.6 |

Total amount of water withdrawn in cubic metres (2011)/Total number of employees (2011).

Sector Leaders

