

Our Climate, Your
Business

New Mexico has
the Best Business
Climate in the
West for
Manufacturing





A report released by Ernst & Young in January 2014 determined that the state has the lowest effective tax rate for manufacturing among the western states

In 2014 Kiplinger ranked New Mexico the 8th most tax-friendly state

New Mexico has the lowest property tax in the nation (Tax Foundation) and no inventory tax

The 2014 State New Economy Index ranked our workforce first in manufacturing value added

Wages, real estate and utilities are extremely competitive equating to a low cost of doing business

Home to three national research facilities, New Mexico is first in non-industry investment in research and development

New Mexico is 9th in high-tech jobs (2014 State New Economy Index)

Table of Contents

Introduction	5
Tax Incentives	7
Competitive Natural Gas and Electricity Prices	13
Workforce	15
Transportation and Infrastructure	17
Reasearch Capacity	22
Lifestyle	24
Appendix: Research Capacity Detailed	29



INTRODUCTION

New Mexico offers a retooled business climate, quality workforce, advanced technologies and facilities, and ideal weather for manufacturing.

New Mexico is home to three national research facilities and three nationally-recognized research universities. The state is ranked first in non-industry investment in research and development and 9th in high-tech jobs, providing unparalleled capacity for research collaboration and technology commercialization in many areas that contribute to advanced manufacturing (2014 State New Economy Index). New Mexico has many companies utilizing technologies spun out of these institutions. Education and research opportunities at these facilities contribute graduates in many fields including engineering, optics, nanotechnologies, physics, manufacturing hardware, and software development.



TAX INCENTIVES

Consumables Gross Receipts Tax Deduction for Manufacturers

In 2012 Governor Martinez signed into law an expansion to the deduction for the sale of tangible personal property to manufacturers. A seller may deduct receipts from sales to a manufacturer of tangible personal property that becomes an ingredient or component part of a manufactured product.

The deduction is phased in as follows:

- 20% of receipts received in calendar 2013
- 40% in 2014
- 60% in 2015
- 80% in 2016
- 100% of receipts after January 1, 2017

New Mexico's corporate income tax rate is currently being phased down to a maximum of 5.9% by 2018.

For the purposes of this deduction, “consumable” is defined as tangible personal property that is incorporated into, destroyed, depleted, or transformed in the process of manufacturing a product, including electricity, fuels, water, manufacturing aids and supplies, chemicals, gases, repair parts, spares, and other tangibles used to manufacture a product.

Investment Tax Credit for Manufacturers

Manufacturers may take a credit against gross receipts, compensating or withholding taxes equal to 5.125% of the value of qualified equipment imported and put into use in a manufacturing plant in New Mexico, provided the manufacturer meets the criteria of hiring additional workers to earn the credit, as follows:

- For every \$500,000 of equipment, 1 employee must be added up to \$30 million
- For amounts exceeding \$30 million, 1 employee must be added for each \$1 million of equipment

The credit may (also) be claimed for equipment acquired under an industrial revenue bond. This is a double benefit because no gross receipts or compensating tax was paid on the purchase or importation of the equipment. The manufacturer simply reduces its tax payment to the state (by as much as 85% per reporting period) until the amount of the investment credit is exhausted. There are also provisions for issuing a refund when the credit balance falls under \$500,000. The credit does not apply against local gross receipts taxes.

High Wage Jobs Tax Credit

A taxpayer who is an eligible employer may apply for and receive a tax credit for each new high-wage economic-base job. The credit amount equals 10% of the wages and benefits paid for each new economic-base job created.

Qualified jobs:

- Pays at least \$40,000/year (for jobs created after July 1, 2015)
- Pays at least \$60,000/year (for jobs created on or after July 1, 2015)
- Occupied for at least 48 weeks by the employee

Qualified employers:

- Made more than 50% of its sales to persons outside New Mexico during the most recent 12 months of the employer’s modified combined tax liability reporting periods ending prior to claiming this credit
- Are eligible for the Job Training Incentive Program
- Are growing with employment greater than the previous year

Qualified employers can take the credit for four years. The credit may only be claimed for up to one year after the end of the four qualifying periods. The credit can be applied to the state portion of the gross receipts tax, compensating tax, and withholding tax. Any excess credit will be refunded to the taxpayer. The credit shall not exceed \$12,000 per year, per job.

Qualified employees:

- Must be a resident of New Mexico
- Cannot be a relative of the employer or own more than 50% of the company

Single Sales Factor

On January 1, 2014 New Mexico began phasing in a single sales factor apportionment methodology for corporations whose principal business activity is manufacturing.

For the purposes of apportioning income, “manufacturing” excludes construction, farming, power generation, and processing natural resources including hydrocarbons.

Five-Year Policy Changes	
YEAR	APPORTIONMENT
2014	Double-Weighted Sales
2015	Triple-Weighted Sales
2016	70% Sales
2017	80% Sales
2018	Single Sales Factor

Manufacturers that call New Mexico home include Intel, General Mills, Honeywell, Johnson & Johnson, and Tempur-Pedic.



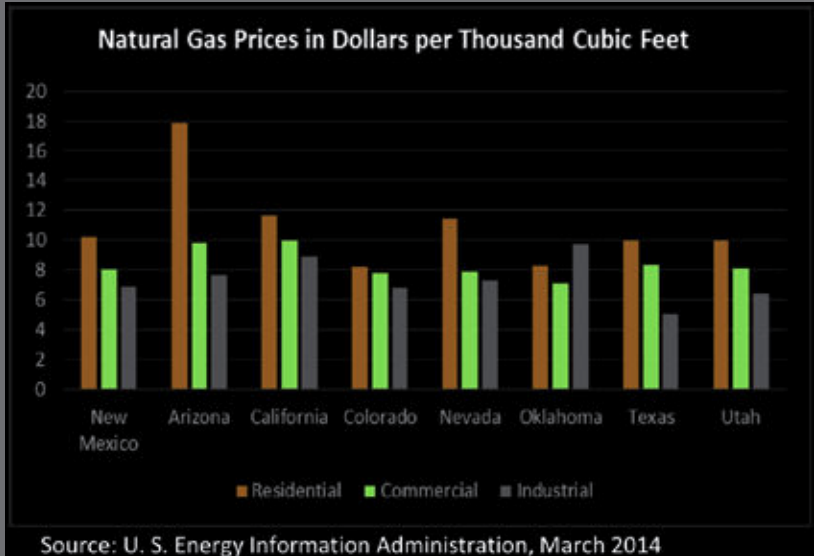
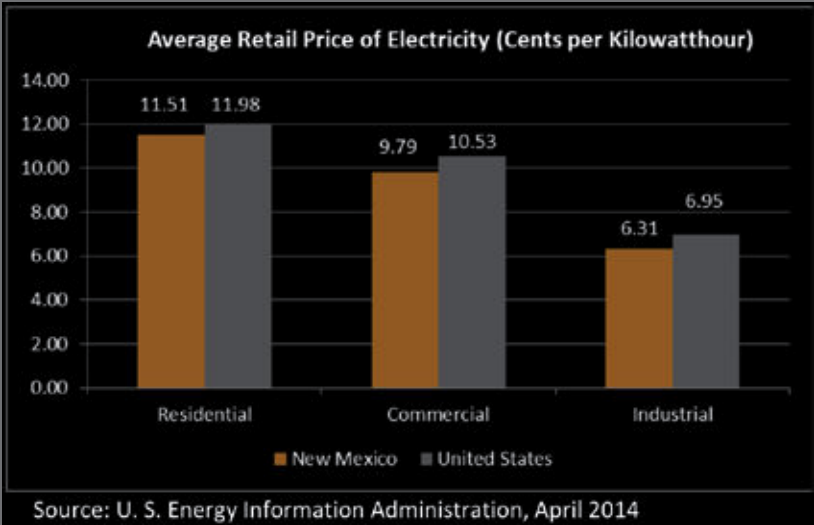


COMPETITIVE ELECTRIC POWER AND NATURAL GAS PRICES

New Mexico generates about 2.7 times the amount of total energy consumed statewide. Consequently, New Mexico is a large net exporter of energy to Arizona, California, Utah, and Texas. This translates into competitively-priced electricity.

According to the Department of Energy, New Mexico's energy cost was 7% below the national average in 2013 – one of the lowest in the southwest.

The New Mexico Public Utility Act allows both investor-owned and electric cooperatives to offer a discounted economic development rate to a customer for four years with the possibility of extending it one more year, to a total of five years.



The state's largest electric utility provider is Public Service Company of New Mexico (PNM). PNM has repeatedly been rated one of the most reliable electric utilities in the nation, with a reliability rating of over 99.99% over the past several years. PNM has some of the lowest electric rates in the Southwest, offering an important competitive advantage to businesses that use a large amount of electricity.

Xcel Energy serves the majority of eastern New Mexico. Commercial utility rates are among the lowest in New Mexico and the Southwest. Xcel consistently ranks high in reliability indices published by the New Mexico Public Regulation Commission.

Southern New Mexico is primarily served by El Paso Electric (EPE). EPE has a net dependable generating capability of 1,795 MW and is ranked extremely high in reliability in both New Mexico and Texas.

Sixteen rural electric distribution cooperatives as well as two generation and transmission cooperatives serve approximately 200,000 families and businesses in New Mexico. They are established as member-owned and controlled cooperatives, delivering efficient and reliable service.

All of these utility providers serve as strong economic development partners working with stakeholders to ensure a relatively inexpensive and highly reliable service is provided to relocating and growing businesses.



WORKFORCE

Education and research opportunities at New Mexico's research facilities contribute graduates in many fields including engineering, optics, nanotechnologies, physics, manufacturing hardware, and software development. Our workforce is talented, productive, and affordable.

New Mexico has one of the most generous training incentive programs in the country. The Job Training Incentive Program (JTIP) funds classroom and on-the-job training for newly-created jobs in expanding or relocating businesses for up to six months. JTIP funds three types of customized training for newly- created jobs:

- Custom classroom training at a public education institution
- Structured on-the-job training
- A combination of the two

The program reimburses 50-75% of employee wages. Custom training at a New Mexico public educational institution may also be covered.

Intern positions may also be eligible for JTIP provided the trainee is enrolled in a post-secondary training or academic program and meets program eligibility requirements. Companies that utilize the WorkKeys® program as part of their hiring process may be eligible for an additional 5% wage reimbursement above the standard rates.

JTIP's STEP UP Training Program reimburses qualified companies for a portion of direct training costs associated with enhancing the job skills of incumbent employees. STEP UP helps companies to provide fundamental training in areas such as integrating new technology into production processes, product line adjusting to keep up with market demands, or substantial change in delivery processes -- all factors which may require new skills or technological capabilities. STEP UP may also be used to prepare an employee to advance within a company and earn a higher salary.

The New Mexico State Legislature created JTIP, formerly known as the Industrial Development Training Program, or "in plant training," in 1972. Since then, JTIP has supported the creation of more than 43,000 jobs for New Mexicans in nearly 1,300 businesses across the state.



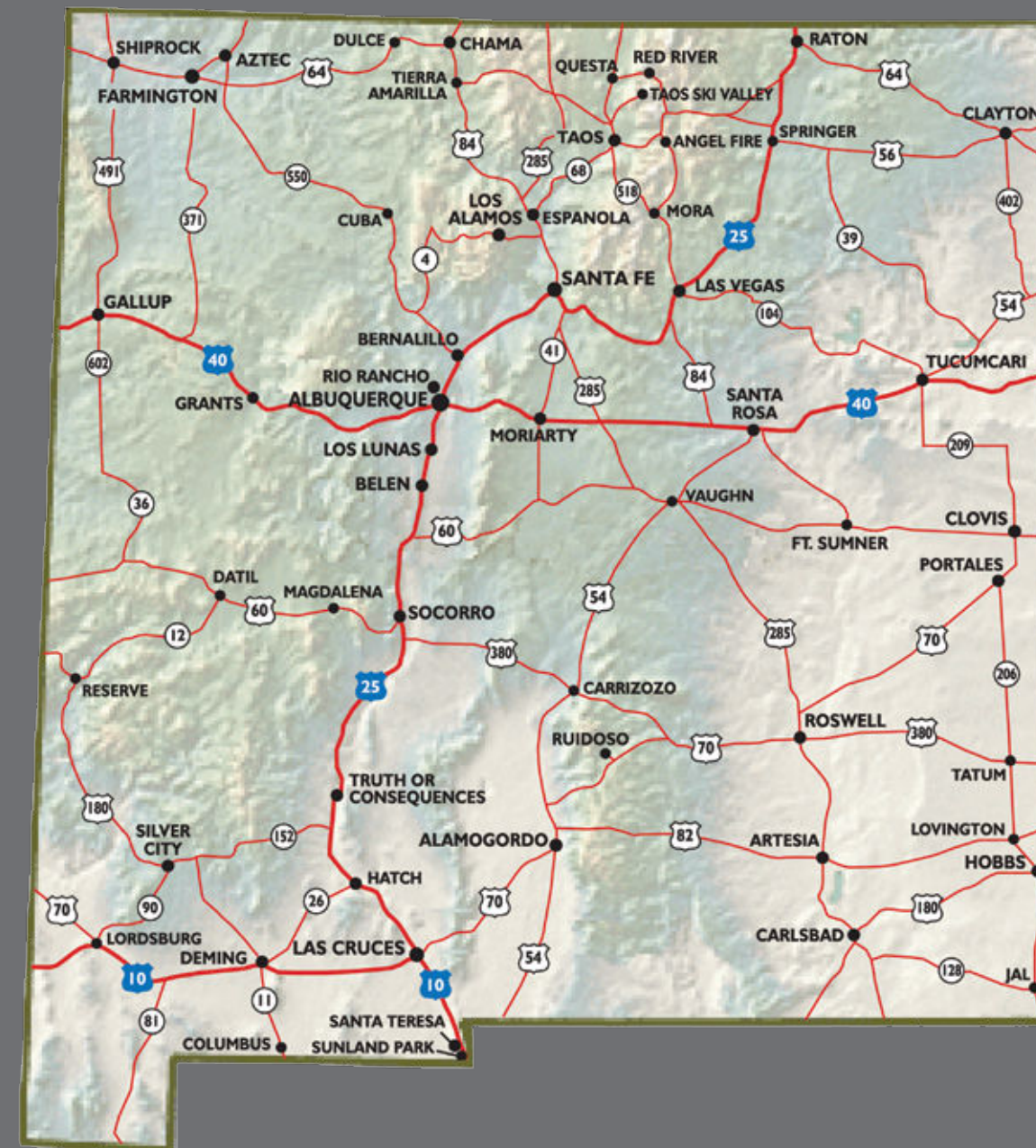
TRANSPORTATION INFRASTRUCTURE

New Mexico is strategically located in the rapidly-growing Southwest. An excellent highway and rail infrastructure provides direct access to the east and west coasts, Texas, the midwest, and the international borders of Canada and Mexico.

From New Mexico goods can be delivered to Texas, Arizona, Colorado, Kansas, and Utah within one day, and California markets in two days. The volume of truck traffic into the state translates into low backhaul rates for goods leaving the state.

Union Pacific serves 25,000 customers in 23 states across the western two-thirds of the U.S. – a total of 31,900 route miles. The railroad has a \$400 million, 2,200 acre intermodal facility near the Santa Teresa International Port of Entry to Mexico. The new facility is located just west of the Santa Teresa Airport and includes fueling facilities, crew change buildings, locomotive inspection tracks, an intermodal ramp, a switching yard, and 200 miles of track. Santa Teresa is halfway between the ports of Long Beach and Houston.

Burlington Northern (BNSF) serves 28 states and two Canadian provinces – a total of 32,500 route miles. It operates a multimodal rail yard in Belen, 30 miles south of Albuquerque. The railway is investing \$68 million on a double-track project in New Mexico, which is expected to be in service in mid-2015. BNSF is also investing approximately \$1.1 billion on locomotive, freight car, and other equipment acquisitions, many of which will serve New Mexico.





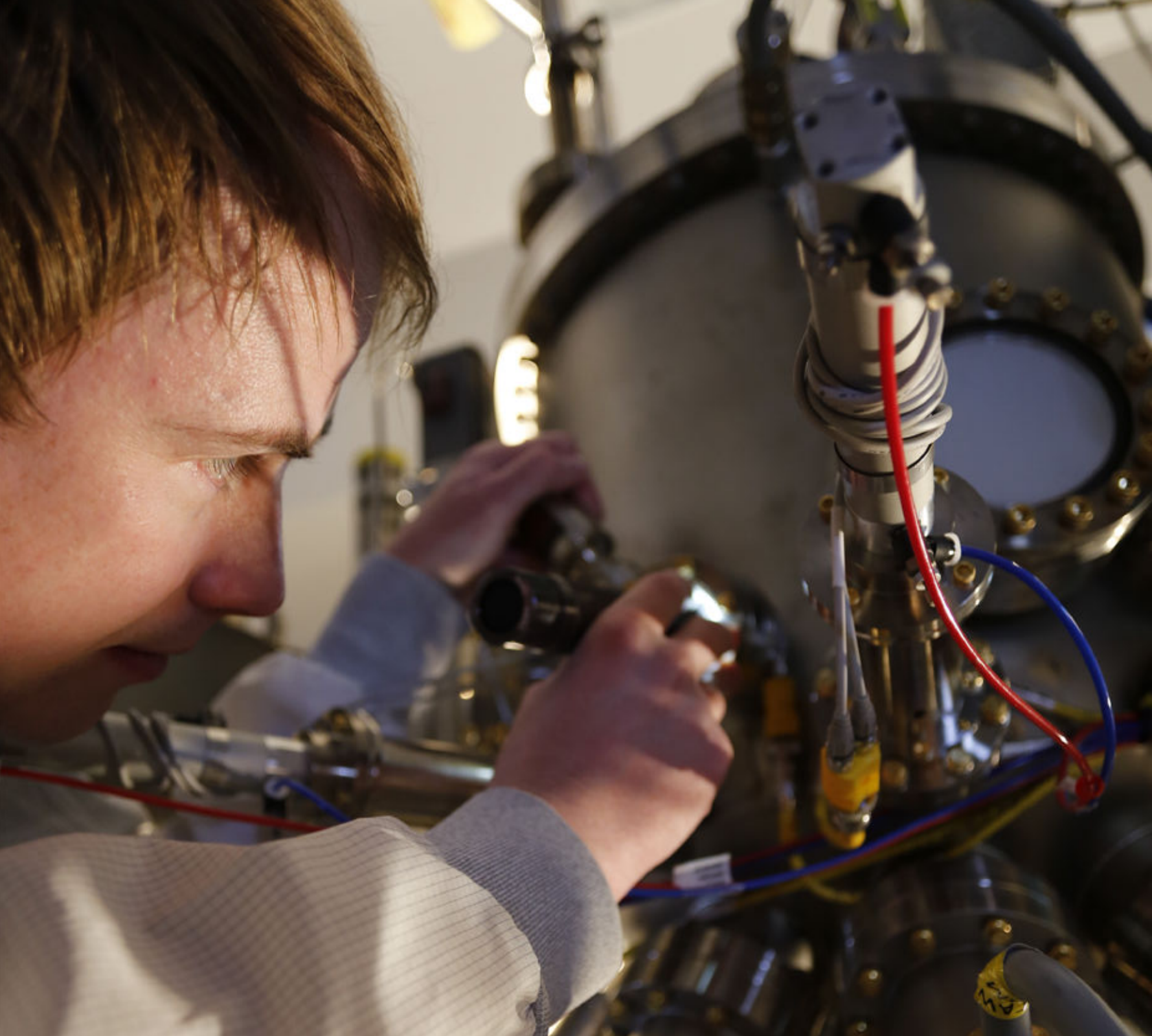
More than 60 airports are located throughout New Mexico. Two international airports serve the northern and southern regions of the state:

- Albuquerque International Sunport provides nonstop service to 23 cities daily via eight commercial carriers. Two cargo carriers serve the airport: Federal Express and UPS.
- El Paso International Airport is served by five commercial carriers with nonstop service to ten cities. It is served by four cargo carriers: Federal Express, UPS, DHL and C&M Airways.

Four regional airports offer commercial air service:

- The Santa Fe Municipal Airport is served by both American and United Airlines. American provides nonstop service to Dallas-Fort Worth and Los Angeles. United provides daily nonstop service to Denver.
- Boutique Air offers direct service between Clovis and Dallas-Fort Worth and between Albuquerque and Silver City.
- Lea County Regional Airport, in Hobbs, is served by United with daily flights to Houston.
- Four Corners Regional Airport in Farmington is served by Great Lakes Airlines, a code share partner for United Airlines. Service is available to Denver and Alamosa Colorado, and to Phoenix and Show Low, Arizona.





RESEARCH CAPACITY

New Mexico is home to three national research facilities and three nationally-recognized research universities. Many companies take advantage of the technologies offered by these institutions either through a CRADA or by licensing a technology. Through the New Mexico Small Business Assistance program businesses facing a technical challenge can access the unique expertise and capabilities of Los Alamos and Sandia National Laboratories. At no cost to the business, lab scientists and engineers assist with design consultation, testing, and access to special equipment or facilities.

More information on these research institutions is provided beginning on page 29.

New Mexico is an optics and photonics hub with about 100 companies in the state employing more than 6,200. This is largely due to the research undertaken at all three national laboratories. The largest contributor to these technologies is likely the Directed Energy Directorate at the Air Force Research Lab (AFRL) on Kirtland Air Force Base in Albuquerque. AFRL, in cooperation with homegrown New Mexico engineering firms and industry giants like Raytheon and Boeing, has developed advanced laser systems that could soon be mounted on Navy ships to shoot down missiles and on ground vehicles to destroy things like improvised explosive devices, or breaking sensing and measuring tools for satellites and other space vehicles.

Laser technology developed at LANL was selected for NASA's new Mars mission in 2020. The SuperCam instrument, embedded with Laser-Induced Breakdown Spectroscopy (LIBS) technology, allows researchers to sample rocks and other targets from a distance using a laser. It also adds color to its high-resolution visible imaging capability as well as visible and infrared spectroscopy



LIFESTYLE

Few places on earth offer the rich history and cultural diversity found in New Mexico. Native American culture has been present in the state for more than 2,500 years, and is home to 22 Native American tribes. Their rich history is celebrated today in museums, ceremonial dances, arts and crafts, language, and traditional villages. Visitors can celebrate on the pueblos year round during designated feast days, and partake in native homemade cuisine and tradition. The annual SWAIA Santa Fe Indian Market is held the 3rd weekend in August and features more than 1,000 Native artists.

Chaco Culture National Historic Park dates to 850AD and is considered the most exceptional concentration of pueblos in the American Southwest. It is one of only 20 World Heritage sites in the U.S. Chaco is probably the best representation of the first art ever created in New Mexico. Follow the Trail of the Ancients to visit more historic and cultural sites in the Four Corners.

Spanish colonial culture arrived in the state in the late 1500's, contributing over 500 years of Hispanic influence to the New Mexican way of life. The Annual Traditional Spanish Market displays this influence through food and art in Santa Fe during the summer and in Albuquerque during the winter. The combination of Native and Hispanic elements results in a strong culture found in every aspect of the state from food and fiestas to architecture and art.

The Taos Art Colony and Taos Society of Artists began in 1898 when Ernest L. Blumenschein and Bert Geer Phillips broke a wagon wheel while headed to Mexico to sketch and paint. Both eventually made Taos home and would be joined by many others in the years to come. Taos is still the residence of many talented artists. New Mexico is known as The State of the Arts because it is home to more working artists, open studios, artist-owned galleries, and specialty and artisan-oriented shops than any other state per capita. Visitors can schedule studio tours, which is a great way to explore New Mexico by finding new and traditional art, meeting the artists, and eating local food.

While local events are common, New Mexico has just the perfect environment to host international events every year. Every visitor, no matter where they are from, will find the relaxed lifestyle charm-

ing and endearing, while also experiencing other worlds at their fingertips. The Santa Fe International Folk Art Market is the largest of its kind bringing in cultures from more than 40 countries for over 20,000 visitors to experience at the height of New Mexico's beauty in the summer. Other colorful events include the Roswell UFO Festival, the Great American Duck Race in Deming, the Lincoln County Cowboy Symposium, and Whole Enchilada Festival in Las Cruces.

Visitors are also drawn to the state's many historical sites, museums, and celebrations every year. The State of New Mexico operates eight museums covering a range of interests, from Space History to Folk Art. There are over 40 museums, and hundreds of art galleries throughout the state covering anything from local artisan art to globally-known fine art. Summer is the season for art in New Mexico, including performance art. Thousands come to New Mexico for the Santa Fe Opera season in the world-renown venue that is like no other. The annual Blues Festival held Memorial Day weekend each year draws hundreds of blues enthusiasts to Silver City, a beautiful town in the Gila Wilderness with its own rich history and, today, home to many art galleries. New Mexico's beautiful historic theaters offer a variety of performing arts, symphonies, chamber music, concerts, and plays.

For those who want to experience the beauty of nature, the state operates 36 parks, 3 national parks, and 12 national monuments. The most famous of these is Carlsbad Caverns National Park, with some of the largest underground caves and chambers in the world. During the summer, stay until



dusk and watch as nearly 400,000 bats fly out of the cave for their evening adventure. Nearby Lechguilla Cave, explored to depths of 1,593 feet, is the nation's deepest cave, and the Gila Wilderness, an area of mountainous beauty and ancient cliff dwellings, was the first wilderness area to be so designated by Congress. Viewers will be struck by White Sands National Monument, which is 275 square miles of pure white sand.

Hiking and biking trails are for you to discover from Angel Fire to Las Cruces, or you can rock climb in Diablo Canyon or see the natural sights at Tent Rocks near Cochiti Pueblo. After a long day of outdoor activity, soak in any one of the hot mineral springs throughout the state in Jemez Springs, which offers both hot and cool, primitive and luxurious pools; Truth or Consequences, whose springs heat up to 115 degrees Fahrenheit; or the 145 year-old Ojo Caliente Mineral Springs, which are known for their healing powers.

Boating on any of the 20 lakes in our state parks from Elephant Butte in the south to Navajo Lake in the northwest is a great way to enjoy the fresh air and beautiful scenery, and the quality trout waters of the San Juan River are well known to fly fishermen everywhere. Go rafting or kayaking in any one of New Mexico's rivers, totaling 200 miles of waterway, or dive into the Blue Hole in Santa Rosa, a natural 80 foot deep pool, for scuba diving.

Or if you'd rather take a day trip, nearly any town you visit has its own story of life in the wild 'old west' and getting there is an experience in itself. This is especially true of the many ghost towns you may encounter along any one of New Mexico's 25 magnificent scenic byways, which equal over 2,900 miles across a diverse landscape. You can follow one of these paths to take a tour of Georgia O'Keefe's Ghost Ranch in Abiquiu, then visit the museum dedicated to her life and work in Santa Fe. You can also follow the Film Trails and tour the scenes from films and television shows made in New Mexico.

New Mexico hosts all four seasons and fall is one of the most beautiful. The smell of roasting chile in the air, the taste of freshly picked and roasted pinon, and the golden sight of the aspen leaves changing colors on the mountain tops bring warmth to you as the breeze turns cooler. Fall is also a season for fiestas! The International Balloon Fiesta attracts visitors from all over the world to see the Albuquerque sky decorated with colorful and special-shaped hot air balloons. Santa Fe kicks off the harvest season with Fiestas de Santa Fe and continues the celebration with the Wine and Chile Festival, Hatch hosts their chile festival, and the Whole Enchilada Fiesta in southern New Mexico. This is the 3rd largest event in the state and one of the top 100 events in the nation.

From the stark, arid beauty of southern New Mexico's deserts to some of the country's finest ski slopes located on over 20 mountain ranges, this land of breathtaking contrasts offers a myriad of outdoor activities year-round. Each season New Mexico slopes average 300 inches of snow, the Kachina lift at Taos Ski Valley is one of the highest in North America, and Angel Fire is the only New Mexico resort with night skiing. If you are not a skier, there are plenty of other snow activities inner tubing, snowshoeing, snowmobiling, sleigh rides, ice fishing, and ice skating.



RESEARCH AND TECHNOLOGY DEVELOPMENT IN NEW MEXICO

Los Alamos National Laboratory (LANL)

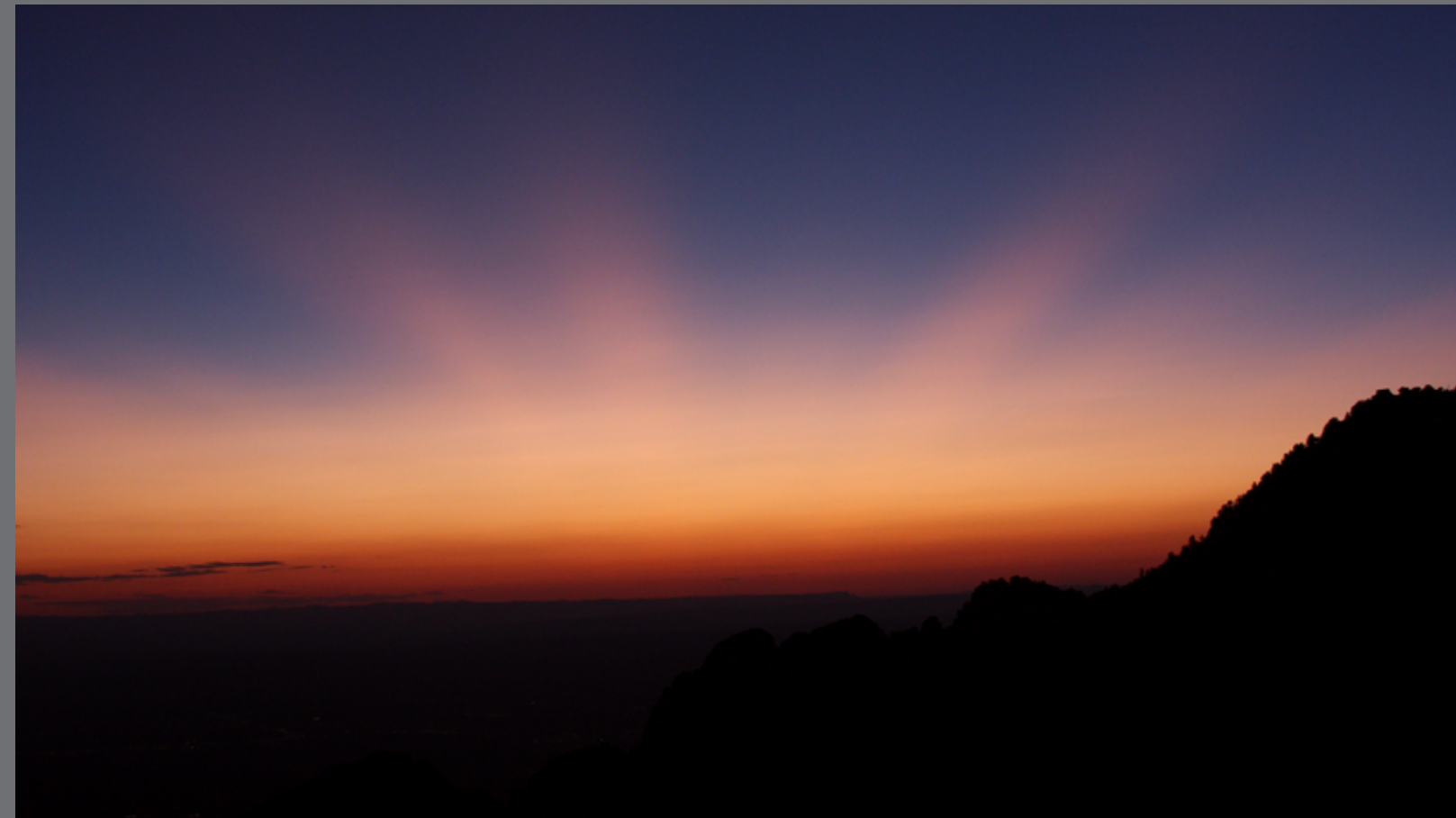
LANL is a premier research and development institution with more than 9,000 employees and an annual budget of approximately \$2.2 billion. LANL is managed by Los Alamos National Security, LLC which is comprised of four organizations: Bechtel National, University of California, The Babcock and Wilcox Company, and URS Corporation. Collaborative research is accomplished through LANL's institutional centers:

- Center for Information Science and Technology: energy/climate/information nexus, predictive materials modeling, situational awareness, synthetic cognition
- Center for Integrated Nanotechnologies (CINT)
- Center for Nonlinear Studies: computational molecular biology, agent-based systems and modeling
- Energy Security Center: materials and concepts for clean energy, mitigating the impacts of global energy demand, sustainable nuclear energy
- Institute for Complex Adaptive Matter/LANL: emergent or nonlinear behavior in materials science
- Institute for Geophysics and Planetary Physics: astrophysics, complex dynamic systems, solid earth geoscience, space physics
- Los Alamos Neutron Science Center: spallation neutron sources for research
- Lujan Neutron Scattering Center: employs pulsed spallation neutron source for neutron scattering studies of condensed-matter
- National High-Magnetic Field Laboratory: exotic, nonmagnetic materials for megabauss sensors
- Quantum Institute: quantum cryptography, quantum computing
- Seaborg Institute: plutonium and lighter actinide elements research
- Superconductivity Technology Center: electric power and electronic device applications of high temperature superconductors

LANL collaborates with private industry on a daily basis toward the enhancement of advanced manufacturing technologies. Corporate partners include Chevron, General Electric, and EMC.

Under a Cooperative Research and Development Agreement (CRADA), LANL and P&G have collaborated for two decades, incorporating computational technologies developed for national security into cutting-edge tools for advanced manufacturing. Los Alamos researchers and P&G engineers enlisted computer codes developed to model the flow, transport, and interaction of fluids and particles to help design a more efficient diaper manufacturing process.

The Richard P. Feynman Center for Innovation helps move technologies from the Lab to the marketplace to benefit society and the U.S. economy. This is accomplished by ensuring that Laboratory inventions receive intellectual property protection, which enables LANL to license Los Alamos technologies to industry and start-up companies. The Richard P. Feynman Center for Innovation manages Lab-industry research partnerships and serves as the Laboratory's resource on industry relations. <http://www.lanl.gov/>



Sandia National Laboratories (SNL)

Sandia National Laboratories is a government-owned, contractor operated facility managed by Sandia Corporation, a division of Lockheed Martin. The lab collaborates with other government agencies, industry, and academic institutions on its fourfold mission which is composed of nuclear weapons; defense systems and assessments; energy and climate; and international, homeland, and nuclear security program areas. Sandia's core capabilities reside in four broad areas: systems engineering and integration, high-performance computing and modeling and simulation, extreme-environment testing at unique facilities, and nanotechnologies and microsystems. Research foundations at SNL focus on seven areas: bioscience, computing and information science, engineering science, geoscience, materials science, nanodevices and microsystems, and radiation effects and high energy density science.

- Bioscience: biofuels, biodefense and emerging infectious diseases, microfluidics, computation, systems engineering, nanobiology, and bioimaging
- Computing & Information Science: device physics, computer architecture, mathematics, computer science, and informatics; world-class modeling, simulation, and data analysis capabilities; first-of-a-kind computers and world-leading computational capability
- Engineering Science: provide predictive simulations with quantified margins and uncertainties; improve our ability to address high-impact, coupled-physics simulations; increase the use of computational modeling as a discovery tool for driving experiments; high-performance computing and world-class modeling, simulation, and visualization capabilities; integration of physical and computational simulation
- Geoscience: energy production, storage, and security; carbon capture, reuse, and sequestration; monitoring for nonproliferation, defense applications, and border security; geotechnical systems analysis and engineering; solving applied problems in subsurface flow and transport
- Materials Science: predicting performance and reliability; control of energy, mass, and charge transfer; developing new materials; computational materials synthesis and processing; novel characterization and diagnostic tools and techniques
- Nanodevices & Microsystems: enable the understanding and creation of microelectronics that are impervious to subversion; develop nano- and microscale concepts, devices, and systems; discover and create advanced optoelectronics at the nano- and microscale; enable portable chemical, biolog-

ical, radiation, nuclear materials, and explosives detection that exceed current limitations in selectivity, sensitivity, and robustness by developing nano- and microscale concepts, devices, and systems; provide new functionality and performance as a result of nano- and microscale phenomena

- Radiation Effects & High-Energy Density Science: improve the understanding of the radiation response of engineered systems; develop new radiation-resistant materials and technologies; create and use new technology to generate extreme radiation environments; produce extreme environments of high energy density, including high-photon energy X-ray sources for radiation- effects testing, very high-pressure Hugoniot and off-Hugoniot dynamic materials-properties measurements, and intense X-ray environments for radiation physics; enable the construction and operation of terawatt to petawatt pulsed-power systems that deliver electrical energy in pulses that are flexible in shape and duration to different types of loads





Engineering Science

The Engineering Science Research Foundation is leading engineering transitions in advanced, highly critical systems by integrating theory development, experimental discovery and diagnostics, modeling, and computational approaches to refine the understanding of complex behavior in engineered systems. Engineering Sciences develops foundational knowledge in the areas of:

- Solid mechanics
- Fluid mechanics of reacting and nonreacting systems
- Aerodynamics
- Thermal and combustion science
- Structural dynamics
- Shock physics and energetics
- Electromagnetic sciences

Materials Science and Engineering Center (MSE)

MSE provides the knowledge of materials structure, properties, and performance and the processes to produce, transform, and analyze materials. Materials Science and Engineering Capabilities include:

- Electronic and optical materials
- Thin films and coatings
- Nanostructured materials
- Ceramics synthesis and processing
- Catalysis and reaction processes

SNL Manufacturing Science and Technology Center (MST)
MST develops and applies advanced manufacturing processes for realization of products in support of Sandia's primary mission of ensuring that the nation's nuclear weapons stockpile is safe, secure, and reliable. Components for the stockpile are typically complex electro-mechanical or electronic parts designed to withstand harsh environments with high reliability. The Center focuses on enhancing manufacturing capabilities in four key areas:

- Manufacturing of engineering hardware
- Emergency and specialized production of weapon components
- Development of robust manufacturing processes
- Design and fabrication of unique production equipment

Manufacturing Science & Technology Center Technologies	
Adhesive Bonding	Materials Characterization
Ceramic Chemistry	Mechanical Measurements & Calibration
Ceramic Processing	Mechanical Testing
Composites	Meso-Machining
Dielectric Characterization	Model Based Manufacturing
Electro-Microfluidic Dual In-line Package (EMDIP)	Molding, Thermoforming, & Compounding
Electronic Fabrication	Plating & Lithography
Electronic Packaging	Quality Assurance & Testing
Encapsulation	Rapid Prototyping
Glass Melting & Sealing	Sol-Gel Glasses
Ion Beam Manufacture	Thin Films
Joining & Heat-Treating	
Laser Engineered Net Shaping (LENS™)	Vacuum Engineering
Machining	Vacuum Processes
Magnetics Laboratory	Welding, Fabrication & Metal Forming
Manufacturing Liaison	
Manufacturing Information Integration & Infrastructure	

Research at MST aims primarily in the development-to-application part of the research-to-development-to-application cycle. Work is also done in the research-to-development area with the aim of providing customers more robust, quicker, and/or less expensive processes. R&D to develop processes required for the manufacture of specialized materials and components that can no longer be obtained in the commercial market is also conducted.

Within Sandia, most manufacturing R&D is carried out by MST, the Materials and Process Sciences Center, the Integrated Manufacturing Systems Center and the Intelligent Systems & Robotics Center. Much of the R&D involves cooperative programs among these Centers.

Examples of R&D results from laboratory agreements:

- BaDx (Bacillus anthracis Diagnostic) is a pocket-sized anthrax detector whose past and continued development was funded by the Laboratory Directed Research and Development Program (LDRD) – one of the cooperative partnerships offered by Sandia. The detector is the size of a credit card and is able to determine the presence of anthrax with less volume than any other detector. BaDx is currently being licensed to Aquila, a New Mexico small business that specializes in the design and manufacture of technologies and services for nuclear security and international safeguards.
- Sandia and General Motors have been working together under a cooperative R&D agreement (CRADA) to develop systems modeling for energy, infrastructure, and future generations of vehicles; energy storage: advanced batteries and hydrogen storage; clean, advanced combustion; and future generation vehicle networks and sustainable communities.



MST houses two specialized organizations focused on manufacturing capabilities: Manufacturing Enterprise and Manufacturing Process Science & Technology.

Manufacturing Enterprise

Manufacturing Processing and Manufacturing Processes and Services share the 70,000 square foot shop and lab space facility and over 120 tradepersons and support personnel who work with your engineers to transform ideas into working prototypes. Services provided include:

- Machining
 - Heavy machining: Machines with capacity of 50,000 pounds and 84 inches long
 - Project machining: Machining services and project management
 - Rapid turnaround: Rapid response to manufacturing needs
 - Miniature machining: Microscopic machining
 - Composite machining, grinding & polishing: Machining of non-metals
 - Explosive processes: Explosives machining by remotely operated equipment
- Manufacturing Liaison: Electronic and mechanical liaison groups work with inside shops and over 2,000 outside suppliers
- Welding, Fabrication, & Assembly: Onsite or remote welding, assembly, and repair
- Precision Metal Forming: Aircraft quality sheet metal fabrication
- Heat Treatment: Hardening, normalizing, annealing
- Machine Repair: Preventative maintenance and repair of machine shop equipment
- Abrasives: Grinding and lapping of materials
- Mechanical Measurements: In-process and final dimensional measurements of components
- Calibration: Length, mass, force, and dimensional reference standards

Electronic Fabrication provides solutions for packaging design, production acceptable prototype fabrication, or deliverable production fabrication.

Capabilities:

- Final electronic product packaging from sketches and verbal instructions
- CAD drawing package after project completion if no formal prints are available
- Complete system development and fabrication through concurrent engineering
- Concurrent engineering in prototype and production fabrication
- Integrate commercial equipment into prototype system design
- Implementation and modification of commercial equipment
- Packaging of prototype into finalized product assembly

Resources:

- Customer assistance from fabrication, to testing, to complete system installation
- Engineering review of electronic packaging, drawings, and design requirements
- Certified fabricators to MILSTD 2000, Sandia 9913013, or IPC-J-STD-001C for soldering
- Certified personnel for industry spec IPC-A-610, acceptability of electronic assemblies
- Automated systems including CAD Layout and Engraving systems
- 2500 watt CO2 laser
- Machine Shop Sketch-To-Prototype Fabrication
- Suppliers for quick turnaround

Manufacturing Process Science and Technology conducts research and development on advanced manufacturing process and materials technologies and provides manufacturing process development, technical consulting, and technology transfer to support Sandia product realization needs. Four specific business areas are housed within this organization:

1. Thin Film, Vacuum, and Packaging Technologies organization offers expertise in a variety of materials processes with a mission to work with partners requiring thin film engineering, vacuum system design and fabrication, brazing, electronic module manufacturing and packaging technologies. The team has extensive experience with coating processes, vacuum system design, and manufacturing. The joining team can advance electronics and other manufacturing processes by performing special brazing and diffusion bonding operations. The electronic microcircuit and packaging effort provides an important resource for engineering a variety of microelectronic circuit assemblies. From layout to fabrication of prototype samples, we offer opportunities for concurrent development and testing of these assemblies. An important aspect of these efforts is assisting partners in selecting an appropriate manufacturing technology.

2. Organic Materials in the Advanced Manufacturing and Processing Laboratory provides prototype fabrication, full service small lot production, materials technology, processing expertise, and a broad range of organic material characterization and mechanical testing techniques. This department can encapsulate, join and bond, foam, analyze and image, and build composite structures. The team partners with businesses to find the right combination of materials, processing, and fixturing that will result in the highest value for the lowest price.

3. Ceramics and Glass Processing Department provides a broad range of processing options for many types and compositions of prototype ceramic, glass, and glass-ceramic components. Capabilities range from chemical synthesis of powders and glasses, through powder processing, billet formation and machining, to complete component fabrication and testing.

4. Meso-Manufacturing and Systems Development team offers comprehensive meso manufacturing services and direct engineering support for industrial application. Recent projects include novel femtosecond laser milling and turning of energetic material microstructures, diamond turning of complex optics, and μ EDM of multi-axial flexures.



Microsystems and Engineering Sciences Applications (MESA)

The MESA Complex is designed to integrate the numerous scientific disciplines necessary to produce functional, robust, integrated microsystems and represents the center of Sandia's investment in microsystems research, development, and prototyping activities. This suite of facilities encompasses approximately 400,000 square feet and includes cleanroom facilities, laboratories, and offices. www.sandia.gov

Areas of Expertise:

- Rad-hard electronics & trusted systems
- Fabrication, testing, & validation capabilities
- RF & photonics
- Quantum systems
- Sensors
- MicroElectroMechanical Systems (MEMS)
- Power electronics

Center for Integrated Nanotechnologies (CINT)

CINT is jointly operated by Los Alamos and Sandia National Laboratories as a national user facility devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. The Core Facility is located at Sandia and the Gateway Facility is located at Los Alamos. CINT focuses on four scientific areas: nanophotonics and optical nanomaterials; nanoscale electronics and mechanics; soft, biological, and composite nanomaterials; and theory and simulation of nanoscale phenomena. The scientific work at CINT is organized into four interdisciplinary areas:

- Nanoscale Electronics & Mechanics - Control of electronic transport and wave functions, and mechanical coupling and properties using nanomaterials and integrated structures
- Nanophotonics & Optical Nanomaterials - Synthesis, excitation, and energy transformations of optically active nanomaterials and collective or emergent electromagnetic phenomena (plasmonics, metamaterials, photonic lattices)
- Soft, Biological, & Composite Nanomaterials - Solution-based materials synthesis and assembly of soft, composite, and artificial bio-mimetic nanosystems
- Theory & Simulation of Nanoscale Phenomena - Assembly, interfacial interactions, and emergent properties of nanoscale systems, including their electronic, magnetic, and optical properties

CINT offers three initiatives, called Integration Focus Activities (IFAs), focused on nanoscale integration challenges within the context of specific classes of materials, systems, or phenomena that will have high scientific and technological impact. The purpose of IFAs is to derive the integration focus of materials, systems, and phenomena through a practical science approach that is highly interdisciplinary. The three IFAs currently underway are:

- Nanowires for New Energy Concepts IFA: focuses on integration science issues around nanowire materials and architectures and their potential use in solar and thermoelectric energy harvesting and electrical energy storage. This activity builds on the work of 57 user projects over the last three years.
- Programmable Membrane-based Nanocomposites IFA: focuses on understanding how synthetic nanomaterial components interact with model membrane systems or other reconfigurable matrices (e.g., polymeric hosts) at interfaces, and how the organization of the components can be mediated

by dynamic, fluid, or programmable responses of the host material. Its development incorporates the work from 56 user projects.

- Plasmonics and Metamaterials IFA: focuses on understanding and designing metamaterial and plasmonic structures capable of enhanced interactions with light and to accomplish novel functionalities, from tunable and nonlinear hybrid metamaterials through integration of semiconducting and/or complex oxide materials and structures. Core & Gateway Facilities

The CINT user community can access research capabilities in the Core Facility at Sandia National Laboratories and the Gateway Facility at LANL. Together, these facilities provide laboratory and office space for researchers to synthesize and characterize nanostructured materials, theoretically model and simulate their performance, and integrate nanoscale materials into larger-scale systems in a flexible, clean-room environment.

- Materials Synthesis: Molecular beam epitaxy; physical and chemical vapor deposition; pulsed laser deposition; inorganic, organic, and polymer synthesis; nanoparticles and nanowires; thin film deposition; membranes and monolayers; mesoporous materials; biomaterial synthesis and biomolecular recognition



- Characterization: Scanning probe microscopies; electron microscopies; optical spectroscopy and microscopy; single molecule spectroscopy; ultrafast laser spectroscopies; nano/micro-mechanics; raman microscopy; terahertz spectroscopy; transport

- Nano-Micro Integration: Optical and electron beam lithography; soft nanolithography; focused ion beam; etching and deposition

- Theory and Simulation: atomistic theory; predictive capability development; interpretation and design of experiments; multi-scale material modeling; and large scale computing

- Discovery PlatformsTM: Modular, micro-laboratories designed and batch fabricated expressly for the purpose of integrating nano and micro length scales and for studying the physical and chemical properties of nanoscale materials and devices

The 96,000 square foot CINT Core Facility at Sandia National Laboratories features low vibration for sensitive characterization, chemical and biological synthesis labs, a clean room for device integration, interaction areas and conference rooms, visitor office space, and high-speed communications.

The CINT Gateway Facility, located at Los Alamos National Laboratory in the center of the Materials Science Complex, brings together materials science and bioscience capabilities. The 36,500 square foot laboratory and office building, features approximately 11,000 square feet of laboratory space for chemical and biological synthesis and characterization, biomaterials fabrication and characterization, optical microcopy and spectroscopy, physical synthesis, thin film fabrication, spatially resolved scanned probe characterization, advanced computation, and visualization. <http://cint.lanl.gov/>



New Mexico State University (NMSU)

Manufacturing Technology and Engineering Center (M-TEC)

M-TEC is a state-funded facility that exists to support economic development through the Manufacturing Sector Development Program. Housed in the College of Engineering, M-TEC uses the extensive amount of resources in the College of Engineering to help businesses and entrepreneurs in the state. M-TEC has worked with various individuals, industries, and businesses in New Mexico providing technical assistance in the form of engineering, design, analysis, and product development to find an affordable solution that will fit the clients' specific needs. M-TEC is a recognized leader in prototyping and concept validation, and makes available the resources in the College to the public.

Services & Expertise:

- Product design & development
- Concept validation
- Mechanical design
- Prototyping
- Machine design
- Machining & fabrication
- Engineering analysis
- Design for manufacturability
- Manufacturing training
- Manufacturing & shop safety training



The manufacturing lab is a large machining facility with both manual and CNC equipment, a small foundry, and fabrication and sheet metal equipment.

The Control Lego® Lab is set up as an instructional lab to teach industrial controls and automation. The lab consists of robotics, material handling equipment along with Lego® controllers. The lab is

equipped with PLC controllers, microcontrollers, digital signal processing, and printed circuit board (PCB) design equipment. Custom PCB's are also populated in this lab.

The 2,000 square foot Measurement Inspection Lab contains measurement and inspection equipment that is used for quality control, statistical process control and ISO 9000 standards, along with surface measurement and non-destructive testing capabilities. <http://et.nmsu.edu/826-2/>

New Mexico Tech (NMT)

MicroElectronics Testing & Technology Obsolescence Program (METTOP)

METTOP Microelectronics Semiconductor Testing and Design Center is a research and training division of NMT. METTOP provides cost-effective means to manage issues of Diminishing Manufacturing Sources and Material Shortages (DMSMS). METTOP's mission is to test, evaluate and assess the wide range of microelectronic components that comprise so many of today's sophisticated military, space, and commercial systems. These resources include a Credence® Sapphire S system with a 768+ pin capacity. This mixed signal test system is capable of testing advanced integrated circuit technologies at speeds of up to 1.6 GHz per pin. The Sapphire system with engineering support is available on an hourly basis for customer tests (prototype verification, failure analysis, design validation). Other test systems with engineering support are also available to interested customers.

Electronic Test Equipment: Mainframe Testers

- Credence® Sapphire Mainframe High Speed ATE Tester
- Teradyne® Mixed Signal Tester #A575/A585
- Credence® Personal KALOS II Memory Tester #PK

Benchtop/Lab Test Equipment

- Acterna® Communications Signals Analyzer #FB-8000
- Agilent Technologies® Arbitrary Waveform Generator #33250A, Precision Semiconductor Parameter Analyzer #4156C, and Universal Test Fixture #16442B
- BK Precision® Digital IC Tester #575
- Keithley® 2400 Series SourceMeters, and Picoammeters

- Quick Circuit® #QC-7000 Printed Circuit Board Milling System
- Remstar®/Megastar® Microelectronics Storage
- Tektronix® Arbitrary Waveform Generator #AWG710B, Data Timing Generator #DTG5274, Digital Oscilloscopes #3054B and #3052B, Digital Sampling Oscilloscope #TDS8200, High Power Curve Tracer #371B, Logic Analyzer #TLA721, and Programmable Curve Tracer #370B
- Temptronic® ThermoSpot® #TP27D-1, and ThermoStream® #TP04310A-3C44-4
- Miscellaneous power supplies, fixtures, chambers, and lab equipment

Current Research Activities:

- Lead (Pb) free research and testing
- Component and circuit card assembly MIL-STD-883 thermal testing
- Microelectronics prognostics advanced failure notification and analysis
- Radiation effects on microelectronics survivability and vulnerability assessments
- Methods of mitigation of radiation effects on microelectronic circuits
- Radiation emission microscopy techniques for advanced failure analysis of microcircuits
- Hardware anti-tamper research development test and engineering
- Microelectronics security: counterfeit and trojan microcircuits detection
- RF devices testing
- METHOD 1019 ionizing radiation (TOTAL DOSE) testing including
 1. Accelerated aging test for estimating low dose rate ionizing radiation effects on devices
 2. Time-dependent and annealing effects testing<http://mettop.emrtc.nmt.edu/index.php>

University of New Mexico (UNM)

UNM Manufacturing Training and Technology Center (MTTC)

MTTC is a 57,000 square foot facility that supports teaching and training, research and development, start-up companies, manufacturing prototyping, and extension service activities. Facilities include: offices, labs, classrooms, prototyping bays, CAD rooms, an auditorium, a café, and a 6,200 square foot cleanroom. <http://www.mfg.unm.edu/mttc.php>

The UNM Manufacturing Engineering Program (MEP) includes a DOE University research program in robotics. UNM and the DOE have been developing a cycle-time reduction system, Robotics and Automation Design-and-Drive System (RADDs), for cleanup and remediation of hazardous waste sites, as well as for advanced manufacturing and forensics needs. The goal of RADDs is to reduce the amount of time between a site-defined need and a site-delivered turnkey implementation of the robotic and/or automation hardware that solves the problem. MEP resources include: computers, robot hardware and control software, CAD/CAM packages, factory simulators, dynamic systems modeling software, and extensive semiconductor processing equipment. <http://www.mfg.unm.edu/>

Also within MTTC is the UNM Artificial Muscle Microgripper Lab, a state of the art facility that researches artificial muscle microgrippers made from Ionic Polymer Metal Composites (IPMC), with a focus on the design and improvement of microgrippers. IPMC are a type of electroactive polymer that bend in response to electrical stimulation. They are produced in sheets that resemble gold foil in appearance but are flexible and resilient like rubber, and can be cut to virtually any dimension and have the ability to operate in the wet or dry condition. IPMC are closely related to Teflon, so they are chemically inert and can withstand high and low temperatures. Lightweight, mechanically simple, and silent, they make excellent microgrippers. <http://www.mfg.unm.edu/MicrogripperLab2/index.html>

The UNM Nanoscience and Microsystems Program bridges the distinct properties of the nanoscale to microsystem functionality. The integrated academic and research activities highlight our capabilities and unique breadth in materials synthesis and self-assembly, nanolithography, interrogative platforms, and functional micro/macrosystems. Special emphasis is placed on translating these technologies to radical changes in the way we diagnose, treat and ultimately prevent cancer. The Nanoscience and Microsystems Program highlights three technical thrusts: Informational Nanotechnology, Nano-Bio Interfaces and Complex Functional Systems. The program requires that Nanoscience and Microsystems fellows complete a curriculum of integrated courses. <http://nsms.unm.edu/>

Nanoscience at UNM is a user-friendly facility providing rapid access to state-of-the-art equipment for academia and industry to enable nanoscience research. Areas of expertise include:

- Nanoscale interferometric lithography
- Self-assembly of nanocomposite soft/hard materials
- Nanoscale catalysis, and nano-geo-bio-chemistry
- Epitaxial growth of self-assembled quantum nanostructures (quantum dots)
- Field-emitter tips
- Photonic crystal lasers
- Nanomechanics
- Fiber sensors, molecular electronics, and nanomagnetism
- Synthesis and characterization of nanophase catalytic material
- Mesoporous natural materials and their potential for environmental remediation
- Geomicrobiology and biogeochemistry
- Interactions of microbes and minerals in extreme biological environments
- Mineralogy and geochemistry of low temperature nanophase materials
- Volcanic aerosols
- Early solar system processes involving nanophase materials

The UNM Center for Micro-Engineered Materials (UNM CMEM) Industry/University Cooperative Research Center program serves as a focal point for materials science research and education at UNM. The research performed by CMEM faculty is highly leveraged because of close collaboration with research scientists from SNL, LANL and CINT. The Center owns or has access to state-of-the-art facilities to synthesize and characterize a broad range of materials including a one-of-a-kind Small-Angle X-ray Scattering Center. CMEM serves as a focal point for material science research

and education at UNM and it manages the UNM site of the UNM/Rutgers Ceramic and Composite Materials Center, a National Science Foundation Industry-University Cooperative Research Center. <http://cmem.unm.edu/>

The New Mexico Center for Particle Physics (NMCPP) exists to promote cooperative programs in the general research areas of particle physics and particle astrophysics within UNM and with neighboring institutions in New Mexico. Many of the following research programs are in close collaboration with research groups at LANL:

- Nuclear physics
- High energy physics
- Dark matter and particle astrophysics experiments
- New detector development
- Theory/phenomenology on neutrino physics
- Dark matter physics
- Cosmology/Inflation

<http://nmcpp.phys.unm.edu/>

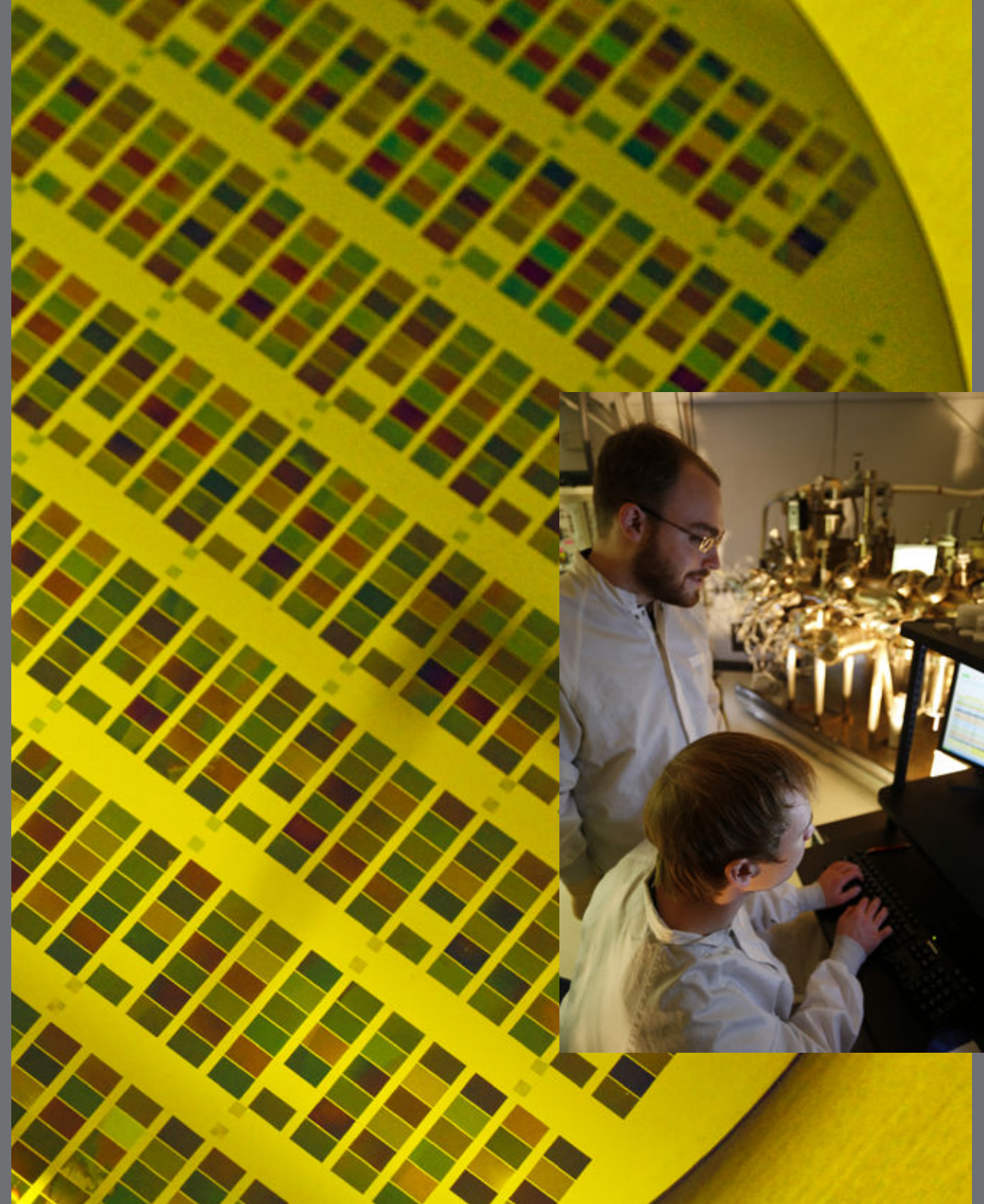


UNM Center for High Technology Materials is a nationally recognized center for photonics and microelectronics research. CHTM facilities are furnished with modern equipment allowing researchers and scientists to maintain a focus on leading-edge research topics that are relevant to government and industry. CHTM offers high quality and advanced research capabilities, a rich research environment, and an active role in research and education that promotes economic development in New Mexico. There are now several spin-off businesses that have grown from research projects at CHTM, and the environment that CHTM is part of has attracted new businesses to the state.

The key to CHTM's strong research capability is vertical integration. Faculty are experienced in the theory and practice of a wide range of photonics and microelectronics devices and have access to powerful computing power when required for device simulation. CHTM boasts two MOCVD reactors and five MBE systems for the materials growth of advanced epitaxial semiconductor structures. CHTM's cleanroom offers a full range of process equipment for the fabrication of advanced semiconductor devices. Characterization provides critical feedback at all stages of fabrication and CHTM laboratories are extremely well equipped with electrical and optical test equipment for the evaluation of materials, devices, and systems. <http://www.chtm.unm.edu/index.html>

UNM Optical Science & Engineering (OSE) Program conducts research in many areas advanced manufacturing, including:

- Advanced materials
- Atomic optics
- Biomedical optics



- Fiber optics
- Laser cooling
- Laser physics
- Lithography
- Nano-photonics
- Nonlinear optics
- Optics education
- Optical imaging
- Optical sensors
- Optoelectronics
- Photonic integrated circuits
- Quantum optics
- Spectroscopy
- Ultrafast phenomena

Pioneering research has originated from the program in areas ranging from the quantum theory of lasers to ultrashort pulse physics to optoelectronic devices. Research facilities are located in the Department of Physics and Astronomy, the Department of Electrical and Computer Engineering, and at UNM's Center for High-Technology Materials. www.optics.unm.edu/



INDUSTRY PRESENCE

There are about 1,400 companies manufacturing in New Mexico. Some of the largest:

Intel	Semiconductors
Sagebrush Technology	Precision motion control devices (gimbals)
Ethicon Endo-Surgery	Medical instruments
STAR Cryoelectronics	Sensors and control electronics products
Honeywell Aerospace	Aircraft avionics
OSO Biopharmaceuticals	Sterile pharmaceutical products
Compass Components	Cables and wiring harnesses
General Mills	Cereals and snack products

General Mills completed a \$100 million expansion of its New Mexico facility in 2009 with the addition of a new manufacturing line that produces granola bars.



505 827 0300 . WWW.GONM.BIZ