

Transportation Energy Demand Forecast

California Energy Commission

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Demand Forecasting Unit Presentation

- Transportation Energy Demand Forecast
- Household Travel
- Light Duty Vehicle Attribute Projections

Frequently used acronyms:

- LDV: light duty vehicles
- HDV: heavy duty vehicles
- VMT: vehicle miles traveled
- MPG: miles per gallon
- HSR: High Speed Rail
- HSRA: High Speed Rail Authority
- DMV: Department of Motor Vehicles
- NEV: Neighborhood Electric Vehicle
- FCV: Fuel Cell Vehicle, Hydrogen
- BEV: Battery Electric Vehicle
- FFV: Flex-Fuel Vehicle, E85



What Do We Forecast?

- Transportation Energy Demand by Fuel Type:
 - Gasoline
 - Diesel
 - E85
 - Natural Gas
 - Electricity
 - Hydrogen
- Statewide
- From 2013 to 2050



Demand Forecasting Unit

- Uses economic models, mostly choice based, to account for the impact of time and/or cost of an activity and/or a product, as well as income and/or economic output in the travel mode and vehicle choice process.
- These models forecast:
 - LDV transportation energy demand for personal travel (Urban and Intercity)
 - LDV transportation energy demand for commercial travel
 - HDV transportation energy demand for personal travel (Urban and Intercity) by transit mode: Bus, Rail, Light Rail, and others
 - HDV transportation energy demand for movement of goods (Freight) by commodity sector and by mode: Rail and Truck
 - HDV transportation energy demand for services (Freight) by sector
 - Aviation fuel demand for intrastate, interstate, and international personal and business travel (Commercial Passenger Aviation)
 - Aviation fuel demand for movement of goods (Commercial Freight Aviation)



Key Inputs

- Transportation energy prices
- Income and economic growth
- Sectoral distribution of GSP
- National and international economic growth
- Household and population growth
- Projections of fuel economy by fuel type and vehicle class
- Projections of LDV vehicle prices, and other attributes by fuel type and vehicle class
- Household preferences for vehicle ownership
- Household and commercial consumer preferences for different LDV vehicle and fuel types.
- Consumer preferences for travel and travel modes
- Travel time and cost by different modes (personal auto, conventional and light rail, bus, and air travel)
- Current stock of California vehicles



What is New in 2012 Forecast?

- New fuel type: Hydrogen
- New LDV vehicle technologies: Diesel Hybrid, CNG Hybrid, CNG Bi-fuel, FCV
- Separate LDV fleet size forecasts for Government, Rental & Neighborhood Electric Vehicles
- Fleet mix forecast for government vehicles
- New Aviation Market Segment: International
- New Travel Mode: High Speed Rail (post-processed)



High Speed Rail (HSR)

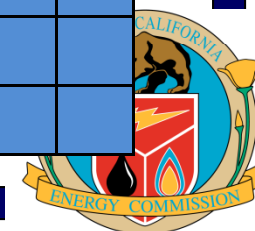
Our models currently do not include HSR as a travel mode.

- We examined the impact of HSR on other modes, after our models generated a forecast (post-processed).
- We used the conservative projected ridership and fares, as outlined in HSR's revised 2012 Business plan.
- HSR projections include high, low and mid-case scenarios.
- Input composition of HSR scenarios varied from the Energy Commission defined energy demand scenarios.
- HSR mid-case scenario is more comparable to Energy Commission's reference scenario.
- Reviewed two scenarios, one with HSR and one without to determine impact of HSR on transportation energy demand.



Scenario Definitions

Scenario Comparison						
Scenarios		Energy Prices		Income	Population	H S R
		Liquid Fuels	Electricity/NG/Hydrogen			
CEC Shared Scenarios	Low Energy Consumption	H	H	L	L	
	Reference Energy Consumption	R	R	R	R	X
	High Energy Consumption	L	L	H	H	
FTD-TEO	Low Petroleum Consumption	H	L	L	L	
	High Petroleum Consumption	L	H	H	H	
HSR	High Ridership	H	-	H	H	
	Mid Ridership	R	-	R	R	
	Low Ridership	L	-	L	L	



HSR Analysis

HSR total ridership was held at HSA projected levels.

HSRA projected mode diversion rates were used to reduce travel by other modes.

Assumptions

- HSR will begin and continue operation on schedule.
- HSR induced travel, ridership and mode diversion rates will hold as projected.
- HSR fares will be set at 83% of airfare.
- HSR was offered as a mode only for long distance intercity travel.

Implications

- HSR only affected the transportation energy demand for intra-California air travel, and intercity travel by other modes.



Attribute Assumptions

- The only LDV vehicle attributes that changes with fuel prices and income (remain the same for all scenarios) is the number of makes and models.
- No distinction between highway and city MPG (city MPG is lower than highway MPG, but reverse is true for EVs)
- On-road MPG estimates (discounted lab MPG at different rates for different fuel types/technologies) posted on LDV car stickers are representative of actual MPG on California road.
- LDV vehicle technologies will be introduced/commercialized according to the projected technology introduction schedule.
- Implicitly assume the impact of repair cost, loan and lease terms and others are captured and held constant at their 2012 levels.
- EIA heavy duty MPG projections and fuel types represent California on-road MPG and fuel types for HDVs.
- EIA projected aircraft fuel economy improvements do not vary by income and fuel price compositions in Energy Commission defined scenarios.



Forecasting Assumptions

- Average VMT is the same for all household cars, regardless of the fuel type.

Fuel Choice

- FFV owners, on average fuel their vehicles 50% of the miles with gasoline and 50% with E85.
- CNG Dual Fuel owners, on average fuel their vehicles with CNG for 50% of the miles and 50% with gasoline.
- PHEV owners drive 50% of the miles on electricity, and 50% on gasoline.

Fleet Mix

- Rental fleet mix held constant at 2012 level
- Government fleet : 11 year old vehicles were replaced with new vehicles, starting in 2013. New government vehicle purchases complied with ZEV mandate.



Different LDV Models for Different Market Segments

Different sectors have different vehicle needs and different behavior.

- Vehicle price is a large share of household income and vehicle usage competes with other transportation modes.
- Vehicles are used to meet business needs and more sensitive to changes in economic activity.
- Government vehicles are used to meet the needs of general population and are more responsive to mandates and policies.
- Rental cars serve the needs of all market segments including the zero vehicle households, tourists, long distance travel and others.
- NEVs are used for low speed and limited distance movements on city streets and in communities and establishments.



2012 Market Segment Stock Distribution by Vehicle Class

Vehicle Class	Total	Total %	HH %	Com %	Gov %	Rent %
CAR-SUBCOMPACT	2528078	9.4%	10.2%	5.2%	2.1%	4.5%
CAR-COMPACT	4485611	16.6%	17.6%	11.7%	5.6%	23.8%
CAR-MIDSIZE	5046853	18.7%	19.3%	15.1%	12.6%	28.5%
CAR-LARGE	1193256	4.4%	4.3%	4.2%	19.1%	9.6%
CAR-SPORT	1171695	4.3%	4.7%	2.3%	0.1%	3.8%
CROSS/UT-SMALL- CAR	465784	1.7%	1.8%	1.5%	0.2%	1.8%
CROSS/UT-SMALL- TRK	1667866	6.2%	6.3%	5.8%	1.8%	10.9%
CROSS/UT-MIDSIZE	754689	2.8%	2.8%	2.9%	0.1%	1.8%
SPORT/UT-COMPACT	1208813	4.5%	4.9%	2.5%	1.0%	0.8%
SPORT/UT-MIDSIZE	620714	2.3%	2.4%	1.8%	1.7%	1.0%
SPORT/UT-LARGE	1234923	4.6%	4.9%	3.1%	2.5%	2.8%
SPORT/UT-8,501-10,000	62037	0.2%	0.0%	1.6%	0.4%	0.0%
VAN-COMPACT	1442853	5.4%	5.4%	5.4%	4.0%	4.9%
VAN-STD	207712	0.8%	0.3%	3.3%	3.4%	0.4%
VAN 8,501-10,000	221361	0.8%	0.0%	5.2%	7.8%	1.7%
PICKUP-COMPACT	1674203	6.2%	6.6%	4.1%	8.5%	0.3%
PICKUP-STD	2262253	8.4%	8.6%	6.9%	15.2%	2.3%
PICKUP 8,501-10,000	689638	2.6%	0.0%	17.3%	12.2%	1.0%
NEV	14108	0.1%	0.0%	0.1%	1.6%	0.0%
Total	26952447	100.0%	100.0%	100.0%	100.0%	100.0%

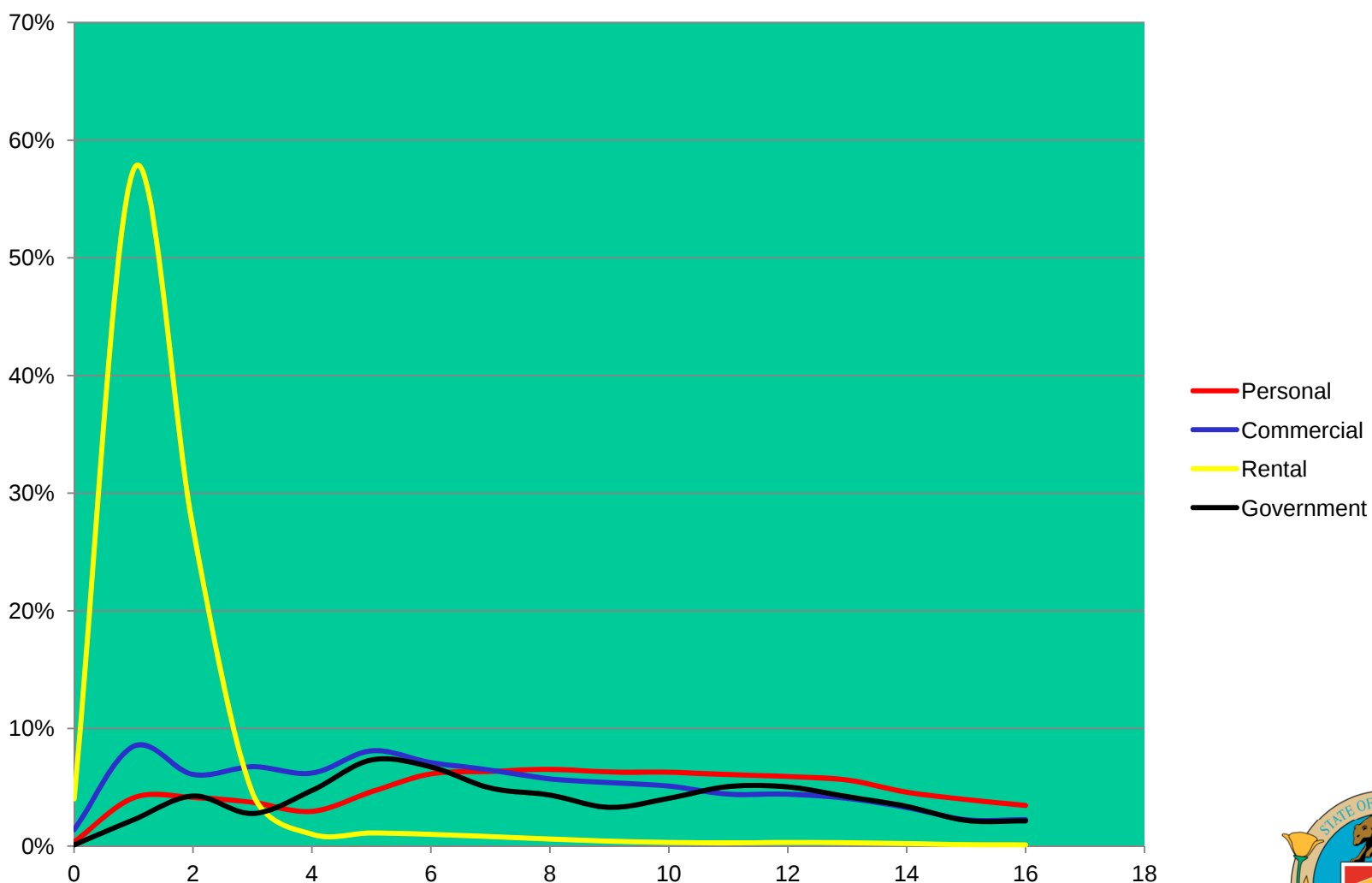


2012 Distribution of Fuel Types by Market Segment

Market Segment	Total	Gasoline	FFV	Diesel	Electric	Hybrid	Natural Gas	PHEV
Personal	84.44%	86.41%	69.29%	19.89%	36.87%	79.42%	44.50%	42.17%
Commercial	14.04%	12.37%	23.35%	78.76%	41.72%	18.75%	31.64%	57.36%
Rental	0.47%	0.41%	3.06%	0.13%	0.18%	0.11%	0.05%	0.07%
Government	0.96%	0.81%	4.30%	1.22%	21.24%	1.73%	23.81%	0.40%
Total	100%	100%	100%	100%	100%	100%	100%	100%



2012 LDV Vehicle Age Distribution



Light Duty Vehicle Forecasts

Choice Based Behavioral Models: Fleet size changes in response to demographic and economic changes. Fleet mix changes in response to technological developments and economic factors.

- Commercial (14%)
- Residential (84.5%)

Growth Models (New): Fleet size grows with population. State government fleet mix is assumed to change in compliance with ZEV mandate.

- Government Fleet (0.98%)
- Rental Fleet (0.5%)
- Neighborhood Electric Vehicles (0.05 %)



LDV Choice Models Tell Us:

Households:

- Still prefer gasoline to other fuel types, but they have grown to consider Hybrid and PHEVs the same as gasoline, statistically speaking.
- Prefer larger vehicles to compact and subcompact vehicles. Midsize cars and small SUVs are on the top of their favorite list.
- Preference for AFVs grows with number of vehicles in the household.
- 3+ vehicle households have strong preference for Hybrid and PHEVs and consider diesel and diesel HEV the same as gasoline, statistically speaking.

Commercial fleet owners:

- Statistically indifferent with between all fuel types and gasoline, but prefer FFVs to gasoline and other fuel types.
- Prefer all vehicle classes to compact and subcompact, with strong preference for standard and small pickups.



Survey Findings of Relevance

- ZEV Mandate requires manufacturers to offer and sell ZEV vehicles.
- This is typically reflected in the increase in the number of makes and models, as one of the attributes of a specific class of vehicle.

We observed in the vehicle survey that respondents less frequently changed their mind with respect to the vehicle type they planned to buy, than the fuel type of the vehicle they planned to buy: If they want a minivan, then they want a minivan.

- Policy implication, if this holds true: If the goal is to increase sales of alternative fuels and technologies, then it is not enough to increase makes and models in one vehicle class, but offering should increase in all vehicle classes.



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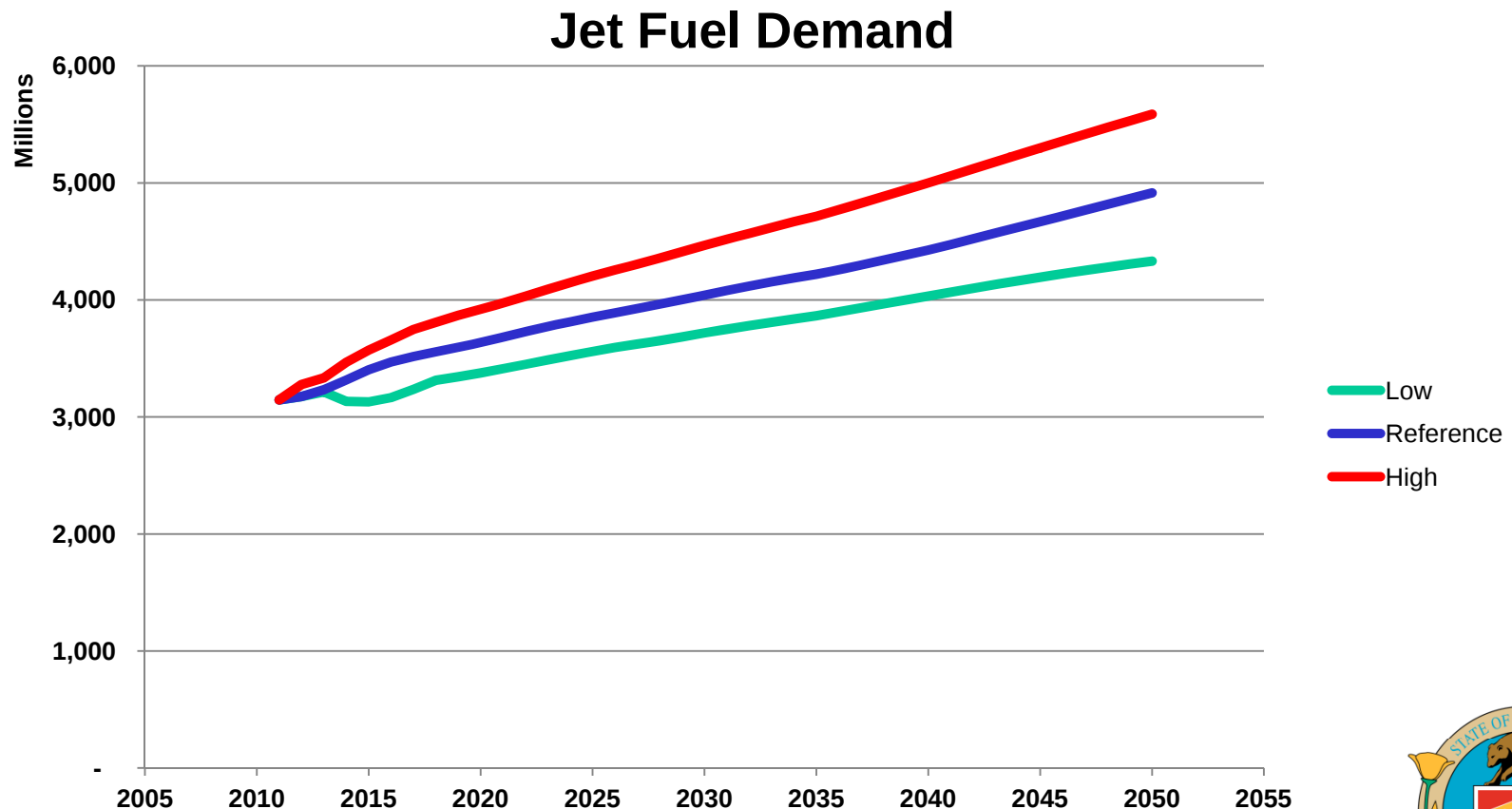
Commercial fleet owners did not choose hydrogen as the vehicle they planned to purchase (in the revealed preferences portion of the survey) but did end up choosing hydrogen once the vehicle was defined by its range of attributes.

- Policy implications if this is true: Consumers need more information than MPG, price, and fuel type to make a decision.

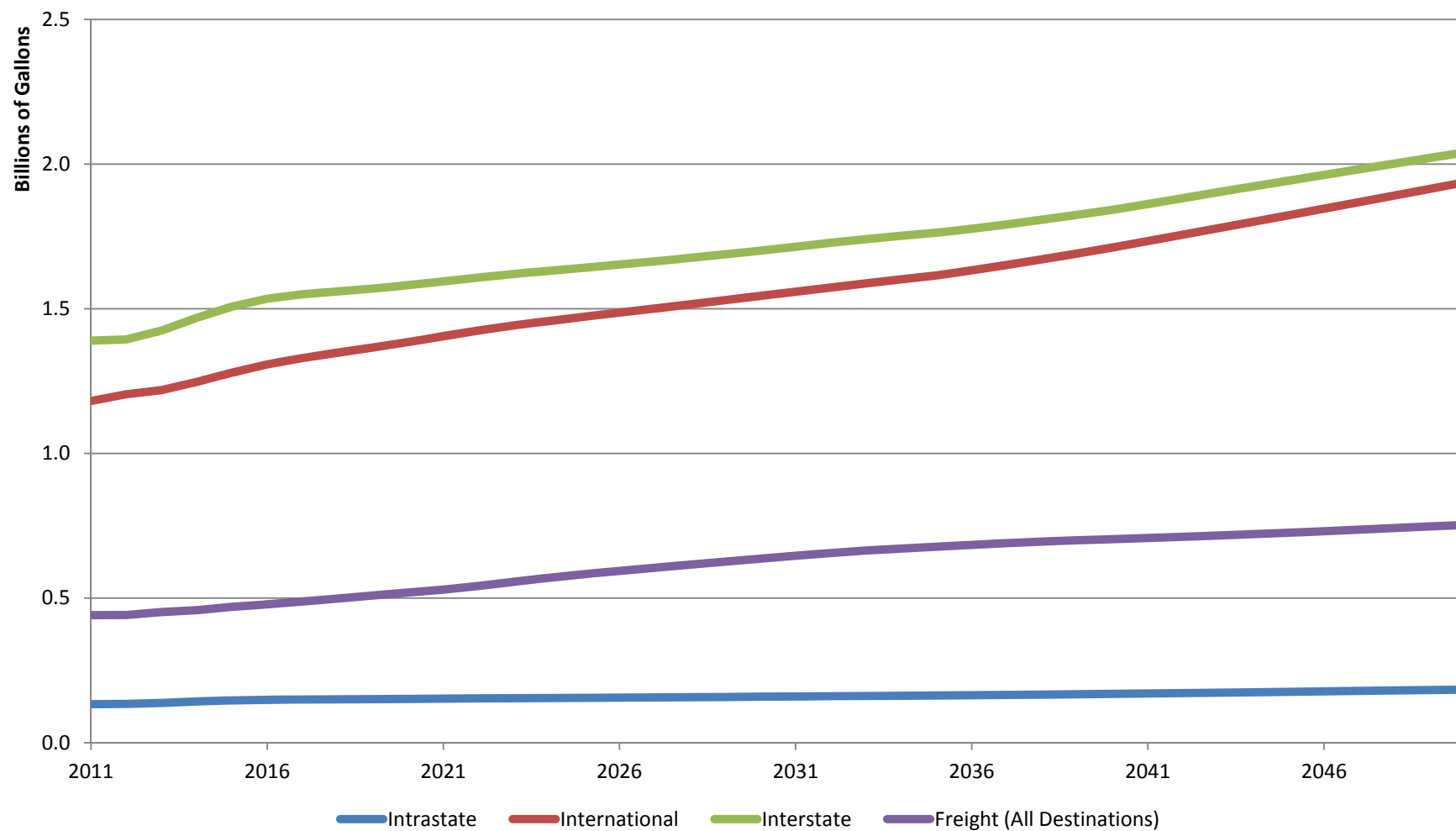


Future According to Our Forecast

- Under all assumptions laid out in our June workshop as well as the ones listed in this workshop.



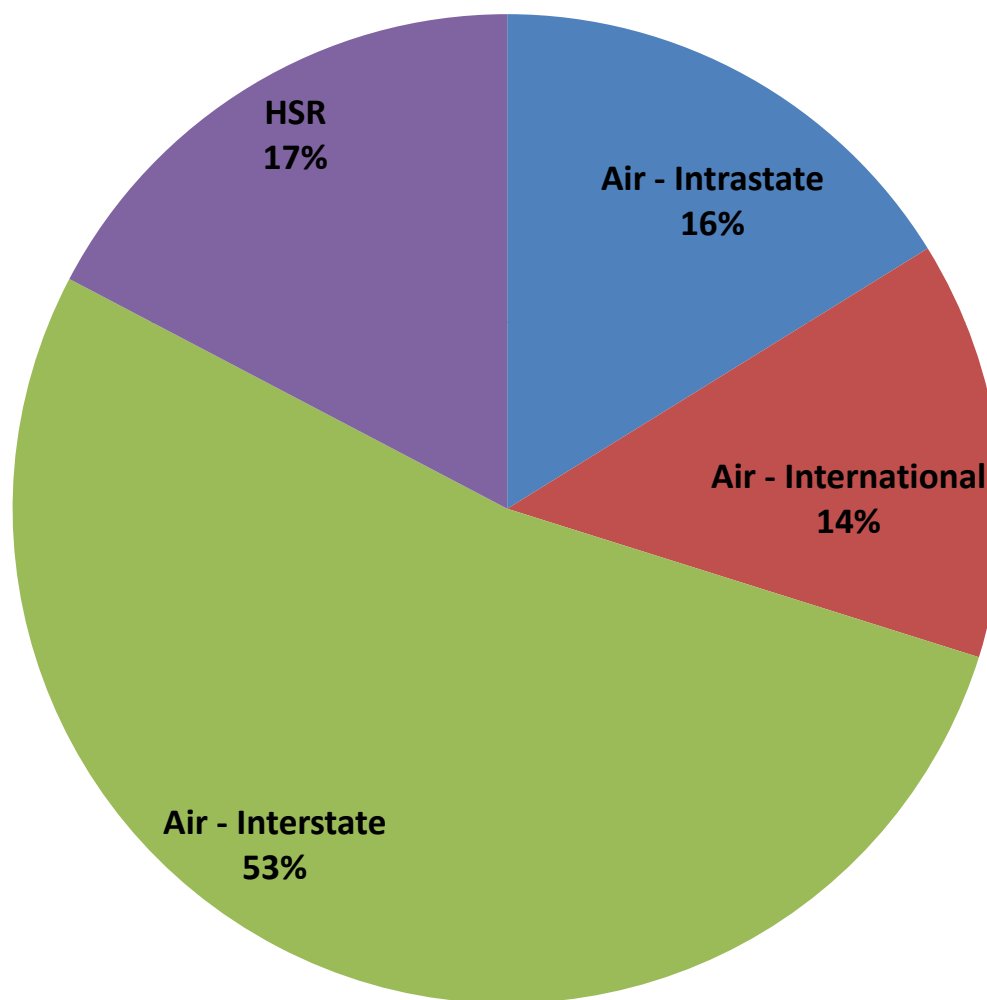
Jet Fuel Demand by Market segment – Reference Case



Source: Energy Commission analysis.



Aviation and HSR Trips - 2030

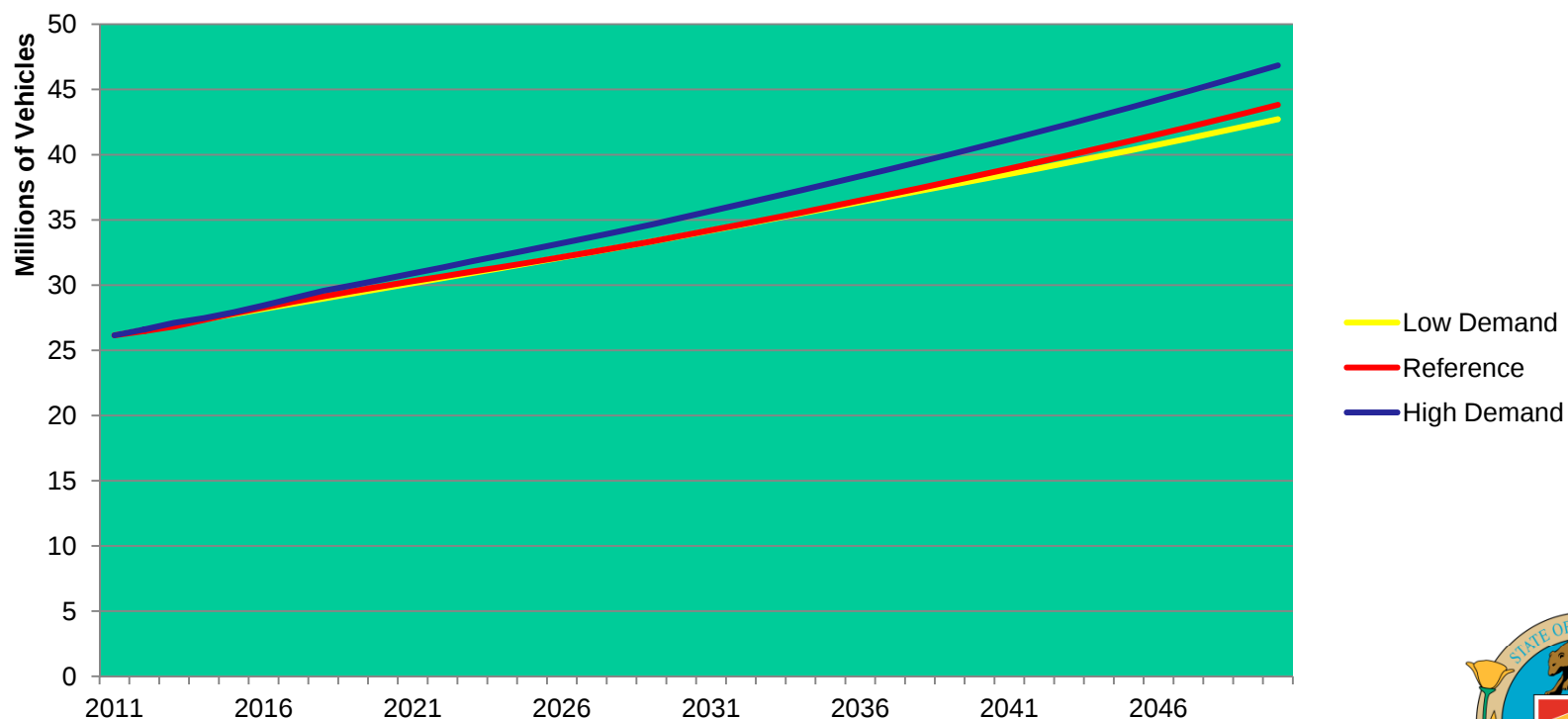


Source: Energy Commission analysis.

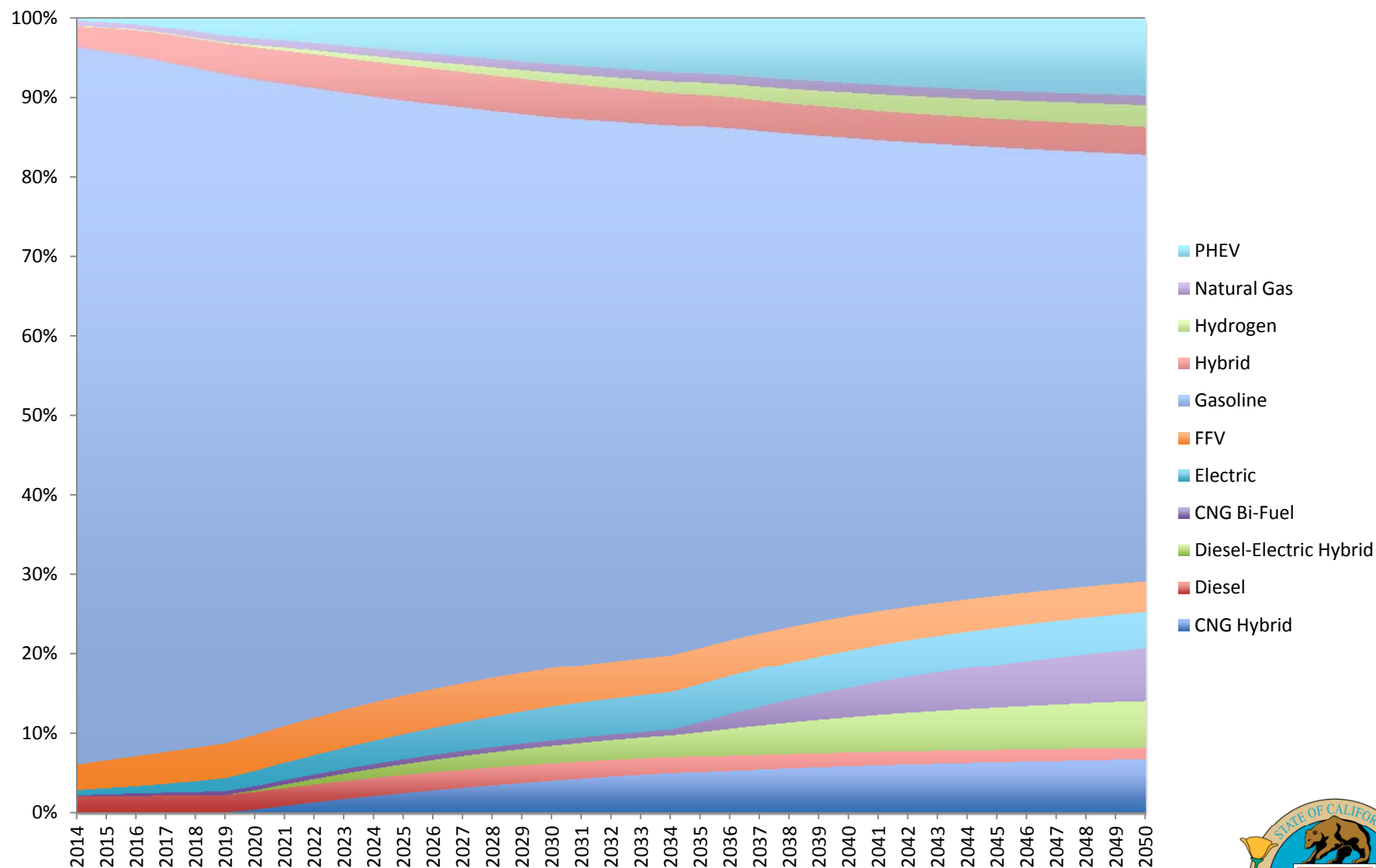


Future According to Our Forecast Fleet Size

Personal and Commercial Vehicle Stock, 2011-2050



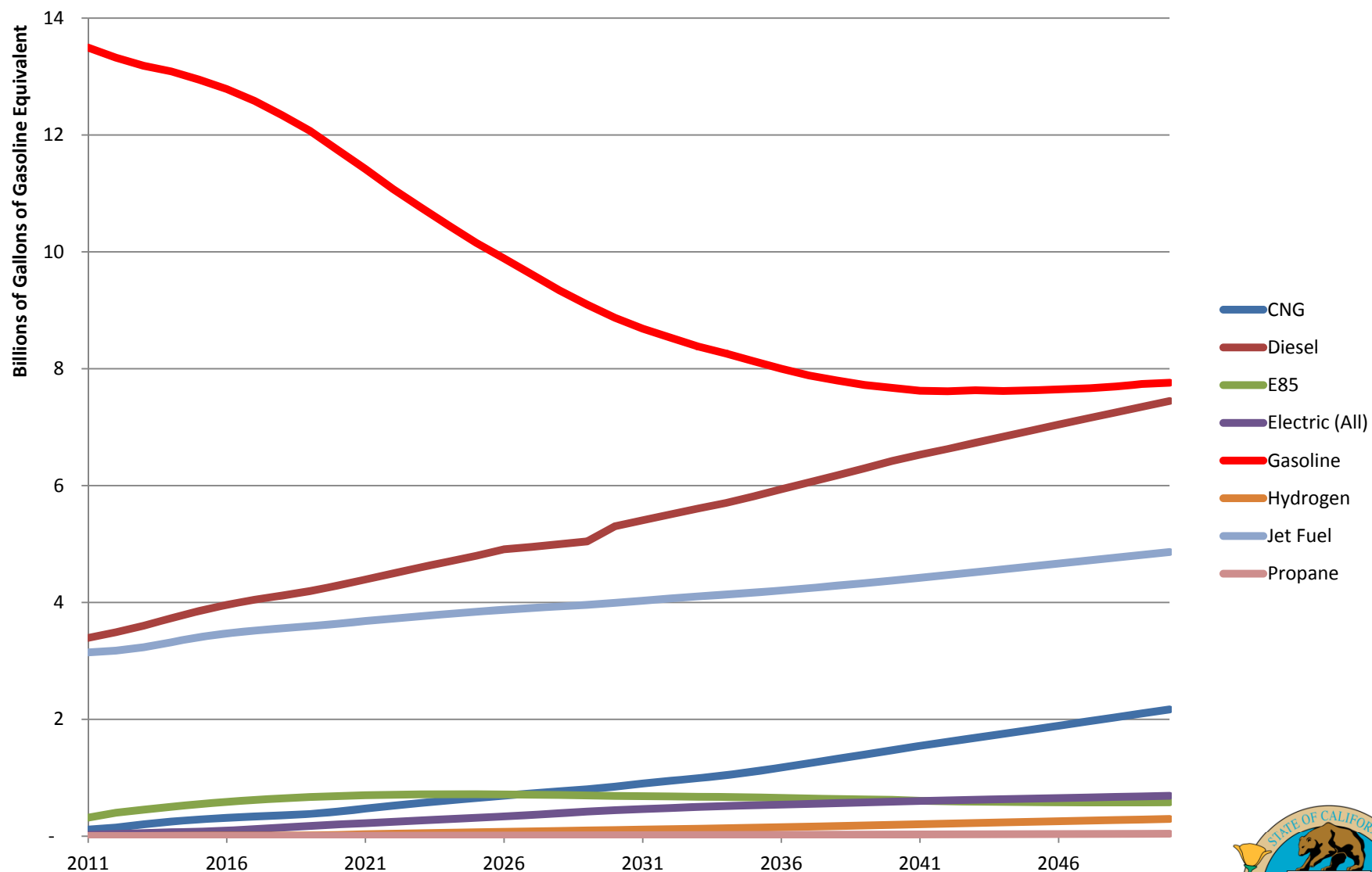
LDV Fleet Mix by Fuel Type (Commercial & Household) Reference Case



Source: Energy Commission analysis.



Transportation Energy Demand by Fuel Type – Reference Case



Source: Energy Commission analysis.



Focus on Plug in Electric Vehicles

- Most of the quantitative requirement revolve around new vehicle sales.
- The mandate require OEMs to offer and sell LDV vehicles in different ZEV categories.
- Government offers incentives to consumers to increase demand.
- Offering a vehicle and selling are different, in that price has to be right for selling a vehicle.
- The analysis with a pure focus on monthly sales reports misses the point on the dynamic interaction of supply and demand.
- Our forecast offers vehicles, with their defined attributes, and allows the consumers to make the choice.
- We keep all incentives in place through 2050.



Market Dynamics

Examples:

- OEM lowers price in 2012 to raise demand in California. In 2013 it attempts to capture a new EV market in the U.S, and lowers supply to California market. **Sales figures go down in California.**
- OEM increases production to meet demand in the tune of 400 a week. It expands market to Europe, and lowers supply to California Market. **Sales figures go down in California.**

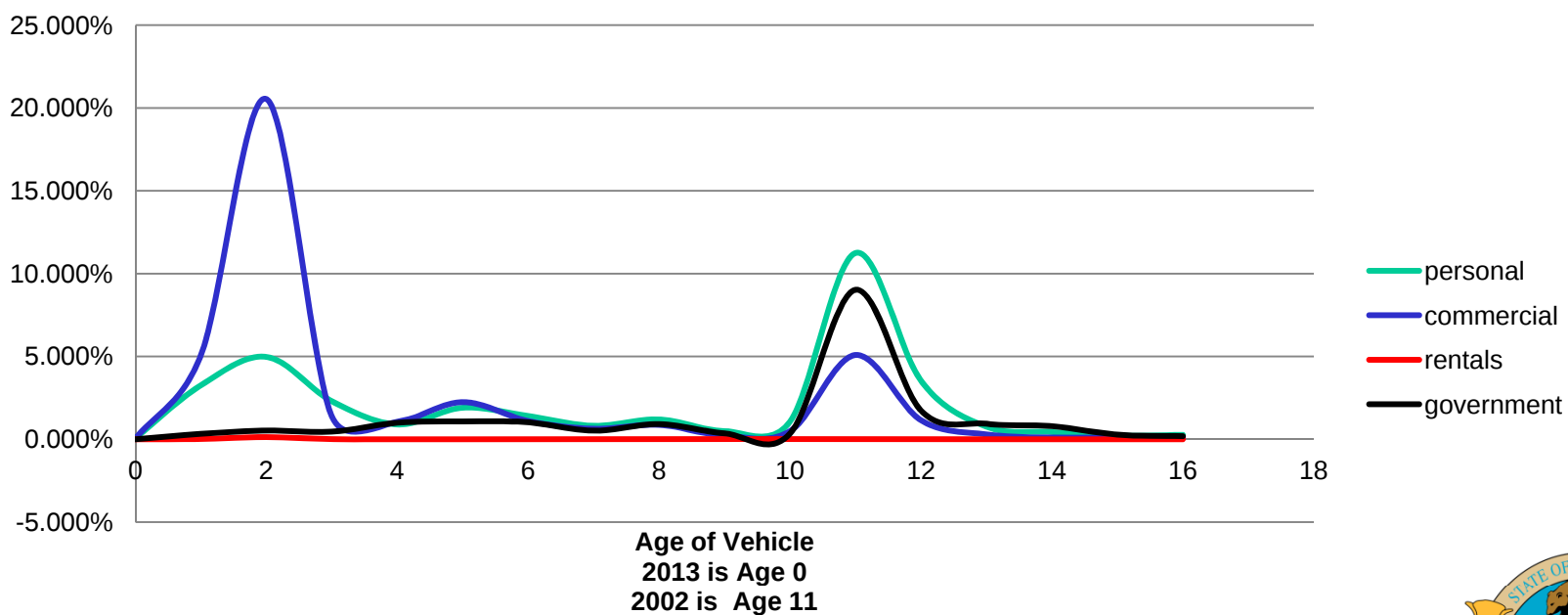
Short Term vs Long Term

- Eventually both companies will increase the production to meet demand in both markets.
- Our demand forecast is long term demand, and not subject to short term fluctuations.



BEV History?

2012 BEV Stock Distribution by Age



Plug in Electric Vehicles in 2012

2012 Registered On-Road PEV Count Distribution				
Vehicle Type	Total Stock All Model Years	2011 Model Year	2012 Model Year	2013 Model Year
EV	9041	5659	1755	22
NEV	14108	401	252	7
PHEV	10298	1268	8209	818



ZEV (BEV+ FCV) and Total LDV Vehicle Stock Reference Case

Year	ZEV Total	PHEV	Total LDV
2020	661,147	760,554	29,919,056
2025	1,280,951	1,350,463	31,766,715
2030	1,887,321	1,988,328	33,775,713
2050	3,245,470	4,305,131	43,817,915



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