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Trends in Energy Intensity and CO_2 Emissions from Truck Freight Transport

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

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- A catalyst for socially, financially, and environmentally sound solutions to the problems of urban mobility
- 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.
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Objectives

- Compare the energy intensity of truck freight transportation across several OECD nations
  - Modal efficiency (megajoules/tonne-kilometer),
  - Carbon intensity (tonnes carbon/capita)
  - Vehicle efficiency (megajoules/vehicle-kilometer)
- Interpret the results and implications for
  - Role of truck freight in future emissions
  - Policy measures affecting trucking and freight
  - Technology to save fuel and emissions from trucking

Background and Methodology

- Approach is Bottom-Up, with Factoral Analysis
  - Activity and Modal Structure
  - Energy Intensity (fuel/tonne/km or per veh/km) and emissions (Co2)
  - Data sources 90% nat. official or semi-official data, 10% other work
- Basis Two Previous Papers
  - Schipper, Scholl, and Price. 1997. *Energy Use and Carbon Emissions from Freight in 10 Industrialized Countries: An Analysis of Trends from 1973 to 1992.*
  - Schipper, Marie-Lilliu. 1999. *Carbon-Dioxide Emissions from Transport in IEA Countries: Recent Lessons and Long-term Challenges*.
  - National analyses of Japan, Australia, New Zealand, US, four European countries carried out by Schipper et al. at LBNL and the IEA 1988-2000.
- Original Surprises
  - Largest countries had largest freight bill, but lowest trucking shares
  - Modal shifts towards trucks offset lower fuel intensities in increasing fuel use and CO2 emissions
  - Freight as source of CO2 grew faster than travel

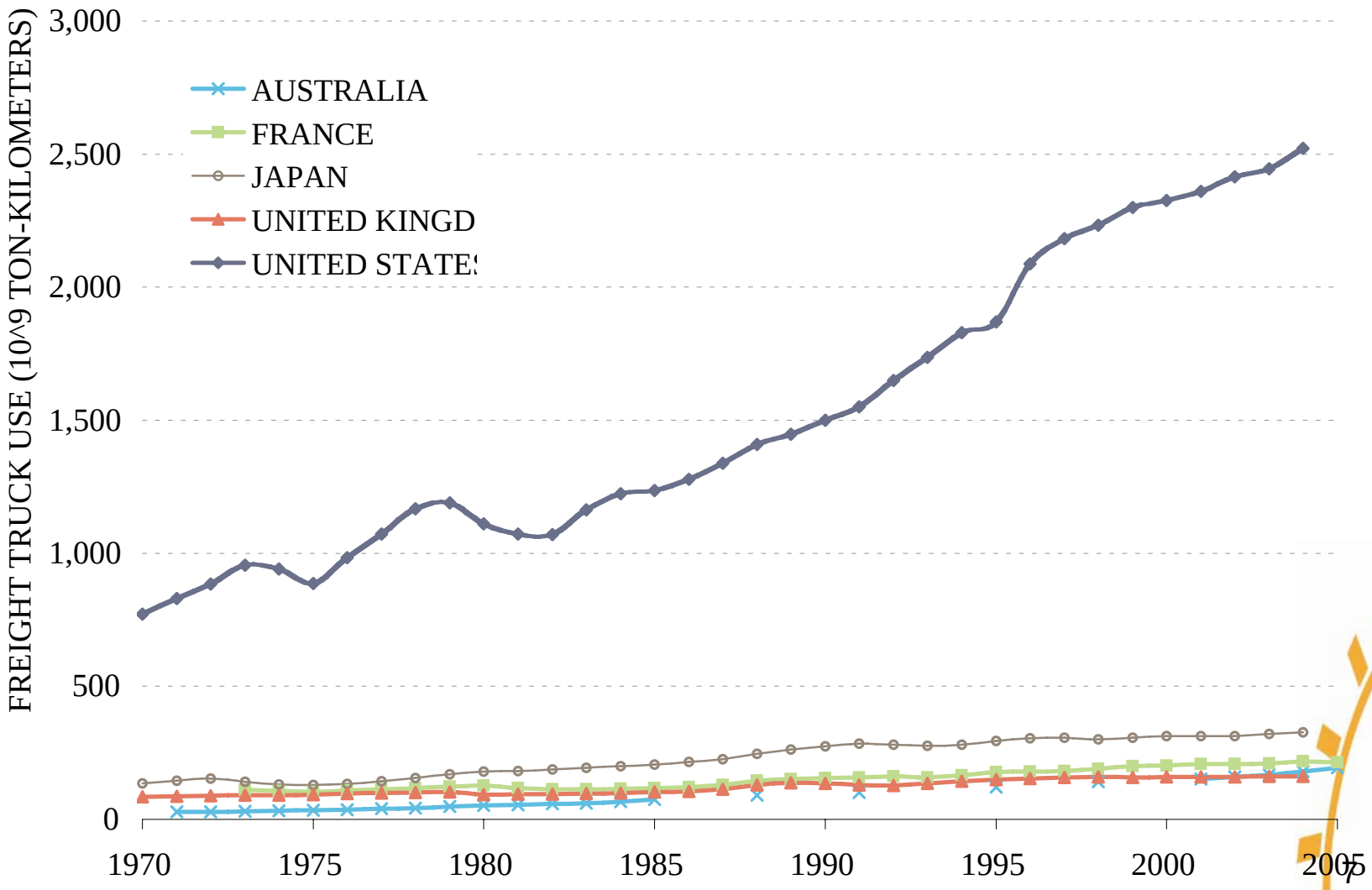
Coverage and Main Sources

- Coverage
  - Includes domestic land-based freight including import/export
  - Excludes international transit freight
  - Excludes natural gas in pipelines but includes oil and coal
- Data Sources
  - Australia
    - Australian Bureau of Statistics
    - Personal communications – Appelbaum Associates
  - France
    - Ministère de l'Ecologie, du Dévelopment et de l'Aménagement Durables
  - Japan
    - Ministry of Land , Infrastructure, and Transport
    - Energy Data and Modeling Center, Jap. Inst. Of Energy Economics
  - United Kingdom
    - Department for Transport
    - Department of Trade and Industry
  - United States
    - Transportation Energy Data-book (ORNL)
    - Bureau of Transportation Statistics
- Coming Soon – Germany, Norway, Sweden, Denmark

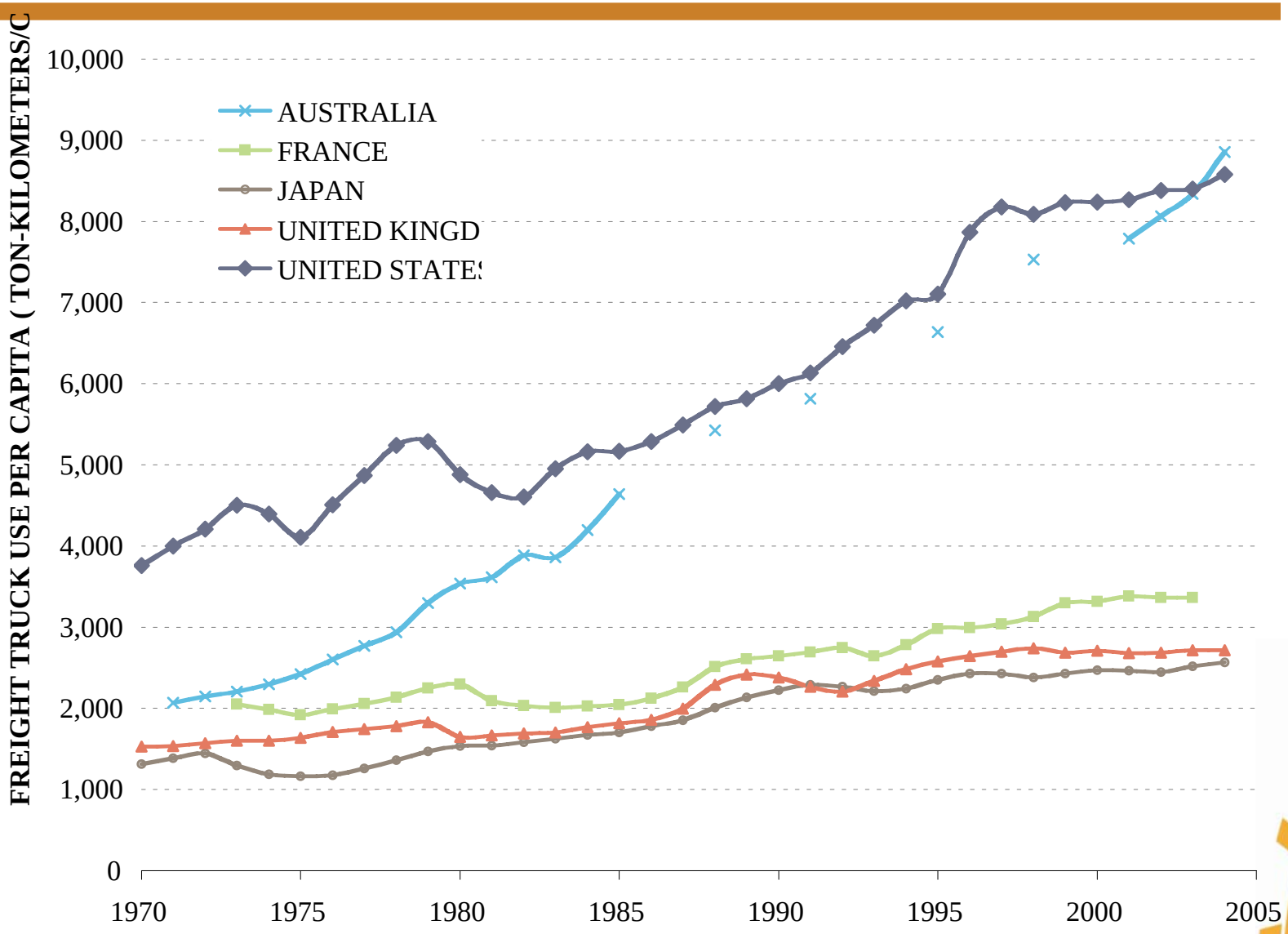
Data Limitations

- Data collection methodologies
  - Timing and scope
  - Vehicle category definitions
  - Sample sizes
- Data limitations
  - Uncertainties on uses, km, haulage of light trucks
  - Difficulties getting accurate data on loading (tonnes/km)
  - For Europe, trans-border haulage, etc.
- **US Example of Data Nightmares**
  - Ton-miles on interstate trucking only (VIUS dead)
  - VMT, fuel estimated by vehicle type, not freight type
  - Increase in short haul, urban delivery untracked
  - CO2 from interstate, Mexicanadian traffic?

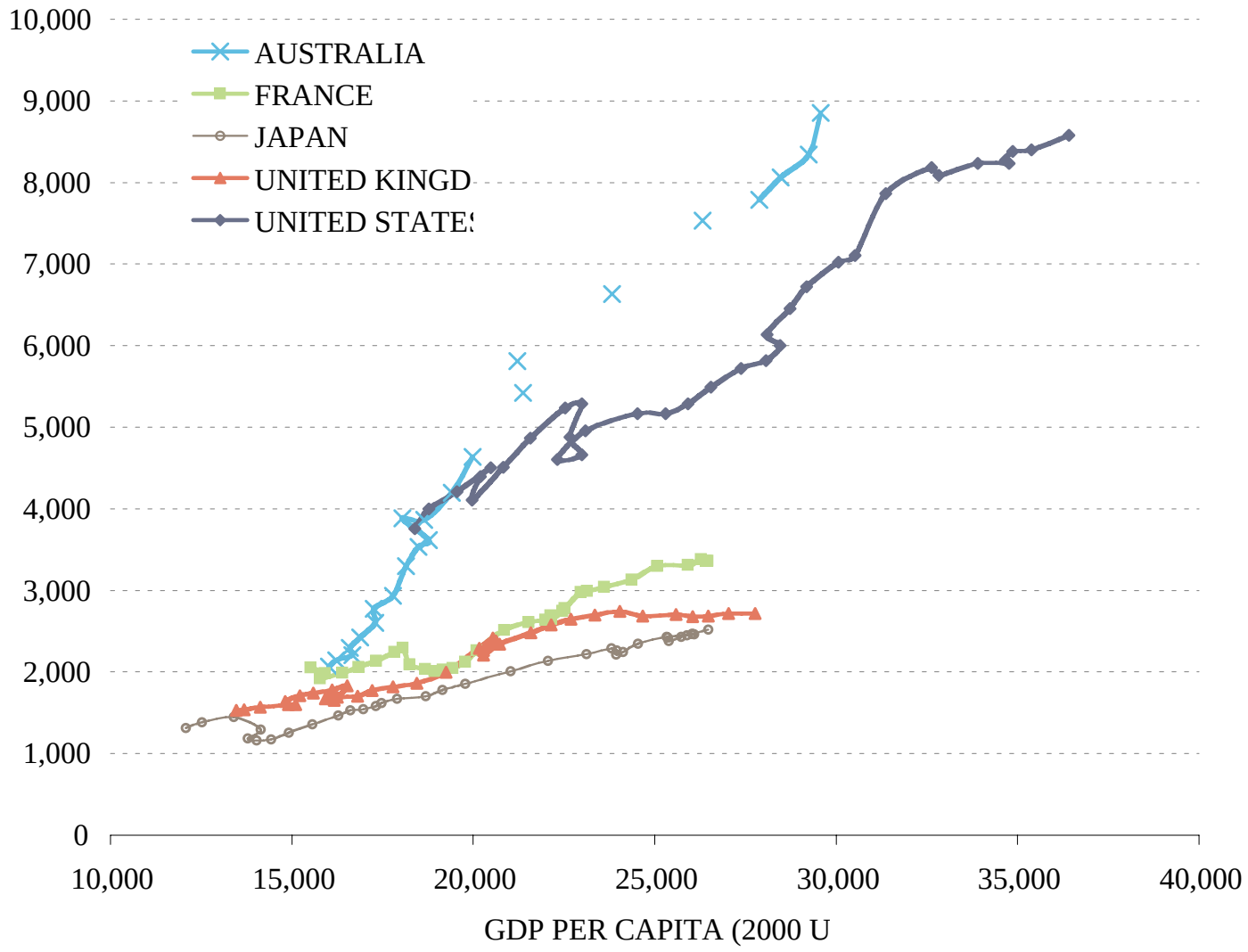
Continued Growth in Ton-Km



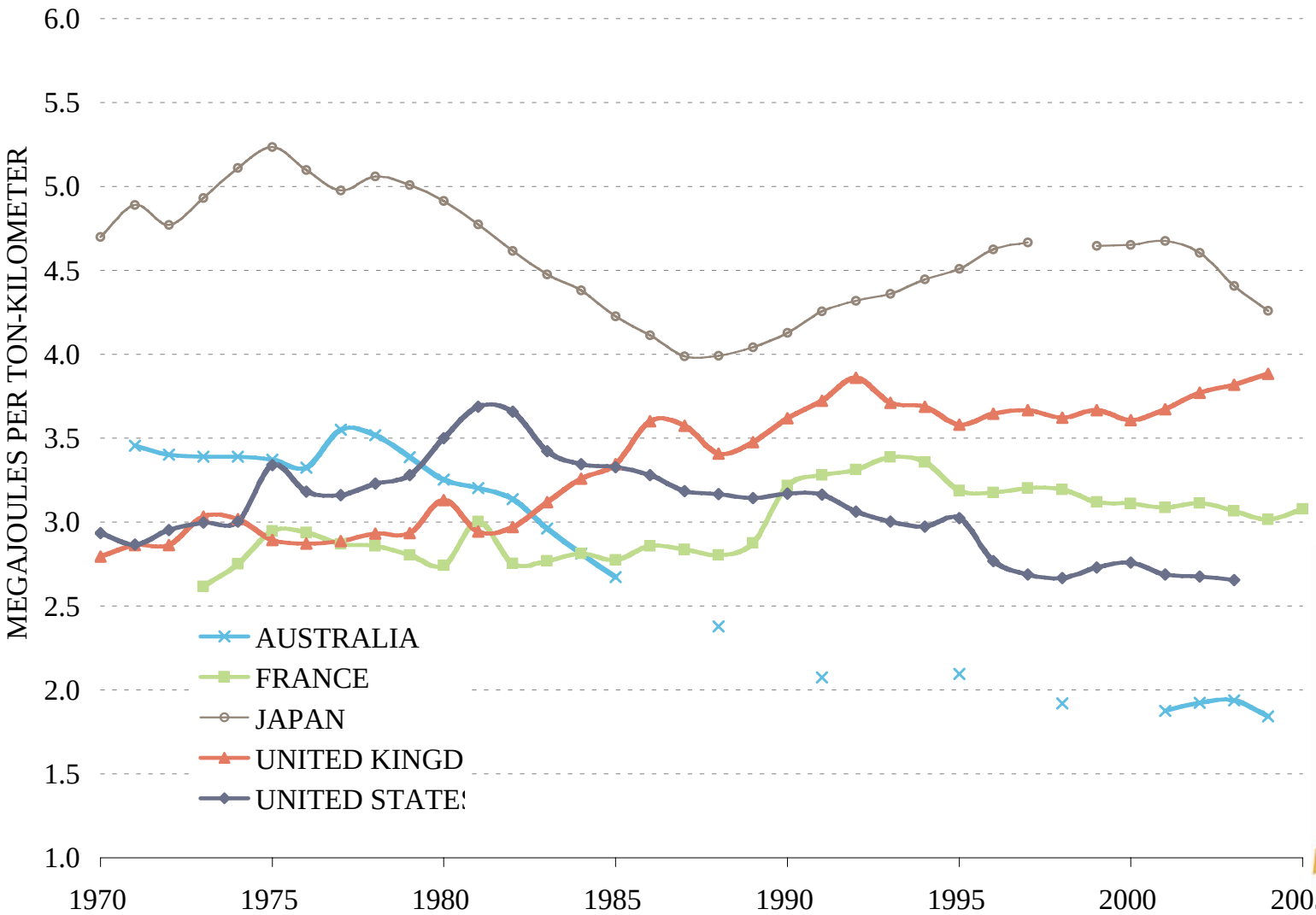
Ton-Km Per Capita



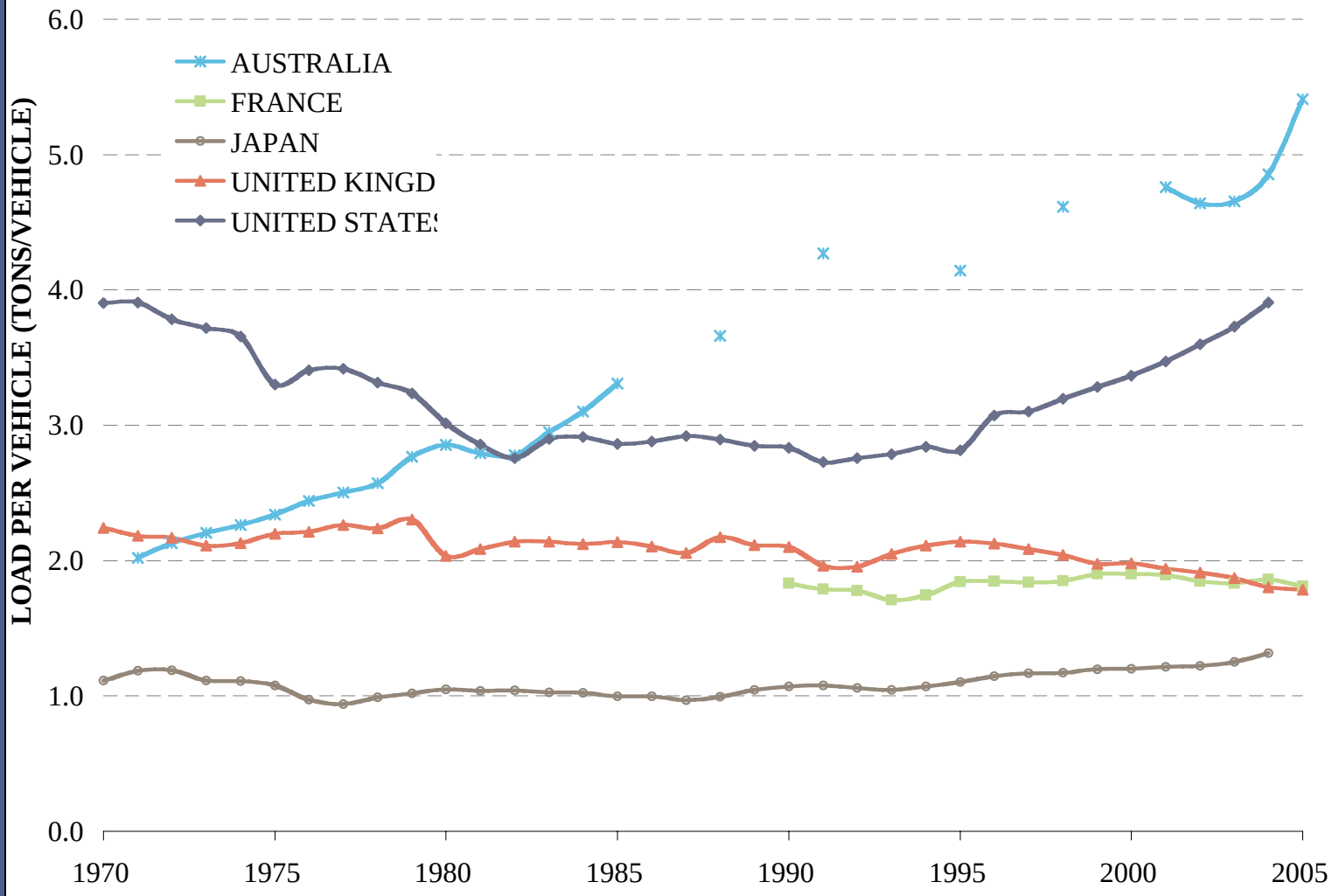
Freight Activity And GDP per Capita 1973-2003/4 Can the Two be Uncoupled?



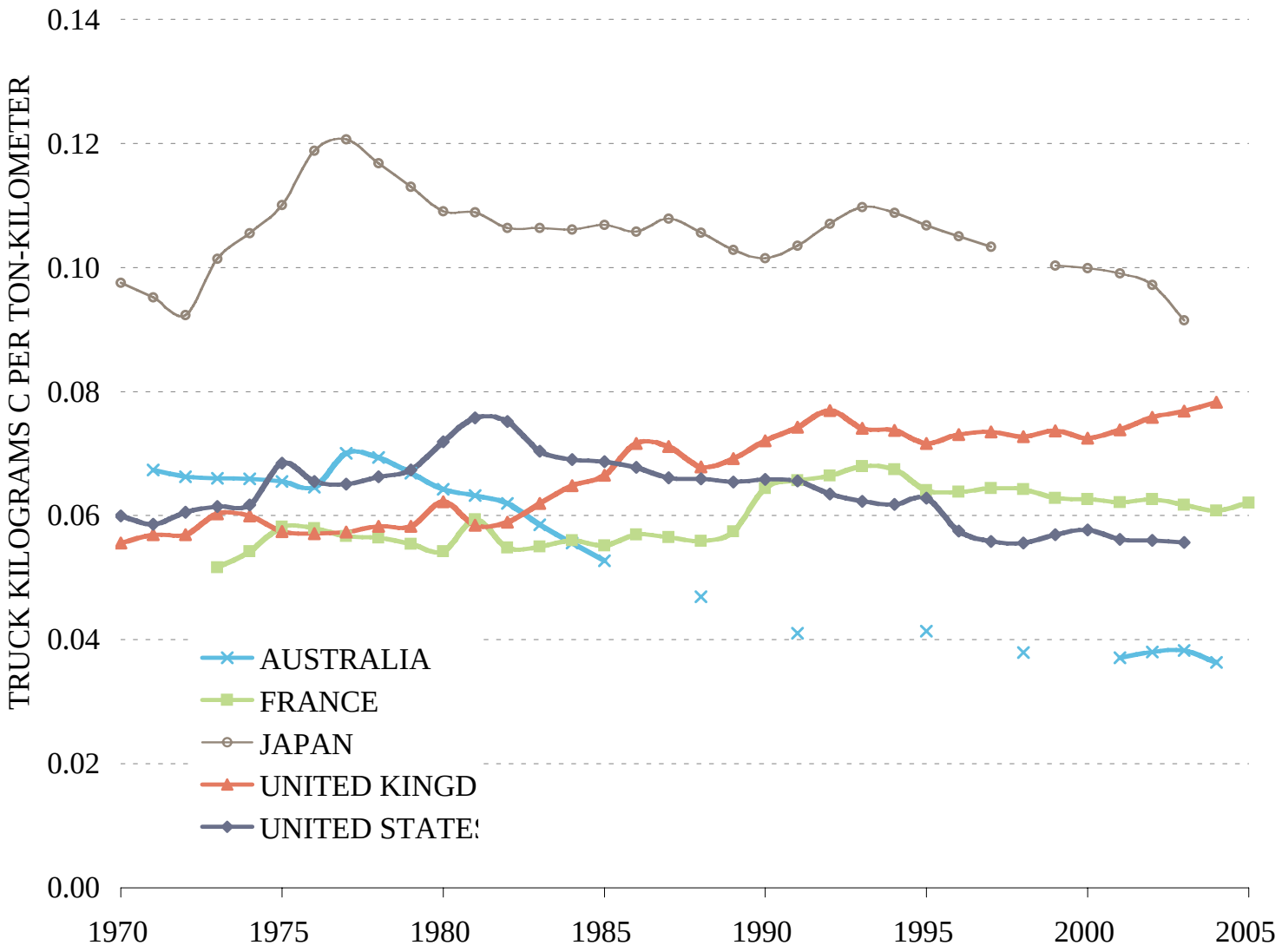
Modal Energy Intensity



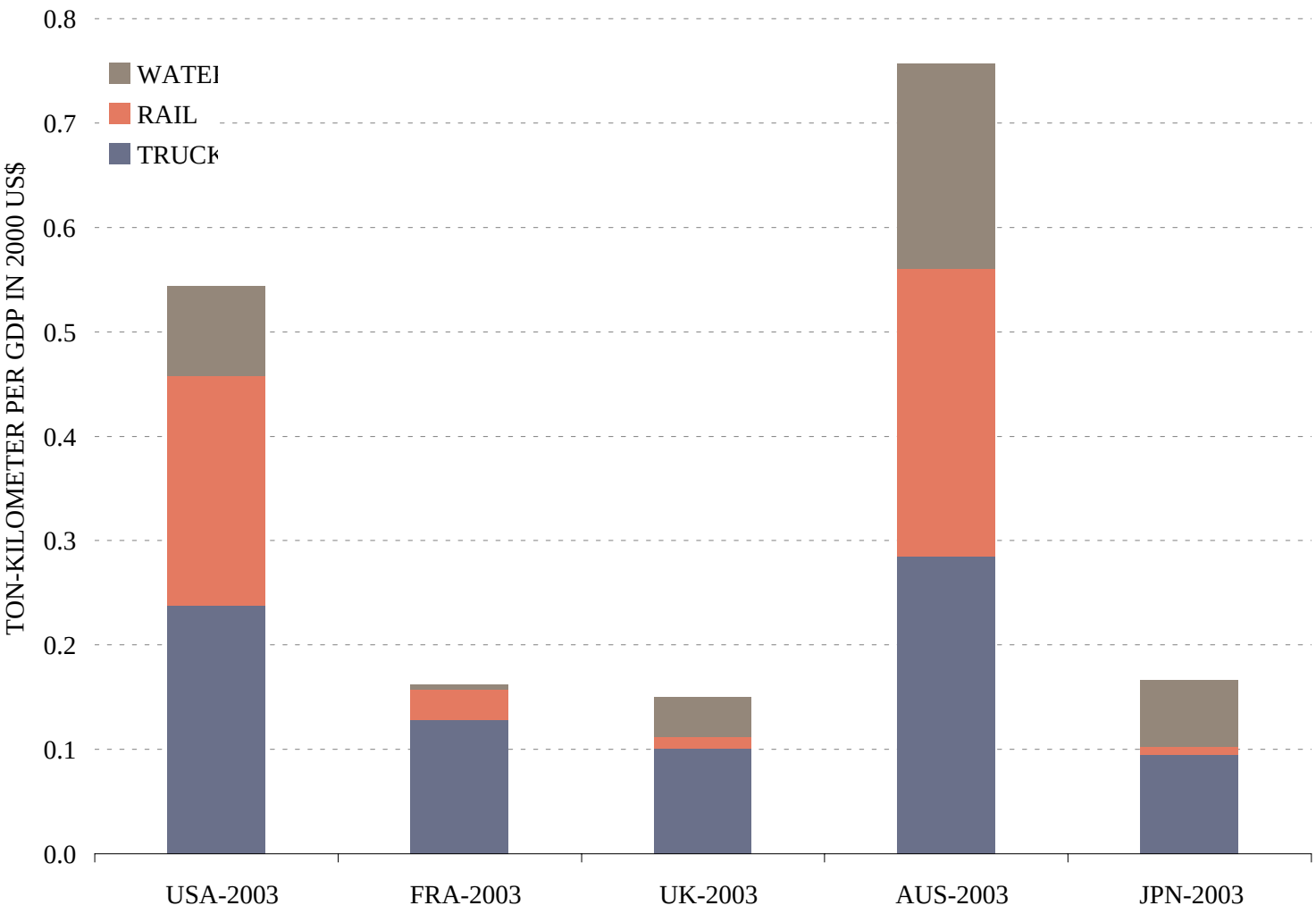
Average Load Per Vehicle



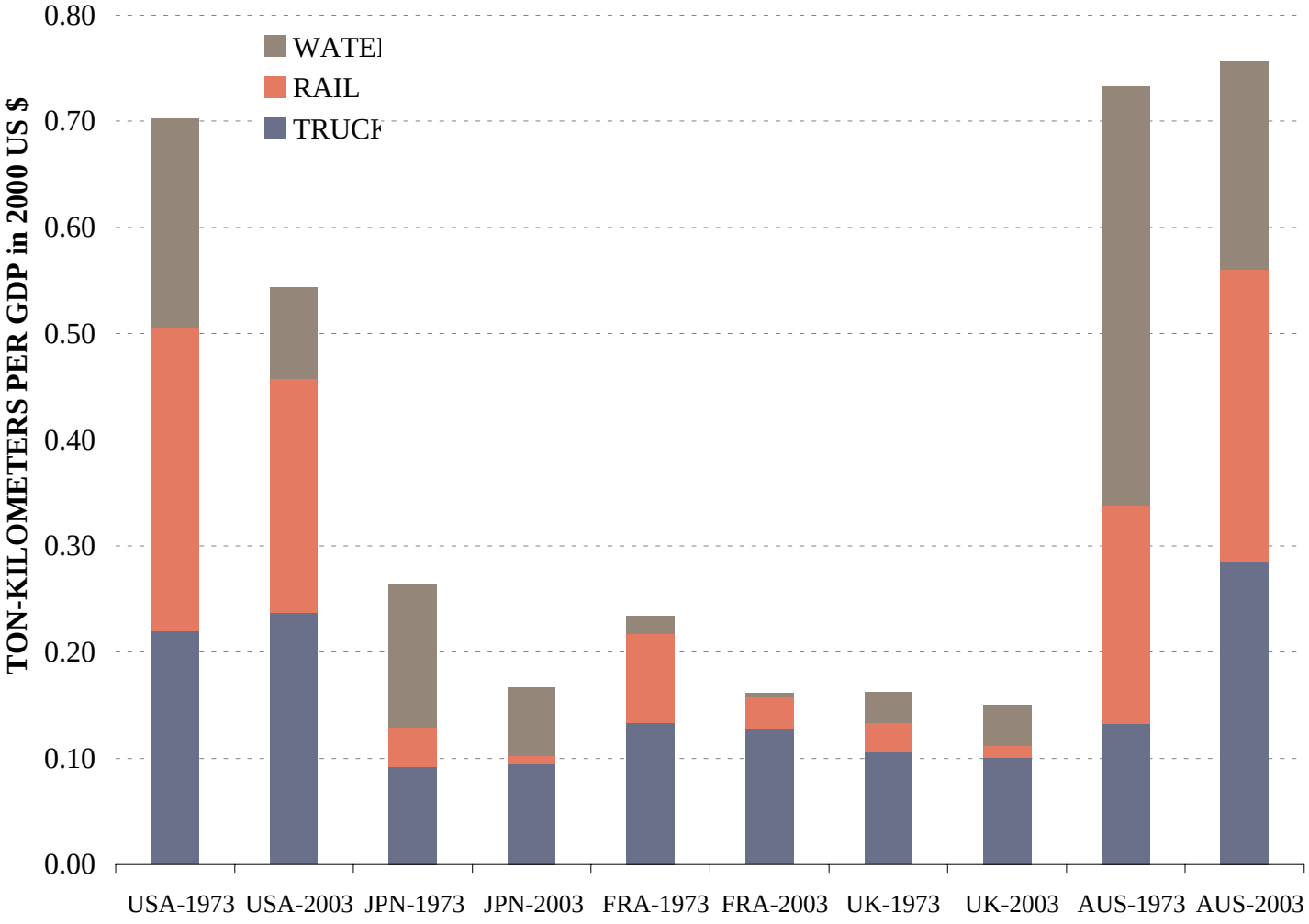
Carbon Emissions per Ton-Km



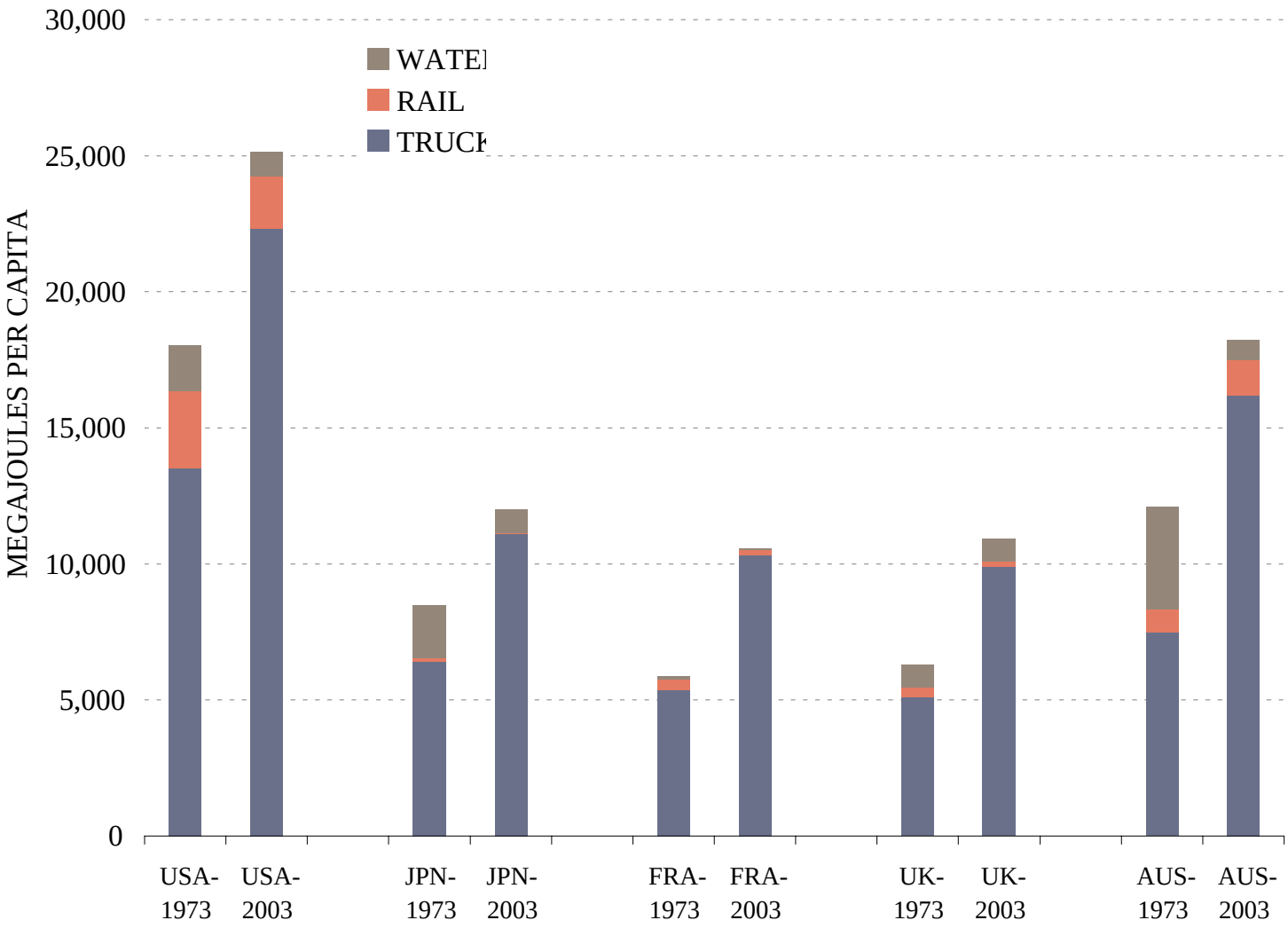
Modal Distribution per GDP



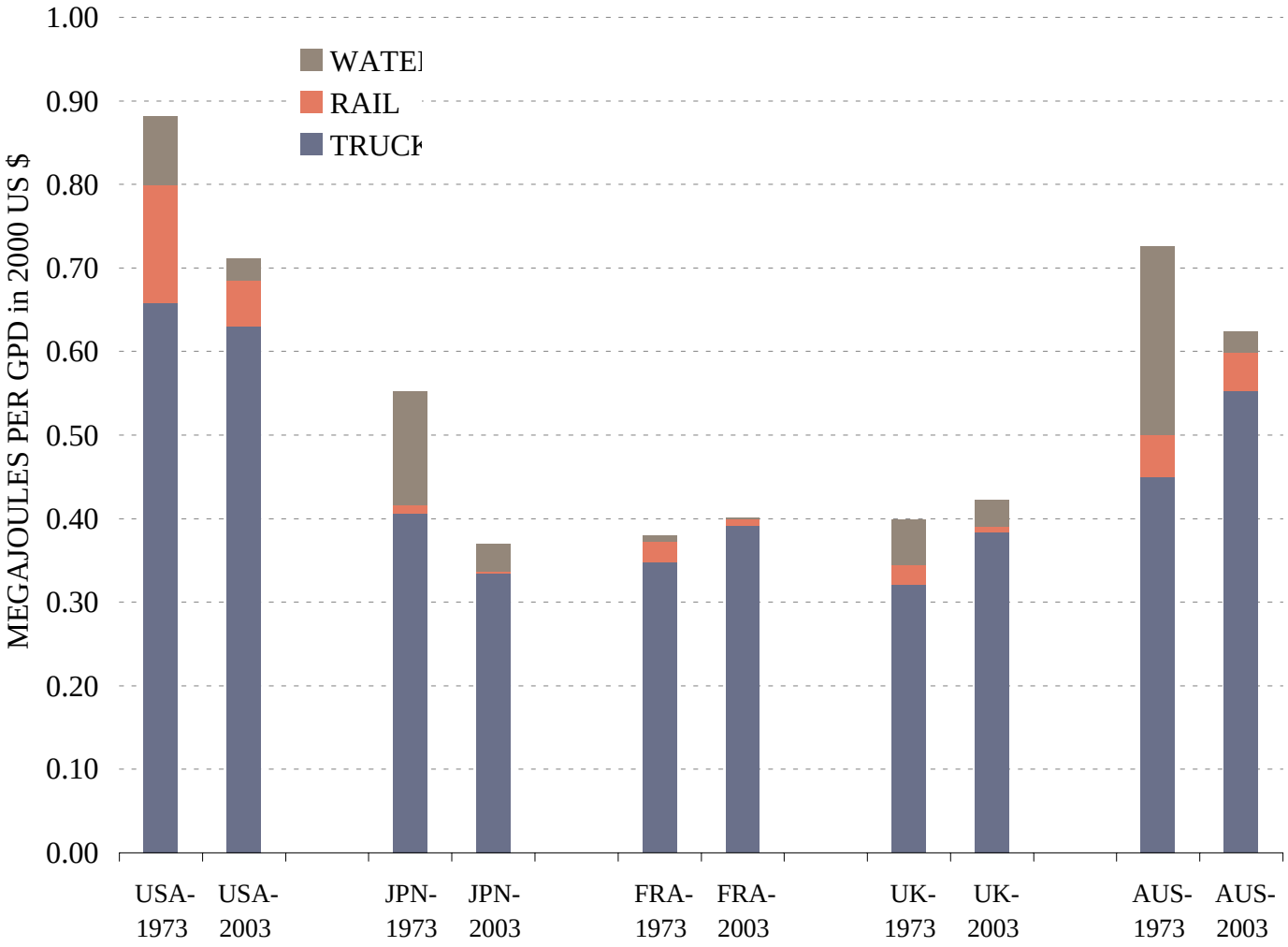
Ton-Kilometer per GDP



MJ per Capita Energy for Freight



MJ of Freight Energy per Unit of GDP



Decomposing Changes in Freight Energy Use

Results for 1973 (2000=100)

	Actual	Intensity	Structure	Activity
AUS	51	189	58	42
FRA	49	85	78	72
JPN	58	113	69	71
UK	54	100	99	56
USA	52	113	79	56

Decomposing Energy Use

Results for 2003 (2000=100)

	Actual	Intensity	Structure	Activity
AUS	113	102	98	112
FRA	102	99	104	99
JPN	97	95	104	98
UK	109	108	102	99
USA	100	96	101	103

Key Findings Reinforce Earlier Work: Reducing Emissions a Challenge

- 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, better loading, low carbon fuels?
  - Slow food grown locally: How to change world trade juggernaut?
  - Modal shifts back to rail – unlikely in any significant degree

Key Issues

- Untangling Components of Change
  - Modal shifts
  - Changes in vehicle size and traffic, i.e. delivery vs distribution vs long-haul
  - Changes in vehicle loading and traffic - logistics
- Untangling Drivers of Change
  - Regulatory factors affecting emissions, costs, etc
  - Shifts in kinds of goods made, kinds of markets, distances
  - Changes in fuel costs, other competitive factors
- Future Trends in Trucking, Fuel and Emissions
  - Technology improvements in fuel economy, local emissions
  - Switch to other fuels?
  - New ideas for logistics and distribution

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