Prospects, Challenges and Solutions for NGVs in a Low Carbon World

McKinley Addy, P.E.

California Energy Commission

NGVAmerica Conference

October 16, 2007

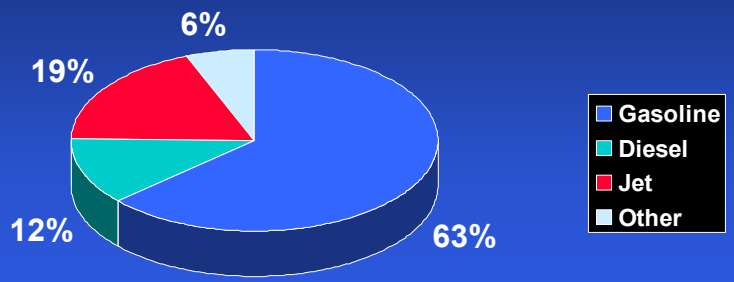
Outline

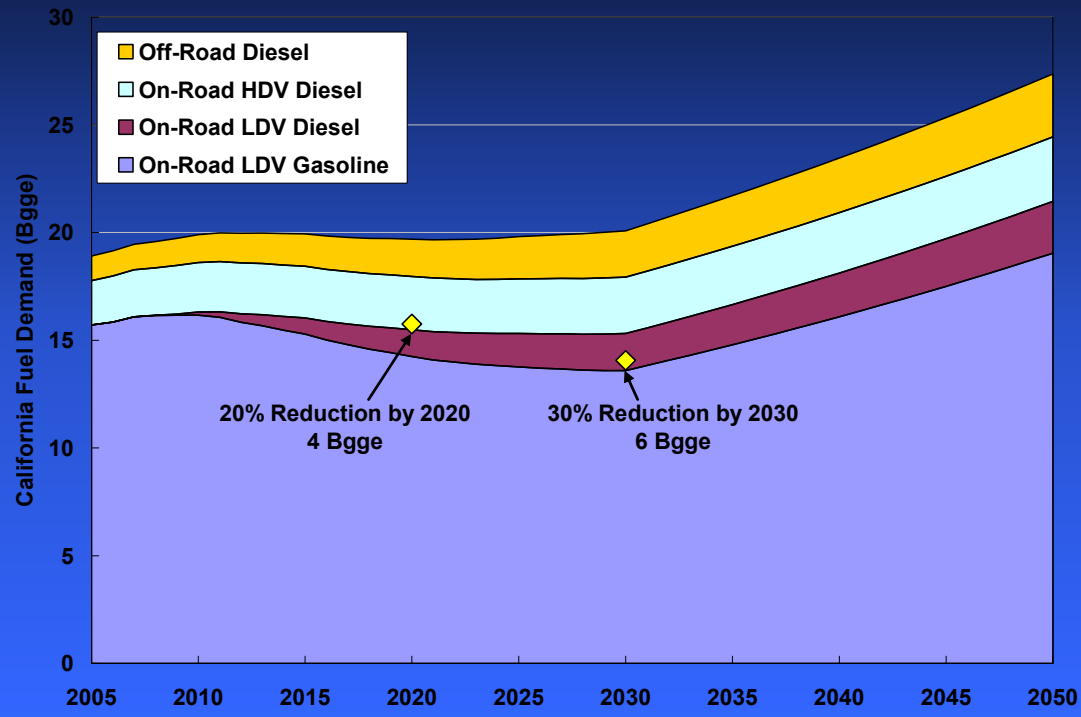
- CEC Overview
- Policy Imperatives and Market Context
- NGV Prospects - AB 1007 Natural Gas Scenario
  - NG AB 1007 Fuel Use Goals
  - NG AB 1007 GHG Benefits
  - NG LCFS Contributions
- NGV Market Challenges
- NGV Market Solutions

Policy Imperatives and Market Context

- AB 2076 – Reduce Petroleum Dependence
- AB 1007 – Alternative Fuel USE Increase
- AB 1493 – CO2 Tail Pipe Standards
- AB 32 – GHG Reduction Act
- LCFS – Carbon Intensity Reduction
- AB 118? – Possible funding for alternative fuels
- True Cost Considerations of Conventional Fuels?

Transportation Petroleum Use in California- 2006





Sources: CEC, ARB, TIAX

Policy Imperatives and Market Context

- Annual True Cost of Petroleum Dependence [1] Billions of US Dollars

	Low Est.	High Est.
Federal tax breaks and subsidies [2]	$65	$113
Health-care costs	$54.7	$672.3
Crop losses	$3	$6
Damage to materials and buildings	$1	$8
Damage to forests	$0.2	$2
Water pollution	$0.4	$1.5
Total of all states' subsidies	$4.1	$4.1
TOTAL	$128.4	$806.9

1. Annual Costs to U.S. Consumers of Oil and Auto Industry Subsidies and Externalities (in billions of U.S. dollars), "Lives Per Gallon: The True Costs of Our Oil Addiction", Terry Tamminen, p 62
2. 2 Ibid, p 60

Policy Imperatives and Market Context

- Other Cost Considerations
  - Volatility premium (est. 10% of prevailing price) [3]
  - Supply disruption premium (est. as high as $2/gallon) [4]
  - GHG premium (est. 22 to 80 cents per gallon) [5]
  - Wealth Transfer (est. $1.60 to $4 per gallon)[6]
  - Current Costs (est. $0.40 to $1.20 per gallon)[7]
- True Cost Est*.: $9 to $17/gallon

Whose clock?

3. Lives Per Gallon: the True Cost of Our Oil Addiction, Terry Tamminen, p 73

4. Reducing California's Petroleum Dependence, Joint Agency Report, California Energy Commission, P600-03-005F, August 2003

5. Based on EU September 2007 Carbon Credit Prices and $85/ton avoided CO2 damage prices (Mechanical Engineering, April 2007)

6. The Hidden Cost of Oil: An Update, Milton R. Copulos, National Defense Council Foundation, January 2007; ORNL

7. Ibid

* Includes the prevailing price of gasoline or diesel.

Policy Imperatives and Market Context

HD NGVs

Alternative, Non-petroleum Low Carbon Fuels can reduce petroleum dependence and cost

50 %?

6 %?

2 %?

H2 FCV

Honda GX

PH/EVs/FFVs

Prospects: AB 1007 NG Storyline

- California will act to increase motor fuel natural gas use in a cost-effective manner, so that by 2012, 2017, 2022, 2030, and 2050, 1 to 3 percent of its on-road transportation fuel is natural gas under a conservative scenario.
- Moderate scenario - 9% of CA's on-road transportation fuel by 2050.
- Aggressive scenario - 19% of CA's on-road transportation fuel by 2050.
- NG fuel use goals enhance transportation energy supply, extend petroleum resources and reduce emissions proportionately.
- "No Net Material Increase in Emissions" occurs from NG use on a full fuel cycle basis.
- Lowers California's Average Fuel Carbon Intensity under the Low Carbon Fuel Standard and helps achieve AB 32 goals.

Prospects: AB 1007 NG SCENARIO

Market Drivers	Market Barriers	Barrier Resolution
•Oil supply constraints •High crude oil prices •Resource nationalism •Renewed interest in alternative fuels •Competitive fuel supply •NG price advantage •Policy Initiatives •-AB 1007 •-AB 32 •-LCFS, SIP •-New Fed. initiatives	•Product availability •Persistent but changing veh. incr. cost •On-board storage technology •On-board storage cost •Limited fueling network •Consumer acceptance •Lack of consumer awareness	•Expand product offerings •Stabilize thru consumer-oriented pricing •Long-term, consistent support to deploy ANG •Develop new materials; achieve scale economies •Implement long-term growth plan, including support for HRAs •Consumer education •Marketing and promotion by auto cos, fuel cos, NPOs, govt

Prospects: AB 1007 NG SCENARIO

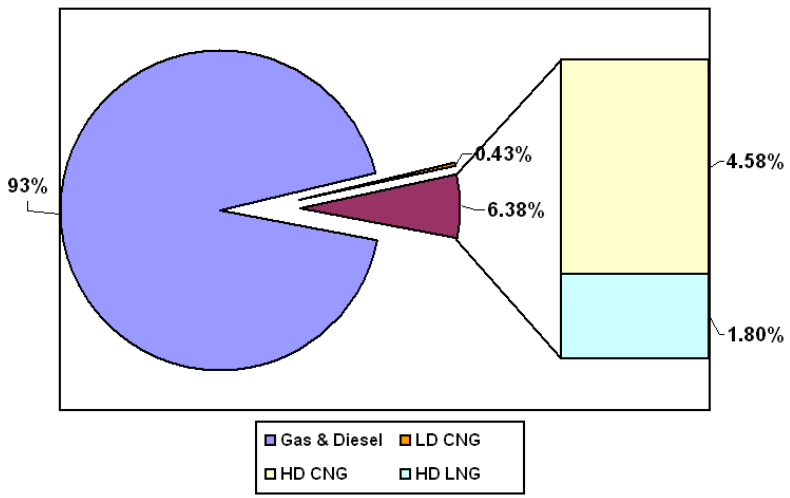
ESTD. FUEL USE GOALS FOR NATURAL GAS (mm gge/yr)

CASE	2006	2012	2017	2020	2022	2030	2050
Conservative	125	218	294	354	399	589	839
%Total	0.6	1	1.2	1.5	1.7	2.3	2.8
Moderate	125	319	536	736	912	1720	2670
%Total	0.6	1.4	2.3	3.1	3.8	6.8	8.9
Aggressive	125	433	803	1170	1500	3270	5570
%Total	0.6	1.9	3.4	4.9	6.2	13	19
Tot. All Fuels	20980	22980	23660	23820	23970	25290	29850

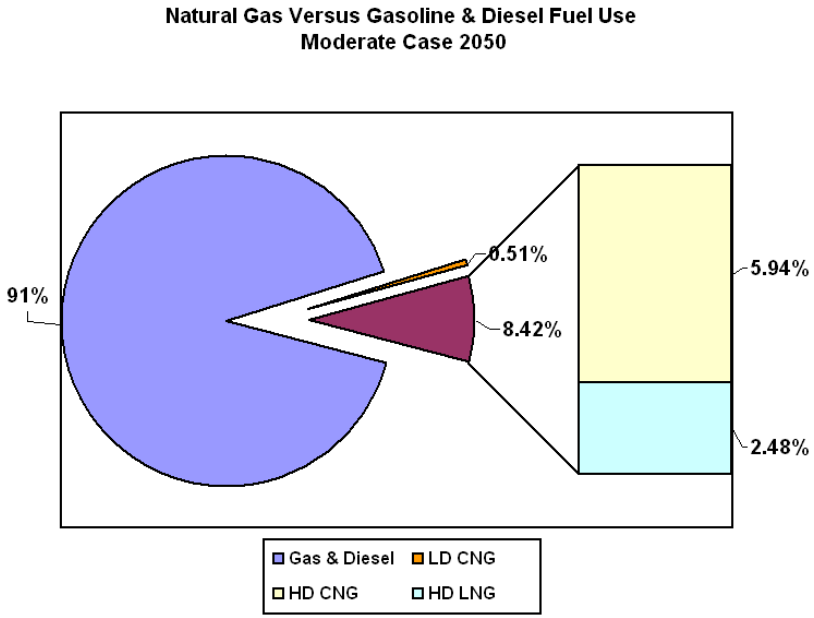
Source: California Energy Commission

Prospects: AB 1007 NG

FUEL USE OUTCOMES – MODERATE CASE



2050, NG 8.9% of on-road transportation fuel



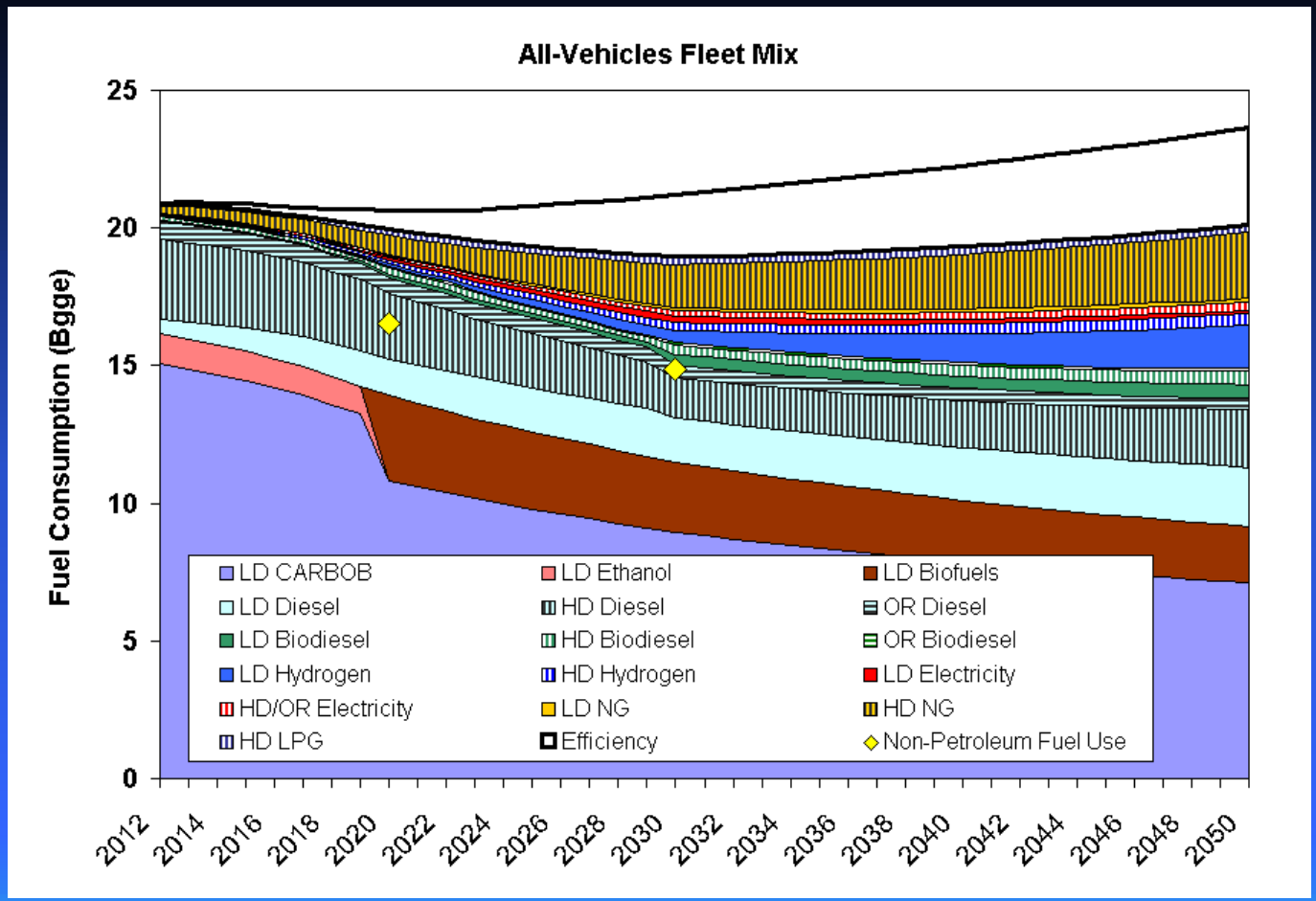
2006, NG < 1% of on-road transportation fuel

2030, NG 6.8% of on-road transportation fuel

Source: California Energy Commission

Prospects: AB 1007 NG

FUEL USE OUTCOMES – EXAMPLE FUEL MIX



NG 36% of 2050 CA motor fuel demand.

Source: Energy Commission DRAFT AB 1007 State Alt. Fuels Plan

Prospects: AB 1007 NG

ESTIMATED ENVIRONMENTAL BENEFITS – AB 32 NEXUS

Case (mm gge)	2006	2012	2017	2020	2022	2030	2050
Conservative	125	218	294	354	399	589	839
GHG Red. (000 metric tons)	N/A	1020	1360	1630	1820	2610	?
%Trans. Total AB 32	N/A	10	4	7	TBD	?	?
Moderate	125	319	536	736	912	1720	2670
GHG Red (000 metric tons)	N/A	1490	2540	3530	4380	8780	?
%Trans. Total AB 32	N/A	15	7	14	TBD	?	?
Aggressive	125	433	803	1170	1500	3270	5570
GHG Red (000 metric tons)	N/A	1880	3470	5080	6490	15900	?
%Trans. Total AB32	N/A	19	10	20	?	?	?
Trans. Total AB 32 mm tons	N/A	10	35	25	?	?	?

Source: California Energy Commission

Note: Estimated environmental benefits from representative LD NGV, MD NGV, HD CNGV and HD LNGV on a full fuel cycle basis. Ref. AB 1007 Full Fuel Cycle Analysis. AB 32 mm tons, illustrative reduction targets & schedule only.

Prospects: AB 1007 NG

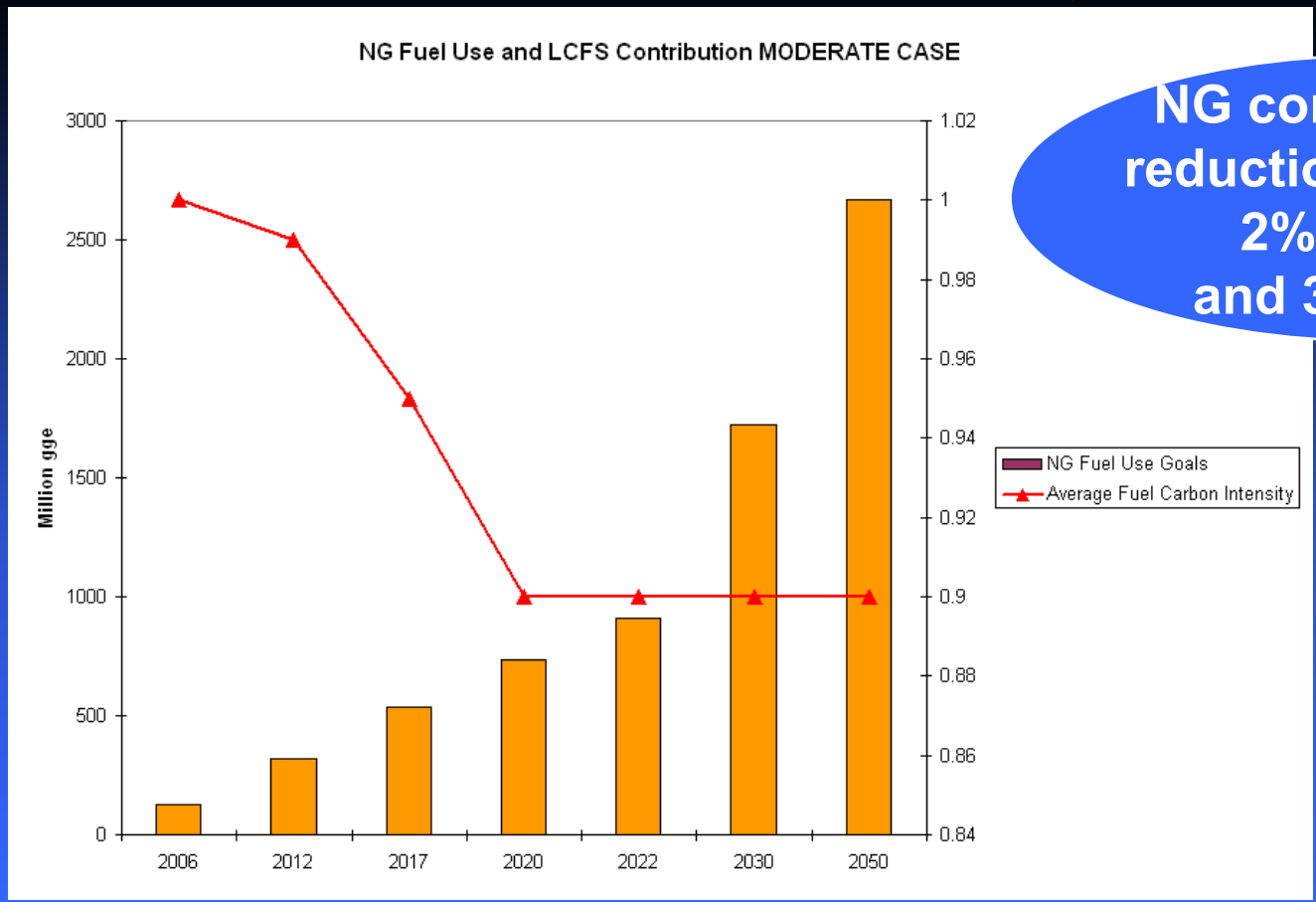
ESTIMATED LCFS NEXUS & IMPLICATIONS

CASE (mm gge)	2006	2012	2017	2020	2022	2030	2050
Conservative	125	218	294	354	399	589	839
AFCI Effect	N/A	-2%	-1%	-1%	-1%	-2%	-2%
Moderate	125	319	536	736	912	1720	2670
AFCI Effect	N/A	-3%	-1%	-2%	-1%	-3%	-3%
Aggressive	125	433	803	1170	1500	3270	5570
AFCI Effect	N/A	-4%	-2%	-4%	-3%	-6%	-9%
AFCI	1	0.99	0.95	0.90	0.90	0.90	0.90

Sources: California Energy Commission, University of California, Davis

Prospects: AB 1007 NG

ESTIMATED LCFS NEXUS & IMPLICATIONS



NG contributes to reduction in AFCI of 2% to 2020 and 3% to 2050

Sources: California Energy Commission, University of California, Davis

Prospects: AB 1007 NG

ESTD. CE w/ Environmental Benefits (2007$/GGE)

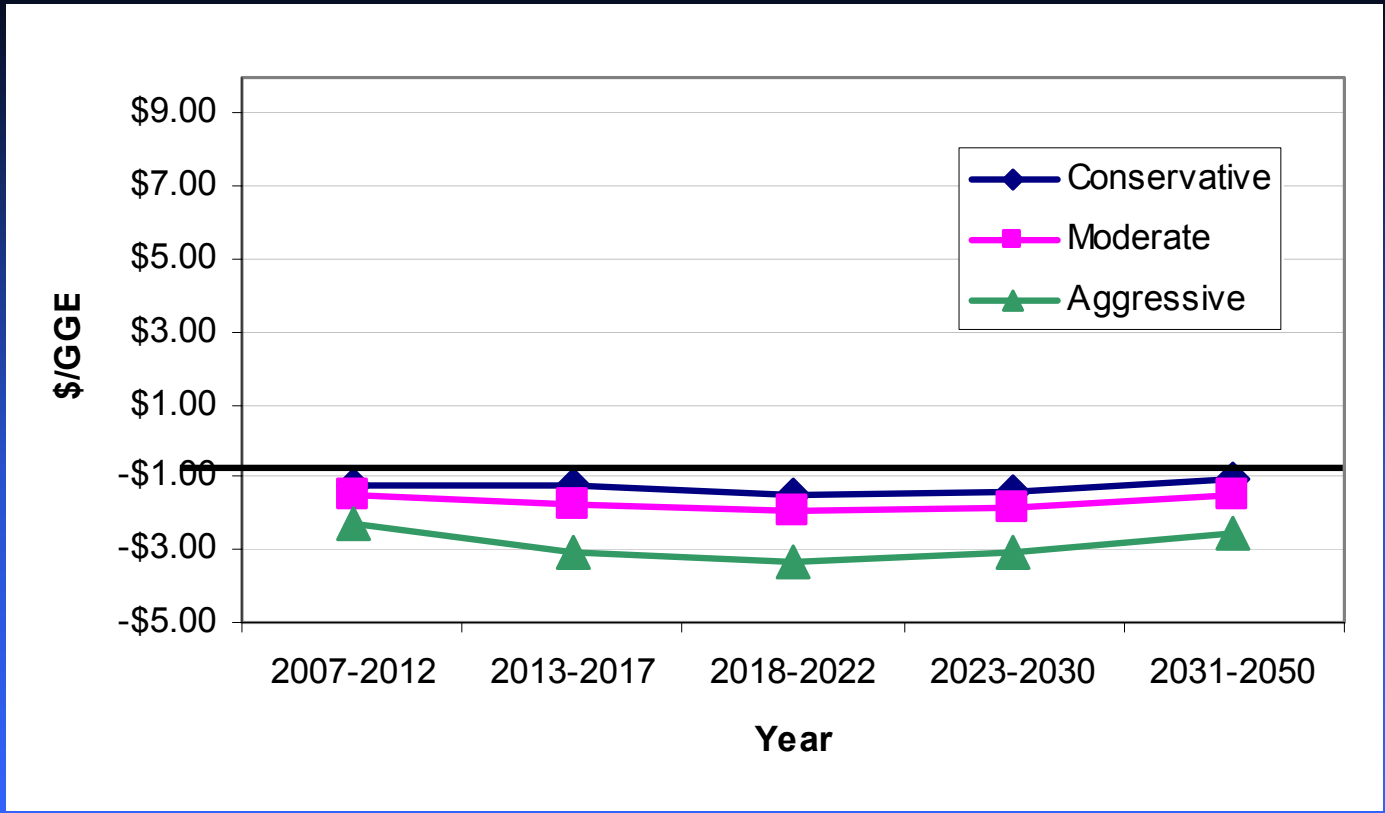
Case (mm gge)	2006	2012	2017	2020	2022	2030	2050
Conservative	125	218	294	354	399	589	839
2007$/GGE	N/A	-$1.24	-$1.21	-$1.47	-$1.47	-$1.39	-$1.09
Moderate	125	319	536	736	912	1720	2670
2007$/GGE	N/A	-$1.48	-$1.75	-$1.93	-$1.93	-$1.87	-$1.50
Aggressive	125	433	803	1170	1500	3270	5570
2007$/GGE	N/A	-$2.24	-$3.09	-$3.30	-$3.11	-$2.51	-$2.24

Source: California Energy Commission

Note: $2007 at 3% discount rate. CE includes fuel savings and tax revenue impacts to government. Negative CE means overall savings to consumer/end user. Weighted averages shown.

Prospects: AB 1007 NG

EST. Petroleum Reduction CE w/ Environmental Benefits

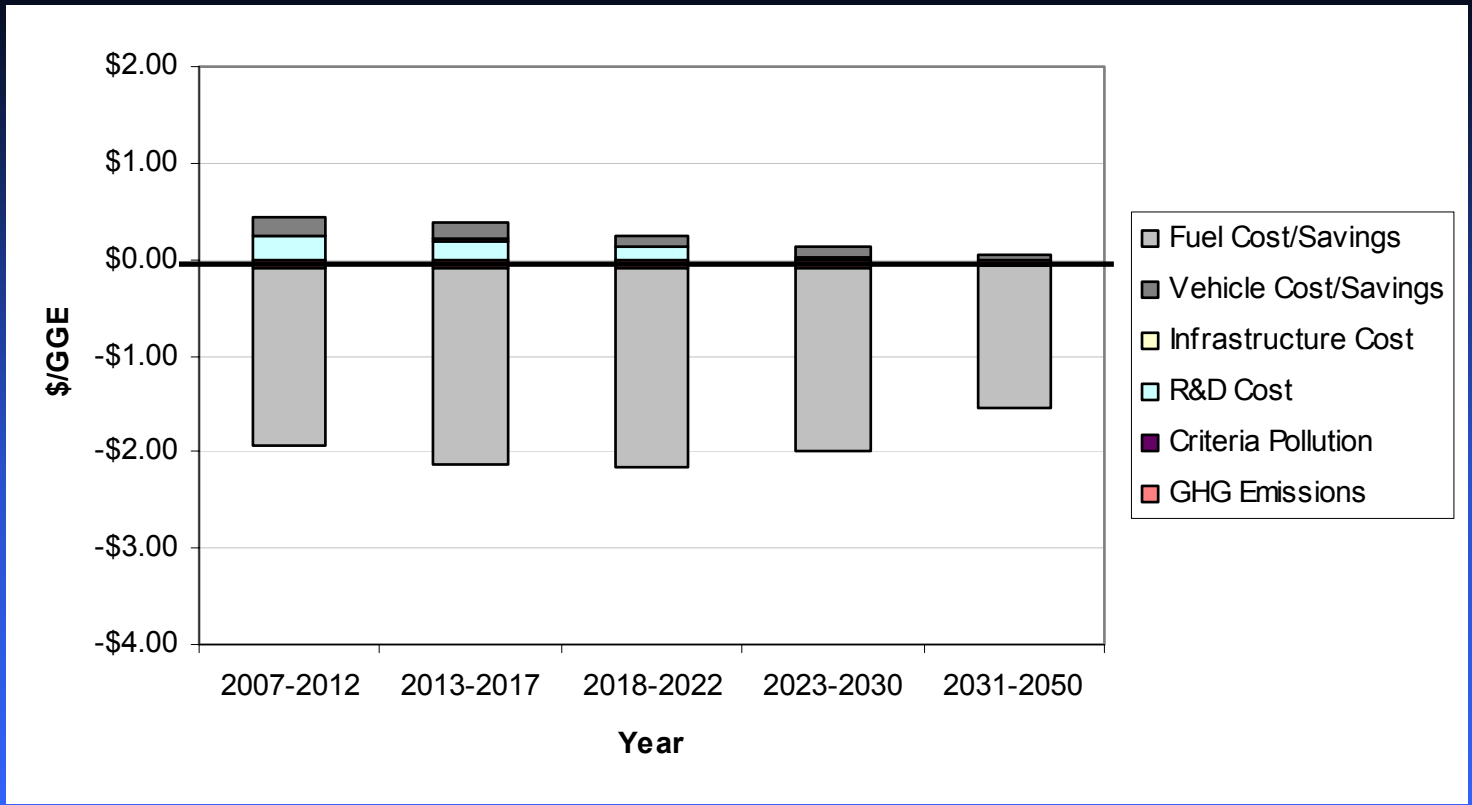


Source: California Energy Commission

Note: $2007 at 3% discount rate. CE includes fuel savings and tax revenue impacts to government. Negative CE means overall savings to consumer/end user. Weighted averages shown. Important: Vehicle, fuel price, R&D investments cost assumptions driven.

Prospects: AB 1007 NG

EST. CE w/ Environmental Benefits - Moderate Case

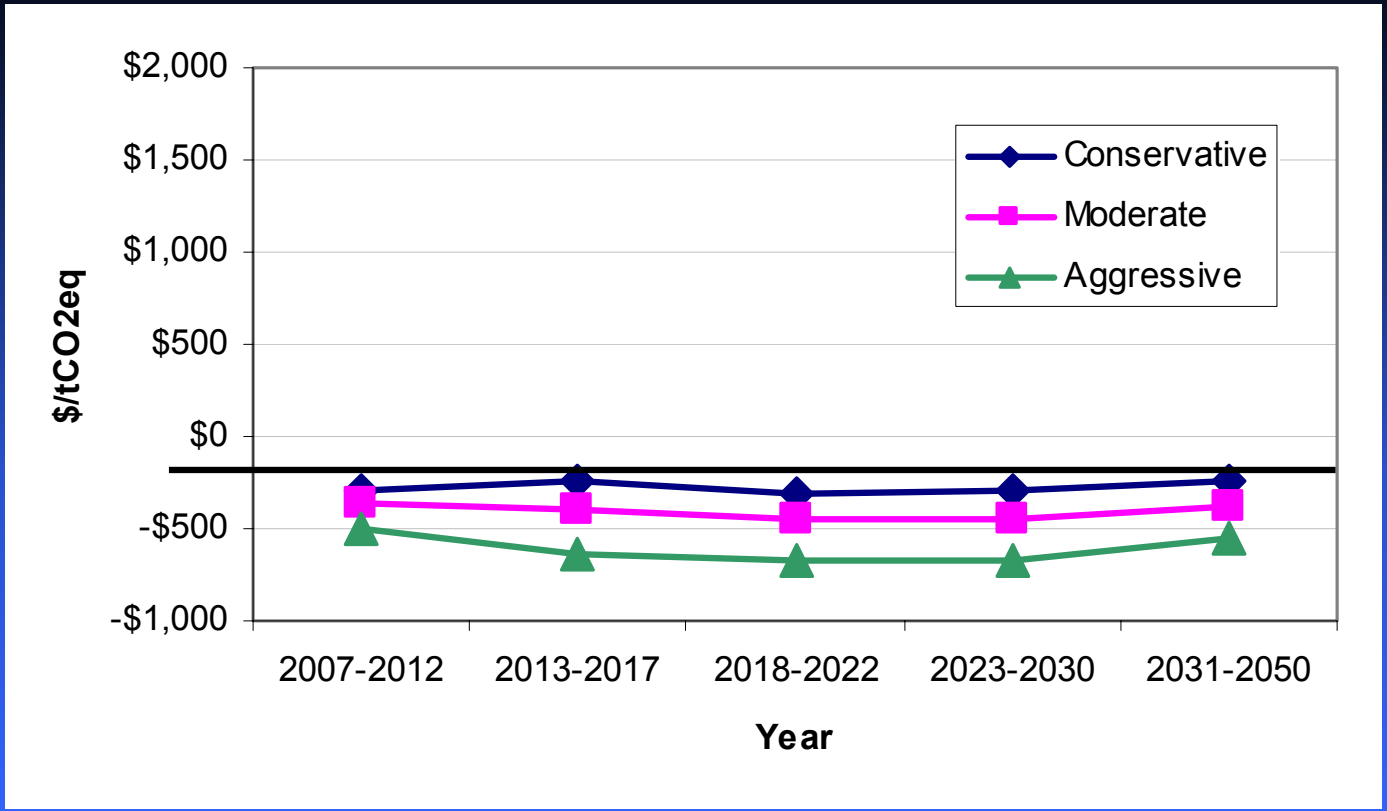


Source: California Energy Commission

Note: $2007 at 3% discount rate. CE includes fuel savings and tax revenue impacts to government. Negative CE means overall savings to consumer/end user. Weighted averages shown. Important: Vehicle, fuel price, R&D investments cost assumptions driven.

Prospects: AB 1007 NG

EST. GHG CE w/ Environmental Benefits (2007$/GGE)

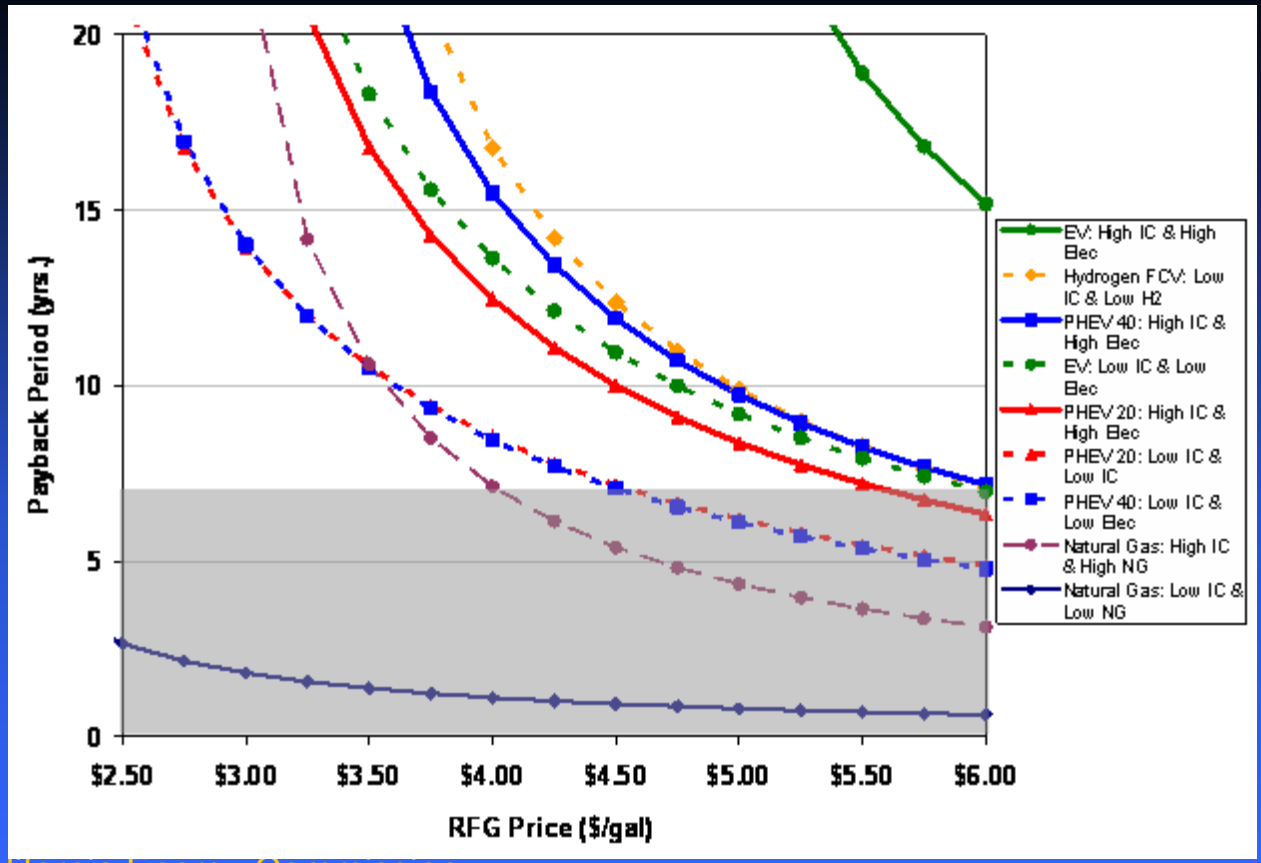


Source: California Energy Commission

Note: $2007 at 3% discount rate. CE includes fuel savings and tax revenue impacts to government. Negative CE means overall savings to consumer/end user. Weighted averages shown. Important: Vehicle, fuel price, R&D investments cost assumptions driven.

Prospects: AB 1007 NG

Matured Market EST. Consumer Payback Periods



Source: California Energy Commission

Note: $2007 at 8% discount rate. CE includes fuel savings and tax revenue impacts to government. Negative CE means overall savings to consumer/end user. Weighted averages shown. Important: Vehicle, fuel cost (price) assumptions driven.

Challenges: AB 1007 NG

ESTD. INVESTMENT – VEH. & INFRA R&D + INCENT.

Case (mm gge)	2006	2012	2017	2020	2022	2030	2050	Total
Conservative	**125**	**218**	**294**	**354**	**399**	**589**	**839**	**N/A**
MM Nom$	N/A	1270	990	1260	880	1070	120	5600
MM $2007	**N/A**	**1000**	**608**	**670**	**422**	**350**	**15**	**3070**
Moderate	**125**	**319**	**536**	**736**	**912**	**1720**	**2670**	**N/A**
MM Nom$	N/A	2260	2030	2040	2230	1350	290	10200
MM $2007	**N/A**	**1770**	**1250**	**1080**	**1070**	**440**	**36**	**5600**
Aggressive	**125**	**433**	**803**	**1170**	**1500**	**3270**	**5570**	**N/A**
MM Nom$	N/A	2520	2380	2270	2760	2250	560	12700
MM $2007	**N/A**	**1980**	**1460**	**1200**	**1330**	**730**	**69**	**6800**

Source: California Energy Commission

Note: $2007 at 5% discount rate. Does not include fuel savings or tax revenue impacts.

Solutions: AB 1007 NG

- Capital Markets and Businesses Respond

Petroleum Dependence Reduction Measure	Company	Investments ($ millions)
Alternative Fuels/Fuel Substitution	Clean Energy	$100+ [1]
	Imperium Renewables	$250+ [2]
	Pacific Ethanol	$400+ [3]
Conservation	IdleAire	$300+ [4]
TOTAL	N/A	$1000+

1. Clean Energy
2. Imperium Renewables (As of September 2007)
3. Pacific Ethanol (as of February 2007)
4. Fortune Magazine, June 2006

Solutions: AB 1007 NG

- Capital Markets and Businesses responding with scale and sophistication

Imperium Renewables Grays Harbor Biodiesel refinery – WA, 2007

100 to 250 million gal/yr capacity

Pacific Ethanol Plant

Madera – CA, 2006: 35 million gal/yr capacity

CA, ID, OR

220 million gal/yr combined capacity, 2008

Conservation: IdleAire Truck Stop Electrification saves CA 6 million gallons/yr

Clean Energy Pickens LNG Plant

Willis – TX, 2006: 100,000 gal/day capacity

Mojave Desert Plant, CA, 2008

50 to 80 million gal/yr capacity

5-yr NG supply goal: 300 million gals/yr

Solutions: AB 1007 NG

- Expand vehicle product offerings and grow infrastructure
- Refine business models to match market opportunities and compete
  - Sophistication of operations
  - Scale of operations
  - Investment performance
  - Incorporate environmental benefits in business planning and investment evaluations
- Raise capital by telling ‘the natural gas story’ and present credible value proposition to businesses and consumers
- Leverage government funding programs and private capital markets to gain market share to achieve AB 1007 Natural Gas Scenario outcomes.
- Educate consumers, businesses, investors and policymakers.

For More Information...

Call CEC's Emerging Fuels and Technologies Office at:

(916) 654-4634

or

Visit our Web site at:

www.energy.ca.gov