

# INNOVATIONS IN MANUFACTURING

Enabling the Future of Industry in the United States





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**Industry** in the United States



*US Manufacturing for  
Advances in Defense and Energy*



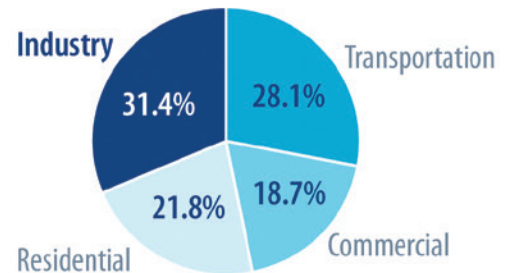
# WHERE INNOVATION HAPPENS

The US manufacturing industry is a cornerstone of the American economy and embodies the innovation and productivity that have allowed the United States to be the dominant leader in advanced manufacturing technologies since the early 20th century. A strong manufacturing base is vital for a balanced economy and critical to our nation's energy security and defense. Advances in manufacturing technology are imperative to avoid further erosion of our manufacturing base and maintain a competitive edge in the global market.

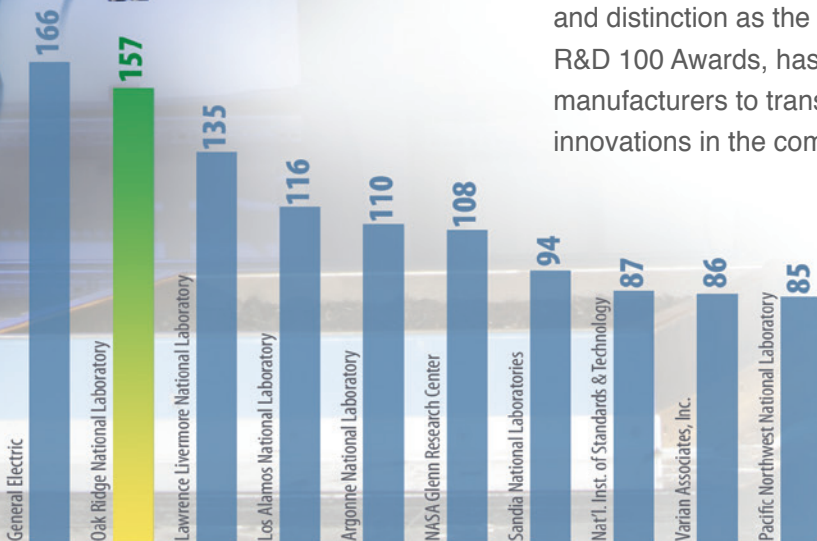
Innovation drives economic growth. New, cutting-edge technologies with real-world applications can both revitalize existing manufacturing industries and support the development of new products in emerging ones.

The development and commercial deployment of

advanced manufacturing technologies remain essential to America's long-term economic competitiveness. Manufacturing and materials research at Oak Ridge National Laboratory is focused on reducing the energy intensity of US industry, supporting development of new products, and strengthening our nation's vitality. ORNL, through its ongoing collaborative relationships with more than 1,000 companies and distinction as the leading Department of Energy laboratory for R&D 100 Awards, has demonstrated the ability to work with US manufacturers to transition technologies that will drive manufacturing innovations in the coming decades.



US industry consumed more than 31 quadrillion Btu in 2008—nearly a third of all energy used in the United States.



## Top Ten R&D 100 Award Winners *Historic Totals*

Annual awards by *R&D Magazine* identifying the 100 most significant newly introduced R&D advances and technologies





# INNOVATIVE PROCESSING TECHNOLOGIES

## Reducing Costs

Two materials of great promise, titanium and carbon fiber, are restricted in application due to high material cost. New titanium powder and near-net shape consolidation processes offer the potential to reduce manufacturing energy intensity and cost up to 50%, as well as increase yields from 12% to near 90%. New low-cost precursor development and conversion technologies hold the key for reducing the cost of carbon fiber. ORNL is the recognized leader in these advanced processing technologies, which will enable broader deployment of these critical lightweight materials.

## Increasing Performance

Use of magnetic fields to complement or eliminate conventional heat treatments can produce enhanced properties in a variety of materials including steel, titanium, magnesium, and other material systems. ORNL's groundbreaking research in magnetic field processing is revealing a new domain of formerly unattainable material properties. ORNL's concerted investment in pulsed thermal processing, spanning most of a decade, is now paying large dividends as it enables manufacturing innovation in flexible electronics and next-generation solar photovoltaic devices.

## Minimizing Lead Time

Additive manufacturing combines digital design, powder materials, and efficient energy sources to manufacture complex, near-net shape components. These technologies enable a paradigm shift in how we design and manufacture components of complex geometry. We are no longer constrained by limitations imposed by forming, casting, or machining processes. ORNL is employing its capabilities in ultrasonic, electron beam, and laser deposition to realize the full potential of this adaptive technology.

## Carbon Materials

Process Intensification

## Additive Manufacturing

Conventional  
Metals & Ceramics

## Nanofermentation

Photonics

Welding & Joining

## Magnetic Field Processing

Powder Consolidation

Continuous Reel-to-Reel

Driving Down the Cost  
of Lightweight Materials

50%





Energy

Defense

Energy

## AUTOMATION & CONTROLS

### Modeling and Simulation

Modeling, simulation, and automation reduce the manufacturing design, production cycle, and cost of manufacturing. ORNL's world-leading supercomputing facilities and broad modeling capabilities allow scientists and engineers to accelerate product design from concept to commercialization.

### Sensing, Tracking, and Measurement

Advanced sensors and sensor networks will revolutionize manufacturing by providing industry the tools necessary to understand and optimize efficiency and lower operational costs. ORNL's research priorities in sensing are focused on biochemical, environmental, robotics, advanced logistics and process control systems, and intelligent sensor technologies for applications that advance science, improve energy efficiency, or enhance national security.

### Communicating Wirelessly

Robust wireless communication networks offer rapid technology insertion and minimum cost of retrofit for reliable process control to improve energy savings, process efficiencies, and raw material utilization. From one-of-a-kind processes to intelligent robotics for manufacturing, the development and deployment of process automation and control are critical for productivity improvement in industry. ORNL leads the industry effort to establish wireless communication protocols and demonstrate the application of high-payoff wireless communication in industrial settings.

1 direct manufacturing job equals  
3 indirect jobs in related industries

JOB

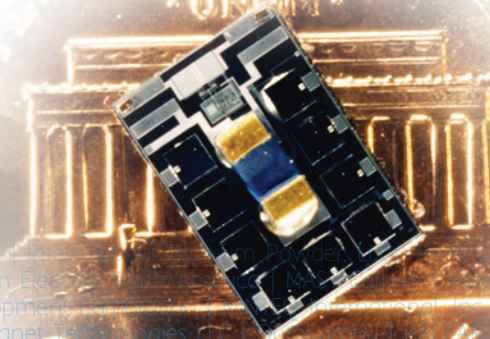
E-PLURIBUS  
UNBVM

Sensors

Wireless Communications

Computational  
Manufacturing

Robotics



IMI Vision / CCI Valve | Impact REW Systems | International Paper | ITN Energy Systems | John Deere | Lockheed Martin Aeronautics | Mach 1 Inc. | Magnesium Electrode | Maxxam | Maxwell Technology Institute | Maxwell Technologies | Metals-Roanoke, Inc. | Michigan Economic Development Corporation | Mossey Creek Solar | MS Technology Inc. | Navy Research Lab | nGinat Corporation | Novacentrix | One Planet Technologies | Palmer Labs | Perpetua Power Source Technologies | Porous Power Technologies, LLC | PPG Industries | Proton Energy Rocket | Queen City Forging | RFViz | Rolled Alloys







Industrial  
Partnerships  
Contact

**Tom Rogers**

Oak Ridge National Laboratory  
PO Box 2008, MS 6196  
Oak Ridge, TN 37931-6196  
rogerstc@ornl.gov

Program  
Management  
Contact

**Craig Blue**

Oak Ridge National Laboratory  
PO Box 2008, MS 6134  
Oak Ridge, TN 37931-6134  
blueca@ornl.gov



U.S. DEPARTMENT OF  
**ENERGY**

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