Introduction to Energy Indicators

Motivation and Approach

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International Energy Agency

CSD 14

4 May 2006

Assessing Energy Efficiency Progress:

A call for action from G8 Leaders and IEA Ministers

- **Gleneagles Plan of Action (G8 Communiqué):**

  We will [G8 Heads of States]….invite the IEA …to develop energy indicators to assess efficiency…

- **Communiqué from IEA Ministers May 2005:**

  "…instruct the IEA to monitor our efforts to [reinforce our energy efficiency effort]…"

Presentation Overview

- Why indicators?
- What are they?
- Examples
- Data needs

Why Indicators?

Indicators can help...

- Understand driving forces behind growth in energy demand
- Separate factors related to energy efficiency from those that are not
- Identify potentials for energy efficiency improvements
- Measure progress of energy efficiency measures

What is an Energy Indicator?

- **Relates energy use to activities driving demand for energy services**
- **Two main types:**

1. **Indicators following activities that drive energy use**

   (e.g. industrial output, building area, appliance ownership, ton-km, car-ownership and use)

2. **Indicators following energy intensity developments:**

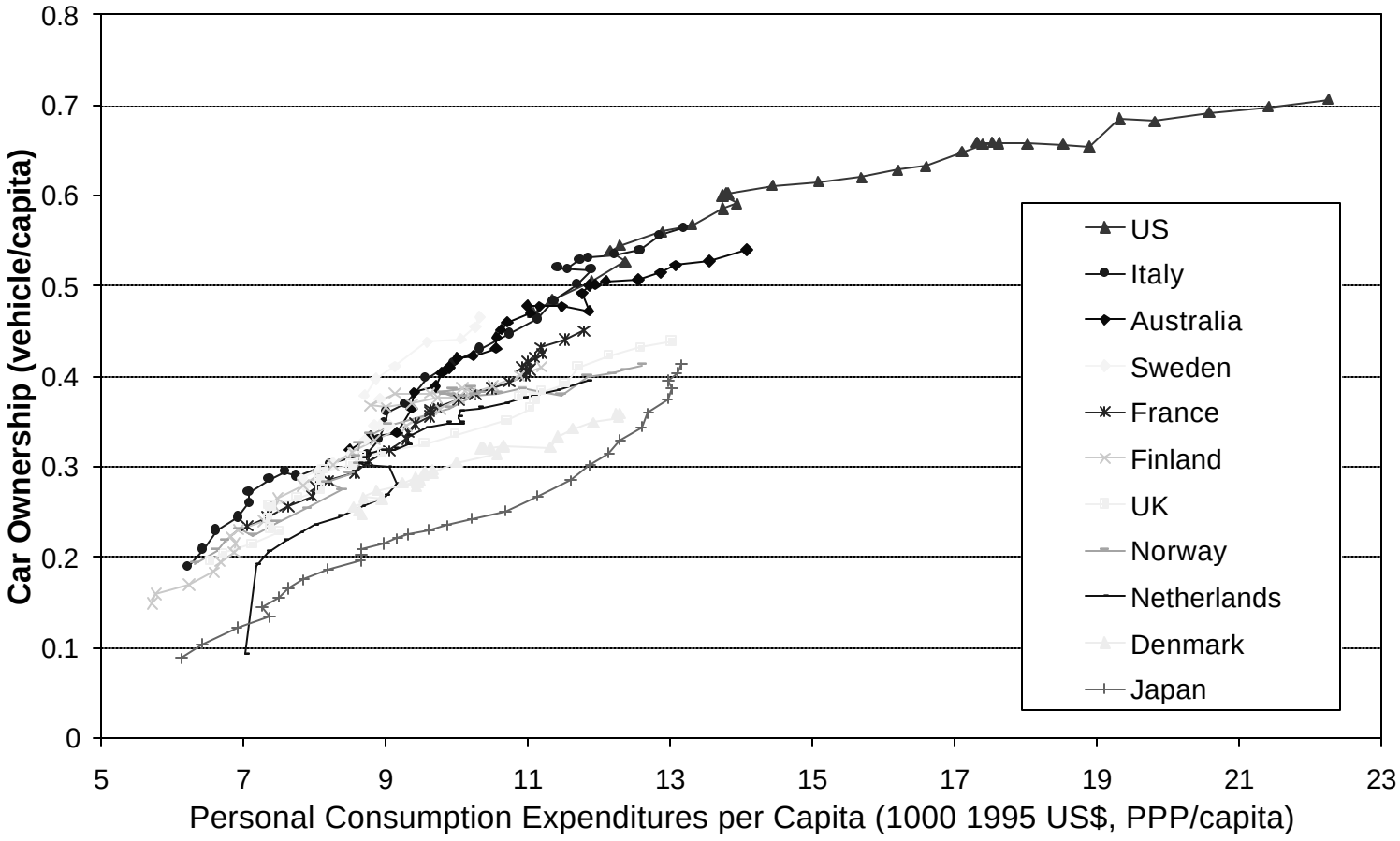
   (e.g. energy/passenger-km, energy/value added by industry branch, space heating energy/floor area)

Example of Driving Force
Car Ownership and Income 1970-2000

Oil Crises & Climate Challenges

30 Years

OF ENERGY USE IN IEA COUNTRIES



Strong growth most places, slowly leveling off in the US

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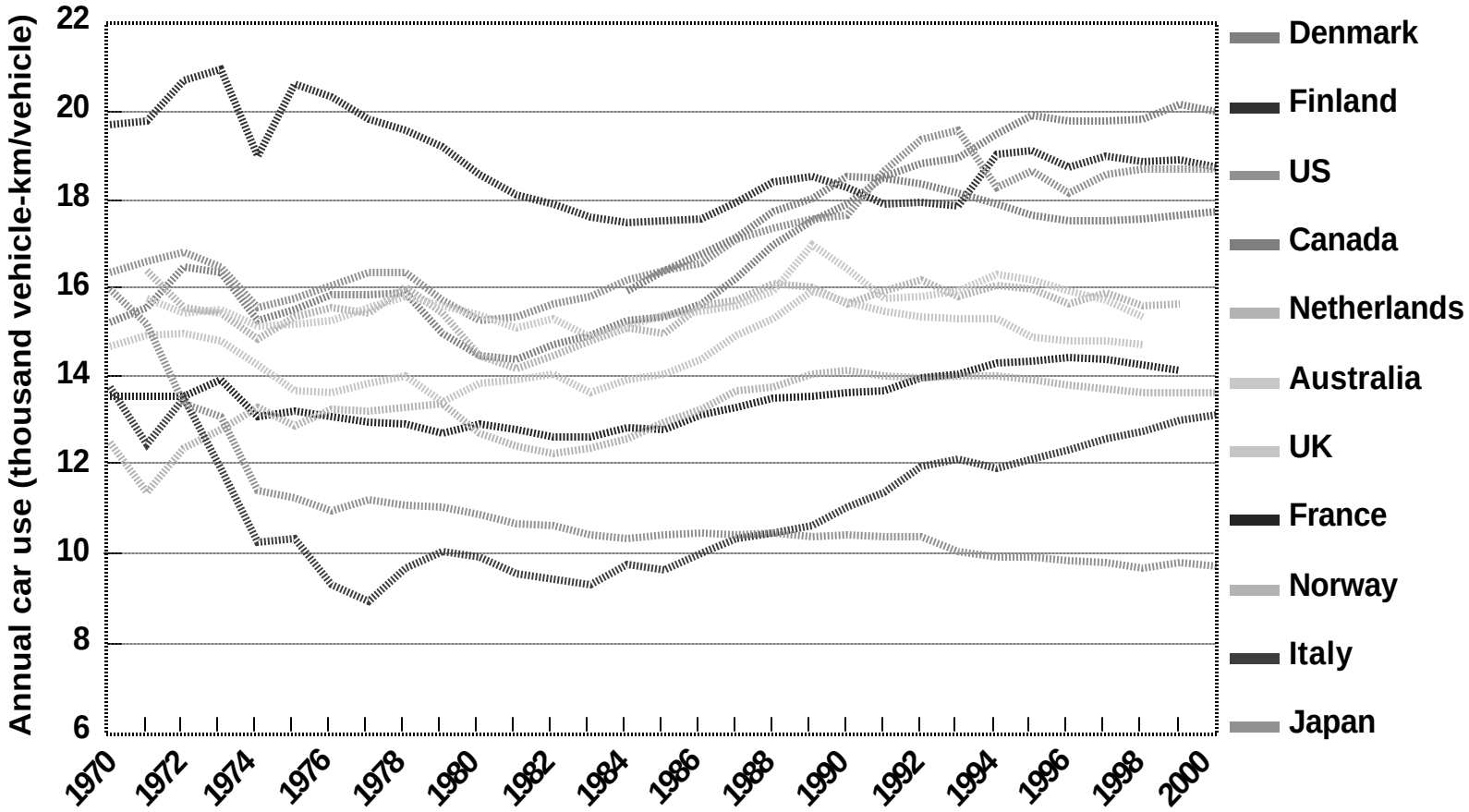
30 Years

OF ENERGY USE IN IEA COUNTRIES

Example of Driving Force
Annual kilometres per Vehicle



Travel per vehicle is fairly stable over time

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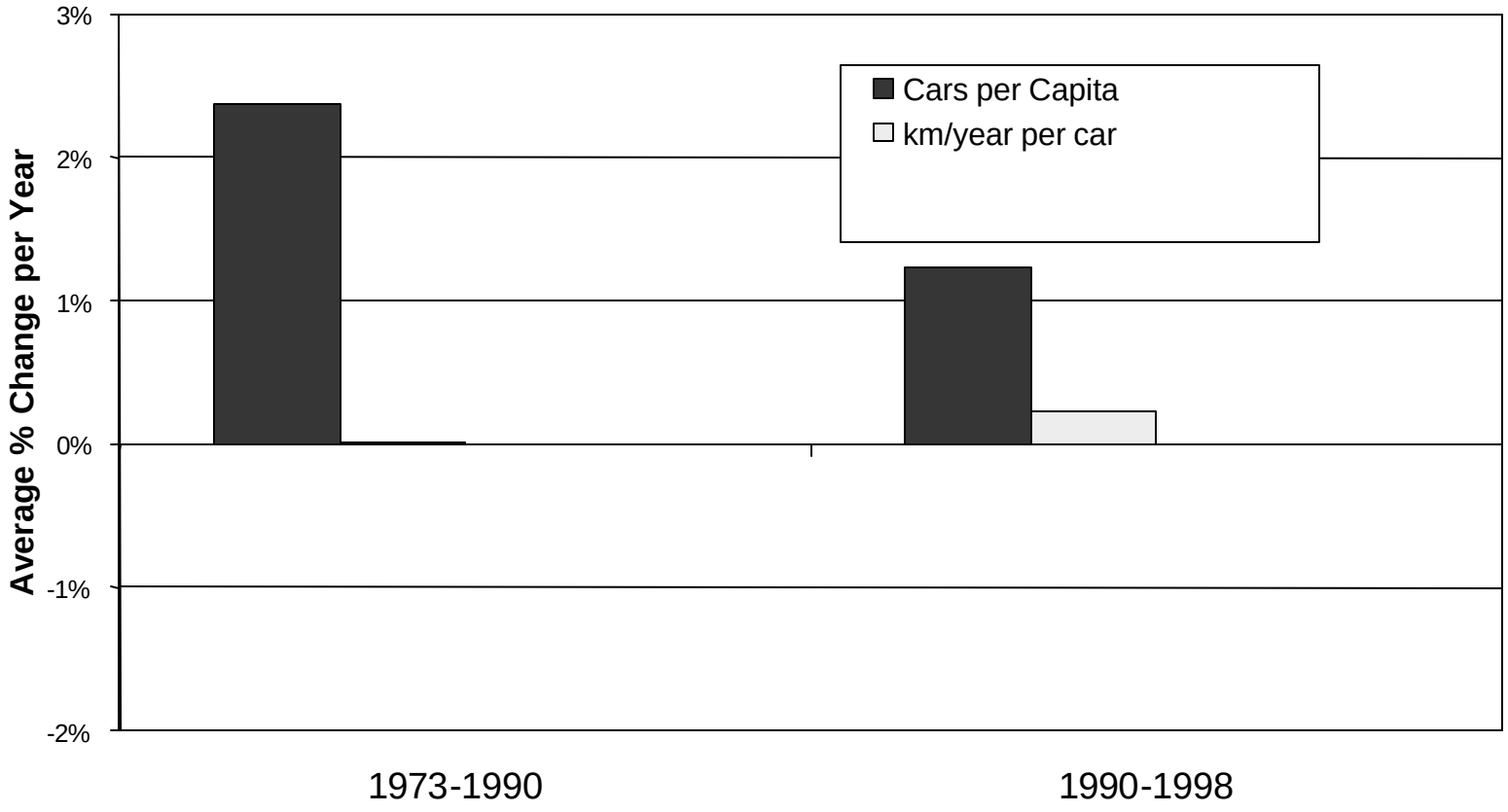
Energy for Cars (IEA-11)

Factors shaping development 1973-1998



Strong growth in car ownership while the use of each car has changed little

Example of Intensity Indicator
Car Stock-average Fuel Intensity

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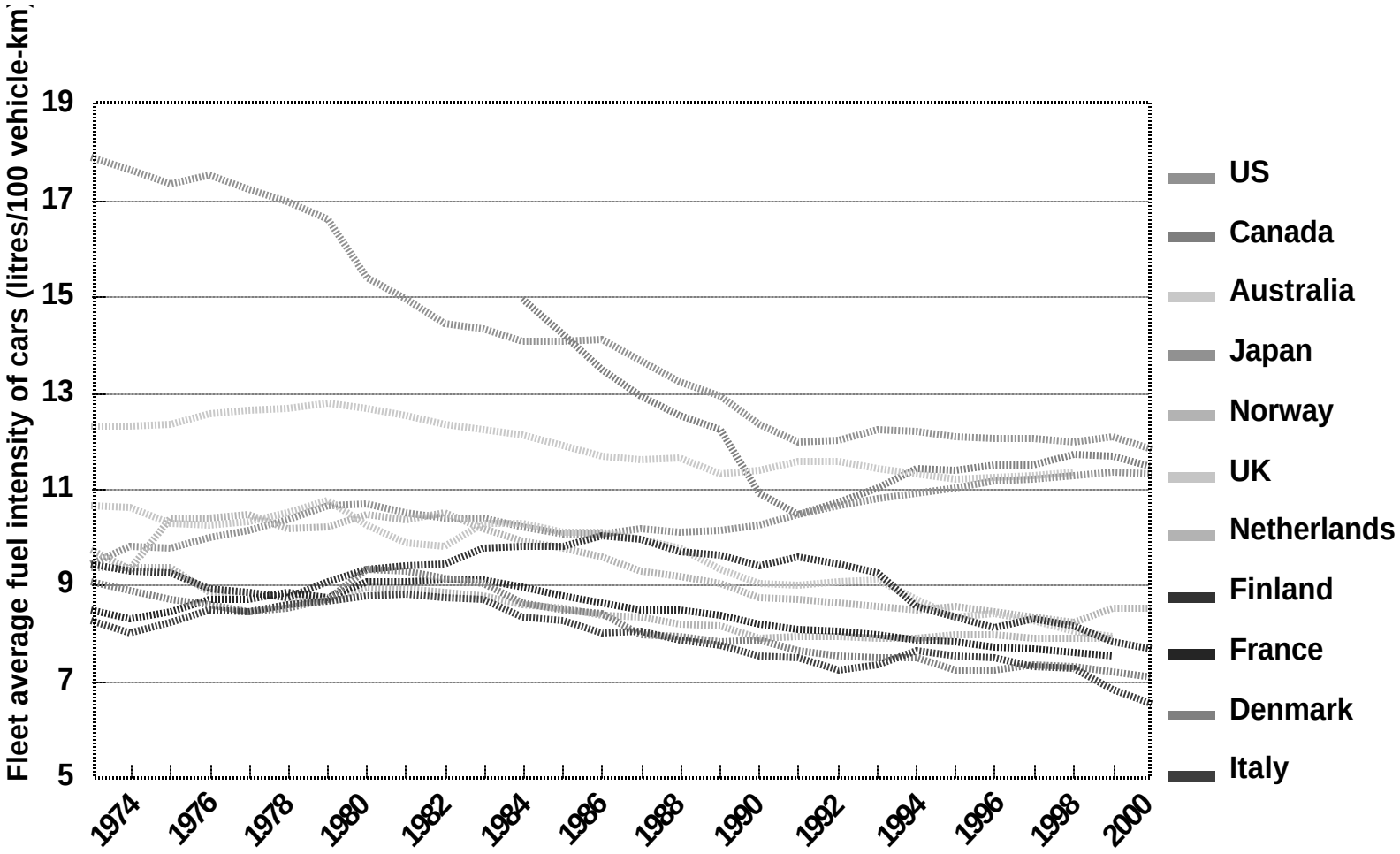

Strong decline in the US until 1990, no change since then

Energy for Cars (IEA-11)
Factors shaping development 1973-1998

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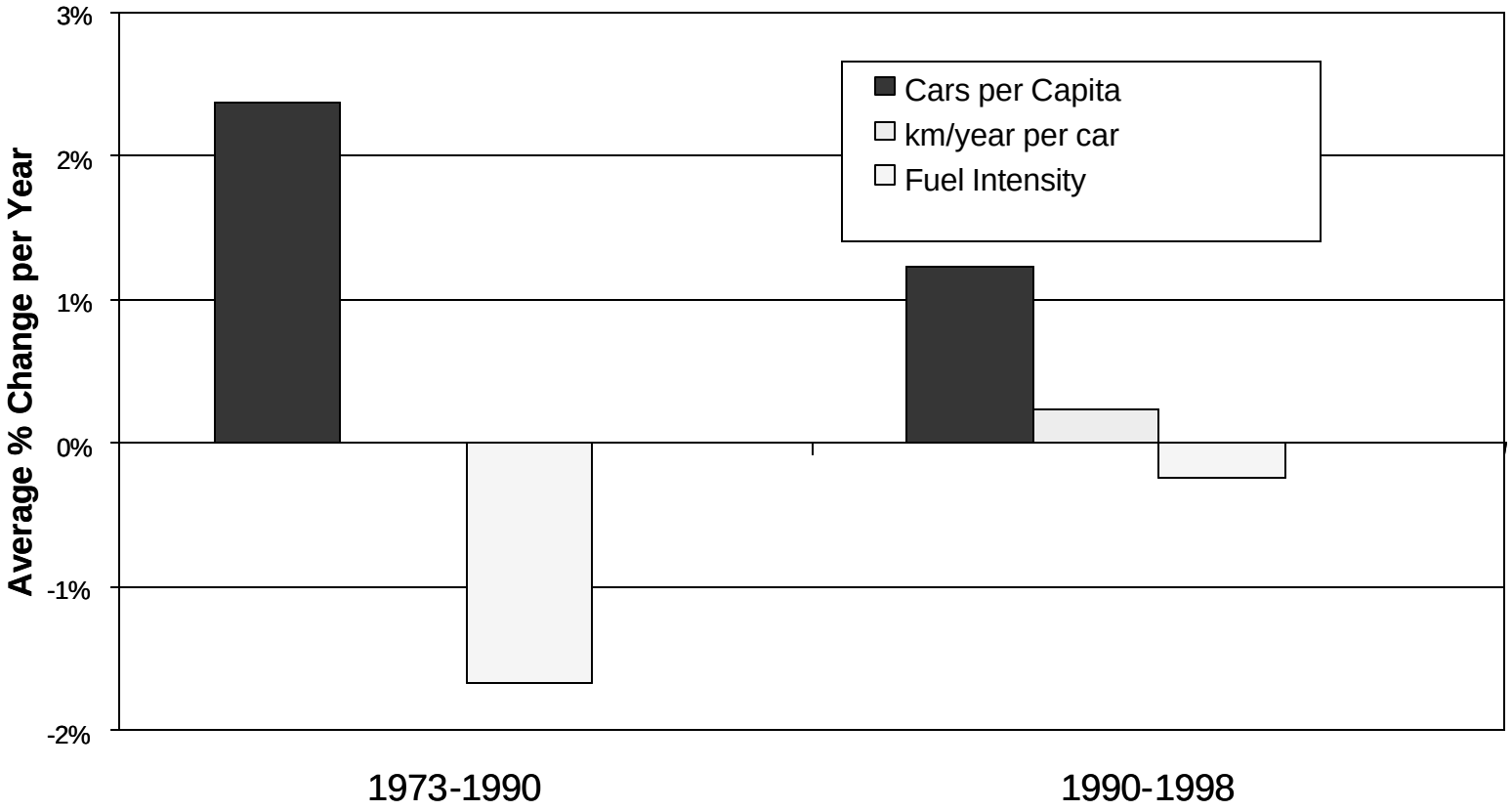

Decline in fuel intensity has slowed….

Energy for Cars (IEA-11)
Factors shaping development 1973-1998

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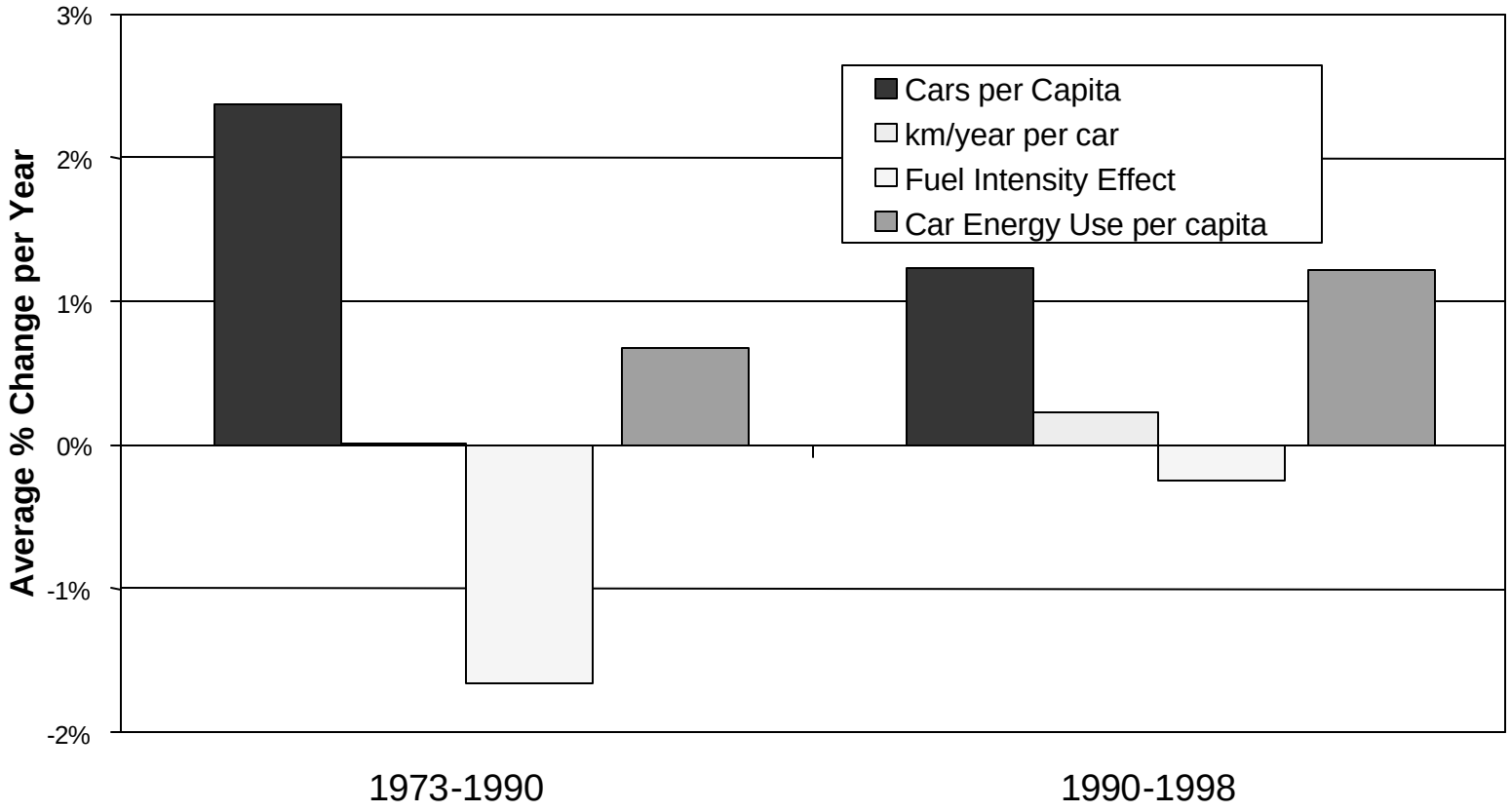

Net result is more rapid growth in fuel demand after 1990 despite lower growth in car ownership

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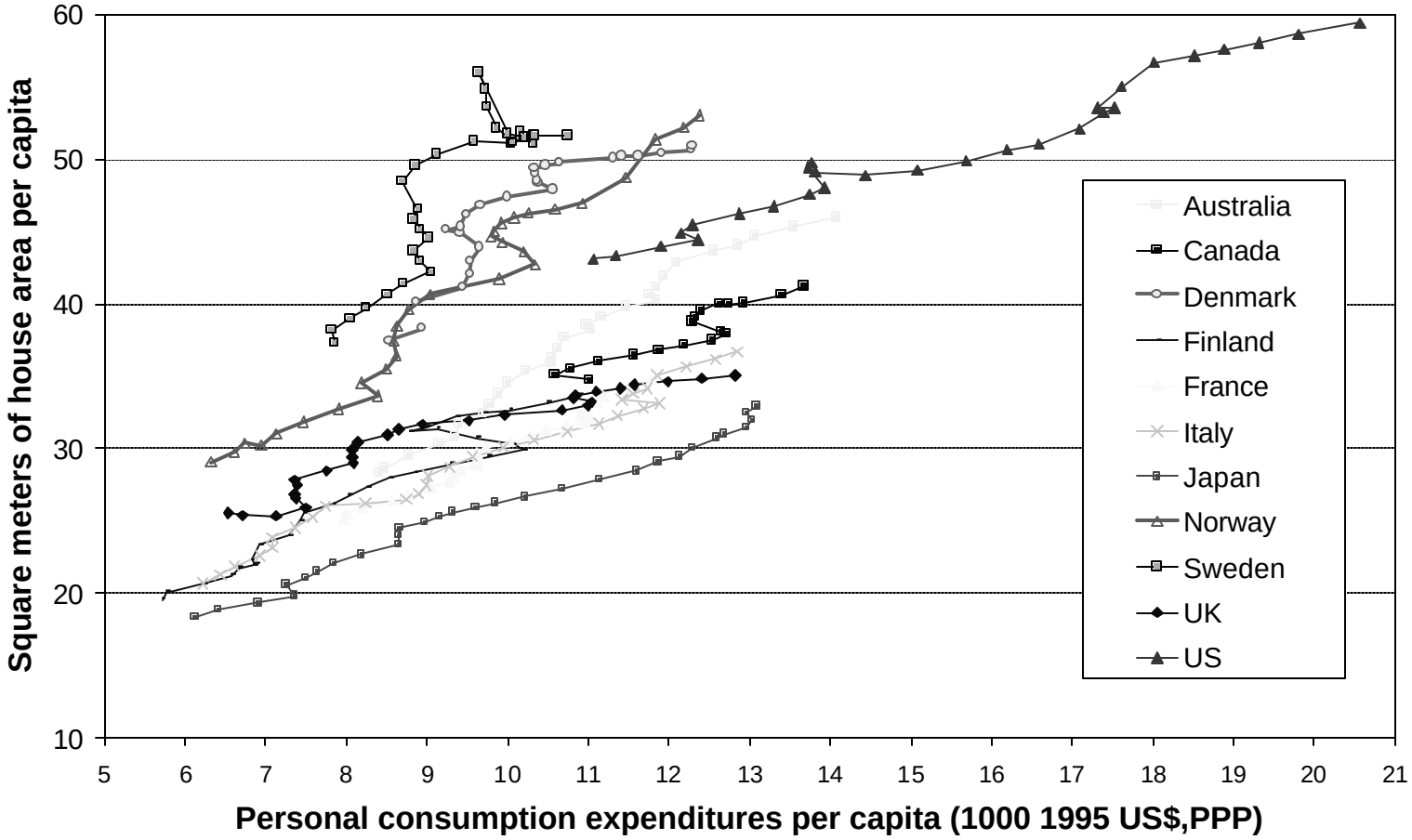
OF ENERGY USE IN IEA COUNTRIES

Example of Driving Force

House Area vs. Income (1973-1998)



Living space gets bigger as we get richer

Energy for Space Heating (IEA-11) Factors shaping development

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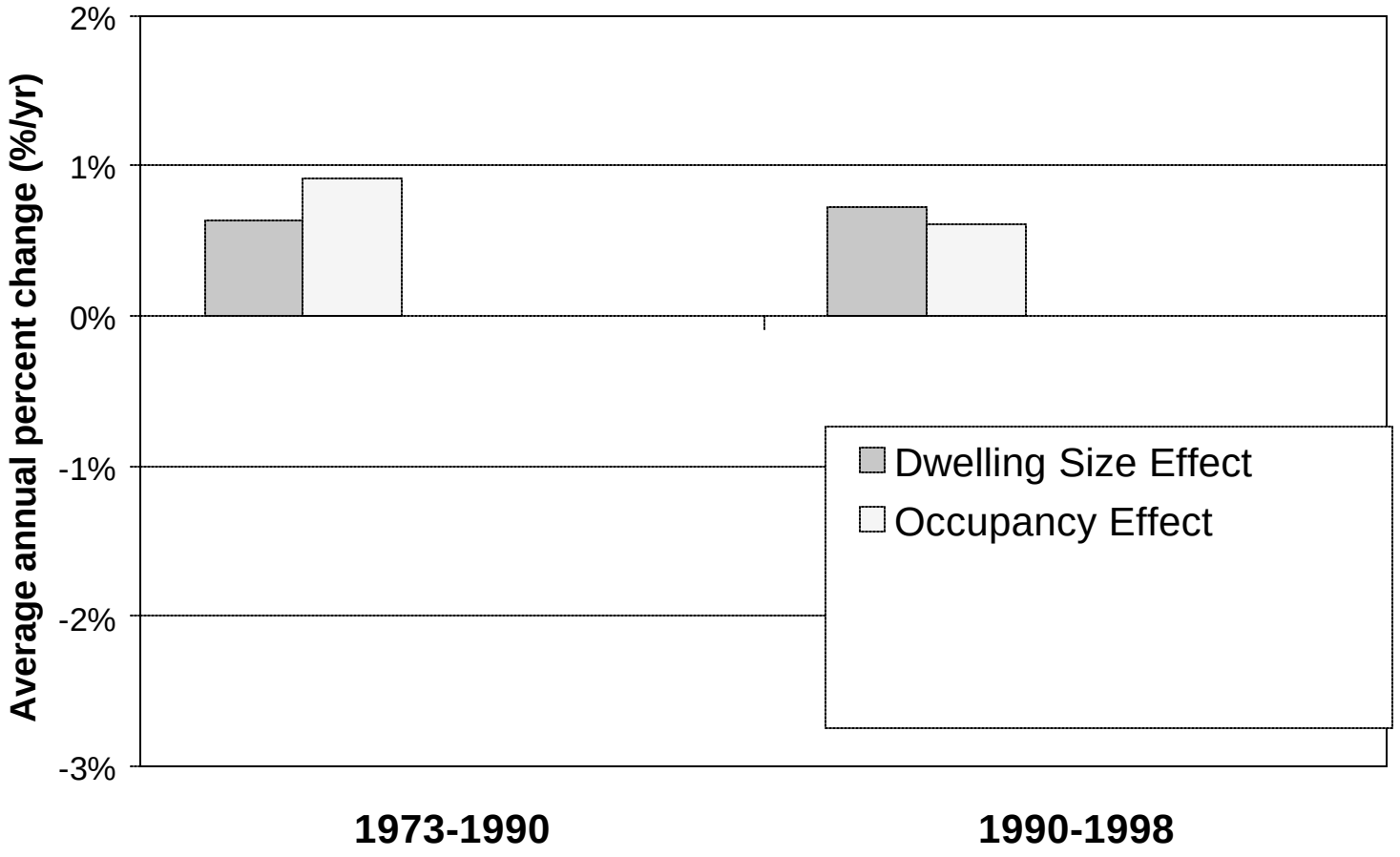
OF ENERGY USE IN IEA COUNTRIES



Bigger homes and fewer people per home steady drivers of space heating demand

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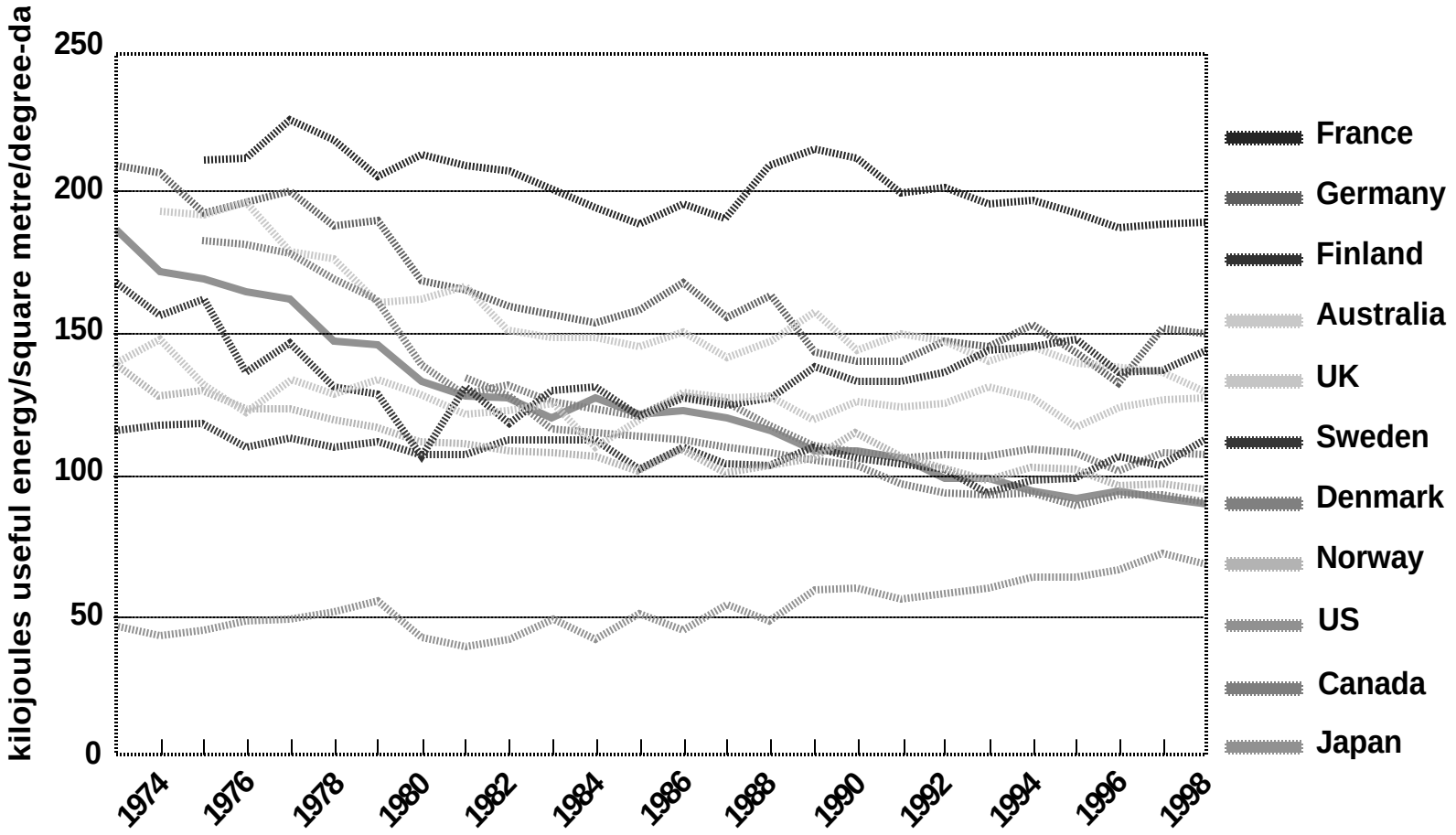
OF ENERGY USE IN IEA COUNTRIES

Example of Intensity Indicator
Useful Space Heating Intensity



Space heating intensities have declined, but increased comfort levels offset the savings in some countries

Energy for Space Heating (IEA-11) Factors shaping development

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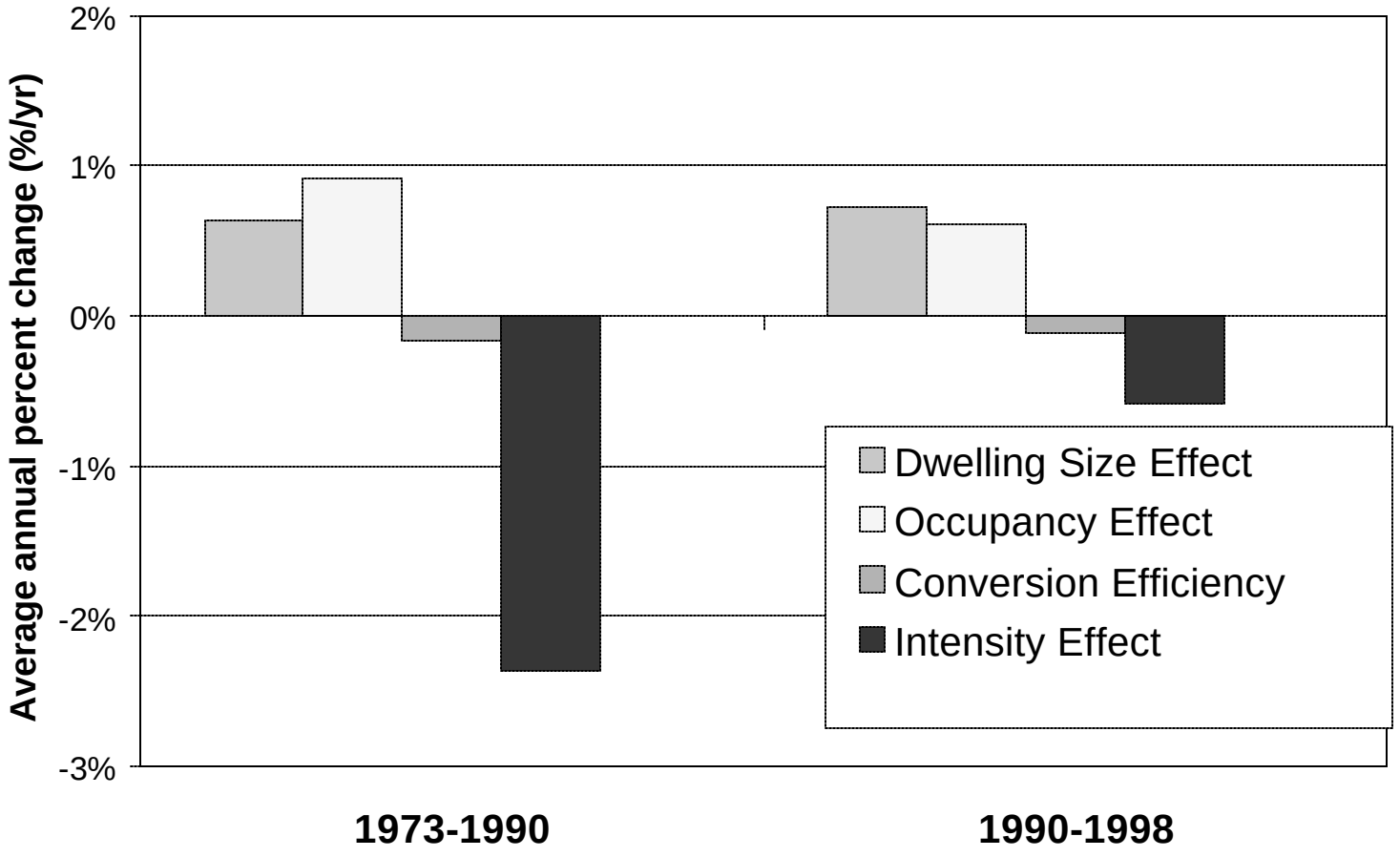

Declines in intensities are slowing….

Energy for Space Heating (IEA-11) Factors shaping development

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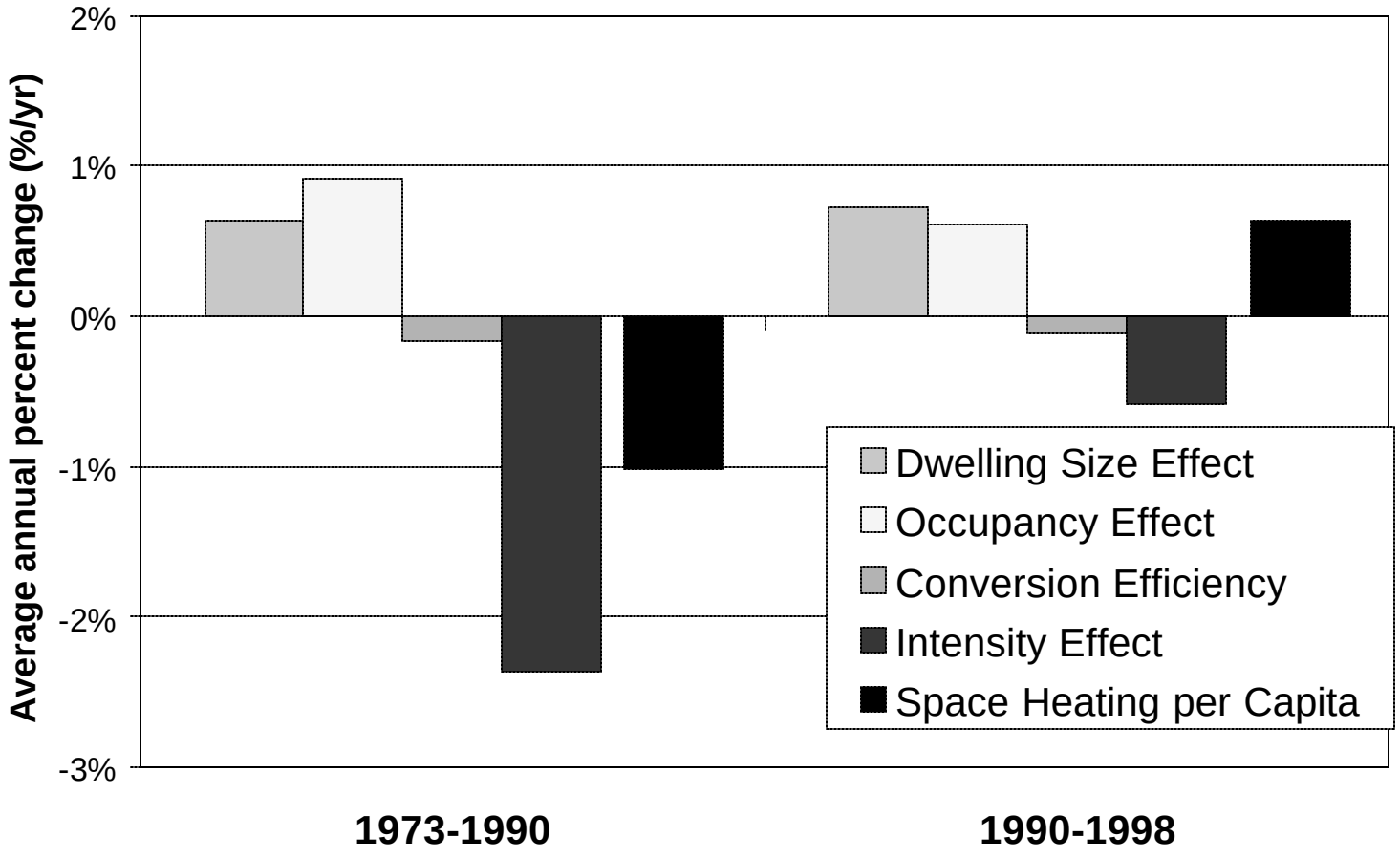
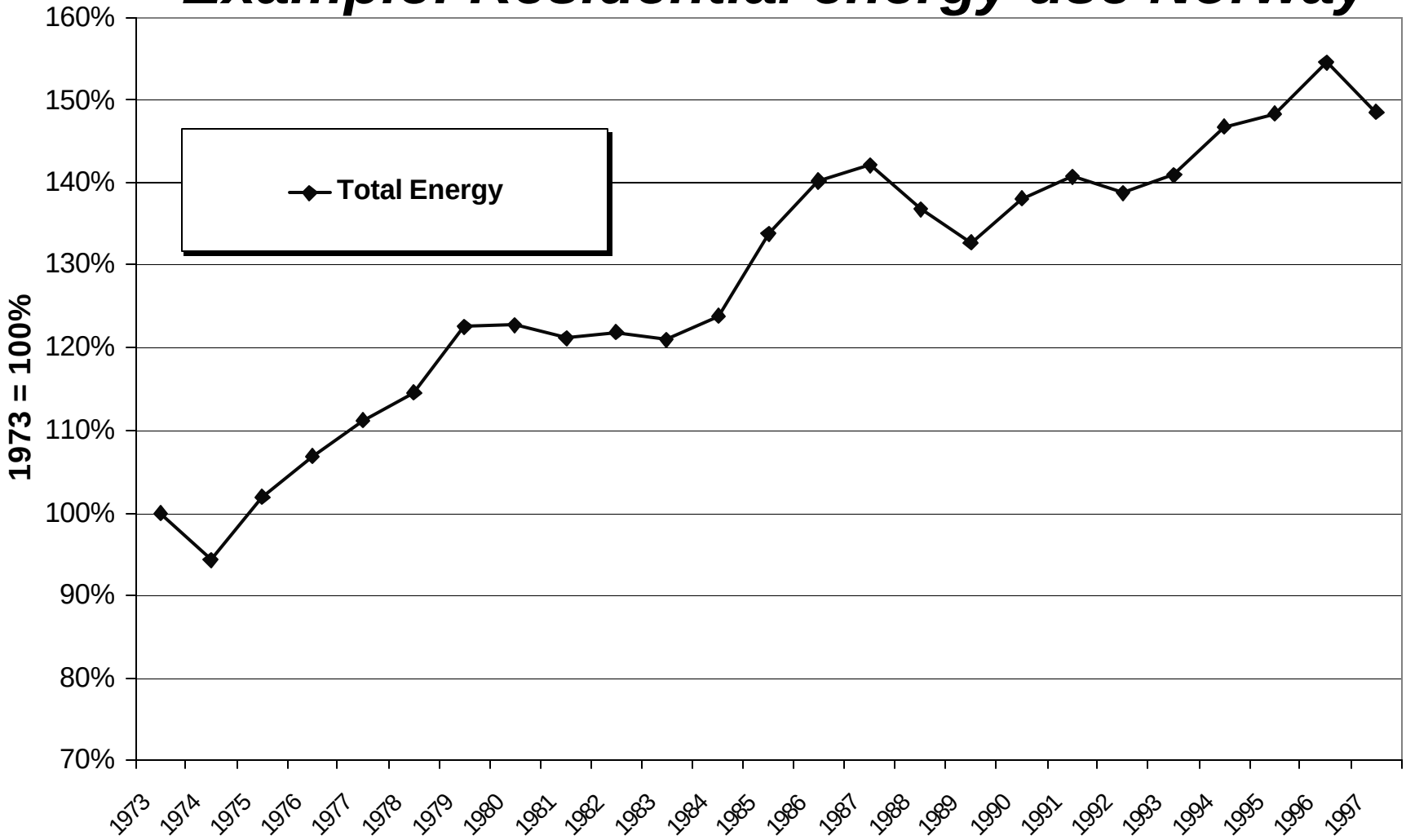


Net result is an increase in per capita heating demand after 1990

Indicators following energy developments

Example: Residential energy use Norway



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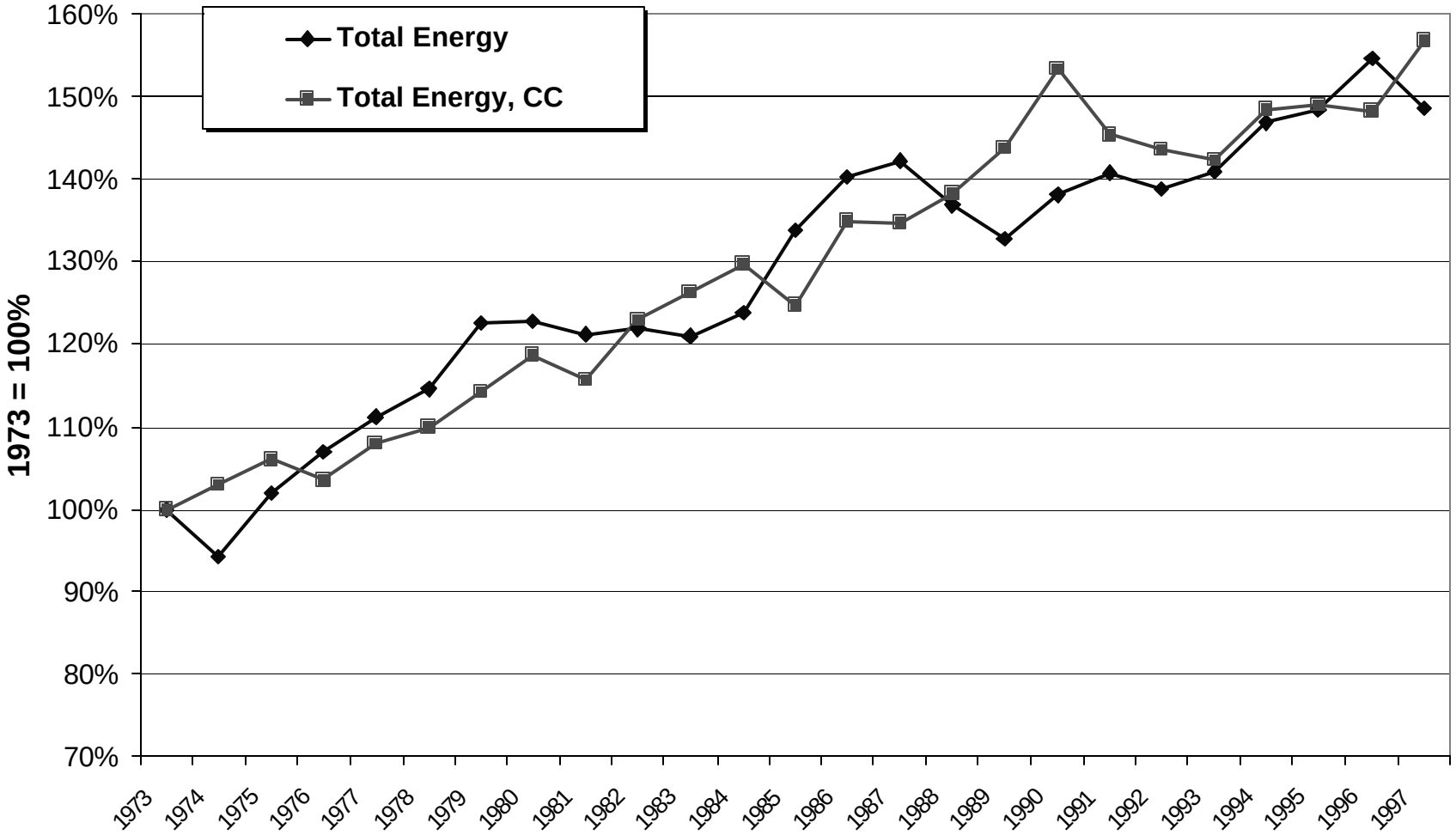

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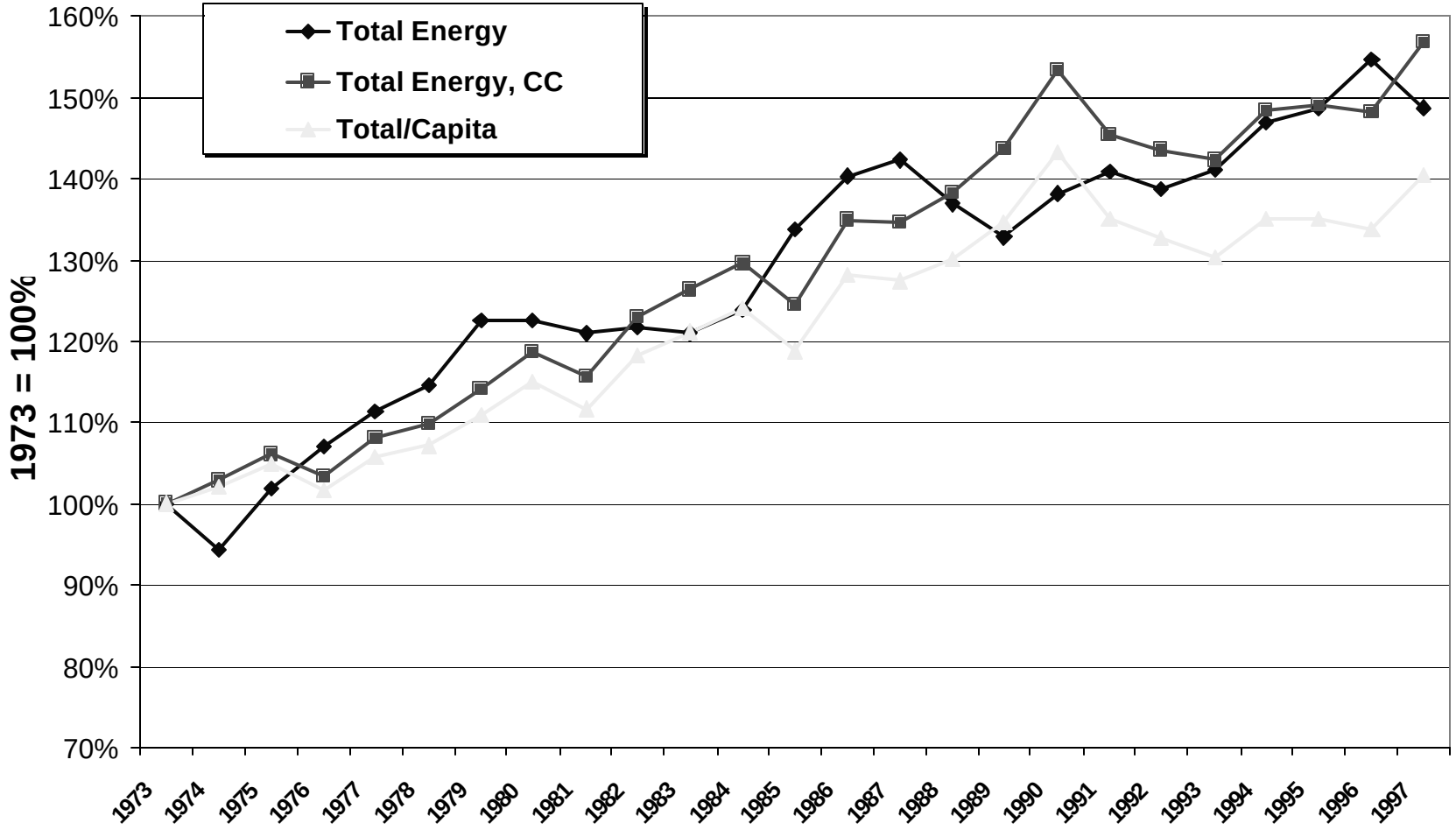

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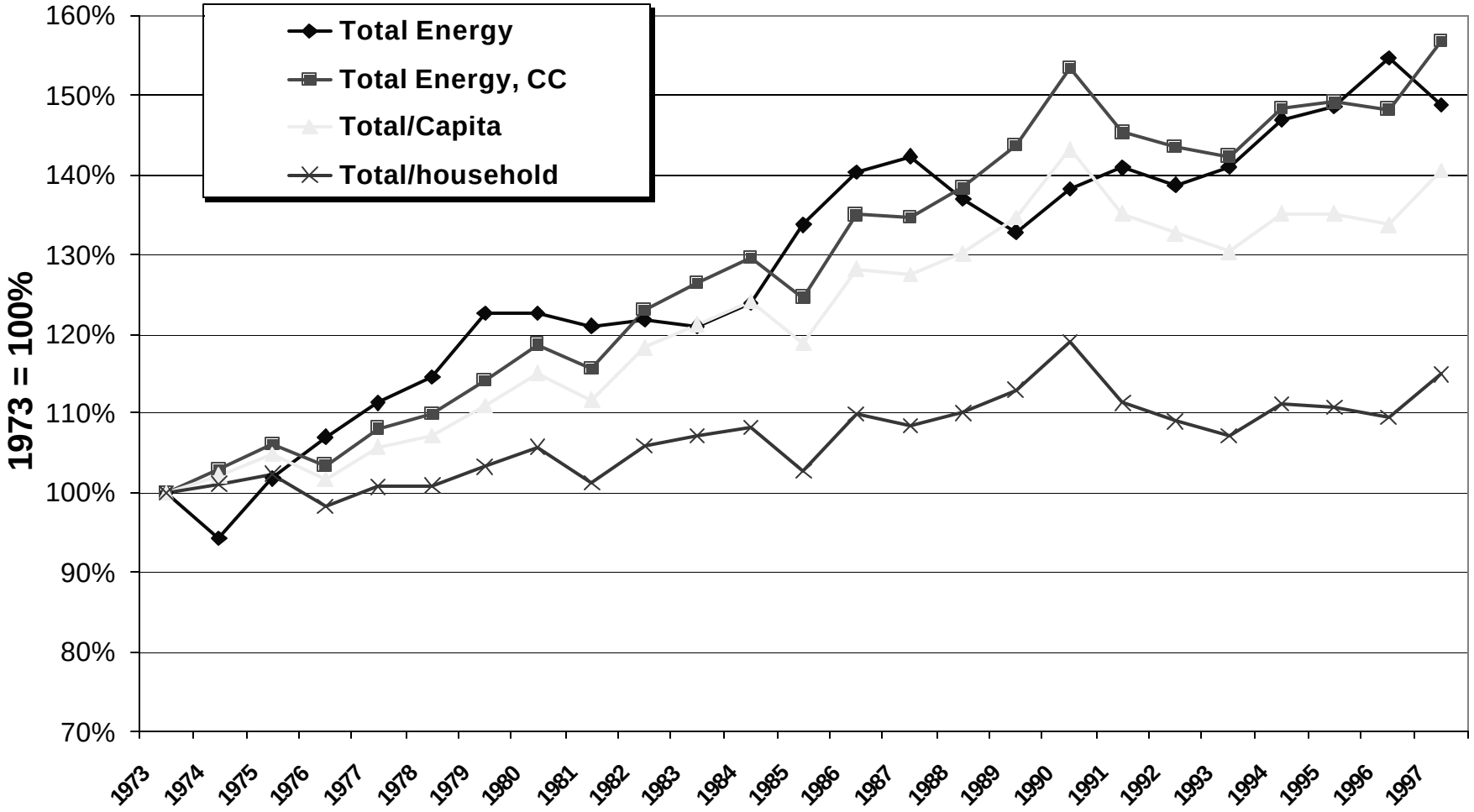

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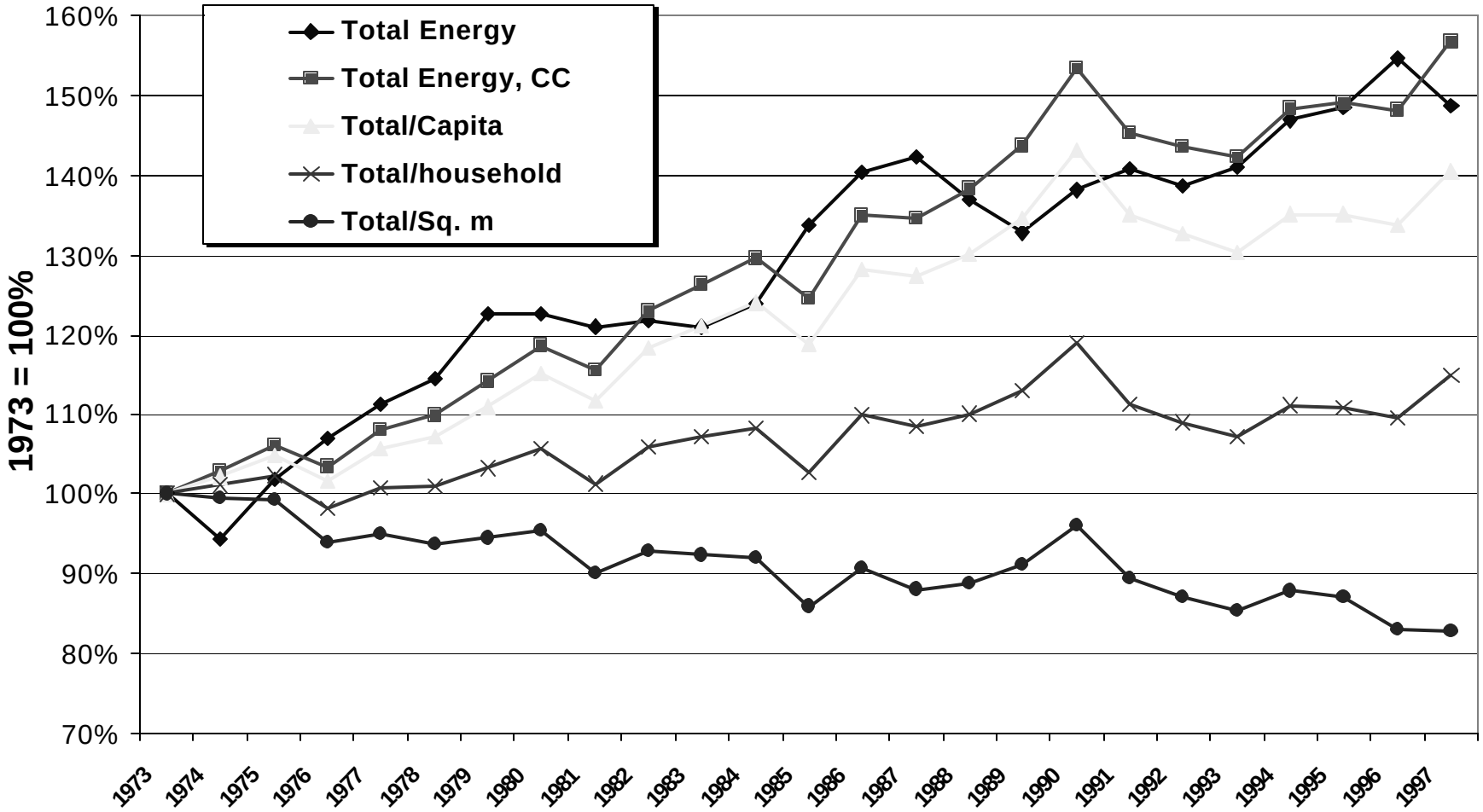

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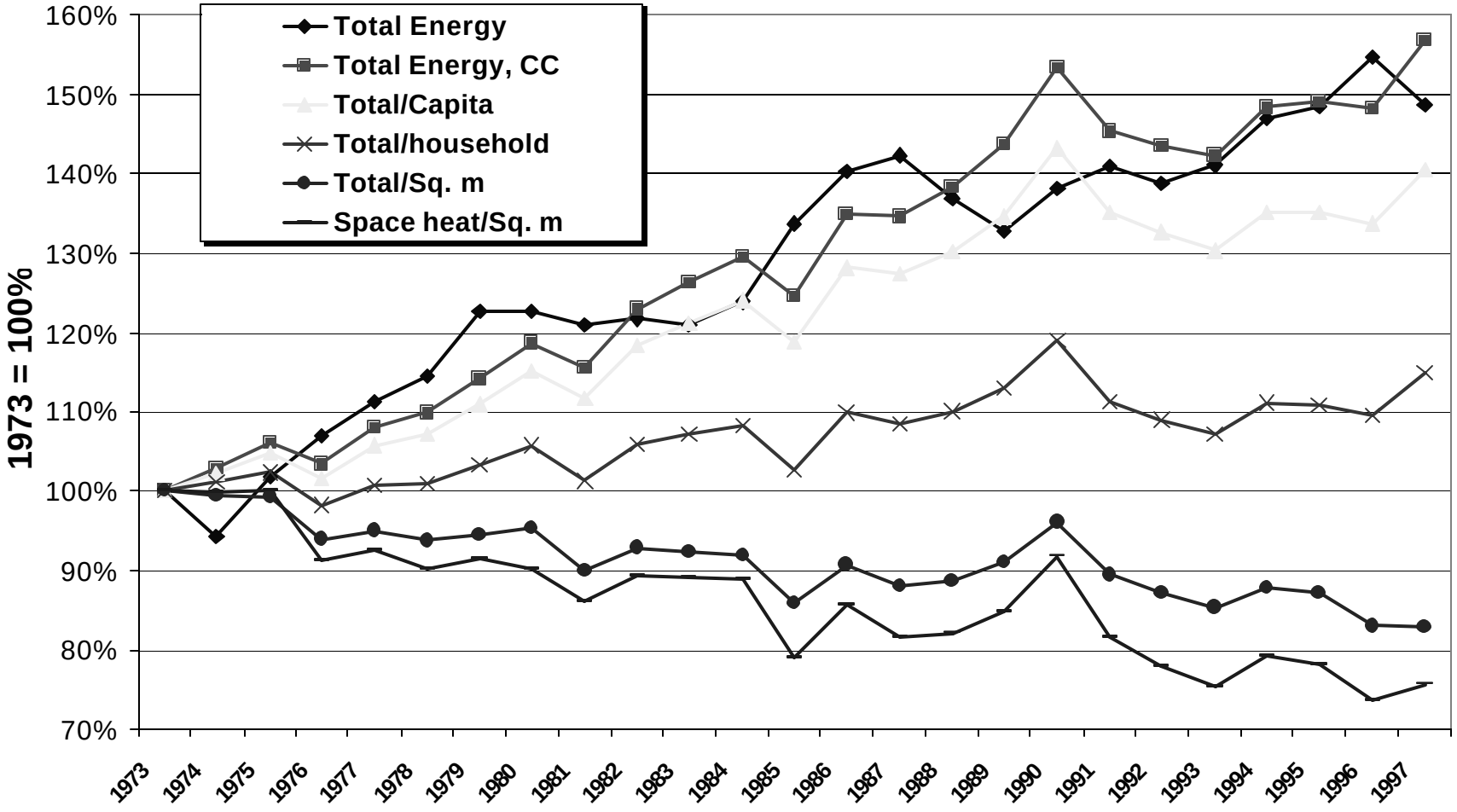

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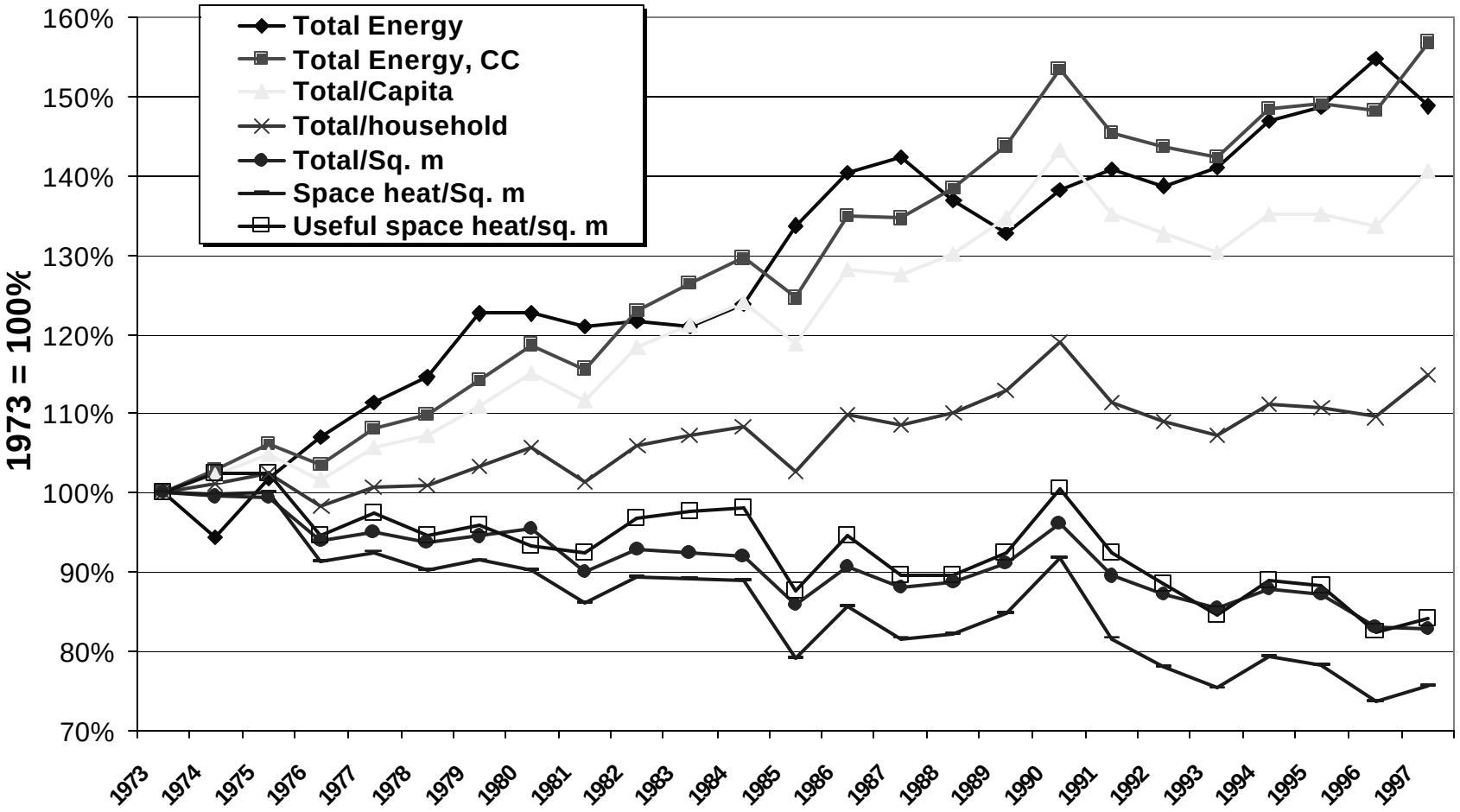
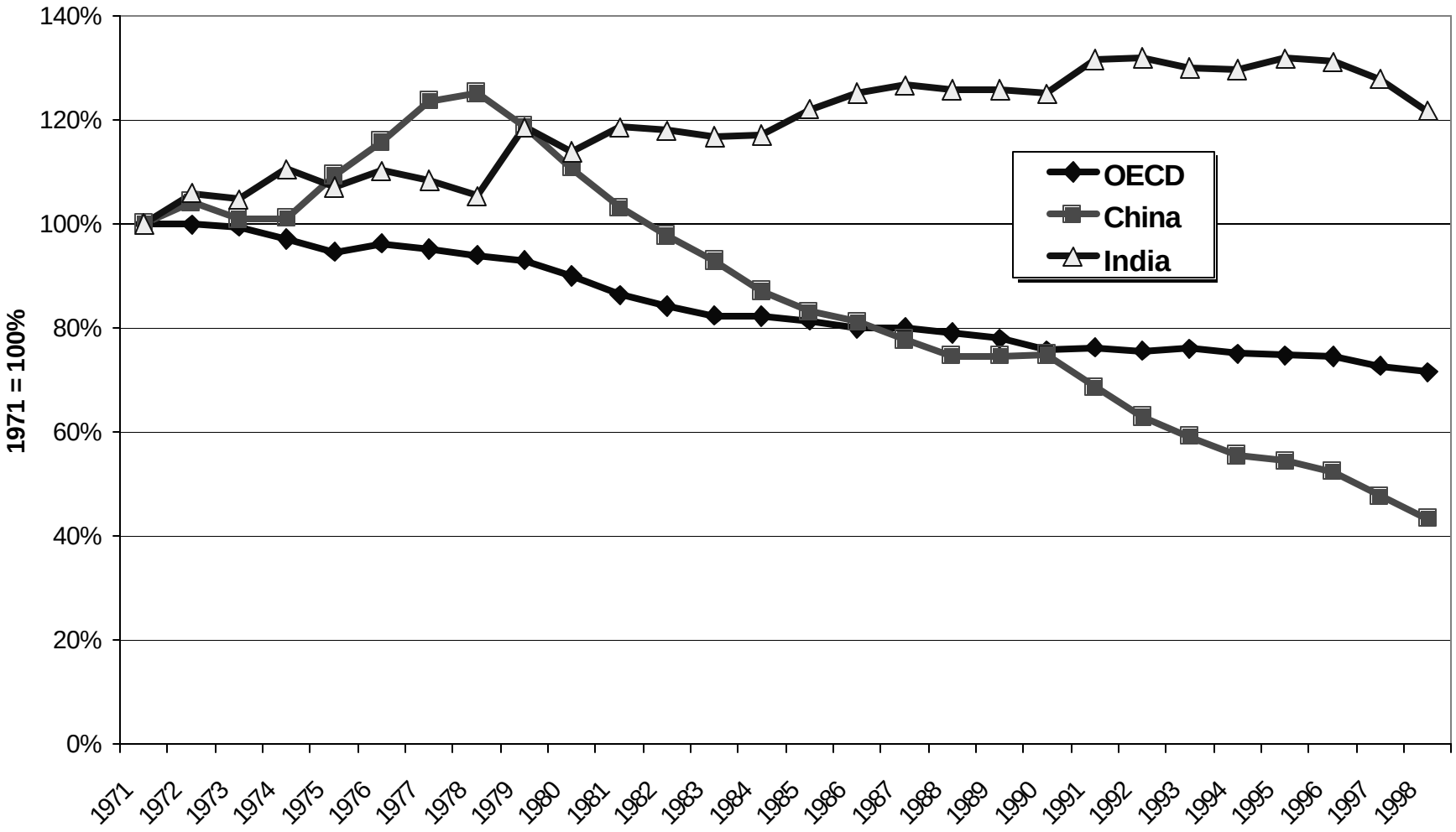


Disaggregated energy indicators are data intensive

Why not simpler aggregated measures?

Example: Energy per GDP India, China and OECD

Total Primary Supply of <u>commercial</u> energy per unit of GDP



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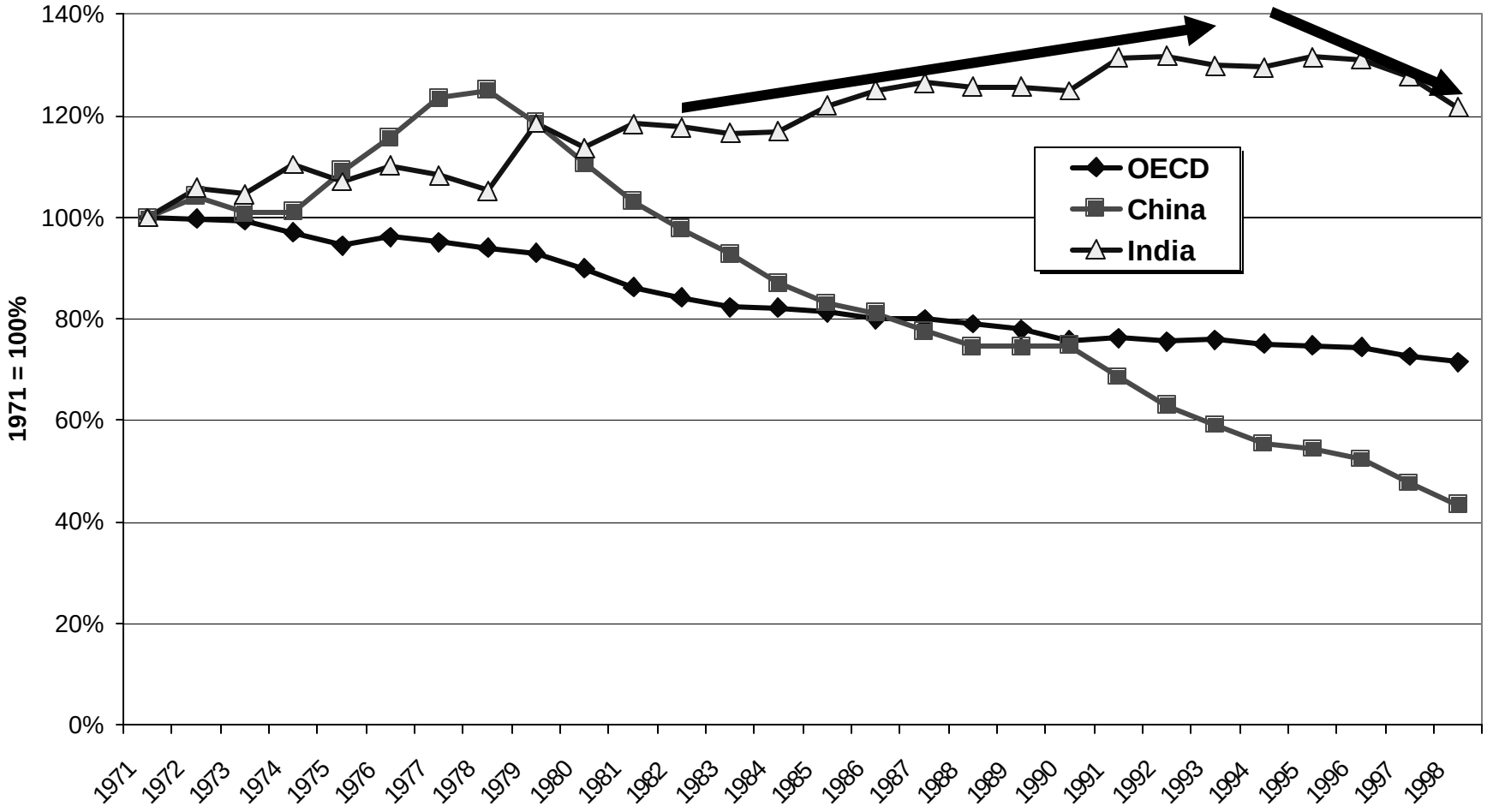
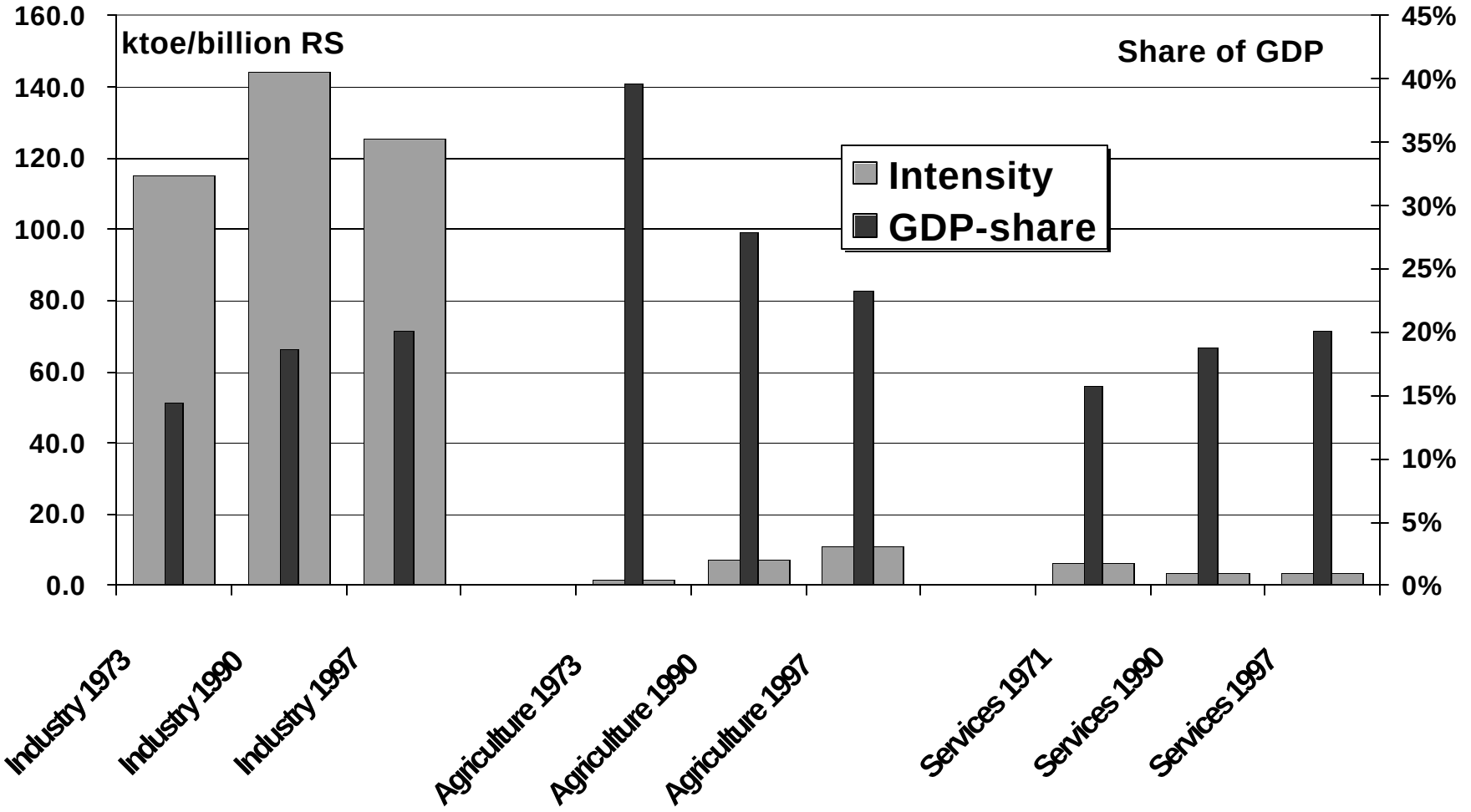


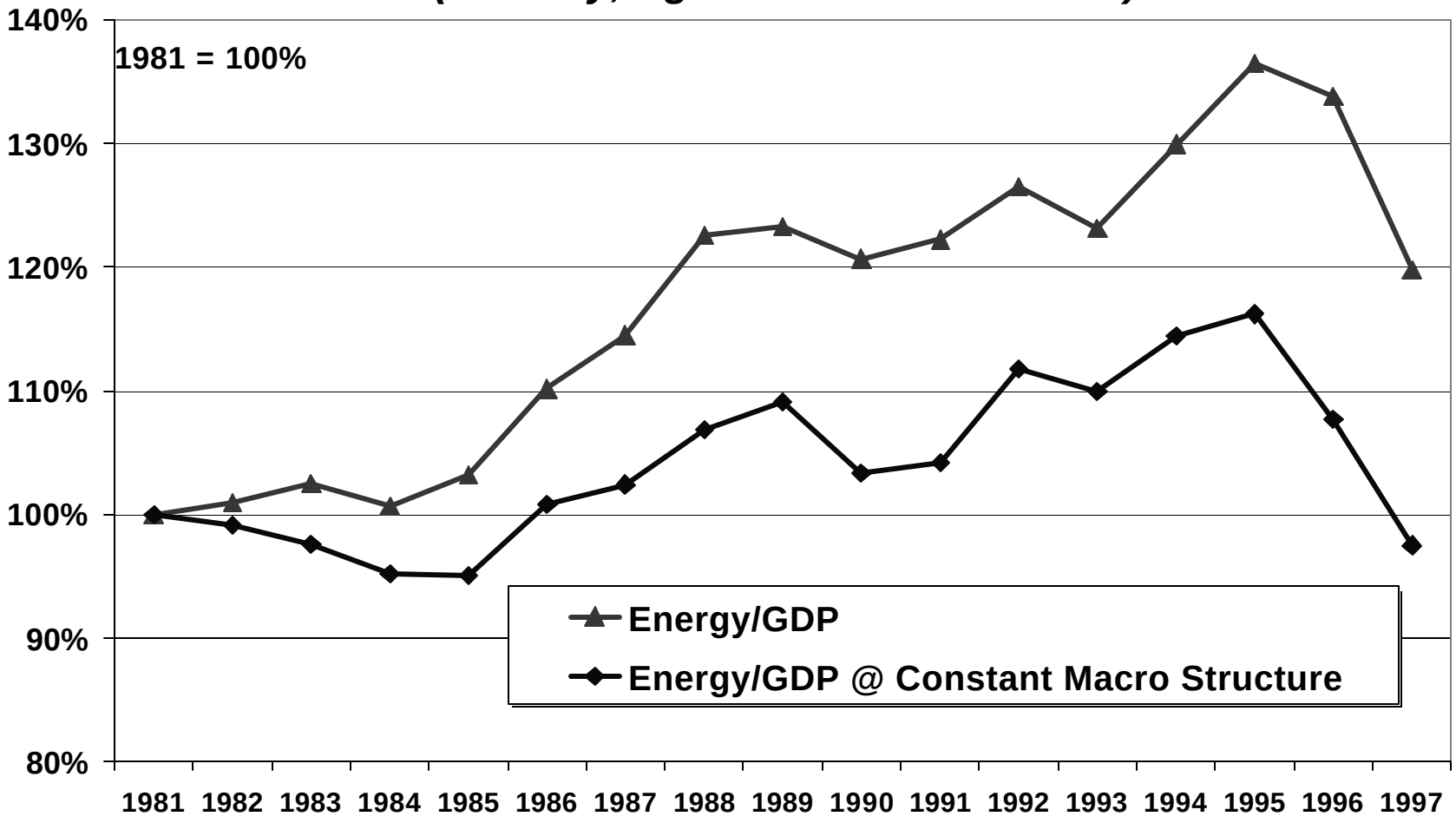
The beginning of an explanation



Impact of Changes in Macro Structure

Changes E/GDP vs. Changes in Sector Intensities

(Industry, Agriculture and Services)

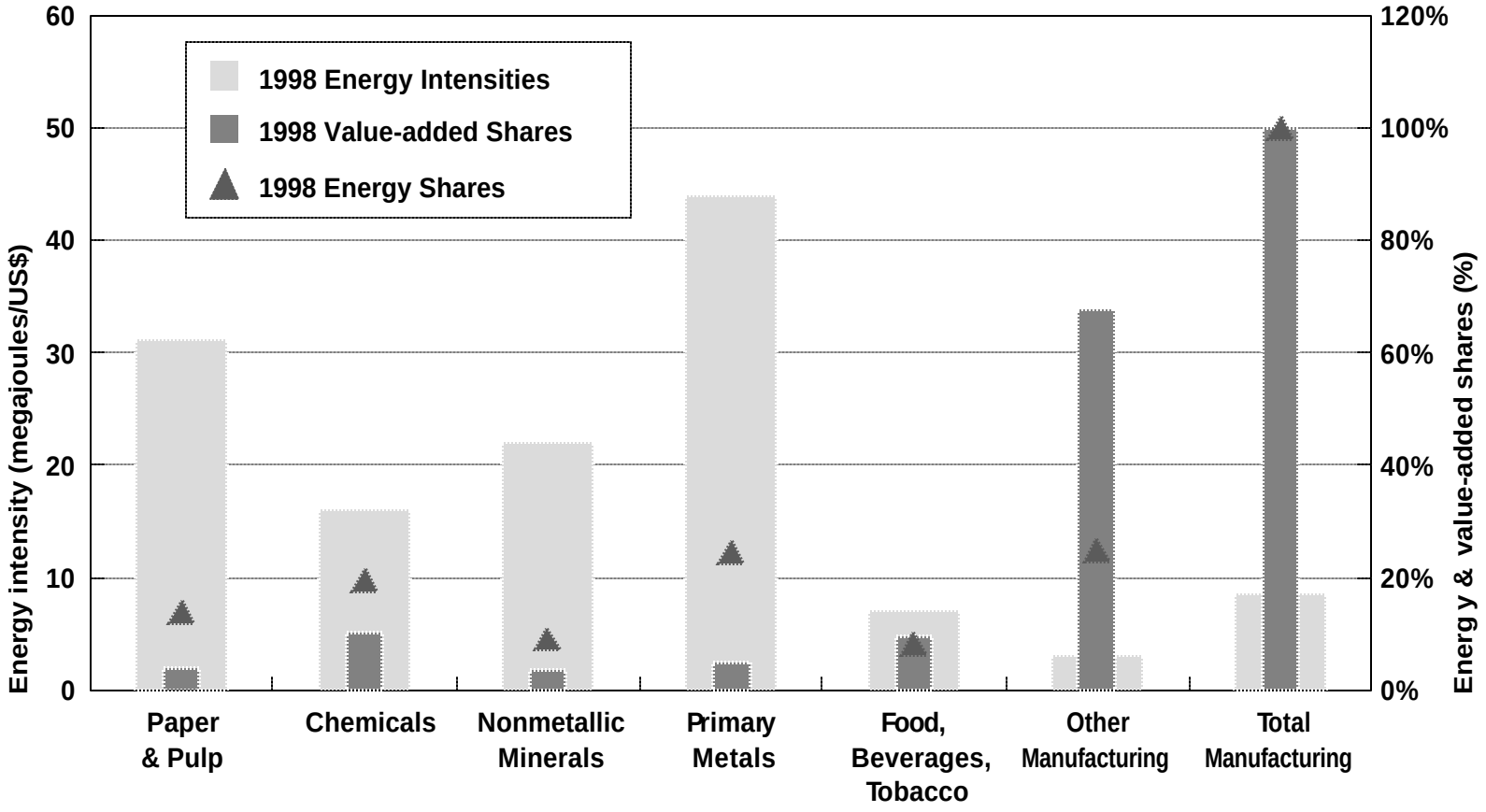


Oil Crises & Climate Challenges

30 Years

OF ENERGY USE IN IEA COUNTRIES

Sub-sector Energy Intensities, Value-added and Energy Shares, IEA-11



Energy-intensive sub-sectors contribute little to overall manufacturing output, but account for a large share of energy consumption

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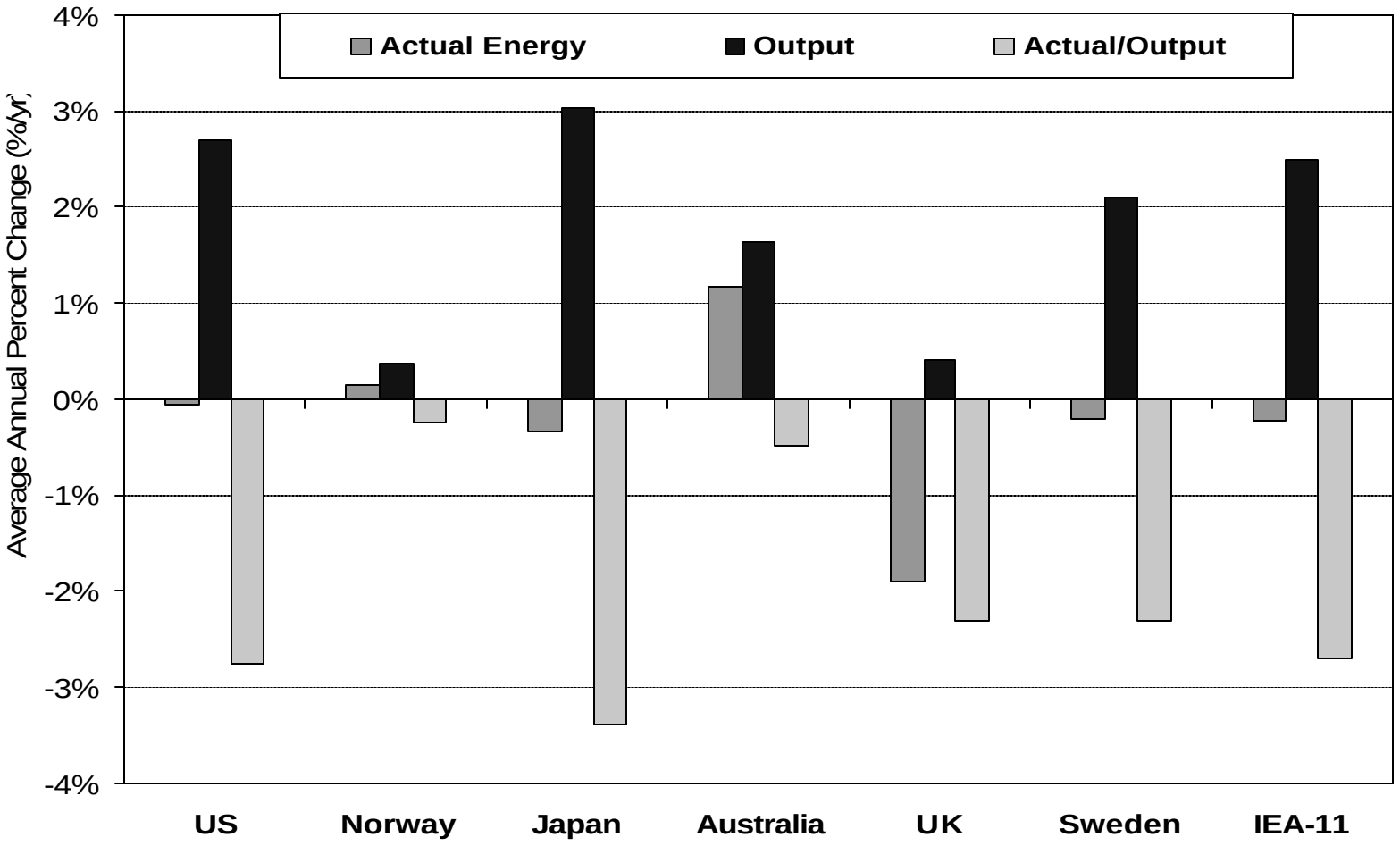
Energy Savings and Structural Change IEA - 11 Manufacturing, 1973-1998



Strong reduction in energy per $ produced almost everywhere

Energy Savings and Structural Change IEA - 11 Manufacturing, 1973-1998

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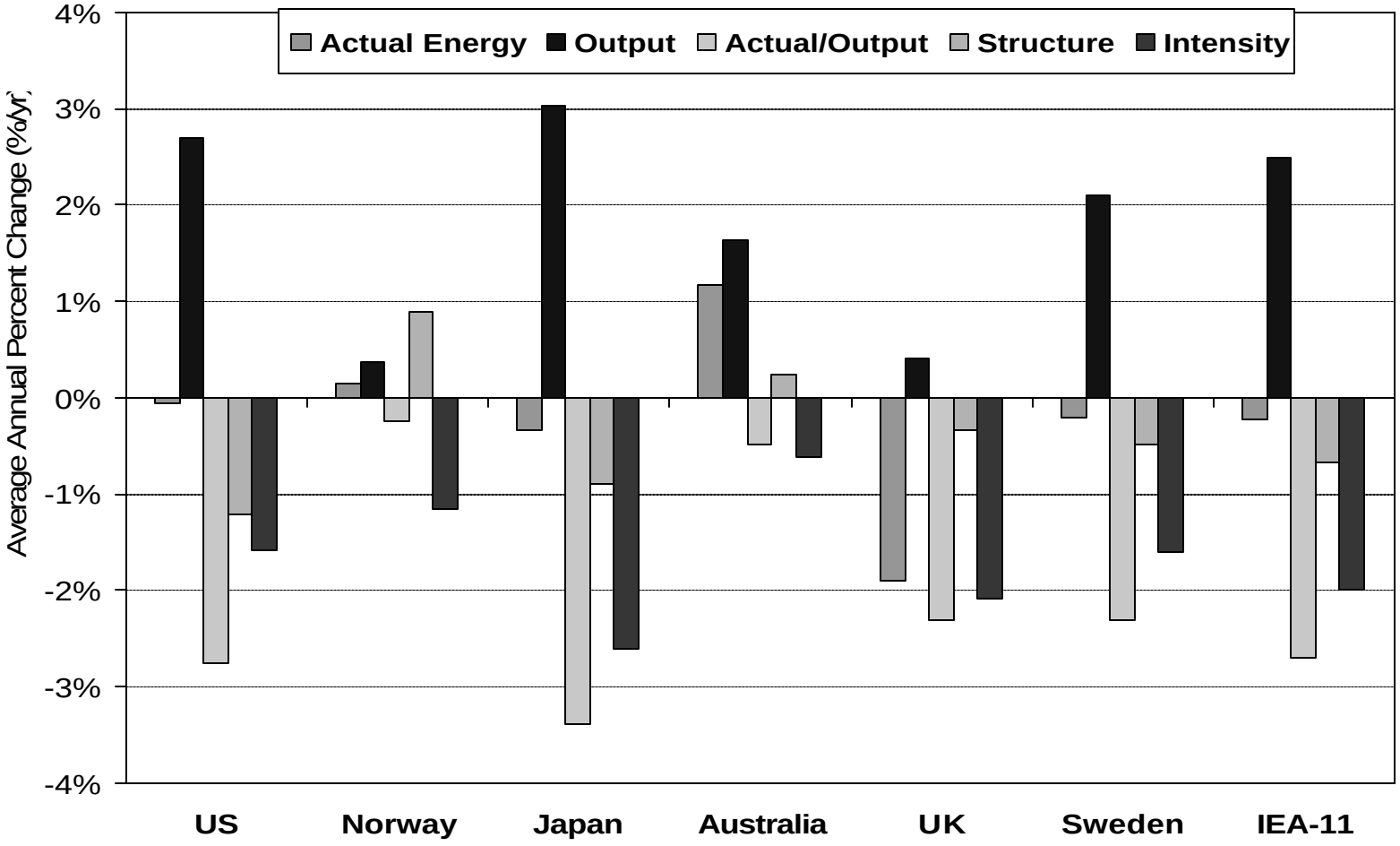
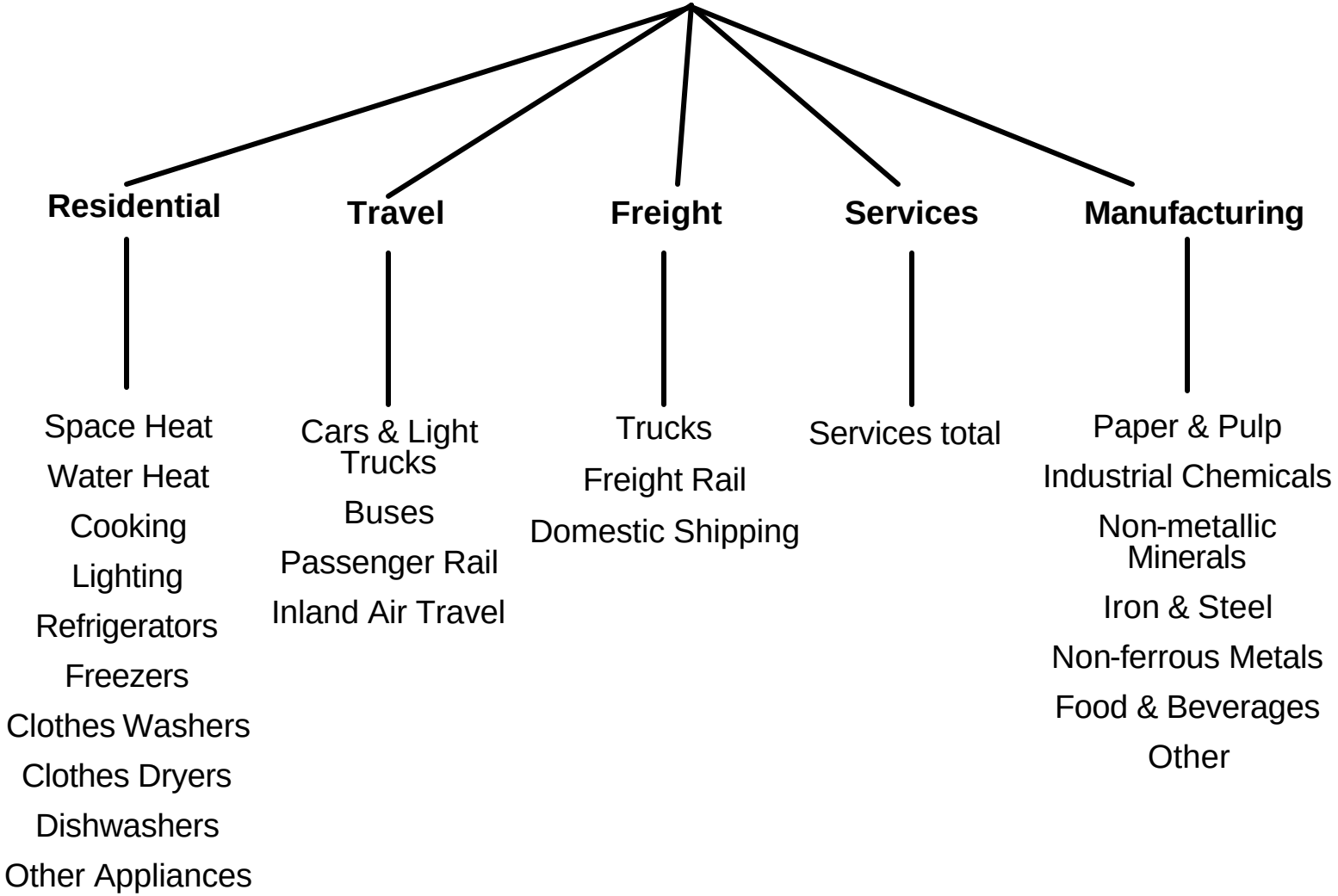


Structural changes explain some of the country difference in aggregate intensity

Sector & End-use Coverage

Total Economy



Energy Intensity Effects by Sector IEA - 11

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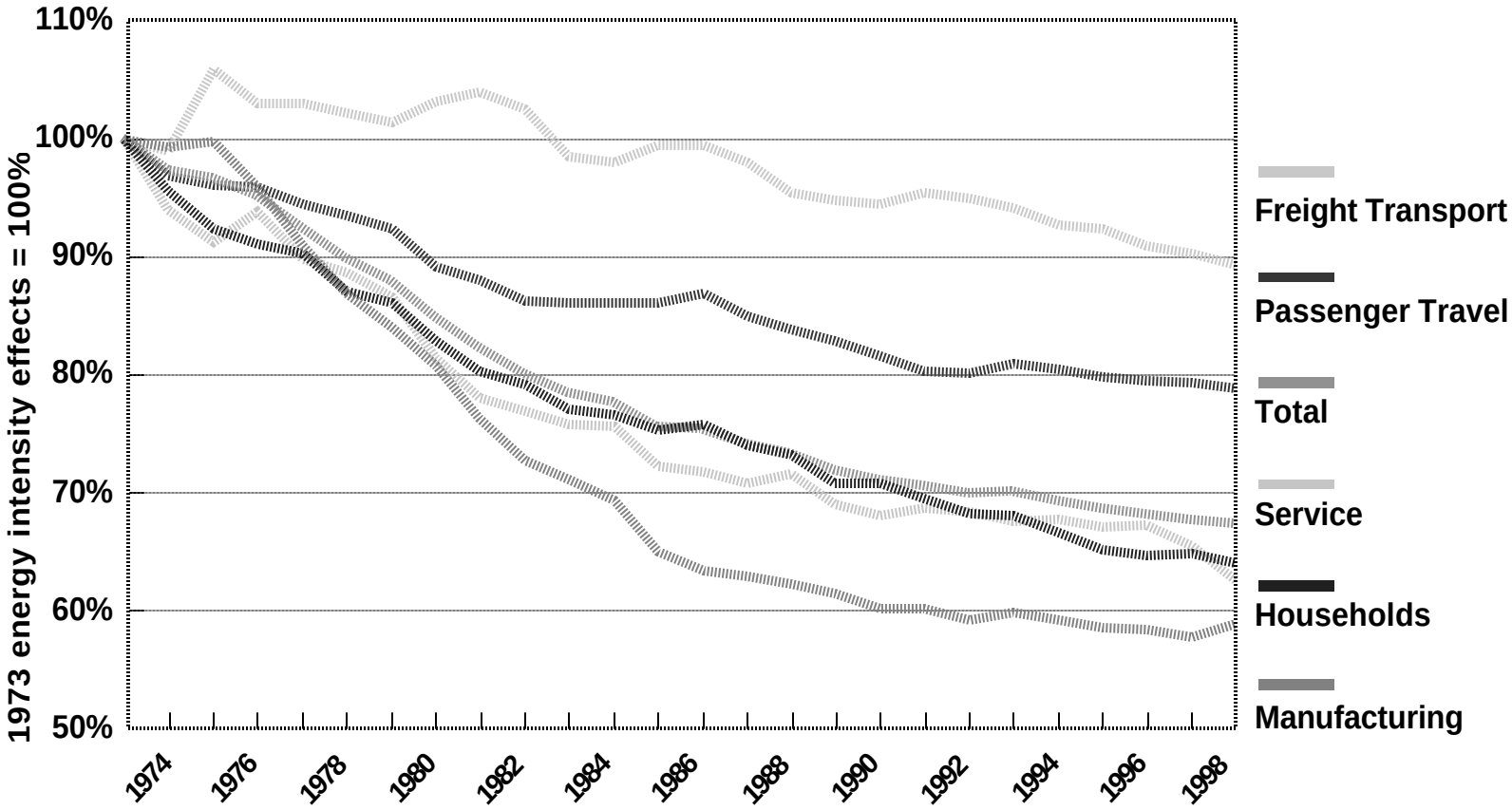

Strong decline in energy intensities for all sectors since 1973

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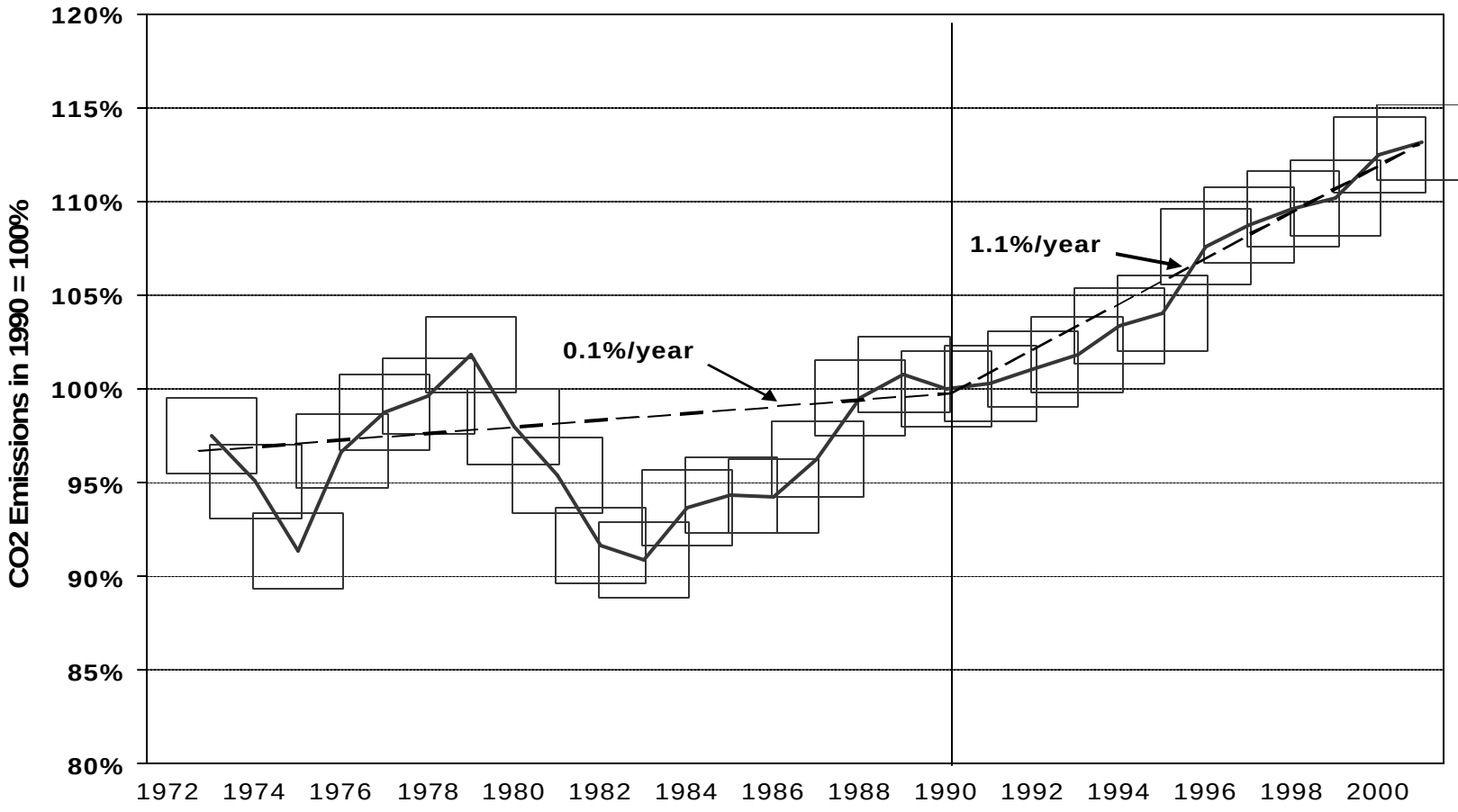
IEA CO_2 Emissions 1973 - 2001



Recent trends show steady increase

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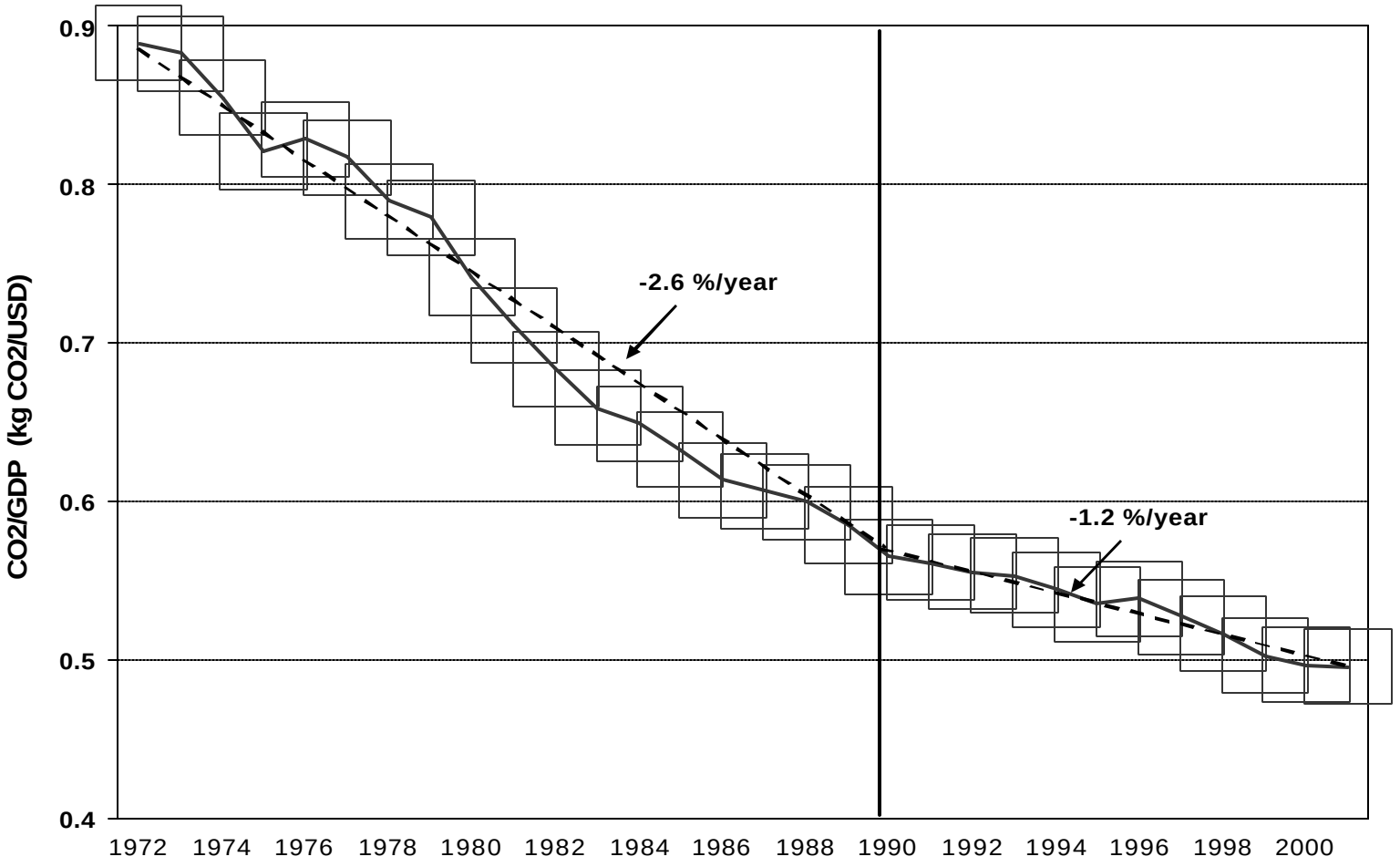
IEA CO_2 Emissions per GDP

1973 - 2001



Rate of decline has slowed since 1990

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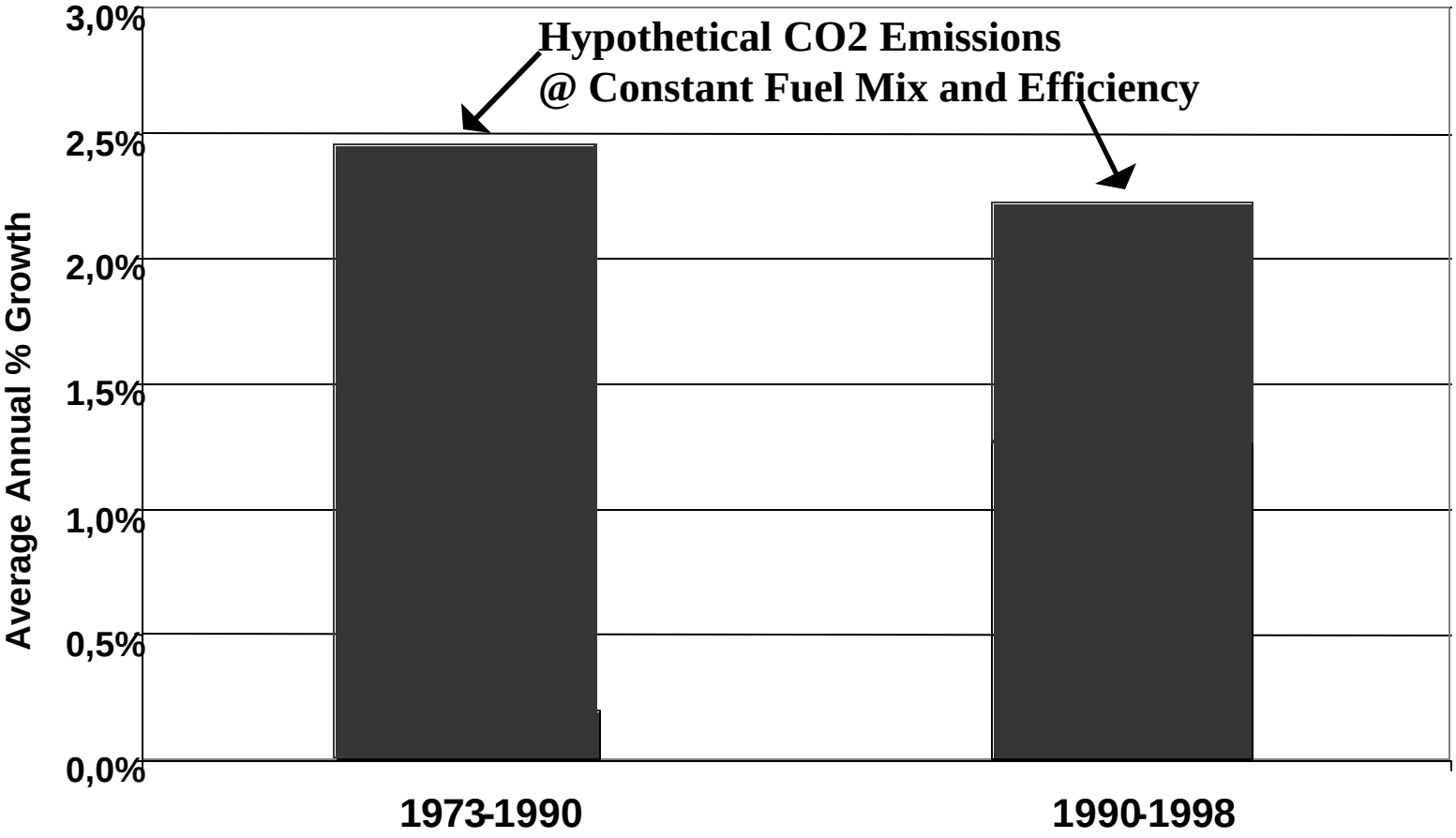
IEA-11 CO_2 Emissions Technology Frozen at 1973-level



Without changes in fuel mix and energy efficiency emissions would have increased 2.2-2.5%/year

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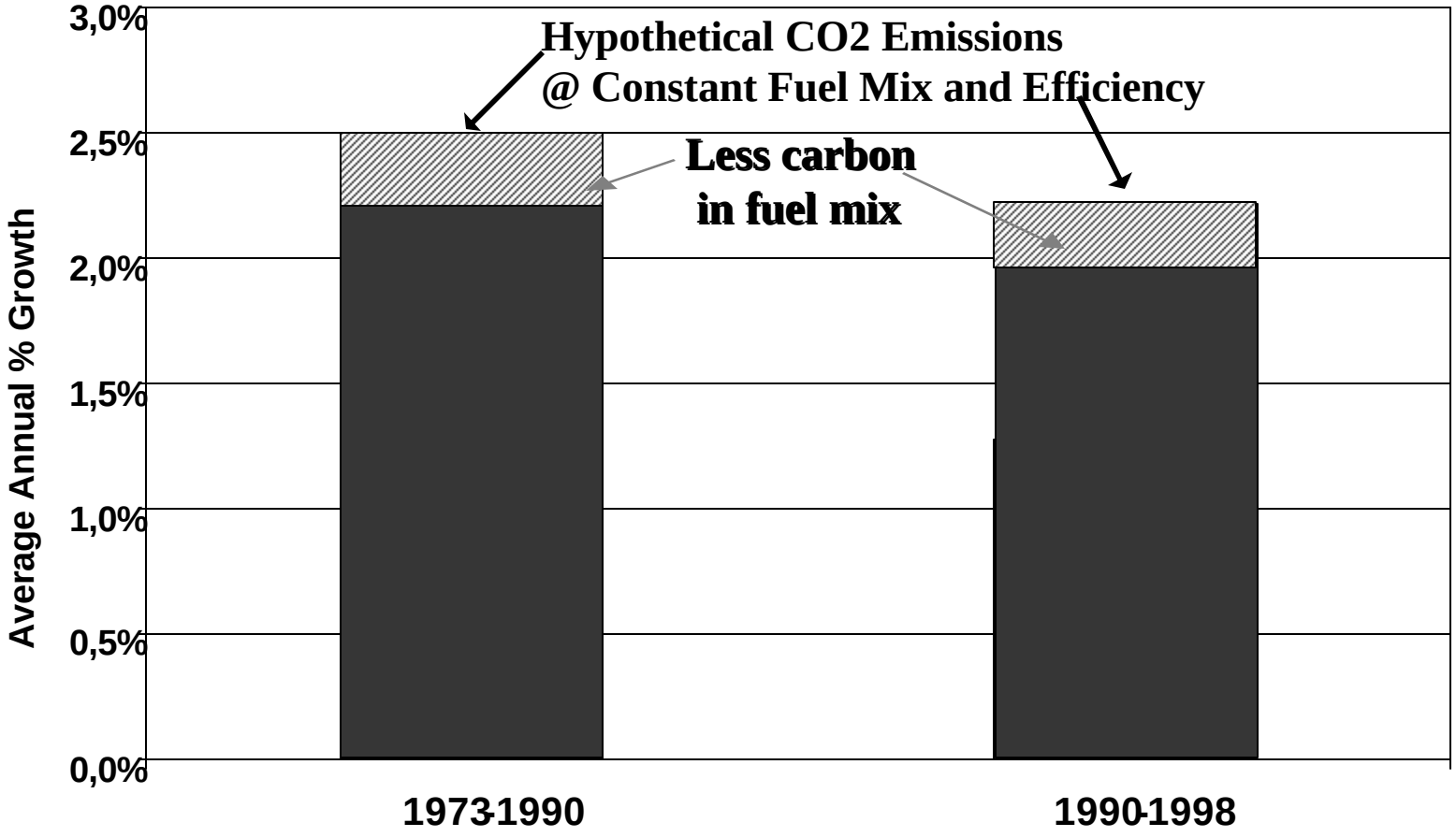
OF ENERGY USE IN IEA COUNTRIES

IEA-11 CO_2 Emissions Impact of Changes in Fuel Mix



Changes in supply and end-use fuel mix moderated growth in emissions by 0.5%/year

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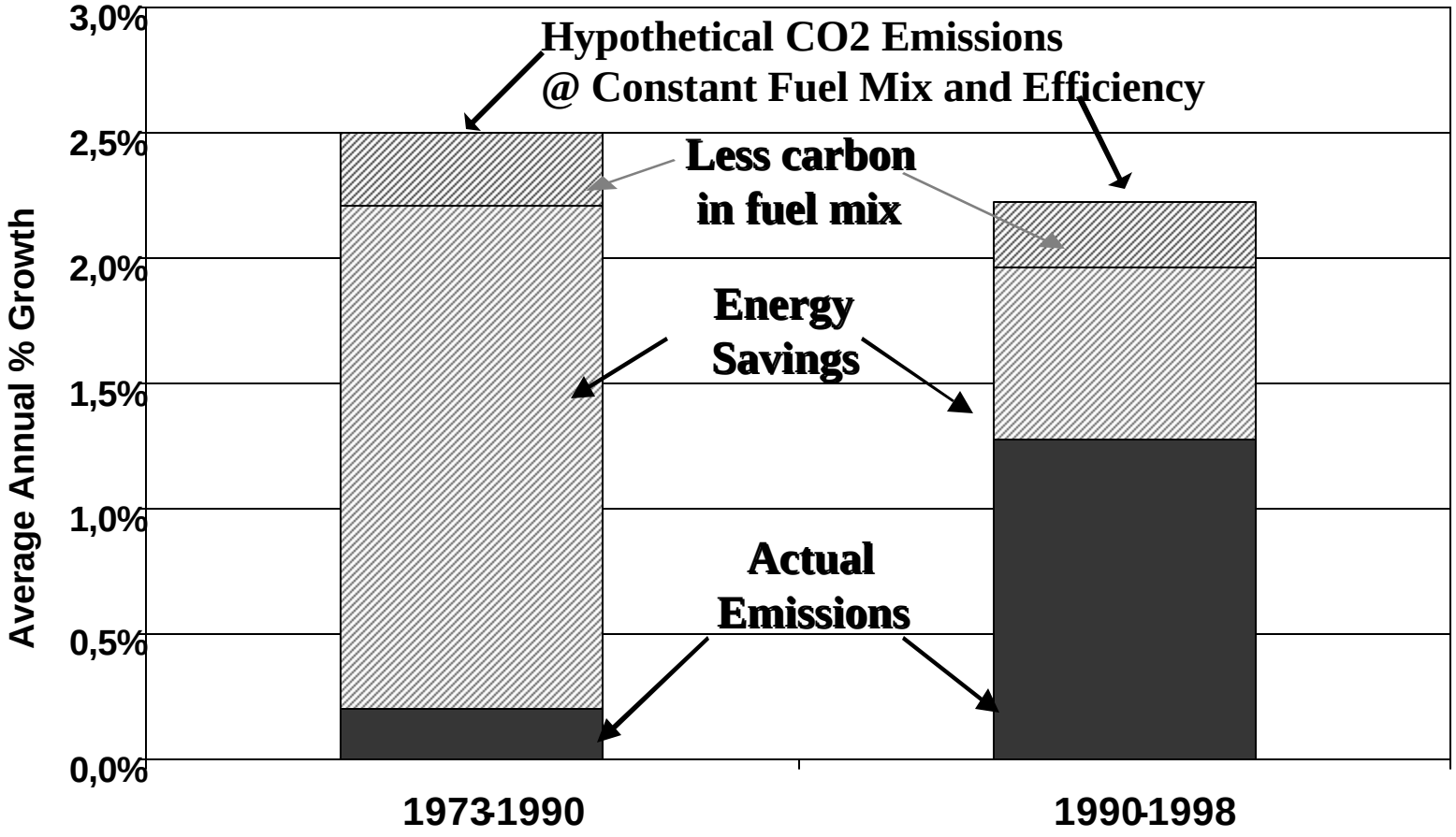
IEA-11 CO_2 Emissions Impact of Fuel Mix & Energy Savings



Slowing energy savings rates primary reason for accelerated growth in emissions after 1990

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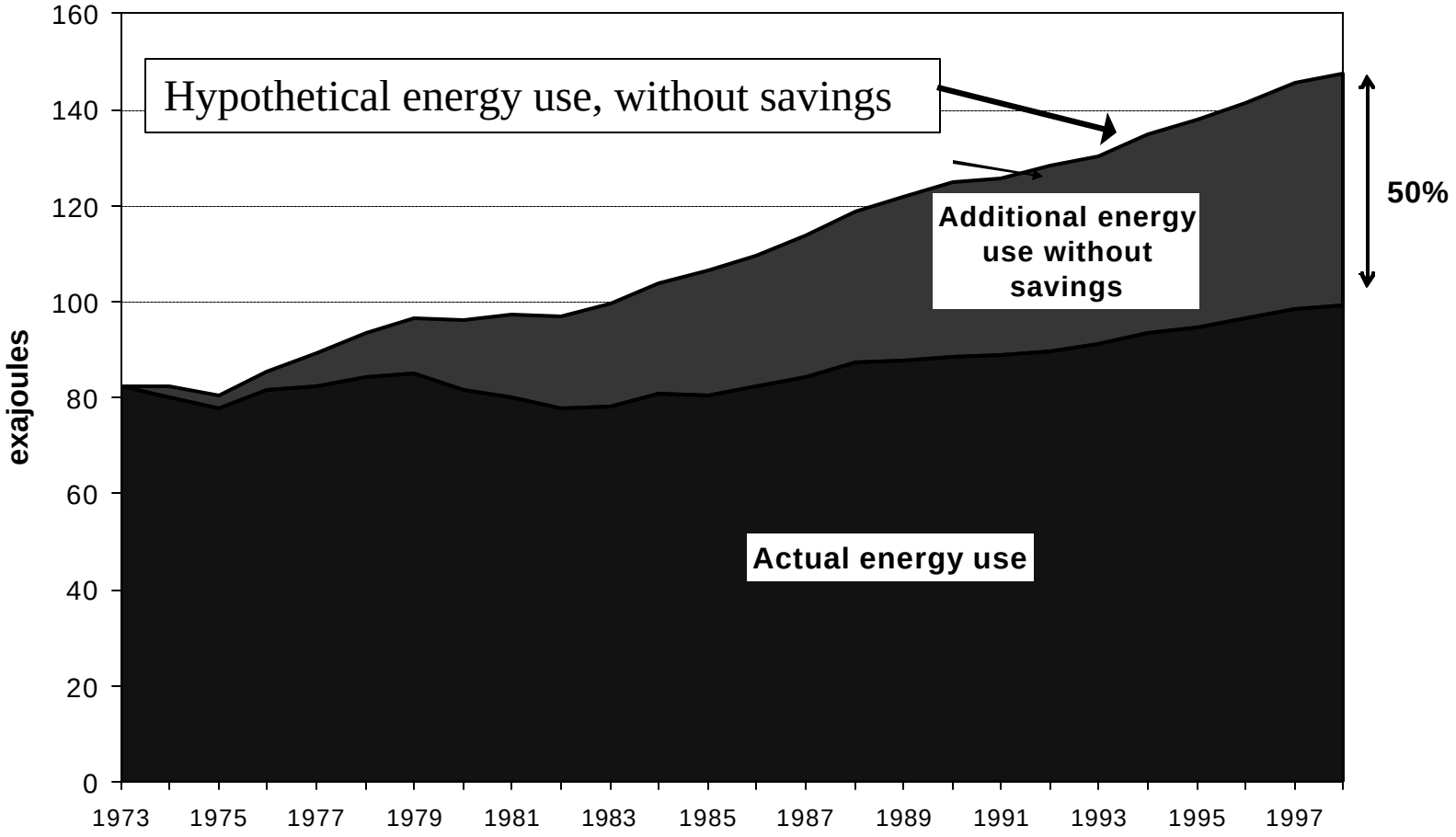
Energy Savings: The Most Important Fuel



Without energy savings achieved since 1973 energy demand in 1998 would have been 50% higher

IEA -11 Energy Demand and Energy Savings

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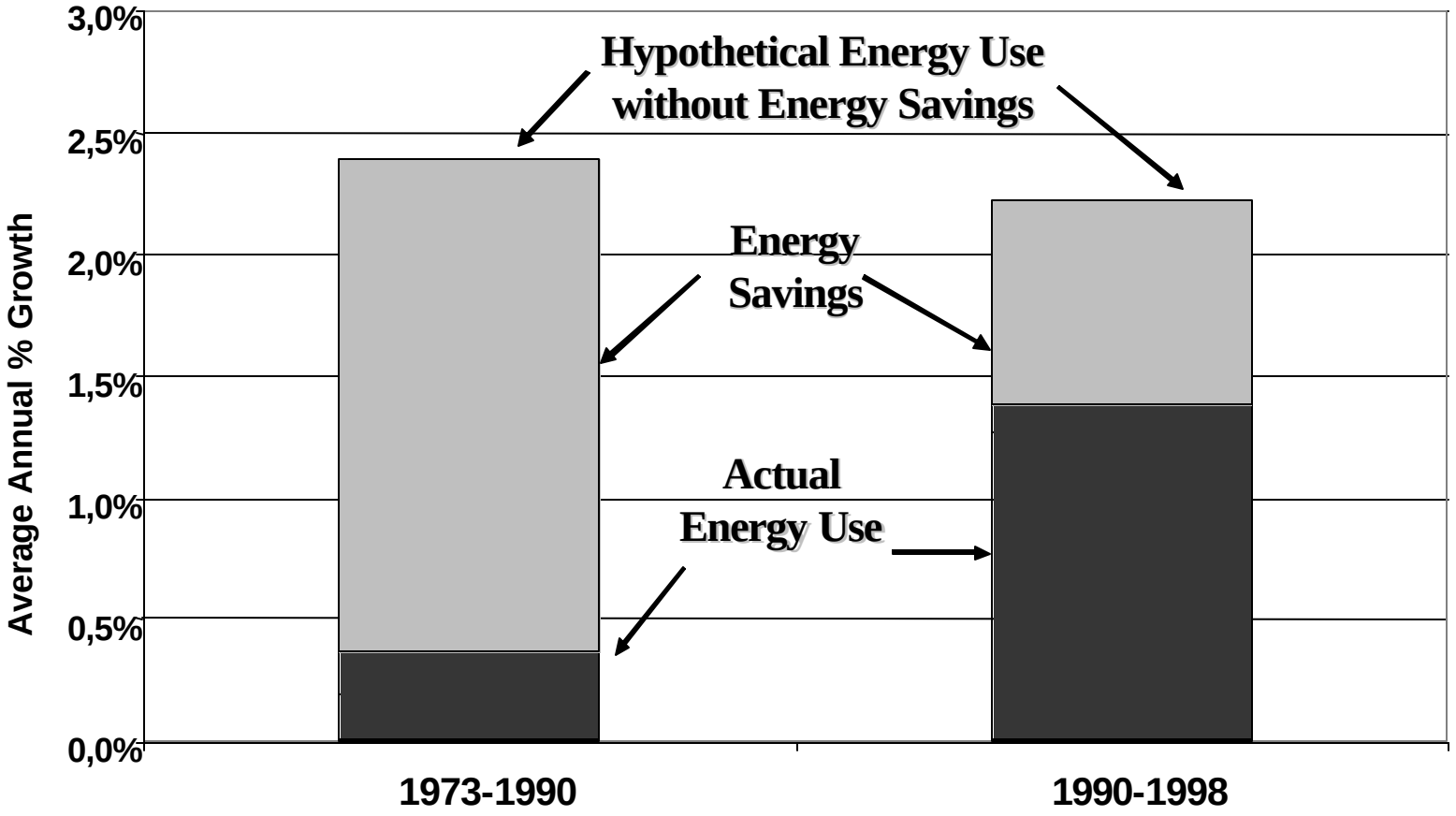

Rates of energy savings have slowed significantly after 1990, leading to rapid demand growth

Economy-wide Intensity Effect

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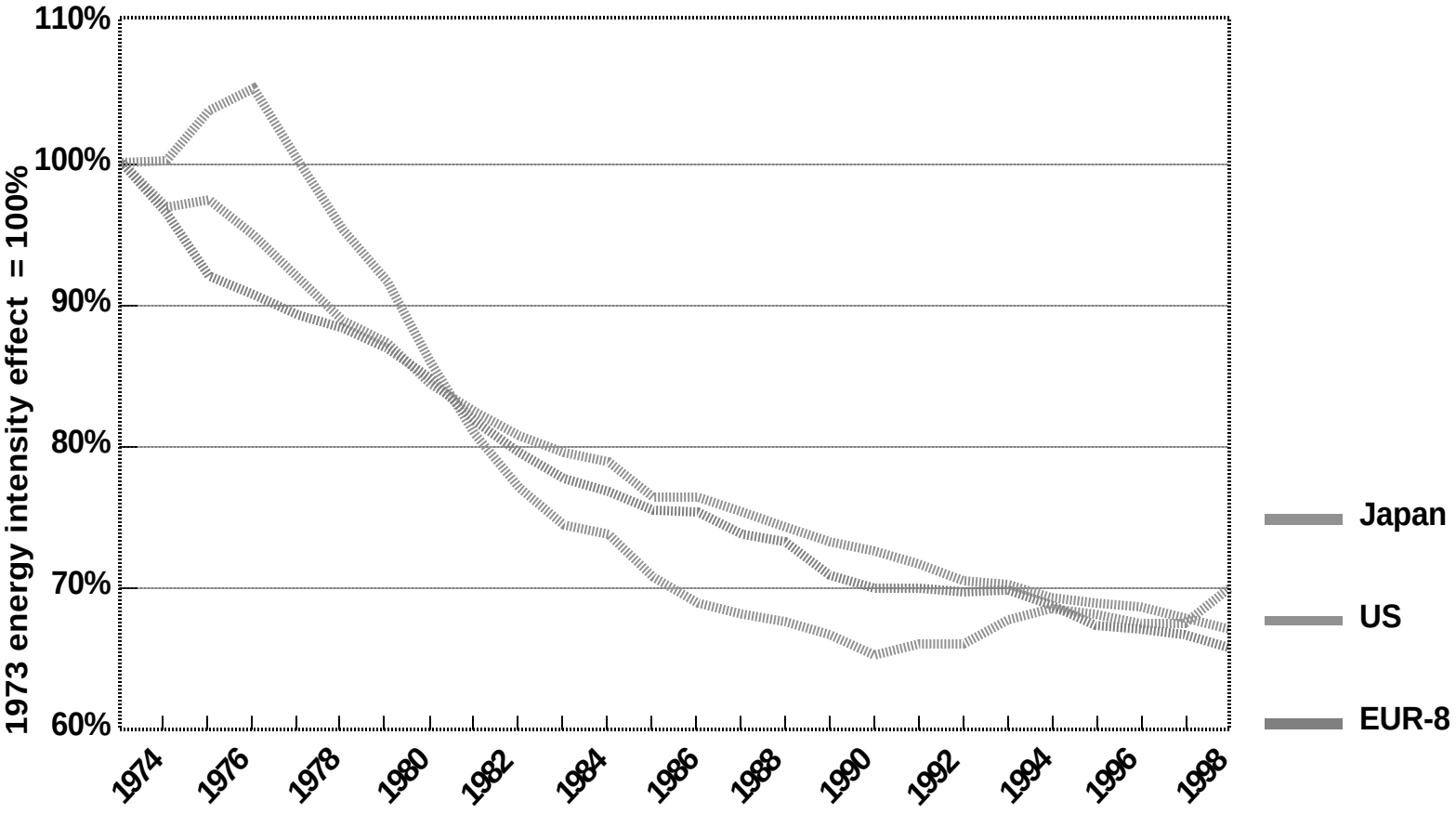

Intensity effect fell by about 30% in all three regions

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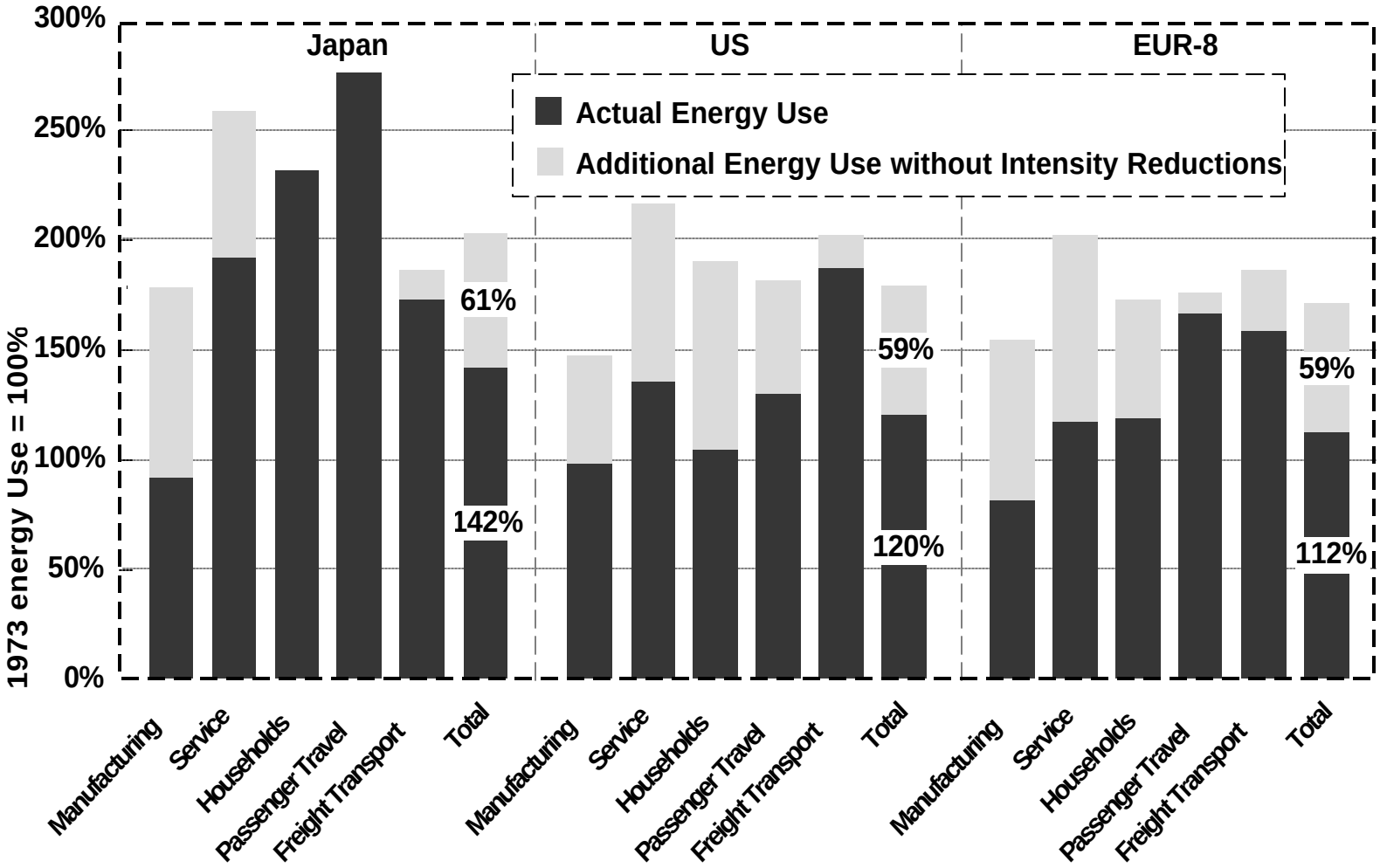
OF ENERGY USE IN IEA COUNTRIES

Actual Energy Use and Energy Savings by Country & Sector



Total energy savings across the three regions are similar, but there are important differences by sector

Contribution to Energy Savings from Sectors and End Uses

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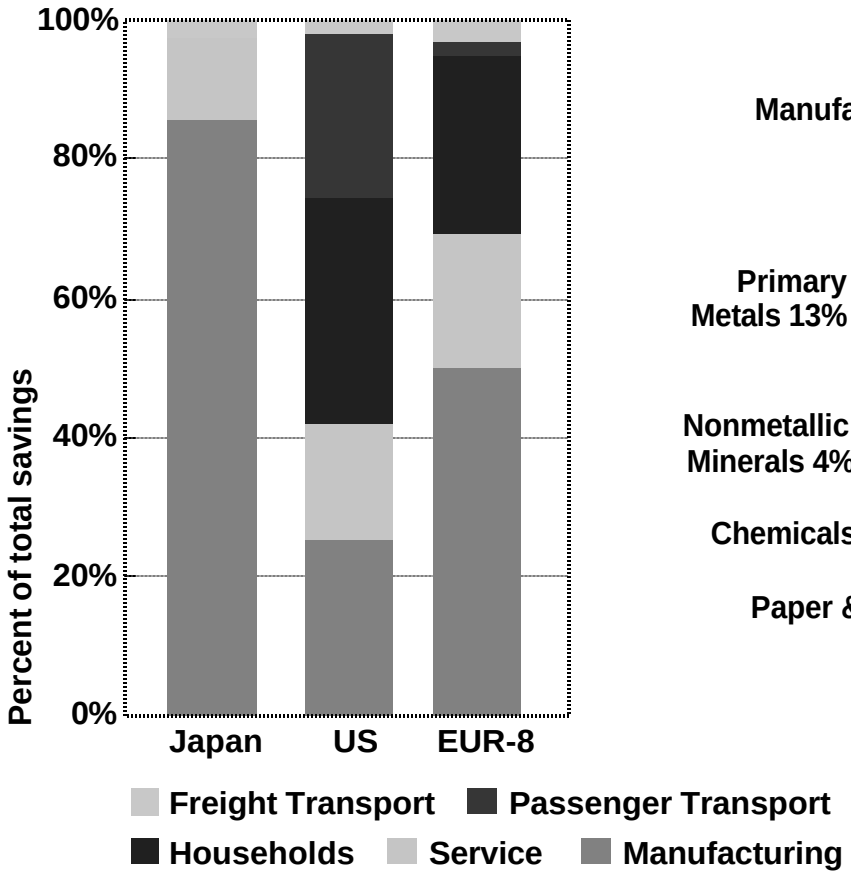

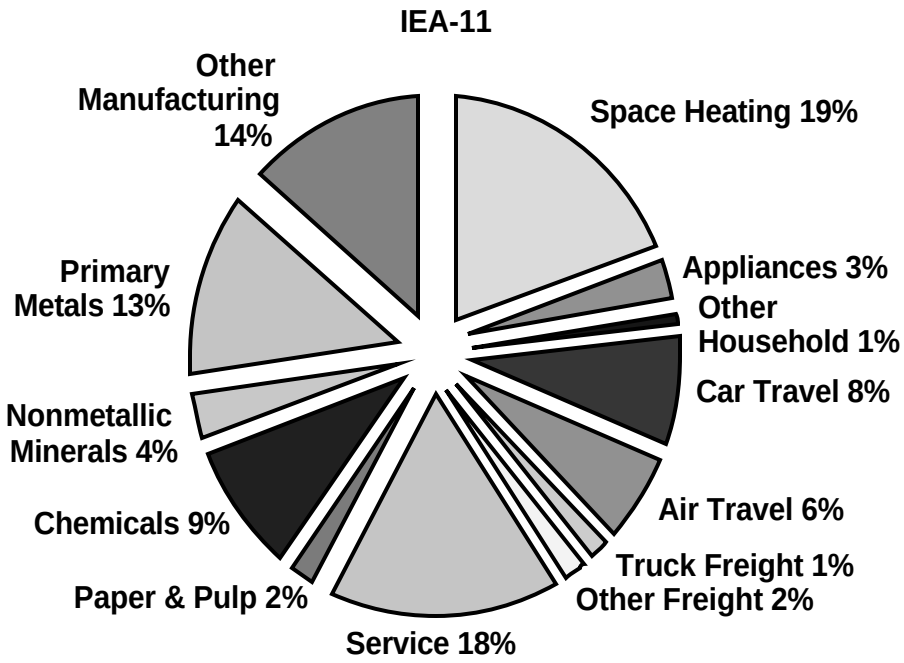

Outside the United States, transport has contributed little to overall savings

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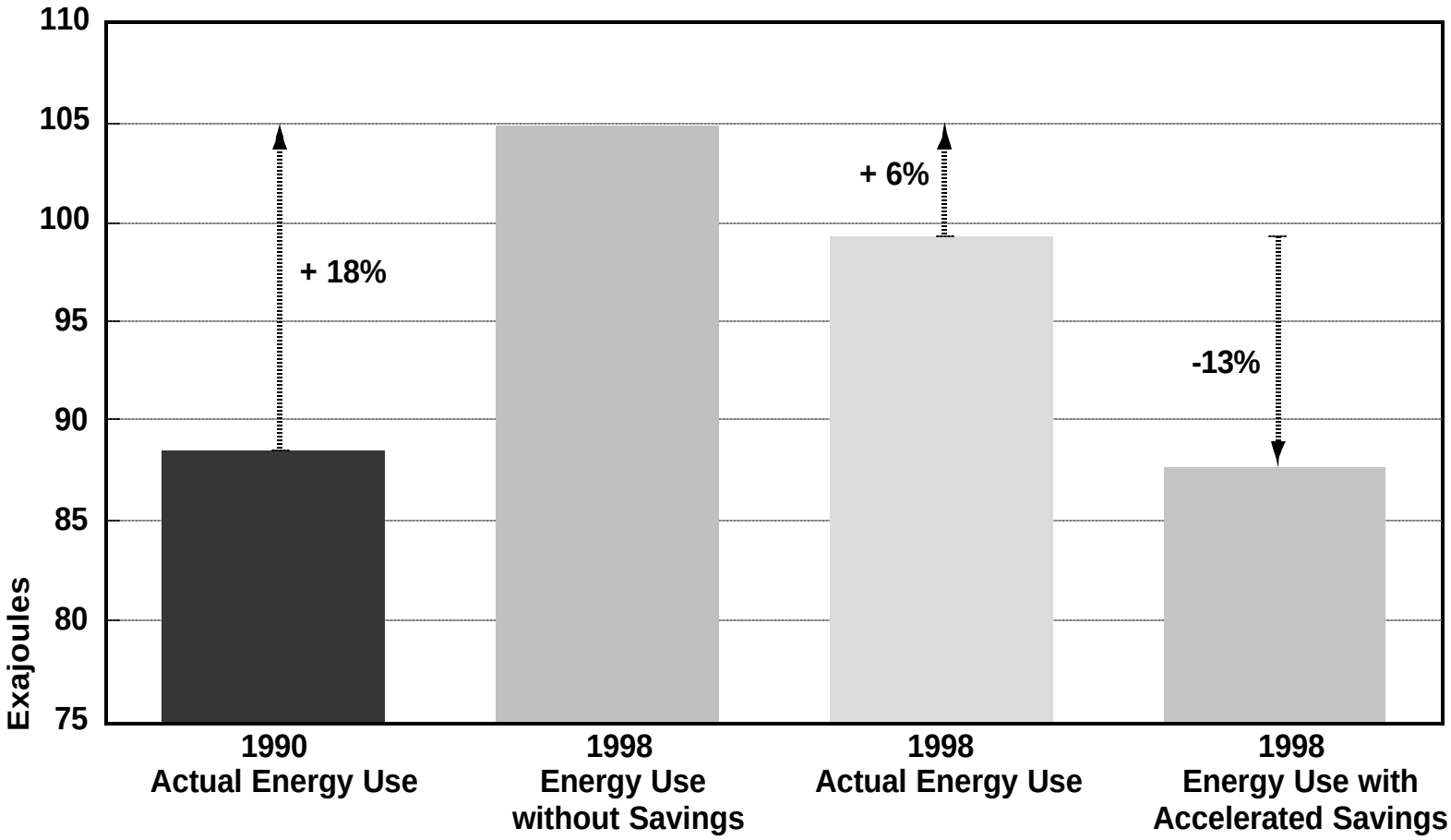
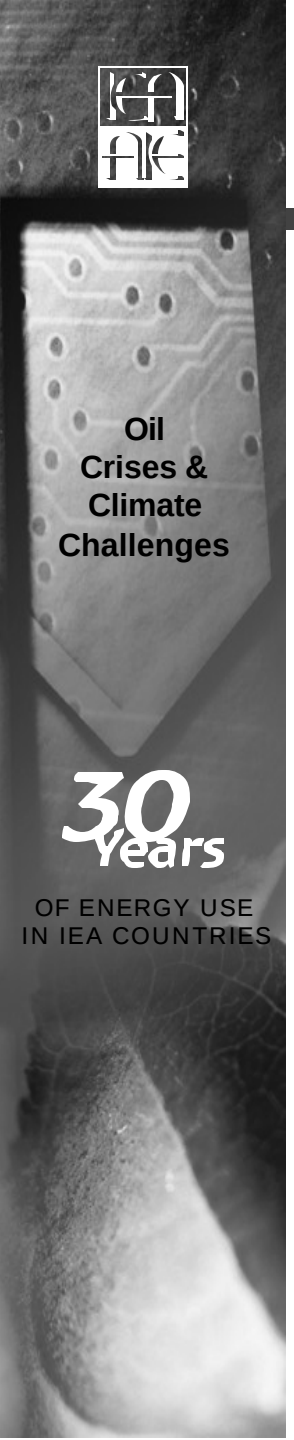
Actual Energy Use & Two Savings Cases, IEA-11



If savings rates had followed "the second best" IEA-11 could have saved 13% more energy between 1990 and 1998



Energy Costs and Savings

- **Falling prices and successful energy savings have helped reducing energy budgets for industry and private consumers since the early 1980s:**
  - **Energy's share of production cost in industry fell as much as 50%**
  - **Energy cost as share of income for private homes fell 20-50%**
  - **Fuel cost per km for cars fell by 20 to 60%**
- **Can explain less incentive to sustain energy savings after 1990.**

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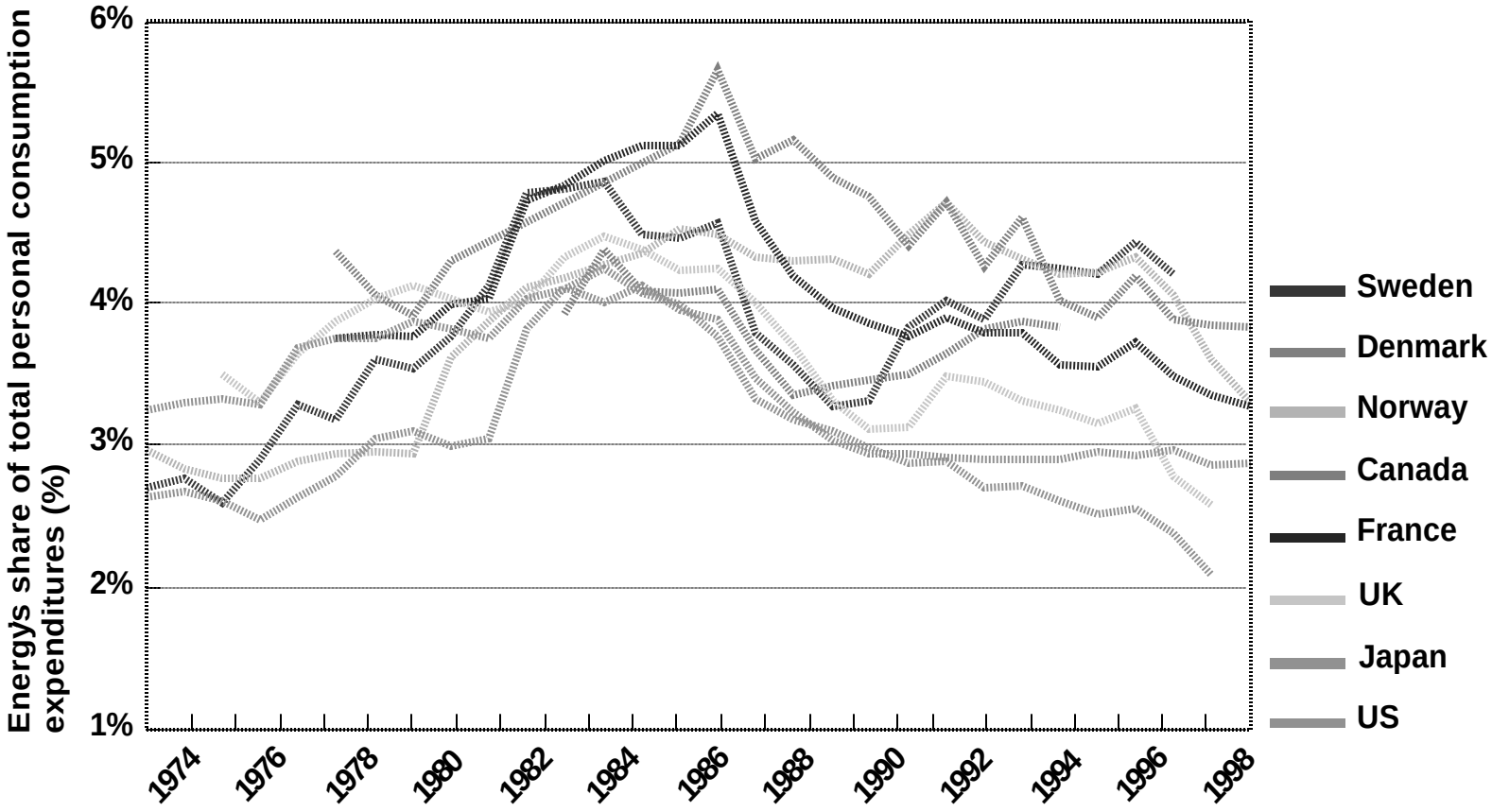
OF ENERGY USE IN IEA COUNTRIES

Household Energy Expenditures as Share of Income



IEA households today spend considerably less of their incomes on energy than in the early 1980s

Real Oil Price and Changes in Energy Intensities

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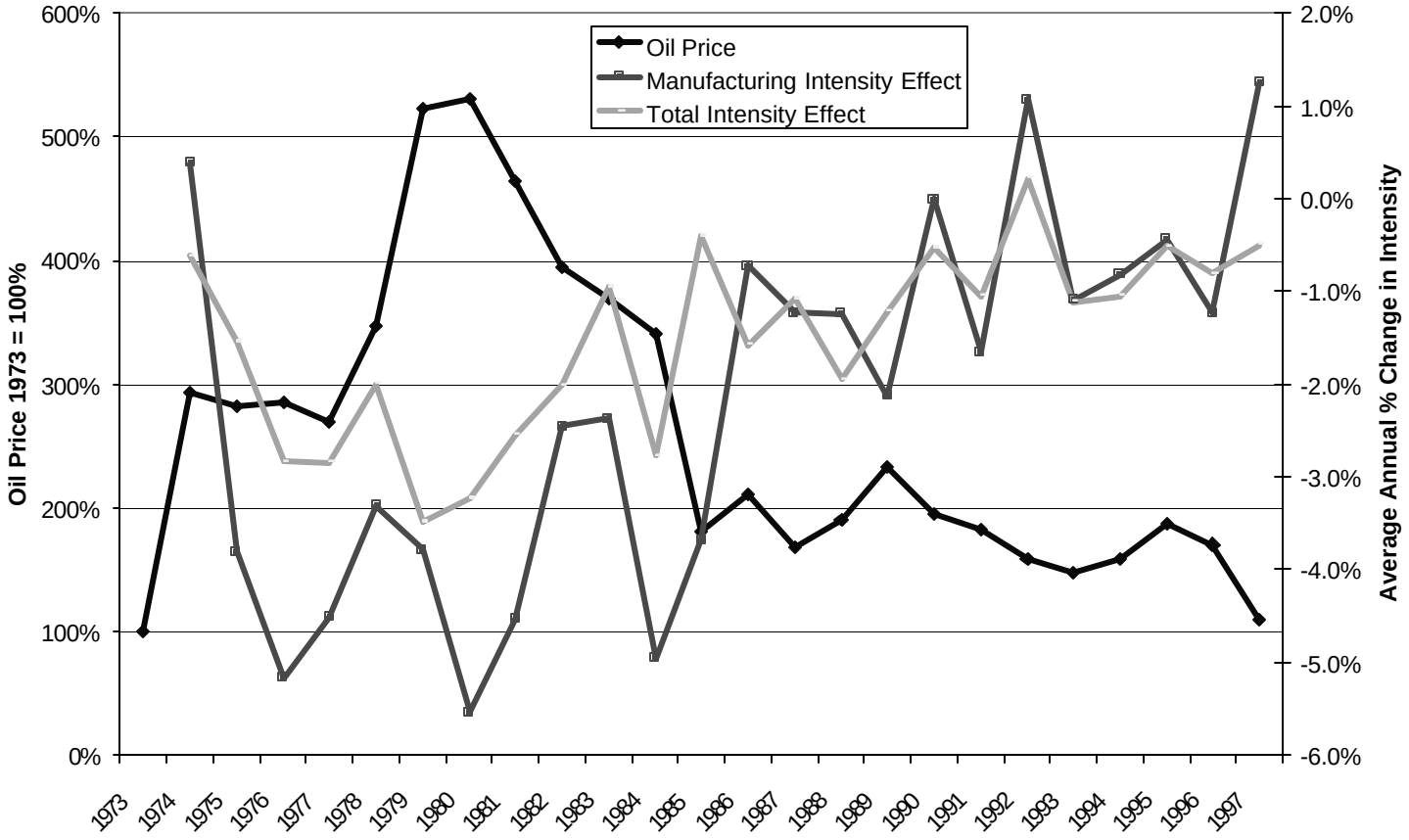

Correlation between slowing rate of decline in energy intensities and oil price level

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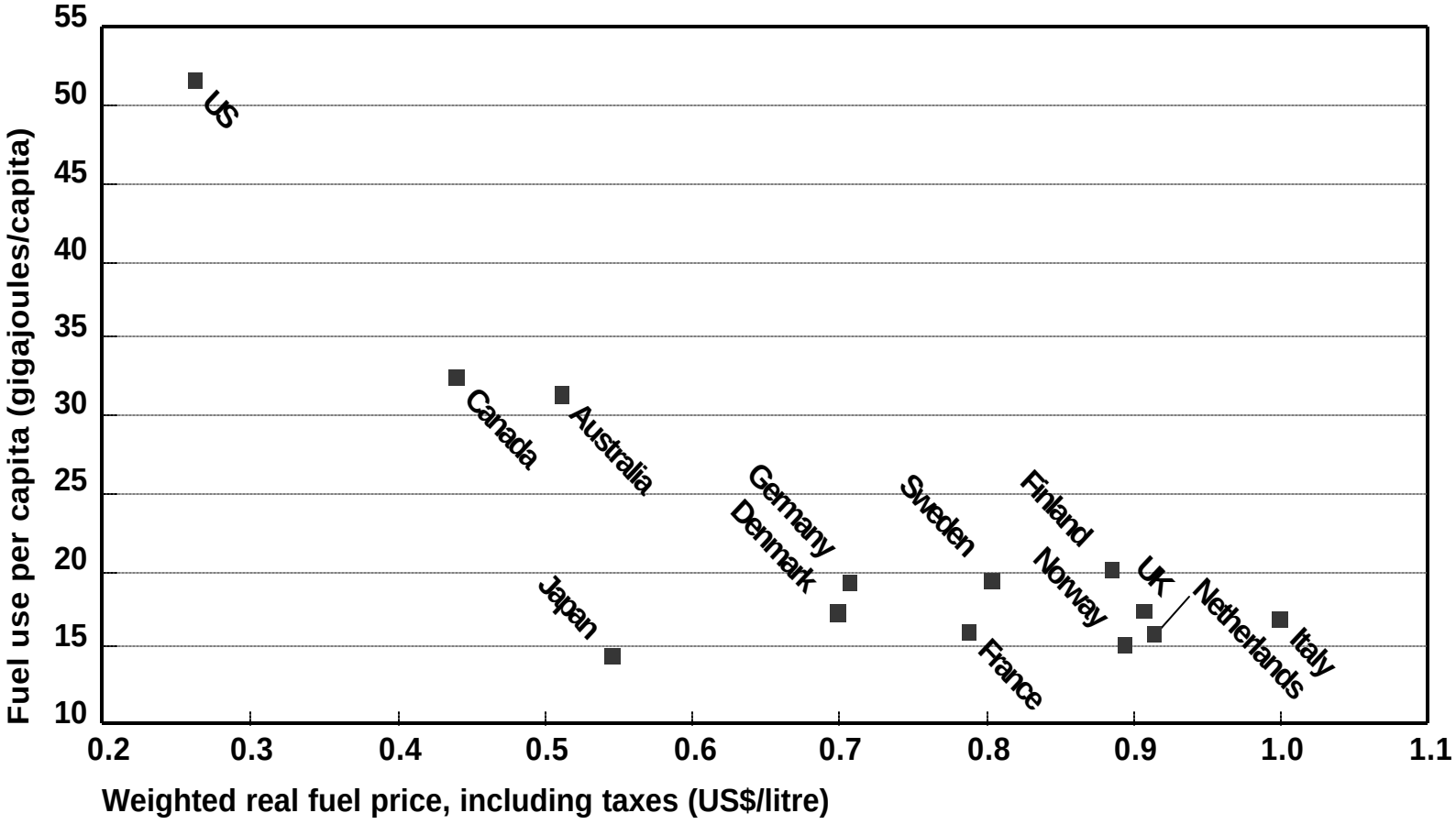
Car Fuel Use per Capita vs. Price, 1998



Energy use for cars is higher where prices are lower

Travel and Intensities vs. Fuel price

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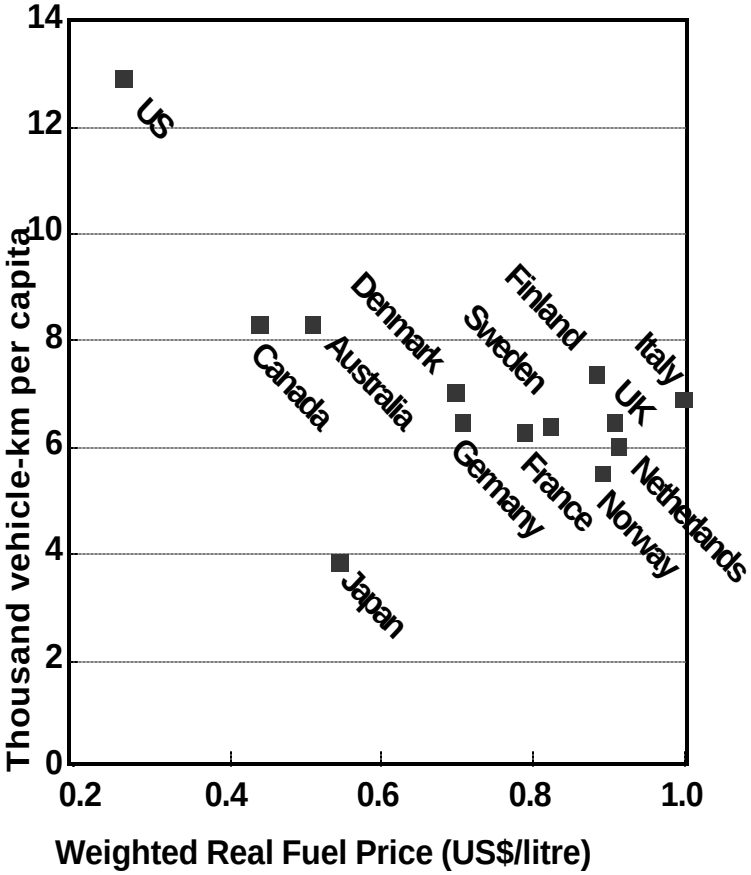
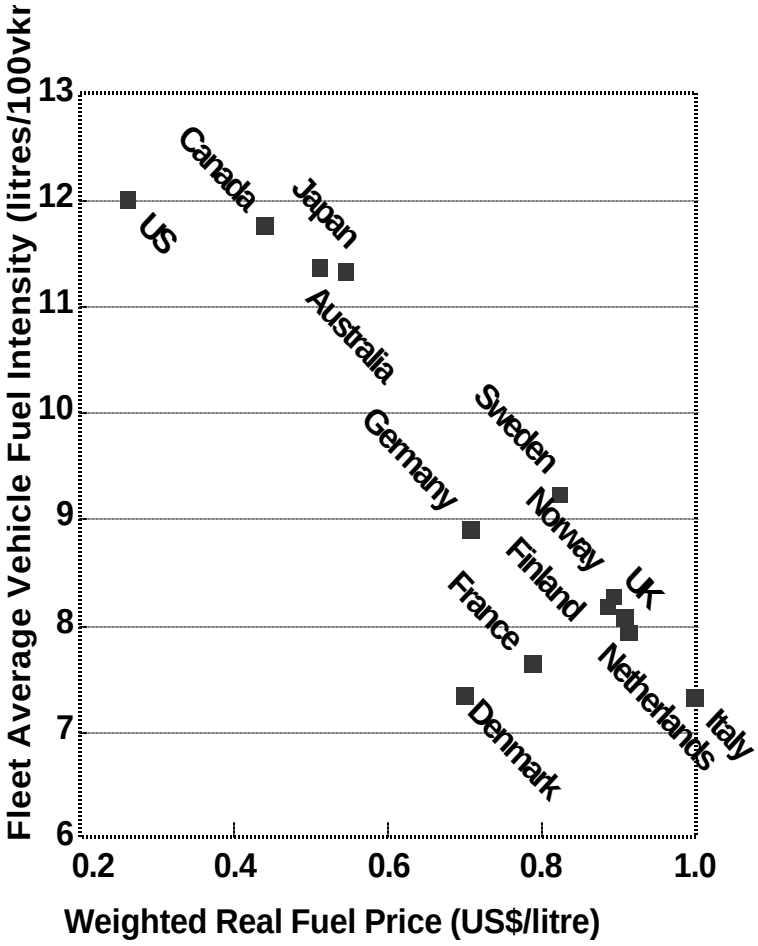
OF ENERGY USE IN IEA COUNTRIES



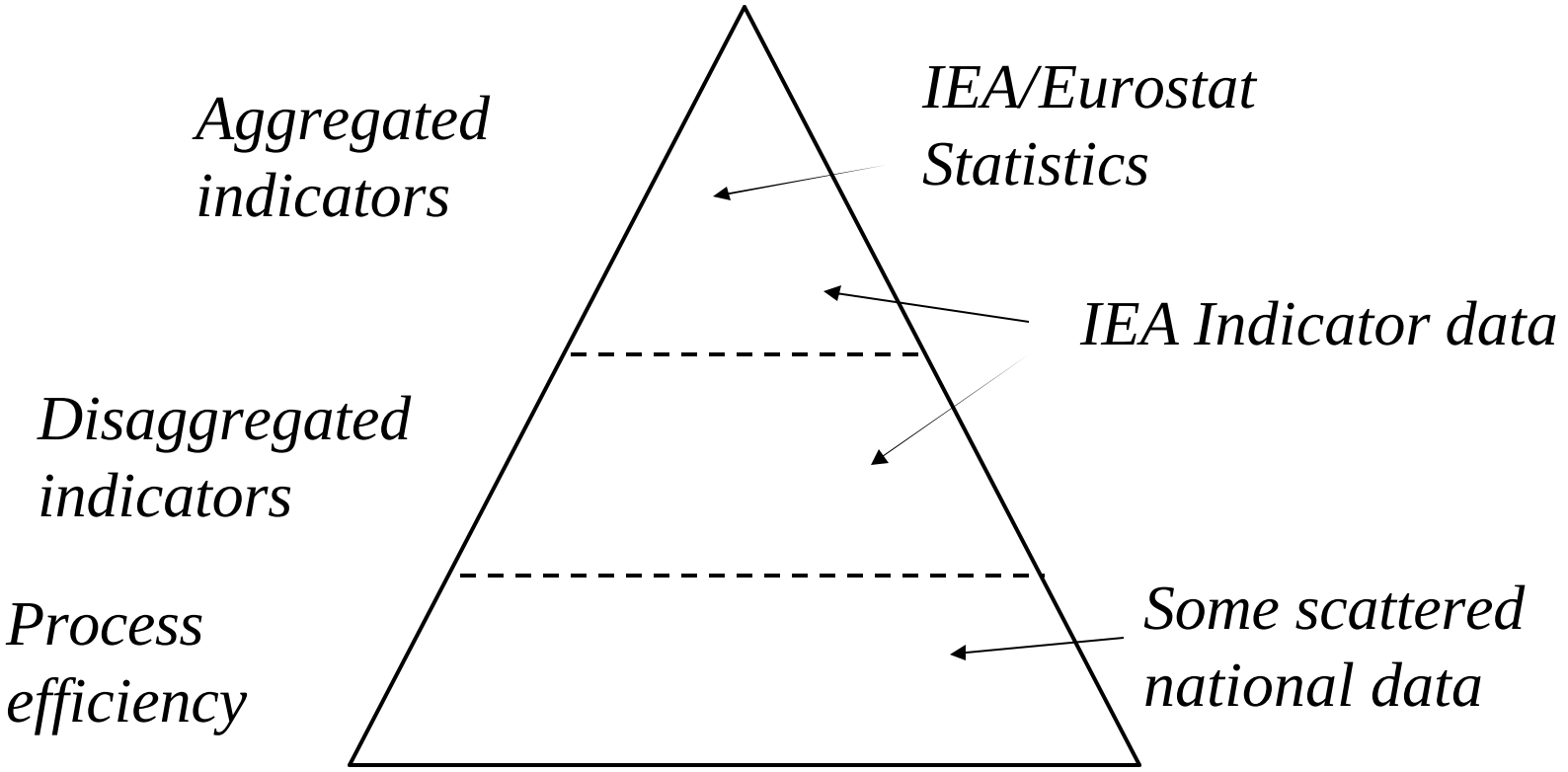


Higher fuel prices correlate with lower fuel intensity

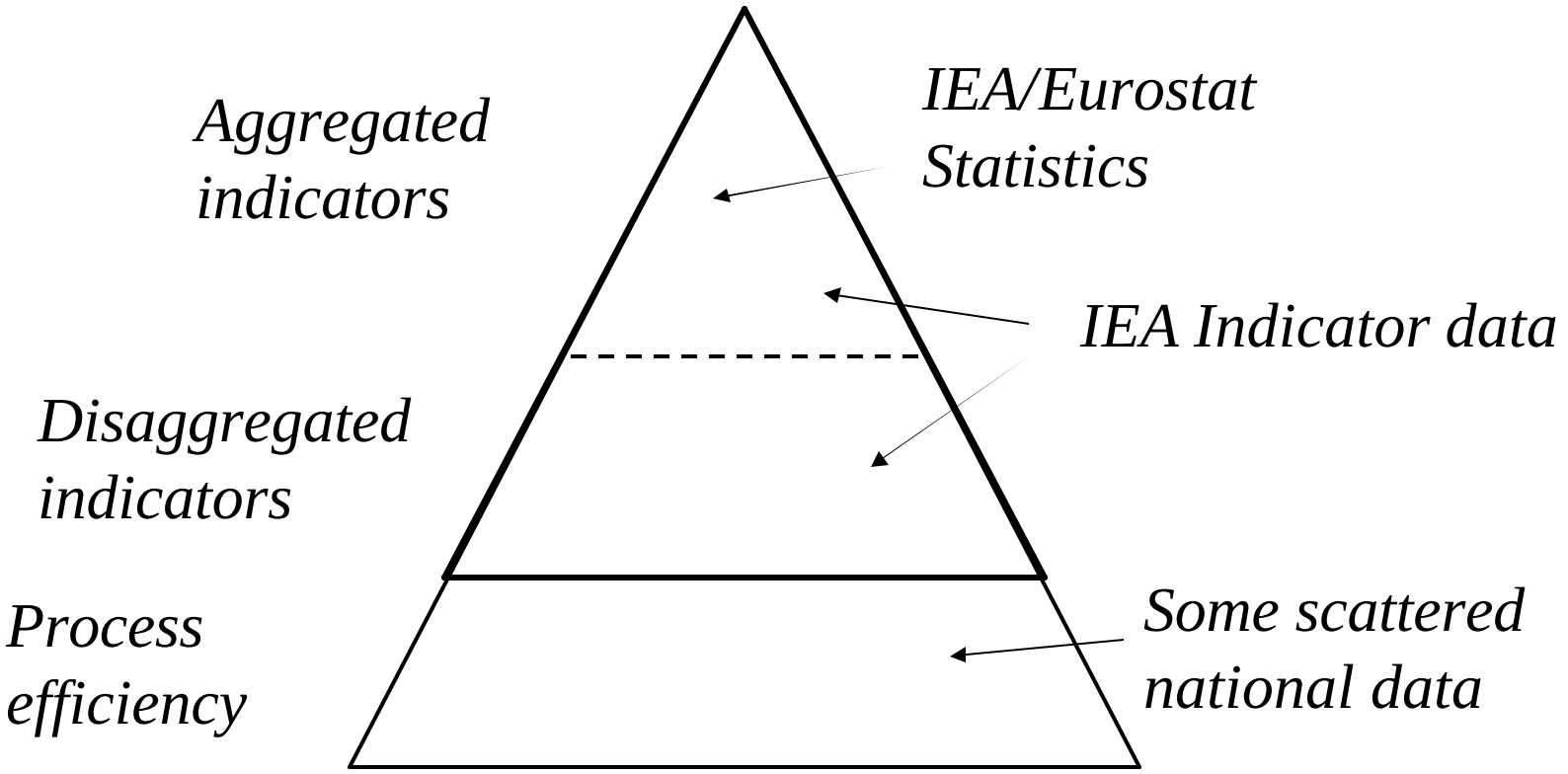
Data

The Painful Necessity

Matching Analysis and Data
The Indicator Pyramid



Matching Analysis and Data
The Indicator Pyramid



Developing Indicators

Collection of data is the starting point

- Analysing energy demand developments requires
  - => Disaggregated data
  - => of good quality
  - => consistent over time and
  - => consistent with international standards
- Improving availability and quality of data requires national efforts
- Participation in international efforts adds value but require submission of consistent data

IEA Energy Indicator Project: Next Steps

- **Update:**
  - IEA Indicator database to most recent year
- **Expand:**
  - Cover more IEA Countries
  - Non-OECD Countries
- **Deepen:**
  - New indicators to improve assessment of energy efficiency progress in all sectors, e.g. for industry:
    - Use physical production, not value added as activity measure
    - More disaggregated to capture production of key energy intensive materials

IEA Energy Indicator Project:
Deliverables

- Continued update of IEA indicator database (next version mid 2006)
- Update of IEA's "30 Years" Indicator publication, presenting trends for all sectors through 2001/2002/2003 (planned for 2006)
- Expanded indicator database with key non-OECD countries (2007-2008)
- Develop more detailed indicators to address the G8 tasks on buildings, transport and industry (2006-2007)
- Workshops focused on non-OECD countries and on development of new indicators (2006-2007)
- Publication on trends in energy use and efficiency in IEA and key non-OECD countries (Spring 2008)

Taking Indicators Forward

Issues Discussed at IEA Workshop

- Data and methodology go together
- Indicators motivate need for data
- Indicators a tool for checking data
- Help to understand what you don't understand
- Short-term analytical needs vs. long-term data collection efforts
- What to do when data is missing?
- Communication between statisticians, analysts and policy makers needed

Taking Indicators Forward

Issues Discussed at IEA Workshop (cont.)

- National efforts crucial to feed data to IEA and to help assessing trends
- The need for assessing new indicators by sector
- Sector specific issues, e.g. household surveys
- Expand IEA indicator project to non-OECD countries
- Collaboration to improve definitions, e.g. energy efficiency vs. conservation