

ANNUAL REPORT
2020



IN²: Catalyst to Success



Founded by: **WELLS FARGO** | **ONREL**



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From the Directors

Gaps. Valleys. Holes. These are the difficult stretches of any trek ... and this is where we love to hang out. It is where philanthropic capital and a national lab can provide a springboard for cleantech startups on their paths to market. And 2020 represented one of the most important and critical times in recent history to stand in this gap, to fill the voids. With environmental crises and a worldwide pandemic compounding the already challenging economics faced by startups, the Wells Fargo Innovation Incubator (IN²) was well positioned to answer the call.

Beginning in the spring of 2020, IN² stepped in to provide nearly a million dollars in grants to startups and their support systems that were struggling due to COVID-19. We delivered the grants through our Channel Partners—a nationwide network of incubators, accelerators, and universities. And we didn't stop there. Despite the pandemic, we kept our IN² projects rolling at the labs, onboarded six more companies into the program, and opened referrals into two more technology incubation rounds.

The journey to the marketplace isn't made in one giant leap, nor can it be attributed to the work of a single group or individual. It takes years of leveraging grants, investments, mentoring, and pilot demonstrations. IN² has been at it since 2014. Now 46 world-class technical incubation projects later, we're proud to be recognized as a crucial steppingstone on the path to market and as a catalyst for our alumni companies' successes.

In 2020, we delighted in watching three of our IN² companies secure acquisitions: 7AC by Emerson, Geli by Q-Cells, and STRATIS by RealPage. And we are most excited about what this really means—that the world will now experience a new approach to air conditioning technology, delivering extreme energy savings and the ability to maximize climate-friendly refrigerants; that industries can manage microgrids

and energy storage in a way that maximizes renewable distributed energy sources; and that families and students living in multi-family units can have more control and reap the savings of their decreased energy use, while reducing waste. This is why we do what we do.

The success of our program indicates it's time to work harder, not slow down. To that end, this year the Wells Fargo Foundation announced \$20 million more for IN² to carry the program forward for several more years. With this commitment, we stand ready to bring in more partners and double the number of companies we assist. We don't just want to contribute to the success of cleantech startups, we must. And we can't do it alone. We ask you to join us in supporting promising startups on their paths to commercialization by providing demonstration opportunities, financing additional projects, or supporting the incubation programs that are building an innovation pipeline across the nation. Together we can serve as a catalyst to address the climate crisis by delivering economically viable and environmentally transformative products to market.



Richard Adams
*Director, Innovation
& Entrepreneurship
Center, NREL*



Mary Wenzel
*Executive Vice President,
Head of Sustainability
and Corporate
Responsibility, Wells Fargo*



“

I look to IN² for what I should be thinking about next. IN² always hits the target on everything from new technology areas to current events. It's very valuable.”

– **Stephanie Yanchinski,**

Executive Director, Caltech Rocket Fund

The What and Why of IN²

The Wells Fargo Innovation Incubator (IN²) is a \$50 million collaboration between the Wells Fargo Foundation and the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL) that provides technical assistance and validation to promising cleantech startups. The goal of the technology incubator is to speed to market innovative and sustainable technologies. Currently, we are working in the built-environment and agriculture sectors, and we have room to expand.

Founded in 2014, IN² has supported 46 companies that have each received up to \$250,000 in non-dilutive funding. The funding is used to engage the world-class talent and facilities at NREL and the Donald Danforth Plant Science Center. Each company is matched with a lead researcher who is expert in the technology area and uses a team of relevant researchers, labs, and equipment to support a collaborative technical assistance project.

Technical Assistance and Validation: NREL and the Danforth Center

The access to resources at two of the nation's most highly regarded research facilities sets IN² apart.

The commercial buildings and affordable housing research takes place at NREL in Golden, Colorado. As a national laboratory, NREL is a global leader in advancing the science and engineering of energy efficiency, sustainable transportation, and renewable power technologies and provides the knowledge to integrate and optimize energy systems. Our companies not only receive expert guidance from researchers at the lab, but also the benefit of multi-million dollar user facilities.

Research with our agtech startups takes place at the Donald Danforth Plant Science Center in St. Louis, Missouri. The Danforth Center is the world's largest independent plant science institute. The nonprofit research institute was founded in 1998 to improve the human condition through plant science. The Danforth Center has 26 scientific teams; \$248 million in competitive research funding from government agencies, industry, and foundations; and a greenhouse complex that provides 54,130 square feet of active growing space.

Impact on the Market

It's a model that works. Our numbers speak to our success.

46

portfolio companies

\$410M

external funding
received after joining IN²

33:1

For every \$1 invested by IN², portfolio companies go on to raise more than \$33.

73%

employment growth for
the IN² portfolio of companies

9

mergers & acquisitions

Building an Ecosystem of Support

More than an incubator, IN² fosters an ecosystem of support and expertise. The IN² Channel Partner network includes more than 60 incubators, accelerators, and universities that refer companies to the program and provide mentorship and connection. IN² relies on the Wells Fargo Board of Directors to participate in the selection of companies and for business expertise and guidance.

Playing a key role, two external advisory boards, the Commercial Buildings and Housing Board and the Food, Energy, Water Nexus Board, provide advice on the direction of IN² and make the final selection of participating companies.

A 2020 SUCCESS STORY

Turntide Technologies

Significant energy efficiency gains can be found right under our noses, within the systems that are so ingrained in our modern lives that we take them for granted. For instance, electric motors account for more than half of the world's electricity consumption, yet have seen very few technological advancements over the past century. Electric motors provide the mechanical power that pumps, conveyor belts, HVAC systems, fans, compressors, and many other critical machines require.



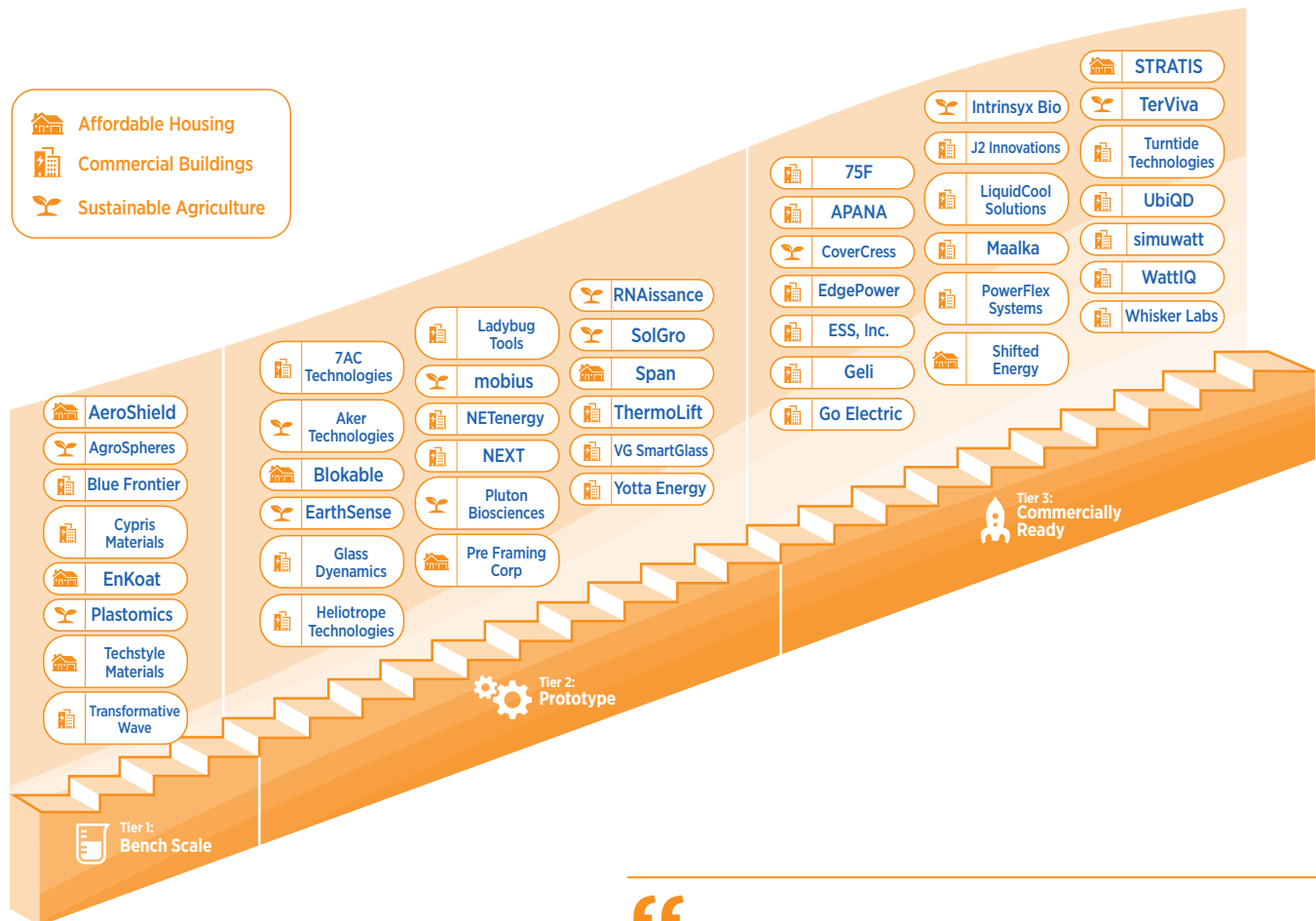
The Turntide Technologies (formerly Software Motor Company) team has remained dedicated to addressing this significant global energy challenge since its founding in 2013, and since it was selected to participate in the IN² program's third cohort in 2017. The company's Smart Motor System pairs an upgraded switched-reluctance motor design with IoT building automation software to optimize and reduce energy consumption and maintenance needs while providing immediate savings for customers.

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IN²: The Catalyst to Success

Traditionally, 90% of startups fail. Not so with IN² portfolio companies. One hundred percent of IN²'s selected companies are active today; most are thriving. IN²'s work derisked investment in those companies and helped propel them along their paths to commercialization. We aim to act as a catalyst to each startup's success.

A majority of our companies enter the program at the bench scale or prototype stage, and more than 55% exit the program commercially ready.



All our portfolio companies make progress within a tier, or from one tier to another. With the technical assistance and validation of the labs, and the prestige associated with that validation, IN² companies are propelled along the path to commercial viability. And when our technologies hit the market, real social and environmental impacts are achieved.

“

IN² came at a critical time for the company. We had a proven core technology but needed a launching pad to get recognition in the space. IN² readily accelerated Yotta Energy as a company, took it from bench scale and provided a great validation point. Testing at NREL opened a lot of doors to financial introductions, forums, commercial partners, pilot opportunities, and press.”

— Sean Walters

Director of Business Development, Yotta Energy

Our Ecosystem

More than an incubator, the IN² program fosters an entire ecosystem of support for our portfolio companies. We have a network of Channel Partners and industry experts that provide the companies and the program with expert advice, market knowledge, and key connections.

Channel Partners

Our Channel Partner network consists of more than 60 accelerators, incubators, and universities that refer companies to the IN² program and provide mentoring and advice along the way. In 2016, we launched the \$5 million Channel Partner Award program to support events, strategic meetings and trainings, and large collaborative initiatives between the Channel Partners. We expanded the program in 2020 and will deliver an additional \$5 million in Channel Partner Awards through 2024.

Channel Partner Awards 2020

In March 2020, we awarded eight Channel Partner awards worth a total of \$950,000 for Channel Partners that are participating in a wide range of activities—serving emerging Midwest and Mid-Atlantic cleantech markets; supporting educational programs for student entrepreneurs; providing pathways, networks, and guidance for high-wealth individuals considering cleantech investing; and more.

In May 2020, we accelerated our Channel Partner award schedule to provide \$900,000 in pandemic relief to Channel Partners and their portfolio companies. Eighteen projects received funding to help retain staff and stay on the path to commercialization.

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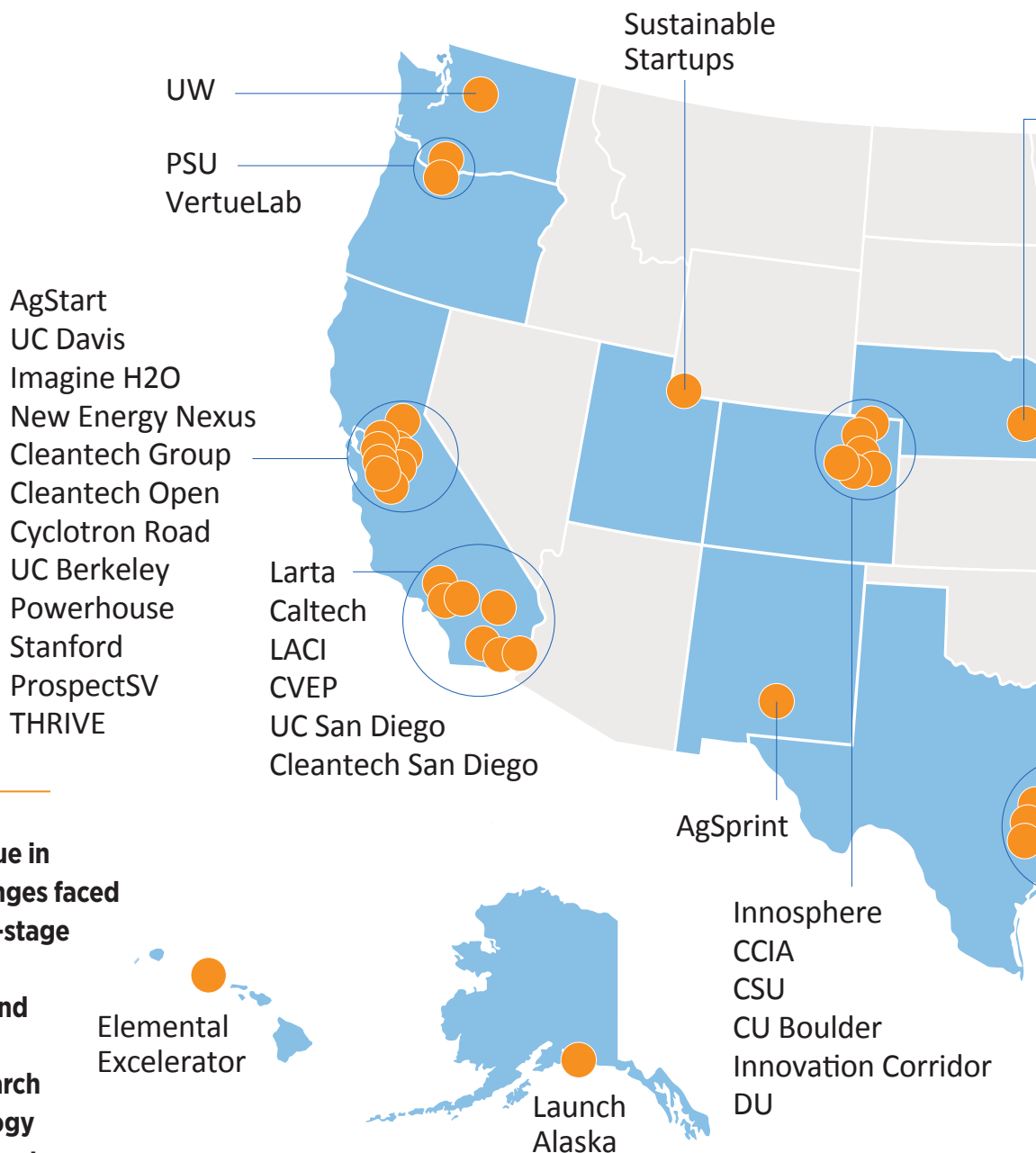
Through the IN² program, NREL researchers helped Turntide Technologies validate the energy efficiency and performance of its Smart Motor System under various operational scenarios while identifying performance gaps in traditional systems.

Turntide Technologies' rebrand from Software Motor Corporation was just one of the cleantech startups' many developments in 2020. Turntide has captured the attention of major investors with its ability to cut electricity consumption by two-thirds and serve significant market needs. It was selected as one of the first five companies to receive funding from the Amazon Climate Pledge Fund, and the Smart Motor System is now being used in Amazon facilities, retailers, and commercial buildings worldwide. Turntide also raised a \$25 million Series B funding round from BMW i Ventures, and the automaker is piloting Turntide Technologies in its manufacturing plants. The startup also received additional backing from Future Shape, with high praise from its principal Tony Fadell, the Founder of Nest. In 2020, Turntide expanded its customer footprint by 12x, and has successfully completed national packaged rooftop unit (RTU) retrofit projects for various retail customers at more than 2,000 sites.

Turntide has also been partnering with dairy technology company VES to deploy DairyBOS, the Dairy Barn Operating System, to automatically manage ventilation, cooling, lighting, and other parameters, optimizing the comfort and health of farmworkers and animals. This tool will provide proof of concept for other building types and applications in the future.

These achievements are even more remarkable when you consider the 2020 economic landscape. As much of the world paused in March due to COVID-19, many Turntide installations went on hold. But within a few months many businesses reopened and demand for its systems increased alongside the growing need for better ventilation systems. 2020 also brought renewed attention to the climate crisis, which is spurring greater demand for solutions that help companies cost-effectively reduce their carbon footprints. Looking ahead, the Turntide Technologies team will focus on fulfilling the growing needs of new and existing customers across different industries and building types.

IN² Channel Partners



“The IN² program is unique in addressing gaps/challenges faced by science-based, early-stage ventures in the sectors of energy, agriculture, and housing. The program provides access to research facilities, deep-technology experts, and seed funding to launch the companies towards commercialization success ... Partnership with the IN² program and Wells Fargo Foundation has been great for us!”

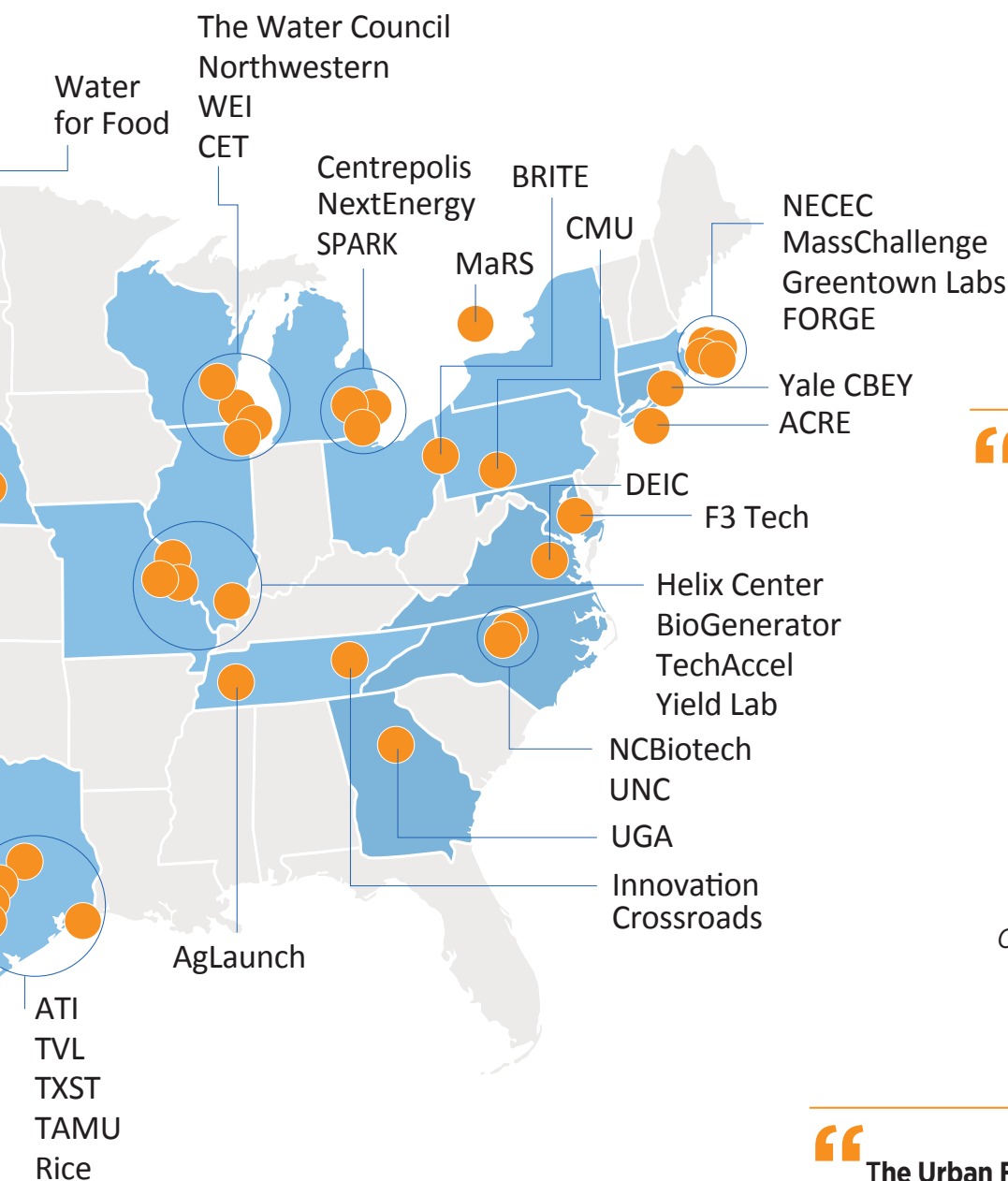
– **Bandhana Katoch**

*Director, Sustainability Practice
Larta Institute
Los Angeles, CA*

“The IN² program was instrumental in the impact that BRITE has had on our community and the State of Ohio’s energy sector growth. Sharing best practices amongst the top cleantech accelerators and incubators has elevated everyone and the access for our companies to the network has been a gamechanger.”

– **Rick Stockburger**

*CEO, BRITE Energy Innovators
Warren, Ohio*



“IN² is a great partner and an excellent resource in the early-stage clean energy ecosystem—both by providing programming for startups directly and by helping to support other entities in the ecosystem who are working to advance clean energy startups.”

— Ian Adams

*Clean Energy Trust Managing Director
Chicago, IL*

“From a national network-building perspective, working with IN² has been one of the most beneficial engagements for us. We’ve connected with investors for our start-ups, partners for programming opportunities, experts from the national lab, and leaders from across the country who are equally driven to accelerate energy and cleantech commercialization.”

— Anna J. Siefken

*Executive Director
Wilton E. Scott Institute for Energy
Innovation at Carnegie Mellon University
Pittsburgh, PA*

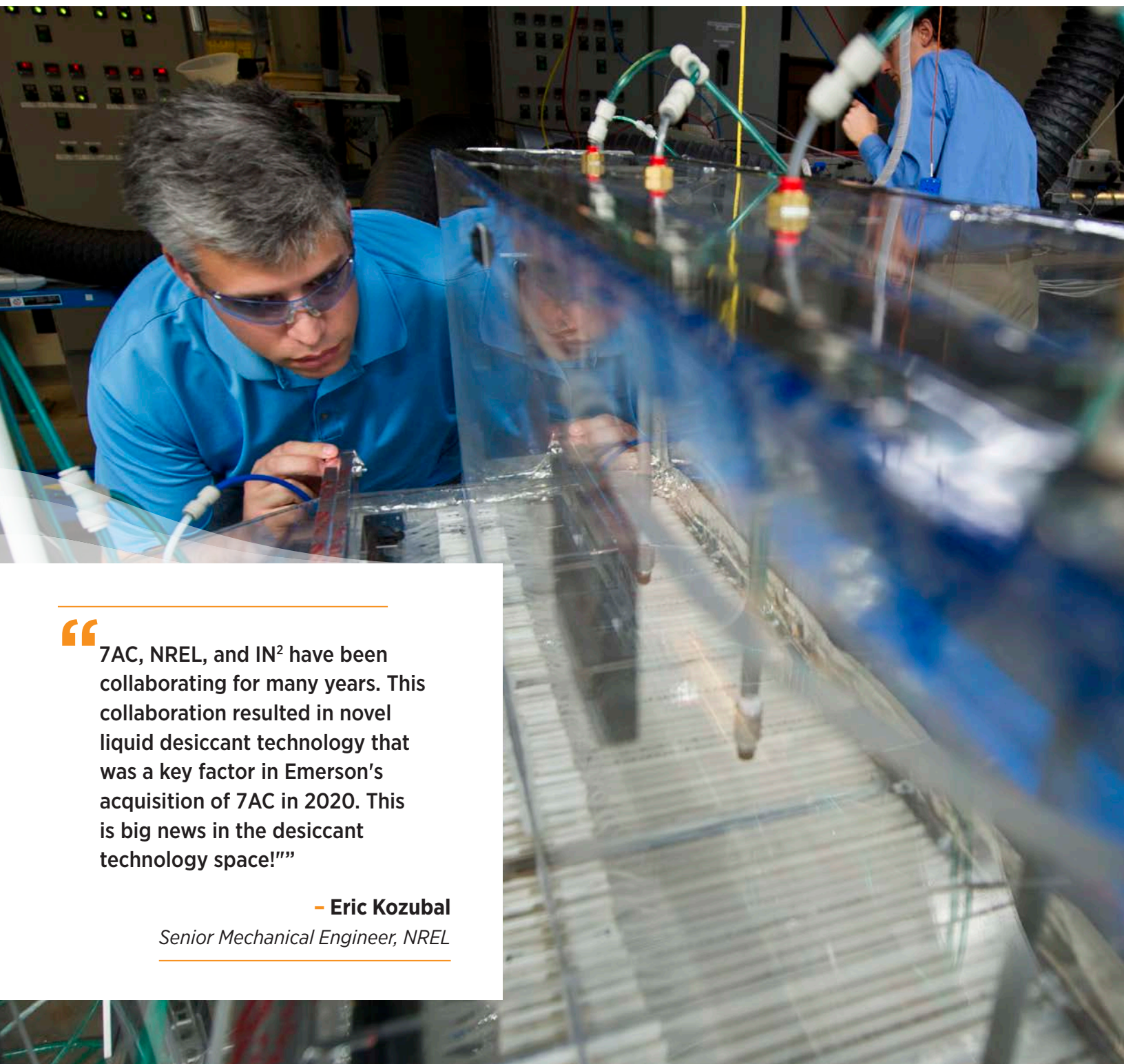
“The Urban Future Lab has enjoyed a terrific relationship with the IN² program. Our companies have engaged in very valuable collaborations with NREL through this program. We’ve received funding that helps us to help our companies.”

— Pat Sapinsley

*Managing Director, Cleantech Initiatives
Brooklyn, NY*

Our Portfolio

Startup companies selected to IN² are chosen because they have a high probability of making a real impact on the cleantech or agtech market. They are providing viable solutions in affordable housing, commercial buildings, and sustainable agriculture.



“7AC, NREL, and IN² have been collaborating for many years. This collaboration resulted in novel liquid desiccant technology that was a key factor in Emerson’s acquisition of 7AC in 2020. This is big news in the desiccant technology space!”

— **Eric Kozubal**

Senior Mechanical Engineer, NREL

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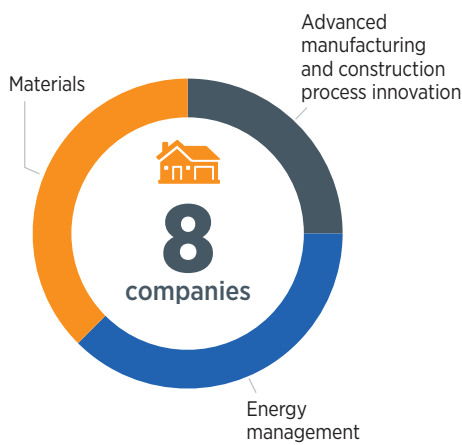
Because we've worked with NREL, we can say we meet performance criteria. We've got the data, we know the data, and we can provide it to regulatory agencies.”

— Aaron Holm

Co-CEO, Blokable



Affordable Housing



Residential buildings consume 21% of the nation's energy. And no state or metropolitan area in the United States has enough affordable rental inventory to meet the existing demand for its lowest income residents. IN² companies are addressing both these challenges with innovative technologies.



Affordable Housing

Our portfolio companies are designing systems that bring cost-effective energy efficiency to residences at all market levels. By including innovative construction processes and advanced materials, our portfolio companies are building in quality and cost savings from the ground up.



AeroShield manufactures a super-insulating, nanoporous form of glass for energy efficient windows. NREL is conducting lab material characterization and durability analyses of the AeroShield material; modeling whole-building energy to quantify the predicted savings on building energy use and cost; and conducting a technoeconomic analysis to help the company apply its resources strategically.



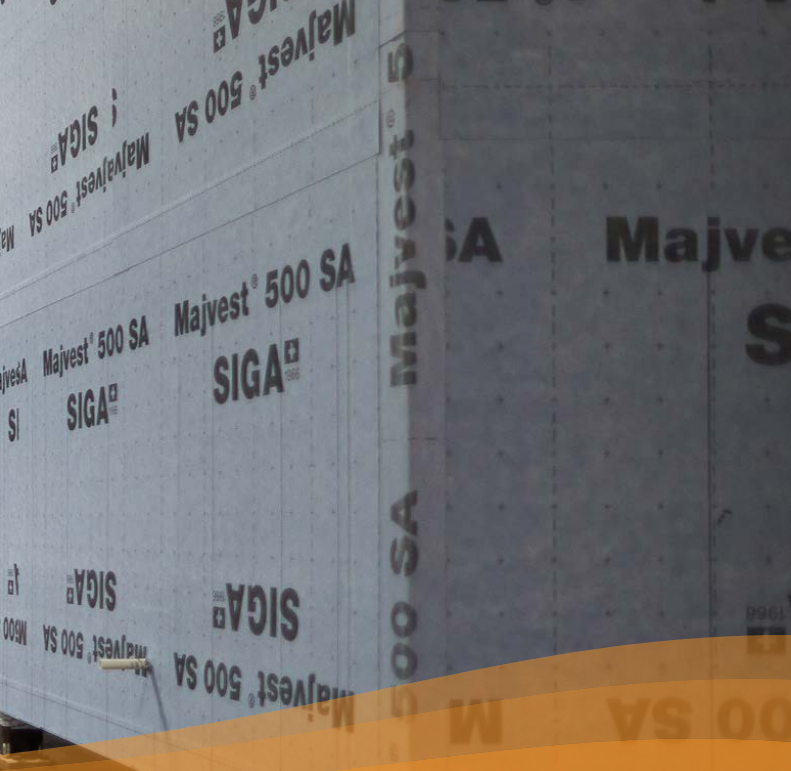
Blokable's Building System is a comprehensive building system designed, engineered, and manufactured to consistently produce high-quality, low-cost, connected housing. Blokable is working with NREL to design, develop, and implement testing processes to validate its building performance as part of its per unit manufacturing process, and to validate the materials waste and energy consumption of its building process compared to traditional site-built construction.



EnKoat has re-engineered traditional architectural coatings, like paint, plaster, and stucco, into energy-saving coatings by incorporating phase change materials. NREL is predicting energy efficiency with modeling and optimization tools; conducting material system performance optimization and verification; and working with EnKoat on the development of a stakeholder engagement and market transformation plan.



Pre Framing Corp is an innovative, partially prefabricated solution that allows homebuilders, general contractors, and framers to build standard and gable walls faster with less waste and more precision than traditional methods. Pre Framing is working with NREL to produce a digital twin of its factory equipment, develop a CAD plug-in for architects and engineers to plan construction processes with this information, and explore 3D visualization as a workforce training tool for energy-efficient advanced framing techniques and pre-insulated wooden studs.



SHIFTED ENERGY

Shifted Energy developed a power controller and accompanying software that converts existing electric water heaters into intelligent, grid-interactive water heaters. NREL is providing technical assistance with the controller's forecasting algorithm and performing lab validation of their algorithms using actual water heaters.

SPAN

Span is reinventing and redesigning the in-home electrical panel. Its goal is to make it easy and inexpensive to integrate renewable energy sources into the average electrical panel. Span is looking to NREL to evaluate the panel in the lab's smart-home simulation system and to characterize the potential value of the panel for effective grid operations/management.

COMMERCIALLY READY

Blokable

Technology innovation can impact markets in big ways. But often, those impacts are only obvious to industry insiders who are focused on important, but incremental change. Not so with IN² portfolio company Blokable. In 2020, this housing developer and creator of building systems provided actual, tangible affordable housing to a dozen people ... and it's just the beginning.

In December 2020, Blokable completed its Phoenix Rising housing development in Auburn, Washington. The project features Blokable's vertically integrated development and building system in which energy efficiency, quality, and livability are integrated into every stage of housing development, construction, and ownership. It's a multi-layered approach that co-founders Aaron Holm and Nelson Del Rio think will fill the ever-increasing gap between people who need housing and people who can afford it.

The Phoenix Rising development includes five studio and seven one-bedroom apartments. The homes are designed for residents who earn 30% of the area median income, are all-electric, and are estimated to be 60% more energy efficient than comparable housing. The development was built in partnership with the state of Washington and financed by Blokable and other private investors.

A Housing System

"From the beginning, we were not motivated to create a nifty product," Holm says. "We were addressing the core structural issues in the housing market."

Holm explains that he and Del Rio, who met in 2015 after starting and selling companies on their own, decided to address housing efficiency by providing a new paradigm to the entire industry.

"Our vertically integrated modular system combines all the aspects of development—land acquisition, product development, manufacturing, and ownership. We believe we need to get rid of the fragmentation and the project-by-project nature of the housing industry."

It's a lofty goal. The Blokable system is designed to meet the most stringent building codes and standards. The company achieves financial goals by attracting investors for both market rate and affordable development, and forming public-private partnerships that reduce the need for public subsidies for affordable housing. Most important, Blokable is committed to providing high-quality, safe, and comfortable housing—almost completely assembled in a factory and delivered to a site by flat-bed truck and crane.

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STRATIS

STRATIS IoT's platform provides smart access, energy, water, and automation management for multifamily and student housing. With NREL's assistance, STRATIS is exploring use cases and design requirements to implement an Open Automatic Demand Response program, which allows consumers to shift or reduce their electric usage during peak demand periods in response to incentives provided by the grid. STRATIS was acquired by Real Page in 2020.



Techstyle Materials is developing a multifunctional building material that automatically regulates the flows of heat and water vapor through surfaces. In evaluating Techstyle Materials' heat- and water vapor-regulating building material, NREL is producing component-level and detailed multiphysics models to predict thermal and hygric performance. Using the thermal and hygric performance parameters, NREL is conducting whole-building modeling to estimate impacts at the building level.

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The Blok at NREL

At the core of the building system is the Blok. That's where IN² comes in. The National Renewable Laboratory (NREL) and IN² are compiling energy data and validating the efficiencies Blokable is working to achieve with its prefabricated construction. The team recently installed a Blok on NREL's Golden, Colorado, campus.

"We are working with IN² to evaluate energy efficiency at multiple stages in the construction process, so we know the full life cycle of energy use," Holm says. He explains that includes waste reduction in manufacturing and along the whole life cycle.

"NREL's work is important. We want qualified and reliable data gathering and evaluation. That's how we'll move the industry to a more performance-based and entire-systems approach, rather than only looking at single products."

The goals are in close alignment with NREL's own.

"NREL's mission is a clean energy future and this is a great opportunity for us to work with the people building housing so we can integrate clean technologies to bring us to a zero-energy housing market," says Stacey Rothgeb, the senior engineer who is leading the Blokable project at NREL.

"Additionally, being all-electric, these units are supporting our clean energy grid of the future. We like to see buildings becoming enablers of renewable energy and a more dynamic energy system."

The close association between lower, more predictable energy bills and affordability is also of importance to the NREL team, as is working on a project where quality housing can be built quickly.

And the Blokable team says the very tight energy envelope of the Blokable units are providing a test bed for more efficient heating and cooling systems. That is work well-suited to the Blok on NREL's campus, and researchers are setting up those projects, now.

Next up for Blokable: They'll be watching the Phoenix Rising data closely, comparing it with the data from conventional buildings on the same site, Holm says.

"This is really important to us and to NREL. We're connecting the dots between energy efficiency and housing affordability."

Learn more at: [blokable.com](https://www.blokable.com).

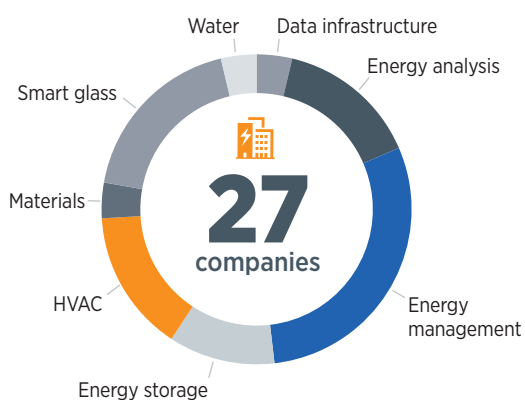
“Working with NREL and IN² has been excellent. NREL really helped shape how we would go about measuring things and challenged us to find opportunities to optimize. The team was very creative in determining places to deploy devices and measure new things.”

— Mark Madsen

President and CTO, WattIQ



Commercial Buildings



Commercial buildings consume 19% of the nation's energy.



Commercial Buildings



75F offers an easy-to-setup heating, ventilation, and air conditioning building management system (BMS) with the potential to cut install time and costs up to 80% compared to traditional control systems. NREL is providing third-party validation of the energy savings estimated by 75F's BMS platform by using building energy modeling and technoeconomic analysis to provide estimated energy and monetary savings based on various factors, such as climate and building type. NREL also validated the savings estimated for a "pandemic mode" sequence of controls, providing a timely response to building owner and operator COVID-related concerns.



Blue Frontier is a pre-revenue cleantech startup, founded to commercialize the innovative integration of low-cost thermochemical energy storage with a revolutionary air conditioning technology. In order to maximize the efficiency of the Blue Frontier A/C technology, NREL is assessing materials (alloys, desiccants, and others), performing bench-scale experiments on components (air turbulator, membrane, desiccant), performing sub-system modeling, and offering design assistance from the project's findings.



Cypris Materials creates paintable heat-reflective coatings as a roofing retrofit for both residential and commercial buildings to reduce cooling loads. NREL is examining the material characteristics of its paintable, heat-reflective coating using a thermal model. Researchers will then translate the most applicable thermal model into a whole-building energy model and then use ResStock to estimate the technology's potential impact at a national scale. The project will also include an exploration of the material's savings potential as a vehicle surface coating.



Ladybug Tools is a collection of computer applications that supports the design process for sustainable buildings and net-zero districts seeking to employ cutting-edge energy technologies. NREL helped Ladybug Tools improve key back-end features of the OpenStudio energy modeling software development kit. These improvements have allowed Ladybug's JSON schema to support energy modeling in OpenStudio, including running models using Cloud services, strengthening results by introducing error checking features, and developing custom data output formats.



Next Energy Technologies (NEXT) offers low-cost, printable, transparent energy-harvesting coatings that are seamlessly integrated into windows to provide onsite renewable power. NREL is working with NEXT to identify potential energy savings and generation in commercial buildings and to characterize balance of systems costs.



Turntide Technologies (formerly Software Motor Company) is developing a reliable, efficient, and intelligent motor system that works in concert with IoT building automation technology. The system is less expensive to own and operate than its conventional alternative. NREL is currently conducting follow-on work with Turntide Technologies to validate the energy savings of the unique control algorithms for its intelligent motor system and maximize energy savings based on climate and building type.



UbiQD is producing nanomaterials for energy harvesting that provide a simple, scalable, low-cost, and aesthetically pleasing approach to solar windows. NREL is conducting durability assessments of UbiQD's prototype devices using an appropriate industry standard for window technologies, as well as relevant standards from the photovoltaics industry. NREL is also conducting varied materials characterization studies related to fundamental properties of UbiQD quantum dots and Luminescent Solar Concentrator devices.



Yotta Energy is developing modular energy storage integrated with solar, designed to reduce cost and expand development of energy storage and grid resiliency on commercial buildings. NREL is characterizing the technology performance of two Yotta Energy prototype units as compared to a baseline unit, first in a laboratory environmental chamber, subjected to a range of ambient conditions, and then potentially in an outdoor installation.

A BENCH SCALE SUCCESS

AeroShield

"We tried that already and it didn't work."

Those were the words that AeroShield CEO Elise Strobach heard from the glass industry when she described her new material for windows.

Few could believe Strobach had found a way to make hyper-efficient windows with silica aerogel—one of the best insulators on Earth.

The technology had existed in theory for decades, offering the promise of increasing efficiency by a whopping 50%. But until this year, the products that had reached the market in the past were simply too hazy, too cloudy to be commercially successful windows.

Strobach had figured out how to make clear aerogel. Now she just needed a way to prove it.



Silica Aerogel: The Holy Grail

The story of AeroShield begins during Strobach's graduate work at the Massachusetts Institute of Technology, where she first started working with silica aerogel. This is a material so transparent and super-insulating that it's described as the "holy grail" for windows.

She started experimenting with its nanostructure, and over the course of several years, hit on a way to make it more transparent glass, itself.

This was big. Standard single-pane windows are a primary source of energy leaks in a building—places where heat moves in and out of a structure, reducing efficiency and making the HVAC system work harder.

By replacing these windows with more efficient ones, a building owner can reduce energy use.

The promise of silica-aerogel windows is vast: a possible savings of thousands of dollars a year for building owners in North America.

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IN² Commercial Buildings Alumni

7AC Technologies

APANA

EdgePower

ESS Inc.

Geli

Glass Dynamics (formerly Polyceed)

Go Electric

Heliotrope Technologies

J2 Innovations

LiquidCool Solutions

Maalka

NETenergy

PowerFlex Systems

simuwatt

ThermoLift

Transformative Wave

VG SmartGlass

WattIQ (formerly Ibis Networks)

Whisker Labs

Continued from page 17

“Our innovations were also to the manufacturing process itself—we’re developing ways of producing these windows at scale,” said Strobach.

This spring, the AeroShield founders were out raising money and pounding the pavement with small, 2-by-5-inch samples of their insulated glass. But what they needed was proof that their material did what they said it could do. That’s where IN² came in.

Crystal Clear Results

As an IN² company in the Affordable Housing portfolio, AeroShield was paired up with an NREL senior researcher in nanostructured materials, Chaiwat Engtrakul. Strobach shipped out her samples to the NREL facility in Golden this summer, and waited to hear back as Engtrakul conducted analyses.

This fall, the AeroShield founders received good news.

“The optical quality of these samples is, quite frankly, amazing,” said Engtrakul, who has been working on dynamic windows for over a decade. “The majority of our work now is accelerated evaluation under controlled temperature and illumination, to see how the aerogel properties change over time.”

Engtrakul and his colleagues are also helping Strobach perfect a method for adhering the aerogel to the inside of the insulating glass unit.

They are on a tight timeline: Aeroshield plans to have first products for niche customers in the third quarter of 2021. As they finish up this year, NREL’s experts will also help develop the fledgling company’s go-to-market plan.

With energy startups, one of the most important questions is: Where should we sell this first? Energy prices, weather, and regulations are different in every county in the United States, so companies want to target locations where the savings will be the greatest for consumers.

To help answer that question, the modeling and optimization experts at NREL are using complex modeling software that can mimic the energy and cost savings for homeowners who install these windows.

Thanks to IN², AeroShield is able to see a clearer and clearer path to the future.

“With the IN² program, we were really looking for the third-party validation aspect—we don’t have certified testing procedures,” said Strobach. “And we were looking for the expertise as well. It really rounded out and enabled us to do our development effectively.”

Learn more at aeroshield.tech.

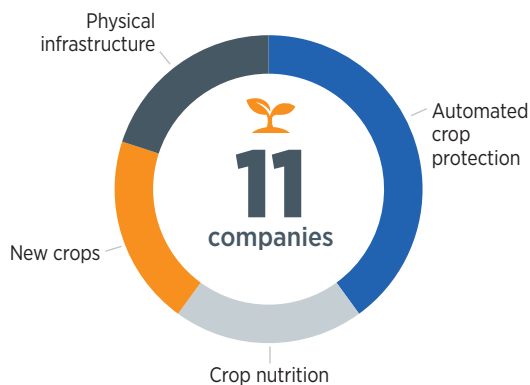
“

IN² positively impacted our ability to raise funds. It gave us exposure. We received a small business innovation research grant in part because of IN². It lends credibility. And IN² allowed us to go into studies we couldn't otherwise fund.”

— Cris Handel

Senior VP Marketing & Sustainability,
CoverCress


Sustainable Agriculture




The agriculture industry uses 14% of the world's energy and creates 24% of global greenhouse gas emissions.



Sustainable Agriculture

 **AgroSpheres** is developing biobased encapsulation and delivery technology to enhance the effectiveness of crop protection products against economically important fungal disease pests. This technology could reduce the amount of expensive biological compounds needed for crop protection. For AgroSphere's IN² project, the Donald Danforth Plant Science Center (Danforth Center) is testing delivery and mode of action of two types of active biological pesticides encapsulated in minicells: 1) double-stranded RNA and 2) peptides developed by the Danforth Center.

 **Aker Technologies'** TrueSense™ technology automates the crop-scouting process that captures and analyzes the presence and intensity of pests and pathogens below the crop canopy. As part of its 2020 field trials, the Danforth Center helped Aker with early validation of early detection of two bacterial pathogens based on digital imagery and analytical algorithms. Aker will continue building this state-of-the-art imaging method for disease detection, identifying additional disease signatures that can be incorporated into future generations of TrueSense™ for enhanced field scouting.



CoverCress has developed a crop from pennycress that covers soil between growing cycles, protecting it from harsh conditions while producing a low-carbon intensity crop for renewable fuel and cooking oil. To enable the development of different varieties of pennycress, through IN², the Danforth Center helped CoverCress shorten the breeding cycle of the crop by transient expression of floral pathway genes to accelerate flowering and has validated specific antifungal peptides whose genes will be incorporated into future generations of CoverCress varieties to provide effective fungal pathogen protection.



EarthSense is developing robots for autonomous and automated field data collection to improve accuracy and reduce labor and energy consumption in agriculture. The EarthSense IN² field trial project with the Danforth Center compared data being collected manually against its prototype robot in-field trials of corn varieties and provided further validation of analytical algorithms needed to extract meaningful biological patterns. Data collection focused on below canopy traits that cannot currently be observed in images taken above the canopy. The trait analysis algorithms will be used to provide R&D tools for more rapid crop breeding and field agronomy.



Intrinsix Bio plant probiotics increase crop yield, reduce excess fertilizer, and improve soil and water conditions. To work, the probiotics must successfully “colonize” a crop. Intrinsix's IN² project focused on better understanding how to entice plants to accept the probiotics and what varieties of crop respond positively to the probiotic microbes.



Mobius is developing renewable biodegradable polymers from food, forestry, and agricultural waste streams. The Danforth Center is testing the functions of these polymers to optimize the release of nitrogen containing compounds into the root-growing region of young plants. This will improve below-ground plant health and root growth in controlled environments.



Plastomics

Plastomics is developing a novel delivery technology to introduce beneficial traits into the chloroplast of plant cells, creating crops that can better withstand the pressure of insects, diseases, and weeds while delivering higher yields and environmental benefits. The IN² program will enable Plastomics to achieve more rapid and focused product development by partnering with Danforth investigators to evaluate the fundamental molecular mechanisms of novel chloroplast-expressed RNAi traits.

Pluton Biosciences

Pluton Biosciences is developing safe and effective pesticides from microbial sources for agriculture and human health. Pluton's IN² project with the Danforth Center is providing validation for its platform technology that mines populations of microbes to identify specific microbes that harbor compounds with beneficial pesticidal activities. The project is identifying the active pesticide molecule(s) capable of killing mosquitos that harbor Zika virus by sequentially fractionating and testing biological samples. This test case will accelerate the development of crop protection applications from other microbes. Candidate compounds in the anti-mosquito application may include proteins or other metabolites.

COMMERCIALLY READY

CoverCress

Cover crops have long offered huge promise for sustainability: They reduce soil erosion, prevent runoff, improve soil health, and sequester carbon.

But for farmers running a business, cover crops often don't pencil out. There is a cost to buy seeds, plant them, and in many cases terminate them. There is also labor and wear and tear on tractors and combines.

Enter CoverCress, an IN² cohort company based in St. Louis developing a solution to this challenge. Its target market: the American heartland, where most of the 30 million acres devoted to corn and soy often sit bare over the winter.



The Magic of Perfect Timing

CoverCress is developing a namesake crop, CoverCress, with the magical characteristic of perfect timing. It is sown right after corn is harvested in the fall, and finishes growing before soy is planted in the spring. (The corn-soy rotation is the dominant form of farming in the United States.)

For 30 million acres in the southern Midwest, currently there are no cover crops that fit between the corn and soybean rotations that are harvestable. This means there is no competition for this plant.

Valuable Plant Oils

Most importantly, the oil pressed from CoverCress seeds can be used to make biodiesel, jet fuel, meal for animal feed, and eventually food oil. So, farmers can make money selling it.

"We think there are so many opportunities with such a flexible product, and the research at Danforth (the Donald Danforth Plant Science Center) with IN² has been very important for us," said Cris Handel, CoverCress' Senior Vice President for Marketing and Sustainability.

But making this miracle crop is not an easy process—at all.

CoverCress doesn't occur in nature in its commercially viable form, but rather as pennycress, a weed that grows in roadside ditches in the Midwest.

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RNAissance Ag produces safe, effective, and environmentally sustainable insecticide for precision pest management. Its technology disrupts the internal microbiome (gut) of targeted insect pests. Through its IN² project, the Danforth Center has helped RNAissance Ag accelerate and validate its current methods for identifying and testing anti-insect RNAi products, focusing on fall armyworm and diamondback moth for its initial product development.



SolGro has created a nanoparticle film for greenhouse windows that converts the broad whole spectrum wavelength of sunlight into more efficient wavelengths that improve the process of photosynthesis. Its technology aims to help farmers increase crop productivity and improve the overall quality of their produce. Through IN², the Danforth Center has helped SolGro obtain data on how much its materials can improve plant growth and under what precise conditions.



TerViva is commercializing the oil seed, climate resilient tree legume, pongamia. Together TerViva and the Danforth Center are investigating root-to-shoot compatibility among TerViva's elite scion varieties and target root stock candidates. These rootstocks and the knowledge of grafting compatibility will enable TerViva to produce more resilient and cost-effective trees through the production processes of grafting, rooted cuttings, and micropropagation, and to accelerate scaleup of its production processes.

Continued from page 21

In order to give this plant more commercially desirable characteristics, the startup and its research partners at the Danforth Center have used the techniques of traditional plant breeding and genetic modification. Rebranded CoverCress, it's now more resistant to fungus, and easier to harvest.

Experts at the Danforth Center, Dilip Shah and Dmitri Nusinow, were able to make suggestions and come up with new possibilities that the company had not thought of themselves. They now have grown dozens of research generations of CoverCress, and counting.

Inventing an Infrastructure

Inventing a whole new production cycle has also been a massive undertaking.

"This is a very different type of startup," said Handel. "Usually, startups are focused on one product or service to start with. In our case, there was no infrastructure around this product. We had to figure out processing and distribution too."

The startup's goal is to make it as easy as possible for farmers to integrate CoverCress into their planting schedule.

Right now, it's planning on a closed-loop business model. The company will give farmers the seed for free, and then at the end of the growing cycle, be paid along with farmers when they deliver the harvested product.

IN², Handel says, has been a huge benefit. The application process was easy and straightforward, which made it easy on the small company. Startups don't have a dedicated staffer who can write grants all day, so the streamlined process and a helpful IN² team helped them save time on reporting.

For Handel and her team, the end results are in sight, and will be worth the journey.

"This is a plant that can protect your soil, add biodiversity in terms of microbes, and prevent nitrogen leaching into the groundwater and then into the Gulf of Mexico".

"There are all these environmental benefits – and then this plant will also increase farmer revenue. If you are using the oil for fuel, your fuel will have a low carbon-intensity score. It's fantastic."

The company is currently recruiting farmers in the Midwest for its first pilot plantings, and is on schedule to have 3-5 million acres under cultivation by 2030.

Learn more at CoverCress.com.

Advisory Boards

External Advisory Boards

The External Advisory Boards ultimately determine the companies accepted into each cohort. They provide insights and expertise in sector trends, challenges, and opportunities and technical understanding of the technologies, both traditional and emerging. Our two boards have expertise in either 1) the commercial and residential built environment or 2) agriculture and the food, energy, water nexus.

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*VP, Energy and Facilities
Maintenance, Walmart*

Food, Energy, Water Nexus



Nicholas Brozović

*Director of Policy,
Daugherty Water for
Food Global Institute*



Christine Daugherty

*VP Sustainable
Agriculture and
Responsible Sourcing,
PepsiCo*



Vonnie Estes

*VP of Technology,
Produce Marketing
Association*



Chad Frischmann

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Scott Fullen

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Corteva Agriscience*



David Russell

*Venture Partner, Lewis
and Clark Ventures*



Mulumebet Worku

*Professor of Animal
Sciences, University of
North Carolina A&T*

“

The IN² program is like no other program I have worked on. It is a pleasure working with companies bringing critical technology to agriculture with funding, mentorship, and the power and resources of the Danforth Plant Science Center.”

– **Vonnie Estes**

*VP of Technology,
Produce Marketing Association*



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The Wells Fargo Board of Directors is comprised of executives and senior managers from Wells Fargo, representing more than a dozen lines of business, who guide the strategic direction of the program. Board members provide applicant feedback as well as subject-matter expertise related to commercial and residential buildings, diversity, sustainability, agtech, cleantech, finance, law, supply chain management, government relations, and more.

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Team

The program management team at Wells Fargo, the National Renewable Energy Laboratory, and the Donald Danforth Plant Science Center work together to grow the IN² ecosystem and to help our cleantech and agtech companies realize success.



Trish Cozart
Program Manager, NREL



Ramsay Huntley
*Sustainable Finance
Strategist, Wells Fargo*



Bianca Diaz
*Business Support
Consultant, Wells Fargo*



Kate Moore
*Strategic Partnerships,
Innovation &
Entrepreneurship
Center, NREL*



Kristin Field-Macumber
*IN² Buildings Technical
Project Manager, NREL*



Claire Kinlaw
*Director of Innovation
Commercialization and
IN² Technical Project
Manager, Danforth Center*



Kimberlee Ott
*Channel Partner
Engagement, NREL*



Tonya McCabe
Operations, NREL



E.J. Bernacki
*Vice President, Corporate
Responsibility Programs,
Wells Fargo*



Kristi Theis
*Communications Lead,
NREL*



The Future

Given the uncertainty and change delivered in 2020, we've all heard the message that we should tiptoe lightly into 2021 and manage our expectations of the new year. Not at IN². We are toasting loudly and diving headlong into 2021 with audacious goals and high expectations.

This spring we plan to launch not one, but two new cohorts of companies: one focused on affordable housing technologies and the other on indoor agriculture. New to the program, our indoor agriculture cohort will capitalize on the expertise of both of our technical partners: the Donald Danforth Plant Science Center and the National Renewable Energy Laboratory. Coupling our expertise of plant biology with our knowledge of energy efficient buildings in the same cohort maximizes the efforts of our researchers and our companies and catalyzes the process of innovation.

We are also looking at the cleantech ecosystem through the diversity and inclusion lens. Together with our Channel Partner network, we are benchmarking the state of diversity in cleantech and analyzing the landscape of our portfolio network. With these data we can begin to determine next steps to encouraging, adding, and fostering diversity in the cleantech ecosystem.

IN² is an invitation-only program that works with its Channel Partners for referrals. For more information visit IN2ecosystem.com and sign up for NREL's Innovation & Entrepreneurship Center newsletter to keep up with program news. Questions about the program: email IN2@nrel.gov.

In 2021, we will be exploring how best to measure, evaluate, and present metrics about climate, emissions, resources, and energy savings. It's a complex topic and will benefit from ongoing discussions with our researchers, ecosystem, and corporate partners. Stay tuned.

Also on the horizon: We are keenly aware of the importance of demonstration projects in helping companies get to market and are working to support even more demonstration projects for startups.

With new partners, new innovations, and a new year—we are determined to catalyze impactful and positive change resulting in a clean and sustainable future.

Wells Fargo Innovation Incubator (IN²)

IN2@nrel.gov

IN2ecosystem.com

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