



PARTNERING FOR **IMPACT**

PARTNERSHIPS AND OUTREACH
Fiscal Year 2023 Report



U.S. DEPARTMENT OF
ENERGY

Argonne National Laboratory is a
U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC.



Paul Kearns
 Laboratory Director
 ARGONNE NATIONAL LABORATORY

Argonne has a long tradition of putting our science to work to deliver value for our partners, and in Fiscal Year 2023, we added to that legacy. Whether it be helping industry solve technical challenges, reaching out into communities to listen and make an impact, or numerous points in between, we are proud of what we accomplish through our collaborations.



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

The U.S. Department of Energy’s Argonne Site Office is proud to support Argonne and its partners in industry, government, academia and nonprofits as they collaborate on breakthroughs that improve our way of life, our understanding of the world around us, and lead to U.S. prosperity and security.



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 (OTT) continues to enthusiastically support our ongoing partnership with Argonne National Laboratory. The laboratory’s researchers have demonstrated groundbreaking accomplishments in clean technology, and OTT has worked alongside Argonne to bring these technologies to public use. Our investments in innovation and commercialization are critical to realizing our clean-energy-transition goals.

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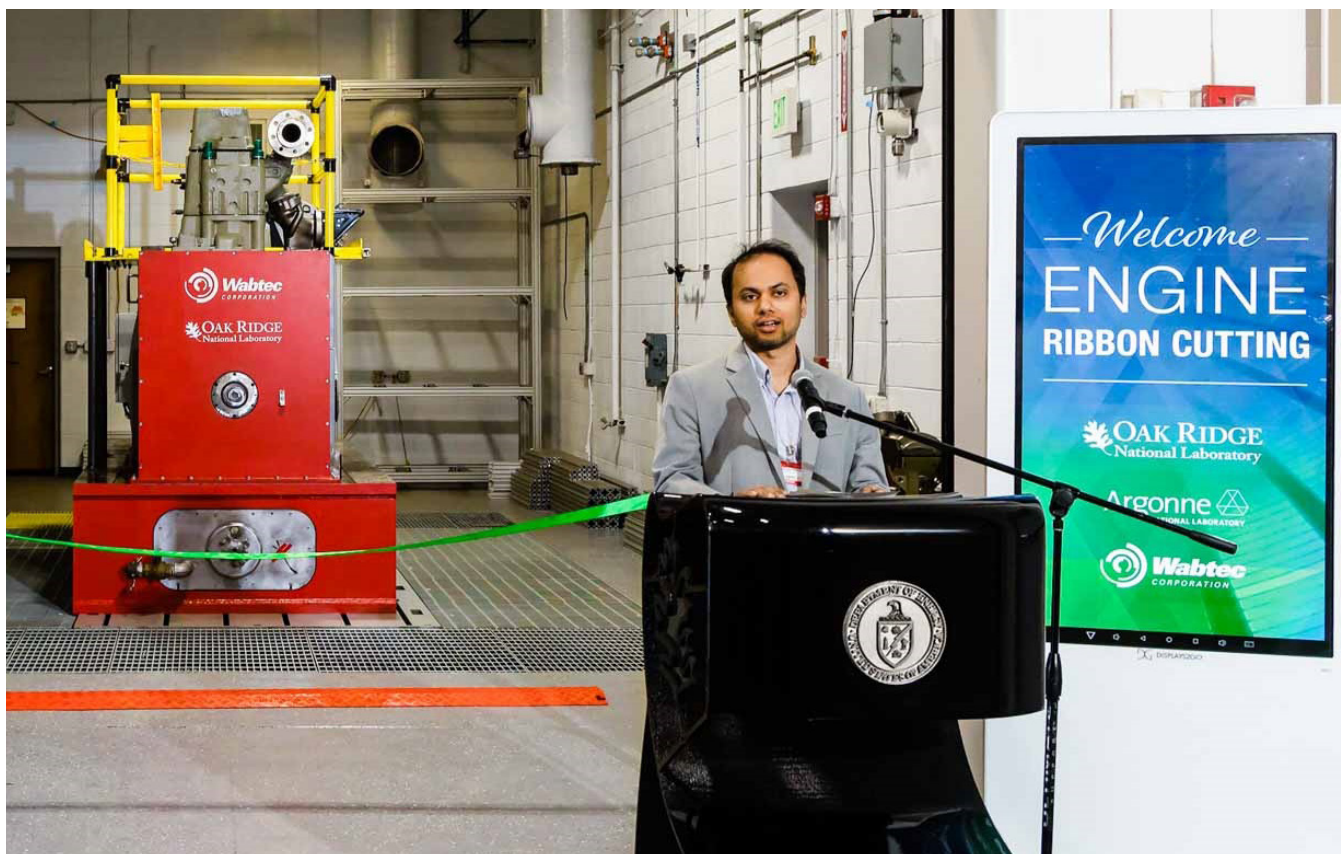
A photograph of a city street at dusk. Tall buildings line the street, with some windows illuminated. A car is in motion in the foreground, blurred. A street lamp is visible on the left. The sky is a deep blue.

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 2023.

INDUSTRY PARTNERSHIPS

Working with Wabtec to develop new hydrogen-powered trains



Part of a team studying the potential of hydrogen-powered trains, Argonne senior research scientist Muhsin Ameen is developing a modeling framework to study combustion and emission control technologies used in hydrogen combustion engines. (Photo courtesy of Oak Ridge National Laboratory)

THE CHALLENGE

Each year, the North American rail fleet emits approximately 87.6 billion pounds of carbon dioxide, a major driver of climate change. While electrification is an effective strategy for reducing carbon emissions from vehicles, it does not work well for certain parts of the transportation sector such as planes, ships and trains.

In order to decarbonize the U.S. rail industry, we will need to find a way to run trains on low and zero-carbon fuels instead of diesel. Hydrogen is one promising fuel option that has many advantages, but you can't simply replace one fuel with another. Locomotive engines will need to be redesigned to run on hydrogen fuel.

“This collaboration will advance the development of hydrogen technology. Railroads will be able to greatly reduce emissions and operating costs while maintaining commonality within their current fleet of trains.”

James Gamble

VICE PRESIDENT OF ENGINE &
POWER SOLUTIONS
WABTEC

THE PARTNERSHIP

Wabtec, a leading manufacturer of freight trains, has turned to Argonne and Oak Ridge National Laboratories to help them develop a new hydrogen-powered train. The team is now working together to develop combustion technology to power the next generation of trains with up to 100% hydrogen and other low-carbon fuels. The team's goal is to design train engines that will deliver the same power, range, and cost-effectiveness as current diesel technology.

The project is advancing hydrogen engine technology for both current and future locomotive engines. As a first step, they are developing

new hardware and control strategies to retrofit existing engines to run on hydrogen and diesel fuel. Then, Argonne will leverage its experience modeling hydrogen injection and combustion to create a digital simulation of the engine. This will allow the team to study what is happening inside the engine, helping predict the impact of future modifications and inform the design of a fully hydrogen-powered locomotive.

This is just one example of how Argonne is working with industry to accelerate the development and commercialization of technologies to help reduce carbon emissions from transportation.

THE IMPACT

- This technology could decarbonize the rail industry by allowing new trains to run on hydrogen or low-carbon fuels instead of diesel.
- Each diesel-powered train that is converted to a zero- or low-carbon energy source is anticipated to save up to 5.6 million pounds of carbon dioxide per year.

INDUSTRY PARTNERSHIPS

Helping Raytheon build a more efficient jet engine

THE CHALLENGE

Aviation is a driver of the global economy, job creation, tourism, and the intangible benefit of human connection. But it's also responsible for 2.5% of all human-induced carbon emissions, which have doubled since the 1980's. In order to address this challenge, Argonne is helping Raytheon Technologies design next-generation aircraft engines with an eye toward improving efficiency, sustainability, and durability—all while lowering operating costs.

To optimize the design of aircraft engines, engineers use complex computer simulations known as computational fluid dynamics (CFD). But the calculations require so much computing power that simulations ordinarily must make approximations that reduce their accuracy. A faster, more accurate approach could usher in a new generation of greener aviation.

THE PARTNERSHIP

Raytheon Technologies Research Center is working with Argonne to develop novel machine-learning models to address the complex physics in jet engine cooling systems. These models can dramatically speed up the design and testing of next-generation aircraft engines and help Raytheon improve fuel efficiency and operating costs.

This partnership will transform the accuracy of CFD models for predicting airflow and heat transfer inside gas turbine engines by leveraging advances in machine learning and supercomputing. By combining data-driven machine learning techniques with the high-performance computing resources available at Argonne, engineers can reduce the trade-offs between speed and accuracy, enabling the rapid development of new fuel-efficient aircraft engines. Although the project is still ongoing,

these new models have already identified complex effects near the surfaces inside the engine that traditional modeling approaches could not have predicted.

As the project evolves, the team will continue to build faster, more accurate models that are more useful to the industry. For Raytheon, Pratt & Whitney, and airlines, the prize is stronger, more efficient engines capable of safely running for longer periods between maintenance. These improvements will also support the civil aviation industry's commitment to net-zero carbon emissions by 2050.

THE IMPACT

- This work accelerates the development of next-generation aircraft engines that are more fuel efficient and reduce carbon emissions.
- It also creates more durable engines that require less maintenance and reduce operating costs.
- In addition, it enables the design of aircraft engines that are better for business and the environment.

“The Department of Energy fields supercomputers that are beyond the reach of even major corporations. These systems enable technology advancements that would otherwise be years or decades away.”

Pete Bradley

SENIOR FELLOW FOR DIGITAL TOOLS AND DATA SCIENCE, PRATT & WHITNEY

ECONOMIC IMPACT BY THE NUMBERS

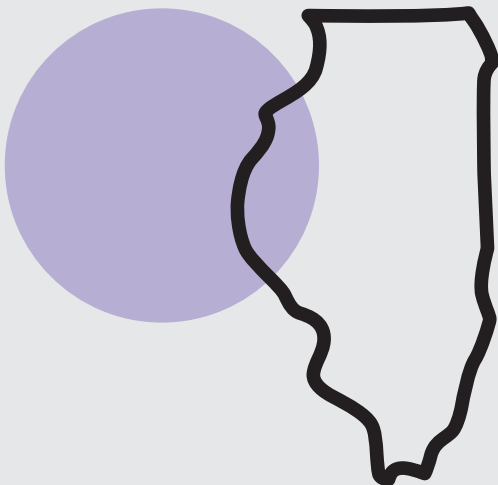
FISCAL YEAR 2021

\$2.67B

U.S. economic impact

13,388

U.S. jobs supported



\$1.29B

Illinois economic impact

7,706

Illinois jobs supported

EDUCATION, UNIVERSITY, AND WORKFORCE DEVELOPMENT PARTNERSHIPS

Argonne’s Institutional Partnerships group works with academic institutions and nonprofit organizations to support Argonne’s research efforts and maximize the impact of the lab’s science and technology. The team fosters strategic research collaborations, offers impactful learning experiences, and builds the science, technology, engineering and math (STEM) workforce of the future.

The group focuses on building partnerships in three main areas—STEM education, university and college partnerships, and workforce development. The team pursues the following goals to make a greater impact in each of these areas.

STEM EDUCATION

- Foster K-12 student awareness of STEM careers
- Build early-career STEM pathways, including with underrepresented minority groups
- Develop activities, curriculum and other resources to support K-12 STEM learning

UNIVERSITY AND COLLEGE PARTNERSHIPS

- Create learning opportunities and career pathways for university and college students
- Manage a lab-wide university partnerships program that includes minority-serving institutions
- Support the development of world-class research programs by facilitating collaboration

WORKFORCE DEVELOPMENT

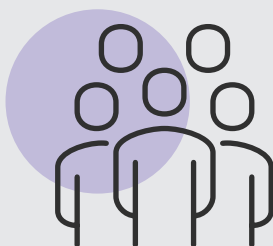
- Build a diverse regional workforce, including research and non-research positions
- Support apprenticeship programs
- Provide community colleges and trade programs with advice on training, certificate and degree programs



BY THE NUMBERS FISCAL YEAR 2023

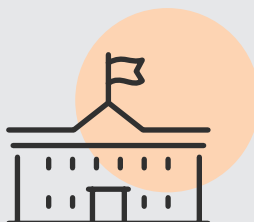
18,245

People who engaged with Argonne at various STEM fests



6,445

K-12 students who engaged with Argonne via STEM education/outreach and workforce development



1,175

Student intern participants

EDUCATIONAL PARTNERSHIPS

Equipping students from underserved communities with valuable STEM expertise

THE CHALLENGE

An internship can open many pathways for students. They can expand a young person's professional network and help them develop marketable skills that are often a ticket to a good first job, particularly in STEM fields. But opportunities for college internships in STEM have historically been relatively scarce for students in underserved communities like those on Chicago's South Side.

Recognizing the need to address this disparity and create equitable access to STEM internships and ultimately STEM careers, Argonne launched an innovative workforce development program known as Bridge Into Internships. Through the program, Argonne provides support to students, enabling them to develop the necessary skills and knowledge to become the STEM leaders of tomorrow.

“By expanding access to STEM internships and promoting intentional and supportive educational opportunities, the laboratory strives to contribute to the development of a more inclusive and diverse STEM workforce.”

John Domyancich

STEM EDUCATION MANAGER
ARGONNE NATIONAL LABORATORY

THE PARTNERSHIP

Bridge Into Internships is an immersive eight-week summer internship program that helps students from underserved communities pursue and excel in STEM fields. By actively engaging with high schools in nine South Side communities, Argonne aims to nurture and inspire a diverse pool of talent, ultimately working towards a more inclusive and representative STEM workforce.

Bridge Into Internships offers students real-world exposure to STEM careers as well as professional mentoring. In the program, students work with scientific mentors at Argonne, but

they also work with members of Argonne's Institutional Partnerships team, learning valuable professional skills that will help prepare them for careers. Through hands-on laboratory experiences, access to cutting-edge research facilities, and one-on-one mentoring by experienced professionals in the field, the program seeks to ignite students' passion for science and technology, while also equipping them with the practical skills necessary for future success.

THE IMPACT

- Argonne is paving the way for a brighter future, where every student has equal opportunities to succeed and make a meaningful impact in the world of science and technology.
- Bridge Into Internships supports and nurtures talented students from diverse backgrounds in our community, helping them prepare for college, secure college internships, and get them ready for STEM careers.
- Ultimately, the program contributes to the development of a more inclusive and diverse STEM workforce.

UNIVERSITY PARTNERSHIPS

University of Illinois Chicago and Argonne promoting collaborative research, building diverse ecosystem for talent

THE PARTNERSHIP

Argonne has worked with research partners at the University of Illinois at Chicago (UIC) for many years, but now the two organizations are working together to broaden and deepen their partnership. The reinvigorated partnership will promote research collaboration while building a diverse ecosystem for talent in the Chicagoland area. Currently, the partnership is advancing a few key scientific initiatives of interest to both institutions, including energy storage, computing, and climate science. The partnership will promote more collaboration and joint appointments in these research areas, and it also seeks to make a positive impact in the area by strengthening Argonne's ties to the Chicagoland community and helping to prepare a new generation of diverse students for the STEM careers of the future.

UIC, located just outside of downtown Chicago and only 20 miles away from Argonne, is the largest and most prestigious state school in the Chicagoland area. It is a top-tier research institution, recognized as an R1 research institution, a status given to the universities with the highest levels of research activity in the country. UIC is designated as a Hispanic-Serving

Institution, as nearly a third of UIC's undergraduate students come from this historically under-served community.

MAKING AN IMPACT

Currently, the Argonne-UIC partnership is focused on leveraging the expertise and resources of both institutions to make an impact in three key areas:

CLIMATE CHANGE

UIC is working with Argonne on the Community Research on Climate and Urban Science (CROCUS), an Urban Integrated Field Laboratory established by Argonne to understand and meet the challenges of Chicago's changing climate, such as heat islands, poor air quality, high energy costs, and flooding. CROCUS's research will inform the design and deployment pathways of technical solutions that promote social equity and enhance urban resilience in response to the climate crisis.

ENERGY STORAGE

Several professors at UIC are collaborating with Argonne to advance the science of energy storage. Their research on the fundamental science of batteries is leading to a better understanding of how batteries work, and to the design and manufacturing of better batteries. This research, which is critical to the development

of a green energy economy, is inspiring the next generation of students to enter the field.

COMPUTING

This partnership seeks to foster interdisciplinary collaborations across Argonne and UIC to find solutions to problems using advanced computing. Among the focus areas will be using high-performance computing tools in support of scientific discovery.

Moving forward, Argonne will be growing the partnership to be more inclusive of additional scientific topics across the laboratory. The goal is to foster more areas of collaboration, increase joint appointments, as well as new opportunities for students to get involved in research across both institutions.

“The power of this partnership is the synergy between the two organizations' science and technology capabilities and our commitment to community and diversity.”

Meridith Bruozas

DIRECTOR OF
INSTITUTIONAL PARTNERSHIPS
ARGONNE NATIONAL LABORATORY

UNIVERSITY PARTNERSHIPS

Preparing University of Puerto Rico-Río Piedras students for careers in Earth and atmospheric sciences

THE CHALLENGE

Each year, the Caribbean receives atmospheric dust transported all the way from Africa. These mineral-enriched tiny dust particles can have important implications. They impact everything from clouds and tropical storms to ocean

ecosystems, and even influence the climate and air quality in the Great Caribbean Basin. However, few institutions in the Caribbean study atmospheric dust storms and how they interact with human and Earth systems.

THE PARTNERSHIP

In a new partnership launched this year, Argonne and Brookhaven National Laboratories are helping to build capacity for aerosol and atmospheric science research at a key location in the Caribbean: The University of Puerto Rico-Río Piedras (UPRRP). The three institutions are also working together to attract more students to the university's Environmental Science Program by providing internships, training programs, and mentorship opportunities to the university's students.

This program will actively engage minority students that are largely underrepresented in the fields of Earth and atmospheric sciences. More than 95% of UPRRP's student body is Hispanic. The four-year project is funded by DOE's new Reaching a New Energy Sciences Workforce (RENEW) Initiative.

The RENEW initiative helps to support historically underrepresented groups in science, technology, engineering, and mathematics (STEM) and diversify American leadership in energy and climate.

THE IMPACT

Together, the partners will create a pathway to bring underrepresented minority students in higher education into the new energy workforce. Through hands-on experiences, they hope to open new career avenues for talented young scientists, engineers, and technicians. Not only is this program preparing students for promising careers, it is building local capacity to conduct research on dust storms in the Caribbean, where these atmospheric events can have a profound impact on people and the environment.



Satellite image provided by the National Oceanic and Atmospheric Administration, NOAA, showing the historic African dust event ("Godzilla" dust event) arriving in the Caribbean on June 22, 2021. The red dot denotes the University of Puerto Rico-Río Piedras.

"We are excited to help prepare the undergraduate and graduate students at University of Puerto Rico-Río Piedras for careers where they can address these scientific challenges."

Yan Feng

PRINCIPAL ATMOSPHERIC
AND CLIMATE SCIENTIST
ARGONNE NATIONAL LABORATORY

GOVERNMENT PARTNERSHIPS

Partnering with the Minnesota Department of Commerce and others to maximize the potential of solar power plants

THE CHALLENGE

As the U.S. looks to combat climate change, solar energy is increasingly seen as a large part of the answer. However, ground-mounted solar facilities occupy large areas of land. What if it that land could provide more than just power?

An increase in the number of solar power plants provides an opportunity to use the land to benefit people and the environment. New solar power facilities could be designed to improve wildlife habitat, sequester carbon, and provide enhanced ecosystem services—the benefits nature provides to people. However, exactly how to do that is not yet clear.

THE PARTNERSHIP

Argonne is partnering with the Minnesota Department of Commerce, universities, private institutions, and other national labs to assess the long-term impacts solar facilities have on the land they sit on. The project will also involve Midwestern tribes to help evaluate different methods for increasing ecosystem services when planning for new solar projects on tribal lands.

With funding from the DOE's Deploying Solar with Wildlife and Ecosystem Services Benefits (SolWEB) program, the project will establish a national soil database and study what the land will be like after 30 or more years of use for generating clean power.

A solar soils database will answer important questions about the ecosystem services provided by large-scale solar facilities.

It will also provide information about the quantities and timeframes of carbon storage in soils, maximizing climate benefits within the solar industry.

THE IMPACT

- If managed properly, solar facilities may be able to provide ecological benefits while also generating carbon-free energy.
- Solar facilities have the potential to improve soil health and carbon sequestration, benefit wildlife, and provide additional ecosystem services to people.
- This study can provide data on which ecosystem services solar facility soils can provide over time, and what types of vegetation management are most beneficial.

“If we hope to have an inhabitable planet for our kids and grandkids, we need to get serious about renewable energy sources—including solar power. As we take steps to combat the climate crisis, we must conduct more research to ensure that we can preserve and protect our ecosystems and wildlife as we transition to renewable energy. I’m encouraged by DOE’s trust in Illinois’ world-class research facility, Argonne National Laboratory, and congratulate the Argonne scientists selected to lead this research.”

Dick Durbin
U.S. SENATOR, ILLINOIS

GOVERNMENT PARTNERSHIPS

Helping improve America's preparedness for climate extremes via partnership with FEMA and AT&T

THE CHALLENGE

Communities across the U.S. are increasingly vulnerable to the impacts of extreme weather events. Climate change is making fires, floods, and heat waves more deadly and destructive. The situation is already so widespread that one in three Americans said they have been personally affected by an extreme weather event in the past two years. These climate impacts, which are becoming more frequent and intense, can vary not just from state to state, but even at the local level.

Local and regional governments want to identify risks posed to their community by a changing climate so they can adapt to protect their citizens and infrastructure now and in the future. However, until now, obtaining reliable information on how climate change might impact their people is beyond the ability of most local and even state governments.

THE PARTNERSHIP

To help improve America's preparedness for future climate extremes, Argonne partnered with AT&T and the Federal Emergency Management Agency (FEMA) to provide people with access to a new portal that provides cutting-edge science for climate projections. The Climate Risk and Resilience Portal (ClimRR) uses some of the most sophisticated climate science modeling in the world to provide state, local, tribal, and territorial emergency managers and community leaders with free access to localized data about future climate risks.

By knowing the risks posed by a changing climate to their communities—such as temperature, precipitation, wind, wildfire, flooding,

and drought conditions—communities explore strategies for resilience. These climate projections are particularly valuable when overlaid with community and infrastructure information, such as those sourced from FEMA's Resilience Analysis and Planning Tool. Now, community leaders can understand how local-scale climate risks may impact their community, including vulnerable populations and critical infrastructure.

Companies and utilities can also use the portal to assess the risk to their infrastructure and plan for future conditions. AT&T originally commissioned Argonne's Center for Climate Resilience and Decision Science to produce the climate projections in ClimRR for the company's own adaptation efforts,

but through this collaboration, AT&T has made this data available to the world.

THE IMPACT

- ClimRR provides some of the most advanced climate data available in a nontechnical format and puts high-resolution, forward-looking climate insights into the hands of those who need them most.
- Community leaders and public safety officials can now understand how increasing climate risks will affect their populations and take the needed actions to become more climate resilient.
- Access to this information will assist leaders as they strategically invest in infrastructure and response capabilities to protect communities for future generations.

STATE-OF-THE-ART FACILITIES

Argonne Leadership Computing Facility now home to one of the world's fastest supercomputers, Aurora

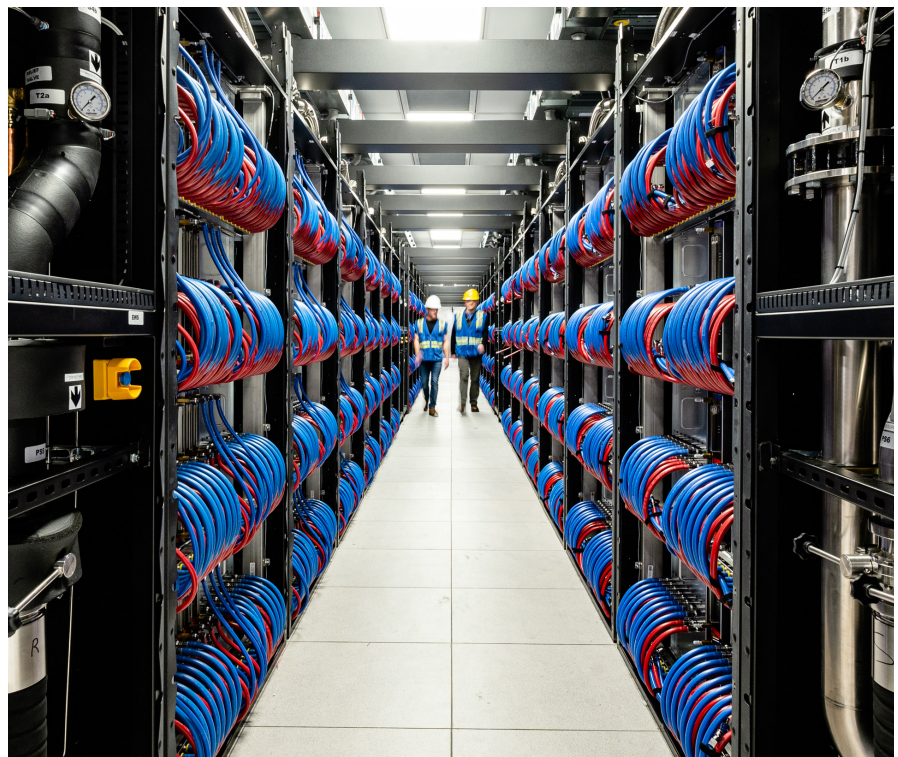
The Argonne Leadership Computing Facility (ALCF), a Department of Energy Office of Science user facility, is nearing completion of the installation of one of the nation's first exascale supercomputers. Named Aurora, it is capable of delivering over two exaflops of computing power, or two billion billion calculations per second. With this amount of computing power, Aurora will enable science that was impossible to do before.

Built in partnership with Intel and Hewlett Packard Enterprise, Aurora seamlessly integrates the important scientific tools of data analysis, modeling and simulation, and artificial intelligence. With all of these capabilities combined in one machine, Argonne will allow researchers around the world to construct vastly more accurate models in a diversity of scientific domains, from climate and materials science, to energy storage and fusion energy, to human health and disease.

The launch of Aurora ushers in a new era of supercomputing at Argonne, one that is sure to drive unprecedented innovations and scientific breakthroughs. Although Aurora has been in development for nearly 10 years, the path to exascale computing at Argonne began over 35 years ago, when ALCF first brought together some of the best minds in computer science and encouraged them to push the bounds of what was possible in high-performance computing.

Renowned for its modeling, simulation, data analysis, and artificial intelligence (AI) capabilities, the ALCF operates several leadership-class supercomputers in addition to Aurora that are orders of magnitude more powerful than the systems typically used for open science. By providing access to its supercomputing resources, ALCF has enabled many breakthroughs in science and engineering and supported the development of technologies that improve our economic prosperity and well-being.

ALCF's computers support many large-scale, computationally intensive projects aimed at solving some of the world's most complex and challenging scientific problems that impact nearly every aspect of our lives. By providing supercomputing time and support services to researchers from academia, industry, and government agencies, the ALCF enables its users to accelerate the pace of discovery and innovation across many disciplines. Now, with the addition of Aurora, the pace of scientific discovery can happen faster than ever.



Creating new materials for quantum technologies at the Argonne Quantum Foundry

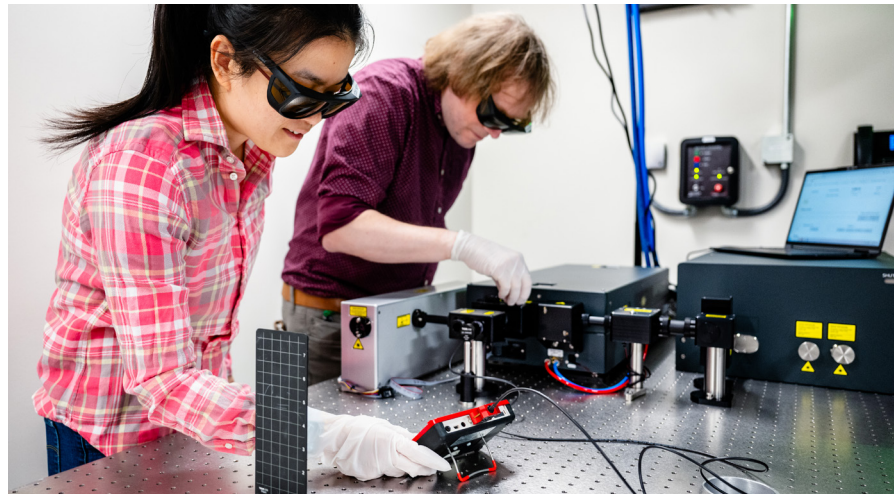
The Argonne Quantum Foundry is a national resource for creating next-generation materials for scalable quantum devices.

Its establishment was led by Q-NEXT, a U.S. Department of Energy National Quantum Information Science Research Center that is led by Argonne.

The state-of-the-art facility has tools for designing, creating, testing, and simulating materials that will advance quantum computing, sensing, and communication. It fills a significant need in the nation's quantum information science ecosystem, providing a robust supply chain of materials and devices as well as simulation platforms for the development of pioneering technologies.

The Argonne Quantum Foundry supports research within Q-NEXT as well as other national research efforts. In addition, students and professionals use the foundry to develop expertise in the critical area of quantum materials development, supporting education and job opportunities.

In quantum information science, researchers take advantage of nature's quantum features, which are available primarily at atomic scales and ultracold temperatures, and turn them to practical purpose. Quantum computers will be able to solve problems that today's most powerful supercomputers cannot. Communication networks based on



quantum principles are expected to be tamperproof. Quantum sensors will be so sensitive, they will be able to measure properties of a single living cell or detect earthquakes well before traditional sensors can.

At the foundation of these quantum devices are sophisticated materials designed to store, process and distribute quantum information. The Argonne Quantum Foundry provides researchers with full-stack capabilities for developing these novel materials, offering tools for materials synthesis, qubit creation (qubits are the fundamental components of quantum technologies) and the integration of qubits into devices.

The Argonne Quantum Foundry focuses on a class of materials called semiconductors. It features areas for developing, testing and

fabricating semiconductor qubits. It will also feature a prototype silicon-based quantum computer, which will run simulations to aid in materials development. Data collected at the foundry will be used to build a national database of materials and their properties, furthering progress in quantum technology development.

Through the foundry, Argonne is creating and strengthening partnerships with researchers and institutions in quantum information science throughout the nation, serving as a go-to for next-generation materials designed for quantum technologies.

The 6,000-square-foot foundry officially opened in 2023, and tools and capabilities will continue to be added to the facility according to researcher needs.



Turning Argonne’s science and resources into U.S. manufacturing’s competitive advantage

Public and private companies working with the Materials Manufacturing Innovation Center (MMIC) have access to a rare concentration of experts and world-class facilities. At MMIC, experts at Argonne help companies develop economically viable processes for manufacturing materials at a commercial scale. This can give U.S. manufacturers a competitive advantage and help them take their business to the next level.

At a time when many companies have scaled back their R&D, MMIC can provide the tools, resources, and expertise needed to move U.S. manufacturing forward. Here, scientists and engineers are dedicated to accelerating the precision scale-up of advanced materials and chemistries, a process that can be prohibitively expensive for small and medium sized companies to do on their own. As a national laboratory, Argonne can take risks

and invest in the cutting-edge science needed to make an impact. The team at MMIC is cultivating new partnerships, accelerating the commercialization of advanced materials and chemical manufacturing technologies, and helping to drive innovative products to market faster.

MMIC serves as an important link to industry, acting as a catalyst to determine what needs and technologies can help manufacturers. By working closely with the scientists and resources only available at Argonne, companies can get the help they need to translate problems into action and solutions that can make a real difference in the world. This is particularly true when it comes to MMIC’s efforts to work with industry on improving sustainability, such as developing the science needed for effective decarbonization or advancing the future hydrogen economy.



“Whether scaling up technology or accessing the added science from Argonne’s top-notch infrastructure, MMIC is an invaluable partner for connecting manufacturers to Argonne’s knowledge base.”

David Boulay
PRESIDENT
ILLINOIS MANUFACTURING
EXCELLENCE CENTER

CAPABILITIES

ACCESS

The Argonne Collaborative Center for Energy Storage Science (ACCESS) is a collaborative of scientists and engineers from across Argonne that helps public and private-sector customers turn science into solutions

CONTINUOUS FLOW SYNTHESIS

Accelerating the scalable synthesis of advanced materials and chemicals

MATERIALS ENGINEERING RESEARCH FACILITY

Advanced R&D of experimental materials and chemicals

CARBON REDUCTION

Reducing greenhouse gas emissions through electrification and carbon capture

RECELL

The ReCell Center is a collaboration of industry, academia and national laboratories working together to advance recycling technologies along the entire battery life-cycle for current and future battery chemistries

CIRCULAR ECONOMY

Turning waste into clean energy or products

CONNECTING WITH THE COMMUNITY

ARGONNE'S NEW OFFICE OF COMMUNITY ENGAGEMENT

Community engagement has been a longstanding and critical component of Argonne's mission.

Building on that foundation, this past year, Argonne established an Office of Community Engagement (OCE) to lead the lab's community outreach and engagement efforts.

Argonne named Robyn Wheeler Grange to serve as its Director, and she brings a wealth of experience to the role as well as relationships built working for more than 20 years within Chicagoland.

The OCE's mission is to advance the impact of Argonne's science and technology through expanded community collaborations and to extend the benefits of Argonne's capabilities and resources to communities.

The OCE is strategic and responsive in building intentional, collaborative relationships with communities and community-focused organizations at the local, state, and regional levels; facilitating and supporting investment in short- and long-term community-engaged research; and tracking laboratory-wide community engagement efforts and programming.

The office produces many of Argonne's community outreach events, including the Argonne OutLoud public lecture series. These free public lectures highlight Argonne's cutting-edge research and pivotal discoveries and are one way Argonne shares our work with the science-interested community.

With a presence on the South Side of Chicago—Argonne in Chicago—and Argonne's campus in the southwest suburbs, the OCE provides a strong framework for the inclusive and collaborative advancement of science and technology in our community.

Argonne in Chicago is working with local community members, advocates and local officials to gain insights into community needs and address issues. These collaborative efforts have helped launch several programs and initiatives to study climate change, advance environmental justice, broaden STEM education, and provide career opportunities.



Paula Robinson (center), president of Bronzeville Partners, speaks with Henry McKoy (left), Director of the U.S. Department of Energy's (DOE) Office of State and Community Energy Programs, and Ruby Goldberg (right), Regional Intergovernmental and External Affairs Specialist for the Midwest Office of Congressional and Intergovernmental Affairs at DOE. They are pictured at the Bronzeville Community Microgrid—the country's first neighborhood-scale microgrid—on Chicago's South Side during a tour facilitated by Argonne.

“Argonne has a proud history of community engagement, but this office brings more structure and intentionality to our efforts. We believe it will increase our impact.”

Paul Kearns

LABORATORY DIRECTOR
ARGONNE NATIONAL LABORATORY



NEW STARTUPS JOIN ARGONNE'S ENTREPRENEURSHIP PROGRAM

In August, four new innovators joined Chain Reaction Innovations (CRI), the Lab-Embedded Entrepreneurship Program at Argonne, as part of the program's seventh cohort.

Each innovator is collaborating with a host scientist at Argonne while embedded full-time at the laboratory. Innovators plan to develop clean-energy startups that reduce greenhouse-gas emissions and increase U.S. competitiveness in emerging energy technologies. The goal of innovators and the CRI program is to support the country's equitable clean-energy economy and its goal of net-zero carbon emissions by 2050.

CRI's impact is far-reaching as it celebrates its seventh year of embedding entrepreneurs at Argonne. CRI's first cohort graduated in June 2019, amassing millions in investment. The combined total raised by CRI startups through November 2023 was over \$427 million, and the program had helped create 641 U.S. jobs to date.

The new innovators in Cohort 7 and their projects are:

- Tim Fairley-Wax, Biomembrane Filtration: Unlocking Energy Recovery from Waste Streams
- Alexis Peña: Man-Made Bioengineered Protein-Based Fibers to Replace Petroleum-Derived Textiles
- Rawand Rasheed: Retrofit Dehumidifier for Substantial Air Conditioner Energy Reduction
- Laura Stoy: Recycling of Coal Fly Ash for Rare Earths and Concrete

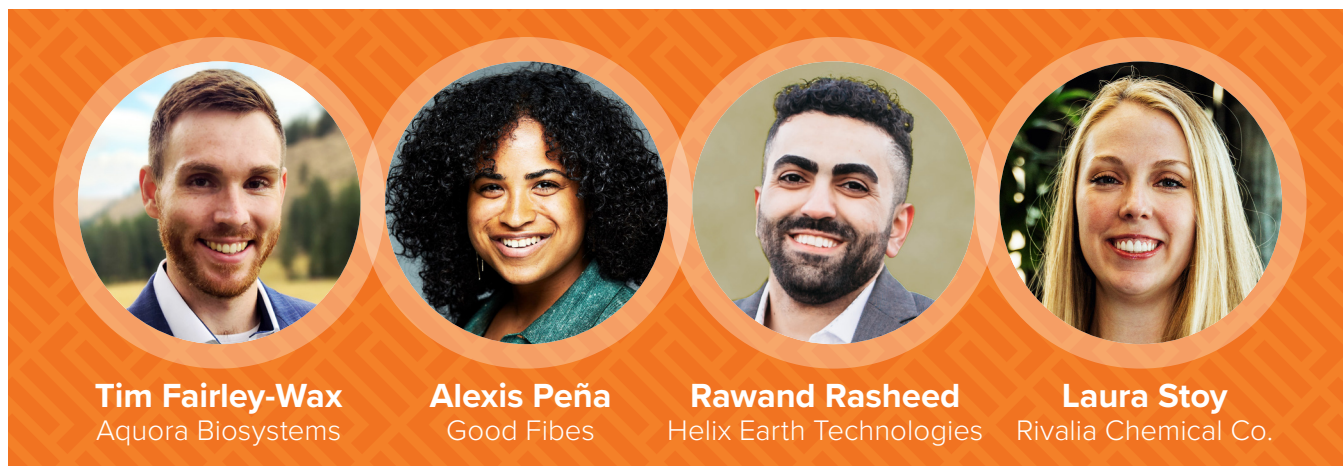
Innovators were selected following a national solicitation process and a two-part pitch competition with judging from local, regional and national industry experts, scientists and engineers.

CRI is supported by Argonne and the following DOE entities:

- Office of Energy Efficiency and Renewable Energy's Advanced Materials and Manufacturing Technologies Office and Industrial Efficiency and Decarbonization Office
- Office of Fossil Energy and Carbon Management
- Office of Science and its Advanced Scientific Computing Research program

"CRI is a unique program that provides unparalleled access to a national lab and the regional innovation ecosystem."

Dick Co
DIRECTOR
CHAIN REACTION INNOVATIONS



U.S. DEPARTMENT OF ENERGY TECHNOLOGY TRANSFER PROGRAMS

Technology Commercialization Fund

Accelerating the commercialization of promising energy technologies

This year, the U.S. Department of Energy (DOE) awarded a total of more than \$5.6 million in funding to six projects by Argonne and partners via the Technology Commercialization Fund (TCF). The goal of the TCF is to promote promising energy technologies for commercial purposes.

“As America transitions to a clean-energy economy, it is vital that we reduce the time from when a clean-energy technology is invented to when it’s available to consumers,” said U.S. Secretary of Energy

Jennifer M. Granholm. “DOE’s national laboratories are developing landmark clean-energy technologies that will lower energy costs for Americans, strengthen our nation’s economic stability, and continue to advance the nation’s decarbonization goals.”

Argonne’s partners in the projects contributed a total of more than \$15.3 million via a cost-share arrangement.

DOE’s Office of Technology Transitions manages the TCF.

\$5.6M

TCF funds awarded to Argonne in 2023



ARGONNE RESEARCHERS WHOSE PROJECTS RECEIVED 2023 FUNDING

LEAD ARGONNE RESEARCHER	PROJECT	PARTNER(S)	DOE FUNDING AMOUNT
Youngho Shin	5 MT/year Supercritical Hydrothermal Continuous One-Step Manufacturing Process	ACTion Battery Technologies (Carrollton, Ga.)	\$900,000
Rui Hu	Advanced System Analysis Code Enhancement for Commercial Deployment of Molten Salt-Cooled Reactors	Kairos Power, LLC (Alameda, Calif.)	\$980,000
John Hryn	Automotive Magnesium from Domestic Aluminum-Magnesium Scrap	Galvotec Alloys (McAllen, Texas)	\$250,000
Meltem Urgun-Demirtas	Scaling up Arrested Methanogenesis Technology for Sustainable Aviation Fuel Production	Great Lakes Water Authority (Detroit); Sulzer Chemtech USA, Inc. (Baton Rouge, La.); University of Illinois Chicago	\$154,085
Peter Tkac	Towards Commercialization of Used Nuclear Fuel Recycling in the U.S.	Orano Federal Services (Bethesda, Md.); SHINE Technologies (Janesville, Wis.)	\$2.45 million
Levent Eryilmaz	Ultra-Fast Thick Boriding Treatment to Enhance Reliability and Reduce Cost in Geothermal Power Plant Components	BlueWater Thermal Solutions (Greenville, S.C.); Controlled Thermal Resources (Imperial Valley, Calif.)	\$900,000

AWARDS AND RECOGNITION

Chicago Innovation Awards

The annual Chicago Innovation Awards is the region’s foremost recognition of the most innovative new products or services brought to market each year.

2022 CHICAGO INNOVATION AWARD

COVID Wastewater Testing Argonne and Discovery Partners Institute

Argonne is among the winners of a 2022 Chicago Innovation Award for its work on a COVID wastewater surveillance system. In collaboration with the Discovery Partners Institute, Argonne researchers assembled

one of the first teams in the nation to reliably analyze samples of raw sewage for evidence of SARS-CoV-2 RNA, providing real-time information to help both the Chicago Department of Public Health and the Illinois Department of Public Health through the pandemic.

Sarah Owens, sequencing laboratory manager in Argonne’s division of Biological Sciences, is among this

year’s honorees. Her team’s work sequencing the virus’s RNA in wastewater helps doctors determine if people are infected in an area, which strains of the virus are circulating, and even which types of treatments would be most effective.

The research pilot was funded by the Walder Foundation, and this full-scale project is now being funded by the Illinois Department of Public Health and the Chicago Department of Public Health. It is being led by the University of Illinois-directed Discovery Partners Institute and includes researchers from Argonne, the University of Illinois Chicago, and Northwestern University.

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.

Three technologies developed by Argonne researchers and partner organizations won R&D 100 Awards in 2023, and another was named a finalist.

AWARDEES

CANDLE (CANcer Distributed Learning Environment)

Principal Investigator: Rick Stevens

CANDLE is an artificial intelligence-based computer code that brings together machine learning, deep learning, and cancer research to accelerate the discovery of new cancer therapies and treatments. This unique and powerful platform aims to solve three major challenges in cancer. First, it analyzes protein behaviors in tumor cells. Second, it looks at the relationship between tumors and drugs. Third, it can analyze biomedical records to extract new

patterns and information. CANDLE was also used to research potential treatments for SARS-CoV-2. In addition, scientists are using CANDLE codes to check the performance of the most advanced DOE computing systems, including Argonne’s upcoming Aurora exascale supercomputer. CANDLE was designed in partnership with DOE and the National Cancer Institute. This research was supported by the Exascale Computing Project, a collaborative effort of DOE’s Office of Science and the National Nuclear Security Administration.

Cardinal: Scalable High-Order Multi-Physics Simulation

Principal Investigator: April Novak

Scientists and engineers rely on simulation to predict the behavior of nuclear reactors under a variety of design conditions. Often, experiments are too expensive to carry out or are incompatible with fast-turnaround design cycles. Modeling and simulation are particularly important to the advancement of novel nuclear reactor designs and can enable critical insight for making better design decisions to increase efficiency and safety. Cardinal is an open-source simulation software package that delivers highly accurate solutions for a wide range of applications in nuclear energy sciences. It features state-of-the-art, scalable algorithms for achieving multiphysics solutions with neutron transport, fluid flow, heat transfer, and material behavior on platforms ranging from laptops to extreme-scale computers. The physical phenomena that can be

simulated with Cardinal range from neutron interactions with matter on the atomic scale to the whole-system response of nuclear reactors coupled to electric grids on the kilometer scale. Funding for Cardinal was provided by DOE's Office of Nuclear Energy.

Climate Risk and Resilience Portal (ClimRR)

Principal Investigators: Carmella Burdi

ClimRR is a free, web-based tool that gives emergency managers and community leaders access to localized data about future climate conditions and hazards. Climate projections and visualization at the neighborhood-level scale create opportunities for local decision makers to take informed action. This information is increasingly of interest to decision makers as the impacts of climate change become more frequent and intense. Argonne developed ClimRR in a unique collaboration with AT&T and the Federal Emergency Management Agency (FEMA).

To create ClimRR, Argonne first used the power of the Argonne Leadership Computing Facility to dynamically downscale data from three different global climate models, and then used that dataset as the basis for rendering more than 100 unique visualizations of climate impact variables over three different timeframes and according to two greenhouse gas emission scenarios. The data in ClimRR can be combined with data from FEMA's Resilience Analysis and Planning Tool to help users understand local-scale climate risks in the context of existing community demographics and infrastructure. For example, users can include locations of vulnerable populations and critical infrastructure.

ClimRR can be used to plan for and reduce heat emergency deaths or target assistance among those communities that are most vulnerable. Communities can use the tool to protect family farms and the future food security of millions of people. Decision makers can use ClimRR to help make infrastructure more resilient against increasingly extreme conditions. Also, decision makers can use the tool to help vulnerable local seasonal economies plan for change, and preserve the cultures, resources, and lifeways of indigenous peoples. AT&T originally commissioned Argonne's Center for Climate Resilience and Decision Science to produce the climate projections in ClimRR for the company's own adaptation efforts, but then sought to make that data publicly available.

FINALISTS

ActivO: A Machine Learning Driven Active Optimizer for Rapid Product Design Optimization

Principal Investigator: Pinaki Pal

ActivO is an innovative software technology developed at Argonne that provides a unique turnkey solution to speed up product design optimization and massively accelerate virtual prototyping across a wide range of industries. Imagine designing a car engine or a wind turbine. You want it to work well and use less energy, but figuring out the best design can take a lot of time and money because of having to test many ideas and prototypes. The secret to how ActivO accelerates the design process is a one-of-its-kind combination of: advanced ensemble machine learning (ML)-driven predictive surrogate models trained

on simulation data; adaptive sampling of the design space via active learning for on-the-fly refinements of the ML surrogate models; and efficient algorithms for controlling the relative degree of local (exploitation) versus global (exploration) search of the design space during optimization—all within an automated, modular and scalable workflow. ActivO can be readily coupled with any simulation tool. It can also efficiently run on high-performance computing clusters, supercomputers, and cloud-based platforms, owing to its highly parallelizable and portable framework. The compact and end-to-end nature of ActivO enables easy adoption by engineers in industry, even those who do not have extensive ML expertise.

ActivO has wide applicability and ability to impact multiple industrial sectors, such as automotive, aerospace, chemical, iron and steel, oil and gas, carbon capture, and biomedical. Argonne has demonstrated the capability of ActivO to speed up design optimization of automotive engines by an order of magnitude—from months to a few days—compared with other contemporary commercial software tools. Companies like Dow Chemical are already leveraging it to optimize their products. By way of drastically accelerating design optimization campaigns, ActivO can shrink industry design cycles/costs and time-to-market for advanced products. ActivO was developed under a Technology Commercialization Fund project funded by the Decarbonization of Off-road, Rail, Marine and Aviation program of DOE's Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Office.

INNOVATION AND PARTNERSHIPS BY THE NUMBERS

FISCAL YEAR 2023



111

New inventions reported



66

New patents issued

**STRATEGIC PARTNERSHIP
PROJECT SPP**

192 New agreements

\$102M
Value

**COOPERATIVE RESEARCH AND
DEVELOPMENT AGREEMENT CRADA**

33 New agreements

\$41M
Value





At the forefront of science and technology

We look forward to working with
you in Fiscal Year 2024 and beyond
to deliver value and impact.



Megan Clifford
Associate Laboratory Director
Science and Technology
Partnerships and Outreach
ARGONNE NATIONAL LABORATORY

To learn more, including how
to collaborate with Argonne,
visit anl.gov/work-with-us.

To submit a partnership
inquiry, visit anl.gov/partners.

ARGONNE NATIONAL LABORATORY

- U.S. Department of Energy research facility
- Operated by UChicago Argonne, LLC
- Midwest's largest federally funded R&D facility
- Located in Lemont, IL, about 25 miles (40 km) southwest of Chicago, IL (USA)
- Conducts basic and applied research in dozens of fields
- Unique suite of leading-edge and rare scientific user facilities

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U.S. DEPARTMENT OF ENERGY

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