
Green Behavior

The Carbon Impact of Daily Travel

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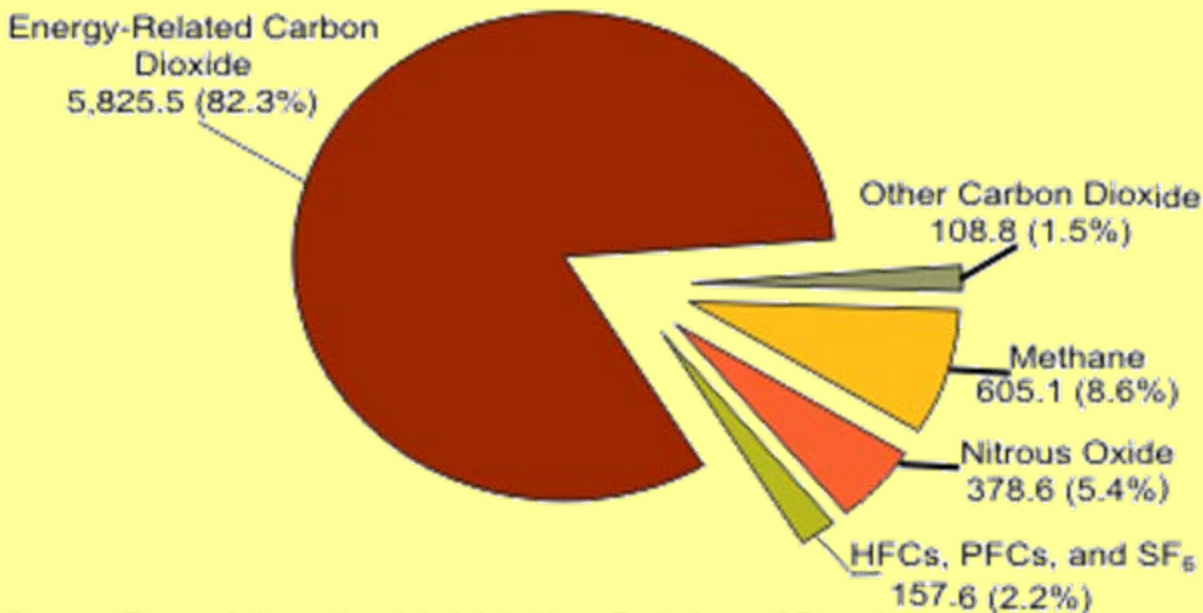
Session #529 - TRB 2009

Outline

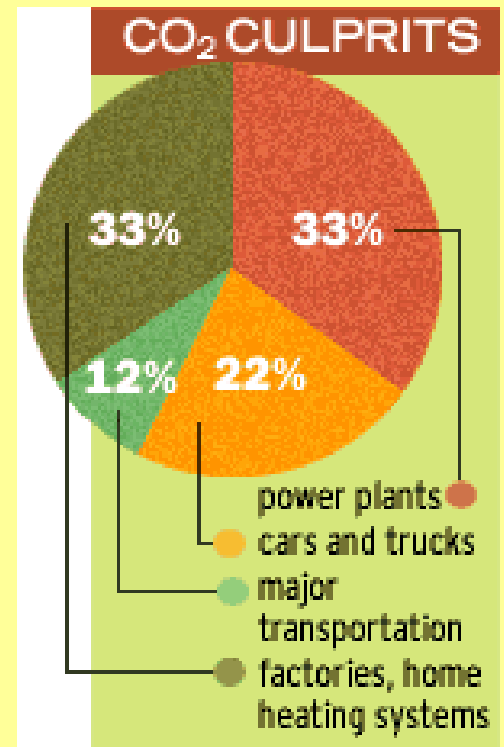
- Background on Green House Gases (GHG) and passenger travel's role
 - US Fleet mix and fuel efficiency
 - Gas costs and the effect on vehicle travel
 - Some thoughts on future directions
-

Carbon dioxide accounts for over 80 percent of total GHG emissions in the US,

Transportation accounts for approximately one third of total U.S. CO₂ emissions...



Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2006* (Washington, DC, November 2007)

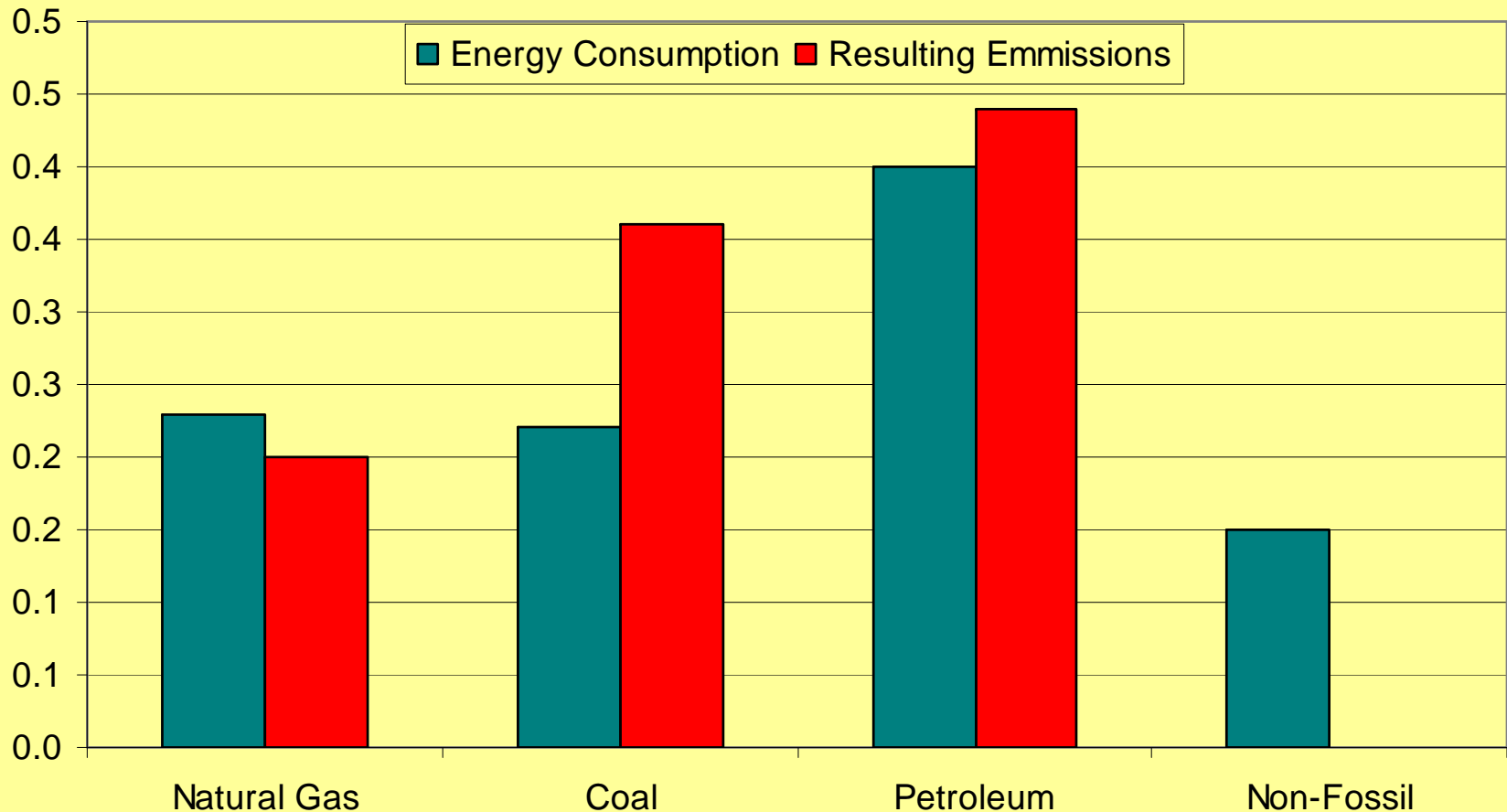


Source:

www.envirolink.org/orgs/edf/sitemap.html

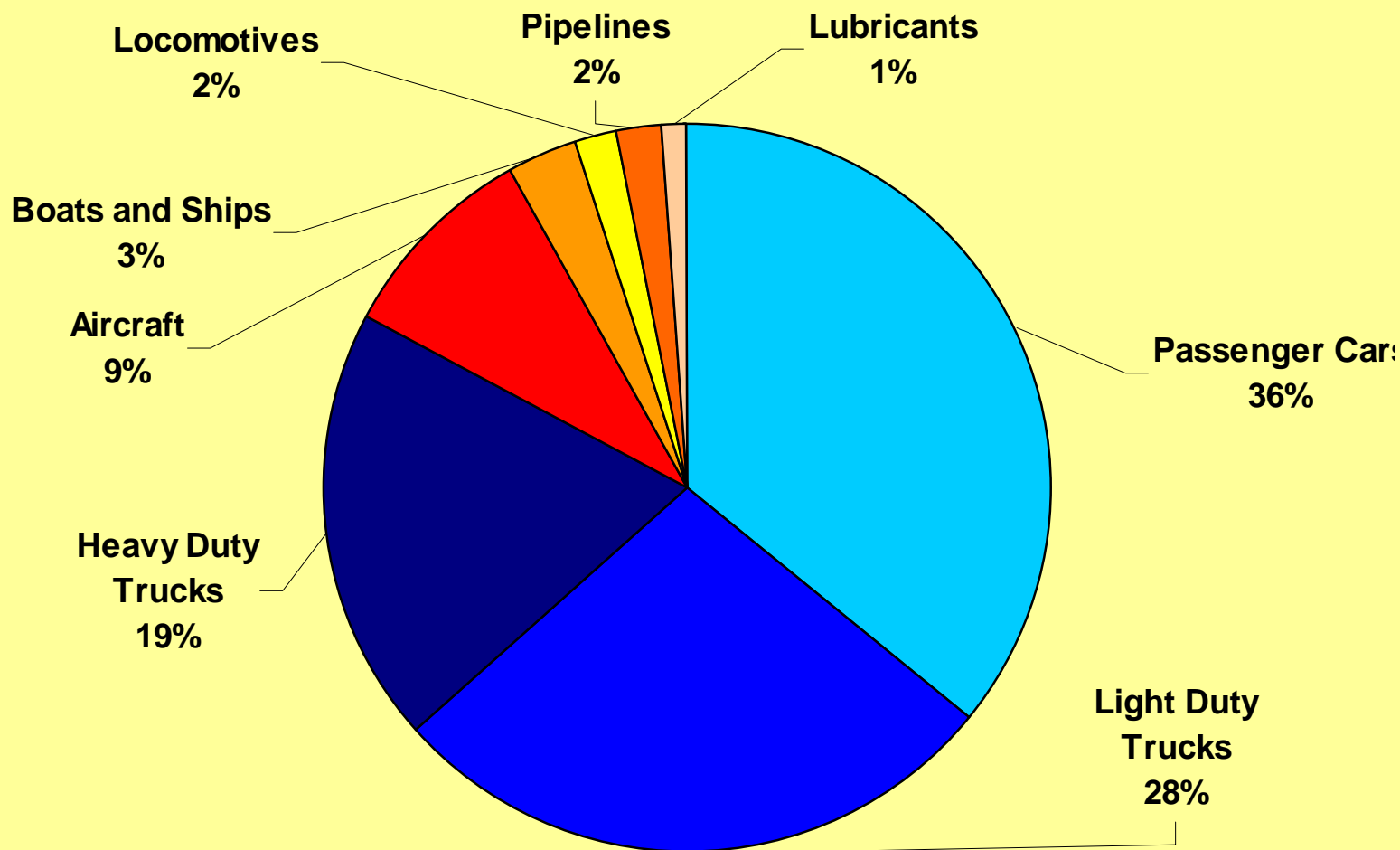
Any process that burns fossil fuel releases carbon dioxide (CO₂), a greenhouse gas, into the air...

US Primary Energy Consumption



Source: Energy Information Agency

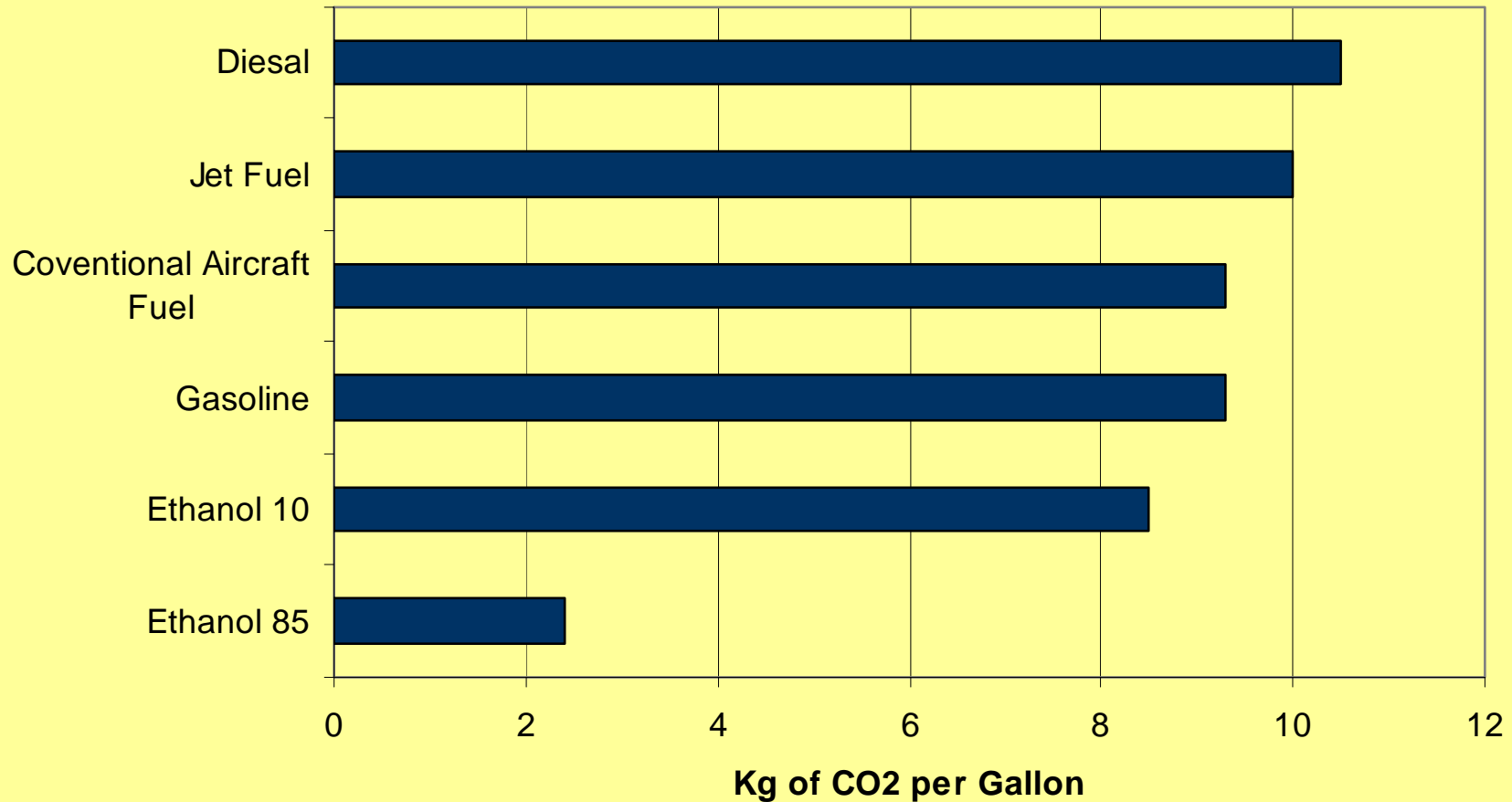
“On-Road” sources account for over 80% of all GHG from transportation...



Source: Green House Gas Emissions from the US Transportation Sector, 1990-2003

www.epa.gov

Fuels used for transportation vary in the amount of CO₂ impact...

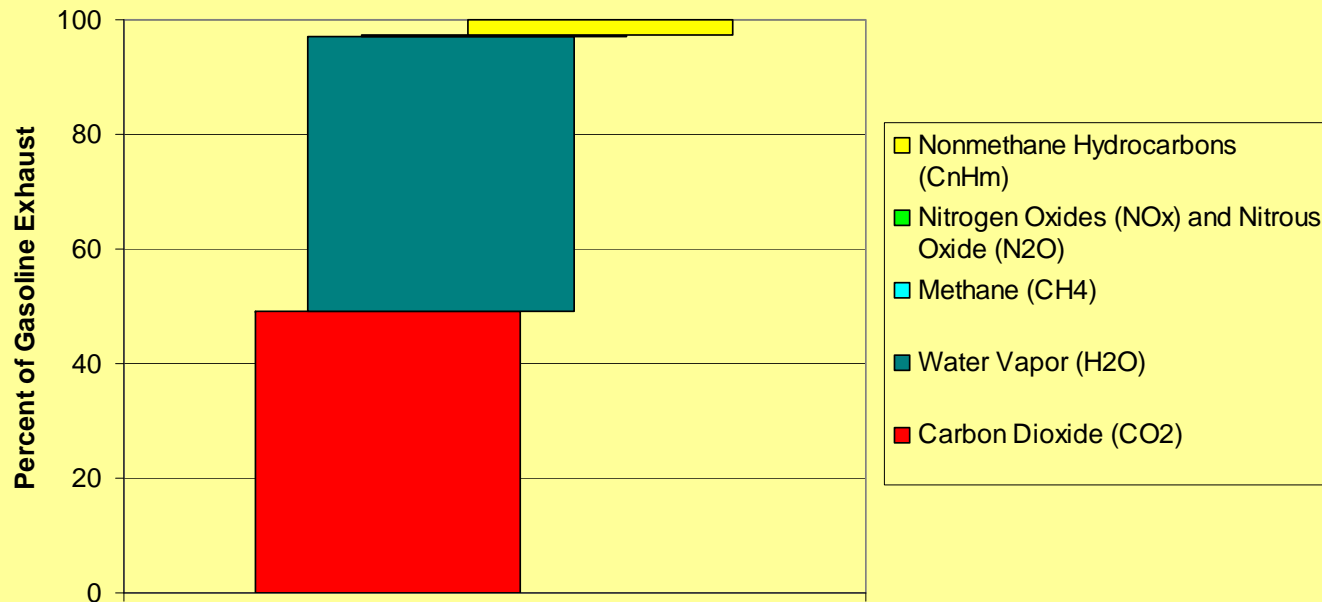


Source: Green House Gas Emissions from the US Transportation Sector, 1990-2003

www.epa.gov

Gasoline 'tail-pipe' emissions are about half CO₂ and half water vapor...

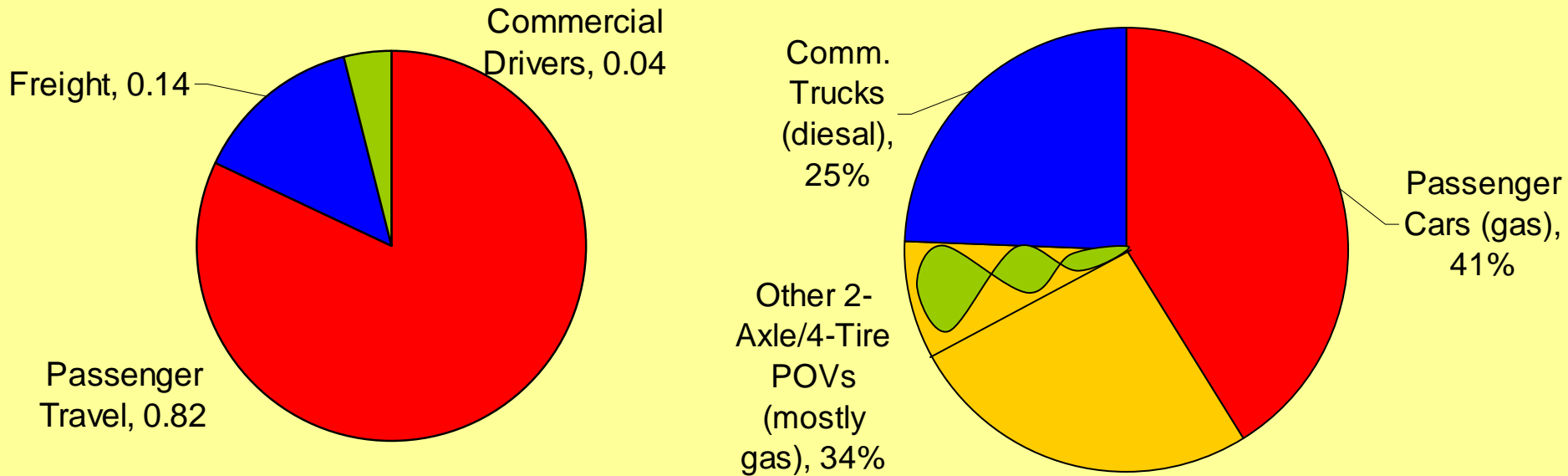
Percent of Gasoline GHG Emission per Vehicle Mile of Travel



Note: Tailpipe emissions account for about 60% of lifecycle emissions from vehicle transport, and do not include manuf./tires/maintenance/fuel production, etc. (VTPI)

Passenger travel is the largest sources of greenhouse gas emissions from mobile sources...

Passenger travel accounts for 82% of VMT and about 75% of CO₂

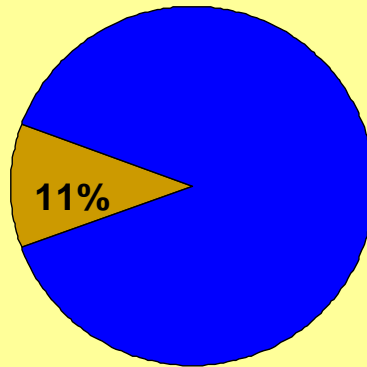
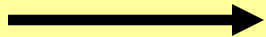


Source: McGuckin's analysis based on Highway Statistics VM-1 2009.
Gasoline=8.8Kg CO₂ per gallon, diesel=10.1Kg CO₂ per gallon

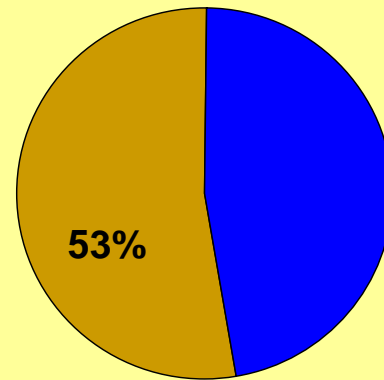
Fleet Characteristics and CO₂ Emissions



Light Duty
Truck
Share of
New Sales



E.U.

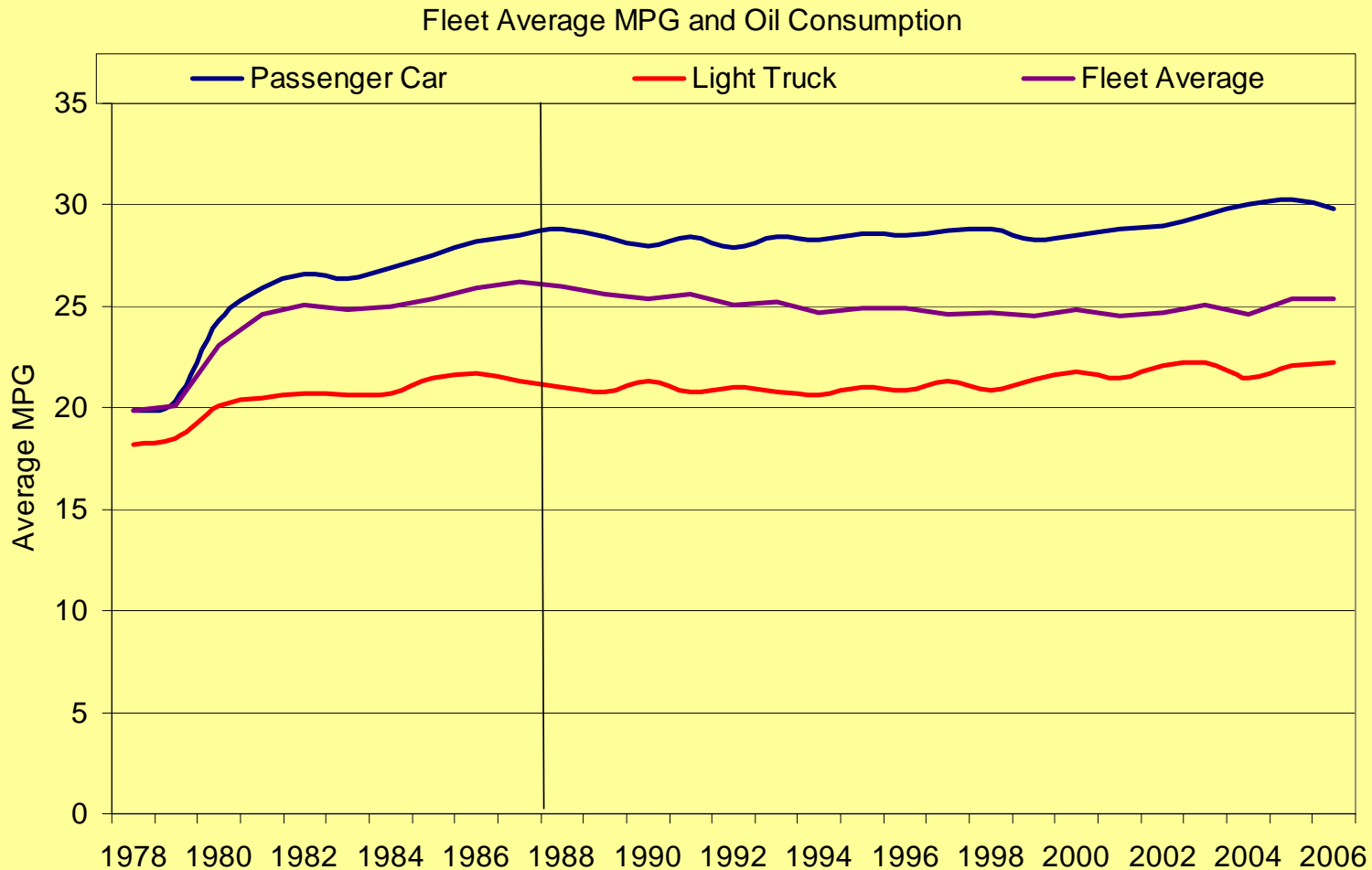


U.S.

Fuel efficiency of the passenger fleet

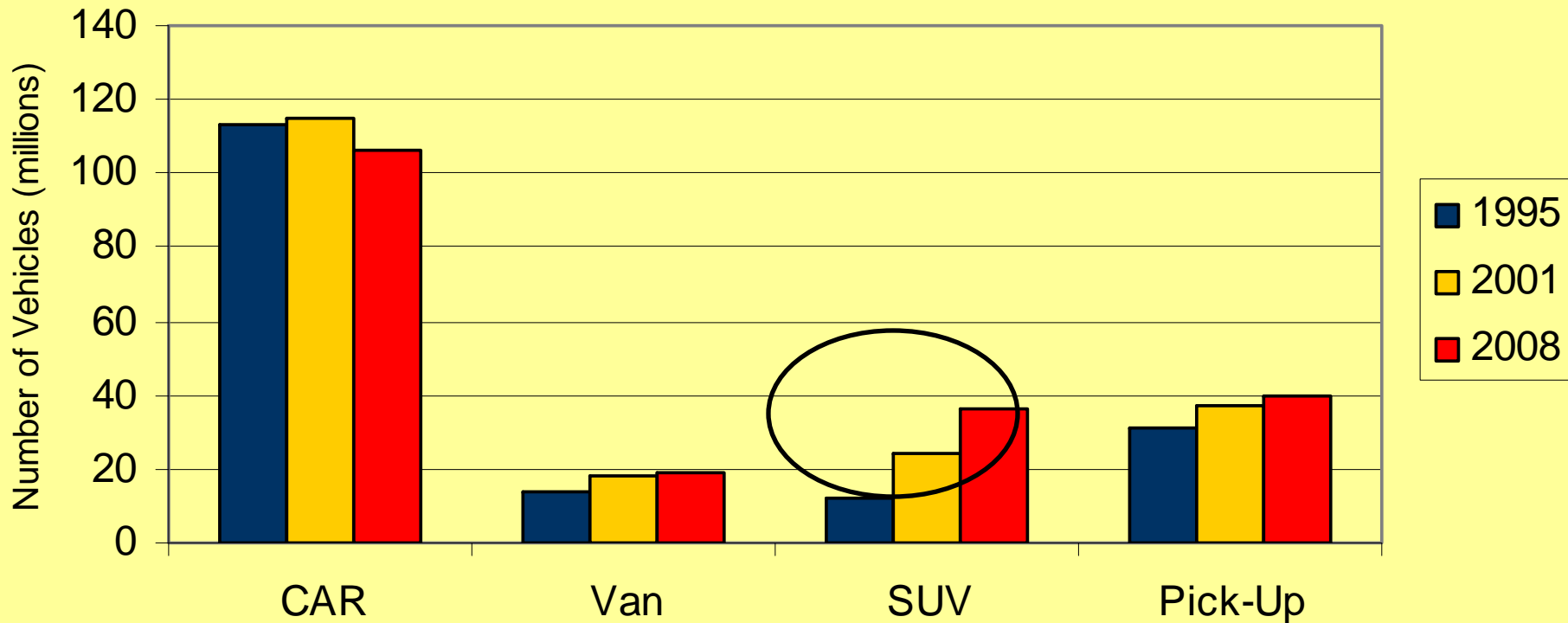
- In 1978, congress passed the National Energy Conservation Policy Act which mandated fuel efficiency standards and planned to double fuel efficiency of the fleet by 1987
- Since 1987, the fuel economy has slowly declined as vehicles have gotten larger and heavier, and as light-duty trucks (SUV's primarily) grew as a share of the passenger fleet.
- The recent (since 2005) overall increase in fuel economy is due to changes in light-truck fuel economy and a slightly *lower* light truck market share, which peaked in 2004 at 53 percent and is projected to be 48 percent in 2008.

US Fleet fuel efficiency has remained virtually the same for many years...



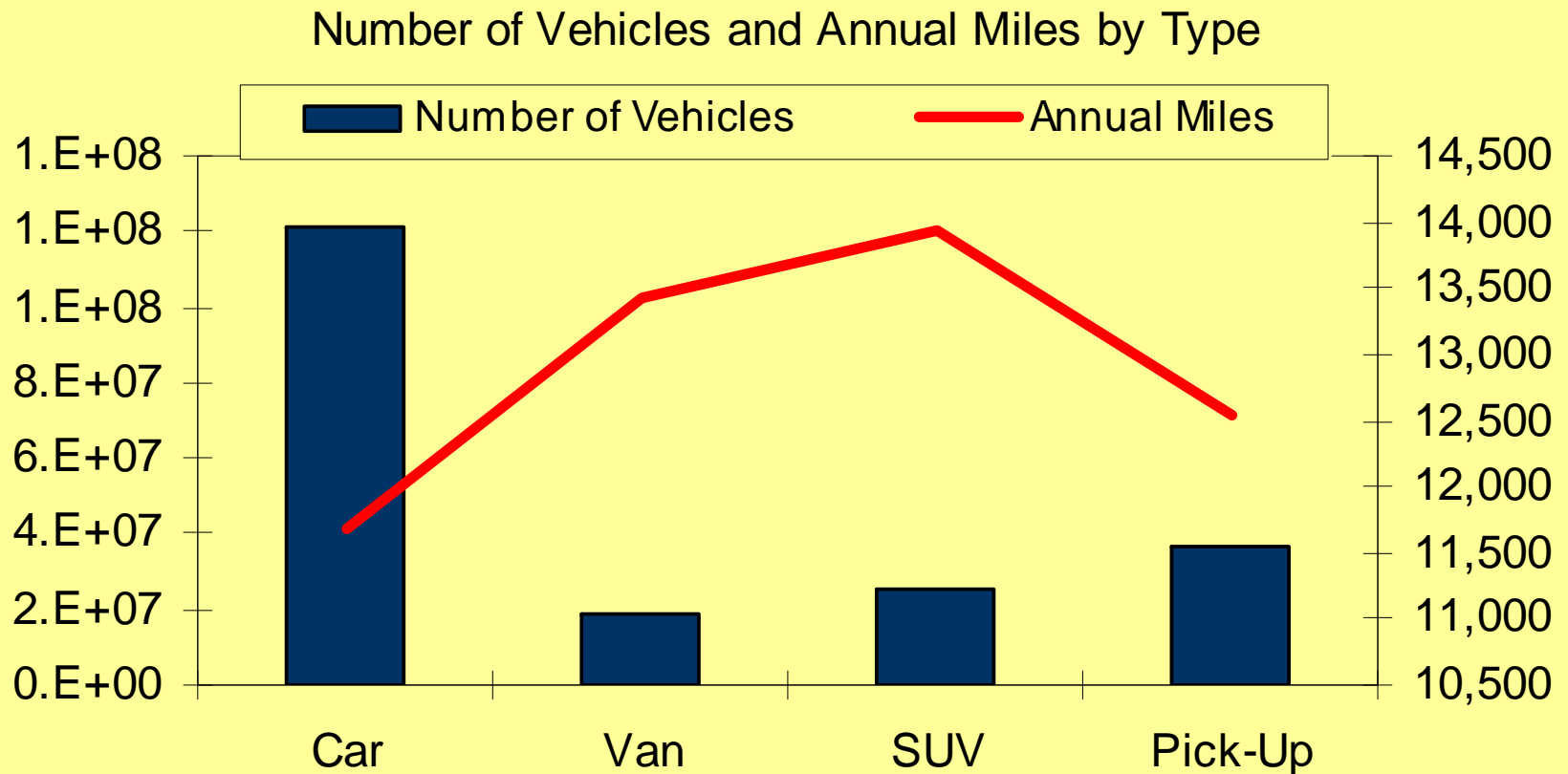
One of the reasons is the rising proportion of SUVs in the fleet mix...

Trends in US Fleet Mix



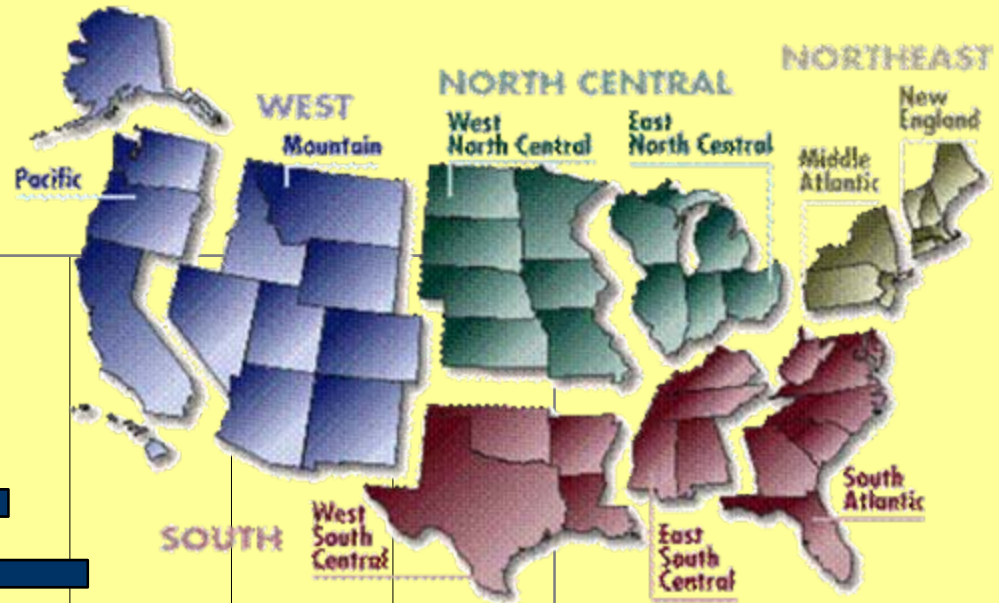
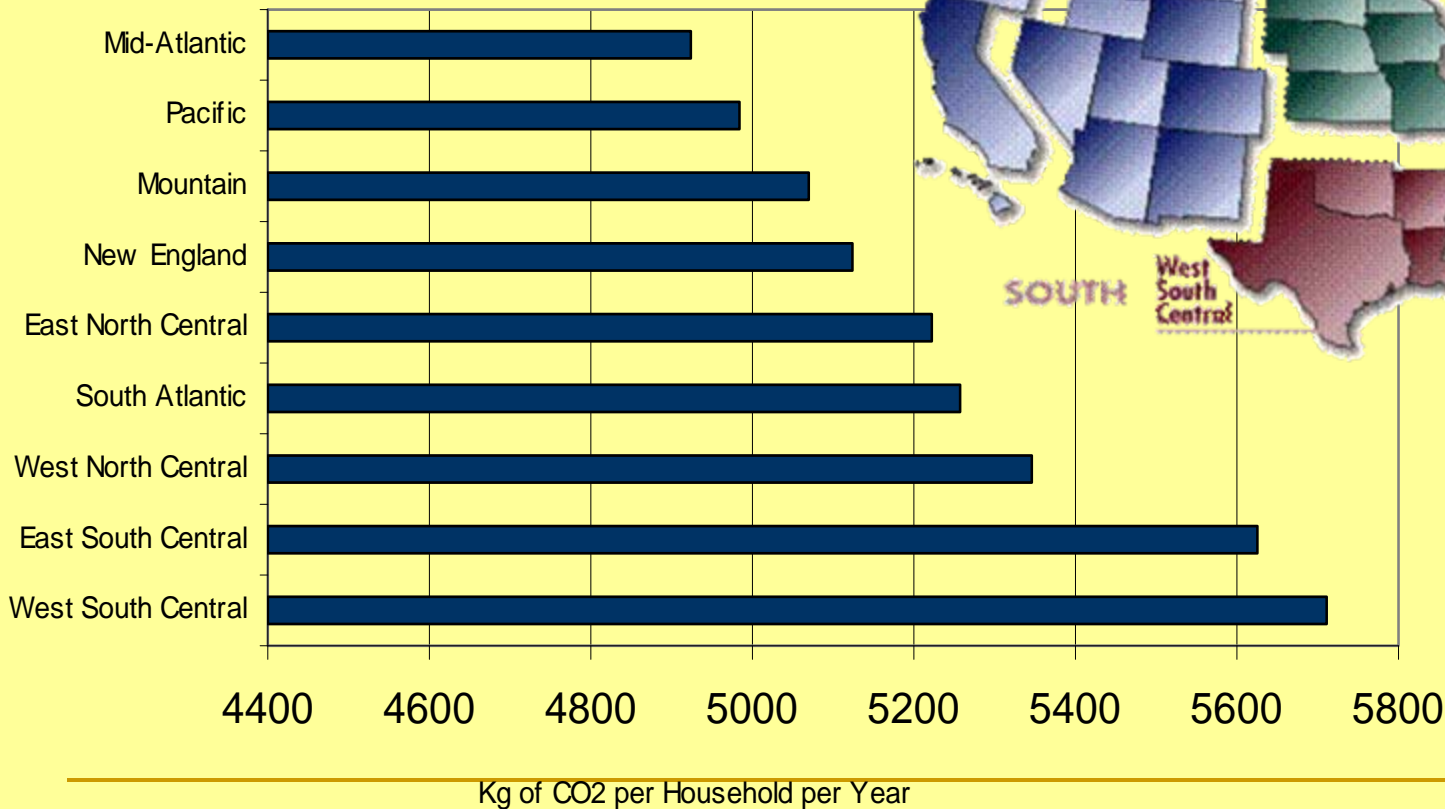
Source: NHTS Data series, including preliminary 2008

Fuel economy standards are based on sales by class and not *use*...



The mix of vehicles, the amount they're driven, and the resulting CO₂ from passenger travel varies by region:

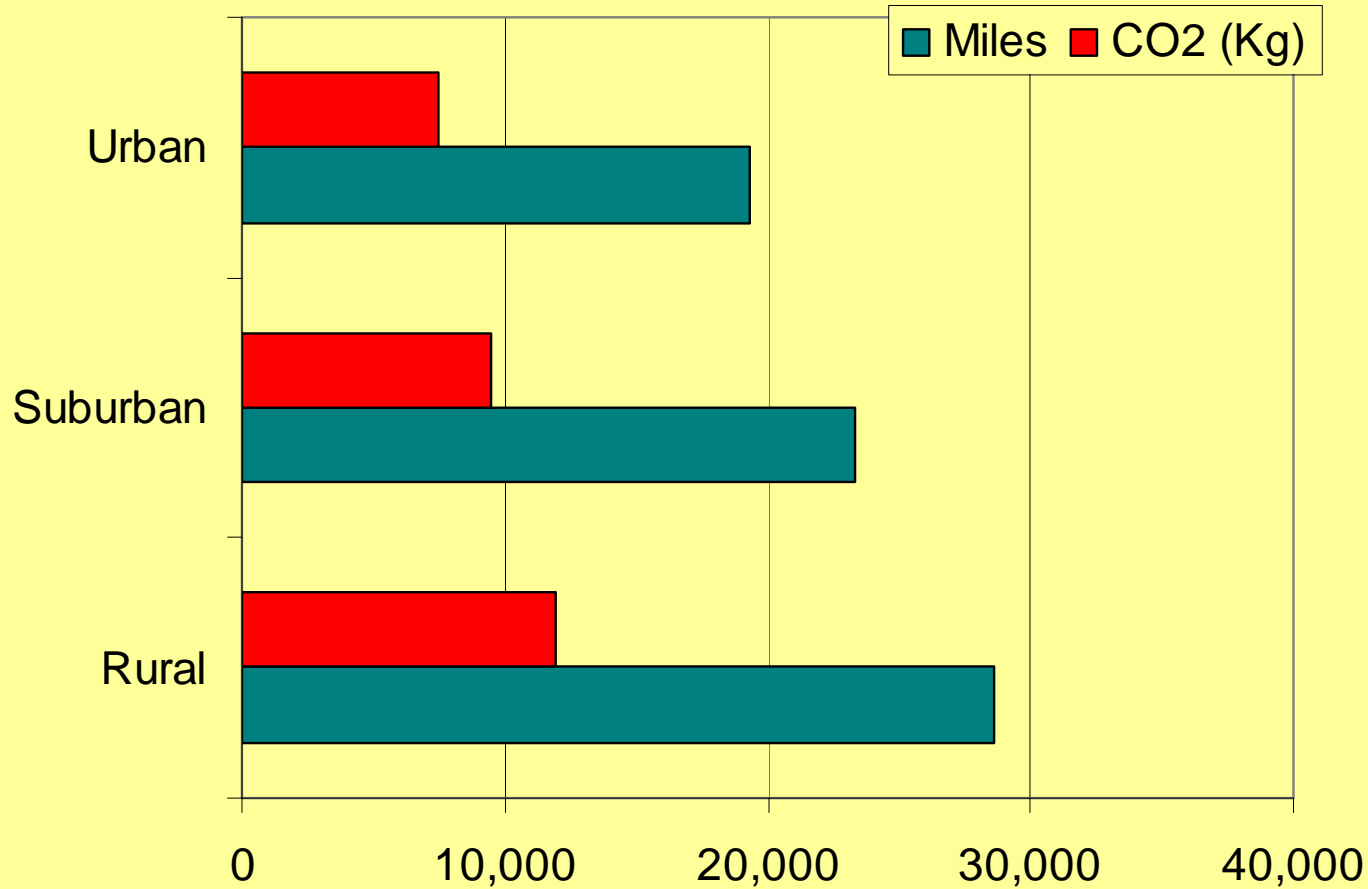
Average Est. CO₂ per Household By Region



Source: National Household Travel Survey (NHTS), 2001

And by area type...

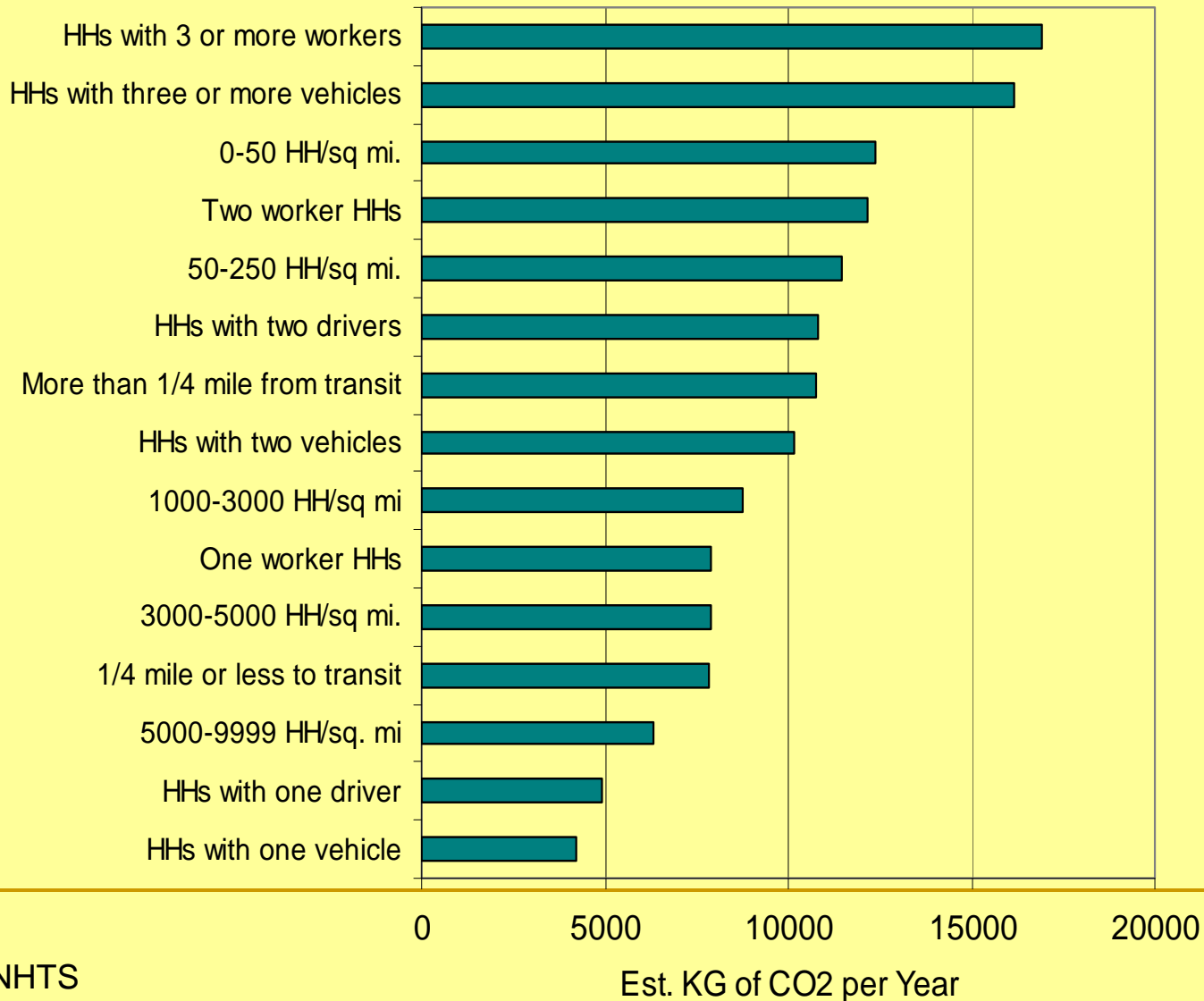
Annual Miles and CO2 by US Households by Area Type



Source: 2001 NHTS

Miles or CO2 (Kg)

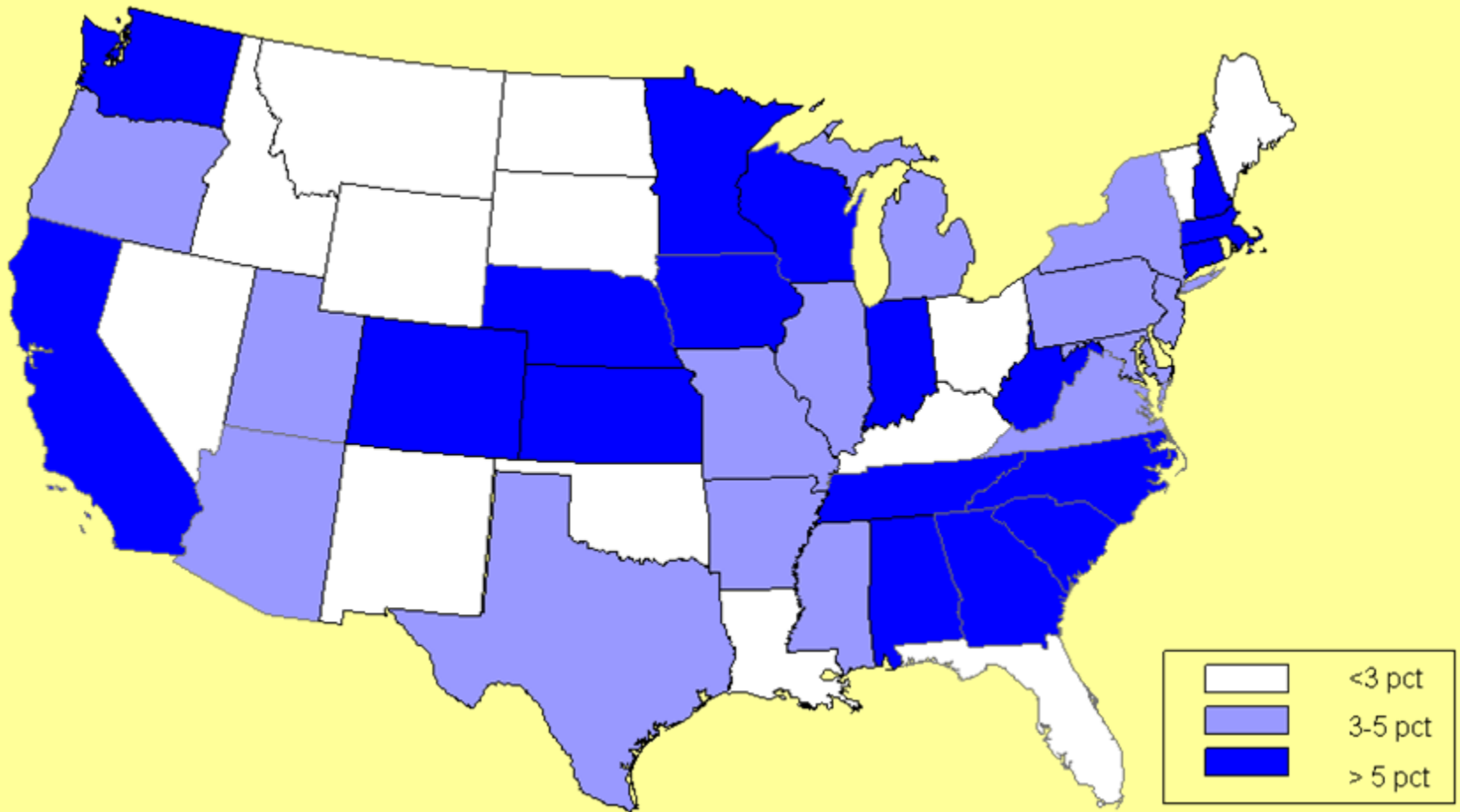
And by factors such as workers, drivers, density, and distance to transit...



Source: NHTS

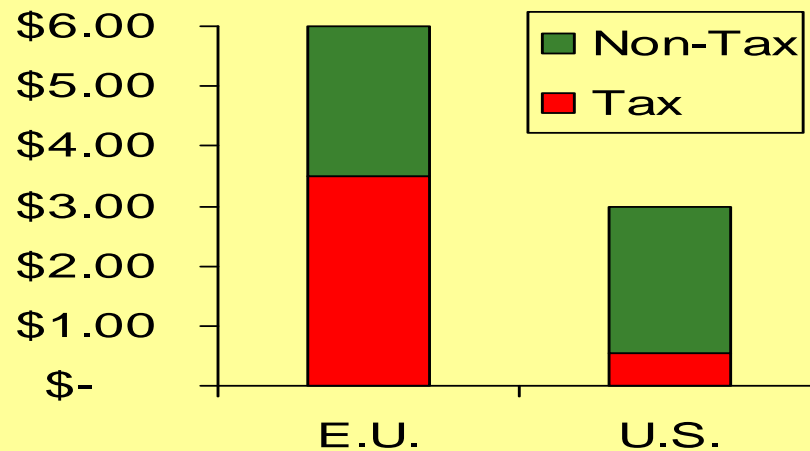
But, the fleet mix may be changing...

Hybrid/Alternative Fuel Vehicles by State



Cost Factors Effect on Carbon Emissions

Price per
Gallon
(2006)



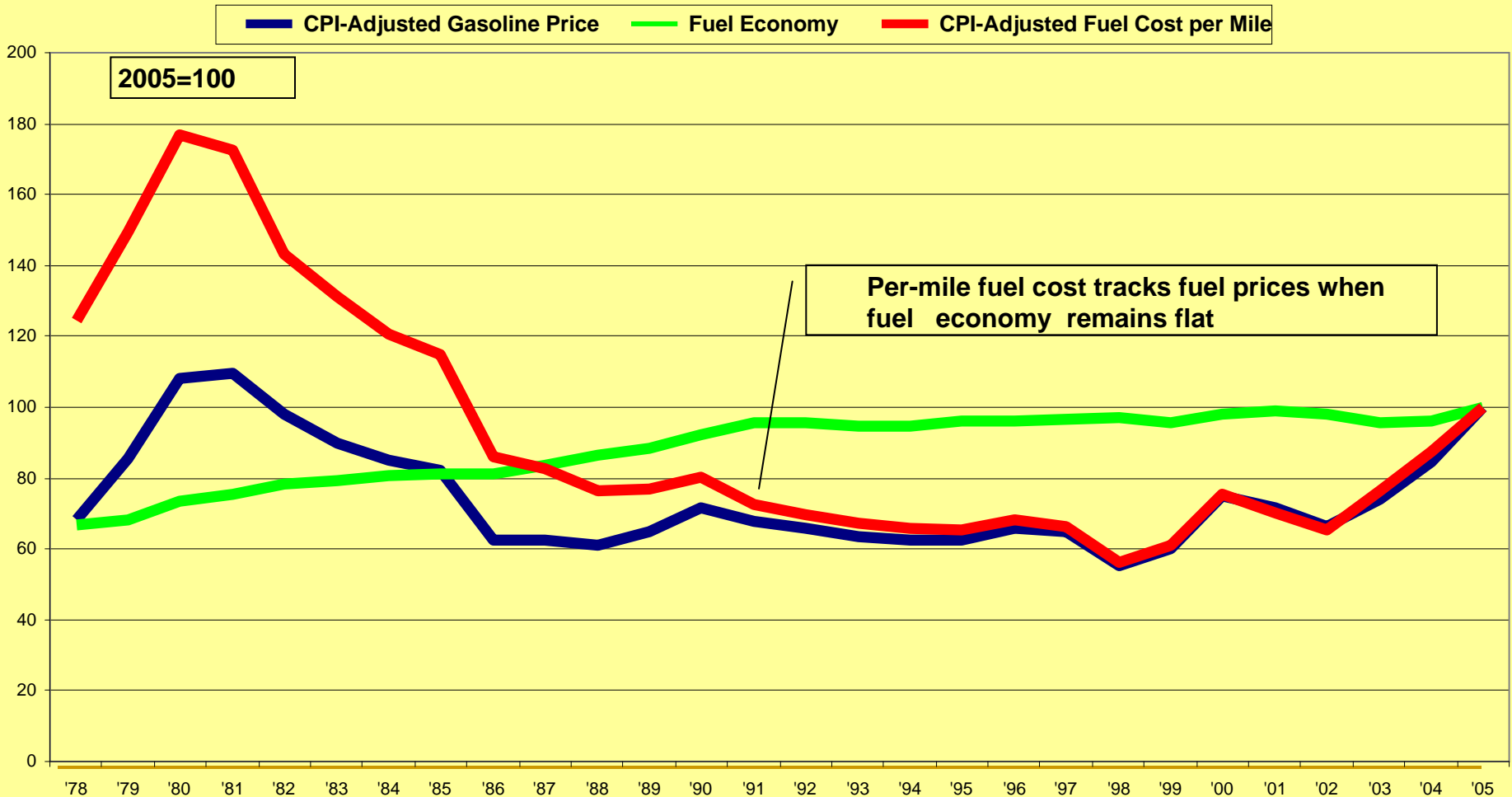
Are Gas Prices High or Low?

Gas Cost, All Grades, All Formulations



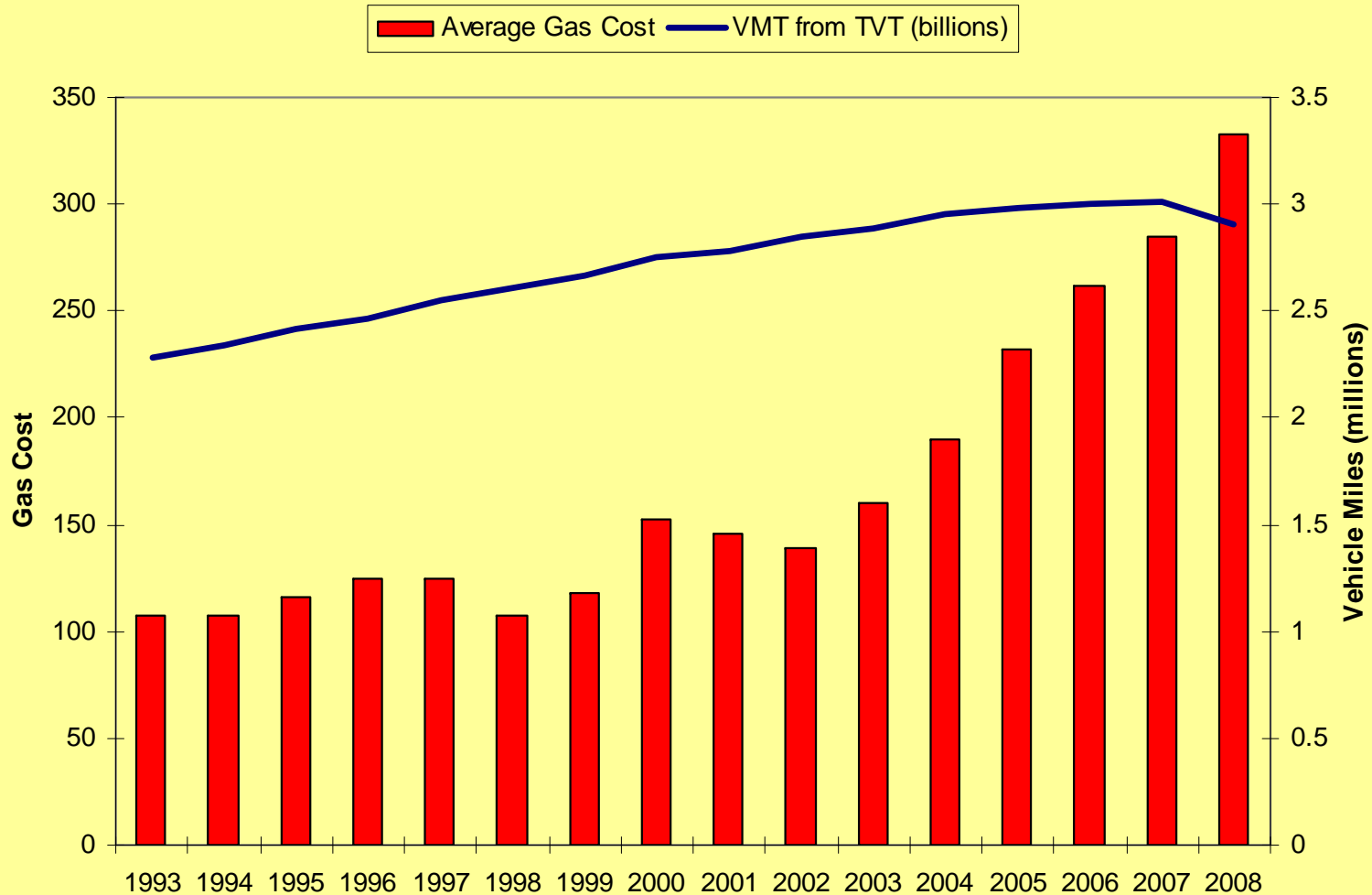
Gas cost per mile of travel is stable...

Fuel-Cost per Mile is 25% lower than in 1978



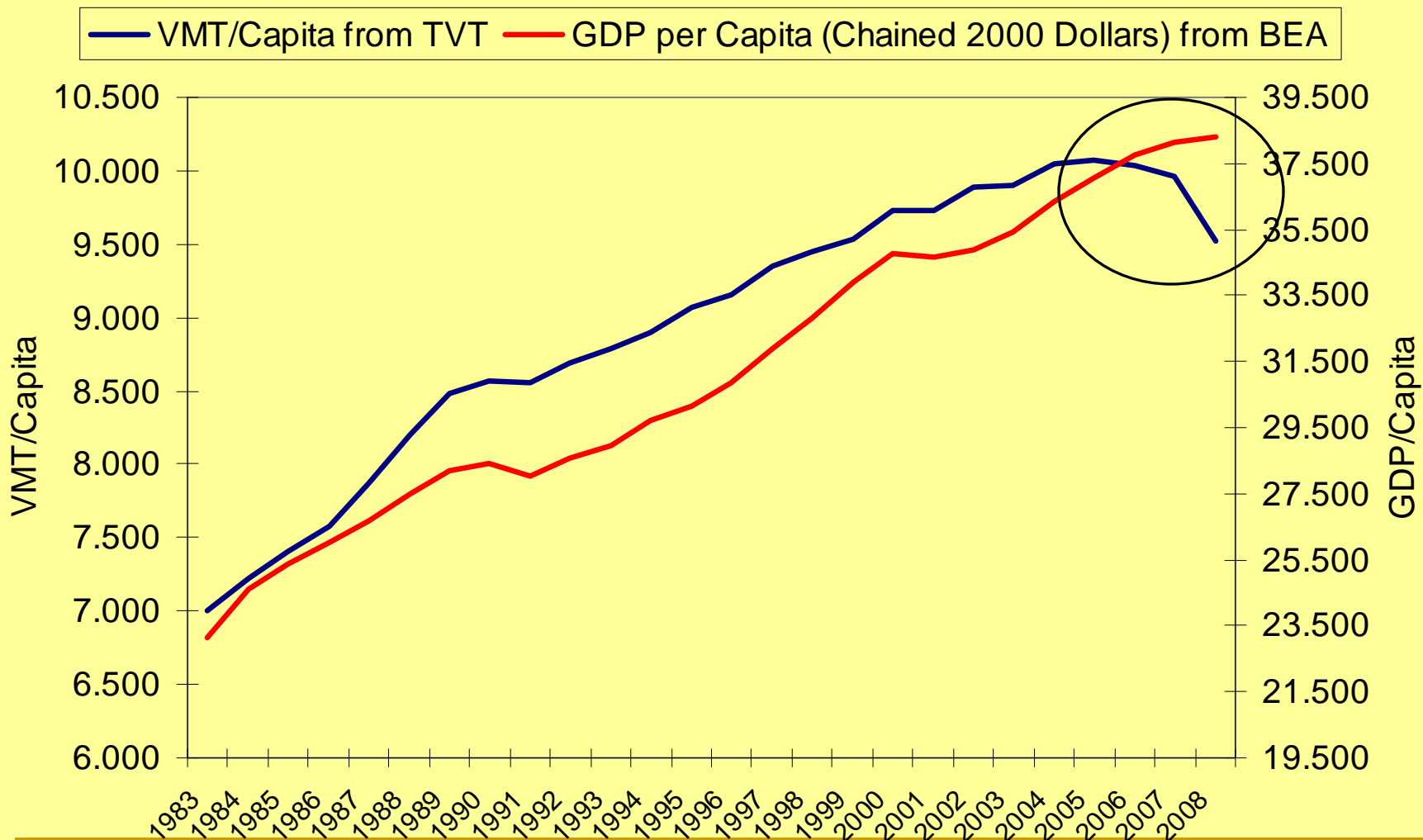
Source: EIA and McGuckin's analysis

Is it the price of gas that effects vehicle travel?



Source: McGuckin's analysis of EIA historical data and TVT, FHWA data

Or is it the economy?



Source: McGuckin's analysis of TVT trends, population, and BEA GDP (US Census)

When gas prices go up and the economy goes down:

- People move to transit
 - *Even a small mode shift can overwhelm transit*
- People share rides to work
 - *HOV lanes can see more congestion*
- People chain more trips together
 - *Short trips may increase cold starts (air quality impacts)*
- Save a trip by having goods delivered
 - *More delivery trucks into neighborhoods (safety)*

All of these also have policy implications...

**Some thoughts on future
directions...**

Just a few ways to cut CO₂ emissions from daily travel...

- Increase fleet fuel efficiency
 - Increase use of the right alternate fuels
 - Improve traffic flow/Less congestion
 - Provide better alternative modes
-

Some 'What if' Scenarios:

Increase fleet fuel efficiency

Pct Decrease
from Base
Case
(Impact)

Based on current VMT per vehicle:

Base Case (Current Est.)

<null>

If 20% of vehicle fleet were hybrid (55 mpg)

2.5%

If fuel efficiency were raised 10% for all vehicles

9.1%

If all Vans, SUVs and P-U were replaced by cars

11.6%

If fuel efficiency were raised to 29 mpg for all vehicles

31.7%

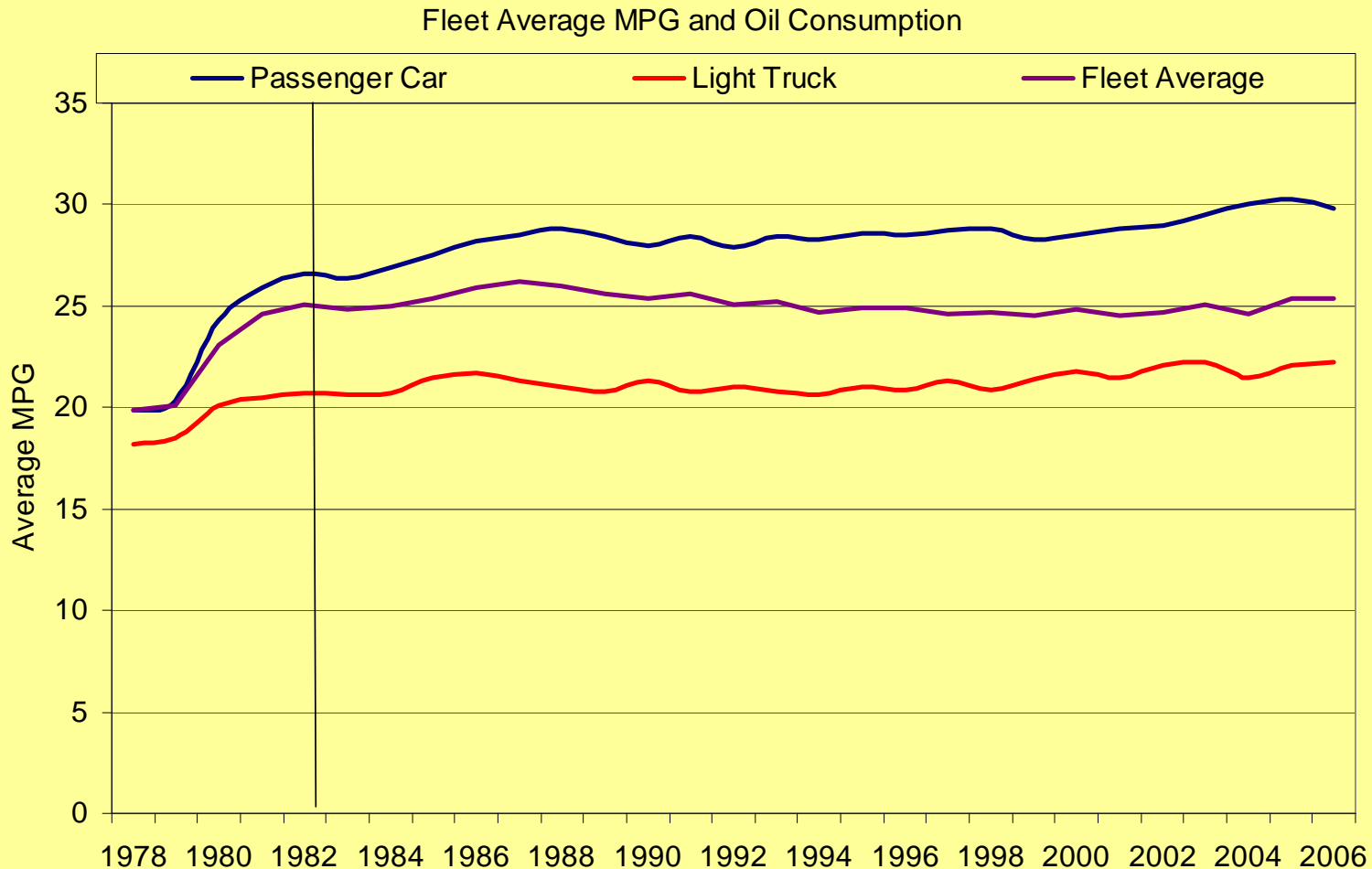
If we doubled fuel efficiency in each vehicle class

50.0%

Source: McGuckin's analysis based on NHTS 2001

It's not just that fuel efficiency has remained flat as much as we've proved it can change rapidly...

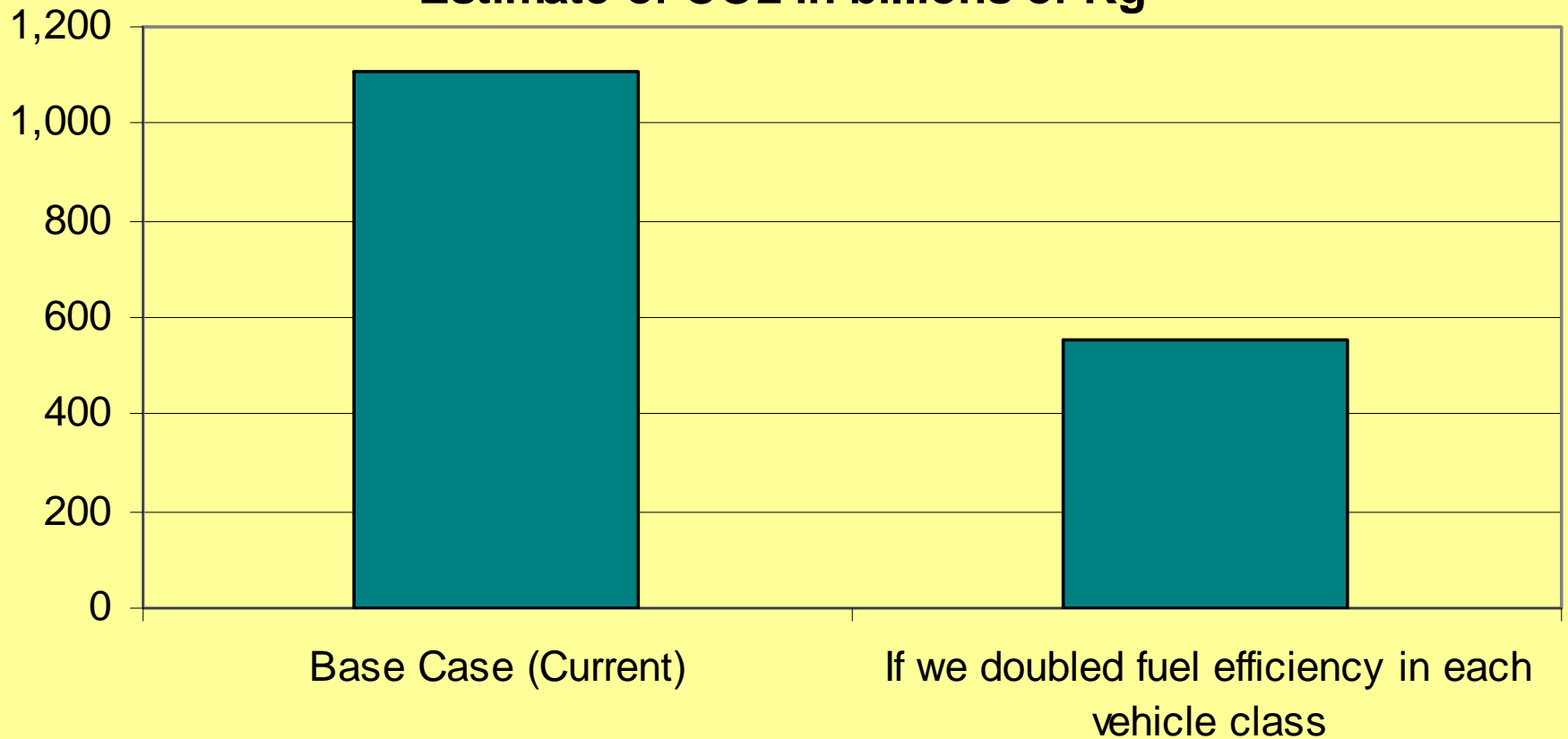
Increase fleet fuel efficiency



What if we doubled fuel efficiency in each class?

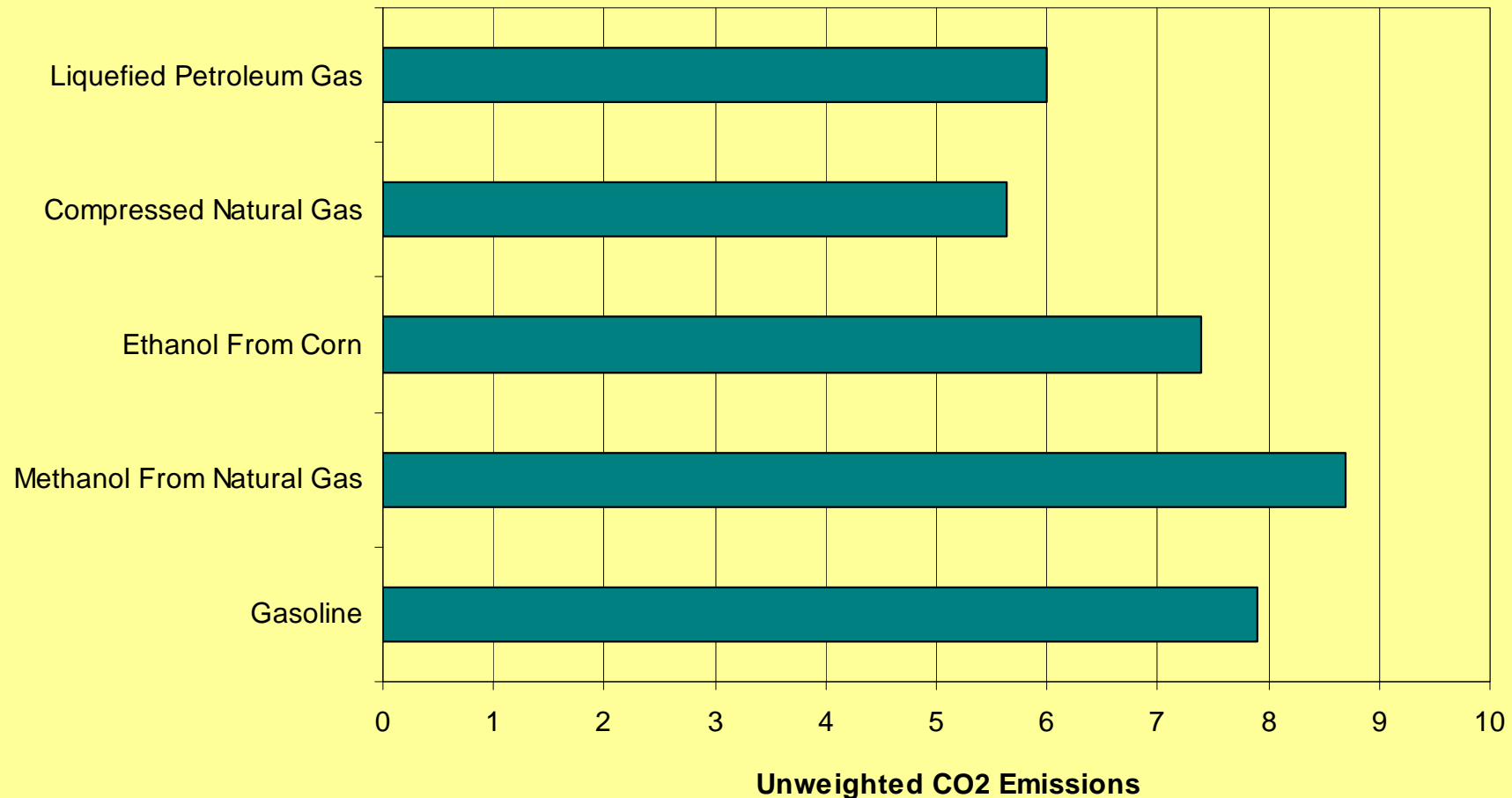
Increase fleet fuel efficiency

Estimate of CO2 in billions of Kg



We have to remember that many common alternate fuels still have CO2 impacts...

The right alternate fuels



And how these fuels themselves get to the consumer has impacts...

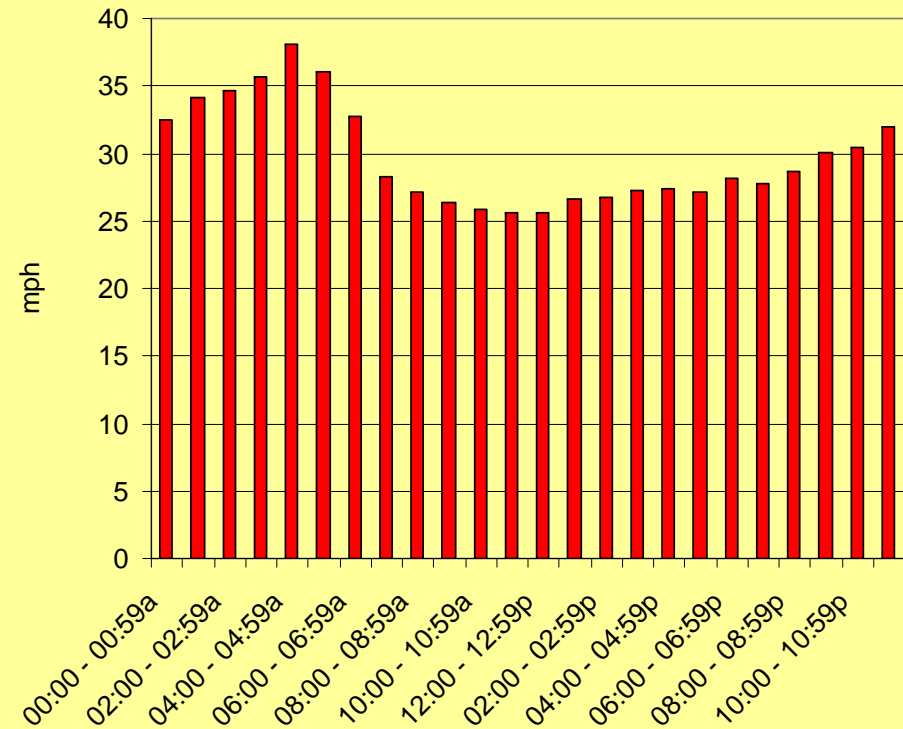
The right alternate fuels: Do the whole equation

| <i>Type of Vehicle</i> | <i>Environmental Impact</i> | <i>Availability</i> |
|--------------------------|--|--|
| Battery-Powered Electric | No tail-pipe emissions, but impact depends on source of electric power (e.g. coal, oil, natural gas, nuclear) | The <i>Telsa Roadster</i> costs \$109,000. Other small companies make low-speed vehicles starting under \$10,000 |
| Natural Gas | Emits 95% less smog-causing pollutants and 30% less GHG than gasoline. | <i>Honda's Civic GX</i> costs \$25,200. Conversion kits start at \$1900. |
| Ethanol/ Biodiesel | Lower emissions than gas, but critics say sometimes more energy is used to produce ethanol than is contained in the fuel itself. | Special models of Chrysler, Ford, and GMC vehicles can run on E85 and cost the same as regular models. |
| Hydrogen Combustion | Depends on whether hydrogen is extracted from fossil fuels or generated from water and sunlight. Virtually no tail-pipe emissions. | BMW and Ford are making test vehicles, but no car is commercially available. |
| Fuel Cell | Depends on whether hydrogen is extracted from fossil fuels or generated from water and sunlight. Virtually no tail-pipe emissions. | Honda FCX Clarity is available for lease in SoCal. |



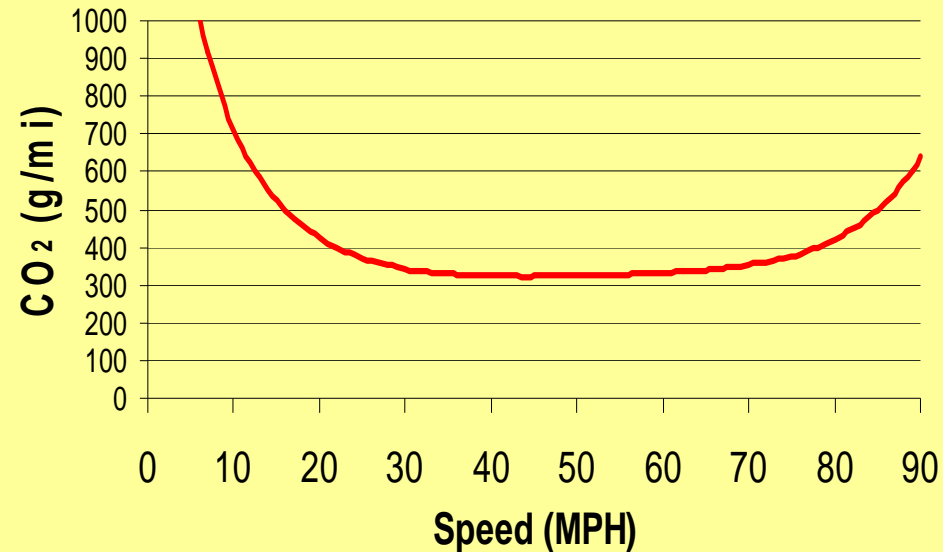
Congestion contributes to CO₂ emissions from vehicles...

Improve traffic flow



Source: NHTS

CO₂ Emissions Rates by Speed

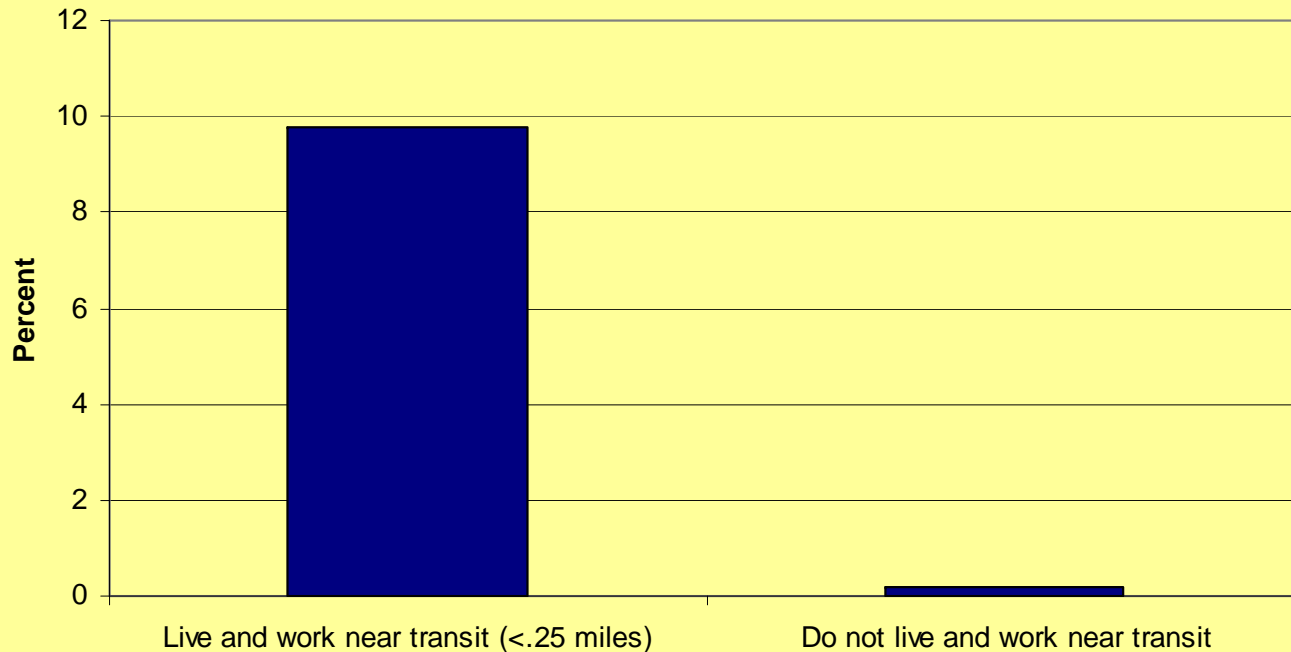


Source: University of California, Riverside, via Alan Pisarski, ITE PPT

A solo commuter switching to public transit for a single day can save 4,800 pounds of CO₂ in a year...†

Provide better alternatives

Percent of Workers Taking Transit to Work



Source: 2001 NHTS

† Source: Public Transportation's Contribution to U.S. Greenhouse Gas Reduction Fact Sheet, Sept. 2007, APTA

Summary

- The economic downturn is going to lower CO₂ emissions from travel
- It is possible to make dramatic changes in fleet fuel efficiency
- We could provide more incentives to improve the fleet/faster turnover
- Remember to do the whole equation on alternative energy sources
- Educate and encourage low-carbon behavior (e.g. 'Conscience' factors)

Thank you!

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