National Center for Sustainable Transportation

POLICY BRIEF

Can Deep Cuts in GHG Emissions from Trucks be Achieved by 2050?

Lew Fulton and Marshall Miller
Institute of Transportation Studies
University of California, Davis

For more information, contact: Lew Fulton
lmfulton@ucdavis.edu

Issue

The United States and California have made commitments to reduce energy-related greenhouse gas (GHG) emissions, with California aiming to cut GHG emissions by 80% below 1990 levels by 2050. Individual sectors and transportation modes are not necessarily required to meet this "80-in-50" goal, but if any one mode (such as trucks) fails to, it puts more pressure on other modes to achieve deeper cuts.

Trucking is the dominant domestic freight mode in the country, carrying 72% of the tonnage, 42% of ton-miles, and 70% of the goods value. The trucking sector is also the fastest growing and consumes more energy than any other freight mode. The California Air Resources Board projects about a 50% increase in California truck miles between 2010 and 2050, and the U.S. Energy Information Administration projects an 80% increase nationally.

Presently, diesel is the dominant fuel for trucking, with some heavy-duty pickups and vans using gasoline and some buses and delivery trucks using natural gas. Trucking companies currently buy almost no zero emission vehicle (ZEV) trucks (i.e., hydrogen fuel cell and plug-in electric vehicles) and use very little biofuel.

Our research suggests that the combination of significantly improved vehicle efficiency coupled with very low-carbon fuels (electricity, hydrogen, or biofuels) can help the trucking sector reach the GHG target. However, for heavy-duty trucks to meet an 80% reduction in GHG emissions by 2050 using a ZEV-focused strategy would require a rapid ramp-up of ZEV trucks beginning shortly after 2020 and almost 100% of truck sales to be ZEV by 2040. We show a second scenario in which the rate of transition to ZEV trucks could be eased considerably by concurrently ramping up to large volume production of advanced, very low-carbon biofuels compatible with today's diesel trucks, such as renewable diesel from cellulosic feedstocks (Figure 1).

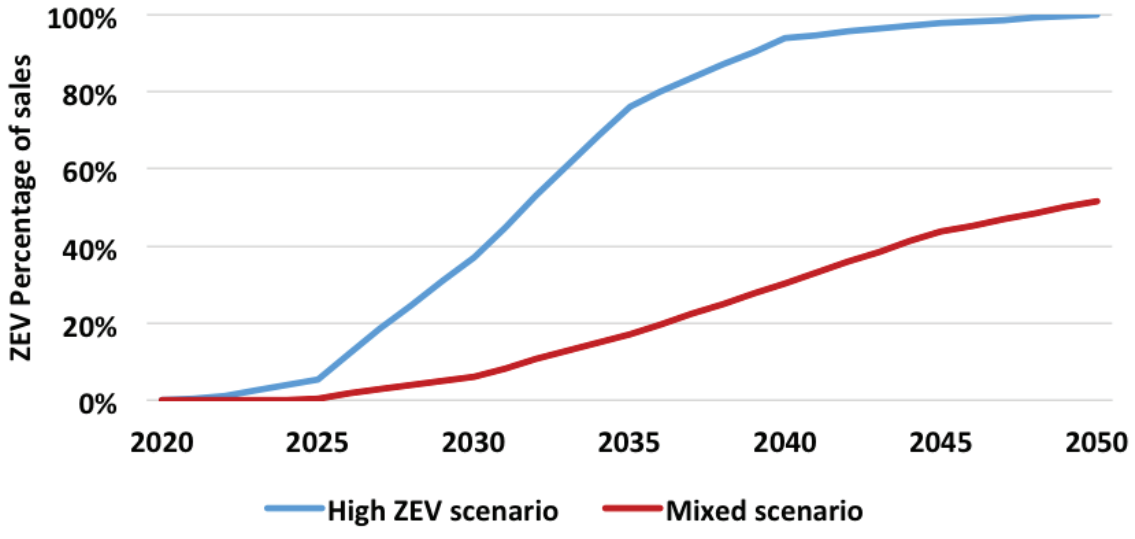

Figure 1: Required ZEV sales share for two different 80-in-50 scenarios. High-ZEV scenario includes no biofuels v. Mixed scenario that includes 60% biofuels blends by 2050

Policy Implications

The primary existing U.S. policy lever is the heavy-duty truck fuel economy and GHG performance standards. These standards will be tightened in 2016, which should help ensure future trucks are more efficient than today's models. However, unless standards are greatly strengthened in the future (beyond what is likely to be adopted in 2016), they will not be enough to promote the adoption of ZEV trucks. Additional policies would be needed to motivate vehicle suppliers and buyers to adopt new types of vehicles and fuels. This could be accomplished, for example, by establishing alternative fuel-related purchase incentive programs or a ZEV truck requirement. California and other states have ZEV mandates for light-duty vehicles, and California has had a limited ZEV transit bus requirement. A similar ZEV truck mandate is imaginable, though the wider range of truck types and applications will likely complicate and possibly increase the cost of achieving such a standard compared to cars.

For biofuels, the most important role for policy is balancing production incentives with safeguards to avoid unintended environmental, social and economic consequences that result when the "wrong" kind of biofuels are produced. Policies should encourage a migration to advanced, very-low-carbon biofuels (typically from cellulosic and waste feedstocks), which include "drop-in" biofuels such as renewable diesel that can be used in blends up to 100% in diesel engine trucks. Renewable natural gas (e.g., gas derived from landfills, dairies, etc.) could also play a role, but would need many more natural gas-compatible trucks. The California Low Carbon Fuel Standard and the national Renewable Fuel Standard support production of advanced biofuels, but have had mixed success. There is currently no national policy that explicitly targets or encourages drop-in fuels, such as renewable diesel, which has become a priority given the limited usefulness of fuels such as ethanol and fatty-acid methyl ester (FAME) biodiesel.

Research Findings

Three prominent studies of low-carbon truck futures were reviewed as part of this research and two new 80-in-50 scenarios were developed. The two new scenarios are:

1) The **"High ZEV" scenario** features significant sales of ZEV trucks beginning around 2020, and then rapid penetration after 2025, along with massive efficiency improvements in conventional trucks. By 2030, ZEV trucks would need to reach 25-40% market share and approach 100% by 2040 (Figure 1). There are few precedents for such a fast adoption rate of completely different propulsion technologies and fuels.

2) The **"Mixed" scenario** adds large volumes of very low-carbon advanced biofuels to diesel fuel used by conventional and hybrid diesel trucks (and to gasoline for trucks using that fuel). The advantage of this scenario is that it creates a more viable "glide path" for ZEV trucks by allowing the ZEV truck adoption rates to be cut in half. However, this scenario requires a rapid ramp-up to large volumes of advanced biofuels, which will be very challenging and be affected by the availability of feedstocks and production facilities, and by competition with other modes also adopting biofuels.

Ultimately by 2050, all fuels must be deeply decarbonized. Both scenarios assume strong efficiency improvements in conventional diesel vehicles, but these improvements mainly help offset the growth in truck travel; by itself, even very aggressive efficiency improvements leave fuel consumption only modestly lower than current levels. Additional efficiency improvements associated with battery and fuel cell vehicles will help but must be combined with deep fuel carbon intensity reductions to hit 80-in-50 targets.

The costs of these scenarios will depend heavily on success in lowering the cost of ZEV technologies and advanced biofuels over time. There is a reasonable expectation that by 2030, both fuel cells and battery electric trucks can be cost-competitive, but transition costs over the next 15 years may be substantial. The net costs and benefits to 2050 are very uncertain and require further research and analysis.

Further Reading

This policy brief is drawn from the full white paper, "Strategies for Transitioning to Low-Carbon Emission Trucks in the United States" by Lew Fulton and Marshall Miller. The white paper can be downloaded at: ncst.ucdavis.edu/white-paper/ucd-dot-wp3-1b.

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