

SANDIA NATIONAL LABORATORIES

Partnerships

ANNUAL REPORT FY2008





innovation
through partnerships



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Sandia works closely with industry, small business, universities, and government agencies to bring new technologies to the marketplace. Sandia has been transferring technology to external partners for more than two decades, especially where such agreements benefit Sandia's primary mission for the Department of Energy.

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Introduction



Hal Morgan

Senior Manager
Industrial Partnerships and Strategy



Rick Stulen

Chief Technology Officer and Vice President
Science and Technology and Research Foundations

The FY2008 Partnerships Annual Report

highlights Sandia National Laboratories' outstanding work in partnership with industry and universities. We describe breakthroughs resulting from recently developed partnerships, and we celebrate the mutual benefits of long-standing strategic partnerships.

As a leader in technology transfer among federal laboratories, Sandia continuously strives to modernize and improve its approach in building partnerships. A partnership must clearly support Sandia's primary mission for the U.S. Department of Energy's National Nuclear Security Administration (NNSA) to provide high-quality scientific and engineering support for U.S. national security interests. While many of our partnerships address defense and military needs, a considerable amount of our work addresses our nation's economic security and energy challenges.

In the early years of technology transfer, federal laboratories turned their inventions over to industry with the goal of commercializing them. Sandia replaced that approach by teaming with our partners to solve their technical challenges, provided our joint work enhances national security. This has produced impressive results and helped Sandia's tech transfer program earn

"outstanding" performance ratings from NNSA for more than 10 years.

In Sandia's public-private partnerships, the nation's best scientists, engineers, innovators, students, and educators collaborate to strengthen our nation's security and prosperity, while playing a vital role in training our nation's next generation of scientists and engineers.

Energy is critical to our national security. While energy-related work at Sandia is extensive and diverse, our partnerships have stepped up our efforts to address alternative and transportation energy challenges. Our story, "Transportation Energy," shows Sandia's leading role in studying internal combustion and in discovering, understanding, and developing new fuels and fuel sources for internal-combustion engines.

Partnerships at Sandia will continue to aid our nation in addressing and mitigating security challenges. We remain clearly focused on that mission and will adjust our emphasis according to the priorities of our nation's political leaders, including their goal to achieve national energy independence. We have already begun to address these changing priorities head-on.



Recognition



Sandia won three **R&D 100 Awards** in 2008. These awards are given by *R&D Magazine* to the 100 most significant technical products that became available in that year.

- Superhydrophobic Coating – A transparent coating that actually makes water bounce off a surface to prevent corrosion, protect electronics, or provide a new, more efficient surface to collect pure water.
- Xyce™ – The world’s first computational tool for full simulation of large digital circuit systems through massively parallel computation.
- Silicon Micromachined Dimensional Calibration Artifact for Mesoscale Measurement Machines – An accurate calibration artifact that will help improve measurement accuracy for producing miniaturized devices.



The **Federal Laboratory Consortium** is the nationwide network of federal laboratories that provides a forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

Sandia received three National FLC awards for Excellence in Technology Transfer and one for Outstanding Technology Transfer Professional.

- ElectroNeedle™ Biomedical Sensor Array – A device that on contact provides rapid, on-demand, point-of-care biomedical assays for medical diagnosis in emergency, battlefield, and remote settings where it is impractical to send the patient’s samples to a conventional laboratory for analysis.
- Secure Sensor and Seal Technologies – A system that makes it highly difficult to open or remove containers without breaking a seal on a fiber-optic loop. When a seal is broken, the event is transmitted by RF to a monitoring system.

- Helical Fiber Amplifier – A laser component that revolutionizes potential applications of fiber lasers to filter out undesirable light modes, thereby making small, light-weight, high-power fiber lasers possible.
- David Goldheim – Outstanding Technology Transfer Professional award recipient, whose significant contributions include leadership, inventiveness, and tenacity in developing and shepherding innovative programs that support Sandia’s business development and strategic intellectual property management efforts.

In the FLC Mid-Continent Region, Sandia received two Notable Technology Development awards.

- TacNet Tracker® – A hand-held smart phone-size device that enables individuals to communicate securely with communication and data-sharing capabilities similar to a laptop computer.
- Self-Assembling Process for Fabricating Tailored Thin Films – A simple, economical nanotechnology coating process that enables development of nanoparticle thin films with properties unattainable by any other processing method.

Popular Mechanics

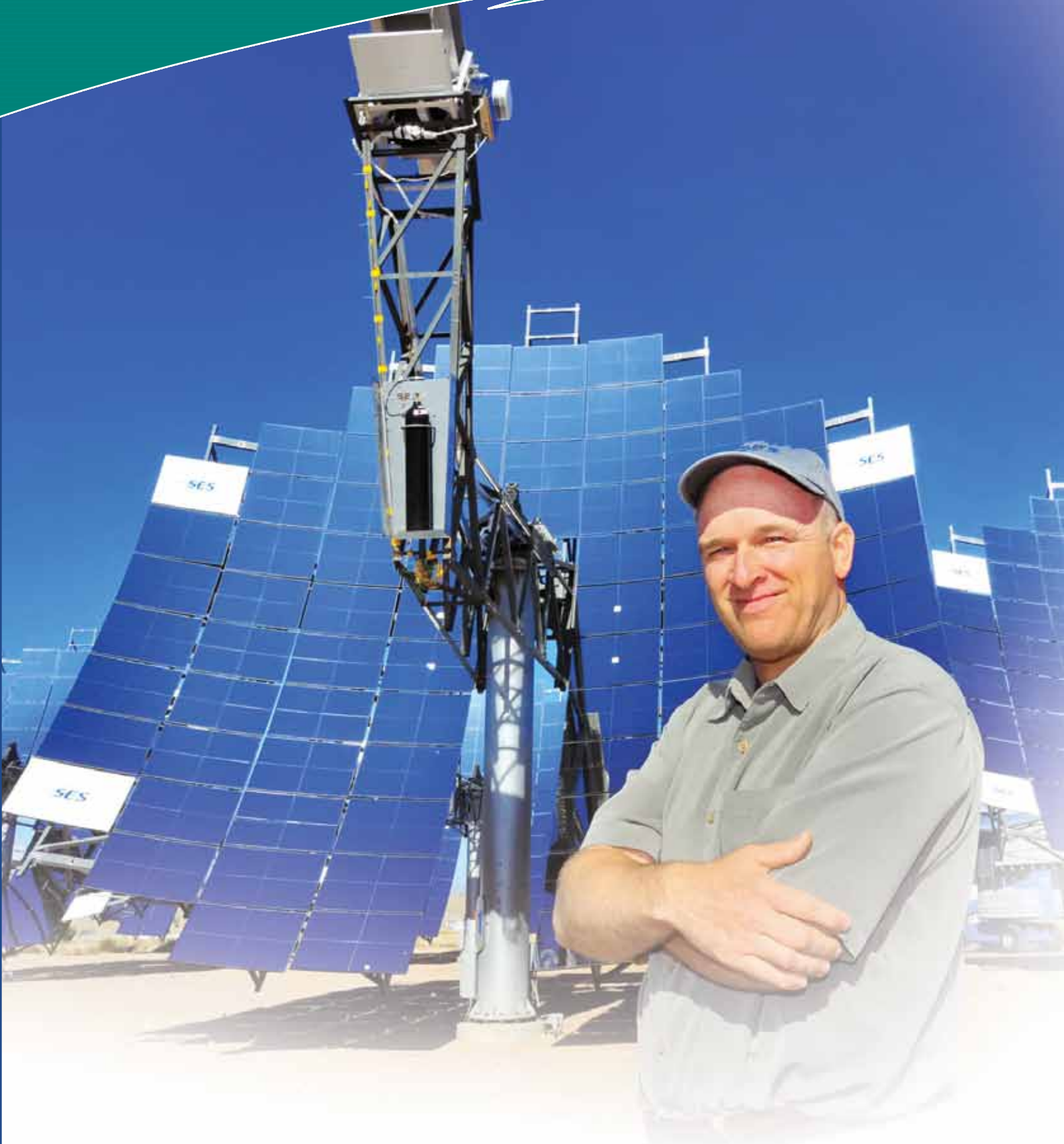
Sandia and Stirling Energy Systems (SES) have been honored by *Popular Mechanics* Magazine with a Breakthrough Innovator Award that recognized its solar-to-grid system conversion efficiency record.

The Association of University Research Parks selected the Sandia Science & Technology Park as “Outstanding Research Park of the Year.”



Creating Communities of Innovation

New record for solar-to-grid efficiency



Sandia engineer, Chuck Andraka, in front of the Stirling array at Sandia National Laboratories.

Stirling Dish Partnership

Sandia and Stirling Energy Systems (SES) set a new solar-to-grid system conversion efficiency record — 31.25% net efficiency — on January 31, 2008 at Sandia's National Solar Thermal Test Facility. This tops the old record of 29.4% (from 1984).

This project was honored with a *Popular Mechanics* Magazine Breakthrough Innovator Award that celebrates innovations poised to change the world.

Gaining almost two points of conversion efficiency takes this dish-engine system well beyond the capacities of any other solar dish collectors, and one step closer to being an affordable commercial system. A prototype six-dish Model Power Plant at the Solar Thermal Test Facility produces up to 150 kilowatts (kW) of grid-ready electrical power during the day.

Several technical advancements to the systems made jointly by SES and Sandia led to the record-breaking solar-to-grid conversion efficiency. First was improved optics — focusing as much as 94% of the sunlight on the engine system. The mirror facets, patented by Sandia and Paneltec Corp. of Lafayette, CO, are highly accurate with minimal irregularities in shape. Other advancements to the solar dish-engine system were a new, more effective radiator that also costs less to build, and a new high-efficiency electrical generator.

SES is working to commercialize the record-breaking system and has signed power purchase

agreements with Southern California Edison and San Diego Gas & Electric for the world's two largest solar power contracts ever granted. Collectively, these contracts will require up to 70,000 solar dish-engine units.

Such systems promise to provide cost-effective, environmentally friendly power production. SES is actively engaged in establishing partnerships with substantial manufacturing and industrial organizations to develop a cost-effective manufacturing process and supply chain.

Demonstrated high-efficiency energy generation means more energy is generated for a lower investment, lowering the cost of the energy delivered. That's what *Popular Mechanics* meant by "an innovation poised to change the world."

“ This advances our dish-engine systems well beyond the capacities of any other solar dish collectors, and moves us one step closer to commercializing an affordable system. ”

Bruce Osborn
President
Stirling Energy Systems

New flash-bangs safer for law enforcement, military



Safer and more effective flash-bangs help military and law enforcement personnel.



Sandia Licenses Improved Flash-Bang Technology

Flash! Bang! Suddenly you are severely disoriented — your eyes aren't working very well, nor can you hear anything. Then, gradually, you realize that you're OK — no permanent damage done.

Diversionary devices — called flash-bangs — are non-lethal devices used by law enforcement and the military to temporarily distract or disorient an adversary. When thrown, a flash-bang creates a loud bang and an intense flash of light. Flash-bangs have been used in hostage rescues, room-clearing, crowd control, and other specialized operations.

The original Mk141 flash-bang diversionary device, developed at Sandia more than 20 years ago, was intended for limited, specialized applications. This new flash-bang technology, based on that original work, produces a flash-bang far safer for law enforcement and military personnel.

Sandia recently licensed its safer technology to Defense Technology Corporation of America, in Casper, WY. When deployed, a cloud of aluminum powder is expelled by a gas generator, resulting in a disorienting explosion, but without any shrapnel — just a flash and a bang. The device produces a dust explosion on a very small scale.

While that dust explosion also provides the intensely bright light and the “explosive” bang, the body of the device itself does not explode,

making the operation much safer for the person deploying it, and for anyone in the area. If a mishap should occur, this lessens the likelihood and severity of a potential injury.

Conventional flash-bang devices, employing a flash-powder explosive, have caused serious injuries, both operationally and in training. Because safety is of paramount importance, the new technology was developed to address the severe over-pressure that is produced in the near field by older-style diversionary devices.

The new flash-bang can be made into many body styles appropriate for use by the military and law enforcement for a variety of applications and scenarios. Economical, refillable versions can be made for training purposes.

“*This new technology is a major breakthrough for these devices. The law enforcement and military communities welcome a safer and more effective device.*”

Sid Heal

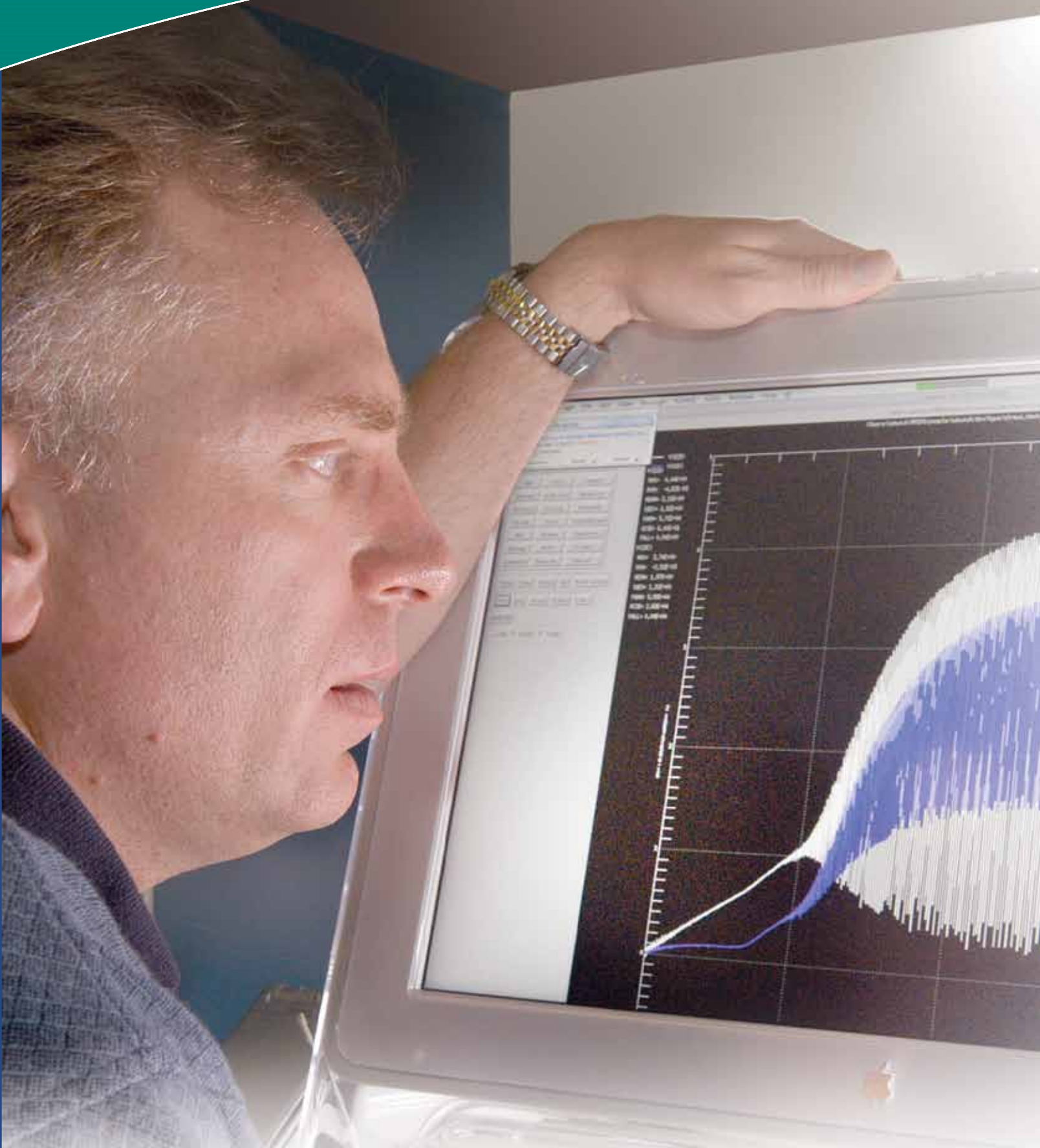
Vice President,

California Association of Tactical Officers;

Technology Section Chairman,

National Tactical Officers Association

Speed-up of two orders of magnitude



Sandia Manager, Scott Hutchison, studies a computer simulation of a voltage waveform from an oscillator circuit.



Xyce™ 4.0.2 Parallel Electronic Simulator

Researchers at Sandia have achieved a speed-up of two orders of magnitude over traditional electronic circuit simulation for parallel simulation of traditional transient algorithms. This accomplishment was recognized with an **R&D 100** Award.

Circuit simulation is a key part of electrical design cycles. Simulation techniques used in previous generations of integrated circuits are no longer adequate because feature sizes have shrunk to a point where verifying designs via simulation is crucial, yet much more difficult. Sandia's Xyce™ 4.0.2 Parallel Electronic Simulator is the world's first massively parallel analog circuit simulator. It is the first circuit simulation tool capable of simulating full integrated circuit systems without resorting to simplifications that compromise accuracy.

Xyce™ accurately simulates more than 10 million circuit elements on hundreds of processors, far exceeding any other simulation tool available in the market today. Xyce™ is in a position to uniquely impact the electronic design automation (EDA) community.

Mathematical models replicating the behavior of actual electric circuits have been the foundation of the EDA industry – a billion dollar industry of tools for designing and producing electronic systems. EDA is in transition from serial to parallel processing.

Fastrack Design, Inc., in San Jose, CA, has licensed the Xyce™ parallel electronic simulator

technology from Sandia. This transfer of the Xyce™ unique technologies is expected to have a large, positive impact on the EDA industry. Fastrack has integrated Xyce™ into its suite of commercial software and will subsequently commercialize it as part of its integrated technologies and products.

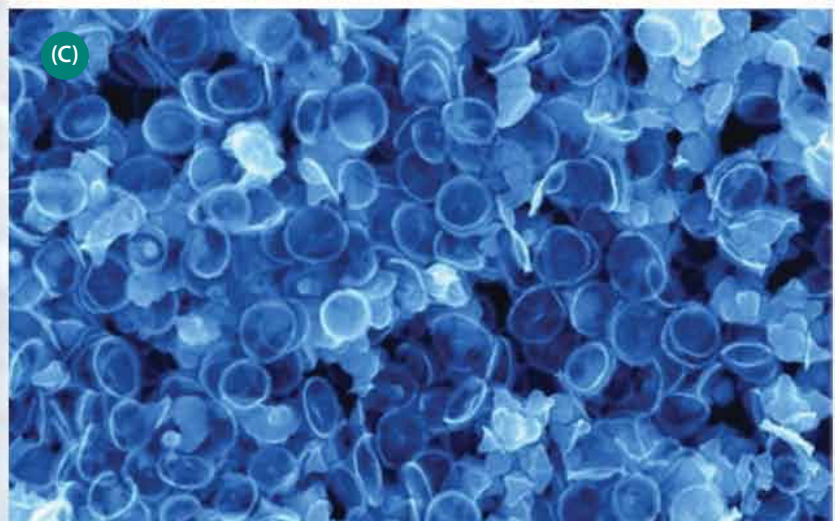
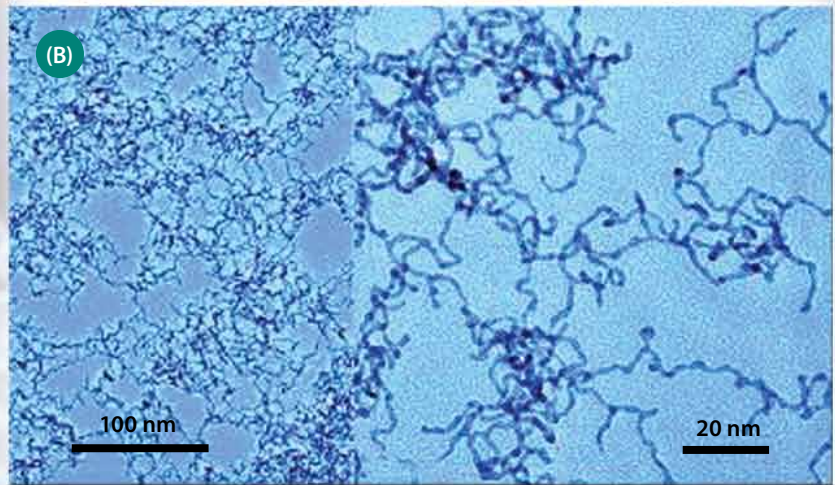
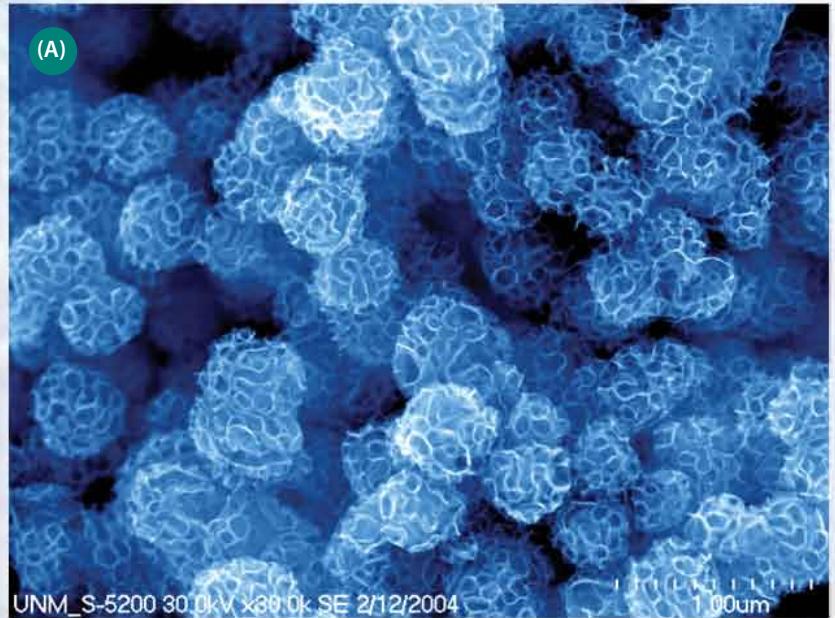
Commercial applications of Xyce™ will create simulations that accurately cope with decreasing feature size and the increasing number of integrated circuit components. It is highly compatible with existing circuit simulators, and thus is applicable to a wide range of electrical circuit applications. Xyce™ has also been applied to non-circuit applications, most notably to biological and MEMS (micro-electro-mechanical systems) simulations.

“*Sandia's partnership with Fastrack has produced another important "return on investment" for the American taxpayer. Xyce™ applications in integrated circuits will contribute significantly to U.S. competitiveness.*”

Rick Stulen
Vice President and
Chief Technology Officer
Sandia National Laboratories

Making fuel cells practical

- A) Foam-like nanospheres composed of convoluted nanosheets, approximately 8 atoms thick.
- (B) Two-nanometer-diameter nanowire networks.
- (C) Platinum nanowheels.



Nanoscience Improves Platinum Catalysts for Fuel Cells

Hydrogen fuel cells are an attractive alternative to fossil fuel use, but most fuel cells use platinum or platinum alloys as catalysts, and the limited supply and cost of platinum now restrict their use. We must develop more durable, efficient, and inexpensive catalysts before hydrogen can become an economically feasible alternative to fossil fuels.

Nanoscience (the study of matter at the atomic level) promises novel, unprecedented technologies for energy production, storage, and use, with the expectation that it will play a critical role in hydrogen fuel cells.

Nanoscience research at Sandia has realized the capability to manipulate the size and shape of platinum nanostructures for high-quality platinum electrocatalysts using less platinum. The synthesis processes use common, environmentally benign materials, and are amenable to commercial-scale production of these catalysts for hydrogen fuel cell applications.

Sandia has licensed the rights to ten patents to Compass Metals, Inc. to make, use, and sell these platinum catalysts for fuel cells. Under a cooperative research and development agreement (CRADA), Sandia and Compass Metals are collaborating to further improve the synthesis of platinum nanomaterials to determine the best methods for incorporating these new nanomaterials in fuel cell electrodes, and to discover new nanomaterials.

The surface areas of the Sandia-developed and Compass-produced platinum nanowire networks

are the highest reported for unsupported platinum nanomaterials – approximately 2 nanometers across.

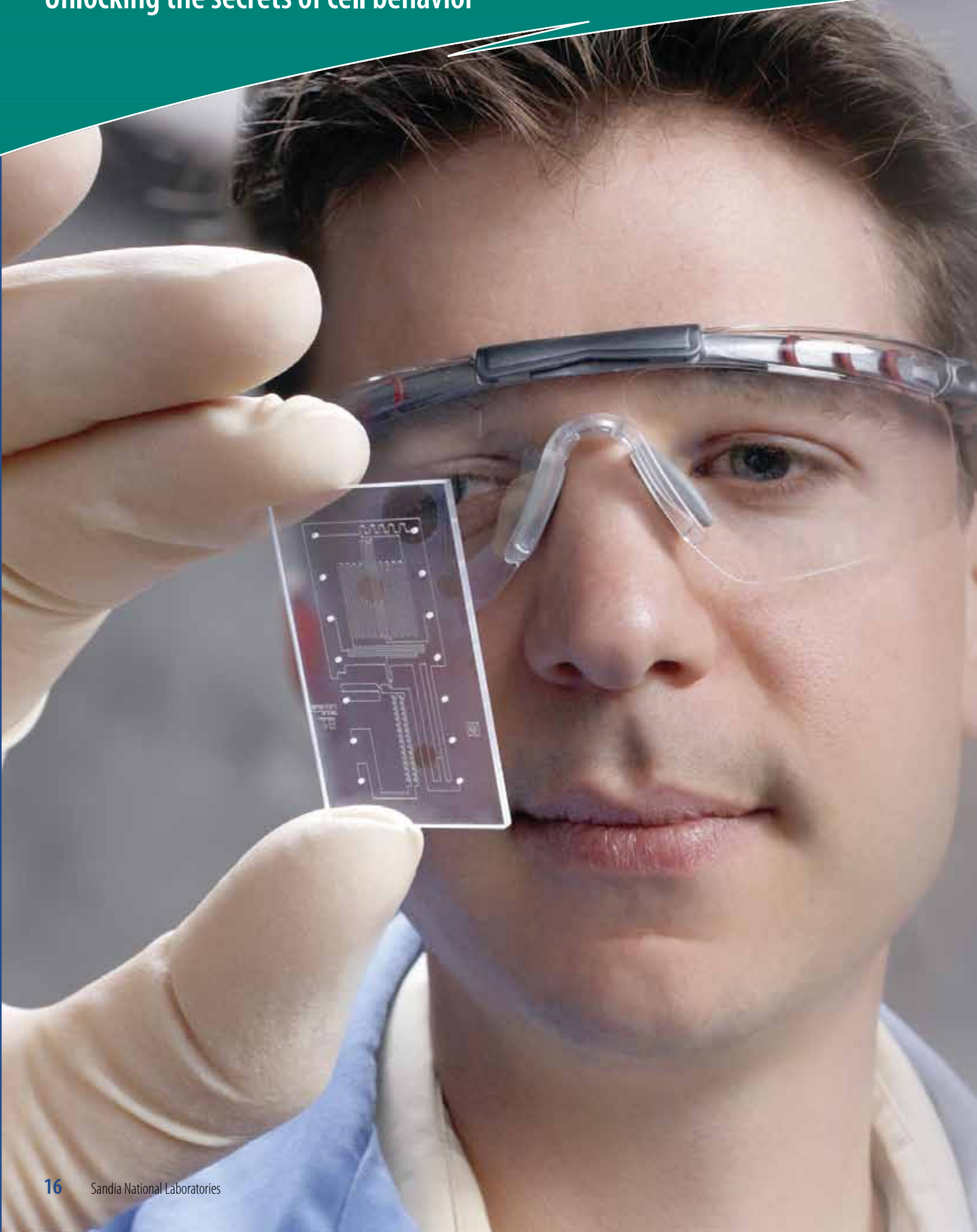
Thus, the Sandia-Compass Metals partnership for producing platinum catalysts for fuel cells is expected to dramatically reduce the cost of hydrogen fuel cells. Ultimately, advances achieved through this technology will lead to improved energy security for the United States.

Nanomaterials can also be designed with properties that can meet other specific needs, leading to significant improvements in solar energy conversion, catalysts for fuel and chemical production, energy-efficient lighting, and chemical and biological sensing devices.

“ *This program supports our nation’s long-term vision for commercially viable hydrogen-powered vehicles to reverse America’s dependence on foreign oil by helping reduce the cost of hydrogen fuel cells.* ”

Rick Stulen
Vice President and
Chief Technology Officer
Sandia National Laboratories

Unlocking the secrets of cell behavior



Sandia researcher, Thomas Perroud, examines a MICA chip. MICA enables researchers to precisely target, sort, and measure samples as small as a single cell in an automated system.

Microscale Immune and Cell Analysis

The future of biological research lies in understanding both the actions of single cells and the interactions of these cells with their environments.

Researchers at Sandia, in collaboration with researchers from the University of Texas Medical Branch (UTMB), have created a sophisticated integrated platform for single-cell manipulation and interrogation. The Microscale Immune and Cell Analysis (MICA) platform represents a revolutionary breakthrough in biological research – the ability to understand cell behavior at the molecular and cellular levels with unprecedented speed, resolution, sensitivity, and multiplexing capability.

MICA can facilitate study of a wide variety of cellular processes, including those that have proven impossible or impractical to study at conventional scale, and immune-cell responses to potentially deadly microbial pathogens. It helps researchers target, sort, and measure samples as small as a single cell in a precise, automated system.

MICA has proven the value of Sandia's Memorandum of Understanding with the University of Texas. MICA, funded by Sandia, may enable scientists to integrate experimentation

on myriad cell types, thereby providing a systems understanding of multiple cellular mechanisms that has long eluded researchers.

When fully developed, MICA promises to facilitate advances in drug discoveries and therapeutics, diagnostics, personalized medicine, and combating infectious diseases.

“MICA is emblematic of Sandia's maturing biology research. In particular, Sandia's partnership with UTMB brings together expertise providing unparalleled access to realms of biological research we are only beginning to explore, especially in systems-level analysis of the behavior of individual cells.”

Paul Hommert
Vice President
California Site
Sandia National Laboratories



Transportation Energy

The United States and, indeed, the whole world *must* resolve our transportation issues in the 21st Century. The challenge is to develop energy sources with a positive energy and ecological balance. We must enhance performance, increase fuel efficiencies, and reduce emissions. Diversifying our energy supply, a critical priority, will require breakthroughs in new and renewable fuel sources, while reducing land and water use, and rapidly disseminating research into technology.

Through Sandia's work, the necessary research to fundamentally change how we look at transportation energy is rapidly moving forward.

Studies consistently rank biofuels — liquid fuels derived from plants — among the top candidates for meeting large-scale energy needs, particularly in transportation. DOE's Joint BioEnergy Institute (JBEI) focuses on biofuels. JBEI's partners are Lawrence Berkeley, Sandia, and Lawrence Livermore National Laboratories;

the University of California at Berkeley and Davis; and Stanford University.

Researchers at JBEI are developing ways to convert biomass into biofuels. Producing biofuels by extracting simple fermentable sugars from cellulose can realize the potential of the most energy-efficient and environmentally benign fuel crops. Harnessing even a tiny fraction of the energy available from plants could meet most of the nation's transportation energy needs. DOE's goal is to make cellulosic ethanol cost-competitive with gasoline by 2012, and to reduce the U.S.'s gasoline consumption by 20% in 10 years.

The need for fossil-fuel energy efficiency lies at the heart of research at Sandia's Combustion Research Facility (CRF). The CRF leads the way in research and development around transportation energy. Some of Sandia's industry partners in the CRF include Ford, General Motors, Daimler Chrysler, ExxonMobil,



Far Left: Everyone needs better fuel efficiency and cleaner air. Near Left: A laser experiment to detect chemical intermediates in flames. Near Right: Plants engineered for biofuels development. Far Right: Materials to be used for H₂ storage in automotive applications.

ConocoPhillips, Chevron, BP, General Electric, John Deere, and Cummins.

CRF researchers work to increase scientific understanding of internal combustion engine processes affecting efficiency and emissions by simulating engine conditions in a wide variety of environments. The results of this research vary from ways to clean up pollution from coal-fired power plants to improving the efficiency of fossil-fuel combustion.

An in-depth study by Sandia and General Motors has found that plant and forestry waste and dedicated energy crops could sustainably replace nearly a third of the U.S.'s gasoline use — 90 billion gallons of ethanol would be enough to replace more than 60 billion gallons of the 180 billion gallons of gasoline expected to be used annually by 2030.

Hydrogen-powered vehicles are an exciting alternative to those that use fossil fuels.

Sandia's Hydrogen Program aligns with a national directive to develop commercially viable hydrogen-power vehicles to move the U.S. toward a new energy economy. It ranges from fundamental research on hydrogen properties to comprehensive systems engineering of hydrogen technologies that could be ready to roll out today. Sandia's partners include Ford, General Electric, General Atomics, Princeton, and Stanford.

Hydrogen can be produced from domestic sources in many ways, thereby diversifying beyond petroleum to fuel our transportation needs. Powering automobiles with hydrogen reduces greenhouse gas (CO₂) emissions and other air pollution, and reduces our dependence on foreign oil. Hydrogen-powered vehicles are more than twice as efficient as conventional gasoline internal-combustion engines; thus, 10 gallons of gasoline is equivalent to 5 gallons (~5 kg) of hydrogen.

Optimal technology management



Optimal technology management allows efficient, proactive, accurate decision making in sophisticated systems.

Technology Review & Assessment Model (TRAM)

The Technology Review & Assessment Model (TRAM) is a game-changing decision-support tool. It enables analysts and executives to understand the impact of obsolescence and diminishing manufacturing sources over the life-cycle of technologically sophisticated, high-value systems. TRAM is the only decision-support software application that integrates factors of performance, cost, schedule, risk, and obsolescence to develop optimal technology management strategies and technology road maps over long periods.

Developed by Sandia in conjunction with Lockheed Martin, TRAM is anticipated to have a significant impact on optimizing technology management for sophisticated systems and systems-of-systems, from upgrading military combat systems to mapping energy futures. In managing the life-cycle of large-scale, complex systems with multiple interdependent subsystems such as weapons systems, planning for the effects of component obsolescence is particularly difficult and can have dramatic effects on system maintenance. TRAM provides a way to construct a model of a system, allowing an analyst to define system and subsystem components and decompose system functions.

TRAM then factors in the impact of these constraints to provide alternatives for improving system performance through improving system

functions. TRAM's cutting-edge, evolutionary algorithms develop potential solutions based on highly customized parameter settings, using defined system constraints to establish feasible boundaries for cost and other limiting factors (e.g., size, weight, and time). It then provides a solution that evaluates how the system can be improved over time as well as analyzing impacts on other factors like cost, risk, and other system constraints.

TRAM reduces errors, increases efficiency, and allows for easy "what-if" scenarios for proactive, accurate decision making in highly sophisticated systems and systems-of-systems.

“In today's increasingly complex world of national security threats, our defense systems must be evermore capable. Analytical capabilities such as TRAM help us meet those challenges.”

Steve Roehrig

Director

*Energy Resources and Systems Analysis Center
Sandia National Laboratories*

New alloys developed at Sandia



100 μm

Scanning electronic
microscope image of a
lead-free solder joint.



Lead-Free Solder

Solder — that shiny metallic “glue” that holds electronic components together and bonds other connections — has traditionally been made of lead. It works very well for those purposes, but lead is toxic. Now the world is increasingly sensitive to technology’s environmental impact in the manufacturing, use, and disposal of electronics, and lead solder needs to be replaced.

The United States discards about 3,000 tons of electronics waste daily. According to the United Nations, up to 50 million tons of electronics waste are generated annually — mostly computers and cell phones. About 70% of that waste ends up in China, generating an enormous threat to the environment through air pollution and run-off into groundwater.

The European Union has strictly limited the amount of lead and other harmful materials used in the circuitry of any electronic product on the market. Japan has a similar initiative. These restrictions have prompted a dramatic increase in interest in lead-free solder that is not toxic, that sets up and maintains the original strength and conductivity of the joint, and is also extremely resistant to long-time, high-temperature aging of the joints.

Sandia has been at the forefront of lead-free soldering technology for more than twenty years, beginning with lead-free alloys that allowed the plumbing industry to meet the Clean Water

Act requirements that prohibited lead-bearing solders in potable water systems. Then Sandia researchers became involved in lead-free solders for electronics, working with Lockheed Martin. New alloys developed at Sandia include several novel compositions for hybrid microcircuit and elevated-temperature applications, some of which were codeveloped in collaboration with Iowa State University, with whom Sandia co-owns the patent.

The lead-free solder expertise has been shared with corporations such as Indium Corporation, Johnson Manufacturing, and others around the world, helping reduce those millions of tons of electronic waste.

“*The information age provides us a magnificent array of useful electronic devices. Lead-free solder will sharply reduce, even eliminate, one of the most negative by-products of our high-tech world.*”

Rick Stulen
Vice President and
Chief Technology Officer
Sandia National Laboratories

Predicting material failures in aircraft



Predicting unseen structural damage means
we all fly more safely.

Modeling Impact Damage in Aircraft Components

How do we predict damage in aircraft components due to impact events such as runway debris, hail, birds, etc.? Aircraft materials can suffer complex patterns of internal damage due to impacts — damage that may not be evident by visual inspection.

Sandia and the Boeing Co. are collaborating under a CRADA to develop improved computational models for predicting material failures, oriented toward fracture analyses in complex heterogeneous materials. Our analytical technique predicts delamination and cracking due to impact loads and analyzes the residual strength of the material.

This model predicts the spontaneous growth of defects in materials under load by analyzing the residual strength of damaged structures. This method has been applied successfully to damage and failure analysis, predicting in detail the delamination and matrix damage process in laminates due to low-velocity impact. The simulation of the damaged area correlates very well with the experimental data.

This may provide practical guidance in associating damage visible from the outside of a functional structure with the degree of internal damage and the need for possible repair to the structure. This would make flying much safer for us all.

“*Sandia is honored to serve as a leading technology arm for Boeing. Boeing is one of our key strategic alliances ... an enduring partner since 2002.*”

Jerry Langheim
Program Director
Strategic Alliances
Sandia National Laboratories

Developing innovative leadership



Sandia Manager, Regan Stinnett, supports students brainstorming during NINE program.



Nano-Engineering Seeks New Talent

America's pipeline of science and engineering students that fuels our education and innovation engine is in danger of running dry. The National Institute for Nano-Engineering (NINE), a government/university/industry collaboration, seeks to develop our next generation of innovative leaders by involving students in large-scale, multi-disciplinary research projects focused on developing nano-technology solutions to national problems.

NINE was established as a national innovation hub in the exciting, rapidly developing field of nano-engineering — a novel partnership among universities and companies throughout the nation and the Department of Energy (DOE). Sandia is the host laboratory for NINE.

This highly collaborative environment matches students with Sandia and industry mentors and university faculty. It capitalizes on DOE's micro/nano R&D equipment and facilities at Sandia and at partners' sites. Graduate students' thesis projects become part of the NINE research program.

Industry partners participate in NINE activities, provide summer internships for students, co-fund research projects, and receive rights to intellectual property resulting from NINE projects.

University partners are nationally recognized leaders in nano-engineering research, participate in NINE activities, respond to NINE proposal calls, and provide students and faculty to participate in NINE projects.

Sandia contributes its enormous infrastructure base, expertise, and mentors, and identifies projects that are strategic to the nation and synergistic with Sandia's strengths. Top students, faculty, and industry researchers collaborate with Sandia, contribute to its knowledge base, and become partners through the NINE work.

Motivating top undergraduates to obtain advanced degrees is a NINE priority. It supports the selection of promising undergraduates by NINE faculty to participate with graduate students in projects at their university during the academic year. These undergraduates also have opportunities for summer internships in industry or at Sandia.

“Public-private partnerships like NINE strengthen national security. These “win/win/win” interrelationships tap some of our best minds to solve some of our most challenging science and engineering problems, while building a key component of our future workforce.”

Duane B. Dimos
Director
Materials Science and Engineering
Sandia National Laboratories

Leveraging Sandia partnerships to create jobs



TED
HOBBS
PARK



Technology-Based Economic Development

Sandia National Laboratories is a “technology engine” which utilizes several partnership programs to leverage the technology assets of the Labs to create jobs and economic wealth. These programs include the Sandia Science & Technology Park (SS&TP), New Mexico Small Business Assistance (NMSBA), and Entrepreneurial Separation to Transfer Technology (ESTT).

The SS&TP is a 200+ acre technology community located adjacent to Sandia National Laboratories, where tenants have easy access to world-class facilities, technologies, scientists, and engineers. The Park continues to grow and prosper, celebrating its 10 year anniversary with a Proclamation from Governor Bill Richardson recognizing the Park for being an “economic driver generating growth and prosperity for the citizens of New Mexico.” Albuquerque Mayor Martin Chavez issued an Executive Order acknowledging the SS&TP as a “pivotal point when Albuquerque made a real commitment to technology-based economic development.” Lastly, the SS&TP was recognized by the Association of University Research Parks, an international organization, as “Outstanding Research Park of the Year.”

The NMSBA Program enables Sandia and Los Alamos National Laboratories, through a joint program, to provide technical assistances to small businesses in New Mexico in exchange for receiving New Mexico gross receipts tax credits. In 2008, Giggling Springs, a business with a natural hot springs pool located along the Jemez River, approached Sandia to investigate a heating system for its buildings by using geothermal energy from its hot spring. Rich Jepson, a specialist in fluid and thermodynamics at Sandia, proposed a heating exchange system that transferred heat without transferring spring water. Jepson measured the flow rates and temperatures from the hot spring and created a balance between heating the therapeutic pool and providing heat to the cabins. The system allowed

Giggling Springs to use 130 degree water to heat both the pool and the buildings. Rich Jepson and Giggling Springs, along with 7 other projects, were honored at NMSBA’s annual Innovation Celebration.

The ESTT Program allows a Sandia employee to leave the Labs in order to start up a new technology company or help expand an existing business. These individuals are guaranteed reinstatement by Sandia if they choose to return to the Labs within two years. Randy Normann left Sandia this year to start up Perma Works, LLC. He licensed two pieces of intellectual property from Sandia and is building instrumentation for Enhanced Geothermal Systems (EGS). If EGS can be engineered as a reliable energy source, it could become a dominant energy resource to help the United States meet future alternative energy needs. The Department of Energy estimates that EGS energy is 50,000 times more abundant than fossil energy.

Together, these Sandia programs have had an enormous economic impact on the State of New Mexico and City of Albuquerque.

Technology Ventures Corporation

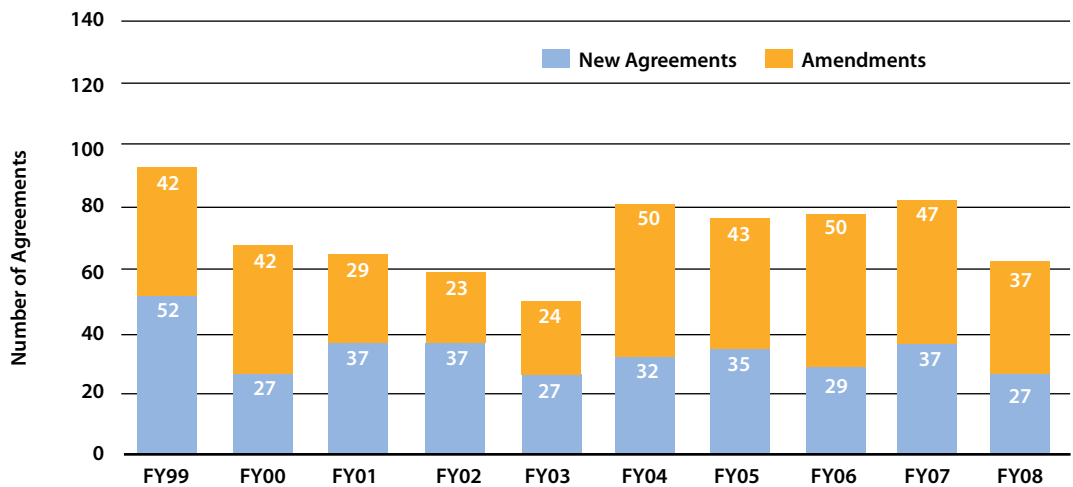
Adding synergy to these Sandia technology-based economic development programs is Technology Ventures Corporation (TVC). Working to commercialize technologies and create jobs, TVC helps entrepreneurs build high-quality business cases and find the right investors. They support companies licensing technologies from Sandia, find investors for Sandia entrepreneurs who leave the Labs to start up companies through the ESTT program, and refer many of their clients to the NMSBA program for technical assistance. Finally, as co-founders of the SS&TP, they help to manage and develop the Park through the nonprofit Science and Technology Park Development Corporation.

Sandia National Laboratories' Partnerships programs are committed to principles of quality management and continuous improvement. Tracking our work over time, we demonstrate a consistent return on investment for the American taxpayer and assure the DOE/NNSA that Sandia strongly supports its technology transfer mission. The graphs and summaries that follow depict year-by-year and cumulative levels of activity for our most important Partnership metrics over the past decade and beyond. The *Scorecard* shows that Sandia has maintained a robust, wide-ranging, and abundantly successful portfolio of technology partnership programs for many years.

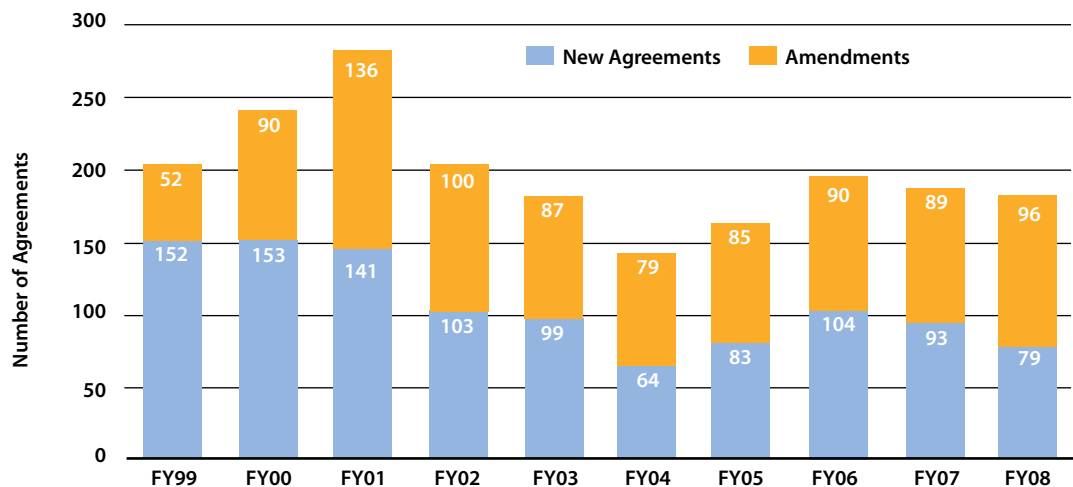
CRADAs and WFO-Industrial

The number of new CRADAs and Work for Others (WFO) Funds-In Agreements decreased in FY2008.

Sandia CRADA Program Activity



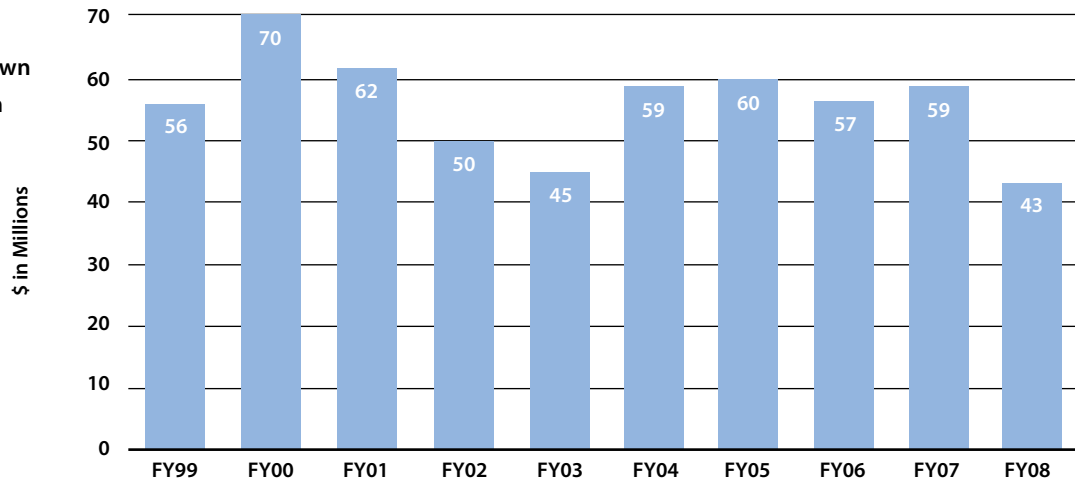
Sandia WFO-Industrial Partners Activity



Industry Funds-In

Industry contributions were down by 27% in FY2008, reflecting an economic downturn.

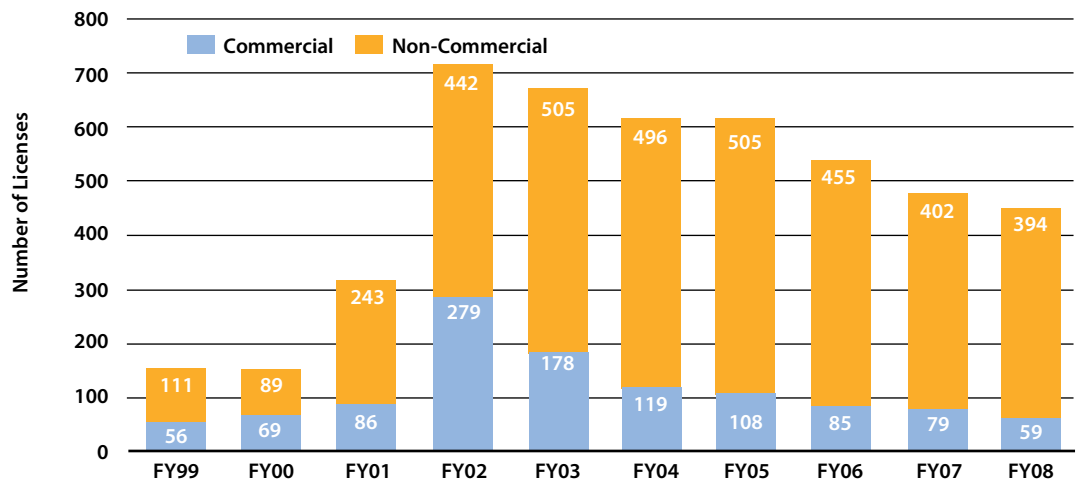
Industry Funds-in to Sandia (\$M)



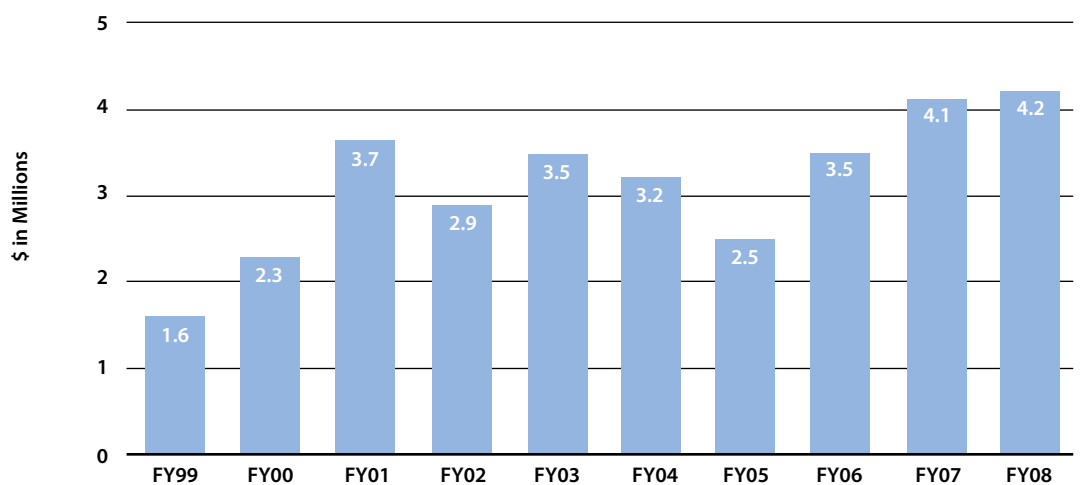
Licenses

License income was level despite a drop in commercial license activity.

Licenses

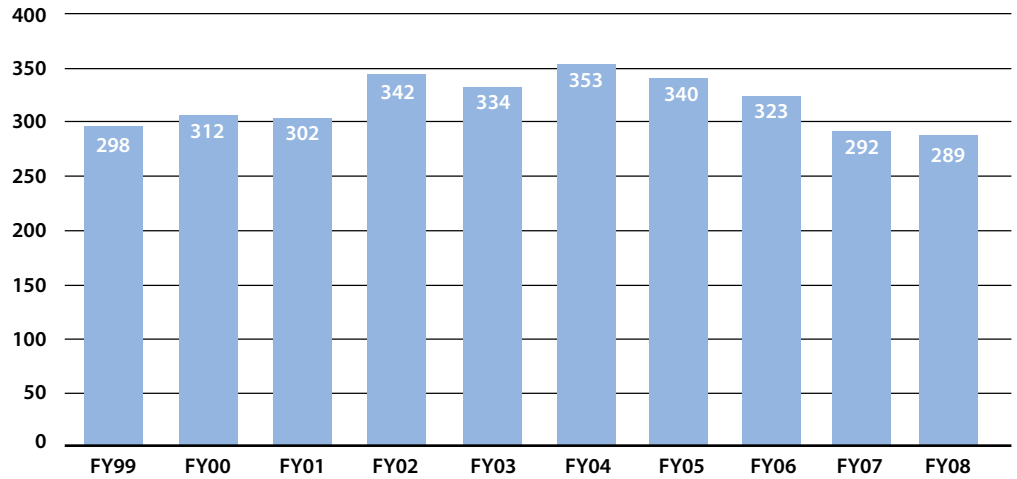


Licensing Income (\$M)

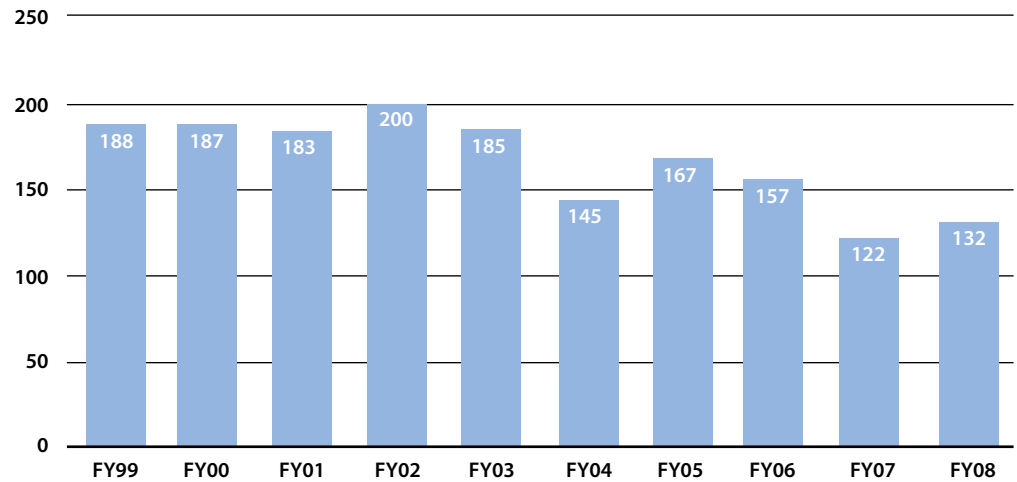


Sandia continues to patent over one-fourth of its inventions.

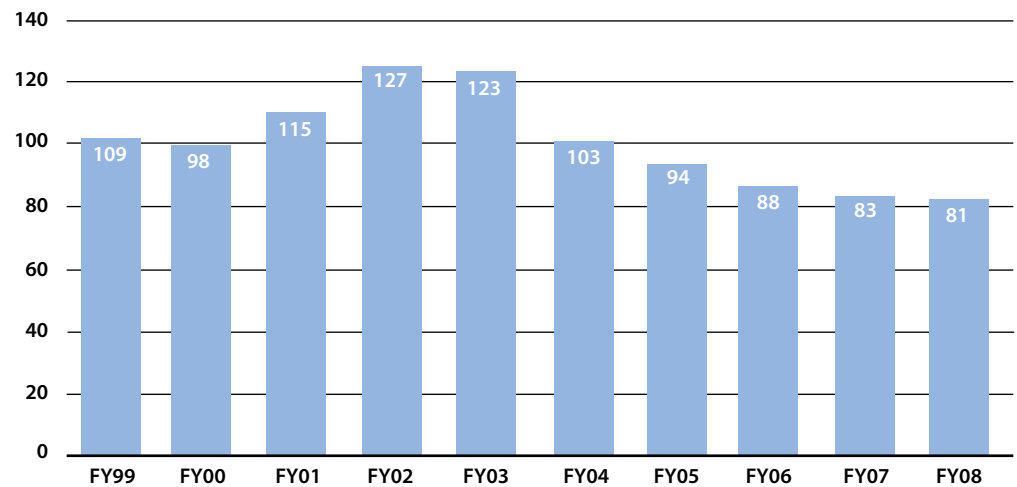
Invention Disclosures



Patent Applications



Patents Issued



The Sandia Science & Technology Park celebrated its 10-year anniversary in 2008 and continues to grow.

Sandia Science & Technology Park (SS&TP)

Results

Number of companies	28
Number of employees	2,118
Number of buildings	18
Number of square feet	898K
Number of acres developed	67
Funds in to Sandia from tenants	\$17.6M
Contracts from Sandia to tenants	\$285.9M
Contracts among tenants	\$7.75M
Public investment	\$67.8M
Private investment	\$241.9M
– Total investment	\$309.7M
Impact on wages and salaries	\$1.5B
Average salary of full-time jobs in park	\$70K
Average salary of full-time jobs in Metro Albuquerque	\$37K

Note: Park opened in 1998.

The NMSBA Program delivered more assistance to New Mexico small businesses in 2008 than ever before.

New Mexico Small Business Assistance (NMSBA) Program

Small Businesses that Received Assistance in 2008

	Rural	Urban	Total
Both Laboratories	186	100	286
Los Alamos National Laboratory	51	11	62
Sandia National Laboratories	135	89	224

Served 25 of the 33 counties in NM in 2008.

Small Businesses that Received Assistance from 2000 to 2008

	Rural	Urban	Total
Small businesses that have received assistance	923	532	1,455
Assistances provided by program	1,588	888	2,476

Served 32 of the 33 counties during life of the program - only county not served yet is De Baca.

Amount of Assistance Provided to Companies in NM

	Rural 2008	Urban 2008	Total 2008	2000 thru 2008
Both Laboratories (\$)	2,773,405	543,462	3,316,867	16,398,044
Los Alamos National Laboratory (\$)	845,678	79,142	924,820	1,272,933
Sandia National Laboratories (\$)	1,927,727	464,320	2,392,047	15,125,111

Economic Impact for Small Businesses from NMSBA Projects

	2000 - 2007*	2007*
Jobs Created/Retained	568	73
Mean Salary (\$)	39,610	43,451
Increase in Revenue (\$)	12,572,700	603,000
Decrease in Operating Costs (\$)	7,561,900	610,000
Investment in NM Goods/Services (\$)	5,750,870	288,000

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

In FY2008, two Sandians utilized the ESTT Program to start up companies based on technology licensed from Sandia.

Entrepreneurial Separation to Transfer Technology (ESTT) Program

Sandia scientists and engineers who left on ESTT	136
- To start up companies	55 (40%)
- To expand companies	81 (60%)
- Did not return	89 (65%)
- Returned to Sandia	38 (28%)
- Active at end of FY 08	9 (7%)
Companies impacted by ESTT	90
- Start-ups	44
- Expansions	46
Licenses for Sandia IP negotiated with ESTT companies	42
ESTT companies that became Sandia suppliers	29

Note: Program began in 1994.

As TVC celebrates its 15-year anniversary, it continues to be a catalyst for creating companies and securing good jobs.

Technology Ventures Corporation (TVC)

Results

New business formations	100
Equity investment	\$1.01 billion
Job creation	12,428

Note: TVC began operating in 1993.

By tapping into the resources, capabilities, and powerful synergies among the SS&TP, NMSBA, ESTT, and TVC, small businesses at any stage of development are afforded unique opportunities not available in most other communities.

Synergy Examples: SS&TP, NMSBA, ESTT, and TVC

- MicroOptical Devices (acquired by Emcore):
 - Was one of the 35 joint clients between Sandia and TVC
 - Was an ESTT start-up
 - Is located in the SS&TP
 - Received technical assistance from the NMSBA
- K Tech, located in the SS&TP, received assistance from NMSBA, and was expanded by the ESTT program
- TEAM Technologies, located in the SS&TP, received assistance from NMSBA, and was expanded by the ESTT Program
- 13 ESTT companies received technical assistance from the NMSBA Program 26 times
- More than 30 TVC clients received technical assistance from the NMSBA
- ESTT and TVC have had 35 joint clients, accounting for 27 of 42 funding events related to Sandia technology
 - These 35 joint clients attracted \$309M in venture funding
 - These 35 joint clients created 3,105 jobs



**Sandia
National
Laboratories**

**For more information on Sandia's technologies:
partnerships@sandia.gov or (505) 284-2001**

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

SAND number: 2009-4094P



innovation
through partnerships