Perspective & Context of Historic Demand and Alternative Fuels

Staff Workshop on the Role of Alternative Fuels in California's Transportation Energy Future

Staff Workshop

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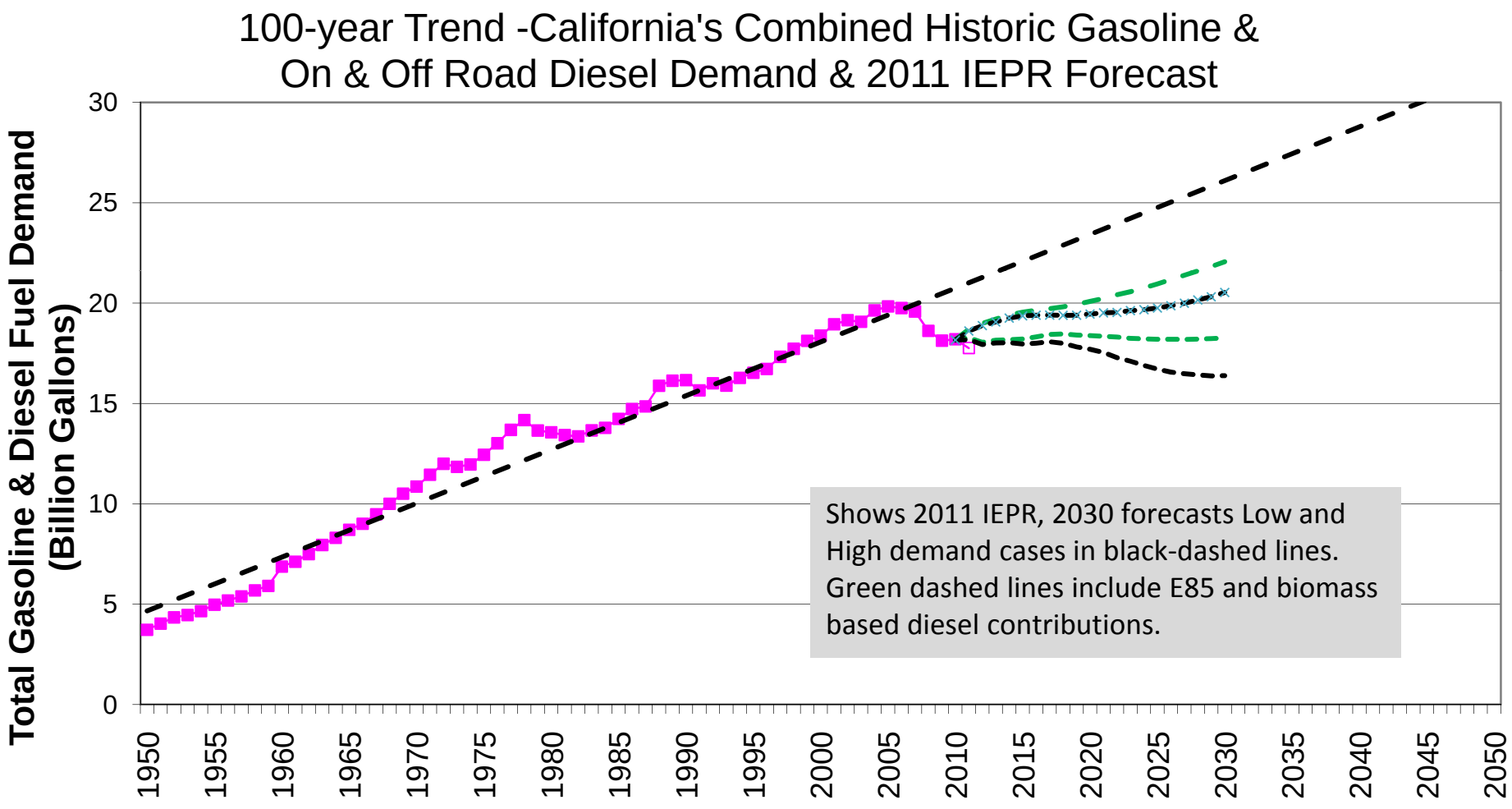
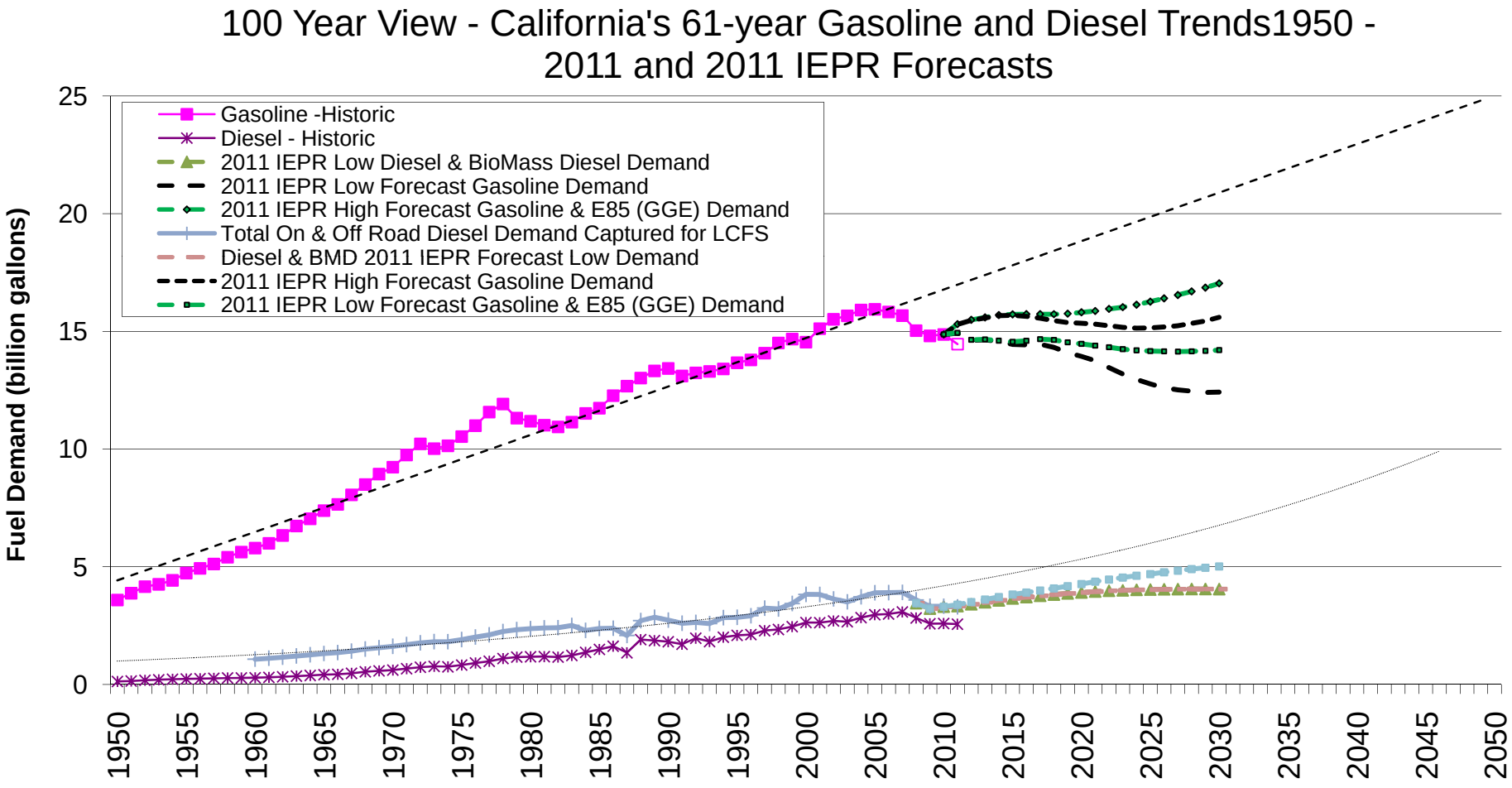
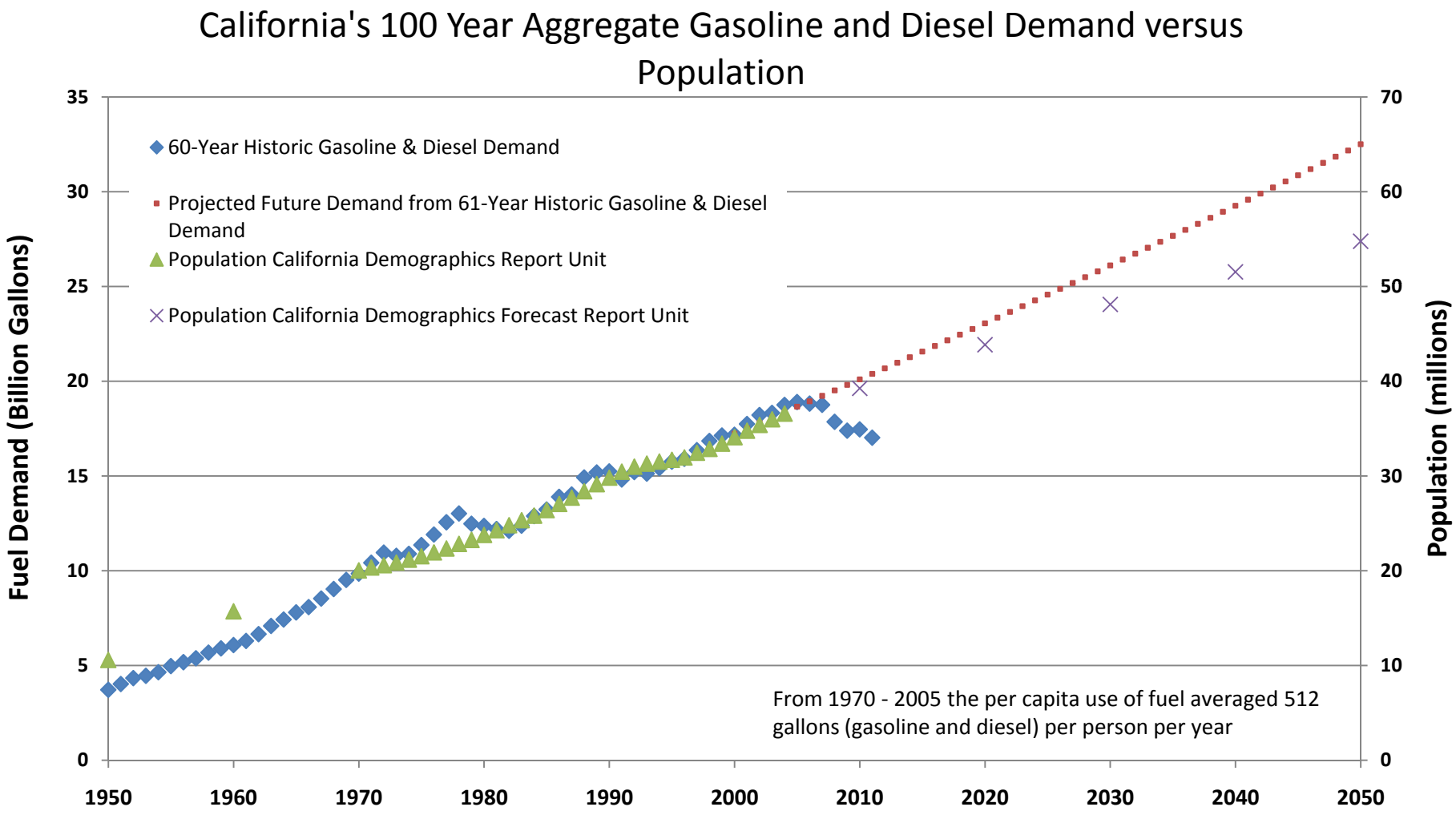
Transportation Fuel Trend & Forecast



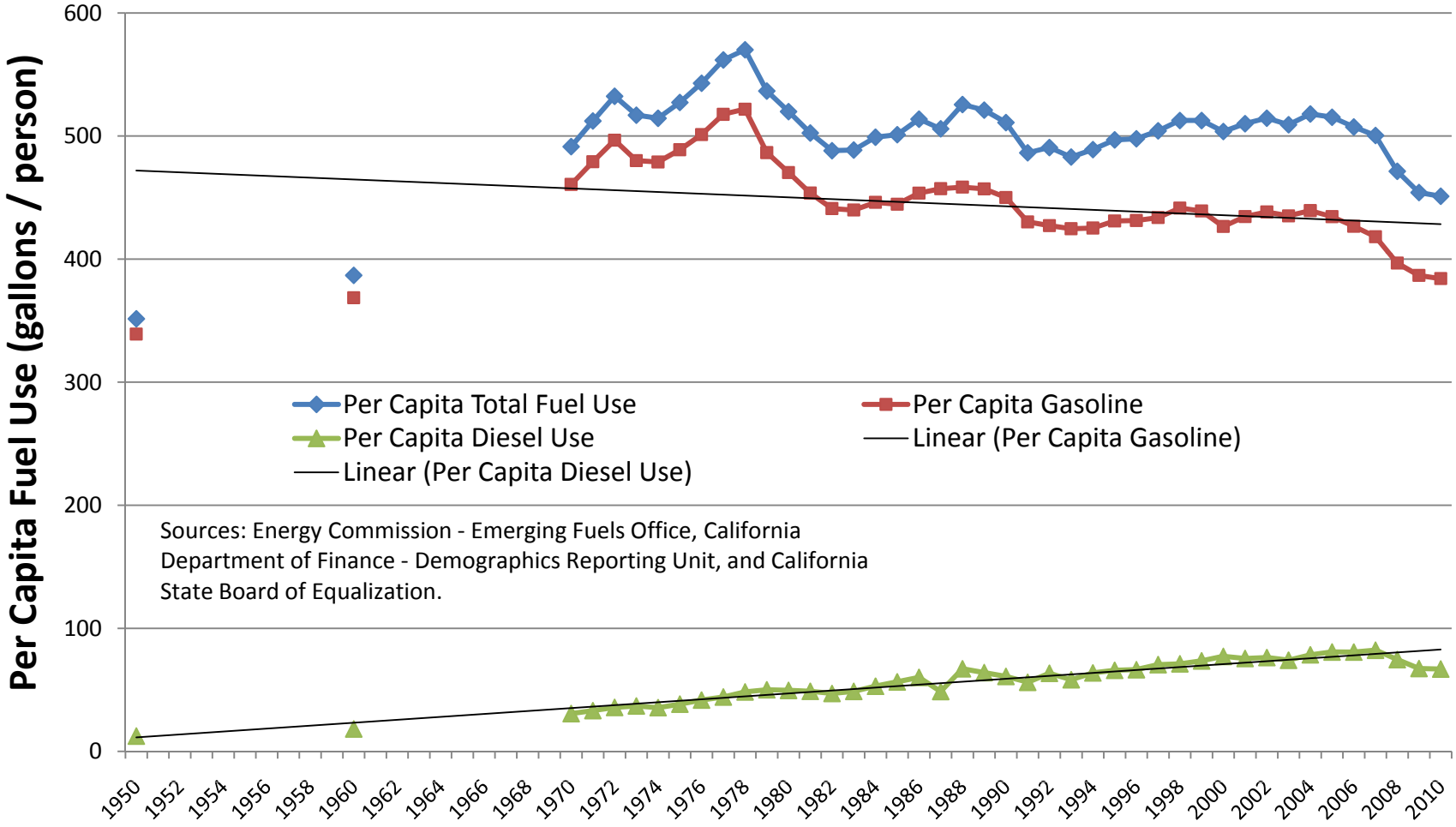
100-Year Transportation Fuel Demand View



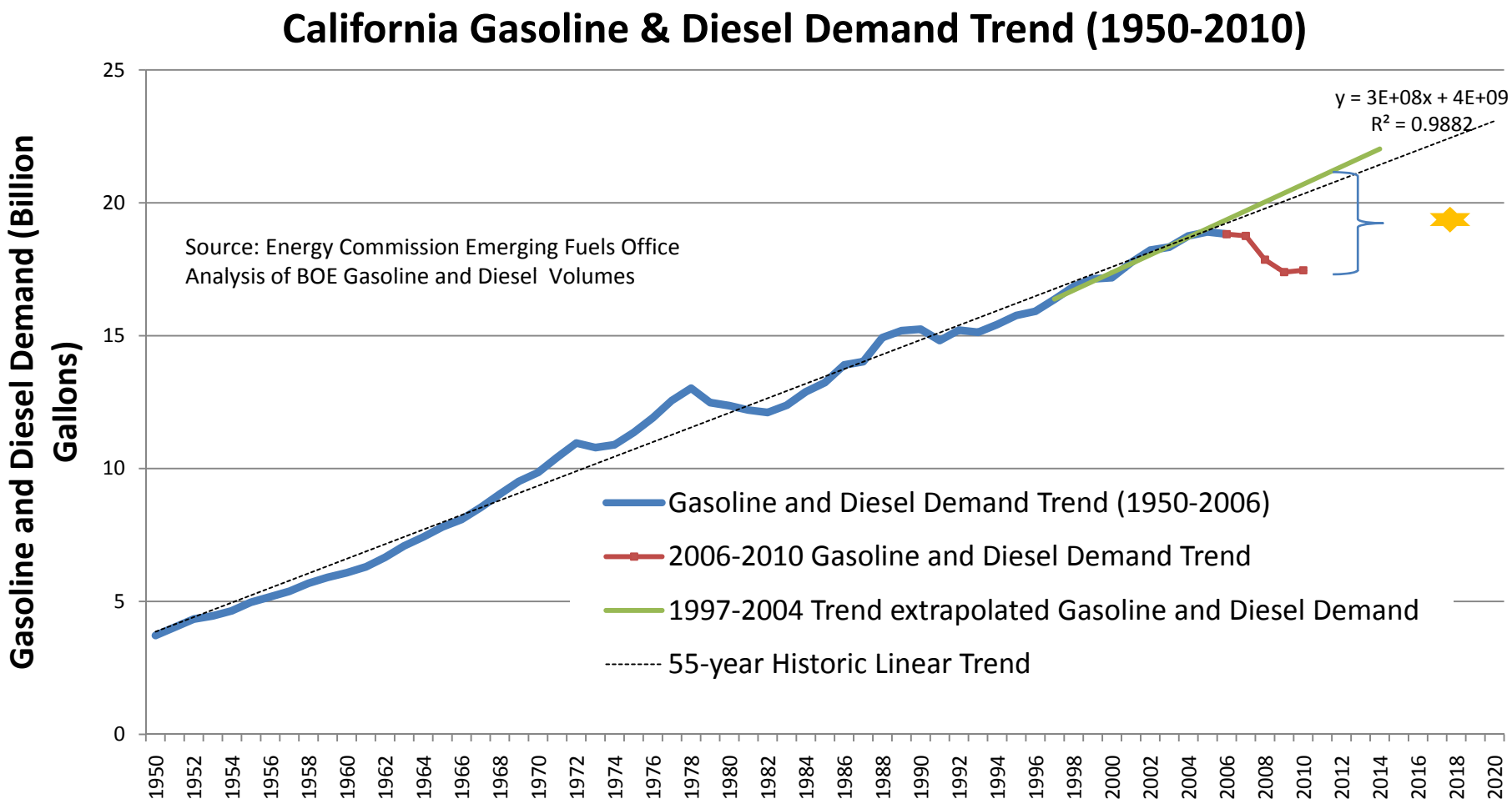
Population ≈ Demand



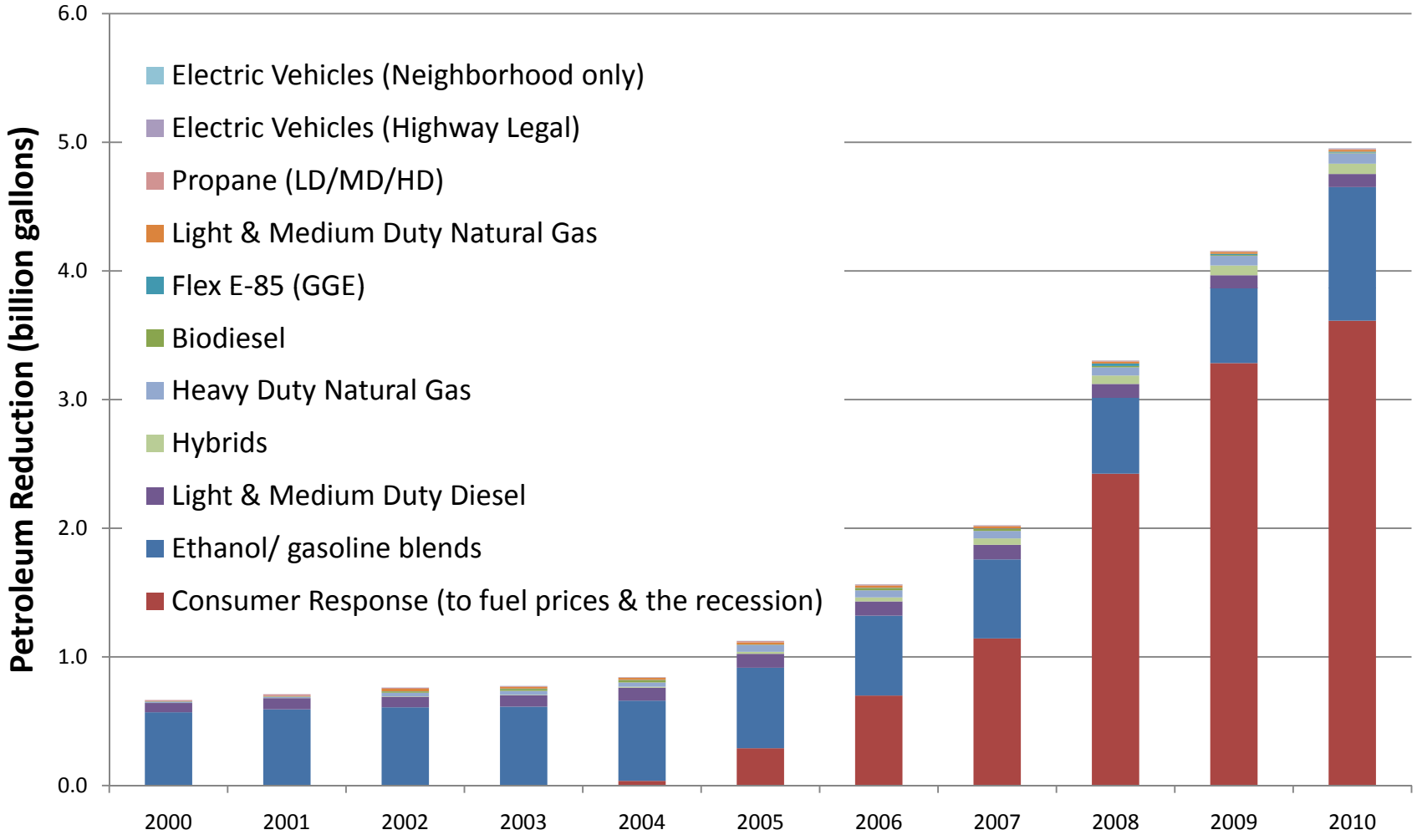
Per Capita Demand: Diesel Up and Gasoline Down



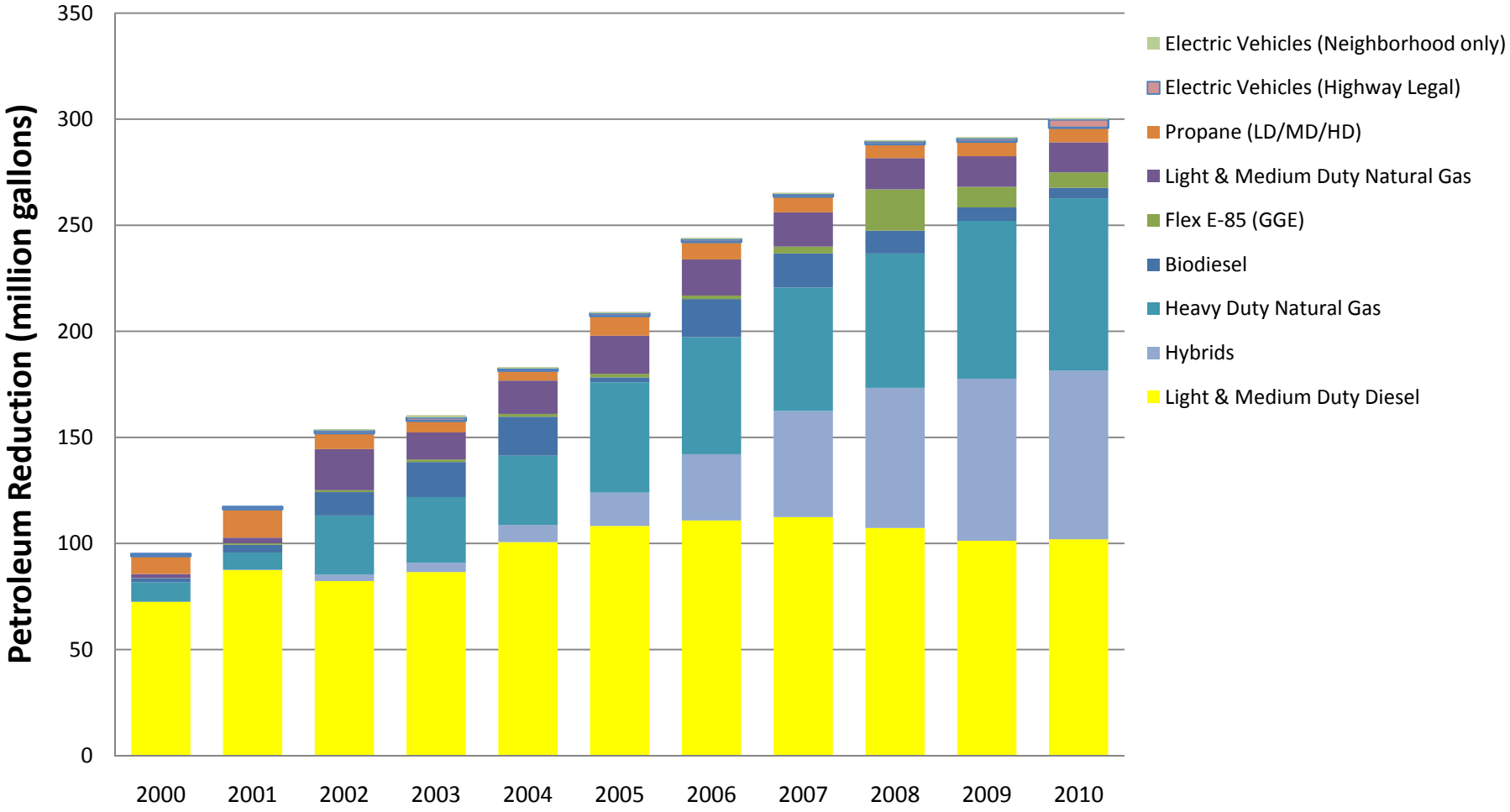
What has changed over the last decade?



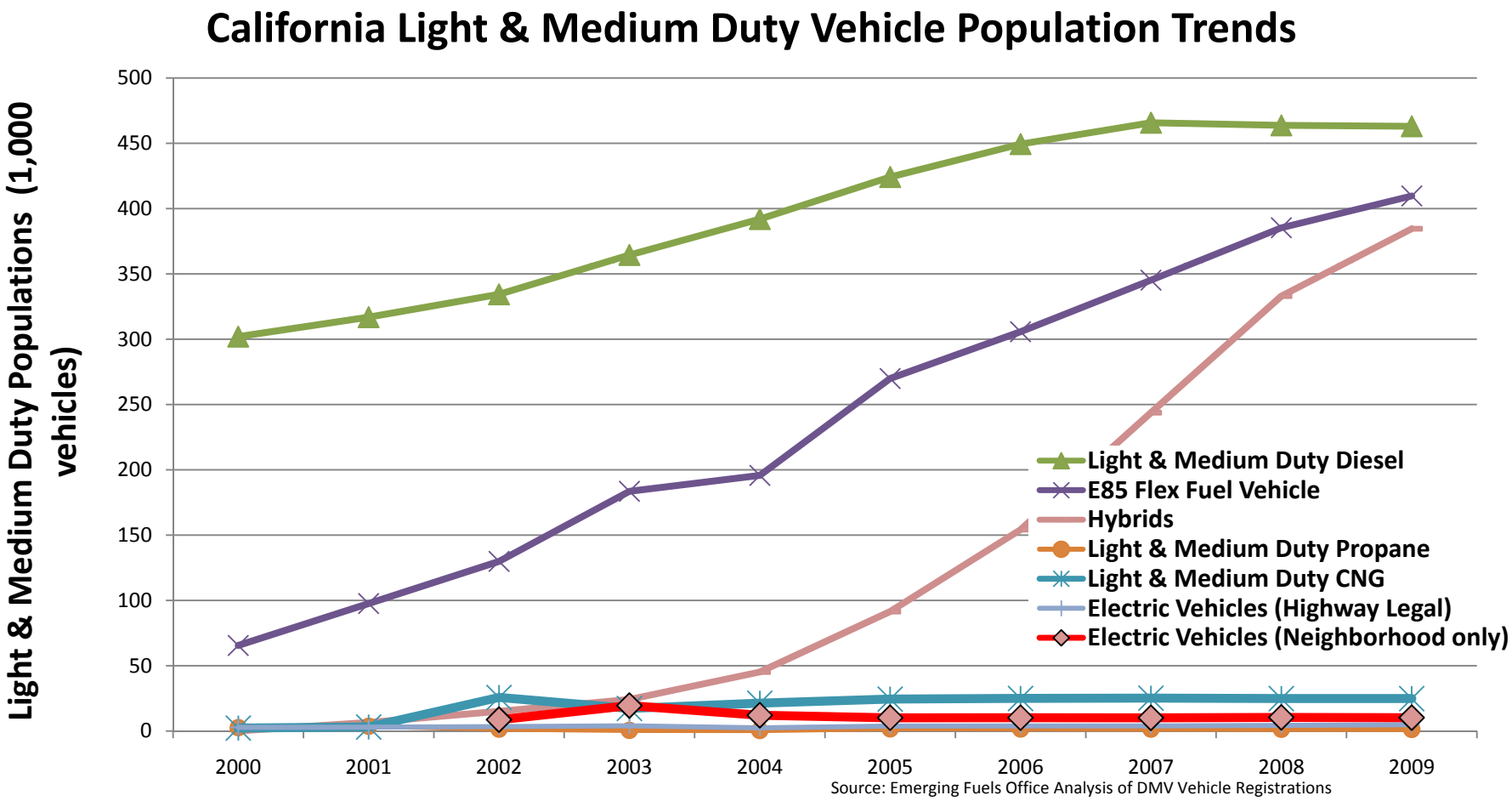
Demand Response & Alternative Fuels



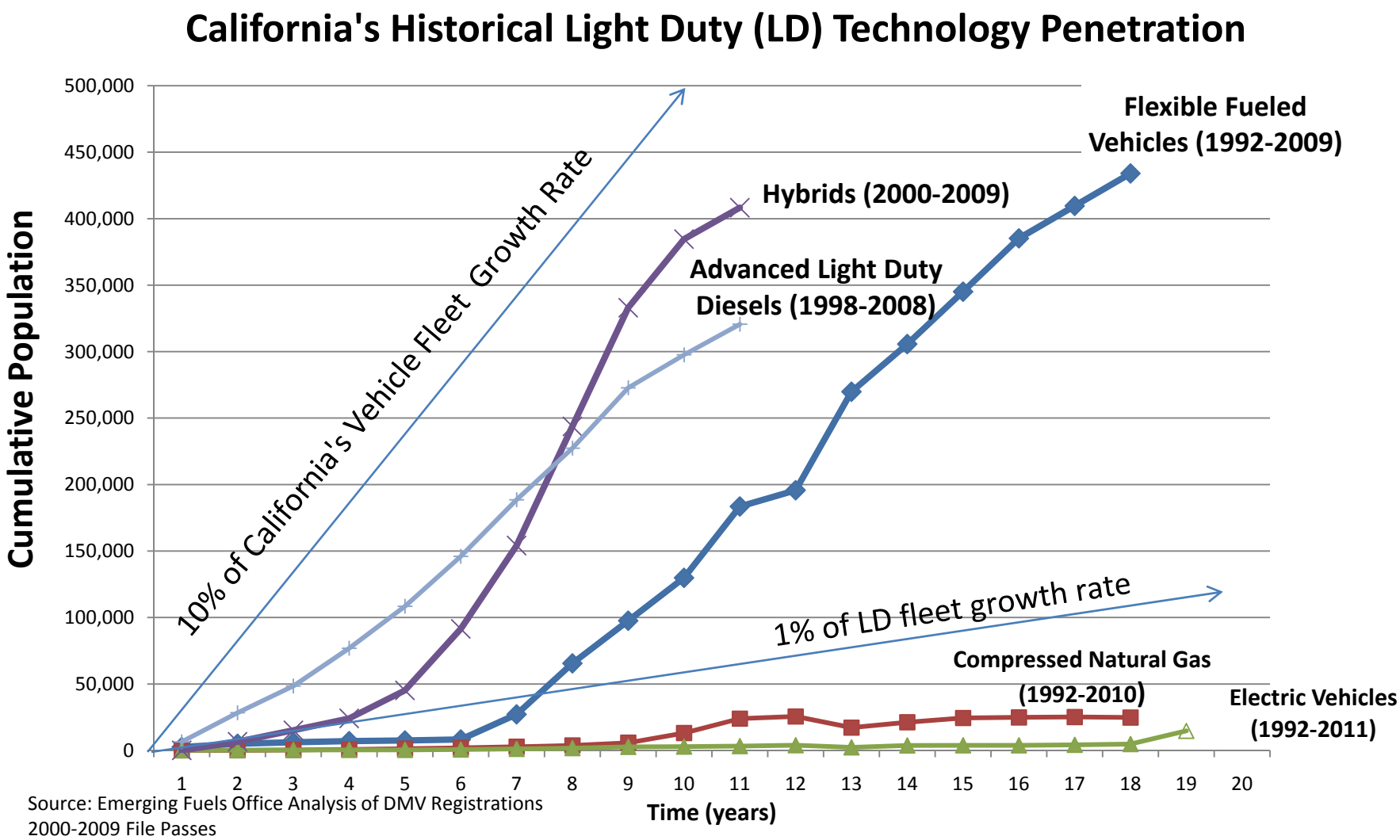
Petroleum Displacement Other Than E10 and Consumer Response



3 Vehicle Types Grew 2000-2009

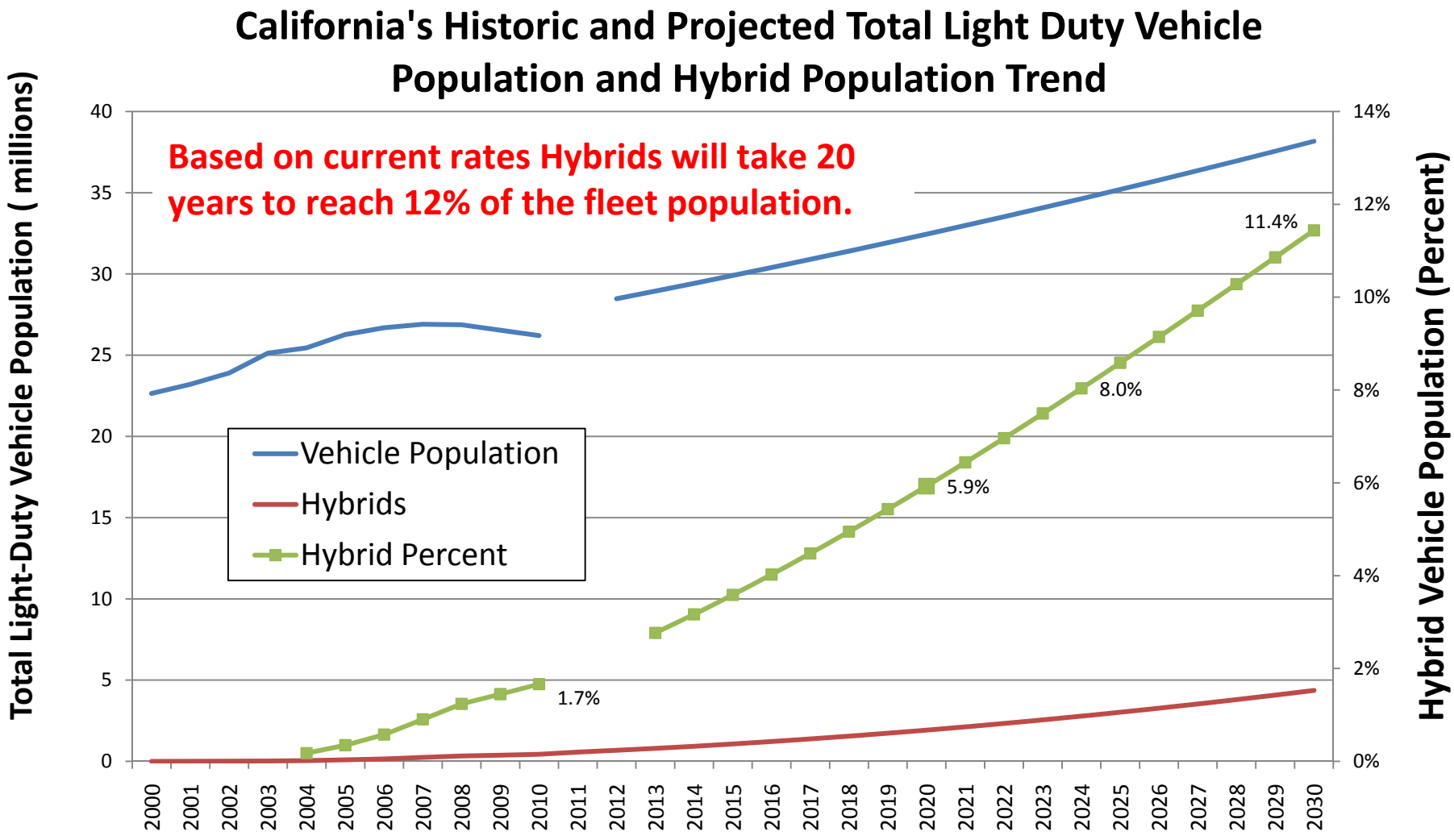


Non-Conventional Vehicle Trends

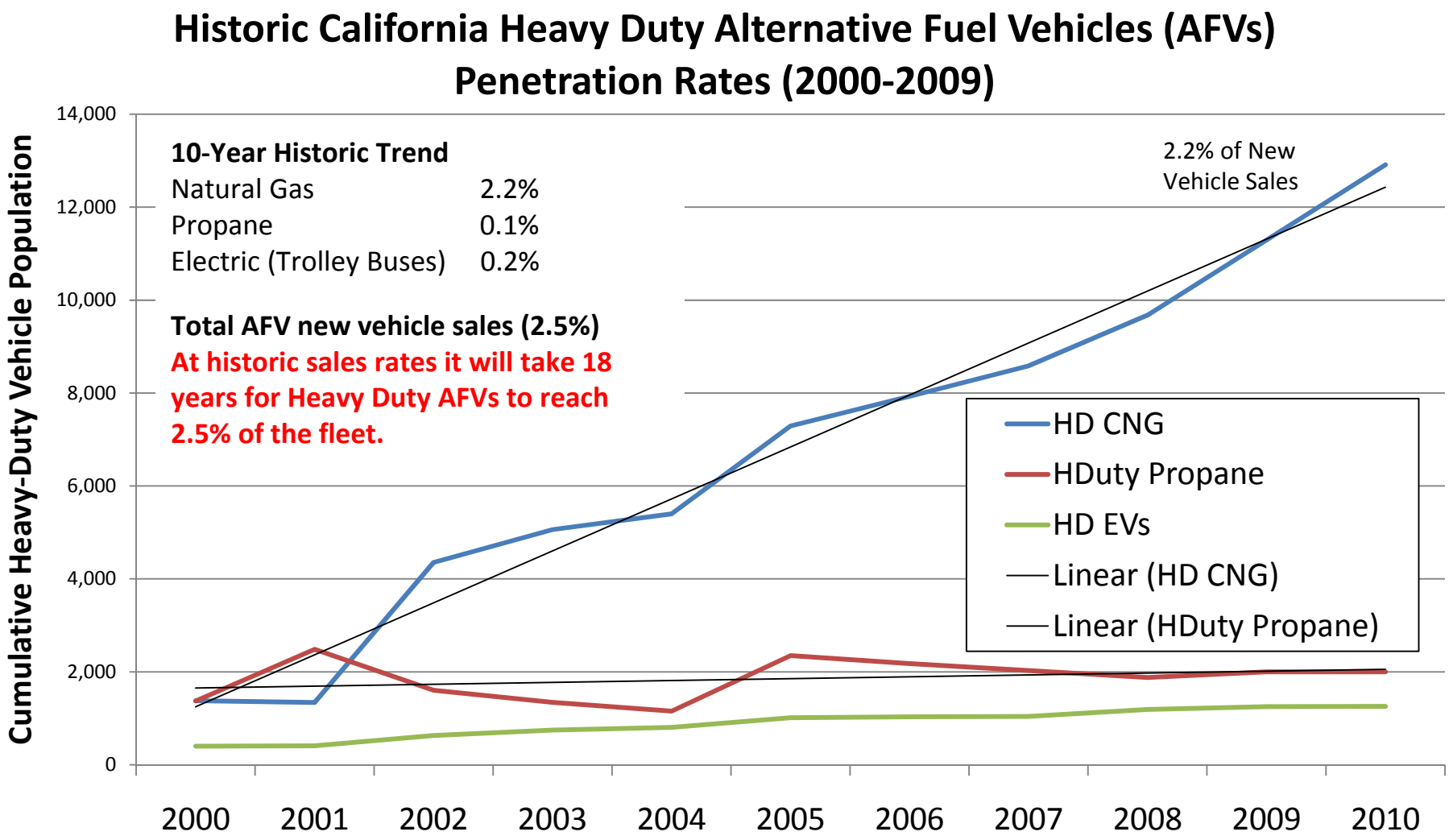


Source: Emerging Fuels Office Analysis of DMV Registrations 2000-2009 File Passes

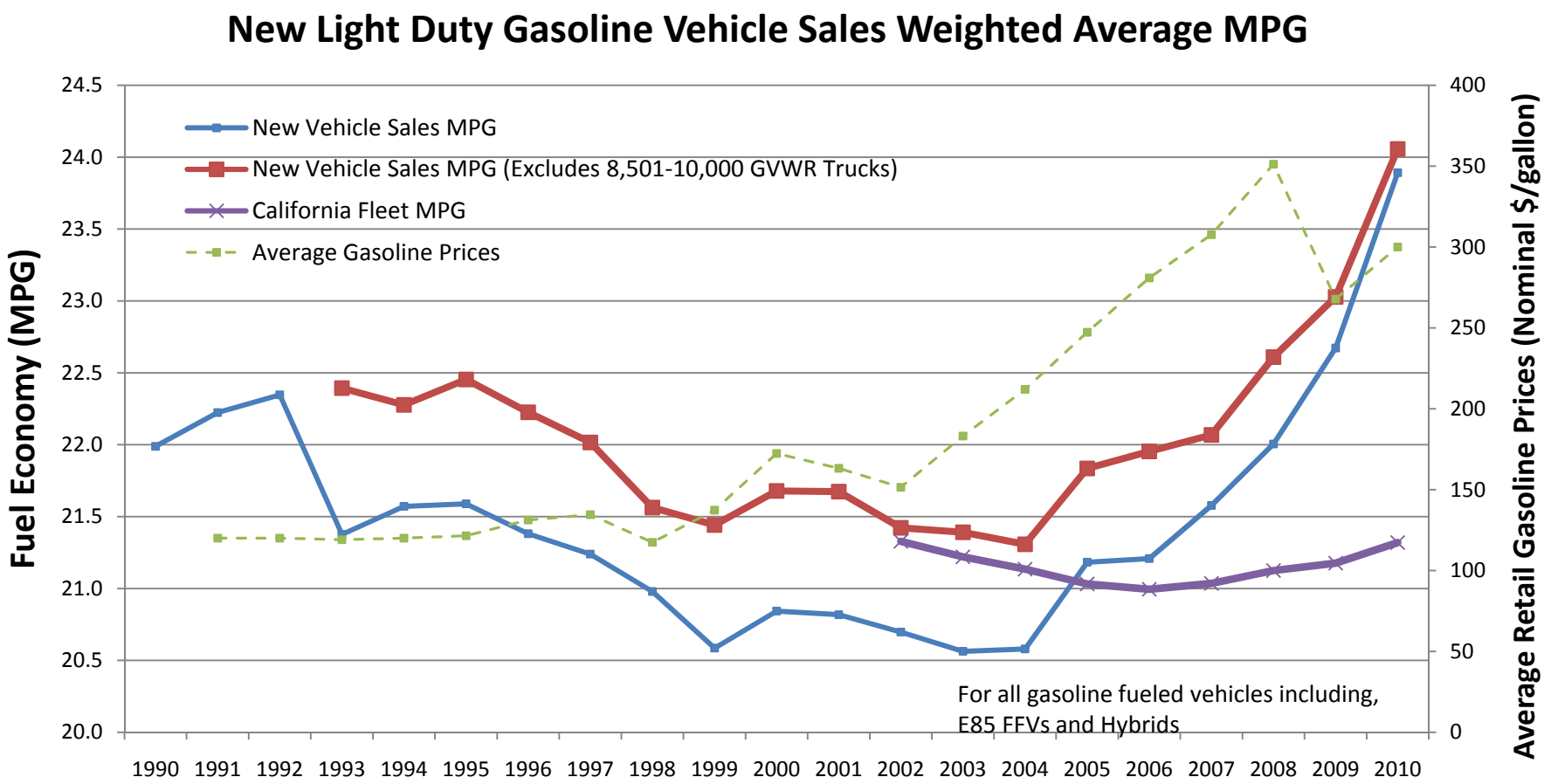
Vehicle Migration Takes Time



Heavy Duty AFV Trend

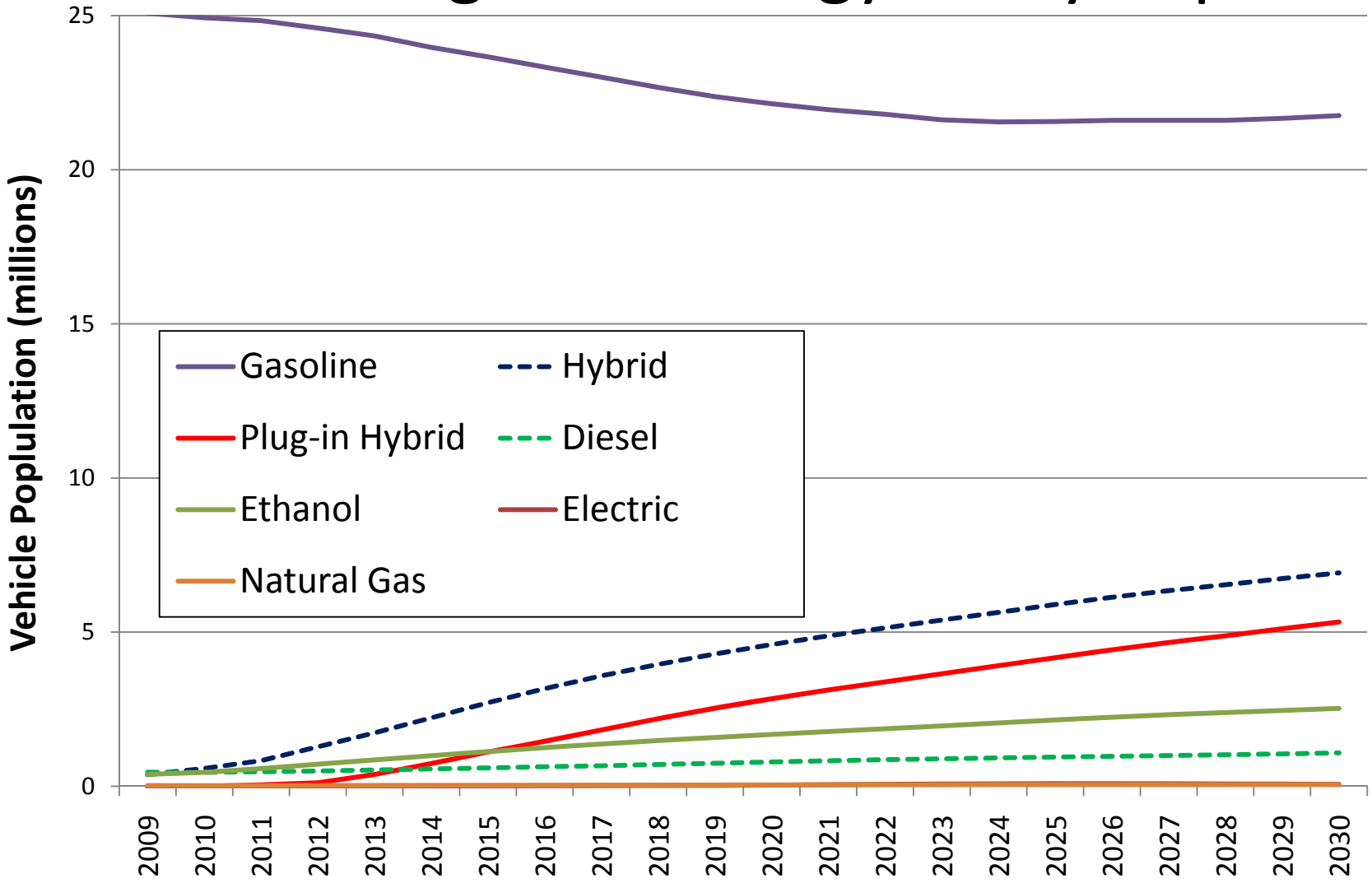


Sustained Fuel Economy Improvement since 2005

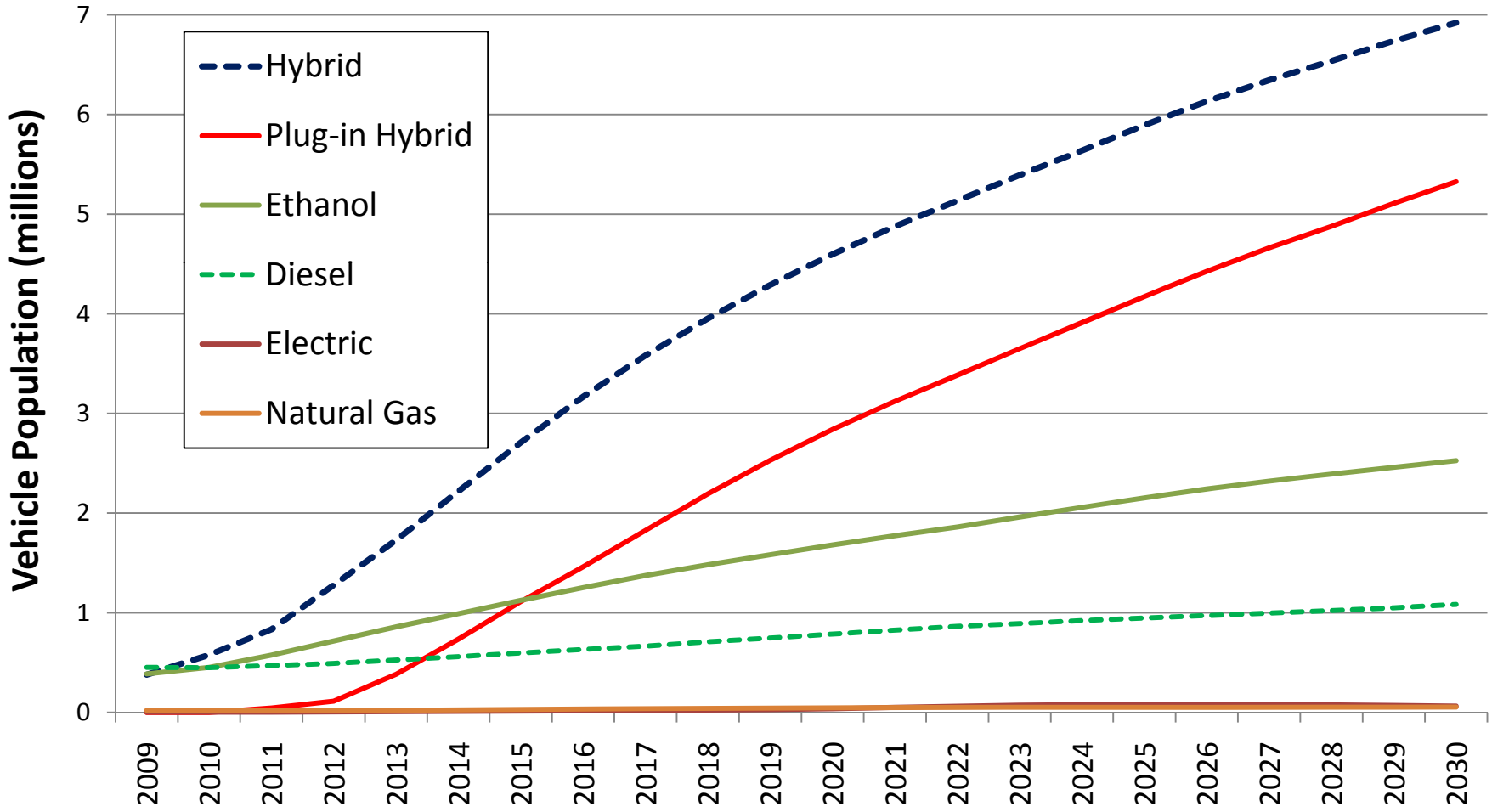


Source: G Yowell, Energy Commission Emerging Fuels Office Analysis, DMV Registered Vehicle, Total Fuel Use Analysis and EIA retail gasoline prices.

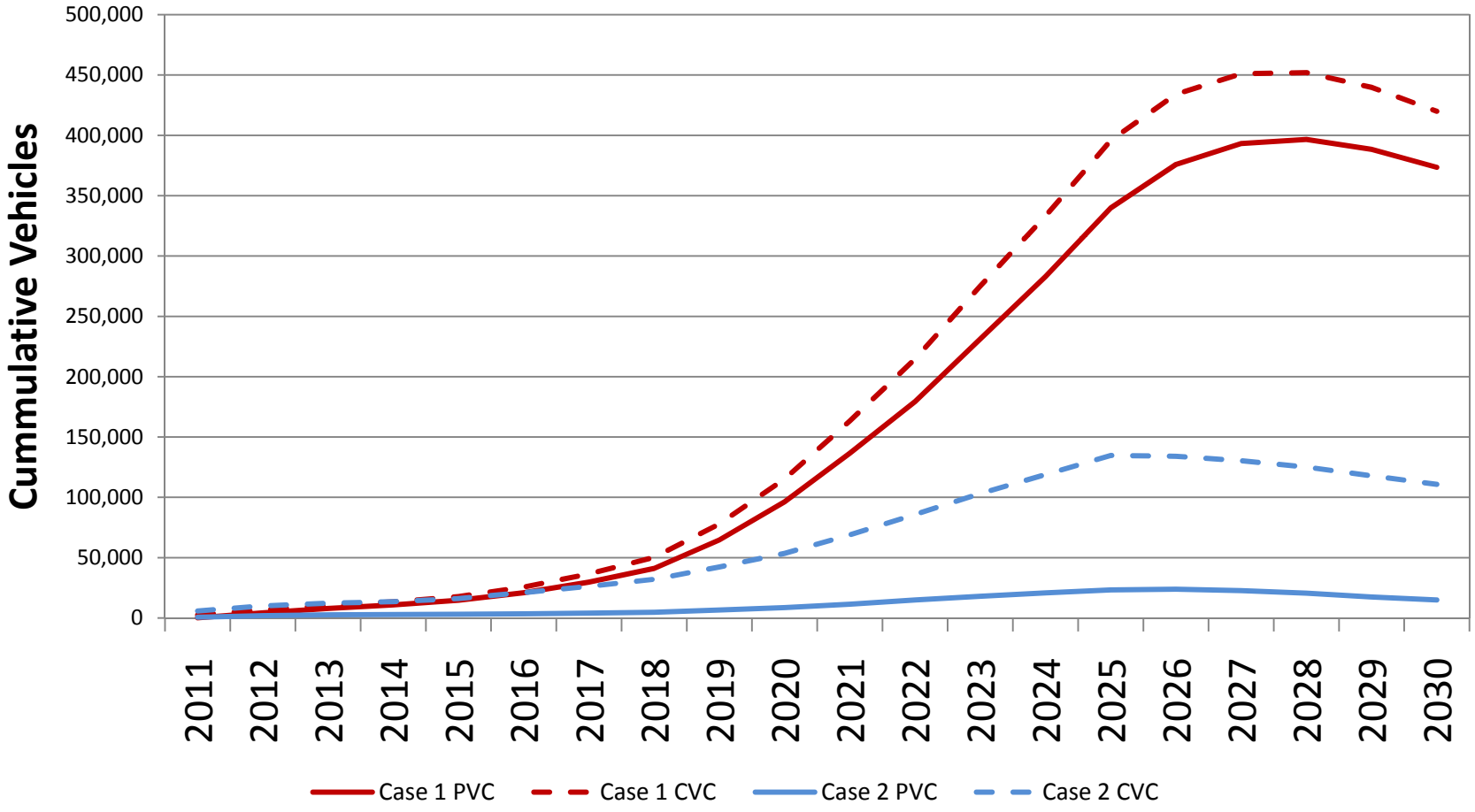
California Vehicle Forecast
2011 Integrated Energy Policy Report



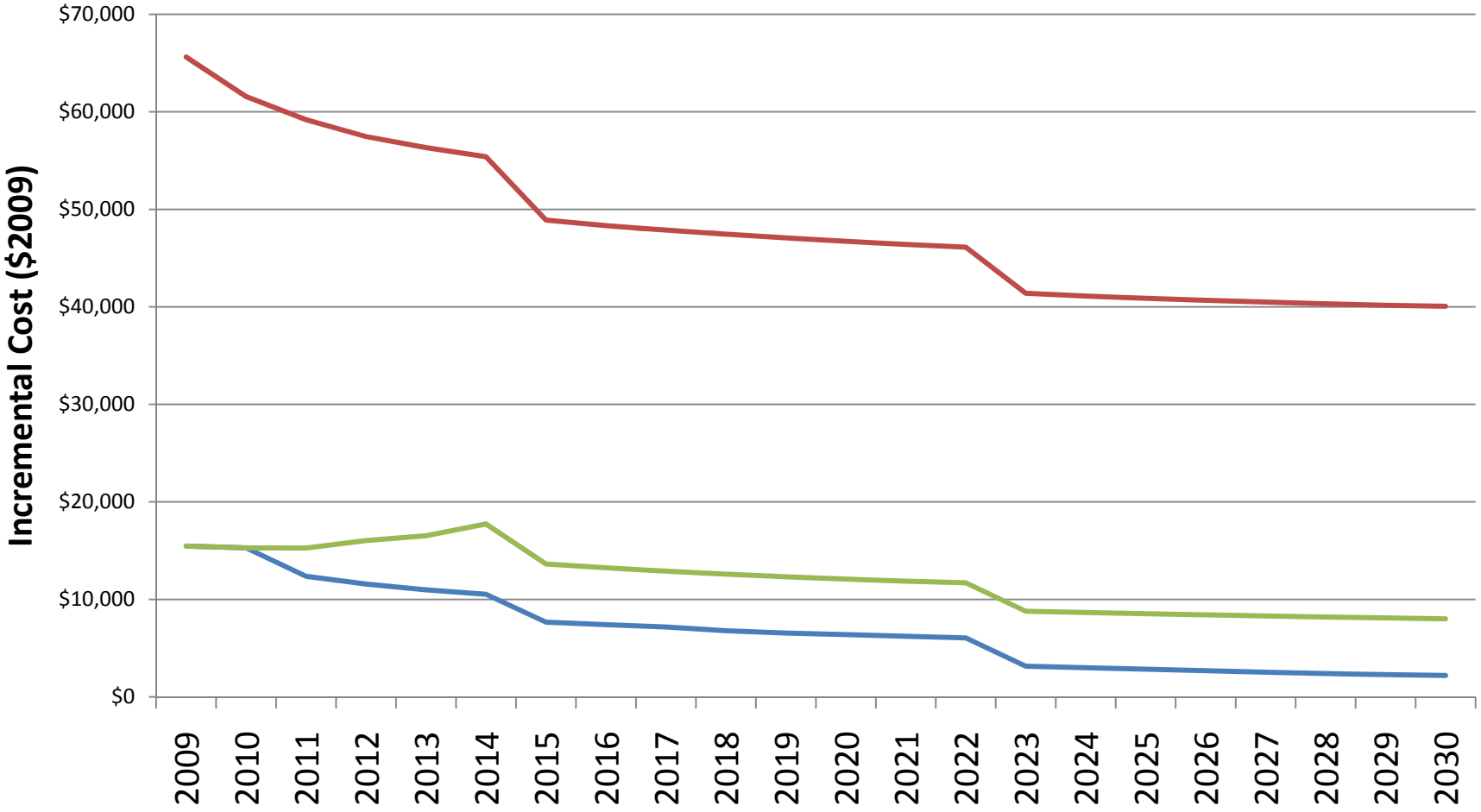
Light Duty Vehicle Forecast – 2011 IEPR



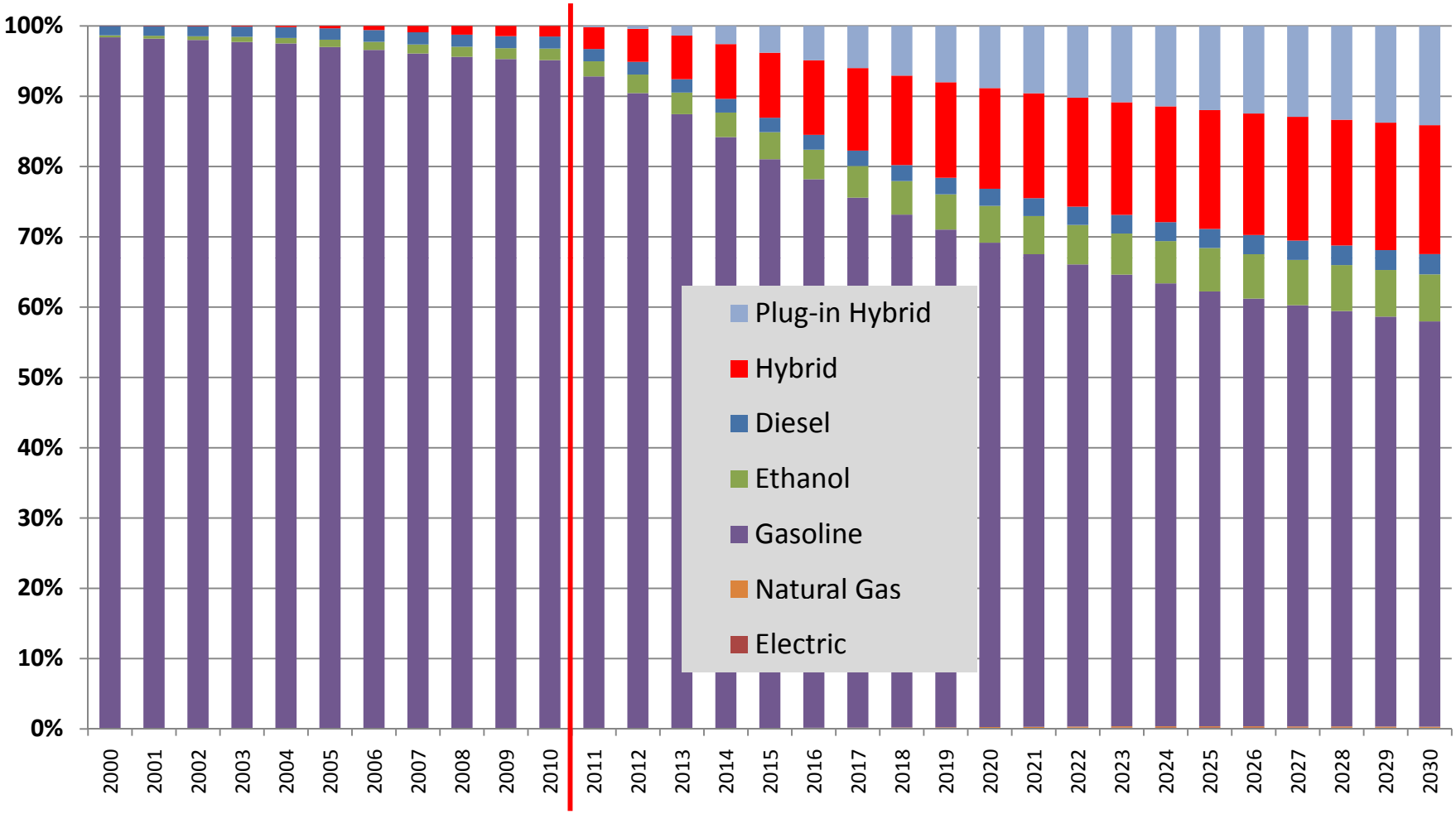
California Electric Vehicles



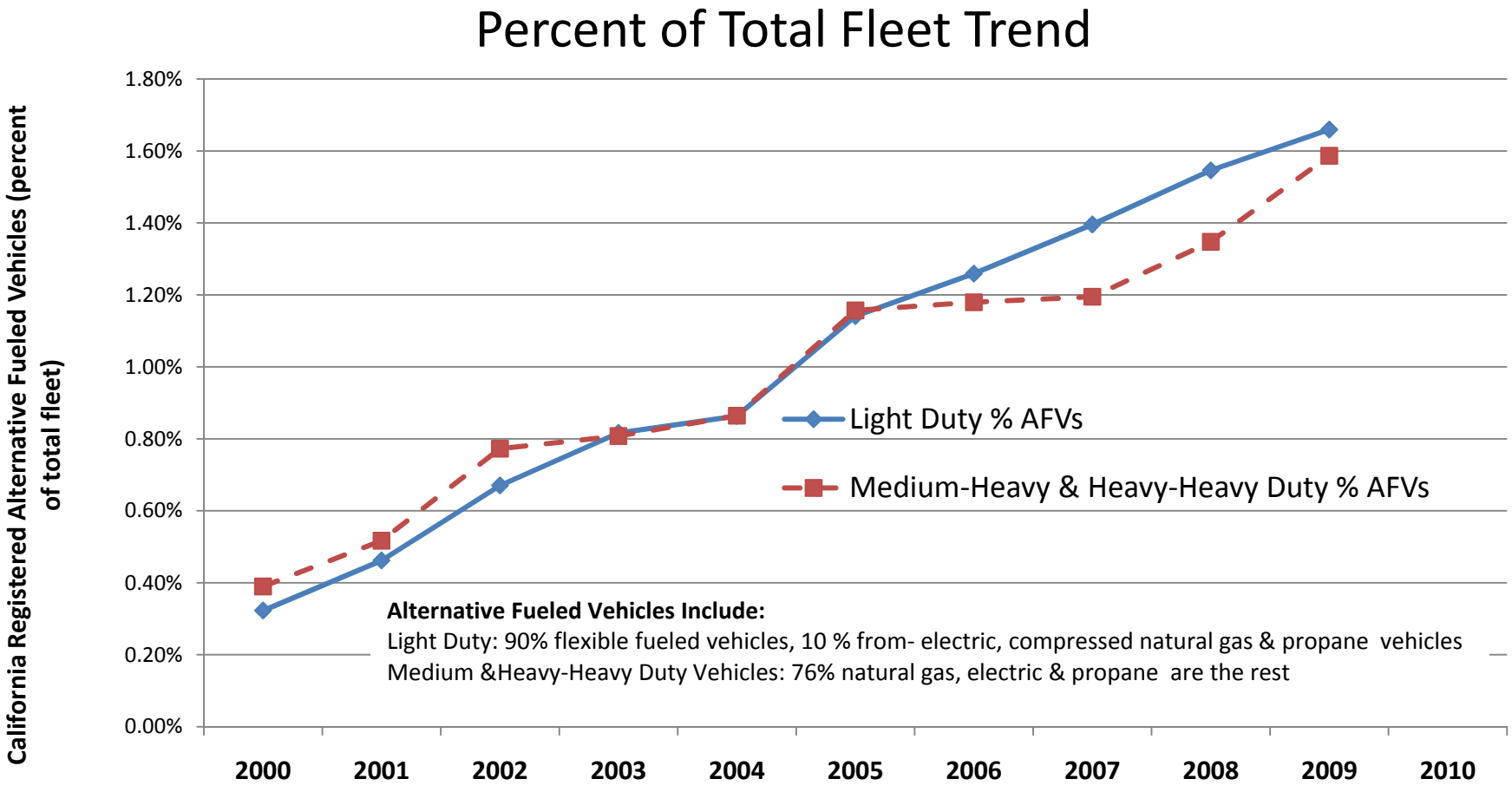
Electric Vehicle Incremental New Purchase Price



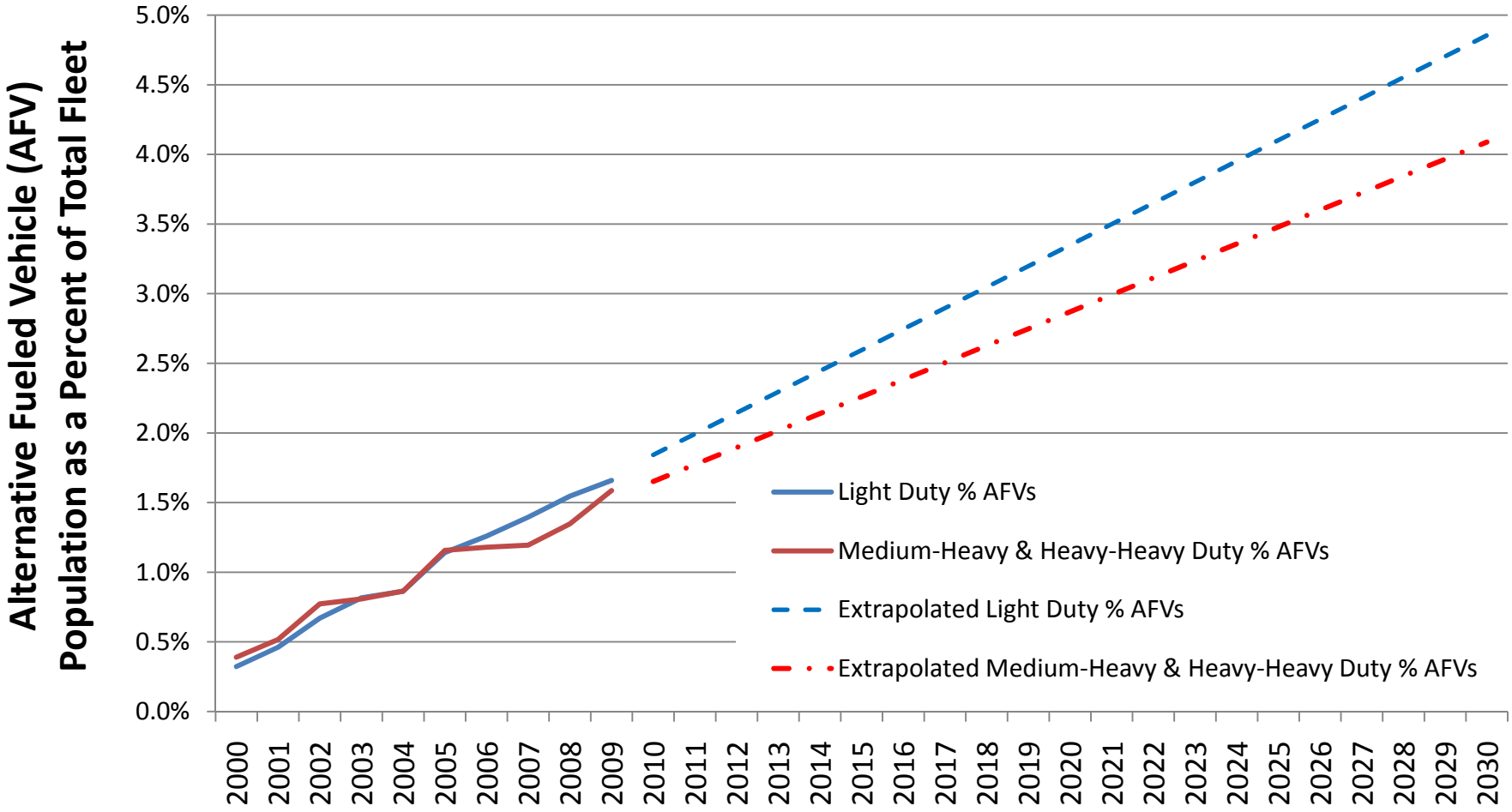
Light Duty Vehicle Trends Historic and 2011 IEPR Forecast



Alternative Fueled Vehicles (AFVs) Migration Rate Has Been Slow



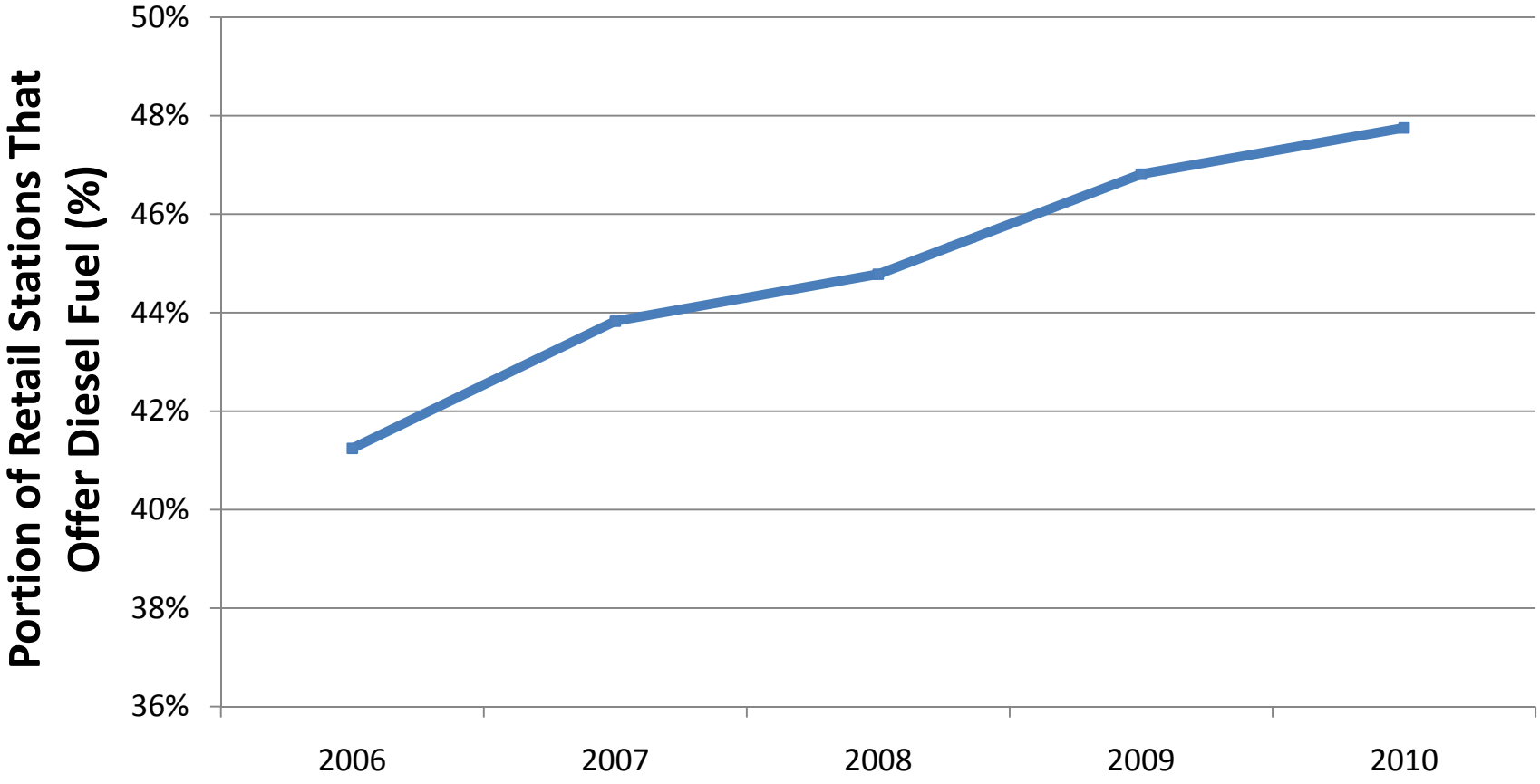
Historic Trends Project AFV Penetration Below 5% of the Fleet by 2030



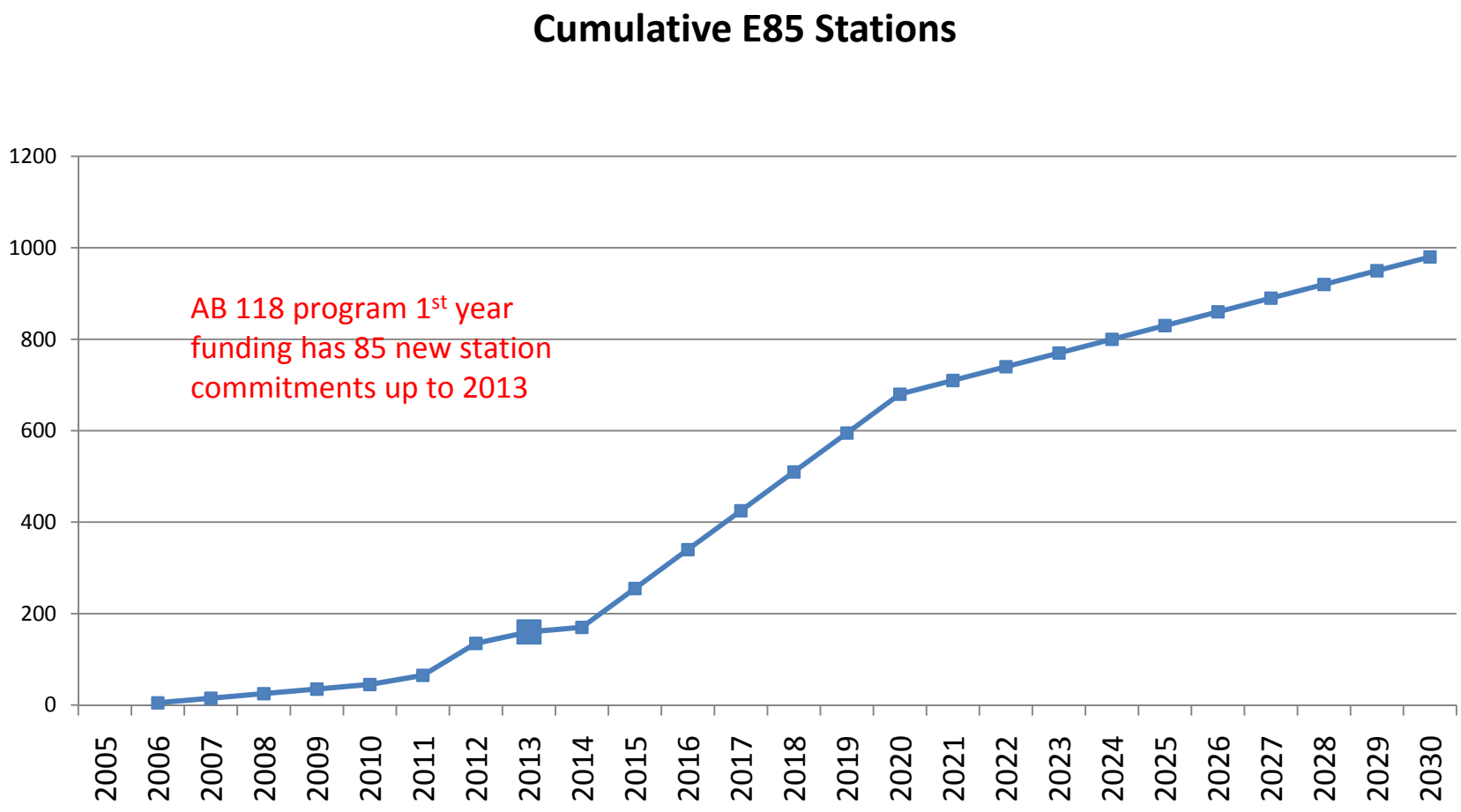
Transportation Fuels Infrastructure Comparison

Fuel Type	Estimated Average Dispensing Station Cost Excluding Land	Estimated Maximum Fuel Dispensing Capacity Per Station Per Year	Source or Number of Stations Used to Estimate Costs	Average Quantity Fuel Dispensed Per Location 2010	Fuel Availability Locations 2010
Gasoline	$470,000	18,235,545	Industry	**1,225,316**	7,700
Diesel	$300,000	18,235,545	Industry	**118,325**	3,700
Propane (0.9 EER -gge)	**$125,000**	**4,275,389**	Industry	**16,784**	190
E85 (gge)	**$331,914**	4,204,800	23	**73,272**	50
CNG (dge)	**$1,747,000**	**1,241,455**	3	**46,307**	54
LNG/CNG (dge)	**$2,474,150**	**8,500,000**	1	**4,400,000**	1
LNG (dge)	**$1,568,667**	**8,795,738**	3	**62,500**	0
EV Home Charger (2.9 EER - gge)	$3,400	2,993	3	360	N/A
PHEV Home Charger (Volt - gge)	$3,400	1,497	3	155	N/A
PHEV Home & Public Charger (Volt-gge)	$3,400	748	4	160	N/A
EV Retail Light Duty (gge)	$8,800	7,483	3	70	N/A
EV Heavy Duty (2.7 EER - dge)	**$125,000**	**22,449**	3	6,000	N/A
Hydrogen (2.2 EER- gge)	**$2,757,208**	**192,720**	11	19,272	11
Hydrogen (@24kg/day) (H2/kg)	**$2,757,208**	**87,600**	11	8,760	11

Fueling Station Availability of Diesel Continues to Grow in California

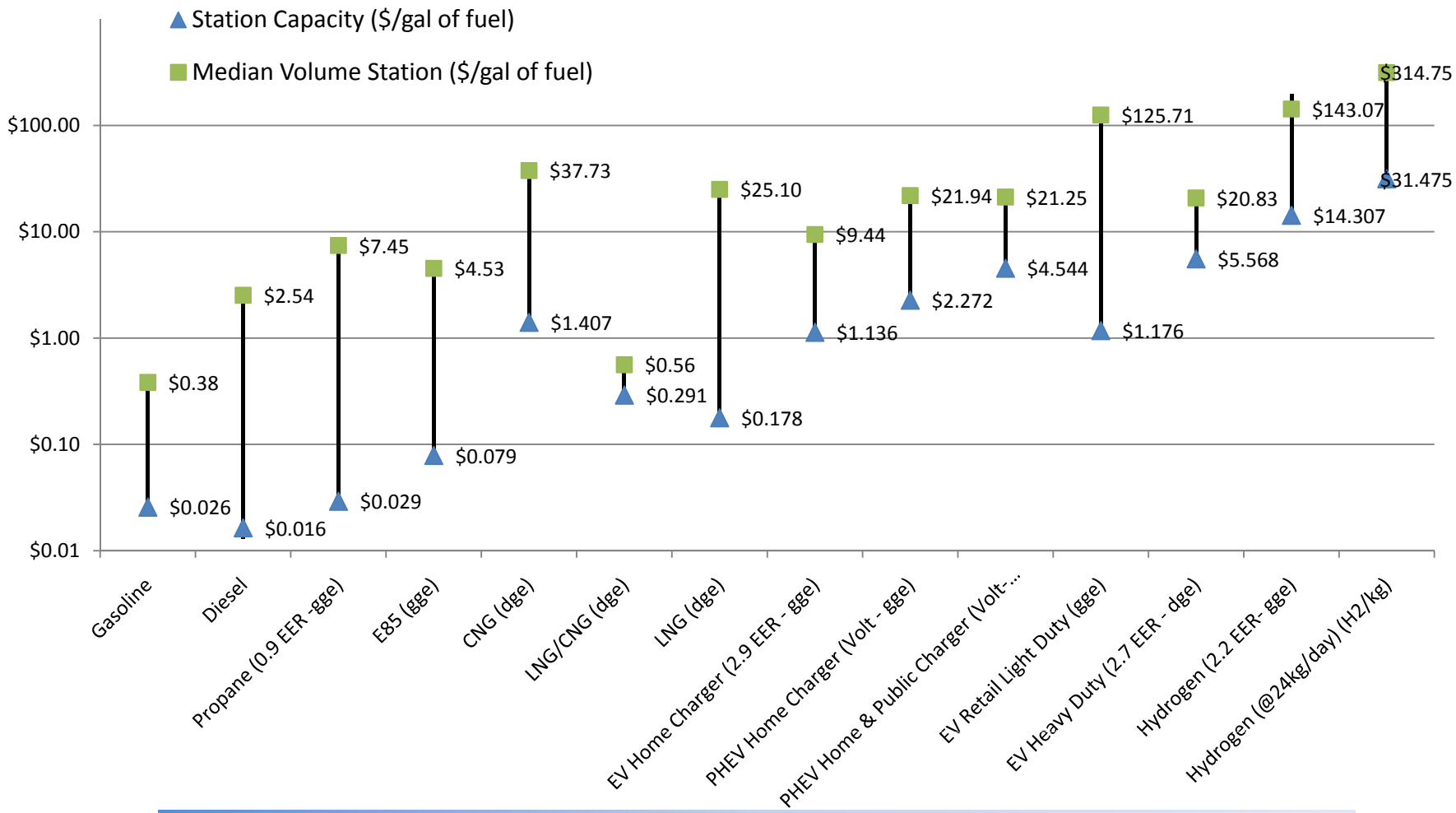


E85 Stations Past and Projected

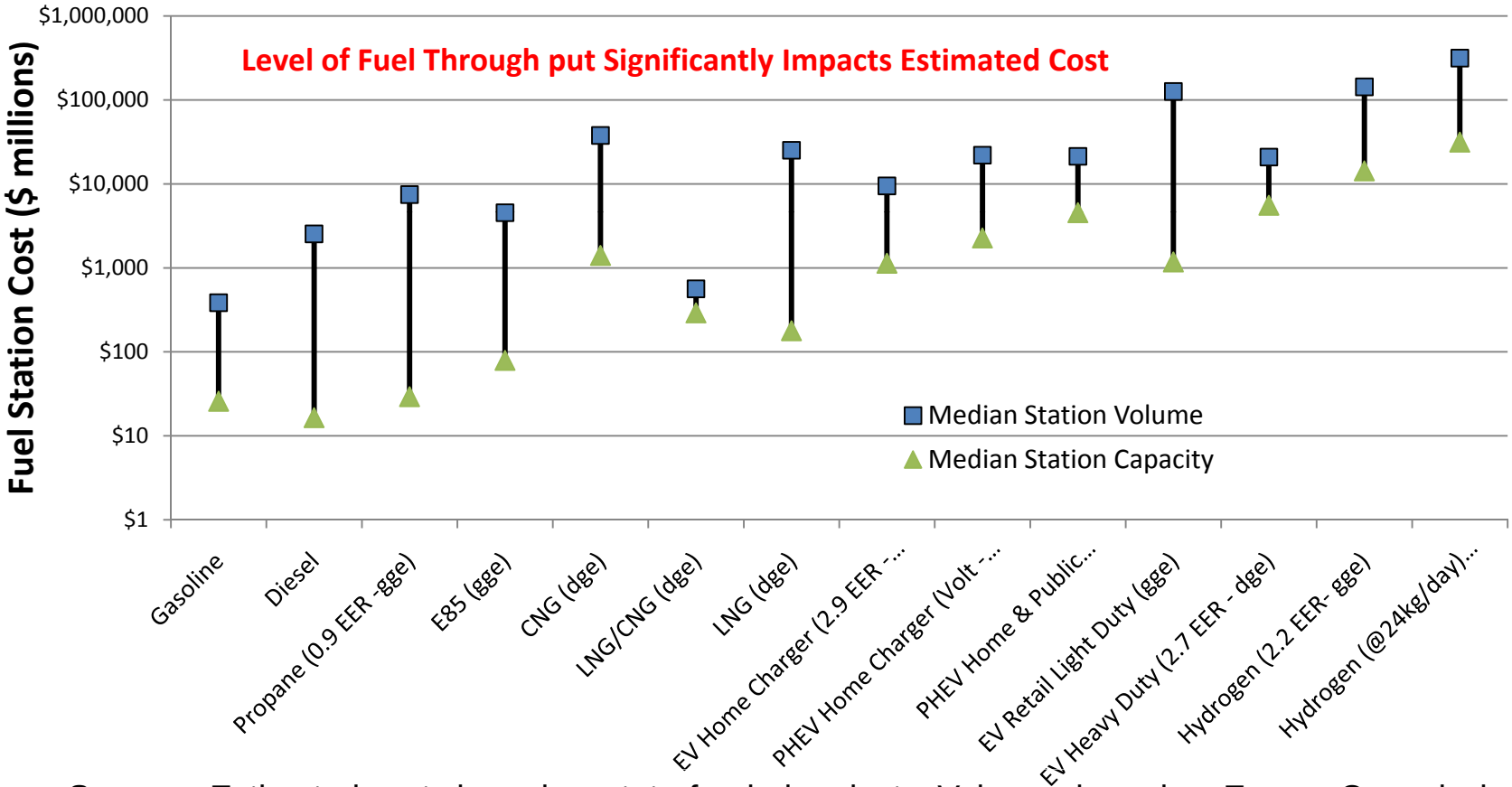


Infrastructure Cost Per Annual Capacity Dollars per Gallon of Dispensed Fuel

(Gasoline or Diesel Gallon Equivalent)

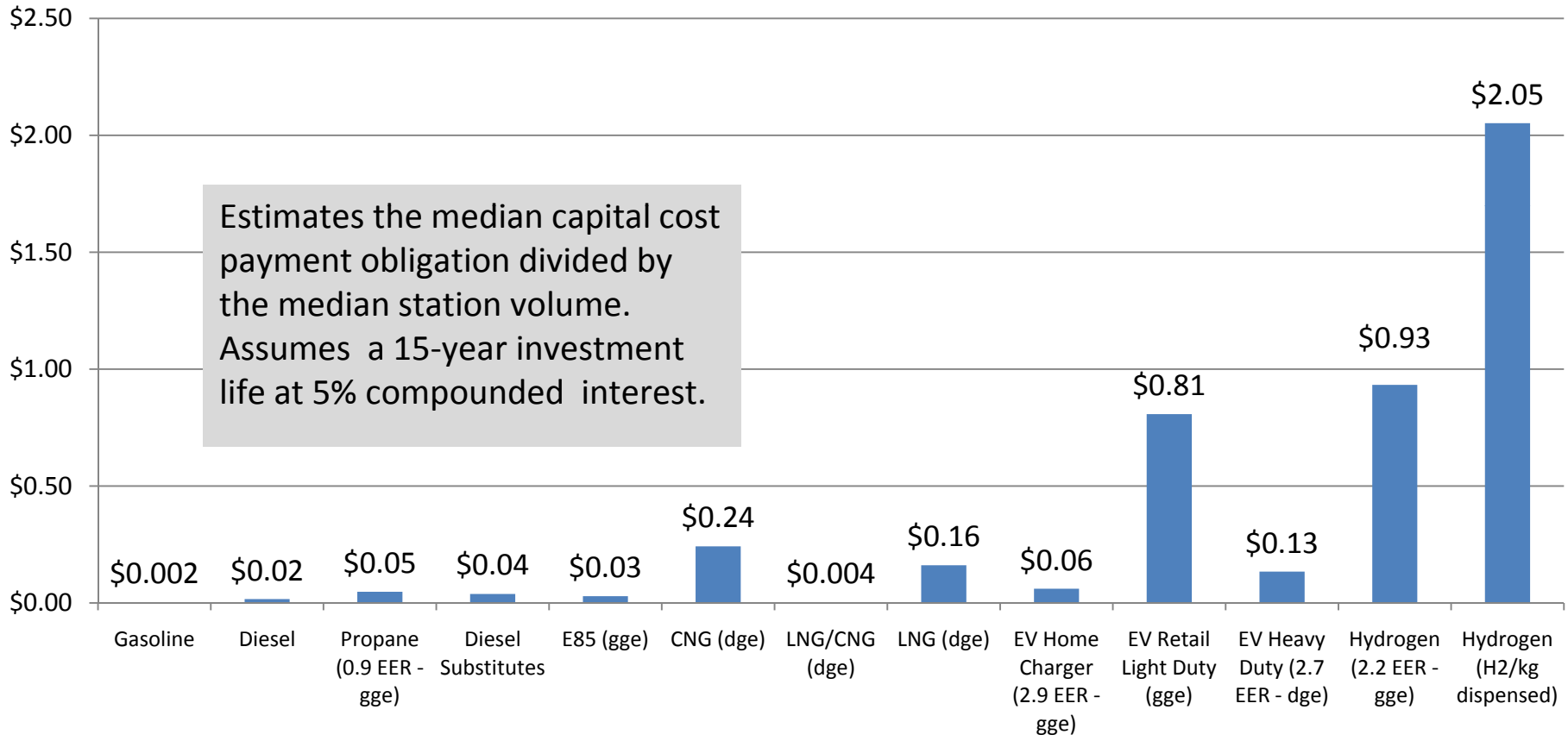


Estimated Fueling Station Capital Costs per Billion Gallons Dispensed



Sources: Estimated costs based on state-funded projects. Volumes based on Energy Commission data.

Median Station Financial Cost per Dispensed Gallon of Fuel



Hydrogen Station Cost Analysis Assumptions

- Fuel cell vehicle (FCV) travels 12,000 miles per year
- FCV fuel economy of 55 miles per kg of H_2
- 2010-2011 hydrogen station cost (AB 118)
  - Average of $2,798,408 per location
  - Capacity of 240 kg H_2 dispensed per 12-hour day
  - 5% interest
  - 15-year station useful life

Hydrogen Retail Equipment Cost ($/kg)

	Number of Hydrogen Stations									
# vehicles	5	10	15	20	25	30	35	40	45	50
100	$61.8	$123.6	$185.4	$247.1	$308.9	$370.7	$432.5	$494.3	$556.1	$617.8
200	$30.9	$61.8	$92.7	$123.6	$154.5	$185.4	$216.2	$247.1	$278.0	$308.9
300	$20.6	$41.2	$61.8	$82.4	$103.0	$123.6	$144.2	$164.8	$185.4	$205.9
400	$15.4	$30.9	$46.3	$61.8	$77.2	$92.7	$108.1	$123.6	$139.0	$154.5
500	$12.4	$24.7	$37.1	$49.4	$61.8	$74.1	$86.5	$98.9	$111.2	$123.6
600	$10.3	$20.6	$30.9	$41.2	$51.5	$61.8	$72.1	$82.4	$92.7	$103.0
700	$8.8	$17.7	$26.5	$35.3	$44.1	$53.0	$61.8	$70.6	$79.4	$88.3
800	$7.7	$15.4	$23.2	$30.9	$38.6	$46.3	$54.1	$61.8	$69.5	$77.2
900	$6.9	$13.7	$20.6	$27.5	$34.3	$41.2	$48.1	$54.9	$61.8	$68.6
1,000	$6.2	$12.4	$18.5	$24.7	$30.9	$37.1	$43.2	$49.4	$55.6	$61.8
2,000	$3.1	$6.2	$9.3	$12.4	$15.4	$18.5	$21.6	$24.7	$27.8	$30.9
4,000	$1.5	$3.1	$4.6	$6.2	$7.7	$9.3	$10.8	$12.4	$13.9	$15.4
5,000	$1.2	$2.5	$3.7	$4.9	$6.2	$7.4	$8.6	$9.9	$11.1	$12.4

The greater the number of fuel cell vehicles serviced per retail location, the lower the average cost for dispensing hydrogen.

Hydrogen Retail Equipment $/ gasoline gallon (2.2 EER applied)

	(2.2 EER applied- gges)										
				Number of Hydrogen Stations							
# vehicles	1	5	10	15	20	25	30	35	40	45	50
100	$5.53	$27.67	$55.34	$83.01	$110.68	$138.35	$166.02	$193.69	$221.36	$249.03	$276.70
200	$2.77	$13.84	$27.67	$41.51	$55.34	$69.18	$83.01	$96.85	$110.68	$124.52	$138.35
300	$1.84	$9.22	$18.45	$27.67	$36.89	$46.12	$55.34	$64.56	$73.79	$83.01	$92.23
400	$1.38	$6.92	$13.84	$20.75	$27.67	$34.59	$41.51	$48.42	$55.34	$62.26	$69.18
500	$1.11	$5.53	$11.07	$16.60	$22.14	$27.67	$33.20	$38.74	$44.27	$49.81	$55.34
600	$0.92	$4.61	$9.22	$13.84	$18.45	$23.06	$27.67	$32.28	$36.89	$41.51	$46.12
700	$0.79	$3.95	$7.91	$11.86	$15.81	$19.76	$23.72	$27.67	$31.62	$35.58	$39.53
800	$0.69	$3.46	$6.92	$10.38	$13.84	$17.29	$20.75	$24.21	$27.67	$31.13	$34.59
900	$0.61	$3.07	$6.15	$9.22	$12.30	$15.37	$18.45	$21.52	$24.60	$27.67	$30.74
1,000	$0.55	$2.77	$5.53	$8.30	$11.07	$13.84	$16.60	$19.37	$22.14	$24.90	$27.67
2,000	$0.28	$1.38	$2.77	$4.15	$5.53	$6.92	$8.30	$9.68	$11.07	$12.45	$13.84
4,000	$0.14	$0.69	$1.38	$2.08	$2.77	$3.46	$4.15	$4.84	$5.53	$6.23	$6.92
5,000	$0.11	$0.55	$1.11	$1.66	$2.21	$2.77	$3.32	$3.87	$4.43	$4.98	$5.53

Alternative Fuel Vehicles Incremental Cost Range

Incremental Vehicle Prices

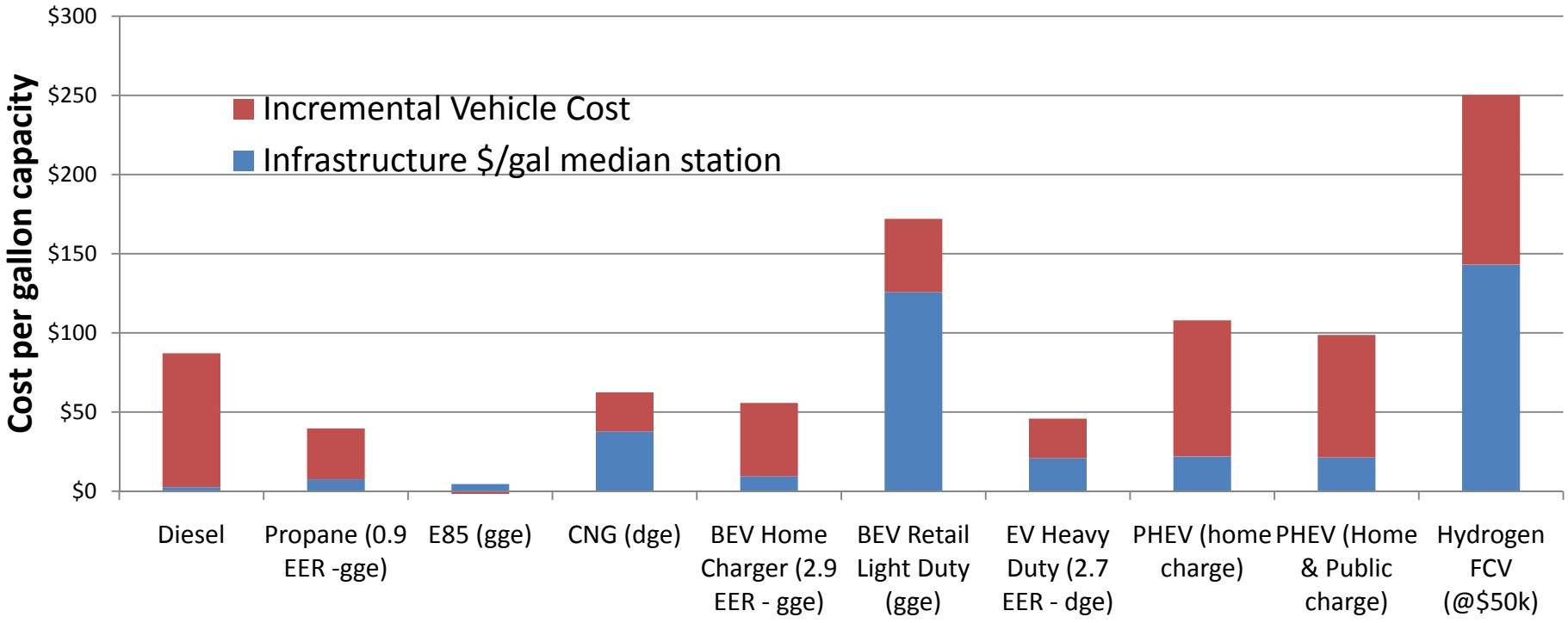
Vehicle	Gasoline	Diesel	Propane	FFVs	Compressed Natural Gas	Liquid Natural Gas	Home Charger	Plug In Hybrids	Electric Vehicles	Hybrids	Fuel Cell
Cars & Light Trucks (SUVS & Vans)[1]	$0	$4,696	$15,000	-$1,005	$9,578	N/A	$3,500	$10,729	$18,097	$3,330	$50,000
Class 3-5[2]	$0	*$6,500*	$25,000	$5,000	$20,000	N/A	$50,000	*$50,000*	*$100,000*	*$100,000*	*$100,000*
Class 6-8s (40 foot Transits)[2,3]	-$44,103	$44,103	N/A	$5,000	$84,935	$41,433	$100,000	*$100,000*	$906,166	$224,344	$2,992,505

[1] Source: CEC 2011 IEPR High Fuel Demand Case, excluding Fuel Cell (staff assumed $50k incremental retail price)

[2] Source: 2010-2011 retail prices, & CEC Medium & Heavy Duty Vehicle buy down program.

[3] CEC AB 118, 2010-2011 Applications, ARB Heavy Duty Hybrid Vehicle buy down program

Vehicle and Fuel Station Cost/Gallon Capacity



ARB Scenarios
Incremental Cost Matrix

	Vehicle Population	Incremental Near Term Vehicle Retail Price Scenarios								
FCVs	**146,784**	$20,000	$30,000	$40,000	$50,000	$60,000	$70,000	$80,000	$90,000	$100,000
PHEVs	**1,618,899**	$5,000	$10,000	$15,000	$20,000	$25,000	$30,000	$35,000	$40,000	$45,000
BEVs	**367,791**	$5,000	$5,000	$10,000	$15,000	$20,000	$25,000	$30,000	$35,000	$40,000
				Cost Below are in Billion $s						
FCVs		$2.9	$4.4	$5.9	$7.3	$8.8	$10.3	$11.7	$13.2	$14.7
PHEVs		$8.1	$16.2	$24.3	$32.4	$40.5	$48.6	$56.7	$64.8	$72.9
BEVs		$1.8	$1.8	$3.7	$5.5	$7.4	$9.2	$11.0	$12.9	$14.7
	Total	**$12.9**	**$22.4**	**$33.8**	**$45.2**	**$56.6**	**$68.0**	**$79.4**	**$90.8**	**$102.2**

Questions?

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