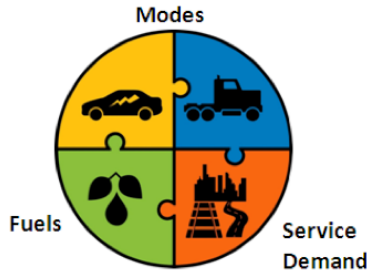


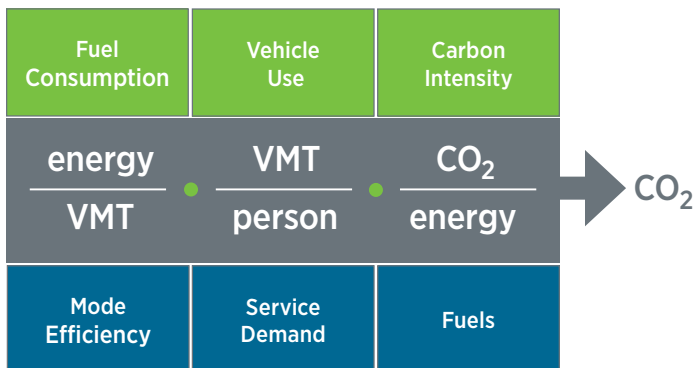
Transportation Energy Futures Study Points to Deep Cuts in Petroleum and Emissions

The U.S. transportation sector has the technical potential to eliminate reliance on oil and reduce its greenhouse gas emissions by more than 80 percent by 2050. This sector is currently responsible for 71 percent of the nation's total petroleum use and 33 percent of our total carbon emissions. The [EERE Transportation Energy Futures](#) study examines underexplored opportunities to combine strategies to increase the efficiency of transportation modes, manage the demand for transportation, and shift the fuel mix to more sustainable sources necessary to reach these significant outcomes.



Coordinating a Strategic Approach

There is no silver bullet to reducing transportation energy use. Deep cuts in transportation petroleum consumption and emissions are instead dependent on combined reductions across three factors: vehicle fuel consumption (modes), vehicle use (service demand), and fuel carbon intensity (fuels).



All three transportation energy use factors must be reduced in order to decrease overall energy use and emissions (VMT: vehicle miles traveled).

Using Less Fuel in Vehicles

Light-duty vehicles (LDVs) like cars and SUVs are already becoming more efficient thanks largely to new CAFE standards. Adoption of advanced vehicle technology such as electricity and hydrogen-based drivetrains can further reduce liquid fuel needs despite increasing travel demand. Non-light-duty vehicles (NLDVs) such as trucks, planes, and ships, however, consume almost half of the fuel used in the transportation sector. Growth

Table 1: Combined effects of changes in transportation service demand, vehicle efficiency, and use intensity can maintain level net energy consumption through 2050.

	LDVs	Trucks	Aviation	Ships	Rail
Travel and freight service demand growth	+75% ^a	+87% ^a	+217% ^b	+32% ^a	+47% ^a
Vehicle energy efficiency improvements (vs. baseline)	39% to 61%	25% to 43%	30% to 50%	0% to 13%	20% to 30%
Per capita vehicle use reductions	0% to 21%	6% to 10%	5% to 15%	N/A	N/A
Resulting changes in total energy consumption	+7% to -47%	+32% to -4%	+110% to +35%	+32% to +15%	+18% to +3%

^a EIA projections extrapolated.

^b FAA projections extrapolated.

in freight and air travel demand could lead to a 50 percent increase in NLDV energy use by 2050. There are a variety of possible efficiency improvements for NLDVs, particularly heavy trucks and airplanes, which have the potential to make up for these increases to keep overall energy use flat. (See Table 1)

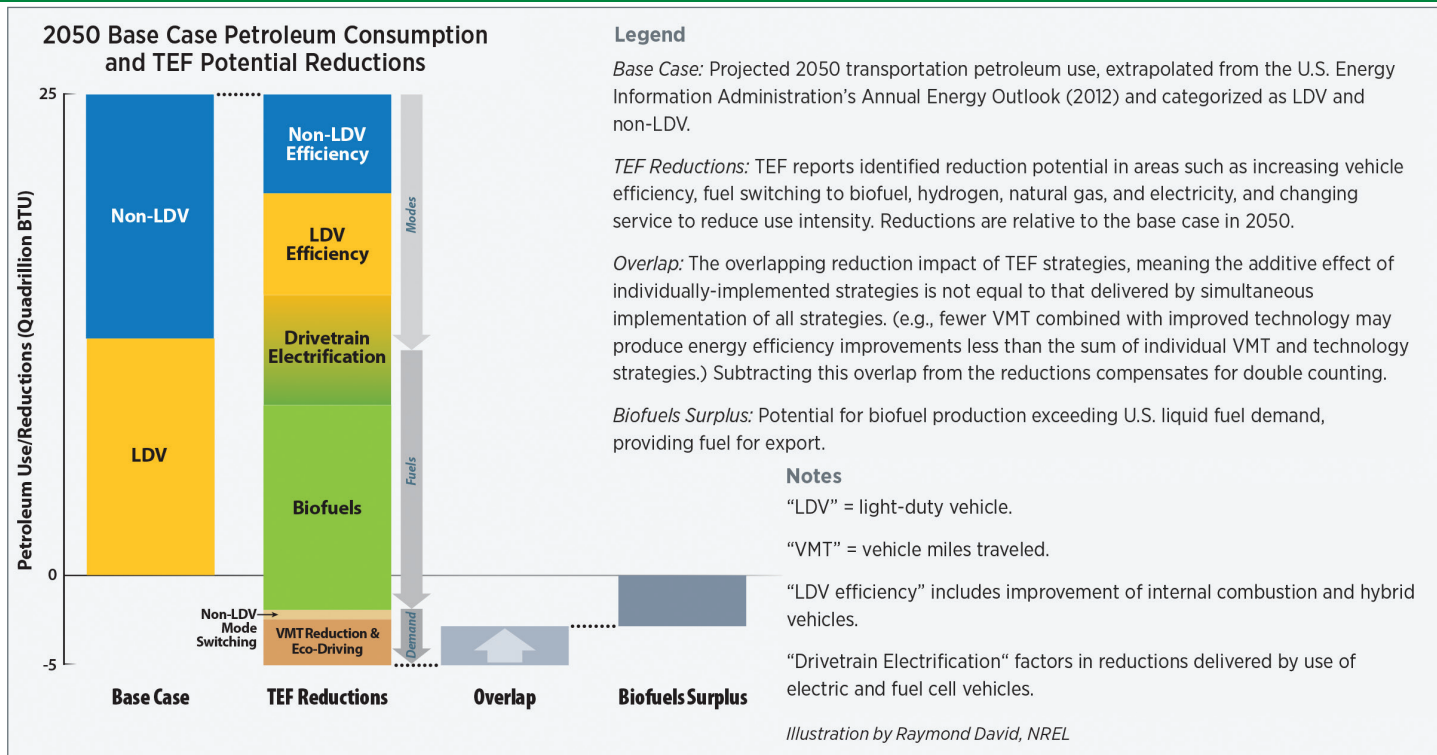
Using Vehicles Less

Effective transportation is central to our economy, and demand for transportation of both goods and people is expected to increase substantially over the coming decades. While individual strategies to curb transportation demand may have limited impacts, TEF shows that implementation of multiple simultaneous approaches can lead to significant reductions in per-capita vehicle use while maintaining service quality (See Table 2). In combination with increased efficiency, these reductions can balance out the increases in service demand and keep liquid fuel needs down to allow for low-carbon fuel substitution (See Table 1).

Table 2: Combined transportation demand reduction and efficient driving strategies can add up to significant reductions in energy use.

Demand Reduction Strategy	Impact Type	Potential Magnitude of Impact
Built Environment Characteristics	LDV VMT reduction	12% to 18%
Trip Reduction	LDV VMT reduction	1% to 10%
Efficient Driving	MPG improvement	1% to 5%
Non-LDV Mode Switching	Ton-miles switched from trucks to rail	<10%

(continued)



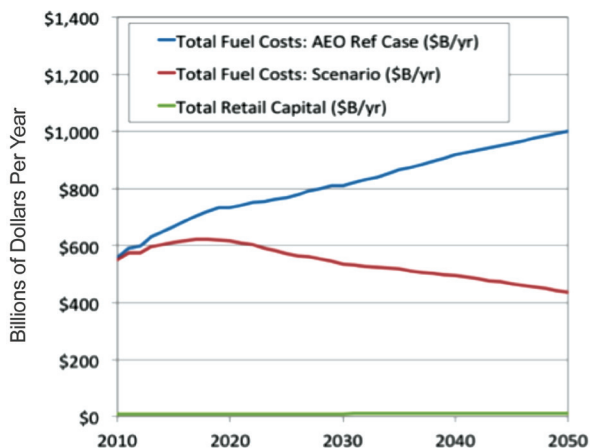
A combination of strategies across transportation modes, demand, and fuels can lead to the elimination of petroleum use by 2050.

Switching from Petroleum to Biofuels

TEF does not project that all liquid fuels will be eliminated from the future transportation sector, but rather that demand can be sufficiently reduced so that biomass can meet all liquid fuel needs. TEF developed a new Biomass Allocation and Supply Equilibrium model to project the equilibrium for biomass supplies and consumption in a mature market. Even at the EIA baseline projected fuel demand in 2050, biofuels could supply as

much as 50 percent of the jet fuel market, and 30 percent of the gasoline and diesel markets if EERE biofuel technology goals are met. Getting to the point where biomass could provide 100 percent of vehicle liquid fuels requires reducing the need for fuel through the efficiency and demand management measures described above, including deployment of electricity or hydrogen fuel alternatives. While new fuel types require new infrastructure, the share of infrastructure cost within total fuel costs is very small (1.5-3 percent), and these costs can be made up for in fuel cost savings of more efficient advanced vehicles.

Total Fuel Expenditures vs. Retail Capital Cost



Fuel retail capital costs (bottom green line) are very small (approx. \$20B/yr) compared to total fuel costs (approx. \$1,000B/yr)

Getting There from Here

Deep cuts in transportation petroleum use and emissions through a combination of strategies to reduce the impacts of vehicle modes, demand, and fuels are feasible based on continued development and implementation of existing technologies. Achieving these outcomes depends on meeting optimistic goals and making concerted efforts in research, development, deployment, and policy across vehicle fuel consumption, vehicle use, and fuel carbon intensity factors to overcome significant market, regulatory, and technological hurdles. EERE’s transportation portfolio is committed to each of these efforts. [EERE’s nine connected reports](#) that make up TEF provide a rich and detailed analysis of opportunities and challenges along the path to a more sustainable transportation energy future.