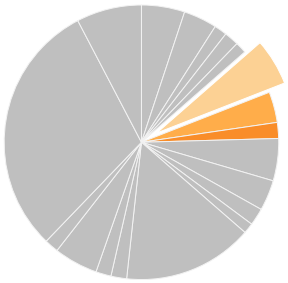
Federal Energy R&D: Vehicle Technologies

BY COLIN CUNLIFF | APRIL 2019

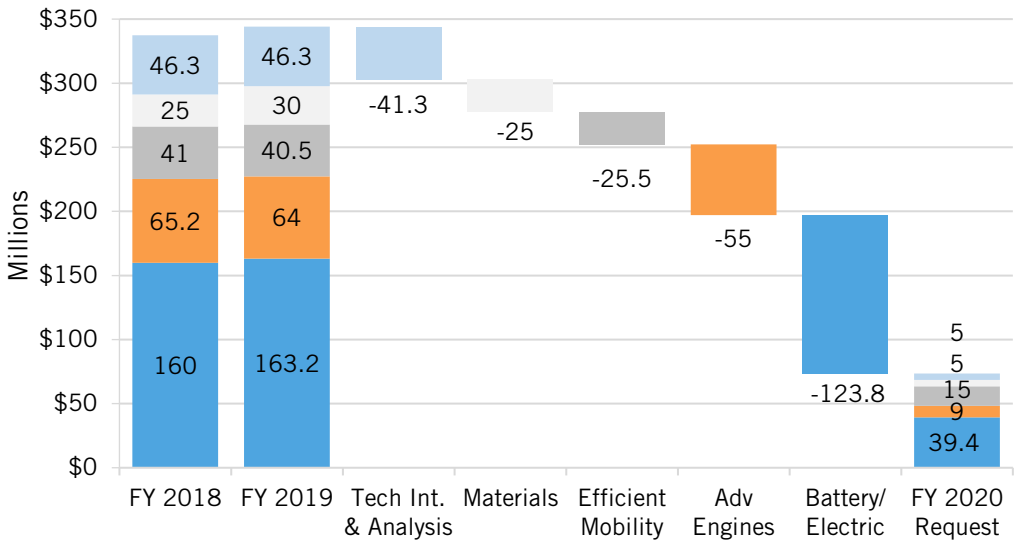
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



Vehicles (light orange)
Other Transportation (orange)
Energy R&D (light grey)

The transportation sector accounts for 70 percent of petroleum use and 34 percent of all carbon pollution, surpassing the power sector as the top source of U.S. greenhouse gas emissions in 2016.[1] The average U.S. household spends 16 percent of its total family expenditures on transportation, making it the most expensive spending category after housing.[2] With nearly 20 percent of U.S. petroleum consumption coming from imports, U.S. consumers send more than $15 billion per month overseas for crude oil.[3] By investing in R&D to use conventional fuels more efficiently and develop domestically produced alternative-vehicle technologies, the Vehicle Technologies Office (VTO) works to keep prices low for consumers, improve national energy security, and enhance environmental performance.[4]

Figure 1: The FY 2020 Budget Request Would Cut Vehicle Technologies R&D by 79 Percent.[5]



What's At Risk

The Vehicle Technologies office has established technology cost and performance targets to help meet national imperatives in energy security, environmental stewardship, and economic growth. Reaching these goals will require new technologies and cost reductions in batteries, efficient engines, fast-charging, lightweight materials, and other enabling technologies, as well as systems-level innovations in automated and connected vehicles and integration into electricity systems.

For electric vehicles (EVs), the office has established targets of reducing the cost of EV batteries by more than half, to $100/kWh, increasing the range to 300 miles, and decreasing charge time to 15 minutes or less by 2028. But new battery chemistries will be needed for the department to reach its cost targets and for electric vehicles to achieve their full potential.[6] Reductions in battery and electrification R&D funding threaten to delay progress toward these targets.

For conventional internal combustion engine vehicles, the office is working to develop the next generation of engines and fuels capable of improving passenger-vehicle fuel economy by 35 percent by 2030. The SuperTruck II research activity has set an ambitious target of doubling the freight-hauling efficiency of heavy-duty Class 8 long-haul trucks by 2020.[7] Long-haul trucking is a key "hard-to-decarbonize" transportation subsector not amenable to electrification using the same lithium-ion (Li-ion) batteries used in light-duty electric vehicles, and improving efficiency is one of the few good near-term options for lowering energy costs and reducing carbon emissions from this sector.[8] Reduced funding for these programs threaten to stall DOE's efforts to improve vehicle efficiency and save energy costs for consumers.

Vehicle Technologies R&D Subprograms

R&D in the Vehicle Technologies program is distributed across six subprograms:[9]

- **Battery and Electrification Technologies** explores new battery chemistry and cell technology to reduce the cost of EV batteries; supports work on EV integration with the electric grid; conducts R&D to improve electric drivetrains; and explores fast charging technologies.
- **Energy Efficient Mobility Systems (EEMS)** applies complex modeling and simulation to explore the energy impact of emerging disruptive technologies such as connected and autonomous vehicles, information-based mobility-as-a-service platforms, and advanced powertrain technologies in order to identify opportunities to improve efficiency.
- **Advanced Engine & Fuel Technologies R&D** works to develop advanced combustion engines and co-optimize fuels and engines to improve fuel economy.
- **Materials Technology** supports vehicle lightweighting and improved propulsion (powertrain) efficiency through materials R&D.
- **Technology Integration** supports cooperative agreements with Clean Cities coalitions, maintains the Alternative Fuels Data Center and the annual Fuel Economy Guide, conducts transportation data and systems research, and supports the collegiate advanced vehicle technology competitions and other workforce development programs.
- **Analysis** provides technology, economic, and interdisciplinary analyses to inform and prioritize the Vehicle Technologies research portfolio.

Key Elements of the FY 2020 Budget Proposal

- **A 76-percent reduction of the Battery and Electrification Technologies subprogram,** including the elimination of battery-safety and thermal-performance research; no new funding for battery development work through the Advanced Battery Consortium; reduced funding for extreme fast charging R&D; reduced funding for battery materials and battery cells R&D; and no new funding for competitively awarded, cost-shared electrification projects.

- **Elimination of SuperTruck II activities,** a cross-cutting activity which aims to improve freight-hauling efficiency of heavy-duty Class 8 long-haul trucks. These trucks haul 80 percent of goods in the United States and consume about 28 billion gallons of fuel per year, accounting for 22 percent of total transportation energy usage. Achieving the SuperTruck II targets would save truck operators nearly $20 billion in fuel expenditures, while also reducing carbon dioxide emissions by 128 million metric tons.[10]

- **An 86-percent reduction of Advanced Engine & Fuel Technologies R&D,** including the elimination of research on spark-ignited engines; and reduced funding for medium- and heavy-duty engine technologies, predictive modeling of engine combustion, pollution control technologies, the co-optimization of engines and fuels (Co-Optima), and natural gas engine technologies.

- **A 63-percent reduction in Energy Efficient Mobility Systems,** including the reduced funding for the Systems and Modeling for Accelerated Research in Transportation (SMART) National Laboratory Consortium, as well as the high performance computing-enabled data analytics work to apply machine learning and data science tools to improve vehicle and transportation efficiency.

- **An 83-percent reduction in Materials Technology R&D**, including the elimination of research on composite lightweight materials, solid phase processing techniques for lightweight metal alloys, and cooperative public-private partnerships through the LightMAT Consortium to accelerate the discovery of advanced materials. Research in propulsion materials technologies, including powertrain weight reduction technologies, would be significantly reduced.

- **An 89-percent reduction in Technology Integration and Analysis**, including no new funding for technical assistance and other partnership activities through the Clean cities program; minimal support to meet statutory requirements for reporting on alternative fuel vehicles, new model year fuel economy, and other public information programs; reductions in the EcoCAR Mobility Challenge, a collegiate advanced vehicle technology competition; and reductions in analysis to inform and prioritize VTO technology investments and research portfolio planning.

ENDNOTES

1. Stacy C. Davis and Robert G. Boundy, *Transportation Energy Data Book Edition 37*, Table 1.13 Consumption of Petroleum by End-Use Sector (Oak Ridge National Laboratory, January 2019), https://cta.ornl.gov/data/tedbfiles/Edition37_Full_Doc.pdf; Environmental Protection Agency, DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, Table ES-2 (EPA, February 2019), https://www.epa.gov/sites/production/files/2019-02/documents/us-ghg-inventory-2019-main-text.pdf.
2. Davis and Boundy, *Transportation Energy Data Book Edition 37*, Table 10.1 Average Annual Expenditures of Households by Income.
3. Transportation Energy Data Book 34th Edition, Table 1.7 "Imported Crude Oil by Country of Origin 1973-2015"; DOE, "FY 2020 Congressional Budget Justification" Volume 3 Part 2, 17, (DOE Chief Financial Officer DOE/CF-0153, April 2019), https://www.energy.gov/sites/prod/files/2019/04/f61/doe-fy2020-budget-volume-3-Part-2.pdf.
4. DOE, "FY 2019 Congressional Budget Justification" Volume 3 Part 2, (Washington, D.C.: DOE/CFO, 2018) 31.
5. The FY2020 budget for EERE would use $353 million in prior year (FY 2018 and FY 2019) balances to fund FY2020 programs. Thus the numbers shown in the figure underestimate the magnitude of cuts included in the proposed budget. Department of Energy, "FY 2020 Congressional Budget Request: Budget in Brief," (DOE CFO, March 2019), p 3, https://www.energy.gov/sites/prod/files/2019/03/f60/doe-fy2020-budget-in-brief.pdf; DOE, "FY 2020 Congressional Budget Justification" Volume 3 Part 2, 19.
6. International Energy Agency (IEA), "Global EV Outlook 2018" (OECD/IEA, 2018), p 65, https://webstore.iea.org/download/direct/1045?fileName=Global_EV_Outlook_2018.pdf.
7. DOE, "FY 2020 Congressional Budget Justification" Volume 3 Part 2, pp 18 and 29.
8. Colin Cunliff, "An Innovation Agenda for Deep Decarbonization: Bridging Gaps in the Federal Energy RD&D Portfolio" (Information Technology and Innovation Foundation, 2018), http://www2.itif.org/2018-innovation-agenda-decarbonization.pdf.
9. DOE, "FY 2020 Congressional Budget Justification" Volume 3 Part 2, 17-50.
10. DOE, "Energy Department Announces $137 Million Investment in Commercial and Passenger Vehicle Efficiency" (DOE, August 16, 2016), https://www.energy.gov/articles/energy-department-announces-137-million-investment-commercial-and-passenger-vehicle, accessed April 11, 2019; American Council for an Energy-Efficient Economy (ACEEE), "DOE's SuperTruck Program: Slashing Fuel Waste from Tractor-Trailers" (ACEEE, May 24, 2017), https://aceee.org/fact-sheet/super-truck; DOE, "INFOGRAPHIC: How SuperTruck Is Making Heavy Duty Vehicles More Efficient" (DOE, March 1, 2016), https://www.energy.gov/articles/infographic-how-supertruck-making-heavy-duty-vehicles-more-efficient, accessed April 11, 2019.

ACKNOWLEDGMENTS

The author wishes to thank the David M. Hart for providing input to this report. Any errors or omissions are the author's alone.

ABOUT THE AUTHOR

Colin Cunliff is a senior policy analyst for clean energy innovation with the Information Technology and Innovation Foundation. He previously worked at the U.S. Department of Energy (DOE) Office of Energy Policy and Systems Analysis (EPSA), with a portfolio focused on energy sector resilience and emissions mitigation. He holds a Ph.D. in physics from the University of California, Davis.

ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized as one of the world's leading science and technology think tanks, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

FOR MORE INFORMATION, VISIT US AT WWW.ITIF.ORG.