

STRATEGIES FOR SUSTAINABILITY

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Support for cleantech innovation crucial for meeting climate targets

Voices in support of climate change abatement and adaptation are growing as awareness across all areas of society about the importance of reducing our collective environmental footprint rises.

Yet good intentions are not enough and must be backed by decisive action, says Maïke Althaus, executive director at Canada CleanTech Alliance and the Ontario Clean Technology Industry Association (OCTIA), who believes one area that can drive substantial impact is cleantech innovation.

"Without clean technologies, we'll not be able to reach our climate targets and decarbonize our industries," she says. "Canada has 14 companies on the 2022 Global Cleantech 100 list. While that's a substantial achievement, we need

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to better leverage this advantage to compete in the global cleantech market and build the economy of the future.”

The work of the CleanTech Alliance as well as OCTIA – which comprise companies with hydrogen solutions, alternative fuels, alternative plastics, innovative renewable energy technology and more – aims to give innovations a better chance to go from idea to impact.

Ms. Althaus explains that while Canada excels in creating intellectual property, domestic adoption can fall short, and some of these technologies end up being implemented elsewhere. “We need to create a more supportive ecosystem,” she says. “Key issues the cleantech sector is facing are access to capital as well as access to

customers, markets and talent.”

Enhancing access to capital can make a big difference in “enabling cleantech to move forward,” she says. Although there are a number of funding programs for clean technologies and climate adaptation available across Canada, they can be hard to navigate.

“Feedback from companies and startups is that they don't have the resources to understand what's out there in terms of funding as well as navigate what often is a complex application process,” says Ms. Althaus, who was recognized with a 2023 Canada's Clean50 award. “We need to look into ways to simplify things and reduce barriers for cleantech enterprises.”

Governments can help to create a runway for technology adoption, for example, through government procurement, co-funding pilot projects or a loan guarantee program, she suggests. “Both federal and provincial governments can play a role, and provinces can complement what's being done on the federal level.”

An example is the recent refundable 30 per cent investment tax credit (ITC) applicable to clean energy technologies, including hydrogen, small modular reactors and all forms of energy storage technology, which Ms. Althaus welcomes as a step in the right direction on the path to net zero.

“This can be a tremendous instrument to facilitate the flow of capital into cleantech,” she says, adding that it's another indication that governments recognize the role of cleantech in creating economic benefits along with solutions for environmental challenges.

However, more efforts are needed to ensure no cleantech innovators fall through the gaps – and government incentives could inspire industry to pilot and adopt technology solutions, explains Ms. Althaus. “There is wide recognition that we need to decarbonize the biggest emitters – such as steel, cement, and oil and gas – to reach our climate targets, so these objectives could be leveraged in the form of economic tools.”

Cleantech applications can also

play an important role in reducing the emissions associated with energy systems. “Ontario, for example, has to further decarbonize energy systems, yet the provincial government recently announced its decision to invest in more natural gas production, which will cause additional emissions,” she says.

“This is a concern: we'd like to see more emphasis on cleaning up the grid. Not only do we have to add renewables to the Ontario grid, we have to enable distributed energy resources, including microgrids. We need to move from central electricity generation to decentralized systems.”

To accelerate renewable energy adoption, Ms. Althaus suggests innovative partnerships, such as co-operative investing models that draw on community participation. “This would be one way to get communities actively involved in these projects – and in seeing concrete benefits,” she says. “There are tons of technologies and ideas out there.”

“Since there isn't a one-size-fits-all solution, we need many creative ideas on how to increase the flow of capital into cleantech and new ways of adopting these technologies, for example, through community participation.”

As these clean technologies will help us in the move towards a low-carbon future, they can be an important driver of economic and environmental benefits across sectors and in all areas of society, she adds.

ADVANCING A PLANT-POWERED PLASTIC ALTERNATIVE

The journey for startup erthos Inc. started with the determination to help tackle the global plastic waste crisis and led to the development of materials that are significantly greener and more circular than their plastic counterparts.

In order to ensure these materials are compatible with existing plastic technology – and fit seamlessly into pre-existing supply chains – the company built strategic relationships with plastic manufacturers and global consumer packaged goods supply chains.

The erthos team enlisted support from within the innovation ecosystem, most notably from AB InBev's 100+ Accelerator, to turn its innovation into a functional product. The result? A groundbreaking keg-sealing plant-powered cap.

They may seem small, but keg caps account for thousands of tonnes of global plastic consumption annually. Keg caps made with erthos's resins, on the other hand, result in significant water, energy and CO2 savings when compared to their traditional plastic counterparts; they are also compostable, biobased and entirely non-toxic, thus food-contact safe.

Building on this success, erthos is currently in the process of scaling up this resin's production

process and working with major consumer packaged goods brands and manufacturers to replace other rigid, single-use plastics.

Dedicated to raising awareness about the plastics challenge and the need to move towards a more circular economy, the erthos team also works with industry leaders and participates on boards, councils and committees that govern the development of compostable plastics – and the industry at large.



INSIDE

The power of renewable energy and smart cities. **SS2**

Reducing carbon emissions from buildings. **SS3**

Energy storage solutions enabling clean power systems. **SS3**



Our strategy for sustainability is cleantech.

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The National Voice of Canada's Cleantech Industry

Solutions for a low-carbon future

Western University advancing renewable energy adoption and smart cities

Today's most complex challenges require an interdisciplinary and collaborative approach, and Western University and Ivey Business School are uniquely positioned to advance robust solutions through a broad range of research strengths, such as developing renewable energy and open-source technologies to reduce the effects of climate change, and building smart cities to optimize energy, telecommunication and transportation networks.

ENERGY SOLUTIONS ON FARMS

Harvesting sunshine is not in the job description of most Canadian farmers, but researchers at Western University in London, Ontario, want to change that.

"Agrivoltaics," using solar panels to generate electricity on a farm still growing food, would not only contribute to more sustainable and cost-efficient farming operations but potentially also create an additional revenue stream for farmers who could sell surplus power into regional grids when the growing season is over, says Joshua Pearce, a professor in the Department of Electrical and Computer Engineering and the Ivey Business School at Western, and leader of the university's Free Appropriate Sustainable Technology (FAST) research group.

"The primary benefits are higher crop yields and water savings because the panels cool and protect the crops," says Dr. Pearce. While some of Canada's conventional solar farms are already benefiting from a symbiotic relationship with agriculture through using sheep to trim the grass beneath the panels which, anecdotally, leads to better quality wool, Canada lags Europe, Asia and the U.S. in the implementation of photovoltaic technology developed specifically for agriculture.

Dr. Pearce says studies in the U.S. have shown yield increases of more than 200 per cent on farms using agrivoltaics, mainly through less water use. "As we enter into an age of severe climate change and the impacts that will have on agriculture in Canada, having protection from being too hot actually makes a lot of sense," he adds.

The current obstacles to widespread adoption of agrivoltaics in Canada are primarily regulatory. For example, solar panels are not permitted on agricultural land surrounding Toronto, which may have made sense 10 years ago when the objective was to protect valuable farmland from conventional solar farms, says Dr. Pearce. "But now, if you allow or even encourage agrivoltaics, you get the renewable energy with no carbon emissions, a reduction in pollution and increased yield for the same crops that are being grown right now."

The design and placement of solar panels on farmland depends on the type of crop being grown and is an important focus of Western's research. PhD candidate Koami Soulemame Hayibo is part of the research group looking at wood-based racking for solar panels to replace the more costly metal racks that have typically been the primary support structure up to now.

Mr. Hayibo is also exploring optimal designs for solar panel modules that may need to be tilted or moved during harvest season or at any other time.

"For smaller farms in particular, solar panels need to be affordable; easy to install, maintain and operate; and be cost effective and durable," he says.

Dr. Pearce says a farmer's initial capital outlay to install photovoltaic technology would be offset by higher crop yields and cost savings plus the opportunity to sell surplus power at different times of the year – and with new solar projects now being designed to last for up to 50 years, the life of any additional income stream could be considerable.

"These are solid-state devices with no moving parts, so there's no reason they should fail until they start to delaminate, and that takes decades," he notes. "This is an investment you can think of for your grandchildren."

Dr. Pearce believes photovoltaic power is the future of sustainable electricity generation.

"The real advantage is that it works everywhere at every scale. You can provide power for your house through solar panels on the roof, for



Joshua Pearce, a professor in Western University's Department of Electrical and Computer Engineering and the Ivey Business School, and Koami Hayibo, a Western Engineering PhD candidate, are advancing solar-powered, open-source technology. CHRISTOPHER KINDRATSKY

the farm by doing something like building a solar panel fence around a field, and you can power large cities or industry using large-scale agrivoltaics," he says.

SUSTAINABLE INTELLIGENT CITIES

Technology to support the move towards global sustainability is advancing steadily, but unless it can be harnessed to work as a single system in rapidly expanding mega-cities, the true benefits may be lost, says Bissan Ghaddar, an associate professor of Management Science at Western's Ivey Business School.

Her work on the problems at the intersection of smart cities, machine learning and optimization models is focused on three key elements of a "smart city" – energy, transportation and telecom – and how these components can operate in harmony to promote sustainability.

"Energy, transportation and telecom networks have always been thought about as independent, without considering how one can benefit the other," says Dr. Ghaddar. "If we want to start talking about sustainability and intelligent cities, we have to start thinking about the integration of these components."

For example, she adds, electrified transport, both commercial and private, can be made more sustainable through smart grids, and 5G telecom networks can provide the informa-



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tion needed to support sustainable transportation systems.

Canada currently lags behind Europe and the U.S. in providing the regulatory framework and infrastructure to take advantage of the advancing technology, says Dr. Ghaddar.

"We need policies and regulations to provide financial incentives for businesses and households to adopt these technologies. For example, e-commerce companies like Amazon and recently Walmart are already using EVs for last mile deliveries, but to encourage more widespread adoption we need the infrastructure to support this type of transportation," she says.

The bottom line, adds Dr. Ghaddar, is a more sustainable use of resources and a more integrated utilization of existing disruptive technologies, which will open up opportunities that haven't been seen before.

"Integrating these systems together will result in new business models, better utilization and more efficient resource planning. That's what my research is about," she says.

Excellence in designing solutions for a sustainable future earned Western University first in Canada and third in the world in the 2022 Times Higher Education Impact Ranking, a global ranking of universities working toward the United Nations Sustainable Development Goals.

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#1 in Canada & #3 in the World
for Sustainable Development

Learn more about the 2022 Impact Ranking

Decarbonizing buildings

A purposeful approach to lowering emissions from the built environment

With over 16 million dwellings and about 500,000 commercial and public buildings, Canada's building sector is responsible for 13 per cent of the country's greenhouse gas emissions. This number is even higher – 18 per cent – if electricity-related emissions are included, according to Natural Resources Canada. The emissions have grown 30 per cent since 1990, with only a one-year slow-down during the coronavirus pandemic.

Over 75 per cent of building emissions come from space and water heating equipment, and Doug Webber, principal at Purpose Building, proposes that with today's technologies and financial models, we can cost-effectively reduce operating carbon in new and existing buildings by more than half.

Case studies from Purpose Building projects show that such significant reductions are within reach, says Mr. Webber. "In one example, we are leading a \$40-million retrofit of a 50-year-old, 2-million-square-foot, multi-building office complex. The result will be a 75 per cent reduction in carbon and a modest increase in operating cost of 5 per cent over the next 20 years, compared to business as usual."

The goal of the company is to help clients develop and implement strategies that prepare them for a healthy, circular, low-carbon economy. "Our deep understanding of how buildings are designed, constructed and operated – paired with extensive experience in the business of real estate – allows us to give project teams the confidence to achieve positive change by accelerating the adoption of solutions for a better future," says Mr. Webber. "We are working with several of Canada's global real estate groups, with over \$100-billion of combined assets under management, to develop and implement pathways to zero carbon for their portfolios."

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Doug Webber
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According to the Canada Green Building Council, the Dream Unlimited LeBreton in Ottawa is Canada's largest residential zero-carbon development. The innovative approach, designed in partnership with Purpose Building, includes heating with energy recovered from a municipal sewer under the site feeding electric heat pumps and generating a portion of its electricity with photovoltaic panels. SUPPLIED

In addition to developing strategies to decarbonize real estate portfolios, the Purpose Building team supports these plans by "executing low-carbon transitions on individual buildings."

While existing cleantech innovation can help to reduce the carbon

footprint of buildings, Mr. Webber advocates for supporting research and innovation to enable us to better address the entirety of emissions from the built environment, including embodied carbon.

"We have proven that we can cost-effectively deliver 70 per cent reductions in operating carbon in both new and existing commercial buildings and about 30 per cent reduction in the carbon embodied in the materials used to construct or renovate those buildings," he says. "Yet we don't yet see a viable path for dealing with the rest of the carbon."

What can make a difference is advancing innovation in areas as diverse as material science, energy systems and business models to deliver outcomes like:

- clean electrical grids supporting cold-weather heat pumps;
 - circular supply chains for building materials; and
 - business models where decision-making is aligned with climate change time horizons.
- "Getting to zero carbon can seem a big challenge, but at Purpose, we believe by creating a clear picture of the desired outcome and pursuing collaboration excellence we can inspire partnerships across industries, academia and the public sector," says Mr. Webber, who points to Canada's Clean50 for the breadth of talent available in Canada. "This can enhance our position as a magnet for global talent and future-proof Canada's economy and infrastructure."



In order to advance the energy storage assets that will enable a cleaner electricity system, policy-makers and government agencies need to co-ordinate a revamp of regulatory and legislative frameworks, according to Energy Storage Canada. SUPPLIED

ENERGY STORAGE SOLUTIONS POWERING PATH TO NET ZERO

As the world's sixth-largest electricity producer and third-largest electricity exporter, Canada is an electricity heavyweight. And with a grid that is already 83 per cent emission-free, the country seems well positioned for meeting ambitious net-zero and economic ambitions.

However, the Canadian Climate Institute (formerly the Canadian Institute for Climate Choices) predicts that the electrification of Canada's grid – which involves connecting an increasing number of electric vehicles (EVs), heating systems and industries to a clean electricity grid – will require the production of roughly twice as much non-emitting electricity as it does today in just under three decades.

However, when we talk about expanding Canada's electricity grid, we tend to focus strictly on increasing the generation of clean electricity, which according to Justin Rangooni, executive director of Energy Storage Canada, will not be enough. We must also knit the system together through the large-scale build-out of diverse forms of energy storage, which

can optimize generation assets and help to advance Canada on its path to carbon neutrality.

"Canada has set an ambitious goal to achieve a net-zero electricity system by 2035, the success of which depends on energy storage," he says. "The versatility of energy storage is going to be absolutely essential to meeting the needs of more end-use electricity, an increasing volume of which will be generated by intermittent renewable and non-emitting resources."

The issues of how to expand hydropower capacity, where to best locate solar panels and wind turbines, or how to maximize the potential of new fuels such as hydrogen and ammonia are important. Yet Mr. Rangooni emphasizes the importance of viewing the energy system as a single entity, including the need for the system to be able "to even out variations in supply and demand."

A recent Energy Storage Canada report estimates that the installed capacity of energy storage required to get Canada to net zero will need to be in the range of 8 to 12

gigawatts (GW) nationally by 2035. With today's national built capacity sitting at less than 1 gigawatt, Mr. Rangooni maintains we have a big gap to close.

"But we need to close it if we are going to successfully realize the dual imperatives of meeting more of our energy end-use needs with electricity, and of enlarging the proportion of that electricity that comes from renewables and other non-emitting resources," he says.

Furthermore, Mr. Rangooni explains, the variety of energy sources across the country means that the "versatility of energy storage technologies will be crucial to ensuring Canada is able to meet the electricity needs of all its provinces, through maximizing the capability and efficiency of existing and new generation, transmission and distribution infrastructure."

Energy storage can help level out supply to urban centres or capacity constrained areas without additional transmission systems upgrades. It can address the intermittent nature of wind and solar generation. Even for baseload resources like nuclear, energy storage can help provide more consistent and cost-effective production that isn't constrained by hourly demand rates.

"As a whole," says Mr. Rangooni, "energy storage resources are a versatile, reliable and growing group of technologies that offer a range of stability-enhancing services to electricity systems, extending beyond the essential benefit of flexible capacity."

However, because energy storage was not a key consideration when electricity regulatory frameworks in Canada were created, it is generally perceived as an incumbent or new clean technology to add to the grid. According to Mr. Rangooni, this means that in order to effectively deploy energy storage assets, policy-makers and government agencies need to co-ordinate a revamp of regulatory and legislative frameworks to accommodate them.

"Currently, we lack even basic regulatory definitions of energy storage in some provinces, as well as clear expectations and processes relating to the crucial issues of project siting and inter-connections with electricity grids," he adds.

"The variety and versatility of energy storage resources make them a critical component of a net-zero electricity grid – a component without which Canada will not reach its net-zero goals. We've seen some exciting progress over the course of 2022, and we're keen to see what 2023 holds for the sector in Canada as we continue to aim for 2035."

DIVERTING FOOD WASTE, FEEDING FAMILIES

About 5.8 million Canadians – including 1.4 million children – live in food-insecure households, according to Statistics Canada. At the same time, Second Harvest estimates that 58 per cent of all the food produced across the country is wasted, with close to 80 per cent of this food loss happening in businesses along the supply chain.

Beyond the social impact of food insecurity, this amount of food waste generates 56 million tonnes of methane gas, which has a significant detrimental impact on the environment.

Enter Be One to Give Inc. (B12Give), a for-profit social enterprise that has developed an app that aims to connect with over 127,000 food business operators with surplus food across Canada.

B12Give created an on-demand business-to-business app that provides retailers with the tools to eliminate 100 per cent of surplus food with a limited shelf life from their daily operations. Instead, they deliver it to agencies supporting people who are food insecure.

With current partners, B12Give has already redistributed over 24,000 pounds of food to more than 18,000 people and diverted roughly 90,000 pounds of methane gas from the atmosphere.

It's the first app in Canada to facilitate the business-to-business redistribution of surplus food, creating a circular food economy that can easily be scaled to both national and international markets.

