Year in REVIEW 2021

GCxN

Shell + NREL:
A Global Energy GameChanger

Founded by:

Shell + NREL

From the Program Managers

During what proved to be (another) year of unpredictability requiring agility and pivots, the Shell GameChanger Accelerator™ Powered by NREL (GCxN) remained a positive force for cleantech commercialization in 2021. Some things came full circle, such as the first companies successfully completing the program while realizing notable milestones in the process. Other areas of GCxN embraced new opportunities, including new leadership, a fifth cohort of five companies working on innovative projects in industrial electrification and e-mobility, and lofty goals on the part of both Shell and the National Renewable Energy Laboratory (NREL). GCxN's momentum continues to build toward a promising outlook in 2022 and beyond.

Five early GCxN portfolio companies graduated in 2021: Antora Energy, Microgrid Labs, Feasible, Inc., AllCell Technologies, and EGM. Alongside NREL researchers, these startups completed their technical projects, solving critical problems spanning themes of long-duration energy storage, fast electric vehicle charging, and grid of the future, and presented the results before expert panels. These companies not only reaped the full R&D benefits of the program, but also celebrated technical breakthroughs recognized by the scientific community. They developed key commercial partnerships, garnered high-profile press coverage, and secured follow-on investments through Shell Ventures and other interests that will help the startups move their ambitions to implementation. As these five companies move on, projects continue with the other GCxN teams. With the kick-off of cohort 5 in December, the GCxN portfolio now includes a total of 19 startups across multiple technology sectors and stages.

Building on the legacy established since GCxN's inception, we welcomed new leadership in 2021 and bid fond farewell to key teammates essential to the program's success to date. As Program Managers, we're thrilled to be at the helm of this outstanding accelerator, bolstered by the expertise of our Steering Committee, which also welcomed new members. Also in 2021, Shell announced a new goal of reducing absolute emissions by 50% by 2030 compared to 2016 levels, and three new critical technology focus areas in hydrogen, electrification of demand, and nature-based solutions, underscoring the sense of urgency for a net zero future sooner and the importance of GCxN's quick-paced work with startups to reach these goals.

Looking ahead to 2022 and future years, GCxN remains poised for growth and expansion in alignment with Shell and NREL footprints and priorities. We will continue our critical work of expanding research horizons and partnerships to advance and accelerate the clean energy transition. We will assist promising cleantech startups in pushing boundaries and commercializing their technologies to lower the green premium and unlock affordable, sustainable energy solutions for everyone.

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Shell GCxN Program Manager

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NREL GCxN Technical Project Manager

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$131M+

RAISED BY COHORT COMPANIES TO DATE

$28:$1

LEVERAGE RATIO FOR SHELL FUNDING

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NEW STARTUP HIRES SINCE PROGRAM ONBOARDING

About 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 Channel 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 are 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:
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's world-class facilities and top-tier researchers from both institutions, who help develop, validate, and incubate the companies' technologies.

About Shell

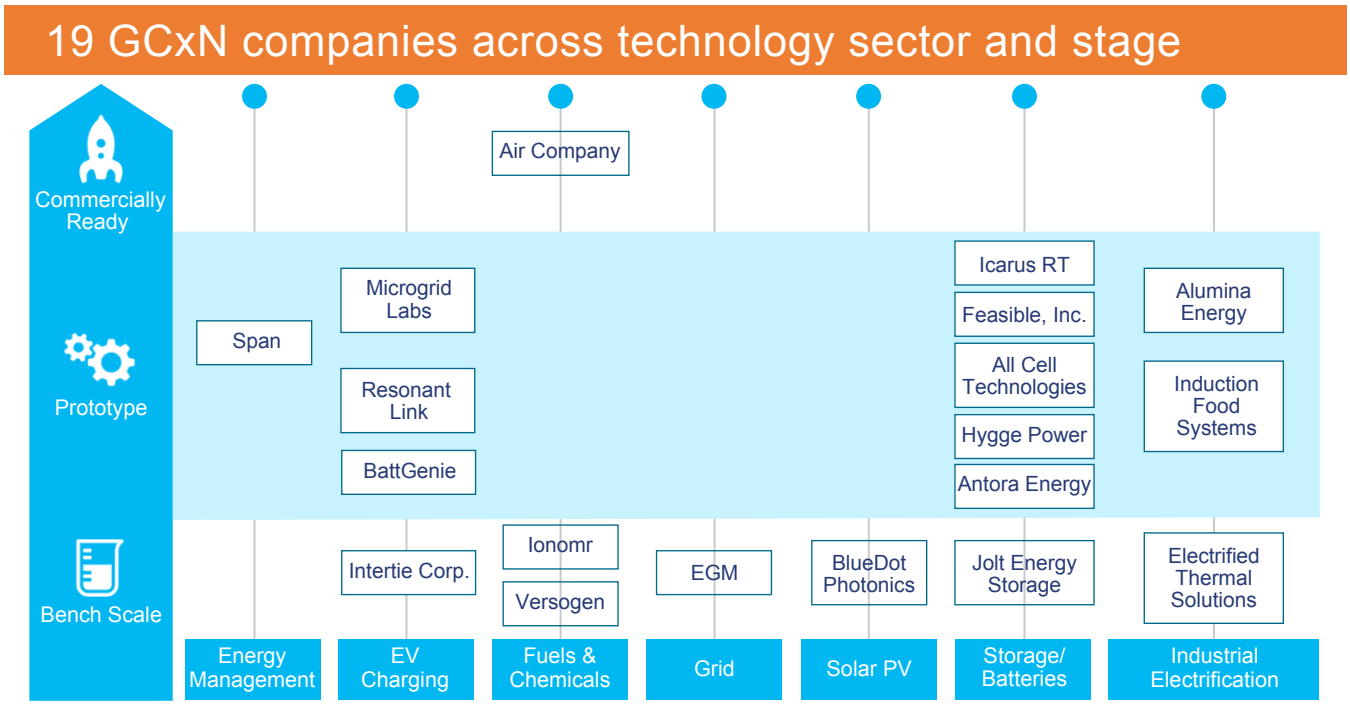
Shell's purpose is to power progress together with more and cleaner energy solutions. We believe that rising standards of living for a growing global population are likely to continue to drive demand for energy for years to come. At the same time, the need to tackle climate change means there are transitions underway to a lower-carbon, multisource 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 helping early-stage technologies go from laboratory-scale science to commercially viable products. GameChanger provides start-ups with support, expertise, and seed funding, while the companies maintain the independence to make their own decisions. Founded in 1996, GameChanger has worked with more than 5,000 innovators from around the world and turned more than 150 ideas related to the energy transition, digital transformation, and a broad spectrum of energy technologies 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 focus 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. In 2021, Air Company and its unique vodka and fragrance products were featured in media outlets including CNN and Fast Company. The company also won a sizeable and competitive award from NASA.

AllCell Technologies

AllCell Technologies 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. Autonomous shuttles, electric planes, robotics, lightweight electric vehicles, and commercial drones can use AllCell Technologies' batteries. AllCell presented key technical findings from their GCxN project as a keynote speaker at the MIT A+B Allied Energy Symposium and as an invited speaker at The Battery Show in 2021, driving a record sales year.

Alumina Energy

Alumina Energy develops HEATER (Heat Exchanger and Thermal Energy Reservoir), a cogeneration solution for industrial customers that is economical, flexible, and zero-carbon. 2021 marked not only the commencement of the company's GCxN journey, but also selection alongside only three others by Halliburton Labs for the second cohort of its industrial scaling program.

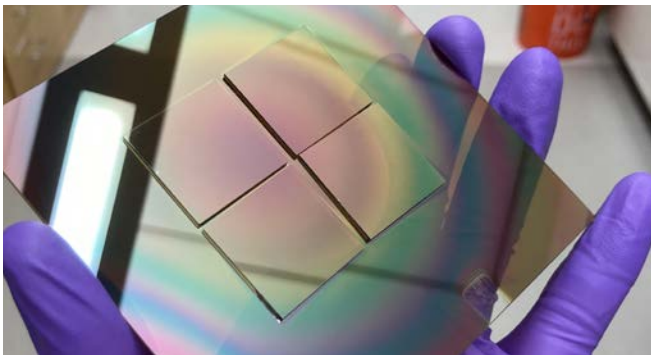
BattGenie

BattGenie provides software solutions for battery management systems to enable faster EV charging and longer battery cycle life for electric vehicles and grid storage battery applications. A 2021 Science Direct article prominently highlighted their co-founder and technology, and it explains the promise their solution holds for accelerating electric vehicle adoption.

Antora Energy

Antora Energy 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. In 2021, Antora Energy moved into its new headquarters, almost doubled the size of its team, and made significant cost and design strides in its technology. This success is reflected in recognition as a Cleantech Group 50 to Watch list and other industry media exposure.

BlueDot Photonics



BlueDot Photonics works to develop the next generation of solar panels made of perovskite materials, with the goal of increasing output by at least 10 percent. 2021 was a banner year for BlueDot, who secured funding through both a Series Seed Round and NSF SBIR Phase I award. They were also a finalist for Entrepreneur of the Year by the Association of Washington Business and featured by premier publications including *Scientific American* and *CleanTechnica*.

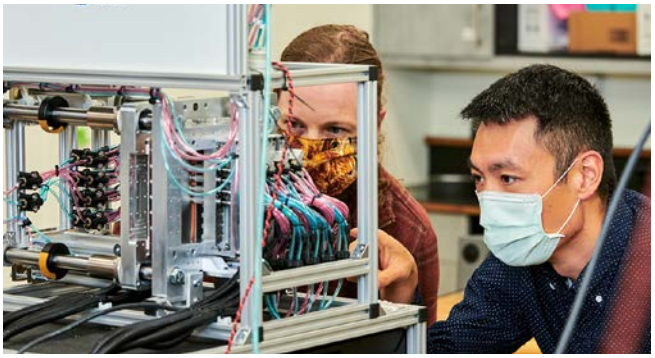
EGM

Electric Grid Monitoring (EGM) 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. EGM ended the year on a high note by closing a $17.5M fund raising round with investment from both venture capital and a strategic firm. 2021 also brought completion of key system abilities around voltage measurement and fault location, which, combined with the promising GCxN project findings, drives increased interest from utilities.

Electrified Thermal Solutions

Electrified Thermal Solutions focuses on developing the Joule Hive: a new energy storage technology that converts surplus zero-carbon electricity into heat. Their technology and team generated remarkable interest in 2021, including an ARPA-E grant, Activate fellowship, and awards from the World Materials Forum and Massachusetts Clean Energy Center.

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 currently impossible at commercial scale. This patented technology enables customers to build dependable, safe batteries and deliver premier performance at a lower cost. Feasible, Inc. received the Startup of the Year–Innovation Award at Associated Air Balance Council 2021. The company also initiated several key grant-funded projects and kicked off a Series A investment round.

Icarus RT

Icarus RT's product, Quartet, is a hybrid photovoltaic/thermal solar-plus-storage cogeneration system that extracts, collects, and stores "waste heat" from solar panels. Quartet converts the stored heat to hot water and/or power on demand. In 2021, Icarus RT joined the Halliburton Labs Scale Up program and was awarded a grant by the California Energy Commission for a major installation at a local police department headquarters.

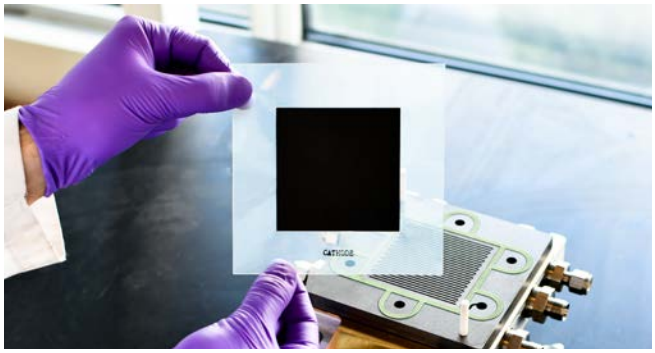
Induction Food Systems

Induction Food Systems heats flowing fluids from the middle-out instead of the outside-in. This breaks fluid heating bottlenecks for industry improving productivity and helping to decarbonize operations. The company closed a pre-seed round and won a grant from the DOE's Advanced Manufacturing Office in 2021. Over the course of the year, they also made significant technical strides, conducted successful proof of concept projects, and sold the first piece of equipment to an enterprise client.

Intertie Corp.

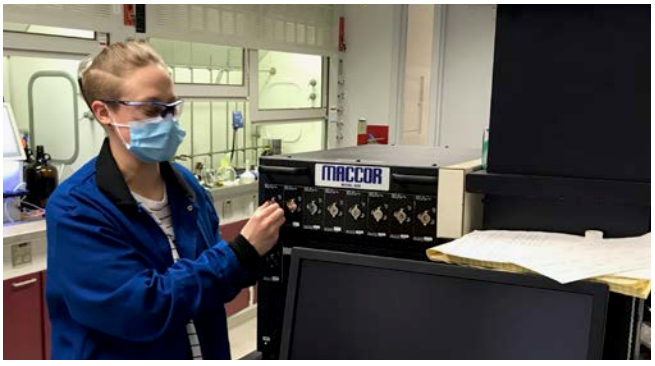
Intertie Corp. developed a battery-boosted EV charging station, known as the EV ChargePod. The EV ChargePod uses a DC microgrid and battery buried underground with a charging station above ground that promotes a low cost, user-friendly experience. Intertie Corp. had a strong funding year, closing a Series A round for microgrid commercialization and winning a competitive fast-charging grant from the California Energy Commission. Also in 2021, the Transmission and Distribution conference accepted a paper arising from their GCxN project for presentation.

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 come from a hydrocarbon base, making them fully recyclable, recoverable, and bio-accumulative. In 2021, Ionomr received numerous high-profile accolades, including: Technology Pioneer by the World Economic Forum, top 10 finalist for Amazon Web Service's inaugural Clean Energy Accelerator program, and one of Canada's top 50 cleantech ventures.

Jolt Energy Storage



Using organic compounds, Jolt Energy Storage makes organic redox flow batteries that have large-scale storage capabilities similar to lithium-ion, but are safer, more efficient, and less expensive. Jolt's multi-electron, higher-voltage capabilities enable utilities to capture energy from intermittent sources, such as solar panels or wind farms, and deliver that on demand. In 2021, Jolt secured an investment from a strategic partner, enabling execution of two development and optimization contracts. They also filed two key provisional patent applications and grew the size of their team.

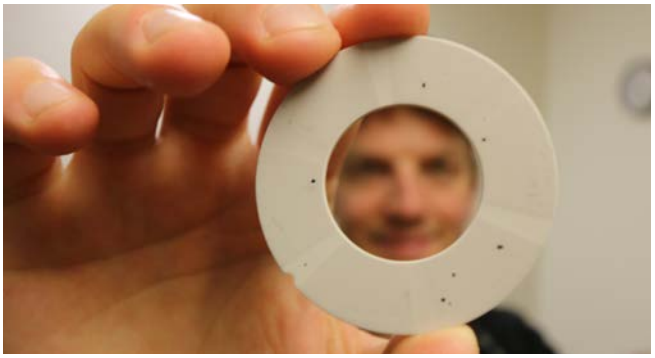
Hygge Power

Hygge Power offers reliable energy through its in-home network of small storage devices. Hygge Power's 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. Hygge Power successfully secured their first patent, hired a new and experienced CTO, established key manufacturing partnerships, and made significant device and app improvements in 2021.

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. 2021 brought many exciting developments for Microgrid Labs, including a seed funding round, five new full-time employees, the advancement of numerous major projects with even more inked, and the establishment of multiple strategic partnerships.

Resonant Link



Resonant Link powers EV fleets while they work by charging wirelessly during short stops that already exist during operation. In addition to joining GCxN in 2021, the company grew from 3 to 17 employees, closed a seed round, landed several key customers, and kicked off two Department of Defense grants.

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. 2021 was an exciting year for Span, which secured key partnerships including with the residential solar provider Sunrun, as well as Green Mountain Power and Green Home Systems, in addition to an integration with Amazon's Alexa. The company also celebrated a $20M funding round, unveiled a new EV charging system, and gained exposure in media outlets such as TechCrunch, Wired, and Forbes.

Versogen

Versogen develops 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 hydro-gen-generating solution will substantially reduce industrial carbon emissions and lay the foundation for a sustainable energy future. In 2021, Versogen secured two major grants, including one from DOE's SBIR program, and hired two full-time engineers.

Technical Achievements

Feasible Inc.'s non-invasive battery inspection technology, based on ultrasound and data analytics, demonstrated it is a valuable tool for process improvements and optimization during cell manu-facturing—the estimated value of which is $14/kwh at-scale. Insight provided by acoustics also determines cell distributions with higher sensitivity than current state-of-the-art methods both during cell manufacturing and for tracking the individual cells' state of health during operation.

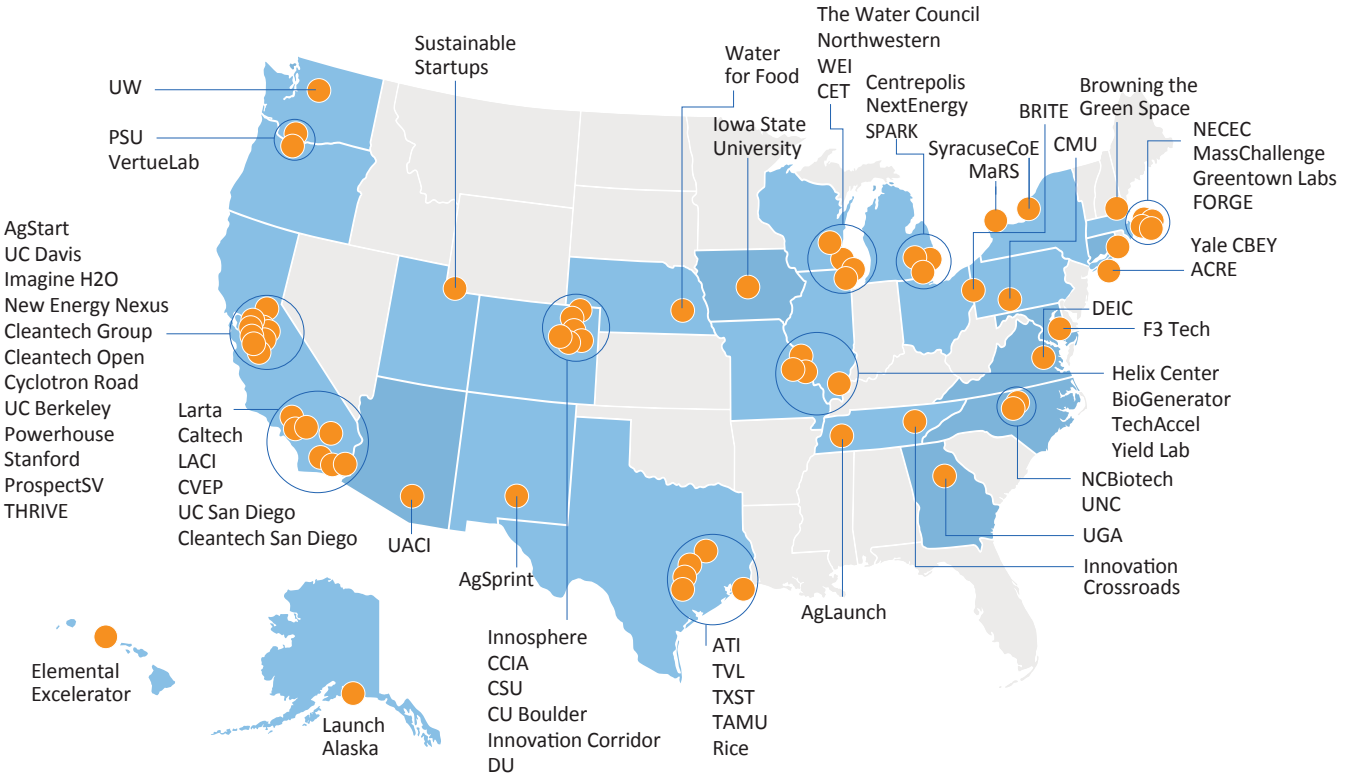
Icarus RT enhanced their engineering analysis and simulation models with NREL's models to design Icarus' next-generation photovoltaic-thermal (PV/T) collector and to optimize Icarus' Quartet System thermal storage control strategies considering time-of-use electricity rates.

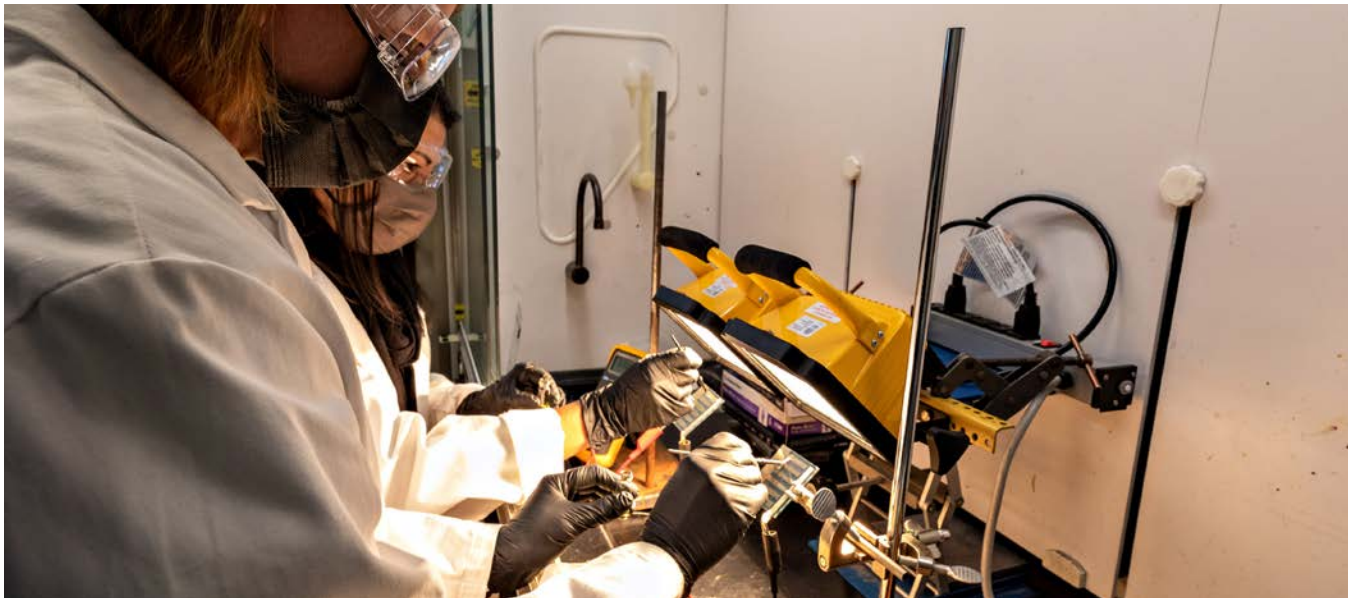
Ionomr membrane electrode assemblies demonstrated greater than 1 A cm-2 at 2 V in a supporting, hydroxide electrolyte with a non-precious metal anode. Performance losses were not found following greater than 500 h of operation.

Look ahead: In 2021, GCxN selected its fifth cohort of startups focused on two distinct themes, industrial electrification and e-mobility. Selected companies for the industrial electrification theme focus on reducing scope 1 emissions through novel technologies that electrify industrial processes such as heating and chemical conversion. Our selected e-mobility startups focus on improving the efficiency of electric vehicle charging at the charger level and within charging hubs. Stay tuned to our 2022 end-of-year report to learn more about cohort 5's achievements.

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 Channel Partners. These partners represent the leading edge in academia, research, and industry, each providing unique insights into cleantech.





GCxN Steering Committee

Marwa Al-Ansary
Shell General Manager
Long Range Research

Richard Adams
NREL Director Innovation and
Entrepreneurship Center (2021)

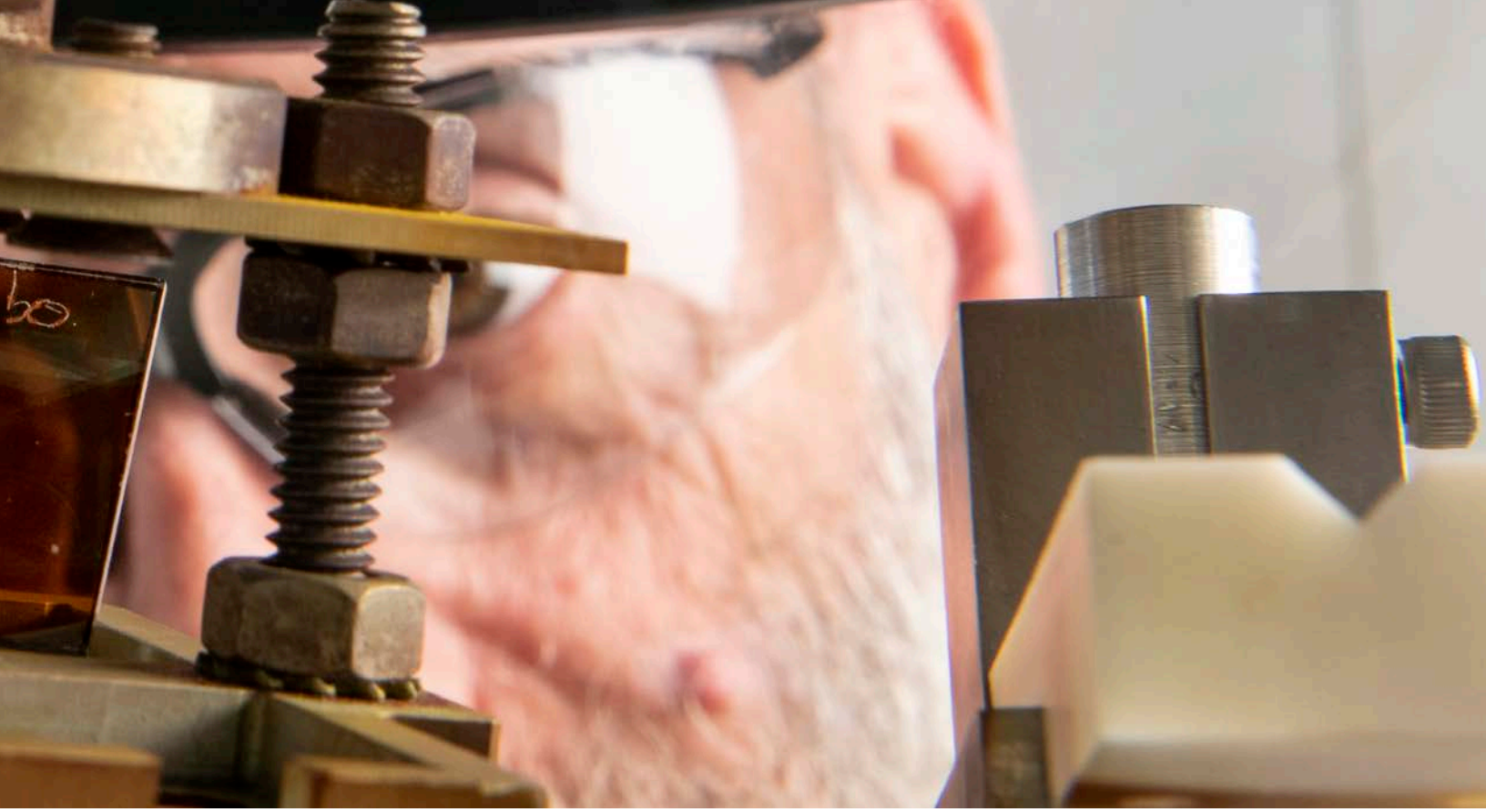
Akilah LeBlanc
Shell General Manager
Commercial Innovation
Partnerships

"The GCxN program was critical in advancing funding and partnership expansion activities over the first year of the program, by providing highly credible third-party validation of Ionomr materials and claims. The quality of the expertise at NREL is unparalleled and has set the strongest possible baseline to advance pilot activities with Shell and other customers in both green hydrogen production by water electrolysis, and green fuel synthesis from carbon dioxide."

— Ionomr

"It's a great pleasure to work with Span and their technologies, under the GCxN program. Coming from a startup background myself, I have thoroughly enjoyed this GCxN project—it gave me the chance to help with Span's exciting journey and experience their business expansion from close quarters. Within the scope of this project, Span integrated proprietary technology with NREL's grid simulation capabilities in a plug-n-play manner. The project also brings in grid perspective for Span's product deployment, thanks to our utility advisor, Hawaiian Electric Company. Our aim was to help Span understand how their smart load controls would benefit consumers, as well as provide grid benefits. This project widens our understanding of taking emerging technologies to market and helping with their adoption among end users."

— Shibani Ghosh
NREL



> "GCxN provides a truly unique environment for entrepreneurs to tackle tactical proof-of-concept challenges while supported by deep and broad technical expertise from NREL. As an industrial researcher working for more than a decade to accelerate decarbonization through electrification, this powerful combination is inspiring and has yielded results and insights beyond my expectations and previous experiences."
>
> — Elizabeth Endler.
> *Shell*

> "AllCell technical and commercial accomplishments propelled to greater heights with the help of the NREL and Shell technical and commercial teams, as part of the GCxN project. These accomplishments include submission of new, revolutionary intellectual property, implementation of new products for our customers, publication and presentation in many technical peer-review articles and conferences, the addition of many high-value customers, which led to a record sales year in 2021. We are thankful to the NREL and Shell teams for their involvement throughout our GCxN project!"
>
> — AllCell Technologies

Engage with Us

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February 2022

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A Global Energy GameChanger

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