

The Vehicle Technologies Office (VTO) supports early-stage research on cutting-edge technologies to generate knowledge for U.S. industry to develop efficient, affordable transportation systems for consumers and businesses. With more than 11 billion tons of goods transported by truck, and people traveling 3 trillion vehicle miles across America in 2016, advanced vehicle and transportation technologies have the potential to contribute significantly to the domestic economy and energy security.

Economic Highlights

VTO strengthens U.S. energy independence and security through early-stage research across a broad portfolio of domestic vehicle, fuel, and transportation systems.

- VTO stewards unique National Laboratory capabilities in fundamental advanced combustion and fuel technologies; new and innovative battery/charging technologies; lighter-weight structural and powertrain materials technologies; and energy efficient mobility technologies and systems research.
- Nearly all battery technology on the road today can be traced to VTO research.
- Recent improvements in the fuel economy of light vehicles and trucks are based on new knowledge and fundamental combustion research funded by VTO.

VTO research stimulates the U.S. economy, job growth, and competitiveness by creating new innovations and knowledge that businesses can develop into customer-driven, clean and efficient mobility services.

- Of the nearly 2.4 million Americans employed in the motor vehicle/parts sector, over 259,000 work with alternative fuels such as natural gas, hybrid, plug-in electric, and fuel cell/hydrogen vehicles – an increase of 69,000 jobs in 2016.
- Nearly 80% of the alternative fuel vehicle jobs focus on hybrids and plug-in electric vehicles (EV).
- Rapidly evolving transportation technologies, as shared services, connected and automated vehicles, create opportunities to increase energy efficiency, reduce cost, spur economic growth, and enhance mobility.

FY 2018 Priorities

FY 2018 Program Focus

- VTO will concentrate on early-stage research that advances fuel diversification, vehicle efficiency, and mobility systems, with focus on increasing energy security and economic productivity, and reducing dependence on foreign oil.

Program Strategy

- VTO will pursue research to advance state-of-the-art technologies for vehicles, from passenger cars to tractor-trailers, and the mobility systems in which they operate.
- VTO will target research that offers significant energy efficiency gains for light-, medium-, and heavy-duty vehicles, where federal funds have the greatest impact.
- VTO will add the subprogram Energy Efficient Mobility Systems (EEMS) to its program portfolio, building upon the Transportation as a System initiative.

Activity Highlights

- Research new high-voltage cathodes, electrolytes, high-capacity anodes, electrochemical optimization, advanced battery cell technology, and high-power charging technology to reduce battery cost and charge time.
- Co-optimize engines and fuels through lean/next generation compression ignition, predictive modeling, catalyst research, and heavy-duty combustion research.
- Reduce vehicle weight through research in lightweight multi-material structures and propulsion materials for extreme environments.
- Create new modeling and simulations through a five lab consortia, develop artificial intelligence/big data tools, and leverage the national lab high performance computing capabilities to improve mobility system energy efficiency.

FY 2018 Budget Summary

Budget Authority (Dollars in Thousands)	FY 2018 Request
Batteries and Electrification Technologies	36,300
Energy Efficient Mobility Systems	12,200
Advanced Engine Combustion Engine R&D	22,000
Materials Technology	7,500
Outreach	2,000
Analysis	2,000
Total, Vehicle Technologies	82,000

VTO R&D enables low-cost, secure, efficient, and clean energy for the transportation of people and goods across America.

Major Accomplishments and Goals

Building on a successful history, in 2016, VTO research and development (R&D) –

- Demonstrated improved light-duty engine efficiency resulting in a 27% increase in fuel economy compared to a 2009 baseline.
- Demonstrated an unprecedented 50% brake thermal engine efficiency to significantly improve heavy truck fuel economy.
- Lowered the cost of EV batteries to \$245/kilowatt per hour (kWh), about a 75% reduction since 2008.
- Achieved a more than 20% vehicle glider (frame) weight reduction with multi-material lightweight vehicle versus a comparable conventional vehicle.
- Developed a low-cost, easy-casting, high-performance aluminum alloy to enable next-generation high-efficiency automotive engines with rapid tech-to-market transition potential.

VTO R&D seeks to accelerate applications and accessibility of new high-performing energy cost-saving technologies.

- Advanced Battery R&D – VTO battery research will reduce the cost of EV batteries by more than half, to less than \$100/kWh; increase range to 300 miles; and decrease charge time to 15 minutes or less.
- Advanced Engines and Fuels – VTO will support research of next-generation combustion and fuel technologies to improve the fuel economy of light-duty vehicles by 50% and heavy-duty vehicles by 35% (versus 2009 baseline).
- Advanced Materials Research – VTO will pursue innovative technologies to enable light weight, multi-material structures, reducing vehicle weight by 25% (versus a 2012 baseline), utilizing more cost-effective technologies.
- EEMS – VTO will create cutting-edge modeling, simulation, and data tools to improve energy efficiency of the transportation system.

Success Stories

Advanced Materials Innovations Improving Transportation Efficiency

VTO is pursuing a number of light-weight and high-efficiency engine strategies to significantly improve the fuel economy of passenger cars, light trucks, and heavy-duty trucks by 25% to 50%.

Engine Materials: Many innovative engine technologies require operating temperatures and pressures that are too high for the current metals to operate reliably. VTO research at ORNL developed a high-temperature alloy that is more than 25% stronger at 300°C (50°C higher than baseline material). Working with industry, the team leveraged multiple capabilities unique to ORNL, including high-performance computing, to shorten development time by 50%.



Vehicle Structural Light Weighting: Carbon fiber reinforced composites have the potential to significantly reduce vehicle weight and improve fuel economy. VTO research at ORNL has developed a new plasma oxidation technology that shortens the carbon fiber process time by one-third – reducing the energy consumption of the carbon fiber production line by 75% and lowering production cost by 20%. **4M Industrial Oxidation** has licensed the technology for commercial production.



Driving Long-Haul Truck Efficiency

Long-haul tractor trailers are essential to the U.S. economy – moving more than 70% of all freight (about 11 billion tons) per year. Making up just 4% of over-the-road vehicles, they use about 20% of the fuel consumed.



Working closely with DOE National Laboratory partners and matching funds dollar-for-dollar, VTO-sponsored teams delivered innovations in engine technology, lightweight materials, aerodynamics, and systems-level improvements demonstrating freight efficiency as high as 115% over their 2009 baseline vehicles.