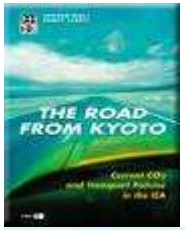
# Fuel Economy, VMT, and Transport Policy
# They All Matter to Restraining GHG Emissions

Lee Schipper, Ph.D.

Visiting Scholar, UC Berkeley Transportation Center

Alex Farrell 1962-2008




# "The Road From Kyoto": Transport/CO2 Policies in 6 IEA Countries" "Saving Oil And Reducing CO2 Emissions In Transport"

- **Potential Large, Progress Slow, Risks High**
  - Technology getting better there but economic signals still weak;
  - Political will missing in 2000, stronger now
  - Absence of meaningful initial progress in the US notable
- **Main Elements Still Important Today – Transport Sector Leads**
  - Transport sector reform as umbrella for process
  - Voluntary agreements on car fuel economy important
  - Fuel pricing also important policy element de jure (except US, defacto)
- **Hard Lesson: Many Years to See Impacts**
  - Countries moving slowly towards better transport policies
  - Voluntary agreements in Japan, EU achieved half their goals
  - Threats from distractions (bio-fuels, oil-price fluctuations, CO2 denials)

*Oil and CO2 More Important in 2008 than 2000*
*What are the Next Steps?*

# International Evidence: What Reduces Emissions From Transport?

- **Fuel Prices**
  - Higher prices always mean smaller, slower, less powerful than otherwise;
  - Higher prices mean less driving than otherwise
  - Higher prices mean more mass transit, somewhat denser settlements
- **Mandatory Fuel Economy Standards**
  - U.S. and Canadian experience unique so far – good impact
  - Exhortation and Voluntary F.E. Agreements (Eu, Japan) – modest impact
  - Early national VA (Japan, France, Germany, Sweden) - small impact
- **Other Factors**
  - Various Fee-bates on new, existing cars (Denmark) – small impact
  - Transport policies integrating externalities into variable costs
  - Higher urban densities

*Fuel Economy Standards Improve F.E.*
*Other Factors like Fuel Prices Reduce VMT*

# International Evidence: What Increases Emissions From Transport?

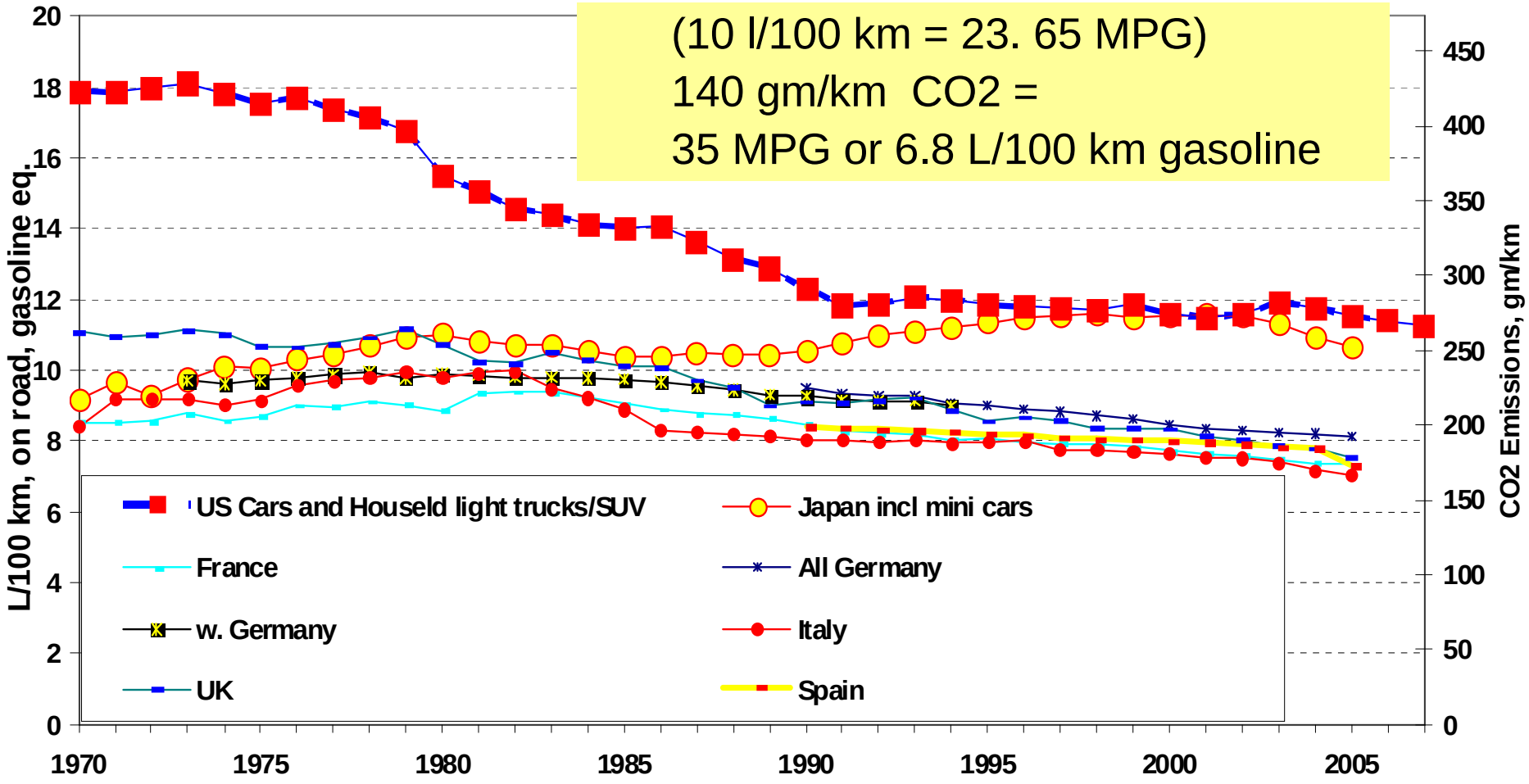
- **Rising Incomes**
  - Propel car ownership, larger cars sprawl to larger homes
  - Leave transit use behind (Webster and Bly 1986)
  - Permits consumers to ignore all but strongest fuel price signals

- **Low Fuel Prices**
  - Cheaper diesel in Europe raises use, backfires on diesel policies
  - Low price countries like US locked into low fuel-price development
  - Fuel subsidies (e.g. ethanol, diesel) that hide marginal cost of fuel
- **Tax Policies**
  - Weak treatment of company provided cars
  - Mortgage interest tax deductions
  -

*Fuel Economy Standards Improve F.E.*
*Other Factors like Fuel Prices Reduce VMT*

# Real Automobile Fuel Intensity – All Fuels

## When the Rubber Hits The Road

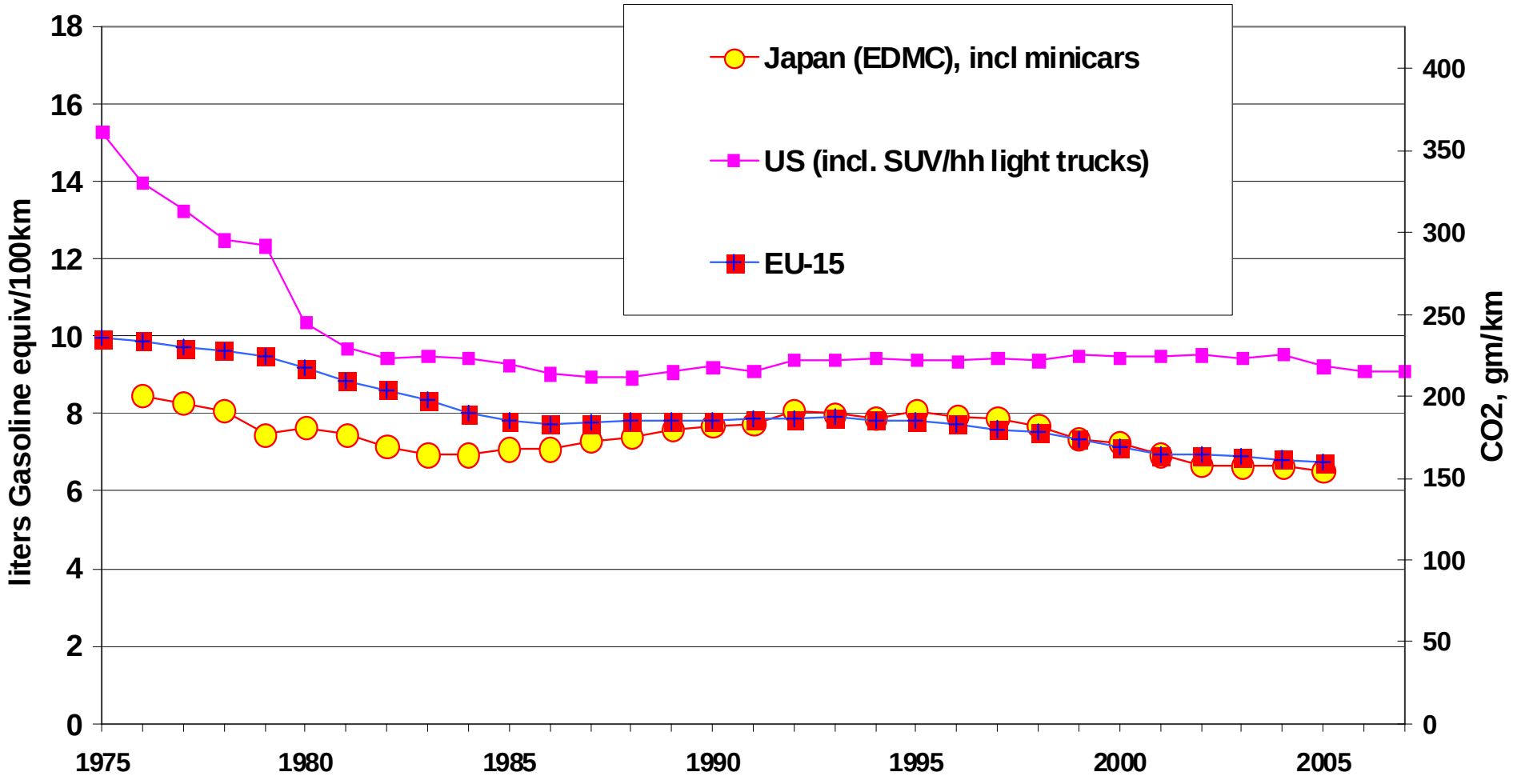



Diesel and LPG converted to equivalent gasoline on an energy content basis.

Source, L Schipper, based on official national data

# Trends in New Car Fuel Intensity

Sales Weighted Tests of New Vehicles by Year




Diesel and LPG converted to equivalent gasoline on an energy content basis.

Source, L Schipper, EMBARQ, based on official national data

# Diesels Close to 50% of New Car Market in Europe: Yet Savings of CO2 from Diesel Small

- **The Data Show Little Savings (Counting emissions, not gallons!)**
  - On road diesel fleet emissions (gm/km) slightly (<10%) lower than gasoline
  - New vehicle test diesel emissions slightly (<10%)lower than gasoline
  - Diesel cars driven 50-75% more than gasoline cars
- **Huh?**
  - Cheaper diesel in Europe raises use, backfires on diesel policies
  - Diesel model more powerful than gasoline equivalent
  - Diesel choices overall heavier, more powerful than gasoline
- **But Diesel Drivers Are Different -- That's the Point**
  - Long distance drivers buy more expensive diesels with lower fuel costs
  - Increased switching to diesel stimulated by price – switchers drive more
  - Diesel SUVs increase attractiveness of SUVs ("Gelaendewagen")

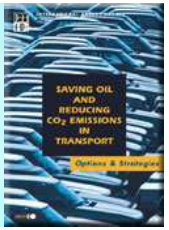
# Dieselization in Europe

## At Best Small Impact: At Worse, a Boomerang

Source, L Schipper, EMBARQ, based on official national data

| | | France | | Germany | |
|---|---|---|---|---|---|
| | | 1995 | 2005 | 1995 | 2005 |
| **New Diesels** | | | | | |
| Share of Sales | % | 46.5% | 69.1% | 14.6% | 42.6% |
| Test Fuel Economy | L/100 km | 6.60 | 5.60 | 6.5 | 6.511 |
| Relative to gasoline | % | 88.0% | 83.6% | 85.5% | 86.4% |
| Rel. to gasoline, CO2/km | % | 104% | 99% | 101% | 102% |
| **Stock of Diesels** | | | | | |
| Share of Stock | % | 26.5% | 46.6% | 13.7% | 20.0% |
| Yearly Distance | KM/ car | 20,627 | 16,736 | 17,980 | 19,470 |
| Distance, Rel. to Gasoline | % | 178% | 164% | 144% | 180% |
| **On Road Fuel Economy** | | | | | |
| Fuel Economy | l/100 km | 6.67 | 6.43 | 7.47 | 6.82 |
| Relative to gasoline | % | 78.6% | 83.9% | 81.7% | 81.7% |
| Rel. to gasoline, CO2/km | % | 92.7% | 99.0% | 96.4% | 96.4% |
| **COMBINED FLEET FUEL ECONOMY** | | 8.05 | 7.33 | 9.00 | 8.13 |

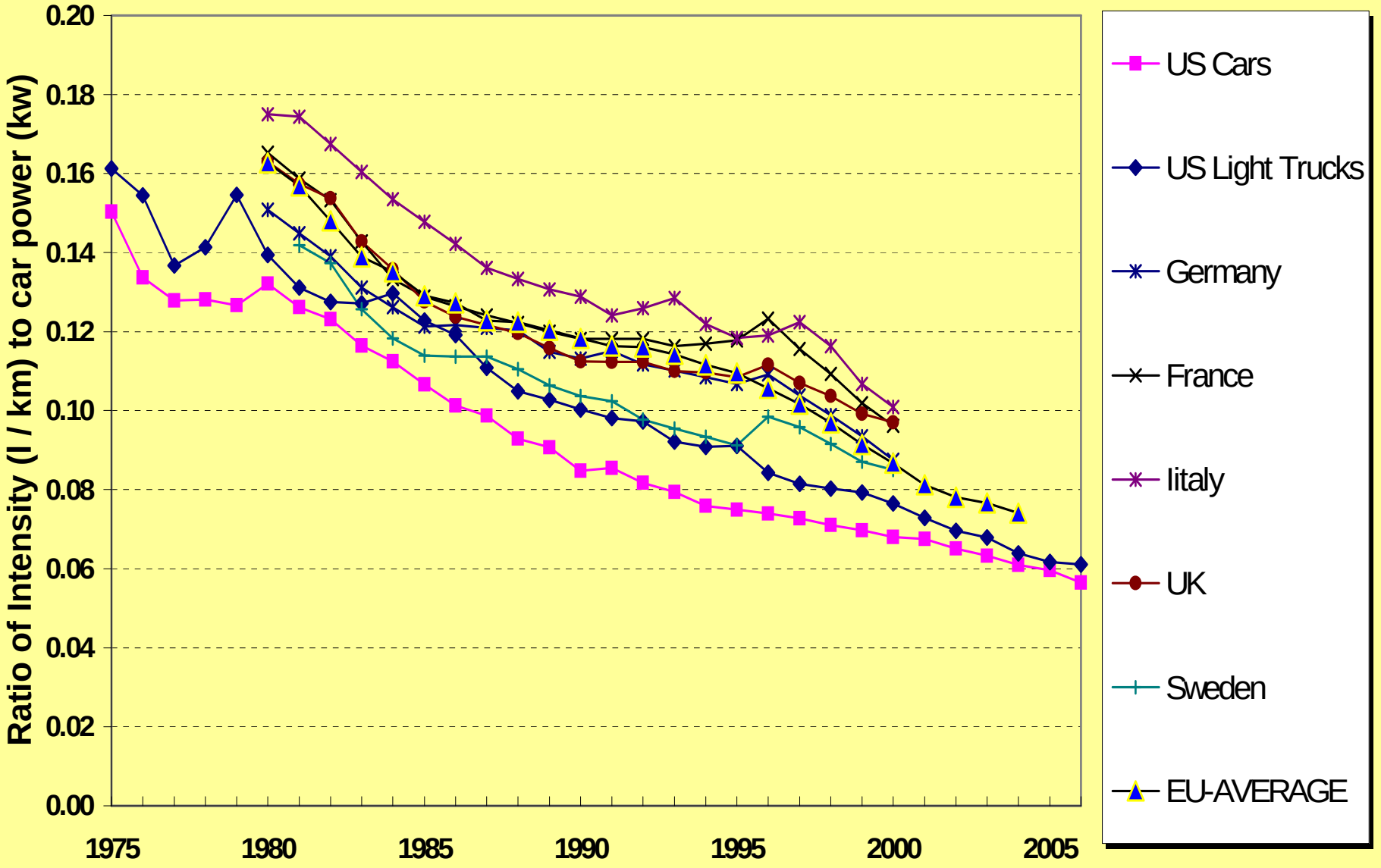
# International Evidence: Power and Weight, and Fuel Economy




- **Power and Weight Rising Everywhere, BUT**
  - In US rise offset all technological improvements in "efficiency"
  - In Japan "Top Runners", Mini-cars meant new car fuel economy improved from 1998
  - In EU, technology improved faster than power or weight, FE improved
- **Cross Sectional Differences**
  - Power, weight, engines, etc account for most of US/EU-J differences in FE
  - Small impact of efficiency technologies (Fulton, IEA 2000)
  - High fuel prices, weight or engine size taxes keep Europe, Japan "small"
- **The Future – What California Could Do**
  - Taxation of fuel, fuel economy (fee-bates) will limit size of engines
  - Parking, crowding also favoring smaller cars in EU, J– US?
  - Speed limits, enforcement, speed governors would also slow rise in power

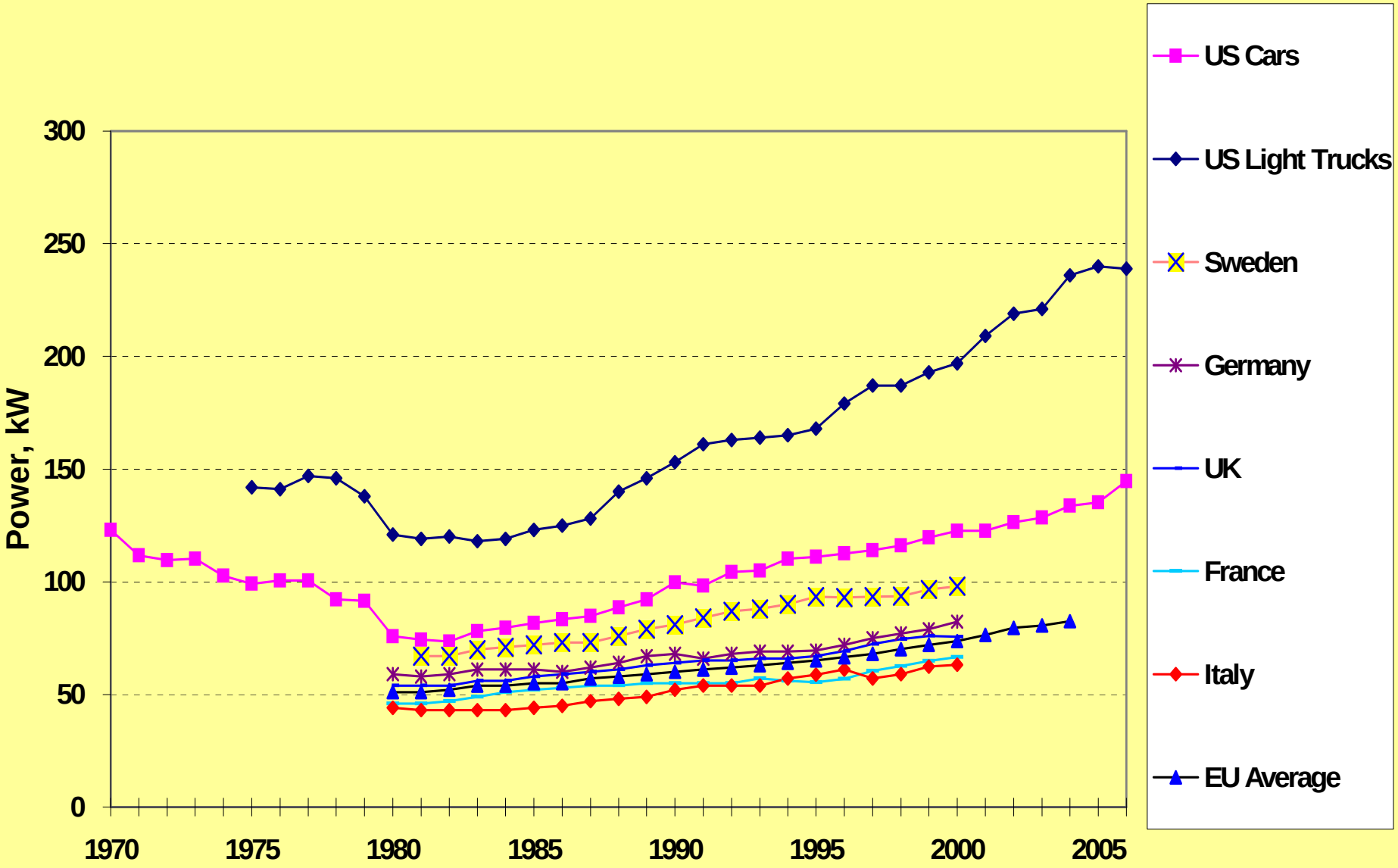
*The Real Rebound Effect – When Technology Gave More Macho at Constant Fuel Economy, rather than More Fuel Economy at Constant Macho*

# "Efficiency" Improving Everywhere



# Efficiency Only Feeding Pep

## Zip (power/weight) and Weight Look the Same



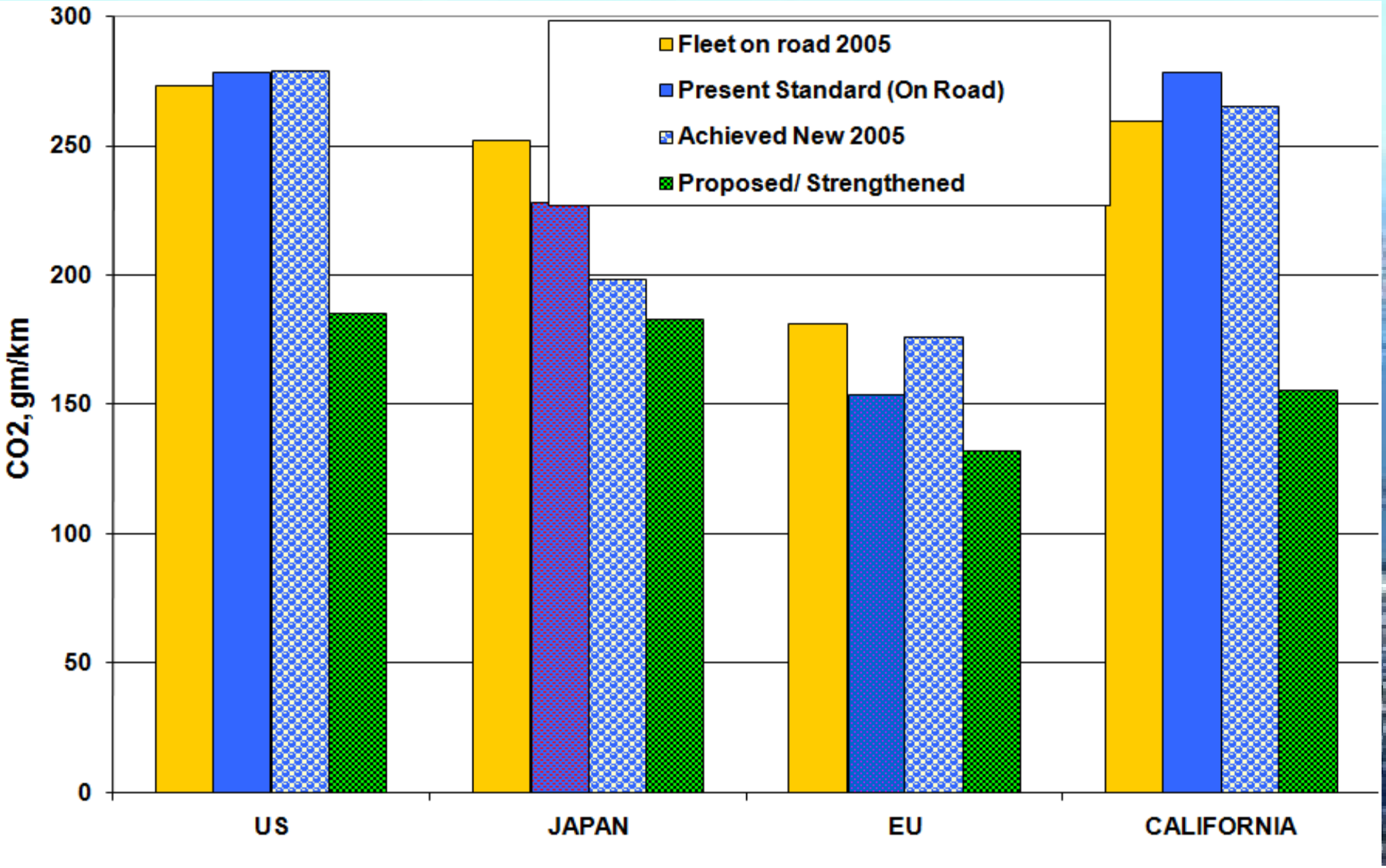
# International Evidence: Fuel Economy and F.E. Standards

On road =1.17 xT [test] (US), 1.1xT (EU), 1.33xT (J)

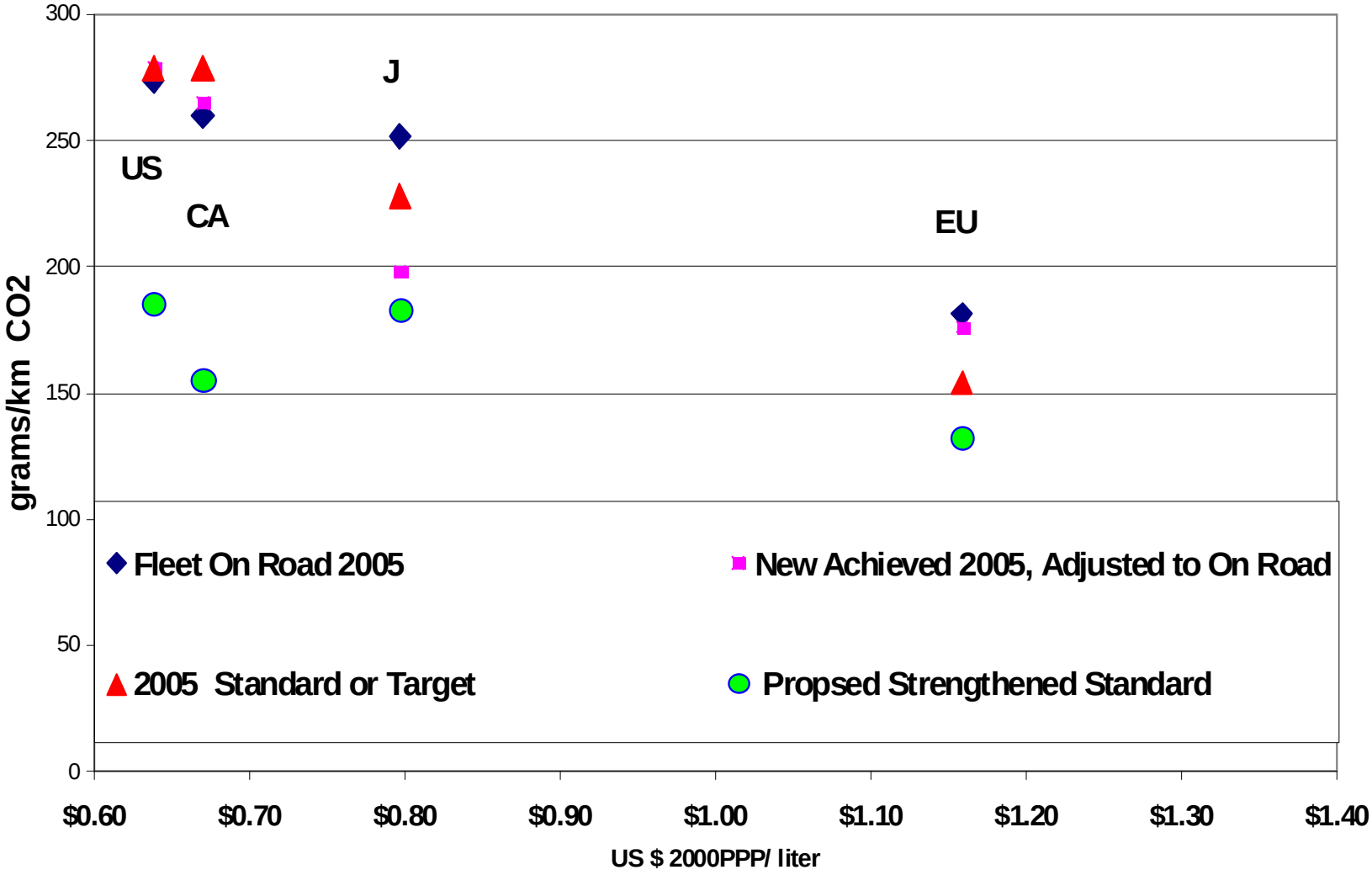
- **Situation Today (corrected to "on road", gasoline equivalents)**
  - US roughly 275 gm/km fleet and 2006 sales
  - Europe 181 gm/km fleet and 176 gm/km 2005 sales
  - Japan 252 gm/km fleet and 198 new sales 2006
- **Current Laws/Agreements in Effect and Proposed– Rough on-Road**
  - US (CAFÉ) 278.5 gm/km new, with 184 gm/km by 2020 (CA sooner?)
  - Europe VA 154 gm/km new, with 132 gm/km proposed (incl. other credits)
  - Japan VA 228 gm/km and 182 gm/km proposed
- **Observations**
  - Japanese buyers exceeded standards with 1/3 mini-cars
  - US has loophole for flex fuel vehicles
  - EU average reflects small cars in s. Europe, larger cars in N Europe

*Most European Countries Ratchet up Fuel Taxes: US Politicians Fear Any Tax Increases*

# *New Vehicle Fuel Economy Standards and Targets: "On Road"*

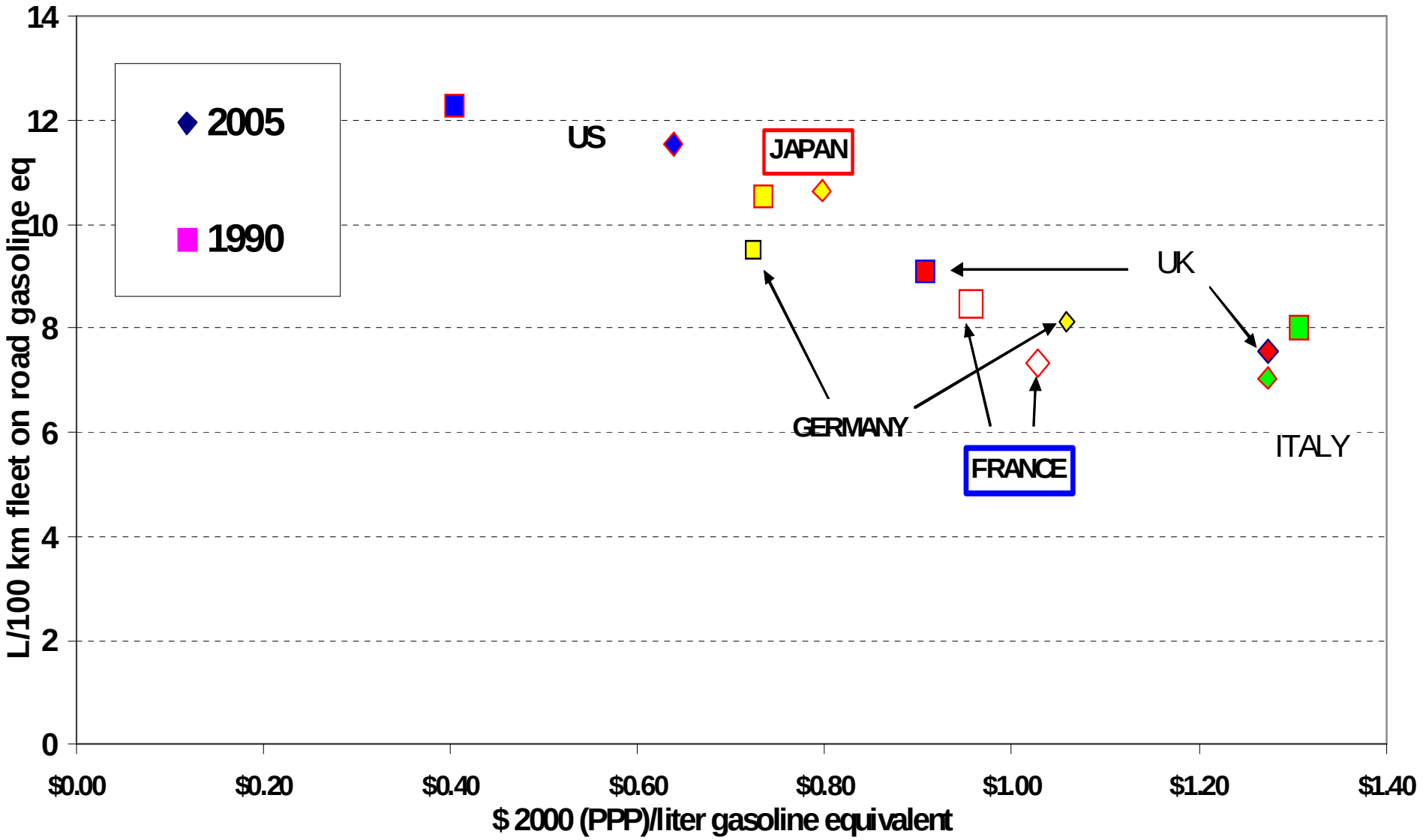


# Prices and Fuel Economy Real, Standards, and Hoped For



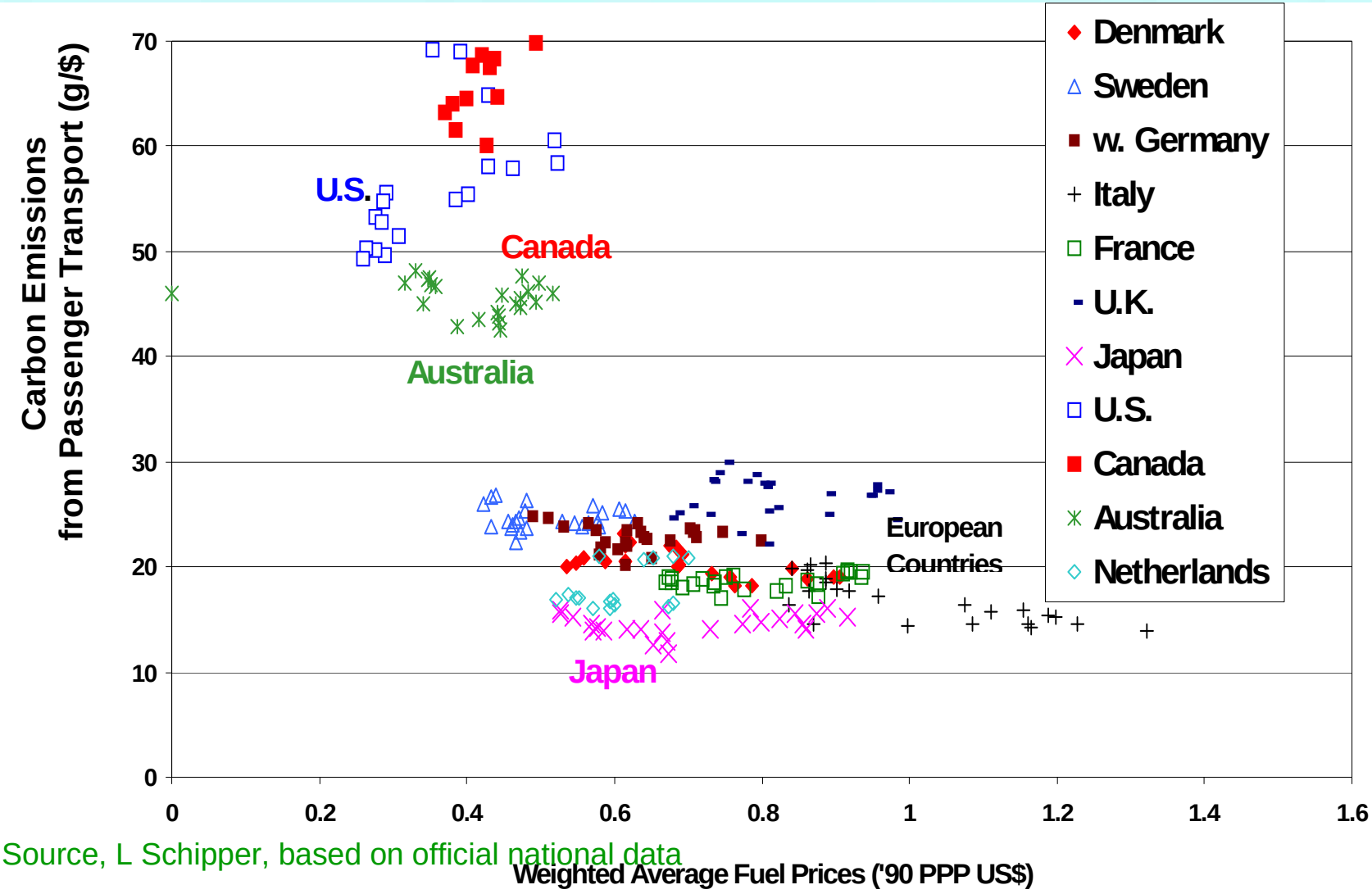

Test to On road: US, CA 1.18 X; Japan 1.33 X; Europe 1.1 X

# Prices and On-Road Fuel Economy 1990 and 2005



# CO2 Emissions from Cars and Fuel Prices 1970-1995

## Fuel Economy Accounts for 1/3 of the US/European Difference!




Source, L Schipper, based on official national data

# Econometric Study: Cross Sectional Times Series

- **Data**
  - US, Canada, Japan, Australia, 8 European countries 1970-1992
  - Stocks, distance/vehicle, stock fuel economy for gasoline, diesel LPG
  - Real prices and incomes measured in purchasing power parity
- **Results for Fuel Demand Synthesized from Six or More Models**
  - Strongly dependent on income (+1.2)
  - Negatively dependent on fuel price (-0.7) and non-fuel taxation (-0.11)
  - Strong negative dependence on population density (-1.0)
- **Interpretation for California**
  - Income elasticity should be lower as cars/driver is close to 1
  - VMT elasticity -0.3 large: higher density, more transit in Japan, EU
  - Indirect taxation of vehicles has only weak affect on fuel demand

*Would be Valuable to Repeat Analysis Including Impacts of More Recent Initiatives*

# Econometric Evidence

## Fuel Demand, VKT, fuel intensity, car ownership

### Johansson and Schipper , JTEP 1997

| Estimated component | Fuel price | Income | Taxation (other than fuel) | Population density |
|---|---|---|---|---|
| Car stock | -0.20 to 0.0<br>[-0.1] | 0.75 to 1.25<br>[1.0] | -0.08 to -0.04<br>[-0.06] | -0.7 to -0.2<br>**[-0.4]** |
| Mean fuel intensity | -0.45 to -0.35<br>**[-0.4]** | -0.6 to 0.0<br>**[0.0]** | -0.12 to -0.10<br>**[-0.11]** | -0.3 to -0.1<br>**[-0.2]** |
| Mean driving distance (per car per year) | -0.35 to -0.05<br>**[-0.2]** | -0.1 to 0.35<br>**[0.2]** | 0.04 to 0.12<br>**[0.06]** | -0.75 to 0.0<br>**[-0.4]** |
| Automobile fuel demand | -1.0 to -0.40<br>**[-0.7]** | 0.05 to 1.6<br>**[1.2]** | -0.16 to -0.02<br>**[-0.11]** | -1.75 to -0.3<br>**[-1.0]** |
| Automobile travel demand | -0.55 to -0.05 | 0.65 to 1.25 | -0.04 to 0.08 | -1.45 to -0.2 |

All fuels used for automobiles and light trucks
US, Canada, Australia, Japan and 8 EU Countries

# International Comparisons of Car Use: How Much does the Rubber Hit The Road

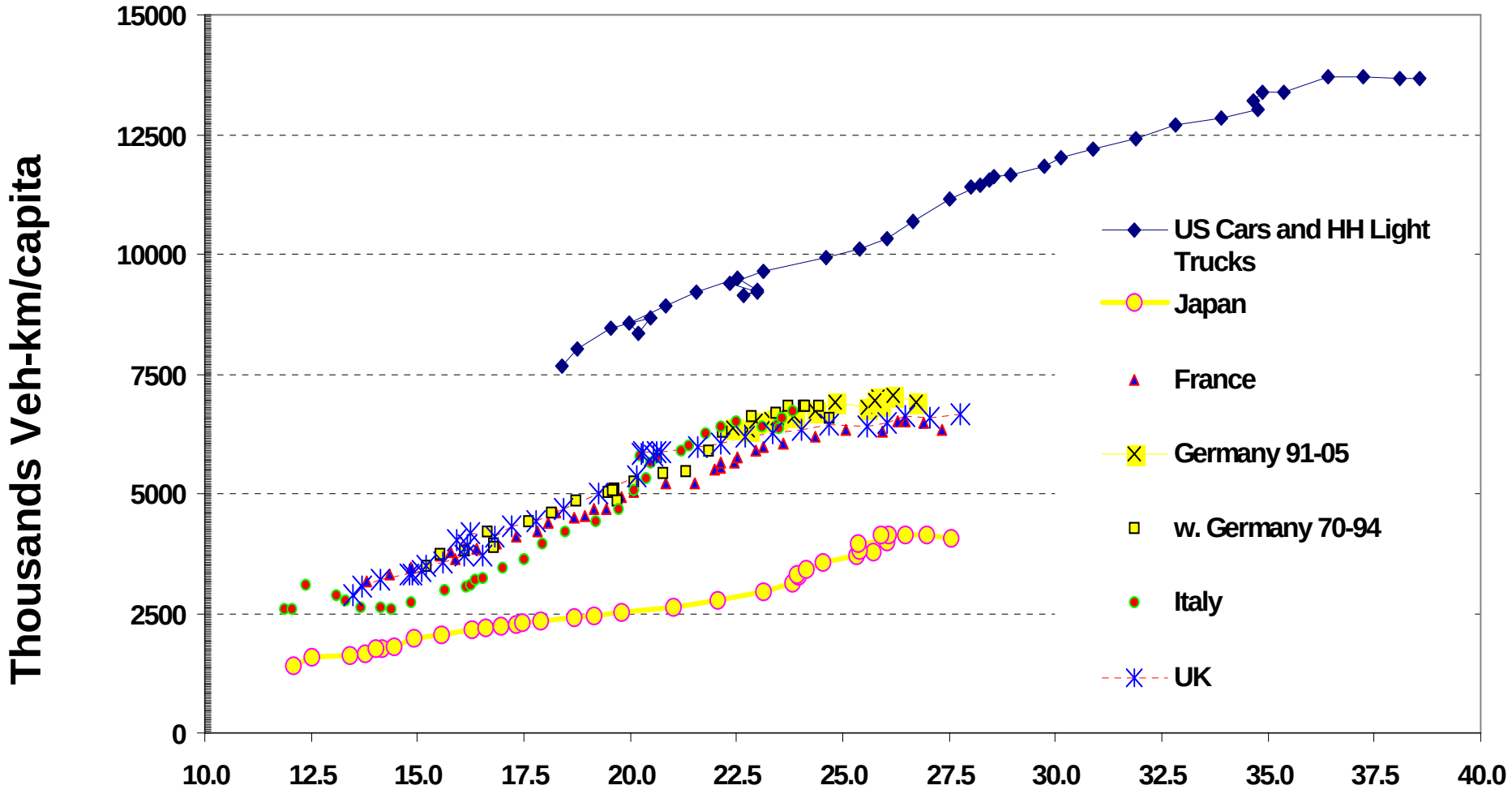
- **Car Ownership and Characteristics**
  - Depends on per capita income, but also new vehicle taxation
  - High fuel taxes moderate demand for power, weight, size
  - Ownership, size lowest in densest areas

- **Car Use – Far Less in Europe, Japan per unit of GDP than N America**
  - Car use/car highest in Europe where car ownership lowest
  - Car use stimulated by company car taxation, cheap diesel
  - Car use lower in densest, mostly centuries-old areas

- **Implications for California (where the Rebound Effect is Small)**
  - In 1990s, driving in CA per dollar of income well below US average
  - Shift taxation from fixed to variable costs?
  - Land use and population density clearly important: how to change?

*Car Use/Capita Explains 2/3 of US/Europe Difference in Emissions/Capita*

# Driving and Per Capita GDP 1970 -2005/6




Source, L Schipper,based on official national data

# Energy and Emissions From Transport
# The Hard Policy Lessons

- **Prices and Incomes Matter – in the Long Run**
  - Fuel economy and car characteristics related to fuel prices
  - Car use, power and size related to incomes and fuel prices
  - Fuel choice related to fuel prices, but cheap diesel has not helped much
- **Policies Matter**
  - Mandatory (US CAFÉ) worked, voluntary (Japan, EU) working now
  - Congestion pricing (Stockholm, London ), km-taxes restrain vehicle use
  - Urban transport policies with teeth matter
- **Boldness Matters**
  - If Americans could raise fuel prices and Germans could lower speed limits
  - If company cars, mortgage interest, diesel and ethanol tax treatment changed
  - If cars were taxed by footprint and use was taxed by distance and footprint
  - If global leaders embraced 4S – slow, safe, small and sustainable

# Energy and Emissions From Transport
# What California Could Do

- **Pricing – Raise Price of Using a Car**
  - Variable Cost Insurance -- #1
  - Congestion and peak pricing where warranted
  - Raise gasoline tax to finance transport locally
- **Revenue Neutral Carbon Tax**
  - Economy wide carbon tax w. lower sales taxes
  - Scare away fake biofuels
  - Urban transport policies with teeth matter
- **Then and Only Then**
  - Strengthened transit
  - Careful land-use controls, growth boundaries
  - Myriad of other measures that will matter more

***California Must Sharpen its Observations:***
***We Can't Master what we Can't Measure***

# Restraining Emissions Abroad
# What Can We Learn?

- **Careful Assessment of European Fuel Economy Trends**
  - What worked; Voluntary or mandatory?
  - What else helped?
  - What undermined them?
- **Other Incentives to Improve Fuel Economy**
  - Danish “Green Owner Fees”
  - UK Diesel Incentives
  - Stockholm Green Vehicle Program
- **Broader Efforts to Reduce Car Use**
  - Congestion pricing in London, Stockholm and ?
  - Careful land-use controls, growth boundaries in N. Europe
  - Measures that demonstrably raise share of transit, intercity rail, feet

***California Need Not Wait for the US:***
***Many Opportunities from International Experience***

# Thanks

Lee Schipper
schipper@berkeley.edu