Oak Ridge National Laboratory (ORNL) is accelerating the pace of research and development for efficient, safe, secure, and 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 materials for next-generation systems; 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**

**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

**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

**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

**Fuels, engines, and emissions research**—Co-optimization of advanced fuels and engines, low-temperature catalysts, and emissions controls; breakthroughs in biofuels production; and integration of vehicle systems

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

**Hydrogen and net-zero carbon fuel technologies**—Advanced catalysis for blue and green hydrogen technologies, materials processing, and manufacturing for electrolysis and fuel cells; advanced processing and scale-up for net-zero carbon liquid fuels and other carbon dioxide-derived products

“By leveraging ORNL’s world-class facilities in high-performance computing, data analytics, and transportation, we’re able to develop and deliver interdisciplinary solutions for next-generation mobility.”

**Jacky Rios-Torres, Connected and Automated Vehicles Researcher**
Impacts and Partnerships

- Using Summit, the nation’s fastest supercomputer for open science, worked with General Motors to advance artificial intelligence to improve sensory perception
- Partnering with Rototest to develop vehicle-in-the-loop technologies in support of ORNL’s virtual–physical research environment that connects laboratories and accelerates the development of advanced technologies
- 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
- Collaborated with National Renewable Energy Laboratory to improve regional transportation networks, developing a digital twin of Chattanooga, Tennessee, to use as a test bed
- Developing a neutronic engine for use with the VULCAN instrument at the Spallation Neutron Source, providing unprecedented measurements in a running engine critical to the development of next-generation engines

Licensed Technologies

Cobalt-free batteries—SPARKZ Inc. licensed five ORNL technologies that will eliminate cobalt in lithium-ion batteries.

Carbon fiber production—RMX Technologies licensed ORNL plasma oxidation technology to reduce energy consumption by 75%, shorten production time by 2.5 to 3 times, 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.

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

DOE’s Most Comprehensive Transportation R&D Facilities

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

The Carbon Fiber Technology Facility is developing 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.

The Battery Manufacturing Facility (BMF) is the country’s largest open-access battery research and development center focused on high-performance, low-cost waterborne processing technology, high-speed curing for advanced electrodes, low-cobalt and cobalt-free cathodes, and high-performance computing for advanced processing, performance validation, and life prediction. The BMF sits in ORNL’s Grid Research Integration and Deployment Center, which focuses on vehicle-to-buildings and vehicle-to-grid integration research for clean mobility and secure energy systems.