



Fuel Economy Trends in Industrialized Countries When the Rubber Hits the Road



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Opinions strictly those of Dr. Schipper





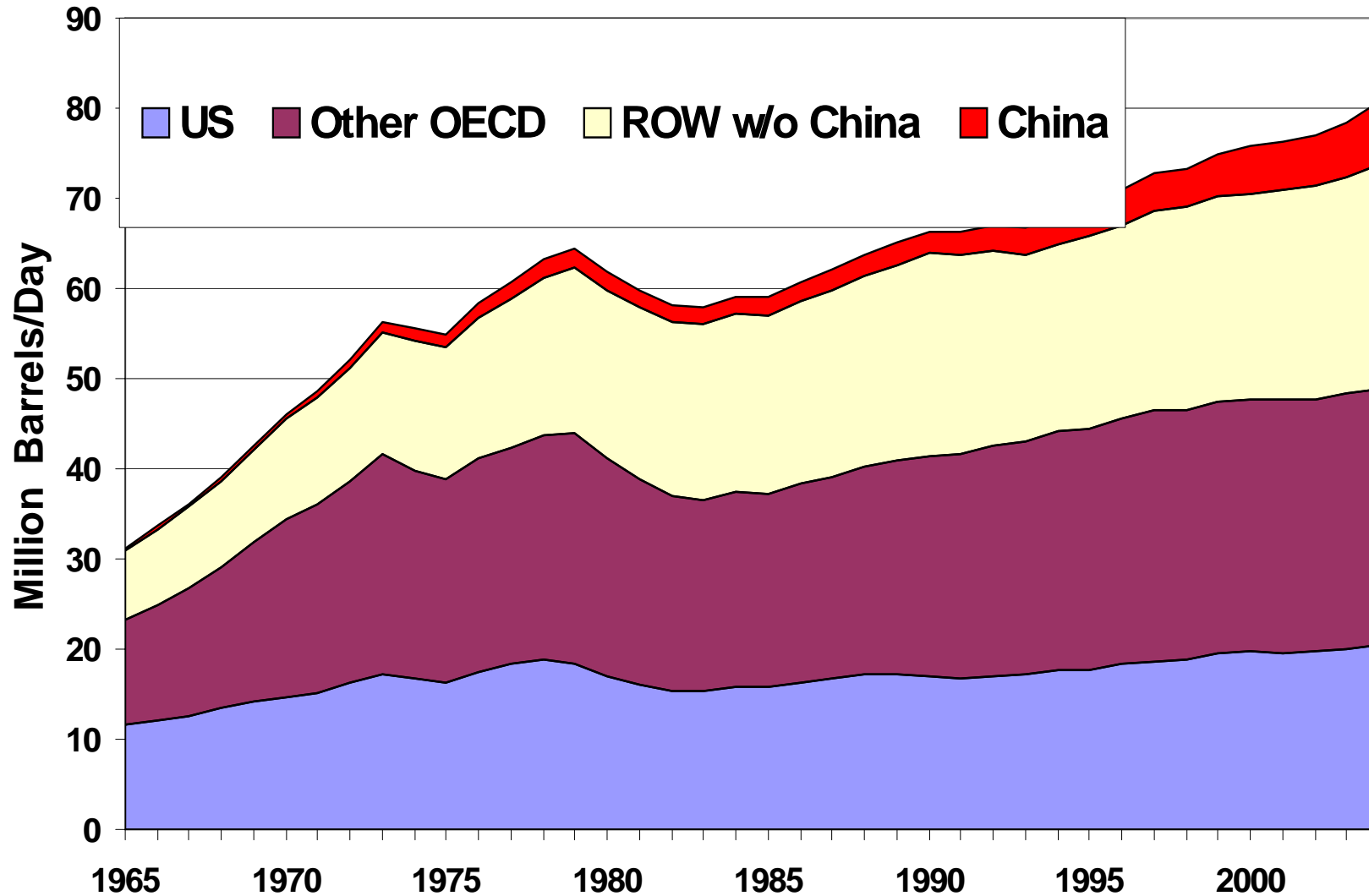
Global Carbon (and Oil) Problems

- **The US Is Still the Big Boy on the Block**
 - Most important oil user, GHG Emitter; also per capita or per GDP (PPP)
 - Oil worries might help or hinder CO2 worries
 - Little meaningful change under Bush - Backwards to the rear!
- **China, India, others – Unsustainable Transport**
 - Very low emissions per capita, but rising rapidly
 - Cities bogged down in impossible traffic and air pollution
 - CO2 not of interest there, but energy and transport woes important
- **The Global Nature – Savings Valuable World Wide**
 - Oil and CO2 are global and fungible – anywhere you save matters
 - Fuels, technology are global – for better or worse
 - Motor vehicles (and US/EU lifestyles) global – for better or worse

Are There Clean, Low CO2 Substitutes for \$130 Oil (>5 mn bbl/day) Except More Efficient Energy Use?

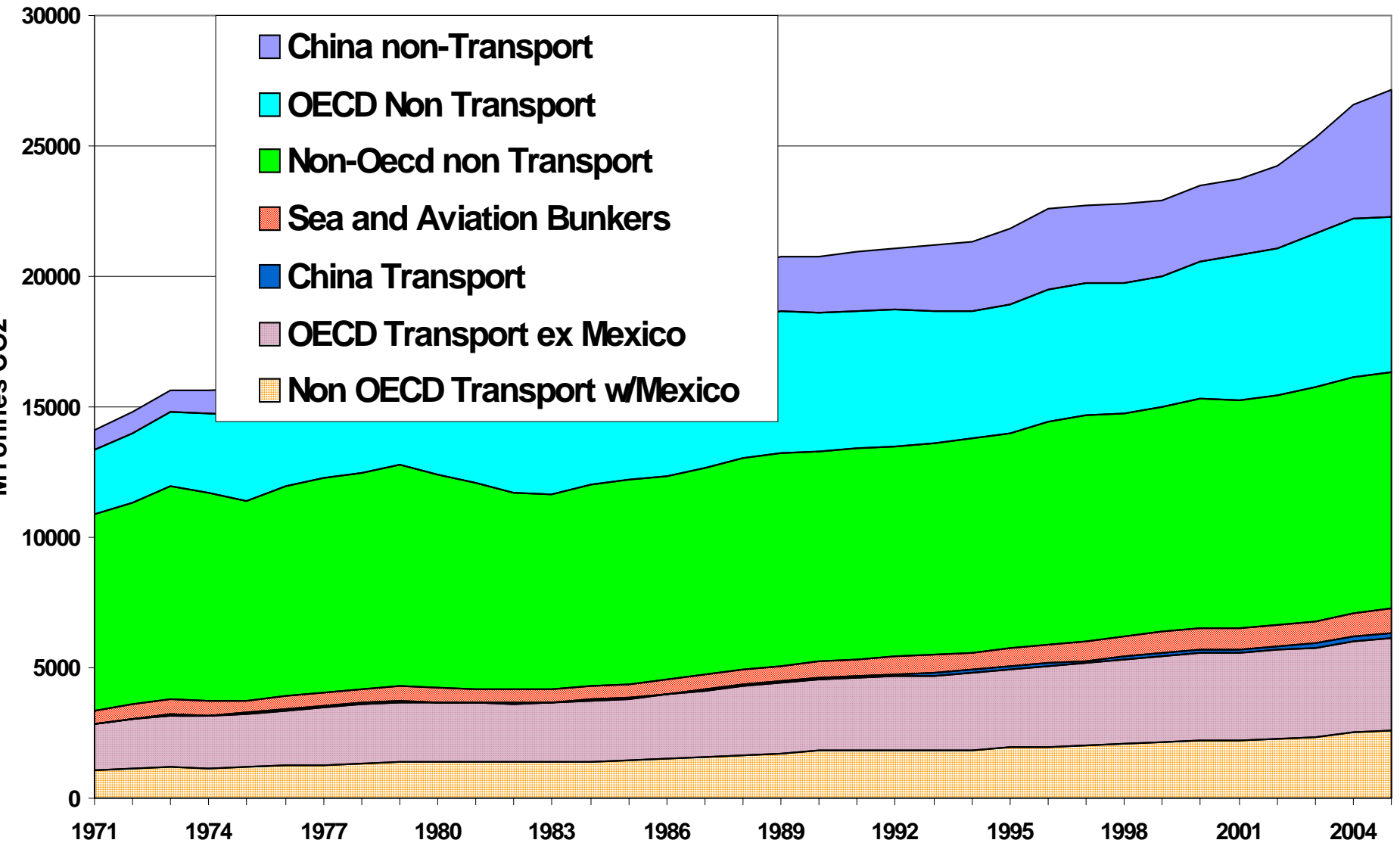
WORLD PRIMARY OIL USE, 1965-2004

(Source: BP)



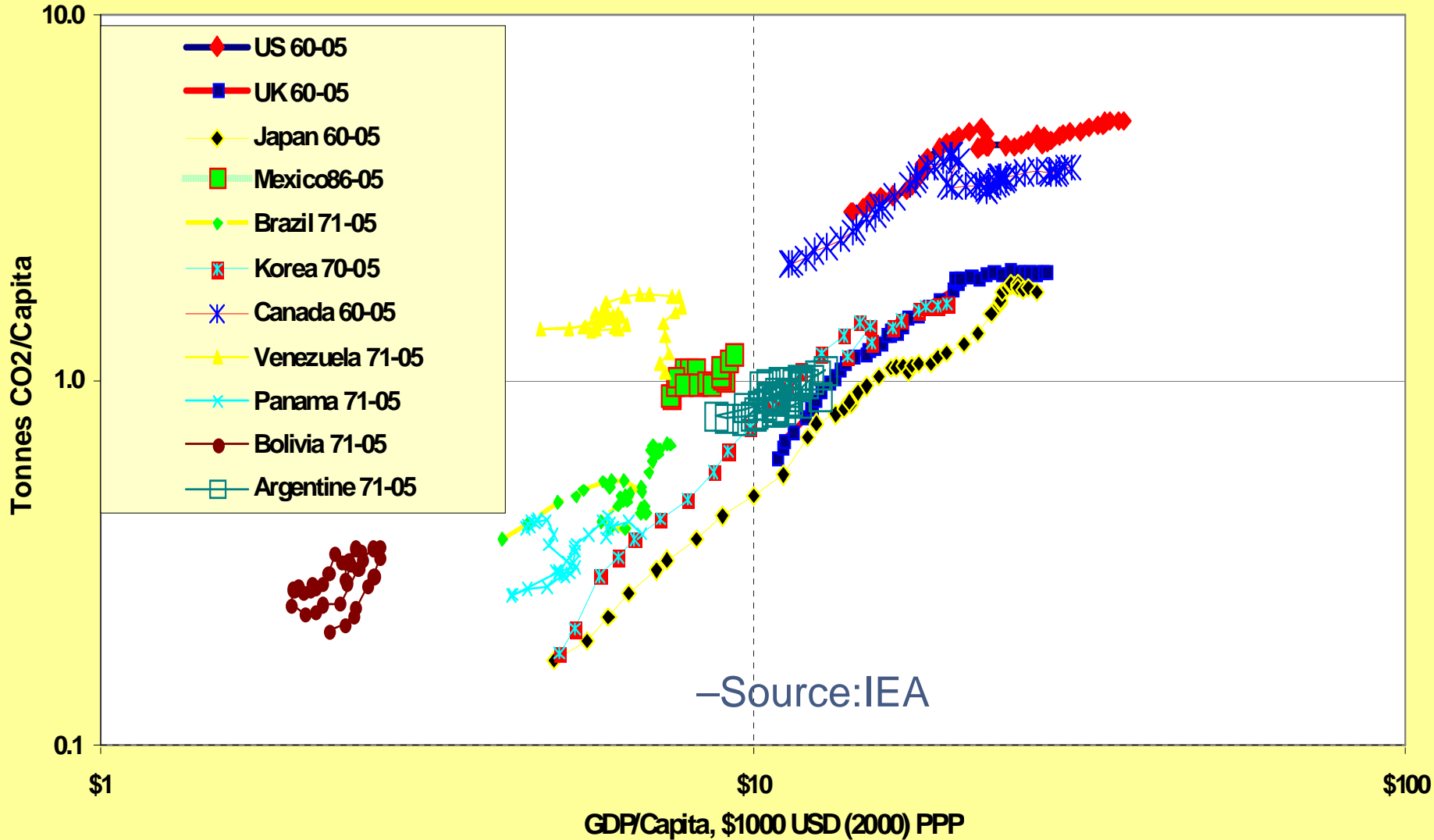
WORLD CARBON EMISSIONS: TRANSPORT

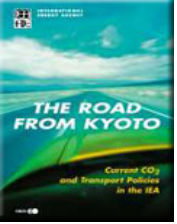
Roughly 35% of Transport Emissions in/around Cities



Oil or CO2 Emissions from Road Transport

Rising Income Leads to Slower Growth in Emissions





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

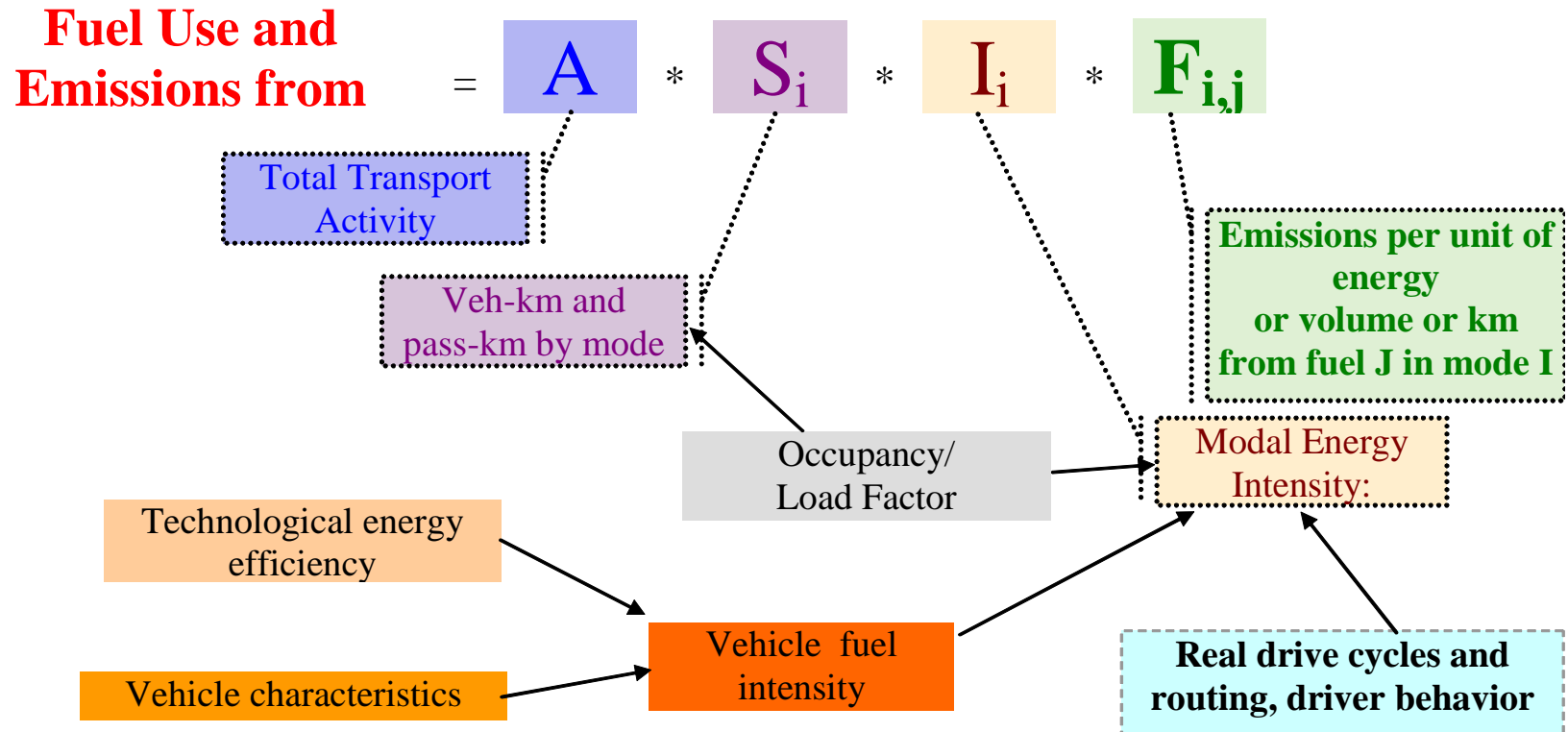
- **Potential Large, Progress Slow, Risks High**
 - Technology getting better there but economic signals still weak;
 - Political will missing in 2000, stronger now
 - Absence of meaningful initial progress in the US notable
- **Main Elements Still Important Today**
 - Transport sector reform as umbrella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

Oil and CO2 more important in 2008 than before: What are the next steps?

Integrated View of Transport Problems

The ASIF Decomposition for Fuel and Emissions

<http://www.iea.org/textbase/nppdf/free/2000/flex2000.pdf>



Lesson : Attack All Components of the Problem



Fuel Economy and Vehicle Use

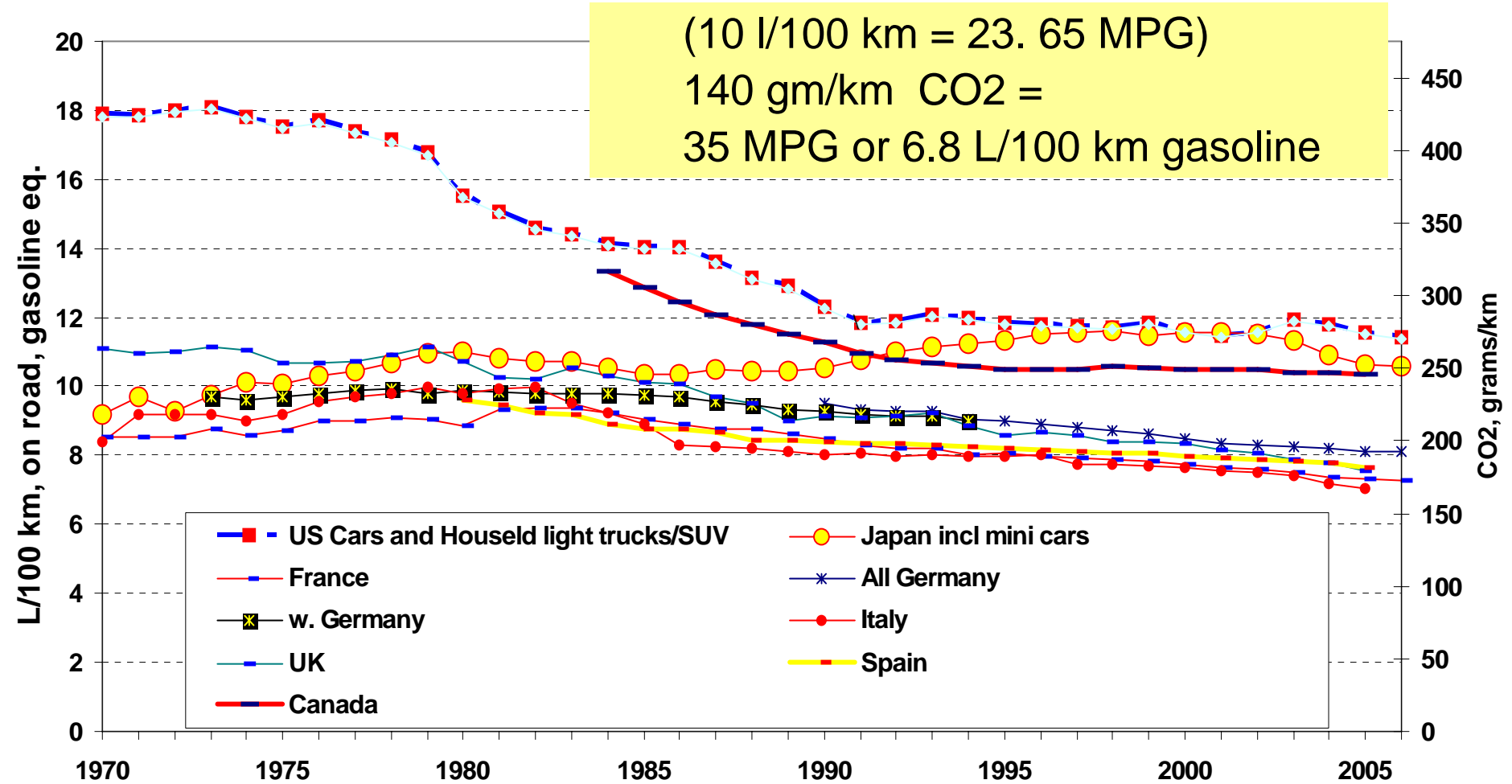
The Double Challenge

- **“I” “On Road” Fuel Intensity (20-25% Higher than “test”)**
 - US, (incl. 80% of light trucks), CDN well above Europe, slightly above Japan
 - US fell recently, Japan and Europe falling steadily
 - We don’t have a clue any more what US on-road fuel economy is
- **“I” New Car Test Fuel Economy- Size over Technology**
 - US new SUV fuel economy improving slowly, Japan and EU improving more
 - US cars bigger each year, Japan 1/3 mini cars, EU only slow increases
 - US passed new fuel economy standards – impacts uncertain
- **“AS” Vehicle Use (Falling in the US right now)**
 - Car use rising more slowly than previously as driving by incomes, sprawl, etc
 - US has no surveys left measuring car use accurately
 - Increased congestion worsening fuel economy, raising local air pollution

*EMBARQ Measurements in Istanbul Suggest
Poor Urban Traffic adds >50% to Fuel Use*

Real Automobile Fuel Intensity – All Fuels

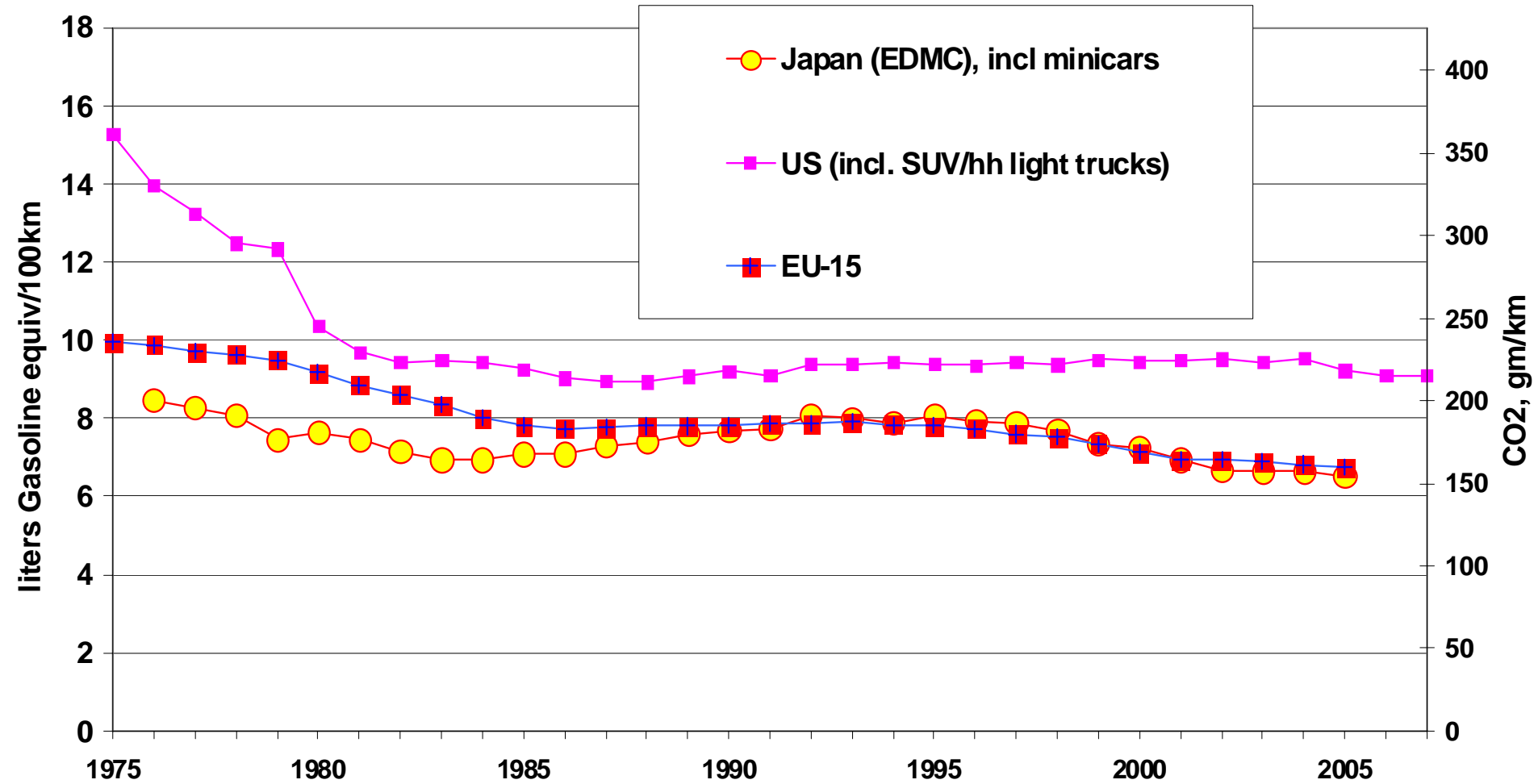
When the Rubber Hits The Road



Diesel and LPG converted to equivalent gasoline on an energy content basis.
Source, L Schipper, based on official national data

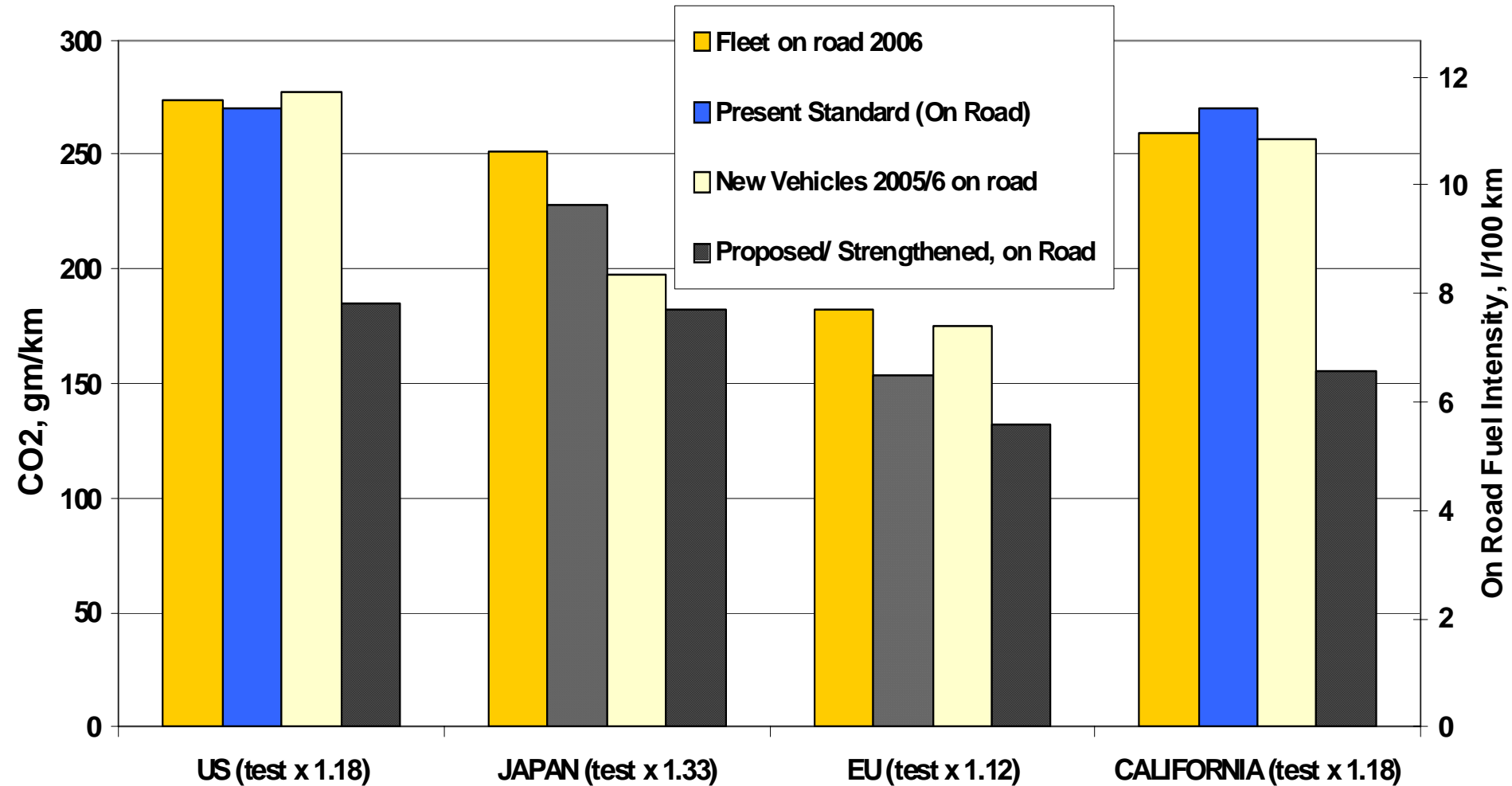
Trends in New Car Fuel Intensity

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

New Vehicle Fuel Economy Standards and Targets: Converted to Estimated “On Road” Values



Saving Emissions From Transport – Three Parts to Technology

- Traditional Technology – 40-60 MPG or 2.5-4 l/100km?
 - Less power, lighter materials, lower drag, CVT, cold cylinders
 - Gasoline or clean diesel hybrids
 - End to the power and weight chase?
- Other Approaches - Cost, Time to Deploy
 - City cars vs. long distance cars?
 - Plug in hybrids – most driving is for local, short trips
 - Fuel cells? Many cost, feedstock, materials challenges
- Alternative or Bio-Fuels – What are They Worth?
 - US Corn ethanol a dead end, other biofuels increasingly uncertain
 - True low carbon fuels not here, won't arrive under present policies
 - Non-oil always possible, but always expensive and higher CO2



*Should the Government Pick Winners like Today
Or Declare Losers (Oil, CO2 Tax)?*

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 more powerful than gasoline equivalent, buyers choose bigger cars
 - Liter of diesel has 12% more energy, 18% more CO2 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”)

*Drive Down Costs and Drive up Emissions:
Subsidizing “Winners” Rarely Pays*

Dieselization in Europe

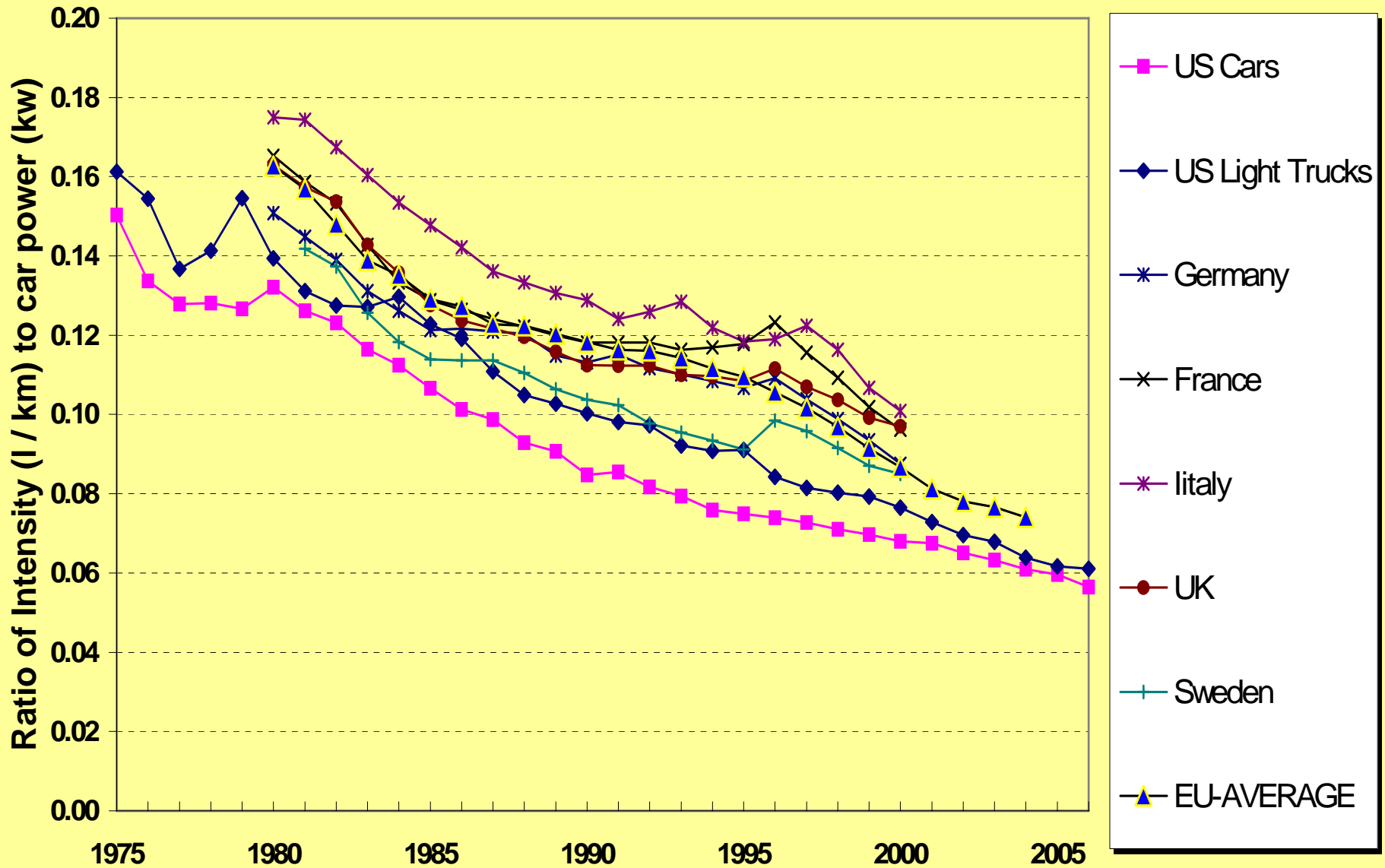
At Best Small Impact: At Worse, Backfire

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

		France		Germany	
		1995	2006	1995	2006
New Diesels					
Share of Sales	%	46.5%	69.2%	14.6%	44.2%
Test Fuel Economy	L/100 km	6.60	5.60	6.5	6.59
Relative to gasoline	%	88.0%	82.4%	85.5%	89.0%
Rel. to gasoline, CO2/km	%	104%	97%	101%	105%
Stock of Diesels					
		26.5%	46.6%	13.7%	20.0%
Share of Stock	%	6.2%	46.6%	13.7%	21.9%
Yearly Distance	KM/ car	15,704	16,736	17,980	20,034
Distance, Rel. to Gasoline	%	130%	164%	144%	191%
On Road Fuel Economy					
Fuel Economy	l/100 km	6.67	6.43	7.47	6.90
Relative to gasoline	%	78.6%	83.9%	81.7%	81.7%
Rel. to gasoline, CO2/km	%	92.7%	99.0%	96.4%	98.4%
COMBINED FLEET FUEL ECONOMY		8.05	7.33	9.00	8.09



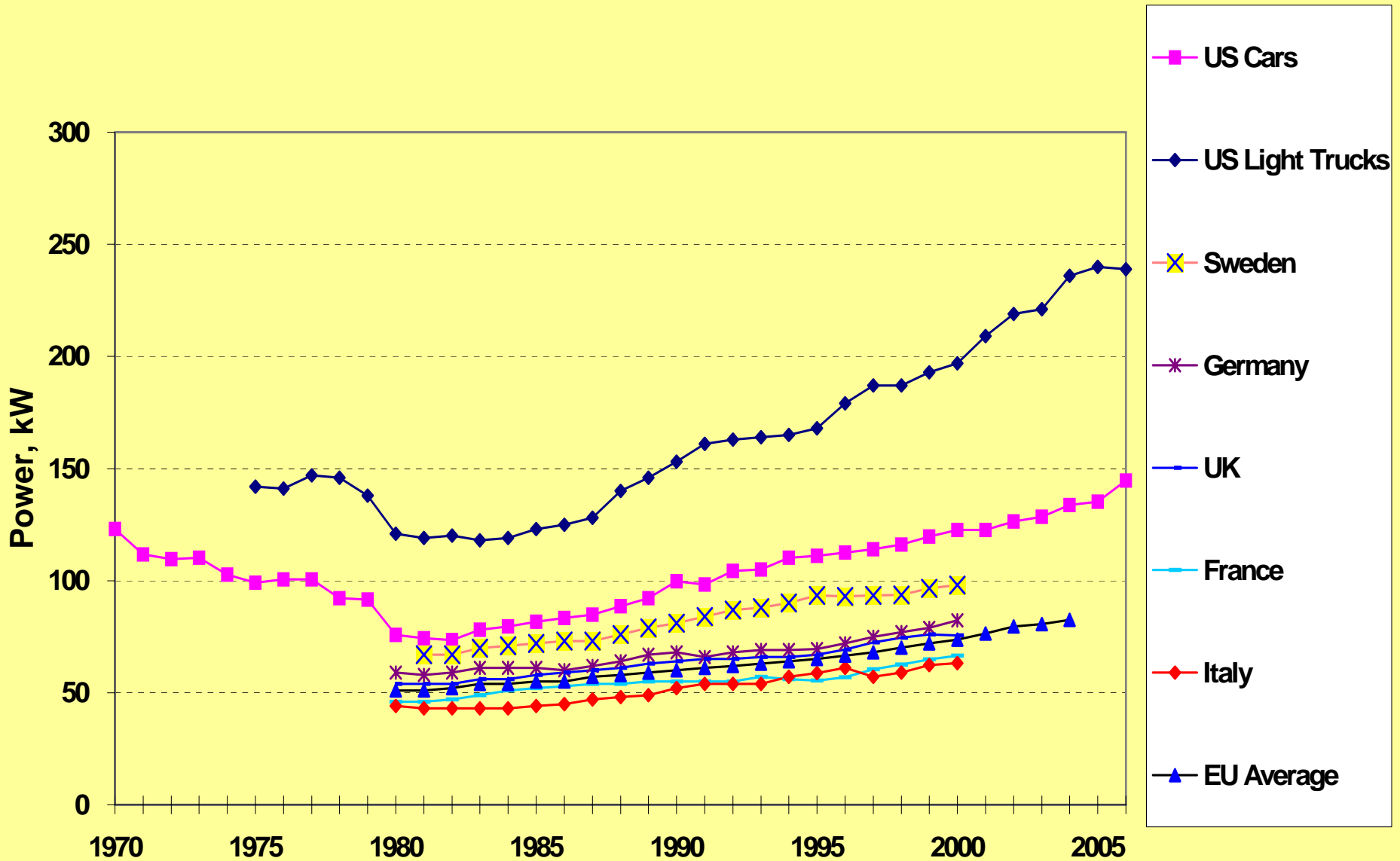
“Efficiency” Improving Everywhere





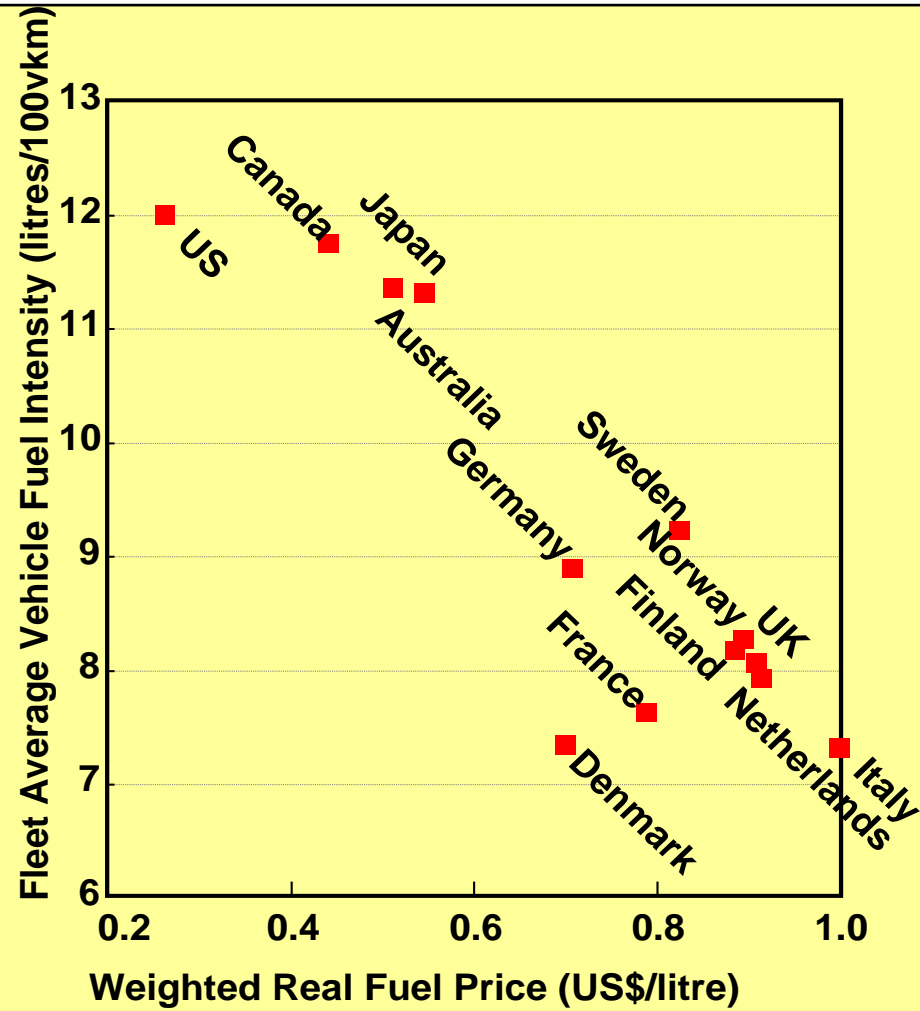
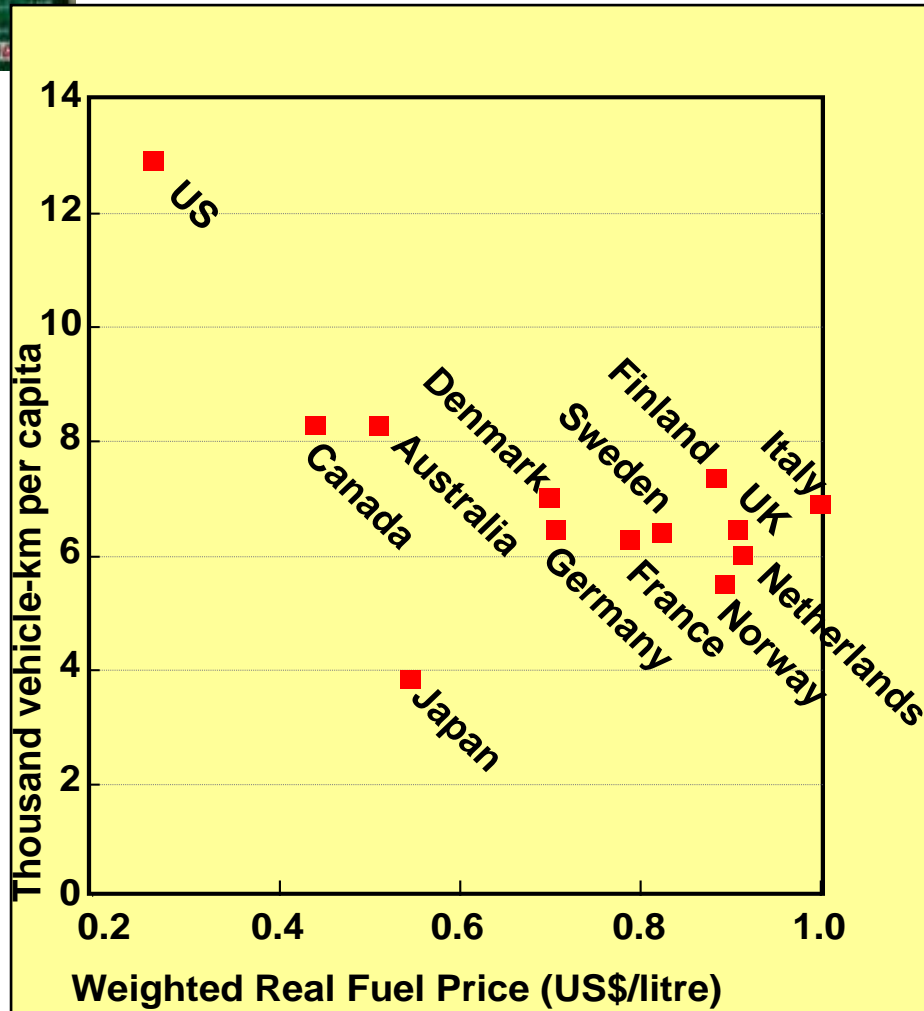
Efficiency Only Feeding Pep

Zip (power/weight) and Weight Look the Same



Car Use, Fuel Intensity vs. Fuel Price, 1998

Source IEA- See also Johansson and Schipper 1997 JTEP (SJ)



JS (1997)- Overall Price elasticity of car fuel close to -1: Mostly Fuel Economy, 0.3 VKT, -0.1 ownership

Econometric Study: Cross Sectional Times Series

(Johansson and Schipper *JTEP* Sept 1997)

• 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 Models

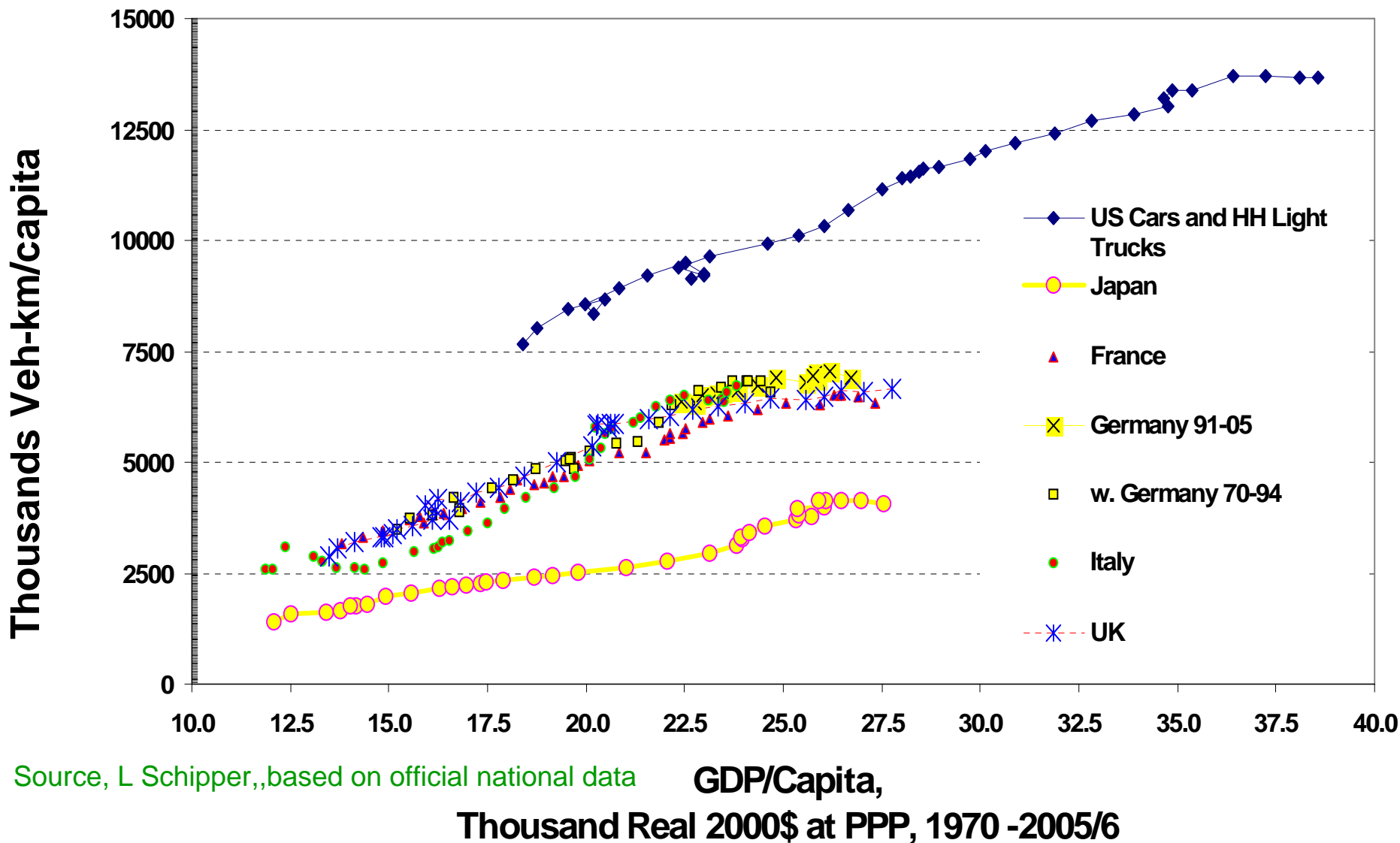
- Strongly dependent on income (+1.2) but value falls as car ownership rises
- Negatively dependent on fuel price (-0.7) and non-fuel taxation (-0.11)
- Strong negative dependence on population density (-1.0)

• Interpretation for Canada

- Income elasticity should be lower as cars/driver is close to 1
- VMT elasticity -0.2 large: Fewer modal choices than in EU, Japan
- Present high prices create huge opportunity

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

Driving and Per Capita GDP 1970 -2005/6



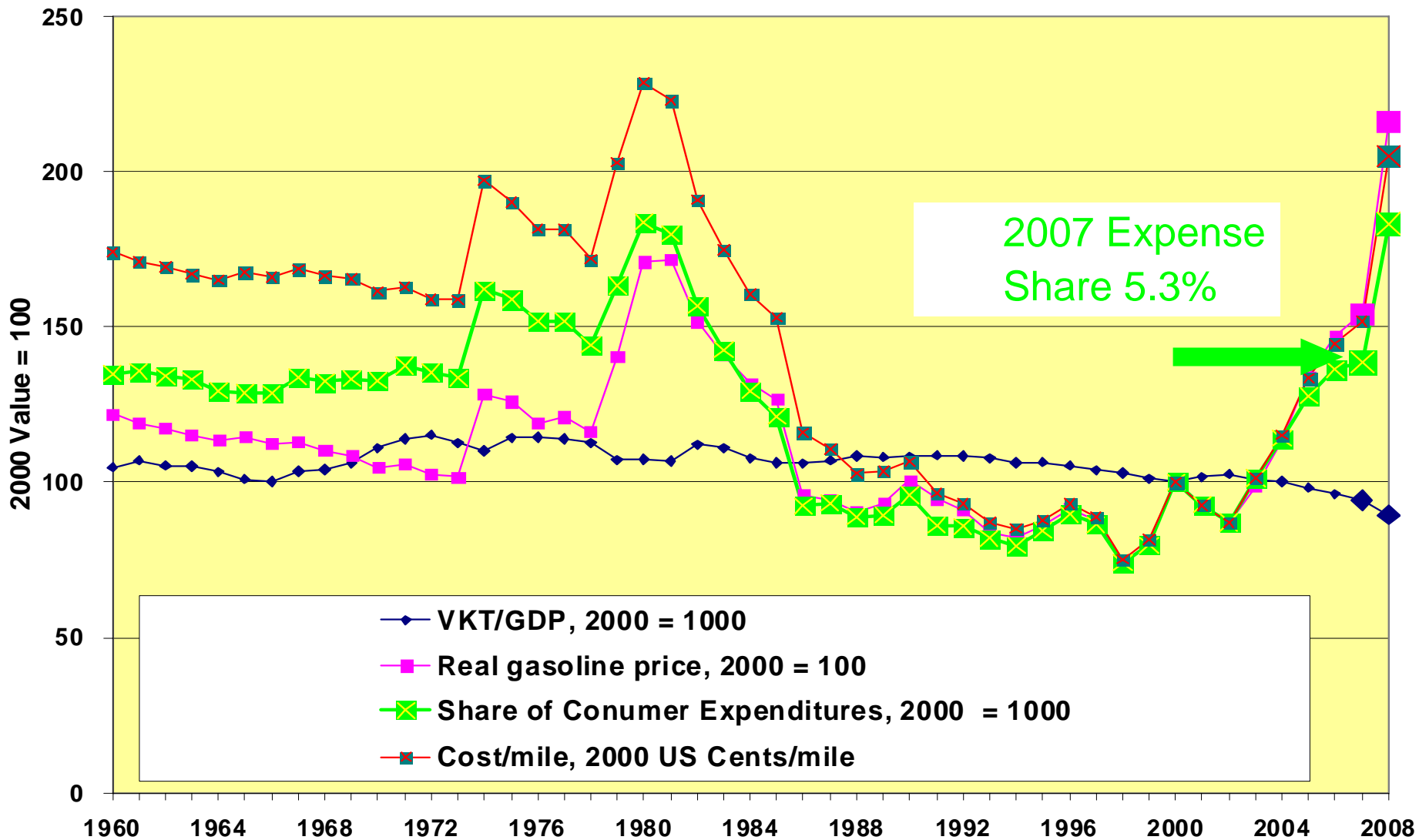
US Car and Fuel Use Trends

Why So Little Change in Fuel Use in Short Term

- **Short Term Price Elasticity of Vehicle Use**
 - Van Dender and Small – Price Elasticity < -0.1 (aka rebound effect)
 - Present fuel cost/km, fuel cost share of consumption approaching 1981/2 peak
 - Still, Veh-km/GDP off its historical growth (below elasticity of +1)
- **Little Short Term Change in New Vehicle Fuel Economy**
 - Present fuel price close to equilibrium with CAFÉ standard?
 - Car producers have not had time to really bring efficiency on to market
 - Consumers value power/weight/features more than saved fuel
- **Additional Factors**
 - Fuel economy not offered as “feature” until hybrids appeared
 - Americans are wealthy – can afford even today’s fuel prices?
 - American car buyers, car market stuck in large car rut?

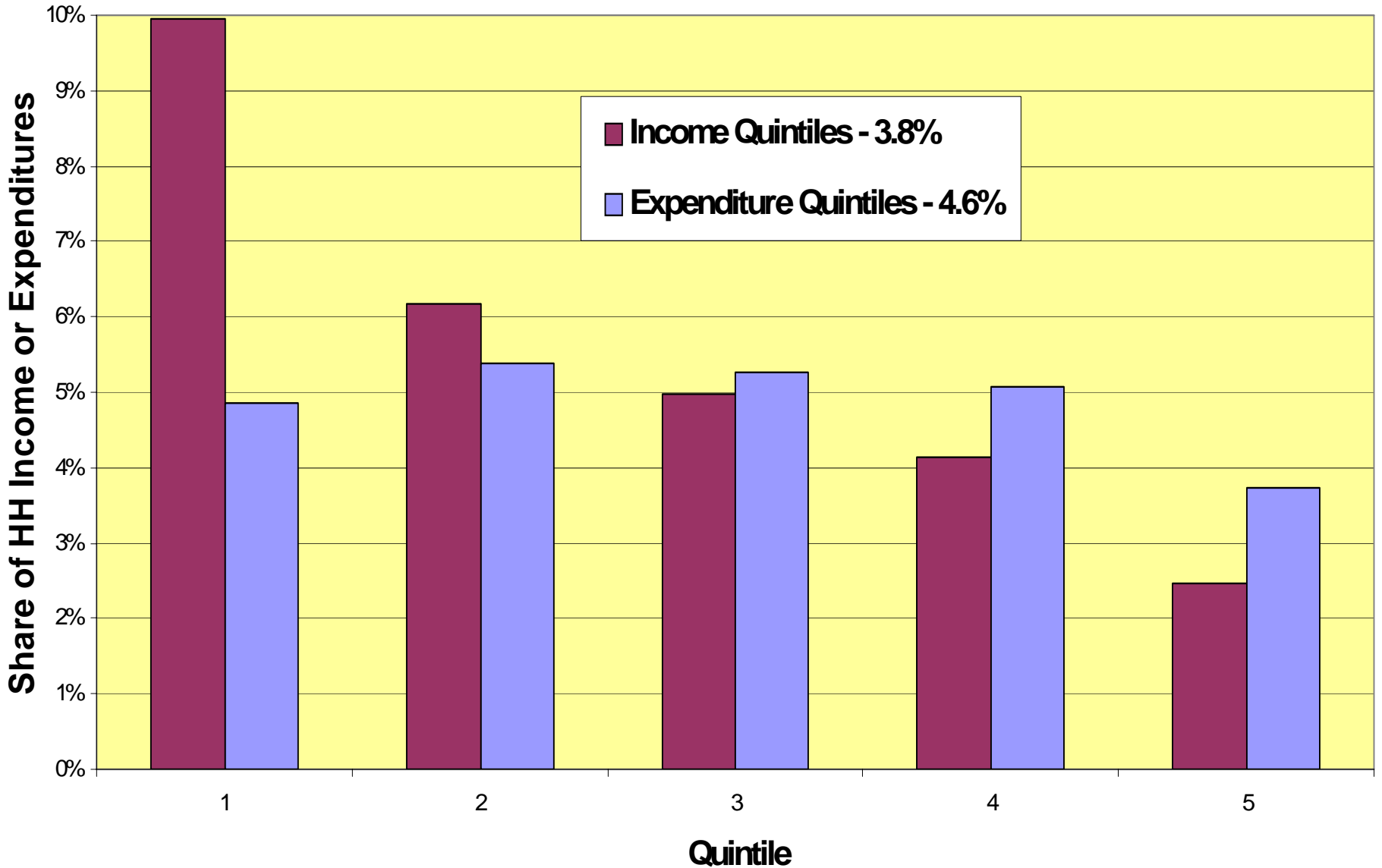
*Public Policy Issue – Should We
Force Ourselves to Changes Car Buying Habits?*

Car and Personal Truck VKT/GDP And Fuel Cost Back to the Future: 2008 Approaching 1980-82 1960-2006 (2007-8 est)



US Gasoline Expenditures in 2006 Compared with Income or Total Expenditures

Source 2006 Consumer Expenditure Survey



Reducing Car Use: Necessary? Desirable? Possible?

- **Reducing Car Use Necessary**
 - Efficiency, low carbon, low oil fuels insufficient quick reaction
 - Efficiency kicks in too slowly to mitigate oil dangers in short run
 - Reduced use contributes to cleaner air, lower congestion
- **Reduced Car Use Desirable? By How Much**
 - Economics – car use under-priced and distorted
 - PAYD insurance, shifting some fuel taxes to km taxes
 - Raising cost of using cars politically difficult
- **Reduced Car Use -- Possible**
 - US travel patterns show considerably flexibility
 - Aging of boomers might lead to lower car use
 - Impact of information vs travel small so far, could grow

*Balance of US and Local Policies Has Increased Car Use
Need to Re-examine Land Use and Transport Policies*

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
- **Policies Matter, Like Them or Not**
 - Mandatory (US CAFÉ) worked, voluntary (Japan, EU) working now
 - Congestion pricing, km-taxes do restrain individual vehicle use
 - Urban transport policies with teeth matter
- **Transport Policy Matters Even More**
 - Strong urban transport policies/congestion pricing reduce car use
 - Better inter-modal facilities reduce car use, delays,
 - Better traffic management/congestion pricing reduces idling fuel losses

*As Much as High Fuel Prices Hurt Some
They Are Causing Unimagined Changes*

Reducing Emissions from More Sustainable Transport

- **The New Model - Small, Slow, Safe, and Sustainable**
 - For OECD, car-flation (power, size, speed) must stop
 - For clogged cities, strong measures to slow car use
 - For developing countries, radical change before it is too late?
- **Political Will**
 - Acceptance by all parties of higher fuel prices, carbon taxes, standards
 - Embed car fuel economy in wider transport reforms
 - Buy-in from the car industry
- **Patience from All**
 - Careful monitoring to measure slow but steady progress
 - Lowering of expectations of what cars should be
 - Prepare for stronger measures if first steps falter

*The Transformation of the Automobile Will Take Decades
We Need to Start Now*

Reducing Emissions

Important Research for Better Policy

- **Monitoring**
 - Clear picture of vehicle use, fuel economy, emissions
 - Who moves, how, from where, to where?
 - Freight flows as well
- **Political and Economic Issues**
 - Alleviation of access difficulties of the poor
 - Understanding of the ongoing 50-year fight over energy
 - Future of car industry in a CO2 constrained world
- **Long Term Global Transport Policies**
 - Land use and NIMBY – Who is really in control?
 - Low impact communities- do they work?
 - New paradigm for Developing World (EMBARQ)

The US Has A lot of Homework to Do

Conclusions: The Slow Path

• Fuel Economy Trends

- On road F.E. improving in Europe, Japan, and finally (slowly) in the US
- New US Standards will bring us in 2030-35 to present EU levels!
- Weight, power increases must stop for meaningful improvements

• Vehicle Use - on the Table?

- Car use fell with higher prices – but much more VMT to be saved
- Increasing congestion talking a small toll in higher fuel use
- Future of car use depends on transport policies, not CO2 policies alone

• Policies

- As painful as it seems, higher fuel prices working a transformation
- CAFÉ standards due for a tightening now, not in 30 years
- Get subsidies and “incentives” out before backfires hurt

The US Has A lot of Homework to Do

Thank You

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<http://www.wri.org/press/2007/12/proposed-fuel-efficiency-standards-small-welcome-step-says-new-wri-report>

Car that absorbs its own carbon?

