# Economic sustainability: How is it defined and calculated

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# Key topics

- Get insights into the term and idea(s) behind of sustainable development
- How is economic sustainability defined?
- How is economic sustainability measured?
- What is sustainable maintenance of urban green areas, and how can sustainability of urban green areas be assessed from an economic perspective

# Your perception of economic sustainability

- Discuss with your neighbor
  - ONLY to minutes
  - Be prepared to give feedback to the audience

# Sustainability and Sustainable Development

- **A concept best known from the 1987 report:**
  - Our Common Future - often referred to as ”the Brundtland report” (World Commission on Environment and Development)
- **The most well-known phrase from this report:**
  - “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
  - What does that mean?
  - Future generations’ well-being/welfare/ standard of living should be as least as good as the well-being/welfare/standard of living of present generation’s wellbeing
  - Not a scientific question but an ethical question

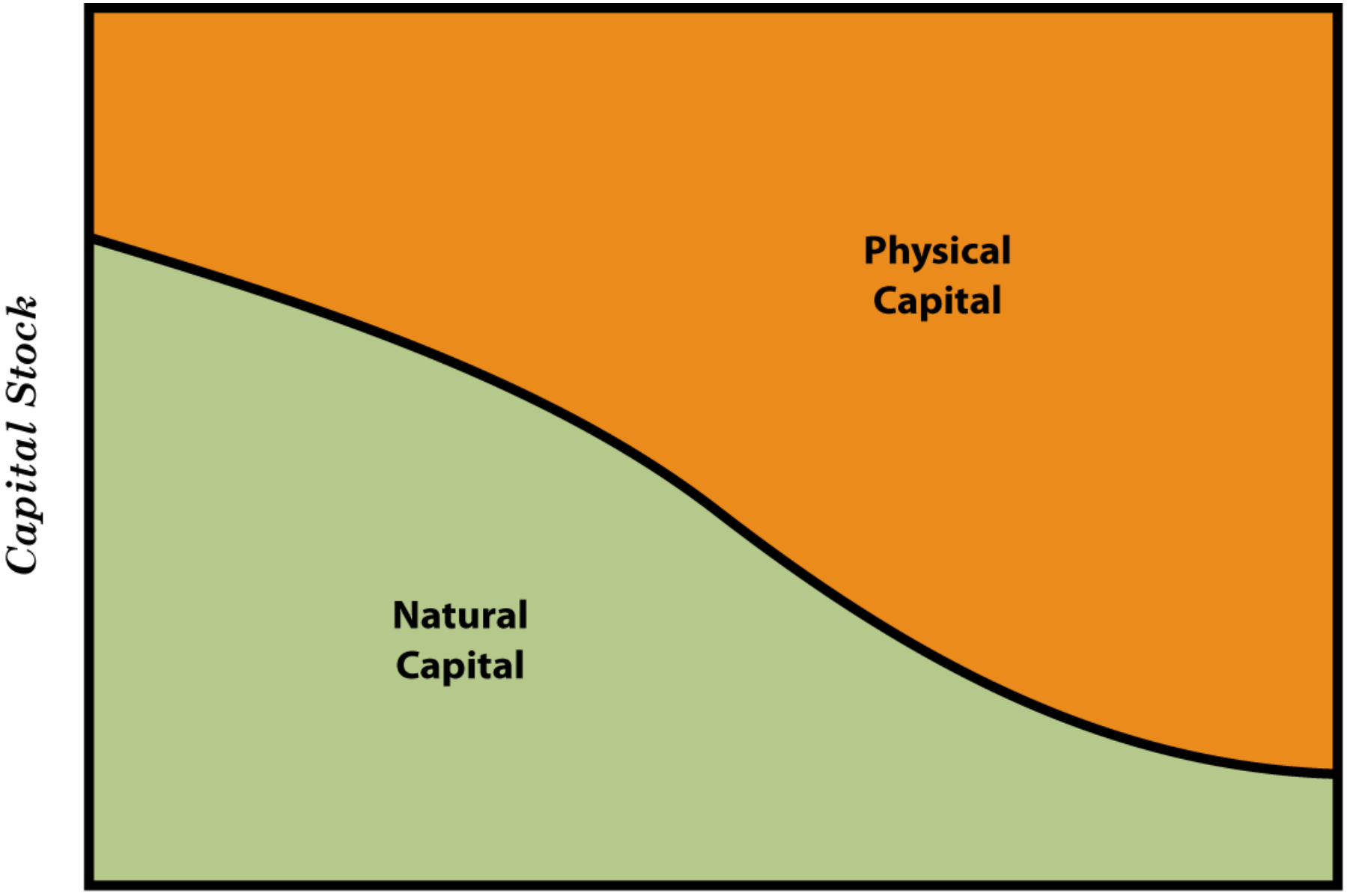
# CRITICAL ISSUES

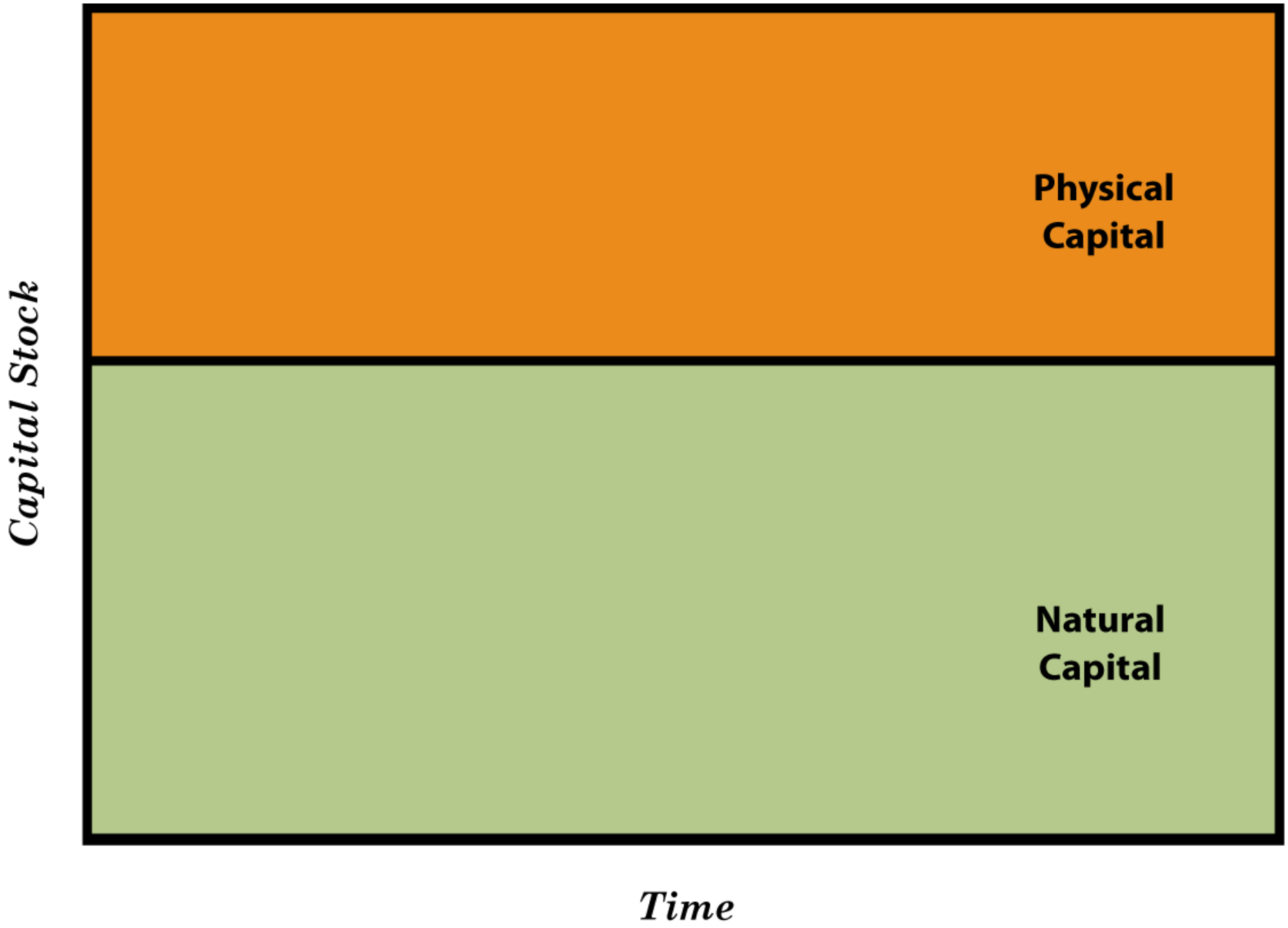
- **Under what conditions is**
  - Non-declining consumption for ever possible?
    - production uses inputs (do we have limited resources of input)
    - of non-renewable natural resources

- **Critical to sustainability is:**
  - the degree of resource substitutability
    - In production and in consumption
  - the rate of technical progress
    - Less polluting technology, new products
  - the degree of eco-system stability and resilience
    - Tipping points and so on

# Weak and strong sustainability

- The importance of the degree of resource substitutability
- IF substitution between all input/resources (labour, capital and nature) is allowed, we have weak sustainability
- IF substitution between all resources (labour, capital and natural capital) is not allowed, we have strong sustainability
  - IF substitution is not allowed between any of the various kinds of natural capital, we have VERY strong sustainability
  - Some argue strongly against weak sustainability
    - Why? Future generations' unknown preferences or ??
    - But we have always substituted between goods!!


Capital Stock
Physical
Capital
Natural
Capital


Physical
Capital
Natural
Capital
Capital Stock
Time

# How to measure sustainability: A Green Gross National Product (GNP)

- Traditional GNP
  - NNP  net national product; production after depreciation
- Green NNP
  - Green NNP = NNP adjusted by the change of the nation's (or world's) natural capital (depreciation of natural capital)
    - Green NNP= NNP – (P(NR) – MC(NR))ΔNR – (P(R) – MC(R))ΔR –MC(S)(ΔS), where

P er prices, MC marginal cost of production, Δ indicates changes and NR is non-renewable resources resourcer , R is renewable resources and S pollution

Do we save for future generations? If yes, the deveopment is sustainable

This makes sense for economists!! But for non-economists??

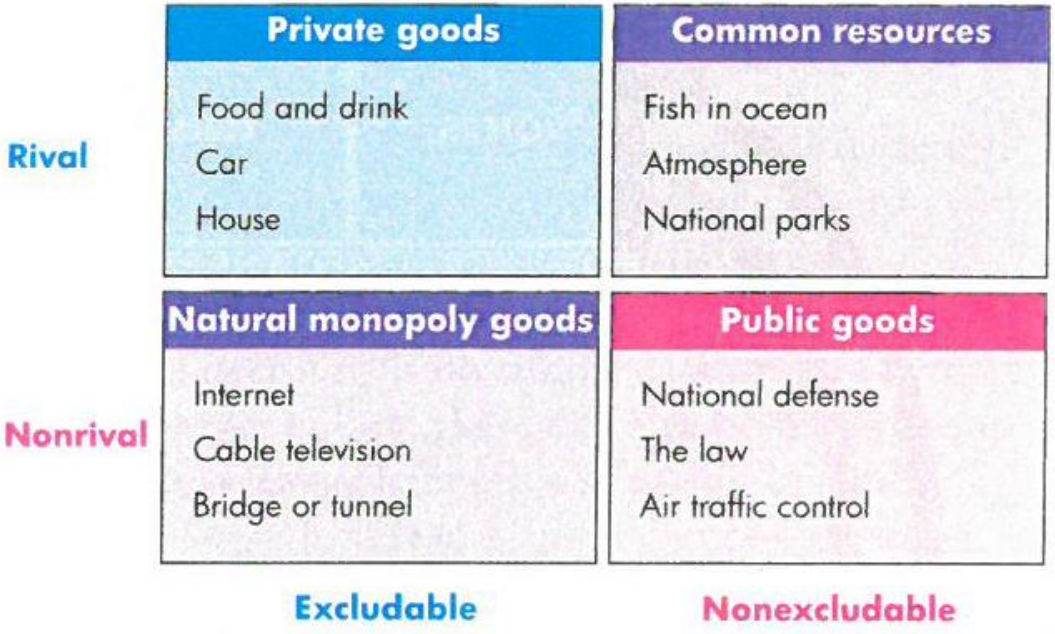
# Where is “urban green areas” in the equation?

- In theory, urban green areas is included
- In empirical work is hidden
  - Urban green areas is a very small number in  a Green Gross National Product
  - How do we value different type of urban green areas
  - How is externalities (side effects) of maintenance of urban green areas calculated and included in the equation?
    - Normally not directed calculated
    - The use of more or less pesticides or other polluting input

# Classification of goods

## can we find markets prices or not

FIGURE 16.2 Fourfold Classification of Goods



# Economy-Environment Interactions and the **Laws of thermodynamics**

- **Economic activity has a material basis**
  - It draws resources from the environment, and provides flows back into the environment.

# Figure 1

- **Environmental resource services and functions:**
  - **Waste assimilation and re-processing by ecological systems**
  - **Environmental systems support processes (air, climate, water, soil)**
  - **Provision of productive inputs**
    - In terms of natural resources
  - **Provision of environmental amenities**
    - that contribute to labour productivity
    - that contribute directly to human well-being/wellfare

# Figure 1: Economic activity and environment

The box represents the environment – a system exchanging energy but not matter with its environment.

Dashed lines from capital represent possibilities for substituting capital's services for environmental services

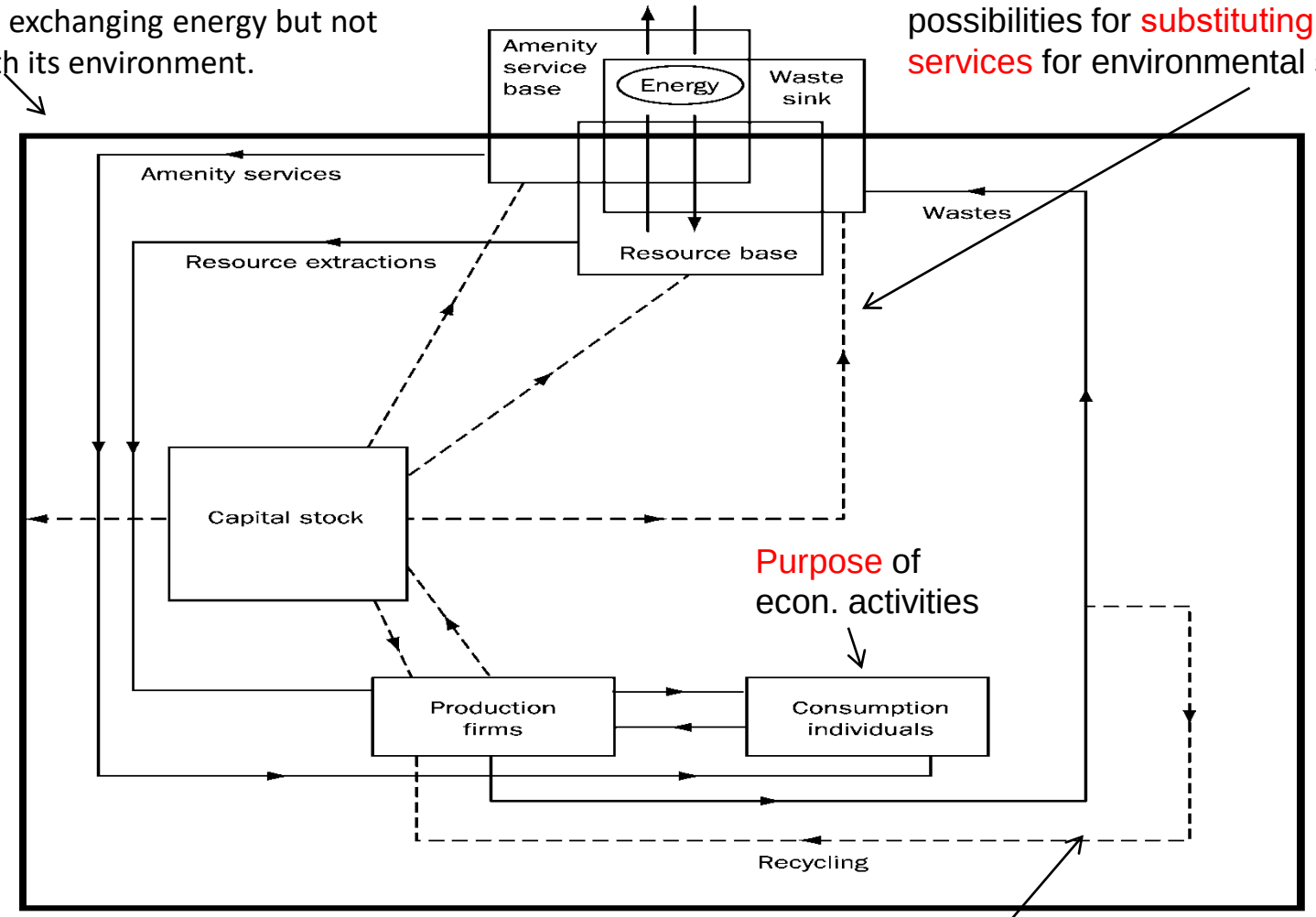



*Figure 2.1* Economic activity in the natural environment

Dashed lines represent possibilities of substitutions for environmental services

# Substituting for environmental services

- **Recycling substitutes for environmental functions in two ways**
  - First, it reduces the demands made upon the waste sink function
  - Second, it reduces the demands made upon the resource base function.

- **Possible to substitute services of capital for environmental services**
  - Capital in the form of a sewage treatment plant substitutes for the natural environmental function of waste sink
  - Energy use can be reduced by the installation of insulation
  - Investments in wind and solar power plant substitutes for fossil fuels.

- **Limited substitution possibilities**
  - Life support function of natural environment (air, climate, water)
  - Quality of life.

# Materials balance principle
# Implications

- **The materials balance principle states an identity between**
  - the mass of materials flow from the environment and
  - the mass of residual material discharge flows to the environment
  - Each sector receives an equal mass of inputs to the mass of its outputs.

- **The treatment of residuals from economic activity**
  - does not reduce their mass
  - But waste management transforms residuals to a more benign form

- **The extent of recycling is important**
  - If recycling of household residuals can be increased
  - then the quantity of inputs into final production can be decreased
    - ➢ Implies less primary extraction of environmental resources.

# Ecology and the economy: Principles of ecology

- **The ability of the environmental system to provide environmental resource services**
  - depends on its “state of well-being”, i.e.
    - ➢ Ecosystem stability
    - ➢ Ecosystem resilience

- **We are interested in**:
  - Reproducibility of each system over time (sustainability)
  - Interactions between the two systems
  - Predictability or uncertainty in the operations of these sub-systems

# Ecosystem stability and resilience

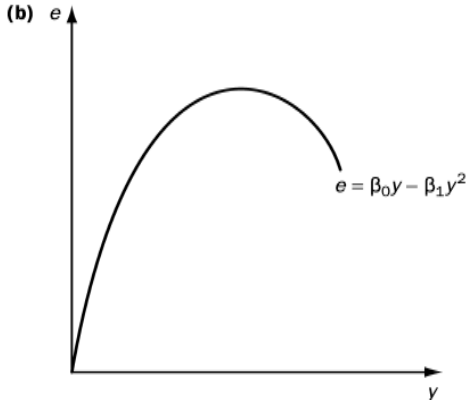
- **Two concepts of fundamental importance in ecology are stability and resilience**
  - Stability is the propensity of a population to return to some kind of equilibrium following a disturbance.
  - Resilience is the propensity of an ecosystem to retain its functional and organisational structure following a disturbance.

- **If waste flow exceeds the assimilative capacity of the receiving system**
  - Dose-response relationships may exhibit very significant non-linearities and discontinuities.

# Environmental Kuznets Curve

Is the effect of growth positive or negative on the quality of the environment?

- Economic growth →
  - initially higher emissions per capita
  - until per capita income reaches the turning point
  - and thereafter reduces emissions per capita




**ECONOMIC GROWTH AND**

**SUSTAINABILITY**

# **Empirical evidence of**
## Environmental Kuznets Curve

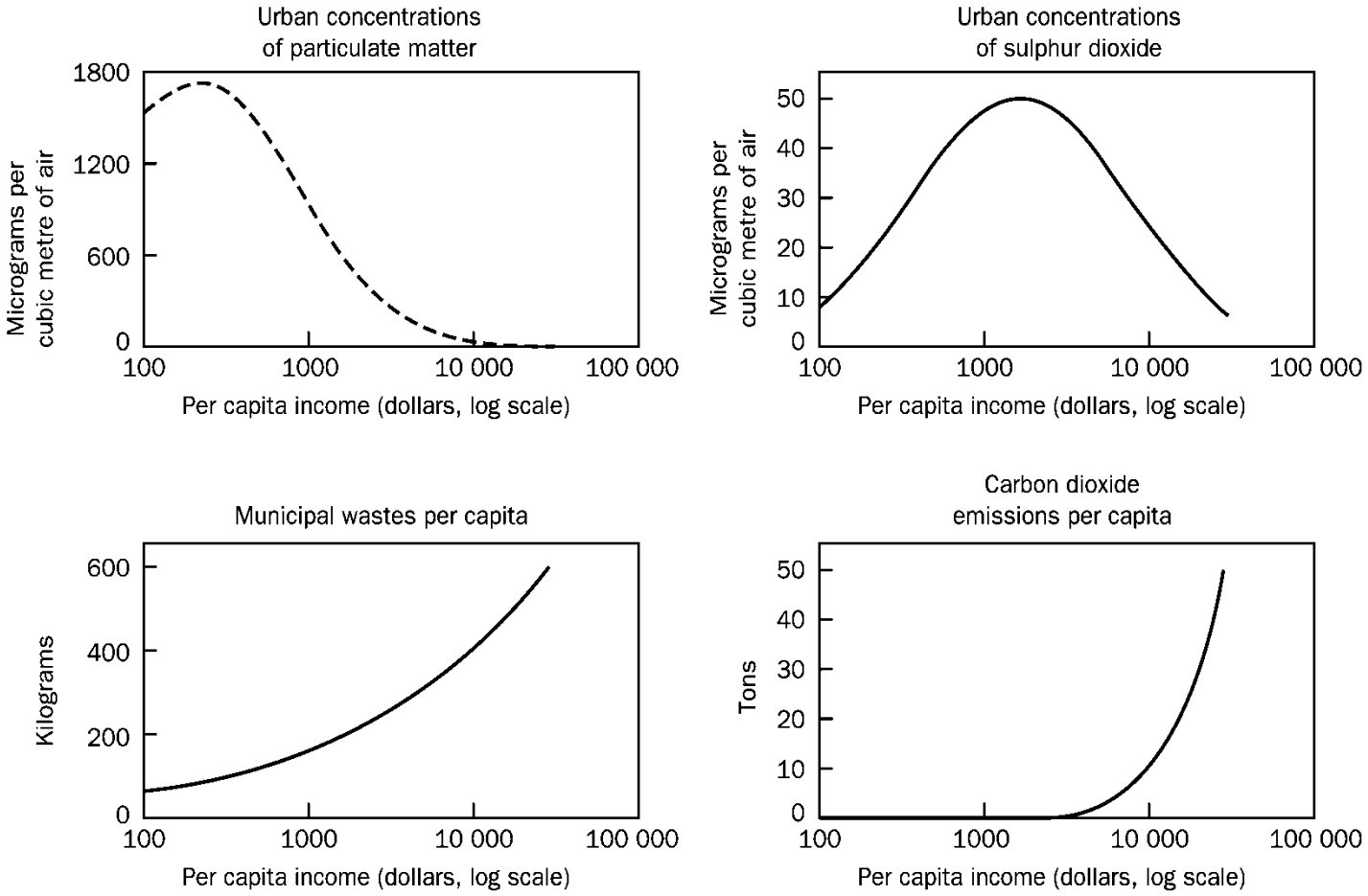
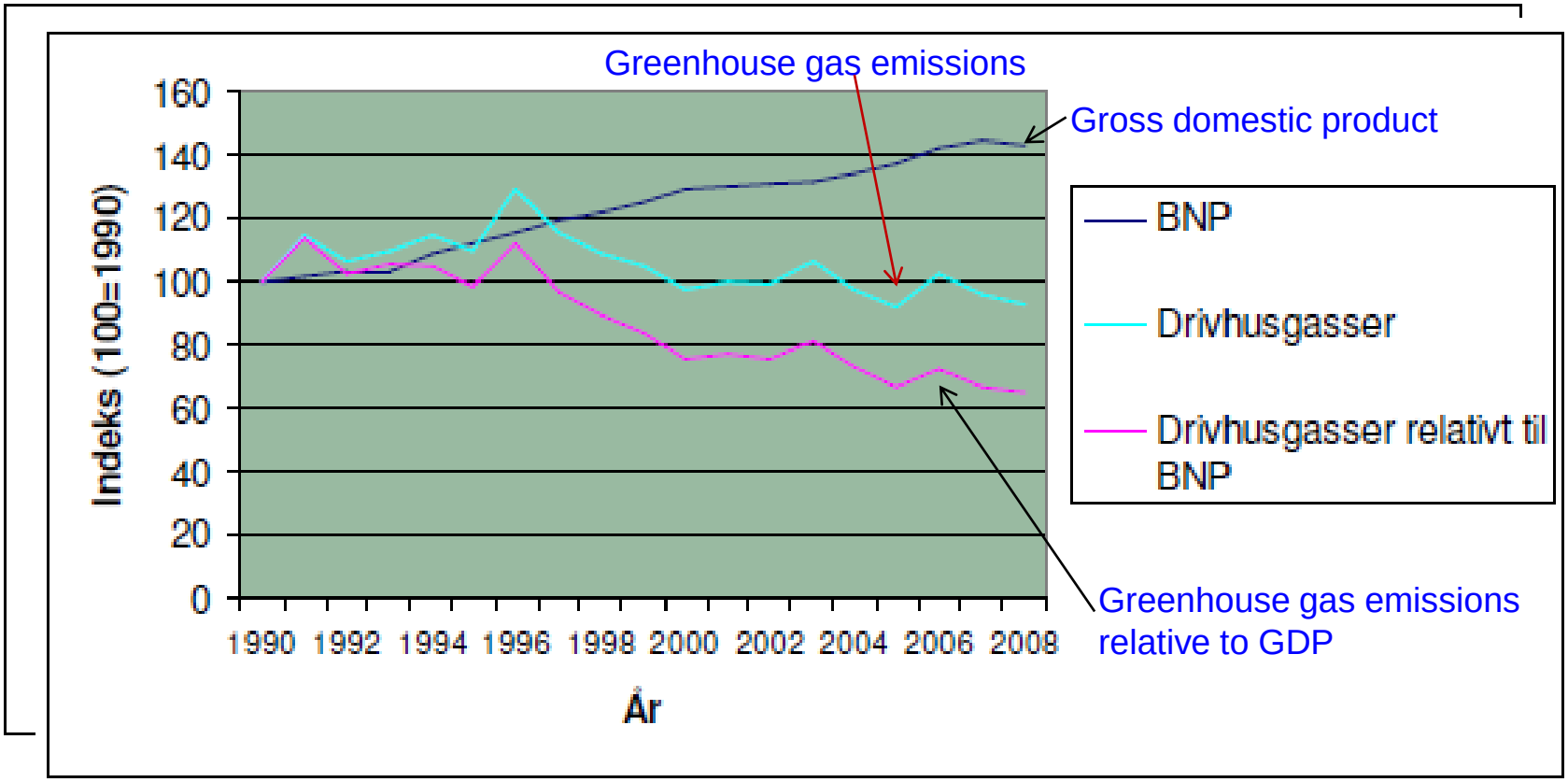


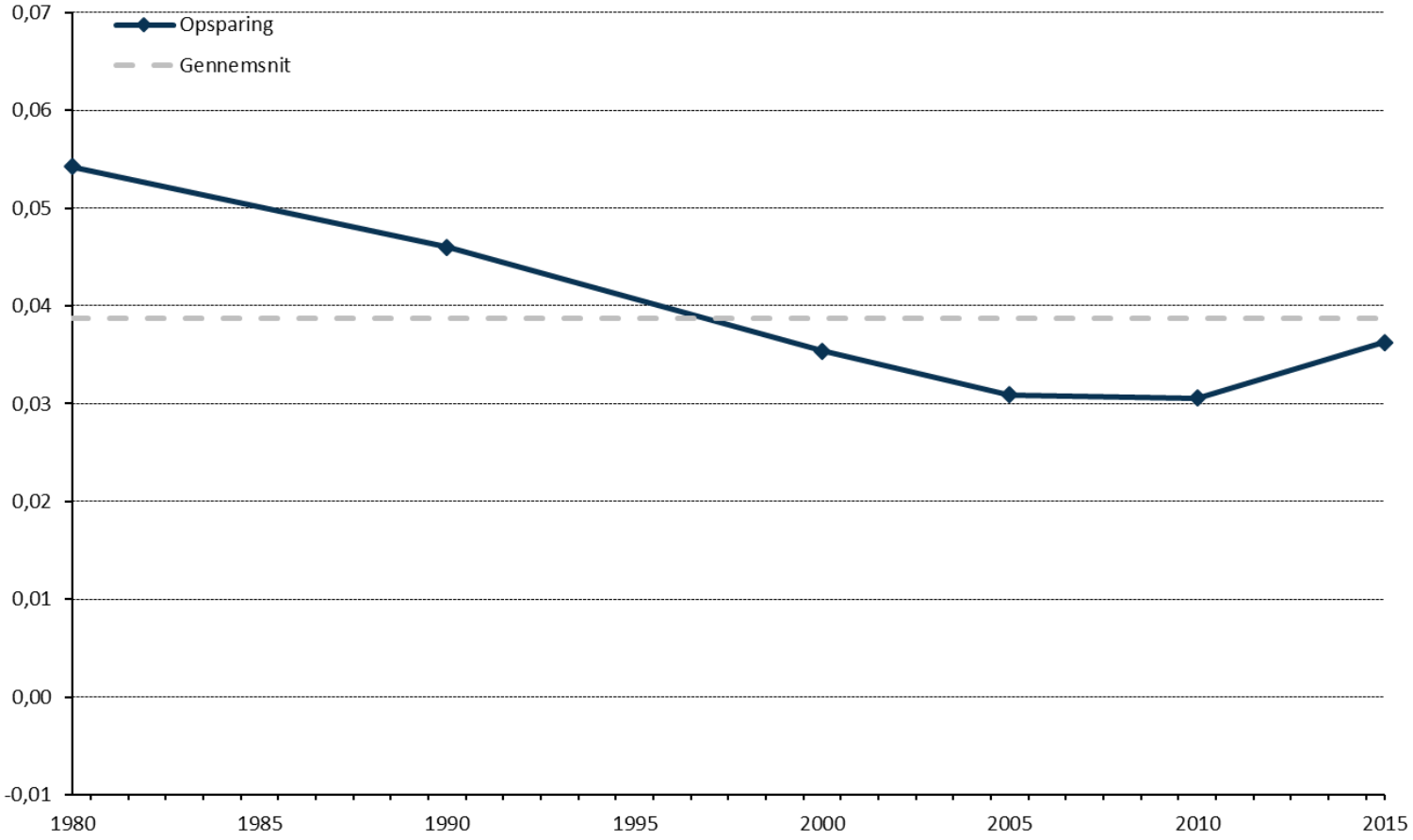

*Figure 2.9* Some evidence on the EKC. Estimates are based on cross-country regression analysis of data from the 1980s
*Source*: Adapted from IBRD (1992)

# Danish greenhouse gas emissions and economic growth 1990-2008



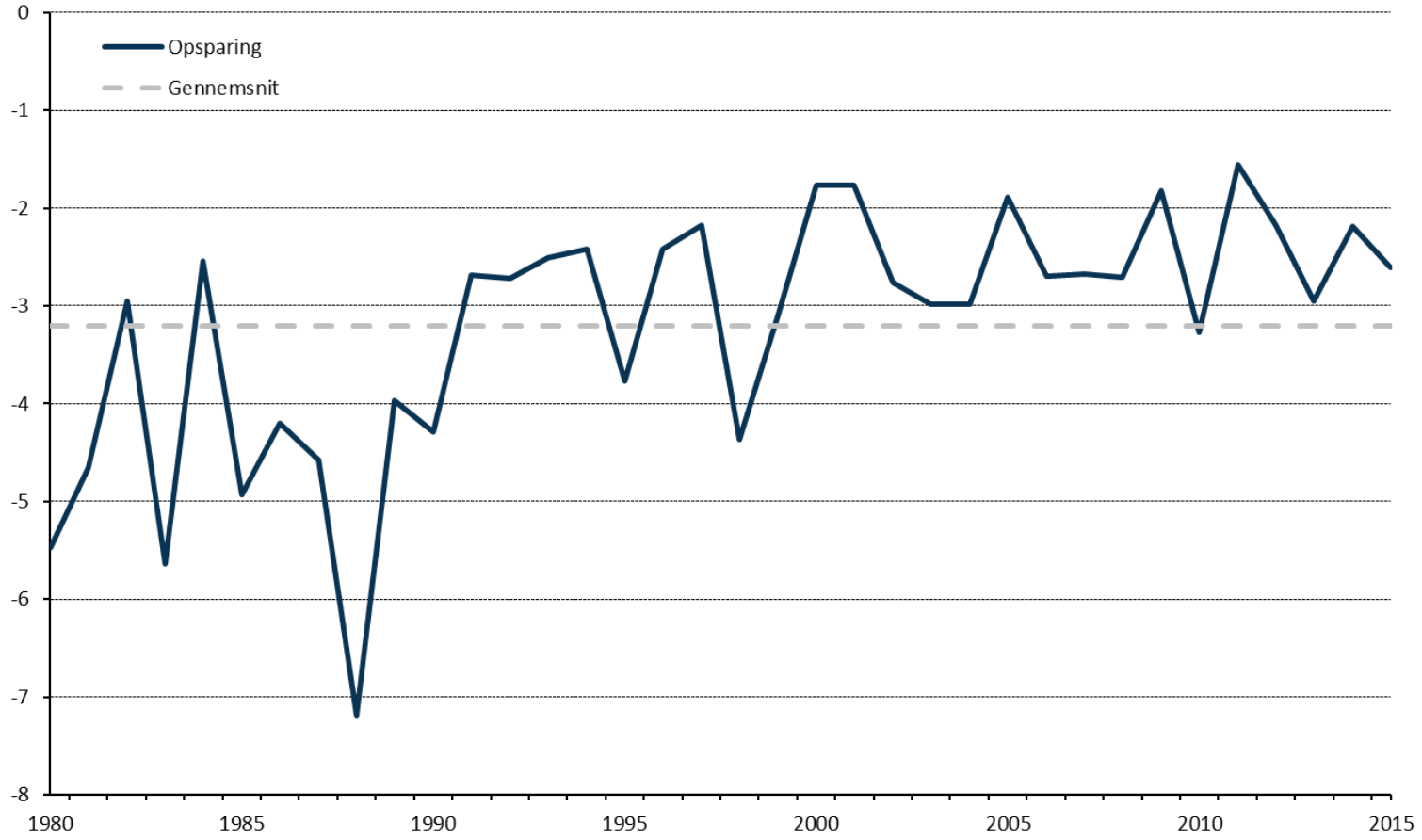
# Saving in forest

% of Gross National Product (source: Danish Economic Councils)



# Saving in climate capital

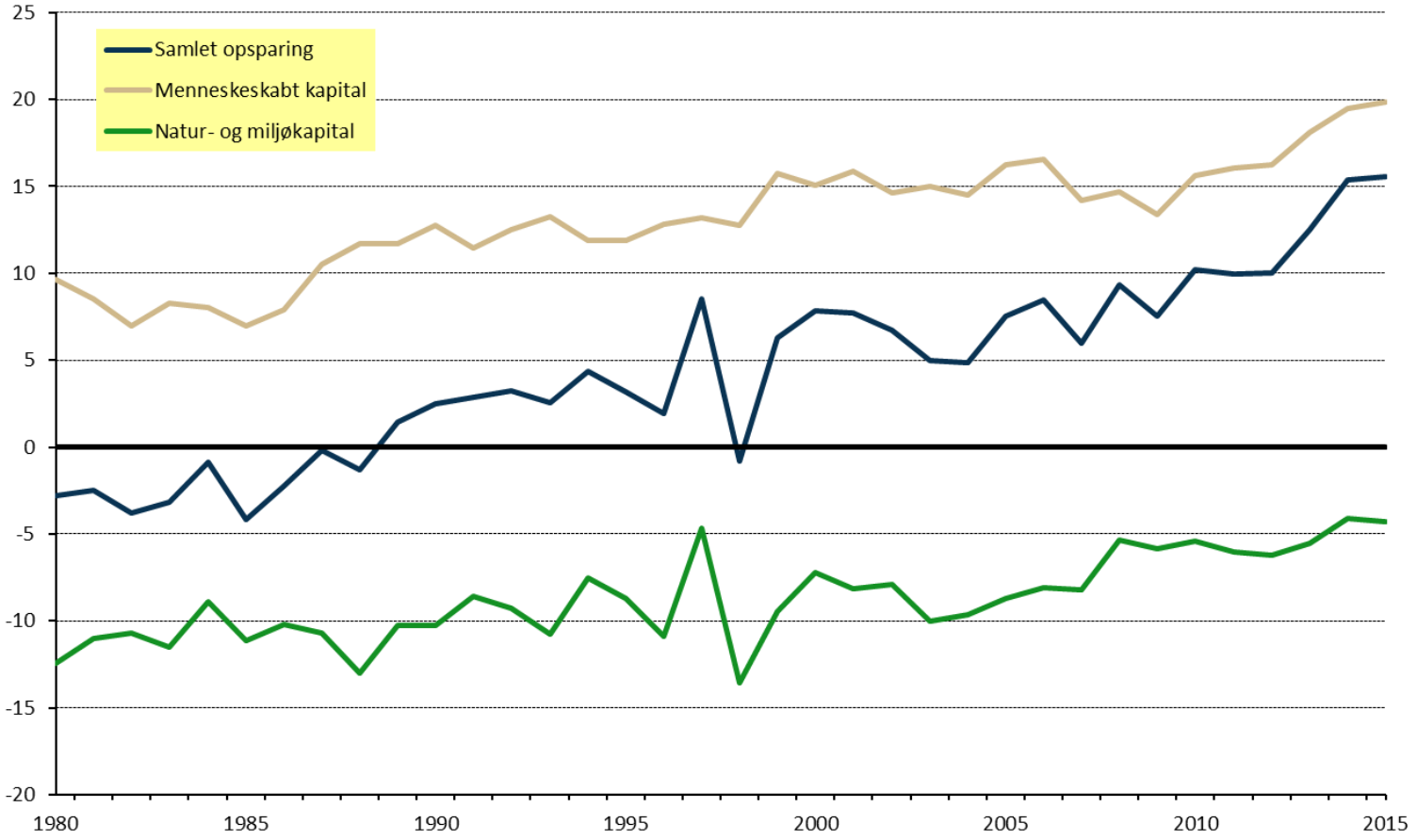
% of Gross National Product (source: Danish Economic Councils)



# Genuine saving

## (Natur and environmental capital, Human made capital)

% of Gross National Product (source: Danish Economic Councils

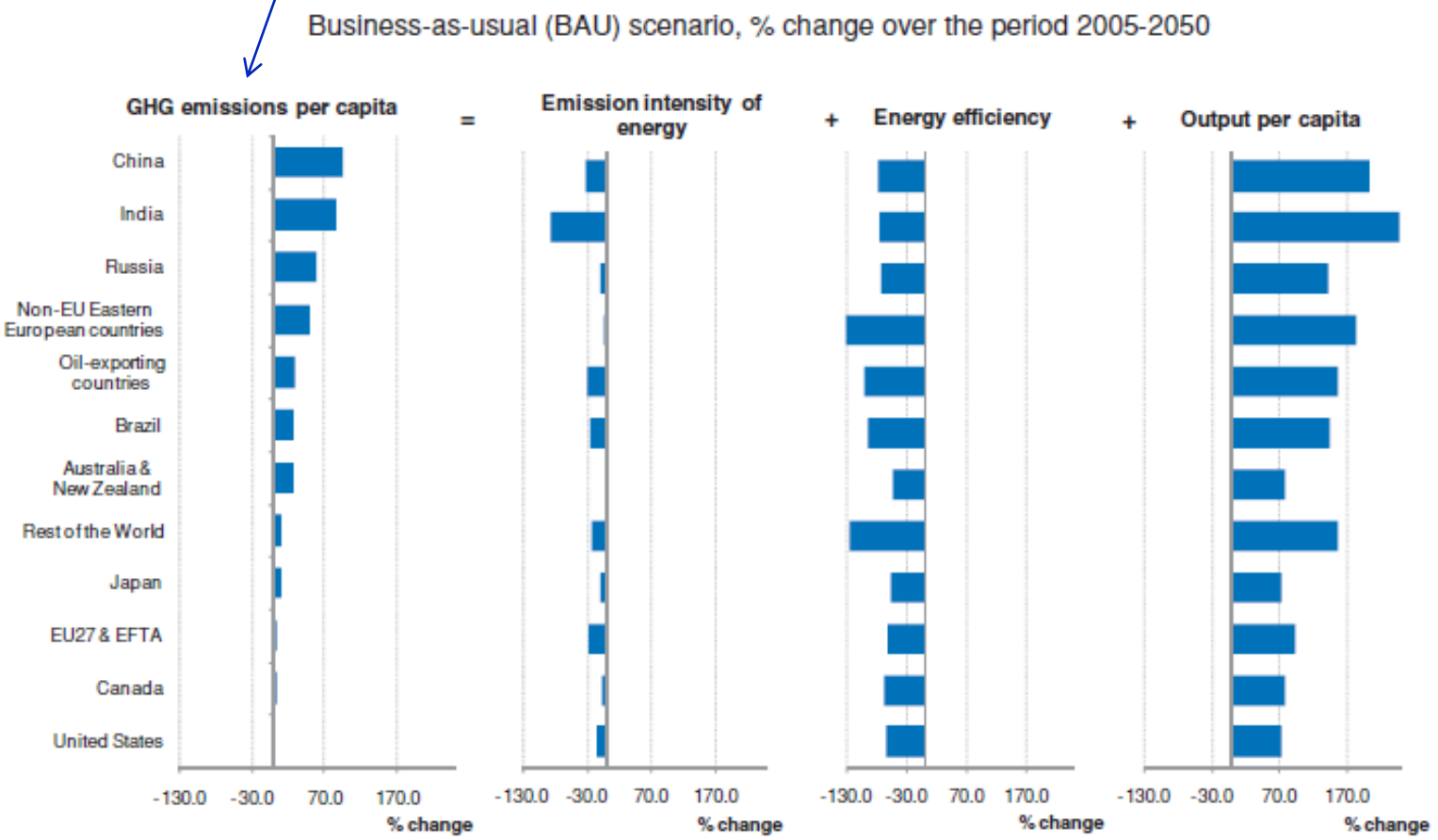


# Green industries
# -some examples

- Reduction af air pollution
- Improvement of energy efficiency
- Protection of soil, groundwater, lakes, fjords and coastal areas
- Energy production from sustainable energy resources
- Monotoring climate protection
- Reduction af noice
- Protection of biodiversity

# Sources of growth in GHG emissions per capita by country/region1

## Business-as-usual 2005-2050




1. Note that not all emissions are linked to the production of energy used to generate output. Hence, a change in the structure of the economy could lead to changes in GHG/energy that are not necessarily linked to a switch to lower-emission technologies or source of energy.

Source: OECD (2009): The Economics of Climate Change Mitigation. POLICIES AND OPTIONS FOR GLOBAL ACTION BEYOND 2012.
http://www.oecd-ilibrary.org/docserver/download/fulltext/9709011e.pdf?expires=1335287814&id=id&accname=ocid195427&checksum=42E1299D46610A0DC8BD35FA6C2F6744

# Social limits to growth

- **Daly (1987) argues that there are two classes of limits to growth**

  1) Bio-physical limits - laws of thermodynamics - fragility of ecosystems.

  2) Social desirability of growth

- **4 propositions limiting desirability of growth:**

  1) Running down resources imposes costs on future generations.

  2) Extinction of species

  3) Self-cancelling effects on welfare (positional goods)

  4) Corrosive effects on moral standards

     - such as glorification of self-interest and a scientific-technocratic worldview.

- **The last two propositions concern 'social limits to growth'.**

# Report by the Commission on the Measurement of Economic Performance and Social Progress

Professor Joseph E. STIGLITZ, Chair, Columbia University
Professor Amartya SEN, Chair Adviser, Harvard University
Professor Jean-Paul FITOUSSI, Coordinator of the Commission

- *Recommendation 1: When evaluating material well-being, look at income and consumption rather than production*
- *Recommendation 2: Emphasise the household perspective*
- *Recommendation 3: Consider income and consumption jointly with wealth*
- *Recommendation 4: Give more prominence to the distribution of income, consumption and wealth*
- *Recommendation 5: Broaden income measures to non-market activities*
- *Recommendation 6: Quality of life depends on people's objective conditions and capabilities. Steps should be taken to improve measures of people's health, education, personal activities and environmental conditions. In particular, substantial effort should be devoted to developing and implementing robust, reliable measures of social connections, political voice, and insecurity that can be shown to predict life satisfaction.*
- *Recommendation 7: Quality-of-life indicators in all the dimensions covered should assess inequalities in a comprehensive way*

# Report by the Commission on the Measurement of Economic Performance and Social Progress

- *Recommendation 8: Surveys should be designed to assess the links between various qualityof-life domains for each person, and this information should be used when designing policies in various fields.*
- *Recommendation 9: Statistical offices should provide the information needed to aggregate across quality-of-life dimensions, allowing the construction of different indexes.*
- *Recommendation 10: Measures of both objective and subjective well-being provide key information about people's quality of life. Statistical offices should incorporate questions to capture people's life evaluations, hedonic experiences and priorities in their own survey.*
- *Recommendation 11: Sustainability assessment requires a well-identified dashboard of indicators. The distinctive feature of the components of this dashboard should be that they are interpretable as variations of some underlying "stocks". A monetary index of sustainability has its place in such a dashboard but, under the current state of the art, it should remain essentially focused on economic aspects of sustainability*
- *Recommendation 12: The environmental aspects of sustainability deserve a separate follow up based on a well-chosen set of physical indicators. In particular there is a need for a clear indicator of our proximity to dangerous levels of environmental damage (such as associated with climate change or the depletion of fishing stocks.)*