

ABSTRACT

Technical studies, market trends, automaker announcements, and forecast assessments suggest that two automotive technologies – hybrids and diesels – will be prominent contributors toward achieving future environmental and energy goals. Technology advances have led to a dramatic penetration of diesels into the European automobile market, while vehicles with hybrid electric-gasoline drivetrains have begun to see modest commercialization in the U.S. and Japan. This study quantitatively compares hybrid and diesel models in the 2010 U.S. market in order to discuss the potential for these two technologies in helping to meet future emissions and efficiency objectives. The findings suggest that both hybrid and diesel technologies offer prominent benefits in terms of fuel economy, greenhouse gas emissions, and vehicle performance. Diesel vehicles offer comparatively less greenhouse gas emission benefit than hybrids and offer an apparent criteria pollutant emission trade-off. Both technologies would have to experience cost reductions to become more mainstream in the U.S. automotive market.

BACKGROUND

There are many reasons for which diesel and hybrid technologies have received considerable media attention, critical automotive acclaim in year-end awards, as well as general optimism by researchers and policy-makers. Both diesels and hybrids tend to offer a mix of performance, efficiency, environmental benefit, and social status that puts these two technologies in discretely different categories from incremental gasoline efficiency technologies (e.g., off-the-shelf, largely unnoticed engine and transmission improvements) that are being regularly deployed by every automobile manufacturing company. Due to how these technologies are viewed as particularly promising and categorically 'different,' they are the particular focus of this study.

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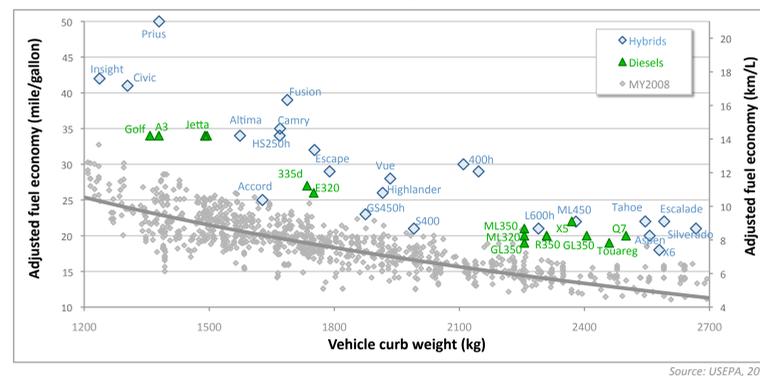
APPROACH

To help meet performance-based greenhouse gas, fuel efficiency, and criteria pollutant standards around the world, hybrid and diesel vehicle models are emerging in the marketplace. From public U.S. EPA certification and automaker specification data on [23 hybrid](#) and [16 diesel](#) vehicle models in the U.S. automobile market, there are sufficient data to quantitatively assess these models' comparative impacts versus their conventional counterparts in terms of –

- Carbon dioxide emissions (gCO₂/mile)
- Fuel economy (mile/gallon, km/liter)
- Criteria pollutant emission (g/mi of NO_x and HC)
- Performance (0-60 mile/hour acceleration time)

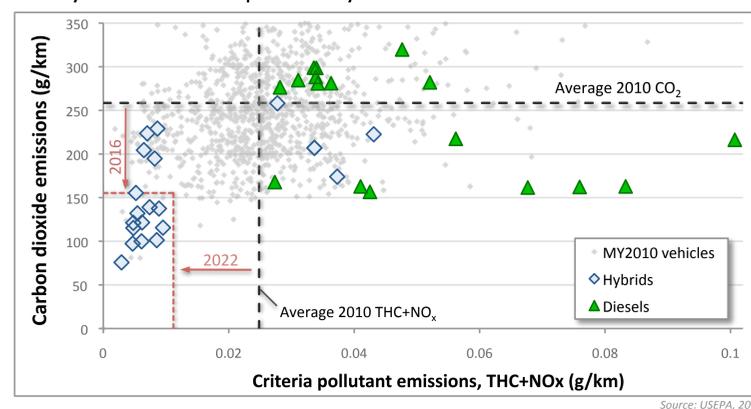
FUEL ECONOMY AND EMISSIONS

Hybrid and diesel models establish a frontier for much higher fuel economy than their conventional gasoline counterparts.



Hybrids are better positioned than diesels in achieving future greenhouse gas and criteria pollutant emission standards.

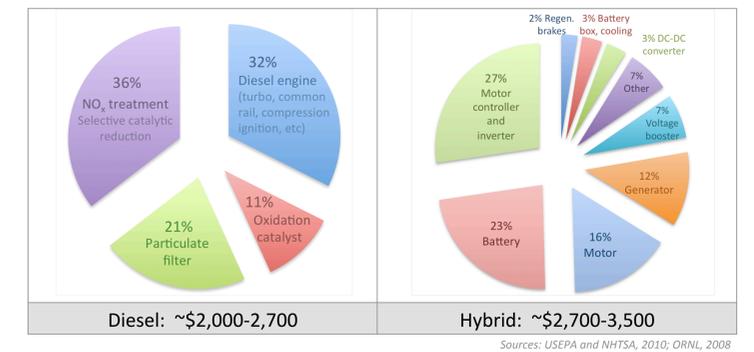
- Diesel has higher fuel-carbon content, lower relative CO₂ benefit
- Hybrid have comparatively lower NO_x and HC emissions



Both diesel and hybrid technologies offer potential for improved acceleration - and a performance-versus-efficiency trade-off.

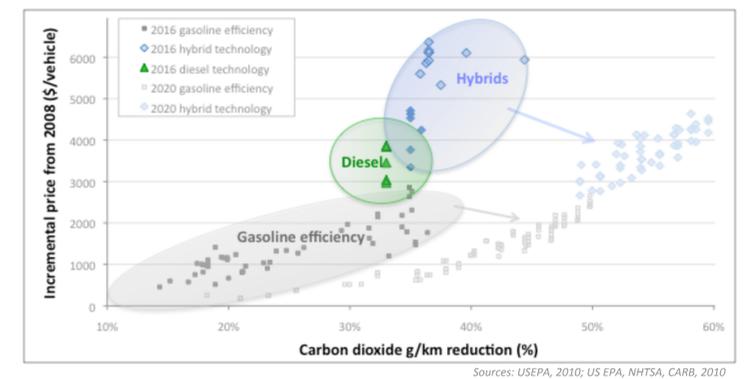
TECHNOLOGY COST

Both technologies currently come at a substantial cost premium.



Hybrids have much greater potential for cost and price reduction

- Diesels will continue to have higher aftertreatment technology costs
- Future hybrids: parallel systems, smaller and less components
- Hybrid battery, motor, electronic costs reduce with innovation, scale



CONCLUSIONS

Direct quantitative comparisons can be made regarding hybrid and diesel technologies, as seen in the U.S. automobile market.

- Diesels, hybrids both offer major fuel economy gains at increased cost, along with a potential efficiency-vs-performance trade-off
- Hybrids generally offer greater CO₂, fuel economy, and criteria pollutant emission benefits than diesels
- Diesels generally offer a lower mass penalty and lower current cost premium than hybrids

Hybrids are better positioned than diesels in achieving future greenhouse gas and criteria pollutant emission standards.

- Hybrid system innovation, component cost reductions, and economies of scale will drive their costs down
- Criteria pollutant standards will continue to put pressure on diesels

Hybrids innovation and deployment also offers a direct bridge toward more advanced, lower carbon vehicle electrification and petroleum use reductions with plug-electric and fuel cell vehicles.