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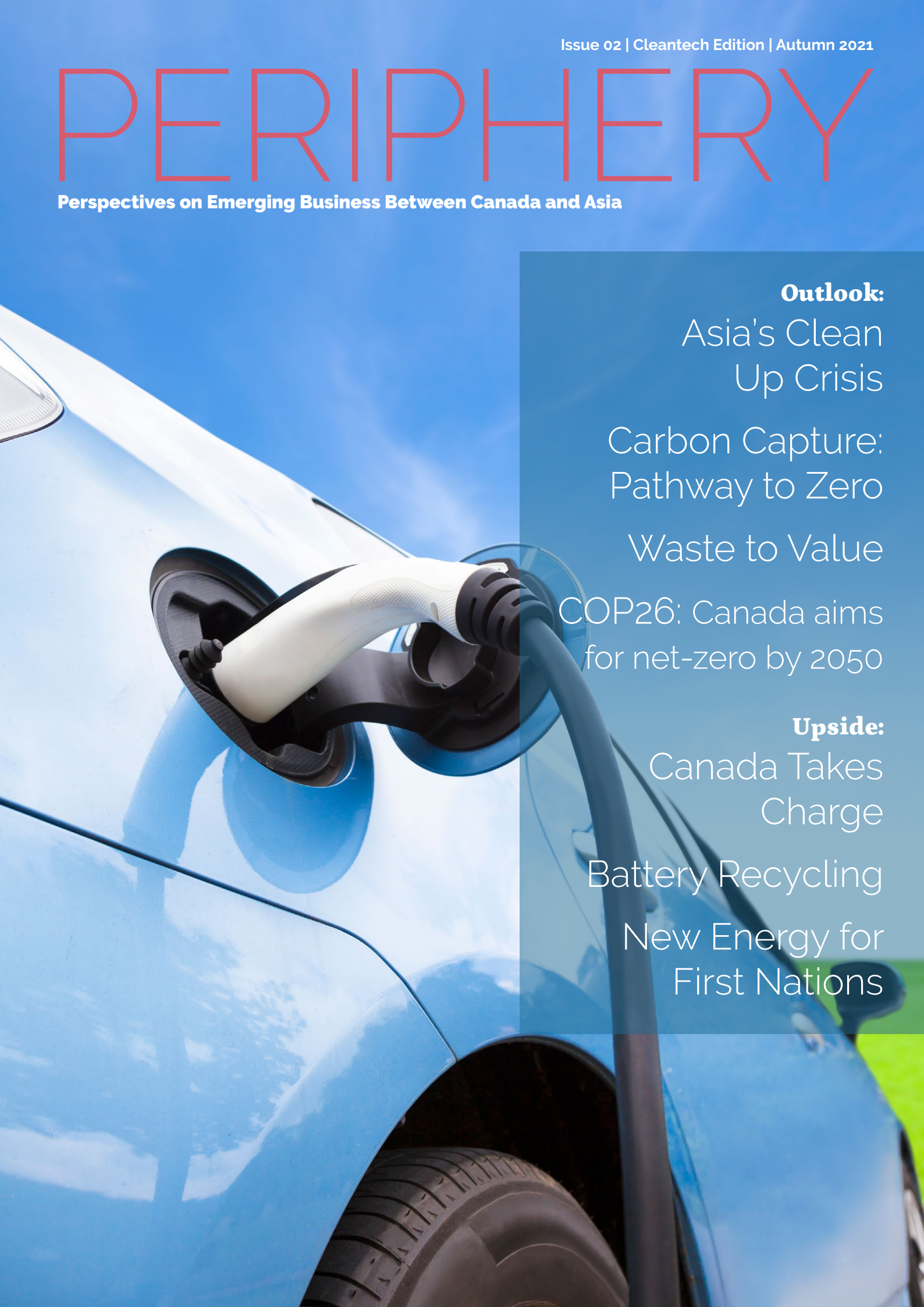
# PERIPHERY

Perspectives on Emerging Business Between Canada and Asia



**Outlook:**
Asia's Clean Up Crisis

Carbon Capture: Pathway to Zero

Waste to Value

COP26: Canada aims for net-zero by 2050

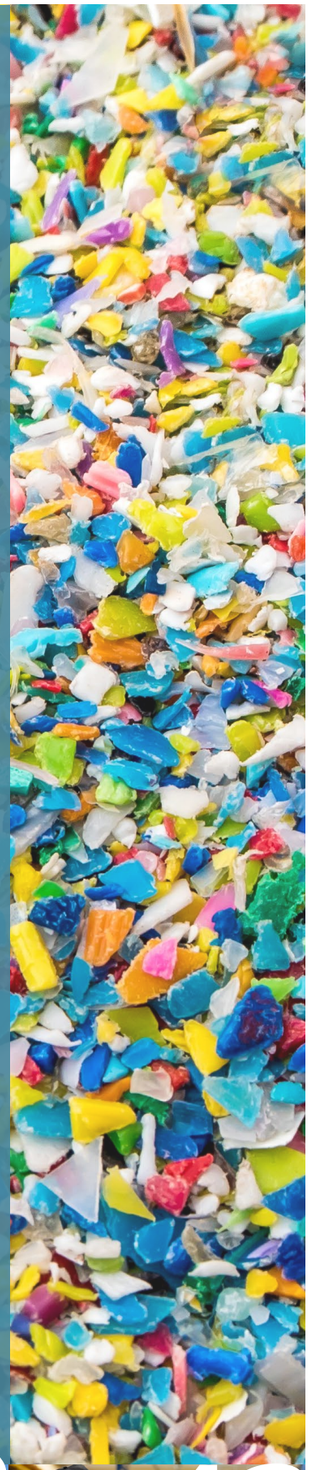
**Upside:**
Canada Takes Charge

Battery Recycling

New Energy for First Nations

# Contents








Welcome

# Canadian cleantech leading the charge

**It seems the topic of climate change is regularly heard but not fully discussed with meaningful discourse, that is until human-influenced, environmental events rear their ugly head close to home.**

This past summer, right as we began uncovering inspiring stories of cleantech innovation on both sides of the Pacific, Canada experienced an unprecedented "heat dome" with blast furnace-like temperatures that reached almost 50°C, killing nearly 600 British Columbians and vaporizing the entire town of Lytton.

Two months later, the Chinese city of Zhengzhou was drowned under a historic flood that claimed over 300 lives resulting in a record setting single-event insurance loss of $2.12 billion.

Following these tragic events, and as proof of pattern goes, a highly-anticipated climate report prepared by the Intergovernmental Panel on Climate Change (IPCC) provided its ultimatum for nations (calling it a "code red for humanity") to yank hard on the greenhouse gas emissions emergency cord and put the brakes on potential catastrophic heating by the close of the century.

For many, this summer has been a tipping point. And while the public and scientific community have long been sounding the alarms, it's telling that the world's financiers are also starting to grasp both the urgency as well as the opportunity for innovations that have a positive impact on the environment.

And if profit by way of opportunity is the catalyst for quickly needed change, then bring it on. Canadian Cleantech financing surged 335 per cent, setting the sector up for a banner year, securing $3.09 billion in equity financings during the first six months of 2021. Globally, sustainable funds hit a record high of $2.80 trillion in assets in the second quarter, up 12 per cent from Q1 of this year. It's safe to say that Canadian cleantech is booming and in some sectors can in fact be seen as leading the global charge.

Asia too, as it does, continues to innovate and invest through forward-thinking policy and action. This alignment in drive and purpose is why this edition of PERIPHERY is dedicated to this fast moving sector. We interviewed a range of visionaries, engineers and innovators in Canada and across Asia in an effort to frame this evolving new industry, identify the priorities of governments and highlight those businesses that are doing business by doing good.

While an enterprising Vancouver-based e-mobility provider, Japanese consumer-focused agri-tech startup and New Brunswick-based recycler making bricks from waste have vastly different skill sets, they share an outlook and an ecosystem that is driving to output clean products and energy.

PERIPHERY is attempting to connect the dots for such businesses to find mutual opportunity, to help propel their increasingly essential work and to share their made-in-Canada technologies with a region that is moving quickly towards a sustainable horizon.

# Telling the Numbers

**If governments collectively earmarked USD 1 trillion towards clean energy investments annually the effort would ignite the global economy, put millions upon millions to work, and greatly curb emissions that meet the Paris-Agreement path. Here are more numbers to ruminate over...**

## COP26:

Canada aims for **net-zero** by **2050**

Of **232** companies committed to Business Ambition for **1.5°C** targets, **only 16 are from Asia**

**80%** of the world's population is left behind in the shift towards **a new and cleaner energy economy**

## COP26:

**India** on track: **450 GW** by **2030**

**Global cleantech activity** should exceed **$2.5T** by **2022**

The share of **global renewable electricity** grew from **18%** in **2009** to nearly **28%** in **2020**

**Indonesia** generates **64M t.** of solid waste per year. **Thailand 27M t.** **Vietnam 22M t.**

**Canada** is **#2** on the **Global Cleantech Innovation Index 2021**

By **2025**, **Canada** aims to make clean technology a **top-five export**

The potential **benefits** of **SEA** going green by **2030** are **$1T**

Only **10%** of **Philippines** wastewater is treated while **58%** of **groundwater** is **contaminated**

The worldwide **WTE technologies market** is expected to grow **7%** by **2025**

**Global clean energy tech industry** to reach **$450B** by **2027**

**70:** percentage of coal plants built globally that rely on **Chinese funding**

*All dollar figures in this report are in CDN.*

*Facts sourced in this report are updated at the latest possible release date though may not be accurate at the point of publication*



THE PERIPHERY MARKET INSIGHTS

# Outlook

Examining the specific challenges in countries across Asia and the opportunities for collaboration with Canadian cleantech companies

## Outlook: Carbon Capture

# Pathway to zero

**Nearly 200 countries have signed the Paris Agreement to keep global warming in check by 1.5°C and that means cutting an estimated one Gigatonne (Gt) of CO2 emissions globally by 2025. The problem is far from going away with current efforts in development projected to only remove some 150 million tonnes of CO2 in that time, well short of what's needed according to a recent report by the Coalition for Negative Emissions (CNE). Furthermore, the assessment spells out that efforts cannot suffer complacency and will require cutting more than one billion tonnes of emissions annually thereafter.**

Negative emission projects involving Carbon Capture (CC), are part of the overarching climate strategy supported by growing Asia Pacific investments in renewable energy. These are set to double to $1.6 trillion by 2030 from the previous decade according to the energy consultancy firm, Wood McKenzie.

Funds also support carbon neutral projects. China, Japan, India, South Korea and Taiwan are among the top contributors for such investments in Asia Pacific, which include solar and wind, producing an average of 140 gigawatts of additional capacities annually.

More than 100 companies and organisations, together with Asia Pacific governments, are co-operating in developing carbon capture, storage and utilisation (CCUS) projects as part of global efforts to achieve carbon neutrality by 2050. Japanese trade and industry (METI) minister Hiroshi Kajiyama recently announced the rollout of the Asia CCUS Network, an industry-academia-government platform to promote CCUS applications and foster a business network for the group to get underway throughout Asia.

Announced in June, the Asia CCUS Network has the commitment of 13 countries, that includes the 10 members of the Association of Southeast Asian Nations (ASEAN), Japan, the US and Australia.

While Canada is not currently part of the Asia league, all eyes are on Alberta's mammoth oil sands project using CCUS to achieve net-zero greenhouse-gas (GHG) emissions by 2050. The association says it is committed to galvanize Canadian industry in line with the climate commitments established by the Paris Agreement.

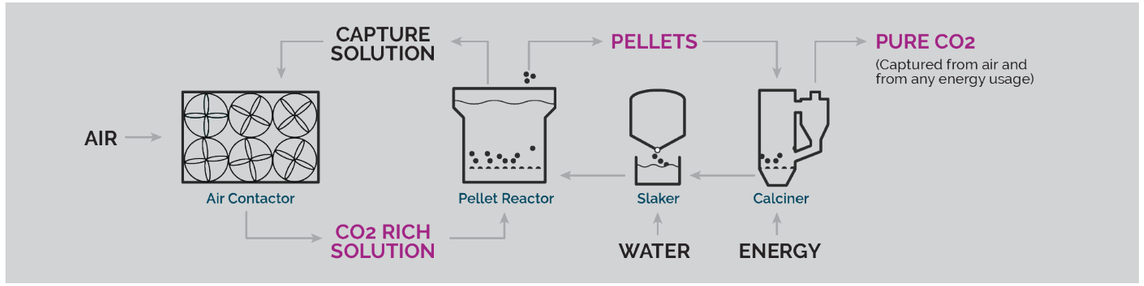
The group of operators that represent nearly 90 per cent of oil sands production in Canada are the industry's heavyweights: Canadian Natural Resources, Cenovus Energy, Imperial Oil, MEG Energy, and Suncor Energy. The five-company alliance is calling its plan the "Oil Sands Pathways to Net Zero."

Like the Canadian quintet, CCUS Asia goes beyond government-to-government cooperation, the alliance has attracted participation of more than 100 international organisations, companies, financial and research institutes, according to METI.

A further $12.5 billion in funding from the Japanese government has been earmarked for renewable and low-carbon, clean energy technology projects in ASEAN under the Asia Energy Transition Initiative (AETI). Investment seems to be in Asia's favor however questions now remain on how to transport CO2, where to store it, and the safety risks involved.

While energy transformation is a trend towards clean energy, five Asian countries (China, India, Indonesia, Vietnam and Japan) at the time of this report are responsible for 80 per cent of new coal power plants planned around the world. According to Carbon Tracker, most would prove uneconomical and new plants would put international climate goals out of reach.

Of the 100 cities worldwide most vulnerable to the dangers of carbon dioxide in the air, all but one are in Asia (most in India and China), according to a recent risk assessment paper. More than 400 cities with a total population of 1.5 billion are at "high" or "extreme" risk, a result of life-shortening environments, decreasing water supplies, suffocating heat waves and natural disasters from climate change. The sinking megalopolis of Jakarta, plagued by pollution, flooding and increasing heat, was ranked the worst.




*Carbon Engineering's Direct Air Capture process*

*Carbon Engineering's pilot air contactor*

The CO2 absorbed in the ocean from the atmosphere is a phenomenon known as "carbon sink." The problem, according to scientists, is that oceans, the Southern Ocean in particular, are no longer soaking up the carbon dioxide that they used to. And excess CO2 from human emissions appears to be lingering on the surface of the oceans instead of sinking while the more CO2 an ocean surface absorbs the more acidic it becomes adversely affecting marine life.

Various pioneering CCUS technologies are in development, and rather than permanently storing CO2 underground, waste conversion solutions include storing CO2 in concrete blocks.

Carbon Engineering, based in Squamish B.C., has another solution, which captures carbon from the atmosphere and converts it into a carbon-neutral jet fuel. Investors include Bill Gates and Murray Edwards, founder and executive chairman of Canadian Natural Resources Limited.

Where does Asia go from here and how does Canada play a role? As detailed in a recent report by the International Energy Agency (IEA), four high-level strategic priorities for CCUS in Southeast Asia are required by governments and industry:

**1.** Increase regional cooperation and collaboration, including through the Asia CCUS Network, to identify and develop opportunities for shared infrastructure development and to build CCUS capabilities throughout the region.

**2.** Identify and develop onshore and offshore CO2 storage resources in parallel with the establishment of robust legal and regulatory frameworks for the safe and secure storage of CO2. Leverage international programmes to support these efforts, such as the ADB CCUS Trust Fund.

**3.** Encourage early investment in CCUS projects, including pilot demonstrations and industrial hubs, through targeted policies and integrating CCUS into national energy and climate strategies. Recognising a role for CCUS in energy and climate strategies can improve access to international finance.

**4.** Build international support and financing for CCUS in the region, particularly increased access to grants and loans from international development and climate finance institutions. Encourage international capital markets to fund a broader range of clean energy investment opportunities, including CCUS, in Southeast Asia.

WTE

# Beyond flotsam & jetsam

**A mere few generations ago, daily consumer needs purchased in towns and villages across Asia, from Bali to Bangkok, Manila to Mumbai, were made largely from local, natural materials created to last or simply biodegrade. Often ceremoniously wrapped in forest leaves or everyday paper, meals and consumables offered micro-retailers time-honored ways of community trade, that was until the introduction of single-use plastics.**

According to a study by recycling and waste expert, Dr. Jenna Jambeck, six Southeast Asian countries are among the top 20 in the world in terms of waste mismanagement; Indonesia and the Philippines, both island nations, ranking second and third, respectively.

In May, ASEAN member states launched a regional action plan to combat marine debris, focused on reducing plastic into the system across the region by enhancing collection capabilities and creating value for waste reuse. The plan provides guidelines for countries to phase out single-use plastics by coordinating regional standards as well as sharing measurement when monitoring marine waste.

In 2020, a panel for a Sustainable Ocean Economy consisting of a group of 14 countries including Canada, Japan and Indonesia (carried out by 250 scientific authors from 48 countries) launched a new ocean action agenda. All member states agreed to sustainably and fully manage their national waters by 2025 to improve the health of the world's oceans and waterways.

The takeaway, according to the panel concludes that such measures would allow the world's oceans to generate some six times more food and 40 times more Waste to Energy (WTE) than current levels, not least lift millions out of poverty and contribute one-fifth of the greenhouse gas emission reductions needed to stay within 1.5°C goals.

There are significant economic opportunities in processing municipal solid wastes (MSW) according to a March report from the World Bank, which found that Malaysia, the Philippines and Thailand alone lost 75 per cent of the material value of plastics alone – the equivalent of $7.5 billion per year when single-use plastics are discarded rather than recovered and recycled.

What are the barriers to adoption of WTE in Asia and how can progressive businesses get involved? According to a study by KPMG, numerous technologies convert non-recyclable waste into usable forms of energy by generating steam in boilers that in turn drive turbo-generators to produce electricity.

Waste management has become crucial given that most Asian cities, especially those in island nations, are running out of landfill locations. With increasingly limited land availability and the steady growth of urban areas, governments need to meaningfully rush towards reducing waste as a public policy while neatly factoring in WTE technologies.

Waste management has become crucial given that most Asian cities, especially those in island nations, are running out of landfill locations.

WTE initiatives are however not without controversy. According to Trang Chu Minh in her article "Five facts about unsustainable waste management in Singapore" published in Eco-business.com, incineration of waste for energy is not the magic bullet: "Singapore is renowned for its efficiency, cleanliness and countless innovations made in sustainable building design, or energy and water efficiency. Yet despite aiming to become a 'Zero Waste Nation' and investing heavily in waste management, the island state fares quite weakly when it comes to responsible resource recovery."

Chu Minh cites that 40 per cent of Singapore's 7.2 million tonnes of solid waste generated in 2019 was incinerated. According to the National Environment Agency (NEA), incineration reduces waste by up to 90 per cent, saving landfill space, and the heat recovered produces steam used to generate electricity.

Some, however, argue that WTE initiatives often mislead people thinking energy comes from green sources and in turn they are not compelled to conserve as they should with no incentives to mitigate waste volumes or motivate responsible recycling.

However, it is no surprise Singapore is ahead of that issue. In 2020, the government opened a waste management plant that produces energy while its refuse is used to create building materials. The facility will eventually process medical and other forms of hazardous waste providing a possible template for other nations in the region.

China plays a leading WTE role in the region, its technology improving from years of operating its many domestic WTE plants. Japan is next in line as a WTE leader actively exporting its expertise and technology and taking a complementing approach to its services such as waste sorting and reduction, training, and recycling.

Since 2019, Japan has pursued agreements with Vietnam, Indonesia and the Philippines, setting aside $23.6 million in its budget to support field surveys and other pre-bid activities. The country has even expressed intention to become Southeast Asia's trash superintendent.

Yet some controversy remains for WTE from leading environmental health experts who say careless development of WTE plants can cause significant environmental impact from hazardous pollution. Sonthi Kotchawat, a recognized Thai environmental health expert says it's the small energy plants which, without careful environmental regulation, can have a counter effect.

The worldwide WTE technologies market is expected to grow 6.54 per cent by 2025. Is this just in time to meet the challenges of a rising tide of ocean pollution? Exploring new WTE technology like Dendro Liquid Energy and Rotary Kiln, along with finally addressing the role that plastic and waste plays in daily Asian life, will need to work hand-in-hand.

Recently announced, Canada's Enbridge in a partnership with Walker Industries and Comcor Environmental, might possess one alternative for the region. The three organizations aim to develop renewable natural gas projects across Canada transforming landfill waste into carbon-neutral energy used to heat homes, power businesses and fuel vehicles.

**From the desk of the Canadian Trade Commissioner Service, Southeast Asia represents many market opportunities for Canadian Cleantech innovators.**

"With a population of more than 640 million, ASEAN represents over 8.5 per cent of total world population and is essentially the third largest market globally with crucial geopolitical significance," says Ritishka Grover, Regional Trade Commissioner for Clean Technology in Asia Pacific.

"For decades, these countries, as with the rest of the world, were accustomed to a linear way of producing, consuming and discarding plastic products. Now, they are taking regional leadership to move toward plastic circularity and combat the economic and environmental consequences of ocean plastics and are also working to improve their management of municipal solid waste.

SEA waste management faces challenges from lagging infrastructural development in trying to keep up with increased economic growth and urbanization. Considering how the urbanization rate is expected to actually pass 70 per cent by 2050, this crisis is likely to get even more challenging in the coming years.

We see a great opportunity for Canadian cleantech companies to support the region through this transition to a more circular economy."

ES

# Saving for a rainy (and windless) day

China and India will represent 43 per cent of global energy demand by 2040.

**The International Renewable Energy Agency (IRENA), estimates renewable projects installed just last year around the world will bring a savings of around $195 billion over their lifespan.**

According to the agency's Director-General Francesco La Camera, "Today, renewables are the cheapest source of power. Renewables present countries tied to coal with an economically attractive phase-out agenda that ensures they meet growing energy demand, while saving costs, adding jobs, boosting growth and meeting climate ambition."

As we reach a critical mass of renewable power the world is indeed in a better place although without the sun shining or wind blowing, that power source needs to be stored to allow instant access between supply and demand.

A report released by commercial intelligence firm, Wood Mackenzie, cites that the cost of front-of-the-meter battery energy storage systems in the Asia Pacific is likely to record a 30 per cent decline through 2025. Reasons for the price reductions are largely due to improvements in battery energy density.

A further study by Guidehouse Insights published in Smart Energy International, confirms the Wood Mackenzie report, that falling battery prices have made utility-scale energy storage projects cost-competitive with fossil fuel generation.

The shift, according to the two reports, has been the economics involved in combining solar and storage projects, today cheaper than natural gas generation in many countries, accounting for a growing share of the global utility-scale energy storage market.

The Energy Storage Association (ESA) based in Washington details a wide array of storage technologies Asia is building upon to maintain stable grids to meet the region's insatiable energy needs (a study by BP indicates that Asia, including China and India, will represent 43 per cent of global energy demand by 2040).

ESA divides storage into five categories: Batteries as electrochemical storage solutions; thermal that captures heat and cold to create energy on demand or offset energy needs; mechanical storage to contain kinetic or gravitational energy to store electricity; hydrogen stored from excess electricity generation and pumped hydropower from large-scale reservoirs of water.

Other than being deployed on the grid to integrate renewables into the energy mix, countries in the region, such as island nations like Indonesia, with remote communities, are increasingly eying energy storage systems installed at the customer's sites or as an isolated remote power system in areas where large-scale electricity grids do not serve.

Technology is favoring the region with almost 1.2 billion people gaining access to electricity in Asia since 2000, according to the International Energy Agency (IEA) with 96 per cent of the region having access to electricity in 2019 compared with 67 per cent in 2000. IEA estimates roughly two-thirds of this progress is in India alone, its government announcing that more than 99 per cent of the population had access to electricity in 2019.


The Energy Market Authority (EMA) of Singapore calls its Energy Storage System (ESS) "game-changing technology," which has the ability to store energy to power its impressive skyline at any time of day even in the monsoon season. "ESS not only addresses solar intermittency but also enhances grid resilience by actively managing mismatches between electricity supply and demand. These advantages are key enablers for Singapore to maximise solar as one of the four switches in Singapore's Energy Story."

Reported in Smart Energy International the city-state's latest storage project to get the go ahead is a consortium led by Envision Digital International to pilot a floating energy storage system utilizing seawater to cool the battery cells and enhance the lifecycle of the system (see Outlook Singapore for further detail).

The future of Asia's transition clearly lies in energy storage given renewable energy has a crucial impact on the stability of power grids. Wind and solar plants produce significant energy although adding more renewable energy sources into the mix increases unpredictability that lead to grid instability. With this challenge lies opportunity for Canadian energy storage system providers like NRstor as the momentum for energy rapidly builds in Asia.

# World heading into unchartered waters

**If cleantech can do its part to help provide clean water to billions of people who still lack basic access to our most prized resource, we have reason to breathe a collective sigh of relief. In Asia alone, nearly 1.8 billion people are without proper sanitation and nearly 700 million without drinkable water. The "without" bullet point list is long, prompting a call-to-action through a growing number of research papers on the state of the world's water.**

A World Bank report, "Quality Unknown: The Invisible Water Crisis," provides a detailed analysis of global water conditions, peerlessly drawing on background papers, advice and analysis from leading academics. The report "brings forth new results that illuminate the impacts of the hidden dangers that lie beneath the water's surface and elucidate strategies for combating them."

The Invisible Water Crisis frames a bleak picture of how we squander water and Asia is far from alone. The issue of declining reserves and polluted water systems affects rich and poor countries alike. Simply put, pollution does not eventually decline with prosperity.

Nevada's Hoover Dam is a recent example of how climate change affects water, the concrete arch-gravity dam experienced record-low water levels in July (leaving it just 37 per cent full at one point in the summer), a significant and worrying development with major implications for water and climate in the entire American Southwest.

The Invisible Water Crisis calls to attention its "Ladder of Policy Interventions" to act quickly through information, prevention and investment. Efforts start with awareness and like combating Covid, will require widespread understanding of this imminent danger and how countries like Canada, notwithstanding its own water issues, can lead the fight.

Throughout Asia, escalating demands, deteriorating quality, shrinking resources and lack of needed investment and policy, reveal a vulnerability to the region's prized and increasingly elusive resource, from the peaks of the Himalayas to the terraced rice fields of Bali.

According to new research by the University of Leeds, forest clearance in Vietnam is leading to unprecedented increases in carbon emissions, critical zones for biodiversity. The Mekong River, running through China, Myanmar, Laos, Thailand, Cambodia and Vietnam, sustains the livelihoods of around 66 million people yet the once mighty river is running dry, its water levels perilously at their lowest in 100 years. Upstream dams built by China on the upper basin of the Mekong River, are to blame.

A further study, "Glacio-hydrology of the Himalaya-Karakoram," published in the journal Science, links climatic warming, precipitation change and glacier shrinkage: "The melting glaciers fulfils the water requirements of more than a billion people of the region who will be affected when much of the glacier ice mass melts throughout this century and gradually stops supplying the required amount of water."

Scarcity is one issue and pollutants are another emerging concern throughout Asia, according to authors of The Invisible Water Crisis: "The usefulness of plastics and pharmaceuticals is immeasurable,



In Asia alone, nearly **1.8 billion people** are without proper sanitation and nearly **700 million** without drinkable water.

and yet the unintended by-products have consequences that are widespread and difficult to quantify and contain."

A report by the Food and Agriculture Association of the United Nations, explains that intensifying water constraints further threaten food security and nutrition. At the same time, rainfed agriculture is facing increasing precipitation variability driven by climate change. These trends will exacerbate disputes among water users and inequality in access to water across Asia, especially for small-scale farmers, the rural poor and other vulnerable populations.

Salt and nitrate pollution and arsenic contamination along with the encroachment of saline into water supplies add to the concern especially for half the global population who are already living in potential water scarce areas at least one month per year (this could increase to some 4.8–5.7 billion in 2050). About 73 per cent of the affected people live in Asia.

Improving the measurement of water quality is a critical first step. Few developing countries adequately monitor water quality. New technologies and techniques have made measurement more feasible and reliable. Recent trials have demonstrated that multilayered monitoring systems involving several parties can improve the reliability of data collected. These in turn can be complemented with remote sensing and machine learning to provide an additional and independent layer of verification.

Given the broad range of challenges facing the immense populations in Asia reflect similar challenges around the world, the opportunity for Canadian cleantech companies to pilot new technologies and also learn from the innovations in Asia are potentially world-saving.

# Using resources sparingly and recycling endlessly

**According to Investment Week, Asia is in the early stages of its sustainability transition, but this is what makes the region attractive to investors and to forward-thinking businesses looking to expand their reach and make meaningful impact on their sustainability initiatives.**

Across the region, startups, brands and younger consumers themselves are choosing options that reduce their impact on the environment. In a large study of almost 10,000 consumers across nine countries in the region, research firm Kantar found that the top three concerns of Asian consumers are specific to environmental worries such as water pollution, extreme weather and air pollution.

The research showed that 58 per cent of people will buy responsible brands while over half will actively reject companies that don't make an effort.

Headquartered in the Philippines, leading instant noodle and biscuits maker, Monde Nissin, is an example of the changes being brought on by shifting consumer demands. The company has adjusted its Environmental, Social and Governance (ESG) perspective through its focus on meat substitutes which it sees as more ethical and environmentally sound and which is becoming adopted more readily due to consumer concerns about health, sustainability, and animal welfare.

Headquartered in Singapore, TurtleTree is tackling the resource intensive dairy industry through the formulation of bioengineered milk. With a mission to one day provide millions access to sustainable dairy and infant nutrition products, they too are focused on the consumer shift towards being gentle towards the planet, animals and each other.




Consumers in Southeast Asia are literally driving change in how consumer brands offer their services. The Singapore-based ride-hailing firm, Grab, launched its new Green Programme in countries such as Singapore and Cambodia, which allows consumers to select electric vehicles for a small premium.

Grab matches commuters' contributions, which go towards carbon credits and investment in projects such as the Keo Seima Wildlife Sanctuary (KSWS) conservation programme in Cambodia and Katingan Mentaya Project in Indonesia. Meanwhile, Grab rival Gojek, operating in Indonesia, Vietnam, Thailand and Singapore, says it aims to make every vehicle on its platform electric by 2030.

Millennials in Asia Pacific are also buying more pre-owned items as the concept of re-commerce allows them to counter the unsustainable fast fashion industry, that continues to take advantage of the region for producing low-cost clothing.

Carousell, a Singaporean peer-to-peer e-commerce company has tapped into the region's growing sustainability consciousness by creating an app for buying and selling new or second-hand goods. Consumers and brands promote and sell pre-loved items that keep them from landfills. The company has grown to become Singapore's largest community-powered marketplace and expanded to countries throughout the Asia-Pacific and Canada.

But for consumers, the solutions aren't always high-tech. Another big issue across Asia is plastic waste. Twenty-five countries have initiatives banning single-use plastic as packaging demands are outpacing global growth rates, and the region's recycling infrastructure remains limited. This has created a need and an opportunity for reducing packaging and incorporating new biodegradable options.

In Indonesia, the second highest ocean plastic polluter in the world, Jane von Rabenau, CEO of Siklus took matters into her own hands by providing refill stations and mobile refill carts across the country, sourcing directly from major shampoo and cleaning brands and using WhatsApp, to ensure customers know of when the kiosks are in their neighborhoods.

"I took the conversation to consumer goods companies and they were interested in the model I was proposing," she explains in an interview with Cleantech.com. "They also were interested in seeing where we could save on packaging costs as well as getting reliable data on consumer purchasing habits."

Another example of reducing toiletry waste is Singapore based, The Powder Shampoo, a fresh startup that uses plastic free aluminum containers and paper refill bags for its bath products. As the name suggests, the product is made of powder that activates with water. The brand even produces a powder based conditioner from its Singapore manufacturing facility.

What's important for Canadian companies and brands in Asia to understand is that Asian consumers don't want standalone campaigns or initiatives but will choose companies that build sustainability directly into their business model. Ride-sharing and re-commerce platforms are examples of new business models built from the ground up with sustainability in mind. For forward-thinking companies, there are opportunities for collaboration with a growing ecosystem of startups and government initiatives across Asia. At the same time, there is plenty for businesses to learn from Asia and apply in Canada, where sustainability is high on consumer consciousness.

# Is China cleantech's holy grail?

"The country emits around one-quarter of the world's greenhouse gases, the largest share of any country yet it is also the world's largest producer of wind energy."

**When the Chinese get behind a sector as important as cleantech headlines are made. Afterall the country emits around one-quarter of the world's greenhouse gases, the largest share of any country, yet it is also the world's largest producer of wind energy with a capacity to create more than double the power of the next largest generator, the United States. China also has roughly one-third of the world's solar-generation capacity, building more systems in the past several years than any other country.**

A pre-pandemic overview by the Canadian Trade Commission cites China as the world's largest producer and consumer of clean technology with a total investment exceeding that of Europe and the United States combined. According to Equity Research by Goldman Sachs, who are closely following investments to Net Zero, highlights of the plan include renewable power with the potential to de-carbonize roughly half of the country's CO2 emissions and power generation by 2060. The investment bank also sees that new clean hydrogen has the potential of driving 20 per cent of de-carbonization, mostly in industry and heating, and 15 per cent carbon capture of China's industrial emissions.

As told to PERIPHERY: "At the Canada China Business Council (CCBC), we advise companies to focus on what we call 'open window' sectors, and the window for cleantech in China is definitely open,"says Sarah Kutulakos, executive director and COO at Canada China Business Council. "In CCBC's recently-published report on China's 14th Five-Year Plan, the cleantech sector plays a prominent role."

## Carbon capture

China completed construction of its largest carbon capture and storage plant to meet its climate goals. The China Energy Investment Corp. finished production of the Guohua Jinjie coal power station in Shaanxi province early in the year. Once in operation the modified plant will capture 150,000 tonnes of carbon dioxide emissions a year (a 90 per cent capture rate), according to the China Electricity Council.

As China increases renewable energy sources with plans for a long-term shift away from coal, carbon capture is seen as a vital game changer at removing greenhouse gas emissions from energy-intensive industrial processes. The capture technology will be an integral part of the country's net-zero energy system, according to the International Energy Agency (IEA).

While Guohua Jinjie is China's largest to date, the 2060 carbon-neutral challenge overall is enormous and requires ambitious facilities. According to BP Plc, the plant captures about 0.002 per cent of China's total emissions from burning fuel. Nonetheless, the July launch of the country's first national emissions-trading scheme (ETS) holds promise. Such carbon-pricing mechanisms exist in around 45 countries already, China's, is already the world's biggest.

China's rules and regulations around the scheme came into effect in February with online trading commencing in July. According to *Nature*, it works based on a "cap-and-trade" model, in which emitters – initially just coal- and gas-fired power plants – are allocated a certain emission allowance up to a set limit and then either trade or buy allowances if they remain below or exceed this.

## Energy storage

China established electrochemical energy storage projects in the first three quarters of 2020 amounting to an increase of nearly 160 per cent from the same period in 2019. The China Energy Storage Alliance's (CNESA) in-house research group, announced the country now has some 33.1GW of installed energy storage capacity (global cumulative capacity is now at 186.1GW) with lithium-ion batteries making up about 85 per cent of this electrochemical storage.

CNESA's research team says 38 per cent of global new energy storage capacity was in China, making it the world's leader in 2020. In addition to the expanded capacity, CNESA's monthly market update cited several major steps forward alongside sizable project news. As reported in Energy Storage News, China's National Energy Administration (NEA) recently published a list of operational energy storage ventures that have been selected as science and technology innovation pilot demonstration projects, eight in total, located in five provinces.

## Waste to energy

According to the World Energy Council, waste-to-energy cleantech is growing quickly, with the global market estimated to be worth $40 billion by 2023, China producing as much as 175 million tonnes alone. The world's largest waste generator will need to factor into the equation

hundreds of landfills and waste-to-energy plants to meet a growing municipal waste emergency.

China's primary methods for waste management have been landfills, incineration, and composting although the poor standards and conditions in the country have resulted in facilities that are generally inefficient and unsustainable.

"In China, environmental protection is now an integral component of economic policymaking, and China aspires to lead globally on sustainability, while becoming a cleaner and greener place for its citizens to live," says Kutulakos of CCBC. "As a result, there are many cleantech areas in which Canadian companies can play a role – from soil and water remediation, to pollution control, to cleaner energy, to anything that reduces resource intensity."

Incineration has become a controversial issue due to emission concerns and high technology costs and composting a difficult proposition for developing countries due to absence of source-segregation. The organic fraction of municipal waste is usually mixed with plastics, metals, healthcare and industrial waste resulting in poor quality composts and a high risk of heavy metals leaking into agricultural soils.

Among the major challenges for waste-to-energy are insufficient data, weak infrastructure, informal waste collection systems and the lack of policies and regulations. Further challenges include lack of economic incentives and the high costs associated with biomass technologies.

The will and determination to produce energy from waste is there and they are meeting the challenges with a 'size matters' attitude. Referred to as the world's largest waste-to-energy plant located in Shenzhen, southeast China, a city of 20 million people known as a major shopping destination, the facility processes up to 5,000 tonnes of waste each day, roughly a third of Shenzhen's daily domestic waste. China has the largest installed waste-to-energy capacity of any country, with more than 300 plants in operation, according to Power Engineering International (PEI).

With a massive population and new environmental pressures brought on by climate change, such as recent flooding in Central China where over 300 people died and 250,000 hectares of crops were destroyed, the time is now for increased waste to energy.

# India's sustainability under pressure

"Earth provides enough to satisfy every man's need but not any man's greed."

*Mahatma Gandhi*


**India-based Reliance Industries Ltd, with its massive refining, petrochemicals, oil and gas operations, plans to come clean by investing $12.64 billion in sustainable energy over three years, carving a committed path to energy transformation. Announced in June, the company will build four "giga factories" located in the state of Gujarat that consist of integrated solar photovoltaic production, advanced energy storage battery facility, electrolyser unit (to produce green hydrogen) and fuel cell units.**

Numerous reports on India's renewable energy sector are relentlessly positive, the Panglosses of the day maintaining an agenda to thrive and even exceed its determined renewable energy targets in 2020 despite coronavirus lockdowns of some 1.3 billion people (the country's clean energy transition hit the pause button in 2020 despite being a successful year with cheaper renewables in the grid). Government stimulus measures for utilities and domestic solar manufacturing initiatives helped prop up the outlook for solar and wind even further.

The government is also encouraging public-private and public-private-civil-society partnerships for better efficiency in electricity consumption and higher levels of renewable energy penetration for the hundreds of millions of Indians without electricity. According to British Business Energy, India is fifth in size among countries when it comes to its energy economy (measured by the combined revenue of energy companies) and third for renewable energy investment and future plans.

## Integrating energy storage

The International Energy Agency forecasts that India will eventually become the largest market for utility-scale battery storage worldwide, and for good reason – the country will soon become the world's most populous nation. A lack of reliable, ongoing power supply for millions of Indian households set to buy new appliances, air-con units and vehicles, presents a quickly approaching concern.

The country's expanding economy, urbanisation and industrialisation means India will experience the largest increase in energy demand of any country leading into 2040. With such an appetite, wind and solar at scale will no longer on its own meet such behemoth power needs.



In July, Delhi police ironically used water cannons to disperse people protesting the widespread lack of access to clean water.

With the widespread ramp up for renewables, utility and energy stakeholders are forced to make a more efficient, smart and resilient grid that works well with advanced battery cells and cutting-edge solar modules.

Over the past decade, the government performed well, adding solar and wind energy capacity at an impressive pace that will work only with substantial structural reforms to create a cleaner and more flexible power system that could be a mix of standalone battery projects and/or renewable energy hybrid systems. The transition to low-cost, variable renewable energy generation simply requires a flexible and stable grid.

## Land and water issues

While India is on the right path for renewables, social-economic issues impede progress, such as water scarcity and land conflicts. For example, renewable power projects – whether solar or wind – require vast tracts of land. According to the Multidisciplinary Digital Publishing Institute (MDPI), the land footprint needed just to meet India's 2022 renewable energy target ranges from 55,000-125,000 square kilometres.

Natural resources are being stressed above and below ground. In July, Delhi police ironically used water cannons to disperse people protesting the widespread lack of access to clean water. It's a story familiar to Devesh Bharadwaj, founder of Pani Energy (see Upside Heavy Industry p40), a Victoria B.C-based cleantech company specializing in cloud-based machine learning software to elevate the efficiency of water treatment facilities. Bharadwaj knows firsthand what water scarcity is all about.

*An Indian boy sits atop a government water supply truck as residents fill water containers. During the hot summers residents struggle with water shortages.*

Growing up in India, Bharadwaj didn't take water for granted, he tells PERIPHERY: "When I moved to Canada, I realized it doesn't have to be that way. Access to essential resources like water and electricity can be a baseline – something you don't have to worry about. To get there, we need to think ahead, and have a willingness to try new approaches. I see this happening in companies, cities, and countries all over the world. India has the opportunity to leapfrog systems and approaches to be a world leader here."

India is hardly alone with its water scarcity. According to University Affairs (Canada's Trouble Waters), Canada faces sobering and bonafied threats to its water security, a reality most Canadians are completely unaware of as many think the country has a bottomless water supply. The insightful report by Kerry Banks calls it a "myth" that we have an abundance of water below our feet. Banks says Canada's water is simply not accessible even though we possess 20 per cent of global freshwater resources.
The fact is, only seven per cent is considered renewable and most of that drains north toward Hudson's Bay and the Arctic Ocean.

# Of EV batteries, geothermal & spirit

**At the time of this report the pernicious delta variant is ravaging the Indonesian medical system and yet despite the horrifying daily news the rupiah saw its best day in weeks while Bank Indonesia (BI) held interest rates steady to support the economy, sounding optimism for the remainder of 2021.**

When tough times test the resilience of the Indonesian people the word "semangat" is often used as a defying exclamation. Translated as "spirit" the word really means: "We are united and moving forward with strength and determination." That special spirit (and billions of Canadian dollars in investment) is supporting the groundwork to build the country's first electric vehicle (EV) battery plant to begin production by 2023.

Much of the country's SDG gains in the past year have been sadly eclipsed by Covid. In July an MOU was inked by the Indonesia Battery Corp. (IBC), a holding company comprised of four state-owned enterprises and a consortium led by Hyundai Motor Group and LG Energy Solution, boosting investment in its EV battery sector to $41.3 billion by 2033.

Could EV be the country's sustainability kismet? A necessary material in the production of EV batteries is nickel and Indonesia, lo and behold, has one of the world's largest reserves, roughly 30 per cent of the world's nickel (760,000 tonnes mined in 2020). EV battery production is also reliant on copper, and Indonesia's Grasberg mine in Irian Jaya has the world's second-largest reserve. According to Mining Technology, Grasberg produced 528 billion ounces of copper up to 2019.

The country is also developing two nickel-based battery blends, consisting of nickel-cobalt-manganese and lithium-cobalt-nickel-aluminum, considered two of the best mixes used in EV lithium-ion batteries. On the back of this news, Indonesia's energy minister announced that all cars sold from 2050 will be EV and that all coal-powered plants will discontinue operation by 2056. No coincidence an August news release announced government optimism to reach net zero emissions by 2060 or sooner.

While the Indonesian government speeds up the development of battery-powered EVs, rolling out initiatives to supercharge the industry and welcoming more investment, it must also deal with the waste and environmental impact that a sizable EV industry generates.

## A veritable powerhouse

With its legendary "ring of fire" volcanic geography, Indonesia's ability to generate geothermal ranks among the world's largest. A geothermal plant produces power by using the earth's heat to generate steam that turns turbines. With an aim to become the world's geothermal powerhouse, Indonesia hopes to install eight gigawatts (GW) of geothermal capacity by 2030, up from what is currently, 2.1 GW.

According to IOPscience, geothermal power plants are commercially viable in areas straddling the earth's tectonic plates, citing Indonesia as having a staggering 29000 MW of untapped geothermal power (40 per cent of the world's geothermal). Once harnessed, it would allow for a sufficient and stable baseload of power for millions of homes across the archipelago.

Indonesia is enviably able to build plants and systems located over accessible heat close to the surface. According to Think GeoEnergy: Not more than a decade from now, the country is projected to surpass the U.S. as the country with the largest geothermal utilization in the world. The government has identified more than 300 sites with an estimated 24 GW in geothermal energy reserves across the entire country. As of 2020, there are 19 existing geothermal working areas.

## Amping up solar

Plans were unveiled over the summer for the world's largest floating solar power and energy storage system with a cost estimated at $2,466 billion. Developed by Singapore's Sunseap Group in cooperation with Badan Pengusahaan Batam, the facility will be located in the Duriangkang Reservoir near sun-drenched Batam Island, 50 kilometres from Singapore.

With construction to begin in 2022, Sunseap expects the massive solar farm will generate more than 2,600 GWh of electricity per annum, potentially offsetting more than 1.8 million metric tonnes of carbon per year (equivalent to taking more than 400,000 cars off the road each year).

A necessary material in the production of EV batteries is nickel and Indonesia, lo and behold, has one of the world's largest reserves, roughly **30%** of the world's nickel (**760,000 tonnes** mined in 2020).

The energy generated and stored will supply non-intermittent solar energy around the clock, a portion of that green energy consumed within Batam, while the balance exported via a subsea cable to Singapore.

Senior solar consultant Pieter de Vries tells PERIPHERY: "The development of floating solar farms such as Sunseap, one of many in development, is a strong indicator the sector is waking up." The Jakarta/Bali-based, Dutch expatriate says Indonesia has 375 lakes or reservoirs where the state power company, PLN, could use for further floating solar plants. "At the same time, the private industrial sector is starting to see the environmental and financial benefits from rooftop solar, often financed by IPP's that offer no investment and lower energy cost deals."

## Waste-to-energy

In April, Indonesian President Joko Widodo urged cities across the country to set up waste-to-energy plants this year to get their arms around the country's growing mountains of rubbish. The world's fourth-most populous country with 260 million people is the second-biggest contributor of plastic pollutants in the oceans. Indonesia's vast archipelago of more than 17,000 islands has struggled to cope with waste, much of it tossed on riverbanks that lead to oceans.

Off Grid Energy Independence reported in July that Riverrecycle and Clean Planet Energy announced they have entered into a partnership agreement to support global efforts for removing non-recyclable plastics from rivers and the environment in Southeast Asia, and then re-purposing the waste as new ultra-clean fuels. The focus of the partnership begins in Indonesia and the Philippines.

While Indonesia's push towards more sustainable industry is a good sign for Canadian cleantech companies looking to grow in one of the most populous countries in the world, even more exciting is the announcement that Canada and Indonesia have launched negotiations towards a potential free trade agreement. The Indonesia-Canada Comprehensive Economic Partnership Agreement (ICA-CEPA) opens the door to Canadian expertise in areas such as infrastructure, energy, and natural resource development.

According to Geoff Donald, Advocacy Chair for the Canada-ASEAN Business Council (CABC), Indonesia is expected to invest $625 billion in these areas over the next five years to support its continued growth. It goes without saying that these investments will need to consider environmental impact as a critical component of any new developments.

# Flip-flopping on climate initiatives

**As monsoon season begins in the Philippines, the country is no stranger to massive floods and the disruptive forces of Mother Nature. But as the world's temperature rises with sea levels, the sense of urgency is growing amongst the island population of 110 million. But despite the need for change in environmental practices of the country's big industries, there is a growing frustration with the disparity between words and actions of the Duterte government.**

Green advocates in the Philippines have begun to voice concerns for the country's stagnating environmental policies, giving President Rodrigo Duterte a failing grade, accusing him of not fulfilling campaign promises.

"Claiming to be a green President during the campaign in 2016, his promises on regulating mining, land use and protecting the rivers and forests have not been achieved – promises that would have lessened the impacts of Covid-19 to the rural poor and indigenous peoples, if they were delivered," the group Green Thumb Coalition (GTC) said in a statement read during an online press conference organized by the Philippine Movement for Climate Justice (PMCJ) ahead of the President's State of the Nation Address (SONA) in late July.

Of particular issue is the government's executive order to lift the moratorium on mineral agreements established by the previous government as well as the development of the Kaliwa Dam, a 60-meter high dam in Quezon that is being questioned for potentially displacing indigenous peoples and negatively impacting the region's plants and animals.

These projects are part of the administration's Build! Build! Build! (BBB) Program that aims to usher in the "Golden age of infrastructure" in the Philippines at a cost of around $2 - 2.25 trillion from 2016 to 2022. But environmentalists and a growing number of citizens are questioning the sustainability of such massive projects.

Like the rest of the world, Filipinos are becoming increasingly anxious about issues such as waste management, ocean health, clean energy and carbon emissions from individuals and industry, while also struggling with increased flooding and land loss due to rising sea levels. This has led to individuals and innovative businesses to take the lead on sustainable alternatives and interventions.

When Covid 19's initial wave hit in summer 2020, one of the Philippine government's responses was to suspend public transportation. This meant that essential healthcare workers in urban centers were forced to navigate the heavy city congestion in private vehicles, which for many is a luxury.

Without the means to safely travel to work, medical front-liners were held back from doing their jobs. SWAT Mobility, a Singapore startup that uses existing map data along with custom algorithms and artificial intelligence to power their mobility engine, partnered with Toyota Mobility Foundation to provide demand-responsive commuter transport for healthcare workers free of charge. Using SWAT's Just In Time booking app, workers could book a ride in advance to pick them up from a close-to-home location and transport them to the hospital.

Because SWAT Mobility is designed for mass transit solutions such as vans and buses, the app organizes all bookings and generates routes that are most convenient for the medical frontliners, reducing time and even more importantly, reduces the environmental impact of commuting with single vehicles using ride-hailing apps.

"Asia continues to be one of the fastest growing economies; as countries establish their new normal to safely reopen for trade and business, traditional industries such as transportation have to keep up with new expectations of safe commuting and contact tracing, while staying viable and relevant in the green economy," explains Grace Ho, president of SWAT Mobility to PERIPHERY.

"In my view, technology has a critical and urgent role in redefining future mobility for the people and the providers. We focus our software to help customers automate and digitize their transport planning; through our suite of applications, we provide a digital audit trail of the commute journey. Our data driven approach in route simulations and calculation of CO2 emissions help provide a convenient starting point towards meeting ESG objectives."

"In my view, technology has a critical and urgent role in redefining future mobility for the people and the providers."

Renewable energy is another key area of focus for the Philippines, whose energy requirements are growing with the country's rapid development. While the Duterte government initially requested the expedition of renewable energy projects, it later signed an executive order creating an Energy Investment Coordinating Council to speed along the construction of coal-fired power plants, to the chagrin of environmentalists.

However, the Philippines' Department of Energy (DOE) recently held a virtual workshop to understand how to effectively partner with the wind industry to tap into the country's massive offshore potential. The DOE aims to collaborate with the Carbon Trust and the Global Wind Energy Council (GWEC).

According to industry trade Offshore WIND, Energy Secretary Alfonso G. Cusi said, "harnessing our wind energy resources would open up a limitless resource of reliable and indigenous clean energy, bringing us closer to our energy security and sustainability goals. This development would also redound to the benefit of Filipinos through job generation, public health benefits, and the influx of significant inward capital investment."

Economic Development Canada (EDC) has recently identified that another area of opportunity for Canadian firms in the Philippines is in medium- and micro-scale hydro power generation, which would "greatly contribute to the country's efforts for improved energy security and positive climate impact."

# Small country, big impact

"Linked to the city's sewers, it treats up to **900 million** litres of wastewater a day through its many pipes, tanks and tubes. The system's recycled wastewater can now meet 40 per cent of Singapore's water demand."

*Courtesy of WSP Global Inc*

**This small island nation of Singapore has always punched above its weight on the international stage. However, despite its small population of just under six million people, advanced digitized infrastructure and trusting citizens, Singapore also has an outsized negative impact on the environment. As the biggest per capita CO2 emitters in Asia, Singapore is also a major contributor to ocean plastic, some 900 million kg of plastic waste discarded every year and only four per cent of it recycled, according to the World Wildlife Fund (WWF).**

In keeping with its position as a regional role model and host to the ASEAN headquarters of most multinational companies, Singapore is accelerating its efforts to align with the global push for sustainable solutions, particularly in areas where it has traditionally been a leader: energy, waste and investment. And while there has been movement by the private sector to address climate change, the influential and (sometimes) conservative public sector, too, is making strides.

Singapore's Ministry of Sustainability and the Environment (MSE) recently launched GreenGov.SG at Climate Action Week 2021, aiming to reduce the environmental footprint of the public sector as part of the national sustainability agenda mapped out in the Singapore Green Plan 2030. The public sector aims to reduce energy and water use by 10 per cent from the average of 2018-2020 levels, and to reduce the amount of waste disposed by 30 per cent from 2022 levels.

According to the MSE, the public sector will set targets for buildings, information technology, transport, and solar deployment that are more ambitious than the national targets. Singapore is already a world leader in green architecture since the launch of the Building and Construction Authority (BCA)'s Green Mark scheme in 2005, which formed a key element of Singapore's first Green Building Masterplan. The target is to have "at least 80 per cent of buildings (by floor area) in Singapore to be green by 2030." By the of end 2020, 43 per cent of Singapore's buildings were greened, according to the BCA.

But while green buildings continue to reach upwards, Singapore's land and water scarcity creates challenges for boosting renewable energy sources and potable water. To solve these, the 'Little Red Dot' as the city is often referred to, demonstrates its innovation in the face of environmental crisis.

## Underground and on the water

As deep underground as 25 stories, the high-tech Changi Water Reclamation Plant on the city's eastern coast is fed by wastewater that flows through a massive 48-kilometre tunnel. Linked to the city's sewers, it treats up to 900 million litres of wastewater a day through its many pipes, tanks and tubes. The system's recycled wastewater can now meet 40 per cent of Singapore's water demand – a figure that is expected to rise to 55 per cent by 2060, according to the national water agency, PUB. This allows the metropolis to lessen its reliance on water supplies from neighbouring Malaysia while at the same time reducing maritime pollution.

Singapore has a long history of reclaiming land from the sea. Given its limited size, typical renewable energy projects, such as wind or solar, aren't always practical. To overcome this, the country recently unveiled one of the world's biggest floating solar power farms. Covering an area of over 45 hectares, the array is made up of 122,000 panels on Tengeh Reservoir producing up to 60 megawatts of electricity, and leading to carbon emissions reductions equivalent to removing 7,000 cars from roads, according to Sembcorp Industries, who constructed the project with PUB.

"Solar energy is plentiful, clean and green, and is key to reducing PUB's and also Singapore's carbon footprint," said the water agency's chief executive Ng Joo Hee.

## Seeking a return on impact

Singapore is an influential financial hub and so its most important step towards helping solve the world's climate problems may be the Monetary Authority of Singapore (MAS)'s recent allocation of $1.8 billion of its Official Foreign Reserves (OFR) to five fund managers to invest into climate-related investment opportunities.

According to MAS managing director, Ravi Menon, the fund allocation is part of MAS's recognition of the renewed sense of urgency and commitment to the climate agenda. "The world is probably on the cusp of the greatest economic and societal transformation since the Industrial Revolution," he said in June at the launch of the Authority's first Sustainability Report.

Southeast Asia Clean Energy Facility (SEACEF) is a Singapore-based fund that is already investing in the future of the planet, with a focus on unlocking Southeast Asia's potential for cleantech innovation. Managed by Clime Capital Management, the fund aims to accelerate the low carbon transition in the region, directing early-stage development capital investment into innovative, high-impact clean energy projects and businesses in critical Southeast Asian markets.

SEACEF's portfolio includes major projects around the region, such as Xurya, an Indonesian clean energy company that seeks to make rooftop solar a ubiquitous source of power in Indonesia; and Levanta Renewables' development of a portfolio of three wind power projects in Vietnam with a combined capacity of up to 330 MW.

With its increased prioritization of clean technologies, creative approaches to innovation and the full weight of government and financial industry investment in the space, cleantech companies continue to seek out Singapore to hub their expansion into the broader region. Given its history of solving seemingly impossible engineering and social challenges while consistently having an outsized impact on numerous global industries, Singapore, while maybe slower to get moving, will be leading the global climate response before long.

## Country Outlook: Malaysia

# The Alberta connection

**In August, the Canadian division of Malaysia's state-owned oil giant Petronas showed its cross-continental resourcefulness announcing plans to look at building a $1.62 billion petrochemical plant that would export hydrogen to Asian markets. The location of the facility is not planned in the Malay peninsula or in the states of Sabah or Sarawak, but 13,000 kilometers over the Pacific in central Alberta.**

The story provides context for the potential of Canada and Malaysia energy projects, building a plant capable of producing one million tonnes of ammonia per year and grabbing its carbon emissions at the same time. The combination of nitrogen and hydrogen would originate from natural gas operations in northeast British Columbia announced Petronas.

According to the International Energy Agency (IEA), a quickly growing global consensus on how clean hydrogen will play a key role in the world's transition to a sustainable energy future, involves reducing carbon emissions from industry and heavy transport, and also providing long-term energy storage at scale.

But it's the Renewable Energy (RE) potential back home, according to the Malaysian International Trade Administration, that needs quick attention, about 10.0 GW of new capacity to meet its growing demand, replacing retiring plants and ensuring system reliability.

The country's Solid Waste Management (SWM) is under increased pressure and urgency to tackle consumer, household and commercial waste generated from manufacturing activities. To overcome the waste produced, the government is encouraging companies to undertake environmental management activities, such as collection, storage, composting, disposal, recycling of toxic and non-toxic waste, and Waste-to-Energy (WTE). To attain sustainability in energy supply, Malaysia is looking at RE resources that are "indigenous" to Malaysia and not reliant on other countries.

Biogas is on the RE radar for the government, typically produced by the anaerobic digestion of organic municipal waste, food waste, and sewage with the potential to decrease the use of fossil fuels for power generation. Food waste is one of the highest potential sources for biogas production, estimated at more than 40 per cent of Malaysian MSW.

Malaysia produces approximately 168 million tonnes of biomass annually from palm oil, rice husks, coconut and sugar cane as well as municipal and forestry waste. This RE advantage means such waste can be pelletized and has attractive potential for co-firing in conventional power plants, which traditionally use coal or natural gas.

In Malaysia alone, daily generated food waste could feed 2.2 million people. Established in 2011, Malaysian start-up, MAEKO, has crafted a unique composting technology on a commercial scale. Combining expertise in biotechnology, mechanical engineering, and marketing, the company's founders have made it their mission to design a closed-loop food industry to break the current spiraling circle of food wastage.

But Malaysia's true potential is widespread solar. In June, the Ministry of Energy and Natural Resources announced that most of the country's RE will be contributed by solar. International rating firm, Fitch, estimated that Malaysia's solar capacity could quadruple to surpass four GW in 2030, up from 996 MW at the end of 2020. To that end, the country intends to introduce battery energy storage systems with a total capacity of 500MW from 2030.



## Country Outlook: Thailand

# Much about water

Thailand's latest Power Development Plan aims to draw **35%** of its power **from renewables** by **2037.**

**Bangkok has long been known for its beguiling network of canals – or khlongs – widely used as a means of commuting, the soot-belching wooden, diesel boats a common feature to its harbours and waterways.**

In recent decades the city gradually stopped dredging new canals opting for road transportation though the maddening congestion of cars and motorcycles plugging city streets, often called the worst traffic of any city worldwide, did not prove to be the solution.

In 2017, plans got underway to revisit transporting commuters throughout the canals, some 960 kilometres available, although with a cleaner approach. The UN Environment Programme along with the Climate and Clean Air Coalition joined Thailand's Pollution Control Department to assess the impact of canal transport on air pollution in the city (In 2019, the city's schools were closed because of suffocating traffic and the city's 2020 marathon was almost cancelled.)

Today, 12 electric boats each carrying 30 passengers are able to run four hours per charge at a speed of 10-15 kilometres per hour. Each features a solar roof to help power the boat, lamps and tracking system. While e-boats present an admirable first step, more are urgently needed to move some 50,000 people a day. With more than 200 e-ferries planned, Thailand may be on its way to becoming the electric ferry capital of the world.

According to Clean Current Coalition, along with China, Indonesia, the Philippines, Vietnam, and Sri Lanka, Thailand is unenviably one of the top contributors of plastic pollution that finds its way into the oceans.

The country's 23 coastal provinces dump an estimated one million tonnes of garbage into the sea each year. Where the new e-boats ply, the Chao Phraya is one of Thailand's longest and most polluted rivers that empties directly into the Gulf of Thailand, collecting large amounts of solid and liquid waste coursing through dense urban areas.

It's not merely NGOs who are involved in the fight for Thailand's sustainability. Thai oil giant, PTT Public Company, whose sales account for roughly 10 per cent of the nation's economic output, may be coming to the rescue spending billions of dollars on EV and renewable-energy companies.

PTT announced it will transform its strategy and vision for sustainable growth with increased environmental awareness along with further acquisitions in clean energy, a transition largely due to investor pressure to abandon traditional fossil-fuel businesses.

According to BNNBloomberg: "The state-owned enterprise is influenced by the Thai government's bio-circular-green economic model, which involves producing renewable biological resources, reusing and recycling, and balancing economic and environmental needs."

Solar Quarter cites Thailand as building one the world's largest floating hydro-solar hybrid projects on the surface of the Sirindhorn Dam, a giant step towards boosting its renewable energy production. Located on a reservoir in the northeast province of Ubon Ratchathani, the farm covers 121 hectares of water with some 144,417 floating solar panels and the last of seven solar farms to be constructed.

The state-run Electricity Generation Authority of Thailand (EGAT) says that this pilot project is one of the world's biggest hybrid hydro-solar power ventures with eight more planned over the next 16 years.

The country has long relied on coal for its energy, but plans for new coal-fired projects have been met with opposition over health and environmental risks, and two proposed southern coal plants were mothballed in 2018. Thailand's latest Power Development Plan aims to draw 35 per cent of its power from renewables by 2037.

# Cleaning up its act is right on trend

**South Korea is known for setting global trends, particularly in areas of entertainment (K-pop, K-drama), technology and beauty. But as it pertains to environmental initiatives, the North Asian country is still lagging behind.**


According to Sustainable Governance Indicators (SGI), South Korea is "lacking ambition and cohesion" around its environmental policies, ranking only 35th in comparison to global peers. But as with most trends in Korea, the younger generation are the ones driving the change.

And while environmental topics are beginning to be addressed, the government continues to prioritize economic growth (the country is the world's second-largest investor in the global coal-finance market, following China.) But this mentality is shifting as there is a growing understanding that a nation's success is increasingly tied to their ability to manage, mitigate and promote environmental sustainability.

The summer of 2020, during the height of the global pandemic, was a wake-up-call for Korea, which experienced a record-setting 54 consecutive days with rain. For a country that readily promotes itself as having four seasons, climate change is now messing with the national psyche. This was the backdrop for the government's 'green new deal' which focuses on investment and promotion of a sustainable economy.

President Moon declared Korea's commitment to become carbon neutral by 2050 through a speech to the National Assembly late last year. Plans are to expand the share of renewables in energy production by 20 per cent, and decrease emissions by 37 per cent below the current trend, by 2030. According to the government, a total of $81 billion will be spent to implement the Green New Deal policies such as green buildings, more green spaces and promoting clean vehicles. A major component of this plan hinges on the most abundant element on our planet, hydrogen.

## Korea's hydrogen future

The global hydrogen fuel cell market is expected to hit $61.49 billion by 2026 and throughout Asia Pacific, countries are mobilizing around clean hydrogen and ammonia. In fact, it is now expected that the development of clean fuel trade flows will happen much sooner and at a larger scale than previously predicted. And South Korea is well on its way to becoming the global leader in this space.

According to a 2019 research report from the Netherlands Enterprise Agency, South Korea is well-placed to achieve its hydrogen ambitions and that the hydrogen economy will represent one of the country's next major growth drivers, creating "$46.6 billion in economic value and 420,000 jobs by 2040." The Korean government along with major industrial players in the country, have recently made a string of announcements that further solidify the opportunity.

Last summer, commercial operations began at Hanwha's Daesan Industrial Complex for a new byproduct-hydrogen-fuel-cell power plant. Occupying 20,000 m², it is the largest industrial hydrogen-fuel-cell power plant in the world and the first to only use hydrogen recycled from petrochemical manufacturing, according to the company. The $265 million facility now produces 50 MW and generates up to 400,000 MWh of electricity per year, equivalent to the electricity needs of 160,000 homes.

SK Group, another Korean industrial giant and Korea's largest energy provider, is investing $20.5 billion in massive hydrogen energy infrastructure and the creation of a Hydrogen Business Development Center, the company announced in late February. This new center will guide the company's transition into the "production and distribution of hydrogen energy, including the creation of a mass production facility and investments in global business opportunities."

And then there is South Korean firm, Hyosung Heavy Industries, which broke ground in June 2021 with German multinational Linde Group on the development of what is claimed to be the world's largest liquid hydrogen production facility in the industrial city of Ulsan on Korea's east coast. It will boast a production capacity of 13,000 tonnes of liquid hydrogen a year – enough to put 100,000 vehicles on the road and reduce carbon dioxide emissions by 130,000 tonnes each year.

This aligns with the Korean government's plans, as part of their Green New Deal, to increase the number of hydrogen-powered cars from 2,000 in 2018 to 6.2 million by 2040, and make the country the leading producer of hydrogen-powered vehicles and fuel cells globally by 2030.

Canada unveiled its Hydrogen Strategy in December 2020, estimating that the clean fuel sector could be worth $50 billion, create 350,000 green jobs and help Canada reach its net-zero targets by 2050. While late in the game, hydrogen from Canada could help Korea and the rest of Asia meet its lofty climate goals while supporting Canada's own green economy.

## Korea's push against plastic

While hydrogen represents a tall order for the government and the country's major industrial players, younger South Koreans, much like the youth around the world, aren't satisfied with waiting for its environment to improve. According to Statistica, they are most concerned about air quality, waste management and climate change that they are experiencing in real-time. This has spurred young South Koreans to become more involved in grassroots initiatives and drive policy changes.

One such effort is spearheaded by a group called Plastic Mill. The company took root last July during the pandemic as increased food deliveries led to more waste they recognized could be repurposed into useful items to keep, rather than toss out after just one use.

According to the Ministry of Environment, Korea's recycling rate is one of the highest in the world. However, more Koreans are becoming aware that even after being sorted and taken away, much of the plastic waste is not recycled and is either buried or burned, releasing greenhouse gases.

"The issues with plastic waste were serious even before the coronavirus. But I think people are now actually understanding their seriousness," said Yona Kim, an activist in charge of Plastic Mill, which is run by the Korean Federation for Environmental Movement (KFEM). Plastic Mill collects small plastic pieces and sorts them according to type before upcycling them into soap dishes and key rings.

In an example of how Canada's innovators can benefit from Asia's green push, Loop Industries, based in Montreal, has recently formed a strategic partnership with SK Group to accelerate the commercialization of Loop's sustainable PET plastic and polyester fiber manufacturing technology throughout the region. The company is focused on finding solutions for a sustainable plastics economy developing a technology that allows for PET fiber to be upcycled into virgin-quality PET using low heat and no added pressure.

Daniel Solomita, founder and CEO of Loop Industries in a press release announcing the partnership said SK Group "is an ideal strategic partner to accelerate the growth of our company and the global commercialization of our technology."

> "According to the government, a total of **73.4 trillion won** ($81 billion) will be spent to implement the Green New Deal policies such as green buildings, more green spaces and promoting clean vehicles."

# Powering a post-Fukushima future


By **2030**, Japan aims to have **800,000 fuel cell vehicles**, more than five million residential fuel cells and to establish an international hydrogen supply chain.

**The 2011 earthquake and the resulting Fukushima nuclear accident had a devastating effect on Japan across numerous industries. But 10 years on, the country and its people have taken up the challenge of improving their systems and as a result, new industries and innovative companies have transformed the country's energy and agricultural sectors.**

Japan has made significant progress towards developing a more efficient, resilient and sustainable energy system with a focus on diversifying how it produces energy to support its massive population and economy, the world's third largest.

The most recent report by the International Energy Agency (IEA), states that "energy-related CO2 emissions have fallen continuously since their peak in 2013, thanks to the expansion of renewable energy, the restart of some nuclear power plants and energy efficiency gains."

In late 2020, the government of Japan announced its plans to reduce greenhouse gas emissions to net-zero and to realise a carbon-neutral, decarbonised society by 2050. This is ambitious given the country's continued reliance on fossil fuels (90 per cent) but if there is any country that can radically shift its society for the better through the application of technology, policy and industry, it's Japan.

The country's new Green Growth Strategy, spearheaded by the Ministry of Economy, Trade and Industry identifies 14 sectors with high growth potential towards its 2050 goal. Some of the ways Japan hopes to succeed include green initiatives such as a renewed focus on nuclear power, carbon recycling, innovations in hydrogen and ammonia electricity generation and the application of new technologies in transportation and agriculture agriculture.

Japan was among the first countries to launch a national hydrogen strategy, making it cost competitive to natural gas. By 2030, Japan aims to have 800,000 fuel cell vehicles, more than five million residential fuel cells and an international hydrogen supply chain.

It is also experimenting with large-scale power generation based on hydrogen. All this will provide valuable lessons to the international energy community and potential collaborations with trade partners such as Canada.

Tokyo Electric Power Co. (TEPCO) has been one of the most progressive Japanese companies seeking to diversify Japan's energy portfolio, working with global innovation partners, accelerators and setting up a venture capital arm. The group has made numerous investments, including in start-ups like Electron, a London-based company who provides peer-to-peer energy trading.

## Moving smarter

Transportation in Japan is another area that is seeing rapid change. Due to Covid-19, travel and commute patterns have shifted drastically, affecting the demand for transportation while still adding to the country's CO2. Public transport providers are still trying to adjust to the changes. For services to remain sustainable, transportation must evolve to become more demand-responsive and clean.

While the transportation industry has been transforming to reap the benefits of cost savings and efficiencies, the pandemic has disrupted and accelerated the progression.

In Japan, Singapore startup, SWAT Mobility's software reduces the number of vehicles and mileage driven through efficient pooling and routing of passengers and goods. Their algorithms help organisations reduce carbon emissions from transportation, especially the indirect emissions that occur in a company's value chain such as employee transport.

"For public transportation, our on-demand buses solve mobility challenges in rural areas and increase accessibility to transport for local people. In Japan, our on-demand buses in Niigata help promote social inclusion by making it easier for the elderly to book and get onboard the public buses," explains SWAT Mobility in an interview with PERIPHERY.

In countries like Japan where public transportation systems are more efficient, there is a need for sustainable transportation solutions in low ridership areas. Japan's ageing population has caused it to be expensive and also inefficient to maintain public transportation as ridership decreases.

Areas outside city centres are less connected, making transport more inconvenient for people living there. In addition to SWAT Mobility, this is also the impetus behind startups like ZMP, a Japanese robotics company pursuing technology development for autonomous driving. They offer new electric microbuses, designed to be outfitted with self-driving technology to progress towards sustainable and safer transportation as the technology becomes more applicable.

## Sustainable Abundance

One of the major impacts of the 2011 tsunami was on the agricultural sector, particularly in the areas that were hit by flooding, as the saltwater destroyed the fertile soil along the coastline overnight. Agritech Venture GRA, which promotes strawberry cultivation and the use of information and communications technology in the farming industry, raised nearly $3.42 million Series B funding in order to expand their Agri-Platform business and strengthen sales for new farmers. They now pride state-of-the-art grow facilities, producing some of the world's most luxurious and expensive strawberries.

Another Japanese startup is looking to democratize food production and create a fun, socially sustainable agriculture and food environment. According to PLANTIO, agriculture has traditionally placed production burdens on producers.

But this model means that produce needs to travel, and that creates a carbon footprint. To solve this, PLANTIO has developed a vegetable cultivation system that allows for modular, off-grid farming systems that allows people to produce food in their home and communities.

Using IoT and AI technologies, they have created a sharing platform and community farming system different from existing community gardens. They consider it an urban agriculture style that could be installed on the rooftops of offices, condominiums, commercial facilities and schools, allying with nearby restaurants and grocery stores to offer fresher, less carbon-intensive food in some of the most populous cities on earth.

As nations with strong traditions in agriculture, transportation and renewable energy, Canada and Japan have a lot to share. Japan is already Canada's fourth-largest partner in two-way merchandise trade and Canada's largest source of bilateral foreign direct investment (FDI) in Asia. And with the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (TPP11), there is a major opportunity for collaboration in key sectors that are seen as combating the climate crisis.

# EV inroads to Canada & renewables

**Vietnam, Thailand, the Philippines, Malaysia and Indonesia represent 84 per cent of the total installed renewable energy capacity among Southeast Asian countries according to analysis by Power Technology (PT), a group that covers the global energy sector. PT further points out that Vietnam leads the sustainability change with 34 per cent of the share.**

In February, the Vietnamese government released a draft of the country's latest national power development plan highlighting an increase in wind and solar capacity along with prioritizing grid infrastructure to ensure stable operation with a higher share of renewables.

A key strategy is an incentive scheme for anyone with a rooftop to install solar panels and sell surplus power to the national electricity grid with buy prices provided a comfortable 20-year guarantee.

The plan has a further upside given land scarcity and such a tight network does not require the development of new transmission lines. Farmers, too, are getting in on the action, buoyed by generous subsidies from the national utility, many installing solar panels on barns and greenhouses, which reduces power bills while earning a monthly payback for selling excess electricity to the nation's grid. What's not to like for those used to agrarian income?

In Vietnam, banks are shunning coal, seeing an neverending resplendence of sunny days for solar; even changes to the law are in favor of RE with public-private partnerships, denoting investments in coal-fired stations do not automatically offer a government guarantee. The International Energy Agency (IEA) regards Vietnam as the second-largest electricity consumer in Southeast Asia, affirming the country's demand has grown at a constant six per cent per year.

According to BloombergNEF, when it comes to solar, the sky's the limit with a 100-fold increase in installations over the last two years, today ranking seventh in the world for total installed capacity. In 2020, the only countries that installed more solar than Vietnam were the world's largest economies, the U.S. and China.

This solar boom according to Mining.com was not due to the country's responsibility to reduce its carbon emissions so much but simply because of global cleantech advances, many with solar panels produced in the country, and affordable prices for renewables. Lending foreign banks, too, are putting their noses up at dirty fossil fuel projects throughout Asia.

## EV & WTE updates

The two-way street for Canada-Asia trade is bolstered with Vietnam's fast-growing flagship car manufacturer, VinFast, announcing its plans to introduce EVs in five new markets, including Canada, in early 2022. The subsidy of the Vietnamese conglomerate, Vingroup, has cleverly pivoted to EV, setting up operations in Burnaby, B.C. as well as the U.S., France, Germany and the Netherlands.

Clāra Ly-Le, a Vietnamese-Canadian and Managing Director of EloQ Communications based in Ho Chi Minh tells PERIPHERY: "Investing in the Canadian market is a bold move for Vinfast, marking an important milestone in Canada-Vietnam trade, clearly displaying competency in demanding foreign markets, not least a fast changing sector opening up a new chapter for industrial export."

Like its impressive solar expansion, Vietnam's waste-to-energy (WTE) facilities also deserve superlatives. The country's Soc Son WTE project was approved by Hanoi's administration in late 2017 with a total investment of $380 million. Once completed in September, it will be the second largest WTE plant in the world with a capacity of churning out 4,000 tonnes of dry solid waste per day generating 75MW of power. What's more, the ash from the incineration process will be used as a raw matter for the production of building materials.


*Branded as a "smart eScooter," the VinFast Klara boasts 3G and GPS integration and smartphone connectivity, allowing users to control their travel information.*

# Upside

Discovering Canadian cleantech innovators driving sustainability through products, services and processes that are well positioned for transitioning industries across Asia

## Upside: Transportation

# Switching gears

The transport sector eats up more than half of the global oil demand and contributes roughly one-quarter of the planet's CO2 emissions from fuel combustion and that means cleaner technology is paramount to ensure energy transitions are met globally. While rail is among the most energy efficient modes of moving us near and far, the topic is often disregarded.

According to a report by the International Energy Agency, the rail sector carries eight per cent of the world's passengers and seven percent of global freight transport yet represents only two per cent of total transport energy demand. Today, three-quarters of passenger rail transport activity takes place on electric trains, an increase from sixty per cent in 2000. The rail sector is the only mode of transport that is widely electrified today.

Magnovate, a Toronto company founded to "accelerate the next quantum leap in ground transportation" with its autonomous commuter transit networks, senses an opportunity to scale in Asia where its technology has room to grow. The company's maglev (magnetic levitation) technology, with an advanced propulsion system has gathered significant attention, though its track switching capabilities is perhaps what separates the company from its competitors.

Based on proprietary halbach magnetic rotors, Maglev's high-speed track crossover ability provides seamless movement, vastly improving routing flexibility. The system is suitable for a range of rail travel: low-speed people movers at airports and theme parks, bulk freight haulers and 500 kph inter-city passenger networks.

PERIPHERY spoke with Magnovate Founder and President, Dan Corns about the potential of his company's commuter transit networks applied in Asia: "Many Asian cities are simply running out of space to build further roads and when a city like Jakarta or Manila reach a certain level of congestion as they have, modern elevated systems are the only practical way to transport large amounts of people in and out of dense urban centers."

Advisory board member Bill Russo tells PERIPHERY Magnovate's expansion plans into Asia are highly compatible. Based in Shanghai, Mr. Russo is the founder and CEO of Automobility Ltd. and a respected opinion leader with deep knowledge in the Chinese market as well as one of the world's leading experts on the global automotive industry: "Global mobility technology start-ups like Magnovate thrive on markets that have the ability to aggregate demand for transportation on a massive scale."

With 15 years of experience as an automotive executive for Chrysler, most recently as leader of the automotive giant's business unit in North East Asia, Mr. Russo can see the next bend in the road quickly approaching: "Emerging Asian markets have huge populations that are underserved with clean mobility services and public and private partnerships are often brought to bear to deploy capital at such opportunities."

High-speed, zero emissions transport of people and goods between urban and regional networks is the answer, says Mr. Russo: "These solutions spur economic development around transportation hubs and help increase property value, which provides a return on the investment."

> "Many Asian cities are simply running out of space to build further roads." **Dan Corns**

And the investment is significant. The Asian Development Bank (ADB) says over $2 billion is needed annually to pay for developing Asia's infrastructure leading to 2030. The most notable infrastructure finance gap is in transportation, where $600 billion is needed annually across the region and almost 80 per cent of that is transportation infrastructure with financing that comes from the public sector.

The Magnovate systems provide a feasible option especially in SE Asia: "Building a kilometer length of elevated light Maglev is vastly cheaper, essentially one-fifth the cost of regular rail, and because systems like Magline are built with modular construction methods, the installation time is much faster to complete," says Mr. Corns. "The narrow footprint of Magnovate's elevated guideways is perhaps another of the company's unique features, providing compatibility with existing roads, increasing potential route options and avoiding costly property acquisitions typically required to accommodate traditional rail corridors."


After recently gaining approval to build North America's first commercial Maglev system in Toronto, the company is now exploring alliances with several strategic partners to build networks in Asia. The potential applications include resort pod links and high-speed inter-city systems. Magnovate's technical team led the South Korea urban Maglev program, which laid the groundwork for the installation of Automated Maglev at the Incheon Airport.

The company is not alone in its efforts to continue Canada's legacy as an innovator in clean transportation. Last year, Sustainable Development Technology Canada (SDTC) announced funding for seven Canadian start-up companies developing cleantech solutions in the transportation sector. The industry start-ups funded in the current round include both battery and charging technologies for electric vehicles, photonics for autonomous cars, hydrogen-as-a-service innovation for transport trucks, software for better traffic management, and artificial intelligence in the dairy industry to manage trucks more efficiently.

These companies would be remiss not to look at Asia for opportunities to scale. In their latest report of The ASEAN, the Association of Southeast Asian Nations (ASEAN) focuses on the regional push to turn cities—home to half of the region's populace—into "habitable, sustainable, and resilient urban environments." A major focus of the report is on transportation initiatives that "reduce air pollution, optimize commutes and contribute to sustainable mobility of hundreds of millions of people."

The Philippines is one example by implementing a Public Utility Vehicle Modernization Program, aiming to phase out the 180,000, heavy-to-the ground, diesel-powered jeepney units and replace them with either electric vehicles or Euro-4-compliant (low carbon emission) vehicles.

Vietnam is manufacturing its first electric buses for deployment to five major cities, namely, Hanoi, Haiphong, Danang, Ho Chi Minh, and Cantho. Thailand recently launched a national plan that will see the local production and circulation of one million electric vehicles – including 400,000 cars and pick-up trucks, 620,000 motorcycles and 31,000 buses and trucks – by 2025.

It's this rapid transformation that is today kinetic across Asia that Canadian cleantech businesses can partner and pilot for lasting outcomes.

## Funds help pave a clean way forward

Sustainable Development Technology Canada (SDTC) recently announced funding for seven Canadian start-up companies developing cleantech solutions in the transportation sector.

**Based in St. John's, Montreal, Toronto, Calgary, and Delta, B.C., the companies are:**

Calogy Solutions (Sherbrooke, Que.), supported by Ecofuel, is creating thermal management technology for Li-ion batteries. This lowers the initial cost of electric vehicles, enhances battery safety, and increases battery life.

Elocity (Toronto, Ont.), supported by Accelerator Centre, is developing data-based smart controls to aid electricity distribution companies in maintaining grid stability during the rising demands of the electric vehicle revolution.

Hydra Energy (Delta, B.C.), supported by Foresight Cleantech Accelerator Centre, is creating Hydrogen-as-a-Service technology and systems. They retrofit diesel-powered heavy-duty vehicles to partially run on hydrogen, and work to supply purified hydrogen.

Milk Moovement (St. John's, Nfld.), supported by Genesis, develops cloud-based software to improve the efficiency of the dairy supply chain through features like transport monitoring, production tracking and route optimization, reducing the carbon footprint of dairy trucks.

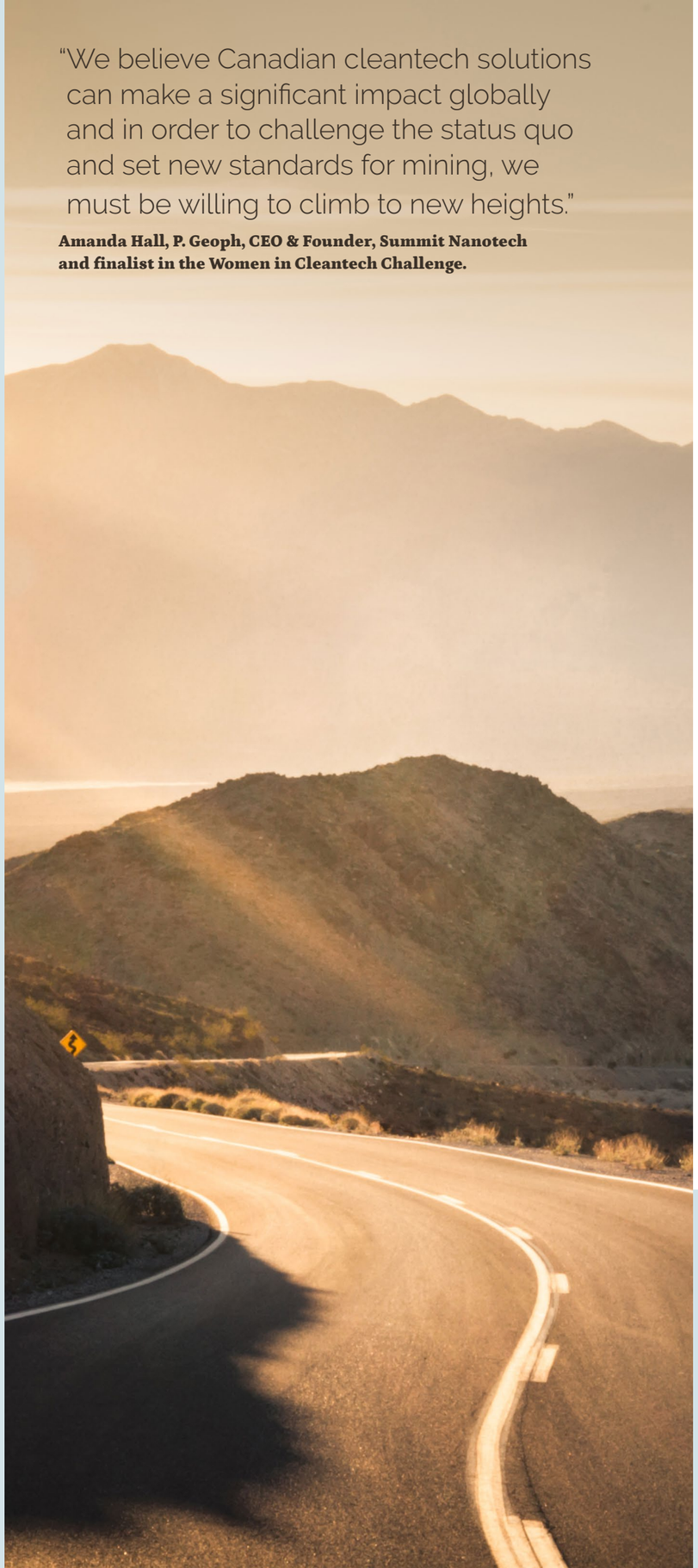
One Silicon Chip Photonics (Montreal, Que.), supported by FounderFuel, builds chips containing extremely compact Inertial Measurement Units used to navigate a moving object. These accelerometer/gyroscope chips are valuable in the autonomous vehicle market.

OPA Technologies (Montreal, Que.), supported by Ecofuel, is developing user-friendly collaboration software to better plan, coordinate and communicate road closures and traffic detours using optimized geospatial data intelligence.

Summit Nanotech (Calgary, Alta.), supported by MaRS, is using nanotechnology to isolate lithium ions from solutions, providing sustainably sourced lithium to the electric vehicle sector. The energy-efficient process uses no freshwater, produces less waste, and doubles the lithium yield.

"We believe Canadian cleantech solutions can make a significant impact globally and in order to challenge the status quo and set new standards for mining, we must be willing to climb to new heights."

**Amanda Hall, P. Geoph, CEO & Founder, Summit Nanotech and finalist in the Women in Cleantech Challenge.**



Upside:
Transportation

# Zipping towards micro-mobility

Micro-mobility is proving to be an essential spoke in the wheel of sustainable city commuting. E-scooters are now common on Asian city streets like Singapore's Orchard Rd or Japan's Tenjin District of Fukuoka. Rental services like Singapore-based Beam and India's Yulu, offer electric scooters and a range of small, lightweight vehicles,, springing up to fill the demand just as they will after the policy and planning stages in Canadian cities like Vancouver for those excited to move toward multimodal, greener cities. E-bikes and scooters while once deemed a nuisance by many are becoming commonplace providing a zero-emission option for quick commutes throughout Asian metropolises.

Vancouver-based Movmi Shared Transportation Services, a consulting firm that provides e-mobility solutions in a post-Covid world, such as car-shares Evo and Modo, is one company that has zeroed in on the need for clean transport integration. PERIPHERY spoke with CEO and Founder, Sandra Phillips, who sees a micro-mobility ecosystem as a decent formula for congested cities throughout Asia: "A clean transportation system that can handle disrupting events, such as a pandemic, and changes in consumer preferences, is best to be adaptable and offer variety of EV mobility options such as scooters, minivans, cars, shared and integrated into one reliable and resilient ecosystem."

Movmi calls itself "the Swiss army knife of personal mobility" and the antidote to car ownership. The company consults to build reliable, seamless and resilient transportation ecosystems for what they call "multimodal integration with both public and private partnerships" through its wide network of partners. Movmi has also finetuned new car-sharing services for cities and private clients through a combination of policy development, financial modelling and operational planning.

Ms. Philipps has applied her consultancy and systems in 60 cities worldwide. "We're currently focusing our efforts in Latin America, specifically Brazil where public transit has been torn apart by the pandemic; if the country doesn't want to end up in "carmaggedon," they need to figure out an alternative quickly. Many Asian cities have for some time headed in a similar direction."

Sharing a car may not be a new idea in commuting but when linked to micro-mobility and micro-transit options while modifying existing and evolving transport alternatives, it certainly has a fresh appeal. For legions of Asian commuters needing to get to the central office or campus, a shared mobility ecosystem offers a clean and collective, whatever works to get there, approach while weening off automobiles.

## Made in Canada SARIT

A Toronto billionaire is developing a new EV vehicle he believes could solve congestion issues on the world's city streets. Frank Stronach is behind "SARIT" (Safe Affordable Reliable Innovative Transport), an electric, single-seat (but two is possible) vehicle with three wheels that could be well suited for the tight byways of Jakarta, Hanoi and Manila. Stronach says the SARIT would be safer and more comfortable than a bike and shield a passenger from monsoon downpours and above all, it's cleaner. The vehicle's speed tops 32 km per hour and can fit into a bike lane.

Upside:

# 3 questions

**Contributor Paul Barker chats with Canadian Electrum CEO Brodie Gunning and Chief Sustainability Officer, Neil MacEachern on the future of EV in Canada and Asia.**

**1 U.N. Secretary-General Antonio Guterres just described a recent report from scientists of the Intergovernmental Panel on Climate Change (IPCC) as a 'code-red for society'. What should we take from this?**

### Neil MacEachern

I'm not surprised that emissions are not dropping. We are now seeing more and more real-world impacts of global climate destabilization. Pardon the pun, but I think this really lights a fire up underneath the global authorities to buckle down and have legitimate strategies because window dressing is no longer going to cut it. We need to get to zero and we need to get to zero quickly. Statements such as 'we need to balance this with this,' are just not adequate anymore. The technology exists for us to be able to transition away from fossil fuels very quickly if we had the political will. We have dragged our heels for far too long, we could have been much further a lot longer ago if we had been more proactive. But now we've really painted ourselves into a corner on a global scale.

*CEO Broderick Gunning at Electrum Charging headquarters, Surrey, BC.*

**2 Why did Electrum decide to locate in Taiwan and Indonesia?**

### Brodie Gunning

I've been doing business in Taiwan since 2013 and spent a lot of time there, getting in tune with the culture. The importance for us was being close to the supply chain and to innovation in the semiconductor space as well as very advanced EV or alternative-energy related manufacturing. In addition, Taiwan is that cog that sits in between China and the U.S. and has spokes to Korea and Japan and in some respects, the Philippines, and other markets. And then of course Indonesia; we're very excited about this market as it's becoming one of the global tech leaders. There are a couple of factors on why we went there: one of our directors is Indonesian. He was at BP Indonesia working as a computing geologist for a number of years and now lives in Toronto. He is spearheading our operations in that market. Indonesia has plenty of growth opportunities for Canadian companies to scale. We all remember Blackberry, another Canadian tech company; their biggest market was Indonesia, in fact almost 80 per cent of cell users owned one.

**3 What is Electrum's take on the recent decision by the Canadian federal government to ban the sale of new fuel-powered cars and light trucks from 2035.**

### Neil MacEachern

Two years ago, it was fairly forward for British Columbia to say 2040 and now here we are in 2021 and federally across the board we're seeing 2035 because so much has changed in that time. We've seen much more dedication by the legacy automakers, we've seen such massive uptake in jurisdictions across Canada. As an example, the Tesla Model 3 is the best-selling passenger car in British Columbia. There is a thirst to move towards more cost-effective transportation.

**www.electrumcharging.com**

*Courtesy of Electrum*



Upside:

# Waste to value

**Not just another brick in the wall**

**Since 2017, a New Brunswick building system company has been quietly engineering a revolutionary brick that is stronger than concrete, a composite made from 90 per cent trash.**

Founder Dustin Bowers was driven to find a solution for what he calls an "insane amount of plastic, trash and waste in the building industry." The outcome: Bowers and his team designed a (patent-pending) modular construction block that is low-waste, reusable, and almost entirely made of recycled waste materials ... and he's about to let Asia know of his building brick alternative described as akin to "plasticized concrete."

The company is now laying the foundation for a permanent manufacturing facility to be built in New Brunswick (or Nova Scotia) as well as licensed globally through a production partner model. Acknowledging he and his team are awaiting lab testing to determine how large of structures can be built with this system, Bowers is confident the first two test projects are on target.

In fact, the company stands firm its PLAEX system is expected to be a superior composite for full foundation and wall systems for all manner of residential and low-rise commercial applications.

The sustainable PLAEX Bricks will divert huge amounts of unused plastic and other construction waste destined for landfills and it makes for an inspiring story, one that does not involve the use of wood and with drastically reduced cement products. Other design features provide for extra insulation, solar and integrated electrical.

The company says the interlocking step-by-step block construction system is easily understood by contractors and integrates with existing structures and traditional finishing methods such as drywall. Furthermore, the bricks hold screws exceptionally well, far better than wood or concrete, and without cracking or chipping, engineered with an interlocking design allowing for water and air tight construction.

PLAEX won the Canadian Technology Accelerator (CTA) programs, Energia and VOLTA, in the Maritimes, and recently caught the attention of the CTA in Singapore, which signalled its support for the company in SE Asia. Bowers tells PERIPHERY he is excited by the prospects: "We aim to create a meaningful impact utilizing waste while helping to build sustainable structures in Asian communities that will last generations."

An ocean away in the historic port and salmon canning centre of Steveston, B.C., a new plastic-processing plant opened to turn garbage found on B.C.'s shorelines into useful products. Thousands of kilograms of debris, including plastic foam and bottles, nets, rope, abandoned boats and tires, were removed by the province's Clean Coast, Clean Waters (CCCW) initiative.

The new recycling facility, operated by the Ocean Legacy Foundation, transforms the ocean detritus into pellets that can be used to create new plastic products as well as furniture and even clothing. According to Ocean Legacy, over 220 million tonnes of plastic are produced each year and an estimated 13 million tonnes of that plastic ends up in the ocean.

## Building on Sustainability

**Three recycling companies are turning waste into value for building materials:**

In Trois-Rivières, Quebec, Waste Robotics integrates advanced waste handling processes, computer vision, deep learning algorithms and state-of-the-art robotic technologies to enable smaller, more precise, safer and more profitable waste recycling facilities.

In Brantford, Ontario, GreenMantra Technologies, is a clean technology company recycling post-consumer and post-industrial recycled plastics—shopping bags and dried-up markers—into synthetic polymers and additives for industrial applications—asphalt and roof shingles.

In Mississauga, Ontario and Calgary, Alberta, Lafarge Canada is the world's second largest recycling company, with 50 million tons (Mt) of materials recycled across its business every year; the company is heading to 100 Mt by 2030 and with concrete being infinitely circular, Lafarge is actively recycling construction and demolition waste.

# Canadian green thumbs

**Could it be Canada's agrarian roots provided the federal government the impulsion to reinvest in AgTech or, is it the encouraging earning numbers, $71,713 billion turnover reported by Canadian farms collectively in 2020? Whether it is time-honored tradition or revenue potential perhaps but the threat of climate change on farming production is tantamount in the government's financial backing.**

This past summer witnessed a severe and lengthy agricultural drought across the prairie provinces, a concerning glimpse into the region's future climate crisis. Such events happen every 20 to 50 years although these troubling dry spells across the prairie provinces are expected to grow in frequency and severity over the coming decades.

Help is on the way: Eco Canada, an online resource for environmental jobs, certification and training, is bullish on the future when it comes to Canada's role in the agriculture sector and how Canadians in this space can assist other nations in Asia with similar issues that are a result of extreme climate change.

We are not alone in the concern. The challenges noted in a UN research paper released in February are staggering and dire and include the hard fact that upwards of 750 million people around the world are exposed to "severe levels of food insecurity," yet nearly one-third of food globally is wasted or lost. And there's further offense, some eight per cent of all greenhouse gases worldwide are the result of food waste.

There's a thankful upside: "Among the staggering food statistics of waste and insecurity, there are incredible opportunities for Canadian cleantech products and service companies to produce food sustainability and reduce our waste," the report adds.

Much of the optimism has to do with the aggressive shift towards AgTech, short for Agriculture Technology and defined by the Calgary Economic Development and Western Economic Development Canada as "the development, design, testing, and production of specialized software and hardware to support core agriculture activities."

One of the oldest professions in the world, land management technology solutions are now being applied in just about every subsector of agriculture, making it an historic industry with tremendous potential; such advancements are turning farmers into technologists and data scientists.

A study released by the two organizations notes that AgTech uses the "Internet of Things (IoT) to monitor and manage farm operations. Farmers use hardware linked by the internet to keep track of and manage their farms, especially across large areas of land. Rapid advances in autonomous equipment including drones, seeders, sprayers and on-farm sensors, all are transformative for how the modern farm operates."

AgTech is well-rooted to becoming a $915 million worldwide market, and it is expected that Canadian companies will no doubt play a major role thanks to two key components: The computer literacy of the nation's farmers and the advances that are coming from start-ups and established technology firms alike.

There is also aggressive support from Canada's federal government. This summer, Marie-Claude Bibeau, minister of agriculture and agri-food, released details of a new $165.7 million Agricultural Clean Technology Program. Under the program, farmers and agri-businesses will have access to funding to help develop and adopt the latest clean technologies to reduce greenhouse gas emissions and enhance their competitiveness.

By supporting and empowering farmers and ranchers across the country, Canada has the opportunity to lead the world in carbon sequestration and turn back the clock on climate change," said Karn Manhas, Terramera founder and CEO.

One only needs to look at the island-state of Singapore with its scant arable land yet their AgTech industry is booming. Here, vertical farming isn't so much in the spotlight but rather basking in the intensifying glow of a billion LEDs. And as more and more companies begin exploring the technology, Singapore has doubled down on a new sector that not only supports the country's food security but also its water security, as vertical farming techniques typically use 70 per cent less water than traditional farming techniques.

The Singapore Food Agency just provided grants totalling $36.8 million to nine urban farm projects. Yet in Canada, according to the Financial Post, neither the government nor big investors have fully bought into the promise of vertical farming. Some may see it as short-sighted, others as prudent 'wait and see' behaviour from a conservative industry. Either way, AgTech presents an enormous opportunity for Canadian agriculture know-how and Asian innovation to cross pollinate.

## AgriTech companies bloom across Canada:

- **Future Fields** of Edmonton, Alta., a biotechnology firm that serves the cellular agriculture industry by producing cell growth media to produce lab grown meat.
- **Terramera** of Vancouver, B.C., which is "fusing science, nature and artificial intelligence to transform how food is grown.
- **Ecoation Innovative Solutions Inc.**, also based in Vancouver, is the developer of automated greenhouse management and crop health monitoring technologies.

"In the face of this new climate reality and the expectations of Canadian and foreign consumers who want to know that their food has been sustainably produced, we must double down on our efforts, particularly by investing in the development and adoption of energy-efficient technologies. Together, we will grow our agricultural sector in an even more sustainable way," **says Minister Bibeau.**

# Seeking efficiencies

**Cleantech is not restricted to industry verticals. People can clearly do their part when it comes to reducing greenhouse gas emissions and fortunately, Canadians have an assortment of software and hardware offerings to choose from.**

There is a growing clutch of enterprising individuals, groups, companies and devices dedicated to helping humans do their part, among them Stuart Lombard, the founder of ecobee, creator of the first smart thermostat, who back in 2007, made it a "personal goal to reduce his environmental footprint."

From this, Toronto-based ecobee was formed and since the launch of their first smart thermostat, the company claims that customers across North America have saved more than 17.6 TWh of energy, the annual equivalent of all the homes in Las Vegas.

A further initiative is Project Neutral, another Toronto- based tech platform currently in use in three southern Ontario municipalities that is designed to help people take action on their climate impact.

A "Getting Started" survey asks questions one can easily answer about your lifestyle such as the age of your home and how it's heated or cooled; how you commute and the type of vehicle you drive; what foods you enjoy; what flights you've taken recently, and whether you recycle or compost. Its carbon calculator then uses your answers to estimate your household's current climate impact.

Results are shared on a dashboard that shows a household's estimated climate impact compared to the average household, and to households who make daily choices that support a healthy climate. According to Project Neutral, measuring climate impact is the first step towards taking climate action.

"Asia is critical to Li-Cycle's global expansion plans with a well-established market for lithium-ion batteries and a growing electric vehicle market."

A third example is Carbonzero, a company formed ahead of its time in 2006 and that provides greenhouse gas measurement, management and offsetting services to help individuals and organizations reduce their contribution to climate change.

Individuals, the company contends, play an important role in the fight against climate change because there is a carbon footprint association with almost everything we do. Driving to your workplace, heating your home, even eating a meal are all associated with a specific environmental impact. The average carbon footprint of a Canadian is usually between 15 and 20 tonnes of carbon dioxide equivalent, depending on the individual's lifestyle.

Such endeavors use novel approaches to apply technology to solve important environmental challenges. Yet there is a dark-side to technology that isn't addressed as often but is affecting the world as we grow more accustomed to mobile, always-on access to digital devices and that is... what to do with old Lithium-Ion batteries?

*Li-Cycle employee feeds lithium-ion batteries on conveyor belt inside one of the company's Spoke facilities*

One Canadian recycler is shedding light on the issue. With their head office in Mississauga, Li-Cycle is working to create a closed-loop lithium-ion battery supply chain to address global challenges that come with satiating our thirst for electric vehicles, smart phones and pretty much any new, electric, remote technology. Through their proprietary process using a combination of mechanical safe size reduction and hydrometallurgical resource recovery, Li-Cycle provides a cleaner, more ethical method of producing battery materials while reducing harmful waste.

Having recently gone public, Li-Cycle has plans to grow to $1 billion by 2025. A major focus of this growth is within Asia according to company co-founder and CEO, Ajay Kochhar in an interview with PERIPHERY:

"Asia is critical to Li-Cycle's global expansion plans with a well-established market for lithium-ion batteries and a growing electric vehicle market.

We have plans to build 14 recycling facilities in the region over the next five years to meet growing demand for sustainable solutions to end-of-life batteries. We are excited to bring our proven, safe, and environmentally sustainable technology to the Asian market to enable a battery supply chain that is rooted in a circular economy."

# Industrial-scale sustainability

*Pani CEO Devesh Bharadwaj pitching Pani's water treatment optimization technology to audience and judges at water accelerator Imagine H2O Asia Demo Day competition in Singapore (2019) which he went on to win*

**Climate change is creating a new generation of cleantech while reducing investment in fossil fuels due to fears that their assets will be left without value. So what's expected of the heavy, resource-intensive industries such as cement, steel, aluminum, mining and others and what are the economic prospects for these big consumers of energy and materials with enormous carbon footprints when carbon-constraint is considered?**

A large part of Canada's GDP growth is from natural resources and when push comes to shove, the heavy industry sector has shown its ability to exhibit new processes and ideas. And with the federal government standing firm with its goal for the country to become carbon neutral by 2050, Canada will no doubt become a global example in the industrial-scale sustainability space.

Some of the biggest environmental and climate challenges are exacerbated by the need for infrastructure, construction, raw materials, and materials such as plastics. But the industry is starting to find ways to mitigate issues and actually be a positive contributor to the planet.

An example of that is Svante Inc., which has developed carbon capture technology that prevents significant release of carbon dioxide into the atmosphere from cement and other heavy industrial plants. In July, the federal government announced a $25 million investment in the Burnaby, B.C.-based company to be used in support of its $97.22 million project to develop and commercialize its offering.

"Lowering the capital cost of the capture of the CO2 emitted in industrial production is critical to the world's net-zero carbon goals required to stabilize the climate," said company president and CEO Claude Letourneau. "Leaders from industry, financial sectors and government agree on the enormity of the challenge and the critical need to deploy carbon capture and carbon removal solutions at Giga-tonnes scale. The carbon pulled from earth as fossil fuel needs to go back into the earth in safe CO2 storage."

According to the company, decarbonization of unavoidable emissions by heavy industries, such as cement, limestone and large-scale hydrogen production, will require significant deployment of point-source carbon capture projects over the next decade. Its innovative net-zero solution will capture CO2, concentrate it, and release it for safe storage or industrial use, all in 60 seconds, by using nano materials called "solid sorbent."

With the investment, Svante will set-up a new Centre of Excellence for Carbon Capture Use and Storage (CCUS) in Vancouver, B.C. that will allow it to "scale up its manufacturing operations to produce commercial scale structured absorbent filters and to test its proprietary rapid adsorption machine (RAM) designs."

Francois-Philippe Champagne, federal minister of innovation, science and industry, said at the time of the funding announcement that the government is "keen to partner with Canadian companies like Svante that are creating clean technologies that will help key industries around the world."

The funding will come from a federal program called Net Zero Accelerator announced in late 2020 that will see the federal government invest $8 billion over seven years to accelerate "decarbonization projects with large GHG (greenhouse gas) emitters, the transition to clean technology and Canada's industrial transformation across all sectors."

A key sector in the heavy industry space is the steel industry and to that end, two days before the Svante announcement, Canadian Prime Minister Justin Trudeau announced that Algoma Steel will receive up to $420 million to retrofit their operations and phase out coal-fired steelmaking processes at their facility in Sault Ste. Marie, Ont.

In July, the federal government announced a **$25 million** investment in the Burnaby, B.C.-based company to be used in support of its **$97.22 million** project to develop and commercialize its offering.

The company has indicated it will transition to Electric-Arc Furnace production. "This electricity-based process is expected to cut greenhouse gas (GHG) emissions by more than three million metric tonnes per year by 2030, making a meaningful contribution to achieving Canada's climate goals," a release stated. "This is equivalent to taking more than 900,000 passenger vehicles off the road – almost the number of passenger vehicles in Toronto."

Meanwhile, Trudeau said in a statement that investments in clean technology benefit both the environment and our economy. "Today's announcement is great news for the people of Sault Ste. Marie. It will help Algoma Steel create good middle-class jobs and cut pollution, while positioning Canada as a leader in cleaner and greener steelmaking."

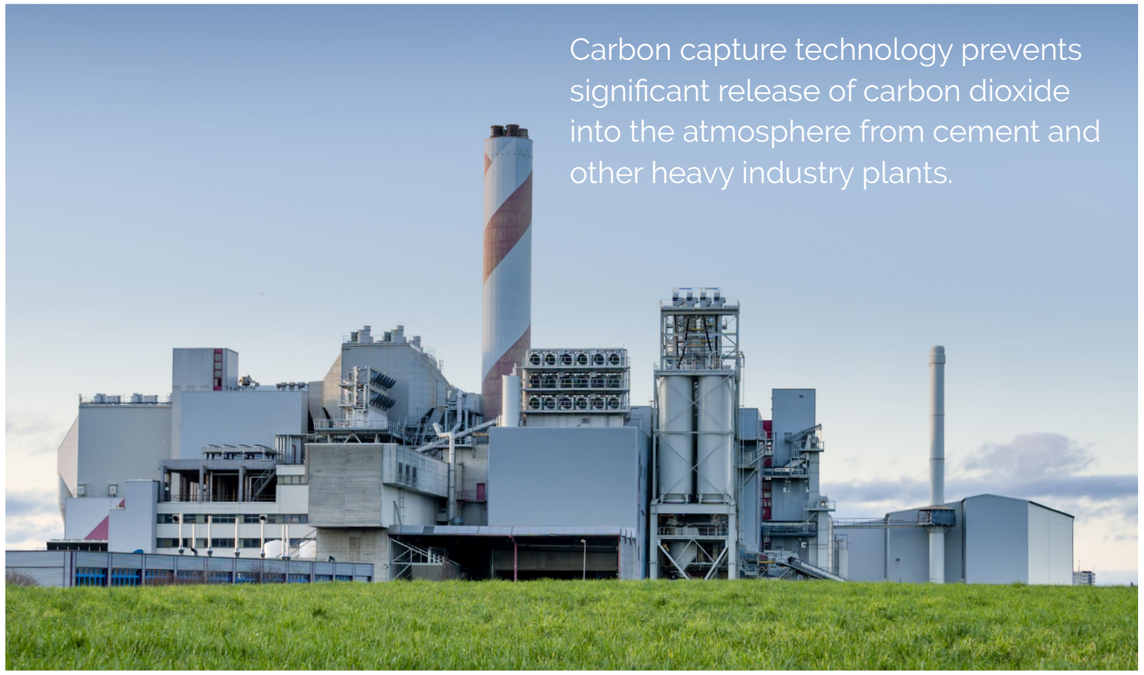
And while Canada begins to make moves into cleaner manufacturing of major commodities like steel, in Asia, companies such as Carbon Re are already putting their technology to work through pilot programs.

As a U.K.-based AI startup that helps manufacturers identify ways to create efficiencies while reducing carbon emissions, Carbon Re told PERIPHERY that the U.K. is still grappling with how to implement the technology, so they've in the meantime pivoted to Asia, where companies and policymakers are more willing to test and learn.

"As an AI and Climate Tech startup, Carbon Re's success relies on open-minded innovative companies being willing to work on pilot projects with us as we demonstrate the unique capabilities of our product to cut energy costs and carbon emissions in energy intensive manufacturing with no CapEx," explains Sherif Elsayed-Ali, co-founder and CEO of Carbon Re.

"Working with partners in South-East Asia we have found significant openness to trying new solutions and technologies. It has been a very positive experience for us, and we have gained a lot of momentum in a short time."

Victoria BC-based Pani Energy took such a lead. The company offers cloud-based analytics solutions that optimize water treatment plants to reduce costs, increase efficiency, and improve sustainability of fresh water production. Its AI Coach™ software has been growing its impact by applying its technology around the world, particularly in Asia, where water scarcity is a more immediate concern. In 2019 the company won the Imagine H2O Asia's demo day in Singapore (see Outlook page 19).



# Making good on cleantech's promise

**A recent federal government paper entitled "Canadian manufacturing sector gateway," estimated that manufacturing accounts for more than 10 per cent of Canada's total GDP, which in dollar terms equates to upwards of $174 billion and further points out that manufacturers export more than $354 billion annually. In order for that to continue it is imperative that business and government will need to work together in order to remain a "vibrant, innovative and competitive contributor" to Canada's economy.**

"Today's manufacturing requires constant innovation, the integration of new ideas and the adoption of up-to-date production processes," authors of the paper state. "The highly competitive nature of the global economy and the growing complexity of manufacturing supply chains will further increase the importance of innovation and the development and diffusion of new technologies moving forward."

Cleantech companies that focus on the manufacturing sector particularly in areas such as quality control and production processes are destined for success. Last year, for example, Economic Development Canada, a financial crown corporation that helps Canadian companies "succeed on the world stage," increased the number of cleantech firms it supported by 27 per cent more than in 2019.

Through these 288 cleantech companies, EDC's solutions facilitated $4.5 billion in cleantech exports, investments and trade opportunities – an 80 per cent increase from 2019. Canadian cleantech accelerator Foresight in a report entitled Incentivizing Low Carbon Pathways For Manufacturing, states that "there are two pathways where clean technology is contributing to industrial transformation, the first is the scaling up of clean technology product manufacturing itself."

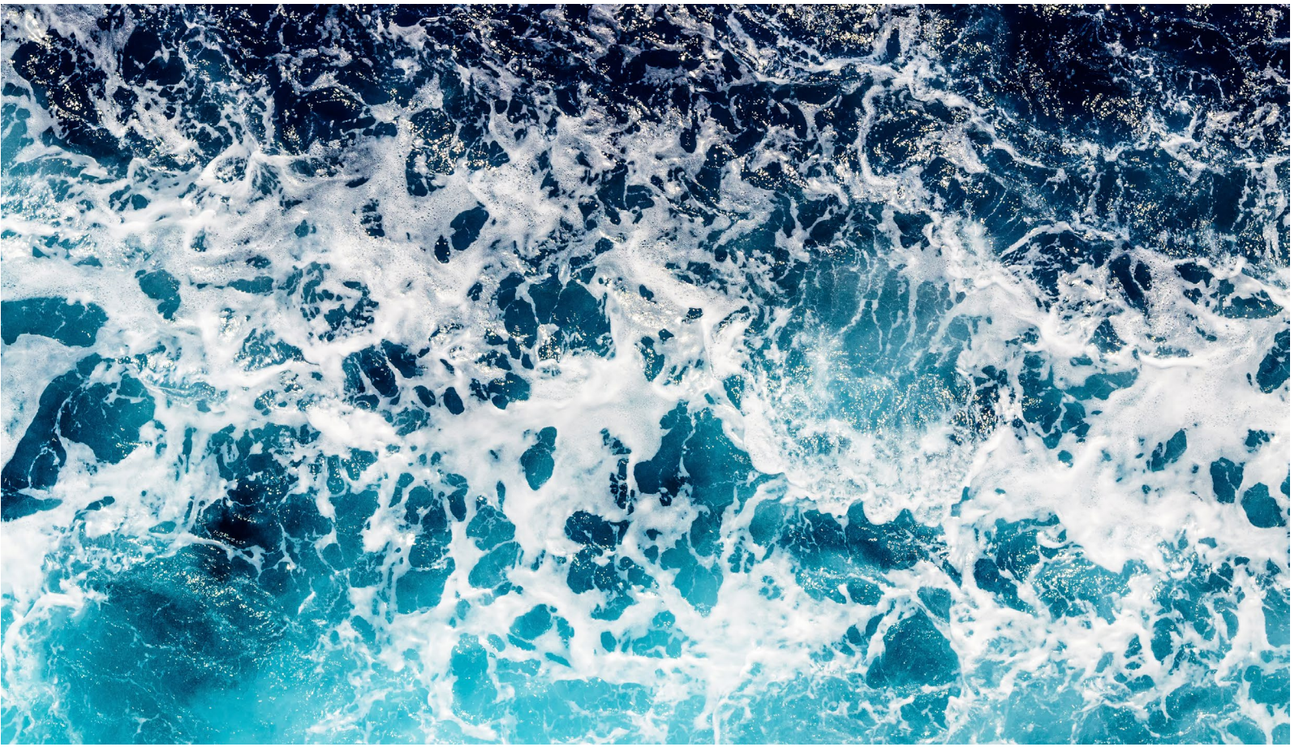
As countries take action on climate change, innovation in manufacturing practices are helping the industry adapt. Canada is placed to become a leader, because of its vast resources and focus on research and development. "There are already a number of clean technology companies located across the country with local manufacturing sites and value chains," according to the report.

The second path where clean technology has a role to play is the actual process of manufacturing goods and commodities. By minimizing negative environmental impacts, conserving energy and natural resources in the manufacturing process, the thinking is that large manufacturers will want to improve environmental performance indicators, especially if it can also create efficiencies and reduce costs.

And as many industrial nations around the world, particularly in Asia, attempt to clean up their manufacturing practices, Canada can again take advantage because of its long-standing environmental legislation and clean manufacturing efforts, which have provided a base knowledge that's now extremely valuable in nations such as Indonesia, China, Vietnam and India.

"Today's manufacturing requires constant innovation, the integration of new ideas and the adoption of up-to-date production processes."

# The next renewable wave



**A sustainable energy project on a remote coastline off Vancouver Island is an inspiring example of how renewable energy unites cultures and engineering minds to support a pristine, off-grid village with its power needs.**

Located on the southwest tip of Nootka Island is the far-flung village of Yuquot (Friendly Cove), site of the Mowachaht Muchalaht First Nations (MMFN) and summer home of Chief Maquinna and the Mowachaht Muchalaht people. The auspicious location is also where Europeans and First Nations people in BC first met and so remote that even today Yuquot is only accessible by boat or floatplane.

Life for the MMFN is simple, with a scant number of rustic cabins and a general store powered by diesel generators. It's not what you imagine when thinking of a location for a cutting-edge cleantech project. But according to MMFN, increasing the diesel generation capacity would conflict with the Nation's vision of environmental stewardship as well as being cost-prohibitive. Given that Yuquot is used extensively during the summer months by the Nation and visitors who come to hike the majestic 37-kilometer, Nootka Trail, MMFN looked to their environment to help address their needs.

MMFN worked with the Pacific Regional Institute for Marine Energy (PRIMED) at the University of Victoria, the Barkley Project Group based on Vancouver Island and a clean energy engineering firm located an ocean away in Seoul, South Korea to build the Yuquot Wave project, a sustainable power generation system that uses the power of the ocean to produce clean energy.

The project got underway in 2018 with MMFN working alongside PRIMED and Barkley. The Community Energy Plan was developed in 2019 that folded in an initial wave resource assessment. The community showed quick interest and soon after, INGINE, a South Korean wave engineering firm and one of the world's foremost wave energy technology specialists was brought onboard, selected by MMFN for their unique "INWave" technology

"The Yuquot project demonstrates the huge potential to generate renewable energy for even the most remote locations. We look forward to continuing building on this collaborative effort and really appreciate MMFN's leadership to bring it all together."

*INGINE, CEO, Yongjun Sung*

(designed with mechanical and electrical components situated onshore). The Nation recognized this design feature would minimize the cost of underwater cables as well as operation and maintenance requirements. Added to that, being onshore mitigated the impact on environmental and marine ecosystems.

In 2019, Victoria-based, Environmental Dynamics Inc. (EDI) offered its environmental assessment experience concluding through its wave resource assessment, that the site offered very high energy potential and suitable wave depth and flow near Yuquot.

The ambitious project is in the Front End Engineering Design (FEED) phase assessing the proposed location, technology details, size and transmission line path. When completed, the Yuquot Wave project will contribute a stable, renewable energy microgrid supported by a member-based workforce, offset greenhouse gas emissions, and minimize costs associated with diesel fuel generation. From the MMFN perspective it's also about enabling a sustainable future for its cultural and ecotourism development, all further strengthening the resiliency of its people.

The project offers a template for harvesting other BC wave energy locations and supports numerous remote, often diesel-reliant, communities along the west coast. It's also a great example of collaboration between Canada and Asia.

UVic's PRIMED will undoubtedly continue to refine their models and identify potential wave energy locations, along with other marine renewables such as offshore wind and tidal energy both in the province and beyond. With this expertise, wave energy systems could be applied to other coastal nations in Asia, such as Vietnam and Indonesia, where INGINE is currently exploring new projects.

https://yuquotwave.barkley.ca/

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*Special thanks to Paul Barker for his reporting*



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