Transportation Technologies

Oak Ridge National Laboratory (ORNL) is accelerating the pace of research and development for efficient, safe, secure, clean, fully decarbonized transportation. By leveraging the National Transportation Research Center—the US Department of Energy’s (DOE’s) only dedicated user facility focused on transportation—researchers identify new technologies for next-generation vehicles; provide decision-making tools and intelligent technologies for the secure, efficient movement of passengers and freight; and create economic opportunity for the nation by improving the energy efficiency of light-, medium-, and heavy-duty vehicles.

Research Focus Areas

**Electrification and fast wired and wireless charging**—Early-stage technologies to speed deployment of electric vehicles, including extreme fast charging; advanced batteries, fuel cells, electric machinery, and power electronics; and roll-to-roll technologies

**Hydrogen and net-zero carbon fuel technologies**—Innovative processes for the generation, processing, storage, and use of hydrogen; exploring advanced characterization, materials development, and manufacturing of technologies such as electrolysis and fuel cells

**Automation and connectivity**—Advanced simulation, hardware, and control methodologies to accelerate the introduction and management of connected and autonomous mobility systems, reducing congestion and improving fuel economy

**Data science and vehicle cybersecurity**—Unique security expertise to detect and prevent cyber intrusions; advanced sensors, controls, algorithms, and other technologies to safely and efficiently guide automated and connected vehicles; and analysis of transportation fuel economy and fleets

**Materials for future vehicles**—Durable, cost-effective, lightweight materials and advanced processes for next-generation vehicles, including high-temperature alloys for engines, carbon fiber, 3D printing, and materials-joining techniques

**Virtual–physical research environment**—Integration of simulation, hardware, and analyses to address the challenges within complex mobility systems

**Fuels, engines, and emissions research**—Co-optimization of advanced fuels, engines and catalysts, emissions control technologies, and biofuels production and integration breakthroughs, with a focus on hard-to-electrify sectors such as heavy-duty vehicle and marine, rail, air, and other off-road applications

“Power electronics research at ORNL focuses on developing a small, high-energy-density capacitor for electric vehicles that can improve performance and increase reliability.”

—Electric Drives Group Researcher Shajjad Chowdhury
Impacts and Partnerships

- Developing, demonstrating, and collaborating to deploy high-power, fast, wired and wireless charging technology for electric vehicles, including a unique polyphase electromagnetic coil that delivers the greatest surface power density available anywhere in the world, supported by advanced, compact power electronics. Partners include Volkswagen Group of America and HEVO Inc.
- Deploying supercomputing, traffic sensors, and advanced controls to simulate regional mobility corridors and automatically direct traffic. Testing in the Chattanooga, Tennessee, region yielded 16% savings in fuel and time for drivers and fleet owners.
- Using ORNL's world-leading supercomputer, worked with General Motors to advance artificial intelligence to improve sensory perception.
- Collaborating with Wabtec to develop a dual-fuel locomotive engine that runs on hydrogen and other clean energy fuels.
- Working with partners FCA US LLC and Nemak, developed high-temperature aluminum alloys for automotive cylinder heads using materials characterization expertise and high-performance computing.

Licensed Technologies

Fast-charging batteries—Marc-Antoni Racing licensed a collection of energy storage technologies that enable fast-charging, energy-dense batteries for electric and hybrid vehicles.

Carbon fiber production—RMX Technologies licensed ORNL plasma oxidation technology to reduce energy consumption by 75%, shorten production time by about 70%, and cut production costs by 20%.

Ethanol-to-jet fuel—Prometheus Fuels licensed a process for cost-competitive production of jet fuel and butadiene from ethanol.

Fast wireless charging—HEVO Inc. licensed ORNL technologies for compact, highly efficient and fast wireless charging of electric vehicles.

Safer batteries—Soteria Battery Innovation Group licensed technology to eliminate thermal runaway caused by mechanical damage in lithium-ion batteries.

DOE’s Most Comprehensive Transportation R&D Facilities

DOE National Transportation Research Center helps industry, academia, and other agencies accelerate the development and deployment of efficient and secure transportation technologies.

DOE Battery Manufacturing Facility is the country’s largest open-access R&D center focused on advanced, energy-dense batteries.

Grid Research Integration and Deployment Center focuses on vehicle-to-buildings and vehicle-to-grid integration research for clean mobility and secure energy systems.

DOE Manufacturing Demonstration Facility houses integrated capabilities to drive the development of new materials, software, and systems for advanced manufacturing technologies that support the secure production of clean energy products.

DOE Carbon Fiber Technology Facility develops methods using low-cost feedstocks to assist industry in overcoming the barriers of carbon fiber production cost, scalability of processes, and development of fiber-reinforced polymer composites for end use.

CONTACT:
Rich Davies,
Sustainable Transportation Program manager
daviesrw@ornl.gov
865-341-1745
One Bethel Valley Road,
Oak Ridge, TN 37831

ornl.gov/transportation