



**THE WRI CENTER FOR SUSTAINABLE TRANSPORT**

## ***Improving Vehicle Fuel Economy We Can't Master what We Can't Measure***

***<http://pdf.wri.org/automobile-fuel-economy-co2-industrialized-countries.pdf>***

***Lee Schipper, Ph.D.  
EMBARQ, the WRI Center for Sustainable Transport  
Washington DC, USA***

***Visiting Scholar,  
Univ. of California Transport Center  
Berkeley CA 94707 USA***

# EMBARQ

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- Established as a unique center within World Resources Institute in 2002, *EMBARQ* is now the hub of a network of centers for sustainable transport in developing countries.
- A catalyst for socially, financially, and environmentally sound solutions to the problems of urban mobility
- Shell Foundation and Caterpillar Foundation are *EMBARQ*'s Global Strategic Partners, supporting *EMBARQ* projects worldwide
- Additional *EMBARQ* supporters include
  - Hewlett Foundation
  - Netherlands Ministry of Foreign Affairs
  - BP
  - Ford Motor Company
  - US AID
  - Asian Development Bank
  - Energy Foundation
  - Blue Moon Fund
  - US Environmental Protection Agency
  - Japan International Transport Institute





# Global Carbon (and Oil) Problems

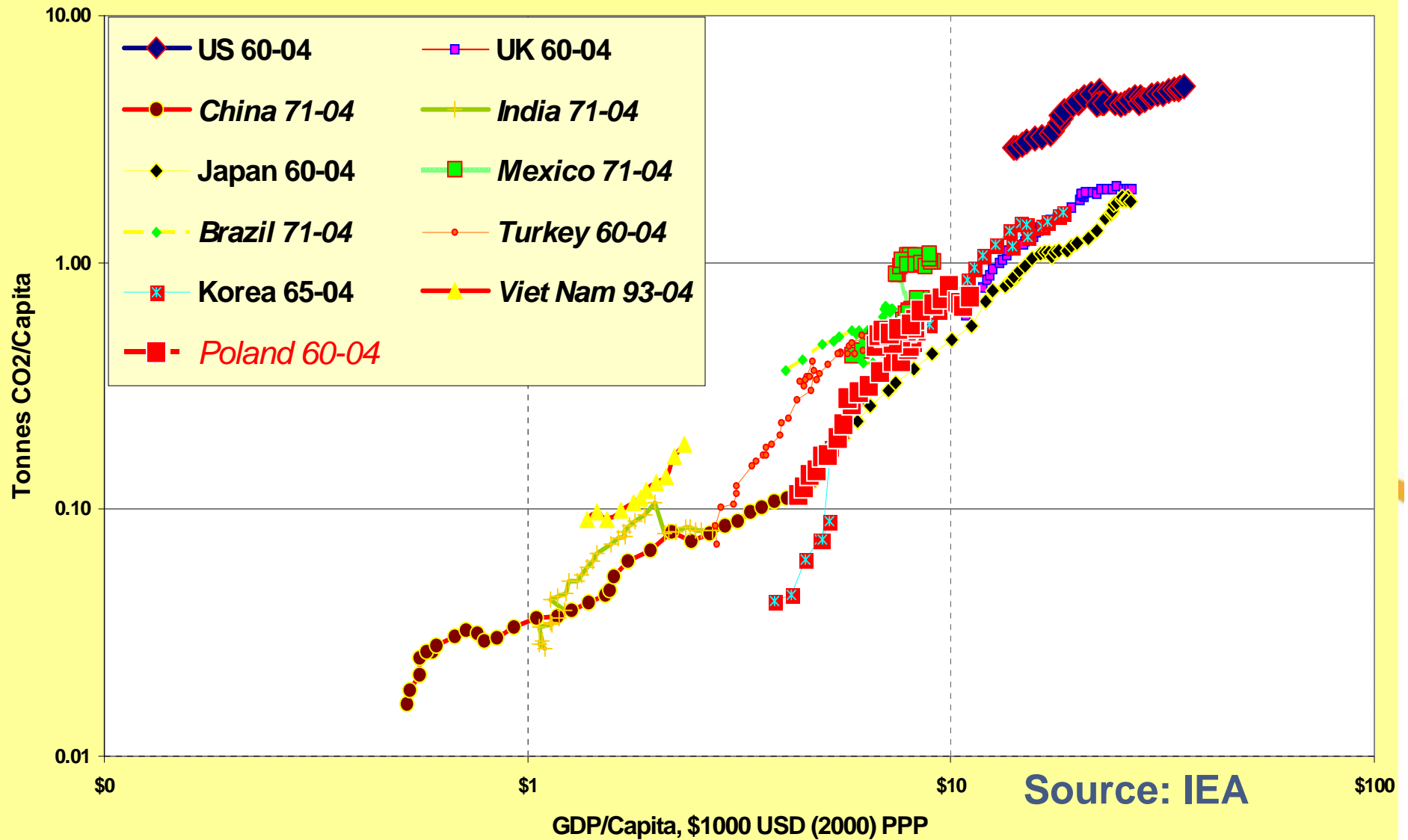
- **The US Is Still the Big Boy on the Block**
  - Most important oil user, GHG Emitter; also per capita or per GDP (PPP)
  - Oil worries might help or hinder CO2 worries
  - Little meaningful change under Bush until 2007 Energy Bill forced on him!
- **China, India and others – Unsustainable Transport**
  - Very low emissions per capita, but rising rapidly
  - Cities bogged down in impossible traffic and air pollution
  - CO2 not interesting, 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

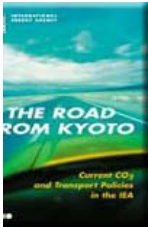
*We Cannot Master or Manage What We Can't Measure:  
In Transport it's the Blind Leading the Blind in the US and  
most of the Developing World*

# CO2 Emissions from Road Transport

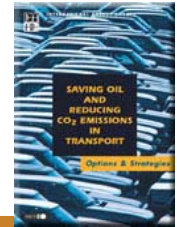
1960s or 1970s to 2004, vs GDP

(roughly 60% is around cities)





# “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 on car fuel economy important
  - Fuel pricing also important (except US, which is in reverse)
- **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 2007 than before: What are the next steps?*

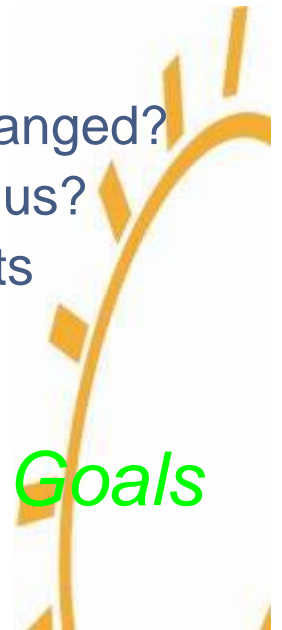


# Why Indicators for Transport?

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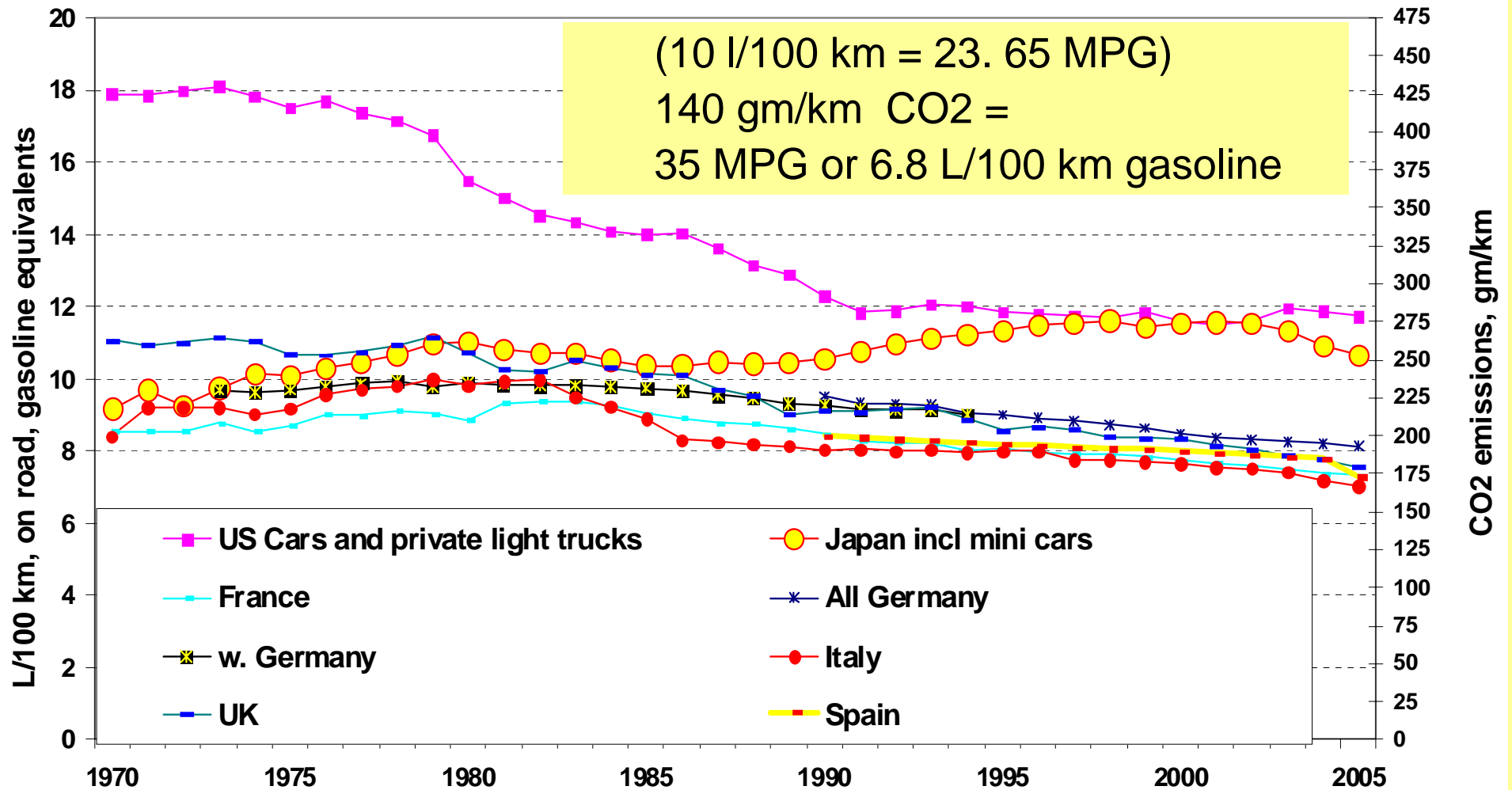
- Define the Scope of the “Problem”
  - Traditional transport externalities – accidents, congestion, noise
  - Oil, CO2, local pollution?
  - Map problems into solutions
- Estimate the Costs of Solving the Problem
  - Traditional economic approach – models, elasticities, etc
  - Technical bottom up approach – what does a widget cost
  - “ASIF” approach – what stimuli change which components of ASIF?
- Estimate Progress Towards Solutions
  - How much has fuel economy, other ASIF components changed?
  - What was the role of a particular policy, technology, stimulus?
  - Observe rebound effects, other perverse or masking effects

*Indicators provide Links Between  
CO2/Oil Mitigation and other Transport Policy Goals*



# Real Automobile Fuel Intensity – All Fuels

## Stuck in the US; Falling in Europe, Japan



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

# Dieselization in Europe

At Best Small Impact: At Worse, a Boomerang

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

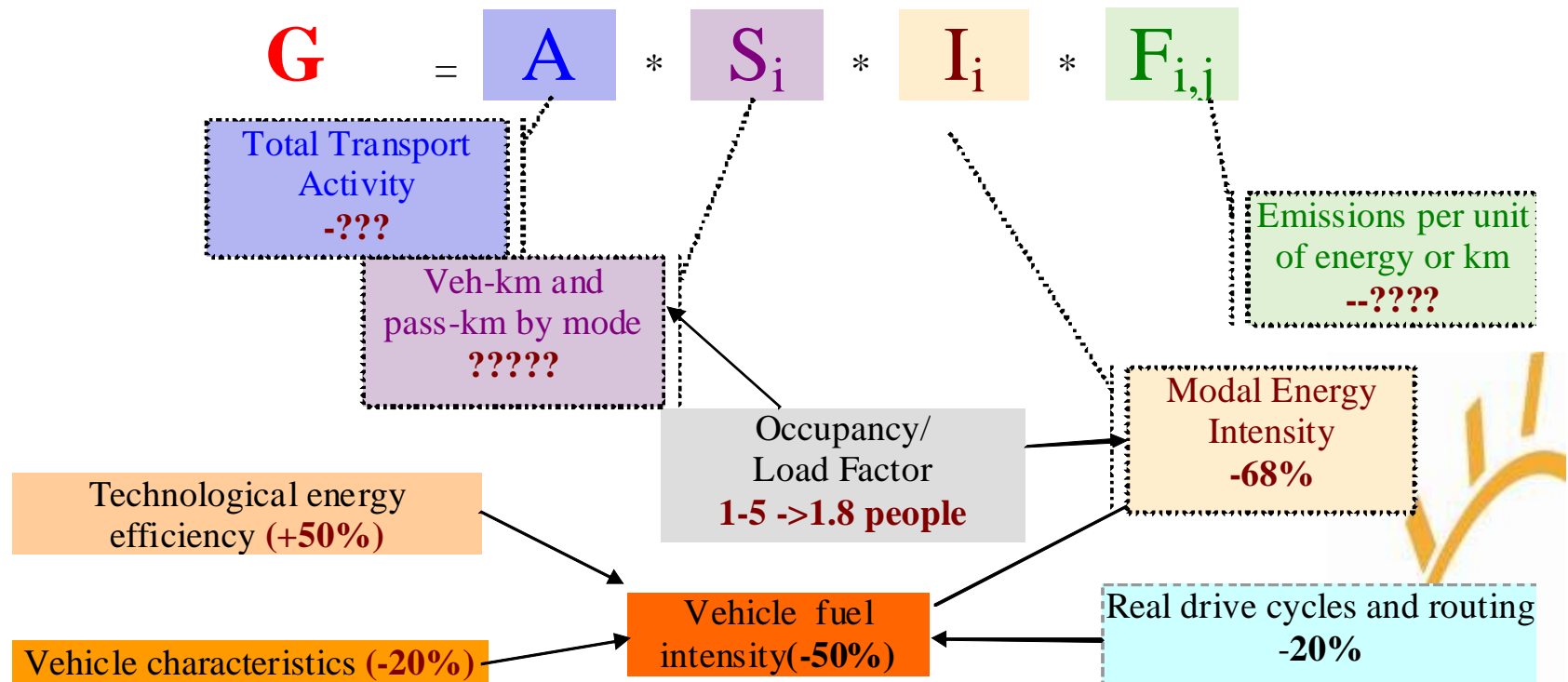
		France		Germany	
		1995	2005	1995	2005
<b>New Diesels</b>					
Share of Sales	%	46.5%	69.1%	14.6%	42.6%
Test Fuel Economy	L/100 km	6.60	5.60	6.5	6.511
Relative to gasoline	%	88.0%	83.6%	85.5%	86.4%
Rel. to gasoline, CO2/km	%	104%	99%	101%	102%
<b>Stock of Diesels</b>					
Share of Stock	%	26.5%	46.6%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

# Integrated View of Transport Problems

## The ASIF Decomposition

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

### Fuel Use and Emissions from



Lesson : Attack All Components of the Problem,

Not just fuel economy

# Bean Counting and Politicking

## Ground Rules and Lexicon

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- **Key Words Almost Always Mis-Used**

- Fuel Intensity or Emissions Intensity - Always per kilometer
- New Vehicle must say test, or new vehicle sales weighted average
- “Fleet” or “Stock” -- reserved for all vehicles, on-road (“in-use”)

- **Key Concepts All too Easily Forgotten**

- The test/on-road (in-use) gap and stock turnover lag time
- Fuel economy standards take years to reach full impact on fleet
- Fuel pricing also important (except US, which subsidizes)

- **Things to Remember when the Rubber Hits the Road**

- Emissions are on-road intensity times distance
- Distances driven, traffic conditions must be kept in mind (and in excel)
- Weight, power, features soak up technological improvements

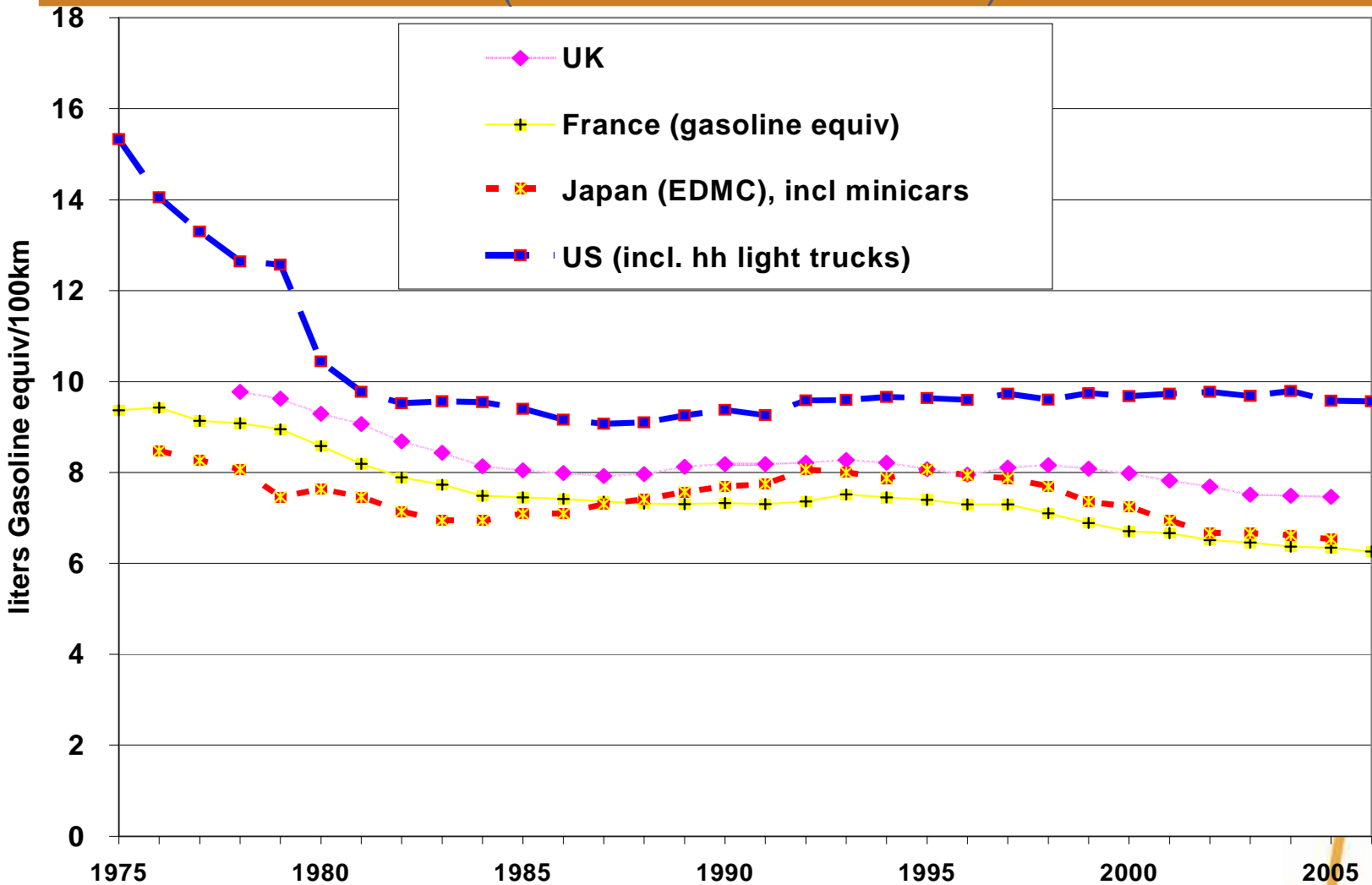
When Journalists and Politicians are Bedazzled, Confused  
Support for Fuel Economy Standards, Higher Fuel Prices in  
Danger



# Trends in New Car Fuel Intensity

Sales Weighted Tests of New Vehicles by Year

(10 l/100 km = 23.65 MPG)



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

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

# Fuel Economy and Vehicle Use

## The Full Set of Indicators

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### “On Road” Fuel Intensity (10-25% Higher than “test”)

- US (incl. 80% of light trucks) well above Europe, slightly above Japan
- US steady, Japan and Europe falling slowly
- Developing world – no data, but affected by horrible traffic

### New Car Test Fuel Economy- Size over Technology

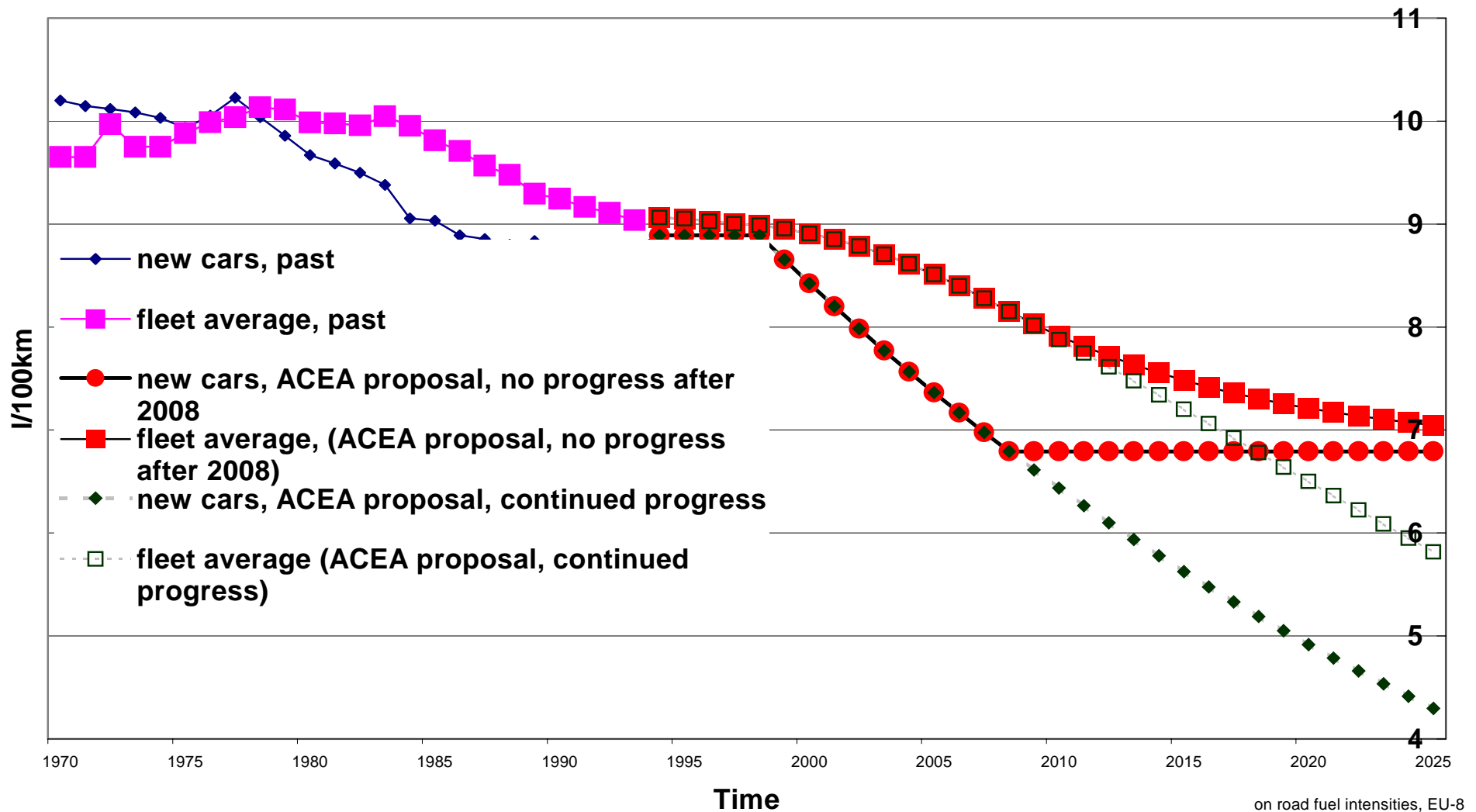
- US new car, fuel economy flat, Japan and EU improving slowly
- US cars bigger each year, Japan 1/3 mini cars, EU only slow increases
- Developing world unknown, but worsened by horrible traffic

### Other Indicators

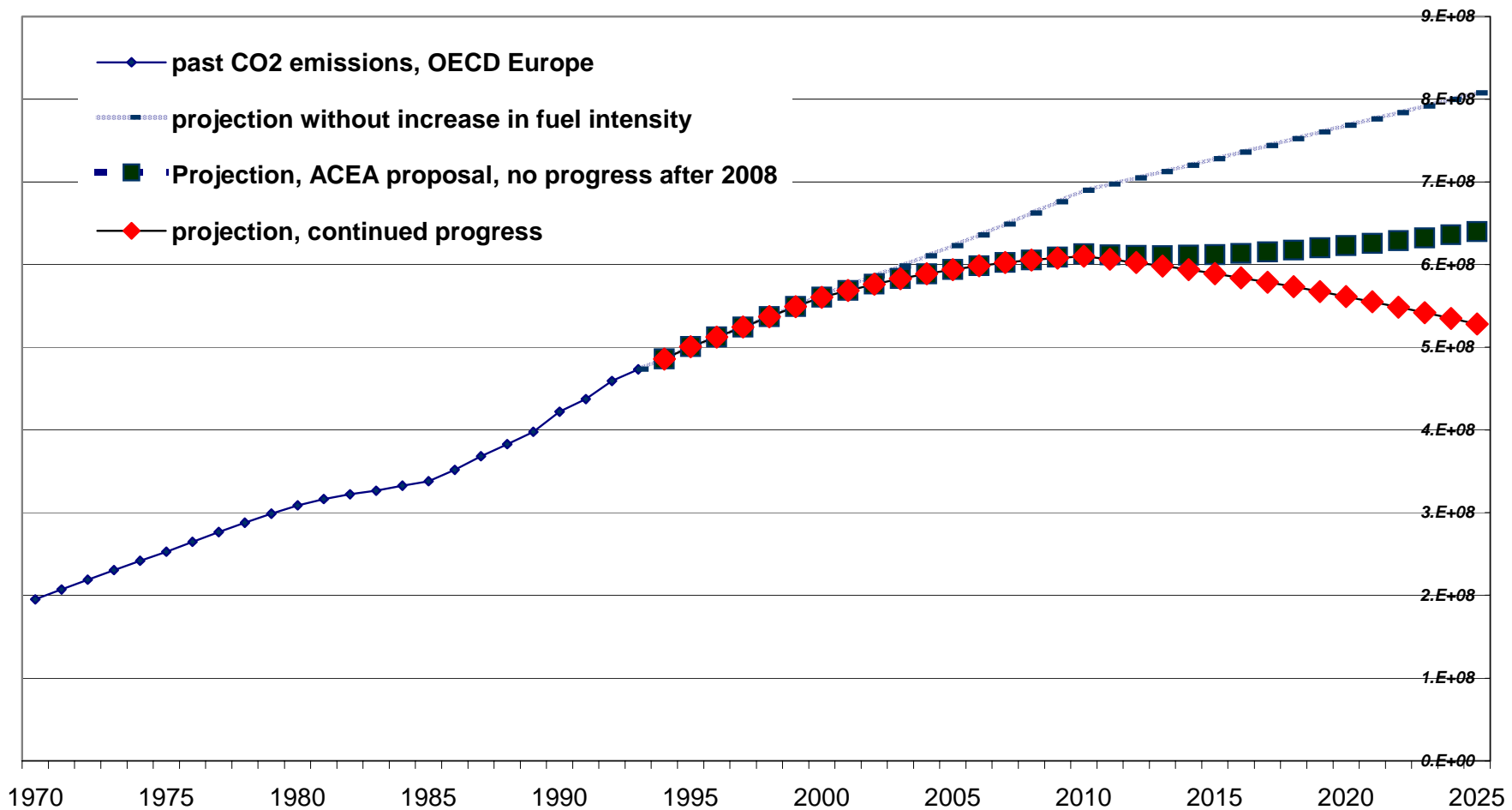
- New vehicle test -> on the road, not theoretical test elsewhere
- Track car usage (rising slowly), new car size, weight
- Socioeconomic variables of ownership, usage, location

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

# Changes in New Car Fuel Economy are Slow Changes in the Impact on the Fleet are Slower



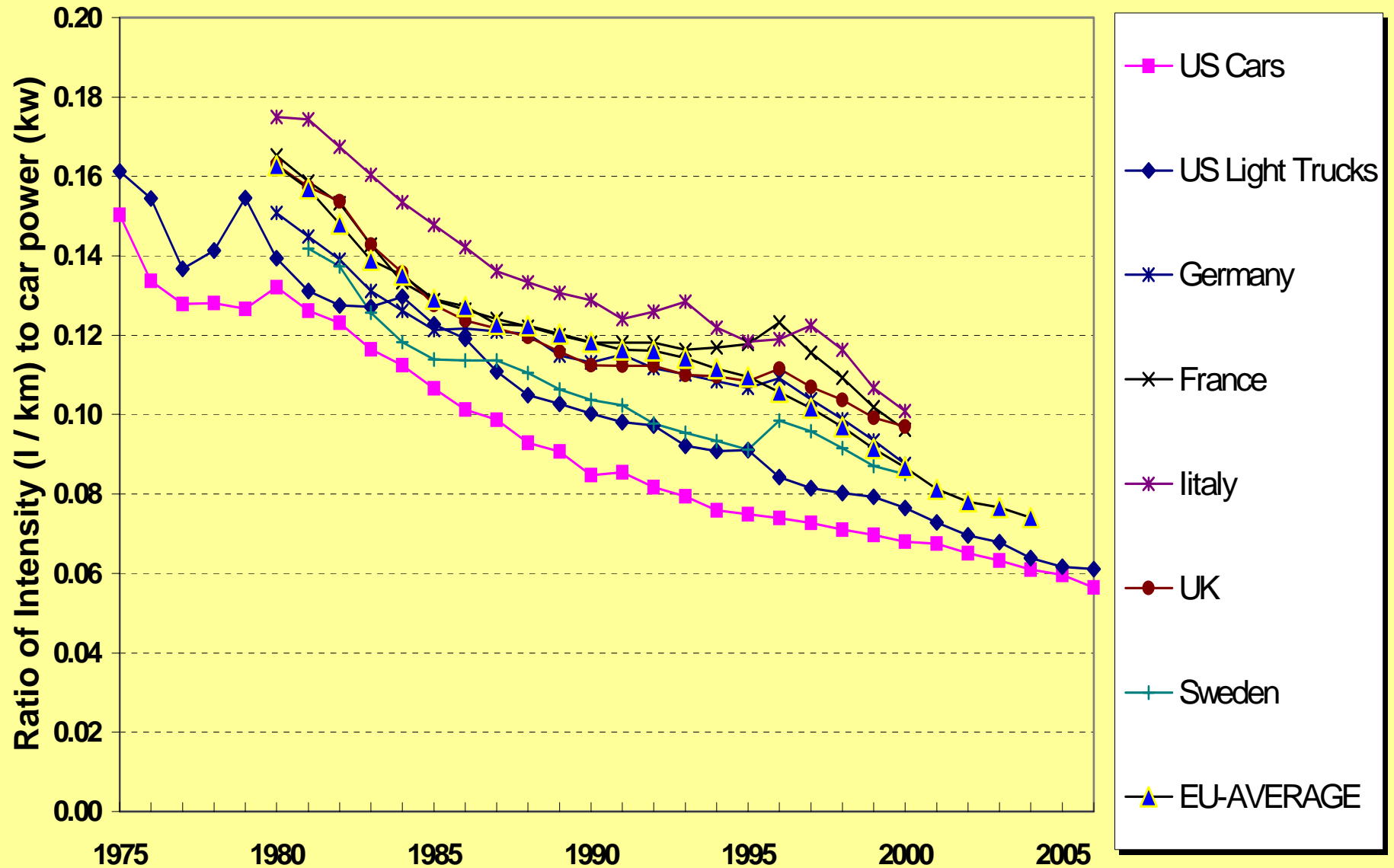
# Changes in Overall Emissions Even Slower as Stock and Driving Grow



Tonnes Co2



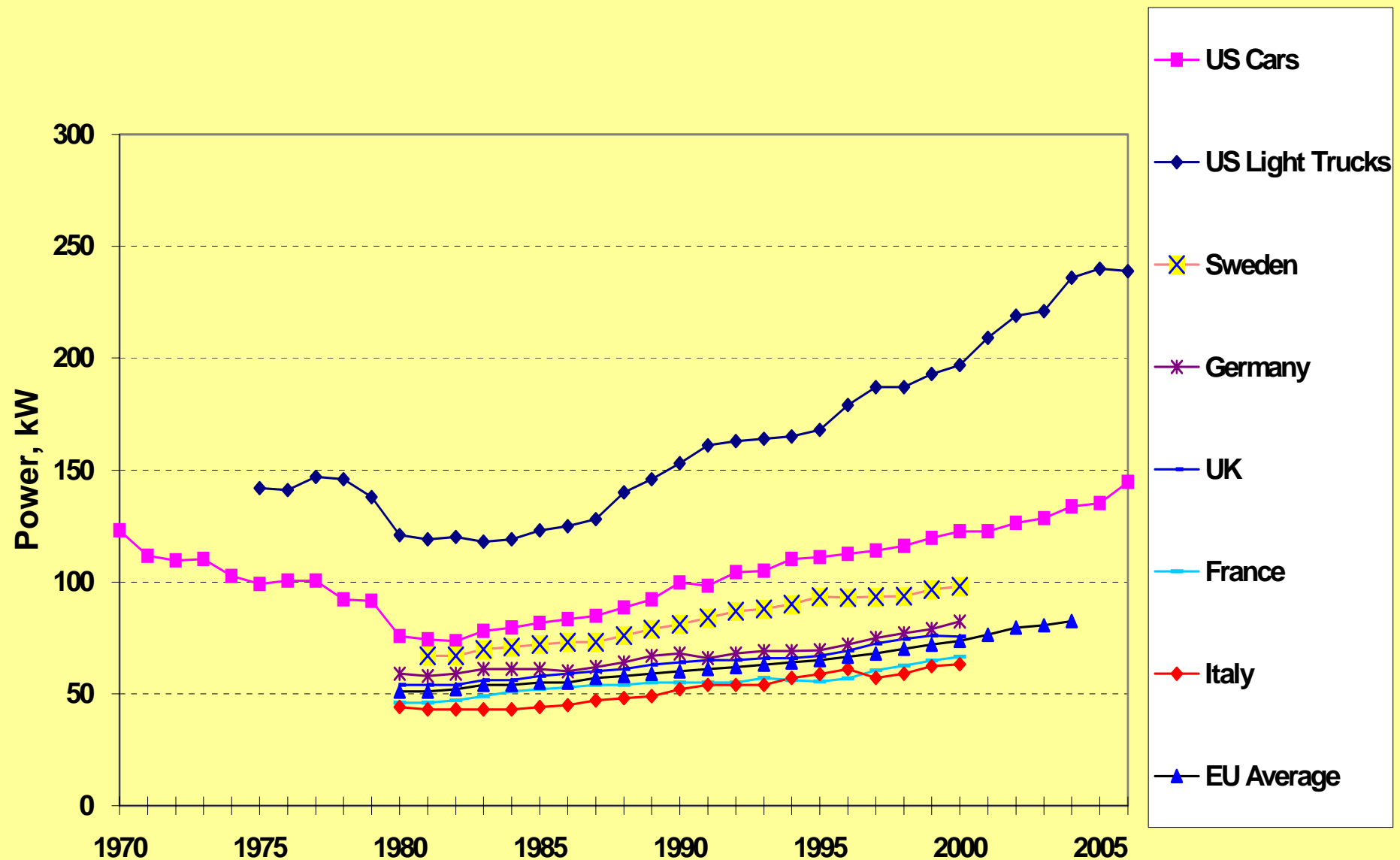
# “Efficiency” Improving Everywhere





# Efficiency Only Feeding Pep

Zip (power/weight) and Weight Look the Same



# Energy and Emissions From Transport – We Don't Know What We Need to Know

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## • Vehicles, Vehicle Use and Vehicle Users

- Travel surveys helpful, but vehicle surveys lacking – need both
- The “L”s; Links between land use, location, lifestyles and vehicle use
- Where are vehicles used?

## • Key Uncertainties for IEA Countries

- Nature of test/on road gap – traffic, driving behavior, or poor test?
- Impact of accessories
- Impact of boutique or serious alternative fuels on fuel economy

## • Additional Uncertainties for Developing Countries

- Parameters of vehicle use, fuel use, traffic, etc.
- Real impact of legal and illegal used imports (“chocolates”), inc. N Zealand
- Technology in developing vs developed countries – is there a gap?

# Developing Fuel Economy Standards – We Don't Know What We Need to Know

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## • Present Patterns of Ownership and Use

- Distinguish private from company cars, taxis
- Understand present and future driving cycles as traffic worsens
- Understand driving forces – fuel and vehicle taxes, company car policies, etc

## • Measuring Impact of Standards- No Small Feat

- Establish present on road fuel use and yearly utilization
- Estimate counterfactual no standards case with growth size/power
- Foresee loopholes (used cars, etc) – which form of standards best?

## • Additional Ideas for Developing Countries

- Establish vehicle use/fuel consumption surveys (like AUS)
- Make sure vehicles registered every year
- Don't abandon other modes for cars!

# Developing Country Issues – Everything

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## • Huge Uncertainties

- Number of active cars +/-25% (use imports, smuggled, inactive cars)
- Fuel use (smuggled or adulterated fuel, other uses of same fuel)
- Distances traveled/driven

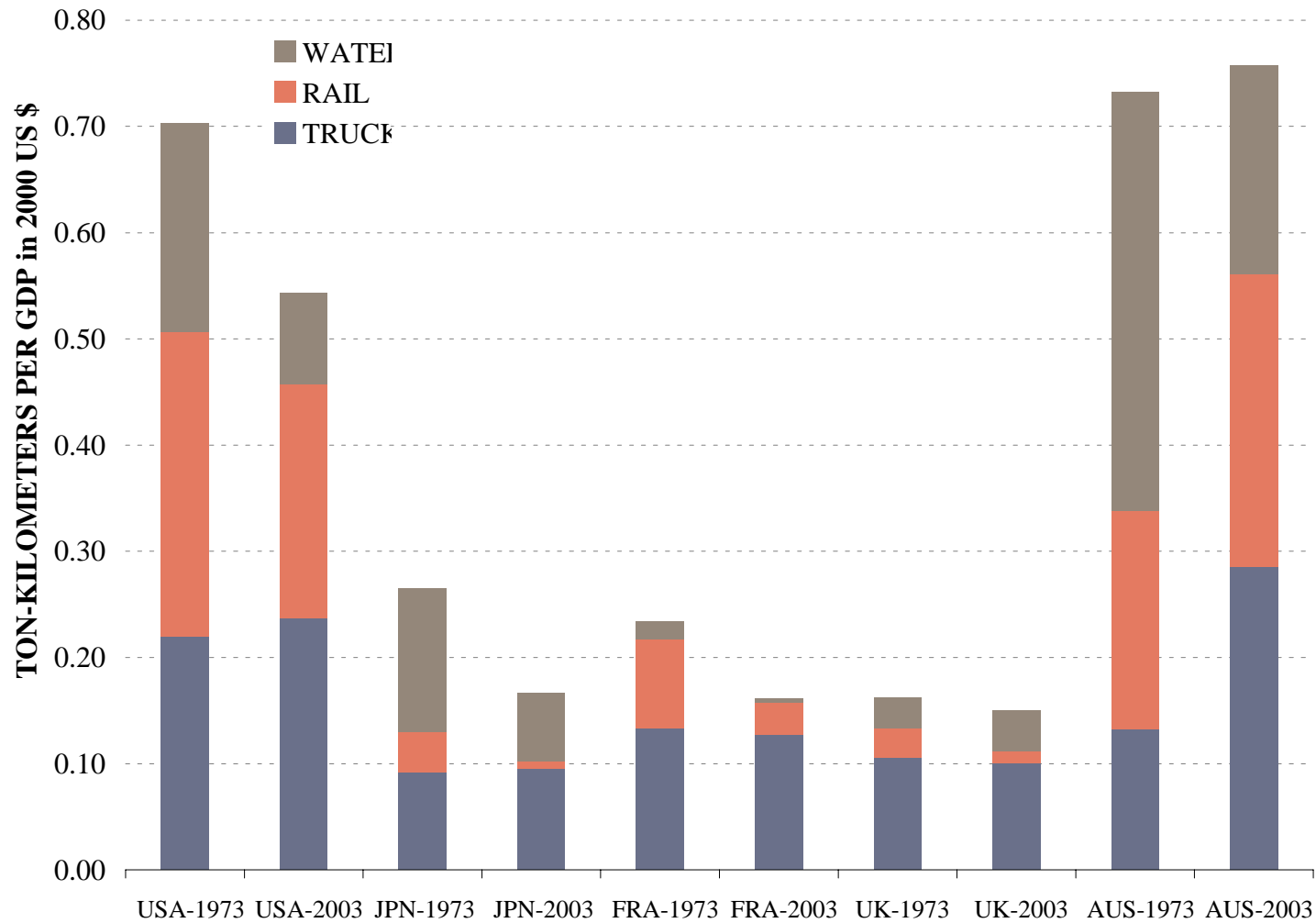
## • Nightmarish Examples

- No reliable road diesel data (India, China before 1995),
- High consumption: 330 gm/km CO<sub>2</sub> in Istanbul measured by EMBARQ)
- Legal and illegal used imports – Mexico, C. America, (Poland, New Zealand)

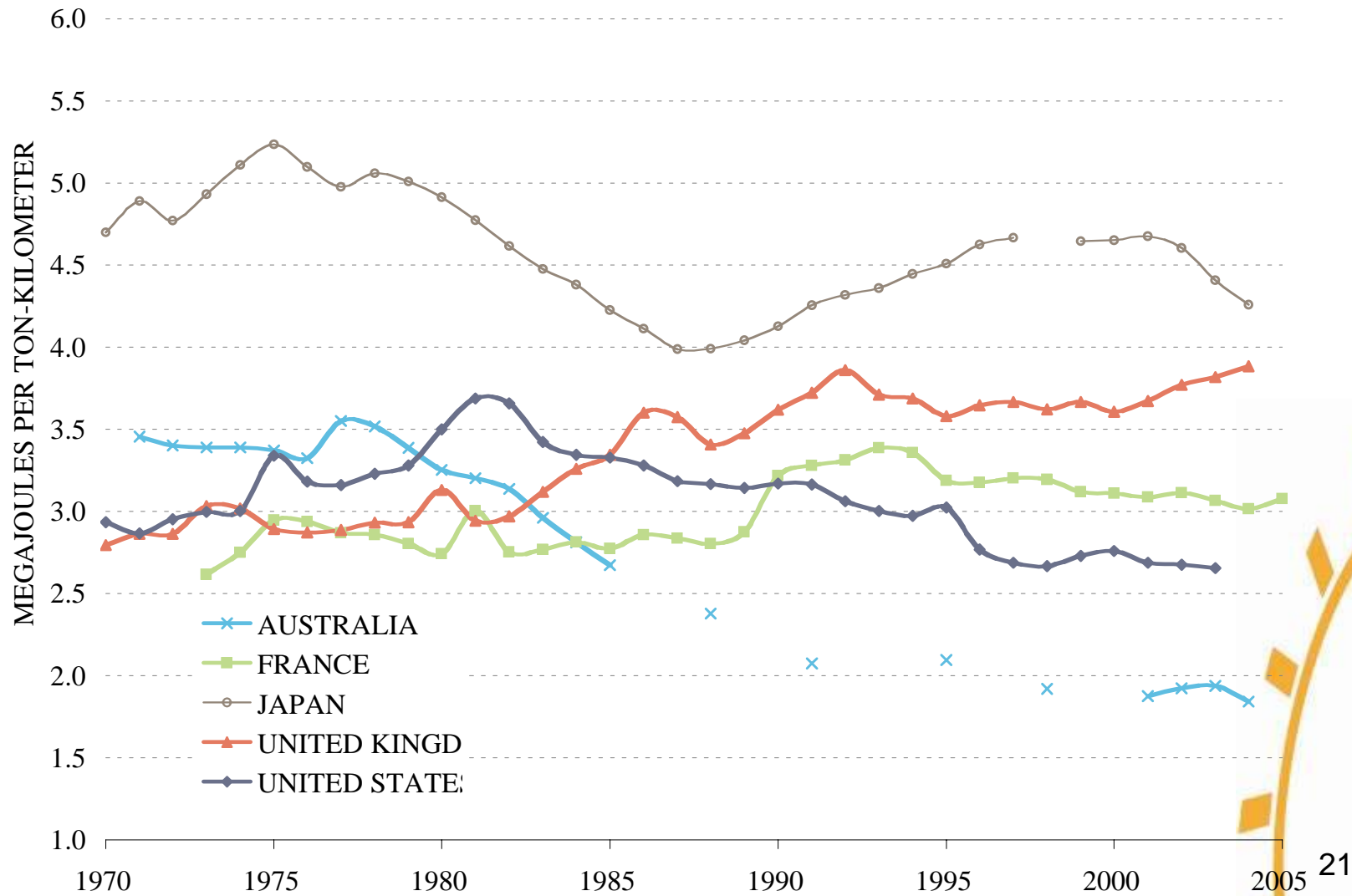
## • Tough Analytical Issues

- Do present use patterns of privileged class represent future?
- Impact of worsening urban and intercity traffic on fuel economy
- Impact of strongly improved fuel quality and local emissions standards

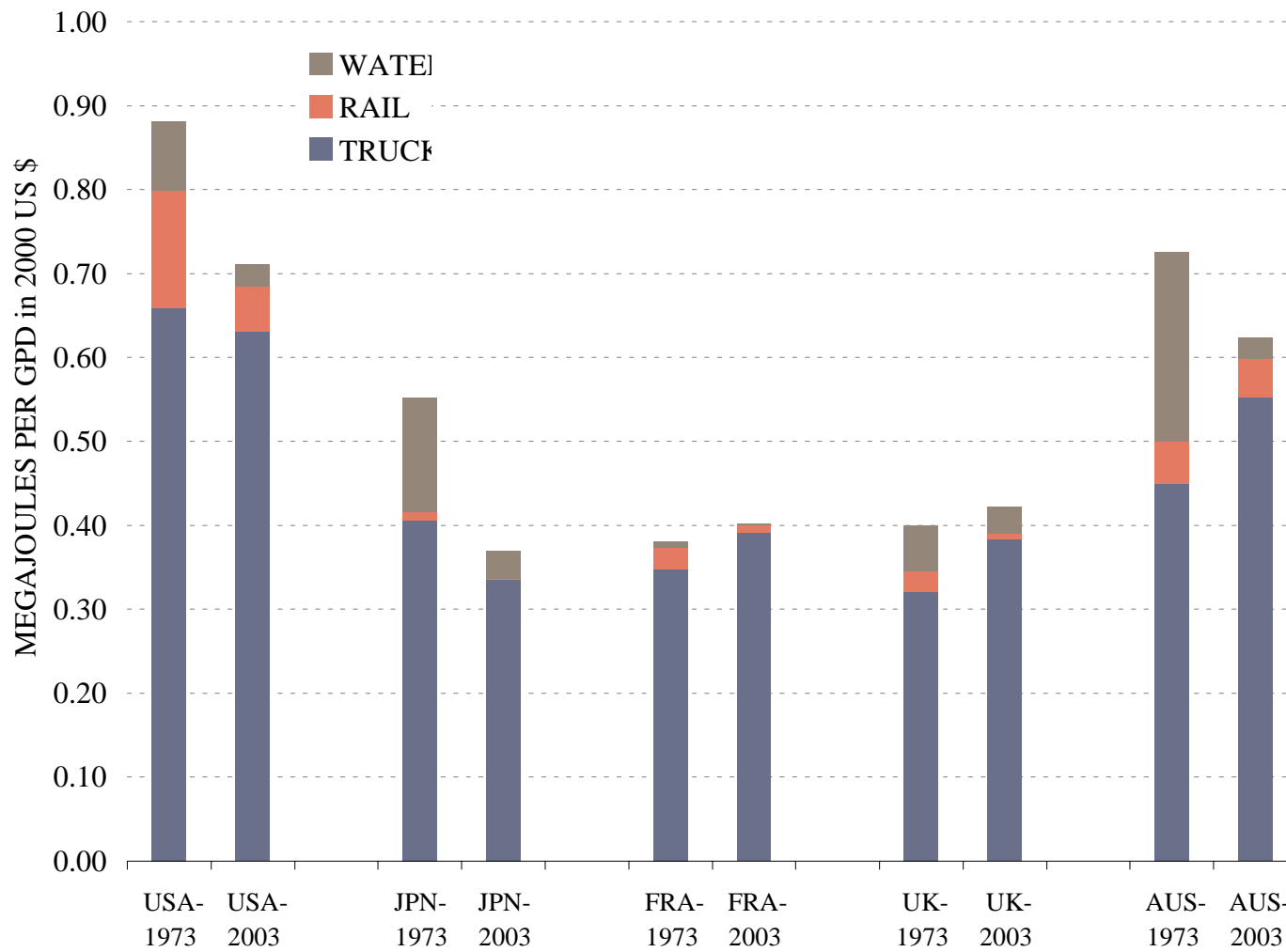
# FREIGHT: Ton-Kilometer per GDP



# Modal Energy Intensity



# MJ of Freight Energy per Unit of GDP



# Key Findings Reinforce Earlier Work: Reducing Emissions a Challenge

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- Tonne-km Track GDP with Various Elasticities
  - Getting Int'l traded goods to ports
  - More handling of intermediate inputs?
  - Books (Amazon) or computers (Dell) – fewer tonnes, more km
- Energy Intensity of Trucking Is Falling but...
  - Most of change likely from improved utilization, larger vehicles, better traffic
  - Trucking gaining modal shares – continued desire for speed etc.
  - Changes in vehicle loading and traffic - logistics
- Restraining Emissions in Freight?
  - Higher efficiency vehicles and low carbon fuels – small impacts
  - Better loading, logistics, traffic – big impacts
  - Slow food grown locally: How to change world trade juggernaut?
  - Modal shifts back to rail – unlikely in any significant degree

# Developing Fuel Economy Standards – Key Policy Issues

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## • **What Factors Shape Vehicle Choice, Usage**

- What are traditional fuel price, income elasticities, rebounds among owners
- Ability of car and fuel suppliers to sell more advanced technology
- Understand driving forces – fuel and vehicle taxes, company car policies, etc

## • **What Other Policy Changes Save Fuel?**

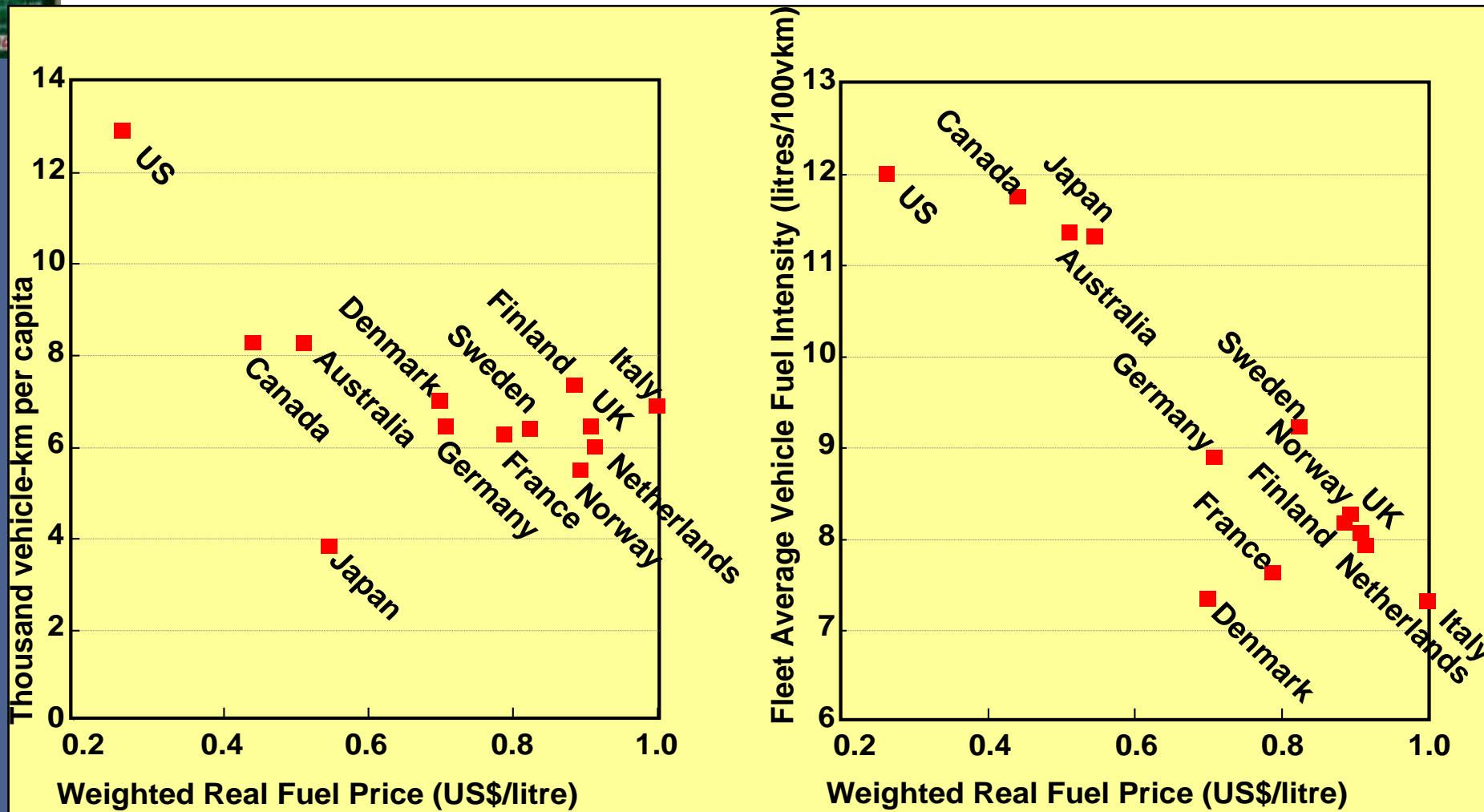
- Taxing cars by footprint saves scarce space, discourages SUVs
- Taxing kilometers and fuel reduces usage
- Smart urban transport policies and land use save fuel

## • **Other Important Issues**

- Should low-cost cars (“Nano”) or two-wheelers blossom or wither?
- Import tariffs on fuel saving features
- Domestic vs knock-down vs imported cars!

# Car Use, Fuel Intensity vs. Fuel Price, 1998

Source IEA



**Better Understanding Urgently Needed of Fuel Price – Vehicle – Use – Fuel Economy**

# Energy and Emissions From Transport – The Hard Policy Lessons

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- **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**
  - Mandatory (US CAFÉ) worked, voluntary (Japan, EU) working now
  - Congestion pricing, km-taxes do restrain individual vehicle use
  - Urban transport policies with teeth matter
- **Boldness Matters**
  - If Americans could raise fuel prices and Germans could lower speed limits
  - If cars were taxed by footprint
  - If global leaders embraced 4S – slow, safe, small and sustainable

# Monitoring Light Duty Fuel Economy – What We Need to Know

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- **Existing Vehicles' Use and Fuel Consumption**
  - Cars, taxis, SUVs, commercial vans by fuel, age
  - Distances run by type, fuel, age, location where garaged, from survey
  - Calculated fuel use by fuel from surveyed fuel economy
- **New Vehicles**
  - Tests of each model for fuel use on specified cycle
  - Estimate of on-road/test gap from surveys above (Canadian or French examples)
  - Transparency of test cycle, comparisons of same vehicle on different cycles
- **International Sphere**
  - Comparison of same cars on different countries' cycles
  - Understanding of different technologies deployed in cars in different countries
  - Estimation of full fuel cycle for traditional and new fuels (imports, exports, etc)

# Energy and Emissions From Transport – Special Problems to Solve

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- **The Diesel Problem**

- Rapidly shifting patterns of users; from heavy to lighter vehicles
- Adulterated and smuggled fuel in developing countries
- Biodiesel and other “don’t ask, don’t tell” fuels

- **The Vehicle Utilization Issue**

- Loading of cars, buses, rail by rural/urban/long distance, commercial, private
- Loading of long distance trucks by size, own vs for hire, long vs short haul
- Trip and freight chains – boardings, journeys, liftings, etc

- **For the International Sphere - Harmonize**

- International ground traffic – mine in your country, yours in mine, (cars, trucks)
- Parameters relating different test procedures (Feng) and traffic conditions
- Differences in vehicle technology and fuel quality among countries
- Border-crossing and transit (2 border) ground traffic
- International air traffic (as well as one-hop domestic<->int'l traffic)
- Int'l vs domestic rail passengers and fuel allocation

All of the Above for some Sub-national Regions (state, metro )

# Energy and Emissions From Transport – Taking Advantage of Other Sector Data

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- **Consumer Surveys**

- Expenditure surveys
- Census (trips to work)
- On board consumer surveys from collective transport, air, etc.

- **Household Travel Surveys (check on car use)**

- Trips, distances, purposes, times, origin-destination
- Driver, passenger; with or without packages
- Time of year

- **Transport Surveys**

- Vehicle counts (but how transformed into vmt by vehicle type)
- Commodity flow surveys (goods by distance and mode)
- Data from transport travel and freight operators (but how to add up?)

# The Next Discussion of these Issue: The Asian Scene, Bangkok November 2008



–Better Air Quality (BAQ) workshops, organized by CAI-Asia together with host government and city, are with 1000 participants, the largest regional events on urban air quality in Asia

–BAQ 2008 will be in Bangkok, Thailand 12-14 November, 2008 with the theme: “*Air Quality and Climate Change: Scaling up Win-Win solutions for Asia*”

–See for more details: [www.baq2008.org](http://www.baq2008.org) or write to [cornie.huizenga@cai-asia.org](mailto:cornie.huizenga@cai-asia.org)

# Thank You

Lee Schipper – [schipper@wri.org](mailto:schipper@wri.org)

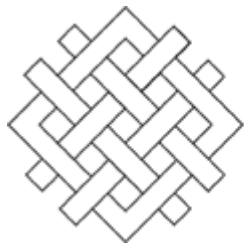
<http://www.wri.org/press/2007/12/proposed-fuel-efficiency-standards-small-welcome-step-says-new-wri-report>



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