U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TRANSPORTATION ENERGY FUTURES

Combining Strategies for Deep Reductions in Energy Consumption and GHG Emissions

Significant Energy Consumption — and Opportunities for Reduction

Transportation is essential to our economy and quality of life, and currently accounts for 71% of the nation's total petroleum use and 33% of our total carbon emissions. Energy-efficient transportation strategies could reduce both oil consumption and greenhouse gas (GHG) emissions.

The U.S. Department of Energy-sponsored Transportation Energy Futures (TEF) project examines how combining multiple strategies could reduce both GHG emissions and petroleum use by 80%. The project's primary objective is to help inform domestic decisions about transportation energy strategies, priorities, and investments, with an emphasis on previously underexplored opportunities related to energy efficiency and renewable energy in light-duty vehicles (LDV), non-light-duty vehicles (non-LDV), fuels, and transportation demand.

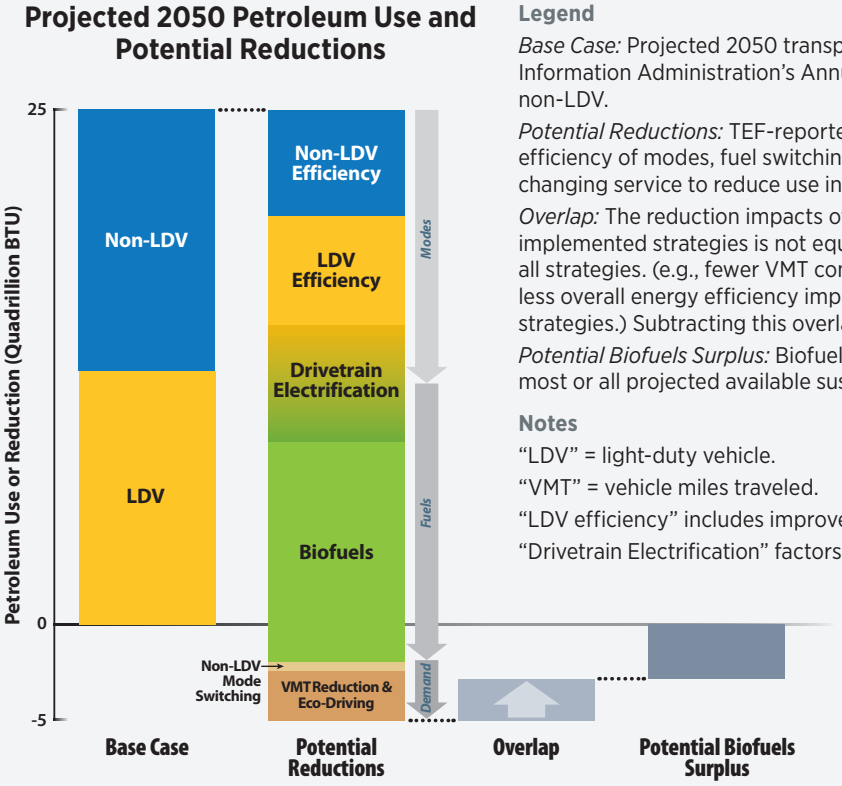
Deep Cuts Possible, but No "Silver Bullet"

The TEF project's analysis of potential pathways to lower energy use and GHG emissions reveals that, while deep reductions are possible, there is no single "silver bullet" solution for cutting transportation-related energy consumption and GHG emissions. Instead, a combined set of transportation strategies to make deep reductions could involve:

- Stopping Growth in Transportation Sector Energy Use
- Using More Biofuels
- Expanding Electric and Hydrogen Technologies

TEF research indicates that these three strategies have the potential to displace most transportation-related petroleum use and GHG emissions if significant barriers can be overcome.

Findings Point to Options for Deep Reduction



Legend

Base Case: Projected 2050 transportation petroleum use, extrapolated from the U.S. Energy Information Administration's Annual Energy Outlook (2012) and categorized as LDV and non-LDV.

Potential Reductions: TEF-reported reduction potential in areas such as increasing vehicle efficiency of modes, fuel switching to biofuel, hydrogen, natural gas and electricity, and changing service to reduce use intensity. Reductions are relative to the base case.

Overlap: The reduction impacts of TEF strategies overlap; the additive effect of individually-implemented strategies is not equal to that delivered by simultaneous implementation of all strategies. (e.g., fewer VMT combined with improved technology may produce fewer or less overall energy efficiency improvements than the sum of individual VMT and technology strategies.) Subtracting this overlap from the reductions compensates for double counting.

Potential Biofuels Surplus: Biofuel production exceeding U.S. liquid fuel demand, with use of most or all projected available sustainable biomass feedstock and providing fuel for export.

Notes

"LDV" = light-duty vehicle.

"VMT" = vehicle miles traveled.

"LDV efficiency" includes improvement of internal combustion and hybrid vehicles.

"Drivetrain Electrification" factors in reductions delivered by use of electric and fuel cell vehicles.

TEF Examines Multiple Strategies and Scenarios

Population size, individual travel activities, the energy used per unit of activity, and the amount of carbon dioxide emitted per unit of that energy all affect the volume of transportation-related fuel consumption and GHG emissions. Using less motorized movement, increasing vehicle and mode efficiency, and using fuels that are less intensive in petroleum and carbon can reduce GHGs and petroleum use while still meeting transportation needs. Each of these strategies can be implemented using different methods, which can be combined into multiple scenarios. The TEF project examines all of these approaches to target areas not covered in previous analyses and present a more comprehensive view of the issues and potential solutions.

Strategy 1: Stop and Reverse Growth of Transportation Sector Energy Use

- Changes to the built environment, strategies to decrease personal travel, improvements in energy efficiency through technical innovation, and replacing as much truck freight as possible with more energy-efficient rail and marine modes hold the greatest potential to stop and then reverse the growth in transportation-sector energy use.
- Non-LDV petroleum use and GHG emissions from truck, aviation, marine, pipeline, rail, and off-road equipment are projected to increase as economic growth spurs higher service demand. Reaching the technical potential for energy-efficiency improvements in non-LDVs could help avert projected energy use increases.

Strategy 2: Use More Biofuels

- Model results indicate that biofuels from sustainably-harvested biomass could supply significant shares of the markets for jet fuel, gasoline, and diesel if DOE biofuels technology goals are met, these markets are mature, and projected market conditions exist.

Strategy 3: Expand Electric and Hydrogen Technologies

- Strong policies and incentives may be needed to overcome consumer cost and range concerns, address automaker production and deployment issues, and encourage energy suppliers to rapidly build infrastructure. Recognizing that uncertain consumer acceptance and fueling infrastructure development may create significant investor risks, the full transition from conventional vehicles could easily take 35-50 years.
- The adoption of electricity- and hydrogen-powered vehicles depends on simultaneous and widespread development of infrastructure for hydrogen production, distribution, and fueling, as well as for electric vehicle charging. While developing this retail fueling infrastructure would be costlier than maintaining current infrastructure, infrastructure costs are only a small portion of total fuel costs. New infrastructure for electricity and hydrogen delivery would enable greater fuel diversification, which can reduce fuel price volatility.

TEF findings illustrate the potential impact of combining multiple strategies and highlight possible courses of action that could help deliver deep reductions in transportation energy use and GHG emissions.

TEF Reports Available Online

eere.energy.gov/analysis/transportationenergyfutures

Light-Duty Vehicles

Non-Cost Barriers to Consumer Adoption of New Light-Duty Vehicle Technologies
Vehicle Technology Deployment Pathways: An Examination of Timing and Investment Constraints

Non-Light-Duty Vehicles

Potential for Energy Efficiency Improvement Beyond the Light-Duty-Vehicle Sector

Fuels

Alternative Fuel Infrastructure Expansion: Costs, Resources, Production Capacity, and Retail Availability for Low-Carbon Secenarios
Projected Biomass Utilization for Fuels and Power in a Mature Market

Transportation Demand

Effects of the Built Environment on Transportation: Energy Use, Greenhouse Gas Emissions, and Other Factors
Effects of Travel Reduction and Efficient Driving on Transportation: Energy Use and Greenhouse Gas Emissions
Freight Transportation Demand: Energy-Efficient Scenarios for a Low-Carbon Future
Freight Transportation Modal Shares: Scenarios for a Low-Carbon Future

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U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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