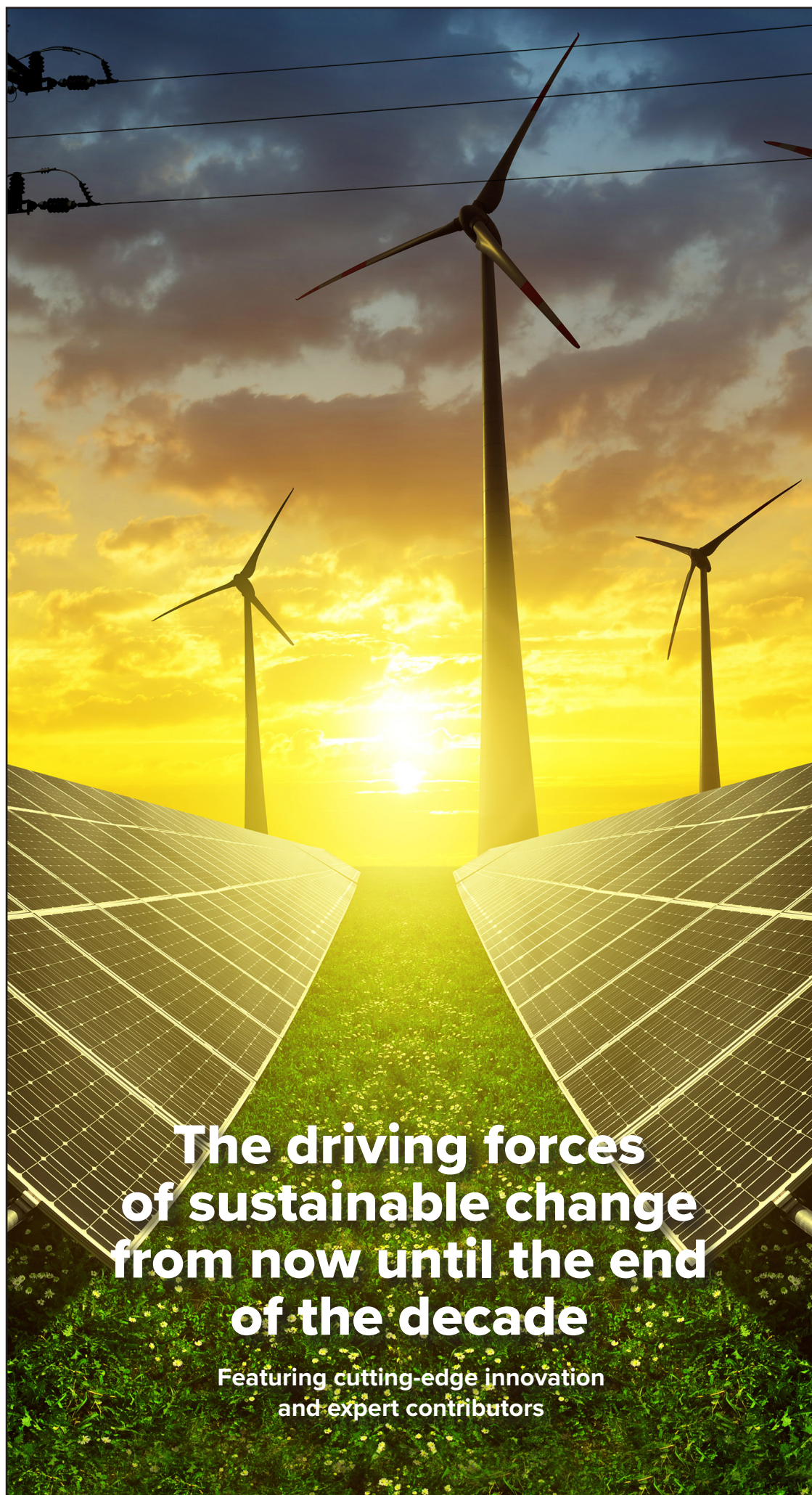


HORIZON 2030



**The driving forces
of sustainable change
from now until the end
of the decade**

Featuring cutting-edge innovation
and expert contributors

Introduction



Photo credit: Gonz DDL, unsplash.com

While the official agreement from the 2023 United Nations Climate Change Conference in Dubai brought the global community a fraction further towards a world without fossil fuels, the need for consensus meant it did not go far enough. It was a nudge in the right direction versus the almighty push required to turn the (oil) tanker around.

The IPCC proposed deadline for halving global emissions by 2030 – if we are to be on track to reach net zero by 2050 – is just around the corner. It is also the target date for the realisation of the 17 Sustainable Development Goals. No one is in any doubt about the scale of what still needs to be achieved to realise these ambitions, with alignment on policy, regulation, and financing from industrialised nations required to turbocharge progress across the globe.

The good news? Technology and techniques already exist that could drive change in the near term. Identifying and keeping track of innovators who are developing real solutions is the lifeblood of Springwise, and for this report we have identified seven key areas in which we see momentum. This progress is due to attractive subsidies, such as the Inflation Reduction Act in the US, tighter regulation from the European Union on waste and the circular economy, or areas where breakthroughs are making previously unaffordable solutions more scalable. We share a selection of the most exciting innovations in these areas and ask a series of expert contributors to share their view. It's horizon scanning but each of the solutions has the potential to make a tangible impact on the 2030 goals. We've had the pledges, now let's get to work.

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Horizon 2030

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SPRING WISE
THE GLOBAL SOURCE FOR INNOVATION





2023 was the hottest year on record, the summer months a relentless barrage of record-breaking temperatures around the world. According to C40, a global network of nearly 100 city mayors, nearly one-third of the world's population is exposed to life-threatening heat extremes for 20 days a year or more, which can have serious health consequences, as well as an impact on productivity.

Lack of cooling kills, but so does providing inefficient, polluting cooling. If left unchecked, emissions from cooling are expected to double by 2030 and triple by 2100, driven by heat waves, population growth, urbanisation, and a growing middle class.

At the opposite end of the spectrum, extreme rainfall that results in flooding has its own series of detrimental environmental and social effects, including soil erosion, destruction of habitats, pollution, and property damage, not to mention loss of life. After a punishing summer of heat in 2023, many places then found themselves at the mercy of torrential rain – floods in Libya alone killed nearly 11,000 people according to the UN.

“We can’t air condition our way out of this”

Eleni Myrivili, global chief heat officer, UN-Habitat, on the global projects leveraging nature to mitigate for weather extremes

Through my role at UN-Habitat, I support a variety of projects that look to improve our built environments and consider how to mitigate extreme temperatures. One of the most recent is the National Afforestation Plan in Bahrain, a joint effort between the UN-Habitat team and the Food and Agriculture Organization of the United Nations (FAO) to increase tree coverage in four different cities in the country, taking into consideration issues that have to do with lowering temperatures and reducing biodiversity loss in the way that they are designed. Another is the Nairobi River Life project – the UN is providing the



ELENI MYRIVILI
GLOBAL CHIEF
HEAT OFFICER
UN-HABITAT

“It’s interesting to try and figure out how we can learn from the Global South instead of trying to impose solutions that have not done so well in the Global North”

technical expertise to reclaim and renovate three different rivers in Nairobi. The end result will be less pollution, an improvement in groundwater, and better management for stormwater, as well as urban water parks and a network of green public spaces.

For me, it’s really interesting to try and figure out how we can learn from the Global South instead of trying to impose solutions that have not done

so well in the Global North. I have worked together with The Cool Coalition led by the United Nations Environment Programme to create pledges on a national level that have to do with limiting active cooling, so we make sure we don’t end up with air conditioning throwing our whole mitigation goals out of the window as we approach 2030.

Who knows? Maybe now that the whole northern hemisphere is under extraordinary heat conditions it will create some momentum? We need to move forward fast in terms of adaption funding, so we can support more of the kinds of projects already underway to create sustainable, liveable environments.

INNOVATION:



Photo credit: Aurassure
Advanced sensors can help keep citizens safe during extreme weather events

A more efficient cooling technology

US startup SkyCool Systems has developed technology based on infrared radiation, which grew out of research in the lab of Aaswath Raman at the University of Pennsylvania. All objects give off heat in the form of infrared radiation, and this heat is then trapped by the atmosphere. However, radiation given off in wavelengths of between 8 and 13 micrometres is able to escape into space. Raman and his team have developed a proprietary material that converts the infrared light leaving a surface into this wavelength range, allowing the heat to escape to the cold sky, cooling the object in the process.

The company's technology can be applied in several ways, such as a system of cooling panels, covered in SkyCool's dual-mode film, that can improve any air conditioning or refrigeration system. The panels reflect sunlight and emit infrared radiation, and, together, these mechanisms keep the panels, and the cooling fluid pumped through them, up to 15 degrees Fahrenheit below the ambient temperature with zero electrical input. As an add-on to an existing cooling system, SkyCool's panels can improve efficiency by 10 to 40 per cent. And, in some situations, the panels can

replace existing cooling systems altogether, in which case energy savings can reach up to 90 per cent.

The company's optical film can also be used in other applications separate from the panels. For example, it can be applied to batteries, outdoor shade structures, metal roofs, or refrigerated vehicles, bringing the benefits of solar reflectivity and infrared radiation to these surfaces.

skycoolsystems.com

Tech that treats wastewater using sunlight and water motion

During times of high rainfall, sewage systems become overloaded, resulting in intentional or accidental spillages into waterways and oceans. A visible side effect of this is an overabundance of algae, known as 'eutrophication', which can cause biodiversity loss among invertebrates. Other water pollutants include pharmaceuticals, heavy metals, and chemicals that can affect hormones. These all have a negative impact on coral as well as other marine and freshwater ecosystems.

Zurich-based startup Oxyle is trying a new approach to wastewater treatment. The company has developed a cost-effective wastewater treatment system that removes PFAS (chemicals found in

products like cleaning materials), pharmaceuticals, hormones, and pesticides. Using a nanoporous catalyst that is activated by water movement or light, a chemical reaction is triggered which breaks down micropollutants in the water. According to co-founder and CEO Dr. Fajer Mushtaq, Oxyle's tech is able to remove more than 95 per cent of harmful compounds.

oxyle.ch

IoT sensors for hyper-local natural disaster insights

The lethal fire on Hawaii's Maui Island in 2023 is an example of a time when planned emergency alerts did not work. With more than 400 outdoor alarms available for use, the fire moved so quickly that disaster management teams didn't have time to activate them.

Local environment trackers are one way of improving safety for residents in the coming years, making it possible to generate super-specific alerts before a threat runs out of control. Using a system of smart environmental monitoring devices with wireless sensors for networking, Indian startup Aurassure tracks meteorological data, including wind direction and speed, humidity, temperature, and rainfall. The Internet of Things (IoT) system also tracks other essential urban information such as noise levels, the amount of UV light present, and the presence of gases and particulates in the air. The sensors are usable in a variety of locations and are easily mounted on existing infrastructure. Depending on local facilities, there are different ways for a neighbourhood to transmit data to the cloud, and information is viewable on the web and via a mobile app.

The company's goal is to provide policymakers, urban planners, and communities with accurate, robust data to inform decisions on improvements to the ecosystem.

aurassure.com

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THE RENEWABLES PLEDGE:

Can we triple capacity by 2030?

At COP28 in Dubai in 2023, 130 national governments endorsed a pledge to triple global renewable energy capacity by 2030. As of the end of 2022, the world had 3.6 terawatts of renewable energy capacity, which means the addition of 11 terawatts is the goal if countries are to meet the pledge.

The big bet is in solar and wind, both mature technologies and the cheapest sources of new generation in most countries, with the cost of solar modules currently the lowest they've ever been. The issue with solar systems is that they cannot generate electricity at night, which is where wind can make up the shortfall. Increasingly large turbines generate more energy, but they also make it more difficult to secure public approval and so find financing. Out-of-the-way locations, meanwhile, require extended grid capacity. A study by Eurelectric found that over one-third of the EU's power grids are already over 40 years old, and this will increase to 50 per cent by 2030. This lack of modernisation reduces flexibility and has a negative impact on both sustainability and cost.

Climate tech and how it is driving Latin America's transformation

Federico Perez is founder and CEO of Selvitas, an international development company based in Colombia that provides export opportunities to rural areas, and leverages the carbon market to establish nature-based solutions to mitigate biodiversity loss and climate change

In Latin America – a region historically overshadowed by its raw material exports and economic volatility – a new narrative is emerging, driven by the burgeoning field of climate technology and pointing towards the region assuming a pivotal role in the new global energy economy. With a history of commitment to renewable energy, the region is uniquely positioned to lead the transition, with incumbent firms collaborating to make change, such as Colombian company, Celsia, which has been pioneering innovation in renewable energy grids and



FEDERICO PEREZ
FOUNDER
AND CEO OF
SELVITAS

“Latin America's unique geographical and ecological attributes position it at the forefront of the climate tech revolution”

storage solutions through its partnerships with startups.

Latin America's unique geographical and ecological attributes position it at the forefront of the climate tech revolution. Home to some of the world's most biodiverse ecosystems, including the Amazon rainforest and the

Andes, Latin America possesses a natural advantage in the global race towards sustainability. The region's vast carbon sinks and abundant water resources are untapped assets in the fight against climate change. However, the journey towards effective climate tech solutions is fraught with complexities. It demands a deep understanding of environmental science, engineering, and local ecosystems. Latin American startups, in this regard, face a dual challenge: developing solutions that are both technologically advanced and



Photo credit: Gonz DDL, unsplash.com
The Rio Blanco river in Chile – Latin America has abundant water resources

deeply rooted in the region's unique environmental context.

Artificial intelligence emerges as a critical ally in overcoming these hurdles. In sectors like agtech and ecosystem restoration, AI's ability to process vast amounts of data and optimise decision-making is invaluable. It enhances agricultural practices, increases crop yields, and promotes sustainable farming methods. This technological intervention is essential for Latin America to meet the growing global food demand and tackle inequality while advancing towards net-zero emissions. Agrosmart and Kilimo are two companies at the forefront of integrating AI into agriculture. Agrosmart, a Brazilian startup, leverages AI for enhanced decision-making through its digital farming platform, focusing on remote monitoring and predictive analytics to optimise irrigation and crop health. Meanwhile, Kilimo, from Argentina, specialises in AI-driven irrigation management, assisting farmers in efficient and sustainable water use. As Latin America continues to harness these technologies, it stands on the brink of a new era where innovation, environmental policies, and economic growth converge, offering a blueprint for a greener, more resilient future.

selvitas.com

INNOVATION:

A novel design could cut the cost of wind power

US startup, AirLoom's wind energy system consists of vertically oriented, 10-metre-long wings attached to a lightweight track, rather than huge blades on tall towers. The wings intercept the wind, which propels them down the track, generating power. Supported by 25-metre-tall poles arranged in an oval, the track can range in length from metres to miles, depending on the desired scale. In addition to being a less disruptive presence in the landscape, AirLoom wind farms can be built for less than 25 per cent of the cost of a conventional wind project, the company claims. How is this possible? First, the slimmed-down design requires far fewer, and more easily sourced, materials that are easier to transport. In fact, the company claims it can shift a 2.5-megawatt unit in a standard tractor-trailer. What is more, the wings are much shorter than turbine blades, and simple steel cables take the place of massive towers in supporting structural loads. Finally, the generators powered by the wings run at higher RPMs than those in traditional turbines, meaning they generate more power at lower weight.

airloomenergy.com

Small wind turbines for micro-grids

Australian company Diffuse Energy has created a powerful micro wind turbine called the Hyland 920. Incorporating more than 20 years of research by engineers and scientists at the University of Newcastle, Australia, the turbine's blades are encased in a diffuser ring to minimise energy loss. With an operating efficiency of 42 per cent, each turbine prevents up to one tonne of carbon emissions by reducing a business's reliance on fossil fuels. Designed to be lightweight, durable, and easy to install and maintain, the turbine works with both 24- and 48-volt electricity systems.

Diffuse Energy is promoting the idea of 'small wind' for situations

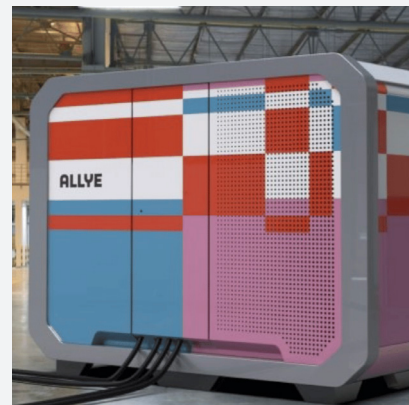


Photo credit: Allye
Batteries offer energy storage flexibility

where there is no or only fringe access to the main power grid. This includes applications such as telecom, broadband, and TV towers, agriculture, mining, and remote sensing sites. The key benefit of the startup's small wind system is that it can be used to complement solar panels as it generates power at night and can be installed in situations where it is uneconomic to add additional solar PV modules. Small wind systems like Diffuse Energy's work particularly well when they are coupled with battery energy storage systems.

diffuse-energy.com

Intelligent battery systems for homes and businesses

UK startup Allye has developed distributed energy storage at the grid edge by creating energy storage systems that use second-life electric vehicle (EV) batteries. These modular systems are flexible and managed via the cloud, with technology, including digital twins, machine learning, and artificial intelligence, optimising behaviour and performance.

Allye repurposes whole battery packs intact, including the battery management system, cooling, and cables. By combining several of these battery packs, the startup creates its innovative energy storage system, dubbed the Max, which can even combine two different lithium-ion battery chemistries.

allye.com

3

NET ZERO:

The challenge for heavy industry

If the recent pledge to triple global renewable energy capacity by 2030 is achieved, electricity will be the first economic sector to be on track for net zero by 2050. This is clearly welcome, however, there remain other heavy-emitting industries, such as cement, steel, and the production of petrochemicals, that have a long way to go. Heavy industry currently accounts for 22 per cent of global emissions and, according to Oxford Net Zero, an interdisciplinary research initiative based on the University of Oxford's 15 years of research into climate neutrality, net-zero heavy industry cannot be achieved through either emissions reductions or clean energy alone. Significant innovation is needed.

No silver bullet but some promising signs

Soline Guerineau, head of commercial strategy, sustainability at ICIS, on where there is momentum in hard-to-abate sectors and where collaboration with startups may drive further change

ICIS is an independent commodity intelligence service that provides data and analysis for the petrochemical, energy, and fertiliser industries. The state of play right now is that the chemicals industry is the largest industrial consumer of energy and ranks third when it comes to direct CO₂ emissions – after steel and cement production. According to the International Energy Agency, the chemicals sector emitted 935 megatonnes of CO₂ in total in 2022. On a product-by-product level, carbon footprints are tapering, yet the industry's overall emissions total



SOLINE GUERINEAU
HEAD OF
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SUSTAINABILITY
AT ICIS

“Waste heat recuperation and efforts to make energy consumption more cyclical are emerging”

is increasing because demand is increasing. At ICIS, we expect the global consumption of chemicals to rise by 23 per cent from 2022 to 2030, despite the macroeconomic challenges the world faced in 2023.

So, what can be done? There are a few levers for the chemical industry that will be similar to those

for other heavy industries. First, the supply chain is important – scope 3 emissions make up 80 per cent plus of the chemical industry's total greenhouse gas emissions. And sourcing low-carbon suppliers can be a challenge.

Energy sources are another challenge. Coal is still the main source of energy in some emerging markets, but we see the more mature industry players moving towards electrification by investing in new facilities. For example, LyondellBasell recently announced a memorandum of understanding with Technip Energies and Chevron Phillips

Chemical to pursue electric steam cracking furnace technology. Further development in this area is dependent on the elevation of the grid and the availability of renewable power, but we are seeing an interesting uptick in power purchase agreements (PPAs) – a type of long-term renewable energy contract – for heavy industries in general, with companies trying to manage their scope 2 emissions while also attempting to control cost.

Beyond scope 3 and energy sourcing, there are some further drivers. For example, waste heat recuperation and efforts to make energy consumption more cyclical are emerging, carbon capture technologies have a role to play but are not yet scalable, and there is also a key thread around the materials transition. For the chemicals industry, this is around feedstocks and moving away from virgin fossil feedstocks to biomass.

Where we do see progress is in recycling and more circular business models, and while the recycled plastics market remains smaller than virgin markets, it is growing. The market will benefit from regulation that is set to come into play – The European Strategy for Plastics, for example, sets the objective that all plastic packaging placed on the EU market will be reusable or easily recyclable by 2030. Crucially, anyone exporting to the bloc will need to comply, which will really accelerate upward market trends.

There is no silver bullet in terms of what is likely to have the biggest impact. I think there is a question around leadership and fresh approaches, and I also wonder what more women in the industry would bring. For our CEO of the year awards 2023, we nominated an emerging leader, Jodie Morgan, the CEO of Nexus Circular, a US series-C-stage company that provides advanced recycling to several larger petrochemical companies. There needs to be more collaboration with innovative startups and industry disrupters like this (or acquisitions) to accelerate technology pathways and drive further progress in the areas that are still in their early stages.

icis.com

INNOVATION:

AI could help decarbonise energy-intensive industries

UK firm QiO Technologies aims to transform the ability of heavy industry to achieve carbon neutrality. Based on artificial intelligence analyses, the startup's Foresight Sustainability Suite improves production efficiency, tracks the performance of every machine, and provides service and maintenance support.

QiO provides the three different parts of the Sustainability Suite separately or together, allowing businesses to focus on the areas they most want to improve. Foresight Optima maximises production efficiency. Meanwhile, Foresight Maintenance tracks and predicts machine failures to help reduce operating downtime, and Foresight Service helps businesses better plan the timing and order of fixes and upgrades. The company's latest product, Foresight Optima DC+, is specifically for data centres – themselves a significant contributor to global GHG emissions.

qio.io

An automated system for carbon-negative concrete

Around eight per cent of all global carbon emissions are due to the use of concrete. Finnish company Carbonaide is working to reduce the impact of its main component – cement. Creating cement requires heating limestone and other ingredients to a very high heat – which takes a lot of energy.

Carbonaide's solution involves the development of an efficient method to bind carbon dioxide into precast concrete using an automated system. This method operates at atmospheric pressure and reduces the amount of cement required to produce the concrete, halving the CO₂ emissions of traditional Portland-cement-based concrete. Industrial side streams, such as industry slags and bio-ash, can be used in place of cement in the process. And when these waste materials are used, CO₂ is

permanently stored and removed from the carbon cycle – making the concrete carbon negative.

Carbonaide's goal is to set up ten operational units by 2026. This would allow it to bind around 500 megatonnes of carbon dioxide annually by 2050 and supply around 10–20 per cent of the concrete market.

carbonaide.com

Carbon-free iron for zero-emissions steel

Steel is one of the most difficult, but important, heavy industries to decarbonise as the material is used everywhere in a range of applications: around 1.9 billion metric tonnes of crude steel were produced globally in 2022. Colorado-based firm Electra believes it has a solution and so does a raft of high-profile backers. In 2022, it raised \$85 million, including investment from Bill Gates-founded Breakthrough Energy Ventures, for technology that does not require a coal-fired furnace and instead uses renewable electricity to make carbon-free iron at 60 degrees Celsius – the temperature of coffee.

Electra uses a proprietary process called 'Oxygen-Decoupled Electrolysis (ODE)', which enables it to refine iron ore to high-purity iron at much lower temperatures than traditionally used. This means that intermittent sources of renewable energy can be used to power the process. ODE accelerates the dissolution of iron ore and removes impurities, which allows Electra to use lower-grade ores that have already been mined – something that is crucial as the world's supply of high-grade ores diminishes. The iron can then be turned into steel using existing infrastructure and electrically powered arc furnaces, which are used to produce 70 per cent of steel in the US today. Overall, Electra claims that its process holds the potential to eliminate iron ore conversion emissions, which account for 90 per cent of the emissions in steelmaking.

electra.earth

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GREEN HYDROGEN:

“It’s going to be a thing”

According to BloombergNEF analyst Jenny Chase, “Hydrogen is going to be a thing.” And the International Energy Agency (IEA) includes hydrogen as an increasingly important piece of the net zero emissions by 2050 puzzle, particularly in sectors where emissions are hard to abate, such as heavy industry, long-haul transport, and aviation.

A key criticism of hydrogen-powered aviation has been the cost. However, in its 2023 study analysing the costs of hydrogen aircraft, Brussels-based non-profit Transport & Environment shares that hydrogen-powered planes will be cheaper to run than those burning fossil fuel as soon as 2035, if EU plans for taxation and carbon pricing go ahead.

Focus vs funding: Australia’s green hydrogen lesson

Australia was one of the first countries in the world to announce a national hydrogen strategy. **Georgia McCafferty**, partner at global thought leadership agency The Action Exchange and Brisbane resident, describes the dangers if innovation is not backed up by funding or investment

As the world seeks realistic solutions to transition from carbon-emitting energy sources and production processes, the hype around green hydrogen in Australia has reached fever pitch. Advocates describe green hydrogen as the ‘swiss army knife’ of climate solutions and tout the nation’s abundant access to water, land, and sunshine as competitive advantages that provide a unique opportunity to develop a lucrative hydrogen market domestically and for export.



GEORGIA MCCAFFERTY
PARTNER AT
THE ACTION
EXCHANGE

“Australia’s pot of green hydrogen gold will be found in less glamorous domestic projects that combine the country’s dominance in natural resources with green hydrogen used at source”

Behind the hype, the reality is that the technology to produce, store, and transport green hydrogen remains nascent. And, in order to be competitive, the cost of green hydrogen production in Australia needs to be around AUD\$2 per kilogramme. With no subsidies

like those freely available in the US, the EU, and the Middle East, the price gap remains significant – the cheapest costs for producing green hydrogen presently sit at AUD\$10-\$15 per kilogramme. That’s before the prohibitive costs of storage and transport are added.

That said, the Australian Government has thrown its support behind green hydrogen with its AUD\$2 billion Hydrogen Headstart programme, and approval of a AUD\$51 million renewable hydrogen plant in Victoria. Domestic and overseas



Picture credit: Marcus Rubenstein, unsplash.com
The Australian government was quick to support hydrogen but needs to do more

companies like Fortescue Future Industries and Singapore's GIC are also actively investing in the industry and policy documents and press releases praise Australia's AUD\$300 billion of potential hydrogen investments.

These projects have yet to reach a final investment decision (FID), yet there are industrial-grade reasons to be bullish. Many experts believe Australia's pot of green hydrogen gold will be found in less glamorous domestic projects that combine the country's dominance in natural resources with green hydrogen used at source to transition heavy industry, air fuel, and agriculture.

Chair of Australia's National Hydrogen Strategy, Dr Alan Finkel, and the national scientific research body, CSIRO, have both said that Australia's green hydrogen advantage will likely lie in projects that use hydrogen as a chemical alternative to black coal or natural gas to produce green iron, or that aim to produce green jet fuel or fertiliser.

In the short to medium term, Australia cannot produce green hydrogen at a scale and cost that will enable it to compete with countries that apply subsidies like the US Inflation Reduction Act. But with immediate and focused investment in a select portfolio that plays to the nation's real strengths, Australia has the chance to lay the foundations for a robust industry that can grow rapidly once technology and economics catch up with expectations.

theactionexchange.com

INNOVATION:



Picture credit: H2Fly
The H2Fly aircraft is powered by liquid hydrogen

Hydrogen-fuelled air travel

Virgin Atlantic made headlines in November 2023 with Flight100, the first transatlantic flight from London Heathrow to JFK in New York to operate using 100 per cent Sustainable Aviation Fuel (SAF). Virgin Atlantic CEO Shai Weiss hailed SAF as "the only viable solution for decarbonising long-haul aviation," but stated that significant investment is required to produce enough SAF at scale.

Elsewhere, a month before the Virgin flight – and to much less fanfare – German firm H2Fly completed what it claimed was the world's first manned flight powered by liquid hydrogen. To date, H2Fly has completed four successful test flights in its HY4 demonstrator aircraft, powered by a hydrogen-electric fuel cell propulsion system and cryogenically stored liquid hydrogen. Crucially, according to the company, replacing

pressurised hydrogen gas storage with cryogenic hydrogen makes it possible to significantly reduce the required volume and weight of the aircraft's fuel tank, enabling much more efficient flying. The company claims that, if its plans to scale are successful it could help to decarbonise at least half of all air travel in the next 10 years. In November 2023, it announced a partnership with Japan Airlines and JAL Engineering to explore the feasibility of using H2FLY's hydrogen-electric power units for Japan Airline Flights.

h2fly.de

Speeding up R&D cycles for green hydrogen

The core piece of hardware needed to produce green hydrogen – an electrolyser – is currently expensive, which means that just one per cent of the world's hydrogen is produced with renewable energy. Bringing

down the cost of electrolyzers will require continuing research and development, and New Zealand-based startup Bspkl is facilitating this process.

Proton exchange membrane (PEM) electrolyzers are one of the two dominant technologies for green hydrogen production today. And at the core of PEM electrolyzers are catalyst coated membranes (CCMs) – components that play a key role in separating the hydrogen and oxygen atoms in water molecules. These CCMs are made up of catalysts – materials that speed up a chemical reaction – applied to a solid membrane. Bspkl has developed a proprietary manufacturing process that enables rapid sampling and testing of innovative CCMs.

Using technology pioneered in the semiconductor industry, the startup produces CCMs using up to 25 times less catalyst material than existing processes. The CCMs produced are also durable yet flexible, which means that the catalyst layer doesn't easily crack or gradually peel away from the membrane. Both the catalyst and the membrane in a CCM vary depending on the precise performance needs of the manufacturer. Bspkl's process is agnostic, which means it can be used with a range of catalysts and membrane materials.

Perhaps the most important benefit of the startup's technology is that it enables fast prototyping of new designs, being able to produce and test new CCM samples in a day. This, in turn, speeds up research and development cycles, and enables manufacturers partnering with the company to develop new catalyst and CCM products and deliver them to market in a matter of weeks or months, rather than years.

Today, Bspkl is capable of small-scale production, but its process is specifically designed to easily scale up as demand for CCMs grows.

If the global energy transition is to be successful, novel technologies need to get on steep cost-reduction curves. This has already happened with solar-generated electricity, for example, which decreased in cost by 89 per cent between 2009 and 2019. Hydrogen electrolyzers are earlier



Photo credit: © pcess609, canva.com

on in this process, so continuous research and development and investment in incremental improvements is essential to drive costs down. Processes, like Bspkl's, that speed up prototyping are therefore extremely important if green hydrogen is to play a meaningful role in our future energy economy.

bspkl.co

Disrupting a 100-year-old process to transport green hydrogen at scale

Hydrogen is the most abundant element on Earth and has been identified as an important clean fuel for the energy transition, emitting only water when burned instead of carbon dioxide. However, producing hydrogen can be carbon intensive, and storing and transporting it is a challenge due to the extremely low temperatures and high pressure needed to keep it stable.

For it to be a feasible alternative to fossil fuels, new methods for storage and transportation are required. Enter Nium, a spinout company from Cambridge University in the UK, which is pioneering a ground-breaking process for getting hydrogen from A to B using 'green' ammonia.

Turning hydrogen into ammonia – which is made up of hydrogen

and nitrogen from the air – makes it much easier to move around. Nium uses nanocatalysis, powered by renewable energy, which achieves this conversion at significantly reduced temperatures and pressures compared to the Haber-Bosch process – the way that ammonia has been produced for nearly 100 years. When the ammonia reaches its destination, the decentralised nature of Nium's system means it is easy to turn it back into hydrogen using the same green process in reverse.

Green hydrogen provides a way to decarbonise hard-to-abate sectors such as transportation by truck or train, or heavy industry. Green ammonia, meanwhile, replaces ammonia produced through the traditional polluting process, which emits around 500 megatonnes of CO2 annually. And, in addition to being a means of transporting hydrogen, ammonia itself can be used in new applications such as shipping fuel, and it remains a key ingredient in fertilisers, which around 50 per cent of the world's food production relies upon.

Nium's new process is turning ammonia into a tool for the future, while cleaning up the way it is used in the present.

wearenium.com

5

CARBON REMOVAL:

High-tech and low-fi solutions

The IPCC Special Report on Global Warming of 1.5 °C highlighted that all pathways that limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) – with no or limited overshoot – depend on some quantity of carbon removal, such as sequestering carbon via natural solutions or through mechanical technologies like Direct Air Capture (DAC). The IPCC AR6 Synthesis Report, meanwhile, states that when used ‘in addition to deep, rapid, and sustained emission reductions,’ carbon dioxide removal can lower net CO₂ emissions in the near term, counterbalance residual emissions from ‘hard-to-abate’ sectors, and achieve net-negative emissions if the world overshoots the 1.5-degree target.

DAC technologies extract CO₂ directly from the atmosphere for storage or use. In theory, according to the International Energy Agency, plans for at least 130 DAC facilities are now at various stages of development, and, if all were to advance, DAC deployment would reach the level required in 2030 under the Agency’s Net Zero Emissions by 2050 (NZE) scenario. However, further government support and private investment are required if all are to get beyond concept stage.

Nature-based solutions for sequestering carbon offer an additional solution and have the added benefit of helping to restore biodiversity on both land and sea.

How ocean innovation could accelerate sustainable development by 2030

Martin Koehring, global director of Impact at the international sustainability non-profit Forum for the Future, on the potential of the ocean to positively contribute to a range of environmental challenges by 2030 and beyond

Ocean-related innovations hold huge potential to address global environmental challenges such as climate change, nature loss, and pollution, by 2030 and beyond. The ocean already generates around 50 per cent of the oxygen we breathe, absorbs around 25 per cent of all carbon dioxide emissions, and captures around 90 per cent of the excess heat that is generated by those emissions. Moreover, the ocean’s potential to produce sustainable food and generate renewable energy is vastly underutilised. For example,



MARTIN KOEHRING
GLOBAL DIRECTOR THE INTERNATIONAL SUSTAINABILITY NON-PROFIT FORUM FOR THE FUTURE

“[The ocean] absorbs around 25 per cent of all carbon dioxide emissions, and captures around 90 per cent of the excess heat that is generated by those emissions”

according to the High Level Panel for a Sustainable Ocean Economy, by 2050 the ocean could supply over six times more food than it does today (representing more than two-thirds of the edible meat needed to feed the future global population). Technology can help to unlock some of this potential.

On a recent trip to Victoria, Canada, I explored the latest cutting-edge ocean technology, including Cascadia Seaweed – Canada’s largest seaweed farm with a mission to produce climate-positive biomass in the ocean. Seaweed has a number of applications in important areas such as food, feed, agricultural fertilisers, pharmaceuticals, cosmetics, bio-plastics, and bio-fuel, as highlighted in Vincent Doumeizel’s recent book *The Seaweed Revolution*.

Seaweed as a feed additive can also reduce methane emissions from cows by up to 90 per

cent. Companies like Volta Greentech have already run successful trial projects. And seaweed can be an alternative feed in fish farming too. Fish feed will be a major area of innovation towards a just and regenerative aquaculture system given the fact that traditional sources of feed such as fish oil, fish meal, and soy are unsustainable. In addition to seaweed-based feed, promising innovations include marine bacteria as well as circular fish feed solutions that use animal by-products and food waste.

Another innovation I encountered while in Canada is the potential to capture CO₂ and store it beneath the sea floor. 'Solid Carbon' technologies like this are being explored by organisations like Ocean Networks Canada (part of the University of Victoria). Meanwhile, on Canada's east coast, the planned North Atlantic Carbon Observatory aims to strengthen the ocean's ability to absorb and store carbon by supporting ocean observation and modelling efforts.

Despite these promising technological innovations, a word of caution is necessary. As highlighted by Forum for the Future's The Future of Sustainability 2023 report, tech optimism risks an overreliance on technology as a solution for all problems. Such optimism has been prominent at global events such as Climate Week NYC, but it is critical that technology is seen as a means to an end rather than the end in itself. In order to build a just and regenerative future, more than technology will be required. Businesses will need to apply a 'courage to transform' mindset that aligns the purpose of business to contribute to solving a range of ecological and social challenges.

forumforthefuture.org

INNOVATION:

Traditional techniques help capture carbon and restore biodiversity

According to the Natural Resources Defense Council, 68 per cent of soil in South America is eroded due to deforestation and overgrazing. InPlanet is a carbon dioxide removal (CDR) startup headquartered in Brazil and Germany with a goal to remove carbon and make tropical agriculture more regenerative. Working with mines across Brazil, the company is scaling a sustainable farming practice that has been in use in the country for generations – remineralising soil with rock powder. The high temperatures and consistent rainfall of the tropics significantly affect the quality of farmed soil. But, spreading ground rock across the fields improves soil biodiversity, and particularly its mineral content.

Once the crushed rock is spread, it will capture CO₂, which will remain inground for thousands of years, whether in the field itself or as sediment in the oceans if it runs off. What is more, by spreading the mineral-rich rocks, farmers can save money they would otherwise spend on chemical fertilisers.

InPlanet is using its research and development capabilities to help farmers economically justify the switch from pesticides and other synthetics to enhanced rock weathering field management.

inplanet.earth

Harnessing geothermal energy to scale Direct Air Capture (DAC)

Kenya is poised to become a world leader in the field of DAC. One of the limitations of the technology is its high energy demand, but this challenge can be addressed by siting DAC machines in areas with abundant geothermal energy, such as East Africa's Rift Valley.

Kenyan startup Octavia Carbon designs, manufactures, and deploys DAC machines as the Global South's first dedicated DAC machine production company – and has built five scaled machines to date.

In July 2023, Octavia Carbon partnered with Cella Mineral Storage, a carbon mineralisation startup. Through the partnership, the companies are creating a pilot DAC facility at the latter's storage plant in Naivasha, which is along the Rift Valley in Kenya. The pilot plant, called Project Hummingbird, will remove 1,000 tonnes of

CO₂ per year. Carbon capture and storage at the plant is set to start in October 2024, and the plan is to sell carbon credits certified by carbon removal platform Puro.earth.

Kenya is rich in basalt rock, which combines incredibly easily with CO₂, permanently storing carbon in the ground. And, crucially, the country is rich in clean geothermal energy, with the grid in most parts of the country run entirely on geothermal power. The company claims that otherwise untapped geothermal waste heat will provide 85 per cent of the energy requirements for the project, with the remaining 15 per cent being supplied by geothermal-generated electricity.

octaviacarbon.com

Growing seaweed between offshore wind turbines

Like land plants, seaweed absorbs atmospheric CO₂ through photosynthesis. And while the exact potential of seaweed habitats for sequestering carbon at scale remains an uncertain area of climate science, some experts believe that the fast-growing macroalgae could help to mitigate man-made CO₂ emissions.

One project that is set to contribute to our understanding of seaweed-based carbon capture is the North Sea Farm 1 project, which will be the first commercial-scale seaweed farm located between offshore wind turbines. The project, located off the coast of the Netherlands, is being developed by non-profit organisation North Sea Farmers.

The 10-hectare farm is forecast to produce at least 6,000 kilogrammes of fresh seaweed in its first year – with its first harvest expected in spring 2024. In addition to analysing and improving seaweed production capabilities, researchers on the project will use funding from Amazon to explore the potential of large-scale seaweed farming to sequester carbon from the atmosphere.

Locating seaweed farms between wind turbines will turn previously untapped ocean space into a tool for fighting climate change through carbon capture. According to Amazon, wind turbines are expected to occupy 1 million hectares of ocean by 2040, and if all this space was used for seaweed production, it could remove millions of tonnes of CO₂ each year.

northseafarmers.org

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PLANETARY BOUNDARIES:

It's all about the Rs...

The concept of planetary boundaries was first shared in 2009 by a group of 28 internationally renowned scientists, led by Johan Rockstrom, then Director of the Stockholm Resilience Centre. Within these nine boundaries, humanity can continue to thrive, while crossing them increases the risk of large-scale, abrupt, or irreversible environmental change. The scientists' analysis – recently updated in 2023 – determines the extent to which they are being breached by human activity, with six out of the nine already transgressed according to the latest update.

Commentators like the Ellen MacArthur Foundation argue that 'living within our means' as a species means moving from a linear to a circular economy. In the past, advocates spoke of the three 'Rs': reduce, reuse, recycle. But such is the scope of the challenge today, that the Rs now need to extend to include 'regenerate' – as depleted soils threaten food security – as well as to 'repairing, reducing, and even refusing' when it comes to consumer culture. Regulation could also be included on the list – the European Union is a leader in circular policymaking and has updated elements of its approach to the circular economy to place greater emphasis on producers taking responsibility for their waste. A growing number of innovations could help companies achieve this requirement.

Working at intersections to solve big challenges

Santiago Lefebvre, founder and CEO of sustainability summit ChangeNOW, the largest global event of solutions for the planet, on driving change

We have four main equations to solve at the same time: the climate, resources, biodiversity, and the human factor. Because of this, I love topics, like circularity and regenerative agriculture, that are at the intersection of the complex challenges we face.

Circularity is one of the strongest conceptual tools we have to address our resource challenges and positively impact the other areas too. If we get better, not just at recycling, but at reusing, repairing, and even refusing, we can start to imagine a world where we are living within our limits.



SANTIAGO LEFEBVRE
FOUNDER
AND CEO,
CHANGENOW

"If we get better, not just at recycling, but at reusing, repairing, and even refusing, we can start to imagine a world where we are living within our limits"

There are challenges of course. In France, there is a debate around recycling, as the country is falling behind EU recycling targets. But recycling is just one of the Rs of the circular economy – we need recycling, but we need to do it better, while reducing the creation of waste. We also need to work on product design so that we are using simpler materials that can be recycled more easily.

What I like about circular economies, is that we can think about large-scale circularity, but what is being done today is more on the level of one product and then another. To make the transition happen, we need both the conceptual and the technological. If we stay at the level of ideas, we will change things, but the ideas will never become concrete. Likewise, if we are just doing innovation, but don't change the way we see the world and consider the planetary boundaries, we will always be chasing short-term progress.

With regenerative agriculture, I had a wake-up call watching the movie *Kiss the Ground*.



Photo credit: Markus Spiske, unsplash.com

The way we've been doing agriculture for thousands of years isn't the right one. In the science of soil, there is a revolution happening – we are starting to understand how soil works and this is a huge tool for climate but also biodiversity and food security. The question is whether we can get the science out there.

ChangeNOW started to help entrepreneurs, and those developing solutions to help the planet, find the support they need. We build bridges and, in a polarised world, we bring peace and respect around the table so that we can work together. The rest is done by the people who come because they are still of the mindset that we can move the needle and change things. This is a particular energy that creates cooperation and impact.

changenow.world



Photo credit: Markus Loke, unsplash.com

INNOVATION:

Clean technology for e-waste recycling and mineral processing

[UN-backed research](#) predicts that global e-waste will increase continually, reaching 74 megatonnes annually by 2030. The authors of the report write that “This makes e-waste the world’s fastest-growing domestic waste stream, fueled mainly by higher consumption rates of electric and electronic equipment, short life cycles, and few options for repair.”

Rather than let so many valuable materials go to waste, UK tech company Descycle has created a low-energy metal recycling and recovery process. This could replace some of the dirtiest methods of chemical recycling with a low-energy, low-temperature method that is also non-toxic and uses chemical compounds that are often biodegradable.

Descycle’s recycling utilises solvents made from salts and organic chemical compounds that have lower melting points than their component parts. Called deep eutectic solvents (DES), the proprietary mixtures are customisable, allowing recycling centres to target specific metals for recovery.

This type of chemical recycling does not require the extremely high temperatures that many of today’s processes need, meaning that Descycle’s technology helps significantly reduce the demand for energy and electricity. Using DES also reduces carbon emissions, and the compounds used in the solvents are found naturally.

descycle.com

Closed-loop clothing

The fashion industry is enormously resource intensive, using 93 billion cubic metres of freshwater annually, and highly polluting, responsible for 120,000 metric tonnes of synthetic microfibres released each year before the textiles have ever reached customers’ washing machines. And then there are greenhouse gas emissions, around 1.2 billion tonnes a year. In addition, fast fashion has fuelled a huge waste issue for the industry, with less than one per cent of all garments recycled to a high quality, with the rest downcycled, incinerated, or landfilled – a loss of \$100 billion-worth (around €94 billion) of material each year.

Historically, the cost of recycling clothes has been high due to the need to disassemble garments manually, and a significant amount of the material is lost during the process. Now, a Belgium-based startup, Resortecs, is offering retailers automated disassembly at an industrial scale. Its Smart Stitch yarns are made from either bio-based or pre-existing synthetic polymers, are compatible with existing stitching machines, and can be used in a variety of applications, from apparel to workwear.

The yarns have melting points between 150–190 degrees Celsius, so when a garment is discarded it can go through Resortecs’ Smart Disassembly system, a closed-loop heating system that maximises energy recovery and minimises CO2 emissions. The garments go into the system and the Smart Stitch yarn simply ‘melts’ away, leaving up to 90 per cent recoverable fabric.

resortecs.com

Autonomous robots provide a boost for regenerative farming

Bio-intensive farming is a type of organic agriculture where methods like succession planting, raised beds, and crop rotation are used to achieve maximum yield from a minimal area of land – all while increasing biodiversity and soil fertility. It is also ideally suited to the use of technology and robotics.

Agri-tech startup Nature Robots has developed a system that uses autonomous robots to create high-resolution, three-dimensional plant maps of crops and weeds, which are then transferred into a monitoring interface for detailed plant management. The robotic system can track the condition and development of individual plants, their size and shape, and other key parameters on a daily basis.

Using the system’s AI-driven data analysis, farmers can then take specific actions to support bio-intensive cultivation methods, protect against disease, plan crop rotations, and more. The robots are intended for use in applications like vegetable and fruit cultivation, viticulture, agroforestry, and agro-photovoltaic environments.

naturerobots.de

HOW CAN BUSINESS MAKE A POSITIVE IMPACT?

Companies of all sizes have a key role to play in mitigating climate change by using resources sustainably, using energy efficiently, and taking responsibility for the impact their products and services have on people and planet. For corporates, climate change presents a potential risk to operations and supply chains, particularly in regions badly affected by extreme weather conditions, while new or updated regulation around carbon reporting or managing waste, for example, will impose restrictions. However, where there are challenges there are also opportunities as authentic best practice, versus greenwashing, will result in a competitive advantage for those who adapt at pace. For smaller impact businesses, adequate finance remains a key challenge, which is why accelerator programmes remain an effective way of becoming investment-ready.

Harnessing innovation through accelerator programmes and financial support

Paul Finch and **Rayan Jawad** are co-founders of Growth Studio, a company that runs global accelerator programmes designed to help startups that protect and preserve the planet. They consider how corporates are best leveraging startups to solve big challenges and where they see innovation having the biggest impact in the next five to ten years



PAUL FINCH
CO-FOUNDER
OF GROWTH
STUDIO

“One of the challenges I have with the corporate world is that often the sustainability role is seen as a token role and not a core commercial nor innovation opportunity”

Rayan: Our clients tend to fall into one of three categories. They may be a large organisation who want to make a positive impact on the world – they know that tech is going to solve a particular challenge in their industry, and they want a solution they can take to market. The second are the companies who are early on in their journey of innovation and they are using programmes

to understand the lay of the land. Then there is the third category. These businesses don't necessarily have a fixed or hard commercial objective for working with startups – they recognise that there is a wide range of value that working with startups can bring and it's simply important to be involved with them.

Paul: One of the challenges I have with the corporate world is that often the sustainability role is seen as a token role and not a core commercial nor innovation opportunity. The responsibility can end up being given to relatively junior people without the scope, experience or autonomy to use it to the company's full advantage.

Where we see the most success is where there is senior 'buy in' and we can have strategic conversations around the right number of startups to invest in to be able to change the 10-, 20-, or 30-year outlook for a company.

With the architecture and engineering firm Ramboll – we had the privilege of working with the global head of innovation. We helped them to develop startups from within the company that could tackle real problems, such as how to visualise air pollution and measure toxic algae blooms in water. They carried out pilots in Lake Windermere where they could try technologies with their startups whereas a traditional corporate approach probably wouldn't have been able to play in that space. Ramboll was able to innovate because there was the political, commercial, and business will to do so.



RAYAN JAWAD
CO-FOUNDER
OF GROWTH
STUDIO

"Innovation is going to drive real change in Saudi Arabia and the way it's being approached is worth keeping a close eye on"

Rayan: In terms of particular regions or countries, innovation is going to drive real change in Saudi Arabia and the way it's being approached is worth keeping a close eye on. The Saudis are building visionary cities, like Neom, and they've committed to delivering on future outcomes for which the technology doesn't exist yet. That opens up the need for more radical innovation that is being pulled by the market rather than pushed by innovators. If successful, and there's no reason it shouldn't be, it would become a case study for a new, more courageous approach for innovator x corporate collaboration.

Paul: India excites me for a number of reasons. One, there are real problems that need to be solved, and second there is a huge emerging, educated middle class coming up that has an outstanding work ethic and entrepreneurial credentials and they are applying that to a huge number of innovations. I predict that India for the next five years will overtake Western Europe for startup innovation investment.

Collectively, we can make a difference

Kate Williams, CEO of 1% for the Planet, on her reasons for optimism for people and planet

1% for the Planet was established in 2002 by Yvon Chouinard, founder of Patagonia and Craig Matthews, founder of Blue Ribbon Flies, with a simple mission: companies that profit from the resources they take from the earth should give something back to protect those resources. Businesses who join us commit to donating at least 1% of annual sales directly to one or more approved environmental organisations. They then submit certified receipts and revenue documentation so that we can track it. Where I'm seeing cause for optimism now and for the future is in the growth of our network. We have over the lifetime of 1% for the Planet certified \$500 million and we've just announced that our target is to get to \$1 billion in lifetime giving by around 2027.

Of the \$500 million, we certified a hundred million in 2023 alone and it's made up of small and large donations. It's diverse, democratic and distributed – most giving at scale is in big chunks by big players who are calling the shots, but we have a mix of players all over the world coming together and demonstrating that if everyone participates, we can drive big, smart change.

When I became CEO in 2015 we were largely US based, with around 25 per cent outside. Now we are 57 per cent outside of the US, which is a big shift as we become a truly global movement. We've also seen significant diversification of our member network – for example, we have a lot more service sector businesses than before. That's an



KATE WILLIAMS
CEO OF 1% FOR
THE PLANET

"If we don't continue to live with some joy, and art, and spirit, what's the point?"

important shift because it says something about business commitment and consumer awareness, and that's an area where I think we will see even more of a shift in the coming years.

Amid so much urgency because of the climate crisis, there can be critiques of incrementalism about what we're doing – but the reality is that it does add up and our growing model is proof of that. As humans, we are not wired to respond to future existential threats, we are wired to respond to immediate things. We haven't evolved yet to have the same emotional response to an intellectual awareness that something is going to happen in 30 years. It's important to remember the human psychology of this.

Finally, I am optimistic that despite all this we are still creating art, and we are still falling in love, and we are still making music. We need nature to remain healthy and human existence has to be meaningful and fulfilling. If we don't continue to live with some joy, and art, and spirit, what's the point?

onepercentfortheplanet.org



Photo credit: Pawel-Czerwinski, unsplash.com

Conclusion

The world needs systemic change to chart a net-zero path to 2030 and beyond. The enormity of the task, not only to decarbonise, but to do all the other things we need to do – restore habitats, eradicate waste, regenerate soil, mitigate for extreme weather conditions – can feel overwhelming. And this is particularly true for anyone entrusted with developing a sustainability strategy or dealing with mandatory ESG disclosures and new or updated regulations.

Constraints can drive creativity and there is opportunity there for those who look to the future with a view to driving positive change. Businesses with senior level buy-in can drive sustainable business objectives via innovation through startups, whether via partnerships or accelerator programmes. The innovations included in this report are just a snapshot of what is being developed across sectors and around the world, but they serve as thought-provoking examples.

There is a tendency to assume that innovation is the sole preserve of Silicon Valley and other hubs in developed countries, yet innovation is a worldwide pursuit and there are many lessons to learn from the Global South. Similarly, innovation need not always be hi-tech, and there is often a sweet spot to be found in the combination of the digital and the natural. For example, in the right circumstances, artificial intelligence can facilitate our ability to implement nature-based solutions at scale.

One of the most important takeaways is that there are technologies already available, that with the right policies in place and adequate levels of investment, are absolutely at the point of being ready to scale – green hydrogen and cheaper wind power to name just two. These can contribute to greater renewable energy capacity and the decarbonisation of previously hard-to-abate sectors. To unlock this potential, collaboration is key – across sectors and different types of organisations. Let's keep the momentum going and get the job done.

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