Resource Use and Resource Efficiency in the Asia-Pacific Region

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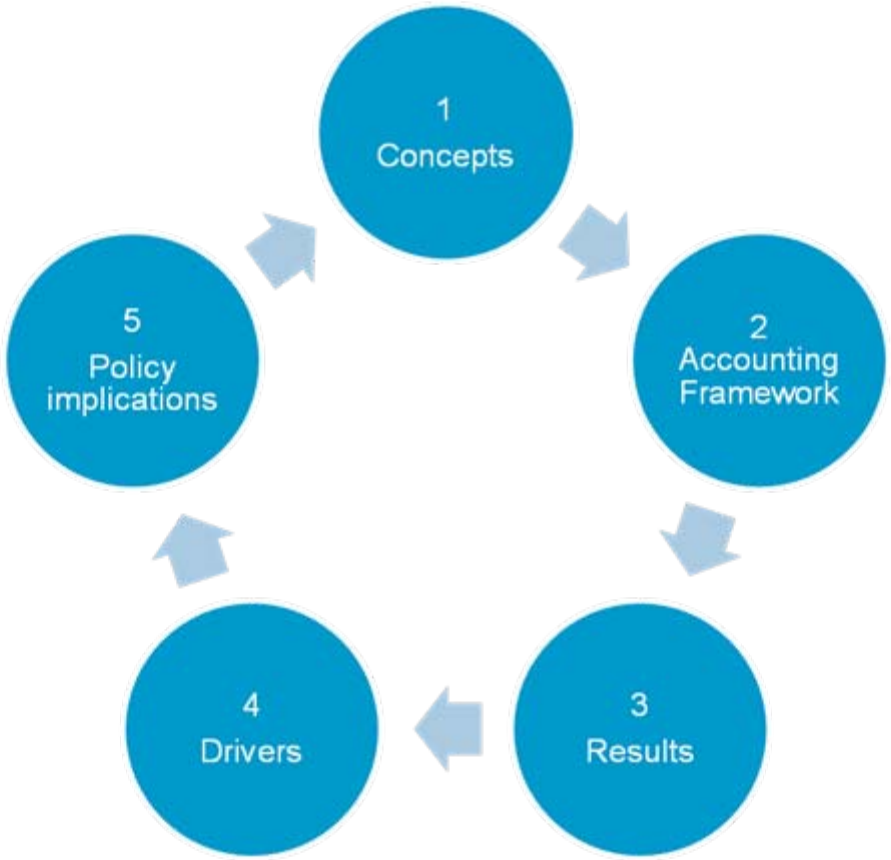
Structure of the talk



1 Concepts


If you want to be taken seriously as a scientist, at least try to look like a scientist
CHRIS MADDEN

Indicators of the ‘quality’ of human life

- List of Social Concerns Common to most OECD countries (OECD, 1973)
- Alternative indicators of the quality of human life have failed
- No consensus on the main qualitative elements of human welfare
- Long and widely differing lists of social indicators
- Indicators overlapped in scope and coverage
- Different units of measurement impaired comparison and aggregation of indicators

“It is no surprise that social indicators were unable to dethrone the leading economic aggregates, gross domestic product (GDP), income, employment and consumption, as the main compasses for national economic policy.” (Bartelmus, 2003)

Focus on negative effects

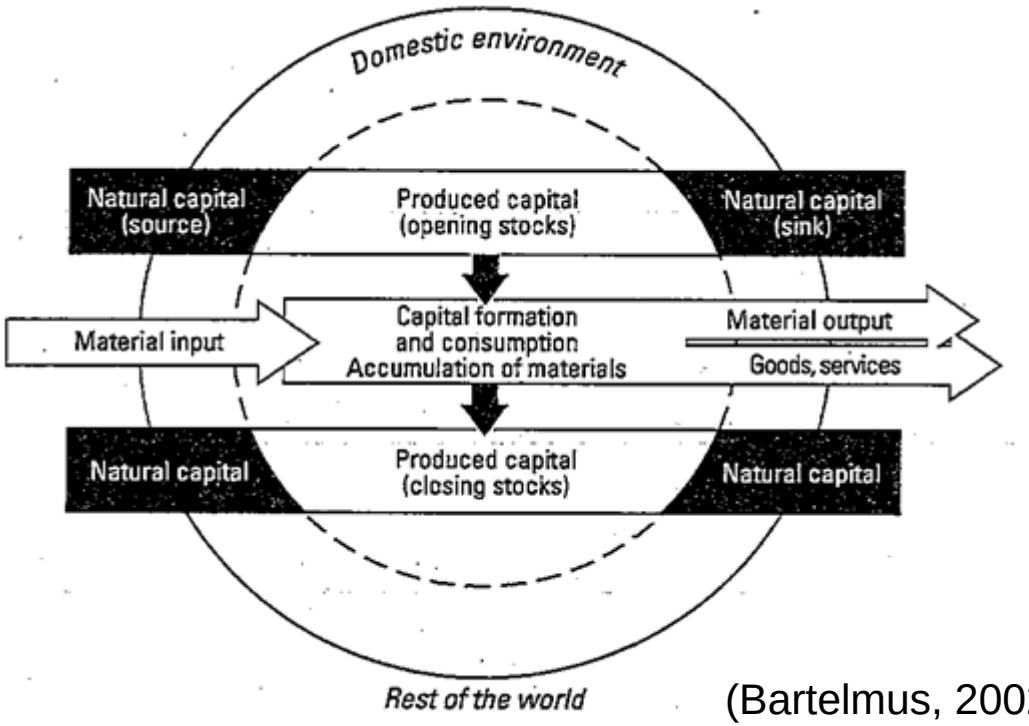
- Late 1980/1990: New focus on the negative side of human quality of life
- Correct GDP for defensive expenditures, include non-marketed goods and services, include environmental externalities, inequities in the distribution of environmental impacts, of income and wealth
- Long lists of environmental and sustainability indicators
- Organised in loose frameworks (PSR of UN/OECD)
- Comparability and aggregation problems

Compound indices

- Overall picture of economic welfare
- Measure of Economic Welfare (MEW) by Nordhaus and Tobin, 1972
- Genuine Progress Indicators (GPI) by Cobb et al. 1995
- Index of Sustainable Economic Welfare (ISEW)
- Human Development Index by the UNDP (annual)
- Deduct ‘regrettables’ and add ‘desirables’
- Lack consistency with standard economic accounting
- Equal weighting of unequal and correlated issues obscure the meaning

Integrative measures of the society-economy interface

- Physical material flow accounts (MFA)
- Physical and monetary system for integrated environmental and economic accounting (SEEA)
- Satellite accounts to the System of National Accounts



(Bartelmus, 2002)

Socio-ecological regimes

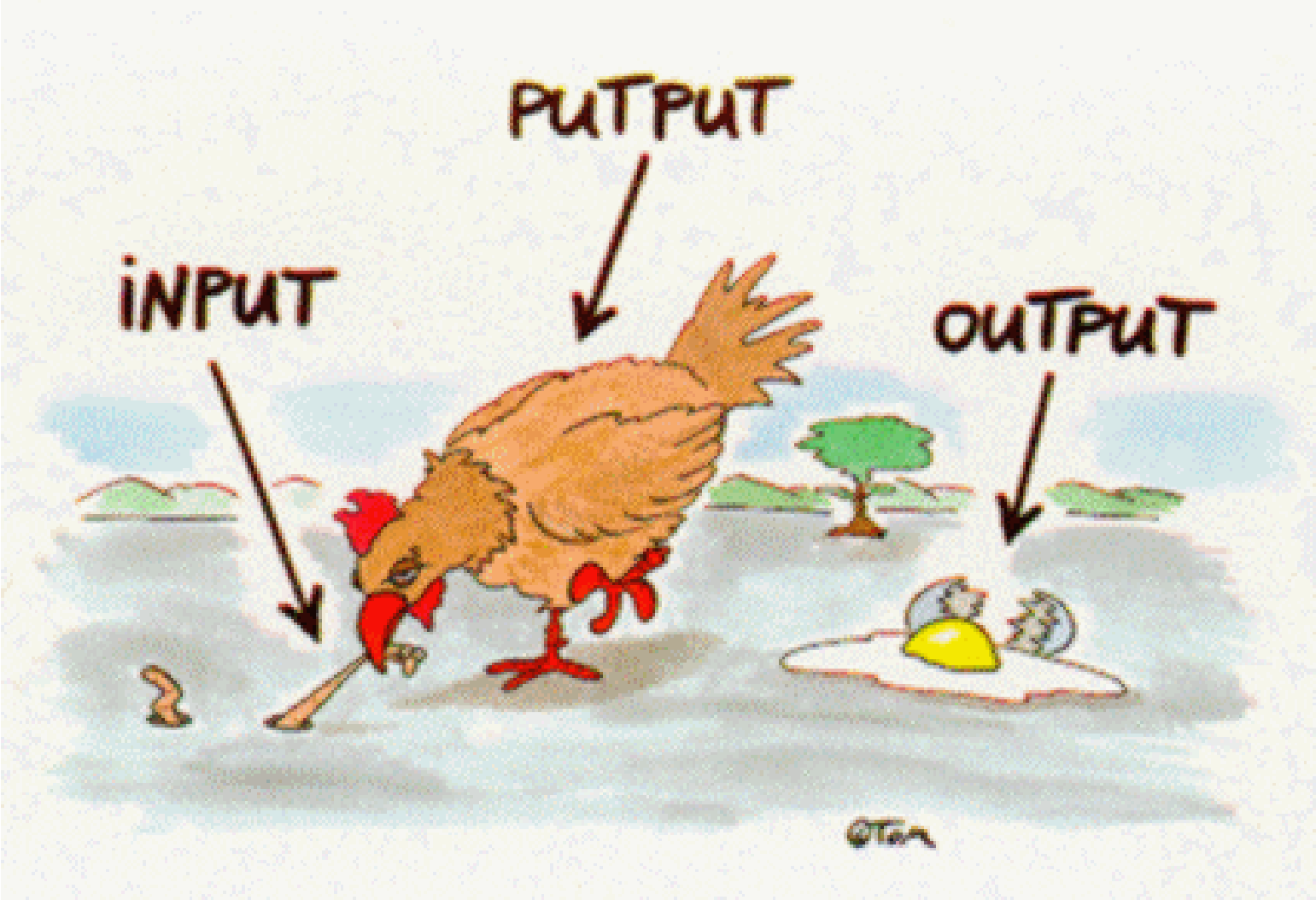
	Agrarian regime	Industrial regime
Resource base	Controlled solar energy system; tapping into renewable flows; biomass	Fossil fuel based energy system; exploitation of finite mineral stocks; fossil fuels, minerals, biomass
Infrastructure and technology	Decentralized infrastructures; land use is the key technology; limited availability of technologies for energy conversion	Centralized infrastructures; industrial technologies; a wide range of energy conversion technologies
Mobility and transport	Low mobility; transport of bulk materials is confined by high energy costs	High mobility; long distance transport of mass materials
Economy	Subsistence economy to market economy; hierarchical differentiation	Capitalist market economy; functional differentiation

Socio-ecological regimes

	Agrarian regime	Industrial regime
Demography, time use	High fertility and mortality rates; high share of agricultural population; work load increases with population growth	Thrifty reproduction; prolonged socialization; low share of agricultural population and high urbanisation; tendency of declining workload
Environmental problems, sustainability	Soil erosion, declining soil fertility, infectious diseases, wildlife and habitat loss; Potentially sustainable;	Large scale pollution (water, air, land), alteration of atmospheric composition, resource depletion, biodiversity loss
Growth	Distinct limits for growth; strong coupling of land, energy and labour	(Temporary) abolishment of limits to physical growth; decoupling of land, energy and labour

(Fischer-Kowalski and Haberl 2007, Schandl et al. 2009)

2 Accounting framework



Establishing material flow accounts

- US Government Paley Report (1950s)
- Ayres and Kneese 1969
- National material flow accounts for Japan (Moriguchi 1992), Austria (Steurer 1992) and Germany (Bringezu 1993)
- World Resources Institute ‘Resource Flows’ (Adriaanse et al. 1997) and ‘The Weight of Nations’ (Matthews et al. 2000)
- MFA methodological guide (EUROSTAT 2001)
- Measuring Material Flows and Resource Productivity. 3 Volumes and a Synthesis Report (OECD 2008)
- MFA Compilation Guide (EUROSTAT 2007)
- UNEP Resource Panel

(Fischer-Kowalski 1998, Moriguchi 2007)

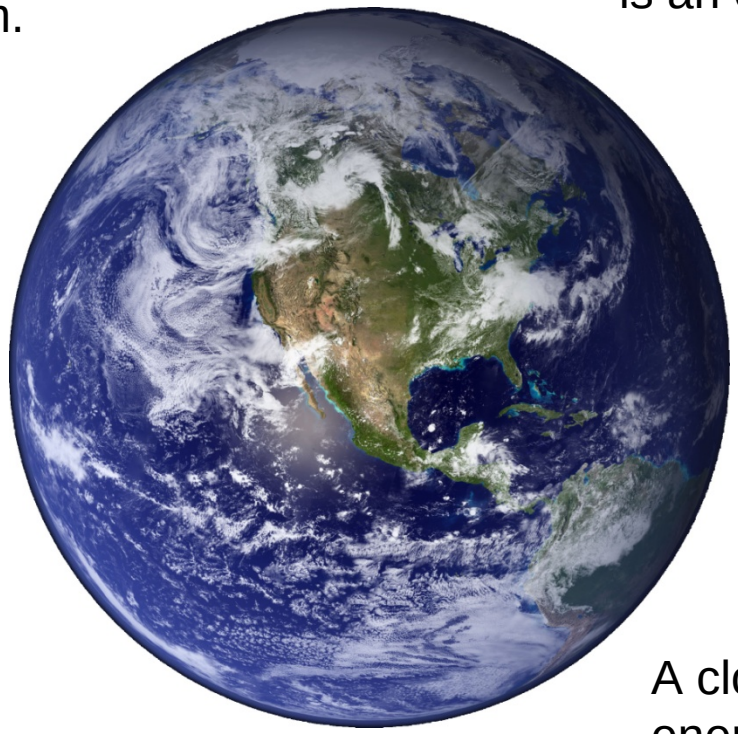
Open and closed systems

Planet Earth is a closed system.

The world economy is an open system.

material, energy
emissions, waste

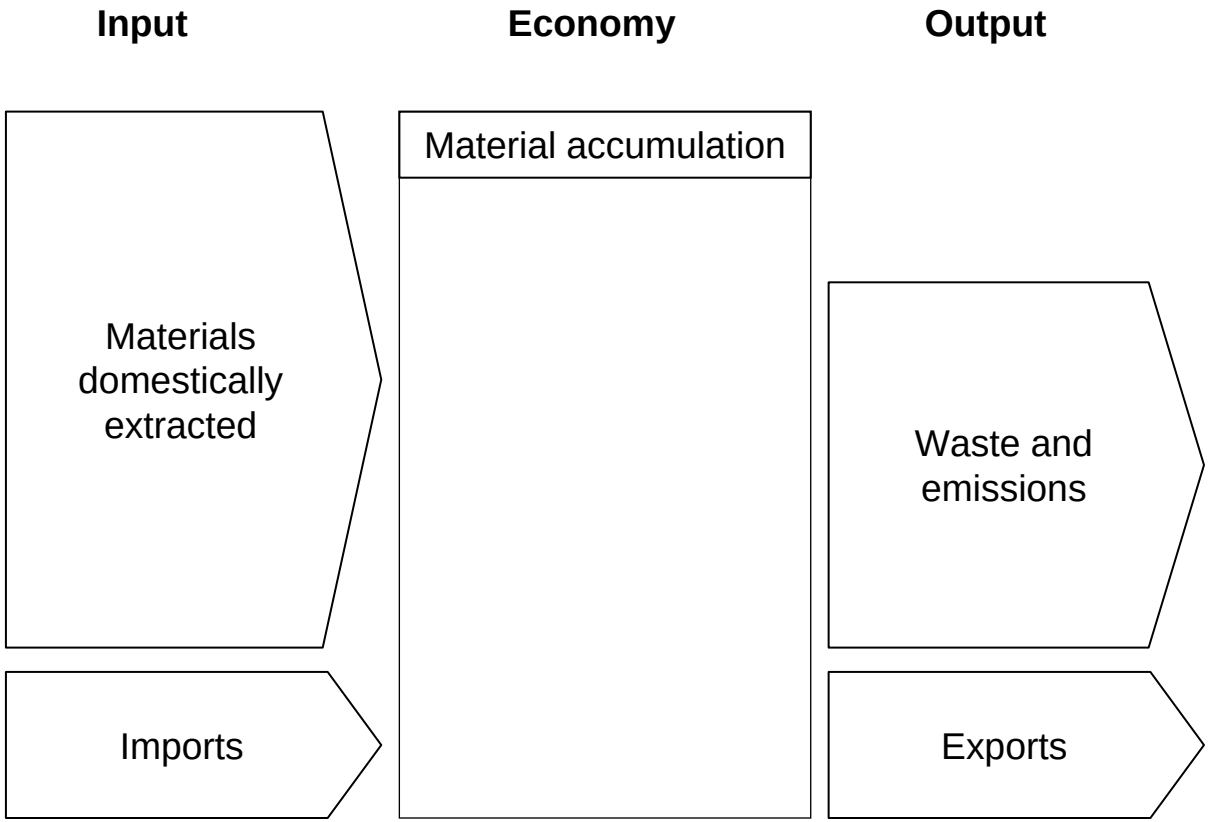
Solar energy



Heat

A closed system exchanges energy with its environment but not material.

Material flow accounting Framework



Which resources are included?

Inputs

Raw materials from agriculture, forestry and fisheries (crops, timber, fish)

Raw materials from mining and Quarrying (fossil fuels, iron ores, industrial and construction materials)

Imported raw materials, semi-manufactured goods, final goods

Outputs

Exported raw materials, semi-manufactured goods, final goods

Emissions to air and water
Waste land filled

Dissipative flows

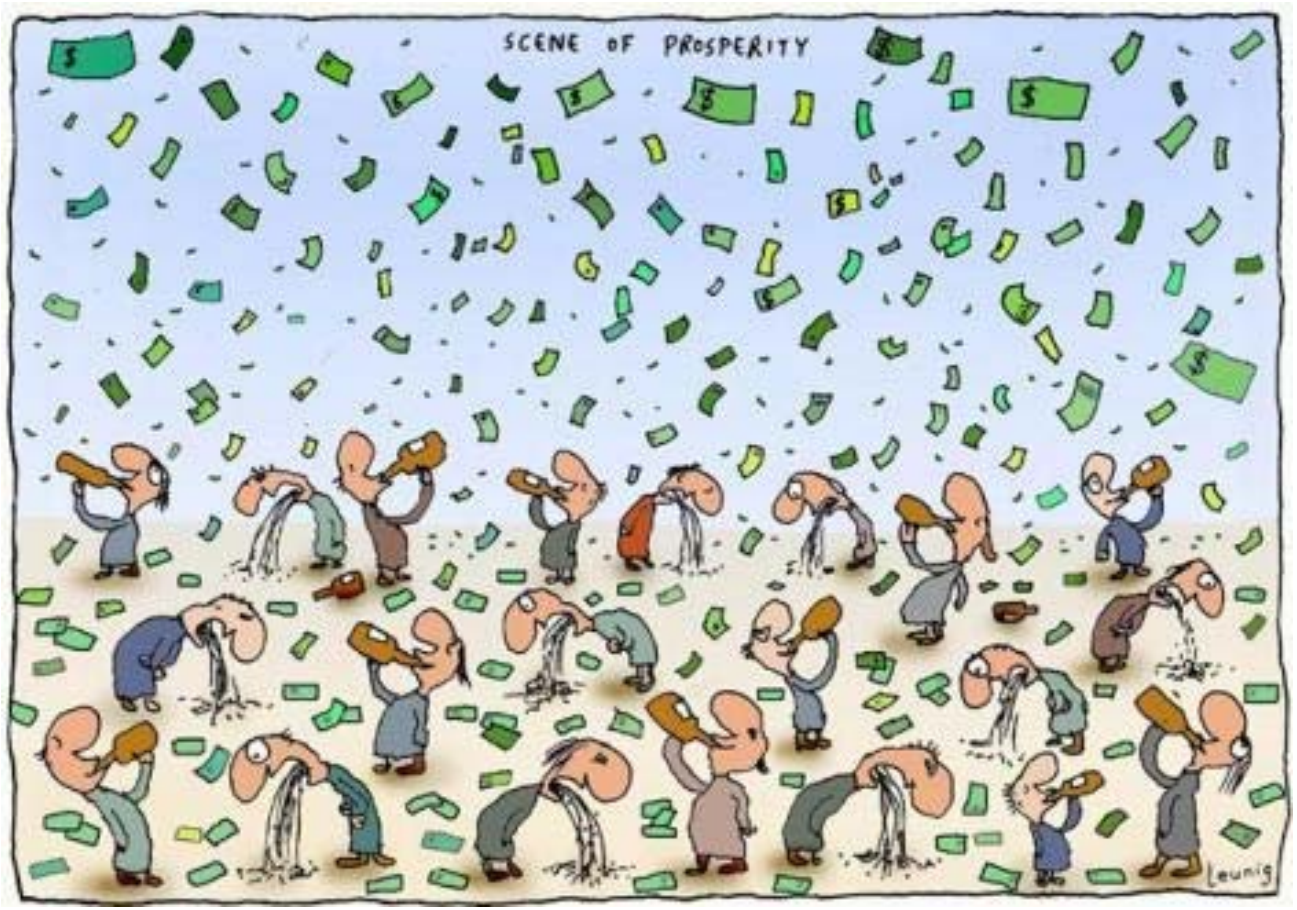
Resource Efficiency: Economics and Outlook (REEO) for the UNEP

- To establish comprehensive data bases on material, energy, water, emissions and land use
- Industrial metabolism
- Agreed accounting methods
- International data sources which are well regarded
- Indicators
- Modelling and Scenarios

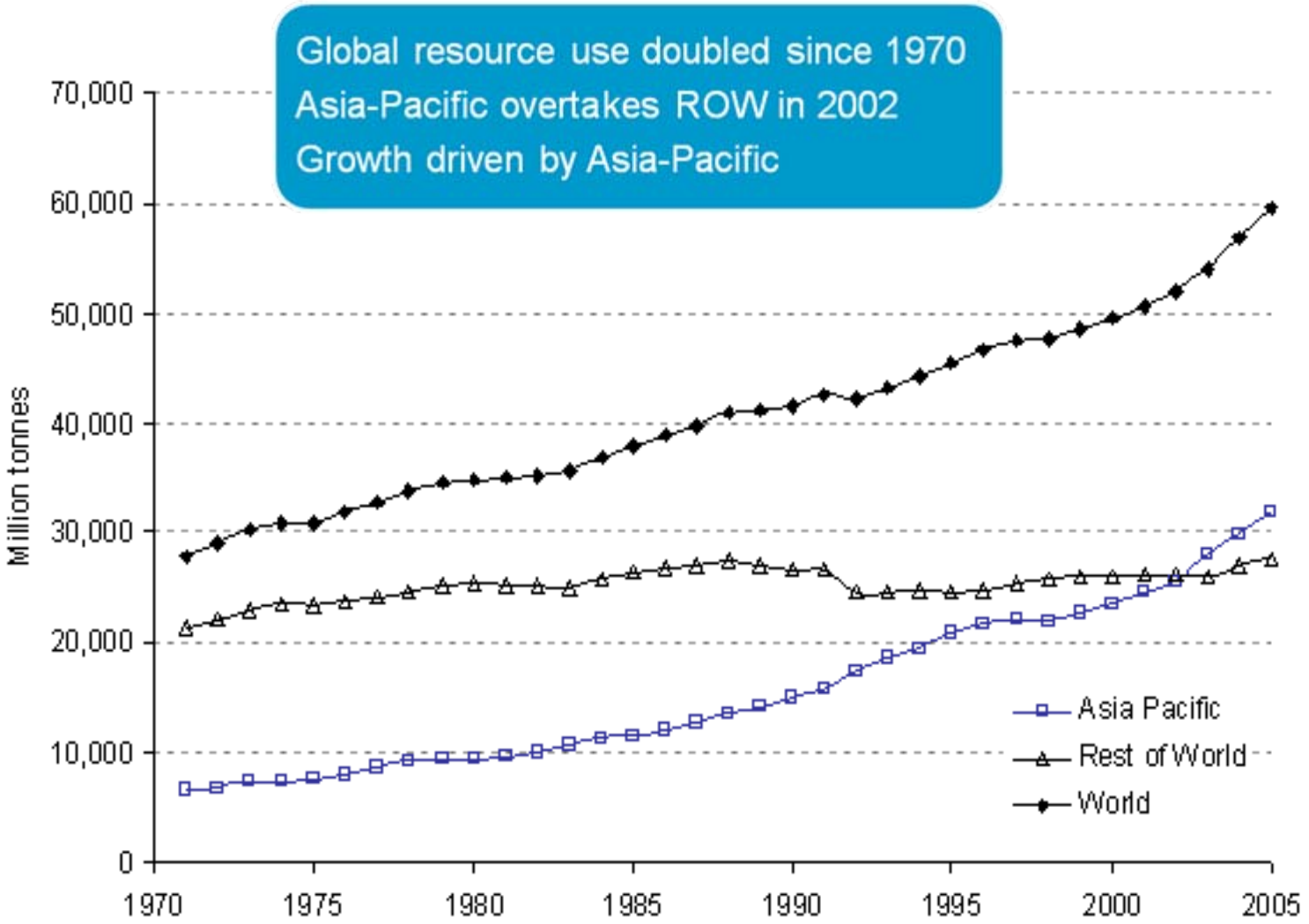
REEO indicators

- **Domestic extraction (DE)**
- Imports and Exports (IM, EX)
- **Physical Trade Balance (PTB)** = Imports (IM) minus Exports (EX)
- **Domestic Material Consumption (DMC)** = Domestic Extraction (DE) plus Imports (IM) minus Exports (EX)
- **Material Intensity (MI)** = DMC Domestic Material Consumption (DMC) divided by Gross Domestic Product (GDP)

3 Results: Resource Use and Resource Productivity in Asia-Pacific

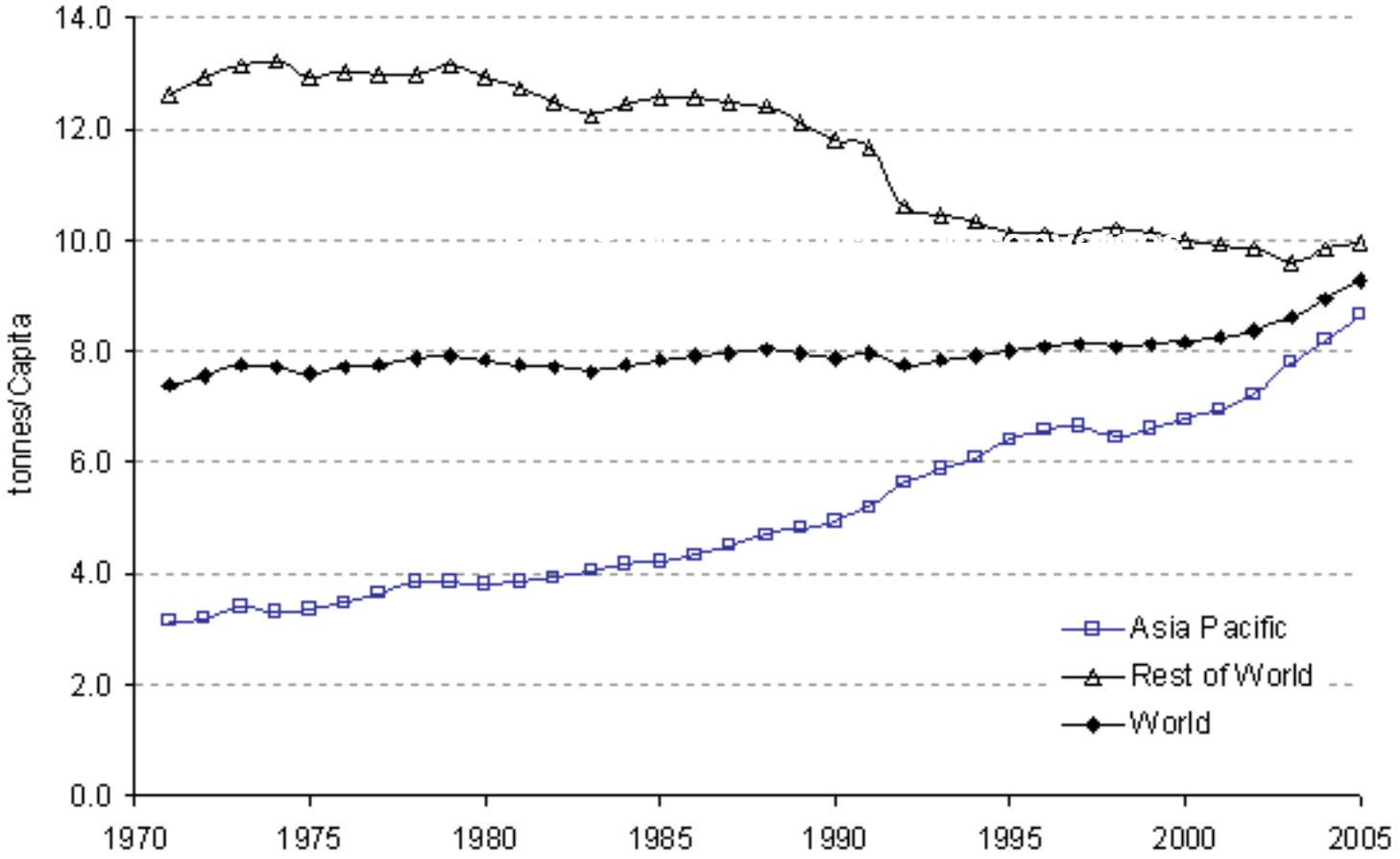


Domestic Material Consumption



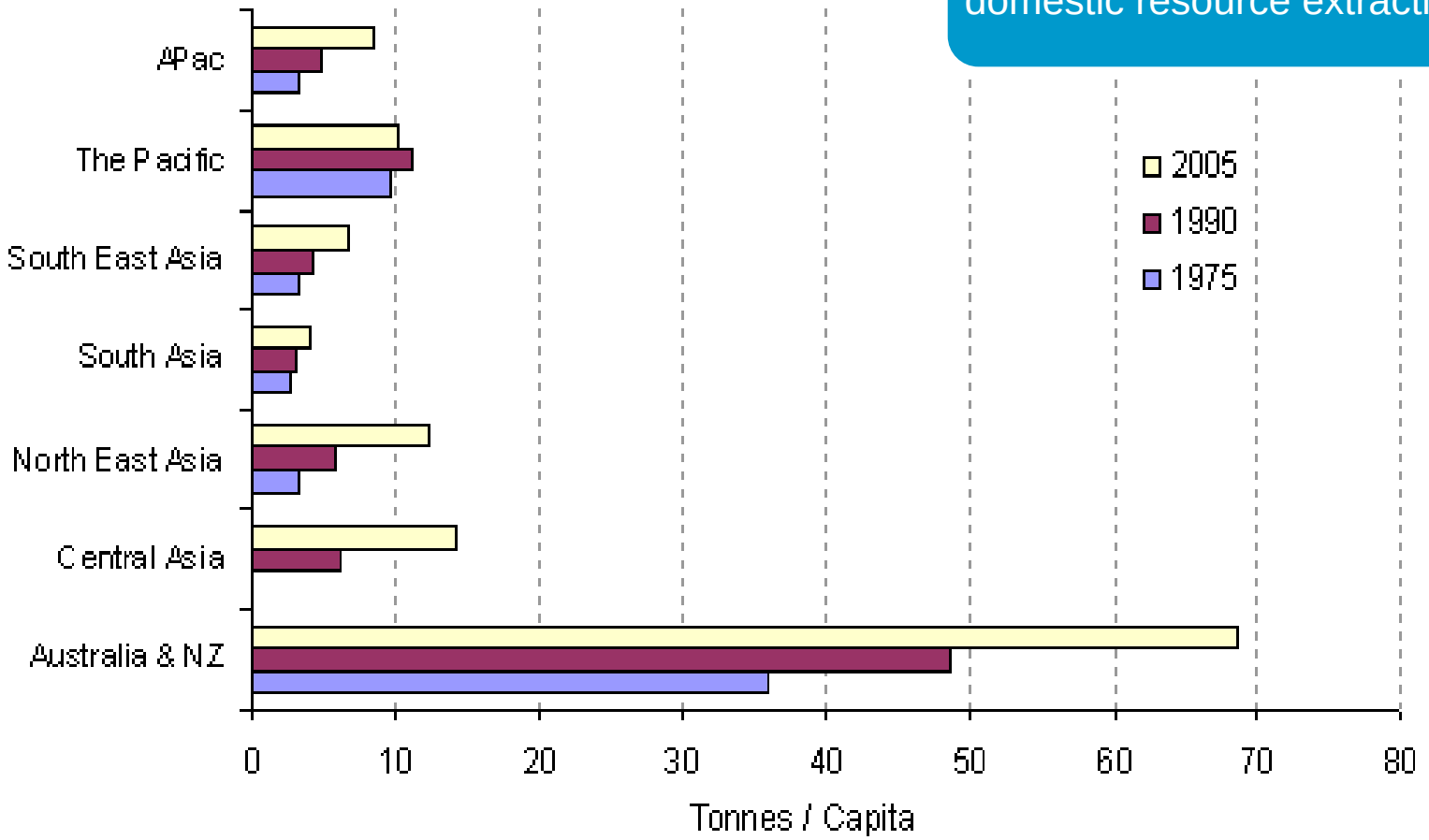
Per-capita domestic material consumption

Per-capita resource use converges at upward sloping trend



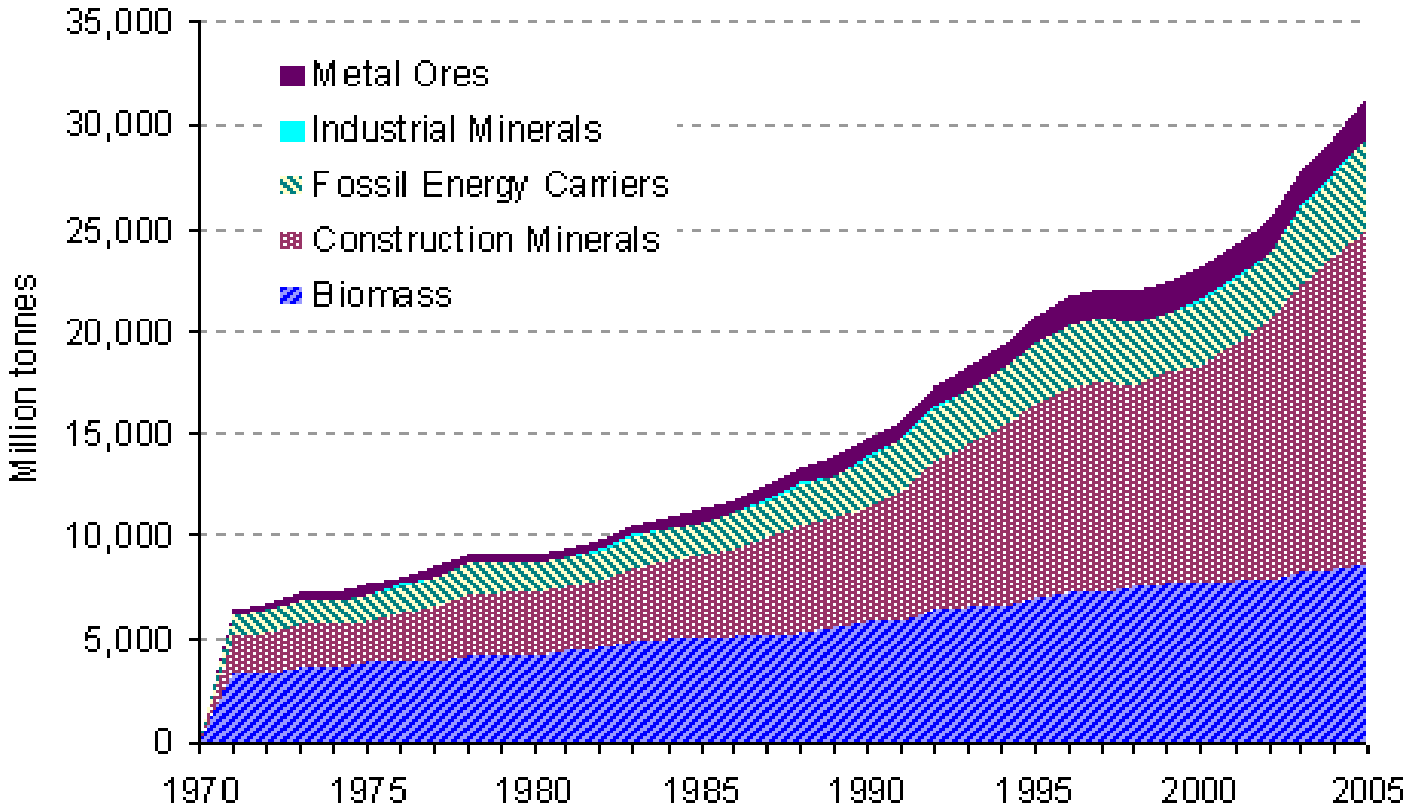
Per-capita domestic extraction

Stark regional differences for domestic resource extraction



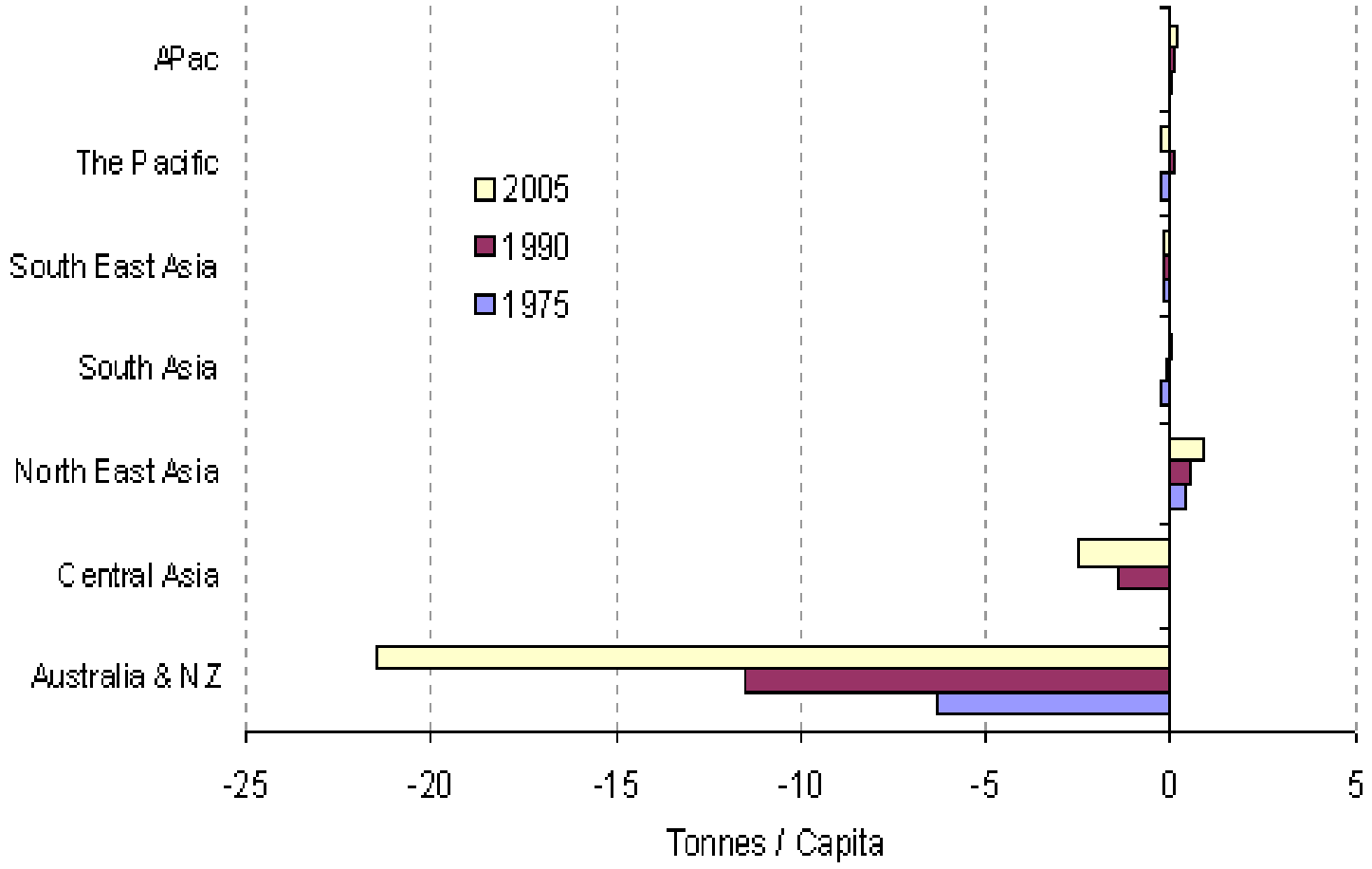
Domestic extraction by material category

Construction minerals grow fastest



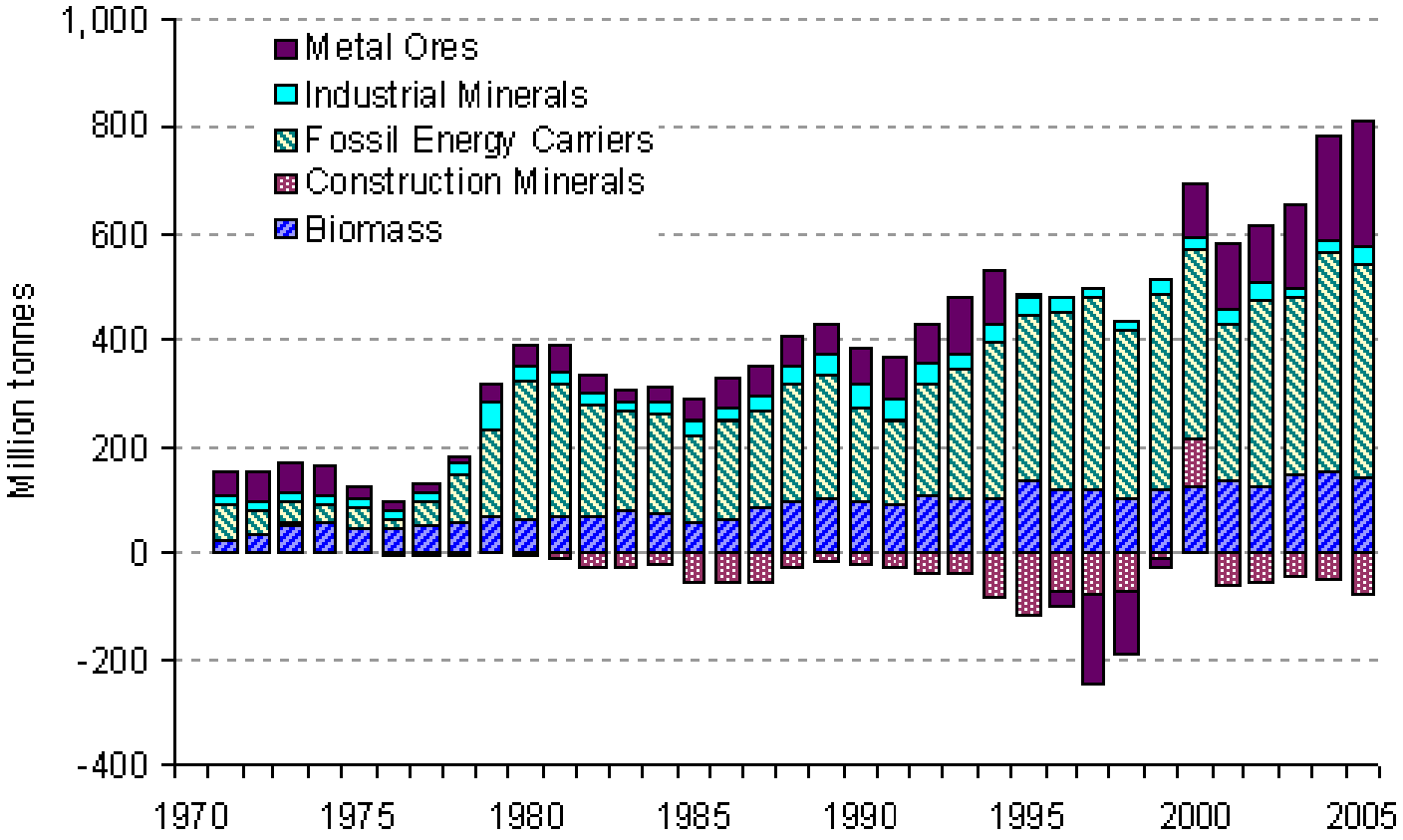
Per-capita Physical Trade Balance

Australia NZL and Central Asia are resource exporters



Physical Trade Balance by material category

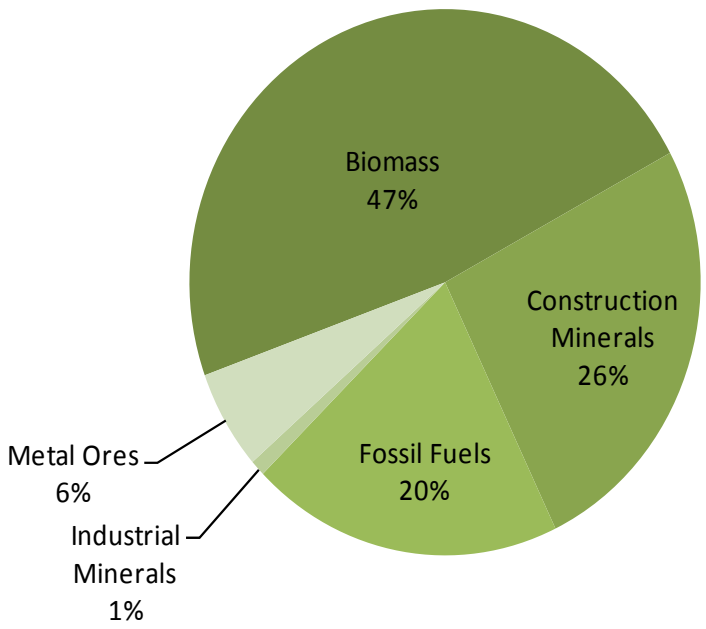
Dependence on foreign resources will grow



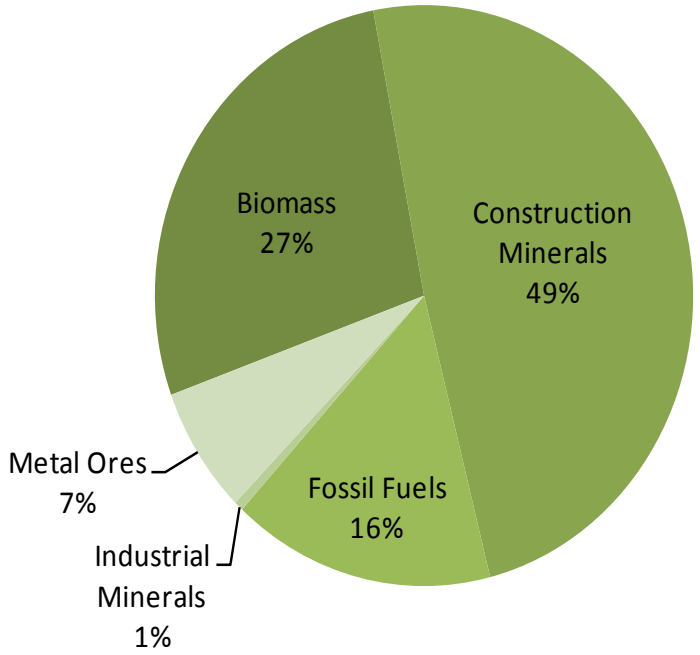
Domestic material consumption

From biomass to minerals

1970



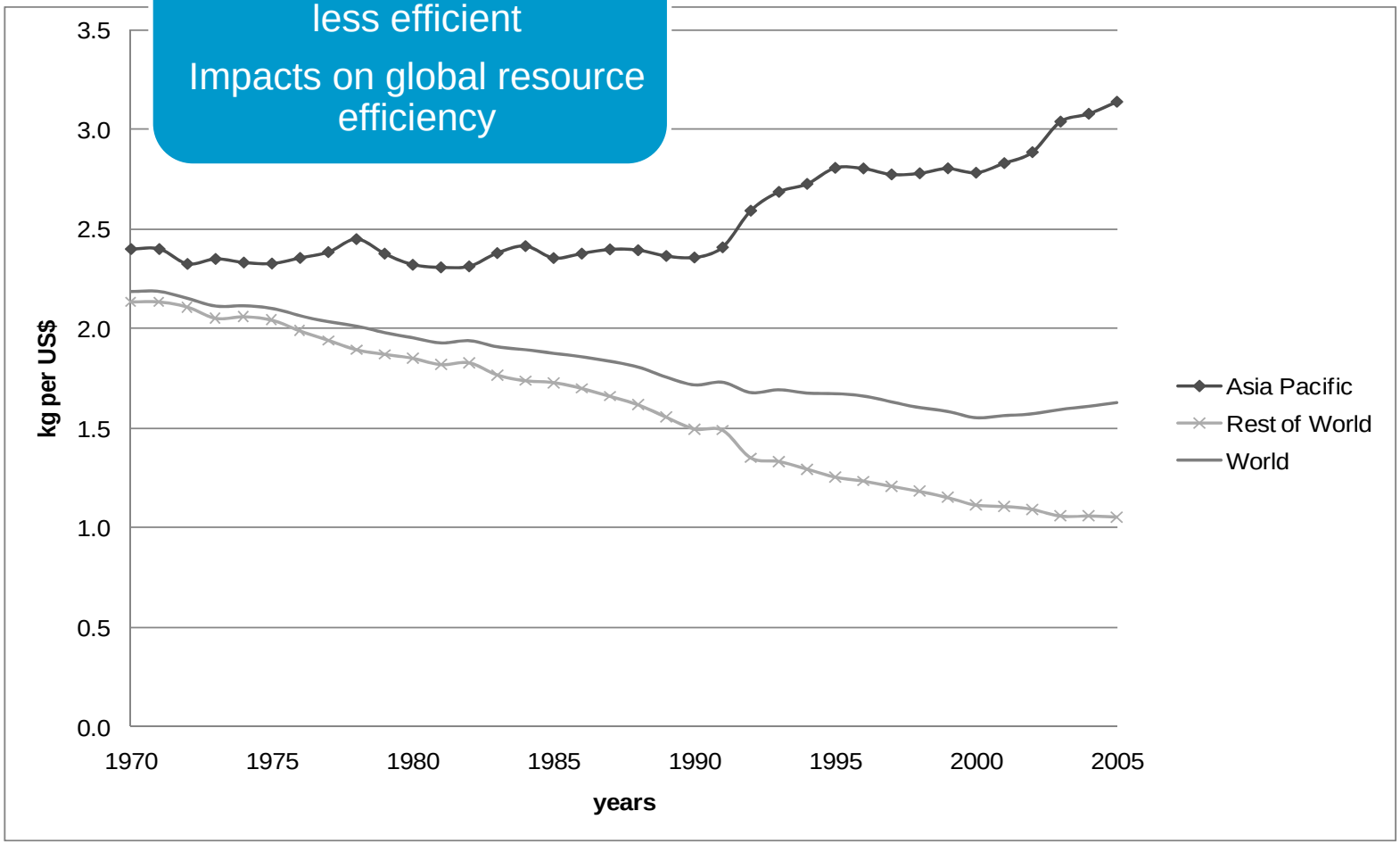
2005



Material Intensity, tonnes per US$

Asia-Pacific becomes less efficient

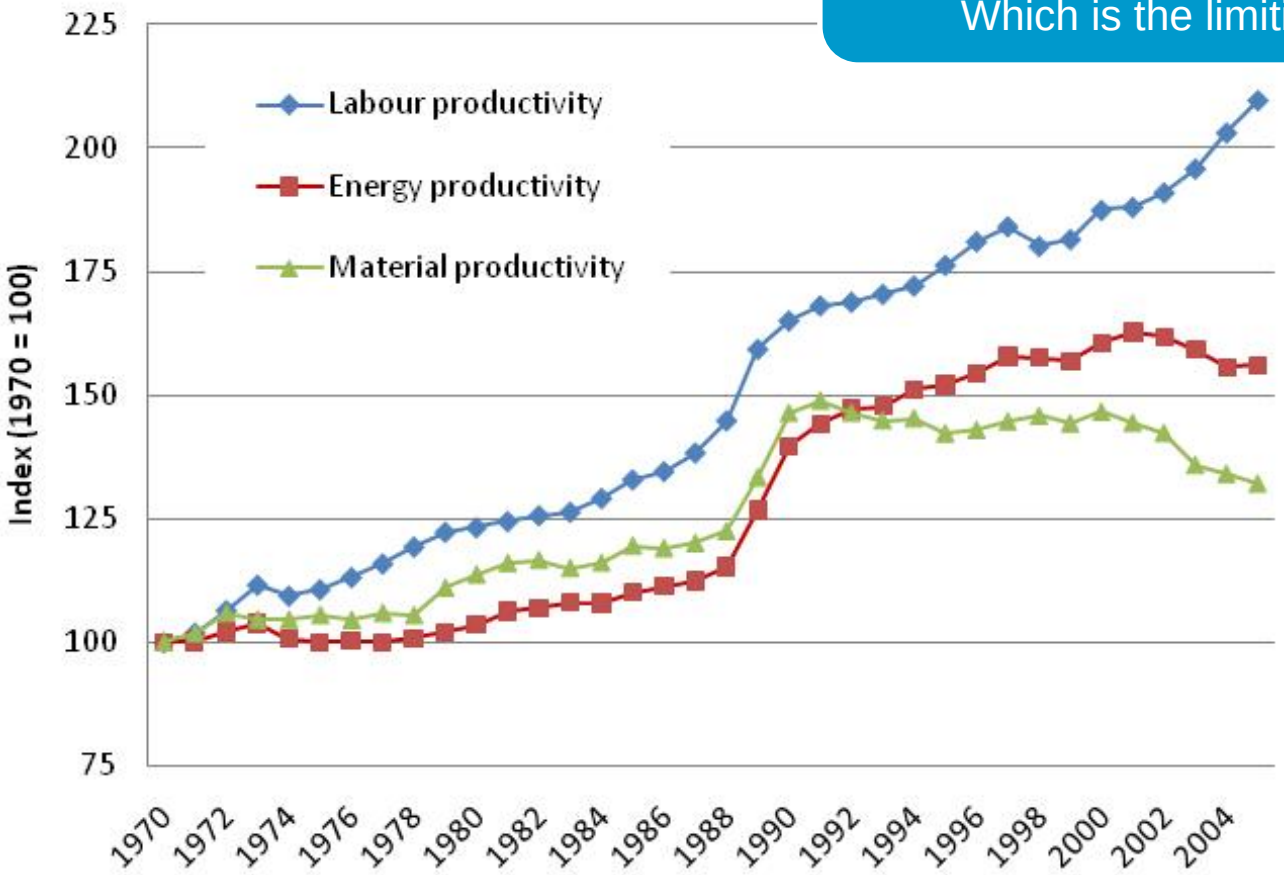
Impacts on global resource efficiency



Labour, energy and material productivity in the Asia-Pacific region, 1970 – 2005, indexed (1970 = 100)

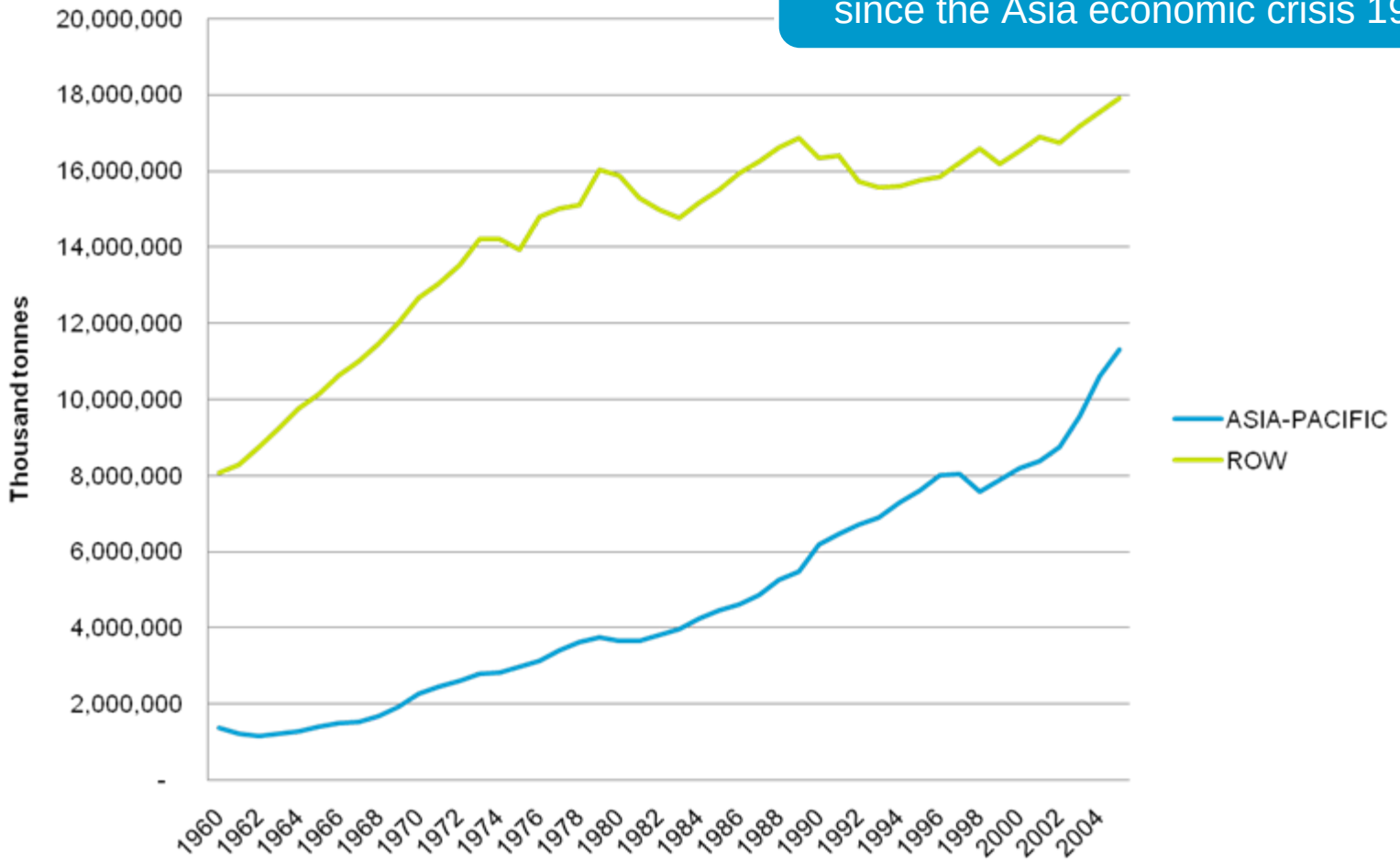
Improvements in labour productivity outpaces resource productivity

Which is the limiting factor?

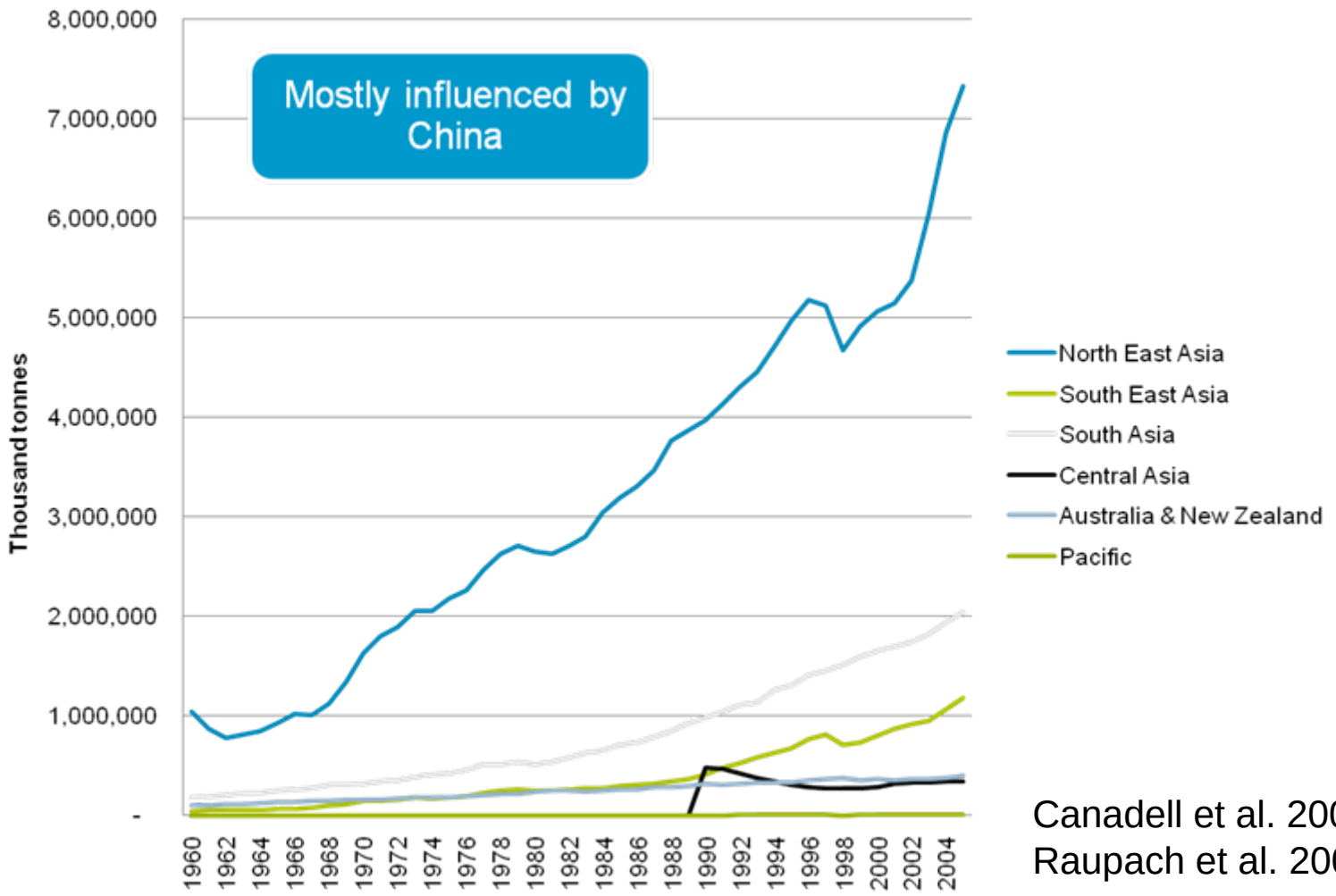


CO_2 Emissions

CO_2 grew exponentially since the Asia economic crisis 1997

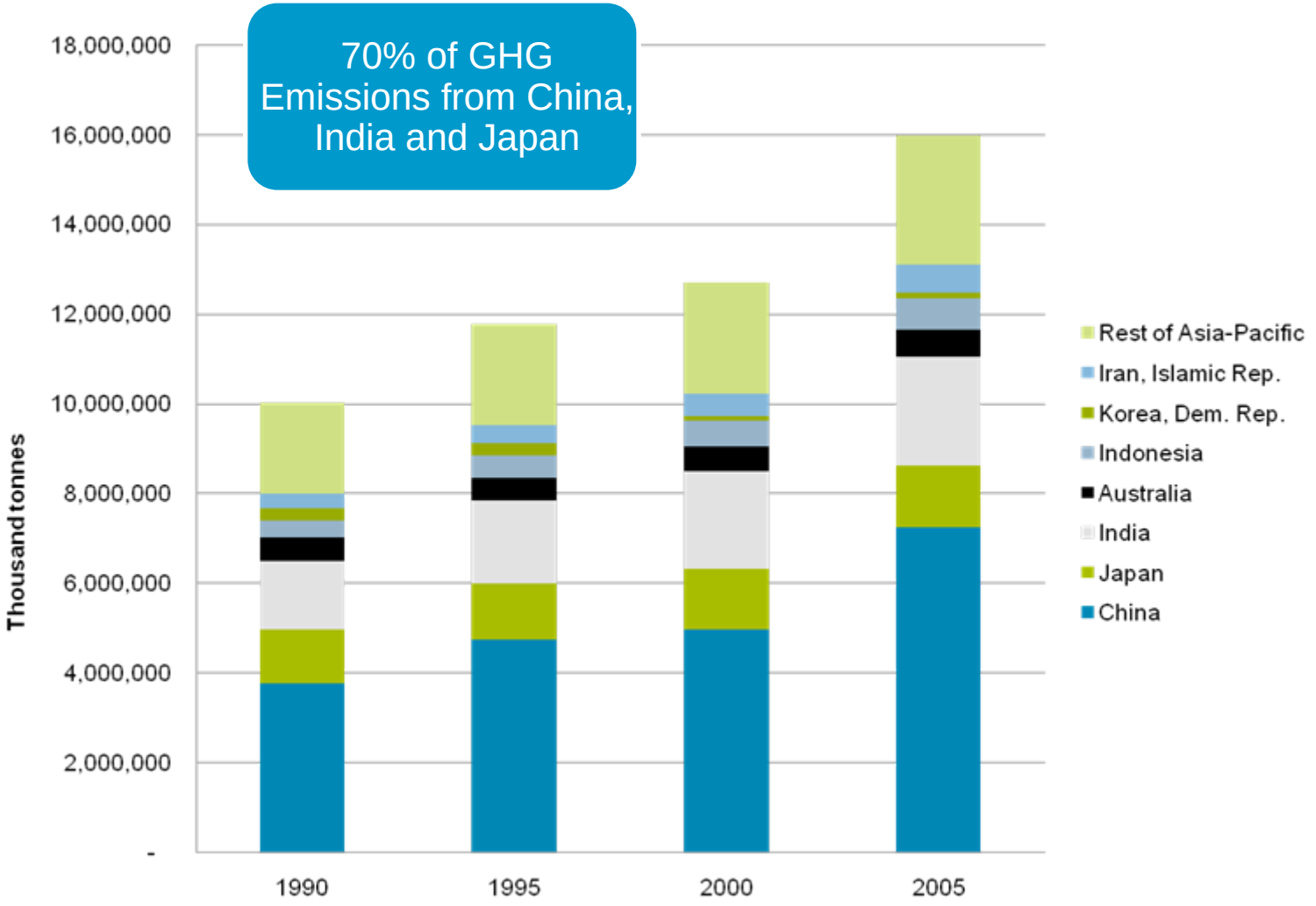


CO_2 Emissions



Canadell et al. 2007
Raupach et al. 2007

GHG Emissions



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4 Drivers of Growth

"Slow down a bit Jenkins - give the economy a chance to catch up."

IPAT Framework

- In the early 1970s, Paul Ehrlich and John Holdren addressed this relationship with their famous ‘IPAT’ formula

- environmental Impact (I) may be estimated by Population (P) times Affluence per capita (A) times a Technology factor (T)

$$I = P \times A \times T$$

- The IPAT approach has increasingly been used to identify the relative contribution of population, consumption and technology to environmental impact.

Drivers of growth in domestic material consumption (DMC) in Asia-Pacific

	ΔI (%)	ΔI (billion tonnes)	log ΔP (%)	log ΔA (%)	log ΔT (%)
1975-1985	50.1%	3.8	44%	72%	-16%
1985-1995	81.4%	9.4	30%	65%	5%
1995-2005	52.9%	11.1	29%	88%	-18%

Drivers of DMC growth in selected regions

North East Asia (China, Japan)

	ΔI (%)	ΔI (billion tonnes)	log ΔP (%)	log ΔA (%)	log ΔT (%)
1975-1985	63.2%	2.5	27%	59%	14%
1985-1995	91.4%	6.0	19%	45%	36%
1995-2005	61.1%	7.7	15%	45%	40%

South Asia (India)

	ΔI (%)	ΔI (billion tonnes)	log ΔP (%)	log ΔA (%)	log ΔT (%)
1975-1985	40.6%	0.9	67%	33%	-1%
1985-1995	47.0%	1.4	51%	69%	-19%
1995-2005	43.5%	1.9	48%	109%	-56%

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5 Policy implications

Green Growth

Why resource efficiency in the Asia-Pacific?

- Since 1950, economic growth and growing standard of living in the OECD
- Today, rapidly developing countries drive global resource use and emissions

"The evolution of the human economy has passed from an era in which manmade capital was the limiting factor in economic development to an era in which remaining natural capital has become the limiting factor. (Herman Daly, 1992)"

- two- to four fold increase in the demand for materials and energy
- Future competitiveness will depend on the availability of 'cheap' resources
- Asia-Pacific will not be able to follow the European-American path to industrialization

Industrial transition in Asia-Pacific

	Agrarian regime	Industrial regime	Factor
Per capita energy use, GJ/cap	40-70	150-400	3-5
Per capita material use, t/cap	3-6	15-25	3-5
Population density, cap/km²	<50	< 400	3-10
Agricultural population, %	>80%	<10%	0.1
Energy use per area, GJ/ha	<30	< 600	10-30
Material use per area, t/ha	<2	< 50	10-30
Share of biomass in energy use, %	>95	10-30	0.1-0.3

Source: Krausmann, Schandl and Sieferle 2008

Green Growth – A New Political Imperative

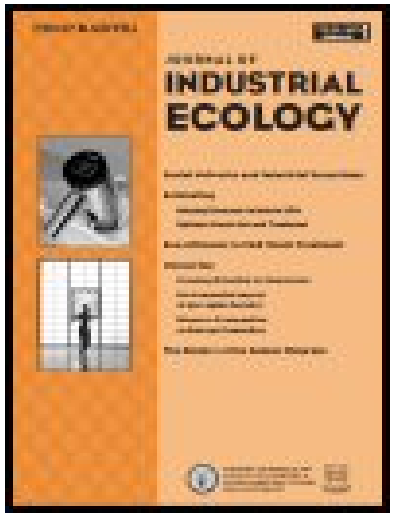
- MCED5 in Seoul in March 2005 agreed on ‘Green Growth’
- ‘Green Growth’ continuing growth to alleviate poverty while reducing environmental pressure
- Eco-efficiency through green tax and budget reform
- UNESCAP to implement Green Growth agenda in Asia-Pacific
- Global Green New Deal (UNEP, United Nations as a whole)
- Green Stimulus
- Green jobs initiative
- MCED6 in Kazakhstan in September 2010 to review ‘Green Growth’ based on the Resource Efficiency: Economics and Outlook (REEO) and the Regional Sustainability Report

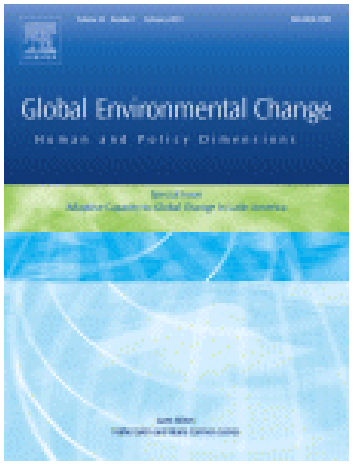
A sustainability transition in Asia-Pacific

- Sustainability transition while the ‘old’ industrial transition happens
- invent, design and create new industrial infrastructures
- less energy and less dependent on a stable supply of energy
- fewer materials
- higher flexibility and lower risks in the face of global environmental change and resource scarcity.
- This will not happen spontaneously but requires well-designed policies
- Environmental information systems – societal self observation

Further reading

Schandl et al. 2008
Schandl and Turner 2009
'Resource Use Trajectories and Dematerialization in Australia'





Schandl and West
'Resource Use in Asia-Pacific'
(submitted)

REEO project website at
http://www.csiro.au/science/Resource-Efficiency-Asia-Pacific.html

Social and Economic Sciences Program of CSIRO Sustainable Ecosystems

Climate Adaptation Flagship, Sustainable Cities and Coasts
'Sustainable Use of Natural Resources' research stream

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Thank you

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