DOCKETED	
Docket Number:	19-IEPR-03
Project Title:	Electricity and Natural Gas Demand Forecast
TN #:	227212
Document Title:	Vehicle Attribute Forecasts
Description:	Presentation by Gopal Duleep of H-D Systems
Filer:	Raquel Kravitz
Organization:	H-D Systems
Submitter Role:	Public
Submission Date:	3/1/2019 11:42:06 AM
Docketed Date:	3/1/2019

Gopal Duleep
H-D Systems

Vehicle Attribute Forecasts

Overview

- Vehicle Attribute forecasts are required by the California Energy Commission demand model to obtain information on vehicle technology, performance, weight and cost at the size/market class
- HDS and its staff have been providing Energy Commission with these forecasts since the 1990s and has also supported the development of the Department of Energy's National Energy Modeling System (NEMS) transport model of fuel demand during various periods.
- Our forecasting model attempts to model the "supply" side i.e., the auto industry and how they will respond to demand and the regulatory framework, but vehicle demand by size class is predicted by the Energy Commission model for both light duty and heavy duty vehicles.
- Unfortunately, our models do not interact dynamically so that the supply and demand frameworks are coordinated externally.

Light Duty Vehicle Issues

- The enactment of the Obama era standards for fuel economy and Greenhouse Gas (GHG) emissions made the entire forecast constrained by regulations to 2025 as the standards were technology forcing.
- Major issue is the recent plans by the current Administration to halt Fuel Economy and GHG standards constant beyond 2020 while California intends to continue with existing regulations.
- It is expected that national/California standards will be handled by scenarios, but Administration claims that increasing standards beyond 2020 levels will lead to very high prices were examined.
- A separate issue is the future of electric vehicles, as well as the possible introduction of autonomous vehicles.

Proposed CAFE Standards

- In August 2018, the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) proposed to modify the Corporate Average Fuel Economy (CAFE) and GHG standards due to 'changes in the market' and new information available.
- A range of alternative standards to the so-called "54.5 mpg" standard were considered and the preferred option is one where 2020 standard are held constant over the 2021 to 2026 period. GHG standards are further modified to exclude air conditioning, methane and nitrous oxide emissions
- The technology and cost assessment supporting the new standards finds that the new standards could be met with an incremental price increase of $700 while the cost to meet the existing standard was estimated at $2650.
- The $1900 differential between the two standards is almost twice as large as the differential estimated by the agencies in 2012 and again in 2016.

Retail Price Equivalent (RPE) Estimates in 2018 Proposed Regulatory Impact Analysis (PRIA)

	2017	2020	2021	2025	2028
Existing Standard RPE	$250	$1400	$2000	$2650	$2650
Attained CAFE mpg	33.9	39.4	42.4	45.7	46.4
Proposed Standard Cost	$150	$600	$650	$700	$700
Attained CAFE mpg	33.7	37.2	38.3	39.2	39.6
Existing CAFE Standard	34.0	36.9	39.0	46.8	46.8
Proposed CAFE Standard	34.0	36.9	36.9	36.9	36.9

RPE Comparison to 2016 Study

- In the new analysis, the forecast is for overcompliance with 2020/21 standards and undercompliance with 2025/26 standards under existing standards case. The RPE increment relative to 2016 is $2650 for 2025 and beyond.
- Under proposed standards, the forecast is voluntary overcompliance with standards by 2.3 mpg, reducing the benefit differential between existing and proposed standards, at a cost of $700
- In the 2016 analysis affirming existing standards, the RPE difference between 2021 and 2025 standards was estimated at $1020 by EPA and $1096 by NHTSA. This is an appropriate comparison because of the overcompliance with 2020 standards in proposed regulation.

Increases in RPE Estimates

- Cost comparisons are inexact because of multiple changes between 2016 and 2018 analyses, but the cost of increasing mpg from ~39 to ~47 mpg increased from $1050 to $1950.
- On the other hand, the cost of meeting the 39 mpg standard decreased a little form $766 forecast in 2012 to $700 in the 2018 forecast.
- A detailed analysis of the technology usage required and resulting technology cost to meet the 2021 and 2025 standards was undertaken for CARB to understand and critique the changes in the 2018 analysis.

Technology and Cost for 2021 Standard

- Overall, differences in technology requirements for meeting a 39 mpg standard between the 2018 PRIA and 2016 analysis are modest .
- The new analysis projects higher use od downsized turbocharged engines to meet the standard but has less weight reduction technology.
- Virtually no change in hybrid, PHEV or EV penetration is forecast to meet the 39mpg standard, consistent with earlier forecasts.
- While the costs of technologies to meet the 39 mpg standard are similar to earlier estimates, the benefits of many low cost technologies are estimated to be lower.

Conclusions from Review

- The new analyses differs in many ways from earlier analyses so that several factors contribute to these differences. However, much of the difference can be explained by
  - Reduced effectiveness assumptions for many low cost technologies. These assumptions do not reflect actual data and the findings of previous analyses
  - Elimination of several low cost technologies from consideration in the forecast. These technologies have entered the market in 2018/2019.
  - As a result, much higher use of hybrid technology is required to meet the 2025 standard, with forecast market penetration of over 55%.
  - The cost of hybrid technology has been increased by a factor of 2.5 to 3. This is surprising since costs are well known and hybrids have been in production for over 20 years.

  As a result, we do not see significant new inputs required for the Energy Commission forecast as the assumptions employed in the new analysis are not supported by data.

Light Duty Electric Vehicles

- Forecasts of future EV prices are largely dependent on estimates of battery costs. Very aggressive cost reduction forecasts for batteries are in the public domain and are key to EV competitiveness in the future.
- Costs vary significantly between a cell, a module (or collection of cells) and an entire automotive battery which includes safety, battery monitoring and battery cooling systems housed in a crash-proof box.
- While press reports suggest current (battery?) costs of $150/kWh, analysis of Tesla financials suggest costs of ~$230/kWh. Cost reductions of 40 to 50 percent may be possible by 2030. Future cost declines will be handled on a scenario basis.
- The trade-off between range and costs must be decided externally from the modeling and vehicles with at least 200 mile range seems to the direction of the industry. However, cheaper small urban vehicles with ~100 mile range are likely to be available in the market as well.

Autonomous Vehicles

- Most observers believe that Level 4 and 5 Autonomous Vehicles will enter the market in the next decade.
- It is not widely known that the radar, lidar and vision systems and computers will require a lot of electrical power (>2kW). Most autonomous vehicles are expected to be hybrids or EV to support the electrical power demand.
- From a supply side perspective, the effect of this power demand on efficiency, and the cost of the system can be modeled.

Light Duty Alternative Fuel Vehicles

- The CEC demand model requires inputs for several alternative fuel types including E85 and Hydrogen
- E85 vehicles are widely available as flex-fuel vehicles. Due to the phase-out of fuel economy credits for CAFE compliance, their future is very uncertain and only a few models will likely be available after credits end in 2020. The number of available models has been declining since 2015.
- Fuel cell vehicles pose a difficult forecasting issue since future cost reductions depend on attaining economies of scale, which appears problematic with competition from EV models and lack of a hydrogen fuel infrastructure. Low and high volume cost scenarios will be examined.

Heavy Duty Vehicles

- A wide range of HDT classes and fuel types are being modeled. The models were updated in 2017 for the Energy Commission forecast so no major forecast methodology revisions are required this year.
- As with light duty vehicles, the technology is being driven by GHG regulations which have not changed under the new Administration. Hence, modeling assumptions used in 2017 will be utilized for the 2019 forecast.
- Alternative Fuel Trucks continue to be an issue and the emergence of electric trucks will be re-examined for this forecast.

CNG/LNG Trucks

- CNG and LNG trucks continue to attract attention as a low emissions competitor to diesels, but have had disappointing market growth.
- Currently, Cummins-Westport (and Westport) is the only supplier of NG trucks. The Cummins Westport models use spark ignition and are~15% less energy efficient than diesel engines. Westport Volvo uses a dual fuel (diesel + NG) system that is more complex and expensive but more efficient.
- Cost of engine + CNG tanks is still significant so that CNG and LNG are not cost competitive commercially with diesel. The engines have attained significant market share in buses and refuse trucks due to local or state requirements. Both these segments could see significant competition from electric and hybrid trucks.

Electric and Hybrid Trucks

- Electric and hybrid truck models have been introduced in the last 3 years in light-heavy and medium- heavy classes of trucks. Tesla has shown a heavy-heavy tractor for potential introduction in 2021/22. The Heavy-heavy truck will be a new addition to the forecast.
- Truck batteries will be more expensive per kWh of energy than light duty vehicle batteries because of the more severe duty cycle. We estimate future costs will have similar percent declines as light duty batteries but will continue to be more expensive.
- Prices for currently available electric and hybrid trucks are more than 2 times higher than those based on cost of components data. Reconciliation of the current market price to forecast price is difficult and will affect short term penetration forecasts.

Project Timing

- Forecast specifications are under development and expected to be finalized shortly to define macro-economic scenarios and electric vehicle cost scenarios.
- Draft forecasts will be developed by early April for input to the Energy Commission model. Forecast refinement will continue over the April-June term.
- Final forecasts and documentation will be completed by the end of Summer 2019.

Thank you

Gopal Duleep
H-D Systems
gduleep@verizon.net