

# Growth and Ecology: Where are the Limits?

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# Limits



# Limits



*Economy?*

# Research Method



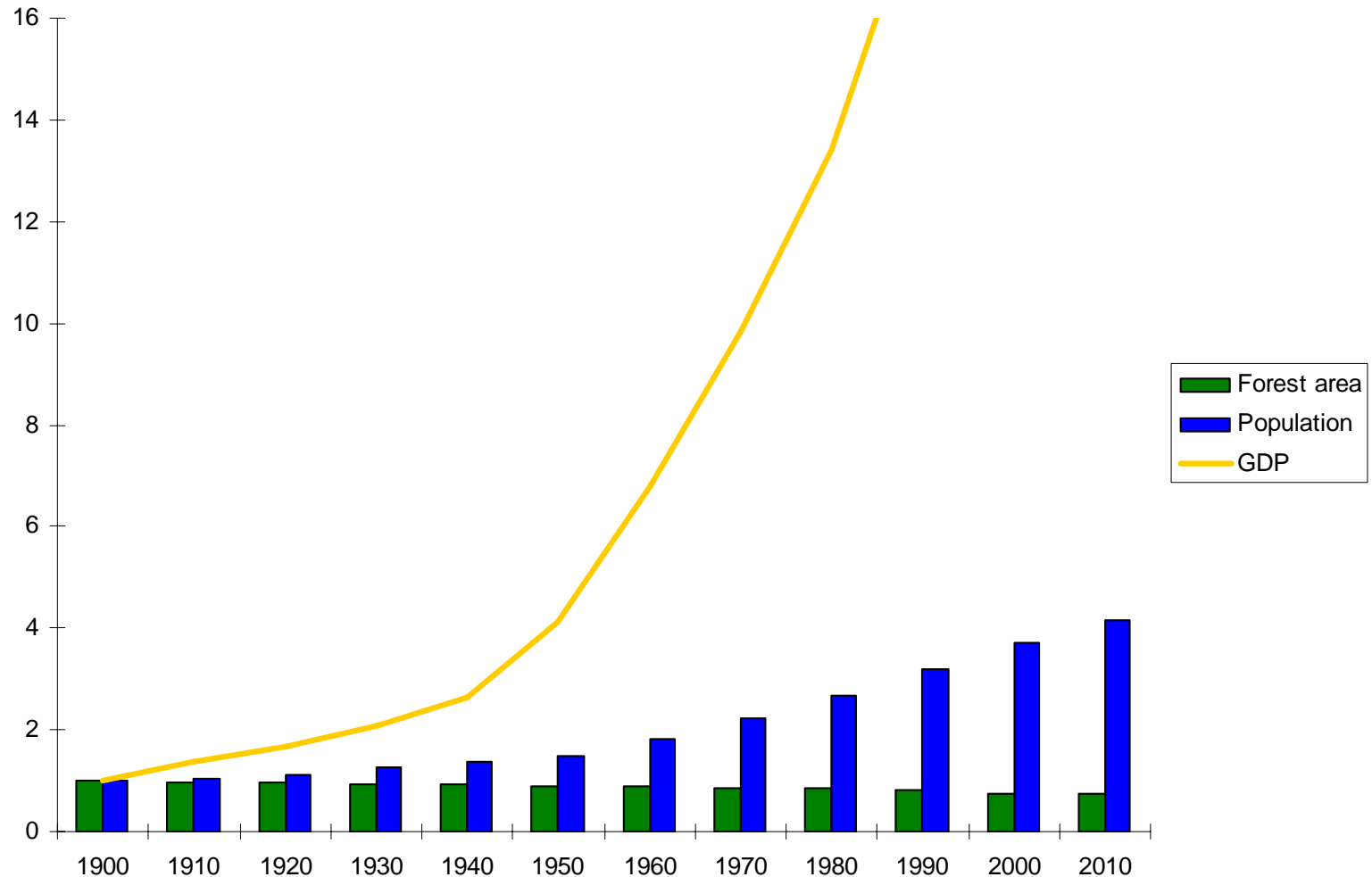
Forest or

tree research ?



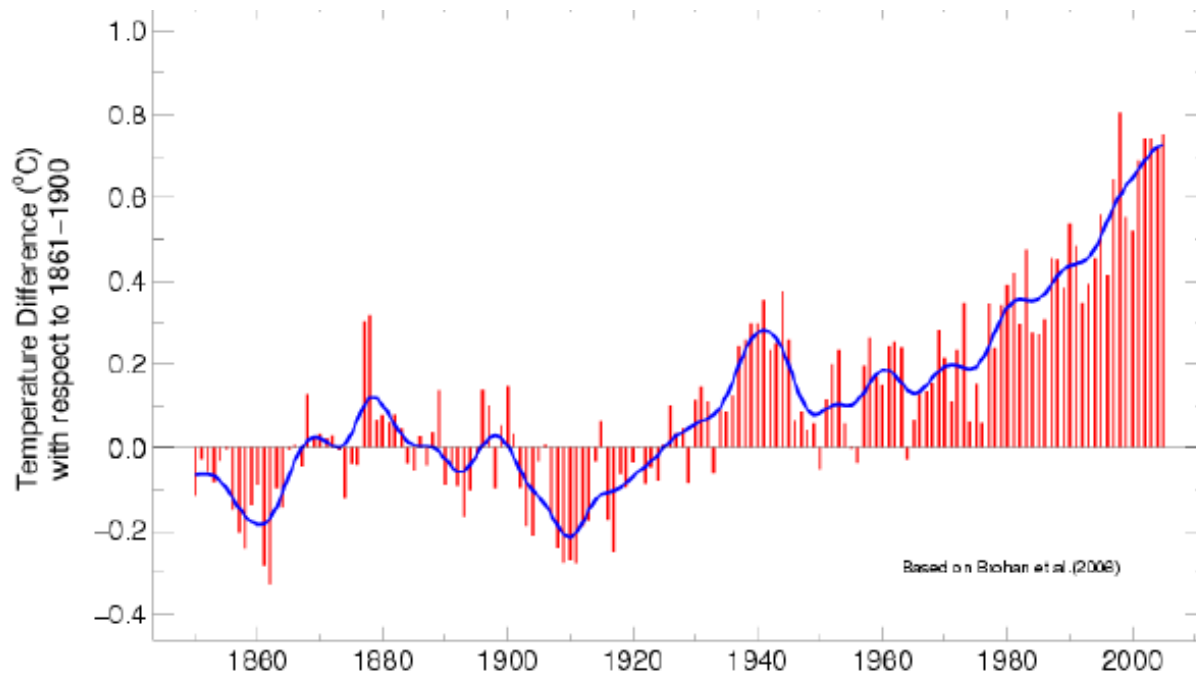
# Forest Area, Population and GDP, 1900-2010

(Index, 1900 = 1)



Sources: U.N. Food and Agriculture Organization (2005), World Bank, US Census Bureau, United Nations Populations division, OECD

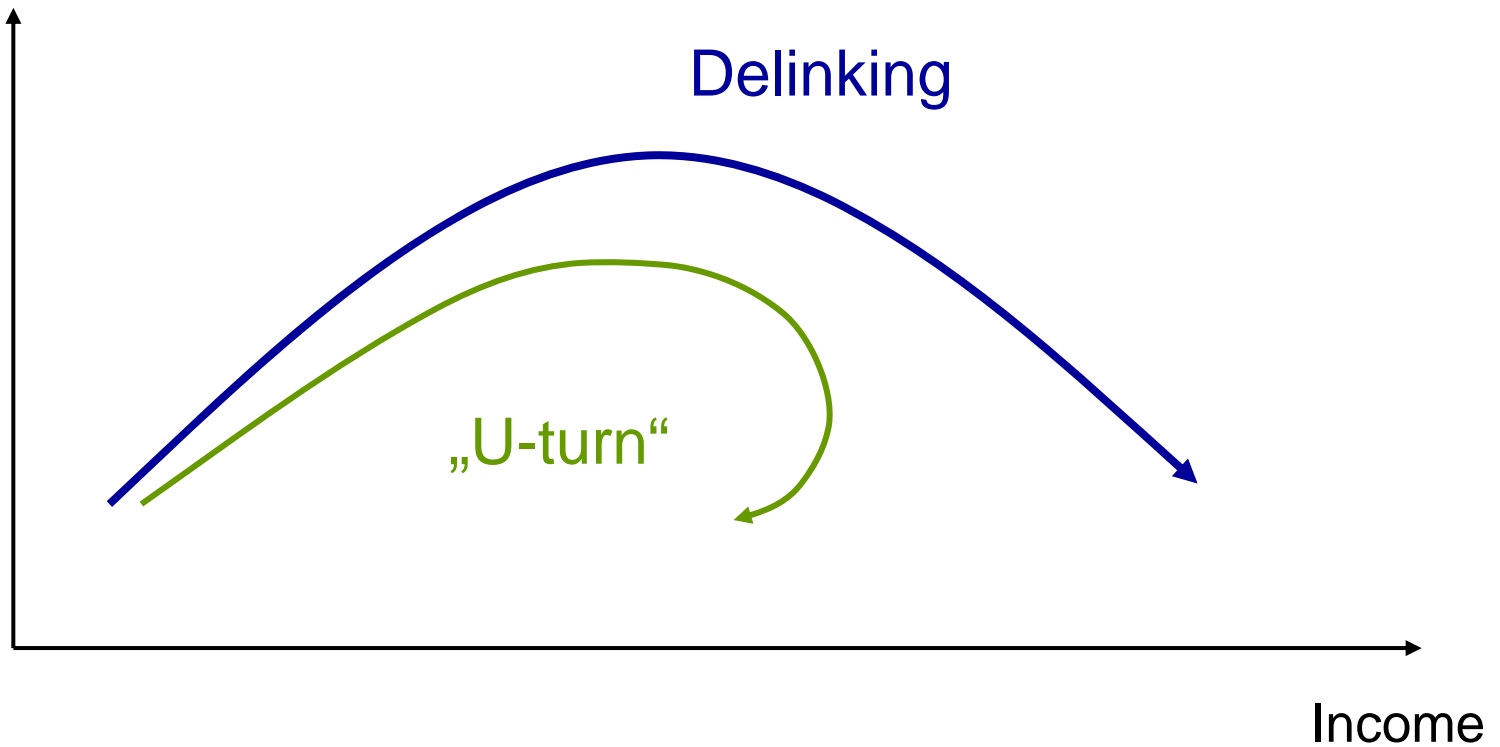
# Temperatures 1850-2005



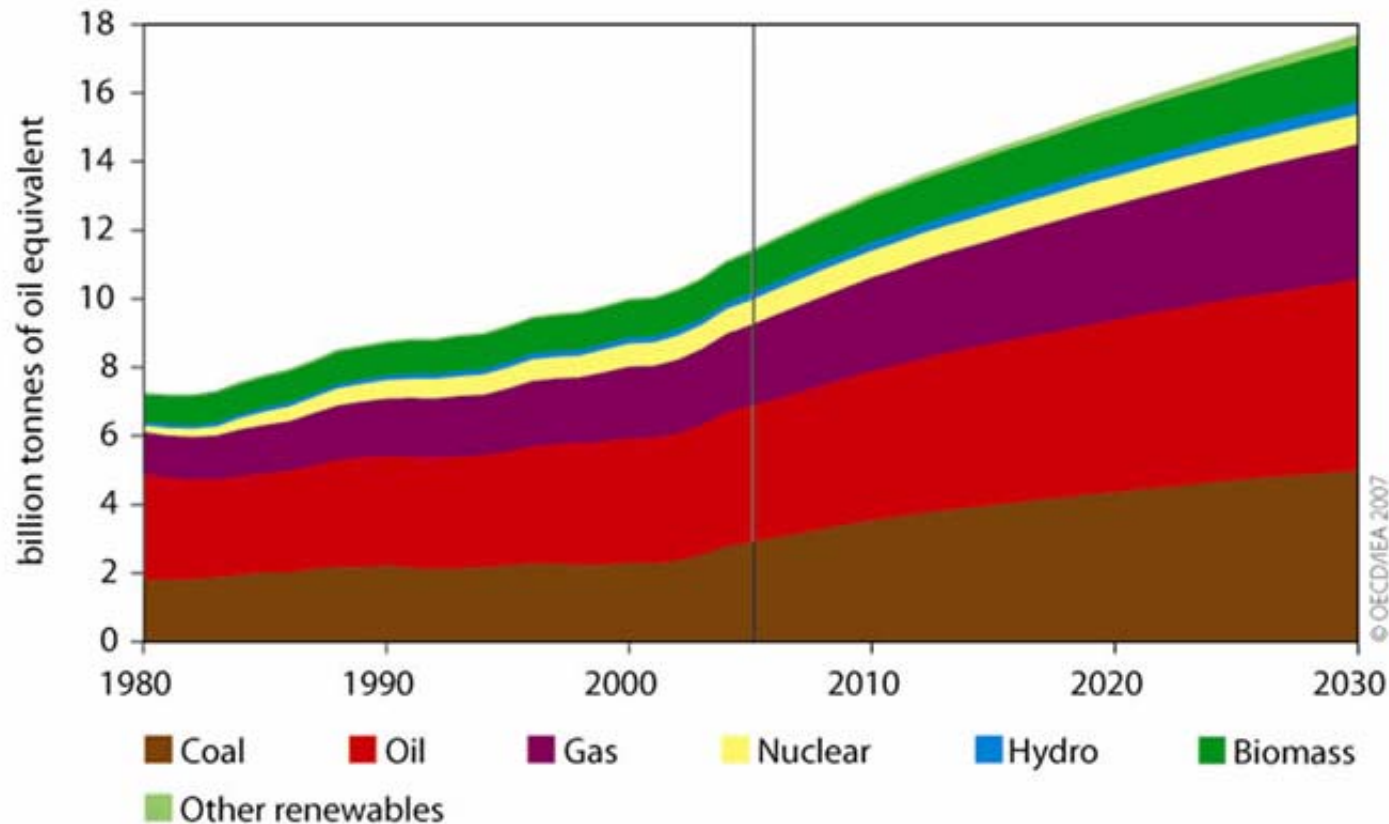
Source: Brohan et al. (2006) in: Stern (2007)

# Limits to Growth?

Natural resource use

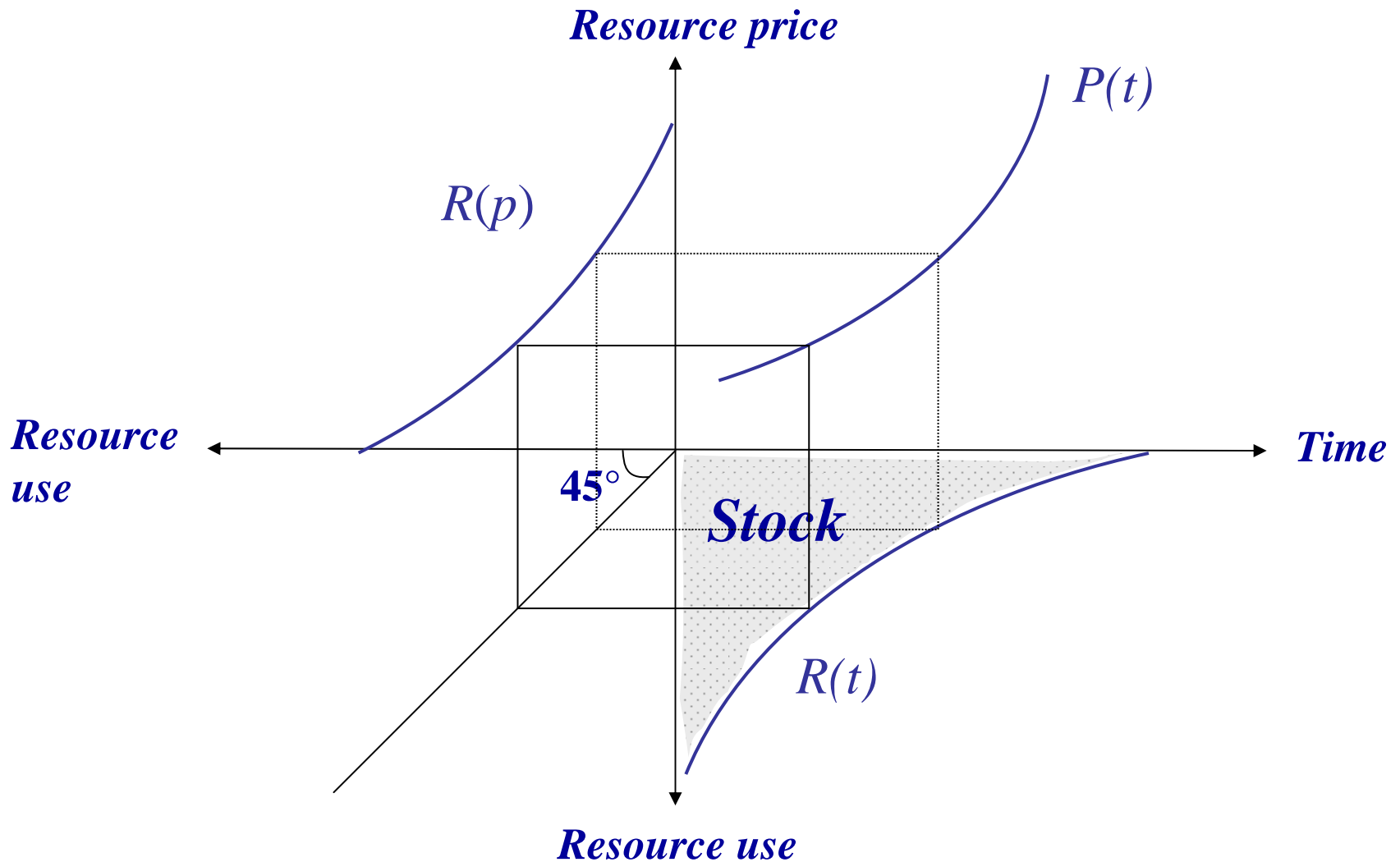


# World Primary Energy Demand in the Reference Scenario



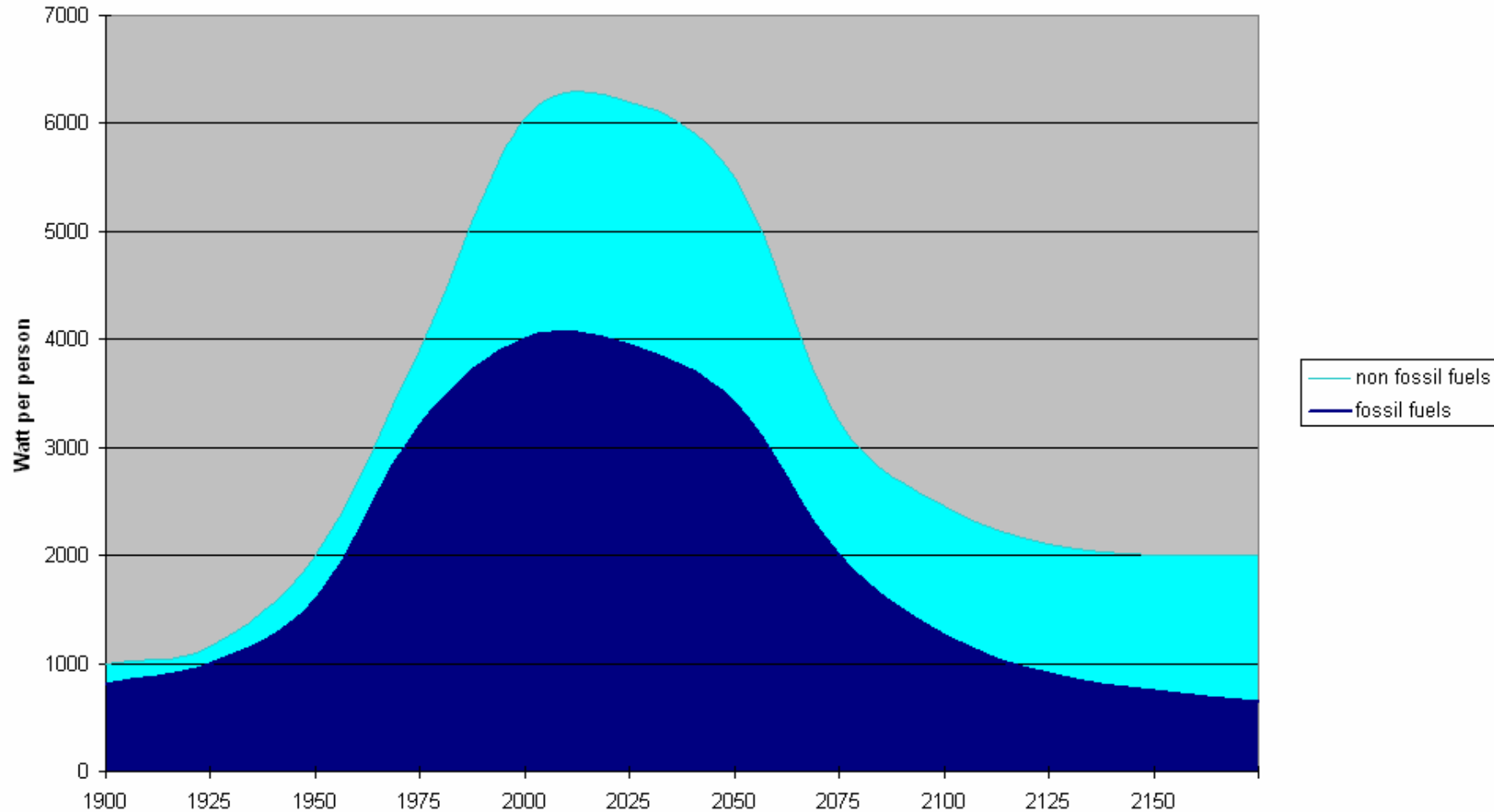
Source: IEA (2007)

# Theory of Resource Depletion



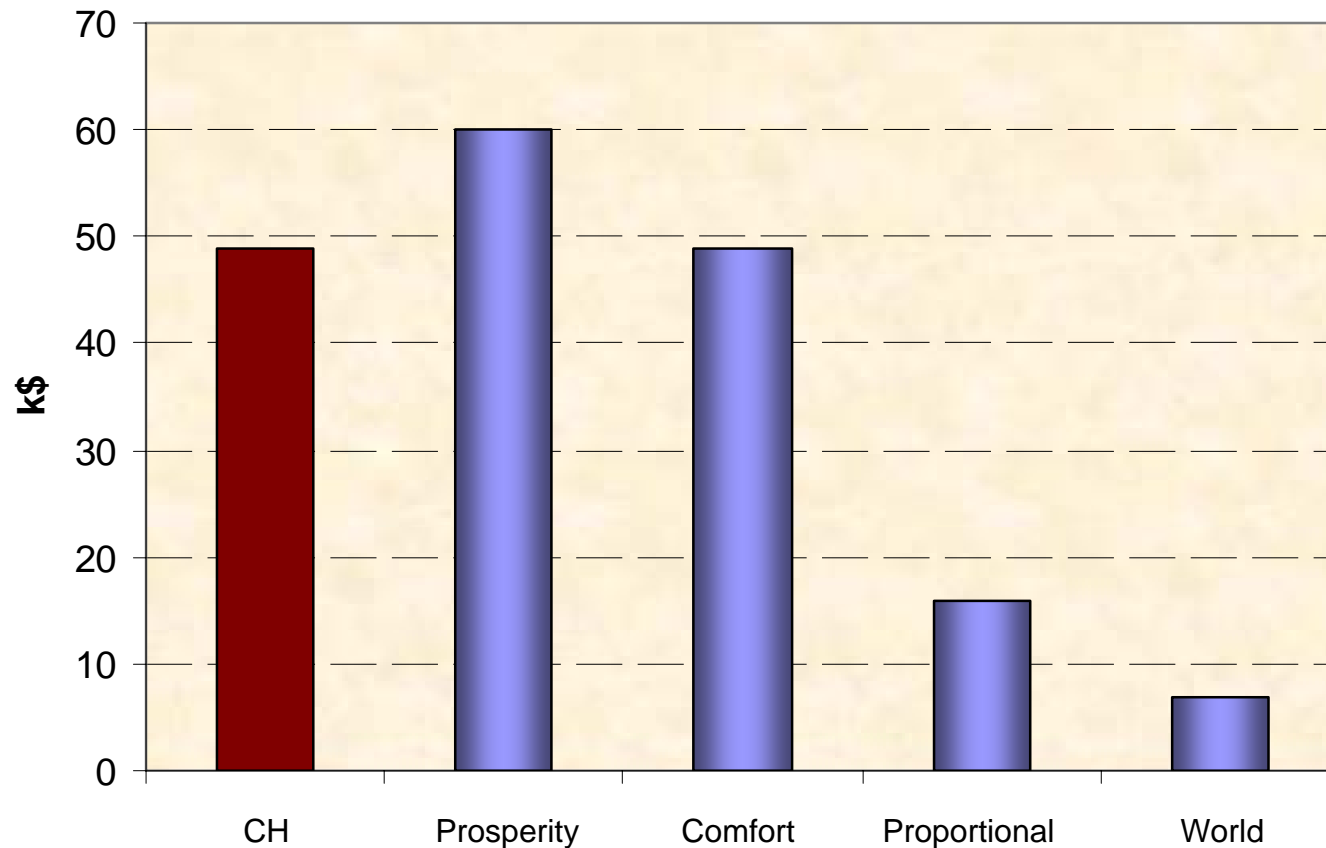
# The 2 kW Society

Transition to the 2 kW Society



# How Rich is the 2000-Watt Society?

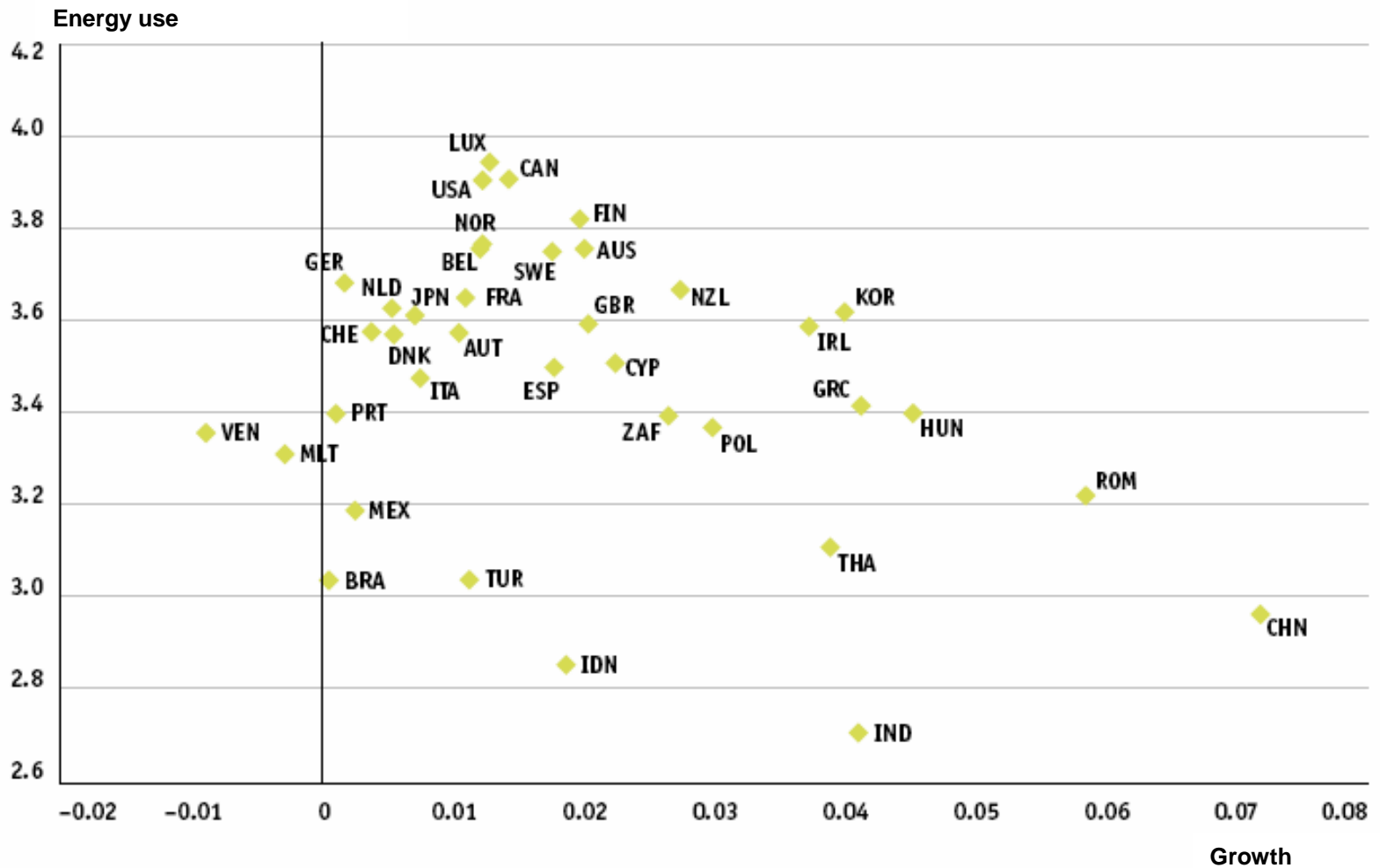
Income with 2000 Watt



■ How sustainable?

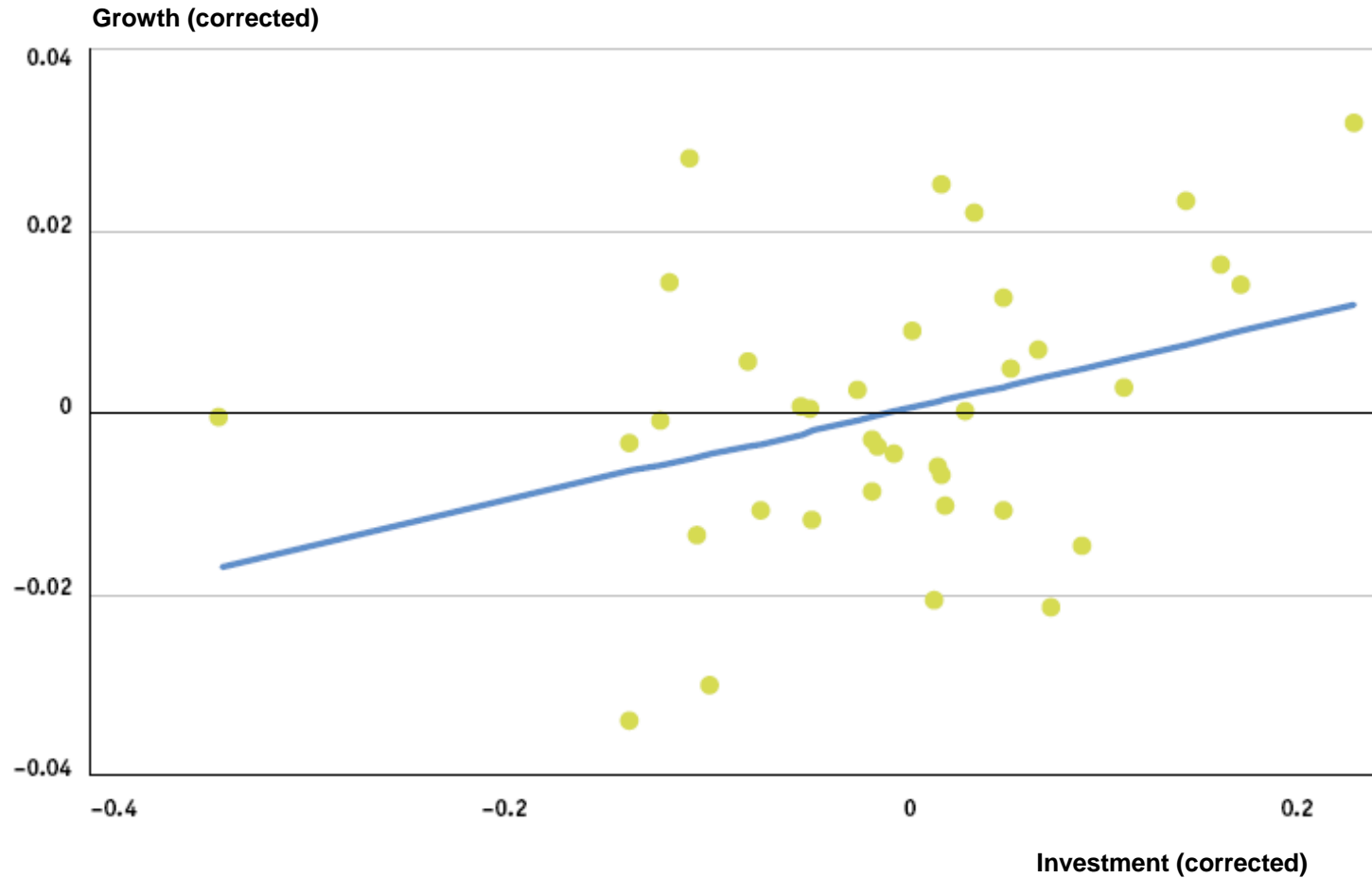
# Energy Use and Growth

37 countries, 2000-04



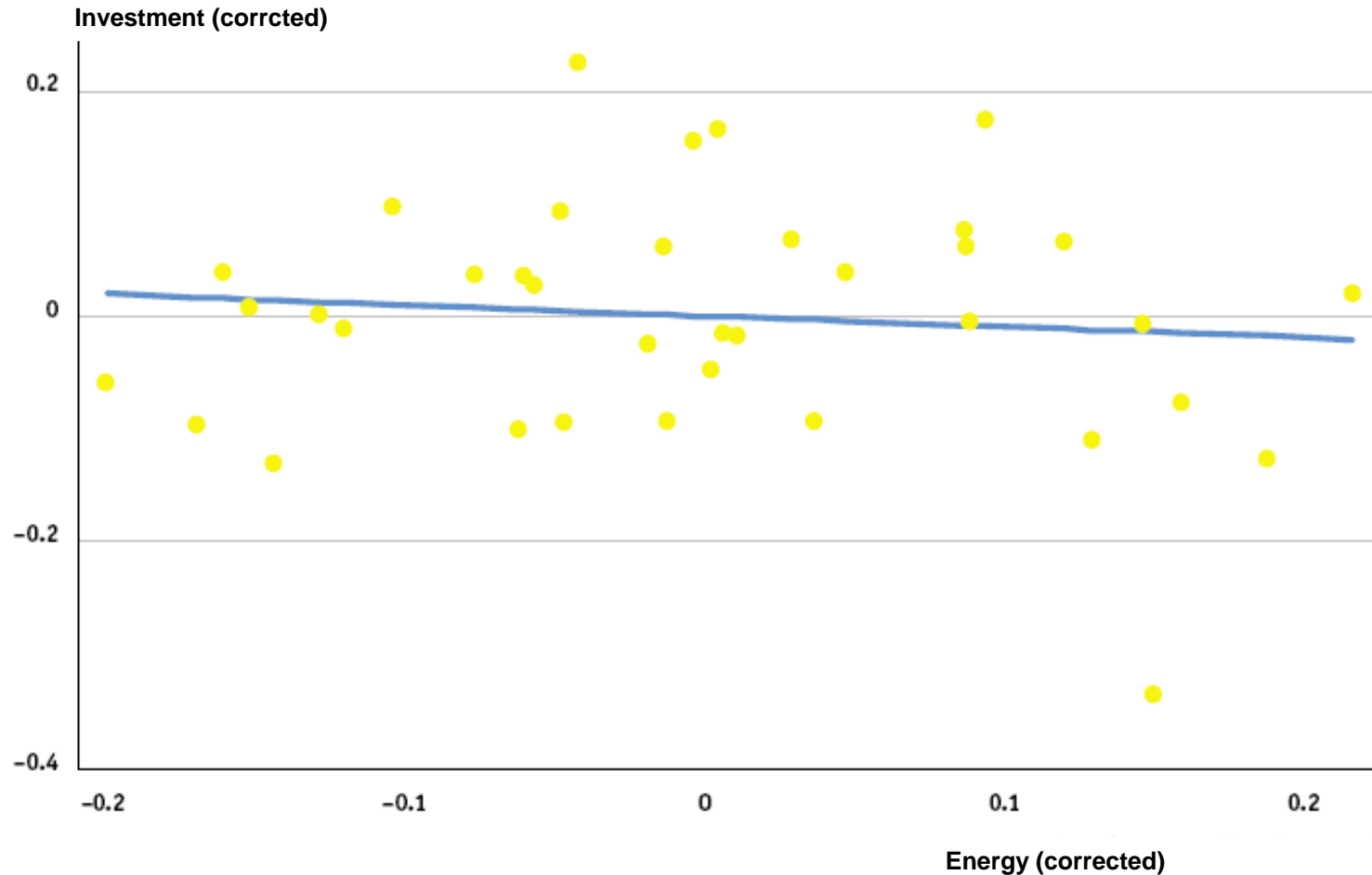
# Investment and Growth

Investment shares and growth rates; 37 countries, 1975-2004



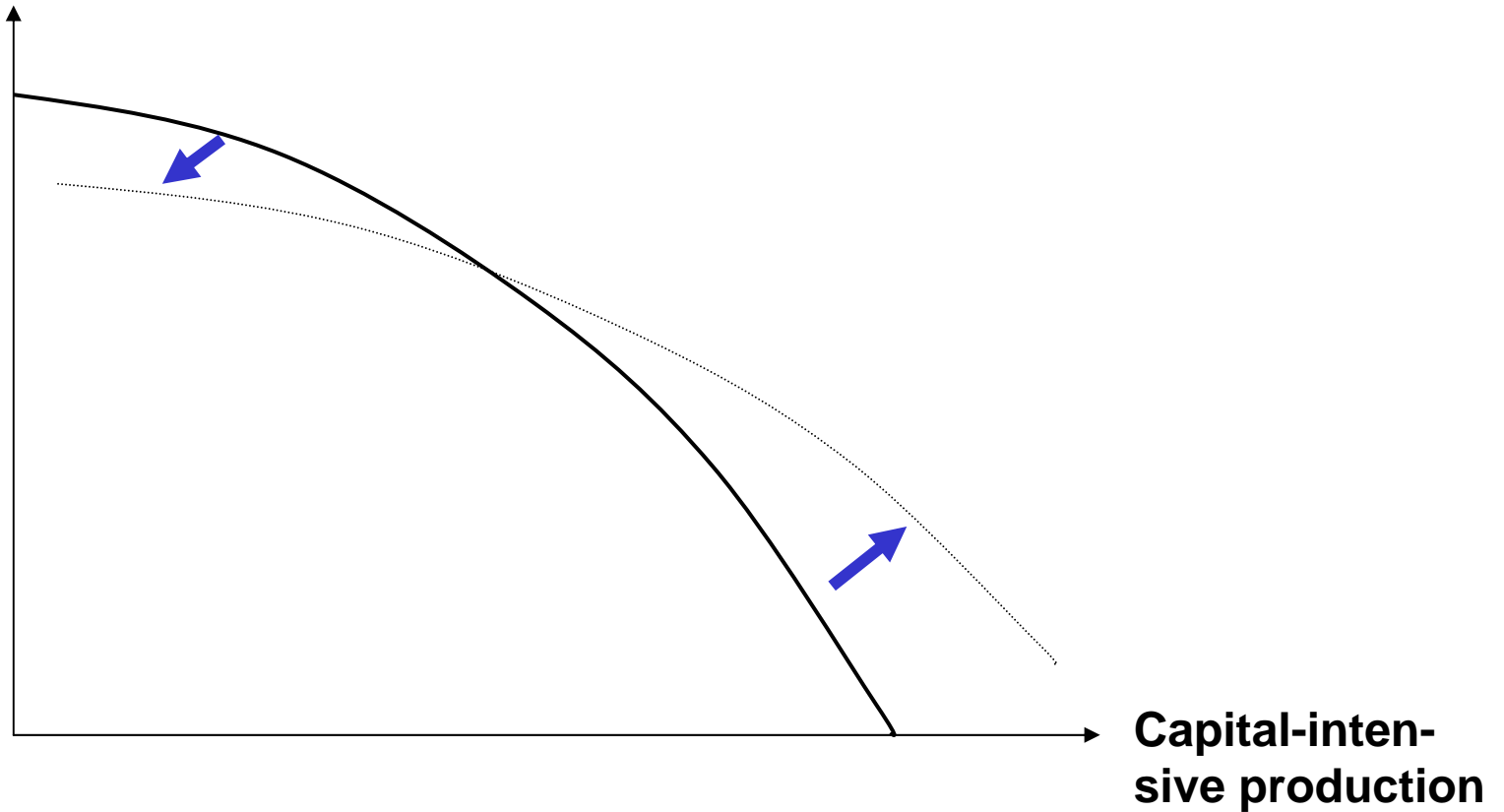
# Energy and Investment

Energy use and investment share; 37 countries, 1975-2004



# Growth of the Limits

Resource-intensive production



# Impact

- $\% \Delta$  energy use /  $\% \Delta$  energy price --
- $\Delta$  growth rate /  $\% \Delta$  energy use --

→ 10 percent increase in energy prices increases growth rate *ceteris paribus* by 0.3 percentage points

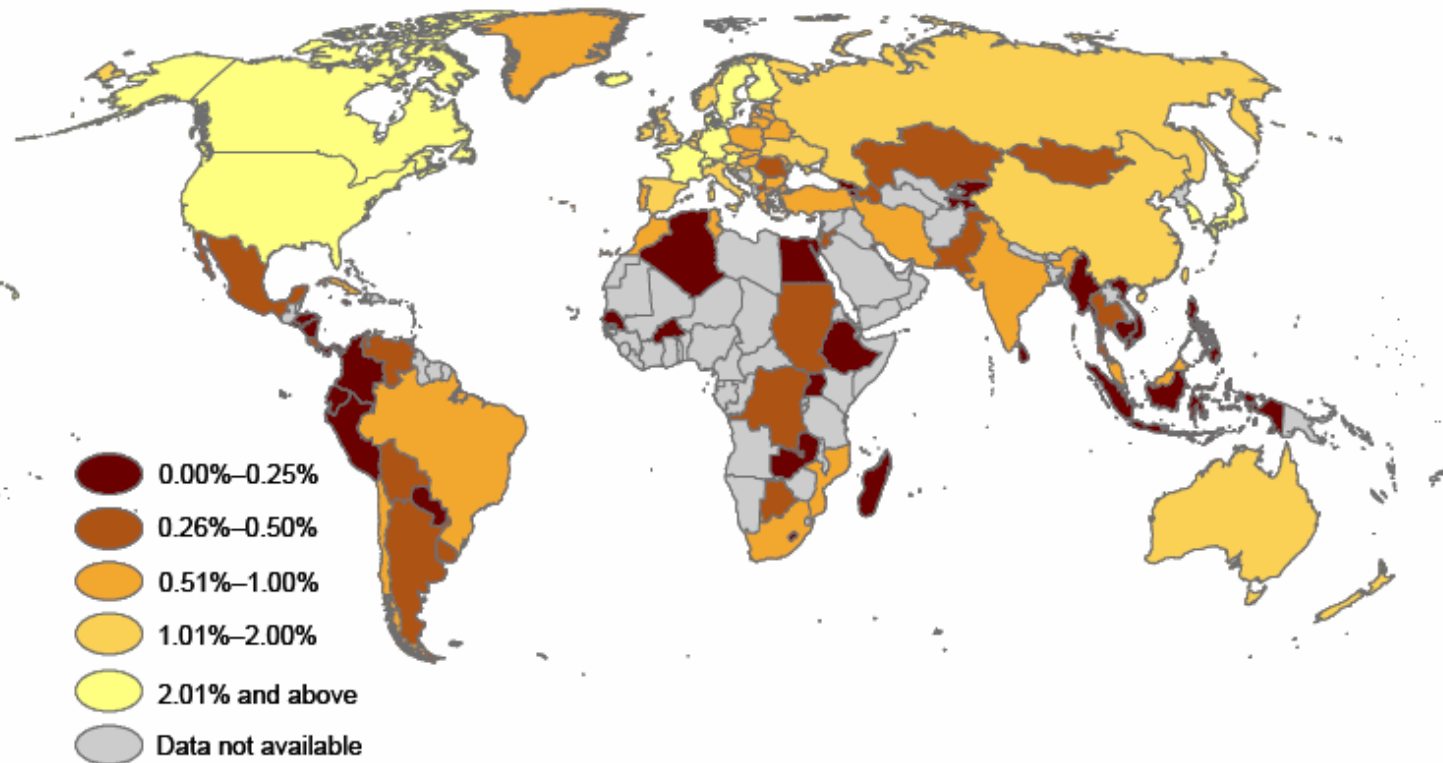
Based on 37 countries 1975 – 2004

# Directed Technical Change

- Resource-augmenting technical change → economically attractive
- Technical change in resource-intensive sectors → economically attractive
- Research is labour-intensive → different view on population growth

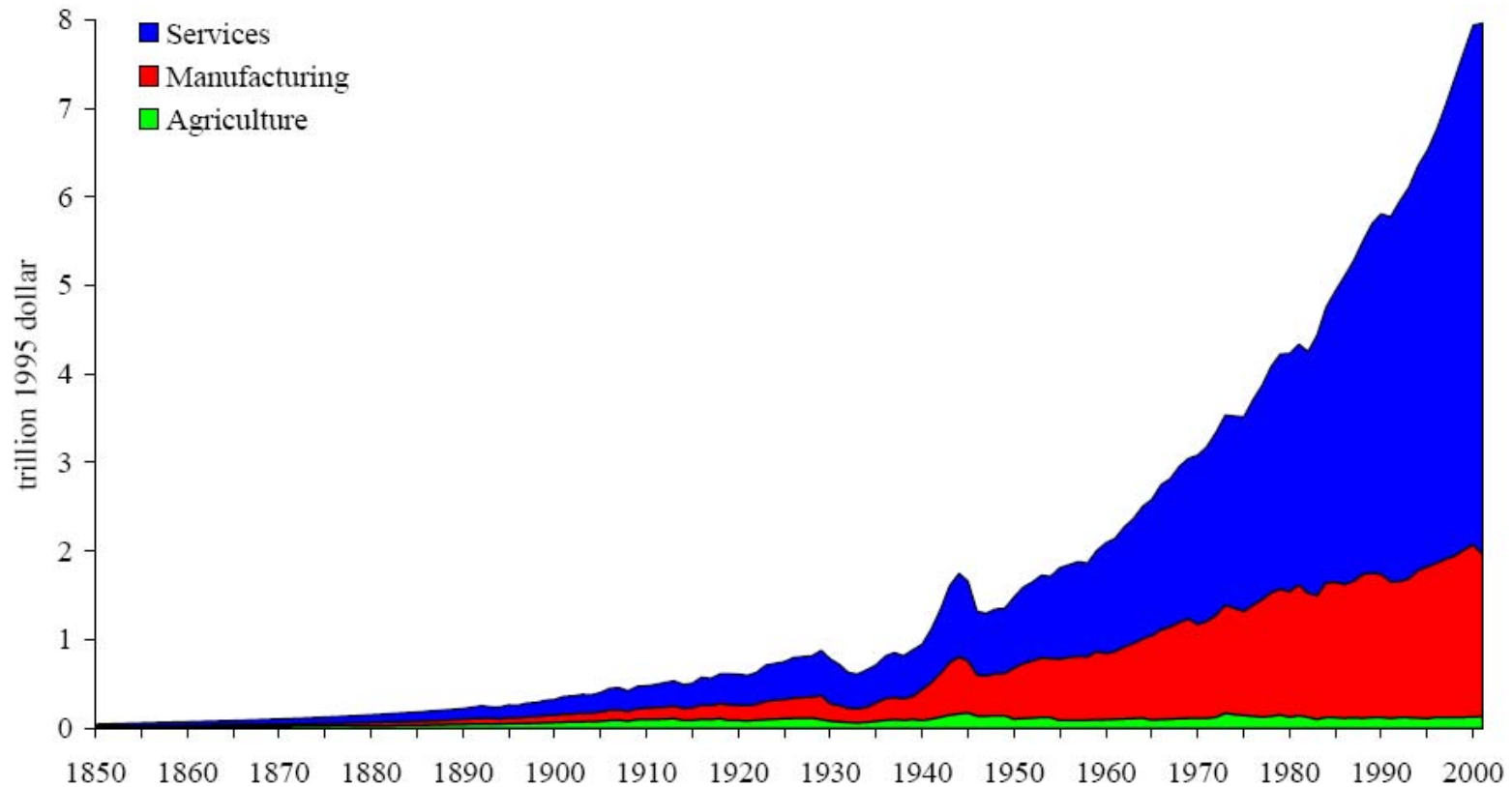
# Research Geography

**Figure 3: A snap-shot of R&D intensity**  
*Gross domestic expenditure on R&D (GERD) as a percentage of GDP, 2005 or latest available year*



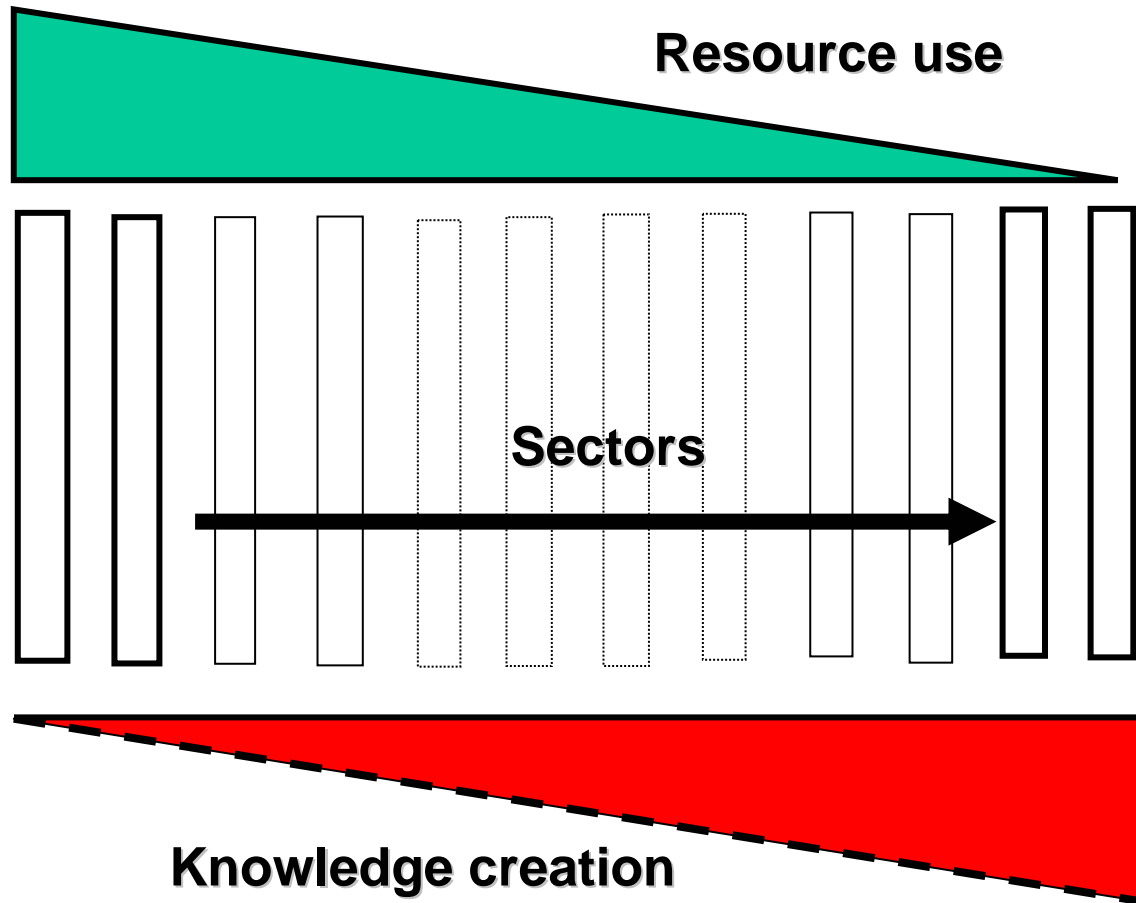
Source: UNESCO Institute for Statistics, September 2007

# Structure of GDP (USA)



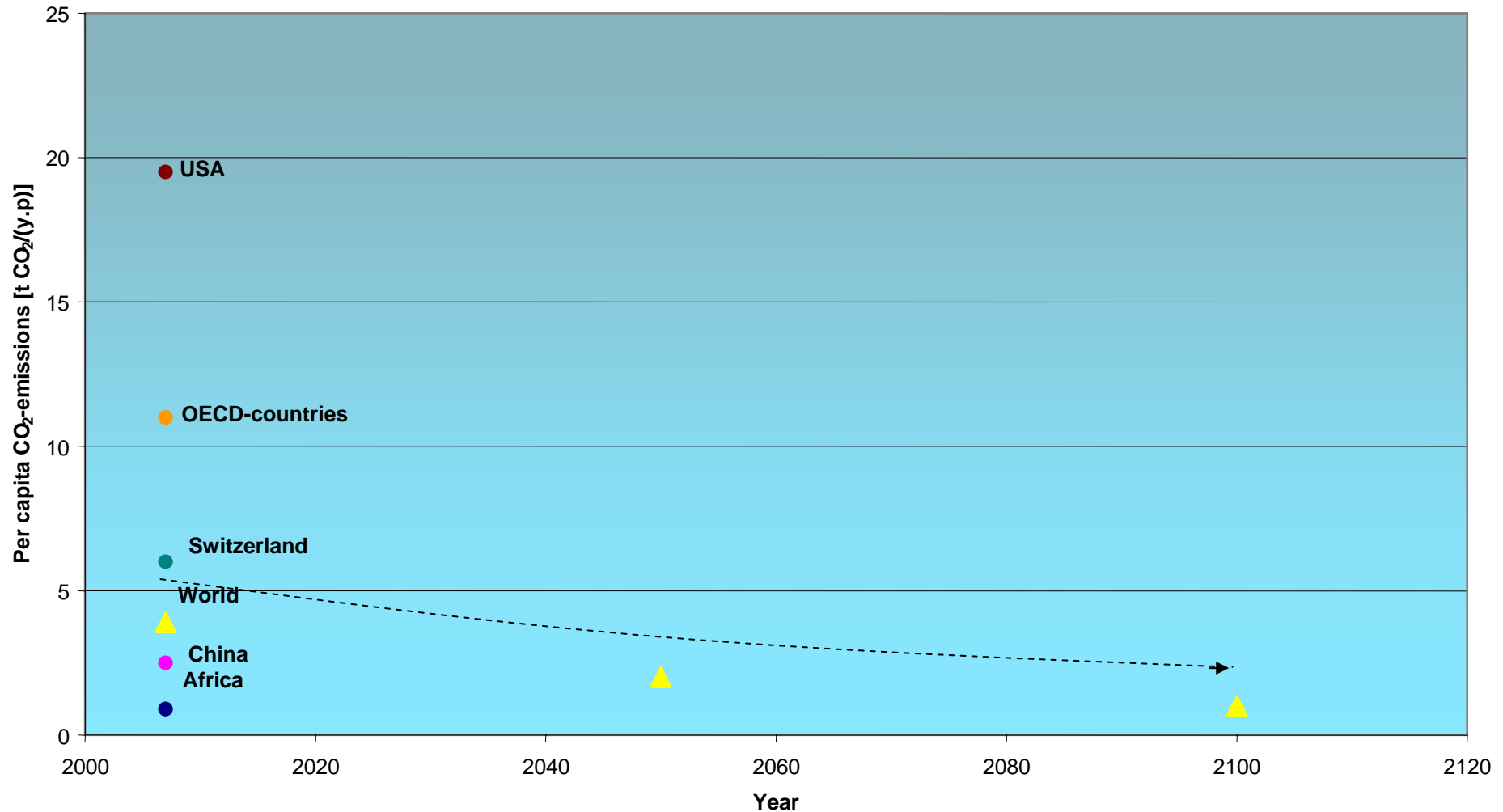
Tol et al.(2006)

# Structural Change



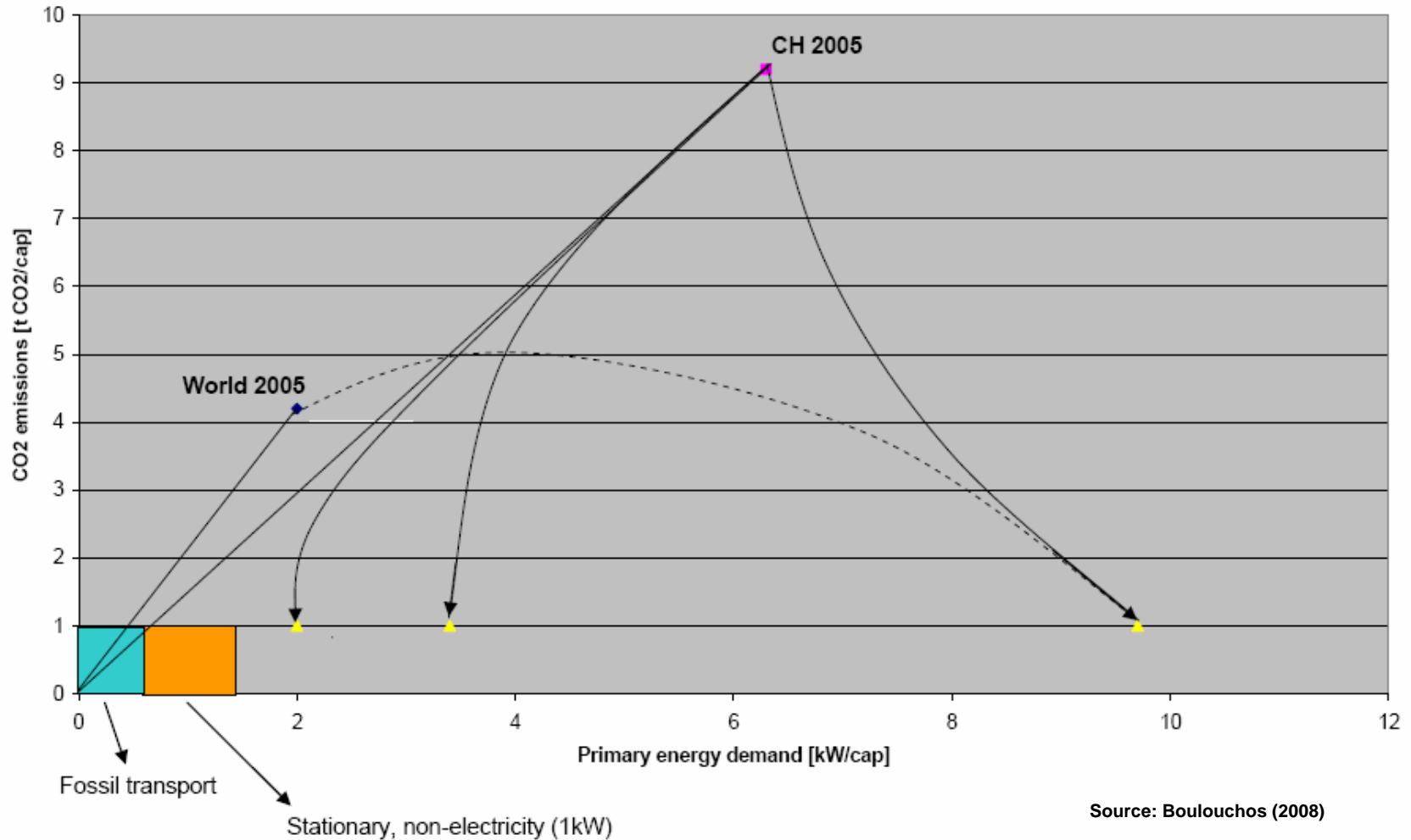
# The 1 Ton Carbon Society

## Transition to the 1 T Carbon Society



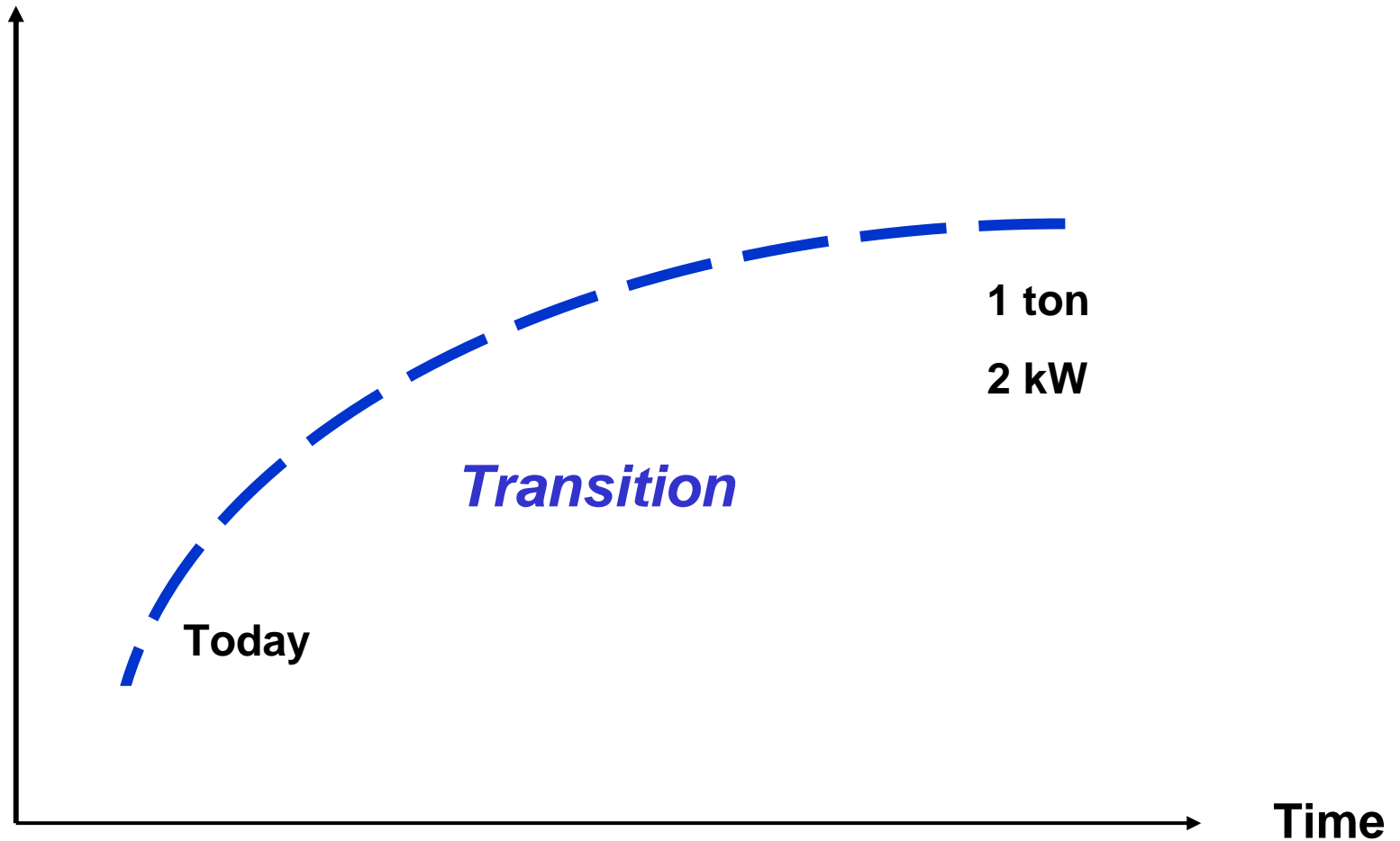
# Combining ..

Combining 2 kW and 1 T



# Welfare

Individual welfare



# Where are the Limits?

- Transition:
  - Price development, policy
  - Induced capital build-up and technical change
  - Structural change
- Long run:
  - Renewable energy supply