Sandia National Laboratories

TECHNOLOGY Partnerships

ANNUAL REPORT FY2020

Speeding Up Neutralizing Antibody Discovery to Help Combat Viruses

"Taking laboratory technologies and launching them in the marketplace is how we deliver the promises we make to the public—it supports job creation, fights climate change, and protects our nation from harm. As this report shows, Sandia continues to excel in this critical mission, and I applaud the Technology Partnerships team's dedication and tenacity."

— Dr. Vanessa Z. Chan

Chief Commercialization Officer
Director, Office of Technology Transitions
U.S. Department of Energy (DOE)

"Our mission-inspired research and development investments have enabled numerous and impactful technology transitions, unleashing the capabilities of Sandia to help counter and respond to the unprecedented demands of a global health pandemic. These technologies are helping to sustain our economy and jobs, saving and enhancing lives, improving productivity and innovation, and strengthening our overall national security."

— Dan Sanchez

DOE Technology Partnerships Manager
National Nuclear Security Administration (NNSA)
Sandia Field Office

"Sandia has a longstanding commitment to collaborating with industry, academia, and government to advance technologies and develop products and platforms that improve peoples' lives. Technology transfer promotes innovation and economic competitiveness, and supports Sandia's national security missions. Our Partnerships Program is vital to the success of Sandia and its partners and will continue to grow and bring trailblazing technologies to the marketplace."

— James S. Peery

Laboratories Director
Sandia National Laboratories

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About the cover:
Abcam scientists work on creating a large library of antibody variants to identify those that could potentially neutralize the SARS-CoV-2 virus, using Abcam's rapid high-throughput screening platform.

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"Partnerships with industry, academia, and other national laboratories always help Sandia fulfill its national security mission. During the international COVID-19 pandemic, these collaborations are more essential than ever in amplifying our efforts to accelerate development of technologies that can safeguard the public."

— **Susan Seestrom**

Associate Laboratories Director & Chief Research Officer
Advanced Science and Technology
Sandia National Laboratories

"University partnerships focus on expanding Sandia's core capabilities. By teaming with academic institutions that possess strengths in synergistic research areas, they also help develop the scientists and engineers of the future who can contribute their talents to solving national security challenges."

— **Basil Hassan**

Director and Deputy Chief Research Officer
Chief Research Office
Sandia National Laboratories

"As Sandia has continued to be an active part of multiple established DOE technology transfer programs, we have also come up with innovative programs of our own. We are leveraging our technology development and transfer efforts to simultaneously address the medical and economic needs of the nation during this challenging time."

— **Mary Monson**

Senior Manager
Technology Partnerships & Business Development
Sandia National Laboratories

Innovative Partnership Solutions During the Pandemic

Sandia National Laboratories has always focused on technology transfer, using partnerships to help advance technologies from research to commercialization. But since the start of the COVID-19 pandemic, technology transfer efforts have accelerated to combat both the medical and economic effects of the pandemic. Both DOE and Sandia quickly established technology transfer programs to help.

In this annual report we share just a few from hundreds of Sandia partnerships with industry, national laboratories, government agencies, and universities. Some are part of long-running programs while others were quickly launched in response to pandemic challenges. These partnerships have had an impact by:

- Accelerating discovery of virus-neutralizing antibodies using molecular modeling and library screening
- Creating software robust enough to quickly model any object needed for simulations, no matter how complex
- Making about two-thirds of Sandia's Intellectual property portfolio available for quickly issued free licenses through the Rapid Technology Deployment Program
- Developing a more secure, resilient, clean electric grid with new technology solutions
- Transitioning Common-Hypersonic Glide Body technology to industrial production for use by the U.S. military

Using the scientific know-how and technology transfer expertise available at Sandia for the good of the nation is nothing new. Quickly pivoting to apply that knowledge towards solving challenges brought by a pandemic affecting everyone in the world is. We are proud to be a part of this country's response to overcoming COVID-19.

LDRD Program Essential to Mission Capabilities

Research conducted within the Laboratory Directed Research and Development (LDRD) program is essential to maintaining the vitality of Sandia's mission-critical science, technology, and engineering capabilities. The LDRD program has benefited Sandia's work in all of its national security mission areas, including nuclear security, energy security, and global security.

The Labs and its strategic partners gain from collaborative research results. Many technological breakthroughs originating from, or improved through the LDRD program, are later transferred to industry, commercialized under licensing agreements, and brought to market for the U.S. public good.

LDRD
LABORATORY DIRECTED
RESEARCH & DEVELOPMENT

Look for the LDRD logo in this report to discover which technologies grew out of the LDRD program.

To learn more, visit
www.sandia.gov/ldrd


DANGER

Advanced Technologies Help Achieve Clean Energy Target and Protect Grid

"We are fortunate to have a national laboratory in Albuquerque, and the combination of their expertise, technologies, and resources with our team's industry experience is an ideal collaboration to solve this challenge. We look forward to this opportunity for shared learning and progress."

— Pat Vincent-Collawn

Chairman, President and CEO PNM

CHALLENGE

Our nation's electric system is foundational to our economic and national security. The threats to this critical infrastructure continue to grow and evolve, brought on by climate change, an aging infrastructure, and the possibility of increased cyber and physical attacks on the system. Additionally, technology advancements — such as new renewable and distributed energy systems — are creating vulnerabilities that require new approaches.

COLLABORATION

Sandia National Laboratories and the local electric utility PNM initiated an umbrella CRADA in 2020 to collaboratively address these threats and develop a more resilient, clean electric grid. The CRADA is the culmination of years of partnered experience on several projects, and opens the way toward broader collaborations on energy generation, delivery, storage, and energy management technologies.

The Sandia/PNM partnership is primed for national leadership. PNM is a leading utility and has established a 100% emissions-free energy target for the year 2040. The company knows that meeting this goal will require advanced technologies in a number of areas to make the transition away from fossil fuels to clean energy sources.

As part of its national security mission, Sandia's energy program portfolio is focused on developing technology solutions for a secure and sustainable energy future. Sandia's recently initiated Resilient Energy Systems Mission Campaign demonstrates this corporate commitment by developing a portfolio of LDRD projects to address this need.

SOLUTION

Currently, Sandia and PNM are working together to assess the role of energy storage in helping to meet the PNM 2040 target. The partners are developing new analytical approaches and capabilities, including technologies to help PNM utilize distributed and centralized sources of clean energy while meeting resilience and reliability goals.

Sandia and PNM will explore different types of storage technologies, such as batteries, thermal storage, and hydrogen that can provide grid resilience. Together, the partners can work to test solutions in real-world scenarios.

IMPACT

The work Sandia and PNM are doing together serves as a model for what can be done nationally. PNM provides electric power for a large part of the state of New Mexico, serving both urban and rural areas, working with municipal, state, and tribal governments. The state is a high resource renewable energy environment and has progressive regulatory and legislative bodies pushing for energy solutions and a business community eager to develop clean energy industries. The work done in New Mexico is positioning the state for national leadership in resilient energy solutions that can be applied across the country.

Sandia Engineers Tu Nguyen, Babu Chalamala, and Raymond Byrne, and PNM Associate Director Jon Hawkins standing by battery energy storage at PNM's Prosperity site.

PARTNERSHIP TYPE: *Umbrella Cooperative Research and Development Agreement (CRADA)*
GOAL: *Developing a more secure, resilient, clean electric grid with new technology solutions*

SANDSTONE

Portable Testing Platform Adapted for More Healthcare Applications

"The high-tech environment at Sandia is ripe for innovation and game-changing technologies. The ESTT program allowed us to launch Sandstone and develop cutting-edge medical products based on technology we originally developed for Sandia's biodefense missions."

— Greg Sommer

Co-Founder and Executive Vice President Sandstone Diagnostics, Inc.

CHALLENGE

Performing medical testing outside of a lab is difficult. Most testing systems are large and require lots of power. A small centrifuge system is changing that, bringing testing to patients almost anywhere.

A lab-on-a-disk technology developed at Sandia National Laboratories has been brought to market by Sandstone Diagnostics. The company has continued to refine and develop the original SpinDx™ technology, which they now call CentriFluidics™.

The technology was originally developed to detect biological threats as part of Sandia's national security mission. Now it is benefiting people all over the world in a variety of healthcare applications.

COLLABORATION

When the two Sandia inventors, Greg Sommer and Ulrich Schaff, realized that there could be multiple commercial applications for the technology, Sommer decided to go on leave through Sandia Labs' Entrepreneurial Separation to Transfer Technology (ESTT) program. Schaff, the lead inventor of the SpinDx technology, also left Sandia to co-found Sandstone.

The company licensed the technology from Sandia in 2012 and looked for a first market need to address. After researching the fertility space, the founders realized that men were vastly underserved, and that a simple at-home testing solution could lower the barriers to male fertility testing. Sandstone launched the FDA-cleared, patented Trak™ Male Fertility Testing System in 2017.

SOLUTION

The success of Trak is changing the way men and couples manage their reproductive health. Its success led to national press attention and strategic investment from clinical partners. The company then was able to expand its CentriFluidic platform into other public health applications.

In 2019 they started promoting their Torq™ system. Torq consists of a compact, battery-powered centrifuge and specially designed discs that spin and separate blood samples immediately following collection. Stabilizing blood specimens immediately improves both the purity and stability of the sample, ensuring higher quality and reliability for clinical diagnostic tests.

IMPACT

Sandstone's first product, Trak, has been used by thousands of couples to improve their ability to conceive. It is also used as a research tool in large, international fertility and pregnancy research studies. The newer Torq system is in use for applications ranging from infectious disease testing at doctors' offices to at-home cancer screening. It also makes lab testing available in underserved areas as part of global health initiatives.

The COVID-19 pandemic has highlighted the need for accurate remote testing tools. Torq is being combined with other companies' medical tests, allowing lab-quality sample collection and preparation almost anywhere.

Sandstone Co-Founder and Chief Technology Officer Ulrich Schaff inspects Sandstone's Torq battery-powered centrifuges and single-use discs for remote blood collection and plasma preparation. Six Torq units have a footprint smaller than one conventional centrifuge.

PARTNERSHIP TYPE: *License and ESTT program*
GOAL: *Bringing accurate medical testing to patients wherever they are—at home, in the doctor's office, or at remote locations*

SIMS INDUSTRIES

Solar Glare Reduction Software Shines with New Uses and Features

"Interning provided a solid foundation for conducting and understanding research and interfacing with industry. I was blessed with the opportunity to develop new tools alongside some of Sandia's finest. The confidence and knowledge gained from these experiences was uniquely influential when starting a new company."

— Cianan Sims
Partner
Sims Industries LLC

CHALLENGE

The number of photovoltaic (PV) installations continues to rise. This is having a positive effect on the goal of creating a secure energy future, one of Sandia National Laboratories' missions. But there's a growing awareness of an associated hazard: solar glare. Once primarily an aviation concern for its impacts on pilots and air traffic controllers, solar glare is now catching the attention of many state and municipal authorities. They want to ensure that PV installations preserve the safety of people impacted by glare in any environment.

COLLABORATION

Cianan Sims was a graduate-student intern working at Sandia as a software developer in 2012. At the time, Sandia engineer Cliff Ho was working on a solution to the emerging global safety issue of hazardous glare coming from PV installations. Sims started collaborating with Ho on the software that became SGHAT, or the Solar Glare Hazard Analysis Tool.

Originally SGHAT was made available for free from a Sandia-managed website. When DOE funding ended, a commercialization plan kicked in for the tool which had already been validated by users, patented and copyrighted, and recognized with an R&D 100 award.

SOLUTION

Sims Industries, a company started by Cianan Sims with his wife Andrea Sims in 2014, licensed SGHAT from Sandia in 2016, added new features, and started offering it as ForgeSolar. A major version 2.0 update, which revamps glare analysis with improvements to both accuracy and speed, will be out soon.

More and more users are utilizing ForgeSolar for purposes completely unrelated to aviation, so changes include improvements to analyzing the glare impacts on roads and rail lines. A new heat-map visualization feature lets users quickly identify the sections of roads and paths impacted by glare to, for example, design screening to alleviate the glare.

IMPACT

Stakeholders are turning to ForgeSolar to analyze PV sites and ensure the safety of all those involved. In 2020, users created 2,050 projects using ForgeSolar, with approximately 30% unrelated to aviation, and conducted over 33,000 glare analyses.

The SGHAT technology and its successful transfer enable more solar installations to be sited safely, whether they are near airports, roads, or residences. It also helps users design systems that maximize annual energy production while mitigating glare, benefitting the solar industry and consumers alike.

As an extension of this work, Ho and Sims have created the Tower Illuminance Model which simulates a field of heliostats and lets users interactively calculate irradiance, glare hazard, and potential hazards to birds. Sims has now licensed this new software from Sandia.

Sims Industries Partner Cianan Sims and Sandia Senior Scientist Cliff Ho hold a solar panel to demonstrate solar glare while trying to not be "blinded by the light."

PARTNERSHIP TYPE: *Licenses*
GOAL: *Expanding the features and use of glare software to maximize safety and output of solar energy sites while minimizing risk*

TWO SIX TECHNOLOGIES

Sensor System and Software Protect the Public from Radiological Threats

"SIGMA is the industry-leading radiological detection system, and our partnership with Sandia gives us access to Sandia's leading expertise in national security R&D. Sandia's considerable knowledge in the field helps SIGMA protect U.S. citizens and critical infrastructure."

— Chris Greamo

Chief Technology Officer
Two Six Technologies

CHALLENGE

How do you protect an entire city from radiological threats such as dirty bombs? Historically, radiological and nuclear detection operations suffered from a lack of efficient, accurate, and cost-effective radiation sensors capable of continuous wide-area monitoring.

Whether protecting a stadium seating 100,000 people, an international airport, or screening container ships for radiological sources, radiological and nuclear detection presents numerous technical and operational challenges. Past approaches were time-consuming, expensive, and non-scalable, requiring specialized teams to physically go to points of interest and spend time collecting data using expensive equipment.

COLLABORATION

Two Six Technologies is an advanced technology research and development company that creates and deploys innovative solutions for missions critical to U.S. national security. As part of a Defense Advanced Research Projects Agency (DARPA) program, Two Six Technologies developed the SIGMA system for radiation detection.

Sandia National Laboratories, as part of its national security mission, conducts innovative research and develops software that can be combined with other technologies to detect, mitigate, and defeat threats. One method of moving these breakthroughs from the lab to the field for operational use is by providing software licenses to partners. In this way Sandia's expertise and innovations are shared to improve global safety.

SOLUTION

SIGMA is an advanced sensor network developed by Two Six Technologies to detect radiological and nuclear threats. The system provides the capability to link thousands of individual sensors into a single network, all monitored through a cloud-hosted command system. This cost-effective network approach enables SIGMA to provide continuous real-time monitoring and detection capabilities across an entire metropolitan region.

Partnering with Sandia and incorporating their software into the SIGMA system provides an even more effective tool for first responders, security, military, police and firefighters. Sandia's technologies and expertise enable SIGMA to deploy and operate more accurate and more capable sensors, including handheld devices, mobile units, and larger static sensors.

IMPACT

The combination of licensed Sandia software with a detection system available to both government and commercial users is helping protect the public from radiological and nuclear threats nationally and internationally.

SIGMA provides automated, high-performance, networked radiation detection capability for some of the nation's most critical transportation infrastructure in and around New York City. It also has been deployed in Washington D.C. and London. In addition, SIGMA has been used to protect events of national security interest such as Fourth of July celebrations in Washington D.C., NFL playoffs and Super Bowls, and the Indianapolis 500.

Two Six Technologies Senior Deployment Specialist Markus Newberg sits by shelves of SIGMA sensors and components in a testing lab.

PARTNERSHIP TYPE: *License*
GOAL: *Advancing real-time monitoring and detection of radiological and nuclear threats to improve public safety*

U.S. ARMY AND NAVY

Transitioning Hypersonics to Industrial Production for Military Use

"The collaboration and exceptional teamwork demonstrated between Sandia, the Army and Navy, and our hypersonic Industry partners have been critical to transitioning the technology from the national lab to industry. This effective teamwork has enabled the hypersonic program to meet extremely tight timelines."

— Chris Mills
Colonel
U.S. Army

CHALLENGE

The U.S. Army and Navy are collaborating with Sandia National Laboratories to transition the Sandia-designed Common-Hypersonic Glide Body (C-HGB) technology to industrial production for use by the U.S. military. While Sandia has a contract with the Army and Navy, Sandia does not have a contract with the industry partners who will be manufacturing the systems. These companies have their own contracts with the military.

For Sandia R&D Manager Scott Nance and his team, the challenge was how to bring people from industry on site to work when they were not under contract with Sandia.

COLLABORATION

In about 6 months the Sandia team was able to bring in 60 people from industry, including 22 engineers who would be learning to build the C-HGB through intensive training and hands-on exposure to the flight vehicles. Sandia utilized these industry partners to help execute work on four prototype systems so that the partners could transition that experience to full scale production at their manufacturing facility starting in 2022.

Army and Navy partners advocated for a unified team among Department of Defense, Sandia, and industry partners, and a free flow of communications to expedite industry training and technology transfer. They also helped balance R&D and production schedules to meet overall strategic objectives.

SOLUTION

The collaboration among industry, Sandia, and the military created the need for new Sandia policies. A Visiting Worker Agreement was developed to set terms and conditions so visiting workers who were not under a contract with Sandia could work in Sandia facilities. Engineers, technical writers, configuration managers, and document control staff all required access to the Labs' facilities.

The Sandia team also had to negotiate issues related to training, cybersecurity, equipment, and access to Sandia facilities, including vault-type rooms. Facilities had to be expanded to accommodate the project, including adding a new 10,000-sq.-ft. lab, to house the assembly line and office space.

IMPACT

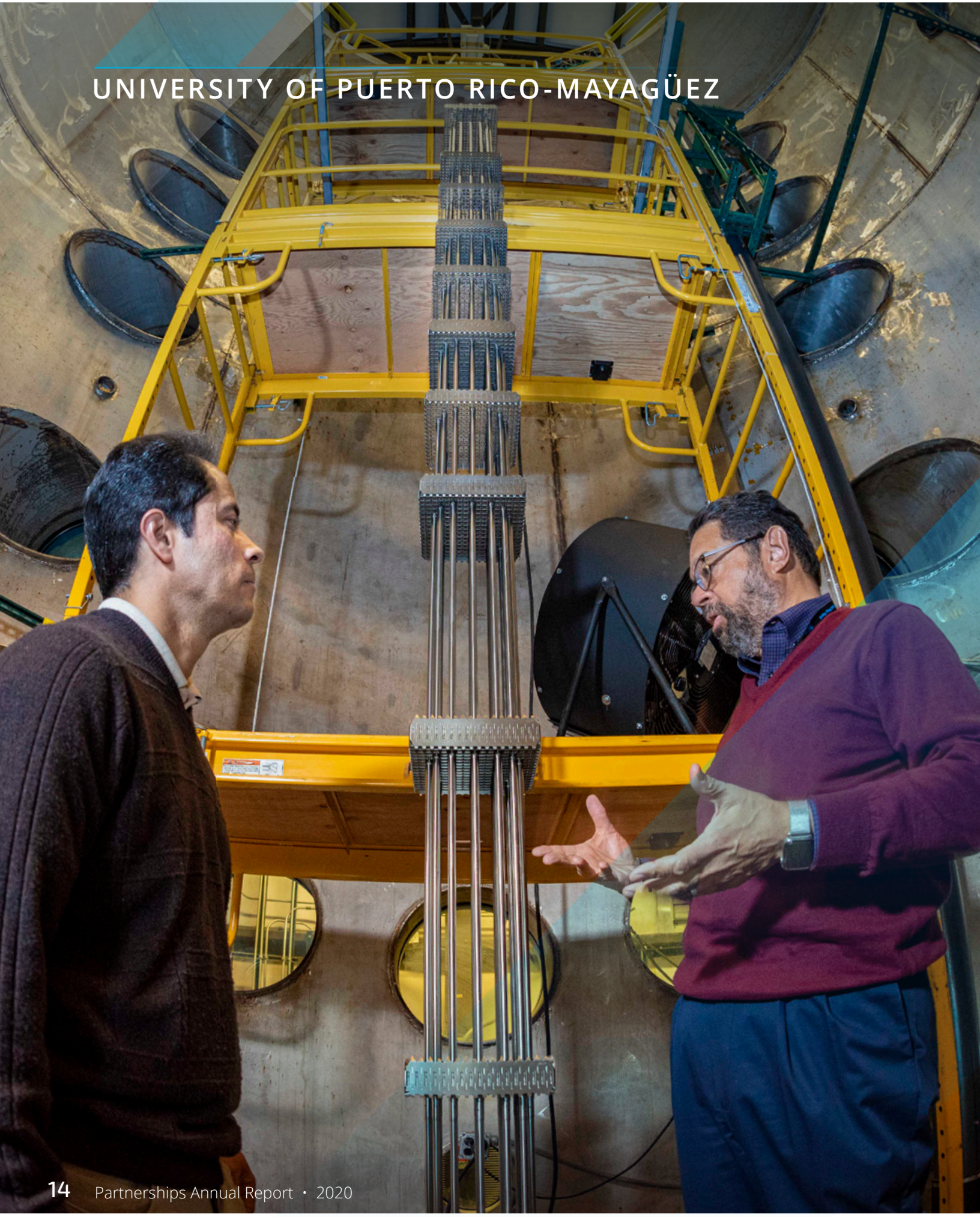
Sandia's national security mission has included more than three decades of work on the hypersonic glide body technology. In order to fulfill the technology transfer part of this project, creativity and innovation were required. Work on the new Visiting Worker Agreement has led to development of a new category of agreements for industry partners at Sandia.

This program has been successful because Sandia's passion for technical excellence, joined with the Army's and Navy's persistent drive to provide the warfighter the very best the nation can give, has brought real value to our military and the nation.

Sandia C-HGB Product Transition Team members select tools to test-run a procedure before it is transferred to industry.

PARTNERSHIP TYPE: *Government Use License, Strategic Partnership Agreement, and Visiting Worker Agreement*
GOAL: *Transitioning Common-Hypersonic Glide Body technology to industrial production for use by the U.S. military*

UNIVERSITY OF PUERTO RICO-MAYAGÜEZ



Energy Security and Sustainability Solutions for Puerto Rico

"We are honored to consolidate our efforts with Sandia through this collaborative alliance. It is a validation of the capacity and talent of our professors and students to find solutions to such an important issue in our country as renewable energy."

— Agustín Rullán Toro

Chancellor
University of Puerto Rico-Mayagüez

CHALLENGE

Increasing minority participation in STEM fields is a high priority for Sandia National Laboratories, its sponsors, and the nation. A 2019 report from the U.S. National Academies suggests that "the U.S. will need 1 million more STEM professionals than it is on track to produce in the coming decade."

The University of Puerto Rico-Mayagüez is the second largest U.S. producer of Hispanic engineers. Sandia and UPRM have been collaborating for the past two decades, but the partnership was strengthened in 2016 with the establishment of the Consortium for Integrating Energy Systems in Engineering and Science Education (CIESESE) sponsored by the NNSA Minority Serving Institutions Partnership Program (MSIPP), which significantly expanded opportunities for UPRM student internships and faculty fellowships at Sandia. This consortium, together with lasting collaborations it created, is helping to build a pipeline of minority engineering talent. The three-year CIESESE program, which concluded in FY2020, has been replaced with a new five-year Consortium for Hybrid Resilient Energy Systems (CHRES).

COLLABORATION

Collaborative mechanisms including a CRADA executed in December 2019, a Memorandum of Understanding, a student cooperative education program at Sandia, and a Corporate Purchase Agreement have formalized the long-running partnership between the two institutions and made it easier to expand joint projects. One key area where both have expertise is energy resilience.

The partnership with UPRM has also spurred a growing list of impactful joint projects. Since Hurricane Maria in Puerto Rico in 2017, Sandia has relied on UPRM's expertise and experience to support DOE's recovery and long-term energy planning efforts on the island that involve scaled-up application of new technologies such as energy storage, renewable energy, and microgrids as part of DOE's energy security mission. The partnership with UPRM is critically important to ensure that energy-resilience solutions for Puerto Rico are appropriate and sustainable.

SOLUTION

Projects undertaken leverage UPRM's academic and research expertise in addressing problems in energy resiliency, critical infrastructure, and development of sustainable energy-efficient processes that complement Sandia's expertise in materials science, grid modernization and resilience, multiple energy sources, and systems engineering.

IMPACT

In addition to providing educational and employment opportunities for UPRM's large pool of well-educated and talented Hispanic and female scientists and engineers that support Sandia's Inclusion and diversity goals, Sandia is also able to work with UPRM faculty and students on real-world projects that benefit the DOE's energy security goals and the 3+ million U.S. citizens that reside in Puerto Rico.

UPRM Electrical Engineering Professor Efrain O'Neill talks about energy research with Sandia Senior Manager Tito Bonano.

PARTNERSHIP TYPE: *Cooperative Research and Development Agreement (CRADA), Corporate Purchase Agreement, Student Cooperative Education Program, and DOE-funded projects*
GOAL: *Leveraging complementary Sandia and UPRM resources to deliver energy security and sustainability solutions for Puerto Rico while supporting strategic goals for both institutions*

UNIVERSITY OF TEXAS AT AUSTIN

Sandia and UT Austin conduct research in a number of collaboration focus areas within their Sandia Academic Alliance (SAA) partnership including quantum information science, resilient materials and nano materials, micro and radiation hardened electronics, autonomous systems, energy, artificial intelligence/machine learning, non-GPS navigation, computational engineering and science, and nuclear engineering.

Polyhedral Meshes Make Complex Computer Modeling More Efficient

"The UT Austin team appreciates the opportunity to collaborate with Sandia partners on an important project. The results obtained by PhD student Jaime Mora-Paz in the course of his dissertation work and the project with Sandia confirm the suitability of VoroCrust and other polygonal meshing techniques for the simulation of foams."

— Leszek F. Demkowicz

Assistant Director
Oden Institute for Computational Engineering and Sciences
University of Texas at Austin

CHALLENGE

Scientists in many disciplines use meshes, or digital representations, to model all kinds of complex parts. For example, a mesh of an airplane wing can be used in computer simulations to learn what might happen in high winds before the new design is prototyped.

Current meshing software can require lots of time-consuming manual labor to clean up the complex objects being modeled. Sandia National Laboratories identified meshing as the single biggest bottleneck in getting simulations completed.

COLLABORATION

Sandia computer scientist Mohamed Ebeida and his team have been working on VoroCrust, software that uses polyhedral elements called Voronoi cells instead of the more typical tetrahedral or hexahedral cells which help it produce meshes for challenging geometries.

UT Austin faculty and students, including Computer Science Professor Chandrajit Bajaj and Post-doc Ahmed Abdelkader, have worked with Sandia for several years on the development of the VoroCrust algorithm and software.

This collaboration was possible because Sandia and UT Austin are partners in the SAA Program, an initiative Sandia has formed with five universities to promote collaborative research and attract top talent to work on tough problems.

SOLUTION

One specific modeling application problem is simulation of deformation of elastomeric syntactic foams, a material used for stress relief of electronic components. Fulbright Scholar Jaime Mora Paz, as part of his PhD dissertation, demonstrated that initial results concerning 2D meshes do extend to 3D by using VoroCrust and other polyhedral meshes with UT Austin's new finite element technology—the Discontinuous Petrov-Galerkin method, enabling discretization with polyhedral meshes.

This is an important step in proving that VoroCrust software is robust and can be used with a variety of numerical methods and applications.

In the future, because VoroCrust has the potential to eliminate the need for manual intervention to clean up geometry, it will also be compatible with exascale computing, automating the entire modeling process and improving overall efficiency.

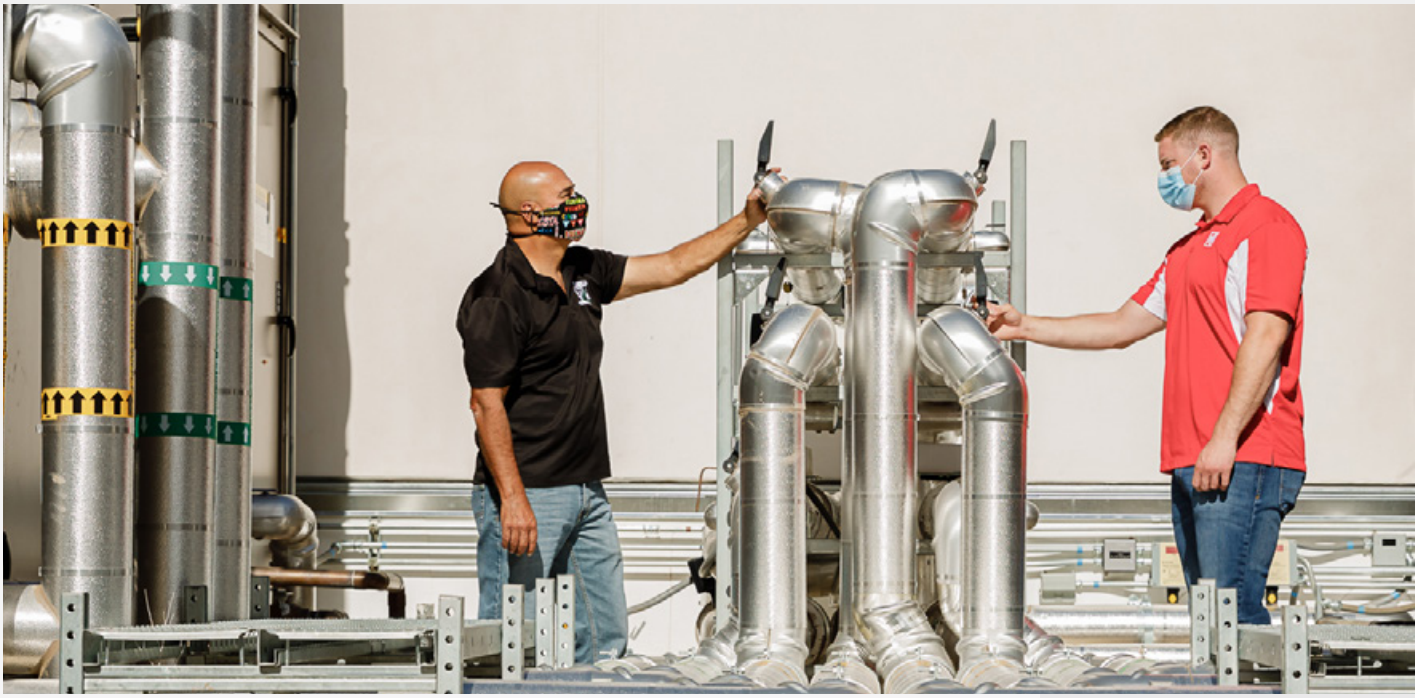
IMPACT

Over the last few years, Ebeida has co-authored a number of publications with Bajaj and members of his group. One of the papers on VoroCrust was also presented at SIGGRAPH 2020, a top computer graphics conference.

Recently Sandia implemented changes in the VoroCrust code, increasing its speed so that a process that took 12-16 hours can now be done in less than 10 minutes. VoroCrust has also already been used by Sandia scientists to make geological models for deep disposal of nuclear waste as part of the DOE's Spent Fuel and Waste Science and Technology Campaign that Sandia leads.

Sandia Computer Scientist Mohamed Ebeida reviewing complex meshes created using VoroCrust software.

PARTNERSHIP TYPE: *Sandia Academic Alliance (SAA)*
GOAL: *Creating software robust enough to quickly model any object needed for simulations, no matter how complex*



Energy Conservation Built into Award-Winning Data Center

An expansion of the 725E Data Center has enabled the deployment of Sandia National Laboratories' latest High Performance Computing (HPC) systems. The Manzano, Attaway, and Astra supercomputers provide over two billion processing hours per year to all Sandia mission areas, including Nuclear Deterrence.

Recently, the facility was awarded the LEED Gold certification. This is the first LEED, or Leadership in Energy and Environmental Design, certification earned under Sandia's LEED v4 Campus effort.

Sandia hired Albuquerque-based sustainability firm Verdacity to partner on the project. The company's expertise helped Sandia find and implement green building features needed to meet the goal of LEED certification.

One way the data center conserves energy is by using warm water to cool HPC systems. Warm water is more efficient in cooling the computers than cool water. For computers that don't exclusively use water cooling, the building was designed with the Airside Economizer, an outdoor air-cooling system. "Since New Mexico is a dry climate, we can leverage 75-80% of our outdoor air without having to cool it," said Dave Martinez, engineering program project lead.

Other green building elements include a Thermosyphon cooling system, which uses passive heat transfer to make the building more efficient and saved more than a half-million gallons of water during its first six months of operation. Highly efficient windows offer natural lighting, a feature not often seen in data centers, and a 250-kilowatt solar system contributes some of the energy used in the building. These and many other features make 725E one of the most efficient data centers in the world, and the first data center to win the DOE's Sustainability Award.

Sandia Engineer Dave Martinez and Information System Architect David Smith inspecting chilled water piping that is part of the Airside Economizer outdoor air-cooling system.

For more information about Astra and Sandia's 725E Data Center, visit https://www.youtube.com/watch?v=6tneOq5M9m4&t=108s

SANDIA PROGRAMS ENGINEERING AND ASSEMBLY RESEARCH FACILITY

Expanded Testing Capabilities for Life Extension Program

The Sandia Programs Engineering and Assembly Research (SPEAR) facility is the first of its kind at Sandia National Laboratories, California. It expands the Labs' capacity to assemble and electrically test components and systems for the nation's nuclear weapon modernization programs.

Experiments performed at the facility will help weapon systems engineers understand hardware systems performance to ensure the safety and reliability of the nation's nuclear deterrent. Sandia is the design and engineering lab for non-nuclear components of the U.S. nuclear weapons stockpile.

The 10,000-square-foot SPEAR facility, with a large activity bay, provides systems engineers the space and equipment for building hardware models and securely storing components, equipment, and assembled test units. SPEAR includes a laboratory for functional electrical testing of weapon assemblies. The lab is equipped with a portable weapon system simulator from the missile contractor and thermal chambers that enable Sandia engineers to perform electrical tests at simulated environment temperatures. Visitor workspaces and video teleconference rooms facilitate close collaboration with Sandia systems engineers and their nuclear security partners.

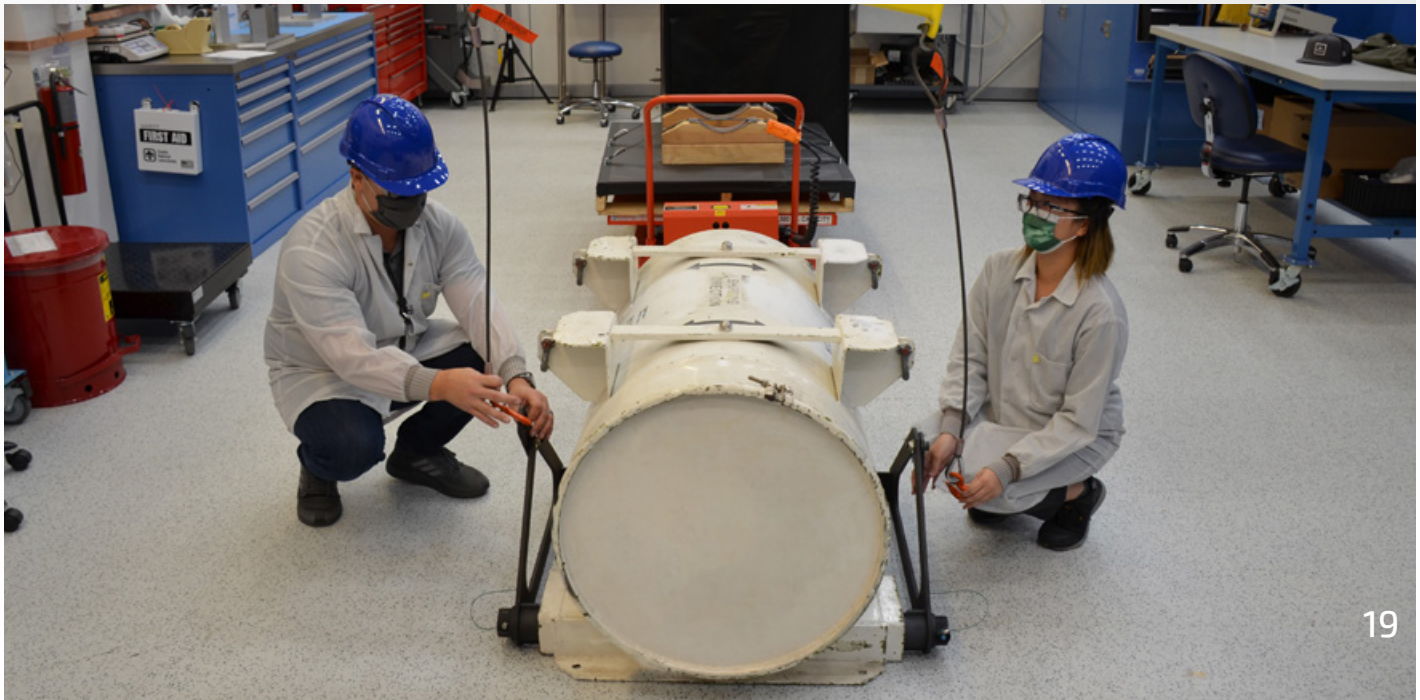
Comprehensive data from tests performed at SPEAR will allow systems engineers to determine if weapon systems meet requirements and refine the hardware accordingly. The data also provide a basis for qualifying designs.

SPEAR enhances the weapon systems engineering capability in California that will be critical to modernization programs going forward. Currently, the SPEAR team is working on the W80-4 and W87-1 modernization programs, helping to ensure that the warheads are safe, trusted, and effective for at least 30 years.

This work ties to Sandia's national security mission. Nuclear weapon modernization programs help our nation to maintain a credible nuclear deterrent without producing entirely new weapons or conducting underground nuclear explosive tests.

Sandia Mechanical Engineer Nique Dizon and Technologist Craig Lovelady working on the latest W80-4 build in the new SPEAR assembly bay.

For more information about SPEAR, visit https://www.sandia.gov/news/publications/labnews/articles/2020/08-28/SPEAR_facility.html



"At this uniquely challenging time, we are excited to be able to combine our in-house antibody discovery and development expertise with Sandia's computer modeling skills and resources in a powerful partnership. Together, we are accelerating the delivery of this critical library of candidate neutralizing antibodies."

— Mennah Moustafa

VP of Business Development
Abcam plc

Speeding Up Neutralizing Antibody Discovery to Help Combat Viruses

CHALLENGE

During the global coronavirus pandemic, the need to accelerate discovery of virus-neutralizing antibodies has become more evident. While multiple vaccines have been developed in record time, scientists are evolving even faster approaches for developing drugs to help people who are already infected.

Neutralizing monoclonal antibodies are already used to treat a variety of conditions, including cancer, autoimmune diseases, and inflammatory diseases. Now neutralizing antibodies are being developed for treatment of COVID-19.

The standard approach is to discover antibodies from human survivors or immunized animals, typically taking over five months even at the fastest pace. The current pandemic has demonstrated the importance of speeding up this timeline.

COLLABORATION

A collaboration between Sandia National Laboratories and Abcam, a global innovator in life science reagents and tools, is creating a large library of antibody variants to identify those that could potentially neutralize the SARS-CoV-2 virus, using Abcam's rapid high-throughput screening platform.

Sandia is using molecular modeling to predict mutations to neutralizing antibodies for the SARS-CoV-1 virus (that causes SARS) that enable them to bind to and neutralize the SARS-CoV-2 virus (that causes COVID-19). Mutation predictions from Sandia are then encoded into an experimental library for screening by Abcam, which has established high-throughput library generation and screening technologies for antibody discovery. Sandia's experimental virology laboratory in Livermore, California, then tests the efficacy of the most promising antibodies resulting from this screening.

Abcam's global discovery and development teams use proprietary high-throughput library generation and screening technologies, coupled with bioinformatics and antibody engineering, to deliver diverse functional libraries that accelerate lead identification and optimization of therapeutic and diagnostic antibodies.

SOLUTION

This approach is beneficial because the library of novel antibodies contains all possible combinations of a set of predicted mutations, with roughly 100 million variants being screened in one library. This large size increases the chance of finding suitable candidate therapeutic antibodies.

This computer modeling and library screening can be performed in about two months, which is less than half the time required by current methods. Abcam's library of potential neutralizing antibodies is now being screened for therapeutic efficacy.

IMPACT

Speeding up neutralizing antibody discovery could reduce the impact of future viral outbreaks by providing therapies on a shorter timescale than is currently possible. This could help reduce hospitalizations, save lives, and decrease negative economic impact.

This partnership also demonstrates how technology originally developed as part of the Labs' national security mission for the Department of Defense can be more widely distributed for the public good.

Data from this joint project will be highly useful for improving antibody modeling methodologies. In the future, it might be possible to discover antibodies by computer modeling alone, which would further accelerate development of virus-neutralizing therapeutics.

PARTNERSHIP TYPE: *Cooperative Research and Development Agreement (CRADA)*

GOAL: *Accelerating discovery of virus-neutralizing antibodies using molecular modeling and antibody library screening*

SS&TP Monument Sign.

SS&TP Continues to Make Significant Contribution to Local Economy

The latest Economic Impact Report analyzing the Sandia Science & Technology Park (SS&TP) concluded that the SS&TP contributed significantly to the local economy by adding 310 jobs, bringing the total employed by companies and organizations in the Park to more than 2,300 people. The report is based on an assessment done every two years by the Mid-Region Council of Governments (MRCOG).

The SS&TP creates jobs, generates large sums of state and local tax revenues, and pays higher-than-average wages for its employees when compared with the average wage in the Albuquerque metro area.

"It's great to see what the SS&TP has become," said Albuquerque Mayor Tim Keller. "The Park is creating opportunities for Albuquerque residents and businesses by advancing state-of-the-art accomplishments in this area."

The report concluded that the SS&TP has contributed significantly to the local economy since its establishment in 1998. Over the course of its history, the Park has helped produce $147.5 million in tax revenue for the state of New Mexico and $32 million for the city of Albuquerque. The Park also paid $6.4 billion in wages and helped generate an estimated $3.7 billion in taxable personal consumption.

Labs Director James S. Peery said, "Everyone benefits when Sandia can team on technical, collaborative projects with Park companies. Together, Sandia and the companies can explore solutions to challenges faced in the public and private sectors. A culture of collaboration continues to be engrained within the Labs because it's an important and essential way to solve problems."

To learn more about the SS&TP, visit www.sstp.org

Small Part Prevents and Extinguishes Arc-Faults in Solar Installations

Since 2008, solar installations in the United States have grown 35 fold to an estimated 62.5 gigawatts—enough energy to power 12 million homes. Yet solar arrays don't have reliable built-in protection against arc-faults, high-power discharges of electricity that can cause fires. To address this problem, Guardian Sensors, Inc., a company in Albuquerque, NM, has developed an in-line connector for solar installations to help prevent and extinguish arc-faults.

Sandia National Laboratories researcher Kenny Armijo has been studying hazardous arc-faults for 10 years as part of the Labs' global energy mission to provide security and resilience to the nation's energy system. He's working with Guardian Sensors through the New Mexico Small Business Assistance (NMSBA) Program, to validate the company's circuit interrupter technology using specialized equipment and expertise available at Sandia.

"As solar panels become more efficient, they're able to produce more power," said Armijo. "As you increase the current and voltage levels in next-generation solar panels, you get a higher propensity for arc-faults. This new self-extinguishing mechanism could solve that problem."

As a result of the technical assistance Sandia provided through NMSBA, Guardian Sensors received $225,000 in cash and vouchers from the DOE's American-Made Solar Prize, which allowed the company to provide research opportunities to three New Mexico universities: New Mexico Tech, New Mexico State University, and the University of New Mexico. The company also was able to hire a new engineer.

In the future, Sandia and Guardian Sensors hope their work can expand to other types of power sources and storage devices, like batteries, helping to make renewable energy be more widely adopted while mitigating the risk of arc-faults.

The Guardian Sensors team of Charmaine Tunell, Kenneth G. Blemel, Michael Spach, Nikolas Berry, and Kenny D. Blemel shows off their in-line connector to prevent and extinguish arc-faults in solar installations.

To learn more about NMSBA, visit www.NMSBAprogram.org.

Cleaning Up Industrial Processes with Concentrating Solar Power

Paul Gauche has transitioned from being the manager of the Concentrating Solar Technologies Department at Sandia National Laboratories to a new role as Vice President of R&D at Heliogen, a concentrating solar power (CSP) company backed by a group of investors that includes Bill Gates.

Gauche was able to make the move by taking part in Sandia's Entrepreneurial Separation to Transfer Technology (ESTT) program. ESTT supports Sandia's technology transfer mission and allows employees to leave the Labs to start up or expand technology companies, with guaranteed reinstatement for up to two years.

Heliogen is using its disruptive CSP technology to clean up heavy industrial processes like making cement, one of the world's most polluting industries, providing the high-temperature heat required without the use of carbon-based fuels. Differentiating Heliogen's technology from other CSP solutions is its unique use of advanced computer vision software to precisely align an array of mirrors to reflect sunlight to a single target, and its modular, lower cost design.

Among an array of projects the company and Sandia are partnering on, Heliogen is using Sandia's Optical Fringe Analysis Slope Tool (SOFAST) under a test and evaluation license. Heliogen is also working with Sandia on a DOE project to construct a grid-connected commercial pilot plant on tribal land in Arizona which will use Sandia's supercritical CO_2 power cycle expertise and on another DOE project to create a roadmap framework for solar thermal hydrogen.

Sandia's CSP program has been developing and testing technologies for the DOE and industry for over 40 years as part of its energy security mission, in part at Sandia's National Solar Thermal Test Facility. The partnership with Heliogen helps Sandia transfer technology to advance large-scale adoption of CSP, benefiting U.S. industry.

Industry partners, government representatives, and Sandia leaders and researchers, including Paul Gauche, touring Sandia's National Solar Thermal Test Facility.

To take a virtual tour of Sandia's National Solar Thermal Test Facility SS&TP, visit https://tours.sandia.gov/NSTTF/

ENTREPRENEUR EXPLORATION

Technology Transfer Stimulated by Entrepreneurial Training Opportunities

The Entrepreneur Exploration (EEx) program is designed to invigorate an entrepreneurial culture at Sandia National Laboratories and help fulfill the Labs' technology transfer mission. The program connects Sandia principal investigators to entrepreneurial opportunities and resources provide by a variety of partners from industry and academia. This year, EEx hosted 16 entrepreneur events including numerous webinar series and speaker series, as well as partnering with the University of New Mexico (UNM) on the Sandia Pitch Competition, UNM's Innovate New Mexico Technology Showcases, and the Sandia Entrepreneurial Equity Forum.

The fourth annual Sandia Pitch Competition provided a stage for five individuals/teams to pitch to an esteemed panel of judges including leadership at the Labs, local entrepreneurs, and investors.

The Innovate New Mexico Technology Showcase is a collaborative event which highlights research and technology opportunities, start-up companies, and economic development resources from the leading research institutions in New Mexico. The seventh such event, held in March, featured technology presentations from Sandians and company representatives.

Sandia Labs Entrepreneurial Equity Forum was a two-day event held in August to explore pathways for increasing the participation of women and Native American entrepreneurs in the New Mexico economy, and the role the National Labs and city, tribal, state, and federal partners can play. The new event featured a combination of panel discussions and participatory sessions that reflected on practical steps to advance an inclusive and resilient economy in New Mexico.

EEx is the flagship program for the Center for Collaboration and Commercialization (C3), which is designed to strengthen partnerships, technology transfer, and ties to the community.

Sandia Chief Diversity Officer Esther Hernandez participated in kicking off the Entrepreneurial Equity Forum along with moderators Astrid Scholz and Vanessa Roadhouse.

To learn more about C3, visit www.C3abq.com

New Program Offers Companies Assistance with Technology Maturation

The technology transfer mission at Sandia National Laboratories has been furthered by the success of the New Mexico Small Business Assistance (NMSBA) program funded by the State Legislature. But the State wanted to do more and asked Sandia to look into the technology transfer process and discover where more assistance would be helpful for New Mexico businesses. Technology maturation was identified as a gap and one where Sandia, and its NMSBA partnering lab, Los Alamos National Laboratory, could make a difference.

The Technology Readiness Gross Receipts (TRGR) Tax Credit Program was signed into law by the New Mexico Governor on March 15, 2020. The three-year pilot program received $4.5 million of funding. It will give businesses the opportunity to utilize NM national laboratory resources to mature their technology towards commercialization.

These collaborations will help advance a technology closer to commercialization milestone such as market introduction, expanding sales, or acquiring customers, and work may include prototyping, proof-of-concept, field demonstrations, technology validation, and applied research.

Up to $150,000 of assistance can now be offered to companies that are engaged in technology transfer with a NM national laboratory. The companies can qualify to submit a proposal by either having licensed a technology or by taking part in a Cooperative Research and Development Agreement (CRADA). While the TRGR program is focused on helping New Mexico companies, unlike the NMSBA program, the companies don't need to be small to take part.

For the first round of TRGR projects, proposals were presented to a panel of judges in October and four companies were awarded assistance.

The TRGR Tax Credit Program was passed by the NM State Legislature at the State Capitol in Santa Fe.

To learn more about TRGR, visit https://www.sandia.gov/working_with_sandia/technology_partnerships/trgr.html

RAPID TECHNOLOGY DEPLOYMENT

Combating Economic Effects of the Pandemic with Free Patent Licenses

Sandia National Laboratories took fast action when the COVID-19 pandemic began and put new programs in place to supplement existing technology transfer programs. While research at Sandia is combating the medical effects of the pandemic, other efforts were developed to take on the economic effects.

Right after a national pandemic-related emergency was declared on March 13, a new employee in Sandia's Intellectual Property (IP) Management and Licensing team came up with an idea to make select Sandia patents available to U.S. companies. The program was up and running in just over two weeks after being conceived.

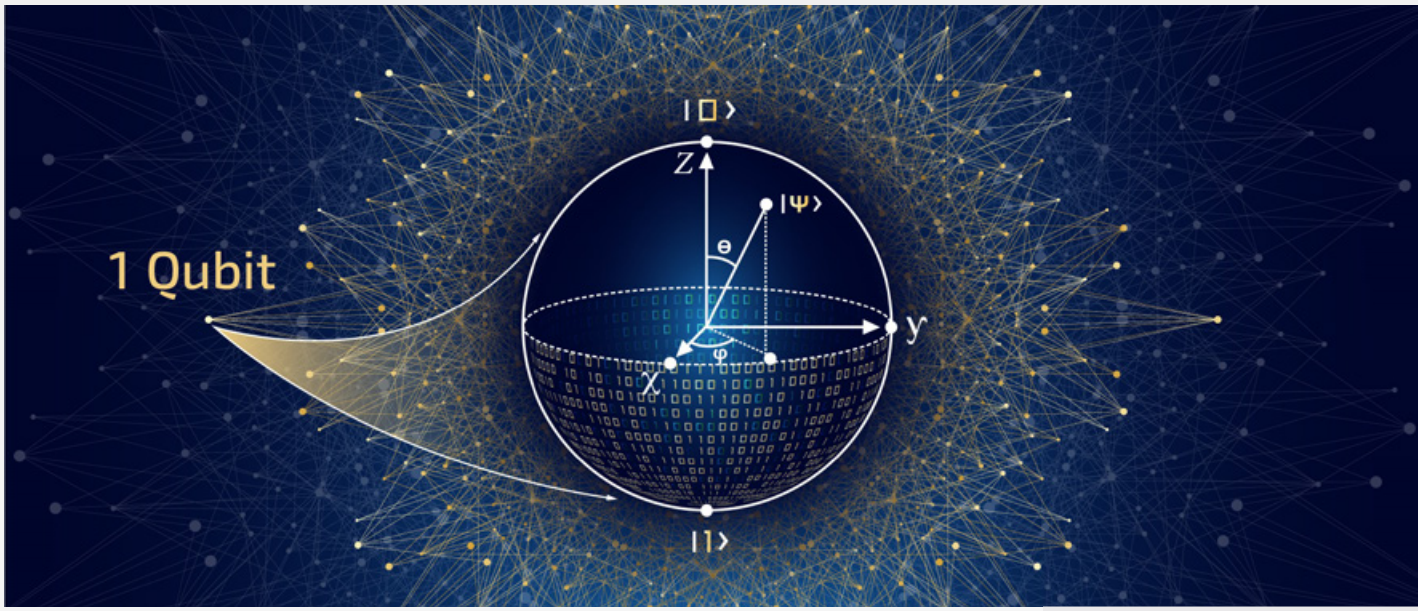
The Rapid Technology Deployment Program (RTD) made approximately two-thirds of Sandia's IP portfolio available for free licenses to eligible companies. Almost 900 technologies were made available for nonexclusive licenses. And the time to get the license was fast—a license was returned to applicants, if they were eligible, within two days. Applicants just filled in a form online.

Sandia also became one of the Founding Adopters of the Open COVID Pledge, along with Facebook, Amazon, Intel, Microsoft, and IBM, because its RTD program fit into the model which calls on organizations worldwide to make their intellectual property freely available in the fight against the pandemic.

During this time of economic uncertainty, the free technology licenses are giving American businesses a way to test and adopt new technologies without a financial investment. There have been 16 licenses, including 30 patents, signed within the RTD program. Other national laboratories have since opened similar programs Due to its success, Sandia's RTD program was extended beyond its initial 2020 timeline through the end of June 2021.

The Sandia Hand is one of the many technologies available for free licensing through the RTD Program.

For more information about the Rapid Technology Deployment Program, visit https://ip.sandia.gov/rtdOverview.xhtml



National Center Promotes Quantum Research and Workforce Development

In August 2020, the DOE awarded $115 million over five years to the Quantum Systems Accelerator (QSA), a multi-institutional national center established to catalyze quantum research and workforce development. The QSA is co-led by Lawrence Berkeley National Laboratory and Sandia National Laboratories.

The QSA is a multidisciplinary team comprising dozens of researchers from 15 labs and universities. They will collaborate to advance science and develop next generation quantum platforms that can impact critical DOE science problems and lay the foundation for next generation systems. This work will affect scientific computing, discoveries in fundamental physics, and breakthrough research in materials and chemistry.

QSA will co-design advanced algorithms, devices, and engineering solutions; foster collaboration with industry and nongovernmental organizations; and lay the groundwork to train a future workforce.

"The QSA combines Sandia's expertise in quantum fabrication, engineering and systems integration with Berkeley Lab's lead capabilities in quantum theory, design, and development and a team dedicated to meaningful impact for the emerging U.S. quantum industry," said Sandia's Rick Muller, deputy director of the Quantum Systems Accelerator.

The QSA Ecosystem team, led by Sandia's Technology and Economic Development Department, will facilitate multi-disciplinary engagement in a research network that includes federal agencies, industry, university partners, and international centers. Ecosystem activities will engage industry for technology transfer and information exchange through partnerships to drive commercialization and entrepreneurship.

The Ecosystem team will also oversee the development of workforce programs, including internships, cross center student exchanges, and workforce retraining, and will collaborate with the Simons Institute to develop a research program, research pods and a summer course series. The One Stop Quantum Shop web portal will enable collaboration with industry, academia, and other research facilities.

Quantum bits of information, or qubits, have the potential to make powerful calculations that classical bits cannot. The QSA will transform rudimentary quantum computers into machines that perform valuable work for DOE and the nation.

To learn more about the Quantum Systems Accelerator, visit https://quantumsystemsaccelerator.org/

TECHNOLOGY COMMERCIALIZATION FUND

Concentrating Solar Power Heats up Hydrogen Production Efficiency

Hydrogen is an alternative to fossil fuels in many applications. The DOE is enabling energy resiliency by exploring the potential for hydrogen production and utilization. A part of these efforts is researching more efficient hydrogen production methods.

Most hydrogen is produced from natural gas. Some is now being made by using electricity produced by renewable sources to power an electrolysis process, splitting water to create hydrogen. But an even more efficient method being explored is taking the heat from concentrating solar power (CSP) and using it to directly power hydrogen production without creating electricity first.

A partnership between Sandia National Laboratories and DLR, the German Aerospace Center, is looking into using the high temperatures produced by CSP solar thermochemical water splitting system. Metal oxides are put into a solar receiver developed by the partners where temperatures rise to about 1500° C. The particles of metal oxide release oxygen and then are put into another reactor where they are exposed to steam. The metal particles re-oxidize by stripping oxygen from the water molecule, leaving behind hydrogen.

The solar receiver has been incorporated into a gravity-fed thermochemical water splitting reactor at Sandia's National Solar Thermal Test Facility. Plans are in place to test the solar receiver at Synlight, the world's most powerful artificial sun operated by the DLR Institute of Future Fuels.

With a long history of conducting collaborative research, Sandia and DLR are continuing work on renewable energy technologies powered by CSP, tied to Sandia's energy security mission. Under a DOE Technology Commercialization Fund (TCF) project, designed to mature promising energy technologies with the potential for high impact, they'll further refine the solar receiver design and collect extensive data as a step towards commercialization.

Members of Sandia's Solar Chemistry team Tony McDaniel (left) and Ivan Ermanoski (right) pictured with DOE Hydrogen and Fuel Cell Technologies Office Managers in the lab with solar receiver back-lit by Sandia's artificial sun.

To learn more about TCF, visit www.energy.gov/technologytransitions/initiatives/technology-commercialization-fund

Sandia Technologies Graduate from Business Development Bootcamp

This year the DOE's Energy I-Corps, an intensive two-month entrepreneurial bootcamp, went completely virtual, but still provided a way for lab researchers to connect with industry mentors and benefit from business development training. Sandia National Laboratories had three teams selected to take part in the 2020 cohort.

SWaP Electronics
Advanced power electronic systems greatly increase power converter performance by using novel semiconductor materials and passive materials, devices, components, and circuit designs that can dramatically improve power distribution and conversion systems. Sandia has a size, weight, and power (SWaP) technology portfolio filled with developments that make next generation power electronic systems possible.

CAP Fastener
The Captive Access Protection (CAP) Fastener is a high security bolt that combines access delay and tamper detection. The unique, two-part design allows the fastener to be used in a variety of applications, particularly for high-value assets. Not only does the CAP Fastener provide additional delay, it is also designed to be easily combined with fiber optic- or wire-based tamper detection systems.

HECATE
Recent advances in adversary sophistication have led to targeting the software supply chain to inject malicious code into trusted software applications. HECATE is an analysis platform that automatically identifies software supply chain risks and provides heuristics on suspect behaviors. HECATE gathers information that can be used to accumulate trust in compiled commercial and open source software. HECATE uses visualization to create a wholly immersive environment to install, execute, and observe software.

Energy I-Corps is part of a DOE effort to help energy and national security technologies from the national labs find commercialization pathways, and ties to Sandia's technology transfer mission.

Sandia Computer Scientist Vince Urias and his team developed HECATE, a software supply chain and assurance platform.

To learn more about Energy I-Corps, visit https://energyicorps.energy.gov/

LAB PARTNERING SERVICE

Quantum Experts from Sandia Join Growing Online Tech Transfer Portal

Expert Search, a selection of lab-identified experts across hot technology areas, is just one of the applications available at the DOE's Lab Partnering Service (LPS), a suite of online services providing access to people, projects, and patents from across the DOE national laboratories. It provides a conduit between innovators and potential partners. With Expert Search, website visitors can search by technical market sector or keywords to find experts with the knowledge they need.

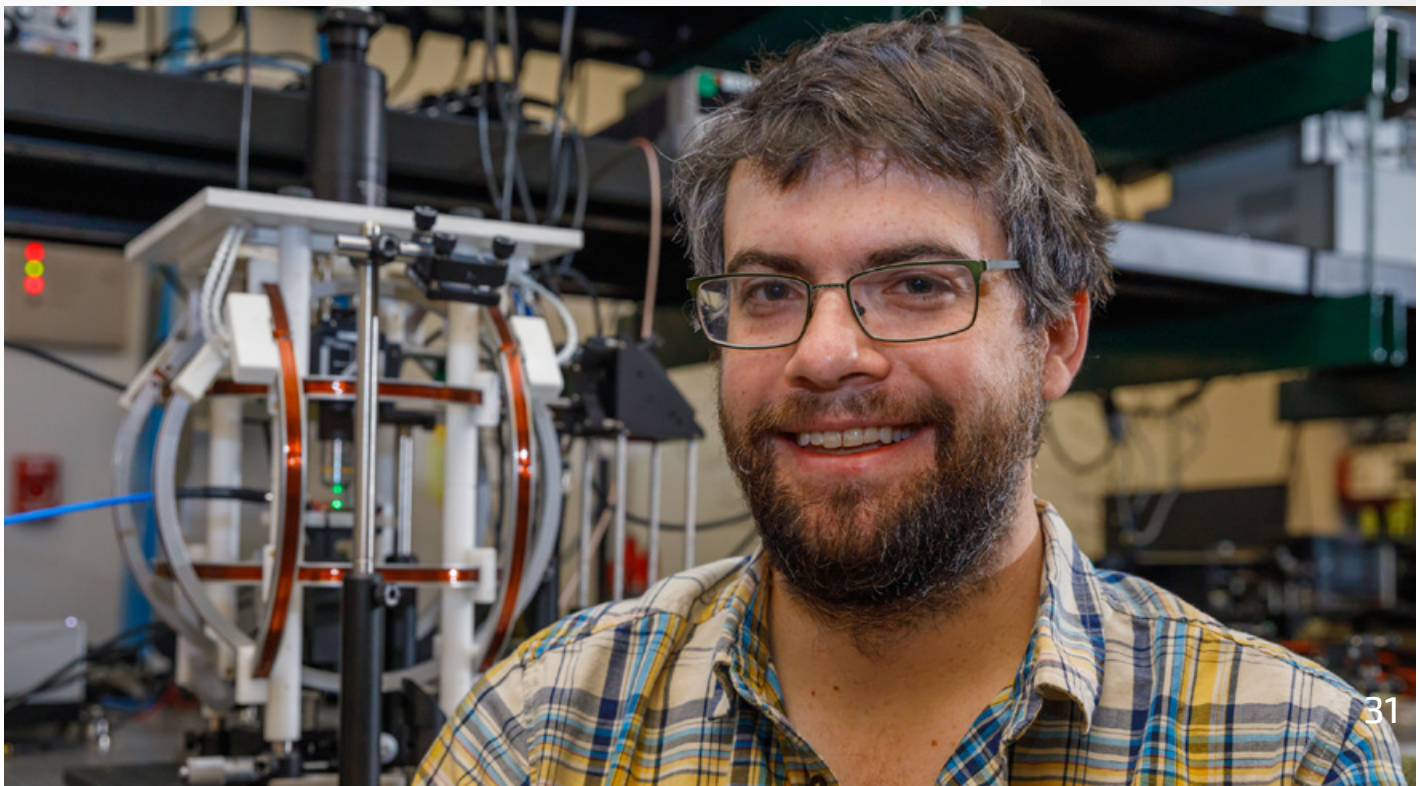
Andy Mounce, a scientist at the Center for Integrated Nanotechnologies (CINT), was one of the Sandia National Laboratories experts added this year in the area of quantum applications. He was contacted by a U.S. synthetic diamond manufacturer shortly after his profile was uploaded. The manufacturer grows diamonds for research purposes and wanted to discuss what types of products would be of interest to the quantum community. Since Mounce is currently using diamonds to detect nanoscale magnetism and investigating the use of defects in diamonds for quantum information applications, he was the right person to be connected with the company. While Mounce only provided some information in this initial interaction, the connection might lead to future partnerships with Sandia or new product development by the company.

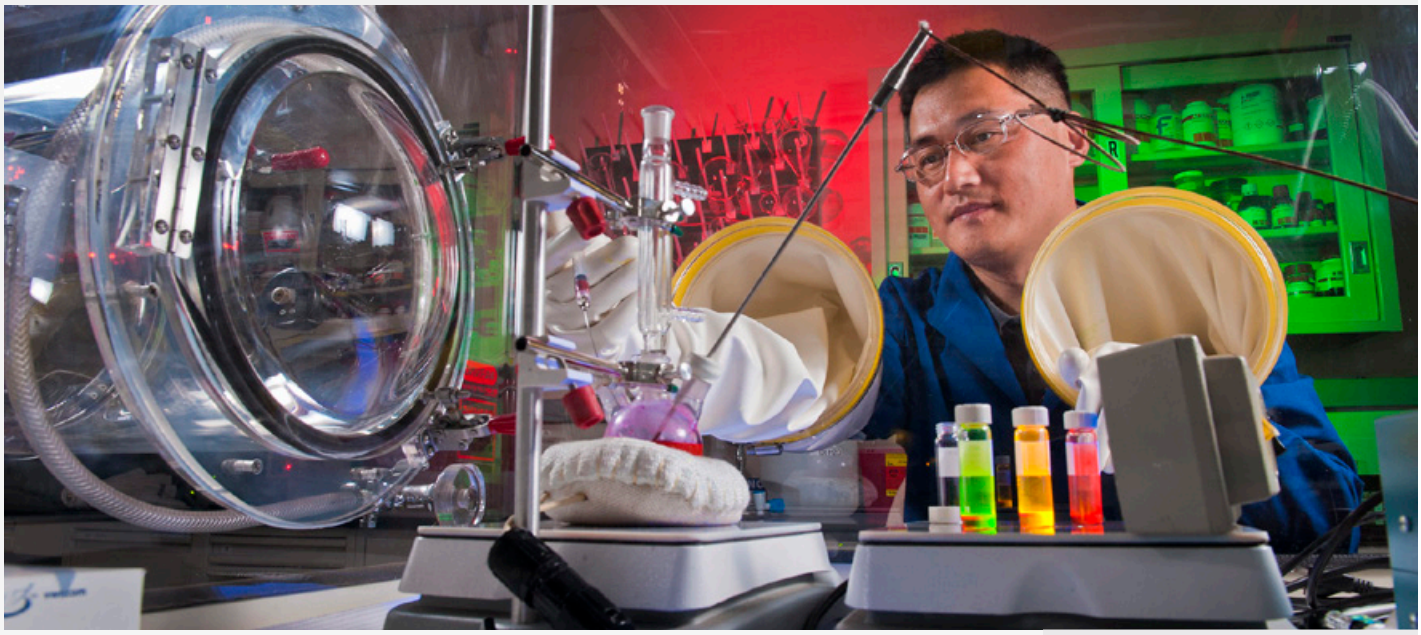
Other LPS applications include Technology Summaries, browsable business-friendly descriptions of technologies available for licensing; Visual Patent Search, a tool that enables a unique way to search DOE-funded patents and patent applications; Success Stories, examples of successful technology transfer; and a Facilities Search Tool, which lets users search for lab facilities available for use. Sandia is included in all of these applications.

Sandia's participation and expanding presence in the LPS is just one of the many ways it meets its technology transfer mission and moves federally funded research to market, creating economic development.

Sandia Scientist Andy Mounce is available to provide assistance in the area of quantum applications to partners through the LPS online service.

To learn more about the Lab Partnering Service, visit https://www.labpartnering.org/





Program Helps Two Startup Companies Commercialize Sandia Technology

Sandia National Laboratories took part in the FedTech Startup Studio again this year. FedTech pairs aspiring entrepreneurs with breakthrough technologies from national laboratories and positions them to launch their own venture using a lean startup model and a customer interview process. Two teams investigating Sandia technologies were part of the 2020 cohort and each has resulted in the formation of a company to commercialize technology.

Lunano, Inc., a company led by Bradley Duckworth, has developed Disinfectant 2.0, an anti-viral/antimicrobial nanomaterial that continuously disinfects for extended periods of time. The nanomaterials can be integrated into sprays, compounds, and membranes, as well as manufactured surfaces.

Lunano's research with the Sandia inventors of the functional porphyrin nanoparticles, Hongyou Fan and his team, and an extensive customer discovery process identified three different product concepts: surface coating disinfectant and sanitizing sprays, sanitized manufacturing surfaces, and air filtration devices to disinfect airflows. Discussions with consumer product goods and appliance companies, as well as auto manufacturers are helping to further commercialize product concepts based on the licensed technology.

The Sandia BioScience team led by Darren Branch and Resonantia Diagnostics Inc. plan to develop a rapid point of care identification and susceptibility profiling platform. The platform's sample preparation will leverage Sandia's micro acoustic lysis system (mALS) where identification will be achieved using a nucleic acid detection method that offers high throughput and efficiency. Resonantia is in the process of licensing the Sandia technology.

Resonantia Diagnostics Founder and President Matthew Jones reflected on the FedTech partnership and said, "FedTech provided an incredible forum to work with cutting edge technology that has the potential to transform the treatment of bloodborne infections and save thousands of lives per year."

Sandia Researcher Hongyou Fan working with nanocoatings in his lab.

To learn more about FedTech, visit www.fedtech.io/

RECOGNITION

Innovation and Intellectual Property Celebrations

Annual Innovation and Intellectual Property (IP) Celebration events recognize Sandia National Laboratories scientists and engineers whose work created IP. The events also recognize Up & Coming Innovators, director-nominated inventors who display enormous potential for supporting impactful innovations, exhibited entrepreneurial talent, and developed unique solutions to complex scientific challenges. Finally, they recognize Mission Innovators (Classified Innovation Awards in California) for their technical and innovative contributions to our national security mission.

Due to the COVID-19 pandemic, an in-person celebration recognizing the calendar year 2019 patent holders, commercial copyright authors, Up & Coming Innovators, and Mission Innovators was not possible. However, the New Mexico Integrated Partnerships Organization (IPO) was able to provide options for in-home recognition to 215 patent inventors, 12 copyright authors, 19 Mission Innovators, and 16 Up & Coming Innovators. Sandia California virtually recognized 25 patent inventors and 22 Classified Innovation Award recipients through leadership acknowledgement and internal congratulatory announcements.

NMSBA Recognition

Projects that achieved outstanding innovations through the New Mexico Small Business Assistance (NMSBA) Program in 2019 were recognized in the NMSBA 2020 Perspectives annual report.

Four projects received technical assistance from Sandia. The Monitoring Range Animals Leveraged Project got help with prototyping a GPS-enabled ear tag that will provide remote monitoring of beef cattle at pasture resulting in over $100,000 in additional funding, including a grant from the National Science Foundation. Osazda Energy was provided with advanced materials characterization of their MetZilla Paste, allowing the company to improve their product, hire an engineer, and negotiate with the DOE's EERE Solar Energy Technology Office for a $1.25 million contract. Wildlife Protection Management received assistance with improving their video capture system that is used to manage feral and wildlife populations humanely, enabling it to use deep learning and neural networks. With the more advanced recognition system, the company obtained approximately $100,000 from private investors.

Guardian Sensors was one of two projects that received the Honorable Speaker Ben Luján Award for Small Business Excellence for demonstrating the most economic impact. The company received assistance with testing of their safe in-line solar connectors and subsequently won prize money, provided research opportunities to New Mexico universities, and hired a new engineer.

NMSBA assists for-profit small businesses in New Mexico with access to laboratory experts at Sandia and Los Alamos national laboratories. These experts help them gain knowledge and solve challenges utilizing the labs' cutting-edge technologies.

R&D 100 Awards

The R&D 100 Awards celebrate the year's 100 most innovative technologies. Sandia National Laboratories competes with universities, corporations, and other government laboratories for these prestigious awards.

Individual Awards

Binary Solvent Diffusion for Fabrication of Large Nanoparticle Supercrystals LDRD

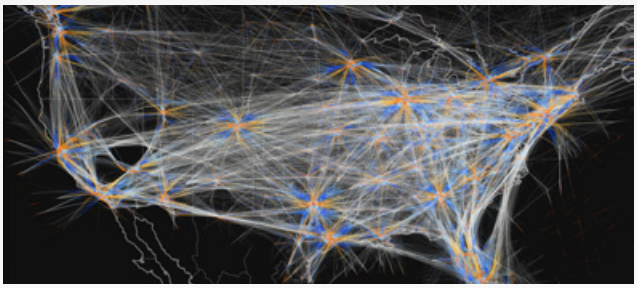
Gold nanoparticles self-assembled into millimeter-sized supercrystals that are sensitive to trace amounts of chemicals with superior qualities in optoelectronics, photovoltaics, and surface catalysis.

HECATE: High-density Evaluator of Commercial-off-the-shelf Applications for Trust and Efficacy LDRD

A software supply chain and assurance platform that reduces the risks for users of commercial and open-source software.

Tracktable LDRD

Applies advanced machine-learning techniques to large trajectory data sets, searching for shapes and patterns in space and time.



Joint Awards

Sandia researchers won three additional awards with partner organizations.

IDAES: Institute for the Design of Advanced Energy Systems Process Systems Engineering Computational Framework

This framework is a comprehensive set of Process Systems Engineering tools supporting the design, modeling and optimization of advanced energy systems for the nation's energy needs.

Legion: A Data-centric Programming System

A supercomputing programming system that boosts application performance and speed by automating task scheduling and data movement, a basic need for computing at the exascale.

XRPBS: X-ray Polarizing Beam Splitter

The first X-ray polarizing beam splitter eliminates reliance upon source stability or repeatability. This diagnostic can be used for high-energy-density plasma investigations, material studies, and X-ray beam manipulation on synchrotrons in addition to weapons-related work.

FLC Awards

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

FLC National Awards

Excellence in Technology Transfer

Small Reactor to Help Solve Worldwide Medical Isotope Shortage

Sandia's concept to produce medical isotopes with a 2-megawatt reactor using low-enriched uranium is being licensed by Eden Radioisotopes to produce a more reliable domestic supply of isotopes.

Water-Go-Round Moves Hydrogen Fuel Cells to Commercial Waters

The world's first zero-emission passenger ferry is being built by Golden Gate Zero Emission Marine based on years of Sandia research into maritime applications for hydrogen fuel cells.

Impact

Sandia Scientists Changing the Way Men Approach Fertility LDRD

The success of Sandstone Diagnostics' first commercial application of Sandia's SpinDx technology was recognized for the impact it has had on male fertility.

Outstanding Technology Transfer Professional

Jason Martinez

Business Development Specialist Martinez was honored for strengthening the Labs' Cooperative Research and Development Agreement (CRADA) strategy and growing the CRADA portfolio.

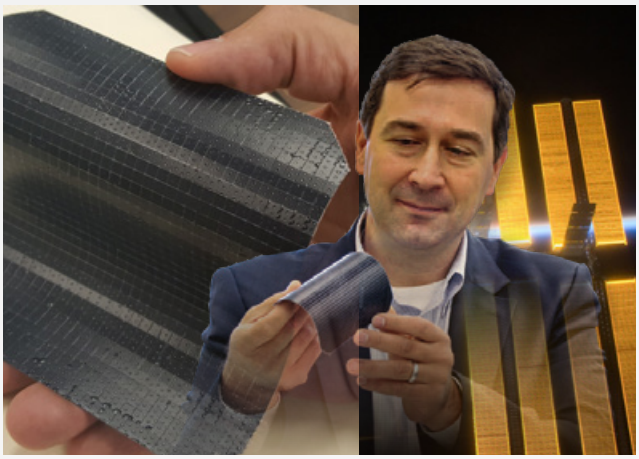
FLC Mid-Continent & Far West Region Awards

Excellence in Technology Transfer

Modular Technology Moves Hydrogen Production to Where it's Needed

Sandia's bayonet reactor technology is being licensed by BayoTech, a manufacturer of modular hydrogen generation systems.

[Small Solar Cells Transform Space Power and Other Commercial Markets]
Sandia's Microsystems Enabled Photovoltaics technology is being further developed by mPower Technology for the space solar power market.



Notable Technology Development

[Ducted Fuel Injection for Clean, Sustainable Diesel Engines and Fuels]
A patented technology that enhances engine combustion, enabling simultaneously lower soot and NOx emissions while potentially increasing efficiency.

Outstanding Partnership

Sandia and UPRM Partnership on Safe, Secure, and Sustainable Energy
Collaborations with the University of Puerto Rico-Mayagüez were recognized for leveraging both institutions' strengths and providing technology transfer and educational opportunities.

Outstanding Technology Transfer Professional

Bob Westervelt
Licensing Executive Westervelt was honored for skill in transferring many Sandia technologies and developing licensing best practices over the past eight years.

Regional Laboratory

Sandia COVID-19 Response Combats Medical and Economic Effects of Pandemic
The Labs' Rapid Technology Deployment Program, which offers free technology licensing, and the New Mexico Small Business Assistance Program were recognized for their pandemic-related efforts.

Other Awards

DOE Technology Transfer Working Group Awards

Best in Class for Licensing

Bob Westervelt was recognized for developing a capacity-based licensing model for the technology transfer with BayoTech to suit the company's unique business model.

Early Career Professional

Kelli Howie was honored for her efforts to on the DIVERSE-W program designed to increase participation in technology transfer by underrepresented segments of the national laboratories.

Member of the Year

Tiffany Gossett was recognized for her outstanding contributions to day-to-day TTWG operations by delivering on impactful activities to further technology transfer within the DOE complex.

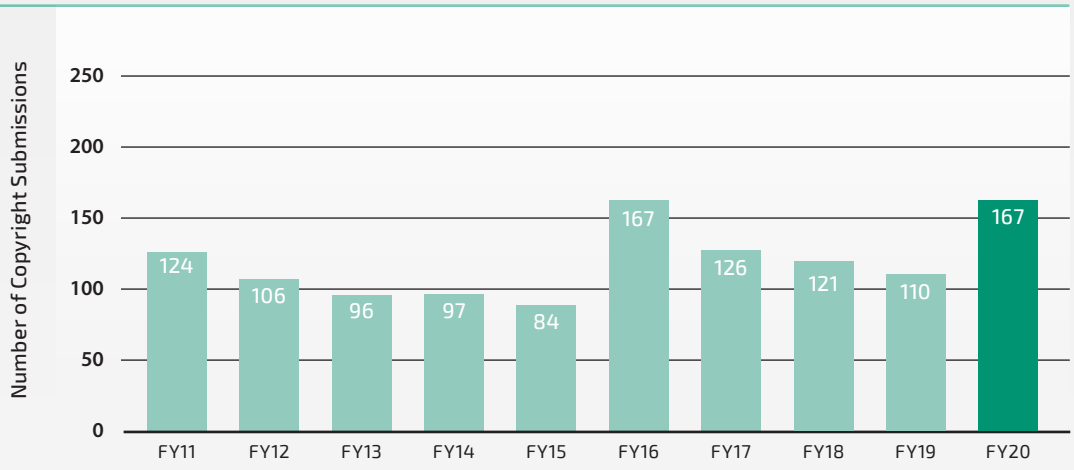
New Mexico Technology Council

Women in Technology Awards

Carol Adkins was recognized for her professional achievements, mentoring other women in STEM careers, contributions to the technology community, and leadership skills.

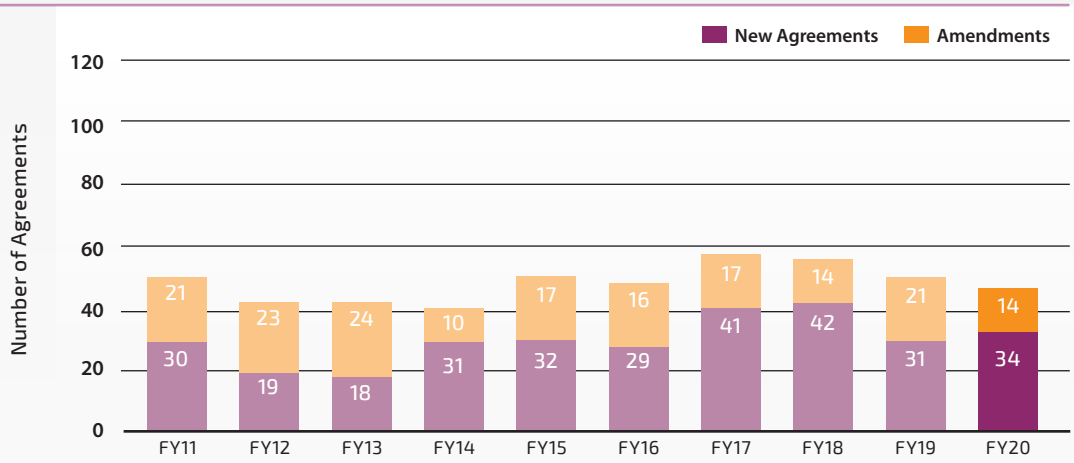
Copyrights

Copyright Submissions

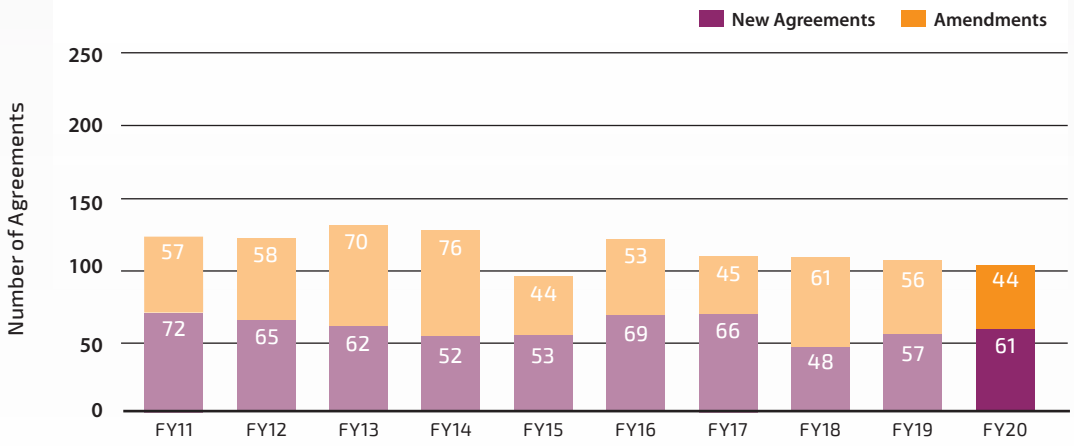


CRADAs and SPP/NFE Agreements

Cooperative Research and Development Agreements (CRADAs)

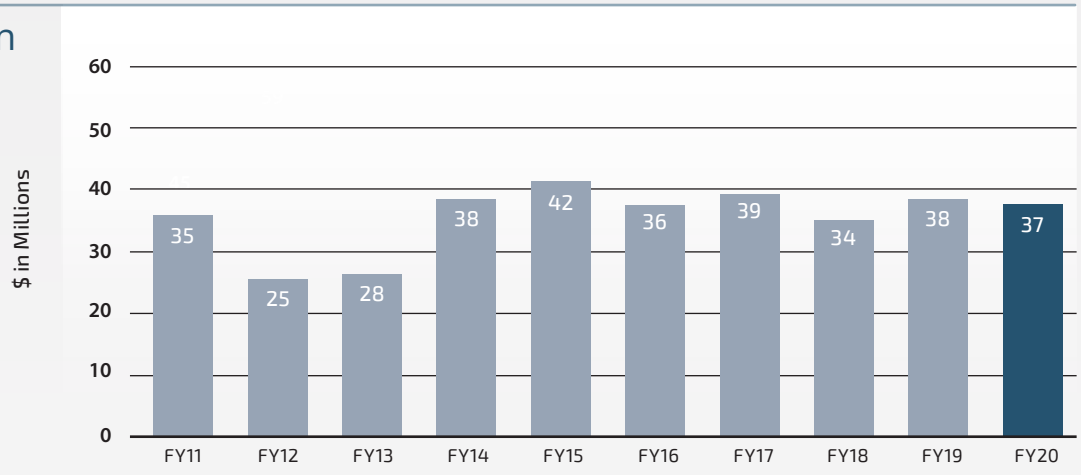


Strategic Partnership Project/Non-Federal Entity (SPP/NFE) Agreements



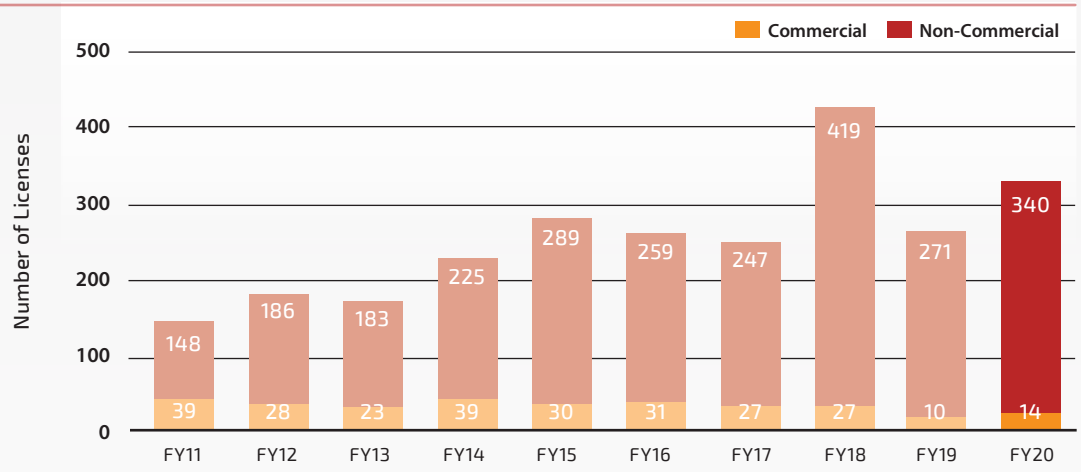
Industry Funds-In

Industry Funds-In to Sandia ($M)

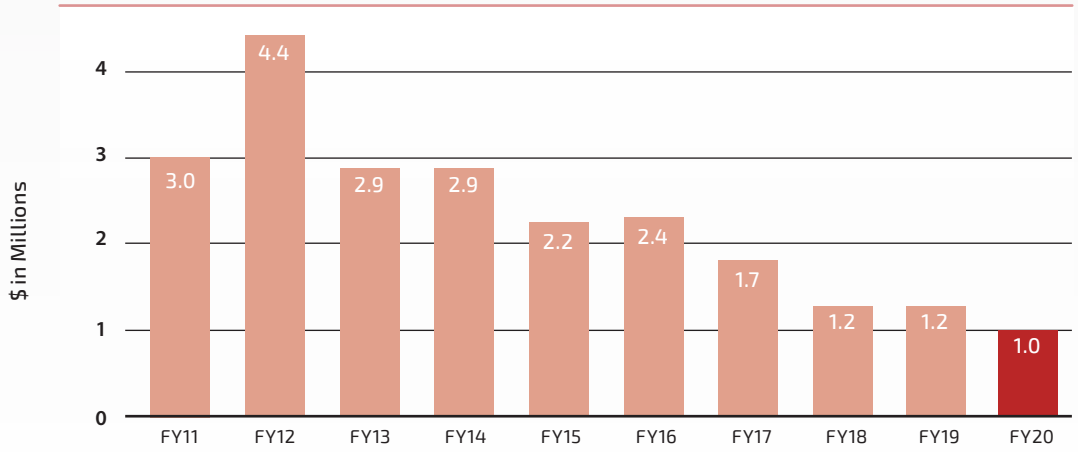


Licenses

Licenses

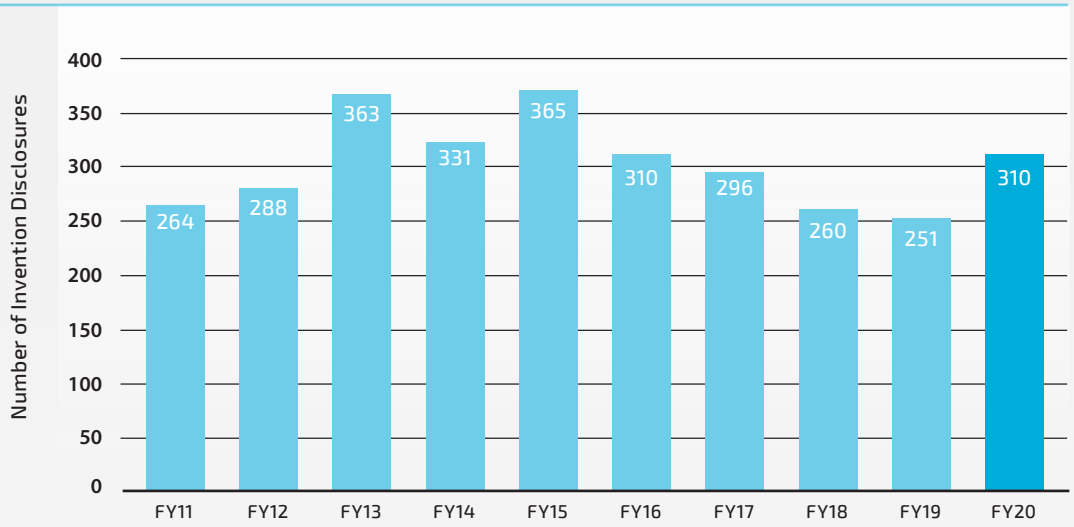


Licensing Income ($M)

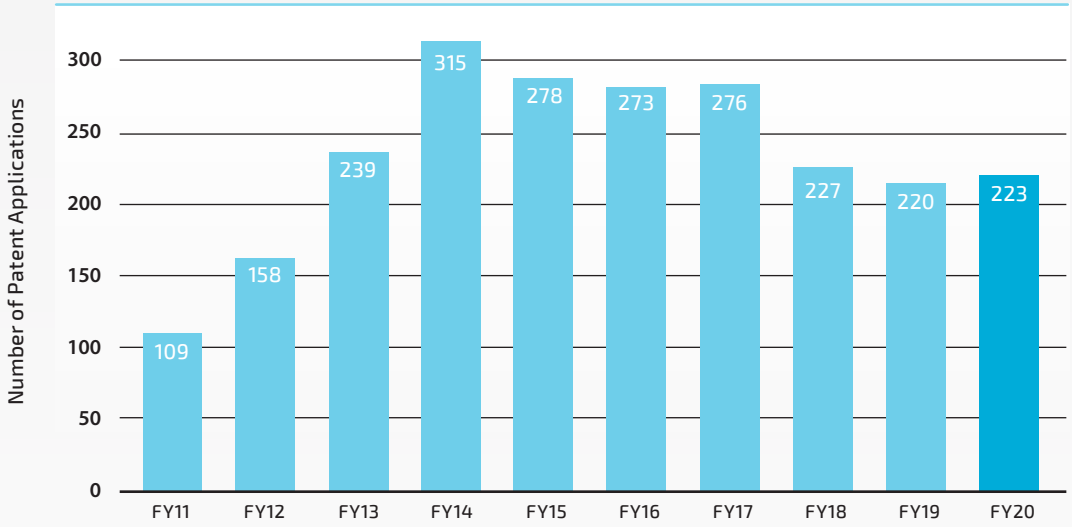


Patent Activity

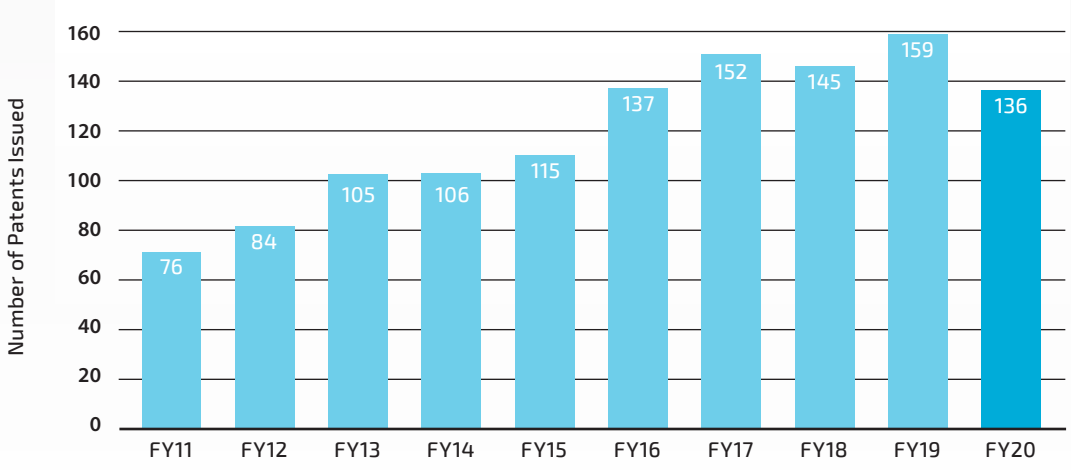
Invention Disclosures



Patent Applications



Patents Issued



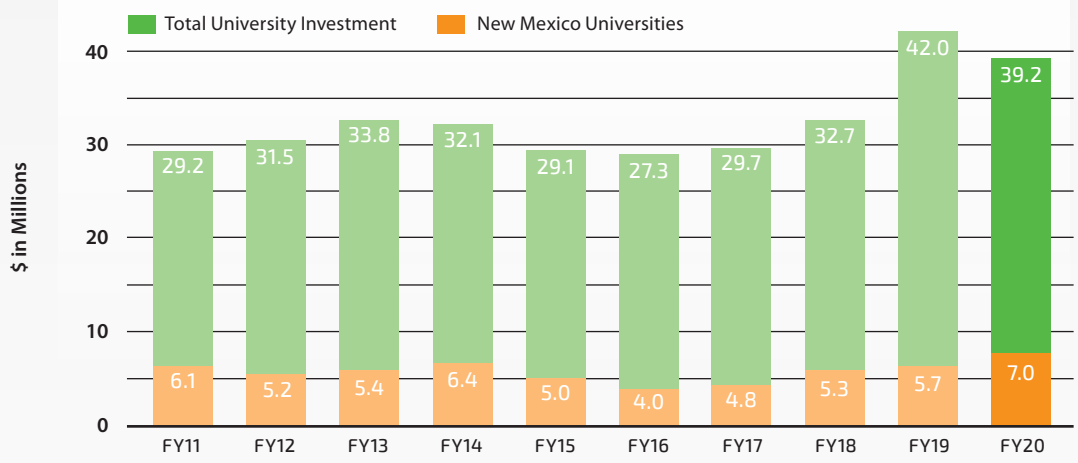
University Partnerships

Since 1997, Sandia National Laboratories has formally contracted for university research to expand its science and technology base. Both Sandia and universities share a need to accelerate the creation of world-class research, develop scientists and engineers, and grow new competencies.

Sandia's university strategy encourages partnerships with various California, New Mexico, and national institutions. Through our Campus Executive program, we have formalized agreements with about 20 schools that define partnership goals, including research collaboration areas and talent pipeline objectives. In 2016, Sandia began more focused collaborations with a subset of the Campus Executive schools under its Sandia Academic Alliance (SAA) Program. These schools have had strong historical partnerships with Sandia, possess synergistic research competencies and capabilities, and share Sandia values and an affinity for national security work. They are working with Sandia to solve big problems, sustain and engage human capital, and accelerate adoption of new technology.

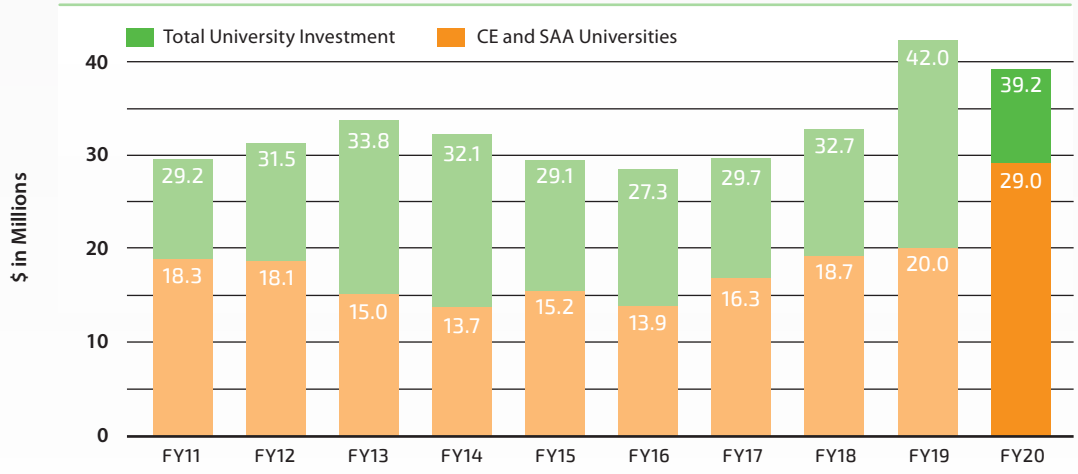
The University Partnerships Office, under the auspices of the Chief Research Officer, serves as the point of contact for university research issues and implements those processes that enable university partnerships. In 2018, a New Mexico partnerships manager was added along with several staff members to facilitate university partnerships.

Investments in Research at New Mexico Universities



Investments in Research at Campus Executive (CE) and Sandia Academic Alliance (SAA) Universities

These programs pair Sandia executives with university officials at schools that share research interests and capabilities.



Sandia Science & Technology Park (SS&TP)

Companies and Organizations	40
Employees	2023
Buildings	27
Public Investment in the Park*	$93M
Private Investment in the Park*	$309M
Total Investment in the Park*	$402M
Increase in Tax Revenue*	$3.7B
Increase in Wages*	$6.4B
Average Salary of Full-time Jobs in Park	$95K
Average Salary of Full-time Jobs in Metro Albuquerque	$49K

**Since Park opened in 1998.*

2020

During the calendar year, 4 companies moved into the Park: BioFlyte, Cybermedia Technologies, IDEAS Engineering & Technology and TekSynap; 2 companies expanded: AEgis Technologies and Excelligent; 1 company constructed a building: Cooperative Educational Services; and 1 company purchased land: PNM.

SANDIA SCIENCE & TECHNOLOGY PARK

New Mexico Small Business Assistance (NMSBA)

	Sandia: 2000-2020
New Mexico Small Businesses Assisted	2400
Rural vs Urban Businesses	
Rural (59%)	1420
Urban (41%)	980
Combined	2400
Dollar Amount of Assistance	$43.6M

	Sandia and Los Alamos: 2000-2019*
Return on Investment (ROI)**	$1.54
(For every $1.00 of state tax credit invested)	
Economic Impact	
Small Business Jobs Created and Retained	9710
Average Reported Salary (2019)	$53K
Increase in Revenue	$438M
Decrease in Operating Costs	$228M
Investment in NM Goods/Services	$159M
New Funding/Financing Received	$189M

**Surveys are performed six months to one year after project completion.*

***ROI is based on salaries of jobs created and retained.*

2020

During the calendar year, Sandia invested $2.37M helping 133 small businesses in 19 counties throughout New Mexico. There were 53 Sandia principal investigators across 43 departments that supported NMSBA.

NMSBA
Los Alamos National Laboratory
Sandia National Laboratories

Entrepreneurial Separation to Transfer Technology (ESTT)*

Sandians Who Left on ESTT	162
To Start up a Company	74
To Expand a Company	88
Companies Affected by ESTT	113
Start-up Companies	58
Expansion Companies	55

**Since ESTT began in 1994.*

2020

During the fiscal year, 1 Sandian was approved for a 1-year ESTT extension, 1 Sandian returned to the Labs, and 1 Sandian terminated employment.

ESTT
Entrepreneurial Separation to Transfer Technology

Center for Collaboration and Commercialization (C3)/ Entrepreneur Exploration (EEx)*

Entrepreneur Events	104
Participants	4827

**Since EEx began in 2015.*

2020

During the fiscal year, EEx held 16 entrepreneur events with a total of 763 participants.

CENTER for COLLABORATION and COMMERCIALIZATION
Entrepreneur Exploration

For general questions and comments, contact partnerships@sandia.gov.
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Partnerships National Reach
Explore our interactive data map which illustrates the amazing breadth of work Sandia National Laboratories does with industry, university, government, and lab partners around the U.S.

www.sandia.gov/partnerships_reach

The Partnership Annual Report contains some photography taken prior to the COVID-19 pandemic. Photos taken more recently followed social distancing and other health and safety guidelines.

Thank you to everone who contributed to this report.

Partnerships Annual Report Team

Sandia National Laboratories

David Kistin, *Manager*
Linda von Boetticher, *Project Manager*
Michael Vittitow, *Designer*

Contractor

Ellen Cline, *Copywriter*

Photos from Abcam plc, Dekker/Perich/Sabatini, Ltd.; Getty Images, Sandstone Diagnostics, Inc.; Two Six Technologies; Lonnie Anderson, Clifford Ho, Bret Latter, Randy Montoya, Wendy Rue, Michael Vittitow, Linda von Boetticher, and Randy Wong, Sandia; Colonel Jim Pringle, U.S. Army; and U.S. Department of Energy.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.
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TECHNOLOGY Partnerships

Sandia National Laboratories

To learn more about the Center for Collaboration and Commercialization (C3), visit **www.C3abq.com**, or stop by our partnership space in downtown Albuquerque at 101 Broadway NE

IPO Integrated Partnerships Organizations

To learn more about industry or university partnership opportunities with Sandia, visit **www.sandia.gov/partnerships** or contact us at partnerships@sandia.gov

To learn more about licensing and technology transfer at Sandia, visit **https://ip.sandia.gov** or contact us at ip@sandia.gov

Small Business First

To learn more on how to do business with Sandia, visit **http://sbu.sandia.gov** or contact us at supplier@sandia.gov