

Overview of Proposed Transportation Energy Analyses

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**California Energy Commission
Staff Presentation
Hearing Room A**

February 10, 2009

Fossil Fuels Office
Fuels and Transportation Division

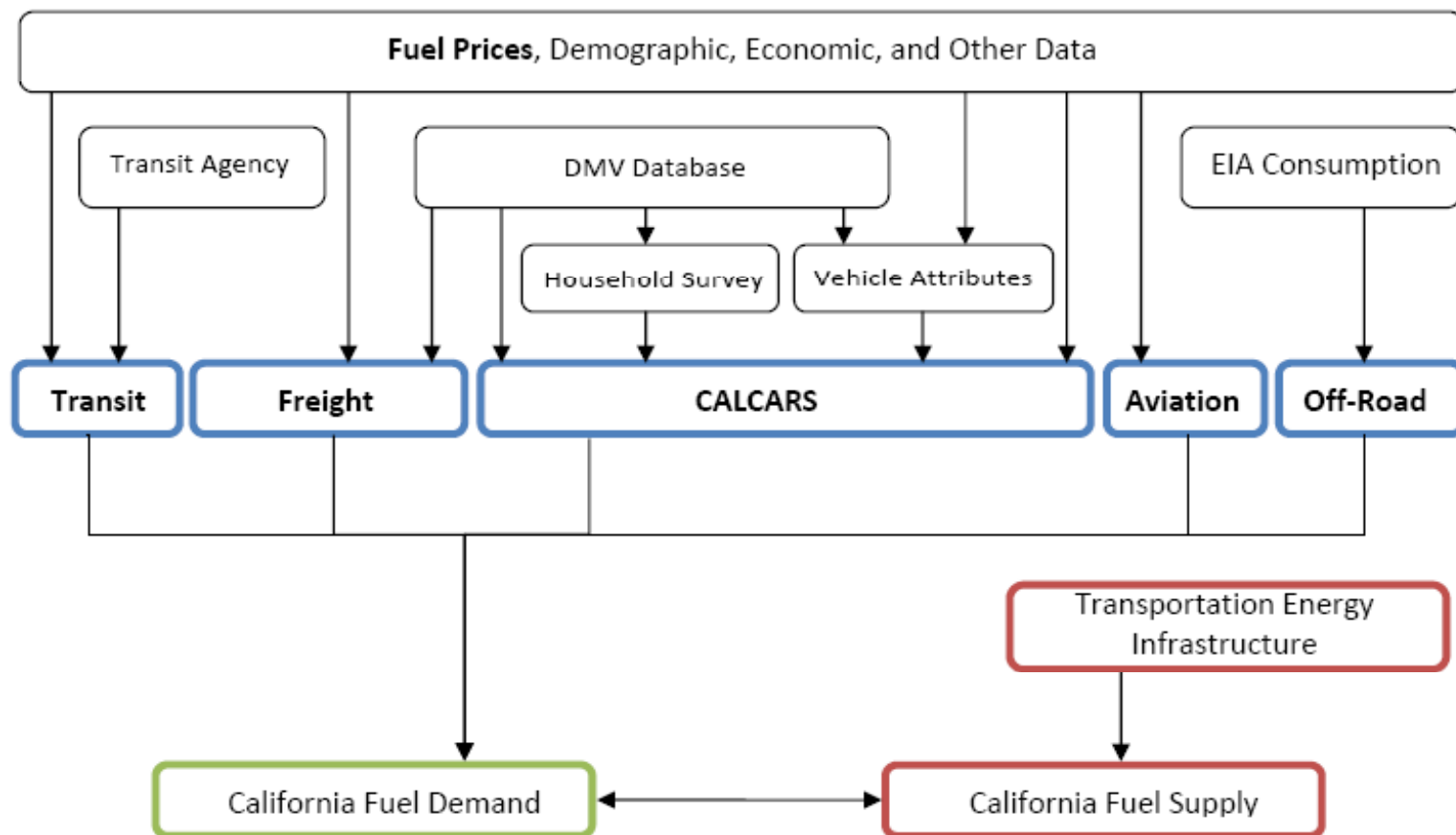


Objectives

- Overall framework and approach
- Demand model discussion – methods, inputs, and assumptions
- Crude oil and petroleum fuel price forecasts
- Alternative and renewable fuels price forecasts
- Next steps



Data Flow to Transportation Energy Demand Models



California Energy Commission Transportation Energy Demand Models

The models proposed to forecast transportation energy demand for the 2009 IEPR include:

1. CALCARS (light and medium-duty vehicles)
2. Freight
3. Transit (urban and intercity)
4. Aviation (commercial)



Proposed Forecasted Transportation Fuels for the 2009 IEPR

Staff intends to include the following fuels in the transportation energy demand forecasts:

1. Gasoline
2. Diesel
3. Electricity
4. E85 (85 percent Ethanol blended with gasoline)
5. Natural gas
6. Jet fuel
7. Biomass-based Diesel
8. Propane
9. Hydrogen



Economic and Demographic Data Used in Modeling

The Economic and Demographic Data includes:

- Population
- Employment growth rates
- Personal Income
- Industrial activity for 23 NAICS
- On-road registered vehicles
- Fuel Prices
- Transportation costs (ticket prices and fares)



Proposed Demand Forecast Cases

Policy Scenario	Low Petroleum Fuel Prices	High Petroleum Fuel Prices
GHG Regulations and EISA	Case 1	Case 2
Pavley 2 Regulations	Case 3	Case 4
Lower or Incentivized Alternative Fuel Prices	Case 5	Case 6
Incentivized Alternative Fuel Vehicle Prices	Case 7	Case 8



Crude Oil and Transportation Fuel Price Forecasts



Forecasting Challenges

- Unprecedented volatility in crude oil and fuel markets
- Lack of in-house world energy model
- In-house models and available data support annual average statewide forecasts
- Need to integrate alternative fuel forecasts into existing in-house models
- Forecast horizon to 2030

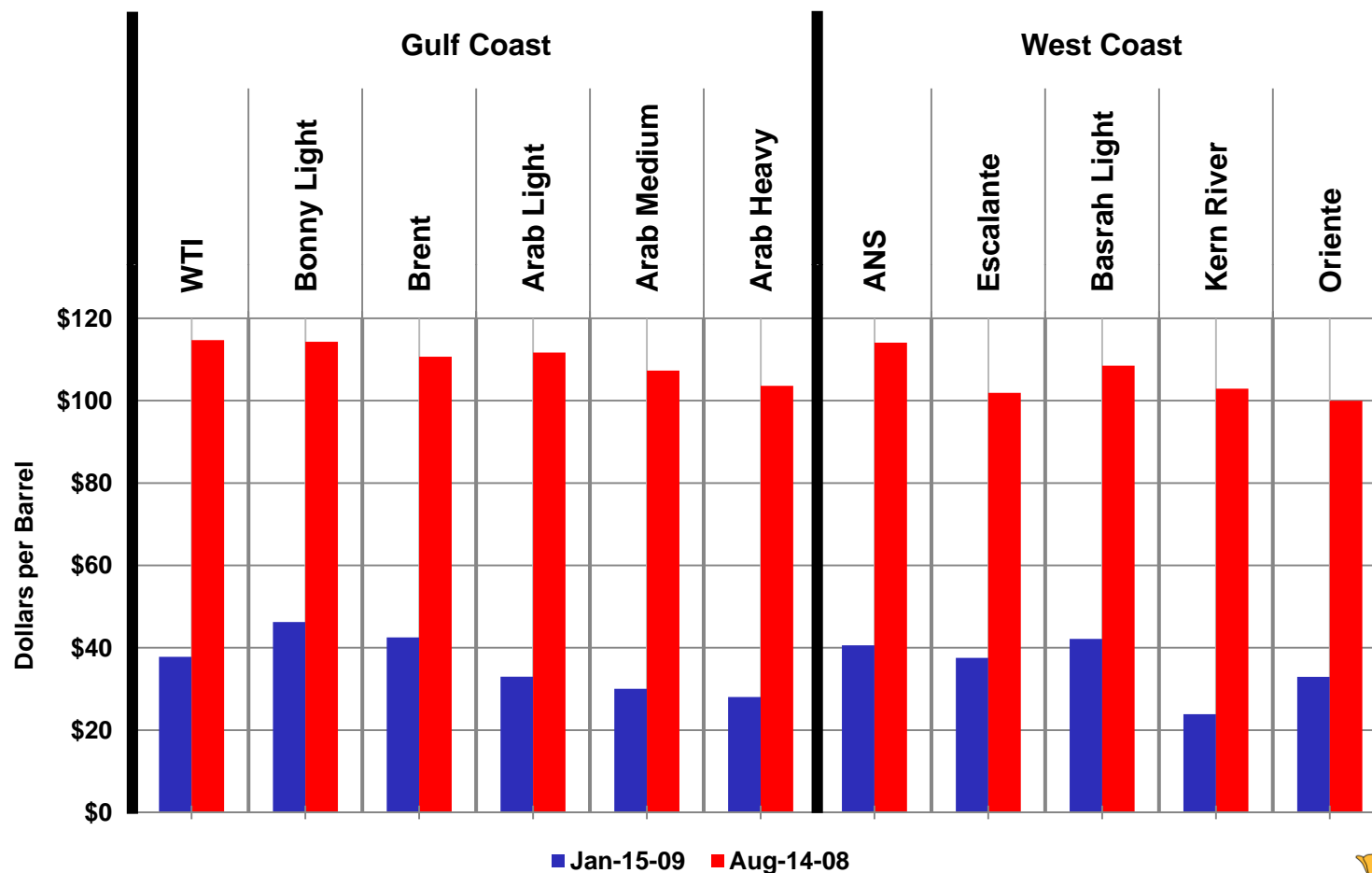


Solutions

- Assess the use of crude oil price forecasts from EIA, IEA, or other organizations
- Use historical data on U.S. Imported Refiner Acquisition Cost (RAC) of crude oil and state petroleum fuel price relationships
- Consult with other offices on E-85, natural gas, hydrogen prices, and electric rates for EVs and plug-in-hybrids
- Solicit expert advice from workshop participants



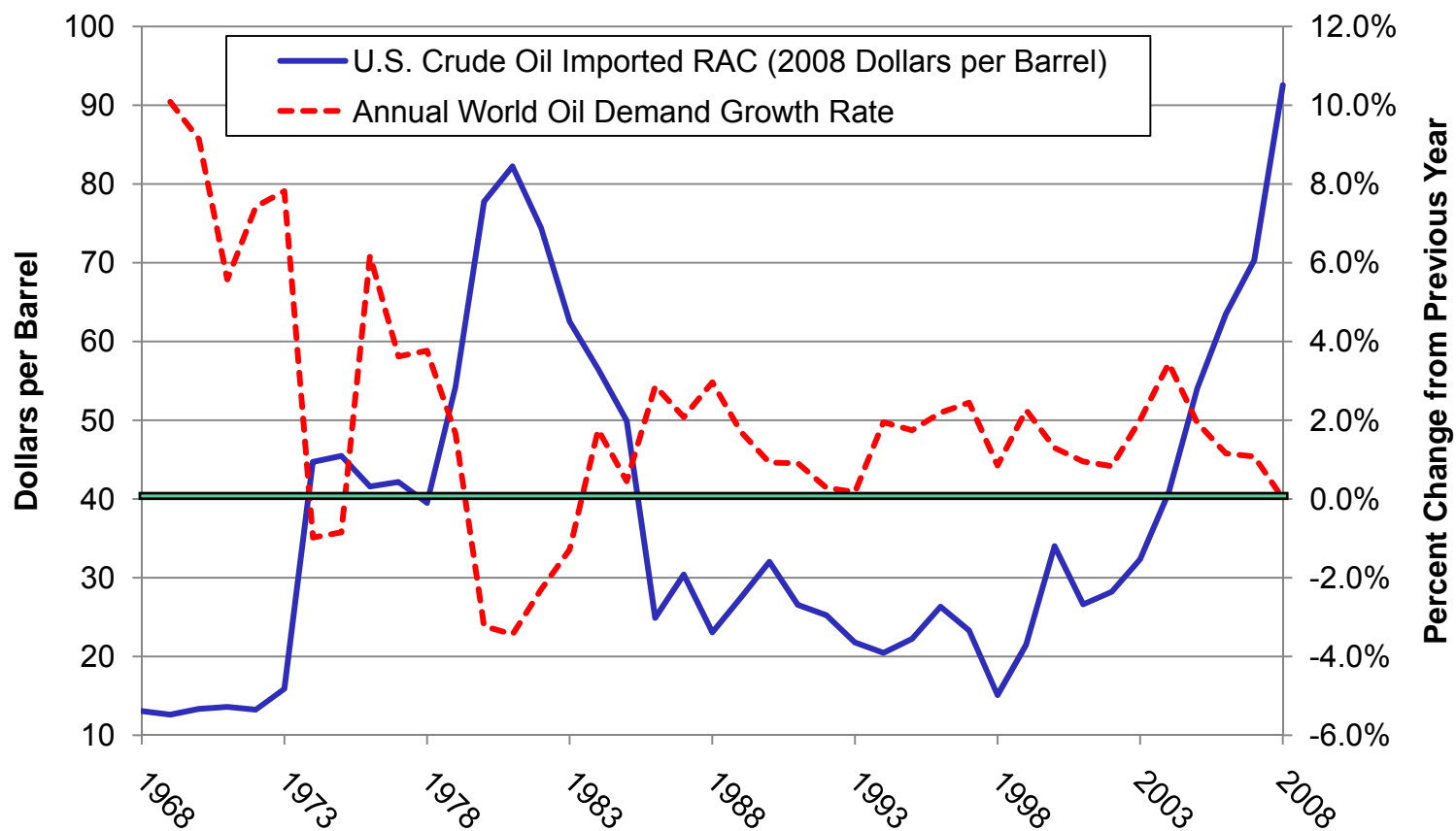
Crude Oil Spot Price Indexes



Source: Platt's Oilgram & Price Report



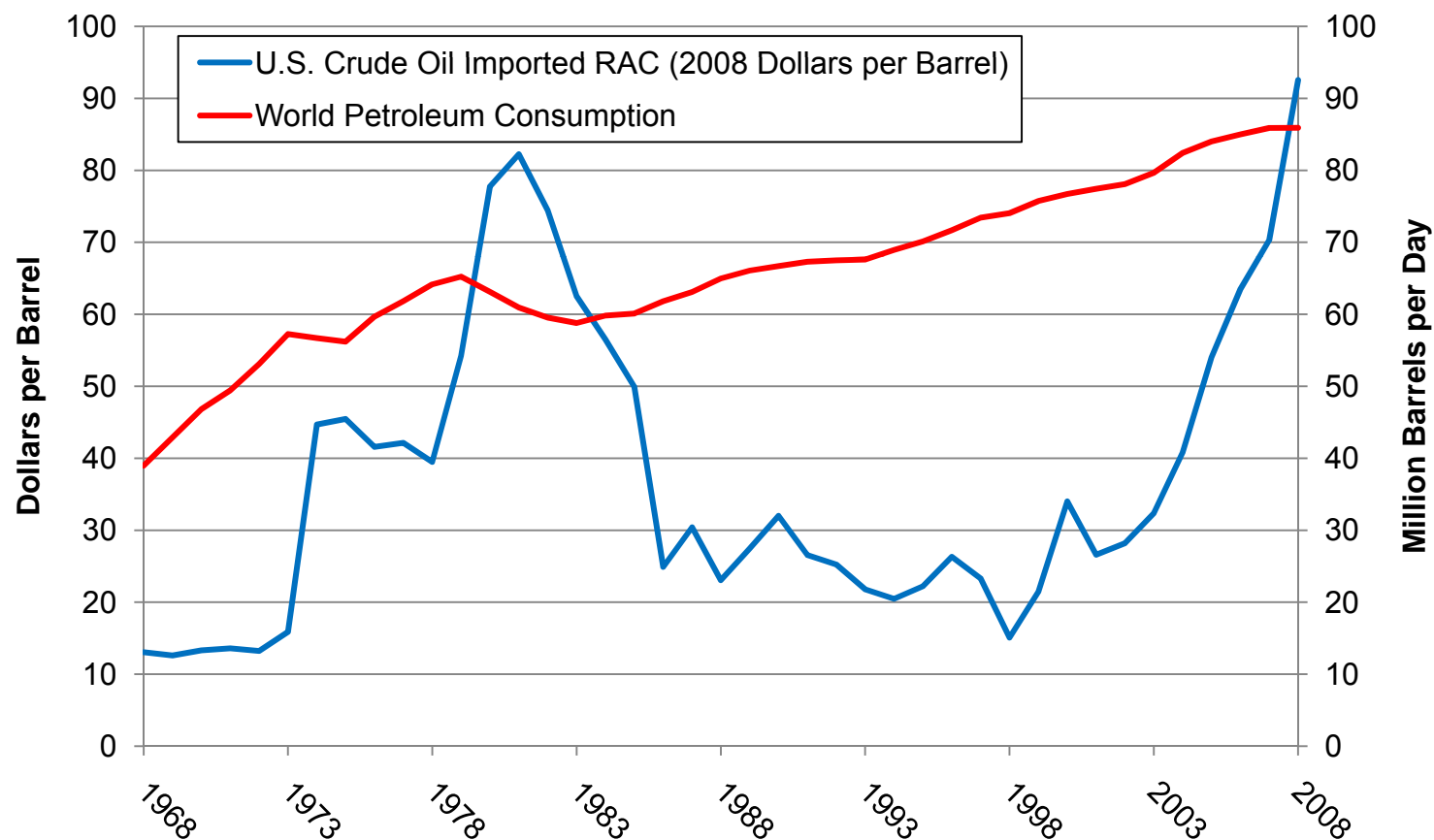
U.S. RAC & World Oil Demand Growth



Source: U.S. Energy Information Administration



U.S. RAC & Total World Oil Demand



Source: U.S. Energy Information Administration



Causes of Oil and Fuel Price Increases (2003 to mid 2008)

- Increasing world petroleum demand
- Resource nationalism
- Rising oil production project costs
- Declining excess oil production capacity
- U.S. refinery outages
- Weather
- Dollar devaluation
- Increased speculative activity

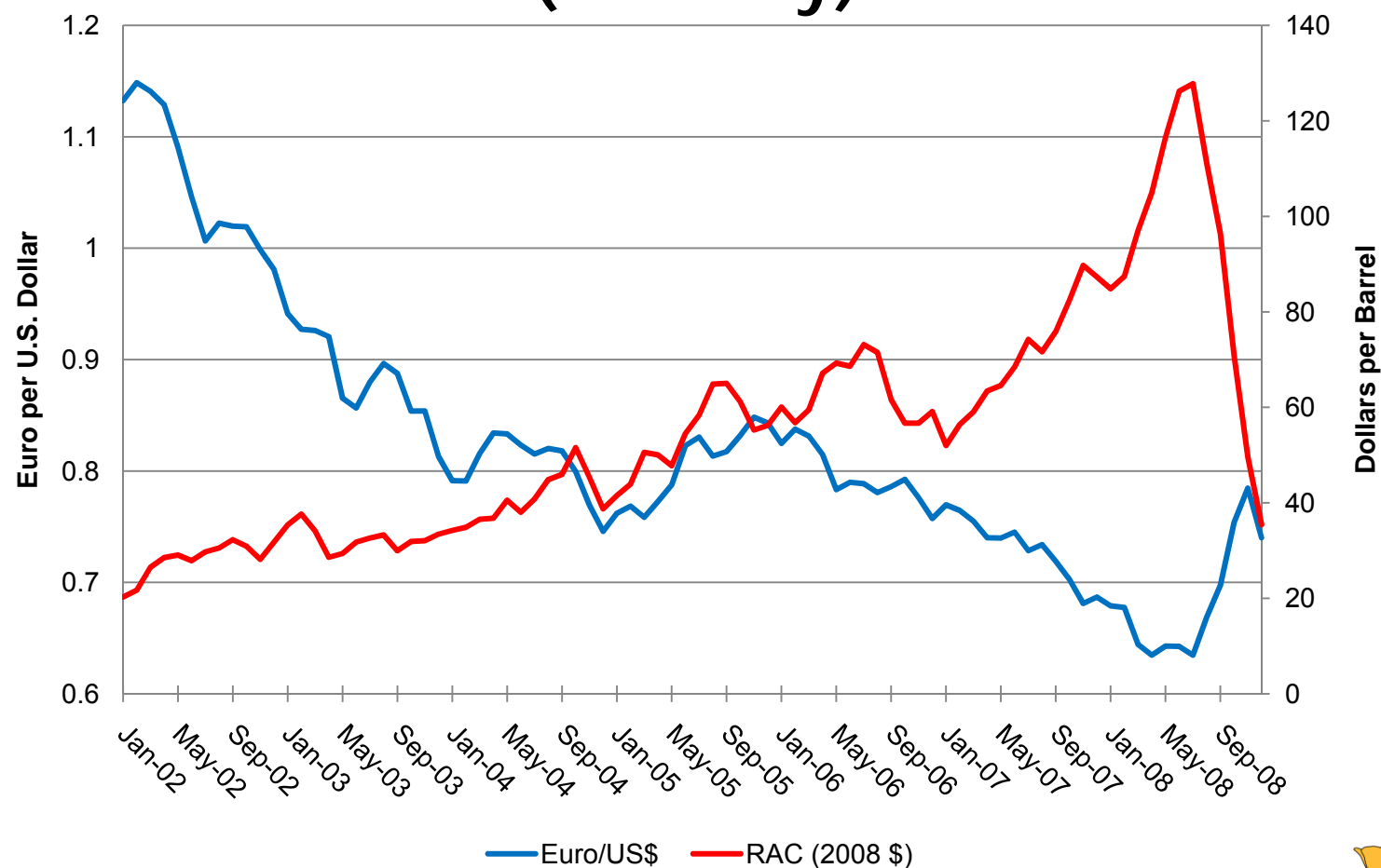


Causes of Oil and Fuel Price Declines (late 2008 into 2009)

- World economic contraction
- Declining world oil demand growth rate
- Increasing excess oil production capacity
- Increasing U.S. oil inventories
- Increasing value of the Dollar



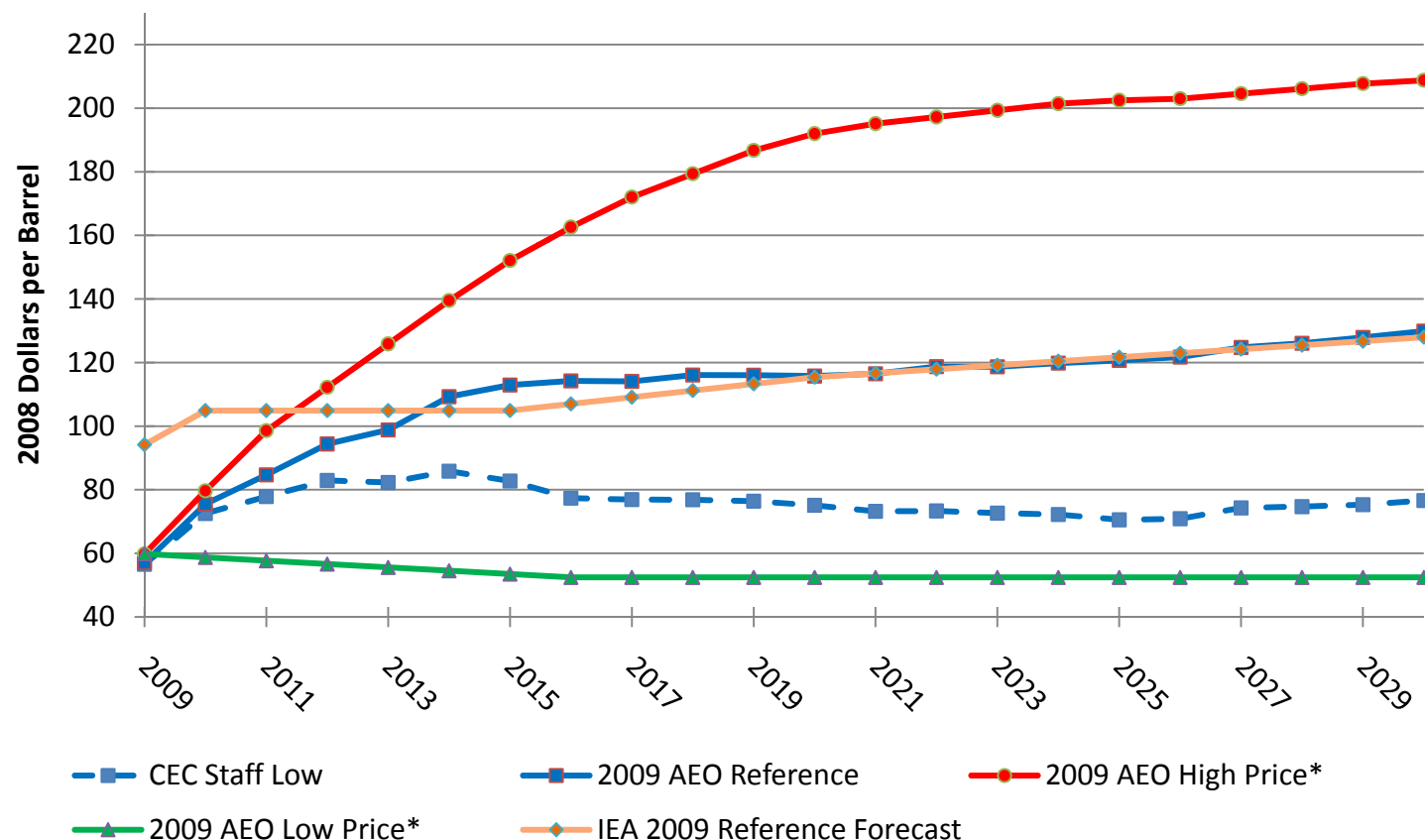
U.S. Currency Value & Price of Crude Oil (Monthly)



Source: U.S. Energy Information Administration



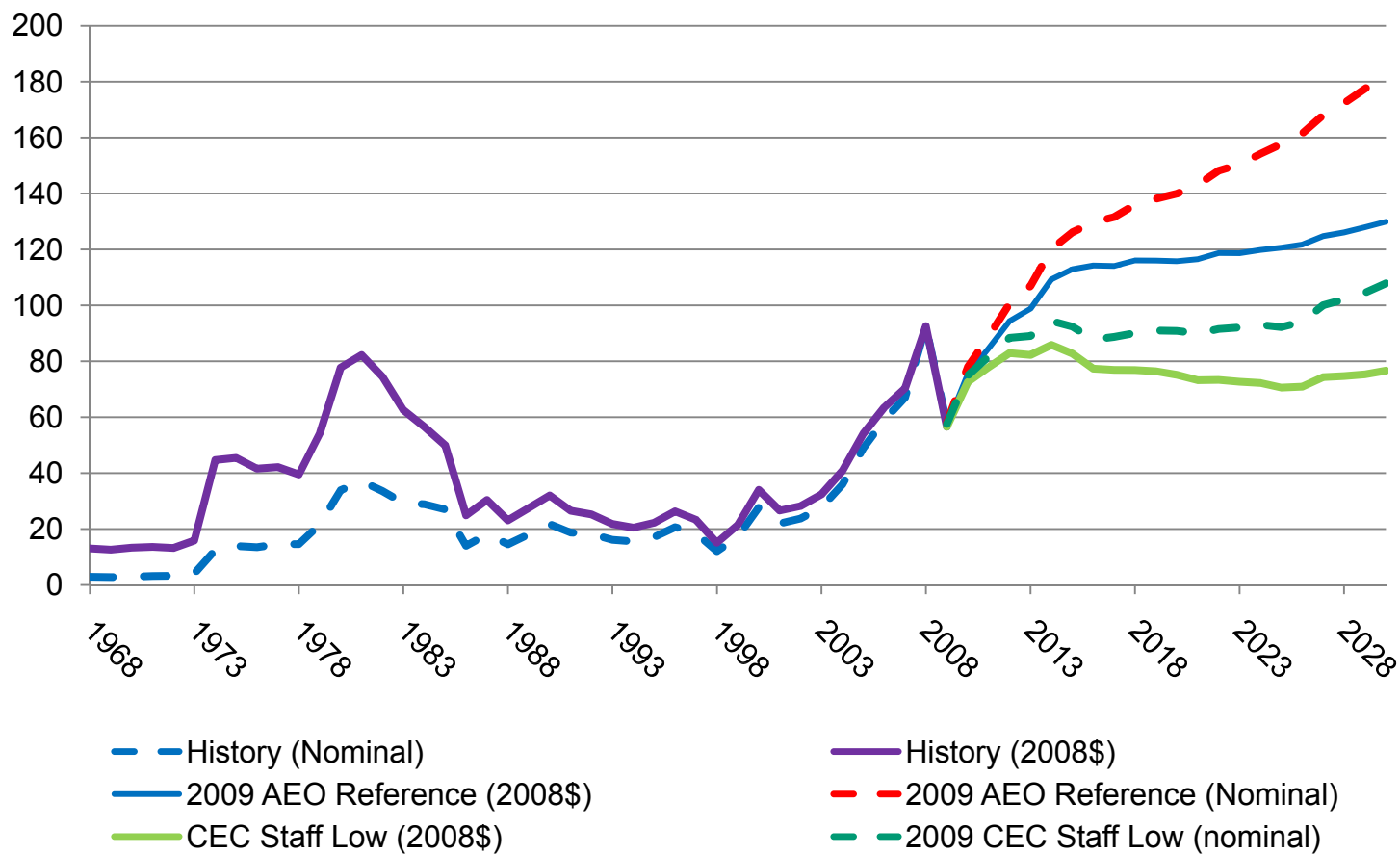
EIA & IEA Crude Oil Price Forecasts (2008 Dollars)



Note: Indexed to U.S. Refiner Acquisition Cost of Imported Crude Oil
(*) denotes that price forecasts are Energy Commission estimates of EIA graphical information



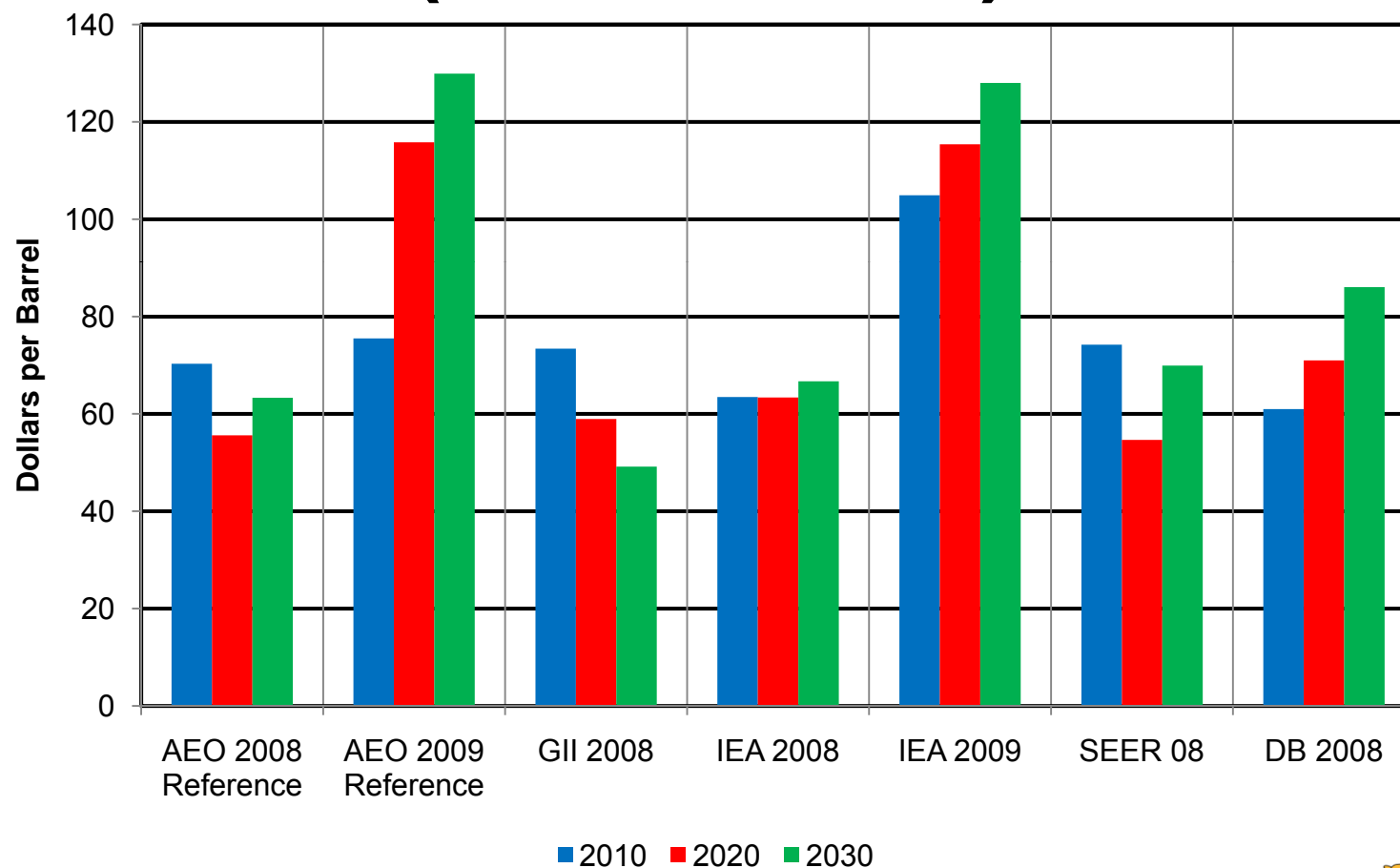
U.S. RAC Historic & Forecast



Source: Energy Commission and U.S. Energy Information Administration



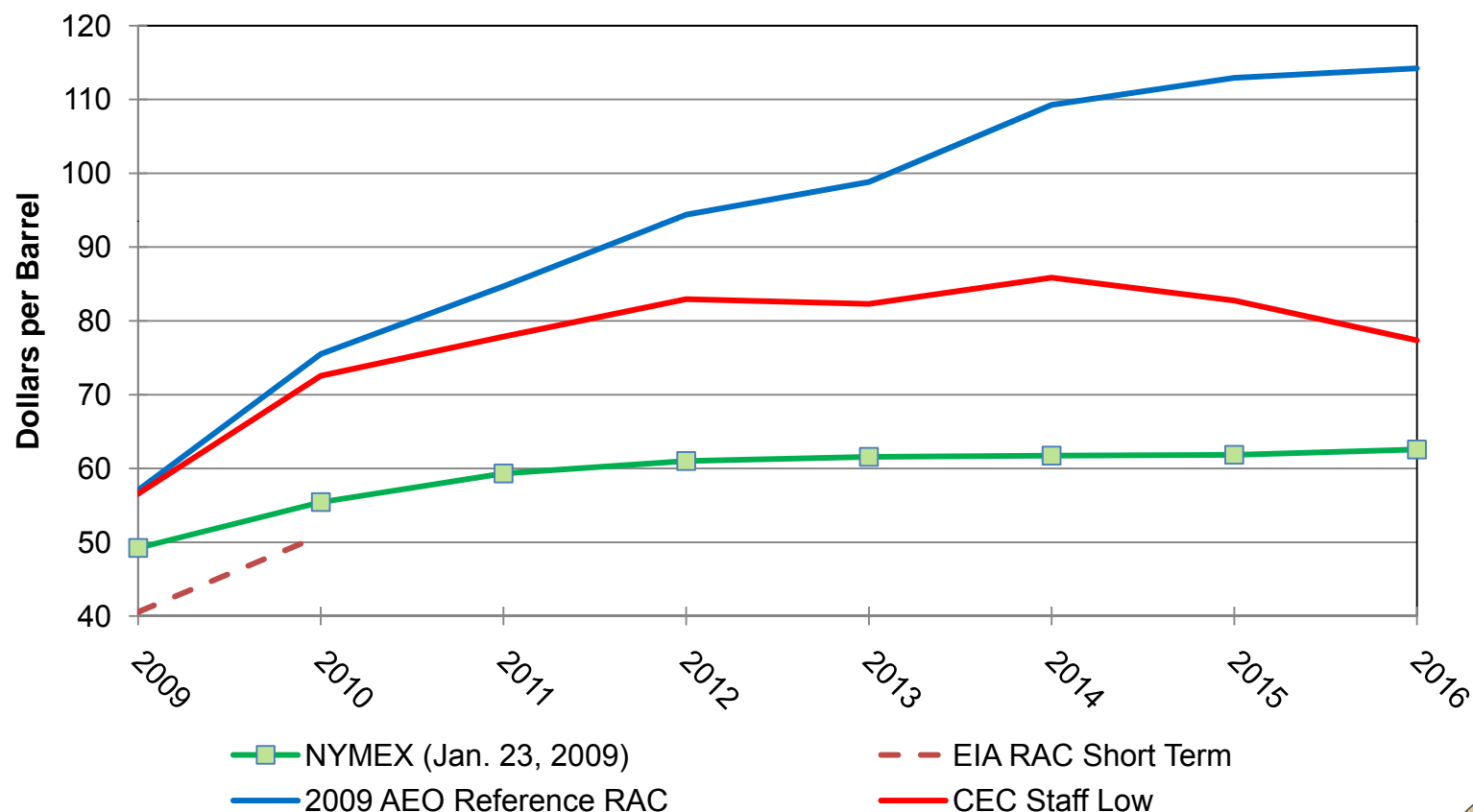
Oil Price Forecasts by Forecast Year (2008 Dollars)



Source: U.S. Energy Information Administration



Short- & Long-Term Price Forecasts Vs NYMEX Futures (2008 Dollars)



Source: Energy Commission, U.S. Energy Information Administration, and NYMEX



Petroleum Transportation Fuel Price Forecasting Method

- Uses forecasted RAC oil price in cents per gallon
- Establishes and adds margins for fuel prices
 - RAC to rack price margin (High and Low)
 - Rack to retail price margin (High and Low)
- Adds California and federal taxes and fees (excise and sales)
- Includes the costs of E-10 changes, 10 cents (high) and 5 cents (low), starting in 2010 at half cost and in full effect by 2012

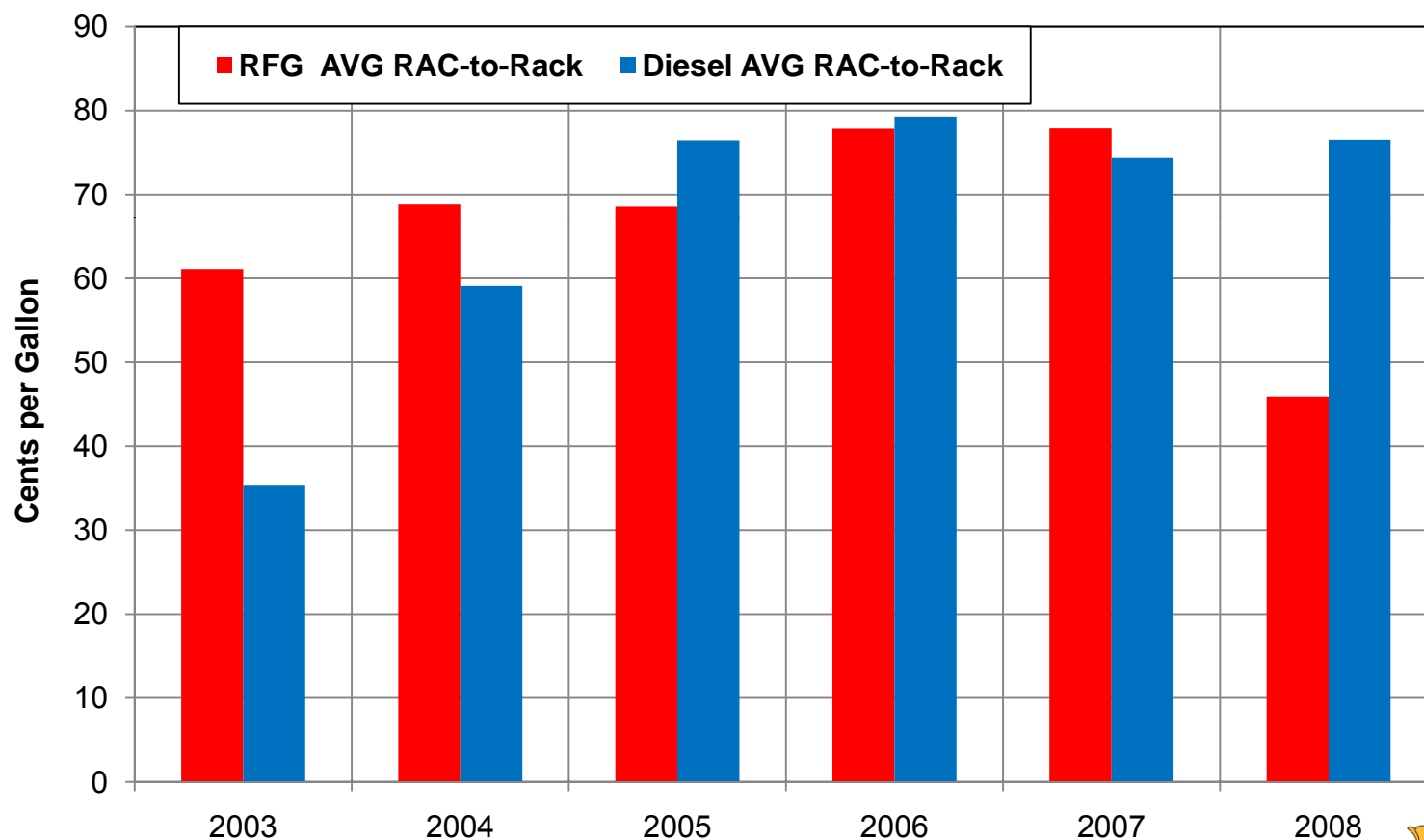


Assumptions

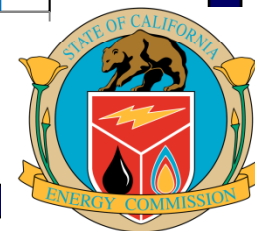
- In real terms, fuel margins held constant
- California and federal excise taxes and fees are held constant in real terms
- Current or planned fuel formulations to remain constant
- No greenhouse gas reduction regulations beyond Pavley rules incorporated in forecasts



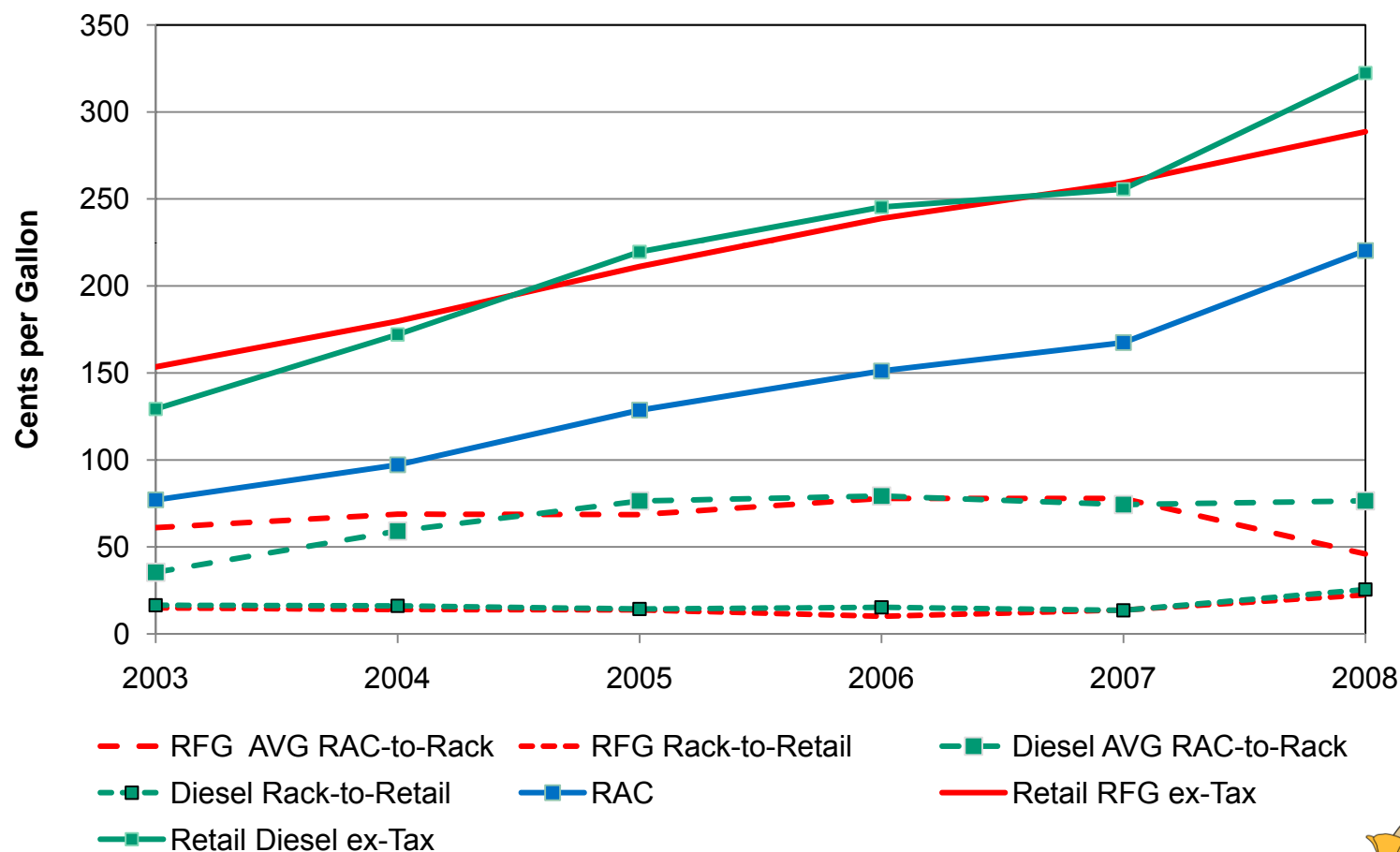
California Gasoline and Diesel RAC-to-Rack Price Margins (2008 Cents)



Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data



California Gasoline and Diesel Margins (2008 Cents)



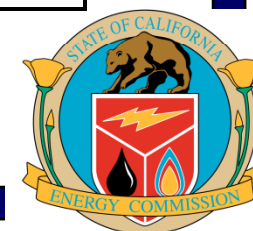
Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data



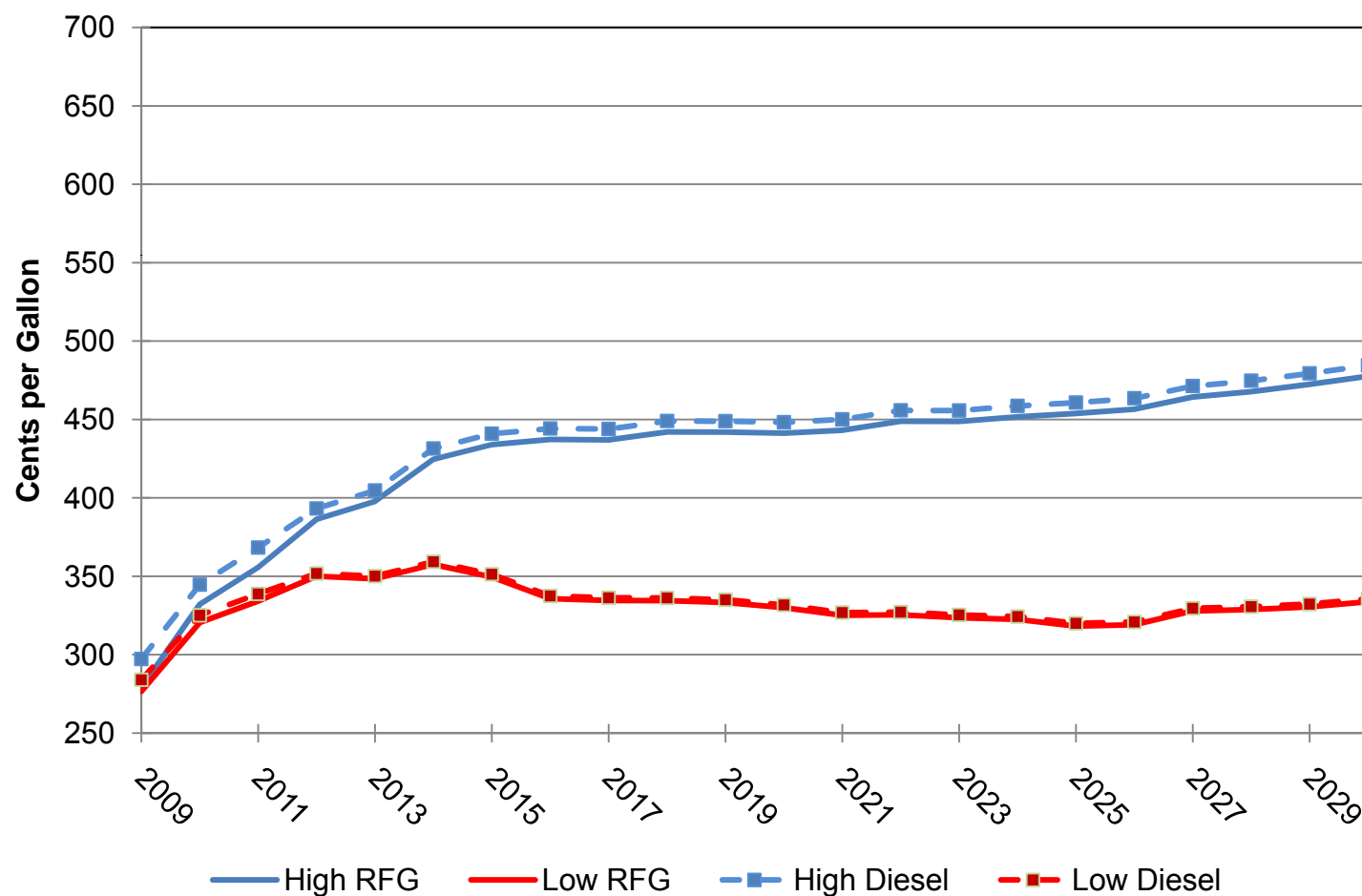
California Transportation Fuel Price Margins & Adders (2008 Cents)

	RFG Crude-to- Rack	Diesel Crude-to- Rack	RFG Rack-to- Retail	Diesel Rack-to- Retail	RFG E-10 Adder (2012- 2030)	RFG E-10 Adder (2010- 2011)
CEC High (2006-2008 average)	67.2	76.7	15.5	18.1	10.0	5.0
CEC Low (2003-2008 average)	66.7	66.9	14.9	16.9	5.0	2.5

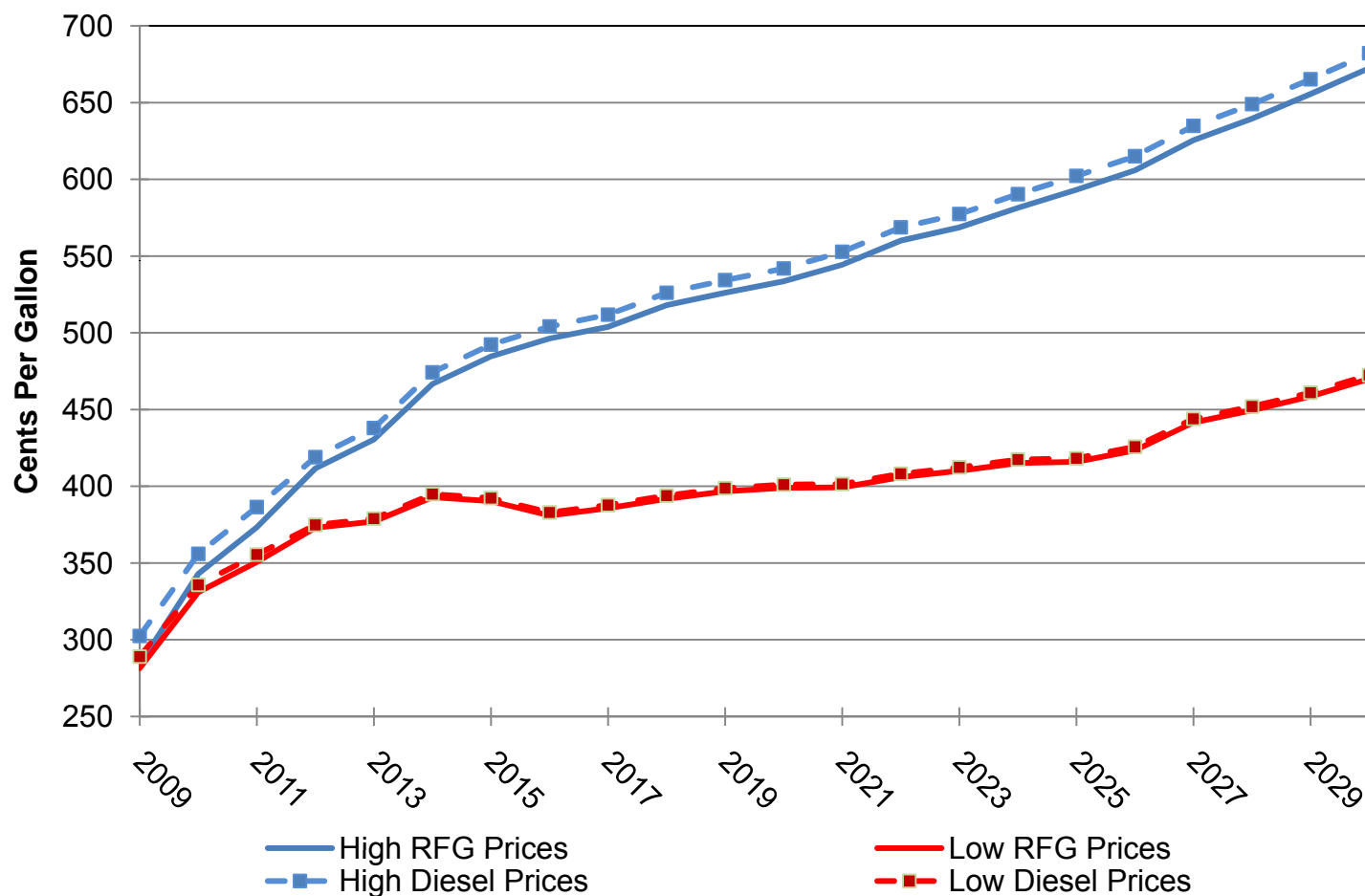
Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data



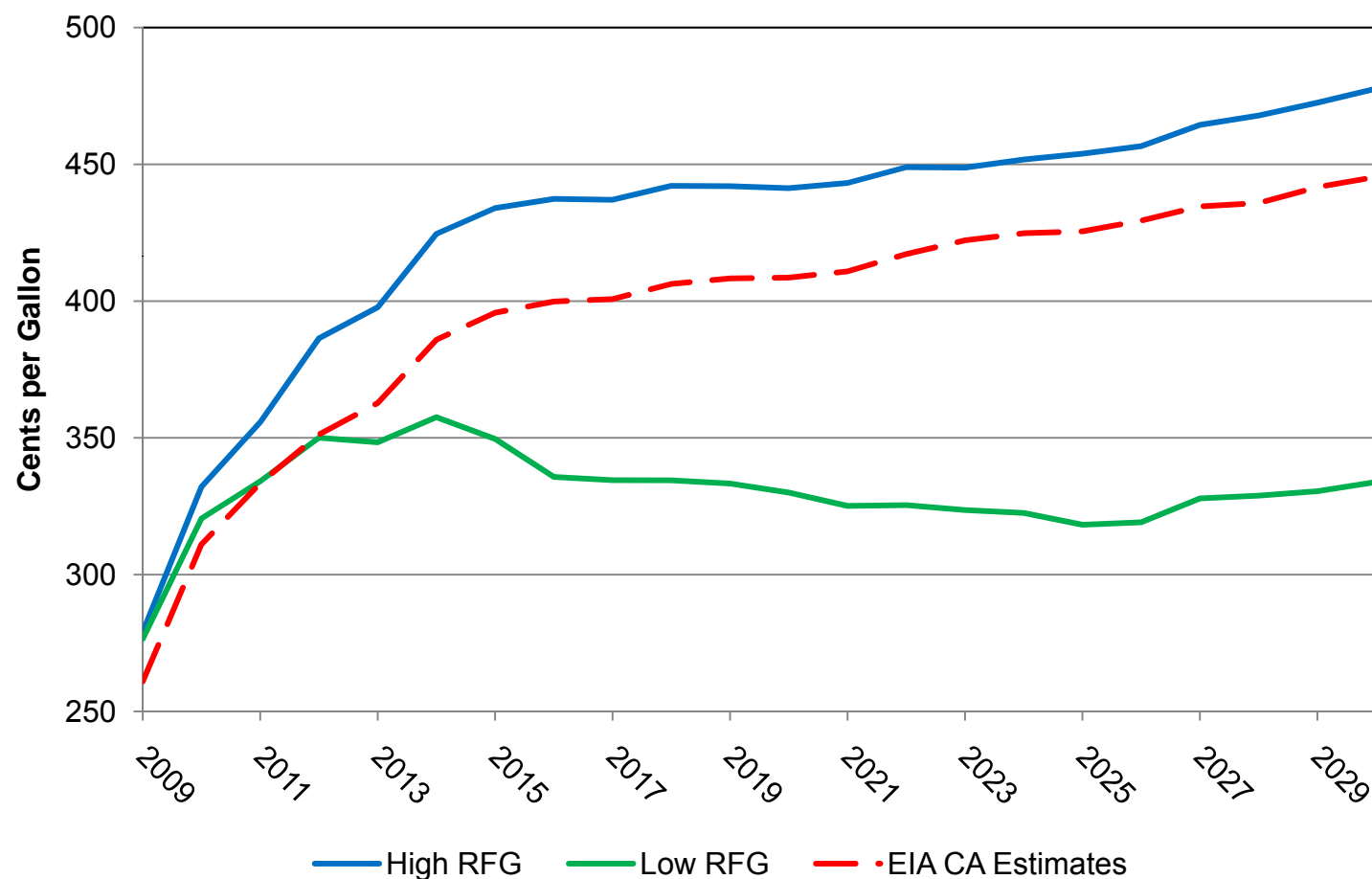
California Regular-Grade Gasoline & Diesel Price Forecasts (2008 Cents)



California Regular-Grade Gasoline & Diesel Price Forecasts (Nominal)



EIA & Energy Commission Staff California Gasoline Price Forecasts (2008 Cents)



Sources: Energy Commission and U.S. Energy Information Administration



Railroad Diesel and Jet Fuel Price Forecasts

Railroad Diesel

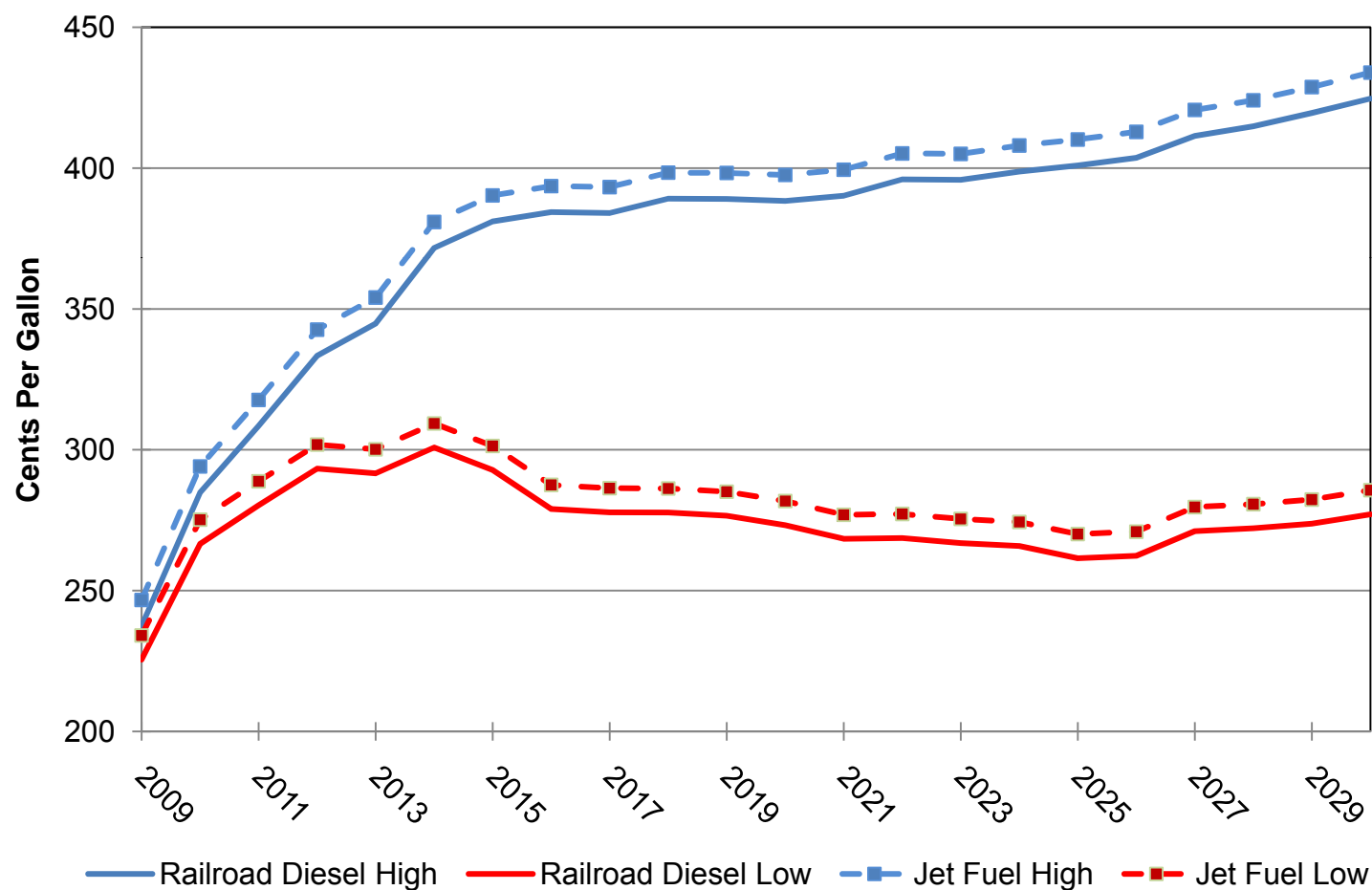
- CEC Diesel Rack price forecast
- 6.9 cent per gallon excise tax (state & federal)
- 8% California sales tax

Jet Fuel

- CEC Diesel Rack price forecast
- 6.4 cent per gallon excise tax (state & federal)
- Distribution adder (1/2 of diesel rack-to-retail margin)
- 8% California sales tax



California Railroad Diesel & Jet Fuel Price Forecasts (2008 Cents)



Ethanol-85 Price Forecasting Method

- Ethanol-85 (E-85) fuel prices are calculated as ranges based on CEC RFG high and low price forecasts
- Upper boundary for the E-85 price is equal to the high CEC RFG price
- Lower boundary for the E-85 price is equal to the low CEC RFG price on an energy equivalent basis
- Yet to be determined whether to use the full range of E-85 price forecasts or a measure of its central tendency



Volumetric Equivalence, Energy Equivalence, and GGEs

Volumetric Equivalent Pricing

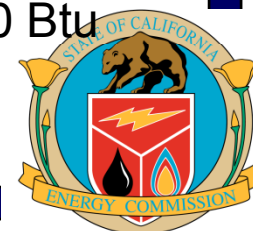
- Price of one gallon of gasoline = Price of one gallon of E85
 - \$2.00 per gallon of gasoline = \$2.00 per gallon of E85

Energy Equivalent Pricing

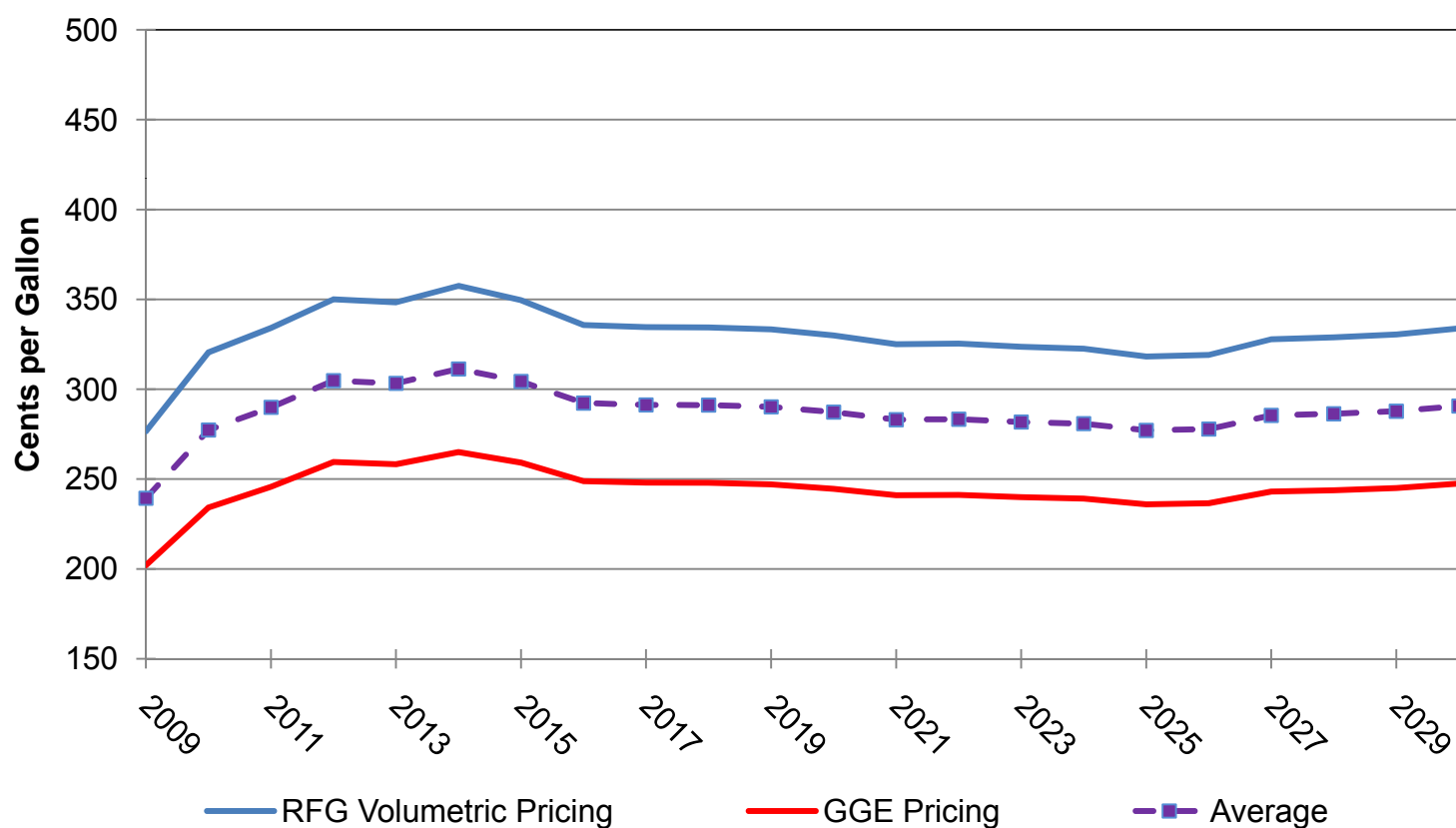
- Price per Btu of gasoline = Price per Btu of E85
 - \$2.00 per gallon of gasoline = \$1.46 per gallon of E85

Gasoline Gallon Equivalents (GGEs)

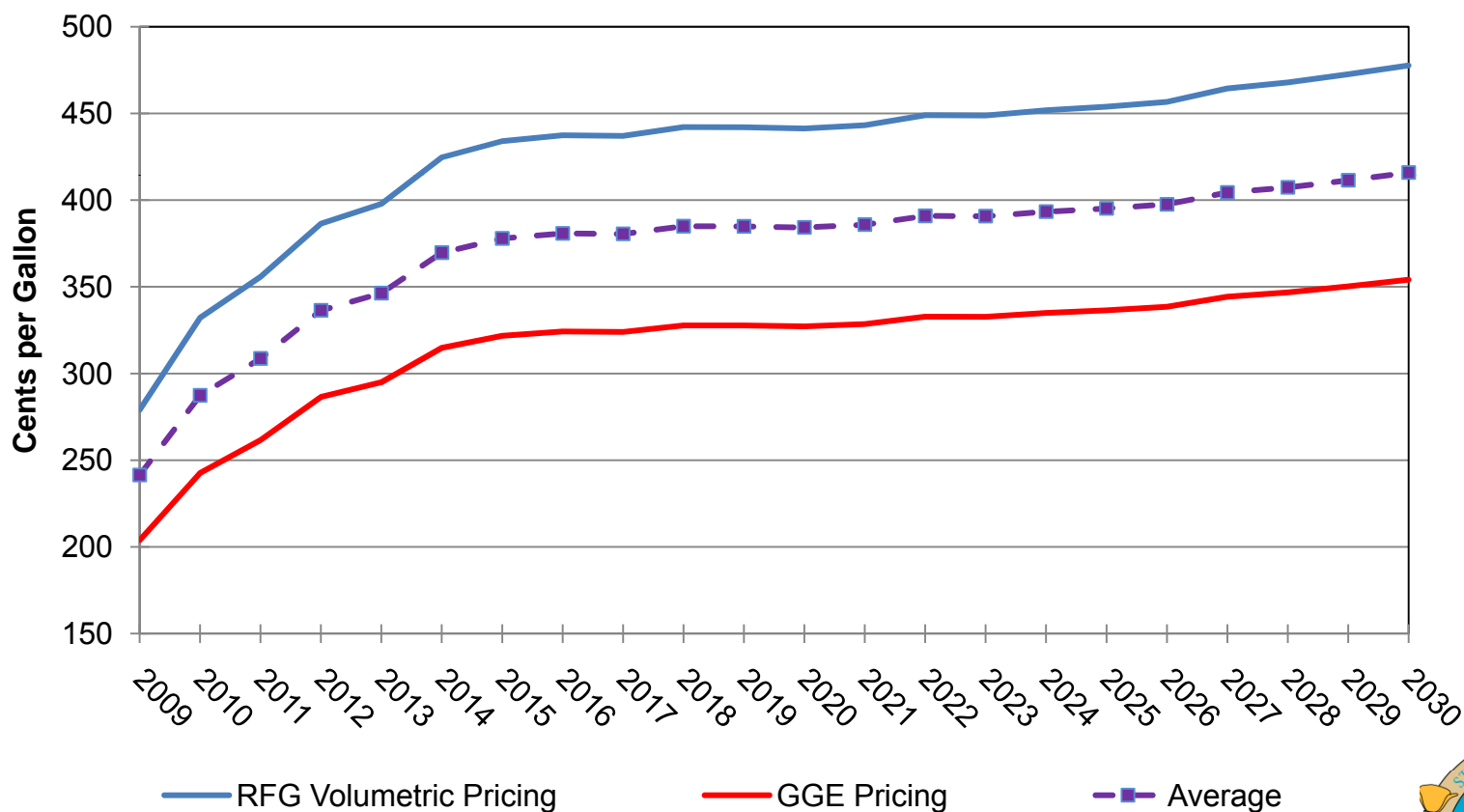
- Placing fuels in terms of the energy content of gasoline (for example 112,000 Btu LHV).
- Volumetric Pricing in terms of GGEs
 - $(\$2.00 \text{ per gallon of E85} / 81700 \text{ Btu per gallon of E85}) \times (112000 \text{ Btu per gallon of gasoline}) = \$2.74 \text{ per GGE based on volumetric equivalent pricing}$



California E-85 Price Forecast Corresponding to the RFG Low Case (2008 Cents)



California E-85 Price Forecast Corresponding to the RFG High Case (2008 Cents)



Biomass-Based Diesel

Biomass-based diesel is an umbrella term which includes:

- **Biodiesel**
- Renewable Diesel
- Biomass-to-Diesel
- Thermal Depolymerization
- Algae Diesel
- Others



Biomass-Based Diesel Price Forecasting Method

- Use Energy Commission forecasted values for Diesel High and Low prices
- Compute historic monthly margins between West Coast rack prices and California Diesel rack prices
- Hold real federal fuel excise tax credit for biomass-based diesels constant
- Hold real state and federal taxes and fees constant

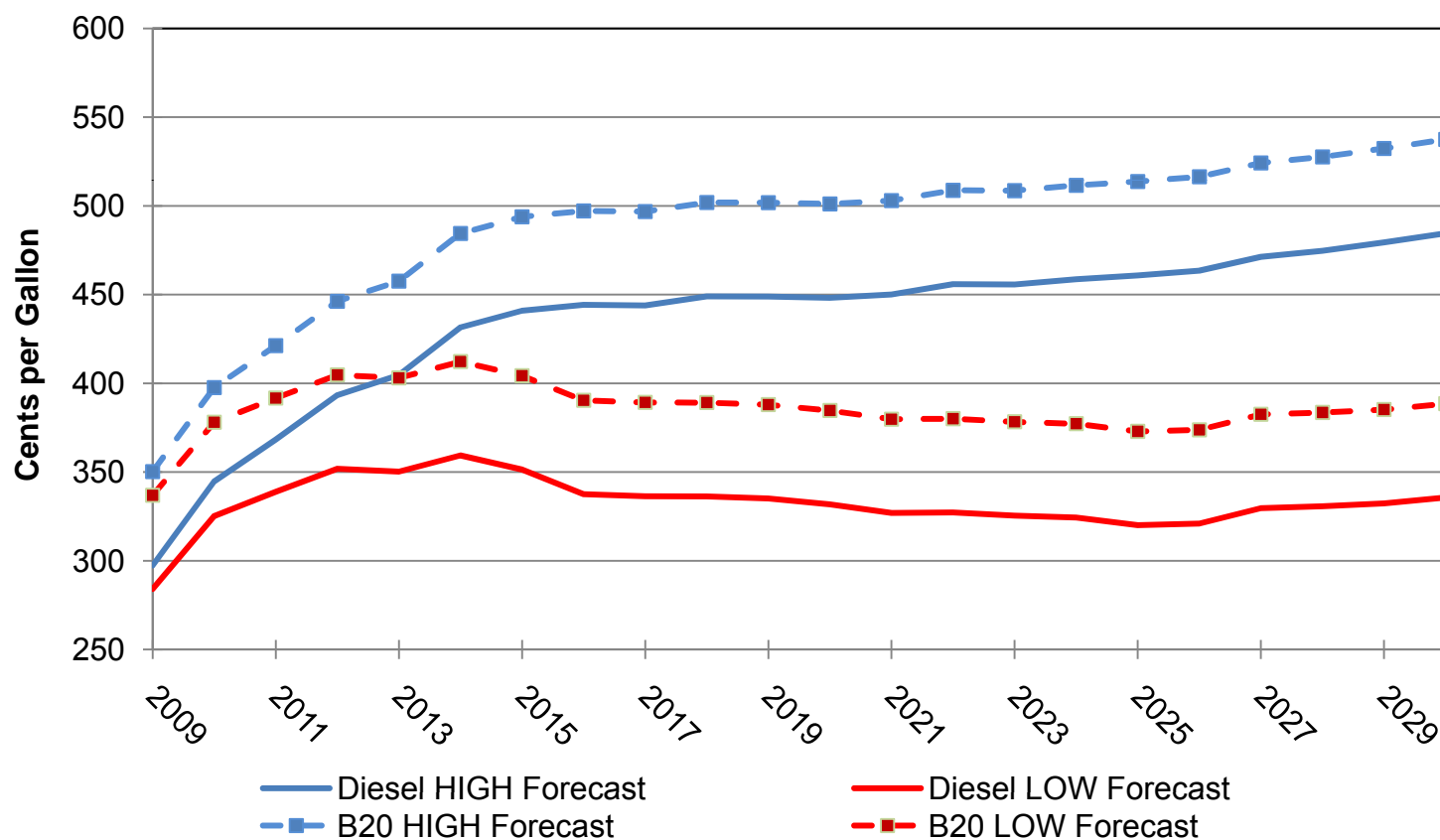


Assumptions

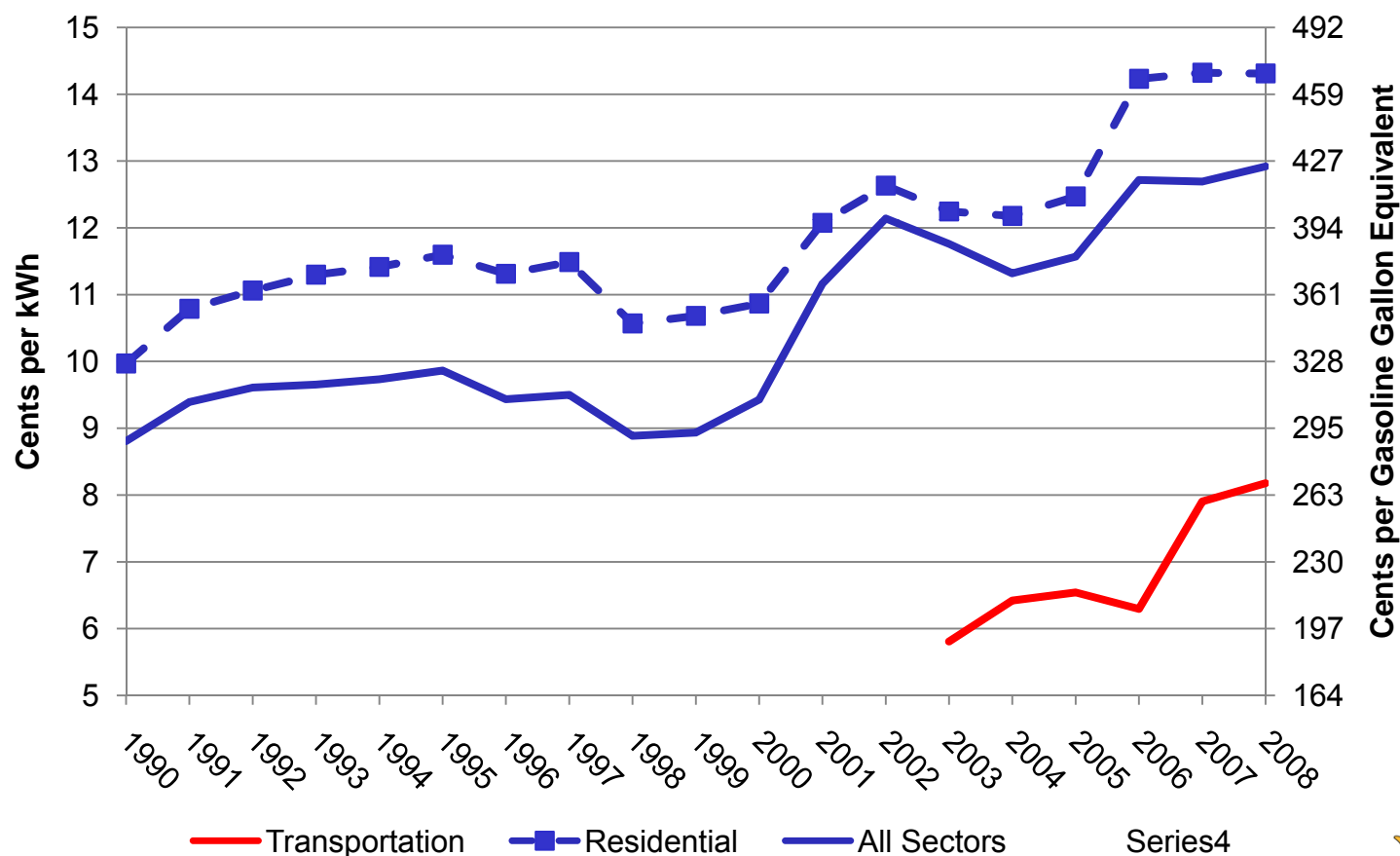
- The West Coast biodiesel rack price and California retail price relationships will remain constant over the forecast period and represents the retail fuel price of biodiesel in California
- Federal fuel excise tax credits will remain constant at \$1.00.
- State and local taxes will remain constant in real terms at their current rates
- Feedstock market prices will not affect the final retail price of biomass-based diesels
- The potential variation in fuel margins and feedstock prices is bounded by the high and low diesel price forecasts presented in this paper.
- Currently the federal excise tax credits will expire on December 31, 2009



California Diesel and Biomass-Based Diesel Retail Price Forecast (2008 Cents)



Historic California Electricity Prices

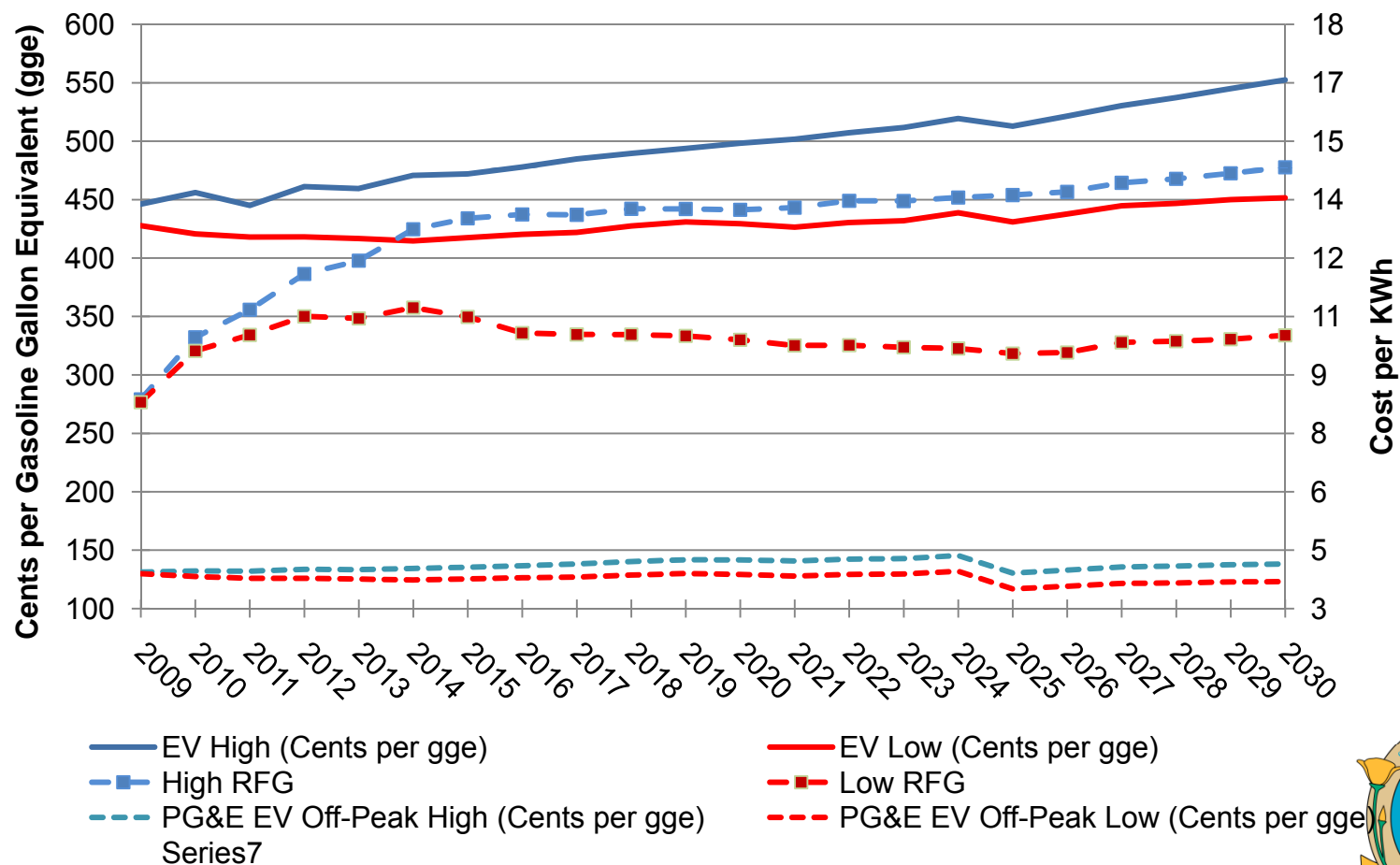


Transportation Electricity Fuel Price Forecasting Method

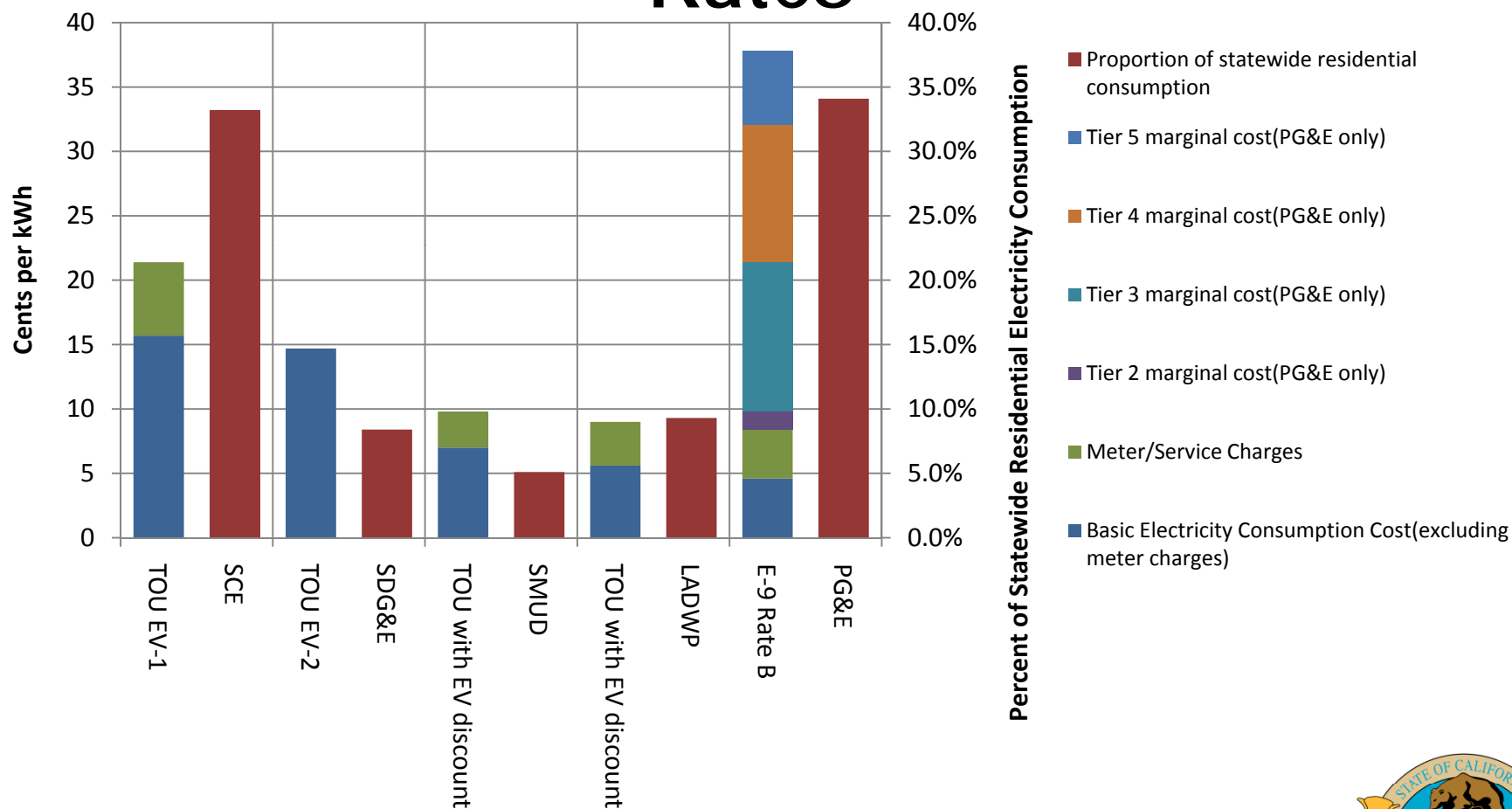
- Rate structures for alternative fuel vehicles were used when available
- Marginal analysis was performed to develop the forecast and includes the addition of transportation electricity consumption
- Utilizes weighted average pricing of evaluated California MOUs and IOUs base on 2006 statewide consumption levels
- Generation and non-generation costs were increased over forecast period using the same method used in electricity evaluation for the 2007 IEPR



California Transportation Electricity and RFG Price Forecasts (2008 Cents)



California Electric Vehicle Off-Peak Tariff Rates



Note: No metering charges were applied to SDG&E TOU EV-2 because that rate structure shares metering with household electricity consumption. All other metering charges were obtained by dividing the monthly metering rate by a 175 kWh/month consumption assumption.



Additional Assumptions

- Charging profile is assumed to be 88 percent off-peak, 8 percent partial peak, and 4 percent in peak hours
- 30 percent of PG&E customers were assumed to use Rate A, the remainder used Rate B
- No metering installation costs are assumed in the evaluation, high installation costs might inhibit adoption of dual metering
- Average monthly increase in electricity usage is assumed to be 175 kWh over normal usage
- Rate structures for alternative fuel vehicles were used when available

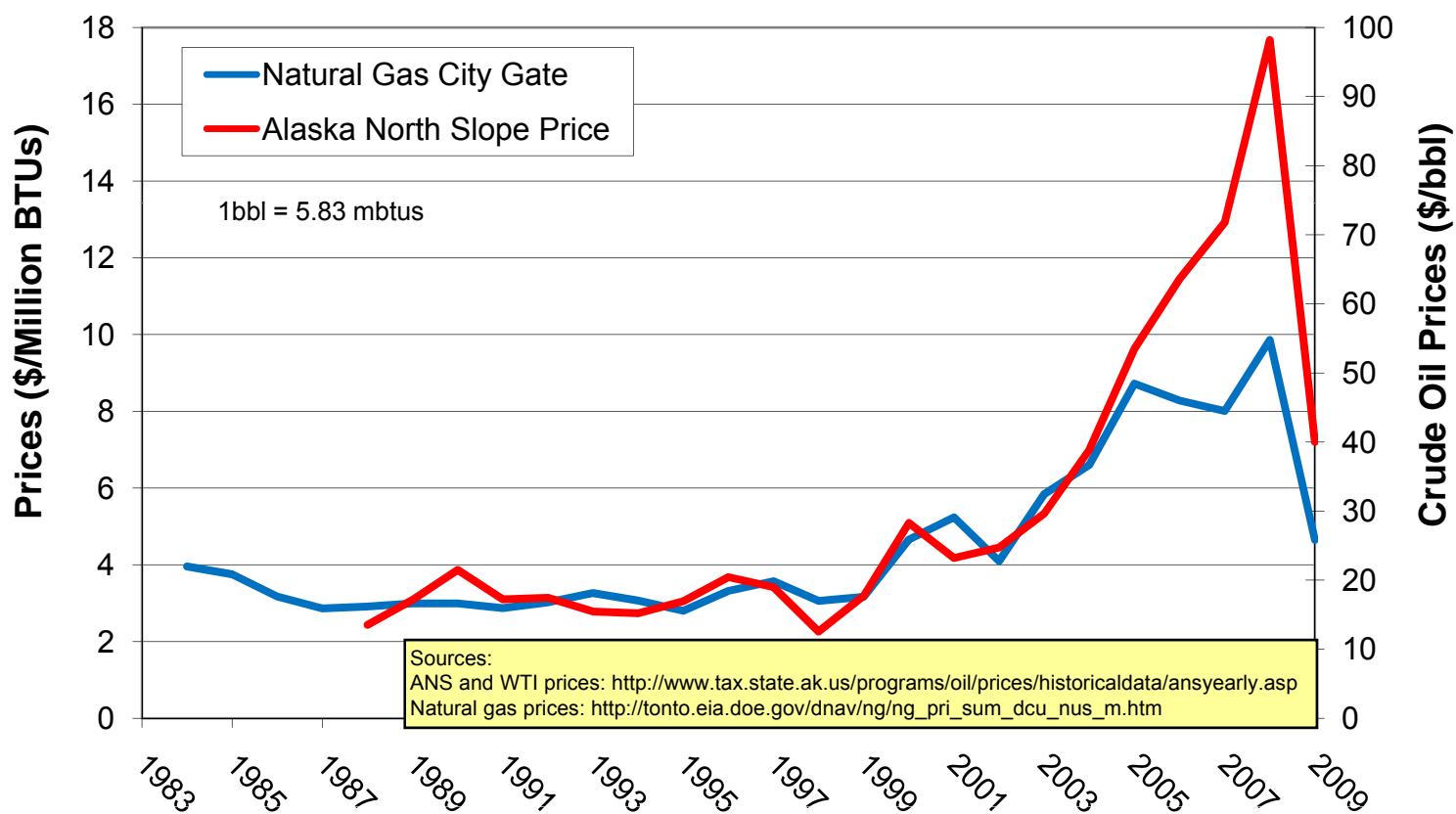


Price Forecast for Transportation Natural Gas

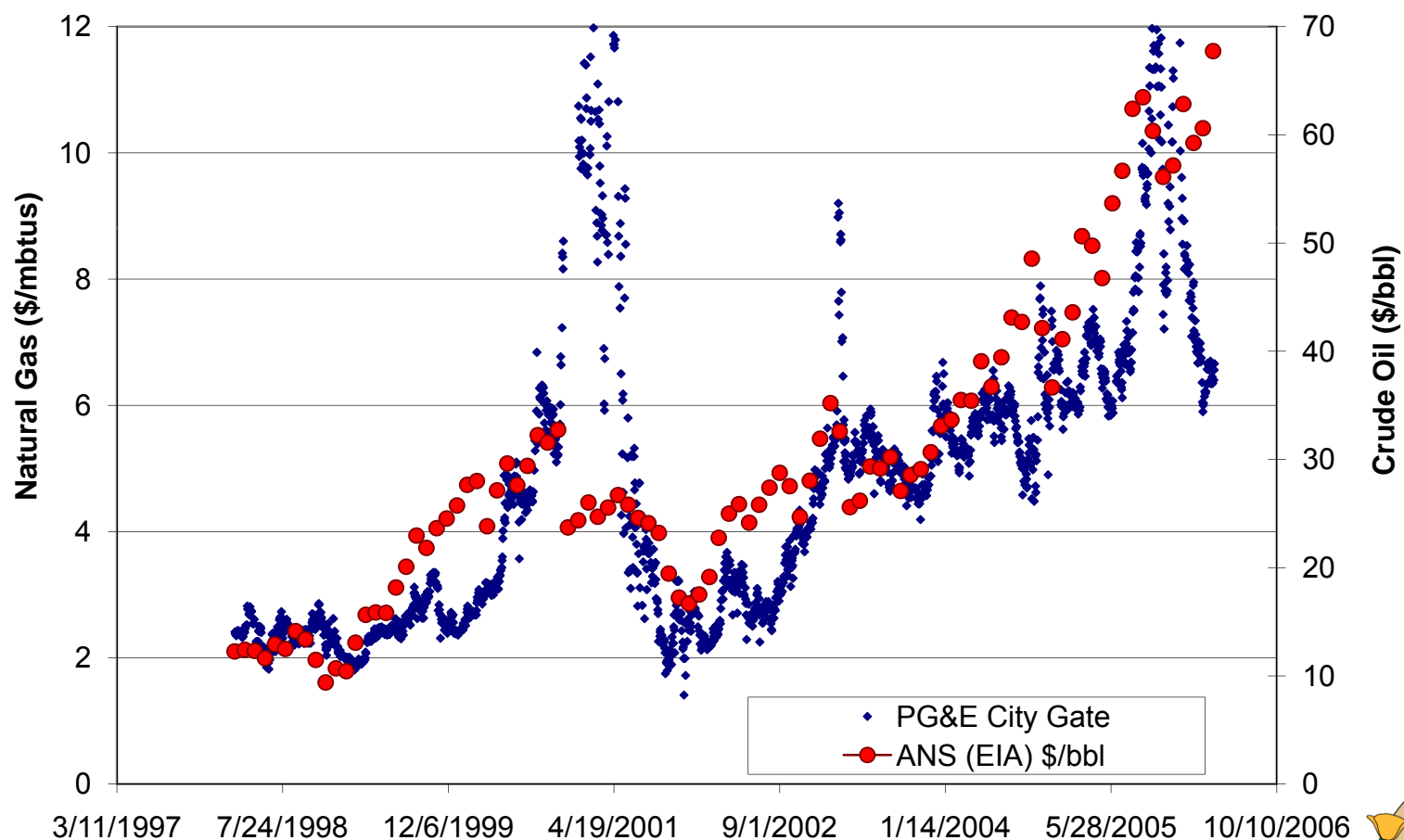
- The proposition is when crude oil prices are ‘High or Low’ as defined by the EIA benchmark levels, then what is the natural gas market price during those times.
- Staff evaluated crude to natural gas markets in two ways:
 - ❑ Top-Down (Retail Market)
 - ❑ Bottom-up (Commodity Cost Plus) Fuel modifications and Retail adders.



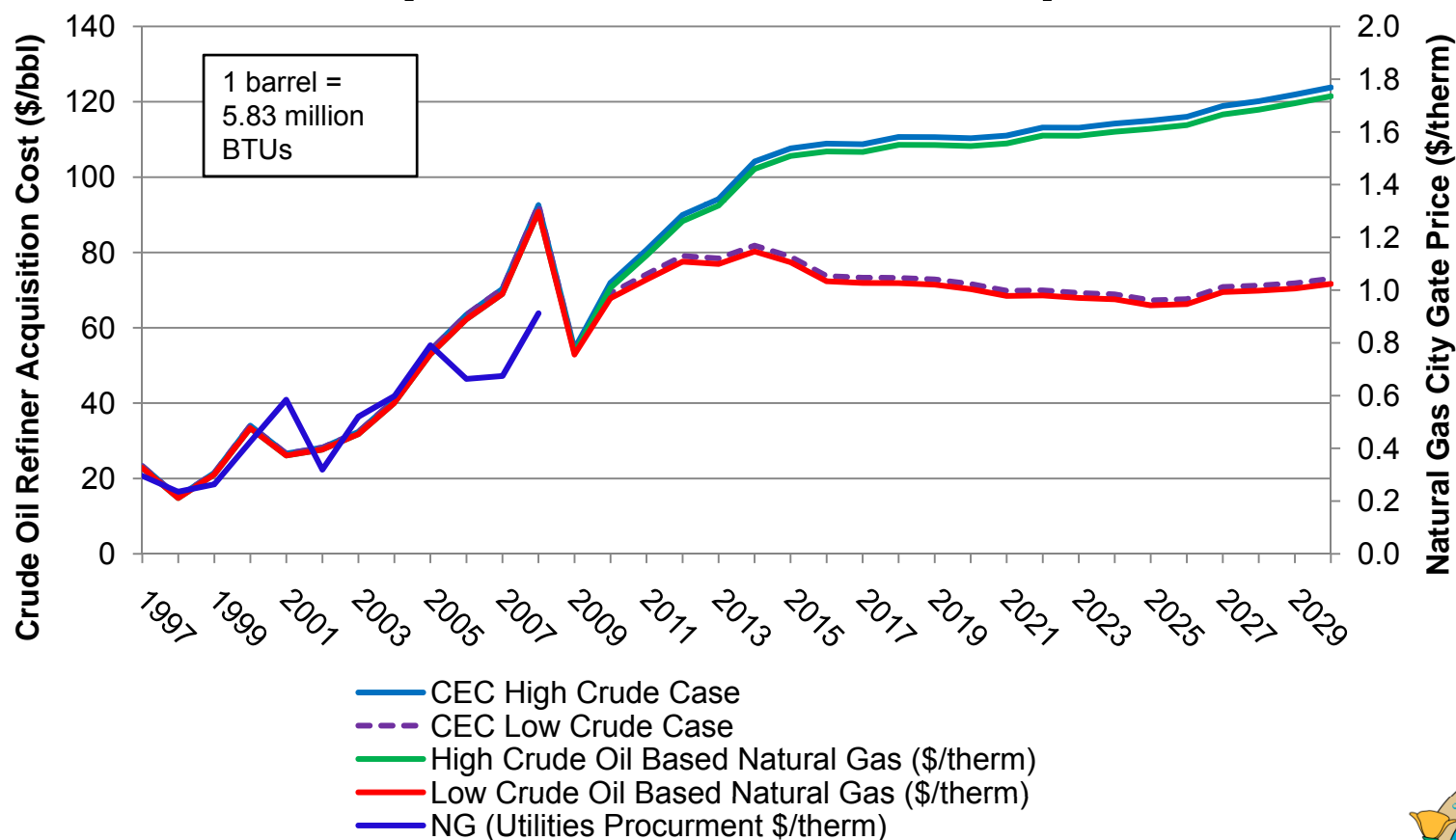
Relationship Between U.S. Crude and Natural Gas Market Prices (Nominal Dollars)



Recent Relationship Between Crude and Natural Gas Market Prices (California)



Commodity Based (Bottom-Up) Based Natural Gas Forecast (Nominal Dollars)



Source: U.S. Energy Information Administration

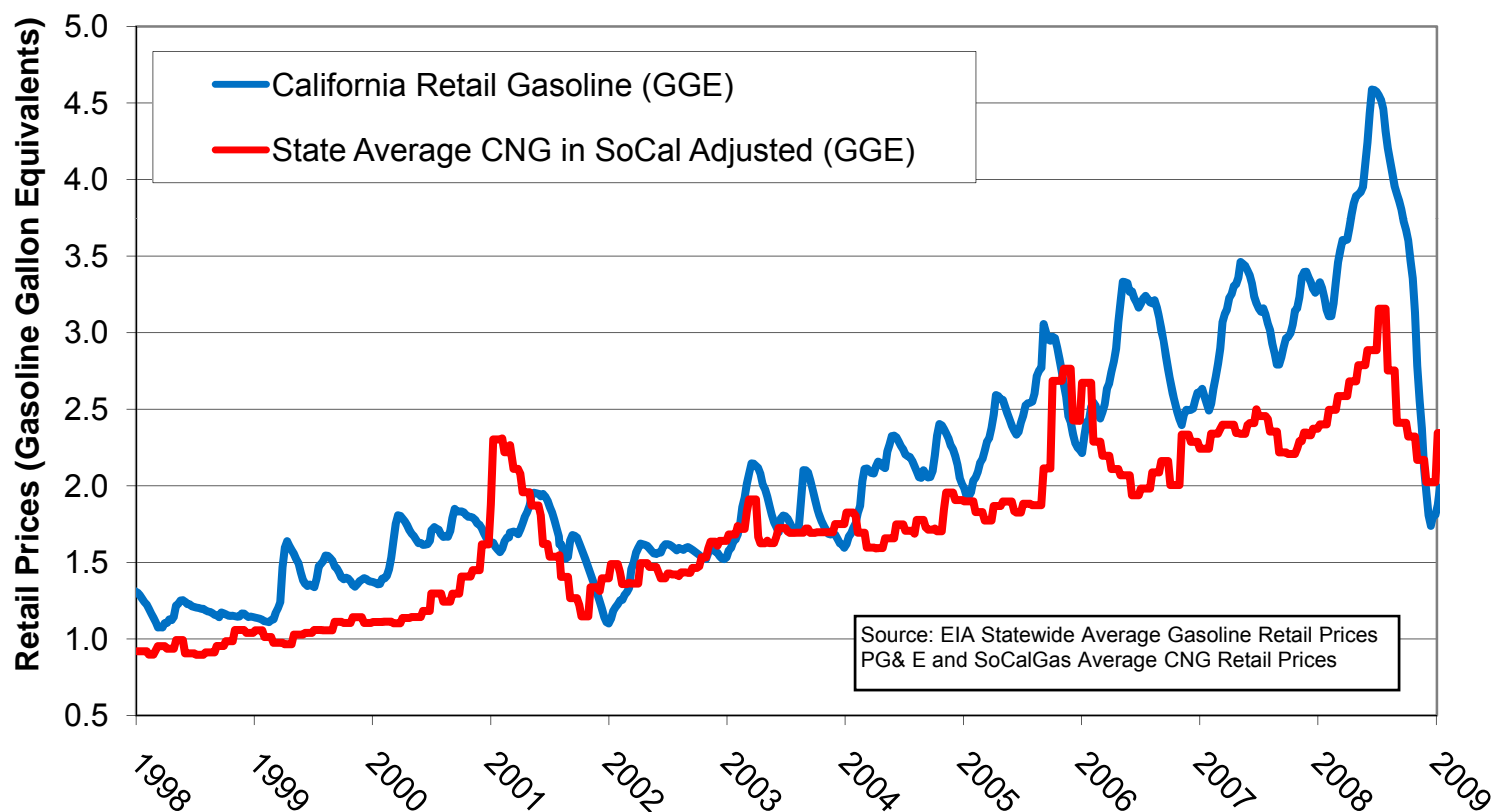


Commodity Based (Bottom-Up) Price Calculations

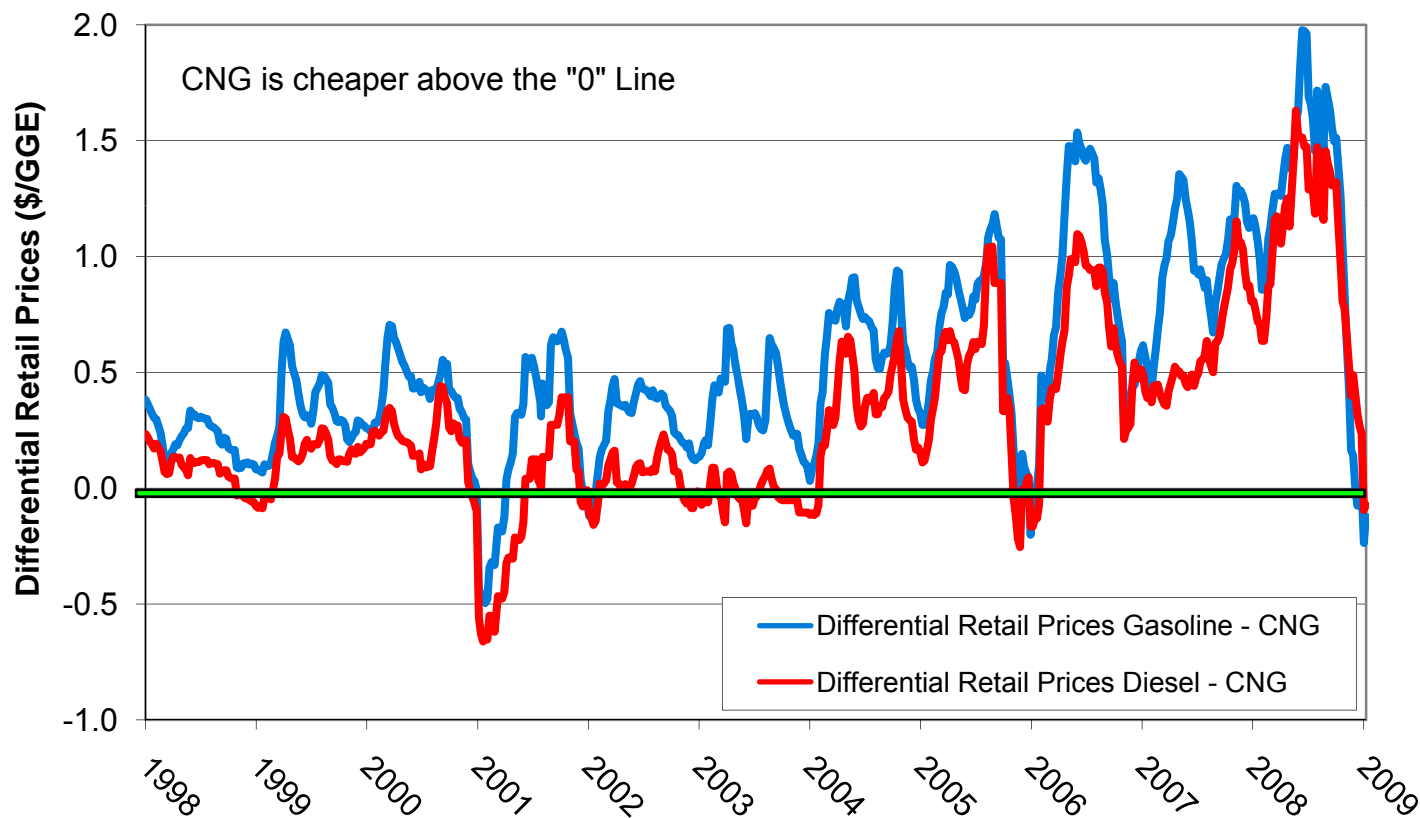
	Street Units	(\$/mbtus)	%/total
Crude Oil Based Natural Gas (City Gate \$/therm)	1.00	0.100	34%
Intrastate Trans. (\$/therm)	0.0880	0.009	3%
Compression Expense (\$/therm)	0.7462	0.075	25%
Sub-Total Gas (\$/therm)	1.83	0.183	62%
SRF (\$/therm)	0.0680	0.007	2%
PPP (\$/therm)	0.02379	0.002	1%
UUT %	0.100	0.010	3%
SFT (\$/therm)	0.0677	0.007	2%
Sub Total (\$/therm)	2.09	0.209	71%
Sub Total (\$/GGE)	2.52	0.315	85%
Federal Excise Tax*	0.183	0.018	6%
Retail Margin	0.03	0.003	1%
Sales Tax (8%)	0.22	0.022	7%
Retail price (\$/gasoline gallon equivalence)	\$2.95		
Retail price (\$/diesel gallon equivalence)	\$3.36		



Relationship Between Retail Gasoline and CNG Prices (California Market)



Retail Market (Top-Down) Differential Price Relationship



Retail Market Relationships (Top-Down)

10-year Summary of Retail CNG to Gasoline and Diesel
Prices and Forecasting Adjustments

Fuel	Retail Prices	Added Federal Excise Tax Change (0.1245 ¢/gge)	Added Retail Margin (6 ¢/gge)	Added State & Local Sales Taxes (8%)
Gasoline	\$0.55 (24%)	\$0.43 (16%)	\$0.37 (13%)	\$0.24 (6%)
Diesel	\$0.31 (13%)	\$0.18 (4%)	\$0.12 (0%)	-\$0.01 (-7%)

*October 1, 2005 Federal Excise Taxes were raised for CNG, LNG and Propane (\$0.1245 for CNG)



Results

Summary of CNG Retail Price Relationship with Gasoline and Diesel

	CNG Price Relative to Gasoline	CNG Price Relative to Diesel
Commodity Based (Bottom-Up)	9 percent less	5 percent more
Retail Market Relationship (Top- Down)	6 percent less	7 percent more



Retail Vs Fleet Fuel Price Assumptions

- Fleets' fuel prices are lower than retail prices for; diesel, gasoline, hydrogen by 50% of the margins.

	RFG Rack-to-Retail	Diesel Rack-to-Retail
CEC High	15.5	18.1
CEC Low	14.9	16.9

- CNG would avoid Rack-to-Retail deliver cost - fleets would expect to save 100% of the above Rack-to-Retail margins.



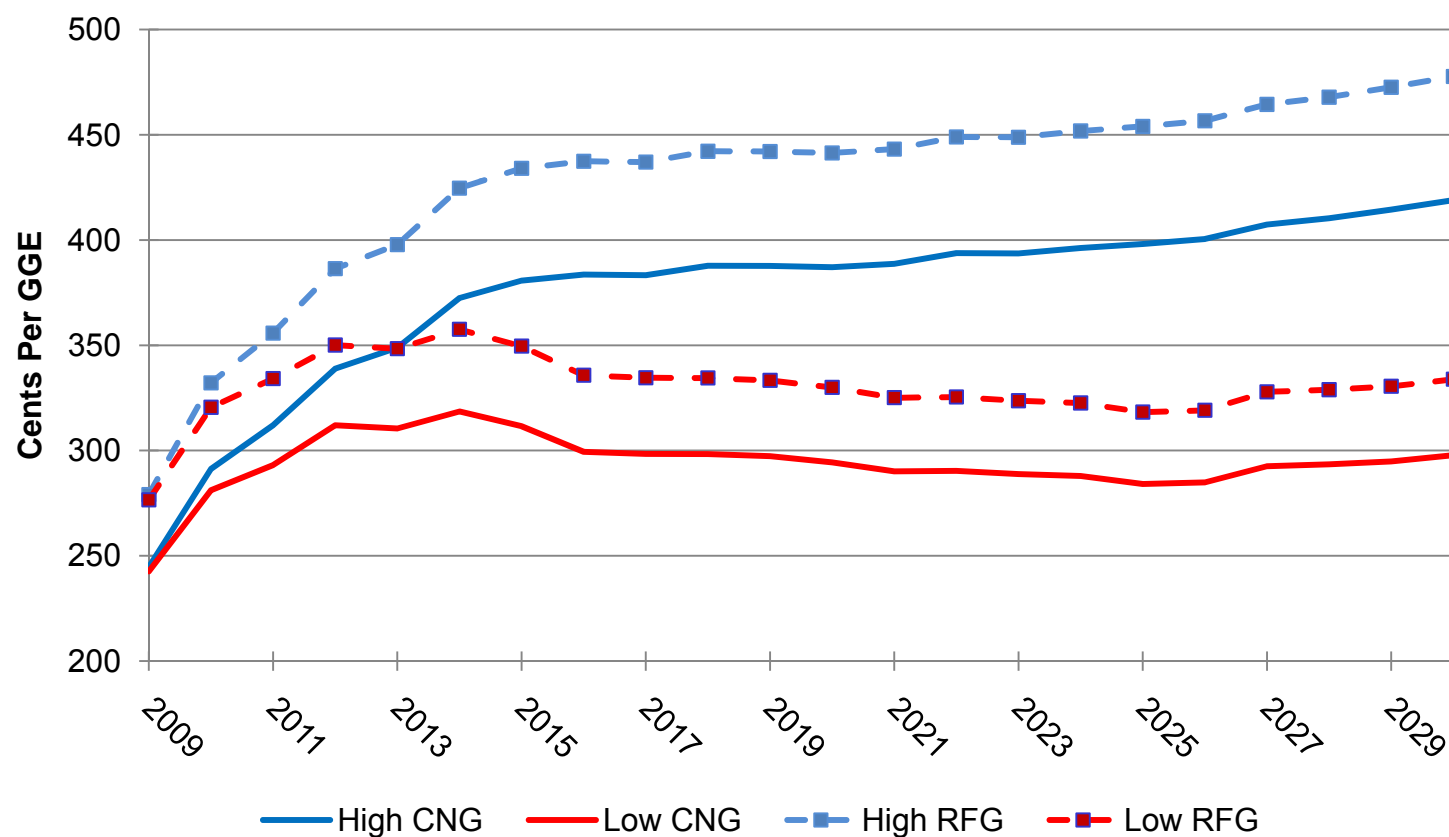
LNG Retail Price Analysis

	(\$/LNG gal)	(\$/mill btus)	% of Cost
Natural Gas (\$/Therm) (Varied annually)	\$1.00		
NG feed cost (\$/LNG gallon)	1.21	\$15.8	67%
Cost to Liquefy (\$/LNG)	0.08	\$1.1	5%
Storage / Terminal Cost (\$/LNG)	0.01	\$0.1	1%
Transportation Cost (\$/LNG)	0.10	\$1.3	6%
Retail Markup/Customer/Storage Cost (\$/LNG)	0.10	\$1.3	6%
Capital Recover of Dispenser (\$/LNG)	0.02	\$0.2	1%
Excise taxes State (per LNG gallon)	0.02	\$0.3	1%
Excise taxes Federal (per LNG gallon)	0.13	\$1.6	7%
Sub total	1.68	\$21.9	
Sales Tax (8%)	0.13	\$1.8	7%
Retail Price (\$/LNG gallon)	\$1.82	\$23.7	100%

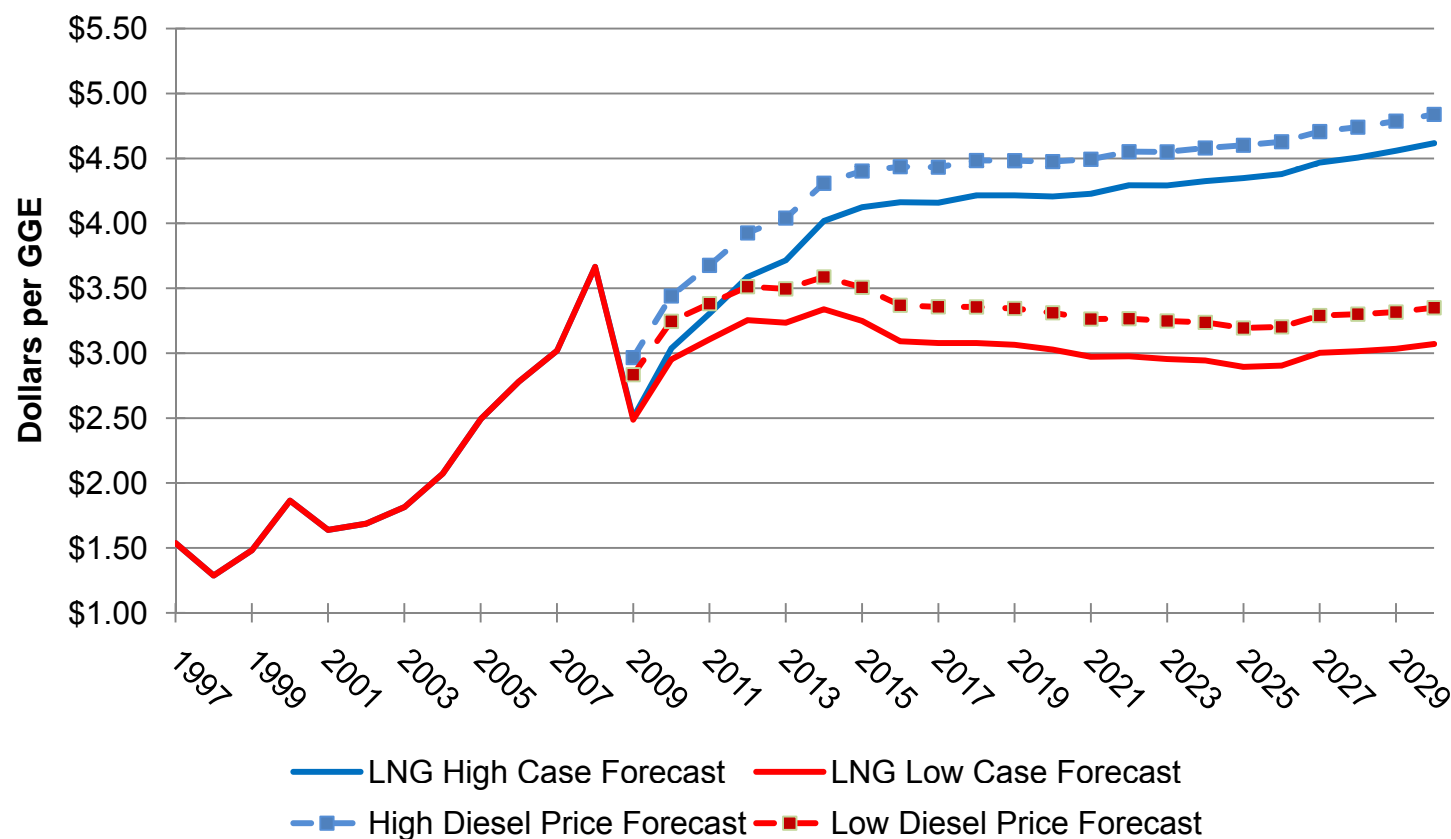
Retail Price per Diesel Gallon Equivalent	\$3.02
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California Transportation CNG Price Forecast



California Transportation LNG Price Forecast



Hydrogen Price Forecasts

- Uses the same Natural Gas Forecast as CNG and LNG forecasts
- Production, Compression, Transportation, & Retail costs were accounted for (mostly constant in real terms)
- 8% sales tax is the only tax accounted for.

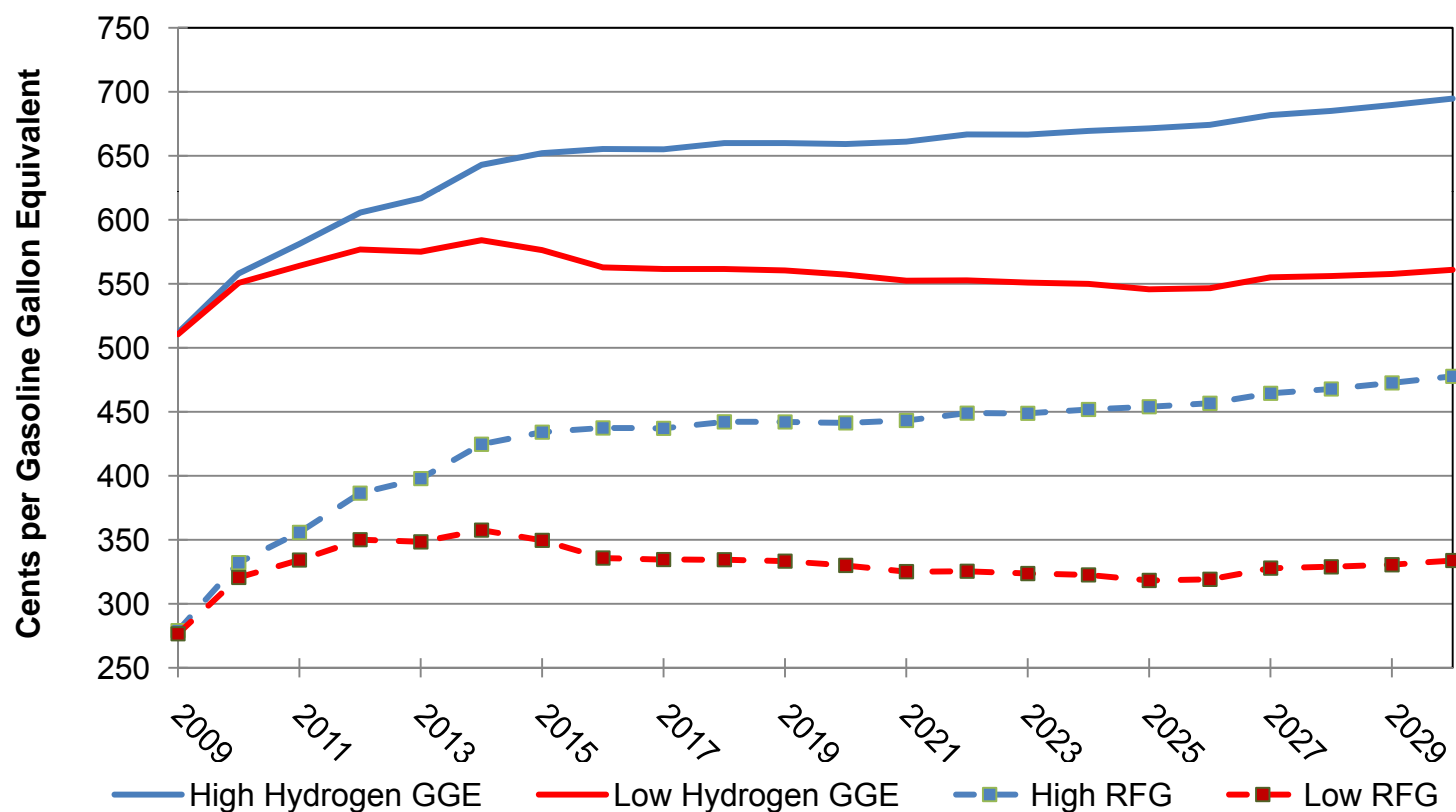


Hydrogen Retail Price Components

(2008 \$)	(LHVs)	% of	
Hydrogen Production	\$/mbtus	Total Price	In GGEs
Natural Gas (\$ in LHVs)	9.55	21%	1.07
Variable Non-Fuel O&M (1%of Capital)	0.11	0%	0.01
Reformer @ x Efficiency 76%	2.29	5%	0.26
Fixed Operating Cost	0.56	1%	0.06
Capital Recovery	1.78	4%	0.20
Electricity (production & compress to 1Kpsi)	0.31	1%	0.03
Sub-total	14.61	32%	1.64
Compression Cost			
Capital Recovery	7.91	17%	0.89
Electricity	8.59	19%	0.96
Maintenance	5.05	11%	0.57
Sub-total	21.55	47%	2.41
Transport			
Over the road deliver cost	3.95	9%	0.44
Sub-total	3.95	9%	0.44
Retail			
Capital Recover Dispenser	1.22	3%	0.14
Retail Markup	1.00	2%	0.11
Retail full Markup	2.2	5%	0.25
H2 sub total pre tax	42.32	93%	4.74
Final Price with Sales Taxes	8%	45.71	100%
			5.12
\$ /Gasoline Gallon		\$5.12	



California Transportation Hydrogen Price Forecast (2008 Cents)

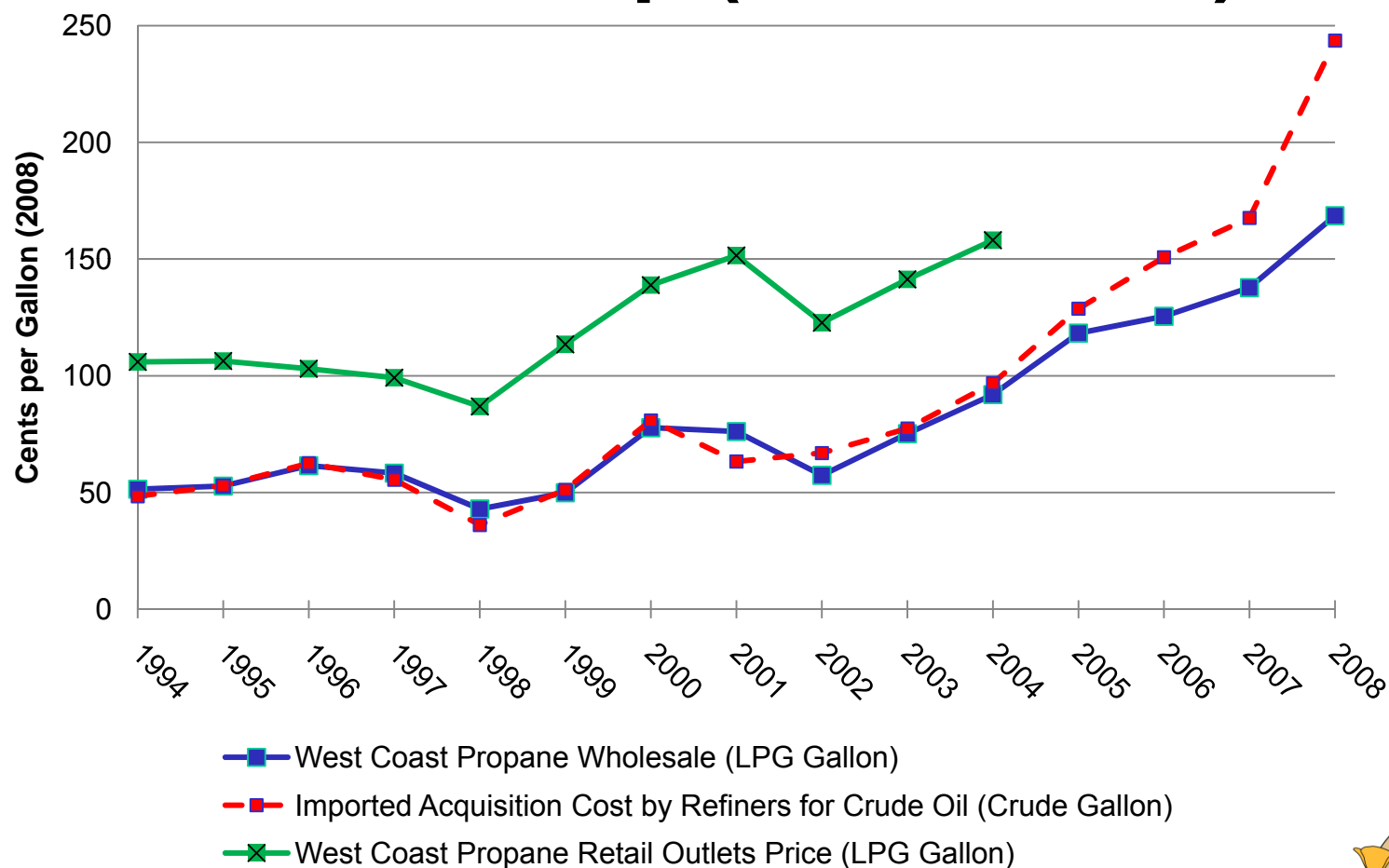


Propane (LPG) Price Forecasts

- Wholesale propane was forecasted as a portion of RAC:
 - 91% in the High Case
 - 76% in the Low Case
- Rack-to-retail margins was forecasted as \$0.64 (High) & \$0.55 (Low)
- Excise taxes of \$0.243 (state & federal) held constant in real terms
- California sales tax of 8% held constant



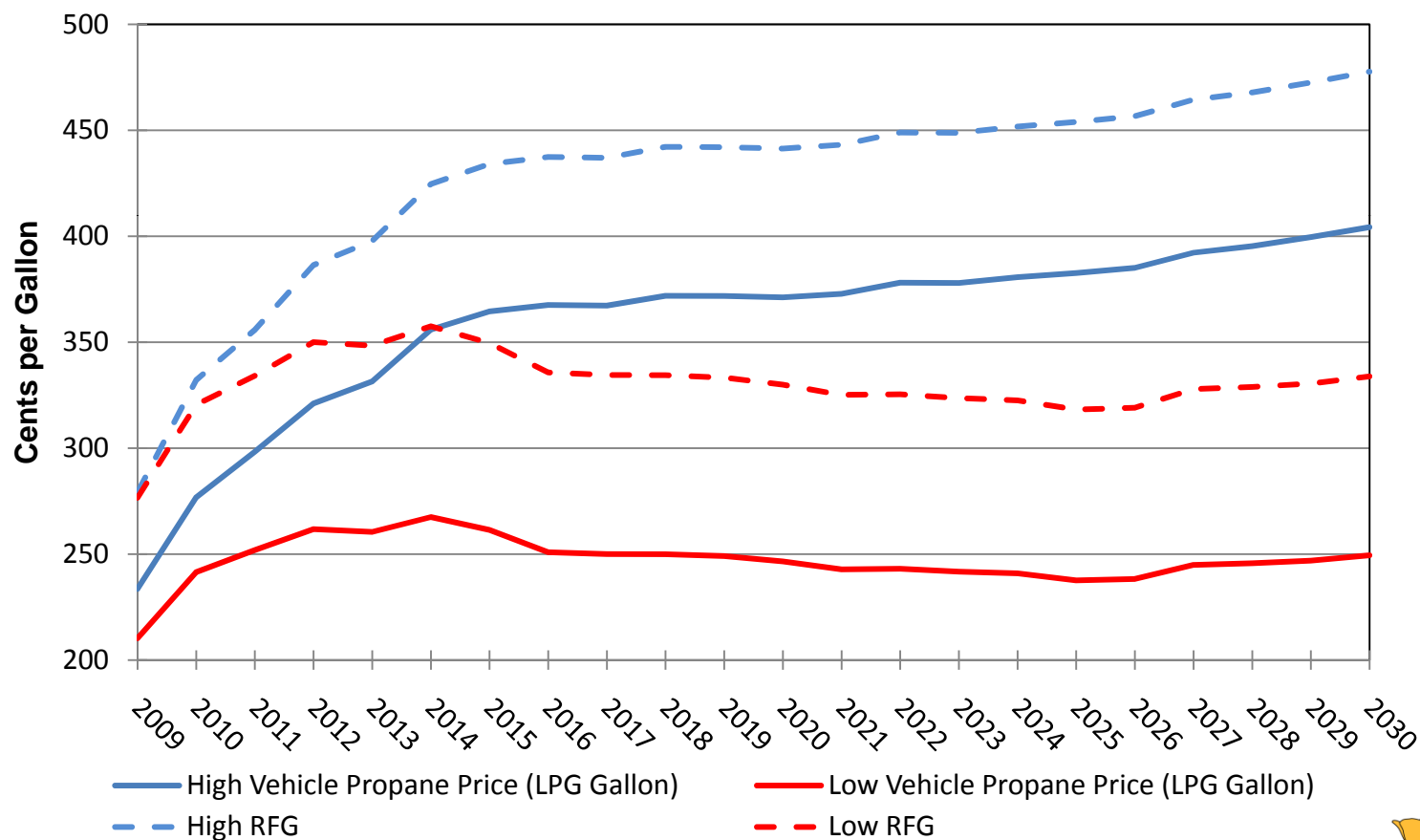
Propane Wholesale Price Relationship (2008 Cents)



Source: U.S. Energy Information Administration



California Transportation Propane (LPG) Price Forecast (2008 Cents)



Next Steps

- Finalize inputs to demand forecasts
- Hold 2nd workshop on transportation energy infrastructure issues (April)
- Prepare demand forecasts and import requirements projections in draft staff report
- Hold 3rd workshop on staff's proposed transportation energy forecasts (June)
- Finalize staff report
- Integrate into IEPR transportation chapter



Energy Commission Contacts

Crude Oil:

Jim Page, (916) 654-4886
Jpage@energy.state.ca.us

Gasoline & Diesel Fuels /
Railroad Diesel & Jet Fuel /
Propane (LPG):

Ryan Eggers, (916) 651-2920
Reggers@energy.state.ca.us

Biomass-Based Diesel /
Transportation Electricity:

Malachi Weng-Gutierrez, (916) 654-4588
Mwenggut@energy.state.ca.us

Transportation Natural Gas /
Hydrogen:

Gary Yowell, (916) 654-4698
Gyowell@energy.state.ca.us

