Review of the CEC's 2011 Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report

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Initial Observations

- IEPR presents data in a shotgun fashion without meaningful analysis.
- IEPR assumptions differ considerably from 2009 CARB assumptions regarding LCFS and electric/fuel cell vehicle sales.
- IEPR forecasts and LCFS scenario assumptions are not consistent – CEC and CARB should use same assumptions.
- LCFS analysis needs to consider fuel and vehicle costs.
- Based on EIA AEO 2011, CA is assumed to have access to bulk of nationwide supply of low CI fuels.

IEPR and LCFS Scenarios Must Consider Barriers to Fuel Introduction

Requirements (Status)	Gasoline w/ E10 (●)	E85(▲)	Diesel w/o B5 (●)	Diesel w/ B5(●)	E15 (■)	E20(■)	E30 (■)	E100 Fuel (■)	Gasoline w/butanol 16% (■)	B6-B20 (▲)	B21-B100 Fuel (■)	R1-R100 Fuel(●)	CNG (●)	LNG (●)	LPG (●)	Biogas (▲)	Liquid Biogas (▲)	H_2 (■)	Electricity (●)	Urea* (Diesel Exhaust) (●)
Future Fuels and Requirements Status-Air Resources Board Issues																				
ASTM	D4814 ●	D5798 ●	D975 ●	D975 ●	D4814 ●	D4814 ●	D4814 ●	None ■	D4814 ●	D7467 ●	None ■	D975 ●	None ●	None ●	D1835 ●	None ●	None ●	None ●	None ●	None ●
Authority to regulate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Regulations	●	●	●	●	■	■	■	●	■	■	■	■	●	●	●	●	●	●	N/A	■
U.S. EPA Requirements	●	●	●	●	■	■	■	●	●	●	●	●	●	●	●	●	●	●	●	●
Multimedia	●	●	●	●	■	■	■	●	■	■	■	■	●	●	●	■	■	●	●	N/A
Compatible with Petroleum Pipelines	▲	▲	●	▲	▲	▲	▲	▲	●	▲	▲	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vapor Recovery	●	▲	●	●	■	■	■	■	■	●	●	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Issues	●	▲	●	▲	▲	▲	▲	■	▲	▲	■	●	▲	▲	▲	▲	▲	▲	▲	▲
Production Issues	●	●	●	●	●	●	●	●	■	●	▲	■	●	●	●	■	■	■	●	●
Fueling Issues	●	●	●	●	■	■	■	■	■	●	●	●	●	●	●	●	●	■	■	■
Future Fuels and Requirements Status-CDFA, Division of Measurement Standards Issues																				
ASTM/SAE	●	●	●	●	▲	▲	▲	■	●	●	■	●	●	●	●	●	●	●	N/A	N/A
Authority to regulate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Regulations	●	●	●	●	▲	▲	▲	▲	●	●	▲	●	●	●	●	▲	▲	●	▲	N/A
Quality Standard for fuel use	●	●	●	●	▲	▲	▲	▲	●	●	▲	●	●	●	●	▲	▲	▲	N/A	N/A
Quality test methods	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	N/A	●
Quality test equipment	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	N/A	●
Metering systems	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●
Quantity test methods	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●
Quantity test equipment	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●
Method of Sale	●	●	●	●	▲	▲	▲	▲	●	●	▲	●	●	●	●	▲	▲	▲	▲	●
Labeling	●	●	●	●	▲	▲	▲	▲	●	●	▲	●	●	●	●	▲	▲	▲	▲	●
Advertising	●	●	●	●	▲	▲	▲	▲	●	●	▲	●	●	●	●	▲	▲	▲	▲	●

Requirements (Status)	Gasoline w/ E10 (●)	E85(▲)	Diesel w/o B5 (●)	Diesel w/ B5(●)	E15 (■)	E20(■)	E30 (■)	E100 Fuel (■)	Gasoline w/butanol 16% (■)	B6-B20 (▲)	B21-B100 Fuel (■)	R1-R100 Fuel(●)	CNG (●)	LNG (●)	LPG (●)	Biogas (▲)	Liquid Biogas (▲)	H_2 (■)	Electricity (●)	Urea* (Diesel Exhaust) (●)
Future Fuels and Requirements Status-CAL FIRE Office of The State Fire Marshal Issues																				
ASTM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Regulated by CA Fire Code	●	■	●	●	●	●	■	■	●	●	●	●	●	●	●	●	●	●	●	N/A
NFPA Standards	●	■	●	●	●	●	■	■	●	●	●	●	●	●	●	●	●	●	●	N/A
Vapor Recovery & Dispenser	●	■	●	●	●	●	■	■	●	●	●	●	●	●	●	●	●	●	●	N/A
Tanks	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	N/A
Future Fuels and Requirements Status - State Water Resources Control Board (UST Program)																				
ASTM	●	●	●	●	●	●	●	■	●	●	■	▲	●	●	●	●	●	●	●	●
Regulated by CA Health and Safety Code	●	●	●	●	●	●	●	●	●	●	●	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leak Detection Functional Testing	●	●	●	●	■	■	■	■	■	●†	■	■	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Testing Organization Approval	●	●	●	●	●	●	●	●	■	●†	■	■	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Industry Code and Engineering Standards	●	●	●	●	●	●	●	●	■	●†	■	■	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

● = There are no technical, or regulatory issues, but there may be local regulations that limit use.

▲ = There are surmountable technical issues, or the fuel can meet existing regulations but it is difficult to do so.

■ = There are significant technical issues, additional regulations are needed, or fuel does not meet existing regulations.

†Regulatory exclusion/variance expires June 2012.

*Urea is not a fuel, it is added post combustion to reduce emissions of Nitrogen Oxides by catalytic reduction.

Source: Cal/EPA Fuels Guidance Document, Version 1.0, May 17, 2011

Ethanol – E10

- Forecast 2020 CA ethanol demand for E10 = 1.31 to 1.45 billion gallons of ethanol
  - 2020 total Brazilian estimate of exports to U.S. = ~ 0.5 billion gallons (Figure 5-12)
    - Down from 0.7 billion gallons for 2017 in 2009 IEPR (Figure 3.26)
  - 2020 EIA AEO 2011 forecast of ~2 billion gallons for total U.S. imports
  - 2020 EIA AEO 2011 forecast of ~2 billion gallons for total U.S. cellulosic production

Ethanol – E10 (cont.)

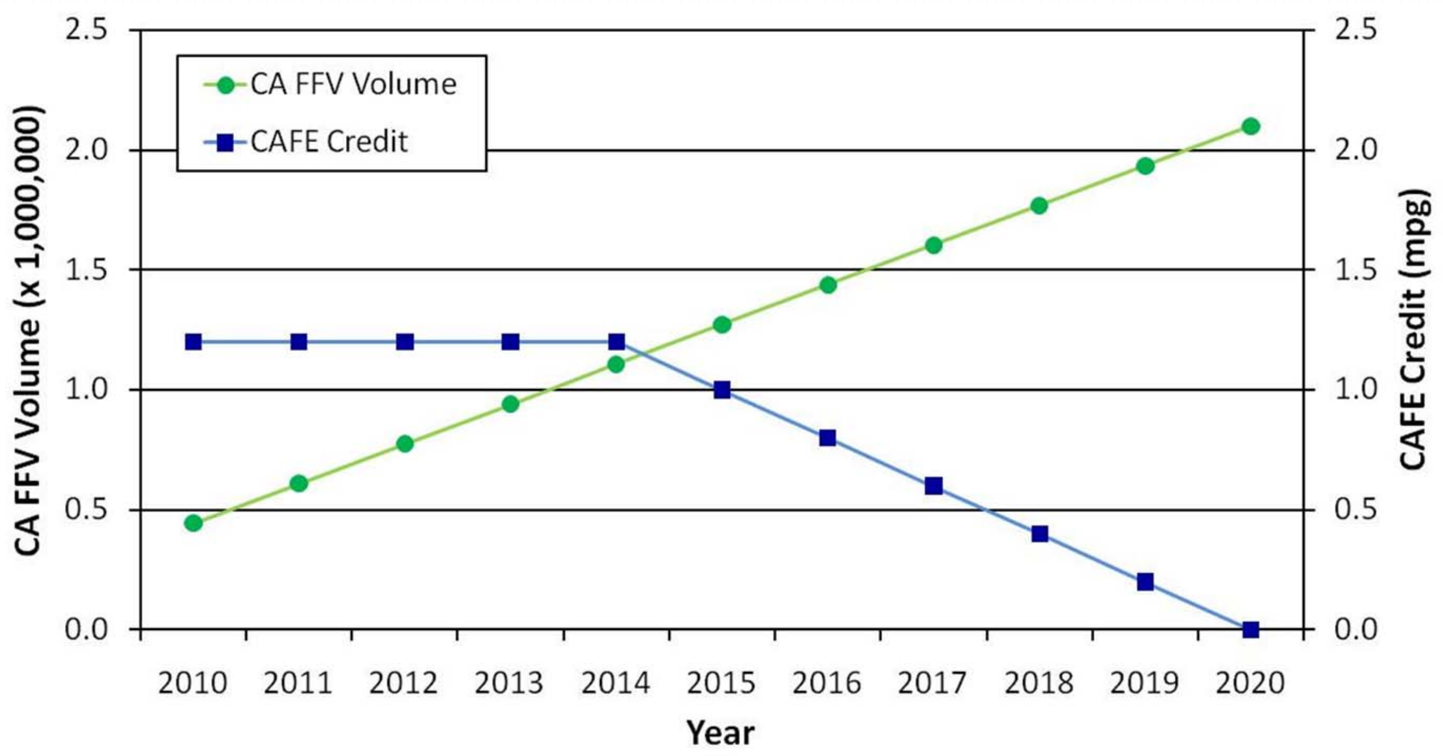
- Price increments for low CI ethanol:
  - "Low CI" $0.02 to $0.10 (page 125)
  - $1.04 -$1.75 per gallon for Brazilian (page 125)
  - $0.88 per gallon for Brazilian (page 133)
  - No price estimate for cellulosic, but credits = $0.25 to more than $1.00 (page 87-88)
- Incremental cost of E10 in CA relative to average ethanol is as much as $2.5 billion in 2020.
- Impacts of infrastructure limits? (page 163-164)
- Impacts of ethanol shuffling?

Ethanol – E85

- Forecast 2020 CA ethanol demand for E85 = ~ 1.3 billion gallons of ethanol (Figure 4-8).
  - Assumes 800 gallons of E85 use per FFV per year = 12,000 E85 miles for a 2010 FFV Malibu.
  - E85 use assumes E85 is cheaper than E10 on GGE basis.
- Incremental cost of E85 in CA relative to average ethanol is as much as $2.5 billion in 2020.
- E85 dispenser infrastructure costs are from $0.8 to $21 billion from 2011 to 2020 (page 99).
- Assumed number of FFVs is much lower in 2011 IEPR (Figure 4-14) compared to 2009 IEPR (Figure 3.15).

CEC FFV Forecasts Questionable

- 166,000 new FFVs assumed per year from 2010 to 2020
  - 2008 Total = 382,000
  - 2010 Total 443,000



Biodiesel

- At B5, required CA volume of B100 in 2020 = 0.2 billion gallons
- At B20, required CA volume of B100 in 2020 = 0.8 billion gallons
- EIA 2020 forecast of total U.S. B100 production = 1.7 billion gallons
  - Forecast total U.S. supply of low CI biodiesel is far less.
- Impacts of cost, infrastructure, and warranty issues above B5 must be addressed.

“Drop-in” Fuels

- 2020 EIA forecast volume for total U.S. production of renewable gasoline/Diesel+BTL = ~0.8 billion gallons.
- Only renewable Diesel is currently produced in commercial quantities (page 180).
- Renewable Diesel is “more costly” than petroleum Diesel (page 180).
- Need forecast of “drop-in” supply in CA and must consider costs in LCFS scenario analysis.

Natural Gas/Biomethane

- NG use is limited by small NG vehicle population, which is not forecast to grow substantially (Figure 3-6).
- Existing refueling infrastructure is limited (pages 187-189), and expansion would be costly (Table 5-5).
- Small vehicle population and limited refueling infrastructure preclude use of significant quantities of biomethane even if supply materializes.
- Impact of CARB NG fuel specs on biomethane cost/supply must be considered.

Electricity

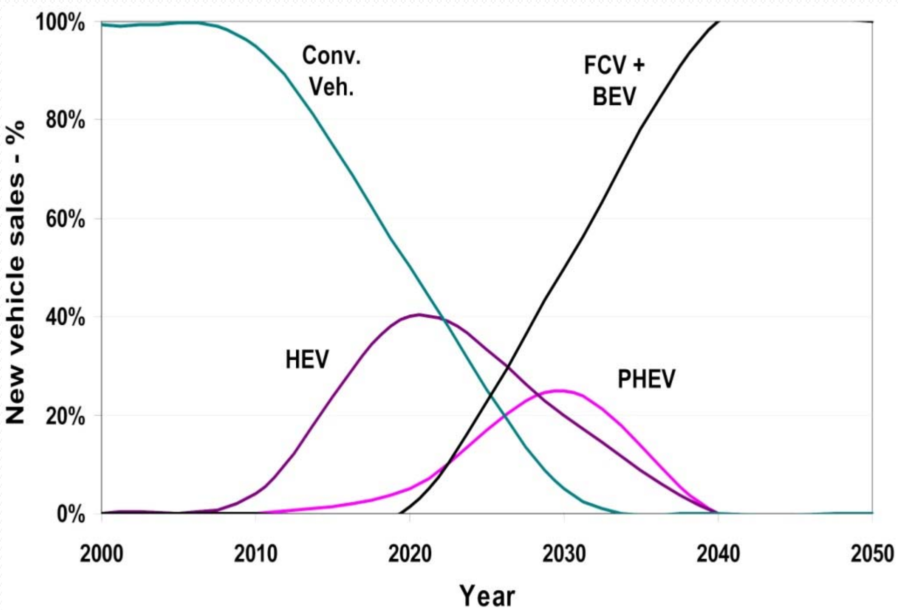
- Major differences between 2009 and 2011 IEPR electric vehicle populations:
  - 2009 IEPR – 1.5 million PHEVS in 2020 (page 18)
  - 2011 IEPR – 3.0 million PHEVS in 2020 (Figure 3-8)
- Major differences between 2009 and 2011 IEPR transportation electricity demand:
  - 2009 IEPR – ~5,000 GWhs = 150 million GGE (Table 2.12)
  - 2011 IEPR – ~ 700 GWhs = 21 million GGE (Figure 3-15)

Electricity (cont.)

- Electric vehicles are assumed to be mainly PHEVs – CARB assumes far more BEVs.
- CEC assumed PHEV sales rates are higher than for FFVs.
- Incremental cost of 3 million PHEVs = $21 billion at optimistic $7,000/vehicle CARB estimate.
- Recharging infrastructure costs at ~ $1,000 per PHEV = $3 billion (Table 5-3).
- No quantification of fuel cost savings or battery replacement costs.

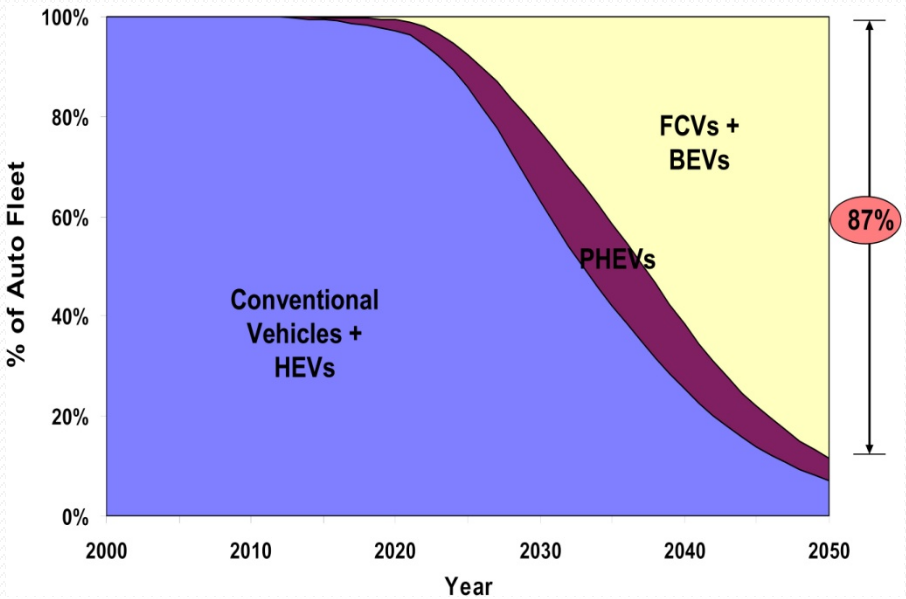
CARB Sales Forecasts

New Vehicle Sales, Passenger Vehicle (cars) Segment[a] – Scenario 2



[a] BEV = 30% of "FCV+BEV" in 2040

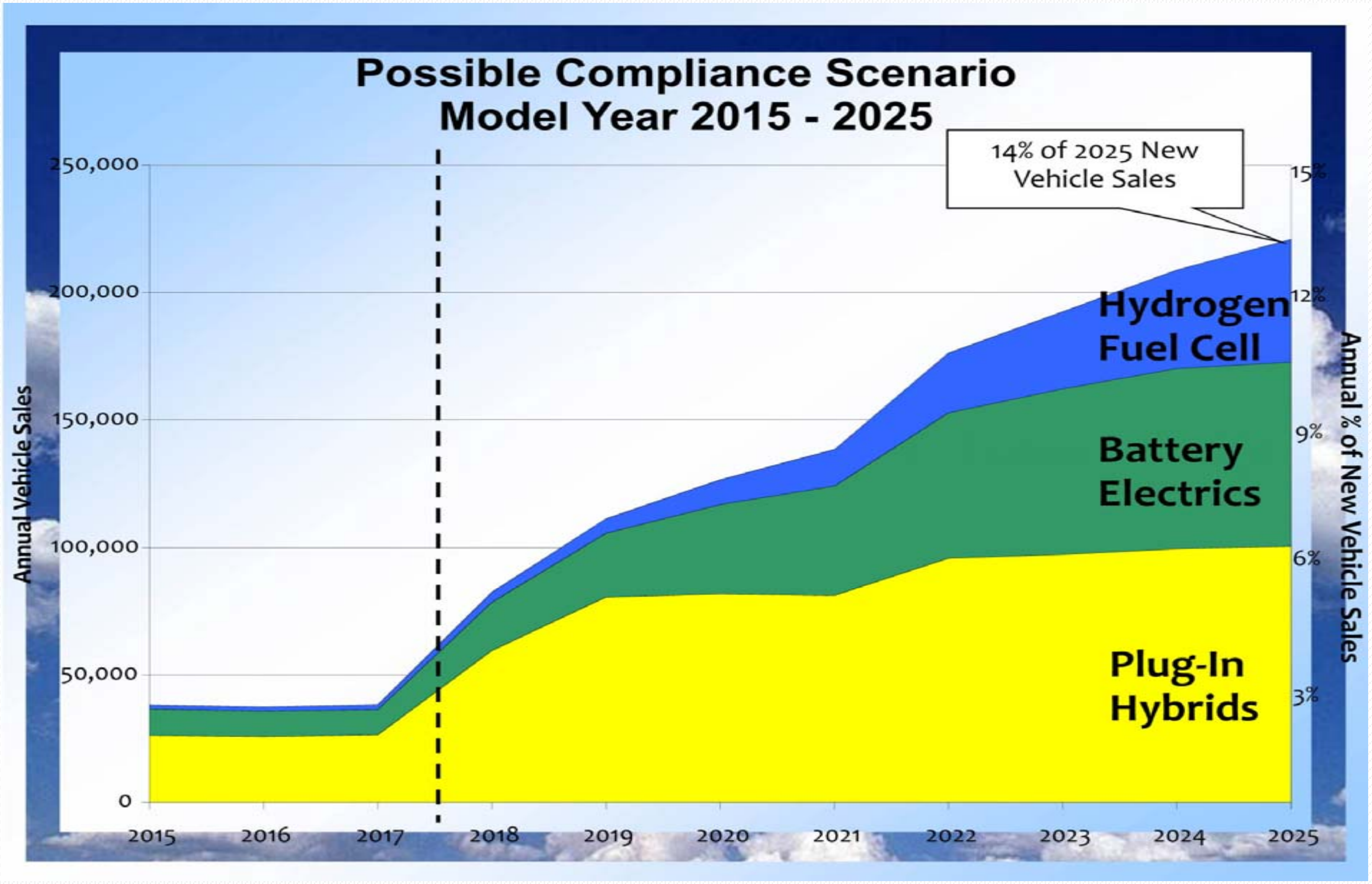
On-Road Fleet, Passenger Vehicle (cars) Segment – Scenario 2[b]



[b] The slope of the ZEV sales over multiple decades is highly uncertain. This analysis assumes an aggressive growth that is similar to assumptions in the NRC 2008c.

Source: CARB, "Attachment B, 2050 Greenhouse Gas Emissions Analysis: Staff Modeling in Support of the Zero Emission Vehicle Regulation"

CARB Forecasts of PHEVs, BEVs, and FCVs



Source: CARB, "Clean Fuels Outlet Workshop III," July 13, 2011

Hydrogen

- No demand forecast.
- No assessment of required refueling infrastructure – at $1 to $2.5 million per station (page 189).
- Hydrogen prices in Table B-6 do not reflect production from biomethane (pages 191, B9).
- Assumption of small fuel cell vehicle population is at odds with CARB assumptions.

Conclusions

- CEC and CARB must use consistent and reasonable assumptions in IEPR and LCFS scenario analyses.
- Reasonable assumptions must be made regarding potential CA share of total U.S. supply of low CI fuels.
- Costs of fuels, vehicles, and refueling infrastructure must be included in LCFS scenario analysis.
- IEPR should include an analysis that highlights all of the issues and costs associated with LCFS compliance.

Questions ?

- Sierra's review of the IEPR is being funded by the Western States Petroleum Association