GCxN

Shell + NREL:
A Global Energy GameChanger

Year in REVIEW 2020

Founded by: + NREL

From the Program Managers

To say that 2020 brought tremendous change would be quite an understatement. However, as we reflect on the progress and achievements of the GCxN program and our portfolio companies, we cannot help but feel immense pride on three levels.

First, we witnessed how resilient the program and the companies are. Despite the global pandemic, the challenging economic environment, and a severely disrupted supply chain, the GCxN companies still made incredible progress in their journey of technology development and market penetration. Antora secured a follow-on investment from Shell Ventures; Span closed its series A funding. Intertie entered into several major agreements for a demonstration project; Hygge sealed a commercial deal with a utility to deploy its technology and product. Inspired by the strength of our startups, Shell and NREL demonstrated the sustainability of GCxN through selecting the fourth cohort despite challenges. This newest cohort provides Shell and NREL's technical experts an opportunity to partner in exciting new developments in carbon utilization and the potential to power a hydrogen economy.

Second, we also saw how powerful it is to work together. When the pandemic hit, Shell and NREL quickly concluded that first and foremost, we needed to support the startups. This included ensuring the companies prioritized protecting employees: no one should rush to the lab to meet a deadline at the expense of health or safety.

Finally, we are encouraged to see how the GCxN program became even more relevant and crucial, as society at large, and Shell specifically, reiterated commitments to energy transitions after COVID-19 began. In 2020, Shell announced that it will "aim to be a net-zero emissions energy business by 2050 or sooner, in step with society." In 2021, Shell announced a new company strategy called **Powering Progress**. GCxN believes the contributions of startups are critical to reaching these goals. Shell's commitment provides a great platform to advance the program, informing both Shell's energy transition journey and benefiting society at the same time.

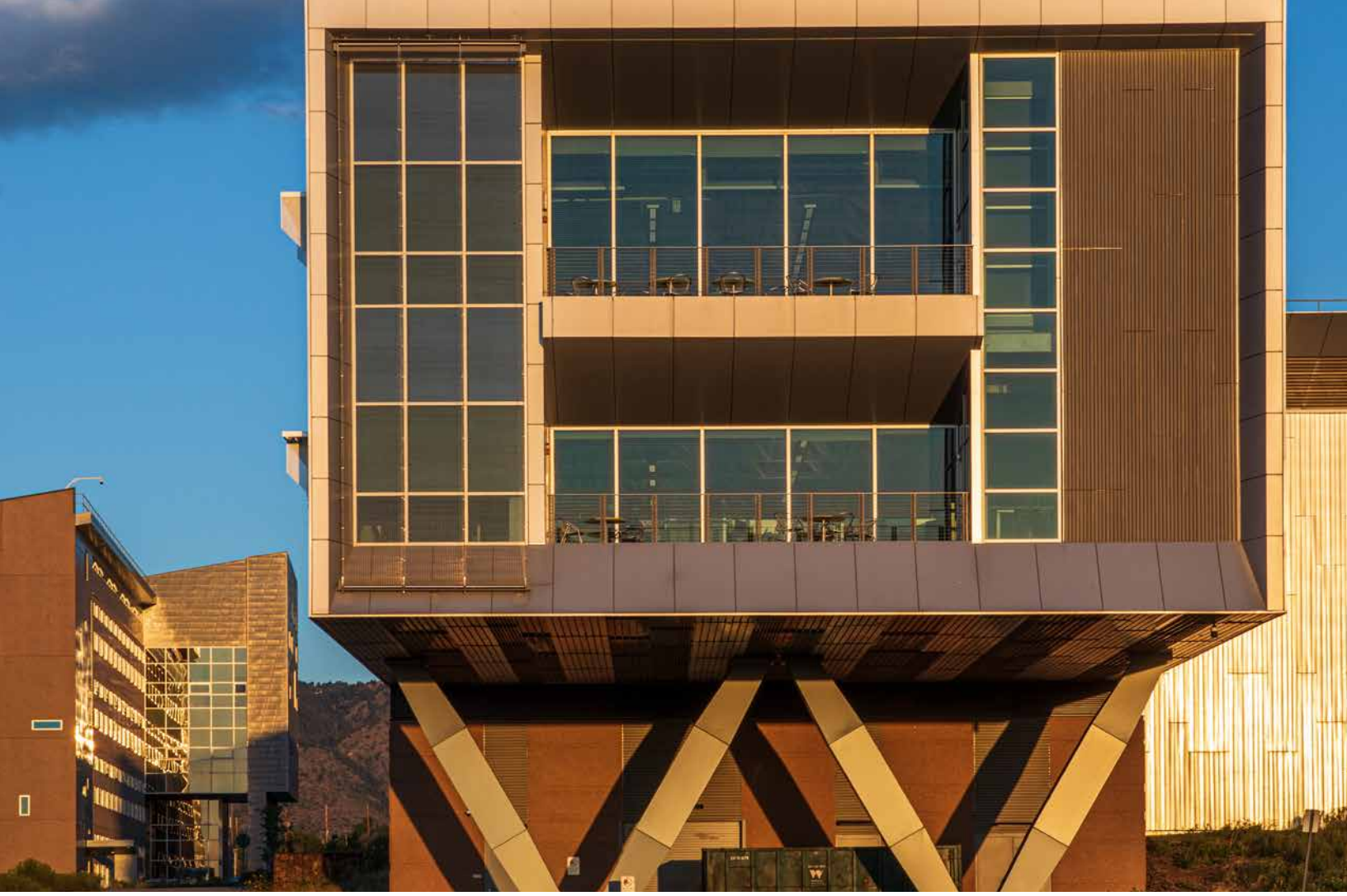
Looking forward to 2021, we are confident and optimistic that there are more great things to come. We are excited to welcome new Program Manager Dr. Katie Richardson, and Technical Project Manager Dr. Rachelle Ihly, both from NREL's Innovation & Entrepreneurship Center.

With new momentum and refreshed energy, we will work hard to build and launch the fifth cohort this year as we continue to support our existing startups. We hope you will join us in taking on this historic journey of changing the world's energy landscape to a low-carbon energy future.

Haibin Xu
GCxN Program Manager, Shell

Katie Richardson, Ph.D.
GCxN Program Manager, NREL

Rachelle Ihly, Ph.D.
GCxN Technical Project Manager, NREL



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$52M+

raised by cohort companies to date

$21 : $1

leverage ratio for Shell funding

51

new startup hires since program onboarding

About Shell GameChanger Accelerator™ Powered by NREL (GCxN)

The Shell GameChanger Accelerator Powered by NREL (GCxN) is a multimillion-dollar, multiyear program focused on discovering and advancing emerging clean technologies with the potential to dramatically alter the future energy landscape. GCxN identifies promising startup companies through our Pipeline Partners, an extensive ecosystem of clean-tech business incubators, accelerators, and universities. Invited companies receive access to up to $250,000 in non-dilutive funding in the form of technical experts and facilities to develop and demonstrate new energy technologies.

GCxN seeks companies operating in the new energy space, with rotating technology focus areas that span the energy continuum from generation to transmission and distribution. Companies applying to GCxN can be classified into three tiers based on technology readiness level (TRL):

Tier 1 – Bench Scale: TRL 1–5, Early stage with physical proof that the concept may work.

Tier 2 – Prototype: TRL 6–7, Prototype available for testing and validation.

Tier 3 – Commercially Ready: TRL 8–9+, Production models available in limited quantity.

GCxN's goal is to help companies at each technology tier meet critical milestones to advance to the next stage of development, accelerating their time to market while minimizing the risks associated with commercializing next-generation technology. Over the course of 18–24 months, participating GCxN companies gain access to NREL and Shell's world-class facilities and researchers, who help develop, validate, and incubate the companies' technologies.

About Shell

Shell's purpose is to power progress together with more and cleaner energy solutions. We believe that rising standards of living for a growing global population are likely to continue to drive demand for energy for years to come. At the same time, the need to tackle climate change means there are transitions underway to a lower-carbon, multi-source energy system. Shell's technological capacity, customer-mindset, operational experience and market knowledge mean we are at the forefront of innovative and collaborative approaches to help build a sustainable energy future.

The Shell GameChanger program, open to the public, helps Shell meet its energy ambitions by de-risking early-stage energy ideas (pre-seed/seed) by offering proof-of-concept funding and technical expertise. Founded in 1996, GameChanger has worked with more than 1,500 innovators and turned more than 100 ideas into productive reality.

About NREL

The National Renewable Energy Laboratory (NREL) is one of 17 U.S. Department of Energy national laboratories. NREL's 2,960 employees are focused on research, development, and deployment of next-generation renewable energy technologies.

With its internationally renowned scientists and world-class facilities, NREL is a perfect partner for Shell GameChanger in supporting passionate cleantech entrepreneurs. NREL provides GCxN with unbiased third-party technology development, validation, and demonstration capabilities to advance and de-risk early-stage technologies.

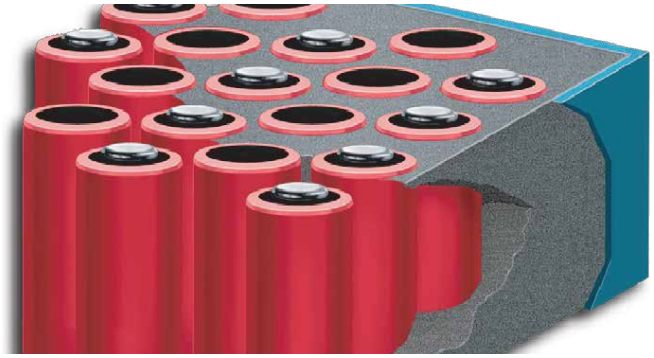
GCxN Portfolio Companies

Air Company

With a mission to develop innovative and effective solutions to anthropogenic climate change, Air Company patented a process that mimics photosynthesis in a way that is not only more efficient but faster at purifying the air we breathe. This technology transforms carbon dioxide captured from the air into impurity-free alcohols that can be used in spirits, fragrances, sanitizers, and a variety of consumer industries.

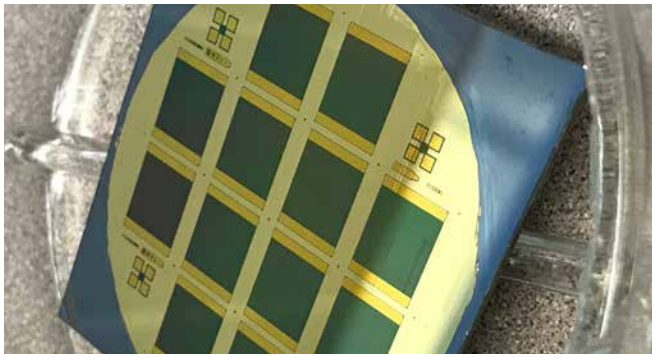
Though "Air Vodka" is the premier product in the Air Company portfolio utilizing this technology, the technology also has the potential to create a carbon-negative fuel.

AllCell Technologies



AllCell Technologies has introduced revolutionary lithium-ion battery packs that incorporate its patented phase-change composite (PCC) passive thermal management technology. PCC keeps the cells at optimal temperatures during operation, enabling a cost-effective energy storage solution with an improved cycle life, advanced performance and enhanced safety. AllCell Technologies' batteries can be found in autonomous shuttles, electric planes, robotics, lightweight electric vehicles, and commercial drones. **In 2020, AllCell appointed new management and expanded its manufacturing capabilities.**

Antora Energy

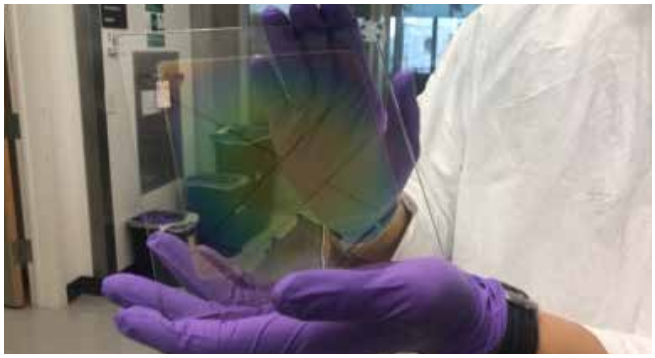


Antora Energy has created groundbreaking, low-cost thermal batteries for grid-scale, long-duration energy storage. Current technology, such as lithium ion batteries, can store a few hours of power while Antora Energy's technology can store multiple days' worth of energy. **Antora Energy had an incredibly successful year in 2020 in which it raised millions in grants, contracts and private capital; made its first commercial hardware sales; built its energy storage prototype system; and broke the world record conversion efficiency for the solid-state heat engine.**

EGM

Electric Grid Monitoring aims to digitize the grid and integrate distributed energy resources. EGM mitigates major grid challenges by delivering effective integration of distributed renewable energy to the grid, enhancing grid reliability, improving security levels, and reducing the cost of ownership. EGM's Meta-Analytics system uses artificial intelligence and algorithms based on comprehensive data collected from the grid in real-time. **In 2020, EGM launched its cooperation with the New York Power Authority and participated in NREL's Innovation and Entrepreneurship Center's virtual Camp Cleantech.**

BlueDot Photonics



BlueDot Photonics is developing the next generation of solar panels made of perovskite materials with the goal of increasing output by at least 10 percent. In 2020, BlueDot Photonics raised $350,000 of dilutive funding, added two new full-time members to the team and joined the inaugural cohort of the Third Derivative program, a joint venture between Rocky Mountain Institute and New Energy Nexus. **Through this program and others, BlueDot Photonics is committed to finding new ways to harvest, manipulate, and transform light using unique materials and simple manufacturing techniques.**

Feasible, Inc.

Feasible, Inc. pioneered a battery intelligence platform that combines ultrasound and data analytics to deliver unique insights across the value chain. Feasible, Inc.'s technology, known as EchoStat, uses ultrasounds to probe the physical condition of batteries in ways that aren't currently possible at commercial scale. This patented technology enables customers to build dependable, safe batteries and deliver premier performance at a lower cost. **In 2020, Feasible, Inc. expanded its reach and worked with NREL's Donnel Finnegan on the DOE Energy Storage Grand Challenge in partnership with Clarios and Amplitude Lasers.**

Icarus RT

Icarus' product, Quartet, is a hybrid photovoltaic/thermal solar-plus-storage cogeneration system. Quartet extracts, collects, and stores "waste heat" from solar panels to increase power output and lower system cost per kW. The stored heat is converted to hot water and/or power on demand. In 2020, Icarus RT was a winner or finalist in many competitions such as the Cleantech Open, Third Derivative, and the Qualcomm Small Business Accelerator while also raising private investments. **Icarus began 2021 as a winner of the $450,000 California Energy Commission CalSEED Prototype Award.**

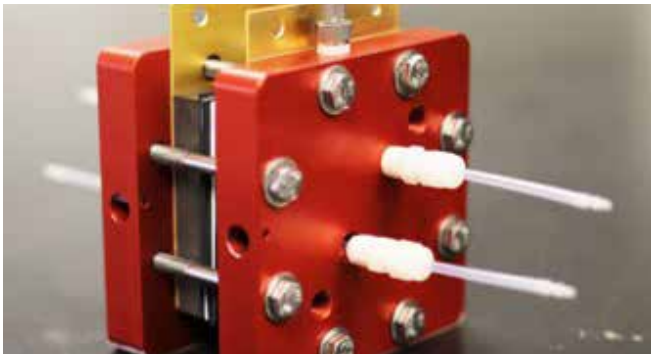
Intertie Corp.

Intertie Corp. is the electric vehicle (EV) charging station of the future. Intertie Corp. has developed a battery-boosted charging station, known as the EV ChargePod. The EV ChargePod has a DC microgrid and battery buried underground with an aesthetic charging station above ground that promotes a low cost, user-friendly experience. Intertie Corp.'s technology combines fast charging capabilities, intelligent storage, and integrated solar power. **Intertie Corp. is dedicated to enabling the grid of the future and is motivated by the opportunity to help California achieve its climate targets.**

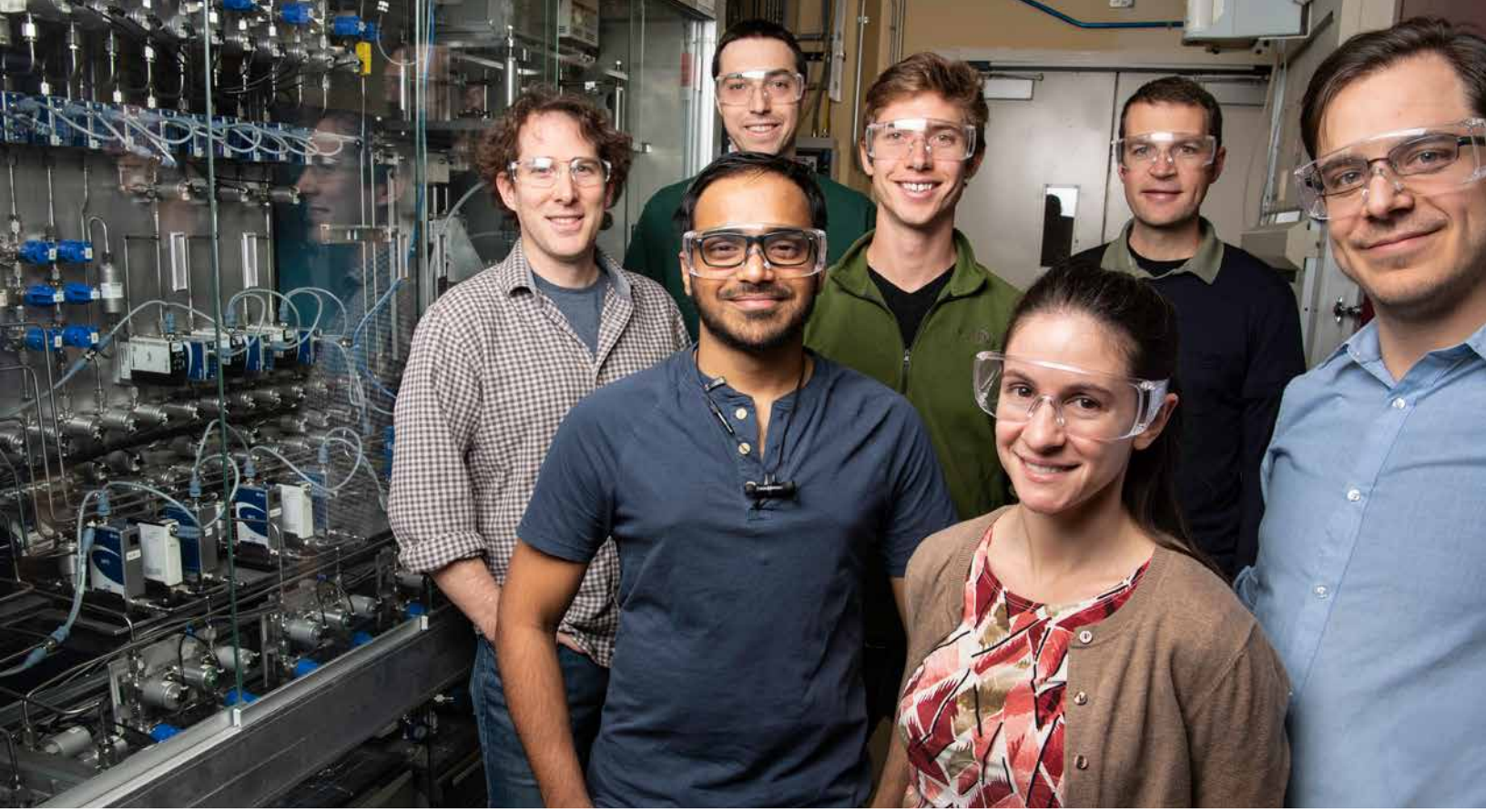
Ionomr

Ionomr is a clean technology company that develops ion-exchange membranes for fuel cell systems, green hydrogen production and carbon capture, and utilization for CO_2-neutral green fuels. Its membranes and polymers are produced from a hydrocarbon base, making them fully recyclable, recoverable, and bio-accumulative. **Among other honors, Ionomr has been awarded the 2020 F-Cell Top Products and Markets Award, the 2020 Energy Tech Summit New Energy Challengers "Top Hydrogen Start-Up" Award, and the 2020 Chinese Society of Automotive Engineers "Global Cutting Edge & Innovation" Award.**

Jolt Energy Storage



Using organic compounds, Jolt Energy Storage makes organic redox flow batteries that have the same large-scale storage capabilities as lithium-ion, but are safer, more efficient, and less expensive. Jolt Energy Storage's multi-electron, higher-voltage capabilities enable utilities to capture energy from intermittent energy sources, such as solar panels or wind farms, and reliably deliver that energy on demand. **In 2020, Jolt Energy Storage extended its partnership with Argonne National Lab, and was invited to participate in the Midwest Energy Research Consortium WERCBench Labs Accelerator.**



Hygge Power

Hygge Power offers reliable energy through its in-home network of small storage devices. Hygge Power's new smartphone application, CO-Z, enables users to manage their power through outage, price, and carbon alerts. CO-Z provides custom information through real-time inputs — such as weather data, the history of reliability in an area, utility restoration performance and distribution structures — to create unique outage risk profiles for homes, apartments, and businesses. **In 2020, Hygge Power launched a pilot with Florida Power & Light and secured a patent with support from Ideaship, a collaboration between the Global Technology Transfer Group and Panasonic Intellectual Property Corporation of America.**

Microgrid Labs

Microgrid Labs is a consulting and software company dedicated to supporting the electrification of fleet vehicles. The Microgrid Labs technology determines optimal sizing of batteries and chargers through its modeling, simulation, and optimization tools. Microgrid Labs also offers fleet electrification and microgrid planning services. **In 2020, Microgrid Labs received a National Science Foundation Phase-II grant for $750,000, and a Colorado Office of Economic Development and International Trade grant for $250,000. The company also worked with several e-bus and charger OEMs to integrate its EVOPT Controller with their products.**

Span

Span aims to dramatically accelerate renewable energy adoption with its smart electric panel. Span provides data insights to allow homeowners to control their home energy via an app making power management convenient. Span also automatically adjusts power levels to ensure the energy in a home is properly balanced based on specific preferences. **In 2020, Span launched a partnership with Panasonic that will integrate Span's electric panels with Panasonic's energy storage systems. In addition, Span was a finalist in the Fast Company list of 2020 Best Home Innovations.**

Versogen

Versogen is developing a breakthrough electrolyzer technology that uses water and renewable energy to produce green hydrogen at scale in a reliable and affordable way. Versogen's systems are built around its patented anion exchange membranes (AEM) and earth-abundant materials. This hydrogen-generating solution will substantially reduce industrial carbon emissions and lay the foundation for a sustainable energy future. **While Versogen is expanding into the electrolyzer systems development, it continues to market its revolutionary anion exchange membranes.**

Transformational Technical Progress

GCxN projects aren't just about one company. The technological innovations NREL and Shell are coming up with together can have industry-wide impacts. Here's a little bit more about what frontiers we are advancing:

The first two cohorts of startups are preparing for graduation in 2021. These cohorts explored technologies enabling high renewable-energy penetration on the grid, long-duration storage (greater than eight hours), and EV fast charging (defined as a 15-minute charge). As NREL technical projects conclude, each graduating company will have a chance to share their impacts with Shell.

Technical Achievement: Antora Energy's thermo-photovoltaic heat engine is the world's highest efficiency solid-state heat engine, with heat-to-electric conversion efficiency greater than 30%.

Cohort 3 companies launched NREL projects to test long-duration storage technologies, and to enable commercial-scale solar perovskite manufacturing. Perovskite manufacturing techniques (roll-to-roll and screen-printing) cost less than those used for silicon-based photovoltaics.

Technical Achievements: Jolt Energy Storage, a long-duration storage company, is employing an NREL technoeconomic model that will allow its organic flow battery to meet a levelized cost of storage of less than $0.05/kWh.

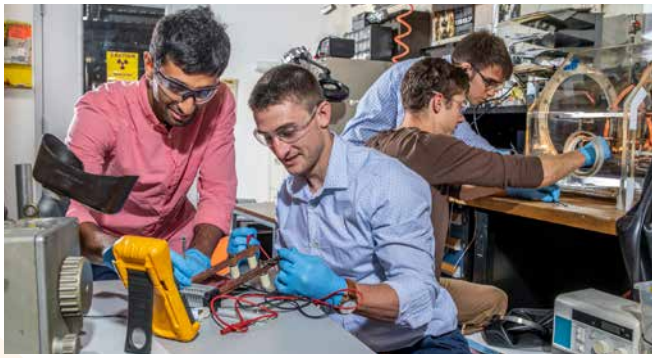
Blue Dot Photonics has reported deposition of perovskite solar absorber thin-film over areas as large as 6"x6", an important milestone.

In 2020, GCxN selected its fourth cohort of startups focused on renewable electrosynthesis of fuels and chemicals. Applying companies offered breakthrough-technology options for the scalable electrochemical production (with a current density greater than >0.5 A cm-2 and able to operate for more than 1000 hours) of hydrogen and other valuable chemicals (ammonia, ethylene, etc.) leveraging low-cost intermittent renewable electricity.

Stay tuned for achievements made by Cohort 4 companies!

GCxN in the News

GCxN continued to make national news for its defining role in the clean energy future. Here are some highlights:



Why Corporate Partners are Essential for Third Derivative, a New Climate-Tech Support Network

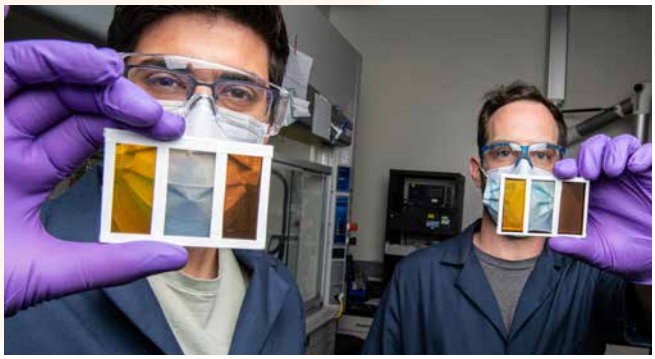
***GreenBiz*; November 30, 2020**

GCxN cohort companies BlueDot Photonics and Antora Energy are a part of the Shell-backed Third Derivative incubator.

Enel X Enters U.S. Public Transit Electrification Market with Grants to Support Electrification of Bus Fleets

***T&D World;* September 18, 2020**

Enel X will work with Microgrid Labs, Inc, provider of EV modeling and optimization software, and the Massachusetts Bay Transportation Authority during the planning and development of a new bus depot that will house a fully-electric fleet of 120 buses and charging infrastructure.



From the Lab: The Energy Transition Needs Perovskite PV and Alternative Storage

***Greentech Media*; September 25, 2020**

The energy sector is making progress toward low- or zero-carbon generation. But even with recent technology developments and corporate and municipal action to deploy renewables, we still have a long way to go, and there is much debate about the best path forward.

'Important to explore alternatives' to lithium-ion, Shell-NREL accelerator says

***Energy Storage News*; May 5, 2020**

A collaboration between the innovation arm of fossil fuel company Shell and NREL selected Jolt Energy Storage, the maker of an organic flow battery, to be among a group of "startups with the potential to dramatically alter the future global energy landscape."

Two GCxN Startups Selected to Present at NREL's 2020 Industry Growth Forum

NREL; March 25, 2020

Feasible and Microgrid Labs—both EV-focused technologies—presented to a panel of expert judges at the 2020 Forum. The IGF is the premier event for cleantech entrepreneurs, investors, and experts from industry and the public sector to build relationships, showcase innovative technologies, and identify disruptive business solutions.

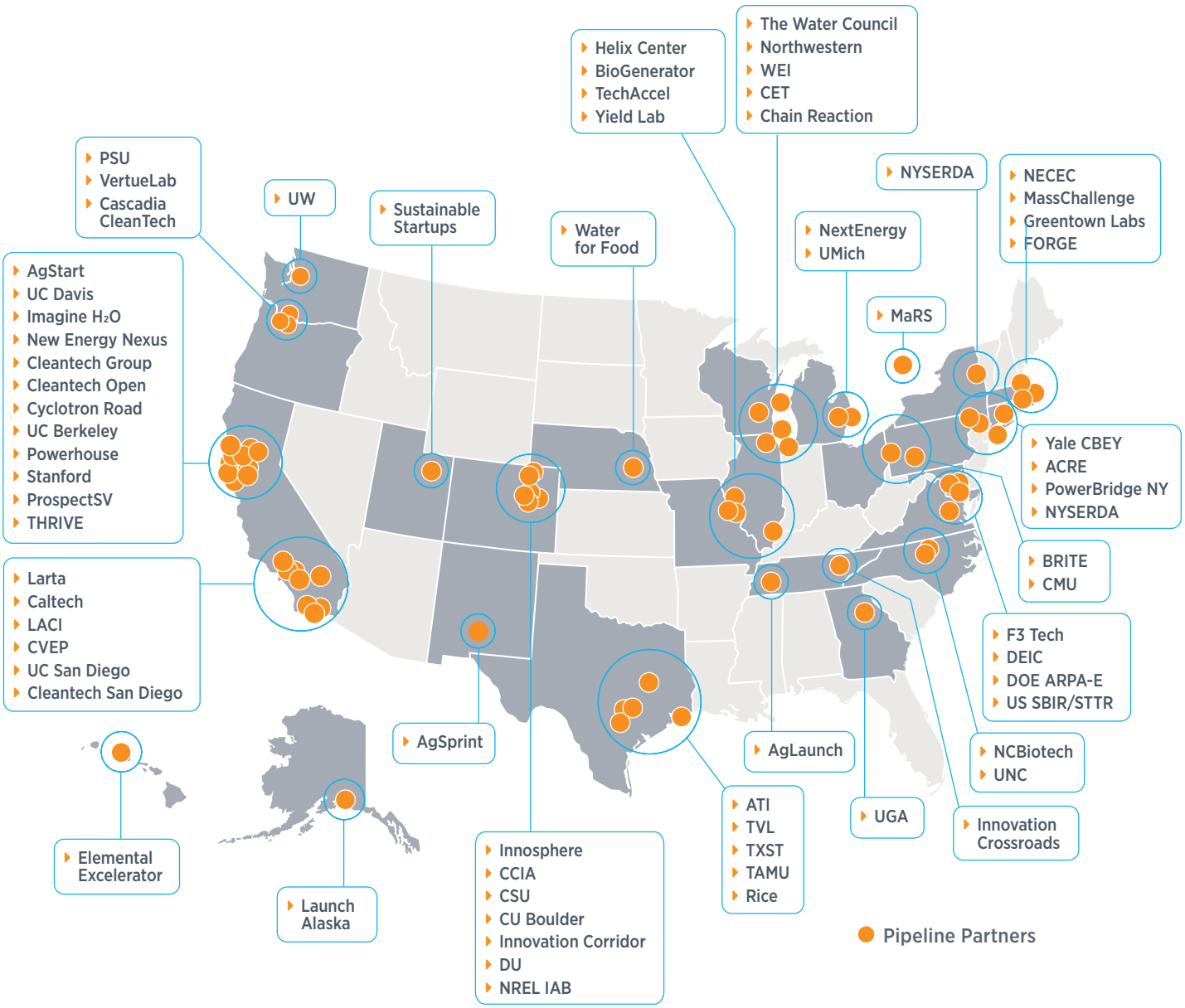
Shell Has A Bigger Clean Energy Plan Than You Think — CleanTechnica Interview

***CleanTechnica*; May 1, 2020**

Royal Dutch Shell has gotten some pretty good reviews for the laundry list of clean energy items in its new decarbonization plan, but there is one little item that hasn't gotten much attention, and it could have an impact on all those other oil and gas giants out there. Back in 2018, the company nailed down a partnership with NREL that leverages 40 years of clean tech research and industry connections, and they've been busy at work shoveling new clean tech into the market as fast as they can go.

Our Ecosystem

During each call for participants, GCxN applicants are referred to the program through an international ecosystem of cleantech business incubators, accelerators, funds, and universities: our Pipeline Partners. These partners represent the leading edge in academia, research, and industry, each providing unique insights into cleantech.



GCxN Steering Committee

Richard Adams
Director, NREL Innovation & Entrepreneurship Center

Lene Hviid
Global Manager, Shell Research Connect & GameChanger, GCxN Board Chairman

Ajay Mehta
Global Manager, New Energies Research & Technology, Shell

"We made record efficiency thermophotovoltaic (TPV) cells for a collaboration with Antora Energy … Those accomplishments have led us to propose new work in several related fields, even as we continue to improve our cells. Collaborating with GCxN and Antora has required us to think carefully about how a developing technology might be manufactured and commercialized in the near term … a valuable frame of mind for applied R&D."

— **Myles A. Steiner, Ph.D.**
Senior Scientist, Chemistry and Nanoscience Center, NREL

"I always look forward to working with the GCxN startups. They extend the scope of Shell's eMobility interests while developing both their businesses and some really game-changing technologies. The electric cohorts are really more like game-chargers!"

— **Cynthia Ginestra**
Shell eMobility Scientist & Team Lead

Engage with Us

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March 2021

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