

Transportation Deployment

Crosscutting Expertise Puts More Green Vehicles on the Road

Automakers, commercial fleet operators, component manufacturers, and government agencies all turn to the U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL) to help put more green vehicles on the road. The lab's independent analyses and evaluations pinpoint fuel-efficient and low-emission strategies to support economic and operational goals, while breaking down barriers to widespread adoption. Customized assessments of existing equipment and practices, energy-saving alternatives, operational considerations, and marketplace realities factor in the multitude of variables needed to ensure meaningful performance, financial, and environmental benefits.

NREL provides integrated, unbiased, 360-degree sustainable transportation deployment expertise encompassing alternative fuels, advanced vehicles, and related infrastructure. Hands-on support comes from technical experts experienced in advanced vehicle technologies, fleet operations, and field data collection coupled with extensive modeling and analysis capabilities. The lab's research team works closely with automakers and vehicle equipment manufacturers to test, analyze, develop, and evaluate high-performance fuel-efficient technologies that meet marketplace needs.

But NREL experts do more than just assist in testing, analyzing, and developing the latest in vehicle technology. Deep understanding of industry needs makes it possible to tailor solutions to match each partner's individual requirements and priorities. Partners benefit from impartial evaluations and recommendations, drawing on a full portfolio of transportation energy expertise and resources, including:

- Strategic guidance for large-scale deployment
- Technology- and fuel-neutral assessments and analyses
- Web-based tools using validated data collected from real-world operation
- Engineering and technical support
- Regulatory compliance assistance
- Clearinghouse for information about funding, procurement, and manufacturing
- Forums for the exchange of best practices.



NREL deployment research not only examines the potential for improvements in vehicle technology, but also explores opportunities for innovation in operating practices and the infrastructure needed to make new technologies viable in the marketplace. *Top photo courtesy of Smith Electric Vehicles, NREL 22848; bottom photo by Dennis Schroeder, NREL 28216*

Vehicle and Infrastructure Deployment Support

NREL works with partners to expand deployment of on- and off-road energy-efficient vehicles and transportation equipment, including:

- Electric, hybrid, biofuel, natural gas, hydrogen fuel cell, and propane vehicles
- High-efficiency petroleum-fueled internal combustion vehicles
- High efficiency light-, medium-, and heavy-duty vehicles and vocational equipment
- Charging and fueling infrastructure.

Research to Match the Right Technologies with the Right Applications

NREL's research team evaluates vehicle technologies for partners by collecting on-road data, performing in-lab testing, and applying simulation and modeling tools. This three-pronged approach allows researchers to compare how advanced technology vehicles stack up against conventional models and helps partners identify the routes where advanced vehicles can offer the greatest benefits.

Optimization tools and implementation support lead to improvements in performance, fuel economy, and return on investment.

NREL technical evaluations include:

- Performance evaluations of conventional, advanced, and alternative fuel vehicles
- Simulations of vehicles operating in real-world conditions
- Investigations and analyses of how technologies and practices affect the energy efficiency and performance of individual vehicles and fleets of all sizes
- Analyses of energy-saving opportunities presented by driving styles, route selection, speed, and driver feedback mechanisms
- Evaluations and analyses of vocational vehicles ranging from delivery vans with frequent stops to long-haul freight trucks that travel great distances
- Assessments and analyses of infrastructure including storage tanks, distribution equipment, pumps, and charging units
- On-road and in-lab measurements of greenhouse gas and pollutant emissions.

Fuel economy, maintenance, and other performance data are typically collected as the vehicles operate in real-world service. This is supplemented with laboratory dynamometer testing to more closely examine fuel economy and emissions in a controlled environment.

Evaluation and analysis results help vehicle manufacturers fine-tune their designs and help fleet managers select fuel-efficient, low-emission vehicles that fit their needs.

In addition to conducting deployment technology research in partnership with the private sector, NREL leads technical, environmental, and commercialization assessments for numerous government agencies from the federal to the local level.



Research is conducted both on the road and in the laboratory, supporting deployment of a wide range of vehicle technologies. *Top photo courtesy of Peloton, NREL 31237; bottom photo by Dennis Schroeder, NREL 32534*

Success Story: Long-Haul Truck Platooning Reduces Fuel Use

Activity: In addition to evaluating the performance of individual vehicles, NREL researchers are assessing the fuel savings potential of configuring trucks in platoons, using intelligent electronic-coupling systems to reduce aerodynamic drag by grouping vehicles together while maintaining safe distances.

Impact: Recent track tests of a two-truck platoon showed a combined "team" fuel savings ranging from 3.7% to 6.4% under various conditions.



NREL provides guidance and resources for private companies and government agencies looking to green their fleets. *Top photo by Dennis Schroeder, NREL 26520; bottom photo courtesy of Glacier Park, Inc., NREL 27574-C*

Making Deployment Efforts Successful

In addition to helping fleet operators understand how specific technologies can work for them, NREL helps stakeholders before and after their vehicle purchasing decisions are made. The lab's largest transportation deployment support effort provides assistance to private sector and government partners through the DOE Clean Cities program, which consists of nearly 100 coalitions across the United States. NREL's activities on behalf of Clean Cities and other related programs include:

- Technology screening to help fleet managers understand the portfolio of available technologies and determine which options best fit each organization's needs
- Implementation support to help companies develop strategies, design incentive programs, access funding, and evaluate business cases
- Training and outreach to support stakeholders as they add new technologies to their fleets
- Technical assistance to help solve implementation issues with vehicles and infrastructure
- Stakeholder and coordinator engagement to facilitate information sharing and best practices
- Market and policy analysis to identify market trends and technology advancements with the potential to shape industry, research, and policy priorities.

NREL efforts help Clean Cities and the National Park Service educate park visitors on the benefits of cutting petroleum use and emissions through the National Parks Initiative. Commercial entities partner with Clean Cities on two other NREL-supported programs: the National Clean Fleets Partnership, which helps large fleets reduce petroleum use and incorporate alternative fuels into their operations, and the Workplace Charging Challenge Initiative, which makes electric vehicle charging stations readily available on-site to employees.

The lab plays a major role in three additional DOE transportation deployment programs. The Federal Fleet Program helps federal agencies meet petroleum reduction and alternative fuel mandates in fleet operations. Activities in support of the Energy Policy Act, known as EPAct, assist state and alternative fuel provider fleets in meeting related regulatory requirements. The Natural Gas Vehicle Technology Forum advances development and deployment of commercially competitive natural gas engines, vehicles, and infrastructure.

NREL also works directly with regional, state, and municipal agencies to plan, implement, and evaluate sustainable transportation deployment strategies.

Success Story: Plan Zeros in on Electric Vehicle Infrastructure Needs

Activity: NREL supports the California Energy Commission in planning, implementing, and evaluating the state's Alternative and Renewable Fuel and Vehicle Technology Program.

Impact: The NREL-developed California Statewide Plug-In Electric Vehicle Infrastructure Assessment has established a framework for California's Zero-Emission Vehicle (ZEV) Action Plan, calling for deployment of the charging infrastructure needed to support one million ZEVs by 2020.

Nation's Largest Collection of Transportation Energy Data and Tools

NREL offers a wide array of unbiased, accurate, and comprehensive data and web-based tools to support transportation deployment, with a focus on alternative fuels, advanced vehicles, vehicle emissions, fueling infrastructure, travel data, and policy incentives. Calculators, interactive maps, and other online tools make it easy for fleet operators, fuel providers, and other transportation decision-makers to assess the potential economic, operational, and environmental impact of different energy-saving strategies.

Members of the general public can quickly access in-depth data sets, while sensitive information is protected behind secure portals.

Alternative Fuels Data Center, operated by NREL on behalf of Clean Cities, provides comprehensive information on alternative fuel and advanced transportation technologies, as well as the best practices for implementing and managing them in fleets. (afdc.energy.gov)

Transportation Secure Data Center, created by NREL in partnership with DOE and the U.S. Department of Transportation, features second-by-second GPS readings for millions of miles of travel, along with vehicle characteristics and survey participant demographics. (nrel.gov/tsdc)

National Fuel Cell Technology Evaluation Center provides a secure repository for proprietary data, as well as detailed analysis and reporting, making it possible to benchmark the status, progress, and technical challenges of fuel cell systems over time and across industries. (nrel.gov/hydrogen/nfctec.html)

Fleet DNA acts as a clearinghouse of medium- and heavy-duty commercial fleet vehicle operating data to help manufacturers and developers optimize vehicle designs and help fleet managers choose advanced technologies. (nrel.gov/fleetdna)



The Transportation Secure Data Center provides free online access to detailed transportation data from a wide range of travel surveys conducted across the nation. *Figure by NREL, source Transportation Secure Data Center*

Working with NREL

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NREL's Sustainable Transportation RD&D

As the only national laboratory solely dedicated to renewable energy and energy efficiency, NREL spearheads the research, development, and deployment (RD&D) needed to put sustainable transportation solutions on the road. The laboratory's innovative and integrated approach helps government, industry, and other partners develop and deploy the components and systems needed for market-ready, high-performance, low-emission, fuel-efficient passenger and freight vehicles, as well as alternative fuels and related infrastructure.

For more information on NREL's transportation RD&D capabilities and successes, go to nrel.gov/transportation.

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