TAFV

The Production of Alternative Fuel Vehicles for CAFE Credits.

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Transportation Research Board

Workshop on Air Quality Impacts of Conventional and Alternative Fuel Vehicles

A1F03/A1F06 Joint Summer Meeting

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Ann Arbor, MI.

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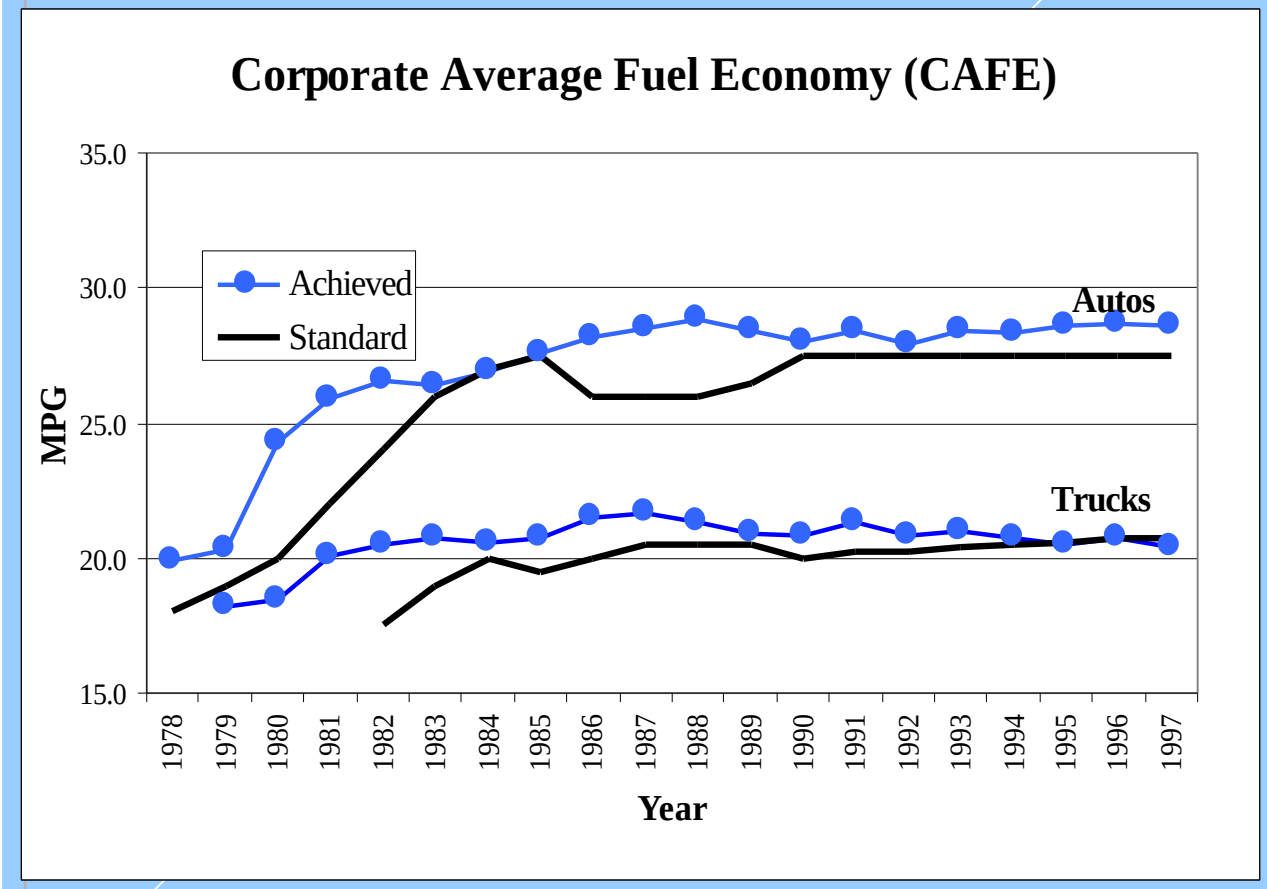
Plan of Talk

- Review history of CAFE, standards and achieved
- Examine laws giving CAFE credits for AFVs, estimate impact and value of credits
- Use Transitional AFV model (TAFV) to look at possible production of AFVs for CAFE credits

Historical New Vehicle CAFE vs Standard

Autos vs Light Trucks, Domestic and Import Combined



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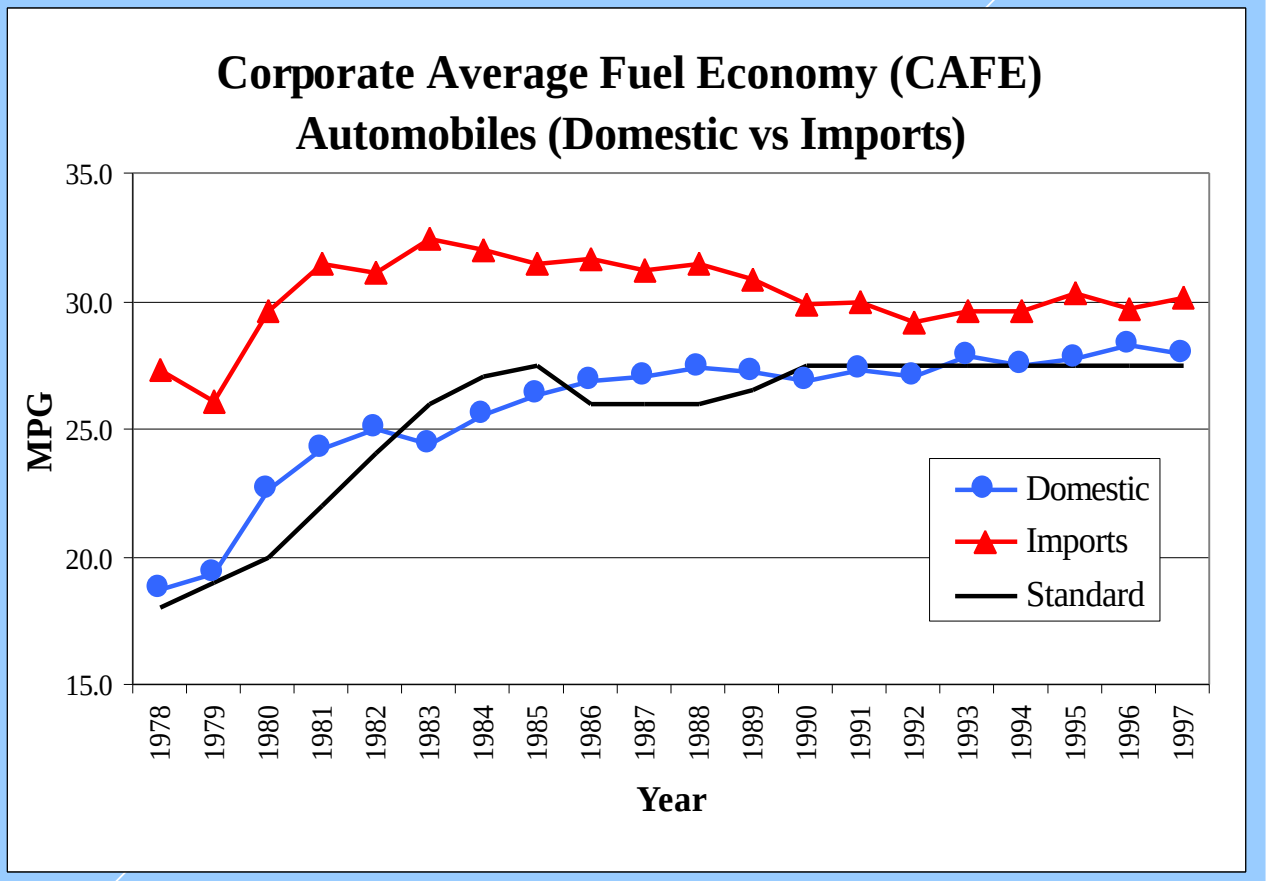
Historical New Auto CAFE vs Standard

Automobiles Only, Domestic vs Imports



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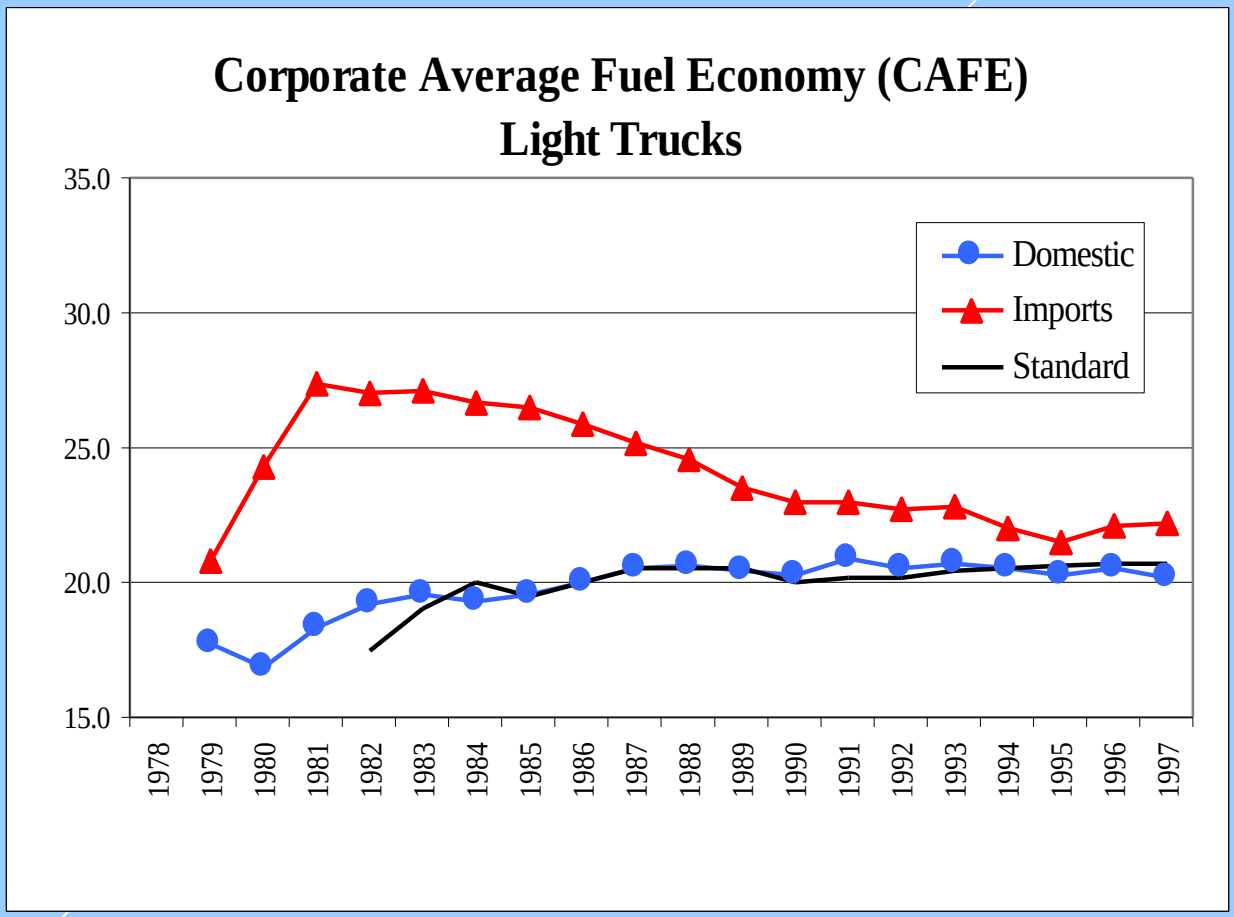
Historical New Truck CAFE vs Standard

Light Trucks Only, Domestic vs Imports



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Observations from CAFE History

- On average, autos exceed std
- But only by small margin for domestic
- Domestic trucks have difficulty meeting std due to mix changes
- Domestic “Big Three” operating at edge
- Tightest constraint is LD trucks for domestic “Big Three”

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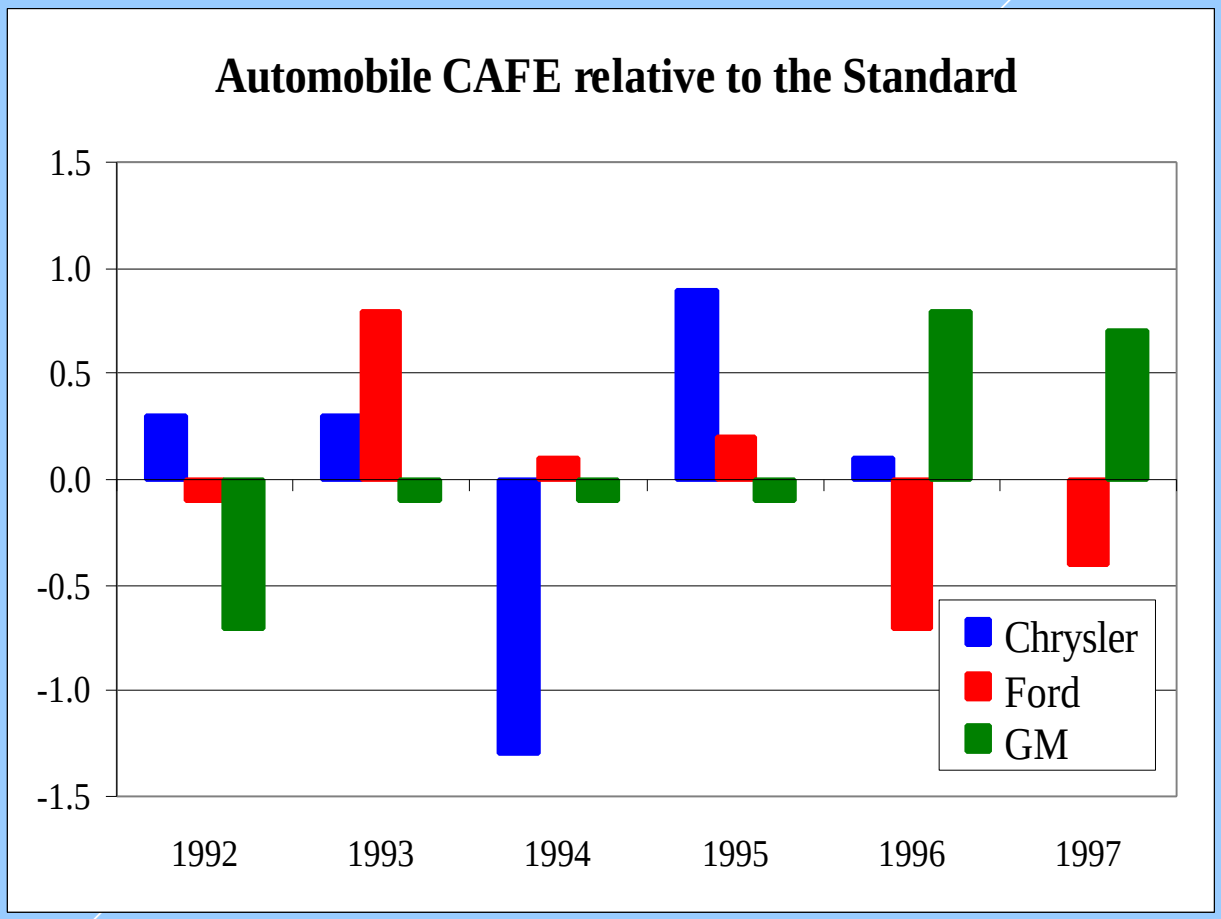
Domestic Automobiles CAFE vs Standard

Automobiles Only,
Domestic "Big Three"



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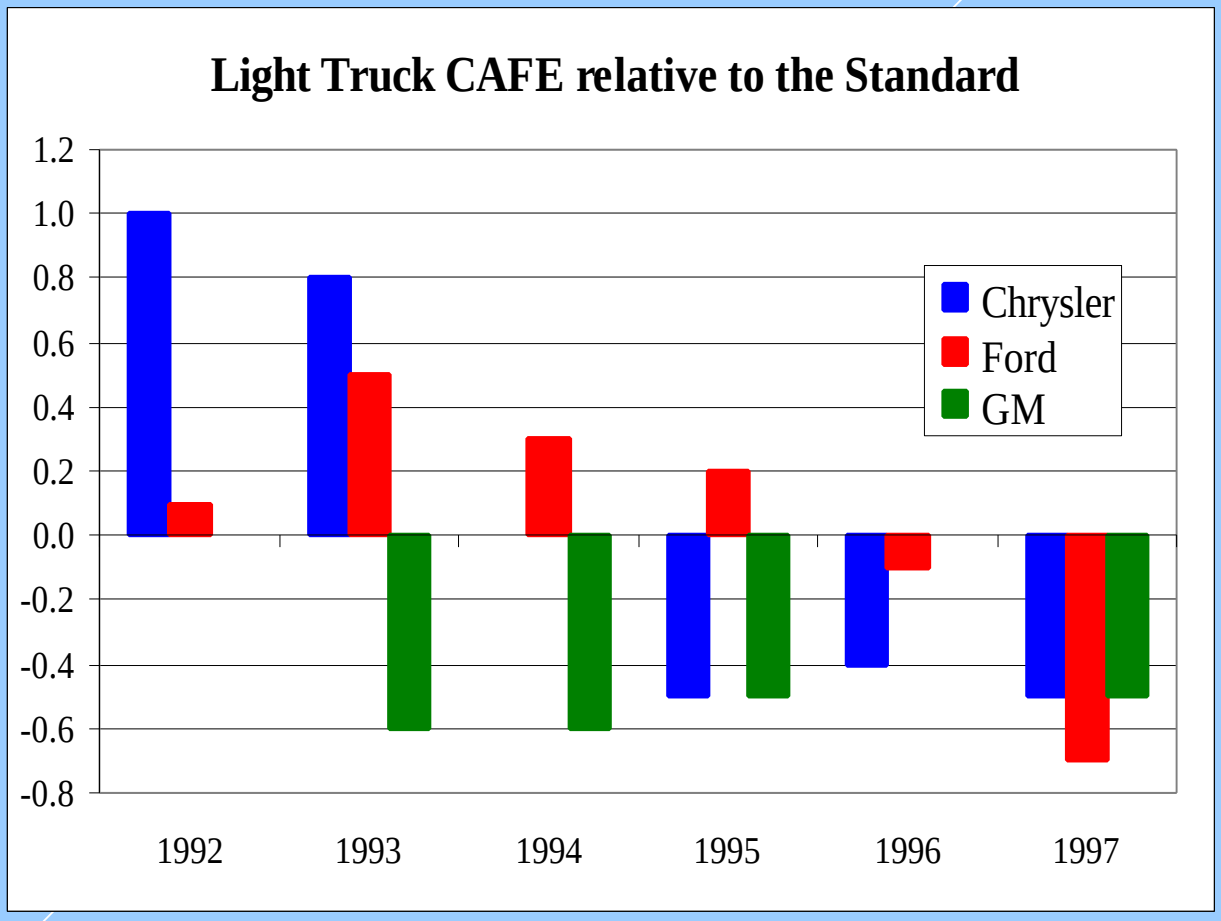
Domestic Light Truck CAFE vs Standard

Light Trucks Only,
Domestic "Big Three"



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CAFE Civil Penalties

- $5.5/0.1 MPG below standard, per vehicle
- Credits may be banked or borrowed for 3 years
- Long history of penalty payments *but not for domestic manufacturers*
- Common observation:
  - Domestic manufactures eager to avoid stigma of penalty
  - Civil penalty is lower bound of violation cost

CAFE Fines Collected

Table: CAFE Fines Collected (Thousands)		
Model Year	Current Dollars	1990 constant dollars
1983	58	76
1984	5,958	7,496
1985	15,565	18,908
1986	29,872	35,603
1987	31,261	35,945
1988	44,519	49,181
1989	47,381	49,946
1990	48,449	48,449
1991	42,243	40,511
1992	38,287	35,645
1993	28,688	25,693
1994	31,474	27,760
1995	39,985	34,267
Sources: Davis (1997, Table 3.41)		

Rules Giving AFVs CAFE Credits

- Treat Dedicated AFV as if using 15% gasoline

$$MPG_D = \frac{MPG_{CV}}{0.15} \cong 6.67 MPG_{CV}$$

- Treat Dual/Flex as if using gasoline half time, 15% gasoline other half

$$MPG_F = \frac{1}{\frac{0.5}{MPG_{CV}} + \frac{0.5}{MPG_{CV}/0.15}} \cong 1.74 MPG_{CV}$$

- Dual/flex credits expire 2005
- Max CAFE increase from AFVs
  - 1.2 MPG

Manufacturers Plan to Produce FFVs

FUEL STANDARDS

A Ticket to Guzzle

Peter Yates/The New York Times

By 2001, Ford says it is going to turn out 250,000 cars, mini-vans and pickups that burn either ethanol or gasoline. Certainly sounds like good news on the clean-air front, right? Take a closer look. First you've got to find a station that sells ethanol — there are now about 40 nationwide. And then you'll have to pay about 15 percent more a mile to use it. Take a wild guess how many of those 250,000 drivers will stick with gasoline. So why did Ford bother? Simple. Federal rules on fuel standards are so, well, fanciful that these dual-fuel vehicles, even though they seem likely to have a minuscule impact on gasoline use, still earn Ford points with the clean-air police. And this, in turn, means Ford is allowed to turn out more of the low-mileage light trucks that are taking over our streets.

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Fuel Economy of Vehicles for CAFE Compliance

AFV Fuel Economy

Gasoline	23.82
Alcohol Ded.	158.80
Alcohol Dual	41.43
LPG Ded.	158.80
LPG Dual	41.43
CNG Ded.	158.80
CNG Dual	41.43
Electricity*	154.00

Per AMFU 1988, Sec. 503.

*Based on the EV1.

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Fuel Economy of Vehicles for CAFE Compliance

AFV Fuel Economy

Gasoline (average)	23.82
Dual/Flexible AFV	41.43
Dedicated AFV	158.80

Per AMFU 1988, Sec. 503.

Basic Math of AFVs for CAFE Credits

- CAFE is sales-weighted "harmonic average" of MPGs

$$CAFE = \frac{1}{\frac{S_{CV}}{MPG_{CV}} + \frac{S_D}{MPG_D} + \frac{S_F}{MPG_F}} = \frac{MPG_{CV}}{1 - 0.85S_D - 0.425S_F}$$

- CAFE Penalty

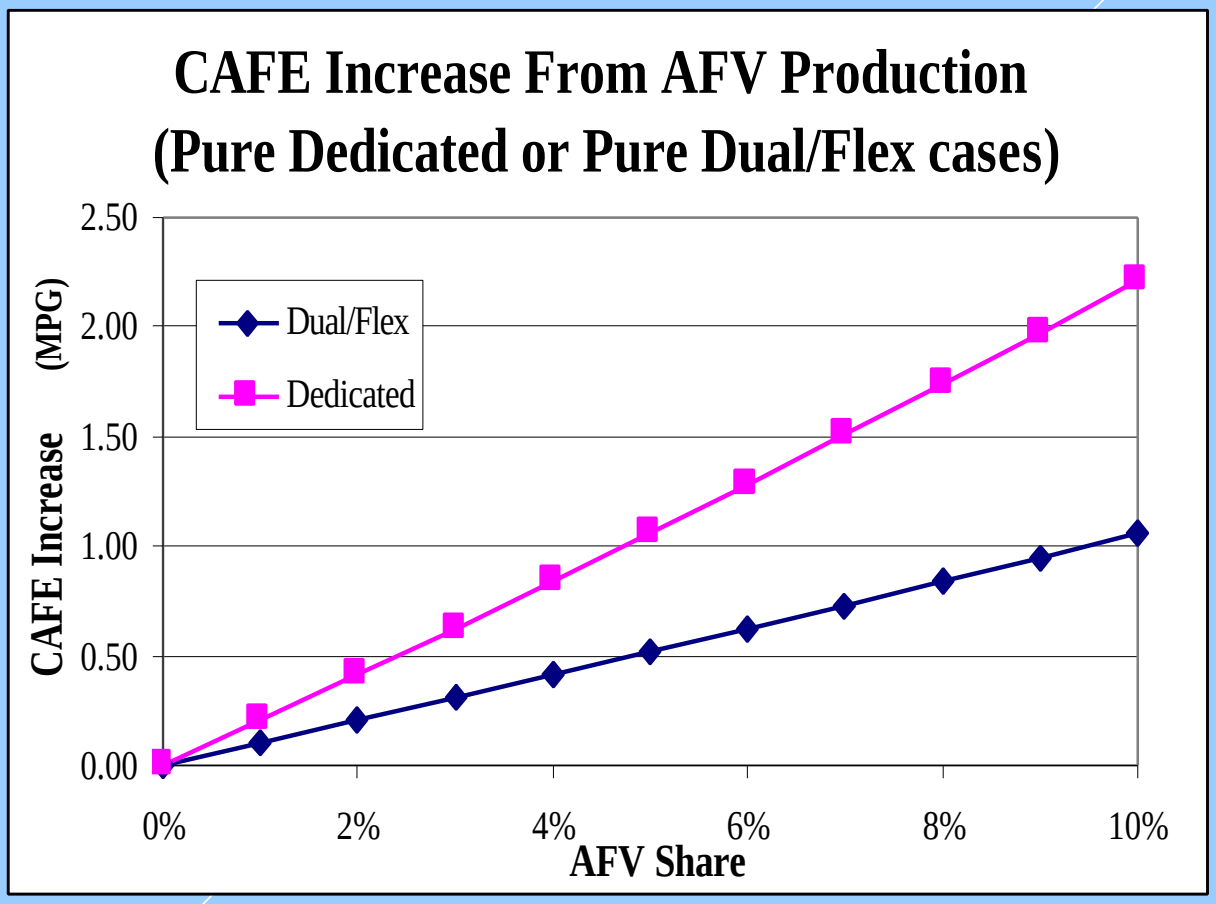
  P = \$55*max[(CAFE-Std)Q_T - Credit, 0]

- Marginal value of AFV for penalty avoidance

$$\frac{\partial P}{\partial Q_D} = -55\frac{CAFE^2}{MPG_{CV}}0.85$$

$$\frac{\partial P}{\partial Q_F} = -55\frac{CAFE^2}{MPG_{CV}}0.425$$

CAFE Increase From AFV Production



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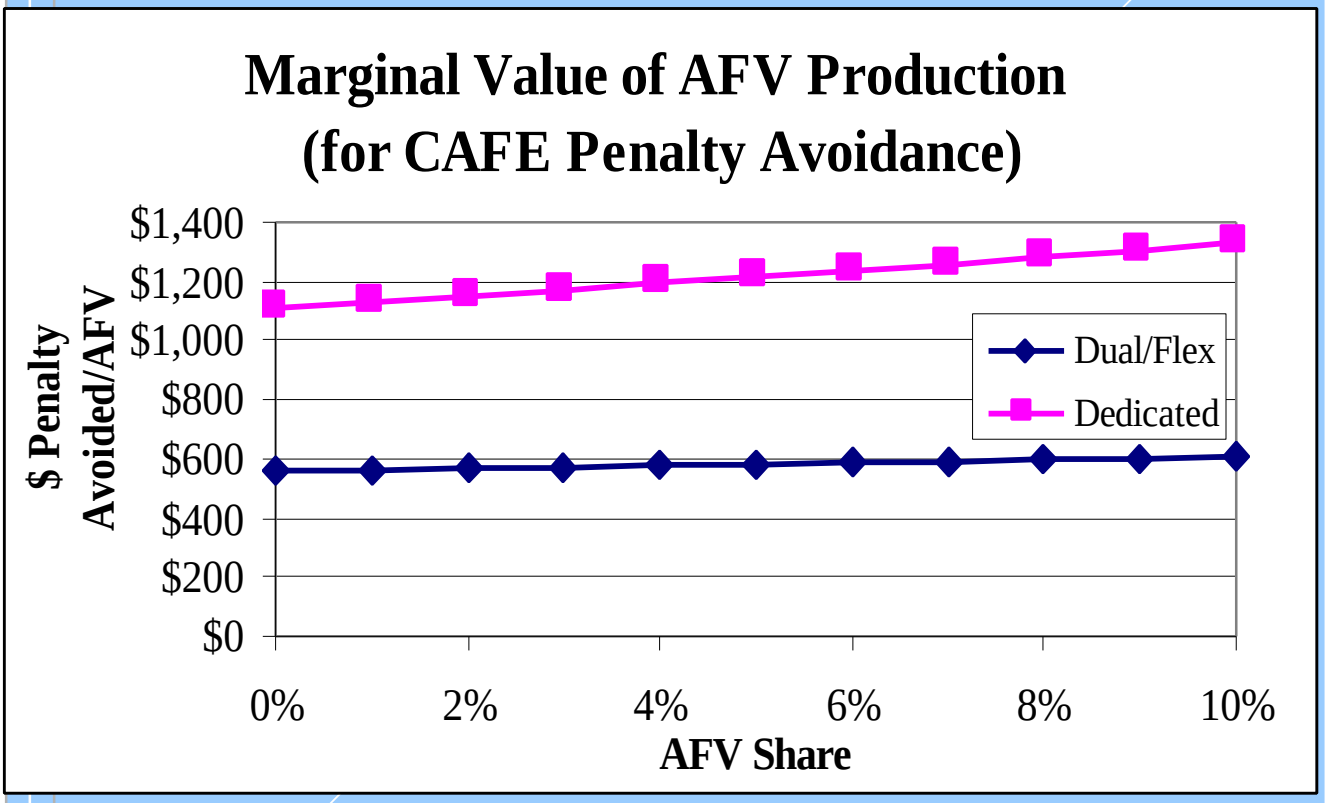
Marginal AFV Value (for CAFE Penalty Avoidance)



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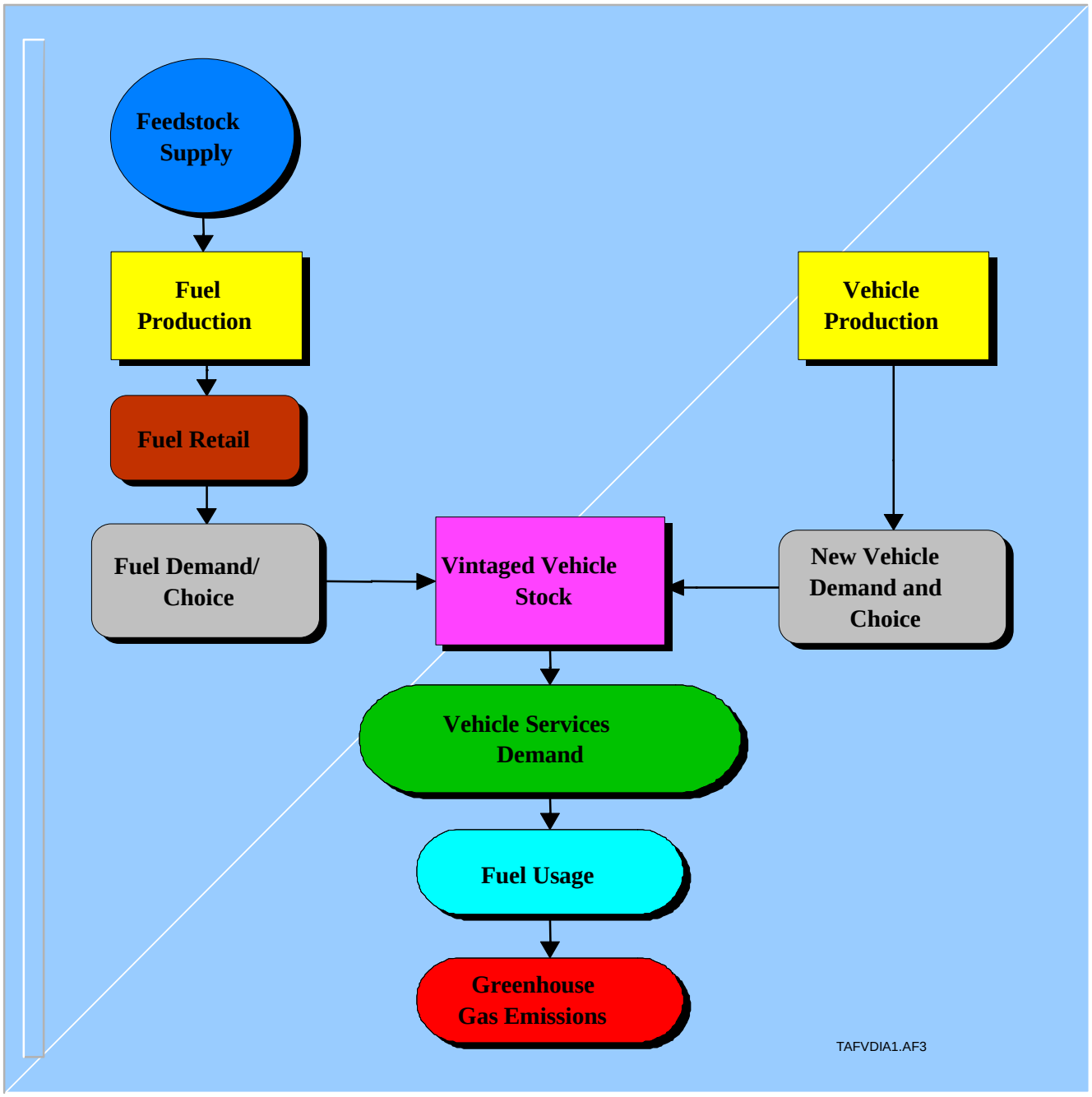
(Compare to unit vehicle costs)

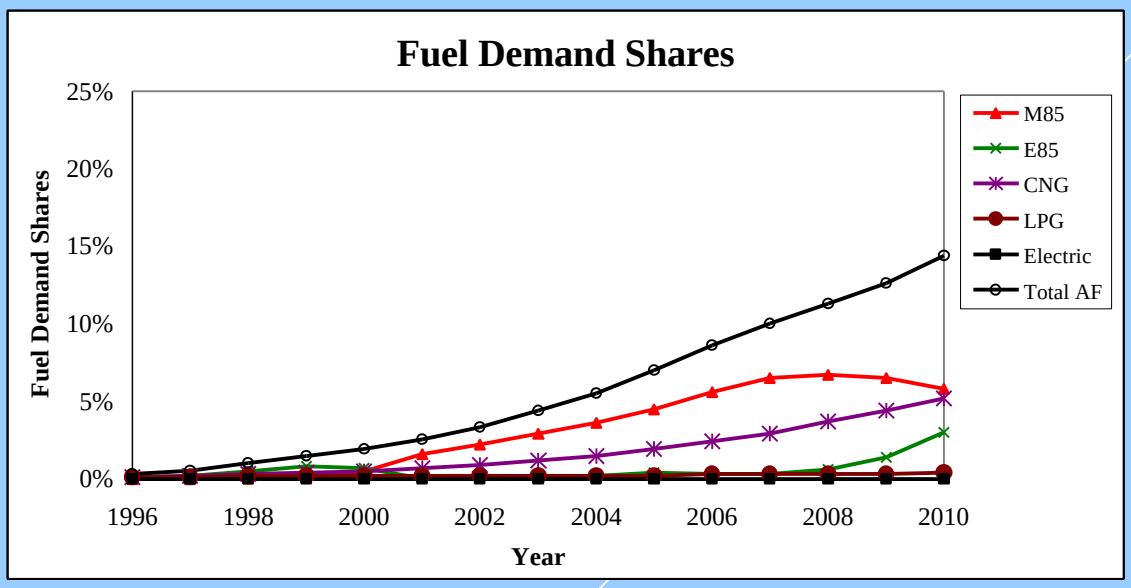
Use TAFV to Model Key Transitional Phenomena

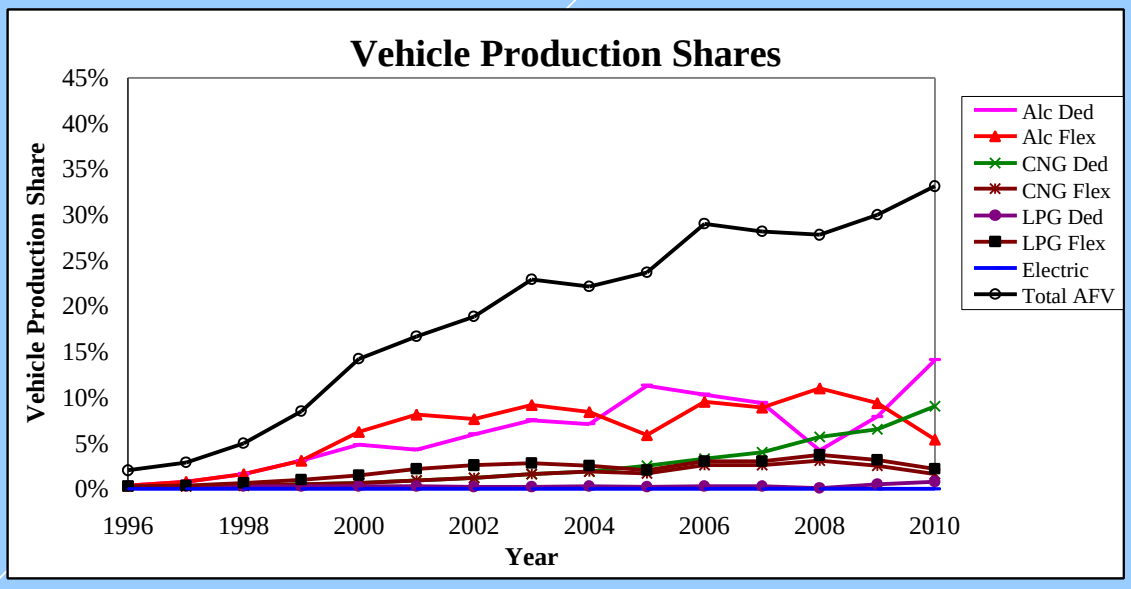
- Capital stock turnover
  - vintaged vehicles
  - durable production plants
- Costs to consumers of limited retail fuel availability
- Production scale economies
- Limited vehicle model diversity
  - Costs to producers
  - Value to consumers
- Various policy handles (EPACT, CAFE, fuel taxes)

Conceptual Diagram of TAFV Model



No Transitional Barriers (Counterfactual Case)





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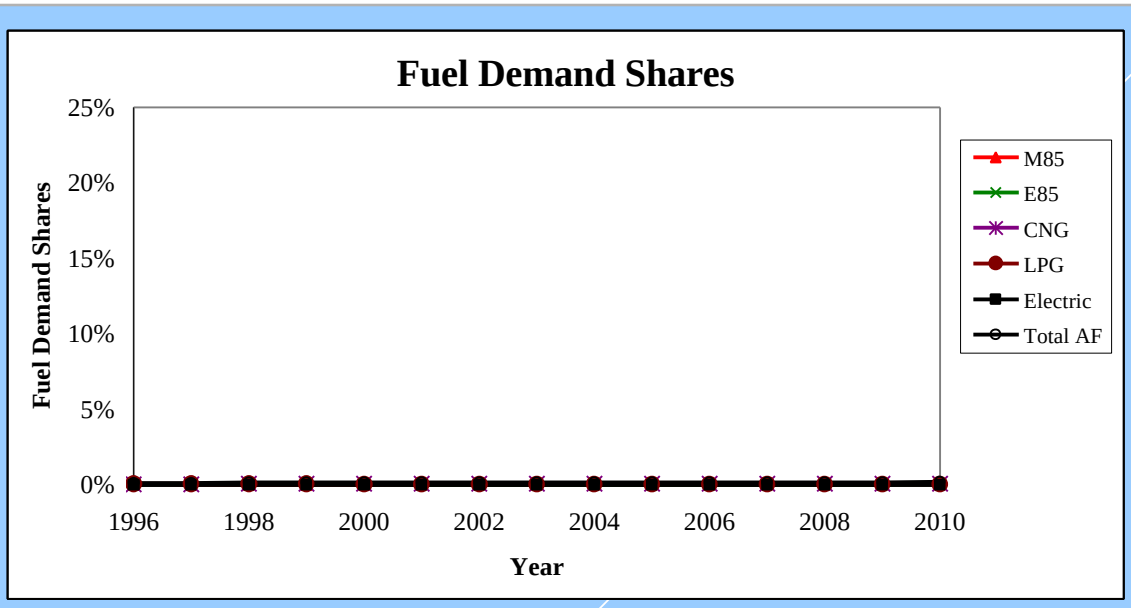
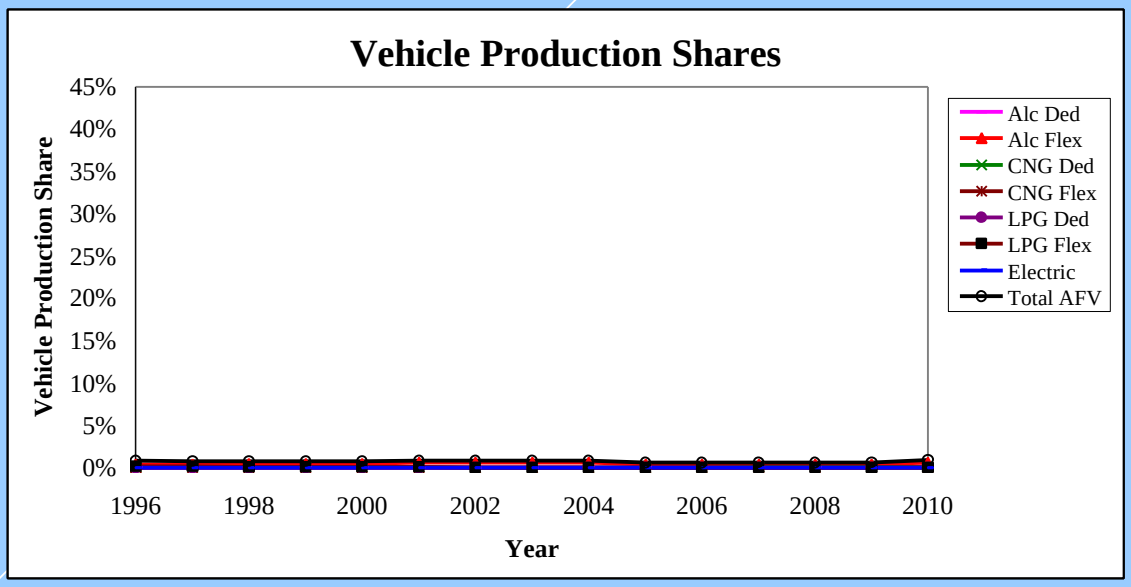
Higher LPG Costs

With Transitional Barriers (Base Case)





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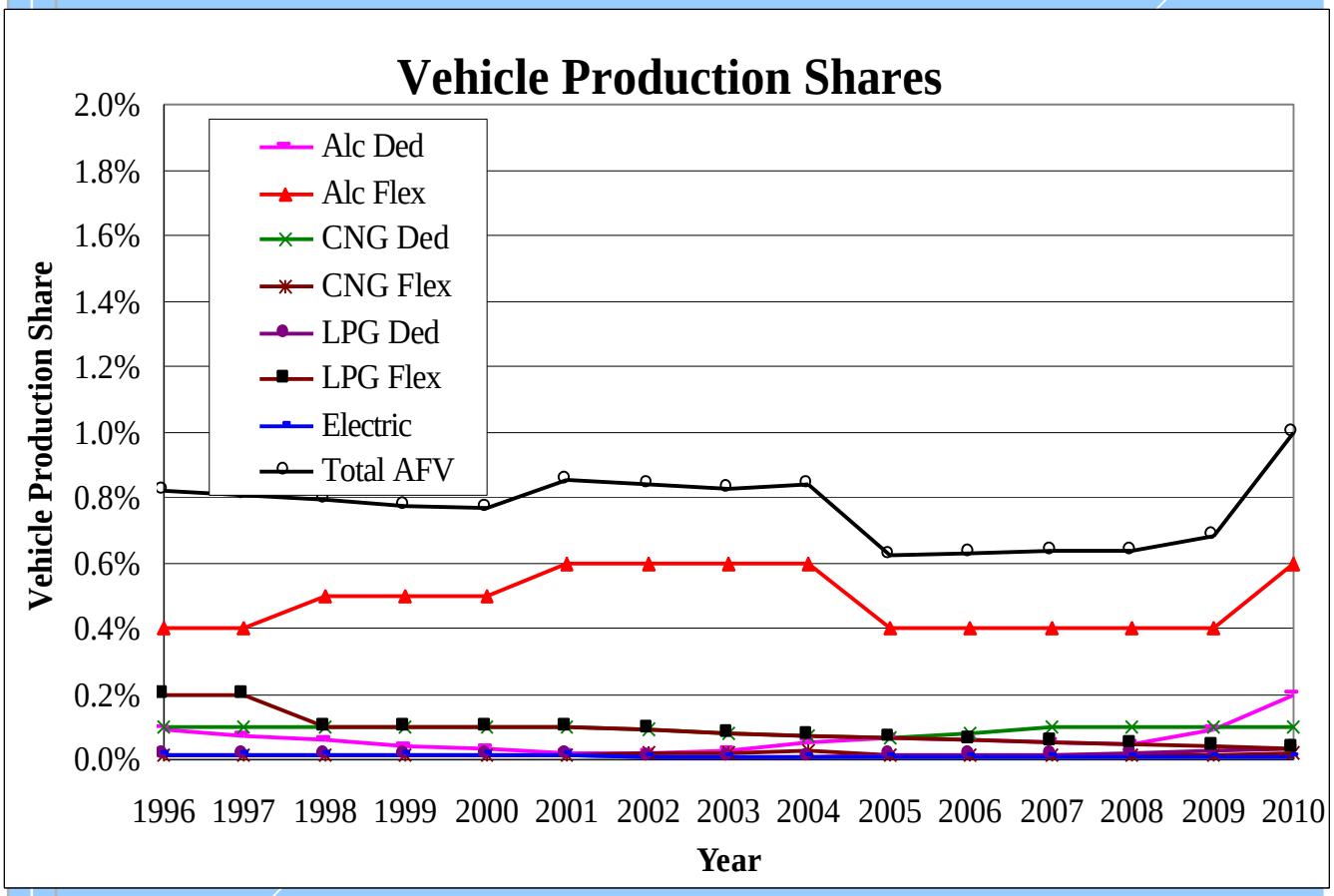
Higher LPG Costs

Base Case Vehicle Demand Shares (Expanded)



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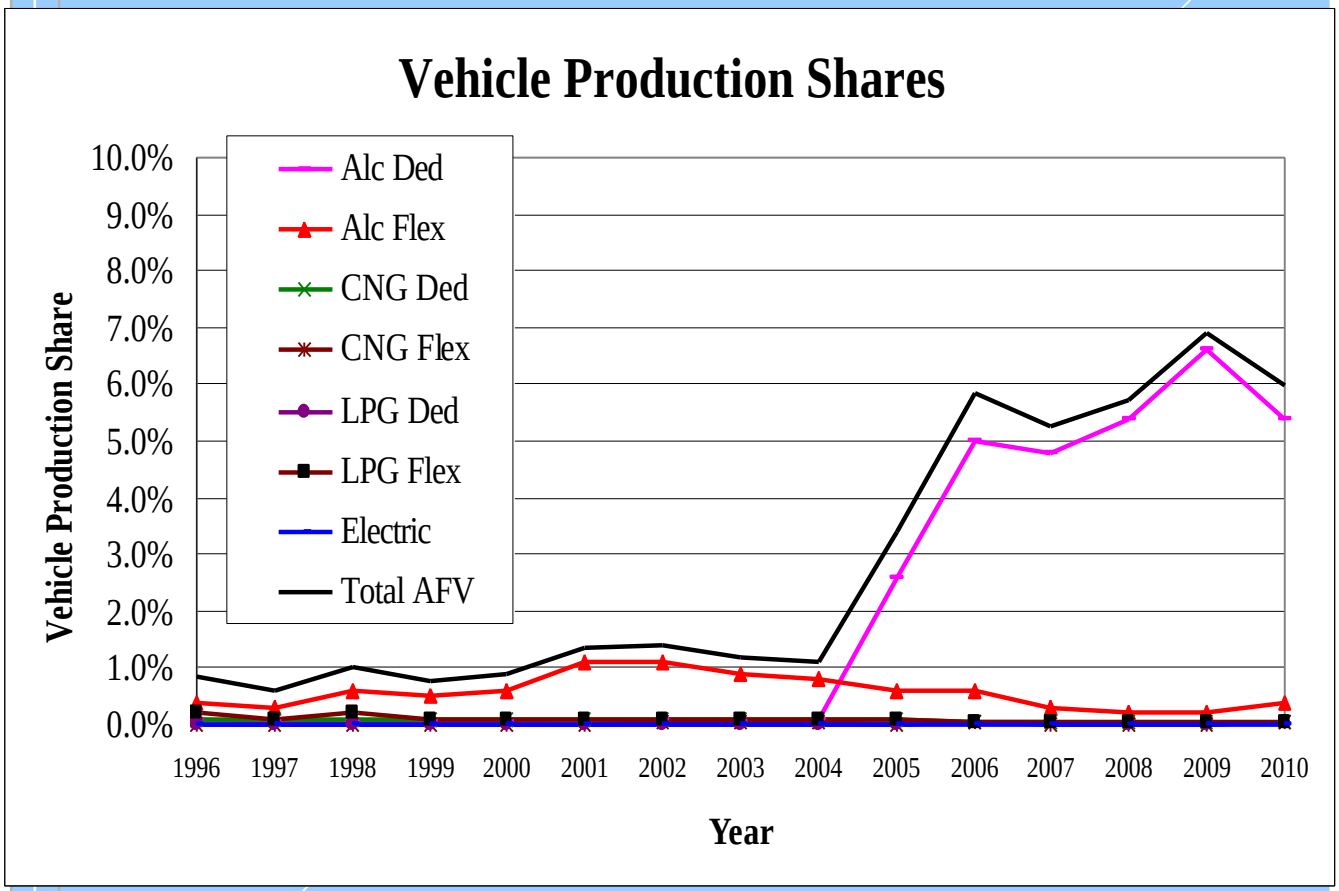
Increased CAFE Standards Case: Vehicle Production



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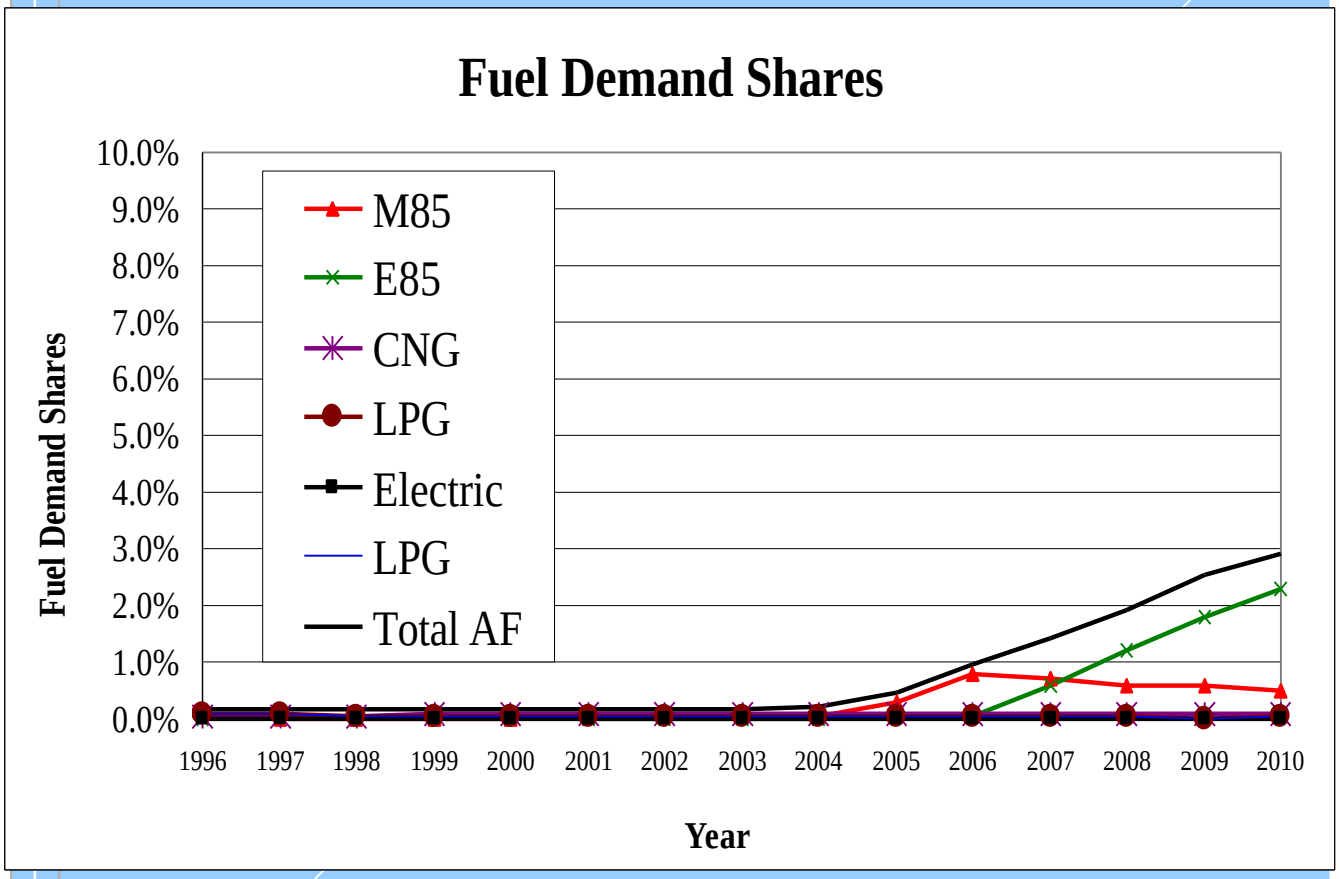
Increased CAFE Standards Case: Fuel Use



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Results and Insights

- Transitional impediments matter
- Limited retail fuel availability and vehicle production scale-economies important
- May be hard for the vehicle/fuel market to get started
- AFV sales encouraged by CAFE credits, but may be little fuel use
- Larger gap between CAFE and standard could begin (alcohol) fuel use in private LDVs