



Transportation Technologies

Oak Ridge National Laboratory (ORNL) is accelerating the pace of research and development for efficient, safe, secure, 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 cars, trucks, off-road equipment, trains, and ships.

Research Focus Areas

Electrification and fast wired and wireless charging—Early-stage technologies for vehicles, including extreme fast charging; advanced batteries, electric machinery, and power electronics; and roll-to-roll manufacturing technologies

Hydrogen technologies—Innovative processes for the generation, processing, storage, and use of hydrogen; exploring materials development, advanced characterization, manufacturing and recycling of electrolyzers 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 energy consumption and improving safety

Data science and systems analysis—Management of data sets and development of models and analysis tools for freight management, transportation infrastructure, advanced technology deployment, and transportation system efficiency

Materials for future vehicles—Durable, cost-effective, lightweight materials and advanced processes for next-generation vehicles, including lightweight high strength alloys and composites, 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



ACCELERATING extreme fast charging for vehicles



ADVANCING technologies for automated and connected vehicles



DEVELOPING durable, lightweight materials for next-generation vehicles



APPLYING data science for vehicle cybersecurity and fleet efficiency



INTEGRATING fuels into advanced powertrains



“My 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 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 Hyundai.
- 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 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 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.
- Collaborating with Caterpillar to develop technologies for marine engines.



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.

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



The Connected and Automated Vehicle Environment Laboratory is a unique proving ground to evaluate intelligent mobility solutions using real-world hardware and data in virtual traffic conditions.

DOE's Most Comprehensive Transportation R&D Facilities

DOE National Transportation Research Center helps industry, academia, and government agencies accelerate the development 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 secure energy systems.

DOE Manufacturing Demonstration Facility houses integrated capabilities to drive the development of new materials, software, and systems for advanced manufacturing technologies.

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.



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