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Argonne NATIONAL LABORATORY

ACCELERATING INNOVATION

PARTNERSHIPS AND OUTREACH

FY2022 Report

Paul Kearns
Laboratory Director
ARGONNE NATIONAL LABORATORY

Argonne is committed to leveraging partnerships that translate our discoveries into real-world solutions and economic growth. I commend our scientists and engineers whose ideas advance electric grid modernization, climate science and resilience, quantum information science, STEM education and workforce development, and many other breakthroughs for all Americans. With our world-class talent and one-of-a-kind facilities, Argonne has the capacity needed for dynamic collaborations.

Roger Snyder
Interim Manager, Argonne Site Office
U.S. DEPARTMENT OF ENERGY

The U.S. Department of Energy's Argonne Site Office applauds Argonne researchers and their partners for pushing the boundaries of science and engineering. We look forward to more collaborations that will accelerate cutting-edge science and technologies for society. Their efforts will offer additional opportunities for technology transfer with the potential to transform the U.S. marketplace.

Vanessa Chan
Chief Commercialization Officer
Director, Office of Technology Transitions
U.S. DEPARTMENT OF ENERGY

The U.S. Department of Energy Office of Technology Transitions is proud to stand alongside Argonne National Laboratory in creating market pathways for technologies to help our country meet its energy goals. We must engage industry directly to use this year's historic legislation to accelerate innovation at our world-class facilities and spur a new era of economic competitiveness in cutting-edge technology.

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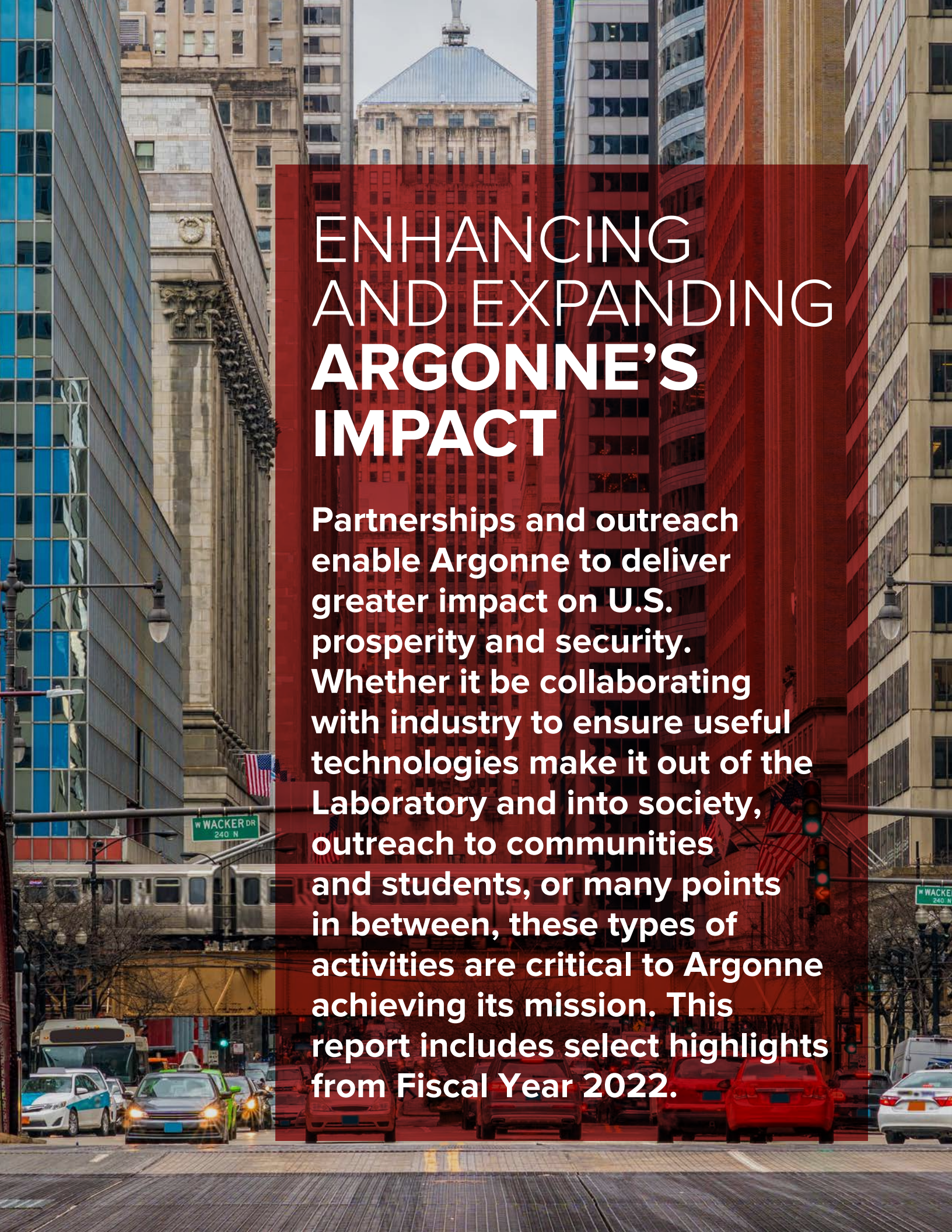


ENHANCING AND EXPANDING **ARGONNE'S IMPACT**

Partnerships and outreach enable Argonne to deliver greater impact on U.S. prosperity and security. Whether it be collaborating with industry to ensure useful technologies make it out of the Laboratory and into society, outreach to communities and students, or many points in between, these types of activities are critical to Argonne achieving its mission. This report includes select highlights from Fiscal Year 2022.

INDUSTRY PARTNERSHIPS

Argonne and ComEd are collaborating to better prepare the electric grid for a changing climate

THE CHALLENGE

The nation's utilities are increasingly challenged by severe weather associated with climate change—things such as flooding, high winds, wildfires, and icing. New and more extreme weather patterns are testing the limits of the existing grid. Meanwhile, electricity demand continues to increase as transportation and industry move away from fossil fuels and toward electrification.

ComEd is one of the largest utilities in the U.S., providing electricity and natural gas to more than 10 million Americans, and serving more than 70% of the population in Illinois. As weather patterns change and demand for power increases, electric companies such as ComEd need to adapt the grid so they can continue to reliably provide power to their customers.

THE PARTNERSHIP

In order to address this challenge, ComEd turned to Argonne's Center for Climate Resilience and Decision Science. Together, they are developing a comprehensive climate risk and adaptation study, which will examine the impact of changing weather due to climate change on the design and performance of the power grid in northern Illinois. This is one of the only studies in the nation to incorporate the impact of increased electrification into the climate risk planning process.

Today's best practices in grid planning look at historical weather patterns, but climate change forces utilities to look into the future and anticipate unprecedented weather conditions. This close collaboration between climate scientists, risk analysts, and power system engineers will help ComEd ensure that the grid is ready to meet customers' needs for years to come.

THE IMPACT

- Armed with actionable projections on how future weather patterns and electricity use will impact the grid, ComEd can plan and build infrastructure that is more resilient to climate change.
- Argonne's high-performance computing capabilities and its analysis are helping ComEd choose the best investments to make now to meet the needs of the future.
- Partnerships like these help ensure the U.S. electric grid is ready to meet demand for years to come.

"As we plan the future grid investments required to enable the state's clean-energy transition, it is essential that we fully understand future grid challenges—including the impact of climate change and electrification—to ensure our grid can adapt to changing conditions and maintain our outstanding system reliability and resiliency."

Gil Quiniones
Chief Executive Officer
ComEd

INDUSTRY PARTNERSHIPS

Helping Pfizer create an antiviral treatment for COVID-19

THE CHALLENGE

As the COVID-19 pandemic raged around the world, the scientific community came together to find effective treatments. Pharmaceutical companies developed vaccinations and intravenous medications at record speed, and they were rapidly searching for a drug that could be easily administered at home to treat active infections before they turned deadly.

In 2020, the U.S. Department of Energy (DOE) formed the National Virtual Biotechnology Laboratory consortium to harness the significant capabilities of the national laboratories to combat COVID-19. DOE invests in user facilities such as the Advanced Photon Source (APS)—a DOE Office of Science user facility at Argonne National Laboratory—for the benefit of the nation's scientific community and supports biological research as part of its mission. This research has been critical in the fight against COVID-19. Using beamlines at the APS, pharmaceutical companies can narrow down drug candidates and zero in on ones that are likely to work by taking a close look at their molecular structure.

THE PARTNERSHIP

Pharmaceutical company Pfizer created the first oral antiviral treatment for COVID-19 approved by the Food and Drug Administration (FDA). The results of the FDA trial indicated the new drug—Paxlovid—could potentially save lives, reduce the severity of COVID-19 infections, and eliminate nine out of 10 hospitalizations.

Scientists at Pfizer created Paxlovid with the help of ultrabright X-rays at the APS.

Work to determine the structure of Paxlovid was done at the Industrial Macromolecular Crystallography Association Collaborative Access Team beamline at the APS, operated by the Hauptman-Woodward Medical Research Institute on behalf of a collaboration of pharmaceutical companies, of which Pfizer is a member. This beamline delivers high-quality results much faster than what the companies themselves can do. Access to this type of facility is vitally important for a breakthrough like Paxlovid to happen.

THE IMPACT

- With the help of a beamline at the APS, Pfizer created the first pill authorized by the FDA to treat COVID-19.
- The new drug, Paxlovid, significantly reduces hospitalization and death of COVID-19 patients.

Advanced Photon Source

INDUSTRY PARTNERSHIPS

Amazon Web Services and Argonne: Advancing quantum information science research and innovation

THE OPPORTUNITY

Quantum information science (QIS) holds promise for revolutionizing how we process and share information, potentially opening doors to advances such as advanced medical imaging, the creation of novel materials, and ultrasecure communications networks. By harnessing features of nature that are available only at nature's smallest scales, researchers can overcome the limitations of today's most advanced technologies. This emerging technology is progressing rapidly, but QIS is still a young field. It will take the best and brightest minds in science and industry, working together, to take this field to the next level.

THE PARTNERSHIP

This year, Amazon Web Services (AWS) became a member of Q-NEXT, a DOE National QIS Research Center that is led by Argonne. Q-NEXT brings together world-class researchers from national laboratories, universities, and U.S. technology companies, with the goal of developing the science and technology to control and distribute quantum information. Through its partnerships, Q-NEXT is creating an innovation ecosystem that enables the translation of discovery science into technologies for science and society.

AWS has always been at the cutting edge of innovation. The company already is developing cloud quantum computing services, building a quantum computer, and applying quantum algorithms to real-world problems.

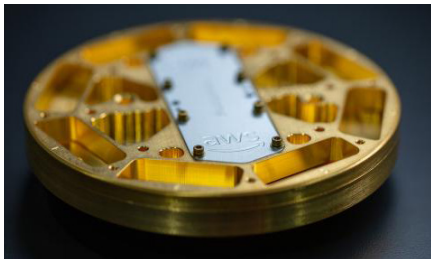
Now, AWS is working with Q-NEXT to advance the state of the art in quantum information science and technology. With AWS as a member, Q-NEXT now comprises 14 companies, 10 universities, and three DOE national laboratories.

THE IMPACT

- AWS's engineering expertise and experience with tech consumers will be invaluable to the Q-NEXT community as it develops next-generation technologies that promise to improve our everyday lives.
- Advances in QIS could be transformational. They have the potential to lead to exponentially more powerful computers, communication networks, and sensors that can solve today's intractable problems.

"We are excited to join Q-NEXT so we can bring together quantum experts from AWS and other top academic research institutions to collaborate on the research and development of new quantum technologies and build a national quantum community."

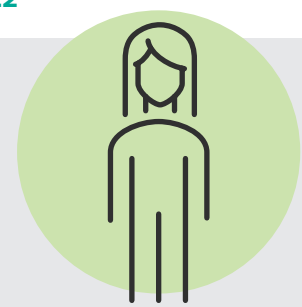
Simone Severini
DIRECTOR OF QUANTUM COMPUTING
AMAZON WEB SERVICES



Amazon Web Services will contribute fundamental research to the Q-NEXT community to advance the use of quantum technologies. Pictured here is an AWS microwave package enclosing a quantum processor. The packaging is designed to shield the qubits from environmental noise while enabling communication with the control system. (Image by AWS.)

STEM EDUCATION AND WORKFORCE DEVELOPMENT

FY2022



1,033

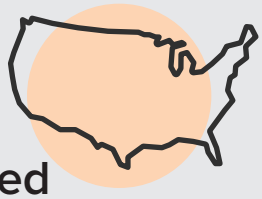
Student intern participants

A record high for Argonne

90%

Argonne's student interns who hailed from U.S. universities

44

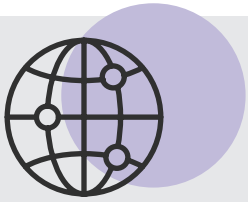


U.S. states represented by student interns

(in addition to Washington, D.C.)

21

Countries represented by student interns attending international universities



JOINT APPOINTMENT PROGRAM

The objectives of Argonne's Joint Appointment Program are to:

- Promote research and collaboration in areas aligned with the scientific and technical priorities of Argonne and the U.S. Department of Energy (DOE)
- Facilitate the building of world-class research programs by maximizing the unique intellectual and physical resources of both Argonne and partner universities
- Establish a network and an exchange of knowledge to enhance the intellectual vitality and research impact of Argonne and partner universities
- Increase synergies between DOE and academic programs

In FY22, there were 79 new Joint Appointments established. As of October 2022, Argonne had 459 active Joint Appointments.

LEARNING CENTER

Argonne's Data4All workshop—an extension of the Learning Center on Argonne's main campus—offers high school students an opportunity to go beyond the basics of computer science and dive into the advanced skills and career pathways that computer science offers.

Argonne manages the workshop in partnership with the University of Chicago's Data Science Institute and the university's Office of Civic Engagement. The program lasts eight weeks, with students meeting on Saturdays near the UChicago campus.

Activities at the workshop include:

- Learning the Python programming language
- Conducting inquiry-driven research in small groups
- Training on how to investigate data problems and present findings
- Developing critical collaboration, problem-solving, and communication skills

STEM OUTREACH

In spring 2022, Argonne launched the STEM Mapping Project in collaboration with Northwestern University's Office of Community Education Partnerships.

The goal of the project is to help build a robust STEM learning landscape by identifying STEM spaces and programs from kindergarten to career across nine communities on Chicago's south side: Douglas, Grand Boulevard, Greater Grand Crossing, Hyde Park, Kenwood, Oakland, South Shore, Washington Park, and Woodlawn.

Argonne and Northwestern sent hundreds of electronic surveys to community members, educators, and workforce institutions in the nine neighborhoods. With the help of student interns from local colleges, Argonne completed surveys from STEM employers and educational institutions, and as of fall 2022, was focusing on obtaining final responses from community organizations and workforce development centers.

After all the data are collected, Argonne and Northwestern will work together to create visual maps that provide a holistic view of STEM resources and collective strengths within the nine communities. Initial maps will be shared with members of each of the nine communities for review and input. Once the maps are finalized, they will be shared broadly with the public to help advance stronger STEM education pathways.

GOVERNMENT PARTNERSHIPS

Enabling enhanced tracking of COVID variants in wastewater

THE CHALLENGE

As the Omicron COVID variant spread through the U.S. in the early months of 2022, scientists were looking for ways to trace the various strains as they moved throughout different communities.

In addition to direct testing of individuals, one resource that scientists have for tracking large-scale COVID patterns is the wastewater system, which includes whatever goes down household drains and what is collected in sewers.

THE PARTNERSHIP

Helped by new funding, Argonne researchers were able to build on a prototype sampling network that was set up in 2021 to work with the Chicago Department of Public Health to detect, and hopefully trace, how different strains of the COVID virus travel through different communities.

At the beginning of the pandemic, funding from the Walder Foundation allowed Argonne scientists to set up a network for sampling at multiple Illinois wastewater treatment facilities. Developed with partners from the University of Illinois's Discovery Partners Institute, the University of Illinois at Chicago and Northwestern University, the network allows researchers to detect the specific genetic information, or genome, of different strains of the SARS-CoV-2 virus responsible for causing COVID, which turns up in wastewater as individuals with the virus shed it in their waste.

The trend analyses generated by the wastewater testing have been shared with the Illinois Department of Public Health and the Chicago Department of Public Health to help inform their decisions.

THE IMPACT

- Wastewater testing can show how variants move from one community to another and how they respond to local efforts to combat the virus.
- This form of surveillance could also provide researchers with the capacity to identify potential new strains as they emerge.

"Initially, we were interested in just seeing if we could detect COVID in the wastewater. Once we knew we could do it, it became important to look for trends. We needed to know what it meant for our public health efforts if we saw a COVID spike in a community's wastewater — for instance, if government agencies would need to implement more controls or target a stronger vaccine or testing campaign."

Sarah Owens
MOLECULAR BIOLOGIST
ARGONNE NATIONAL LABORATORY

STATE-OF-THE-ART FACILITIES

Scaling up solutions at the Materials Engineering Research Facility

Argonne's Materials Engineering Research Facility (MERF) is accelerating the development and delivery of new materials and technologies, helping partners in industry, academia, and government shorten the time from materials discovery to commercialization. Bridging the gap between small-scale laboratory research and high-volume manufacturing, the MERF supports the development, de-risking, validation, and ultimate commercialization of advanced materials and chemistries, including those essential for a decarbonized economy.

Often, novel materials created in the lab are difficult or prohibitively expensive to produce at the scale necessary for commercial testing and evaluation. The MERF works to solve these problems. By scaling up production of experimental materials from milligrams to kilograms, developing new manufacturing processes for advanced materials, and evaluating emerging materials manufacturing technologies, the MERF provides innovators with the support, tools, and expertise they need to rapidly bring new materials and technology to market.

The MERF gives Argonne's partners access to the state-of-the-art equipment and expertise needed to invent new processes for producing transformative materials. MERF work has focused on advanced materials for energy storage and conversion, water purification, and the circular economy, with the potential for expansion into other areas that can enhance the nation's future manufacturing competitiveness.

Since opening its doors in 2010, the MERF has worked with over 60 industrial partners, 10 national labs, and 18 academic institutions.

An expansion completed in 2020 grew the facility to 28,000 square feet—approximately 50 scientists, engineers, and support staff now work in the MERF, helping innovators and industry develop scalable manufacturing technologies for advanced materials and chemicals."

Another expansion of the facility already underway will add 12,000 more square feet of lab space for research into battery recycling methods that will be acutely needed as tens of thousands of electric vehicles reach their end of life.

MATERIALS MANUFACTURING INNOVATION CENTER
Argonne National Laboratory

Potential partners with manufacturing innovation needs can connect to the Materials Engineering Research Facility and related Argonne facilities through Argonne's Materials Manufacturing Innovation Center (manufacturing@anl.gov).

Creating and transforming materials, one atom at a time, at the Center for Nanoscale Materials

The Center for Nanoscale Materials (CNM), a DOE Office of Science user facility, provides researchers from around the globe with expertise, instrumentation, and infrastructure for nanotechnology research and innovation.

Industrial, academic, and international researchers can access the center through its user program for both proprietary and non-proprietary research. There is no cost to use the CNM if the research is intended for the public domain. CNM facilities are also available to users on a cost-recovery basis for proprietary research.

With more than 100 tools and capabilities, CNM offers users a broad range of capabilities for the design, synthesis, characterization, theory, and modeling of nanomaterials. Research at CNM is consolidated under three cross-cutting and interdependent scientific themes:

- Quantum materials and sensing
- Manipulating nanoscale interactions
- Nanoscale dynamics

From X-ray microscopy to cutting-edge nanofabrication techniques, the CNM provides users with a powerful combination of scientific resources found nowhere else. Researchers using the CNM can also access Argonne's other user facilities, including the Advanced Photon Source and the Argonne Leadership Computing Facility, for multi-modal and cross-functional projects.

In addition to offering some of the most advanced capabilities for nanoscale research, CNM scientists also provide users with world-class expertise. In FY21, 702 users from academia and industry conducted research at CNM.

CNM enables high-impact research that has the potential to transform nanoscale science and technology. Research conducted at CNM is leading to breakthrough discoveries using nanotechnology to capture energy, transmit information, advance medical therapies, and improve the environment.

UNIVERSITY PARTNERSHIPS

The University of Michigan and Northwestern University join forces with Argonne to turn waste into energy

THE CHALLENGE

President Biden has set an ambitious goal for America to achieve net-zero carbon emissions by 2050. In order to meet this goal and transition to a clean-energy economy, the United States will have to develop new technologies to power our future.

One promising technology is to convert waste to energy (W2E). This emerging technology aims to produce gas from biodegradable plant and animal waste. Scientists are working on a variety of ways to bring this form of bioenergy to market, but figuring out how to use organic waste to produce bioenergy at scale is still an active area of research.

"The opportunity provided to conduct research, develop novel technologies, and educate the future generation of waste-to-energy professionals through this collaboration is second to none."

Lutgarde Raskin
DISTINGUISHED PROFESSOR OF ENVIRONMENTAL ENGINEERING
UNIVERSITY OF MICHIGAN

THE PARTNERSHIP

The Integrated Biochemical and Electrochemical Technologies (IBET) to Convert Organic Waste to Biopower collaboration is helping to advance the next generation of bioenergy technology while training the next generation of leaders in this field.

Led by the University of Michigan, Northwestern University, and Argonne, the IBET collaboration aims to help industry produce high-purity methane from mixed organic waste streams at scale. Bringing together the best W2E technologies from each institution, the collaboration will test the technologies with industry partners to see which ones show the most promise for bioenergy production.

By integrating the collaboration's research with innovative educational goals, IBET is advancing both W2E technologies and future green-energy workforce development, while addressing risks and challenges in the development of new technologies.

THE IMPACT

- Developing the technology to create power from organic waste would reduce U.S. carbon emissions, provide a novel fuel source, and promote America's energy independence.
- By providing educational opportunities for undergraduate, masters, and Ph.D. students, the IBET collaboration is helping to develop America's future bioenergy workforce.

PUBLIC-PRIVATE PARTNERSHIPS

Bridging the U.S. lithium battery supply chain gap

THE CHALLENGE

The world is at the cusp of a dramatic transition in energy infrastructure. As widespread electrification drives demand for lithium-based batteries to power electric vehicles and stationary storage, the domestic battery supply chain must expand.

Rapid movement to electrification requires as much as a twenty-fold increase in manufacturing capacity—including mineral refining, recycling, material production, component processing, and cell/pack manufacturing.

THE PARTNERSHIP

Li-Bridge is a public-private alliance committed to accelerating the development of a robust and secure domestic supply chain for lithium-based batteries.

Li-Bridge serves as a nucleus, bringing together private industry, national laboratories, and the federal government.

Argonne leads coordination of Li-Bridge by serving as the facilitator between private industry and the Federal Consortium for Advanced Batteries, which has released a National Blueprint for Lithium Batteries, 2021 – 2030. The Blueprint aims to put the U.S. on a path to long-term competitiveness in the global battery value chain.

Argonne works with DOE national labs across the country to meet national Blueprint goals. Private industry participation is facilitated through an alliance with three U.S.-based convenor organizations:

- NAATBatt International
- New York Battery and Energy Storage Technology Consortium (NY-BEST)
- New Energy Nexus.

THE IMPACT

- Li-Bridge is serving as an ecosystem creator, aligning the key parties toward the national need and informing the government as to the gaps and opportunities.
- Li-Bridge represents a major step toward establishing a battery materials and technology supply chain that supports long-term U.S. economic competitiveness and security.

ARGONNE IN CHICAGO

CROCUS
Community Research on Climate & Urban Science

PUTTING CLIMATE IMPACT IN CITIES UNDER THE MICROSCOPE

The DOE has awarded Argonne and a team of academic and community leaders $25 million over five years to advance urban climate science by studying climate change effects at local and regional scales.

The team is establishing an urban integrated field laboratory called Community Research on Climate and Urban Science (CROCUS), focusing on the Chicago region.

CROCUS will use community input to identify questions and specific areas of urban climate change to study, ensuring that research results directly benefit local residents. CROCUS researchers will also work with organizations and students to collect on-the-ground data and develop climate models.

CROCUS will also provide opportunities to educate and train the next generation of workers who are diverse, informed, and prepared for jobs in the climate sector.

Like other U.S. cities, Chicago is already experiencing disruption from climate change in the form of extreme weather, flooding, drought and heat waves. Unfortunately, the neighborhoods that are most at risk for climate-related disasters have historically been understudied and unable to access the resources or services they need. That's why CROCUS has strong representation from local organizations to develop its research goals.

ARGONNE'S CROCUS PARTNERS

- Chicago State University
- Community Colleges of Chicago
- North Carolina A&T
- Northeastern Illinois University
- Northwestern University
- Notre Dame University
- University of Chicago
- University of Illinois at Chicago
- University of Illinois at Urbana Champaign
- University of Wisconsin
- Washington University in St. Louis

REGIONAL ECONOMIC DEVELOPMENT

CHAIN REACTION INNOVATIONS
Entrepreneurship at Argonne

Chain Reaction Innovations is a program that draws some of the U.S.'s brightest innovators focused on clean energy and science technologies to Argonne. During the two-year program, participants receive financial and technical support as well as entrepreneurial training—helping develop technologies and launch companies that are making an impact.

35
Companies nurtured

$371M
Dilutive and non-dilutive funding

585
Jobs created

SUCCESS STORY

Stemloop is a company that has developed a platform for inexpensive and rapid detection of pathogens and heavy metals in water.

Stemloop's CEO and founder, Khalid Alam (pictured at left, working with Andrzej Joachimiak, an Argonne Distinguished Fellow and Director of the Structural Biology Center and Midwest Center for Structural Genomics at Argonne), was a member of the third cohort of Chain Reaction Innovations innovators.

Stemloop's technology repurposes the machinery of microorganisms into easy-to-use formats for testing and surveillance of health threats. Stemloop's µSense Lead-in-Water Test aims to be the most scalable at-home test on the market. It launched publicly on Oct. 4, 2022, manufacturing 500 initial test kits to meet demand.

The company has an office in Evanston, Ill., and as of October 2022, has created 12 U.S. jobs and raised $2.4 million in non-dilutive funds.

<DUALITY>
Accelerating Quantum Startups

SUPPORTING QUANTUM STARTUPS

Launched in 2021 and anchored at the University of Chicago, Duality is the first accelerator program in the U.S. exclusively dedicated to supporting quantum startups. Argonne is proud to be a founding partner of Duality.

U.S. DEPARTMENT OF ENERGY | LEEP

Lab-Embedded Entrepreneurship Program

ARGONNE HOSTS SUMMIT TO HIGHLIGHT EMERGING INNOVATORS AND THEIR TECHNOLOGIES

Since 2015, clean energy entrepreneurs have developed game-changing technologies with the support of the DOE Lab-Embedded Entrepreneurship Program (LEEP). Argonne's LEEP node is called Chain Reaction Innovations.

On July 12, 2022, Argonne hosted the first-ever LEEP Summit as a showcase of the program's science-based climate solutions, highlighting their regional and national impacts.

The summit convened past and present LEEP entrepreneurs and key climate change stakeholders, as well as investors and thought leaders from government, industry, academia and the U.S. climate innovation ecosystem. At the event, more than 20 participating LEEP innovators pitched their technologies/startups to potential investors or research partners from across the U.S.

Chain Reaction Innovations acted as host of the event, broadcasting live from Chicago. The other three LEEP nodes—Cyclotron Road at Lawrence Berkeley National Lab in Berkeley, California; Innovation Crossroads at Oak Ridge National Lab in Oak Ridge, Tennessee; and West Gate at the National Renewable Energy Lab in Golden, Colorado—participated as satellite locations in the hybrid event.

Dick Co, Director of the Chain Reaction Innovations program at Argonne, speaks during the first-ever LEEP Summit.

The fourth cohort of innovators from Argonne's LEEP node: (from left) Pranav Gokhale, Christopher Passolano, Matthew Ackerman, Margaret Kocherga, Karin Calvinho, and Carol Scarlett.

"Argonne is honored to work with the best and brightest science and hard tech innovators the U.S. has to offer," Argonne Director Paul Kearns said. "Together with our scientists, they are leveraging Argonne's unique scientific user facilities to develop a broad range of technologies that will accelerate a clean energy economy. Their commendable efforts are forging next-generation industries that will keep our nation at the forefront of innovations in science and technology."

LEEP is funded by DOE's Advanced Manufacturing Office as well as DOE's Office of Science.

U.S. DEPARTMENT OF ENERGY **TECHNOLOGY TRANSFER PROGRAMS**

Energy I-Corps

Helping scientists explore technology commercialization

THE OPPORTUNITY

A little more than a year ago, Sean Sullivan, a postdoctoral appointee in the Quantum Materials group at Argonne, found himself wondering if his research on qubits could potentially be used in telecommunications. He thought his technology could be scaled up into a platform that could profoundly impact the way people transmit, share, and process data over long distances, but he was not sure if there was a market for this technology. Since the field of quantum technology is so new, its full potential has not yet been realized on a commercial scale.

In order to determine whether to pursue the commercial development of his quantum technology, Sullivan applied to participate in the Energy I-Corps program. Supported by the DOE's Office of Technology Transitions, the I-Corps program gives DOE scientists the opportunity to think more broadly about the practical applications of their research.

THE PROGRAM

Energy I-Corps is a two-month, intensive training program that helps national lab researchers explore the basics of technology commercialization. In the program, participants define the value of their technology, interview dozens of potential customers, evaluate whether their technology solves a real-world problem, and learn how to develop a research and development program that creates value for them and for potential customers. The immersive program combines lectures, hands-on training, and one-on-one coaching to help scientists develop business plans and connect with potential industry partners.

During the program, Sullivan mapped out the ecosystem of who would be involved in every step of product commercialization. He outlined potential customers to whom he would be selling, suppliers who would provide certain parts, and funding pipelines. Then, he reached out to everyone in this ecosystem to gain their insights by asking meaningful, non-leading questions.

"You might have some preconceived idea of what is useful, but other people might have a totally different idea," Sullivan said. "There's a lot of interesting physics from a science and engineering perspective, but the customer discovery process gets you to think from a more pragmatic perspective about how a technology would be deployed to truly benefit as many people as possible and what its value proposition would be."

THE IMPACT

Through the Energy I-Corps program, Sullivan discovered that potential customers were very interested in his quantum technology and excited about its potential to transform the way people share and process data.

To help him take the next step toward commercializing the technology, Sullivan joined Argonne's Chain Reaction Innovations program. This two-year fellowship program helps innovators from across the U.S. turn a great idea into a technology that impacts the market. The program will help Sullivan develop a minimum viable product of the qubit quantum technology he's been researching. The product will be used to validate his ideas and attract early customers who can provide feedback on the next steps of product development and commercialization.

Sean Sullivan

AWARDS AND **RECOGNITION**

Federal Laboratory Consortium Awards

The Federal Laboratory Consortium (FLC) Awards program annually recognizes federal laboratories and their industry partners for outstanding technology transfer efforts.

2022 FLC NATIONAL AWARDS EXCELLENCE IN TECHNOLOGY TRANSFER

ML-GA Design Optimization Software

Argonne and Parallel Works, Inc.

Argonne and Parallel Works, Inc., a Chicago-based high-performance computing (HPC) software platform company, were recognized for their joint effort to bring Argonne's Machine Learning-Genetic Algorithm (ML-GA) design optimization software to commercialization.

Parallel Works has customers in a wide range of government and commercial manufacturing industries, including automotive design, heavy equipment design, consumer goods packaging, and hydrological engineering.

By embedding machine learning into the design process, ML-GA dramatically speeds up the process of running models and simulations for virtual prototypes—shrinking the product development phase from a few months to a few days. This also brings down computational costs.

Pinaki Pal, a research scientist in Argonne's Center for Transportation Research, led the effort for the laboratory. Parallel Works was co-founded in 2015 by former Argonne researcher Michael Wilde.

R&D 100 Awards

The R&D 100 Awards program, known as the "Oscars of Innovation," annually recognizes new commercial products, technologies, and materials for their technological significance.

Four technologies developed by Argonne researchers and partner organizations earned 2022 R&D 100 Awards. Four others were named finalists.

AWARDEES

Flash-X, a Multiphysics Simulation Software

Principal Investigator: Anshu Dubey

Simulating the complex physics in systems ranging from supernovas to the insides of liquid cooling systems requires high-quality, precise software. Developed by Argonne researcher Anshu Dubey, Flash-X is open-source physics simulation software that can be used in a wide range of scientific disciples. It builds upon previous FLASH software, modifying it for use on the newest generation of supercomputers. Research for Flash-X was funded by the Exascale Computing Project of DOE's Office of Advanced Scientific Computing Research.

The Battery Performance and Cost (BatPaC) Model v. 5.0

Principal Investigator: Shabbir Ahmed

As the market for electric vehicle batteries rapidly expands, the industry is investing in research and development to produce cost-competitive, high-performing battery packs for electric vehicles. BatPaC is a freely available modeling tool that designs battery packs for electric vehicles. It can determine the size, mass, and cost of a battery pack from inputs related to the battery chemistry, vehicle type, configuration, and manufacturing specifications. Funding for BatPaC comes from the Vehicle Technologies Office in DOE's Office of Energy Efficiency and Renewable Energy.

Health Analysis and Research for Public Events Tool (HARPE)

Principal Investigators: Nate Evans and Stephanie Jenkins

HARPE is a tool that helps organizations improve safety, security and emergency management for public events and mass gatherings. HARPE examines physical security, cybersecurity and public health so leaders can focus on the most impactful areas related to safety and security. In the context of the pandemic, HARPE evaluates the evolving threat, while maintaining a strong focus on the traditional physical security and cybersecurity at venues and events. HARPE was developed by Argonne researchers with funding from DOE's Office of Technology Transitions.

PGM-free OER Catalyst as Replacement of Iridium for PEM Water Electrolyzer

Principal Investigator: Di-Jia Liu

Hydrogen produced from renewable energy for fuel could play a significant role in combatting the climate crisis. Currently, hydrogen is produced using a Proton Exchange Membrane (PEM) water electrolyzer. The process uses a costly Platinum Group Metal (PGM) catalyst in the Oxygen Evolution Reaction (OER) to split water into hydrogen and oxygen. Argonne developed an innovative new catalyst that is projected to cost about 2,000 times less. By reducing the cost barrier to water electrolysis, the technology would promote the widespread production of "green hydrogen." The work was funded by the Hydrogen and Fuel Cell Technologies Office in DOE's Office of Energy Efficiency and Renewable Energy.

FINALISTS

Advanced Graphene-Based Lubricants for High-Temperature Metal Stamping

Principal Investigator: Ani Sumant

Argonne's advanced graphene-based lubricants help enable the state-of-the-art in high-temperature metal stamping. They are the only solid lubricants that can cost-effectively reduce friction at the high temperatures required to shape the thin-gauge high-strength metals mandated by passenger vehicle safety regulations for vehicle production. They help to maximize productivity by minimizing the formation of tears and wrinkles due to thinning in defectively formed auto parts. The lubricants have also been shown to produce a 10,000-fold reduction in metal mold wear. Funding for the research came from the Vehicle Technologies Office of DOE's Office of Energy Efficiency and Renewable Energy.

Catalytic Upcycling of Plastic Films to High-Performance Lubricants

Principal Investigator: Max Delferro

Plastic is ubiquitous—and amassing in landfills and our oceans as very little is recycled, particularly from polyethylene and polypropylene items. Argonne researchers have developed a new way to selectively convert single-use plastic items into value-added commercial products, including waxes, lubricants, detergents, and cosmetics. This new catalytic technology uses platinum nanoparticles to convert polyethylene and polypropylene plastic waste into higher-value chemical intermediates for re-introduction into the decarbonized economy. Funding for the research came from DOE's Office of Basic Energy Sciences, the REUSE program of the Advanced Research Projects Agency-Energy, and the Advanced Manufacturing Office and Bioenergy Technologies Office of the DOE's Office of Energy Efficiency and Renewable Energy.

Cardinal: Scalable High-Order Multi-Physics Simulation

Principal Investigator: April Novak

Cardinal is an open-source simulation software package developed by Argonne that delivers highly accurate solutions for a wide range of applications in nuclear energy sciences. Scientists and engineers rely on simulation to predict the behavior of nuclear reactors under a variety of design conditions, but these simulations can be expensive and time-consuming to run. Cardinal features state-of-the-art, scalable algorithms for achieving multi-physics solutions with neutron transport, fluid flow, heat transfer and material behavior on platforms ranging from laptops to extreme-scale computers. It can simulate physical phenomena from the atomic scale to the whole-system response of nuclear reactors coupled to electric grids. Funding for Cardinal was provided by DOE's Office of Nuclear Energy.

Argonne X-Ray Perimeter Array Detector (XPAD) / Thermo Scientific Ultra X EDX Solution

Principal Investigator: Nestor Zaluzec

Recognized as the world's most sensitive detector by Guinness World Records, the XPAD / Ultra X is a new design and geometry of an X-ray energy dispersive spectrometer, or silicon X-ray detector system, for the analytical Transmission Electron Microscope (TEM). Installed on Argonne's PicoProbe instrument, it has more than 2.5 times the collection efficiency of the next best commercial detectors available. This advance gives scientists the opportunity to probe the elemental composition of samples in smaller and smaller volumes in less time and with higher sensitivity. Funding for XPAD was provided by a Cooperative Research and Development Agreement between Argonne and ThermoFisher as well as Laboratory Directed Research and Development funds.

PARTNERSHIPS AND OUTREACH
BY THE NUMBERS

FY2022

107 Inventions reported

64 Copyright assertions

61 Patents issued

STRATEGIC PARTNERSHIP PROJECT SPP

183 Agreements

$184.4M Value

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT CRADA

47 Agreements

$64.4M Value

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Megan Clifford
Associate Laboratory Director
Science and Technology
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