The new Net-Zero Energy Residential Test Facility is designed to produce as much energy as it consumes over the course of a year and to serve as a testbed for new home-scale energy technologies. In addition a major new photovoltaic system will provide data needed to develop models that better predict energy output of photovoltaic modules. Consisting of 2,500 solar modules, the new system will feed directly into the electrical grid, generating enough electricity to power 67 homes.

A new Robotics Test Facility will support performance measurements and research devoted to developing next generation robots, with an emphasis on versatility, safety, autonomy, and rapid re-tasking.

Net-Zero House
Building Science Corporation

Engineering Laboratory (EL)

Dr. S. Shyam Sunder, Director
100 Bureau Drive, Stop 8600
Gaithersburg, MD 20899-8600

To learn more about the NIST Engineering Laboratory and to explore opportunities for collaboration:
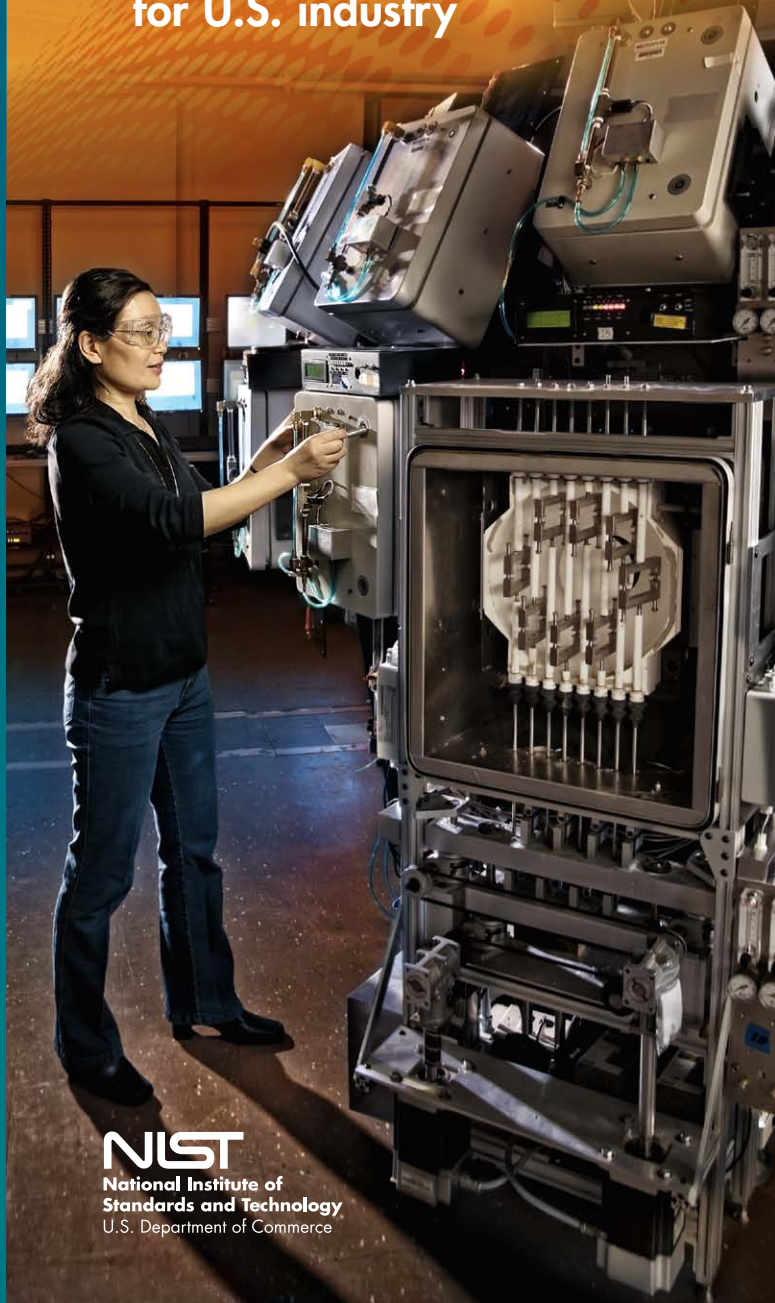www.nist.gov/el, **301-975-5900, or el@nist.gov**

The Engineering Laboratory

Advancing measurement science and standards for U.S. industry

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Putting advances in measurement science and standards to work for U.S. industry and for the benefit of all Americans is the chief objective of the Engineering Laboratory (EL) at the National Institute of Standards and Technology (NIST). Impacts range from saved lives to longer-lasting roads and bridges and from more capable machine tools and more flexible supply chains to more energy-efficient homes and buildings.

EL is one of six major research-and-development laboratories at NIST--the federal government's oldest physical science agency and the only one devoted entirely to U.S. industrial competitiveness. EL delivers measurement and test methods, predictive tools, performance metrics, the technical underpinnings of codes and standards, and a variety of services. All of these outputs are integral to products and processes in the nation's manufacturing, construction, and infrastructure sectors.

Research and Services with an Impact

Consider a few examples of impacts and benefits. EL's contributions have:

- Helped to cut the annual toll of fire-related deaths by at least half, thanks to NIST's technical leadership in the development of standards for smoke alarms, flammability of mattresses, and protective equipment for fire fighters.

An operator using a pendant to teach the NIST robot how to handle packages delivered to a conveyor by an automated guided vehicle
© Earl Zubkoff

- Pioneered the development of standards for exchanging product-related information, improving supply-chain interoperability in the automotive, aerospace, and shipbuilding industries saving more than $150 million annually.

- Paved the way for the development and widespread adoption (by more than 500 manufacturers) of an open building automation and control standard (BACnet) that is delivering significant savings in energy usage and operating costs, worldwide.

- Resulted in improved safety standards for industrial robots, while opening the way to more cost-effective use of the technology in smaller factories.

- Led to 40 major and far-reaching changes in U.S. building codes that will improve the safety of buildings, occupants, and first responders—an outcome of EL's investigation of the 9/11 collapse of the World Trade Center (WTC) and WTC 7.

EL Overview

Through its measurement-focused research and services, EL supplies critical enabling solutions to U.S. manufacturers, construction industry, and the broad array of businesses and other organizations that build, own, operate, or maintain the nation's vast physical infrastructure. These technical contributions help U.S. industry to innovate, raise productivity, and to compete strongly in domestic and international markets.

EL's full-time permanent staff of about 230 includes 174 engineers and scientists. Their expertise and research are complemented by more than 200 visiting scientists and engineers from U.S. universities and businesses and from around the world. Regular consultation and close collaboration with stakeholders are central to EL planning and operations.

Many of EL's responsibilities have been assigned to NIST by Congress. These include fire prevention and control, earthquake hazards reduction, sustainable manufacturing and construction, manufacturing enterprise integration, and construction safety.
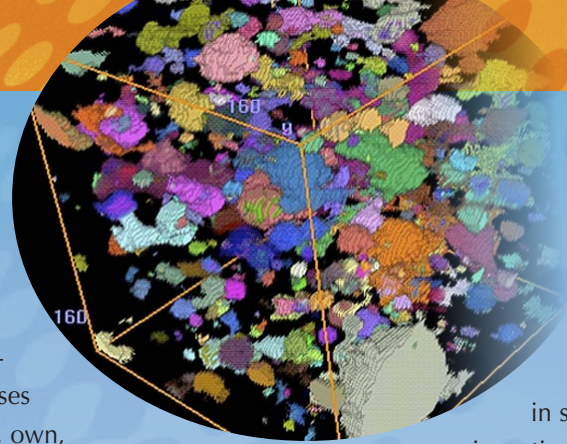
Microtomography image of the pore structure of a fireproofing material
Courtesy NIST

EL serves as the NIST lead for conducting studies of disasters and failures, a job spelled out in several laws. Since 1969, EL has investigated about 40 earthquakes, hurricanes, building and construction failures, tornadoes, and fires—all with the ultimate aim of identifying improvements in codes, standards, practices, and technologies.

World-Class Expertise

With research interests that span from microsensors and nanomaterial-based fire retardants to solar arrays and skyscrapers, EL has assembled a rare blend of complementary core competencies. Recognized for excellence the world over, this expertise encompasses:

- Intelligent sensing and control, robotics, and automated systems;
- Systems engineering and integration;
- Smart manufacturing processes and enterprise integration;
- Energy- efficient and intelligent operation of buildings with healthy indoor environments;
- Sustainability, durability and service-life prediction of building and infrastructure materials;
- Fire protection and fire dynamics within buildings and communities; and
- Resilience and reliability of structures at risk to multiple hazards.

A NIST researcher is measuring the geometry of metal test parts to support the development of standards for additive manufacturing processes
© Earl Zubkoff

Smart, Sustainable, Efficient, Resilient

EL's goals, strategies, and programs are closely aligned with critical national needs. Key areas of focus are energy, manufacturing, and infrastructure. In all three of these priority areas, our nation faces significant—and, often, interrelated—challenges and opportunities. And in each, EL's particular combination of measurement know-how and industry experience, along with its state-of-the-art facilities and, often, one-of-a-kind instruments, are key technical ingredients of a successful U.S. response.

With an emphasis on **smart systems,** several major EL research projects aim to speed development, adoption, and integration of leading-edge intelligent technologies. These innovations will boost U.S. manufacturing and construction capabilities as well as enhance the quality and durability of its cyber-physical infrastructure.

Another aim of EL research efforts is to further progress toward greater **sustainability** and **energy efficiency** in major industry sectors and across the built environment. One example is a project directed toward high-performance, net-zero-energy buildings—the means to substantially reduce energy consumption, since buildings account for 72 percent of electric power use. Another aims to enable an open, standards-based information infrastructure to support sustainable manufacturing practices across supply chains.

National Fire Research Laboratory
Colimore Thoemke Architects
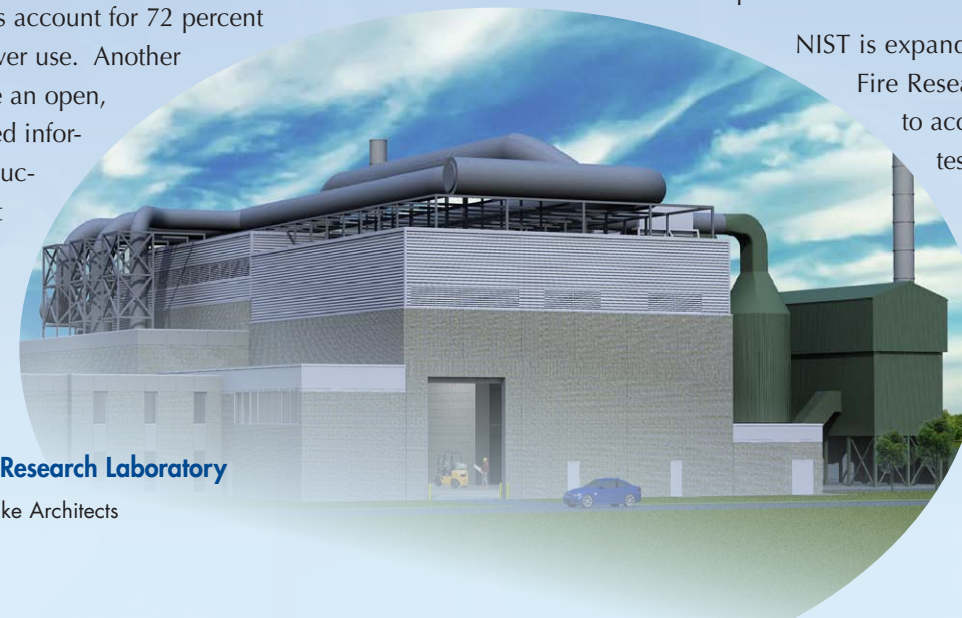
Open office plan fire experiment conducted to study the Cook County Building Fire
Courtesy NIST

With a large percentage of the nation's buildings and infrastructure clustered in disaster-prone regions, EL also is developing measurement methods, models, and predictive tools that will help to make buildings, infrastructural systems, and entire communities more **resilient** in the face of natural and human-made hazards.

Specialized Research Facilities

EL research on manufacturing, buildings, and cyber-physical systems benefits from nearly 20 advanced facilities and testbeds, which are housed on NIST's Gaithersburg, Md., campus and also are available for cooperative and independent research.

NIST is expanding its National Fire Research Laboratory to accommodate testing full-scale structures—up to two stories high—and their components under realistic fire conditions.