

Counting Future Carbs in the Road Sector: Looking Forward by Looking Carefully

Lee Schipper, Ph.D.

Visiting Scholar, UC Berkeley Transportation Center

ADB Transportation Week

Manila, September 9-12, 2008



Counting Carbs

Contents

- **What We Need To Know and How Well – as They Change?**
 - This is mostly a transport problem
 - ASIF – Components of GHG emissions from transport
 - Some existing portrayals – aggregate to bottom up
- **Driving Forces and Farces – Mostly Outside the Domain of CO2 Policy**
 - Incomes, fuel prices/subsidies, costs of moving
 - Transport policies, including structure and governance of transport industries
 - Urbanization, land use, regional development, trade
- **Scenarios and Closing Remarks –**
 - Hanoi 2020 – Transport futures drive emissions, not the other way around
 - Data hitchhiking and relationship therapy
 - You can't count carbs if you can't count transport

You Cannot Master What You Can't Measure





Welcome to Istanbul



Avcılar Köprül  Kav ađı
ve T neli

hayırlı
olsun!

24 Eyl l Cumartesi Saat: 17.00
Sayın Ba bakanımızın katılımıyla...



İSTANBUL B Y K    R BELEDİYESİ









Which of These Are Sustainable Transport?

Delhi CNG



Shanghai Maglev



Delhi Metro



Chicken in Hanoi?



Congestion Pricing Singapore

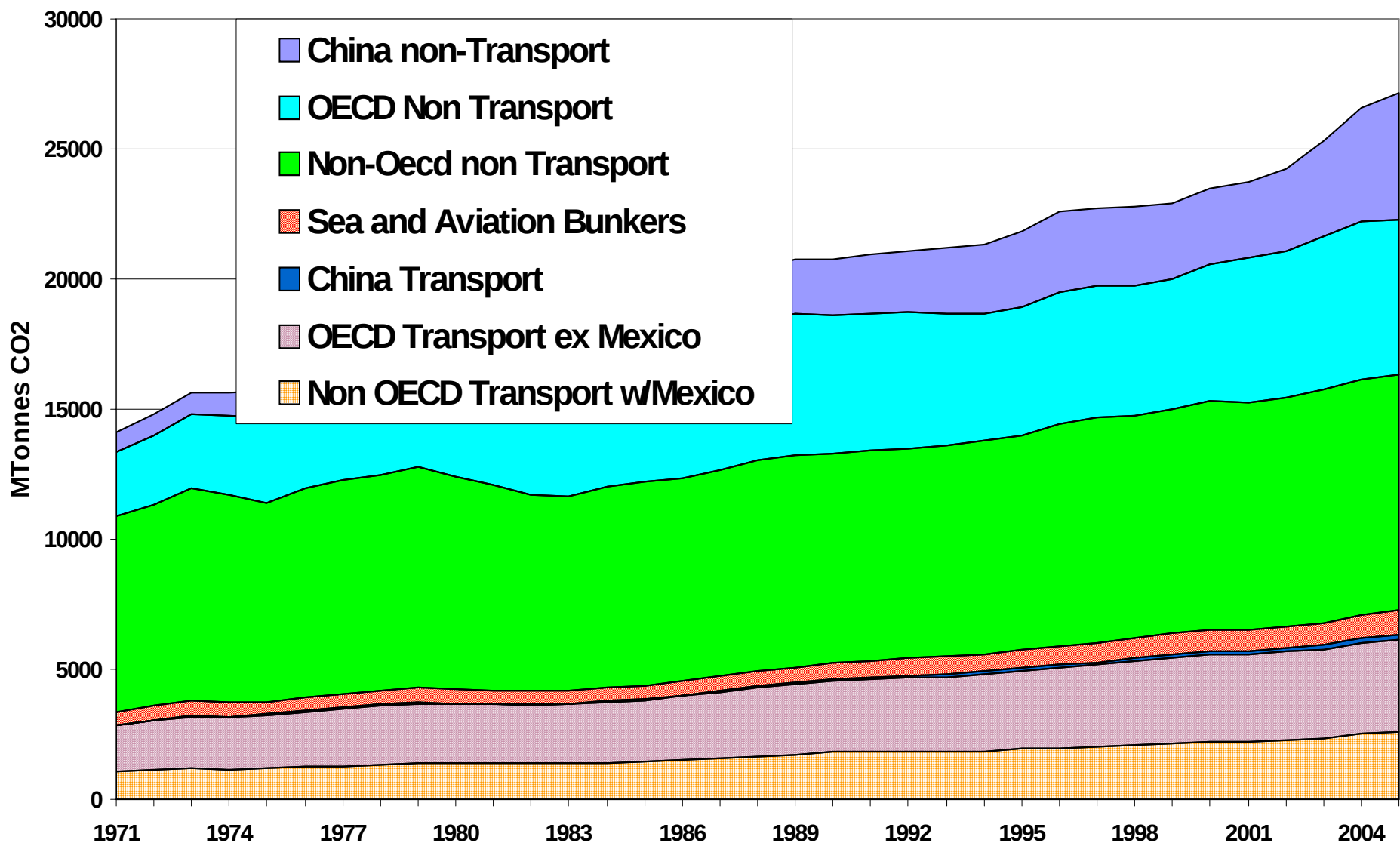


Busses in Bangalore

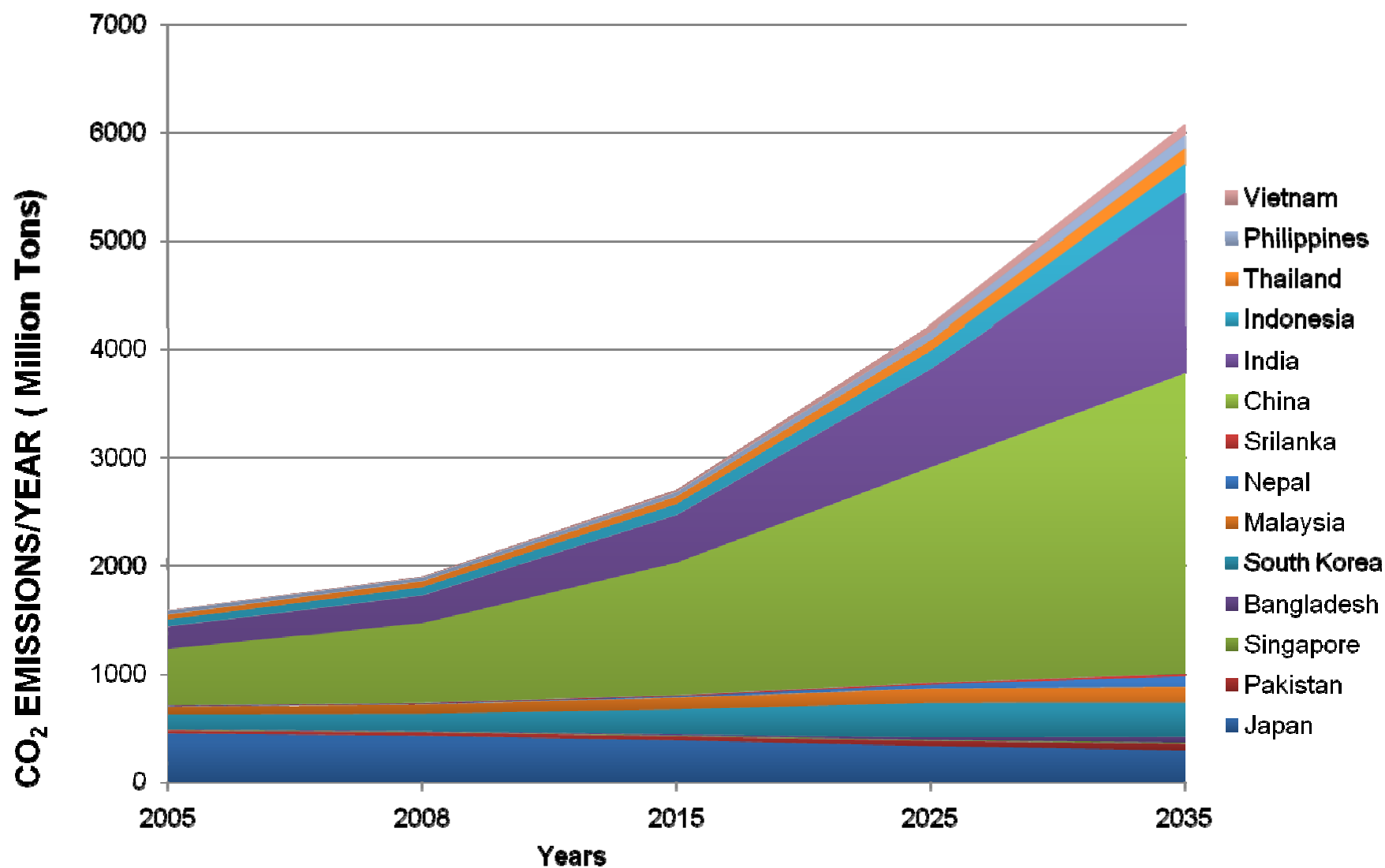


WORLD CARBON EMISSIONS: TRANSPORT

Problem is Policies are National or Local
Measurement Must be Bottom-Up

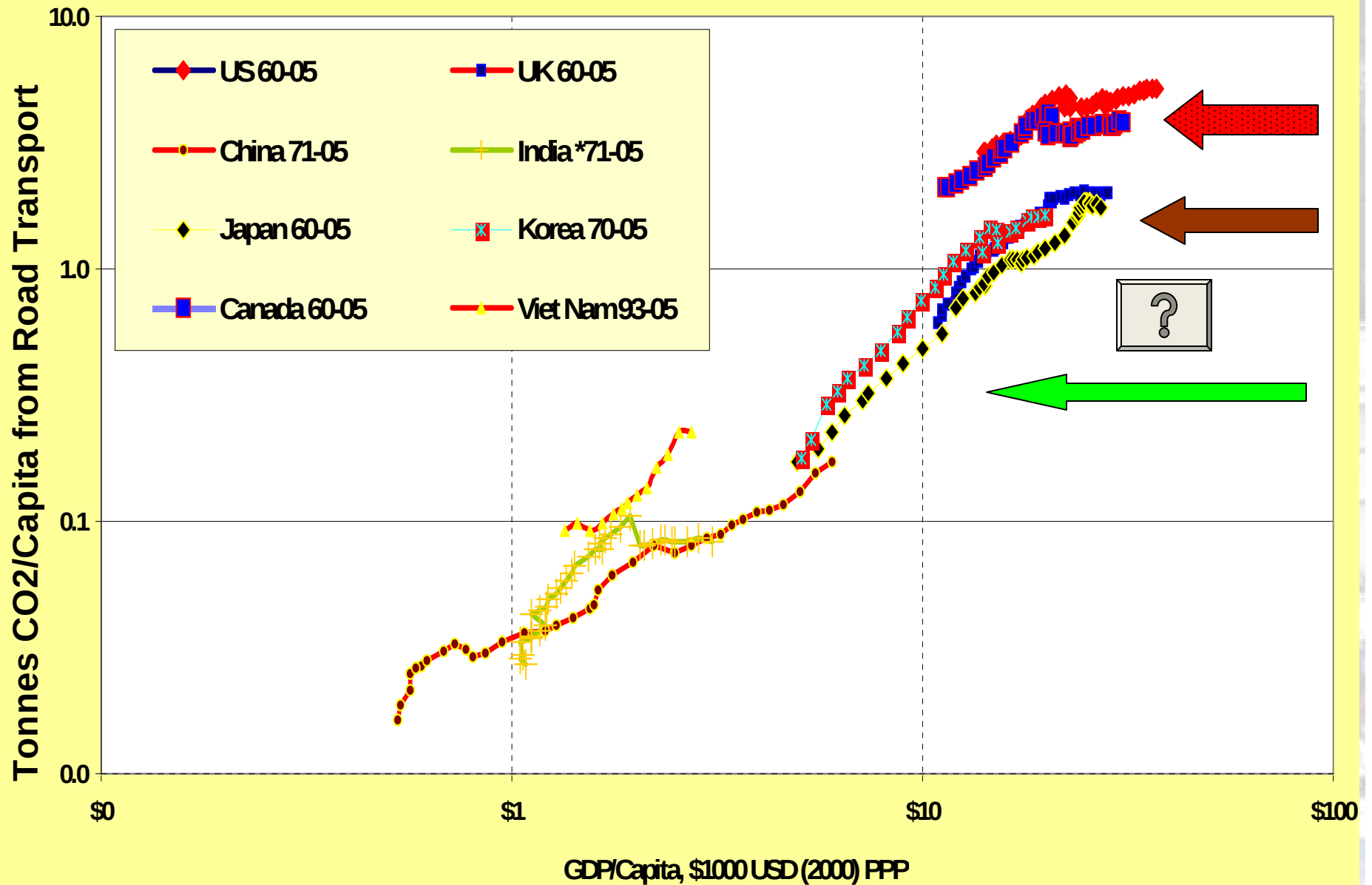


Transport CO2 Emissions in Asia



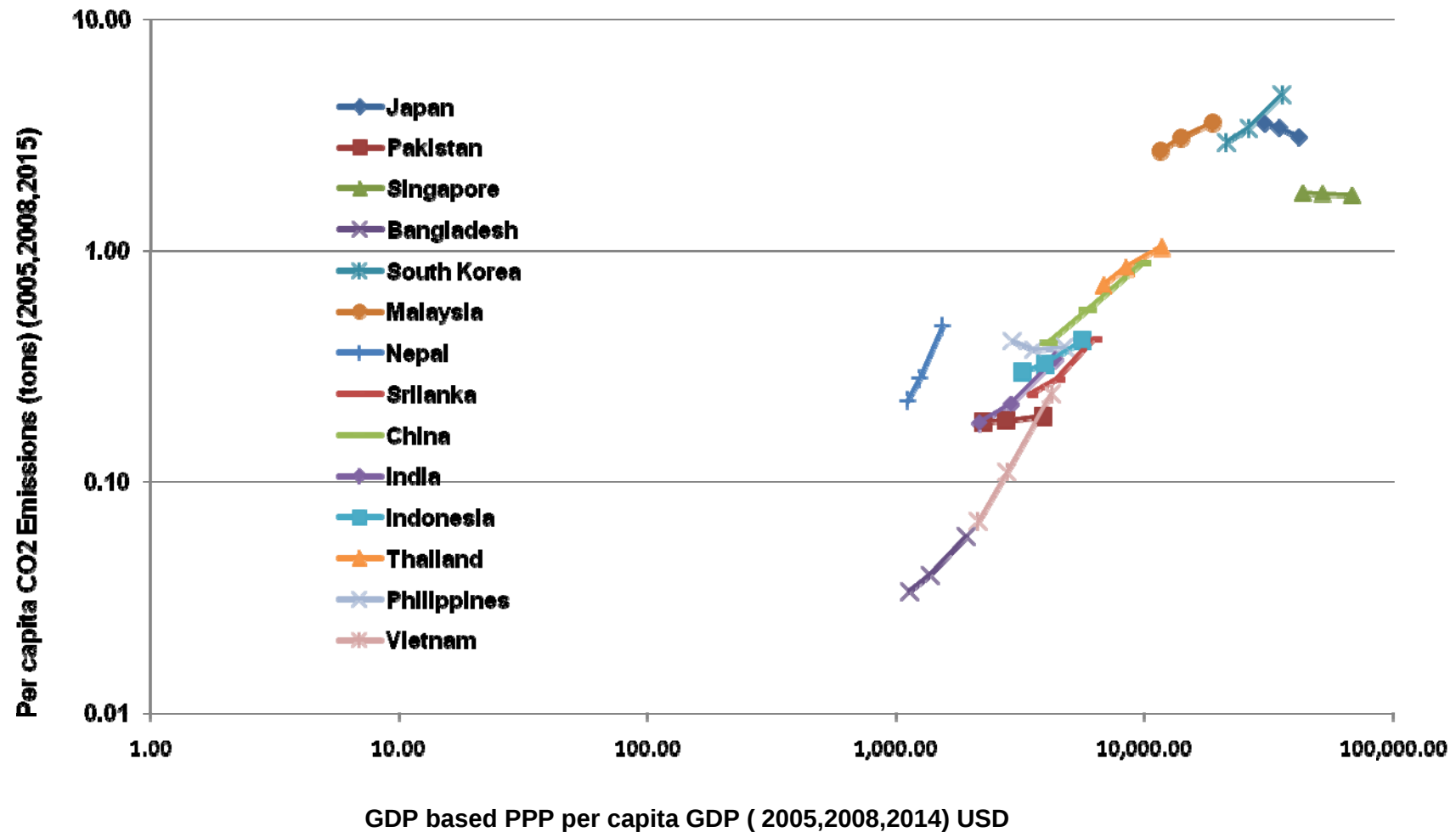
Source: 2008. Segment Y, ADB and CAI-Asia from various sources

CO2 Emissions from Road Transport



—Source: IEA

CO2 Emissions from Road Transport in Asia



Source: 2008. Segment Y, ADB and CAI-Asia from various sources

“ASIF” Decomposition

Air
dispersion
model;
atmospheric
chemistry;
exposure
and health
effects.
|Global CO₂

**Emissions from
Transport**
G

$$G = A * S_i * I_i * F_{i,j}$$

Total Transport
Activity

Veh-km and
pass-km by mode

Occupancy/
Load Factor

Technological energy
efficiency

Vehicle characteristics

Vehicle fuel
intensity

Emissions per
unit of energy
or volume or km

Modal Energy
Intensity

Real drive cycles and routing

Lesson : Attack All Components of Transport,
not Just Fuel and Efficiency

Accounting Rules For ASIF

- **A – Total Distance Traveled**
 - How far different vehicles, people, and goods move
 - Important to specify region, who/which goods traveling
 - Look for possible rebound effects from lower travel/fuel costs
- **S – Modal Split**
 - Distances traveled by mode (or shares of distance)
 - Wide difference in emissions per veh-km, pass-km, tonne-km
 - Walking and cycling have zero emissions
- **Vehicle or Modal Fuel Intensity**
 - Fuel or emissions/vehicle kilometer
 - Fuel or emissions/tonne-km or pass-km important too
 - In mode shifts, issue of whether to count average or margin
- **Decarbonizing Fuel Choices**
 - Focus on CO₂, but other gases important (CH₄, N₂O..)
 - Fuel-cycle analyses (FFCA/LCA) expose hidden fossil fuel inputs
 - Some inputs (indirect land use/soil changes) hard to measure



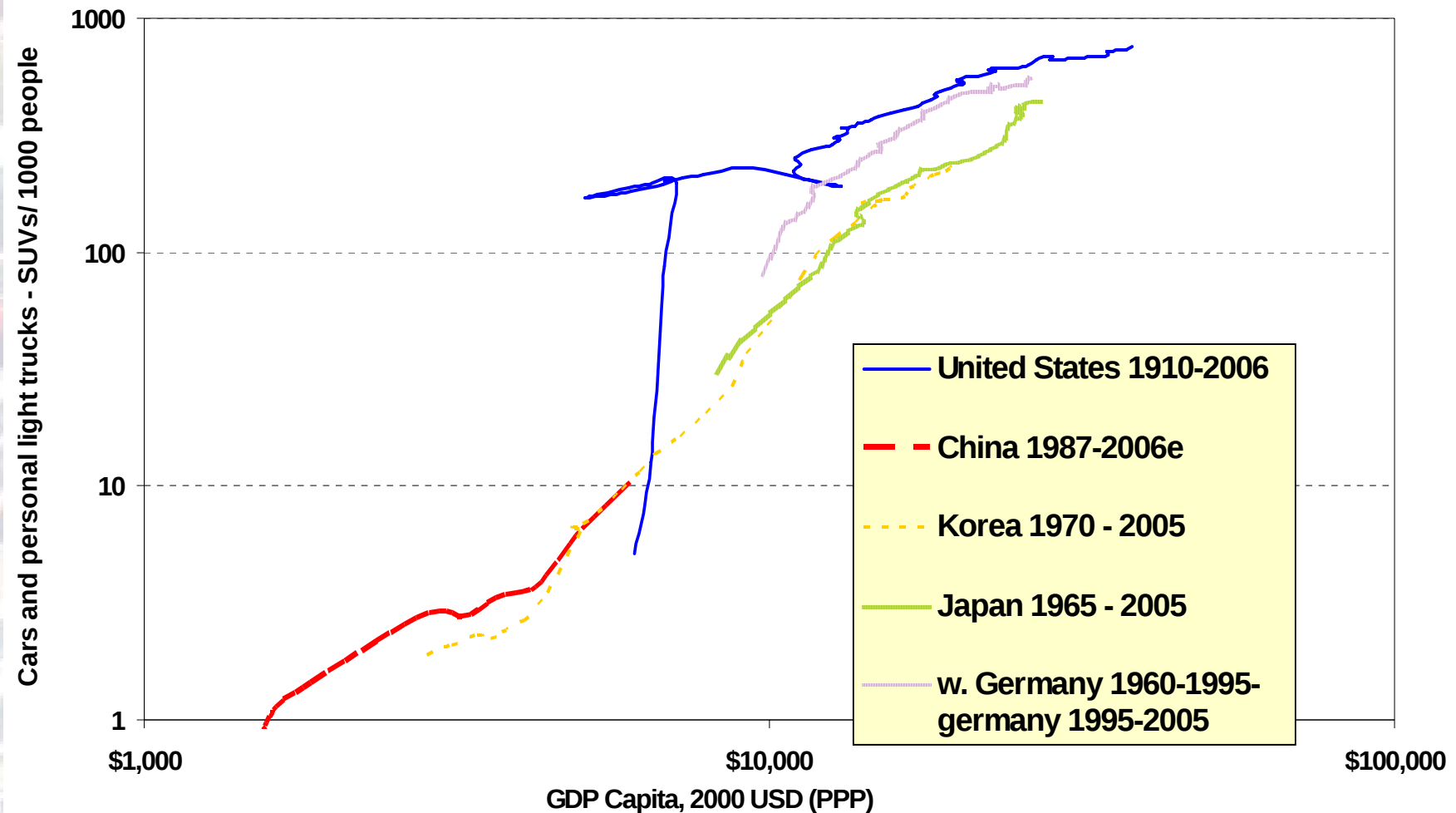
Driving Forces For ASIF

Most are Transport, not CO2 Drivers

- **A – Total Distance Traveled**
 - Incomes (-> car ownership) and their distribution, demography
 - Land uses and distribution of manufacturing trade centers
 - Congestion, costs and dangers of travel
- **S – Modal Split (cars vs public; truck vs rail)**
 - Income and car ownership
 - Land uses and integration with transport systems
 - Relative costs, service (including travel time)
- **I Vehicle or Modal Fuel Intensity**
 - Fuel prices (-> vehicle sizes/power, efficiency)
 - Vehicle utilization (people or tonnes/km)
 - Actual traffic conditions and driver behavior
- **F Fuel Choices**
 - Relative prices (as affected by carbon taxes), efficiencies
 - Mandates (i.e., CNG)
 - Availability and security of supply

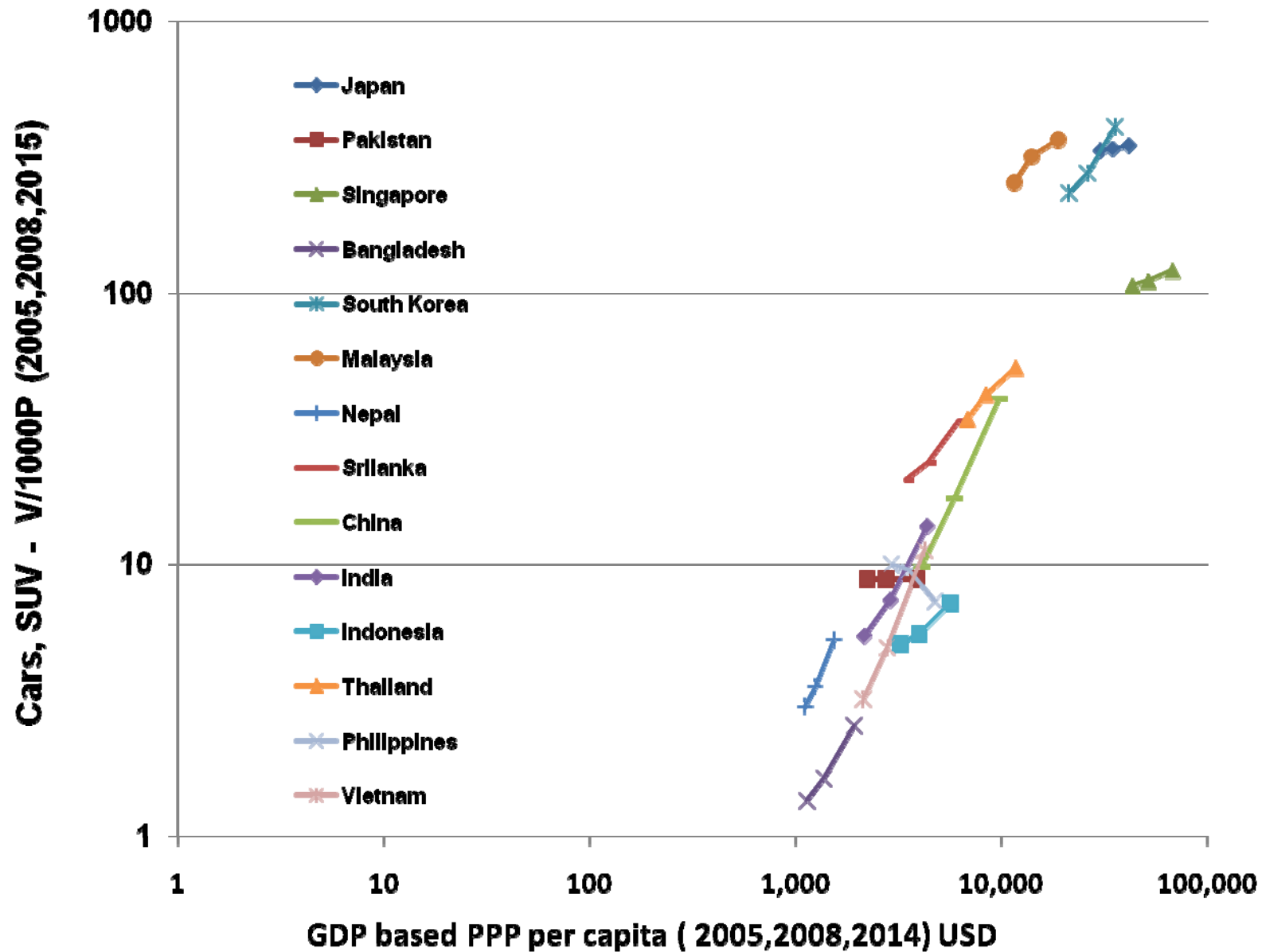
Motorization in Asia

Déjà vu All Over Again?



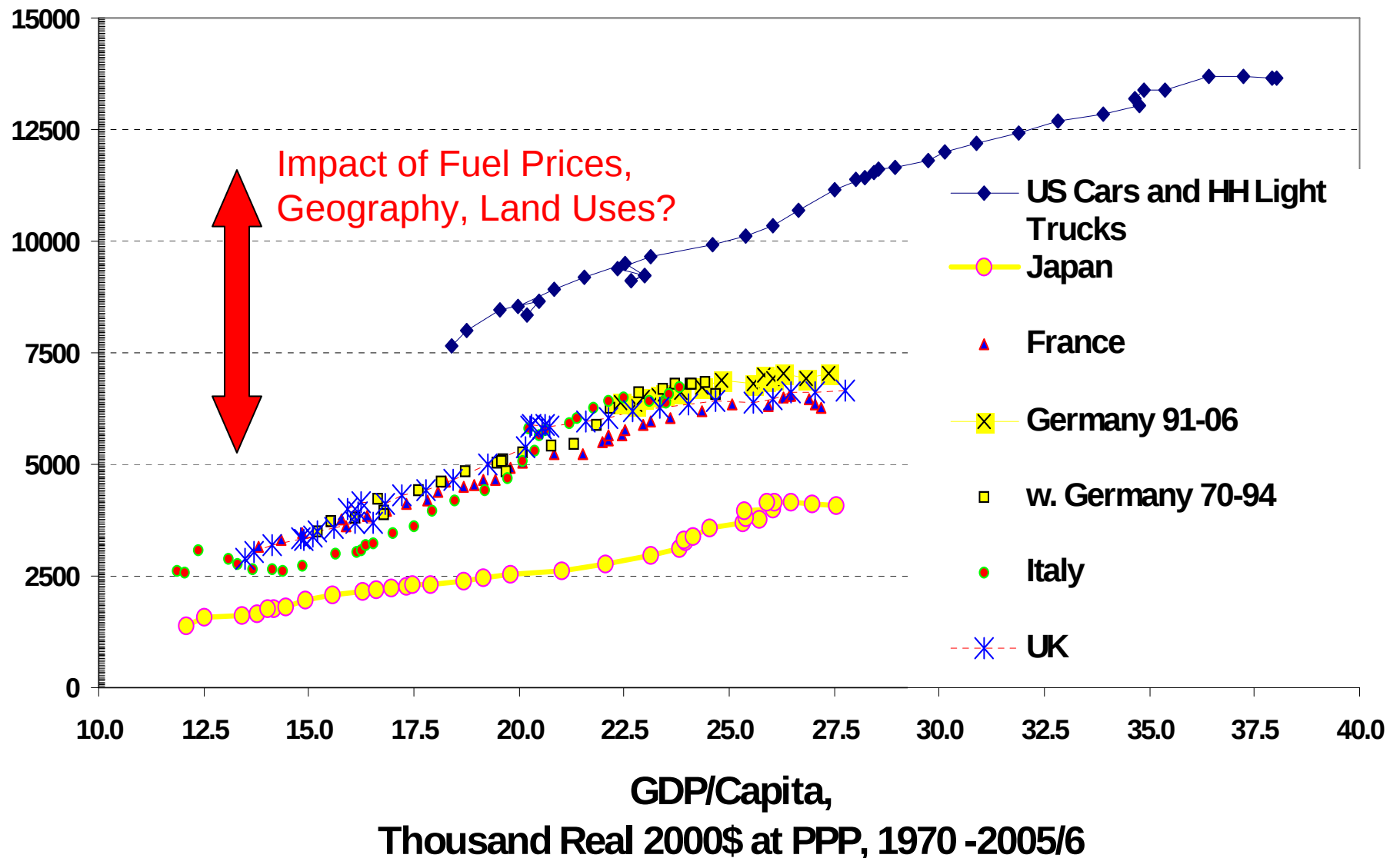
Rapid urbanization and Motorization in China and other Asian countries puts cities and cars on a collision course

Motorization in Asia

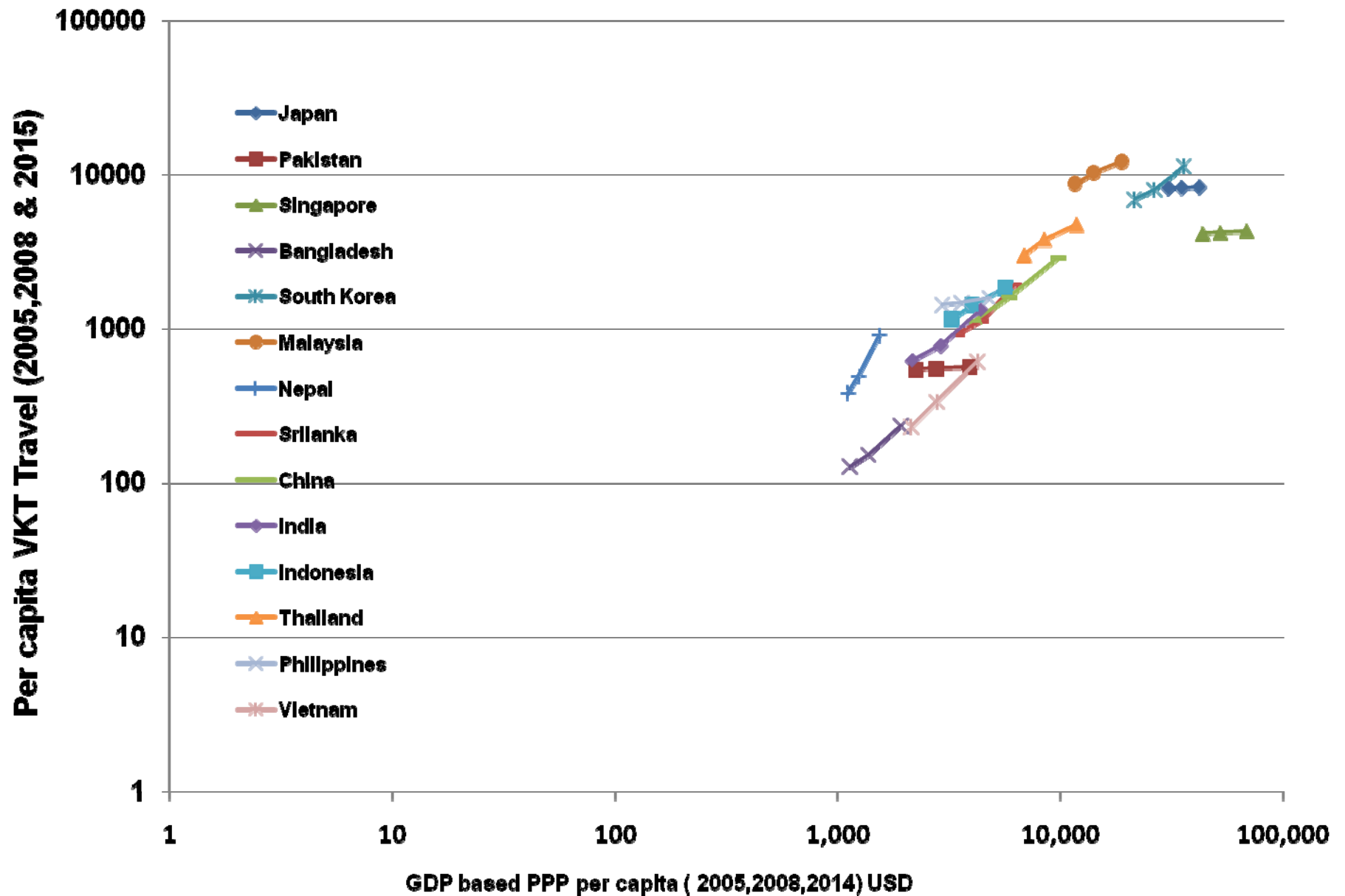


Source: 2008. Segment Y, ADB and CAI-Asia from various sources

Driving and Per Capita GDP 1970 -2005/6: Slowing with Higher Fuel Prices, Congestion ,Aging

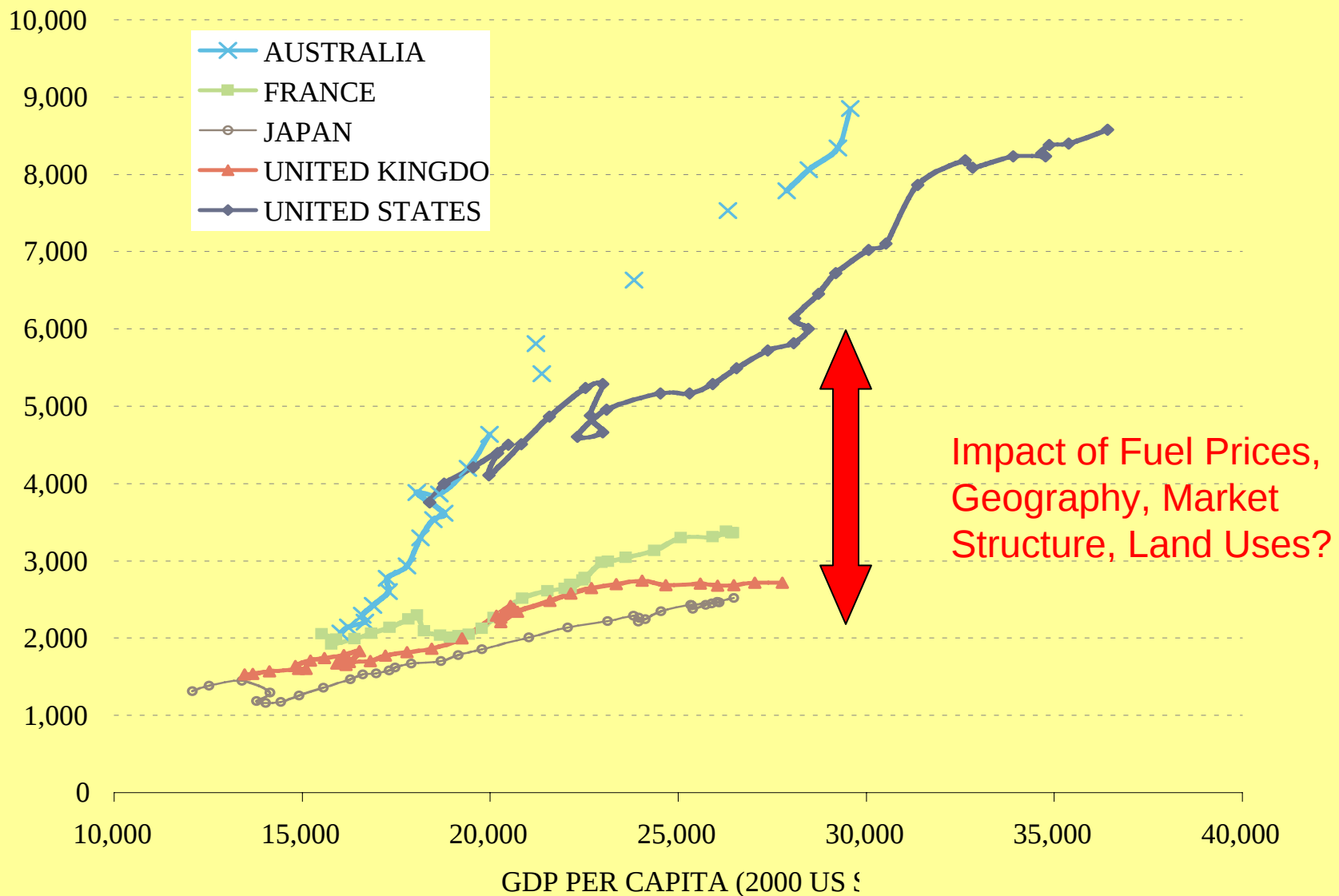


Driving and Per Capita GDP 2005 – 2015 in A

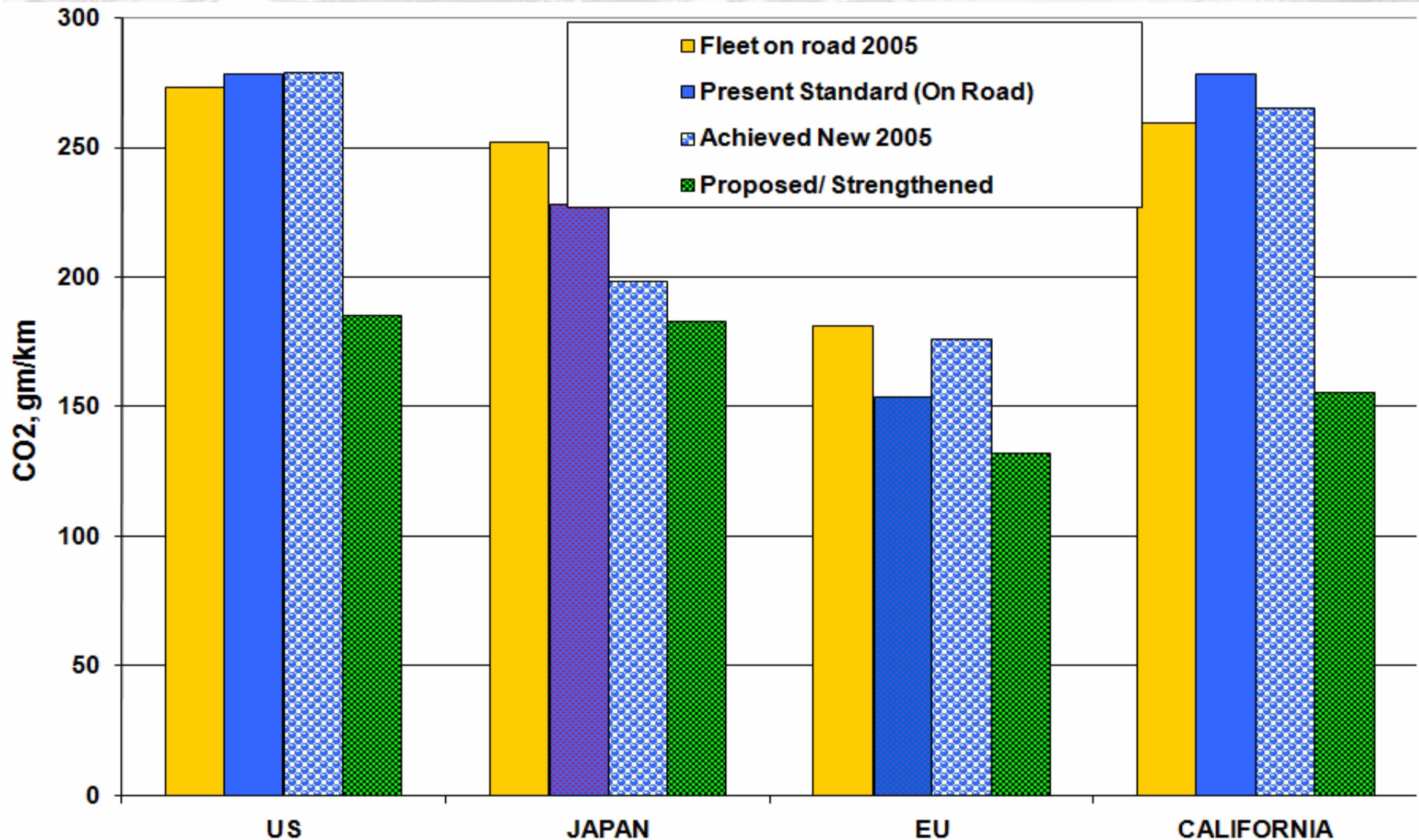


Freight Activity And GDP per Capita 1973-2003/4

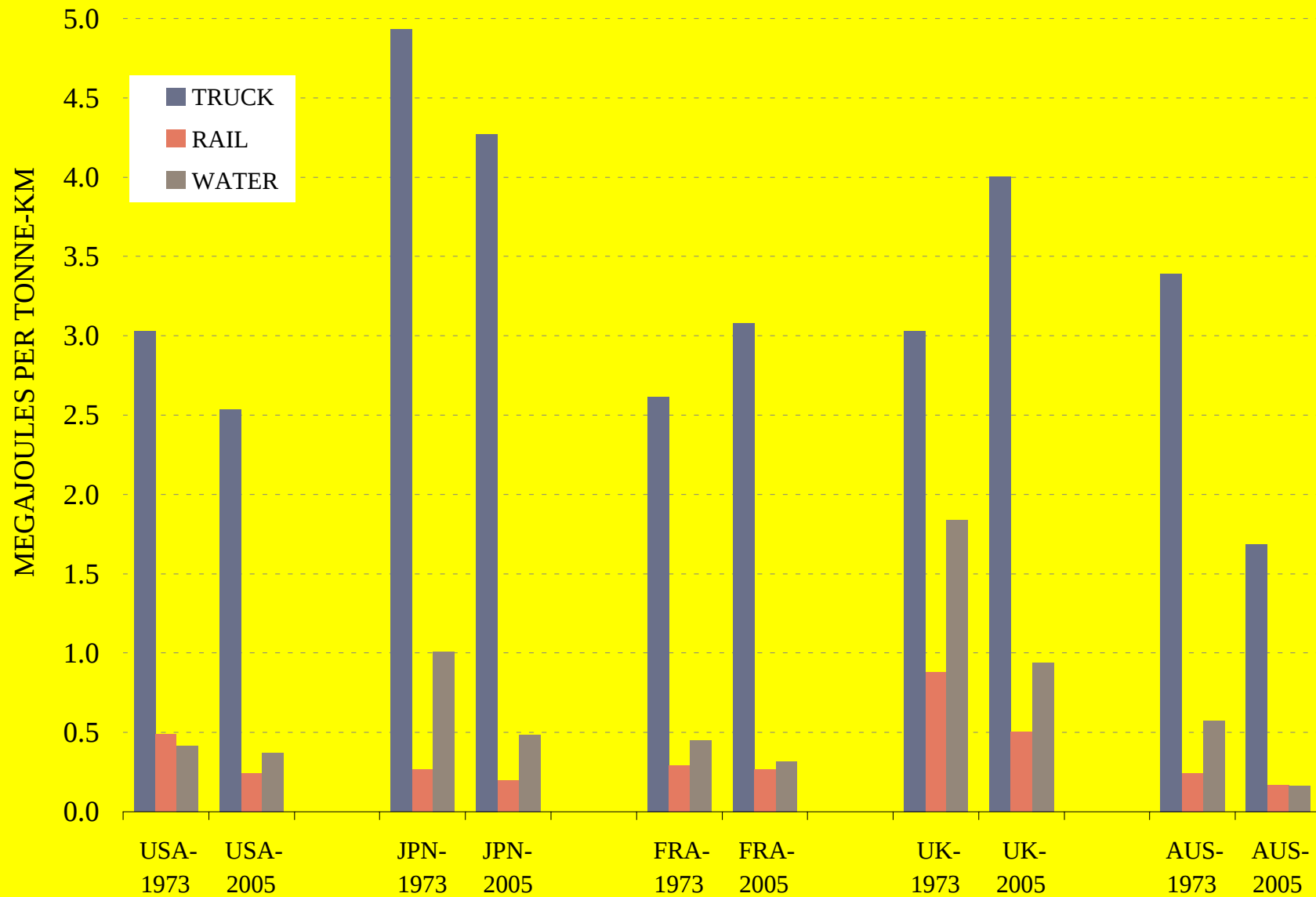
Can the Two be Uncoupled?



New Vehicle Fuel Economy Standards and Targets: “Fleet, On Road”

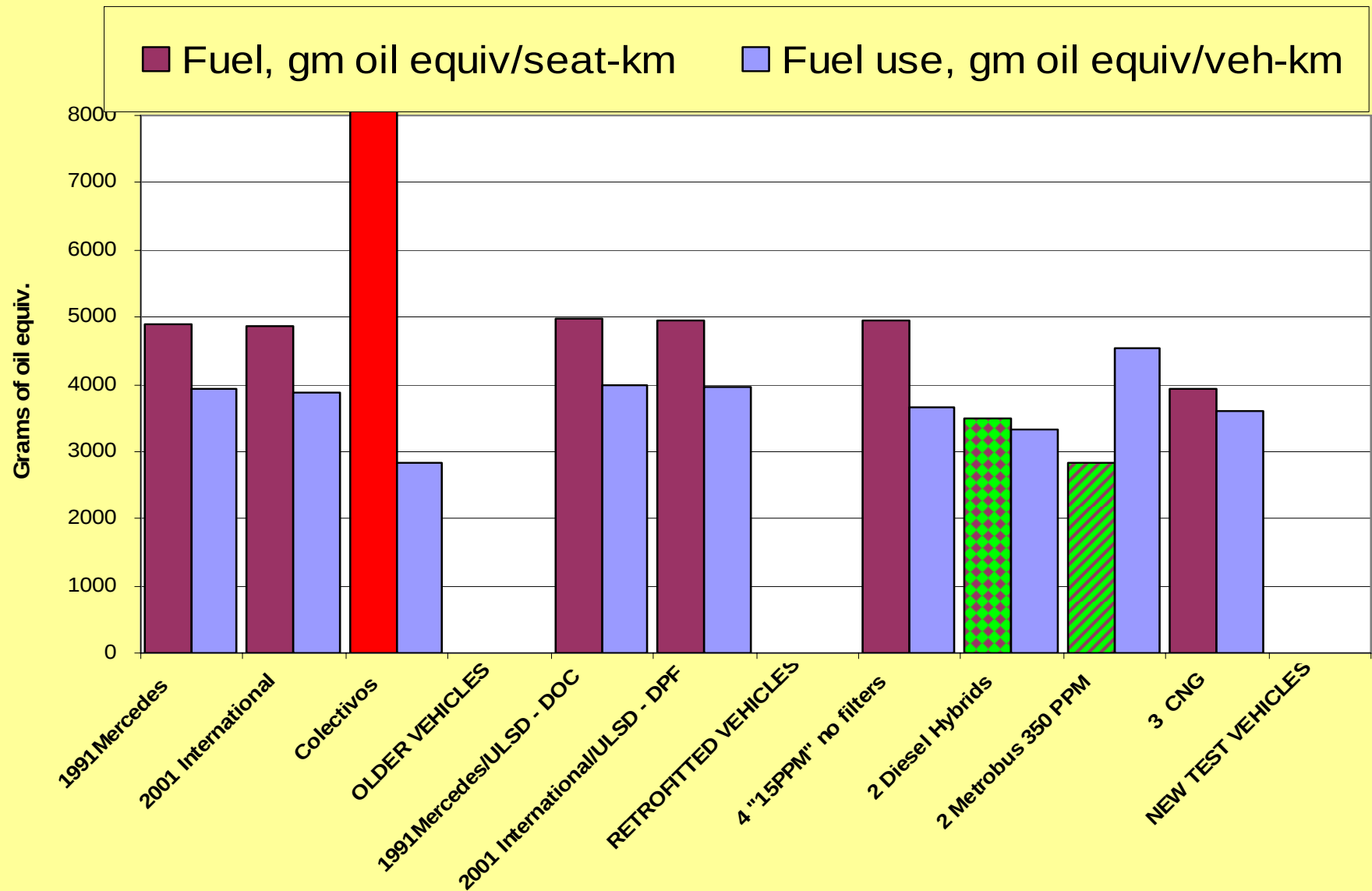


Energy Intensities of Freight Modes 1973 and 2005



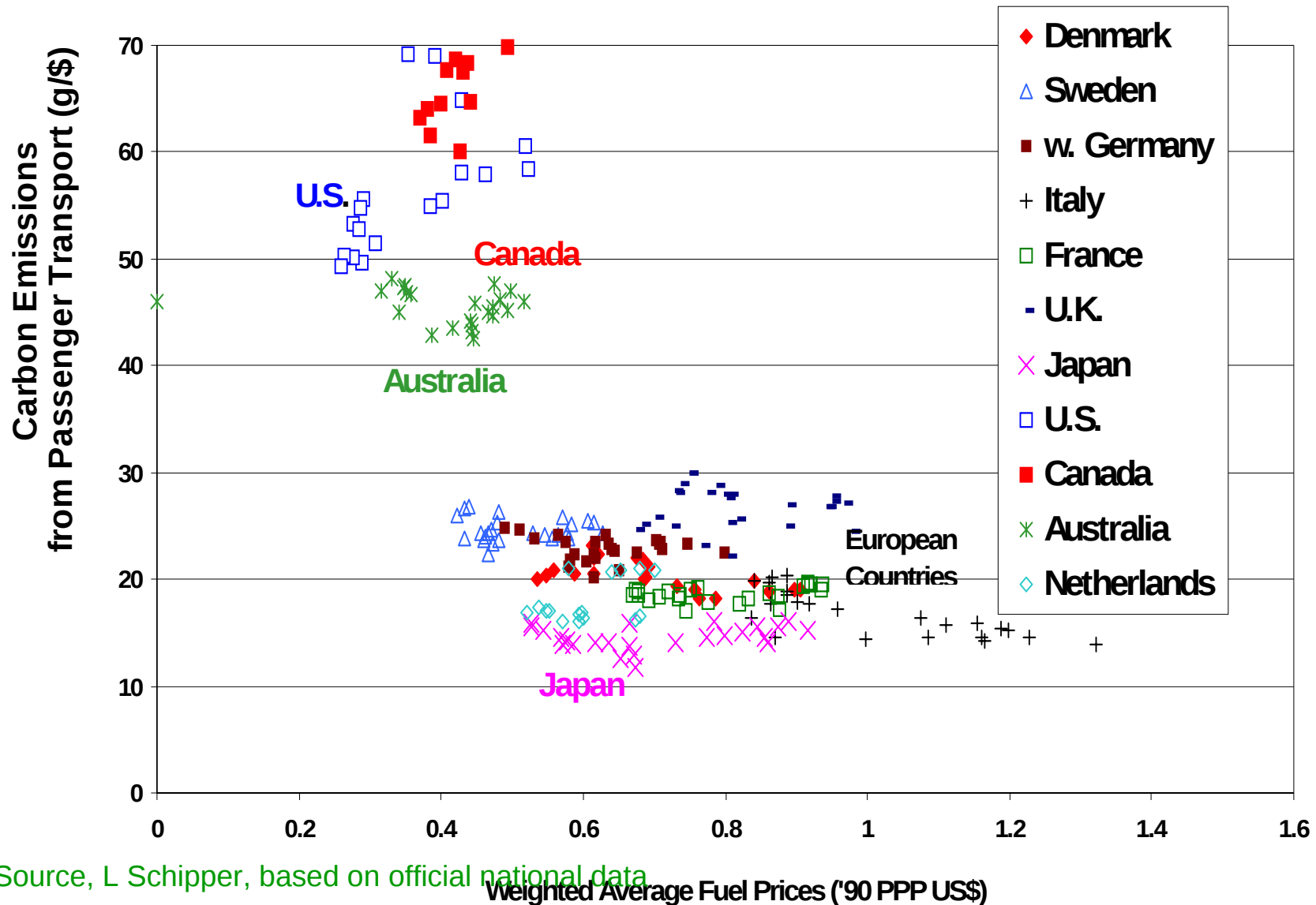
Fuel Use in Buses in Mexico City

The Advantage of Size and Technology



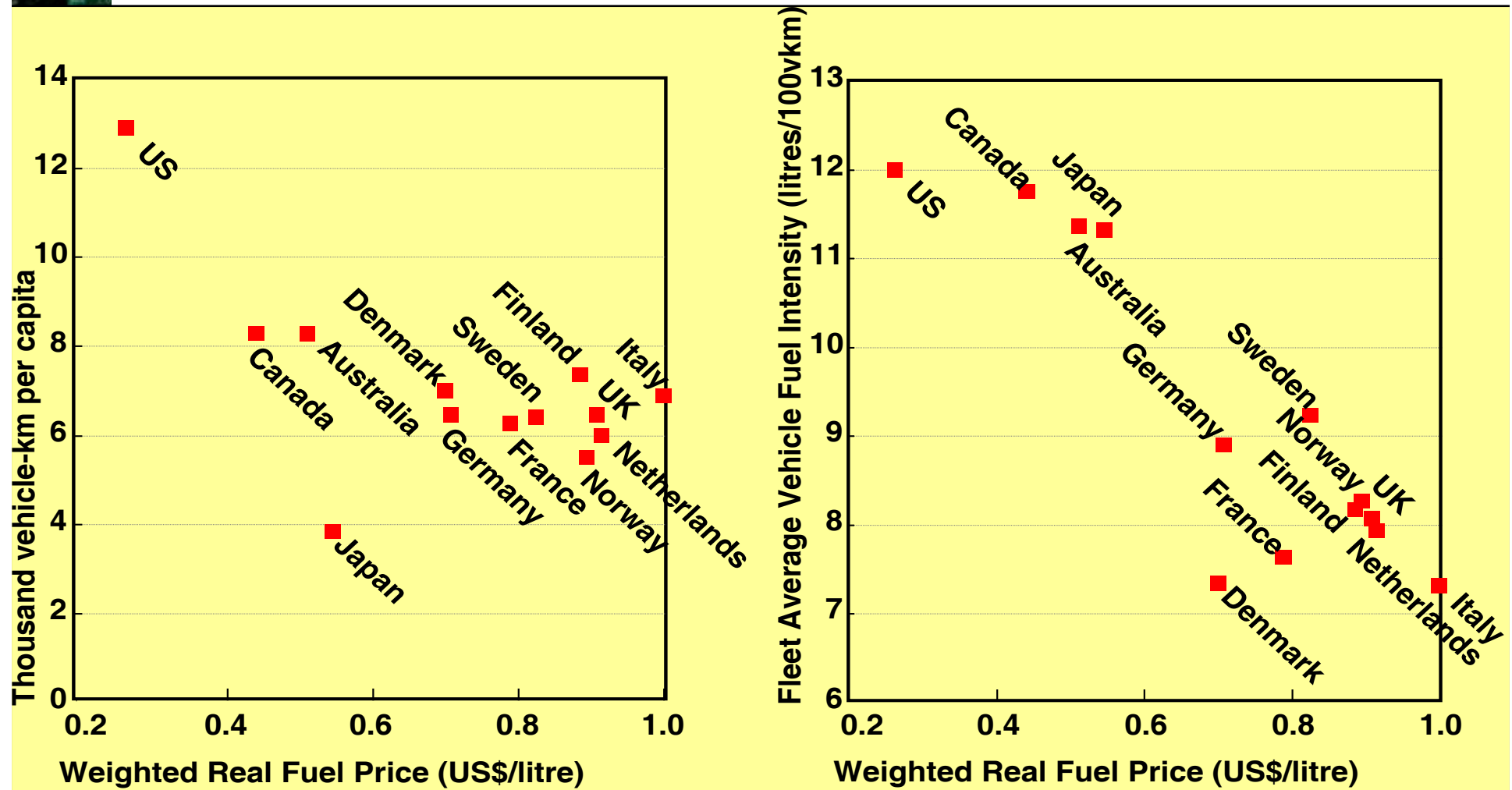
CO2 Emissions from Cars and Fuel Prices 1970-1995

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



Car Use, Fuel Intensity vs. Fuel Price, 1998

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



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



***EMBARQ's* Scenarios for Hanoi**

(Hans Oern (Contrans) and Prof. Tuan Le Anh, Hanoi Univ of Tech.)

Illustrate and Quantify a World We Can't See.. Yet

- Reasonable estimates for “present values”
- Transport vision taken from JICA Master Plan
- Illustrate choices for Hanoi's leaders

Quantitative Assumption-Driven Approach

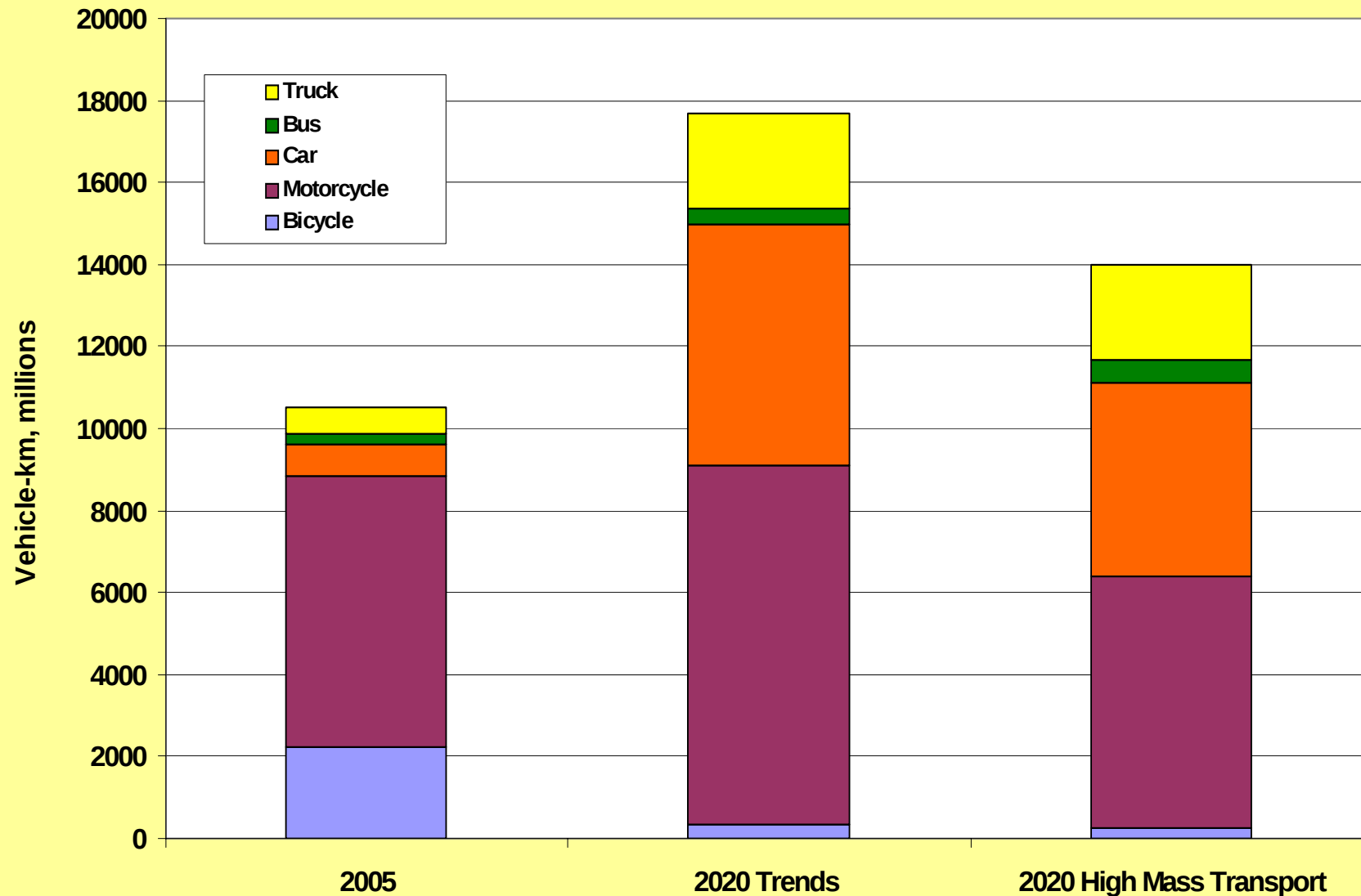
- Transport scenarios by mode and distance
- Fuel and emissions factors from expert judgment
- Total CO₂ and other emissions calculated

Results – Beyond CO₂ Emissions

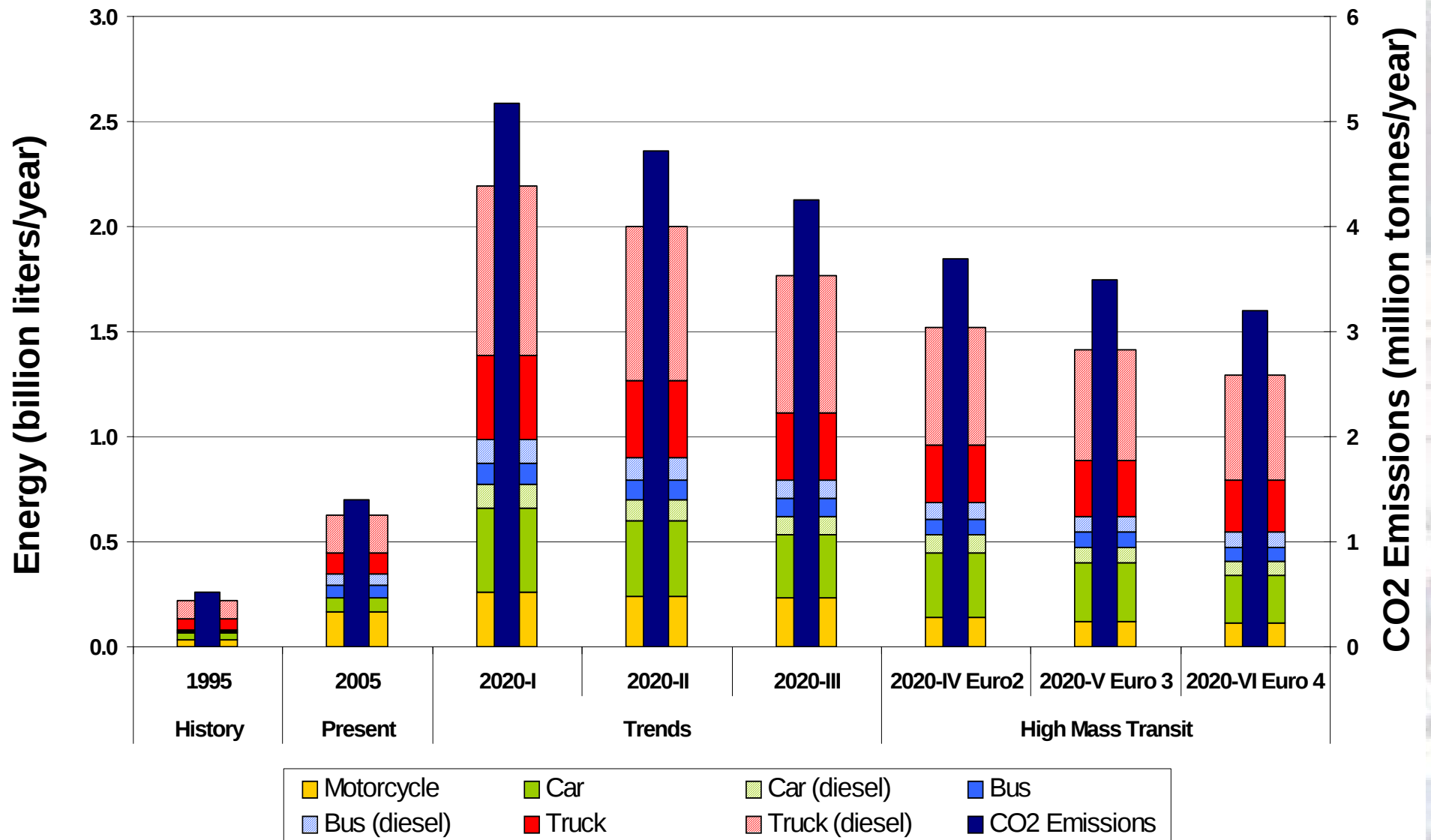
- Illustrate the important role of transport futures
- Illustration of impacts of stronger pollution standards
- Illustration of impact of “fuel efficiency” on total fuel use

Vehicle Kilometers by Mode

Source: Hanoi Master Plan



Fuel by Vehicle and Type; Resulting CO2 emissions



Scenarios and Assumptions for India*

Business as Usual (BAU)

constrained development of road traffic and vehicle demand
infrastructure is assumed to not be a constraint

Technology Efficiency

higher fuel efficiency

1-lakh (\$2500) car (Nano)? Efficiency boon or hypermotorization bust?

Lean Two and Three wheelers

leaner fuels and two and three-wheelers

increases in two and three wheeler modal shares

reduction in all other types of private transport modes

Sustainable Cities/Urban Transport (SUT)

demand management and modern mass transit

regulation of private car use reflected by

reduction in modal share

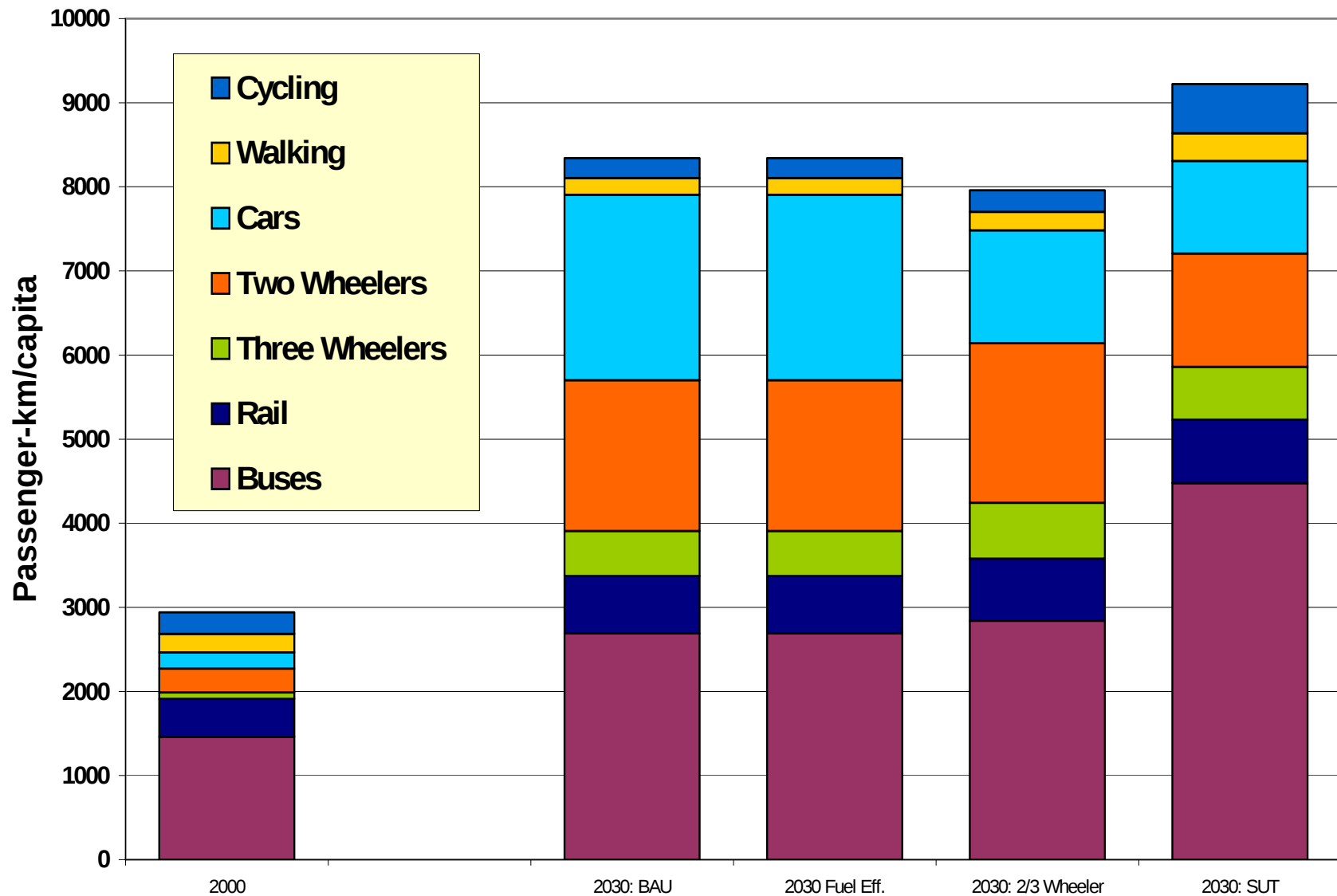
widespread implementation of BRT systems

Max Effort -- All of the above

* Work done with Shyam Menon, W. Bank

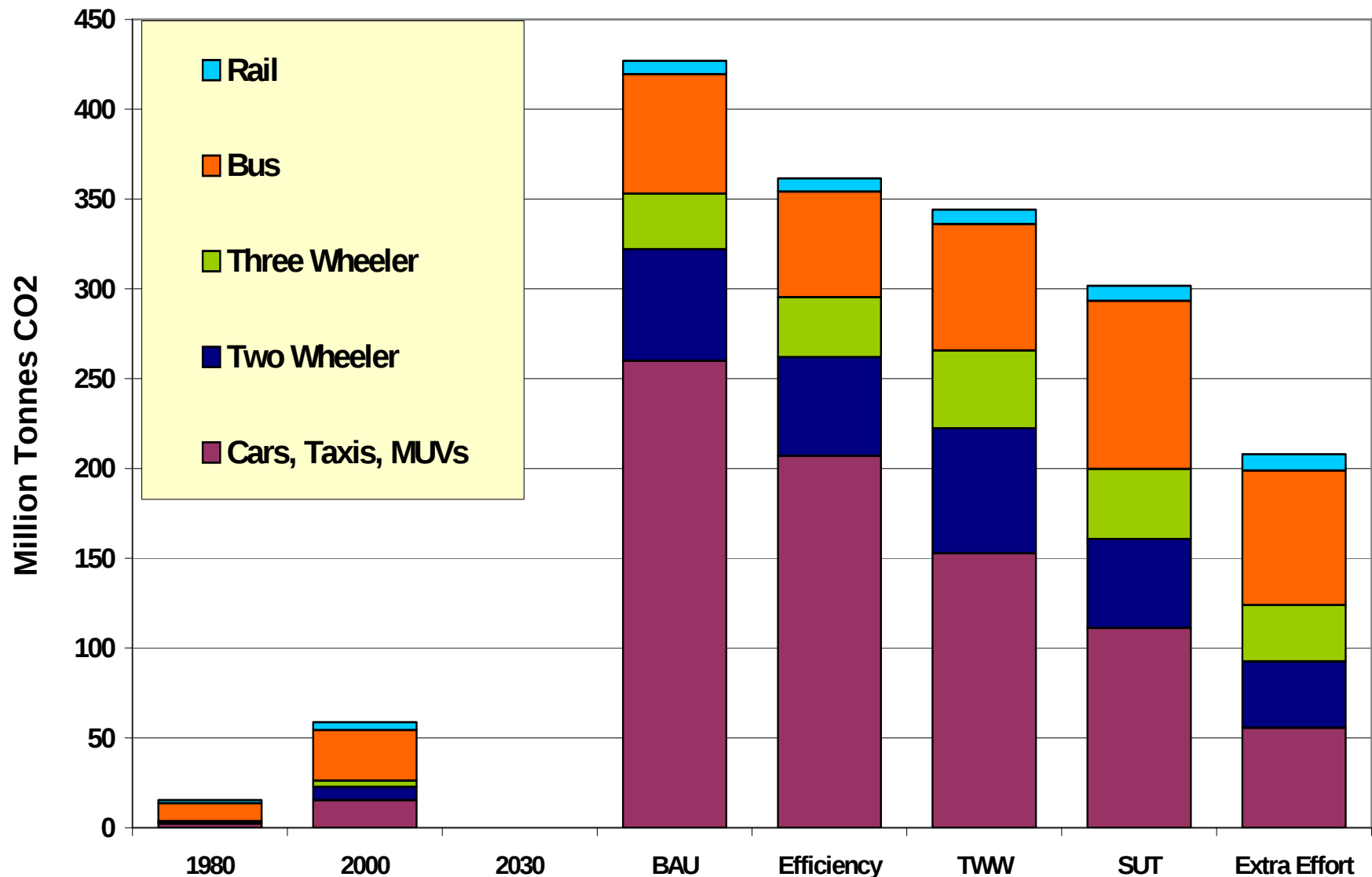


Per Capita Travel by Transport Mode





India in 2030: CO₂ Emissions by Land Transport Mode



Seeing What You Master: Measuring Carbs to Lose Tonnes

- **How Many Vehicles are There Really?**
 - In-use, not just registrations
 - Where are they garaged?
 - Who owns them (vehicles don't drive themselves, people drive them)
- **How Far Do They Run, Where, with Whom or What on Board?**
 - Coupling between mobility of goods/people and purposes of movements
 - Real loadings, both absolute and share of people or tonne capacity
 - Kinds of traffic, drive cycles, speeds etc
- **What are the Real Fuel Consumption Rates?**
 - Difference between test and reality is huge, and varies by region/country
 - Differences among similar vehicles using different fuels can be surprising
 - Diary and measured data needed to develop survey

*These Uncertainties Today's View of Transport
They Make Forecasts Almost Impossible*

Seeing What You Master: When We Have the Data

- **Link to Existing Surveys and Data Collection**
 - Match travel and fuel expenditures to consumer expenditure survey
 - Explore impact of transport and fuel costs on poor
 - Connect with auto service/inspections, police, insurance, logistic companies
- **New Measurement where Vision is Weak**
 - Devise methods of combining regional, national vehicle use and fuel surveys
 - Develop more careful measures of driving cycles, test to on-road MPG
 - “Lents” activity surveys and other links to Clean Air Initiatives
- **New Models and Concepts for Improving Transport Visions**
 - Review of way to internalize transport externalities related to variable costs
 - Vastly improved local and transport planning
 - Better measures of transport-development link and implications for CO2

*Perhaps \$50 Mn/year Regionally to Manage
\$250 Bn of Fuel and \$1 Tn of Transport?*

Mis-Counting Carbs: What if We Get it Wrong?

- **Poor Forecasts and Scenarios of Transport (GIGO)**
 - Miss long-term options for better transport and development
 - Drive headlong into worse congestion, pollution, accidents
 - Risk of missing different drivers of behavior, technology, etc
- **Miss Opportunities to Mitigate Emissions**
 - Can't tell good mitigation from poor
 - Can't estimate costs of emissions mitigation
 - Can't discern low-carbon avoidance from other development strategies
- **Little Chance of Co-Benefits, Avoidance**
 - Cannot measure impacts until it may be too late
 - Difficulties estimating counter-factual cases
 - Loss of good policy arguments that bring CO₂ as a co benefit

Thanks
Lee Schipper
schipper@berkeley.edu

