SANDIA NATIONAL LABORATORIES

Partnerships

ANNUAL REPORT FY2016

Tiny Biosensors Make Affordable Handheld Detection Products Possible

Sandia National Laboratories

"One of DOE's successes of the past few years has been strengthening the Department's mission in technology transfer. Sandia has been an exceptional partner with us, and we look forward to even greater achievements in the years to come."

— **Jetta Wong**

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

"Partnerships are becoming increasingly important. By using mutually beneficial capabilities to synergize research and development, partnerships result in impressive breakthrough technologies that neither partner could have achieved alone."

— **Dan Sanchez**

DOE Technology Partnerships Manager
NNSA Sandia Field Office

"Sandia has a rich history of partnering to advance new technology and execute our national security mission. Our robust partnership programs demonstrate our commitment to promoting innovation through collaboration."

— **Jill Hruby**

President and Laboratories Director
Sandia National Laboratories

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Two Sensor-Kinesis Scientists developing new products using Sandia's SH-SAW biosensor arrays in the Sensor-Kinesis nano-microfabrication laboratory.

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Introduction

"Delivering on complex national security programs often requires the capabilities of several partners working together. Some of our key partnerships are with other national laboratories, each with a wealth of specialized expertise and facilities. When Sandia combines forces with other labs, we create multidisciplinary teams equipped to answer questions of national importance."

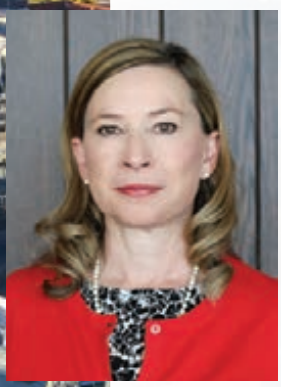
— **Rob Leland**

Vice President
Science & Technology
Chief Technology Officer
Sandia National Laboratories

"Partnering with major national research universities helps Sandia nurture talent, solve big scientific problems, create intellectual property, and accelerate technology transfer. Universities' contributions to important national security programs are increasing. In addition, universities continue to successfully commercialize jointly developed technology for the U.S. public good."

— **Andy McIlroy**

Director
Research Strategy & Partnerships
Deputy Chief Technology Officer
Sandia National Laboratories



"Partnerships between Sandia and industry allow laboratory-developed technology to evolve into new products, medical advances, and infrastructure which improve lives and grow the U.S. economy."

— **Mary Monson**

Senior Manager
Industry Partnerships
Sandia National Laboratories

Diverse Partners Enable Sandia's Success

Sandia National Laboratories partners extensively to deliver on its national security missions. Strategic partnerships enrich diversity, stimulate ideas, and create opportunities. We continue to strengthen our strategic partnerships, adding innovative new approaches with a broader set of collaborators.

Across the varied landscape of partnerships, Sandia engages companies, public agencies, universities, and other national laboratories. We leverage each other's strengths to advance the frontiers of science and engineering. Combining the capabilities of our people and leading edge facilities with those of our partners multiplies our impact.

This annual report highlights just a few examples of the hundreds of partnerships Sandia engages in locally, regionally, and nationally. The stories in this year's report showcase a cross-section of our successes:

- Bringing portable, inexpensive biosensor technology to market so it can be widely used for healthcare and other applications including food safety
- Reducing the time and cost of building new wind turbine blade designs to accelerate innovation in and adoption of wind energy
- Minimizing the economic and safety consequences of natural or manmade disasters on transportation infrastructure through the use of a microgrid
- Accelerating discovery of treatments for viral and genetic diseases through genomics screening and CRISPR-based libraries
- Developing thermally dynamic materials that will be incorporated into new energy-saving products for individuals and industry

Through partnerships, investments in the Labs' capabilities—people, research, facilities and tools—are enhanced and amplified. Partnerships allow Sandia to more efficiently meet its mission objectives and move technology to the marketplace for the public good.

Built on LDRD Laboratory Directed Research and 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

Collaborative Research Large Part of LDRD

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, and 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.

IR Dynamics President William Kurtz and Sandia Scientist Nelson Bell working together in the lab.

Thermally Dynamic Materials Add Energy Efficiency to Products

"We are very excited to develop new products based on Sandia's advanced research; products that will have significant impact in a variety of markets, and benefit the environment."

— William Kurtz

President and COO
IR Dynamics, LLC

CHALLENGE

According to the DOE, doubling the efficiency of single-pane windows can save roughly the amount of energy needed to power 32 million U.S. homes for a year. The associated investments in energy efficient window films could return about $12 billion/year to energy consumers. Yet this would require breakthrough thermal management materials that are low-cost and easy to apply.

COLLABORATION

The Materials Science Center and Physical, Chemical and Nano Science Center at Sandia National Laboratories are working with IR Dynamics (IRD) on thermochromic materials. Together, they're developing nanoparticles that are tunable and triggered by the environment. These nanomaterials transition to let the heat through when it's cold outside and reflect heat when it's warm. The technology can be incorporated into a variety of products where controlling solar heat gain and infrared reflectivity is a significant advantage.

IRD brings industry experience to the partnership, particularly with energy efficient products for the building industry. Sandia brings experience in materials science and the physics of optical materials. The company is now licensing two technologies from Sandia and has developed joint intellectual property with the Labs.

SOLUTION

After working with Sandia under two NMSBA projects to test the feasibility of creating products based on thermally dynamic materials invented at the Labs, work continues under a CRADA to further develop these materials for applications including window films, architectural membranes, and performance clothing.

For windows, this new technology may double the energy efficiency of single pane glass. The new window film contains technologies developed at Sandia, including thermochromic pigments which reject >50% of infrared radiation above 85°F.

IMPACT

IRD was awarded $1.95 million from the DOE's Advanced Research Projects Agency-Energy (ARPA-E) in 2016 to fund further development of the window film application of the nanomaterial technology. Currently the company is raising $2 million in A-round funding and building out new offices and laboratories in Albuquerque, NM.

Madico, one of the largest providers of window films worldwide, is working with IRD to develop window film products and laminated ETFE structural film (an architectural membrane). The company also has a joint development agreement with HeiQ, a fabric finishing company that provides modified performance materials to major apparel brands.

This partnership between Sandia and IRD can help improve the performance of products in industries from apparel to aerospace, and increase energy efficiency in structures from greenhouses to skyscrapers by bringing new technology to market.

PARTNERSHIP TYPE: Cooperative Research and Development Agreement (CRADA), Licenses, New Mexico Small Business Assistance (NMSBA), and Outside Consulting
GOAL: Developing thermally dynamic materials that will be incorporated into new energy-saving products for individuals and industry

Former Sandia Technologist Ricky Sommers inspects a propane leak using the battery powered Sandia shoulder-mounted infrared gas imager.

Imaging Technology Can Be Tuned to Detect Dangerous Substances

"Working with Sandia has given us access to the leading scientists and technology in hyperspectral imaging, helping us to grow as a company."

— Nils Hempler

Head of Innovation Group
M Squared Lasers

CHALLENGE

Whether searching for gas leaks or chemical warfare agents, being able to find small quantities of dangerous materials from a safe distance is crucial.

Passive imaging systems are the most common technology used today. These thermal imaging systems depend on passively emitted infrared radiation, making sunny days ideal. But on overcast days or at night, passive technology doesn't work so well. An image will also not be visible if the material being searched for is at or near the same temperature as the environment.

COLLABORATION

Sandia National Laboratories developed backscatter absorption gas imaging (BAGI) technology to detect gas leaks at petroleum refineries and natural gas processing plants. BAGI is known as active gas imaging due to its use of infrared lasers to illuminate a scene of interest. This allows the device to operate independently of background light and temperature levels.

M Squared Lasers is working with Sandia to develop the BAGI technology and incorporate it into novel, laser-based hyperspectral imaging devices for remote spectroscopy. The collaboration is leading to wider applications of the technology for the defense, security, distilled spirits, and agriculture industries.

SOLUTION

BAGI technology was of particular interest to M Squared because it allows for the detection of a wider range of gas molecules. BAGI has a broadly tunable laser source that can be modified for each substance being scanned, greatly increasing performance. The sophistication of the technology also allows for detection from greater distances.

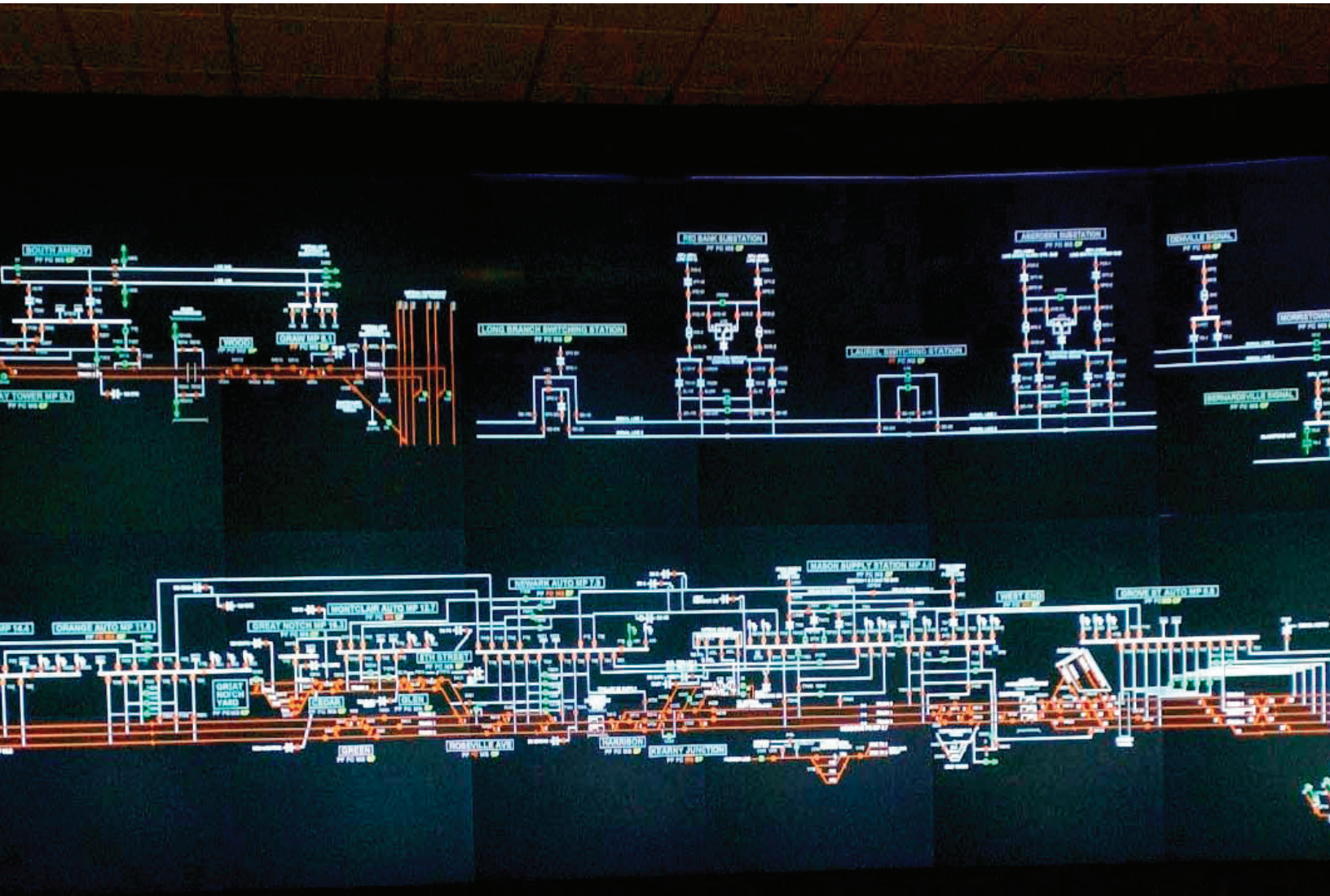
Advances in the BAGI technology have enabled a wide range of sensing applications in different markets. It can detect a variety of substances due to its ability to differentiate unique spectral signatures associated with specific molecules and bonding structures.

IMPACT

Beyond traditional markets for imaging such as the oil and gas industry, M Squared is exploring new markets such as distilled spirits manufacturing. This industry loses 10 million liters of ethanol per year through evaporation or leaks. M Squared has already started helping companies detect losses from barrels using BAGI technology.

For explosives or chemical detection, BAGI can be used to detect trace or large quantities. For agriculture, this technology can look at the moisture content in plants and the fertilizer levels being applied to crops. For environmental monitoring, BAGI can help to understand where emissions are coming from so they can be controlled. By working together with M Squared, a technology invented at Sandia for one purpose is evolving to solve a variety of public and private sector challenges.

PARTNERSHIP TYPE: Umbrella Cooperative Research and Development Agreement (CRADA) and License
GOAL: Incorporating BAGI technology into portable, high sensitivity imaging products which can be used for a variety of applications and industries

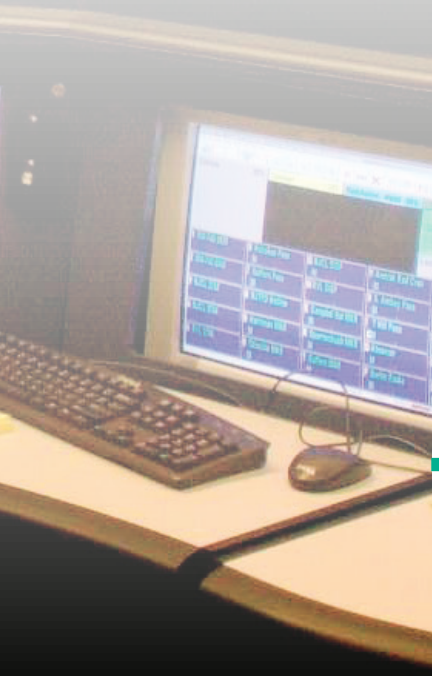


NJT Rail Operations Center will directly benefit from the implementation of the microgrid.

Reducing Disruption of Public Transit in a Disaster

"We're relying on Sandia's experience with microgrids to provide assistance in the design that produces an optimum solution that will allow for reliable and resilient transportation options for our customers."

— **Steven H. Santoro**
Executive Director
New Jersey Transit Corporation



CHALLENGE

After a number of serious storms, culminating in Superstorm Sandy in 2012 which caused billions of dollars in damage and closed parts of the transit system, New Jersey Transit (NJT) wanted to reduce their vulnerability to electric power outages caused by natural or manmade disasters. The Hurricane Sandy Rebuilding Task Force was charged by President Obama with identifying and working to remove obstacles to resilient infrastructure rebuilding while considering existing and future risks.

Because northern New Jersey and New York City have a higher concentration of economic activity compared to other regions, power failure due to major storms can result in significant disruption. Without power, train service is halted, causing extreme economic and safety impacts. NJT links major points in New Jersey, New York, and Pennsylvania, and provides nearly 275 million passenger trips each year.

COLLABORATION

Sandia National Laboratories was brought in by the DOE based on their prior work in microgrid research and their development of microgrid designs for more than 20 military bases.

An MOU between the DOE, NJT, and the New Jersey Board of Public Utilities, allowed Sandia to do a feasibility study for a microgrid. Through the partnership with NJT, Sandia applied its Energy Surety Design Microgrid (ESDM), a risk-assessment approach that has been successfully applied to high security installations.

SOLUTION

Based on the conceptual design, NJT was awarded approximately $410 million from the Department of Transportation (DOT) to develop NJ TRANSITGRID, an innovative microgrid capable of supplying highly reliable power to a core section of NJT's system. The project will include a large-scale gas-fired generation facility and distributed energy resources to supply power during storm-related disruptions or other power failure events.

An umbrella CRADA with a total value of over $1 million was signed so that Sandia could continue working with NJT on jointly developing a technologically and economically feasible microgrid system.

IMPACT

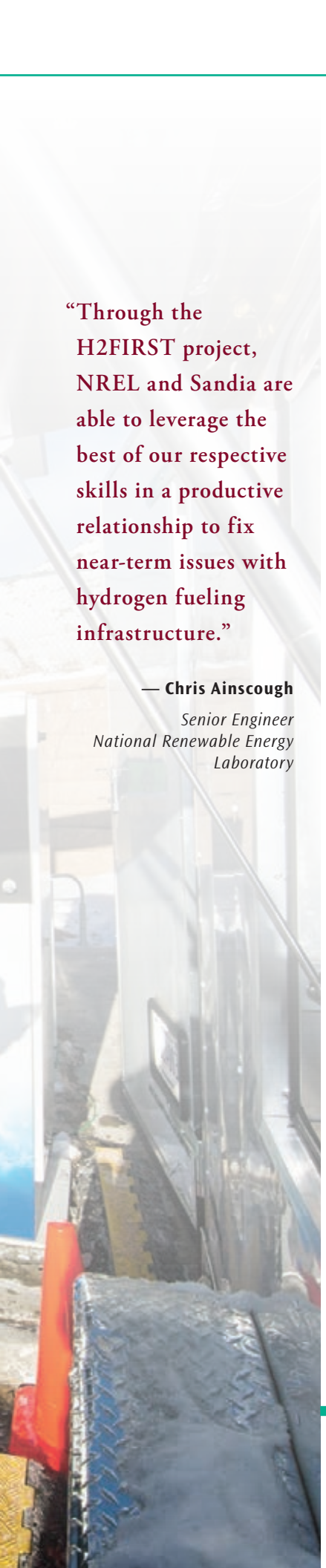
NJ TRANSITGRID is the first critical application for public transportation of a design methodology originally developed for military installations. The project will help identify and address gaps that challenge the widespread deployment of microgrids, including regulatory implementation.

NJ TRANSITGRID will be the largest microgrid by capacity and geographical footprint in the U.S. While it will normally be operated while connected to a utility electrical grid, it will also be able to operate in "island mode." The project has attracted the interest of other cities and organizations, and its success will spur more resilient energy projects.

PARTNERSHIP TYPE: Memorandum of Understanding (MOU) and Umbrella Cooperative Research and Development Agreement (CRADA)
GOAL: Minimizing the economic and safety consequences of natural or manmade disasters on transportation infrastructure through the use of a microgrid

NREL Researcher Chris Ainscough and Sandia Mechanical Engineer Terry Johnson prepare HyStEP for testing at NREL's Energy Systems Integration Lab.

Accelerating the Introduction of Fuel Cell Electric Vehicles



"Through the H2FIRST project, NREL and Sandia are able to leverage the best of our respective skills in a productive relationship to fix near-term issues with hydrogen fueling infrastructure."

— Chris Ainscough

Senior Engineer
National Renewable Energy Laboratory

CHALLENGE

California has audacious plans to deploy 1.5 million zero-emission vehicles (ZEV) by 2025 to improve air quality and develop sustainable, clean-energy transportation options. Fuel cell electric vehicles (FCEVs) are a crucial component of the plan, which includes commissioning 50 hydrogen refueling stations (HRS) by the end of 2017.

Hydrogen FCEVs are already available in the state, but market growth is hampered by the limited number of HRS locations. A lack of instrumentation for evaluating the performance of stations led to each automotive manufacturer performing its own validation testing to verify that refueling protocols were met at each HRS. This has made commissioning stations a very slow process.

COLLABORATION

The DOE Office of Energy Efficiency and Renewable Energy's (EERE) Fuel Cell Technologies Office (FCTO) developed the Hydrogen Fueling Infrastructure Research and Station Technology (H2FIRST) project to address challenges associated with hydrogen fueling infrastructure as a partnership between Sandia National Laboratories and the National Renewable Energy Laboratory (NREL).

Each laboratory contributed unique expertise: Sandia's deep knowledge of refueling protocols and standards, and NREL's experience with systems design and construction of hydrogen refueling infrastructure. The success of this project hinged on understanding both, making Sandia and NREL the right team for this challenge.

SOLUTION

To accelerate the HRS commissioning process, Sandia and NREL conceived of a single device to act as a surrogate for multiple FCEVs, with the aim of eliminating the need for each manufacturer to perform separate testing. The Hydrogen Station Equipment Performance device (HyStEP) is equipped with modular tanks and all of the instrumentation that automotive manufacturers require when performing tests to assess appropriate safety features of HRS.

Powertech Labs was selected to design and construct the device. Working closely with California's Air Resources Board to ensure the needs of commissioning stations were met, HyStEP was designed, built, tested, and deployed in just over a year to help meet California's aggressive timeline for deploying a network of HRS.

IMPACT

HyStEP is helping California reach the goals of the ZEV Action Plan to improve air quality standards and reduce greenhouse gas emissions. Soon composite data based on the use of HyStEP in California will be made available to the public, so automakers and other states can use this valuable information. This project is an example of the national laboratories working together with state governments and industry to support the nation's energy strategy—helping to diversify America's energy sector and reduce our dependence on foreign oil by enabling hydrogen and fuel cell technologies.

PARTNERSHIP TYPE: DOE H2FIRST project, in support of H2USA, a public-private collaboration launched by DOE and industry
GOAL: Facilitating the introduction of hydrogen fuel cell electric vehicles by streamlining the commissioning of refueling stations

The ORNL Manufacturing Demonstration Facility Team next to a 3D printed wind turbine blade mold.

Using Large-Scale 3D Printing to Test New Wind Blade Designs

"Working with Sandia has been a great experience. We're excited to see the blades manufactured with the mold we made flying at the SWiFT facility."

— Brian Post

Associate Research Staff Member
Manufacturing Systems Research Group
Oak Ridge National Laboratory

CHALLENGE

Trying out new wind turbine blade designs is extremely expensive due to the multimillion dollar cost of making the complex molds used in manufacturing. Since short production runs for prototypes are cost prohibitive, innovation is stifled. If a way could be found to shorten the production cycle for new blade designs, the cost of wind energy might be lowered.

COLLABORATION

Sandia National Laboratories wanted to test a new subscale wind turbine blade design. They were able to do so as part of the National Rotor Testbed project, which is developing an open source wind blade that can be used by researchers at Sandia and other labs. Sandia researchers discussed this effort with the DOE's Wind Program and Advanced Manufacturing Office, and were directed to Oak Ridge National Laboratory (ORNL) due to that Lab's expertise in additive manufacturing.

ORNL has the largest polymer 3D printer in the world (8 x 20 x 6 ft.), which makes production much faster than what is possible with most 3D printers. Where a small 3D printer prints 1–5 $in.^3$ of material an hour, this printer completes 2500 $in.^3$, which allowed ORNL to quickly produce the wind turbine blade mold.

TPI Composites, a U.S.-based blade manufacturer, worked on the mold design with ORNL, assembled the mold sections into a complete blade mold after ORNL had printed them, and will produce the wind turbine blade prototype of the Sandia blade design using the completed mold.

SOLUTION

3D printing, or additive manufacturing, is drastically reducing the time and cost associated with building new wind blade designs. It is allowing blade designs to move directly from computer models to mold production, bypassing some of the expensive and time-consuming steps of more traditional manufacturing.

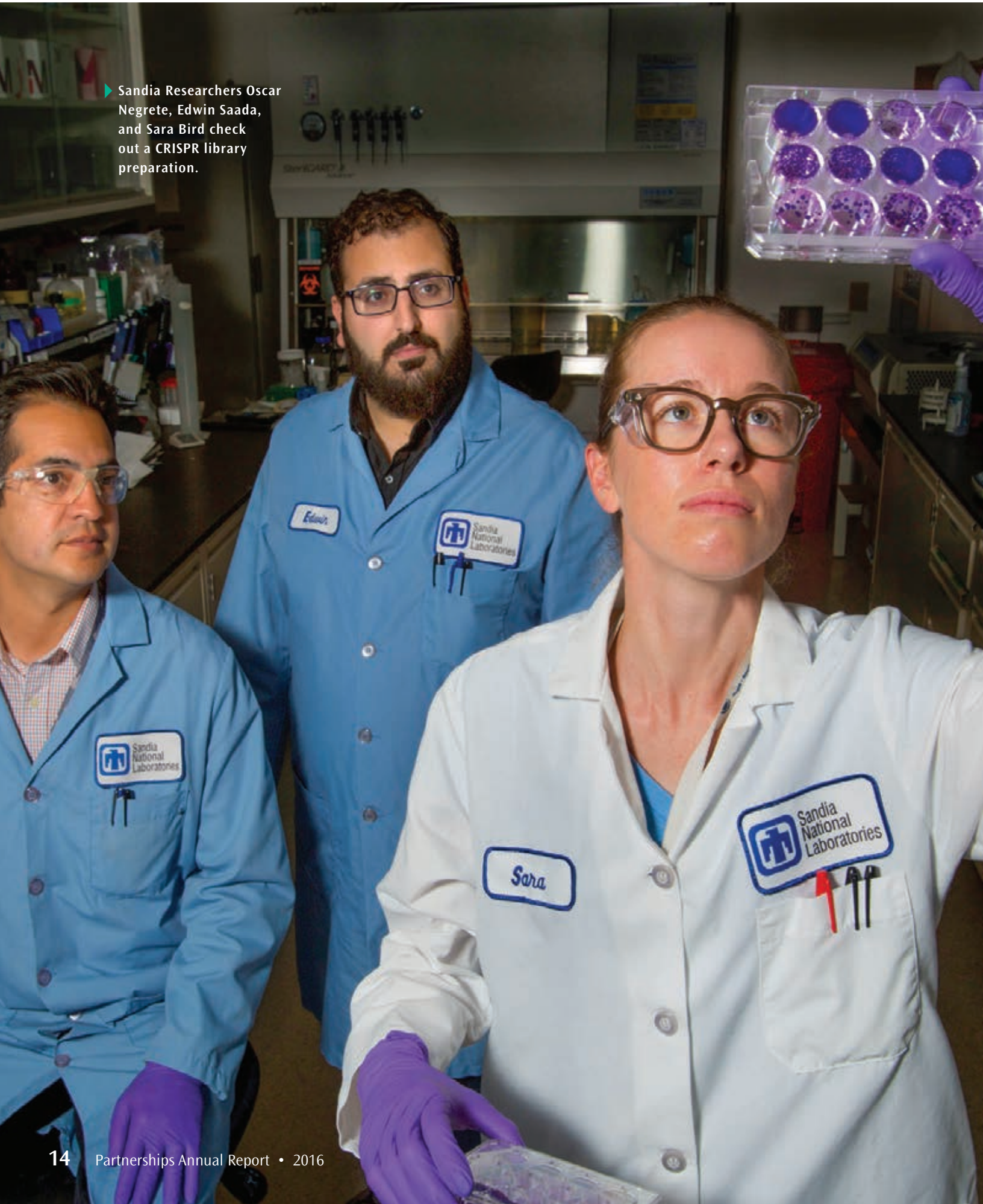
By streamlining the mold-making process, advanced designs can be tested more quickly, accelerating the introduction of new technology, leading to lowered costs for wind energy.

IMPACT

The prototype blades produced from the 3D printed molds will be flown by Sandia at the Scaled Wind Farm Technology (SWiFT) facility in 2017 as part of efforts to conduct basic science research on wind plant performance.

This first test of using additive manufacturing for producing wind blade molds is now being analyzed by ORNL. With more large 3D printers becoming available in the marketplace, TPI is deciding if 3D printing could be feasible not only for producing molds for subscale blade prototypes, but also for larger scale blade manufacturing. Together, two national laboratories, working with industry, are coming up with new ways to lower the cost of wind energy production and accelerate the deployment of wind power.

PARTNERSHIP TYPE: Collaborative Research and Cooperative Research and Development Agreement (CRADA) between TPI Composites, ORNL, and DOE
GOAL: Reducing the time and cost of building new wind turbine blade designs to accelerate innovation in and adoption of wind energy



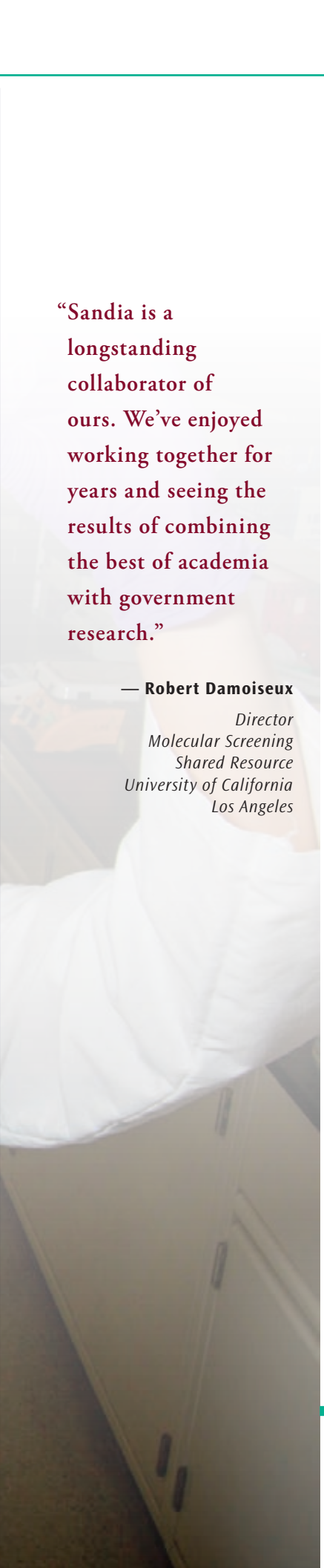
Sandia Researchers Oscar Negrete, Edwin Saada, and Sara Bird check out a CRISPR library preparation.

Improving the Quality and Speed of Research into Infectious Diseases

"Sandia is a longstanding collaborator of ours. We've enjoyed working together for years and seeing the results of combining the best of academia with government research."

— Robert Damoiseux

Director
Molecular Screening Shared Resource
University of California Los Angeles



CHALLENGE

Finding cures for infectious diseases including Ebola and Zika is being made simpler by using DNA screening libraries based on CRISPR (clustered regularly interspaced short palindromic repeats) genome-editing techniques. By discovering host genes essential for infection through CRISPR library screening, researchers can begin to design anti-viral treatments using identified genes as targets.

Many CRISPR libraries are "pooled." While easy and inexpensive to produce, they are complex mixtures, which limits their usability for various applications. In arrayed libraries, on the other hand, each construct is individually handled. This enables more complex experiments and individual constructs can be accessed quickly for follow-up. But until now, producing arrayed libraries has required expensive, labor-intensive methods.

COLLABORATION

Cooperative research being done by Sandia National Laboratories and the University of California, Los Angeles (UCLA) is making use of an alternative method of assembly to produce arrayed CRISPR libraries at a fraction of the cost of standard methods. This new method starts with a pooled library and then separates or arrays the mixture into individual constructs using high-throughput robotic equipment. Using next-generation sequencing, the constructs are then decoded to build the formatted library.

UCLA has the computing power, robotic equipment, and know-how to use data for genome mining. Sandia brings a lot of knowledge about infectious diseases, next-generation sequencing, and validation of constructs.

SOLUTION

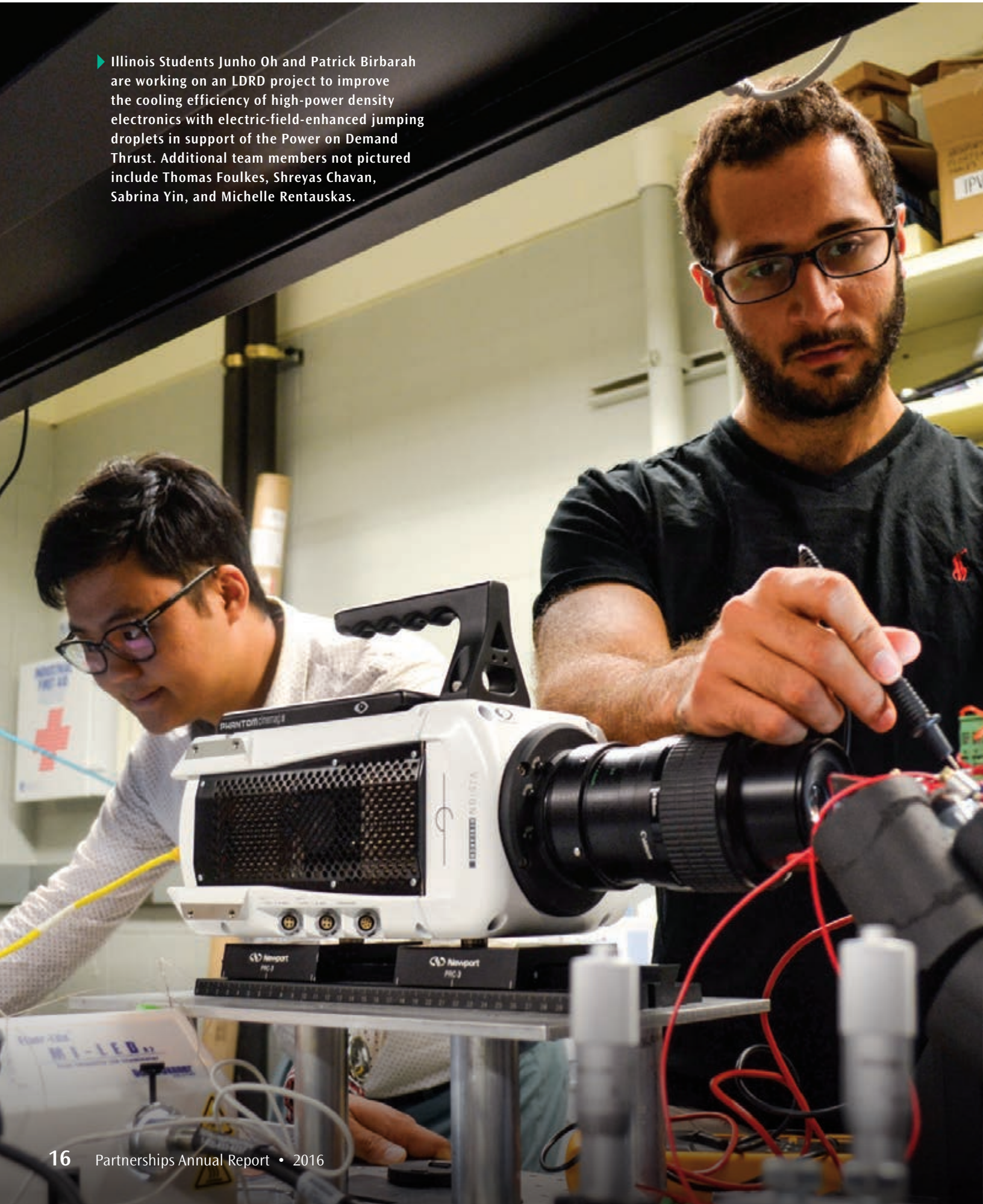
In order to create a better way to utilize and access CRISPR technologies, the latest genome editing technique, UCLA and Sandia are producing arrayed libraries that will be made available to other research institutions. The first library set will be ready in December 2017. These high value collections of genomic tools will help advance research into the mechanism of infection as well as cancer and other diseases.

IMPACT

By creating and distributing more advanced, accurate, and cost-effective screening systems based on CRISPR gene editing technology, Sandia and UCLA will help researchers dramatically speed up and improve the quality of their research. Qualified research institutions will access these valuable libraries through the Molecular Screening Shared Resource at UCLA or the Biological Science and Technology Center at Sandia.

It is hoped that this will help scientists more quickly discover the mechanism of infection for different viruses, identify targeted genes, and develop cures for diseases. Research into cures for viral infections like Zika and Ebola, as well as genetic diseases, can all be accelerated, and advance medical science.

PARTNERSHIP TYPE: Cooperative Research and Development Agreement (CRADA)
GOAL: Accelerating discovery of treatments for viral and genetic diseases through genomics screening and CRISPR-based libraries



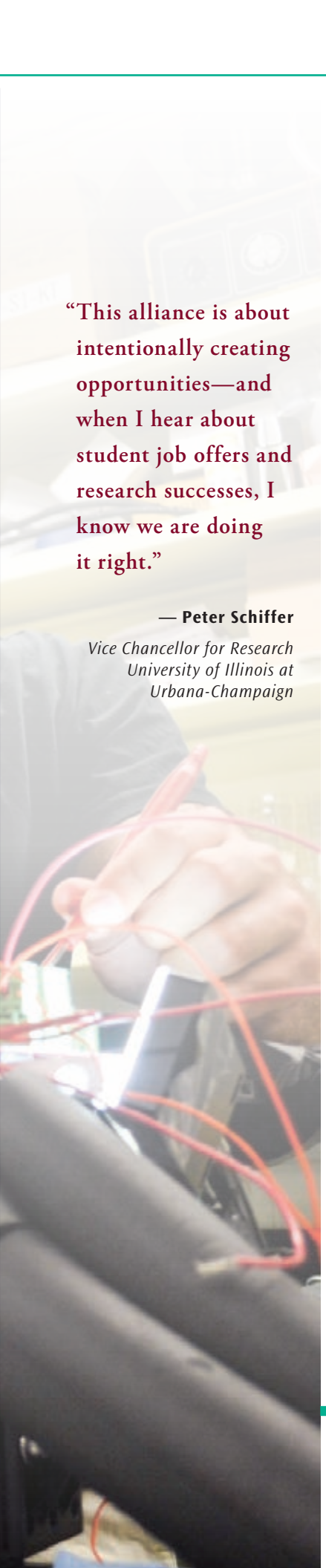
Illinois Students Junho Oh and Patrick Birbarah are working on an LDRD project to improve the cooling efficiency of high-power density electronics with electric-field-enhanced jumping droplets in support of the Power on Demand Thrust. Additional team members not pictured include Thomas Foulkes, Shreyas Chavan, Sabrina Yin, and Michelle Rentauskas.

Academic Alliance Partner Became Model for Program

"This alliance is about intentionally creating opportunities—and when I hear about student job offers and research successes, I know we are doing it right."

— Peter Schiffer

Vice Chancellor for Research
University of Illinois at Urbana-Champaign



FIRSTS

In November 2014, after a successful decades-long relationship, an enhanced model for collaboration and partnership to advance the synergies between national laboratories and research universities was initiated between the University of Illinois at Urbana-Champaign and Sandia National Laboratories. This model became the framework for Sandia's Academic Alliance program with five premier universities.

Key elements contributing to the maturation of the partnership have been leadership commitment and the development of trusted relationships at multiple levels. In addition to periodic executive interactions, Illinois is hosting a Sandia on-campus partnership manager and has designated a member of its faculty to be on-site at Sandia. Both institutions are also making various investments to support collaborative research and education.

GOALS

The partnership goals developed with Illinois are now a part of the collaboration with each Academic Alliance university. These are to: 1) Solve Big Problems—particularly science and technology problems of national importance; 2) Sustain and Engage Human Capital—which includes giving students and faculty the opportunity to collaborate with Sandia on research and providing career opportunities to graduates; and 3) Accelerate Technology Adoption—including developing a strategy to introduce new ideas into the industrial and federal marketplace through enhanced public-private partnerships.

SYNERGY

Illinois is one of the nation's leading research universities, with many federally funded programs that overlap with Sandia's missions and capabilities, leading to synergistic opportunities. Initial research partnerships are focused in four technical areas, or thrusts. These are Complex Systems and Resiliency, Digital Manufacturing, Power on Demand, and Data Science. Sandia and Illinois are working together on a number of research projects in the four thrust areas, many aligned with Sandia LDRD investments.

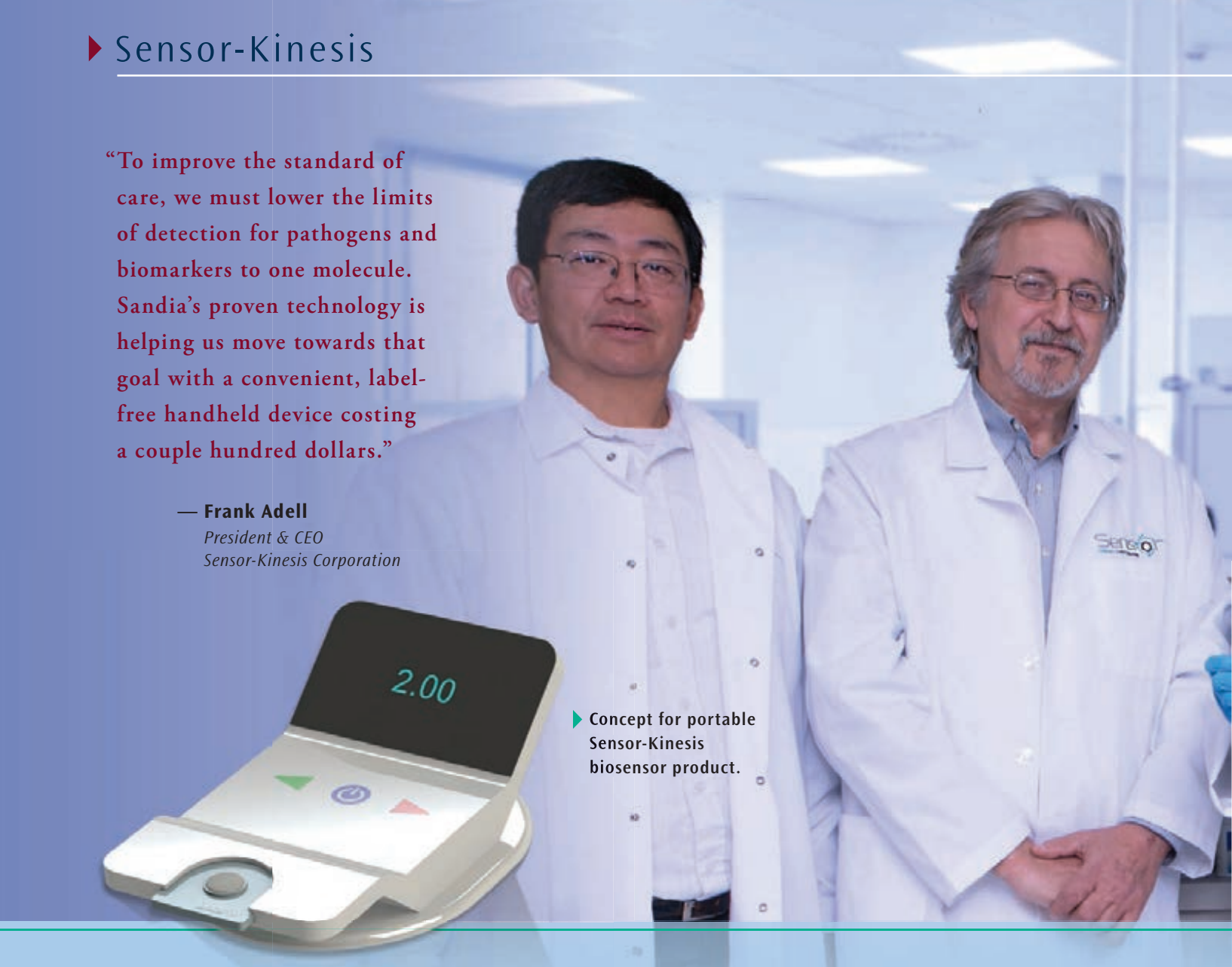
Part of what makes Illinois such a good partner is its collaborative, multidisciplinary research culture, which is similar to the culture at Sandia. Connecting researchers through the Academic Alliance makes it easier for them to work with each other and build on both individual and institutional strengths.

IMPACT

As a result of this long-term partnership, there are now more Illinois graduates working at Sandia than from any other out-of-state university. Looking ahead, Sandia is hoping to increase its presence at Illinois's Applied Research Institute in the University of Illinois Research Park to enhance technology adoption.

Sandia and Illinois's commitment and investment in building connections between the people at their institutions has paid off in successful joint research projects, recruitment, and technology transfer. Over time, this partnership has grown and deepened as the two institutions continue to work together for mutual benefit.

PARTNERSHIP TYPE: Collaborative Research and Academic Alliance
GOAL: Expanding on a long-term partnership to grow research collaborations and recruitment



"To improve the standard of care, we must lower the limits of detection for pathogens and biomarkers to one molecule. Sandia's proven technology is helping us move towards that goal with a convenient, label-free handheld device costing a couple hundred dollars."

— **Frank Adell**
President & CEO
Sensor-Kinesis Corporation

Concept for portable Sensor-Kinesis biosensor product.

Biosensors in Portable Virus and Bacteria Diagnostic Products Improve Healthcare

CHALLENGE

The healthcare system has reached a breaking point. Medical science keeps advancing but costs are rising beyond what is sustainable. One way to manage runaway healthcare costs is through early detection. By keeping people healthy and monitoring their condition regularly, disease can often be detected sooner and treated before it becomes acute and requires more expensive interventions.

Although the technology exists, there is a lack of small, portable, and inexpensive biodetection platforms to link biology to microchips in a way where they can be used easily and inexpensively, and that can then share test data via digital networks. These devices would run tests in seconds or minutes, producing results without sending samples to a lab.

COLLABORATION

In order to fill this need, Sensor-Kinesis, a development stage high-tech company, has come up with a medical technology platform to identify pathogens such as *E. coli, Salmonella,* and *Listeria*, as well as the early stage of certain cancer biomarkers. They are developing a handheld label-free device for early detection of human diseases as well as environmental pathogens.

Sensor-Kinesis Research Development Team with a research tool being used for validation that incorporates a Sandia SH-SAW biosensor array. The finished commercial product will be much smaller.

Sensor-Kinesis is licensing Sandia National Laboratories' shear horizontal surface acoustic wave (SH-SAW) biosensor array technology for use in some of their devices. Sandia's SH-SAW biosensor array is an R&D 100 award-winning technology originally developed with the University of New Mexico. These sensors have been demonstrated for the detection of bacteria, viral particles, and proteins. Sandia is now working with Sensor-Kinesis to validate the commercial use of the sensor in a range of applications in medical and industrial settings.

SOLUTION

By utilizing Sandia SH-SAW biosensors, Sensor-Kinesis is taking advantage of proven technology that will help make their vision of creating portable devices that rapidly produce accurate test results a reality. While they continue to develop products for a variety of applications, they can leverage Sandia's research into products which can be brought to market in the very near future.

IMPACT

Sensor-Kinesis is working to bring biosensor technology to market at a cost point that will make it readily available to individual doctors, smaller health care institutions, and food and air quality agencies, as well as health providers in remote locations. Early applications could include the efficient and inexpensive detection of air and waterborne pathogens in restaurants, hospitals, and hotels. The long-term goal is to have these medical devices be affordable and easy to use. That way they can be used by individuals at home to monitor conditions so they can be caught in the early stages, before they require expensive medical care.

PARTNERSHIP TYPE: Cooperative Research and Development Agreement (CRADA) and License
GOAL: Bringing portable, inexpensive biosensor technology to market so it can be widely used for healthcare and other applications including food safety

Moving Algae-Based Fuels and Products to Commercial Production

Sandia Researchers Pam Lane and Deanna Curtis servicing a paddlewheel at the Sandia Algae Testbed Facility.

Over the past 10 years, Sandia National Laboratories has made significant contributions to algae biomass production through advances in remote monitoring, crop protection, biomass conversion, strain development, and nutrient recycling. Algae are not only being researched as a source for biofuels—they can also be used to produce high-value products currently made from fossil fuels, such as butanol and nylon, making these tiny organisms a potential economic powerhouse.

Yet translating promising laboratory findings for algae-based fuels and biobased commodities to large-scale outdoor cultivation has proven to be a major challenge for advancing the algae industry. The leap from a flask in a controlled lab environment to a large outdoor facility often results in inconsistent results.

In 2016, Sandia commissioned a pilot-scale Algae Testbed Facility located in the Livermore Valley Open Campus to enable testing of promising new strains and technologies in an open, yet environmentally controlled setting. It has three 1,100-liter temperature-controlled raceway ponds with paddlewheel mixing, solar photosynthetically active LED illumination, growth media pumping, CO_2 delivery, and centrifugal harvesting.

In the initial phase, the Sandia team successfully conducted continuous cultivation of a promising algae production strain, *Nannochloropsis salina*, for over nine months under various environmental conditions. Following demonstration of this capability, Sandia was awarded a DOE Small Business Voucher to partner with HelioBioSys to provide scale-up of their technology for producing low-cost sugars from a blue green algal consortium.

Concurrently, Sandia has teamed on successful proposals with MicroBio Engineering, Heliae, and various university and national lab partners to demonstrate improved biomass productivity through strain improvements, crop protection, and comprehensive biomass conversion to fuels and biobased products. The next step for the facility is to add three more 1,100-liter ponds outdoors.

Local Suppliers Meet Powerful Machine's Exacting Hardware Needs

Sandia National Laboratories' Z machine is the world's most powerful pulsed power facility. It produces an electrical current pulse of up to 26 million amps. These current levels create very large magnetic fields that generate very high temperatures and pressures along with powerful X-rays that are used for a variety of scientific experiments. The information from Z is used for research in areas including fusion, material properties, radiation effects, and fundamental science such as astrophysics and planetary science.

During experiments, Z's energy is deposited into target hardware which sits in the middle few inches of the gigantic machine. This hardware must be built to exacting specifications unique to each experiment, and is essentially blown up and replaced every time Z fires.

With the facility conducting approximately 150 experiments a year, a steady stream of target hardware is vital. Sandia's Load and Diagnostic Engineering Department's role is to design and manage the hardware and manufacturing processes, and to make sure experimental hardware is ready on time to keep up with Z's aggressive schedule.

Roger Harmon leads the team that procures and oversees fabrication. With an extensive background in machine shops and manufacturing, he has been able to fine-tune processes and reduce the overall cost of target hardware by approximately one-half over the past several years.

Harmon works with shops that seek to understand Z's relatively unique and high-precision hardware needs. There are now several he views as partners, not just suppliers. These businesses don't hesitate to call to offer suggestions or double-check questionable specifications. Catching errors early means they can be resolved quickly and cost-effectively.

Today, virtually all target hardware is produced by a few key local suppliers who have invested time, money, and resources to build a capability that meets Z's needs. Having local partners helps Z meet its busy experimental shot schedule while benefiting the local economy.

Sandians Leo Molina and Roger Harmon, and Sandia contractor Josh Gonzalez stand with one of the ~150 target assemblies designed and fabricated each year for high energy density physics research at the Z Facility.

SS&TP Recognized for Regional Economic Impact

Over 100 people attended a news conference at the National Museum of Nuclear Science & History to hear about the economic impact of the Sandia Science & Technology Park (SS&TP). The results were presented by Albuquerque Mayor Richard J. Berry, who remarked that the SS&TP is a model for public-private partnerships and job creation, providing high wage jobs and contributing to the prosperity of the state.

Conducted by the Mid-Region Council of Governments (MRCOG), the analysis showed that the SS&TP paid out $4.4 billion in wages and salaries and generated $2.6 billion worth of economic activity since its inception in 1998. Over the past two years, wages and salaries totaled $635.1 million and economic activity added up to $315.2 million.

Speakers at the event reflected on the teamwork between the public and private sectors that has made the Park possible, transforming once vacant land into a vibrant business community. Others noted that while the SS&TP has won awards, what really is remarkable is the number of jobs created.

Mayor Berry said, “The Park’s impact on local and regional economic development is a reflection of Albuquerque’s robust collaborative efforts that ultimately result in valuable jobs for our residents.” The metrics presented in the report showed that the average salary of $83,000 in the Park was almost twice that of the average metro area job.

Over 2,000 employees work in the SS&TP currently, with 42 companies and organizations housed in 25 buildings. Companies that do business with Sandia National Laboratories, as well as Sandia organizations that benefit from the easy access to their industry and academic partners that the Park provides, are based in the SS&TP.

Looking ahead, Mayor Berry said the future looks bright. Public and private sector investment in the Park has created an engine driving economic activity, and the SS&TP is a development any community in the U.S. would be proud to have.

MRCOG Director Dewey Cave, Sandia Director of Research Strategy & Partnerships Andy McIlroy, SS&TP Program Manager Jackie Kerby Moore, Albuquerque Mayor Richard J. Berry, DOE Technology Partnerships Manager Dan Sanchez, and SS&TP Development Corporation Chairman Sherman McCorkle.

To learn more about the SS&TP and its economic impact, visit www.sstp.org

Smart Battery Manager Gives Unmanned Vehicle Companies an Advantage

Whether flying through the air, zipping along the ground, or sailing on the water, unmanned vehicles are part of a global market expected to reach $4 billion by 2020. Many of these vehicles are powered by batteries, and in order to improve system reliability and plan complicated missions, operators need to know the batteries' state of charge and state of health.

Emerging Technology Ventures makes unmanned vehicles for land, air, and sea. Motion Picture Marine uses unmanned vehicles to create sequences for motion pictures like *X-Men*, *Armageddon*, and *Star Trek*. American Lithium Energy manufactures lithium-ion batteries that power unmanned vehicles, and Silent Falcon UAS Technologies is a developer of aerial unmanned vehicles. This group of small New Mexico businesses clustered in the unmanned vehicles industry decided to work together to develop a "smart battery manager."

In 2016 they completed their second New Mexico Small Business Assistance (NMSBA) project. NMSBA gave them access to Sandia National Laboratories engineers Derek Heeger, Dan Wesolowski, and Von Trullinger, and expertise which would otherwise be unavailable to them.

Assistance from Sandia helped them to advance the battery-monitoring electronics and algorithms that could be embedded within the battery's hardware. These updates allow users to monitor battery condition and historical data supporting the safe and reliable operations of autonomous and unmanned systems.

In addition to using the smart battery manager technology to give their companies a competitive advantage, now this group is looking at whether it can be turned into a commercially available system others in the industry could integrate into their products. They are seeking investment based on their intellectual property. So far, the companies have received $2.5 million in new investments and added 12 new employees, including 3 engineers to focus on systems integration of the smart battery management system.

Electronics Engineer William Neeley and Chief Technical Officer Greg Walker of Silent Falcon installing a battery into their Silent Falcon unmanned aircraft.

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

Sandian Takes a "Longshot" on His Own Game Development Company

Longshot Studios Founder Nathan Fabian experimenting with virtual reality controls on a video game.

Nathan Fabian started as an intern at Sandia National Laboratories when he was still in high school and continued as an employee working on satellite ground stations and test equipment. In 2009, when he completed his M.S. degree in computer science, he joined the visualization and analytics group.

Fabian's interest in video game development began in his youth and never faded. However, even after teaching a game development class at the University of New Mexico, and developing and selling his own game online in 2012, he still considered it just a hobby.

Then he realized that the video game industry had an analytics problem—they needed to understand what players were doing and what features and results players found interesting. This is particularly important for single and multiplayer games in the eSports arena, where most data is from pre-launch lab testing, not from real-world play.

Fabian looked into Sandia's Entrepreneurial Separation to Transfer Technology (ESTT) program and saw that it would allow him to take a shot at the private sector, while giving him a fallback. The ESTT program permits employees to leave the Labs to start up or expand technology companies, with guaranteed reinstatement for up to two years.

In September 2016 Fabian began working full-time at his company, Longshot Studios, as a consultant to game developers. He plans to use open source tools, like ParaView and Catalyst, which he helped develop while at Sandia, to capture and analyze player behavior.

ESTT has given Fabian a chance to apply the expertise he developed at Sandia to the commercial market. Although he knows that the games industry is a tough business, he is relieved that ESTT will allow him to return to the Labs if things don't work out.

Expanding Program Connects Scientists to World of Business

Sandia National Laboratories' Entrepreneur Exploration (EEx) program was designed to invigorate an entrepreneurial culture at the Labs and inspire entrepreneurs to either go into the business world or develop that mindset within the Labs. EEx is aimed at Sandia principal investigators interested in learning about the exciting opportunities and resources available to both entrepreneurs and intrapreneurs.

In 2016, EEx held 17 events attended by over 800 participants including Sandians, entrepreneurs, and business leaders. Bootcamps and Roundtables covered a variety of topics including Lean Startup 101, Value Proposition Design, and Raising a First Round of Investment.

EEx also took part in two Innovate New Mexico Technology Showcases, along with the Air Force Research Laboratory, Los Alamos National Laboratory, New Mexico State University, New Mexico Tech, and the University of New Mexico. These events were an opportunity to demonstrate that New Mexico has rich and deep technology assets that could be the answer to real-world problems.

The first Showcase included pitches from researchers from all six institutions, and a panel of "sharks." Sandian Ron Manginell presented *Non-Invasive Disease Detection* and Sandian Kyle Solis presented *Magnetic Vortex Fluids Offer New Routes for Non-Contact Mixing and Heat Transfer.* At the second Showcase, technology presentations were made by Sandian Jeff Nelson on *Next-Generation Energy via Advanced Membrane Technologies* and Sandian Laura Biedermann on *Low-Energy, Chlorine-Tolerant Desalination Membranes*. Former Sandian Murat Okandan, Founder of mPower Technology, participated on a panel with other start-up companies.

Looking ahead, EEx plans to continue expanding its entrepreneur options for Sandians and taking part in the local and regional entrepreneur ecosystem.

Sandia Researcher Laura Biedermann gives a presentation at an Innovate New Mexico Technology Showcase.

Company Expands Product Line of Non-Toxic Cleaners

Canadian Armed Forces personnel applying an ADT Decon Formula product.

Gregoire Charillon was using products based on Sandia National Laboratories' Decontamination Formula at his company, Decon Progreen, to provide cleaning and disinfecting services for residential, commercial, and healthcare customers, and was very impressed. The biodegradable formula had so many different uses and met customer needs in an effective way, without the use of toxic chemicals. Charillon saw business potential.

Instead of continuing to buy products from a vendor who was an existing Sandia licensee, Charillon decided to obtain a license and manufacture the formula himself. He launched a new company, Advanced Decon Technologies (ADT), for that purpose. ADT has now been in business for three years and distributes its products around the world.

After extensive development, the company became the first to manufacture a powder form of the Decon Formula, which previously had only been commercially available as a liquid or foam. This adds a number of benefits related to lowering the cost of transportation and storage while retaining all of the formula's beneficial properties. The powder has been added to ADT's product lines of non-toxic and biodegradable cleaners and disinfectants.

In order to more rapidly expand the company's production capacity, ADT is working with Technology Ventures Corporation (TVC) to gain investment capital. TVC was formed by Lockheed Martin Corporation as part of the management contract for Sandia. Its goals are job creation, business formation, and equity funding.

ADT presented at the 2016 Deal Stream Summit, an annual event TVC holds to showcase promising technology companies originating from the Department of Energy laboratories and other research institutions. As a result, several venture capitalists are showing interest in ADT, and Charillon is refining his plans for the continued growth of the company.

Technical Assistance for Wind Projects Part of Clean Energy Program

Sandia National Laboratories is one of the leads in the $20 million DOE Small Business Vouchers (SBV) program. SBV aims to help small businesses bring next-generation clean energy technologies to market faster by giving them access to expertise and tools that would be otherwise unavailable. Businesses receive vouchers worth between $50,000 and $300,000 which they exchange for technical assistance from participating national laboratories.

In rounds one and two, Sandia received twelve SBV vouchers totaling $2.6 million across seven technology areas. Three wind companies were among those who worked with Sandia.

Balancing supply and demand without reducing energy production has been a barrier to deploying new wind technologies. Group NIRE and Sandia are working to demonstrate essential balancing services using phasor measurement units (PMUs). This technology enables the combined benefits of modulation of wind energy and network-based remote capabilities.

The development of wind plant controllers has been slowed by the need for an accurate and cost-efficient approach to predicting the complex flow at each turbine. Micron Optics' project is aimed at seamless integration of fiber optic systems in commercial wind turbines. Sandia is helping with expertise in system integration and sensor rotor algorithms to provide an integrated rotor-as-a-sensor product that will enable wind plant controllers.

Wind turbine blades are getting larger and more expensive to replace, making it increasingly important to inspect and repair them throughout their lifecycle. SkySpecs develops drones to conduct autonomous visual inspections and is working with Sandia to validate their use. With extensive nondestructive testing experience, Sandia is also helping add other methods to their drones' inspection capabilities such as infrared camera thermography and ultrasonic inspection.

Sandia's participation in SBV lets the Labs share knowledge with small businesses and gives R&D staff the opportunity see the impact of their work on the U.S. energy industry.

Sandia Engineer Ray Ely (second from left) reviews concepts for integrating nondestructive inspection capabilities on a SkySpecs automated drone platform with SkySpecs Team Members Ben Marchionna, Isaac Olson, Jonathan Bendes, Tom Brady, and Danny Ellis.

To learn more about SBV, visit www.sbv.org

Talking to Potential Customers Provides Tech Transfer Insight

Sandia Researchers Michael Hibbs and Cy Fujimoto demonstrate the clarity of their membranes.

Researchers from Sandia National Laboratories who took part in Energy I-Corps (formerly Lab-Corps), an entrepreneurial training program, are enthusiastic about what they've learned. Aimed at accelerating the transfer of clean energy technologies from national laboratories, Energy I-Corps connects researchers to potential customers and industry partners.

Engineer Matt Carlson used his time in the Energy I-Corps training program to investigate one of the many possible markets for his team's new method to make high pressure heat exchangers. Their patent-pending method to cast heat exchangers significantly reduces cost, size, and manufacturing time compared to current diffusion bonding approaches. As a first application, Carlson focused on natural gas capture at remote well sites, where gas is often wasted or unused.

During the Energy I-Corps training, which emphasizes having researchers talk to businesspeople, he spoke to manufacturers of truck-mounted liquefaction systems and learned that they would like to use more advanced heat exchangers if they could be cost-effective. Talking to vendors, he discovered his team's technology could produce superior heat exchangers for just 30% the cost of existing ones. This knowledge is helping his team map their path forward as they work with interested licensees.

Cy Fujimoto found that Energy I-Corps training helped him and his team focus. Even though they had been working in the area of polymer membranes for fuel cells, flow batteries, and other applications for 15 years, and had partners including major automakers, the program helped them better understand customers and the business side of technology.

Being a chemist, he hadn't really thought before about what it would take to start a new materials-based company, effectively scale the chemistry, and insure the products work on a consistent basis. Now he's talking to potential investors. "Even if I never start a company, the idea that we should understand from day one what it takes for a technology to go to market will help us to distinguish between basic R&D and something that can evolve into a commercial product," said Fujimoto.

To learn more about Energy I-Corps, visit https://energy.gov/eere/technology-to-market/energy-i-corps

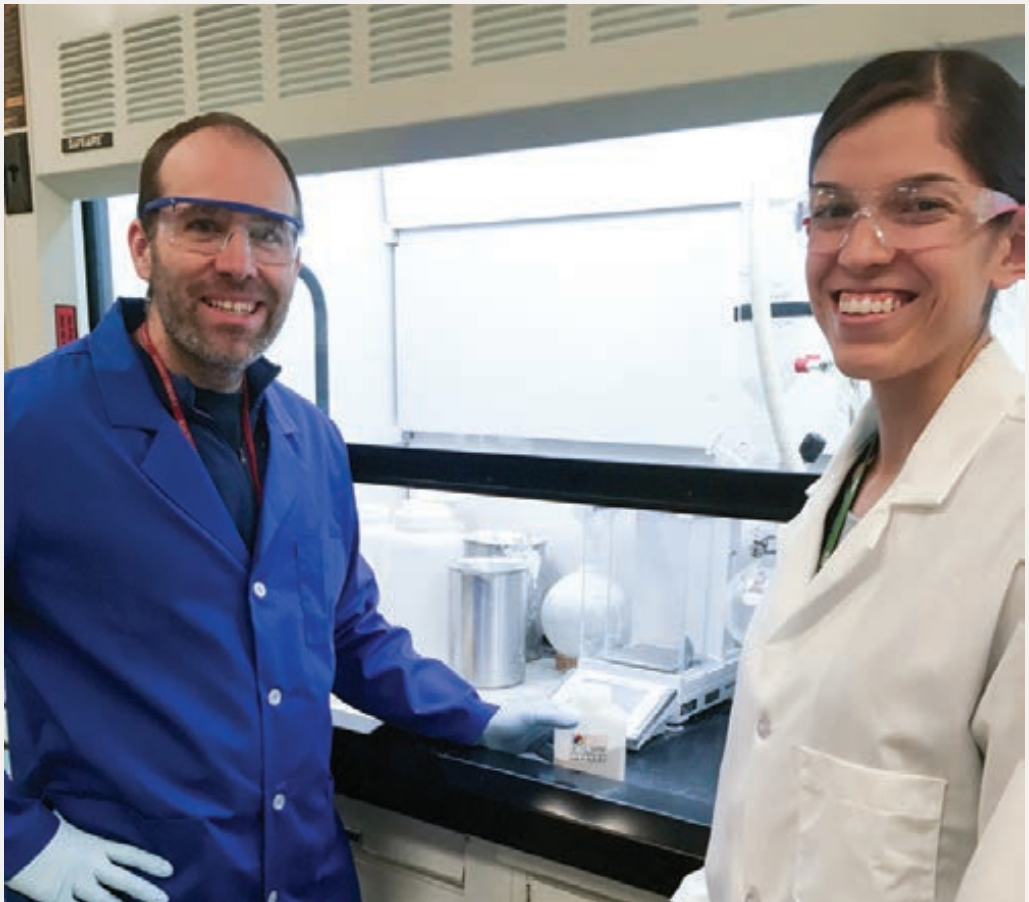
New Funding Program Helps Transition Technologies to Market

Two technologies developed at Sandia National Laboratories received funding to help bring them to market as part of the Technology Commercialization Fund (TCF), a program administered by the DOE's Office of Technology Transitions. TCF is designed to increase the number of energy technologies developed at DOE's national laboratories that graduate to commercial deployment. The DOE funds awarded pay for the work done by the Lab, and an equal amount is paid by the company for their own work in commercializing the technology on a joint project.

The Sandia Cooler is a rotating heat exchanger with a novel design offering many advantages over existing products. It is compact and quiet, so it can replace the heat sink and fan to cool computer chips, and larger sizes can provide efficient cooling for high power electronics in things like solar inverters and medical equipment. Wakefield-Vette is Sandia's partner for this TCF project to fully commercialize and then sell various size rotating heat exchangers. They will work with Sandia in a two-year Cooperative Research and Development Agreement (CRADA), where Sandia researchers will assist them in scaling up the technology from the lab to their manufacturing facilities.

Sandia has been working for years to develop silicon carbide- and gallium nitride-based power electronics that can operate at high temperatures. The ST-BST-BT Capacitors TCF project is developing complementary passive components for the high temperature electronics used in applications such as grid-tied solar. Sandia's ST-BST-BT powders will be used by partner TPL to manufacture capacitors. Working together, the partners will then test the components' performance. It is hoped that the project will lead to a commercially viable manufacturing process for more reliable high temperature capacitors to minimize the need for active cooling.

TCF funding is just one part of DOE's efforts to transition technologies to the marketplace. Sandia is proud to be taking part in this first round of the program.



Sandia Materials Scientist Derek Wilke and R&D Technologist Mia Blea-Kirby prepare the ceramic powder to be used by TPL for fabrication of high temperature ST-BST-BT capacitors.

To learn more about the TCF, visit https://energy.gov/technologytransitions/technology-commercialization-fund

Innovation and Intellectual Property Celebration

Sandia National Laboratories' Partnerships Team hosted the 7th annual Innovation and Intellectual Property Celebration on May 12, 2016, at the Hotel Albuquerque. The annual event honors the innovative culture and intellectual property generated by Sandia's scientists, engineers, and technologists.

Awards were given to 131 inventors for granted patents in calendar year 2015 and 24 copyright authors for copyrights asserted in calendar year 2015. The event also recognized 73 Mission Innovators, who were nominated by their divisions for innovation in support of Sandia's national security missions.

Awards were also presented to 28 director-nominated Up & Coming Innovators, honoring early career Sandians who exhibit entrepreneurial talent, develop unique solutions to complex scientific challenges, and display potential to make significant contributions to the Labs' intellectual property portfolio.

Hong Hou was also in attendance and was recognized as the First Entrepreneurial Hall of Fame inductee. Hou is a former Sandian who left the Labs to expand a semiconductor and solar company, EMCORE, where he led the commercialization of products that stemmed from Sandia technologies.

Sandia Vice President and Chief Technology Officer Rob Leland presents Researcher Eric Forrest an Up & Coming Innovator Award.

NMSBA Innovation Celebrations

Smart Battery Manager Leveraged Project is recognized at one of the Innovation Celebrations: Sandia NMSBA Program Leader Genaro Montoya, Sandia Principal Investigator Von Trullinger, Silent Falcon UAS Technologies Electronics Engineer William Neeley, Los Alamos National Laboratory CTO Duncan McBranch, Silent Falcon CEO John Brown, Emerging Technology Ventures CEO Cliff Hudson, and New Mexico State Representative Jane Powdrell-Culbert.

Projects that achieved outstanding innovations through the New Mexico Small Business Assistance (NMSBA) Program were honored at two Innovation Celebration Awards events in 2016.

Three of these projects received technical assistance from Sandia. IR Dynamics tested the feasibility of developing thermally dynamic materials based on Sandia technologies to be incorporated into energy-saving products. Smart Battery Manager, being developed by a group of companies, advanced the electronics and algorithms used to monitor unmanned vehicle batteries' state of charge and state of health. Right Sized Inventory improved its inventory software's features, and made it more accurate and dependable.

The Smart Battery Manager Leveraged Project was one of two that received the Honorable Speaker Ben Luján Award for Small Business Excellence for demonstrating the most economic impact.

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

Sandia National Laboratories was recognized with awards this year for achievements in technology development, technology transfer, and technology partnerships.

R&D 100 Awards

Widely recognized as the "Oscars of Invention," the R&D 100 Awards identify and celebrate the top 100 technology products of the year spanning industry, academia, and government-sponsored research.

Falling Particle Receiver for Concentrated Solar Energy

Highly concentrated sunlight heats commercially available particles to temperatures greater than 700° C; the energy can be stored to later generate electricity.

Pyomo v4.1

An extensible Open Source software platform for developing optimization-based analytics to support complex decision-making in a variety of applications.

Stress-induced Fabrication of Functionally Designed Nanomaterials

Compressive mechanical stress instead of chemistry is used to create new nanomaterials with better performance and structure control while reducing costs and improving manufacturability.

T-QUAKE (Transceiver for Quantum Keys and Encryption)

A single microchip containing all the components necessary to securely encode, transmit, receive, and decode quantum photonic signals creates an ultra-secure cryptographic network node.

Ultra-Fast X-Ray Imager (UXI)

The fastest multiframe digital X-ray camera in the world is helping researchers capture plasma images, and record X-rays, visible light, or particles.

Virtual Environment for Reactor Applications (VERA)

Developed in partnership with Oak Ridge National Laboratory and other partners, VERA can be used to improve the operation of nuclear reactors.

Green Tech Special Recognition Award

Precision High Power Battery Tester

Significantly improves battery life predictions, helping meet the growing demand for better, longer-life electrified vehicle and grid storage batteries.

Market Disruptor Product Special Recognition Award

Ultra-Fast X-Ray Imager (UXI)

(see description above)

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

Decontamination Technology for Chemical and Biological Agents

Products based on this nontoxic technology are being produced by a number of licensees and are being used to disinfect medical facilities, agricultural processing plants, and housing.

X-Ray Toolkit (XTK)

Image processing and analysis software that helps emergency responders better perform in the high-stress, time-critical mission of disabling improvised explosive devices (IEDs) and which has quickly become the standard in the field.

Outstanding Technology Transfer Professional

Bianca Thayer

Thayer was recognized for her significant contributions to the transfer of technologies including decontamination technology, Sandia's largest international patent portfolio.

FLC Mid-Continent & Far West Region Awards

Excellence in Technology Transfer

SEARCH: The Selection, Evaluation, and Rating of Compact Heat Exchangers Software Suite

SEARCH streamlines the design of high-performance micro-channel heat exchangers used in power generation, refrigeration, refining, and many other industrial processes.

Notable Technology Development

Gaze Appraise: Eye Movement and Analysis Software

The software will be used to improve performance in dynamic image analysis for medical diagnostics, airport security, nuclear nonproliferation and other areas.

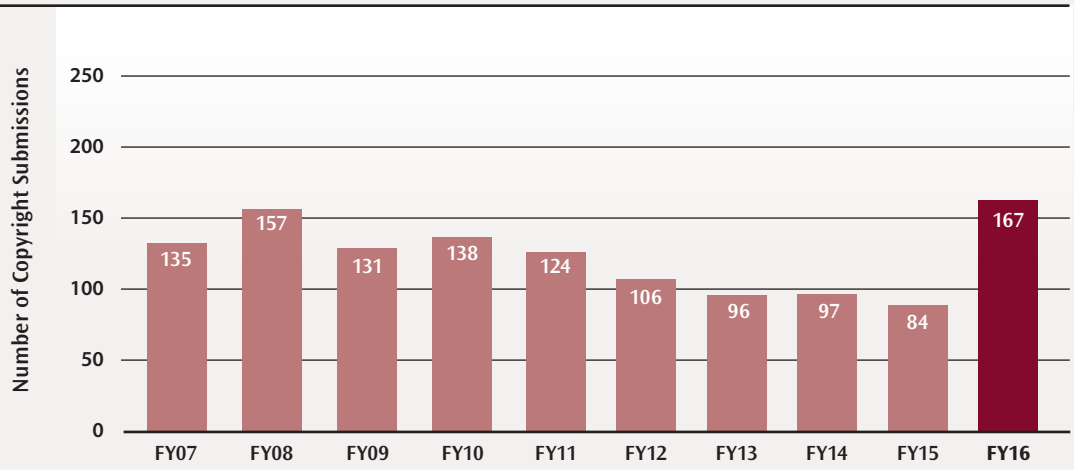
Outstanding Partnership

HyStEP: Hydrogen Station Equipment Performance Device

Developed in collaboration with the National Renewable Energy Laboratory, HyStEP validates the safety and refueling protocols of hydrogen refueling stations to greatly accelerate commissioning.

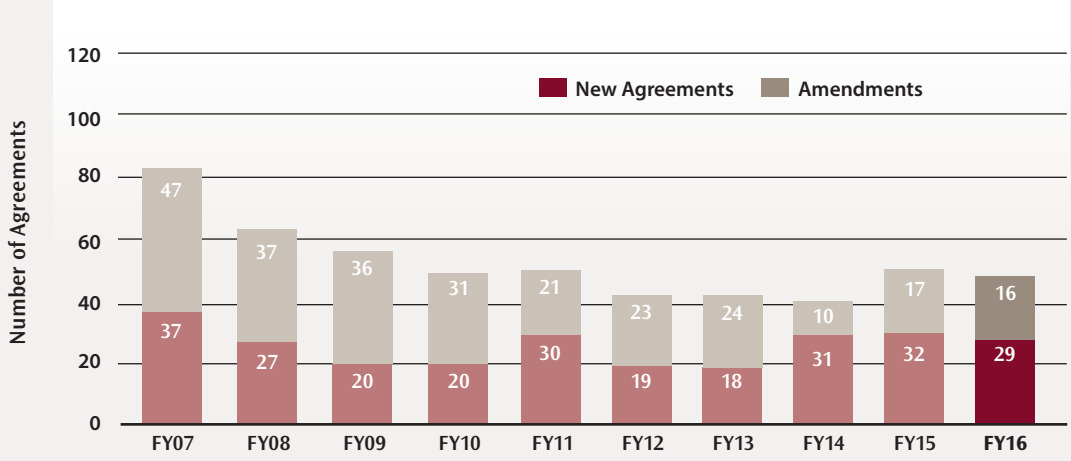
Copyrights

Copyright Submissions

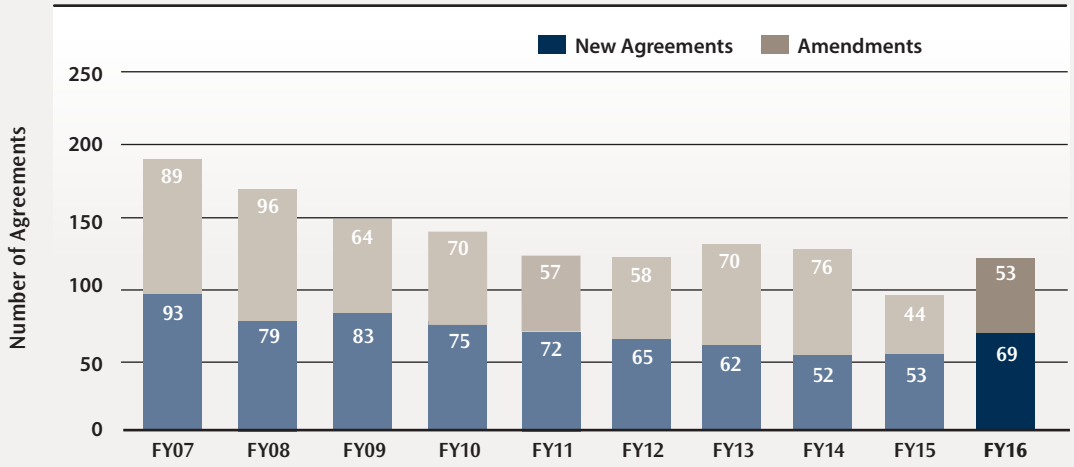


CRADAs and SPP/NFE Agreements

Cooperative Research and Development Agreements (CRADA)



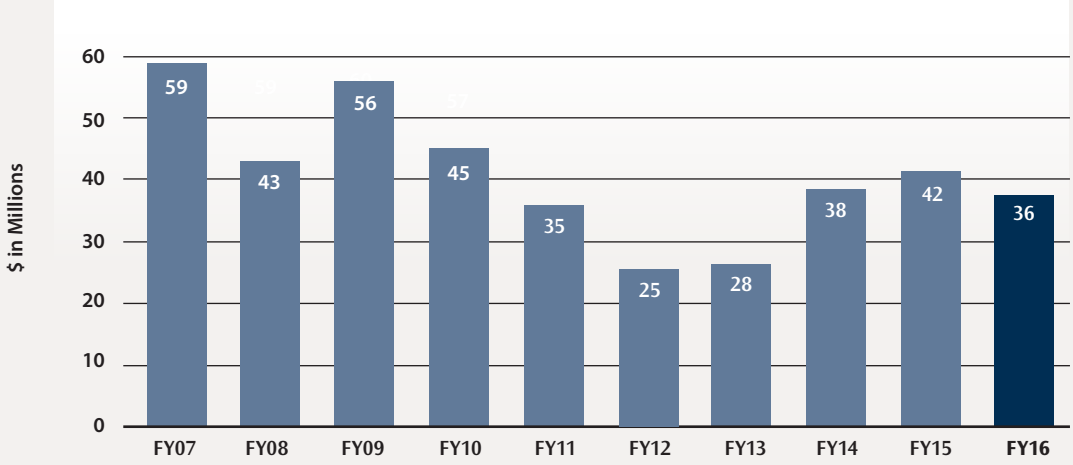
Strategic Partnership Projects, Non-Federal Entity (SPP/NFE) Agreements



Industry Funds-In

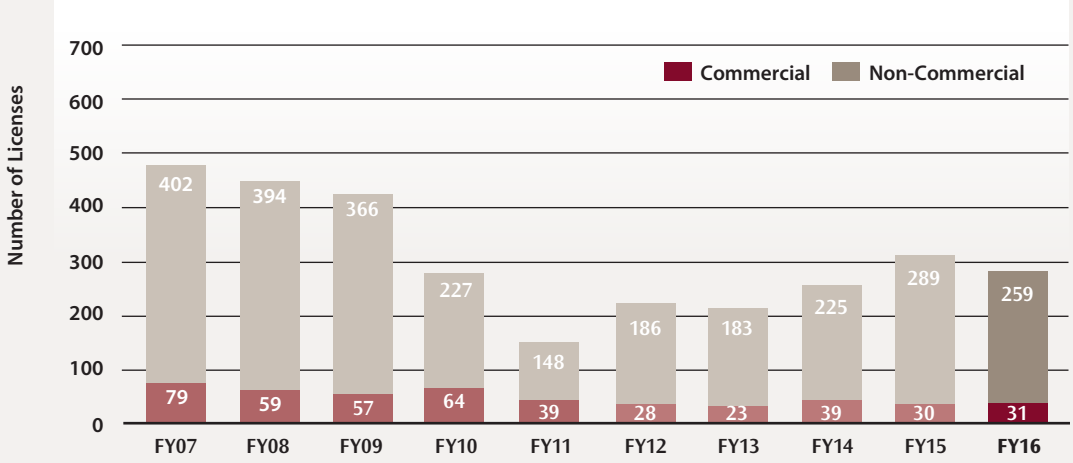
Industry Funds-In to Sandia ($M)

Values represent Funds-In for CRADAs, SPP/NFE Agreements, and Licensing Income.

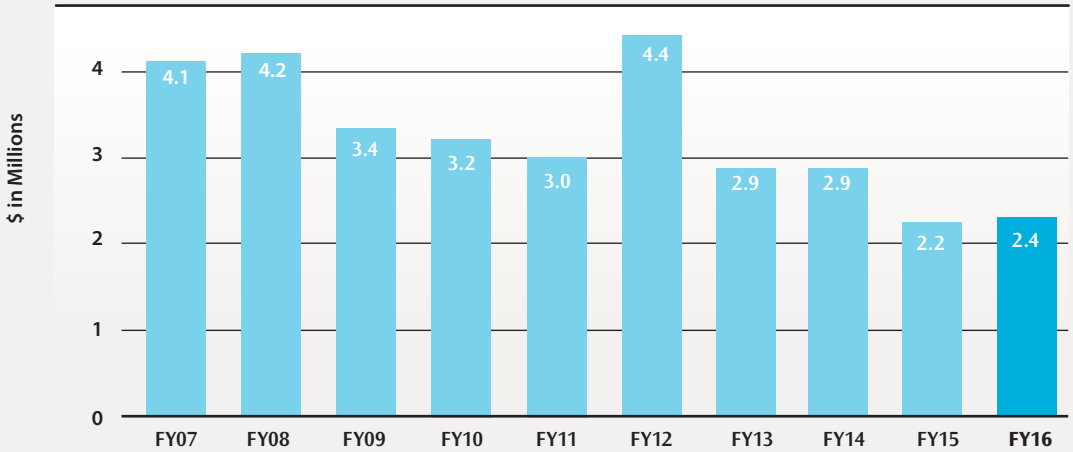


Licenses

Licenses

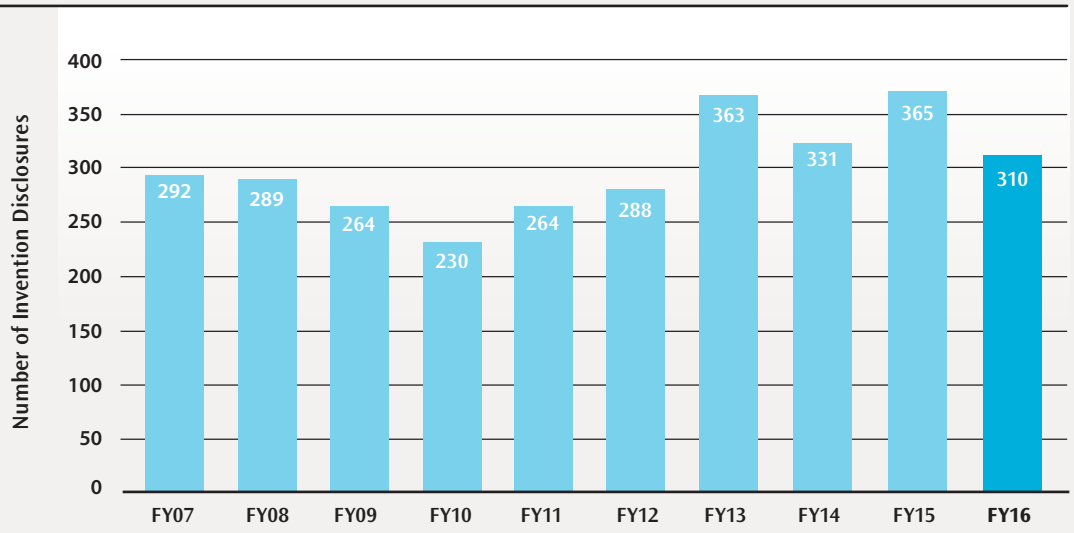


Licensing Income ($M)

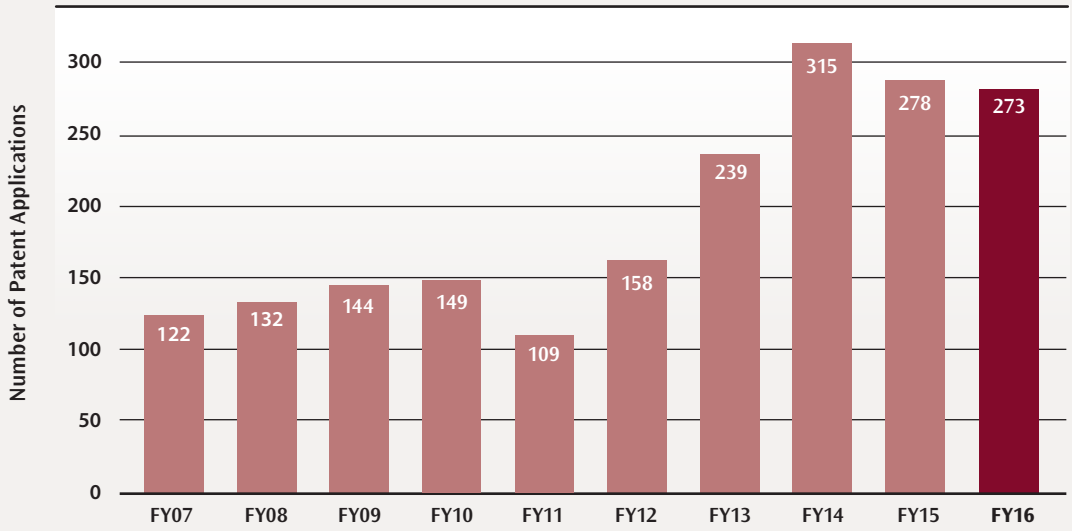


Patent Activity

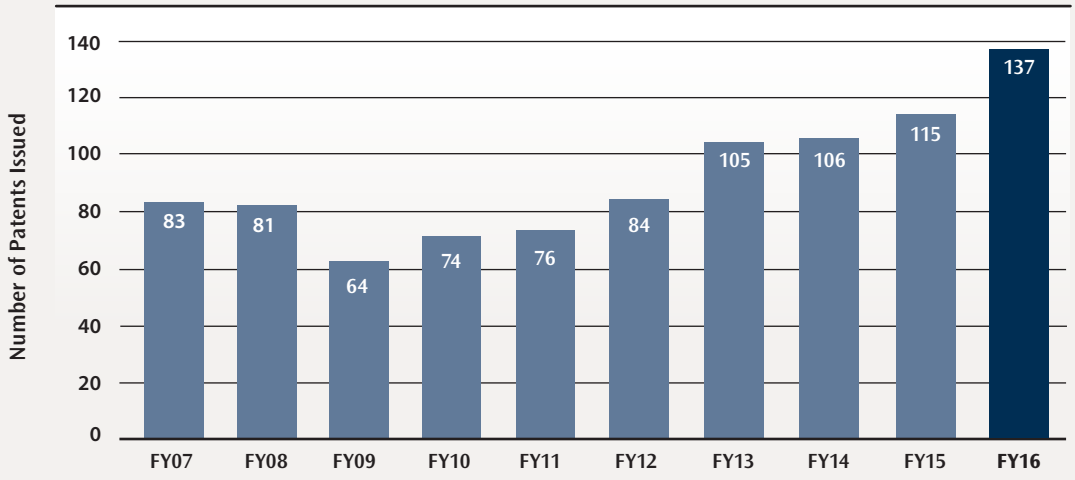
Invention Disclosures



Patent Applications



Patents Issued



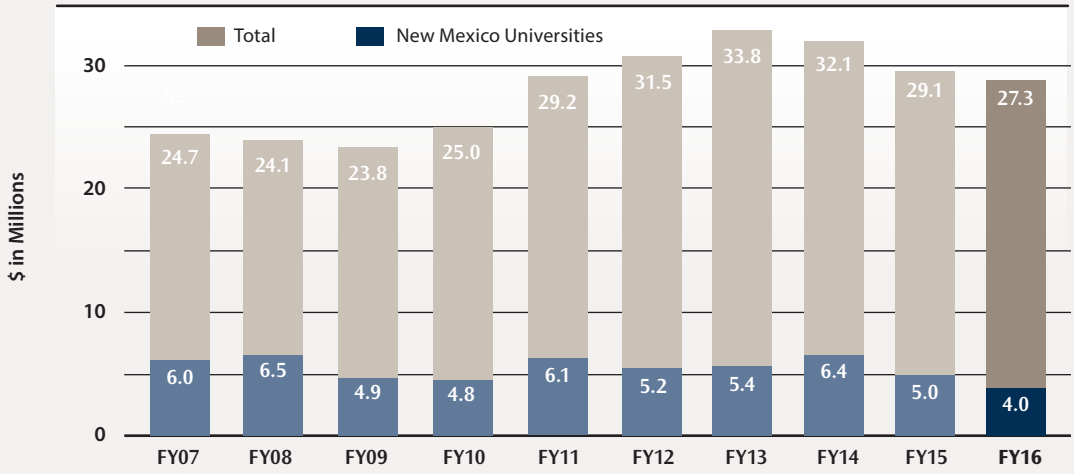
University Partnerships

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 competencies and new businesses.

In 2016, Sandia began focused collaborations with the Academic Alliance schools which are composed of Campus Executive universities that have an existing relationship with Sandia, have 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. These are top-tier universities whose leadership has a commitment to collaborate on projects that have a mutual benefit and are willing to invest in growing the relationship with Sandia. The five Academic Alliance universities are: Georgia Institute of Technology, Purdue University, University of Illinois at Urbana-Champaign, University of New Mexico, and the University of Texas at Austin.

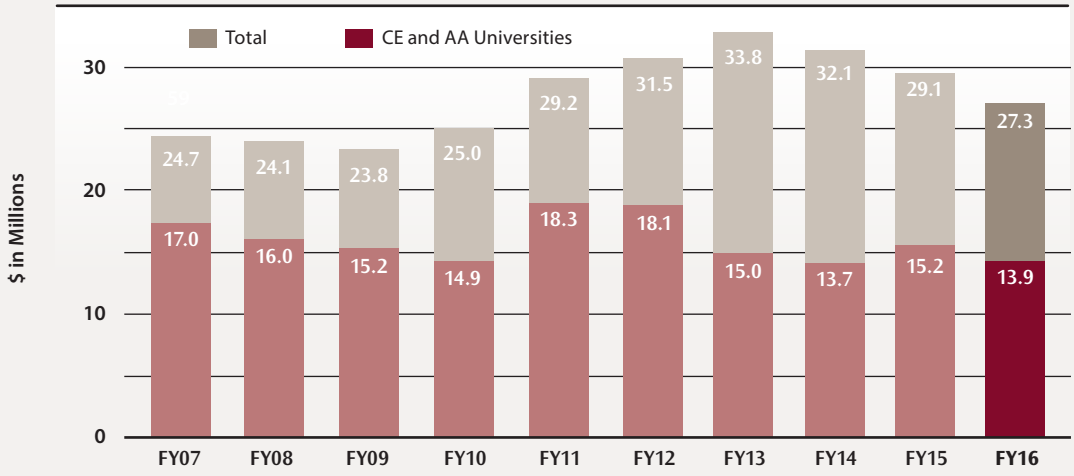
The University Partnerships Office, under the auspices of the Chief Technology Officer, serves as the point of contact for university research issues and implements those processes that enable university partnerships.

Investments in Research at New Mexico Universities



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

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



Sandia Science & Technology Park (SS&TP)

2016: Advanced Manufacturing Analysis & Research Corporation (AMARC) and Advanced Optical Technologies (AOT) moved into the SS&TP.

Results	
Companies and Organizations	42
Employees	2008
Buildings	25
Public Investment in the Park*	$89.0M
Private Investment in the Park*	$291.4M
Total Investment in the Park*	$380.4M
Increase in Tax Revenue*	$2.6B
Increase in Wages*	$4.4B
Average Salary of Full-time Jobs in Park	$83K
Average Salary of Full-time Jobs in Metro Albuquerque	$44K

**Since Park opened in 1998.*

New Mexico Small Business Assistance (NMSBA)

Los Alamos National Laboratory
Sandia National Laboratories
Solving New Mexico's Small Business Challenges

2016: Sandia invested $2.4M helping 198 small businesses in 19 counties throughout New Mexico. There were 75 Sandia principal investigators across 59 departments that supported NMSBA.

In 2016 the State of New Mexico, along with Los Alamos and Sandia national laboratories, invested over **$4.8M** helping **365** small businesses in **29** counties.

	2000 - 2016
New Mexico Small Businesses Assisted	2648
Rural vs Urban Businesses	
Rural (65%)	1709
Urban (35%)	939
Combined	2648
Dollar Amount of Assistance	$53.3M

	2000 - 2015*
Return on Investment (ROI)	1.26

(ROI is based on salaries of jobs created and retained.)

Economic Impact	
Small Business Jobs Created and Retained	5734
Mean Salary	$39K
Increase in Revenue	$272M
Decrease in Operating Costs	$142M
Investment in NM Goods/Services	$109M
New Funding/Financing Received	$111M

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

Entrepreneurial Separation to Transfer Technology (ESTT)

ESTT
Entrepreneurial Separation to Transfer Technology

2016: One employee took the skills and expertise he acquired at Sandia and left on ESTT to start a small business. Currently, there are four Sandians actively out on ESTT.

Sandians Who Left on ESTT*	**153**
To Start up a Company	68
To Expand a Company	85
Companies Affected by ESTT*	**105**
Start-up Companies	53
Expansion Companies	52

**Since ESTT began in 1994.*

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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

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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

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NNSA National Nuclear Security Administration

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