Restructuring energy systems

The next challenge

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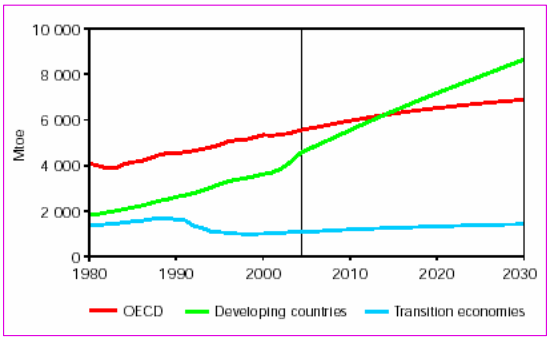
Why we need a restructuring of our energy systems

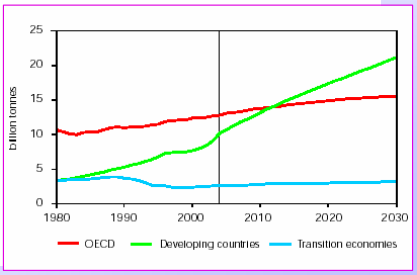
Energy demand up to 2030
The perspective of the IEA



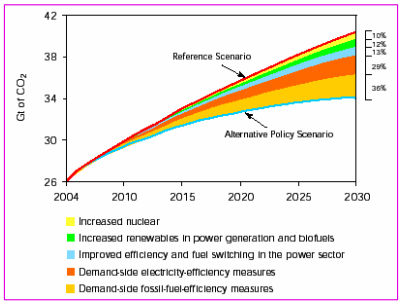
International Energy Agency. 2006.
World Economic Outlook.

Primary energy demand
Baseline scenario

CO_2 emissions
Baseline scenario



CO_2 emissions up to 2030
The perspective of the IEA



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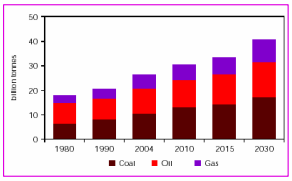
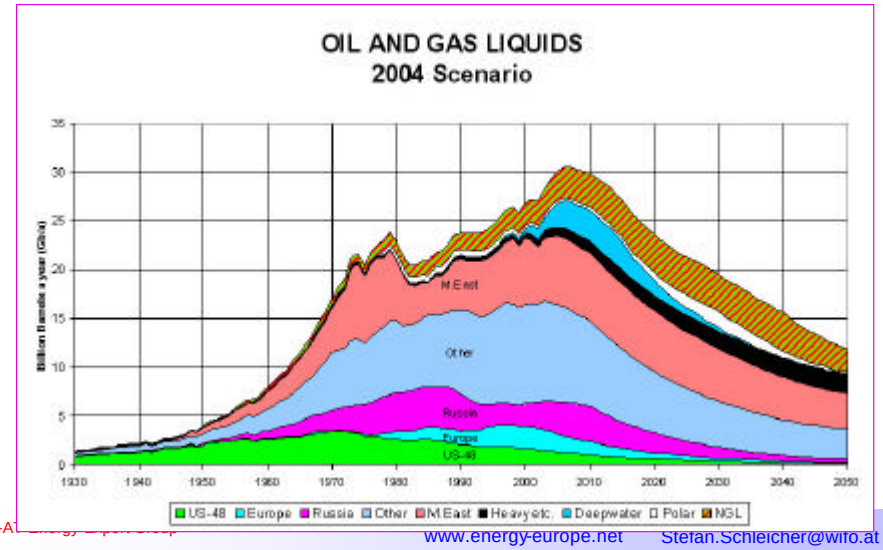
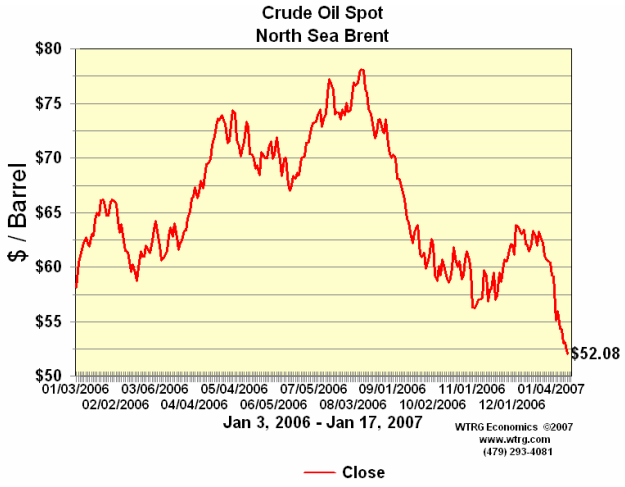


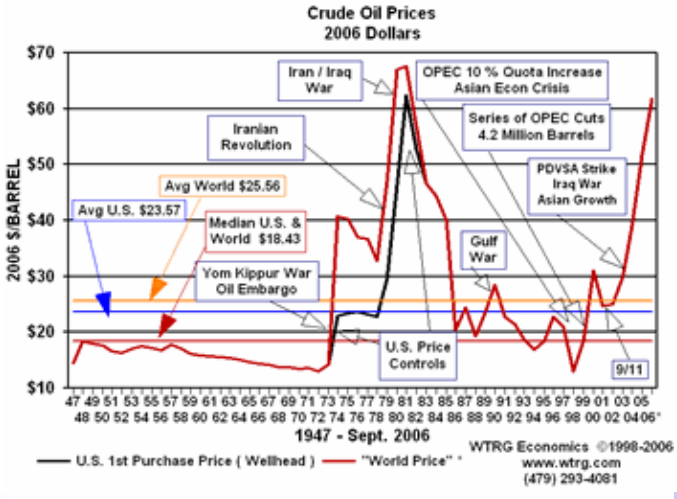
The challenge of oil and gas availability
Approaching global peak-oil production



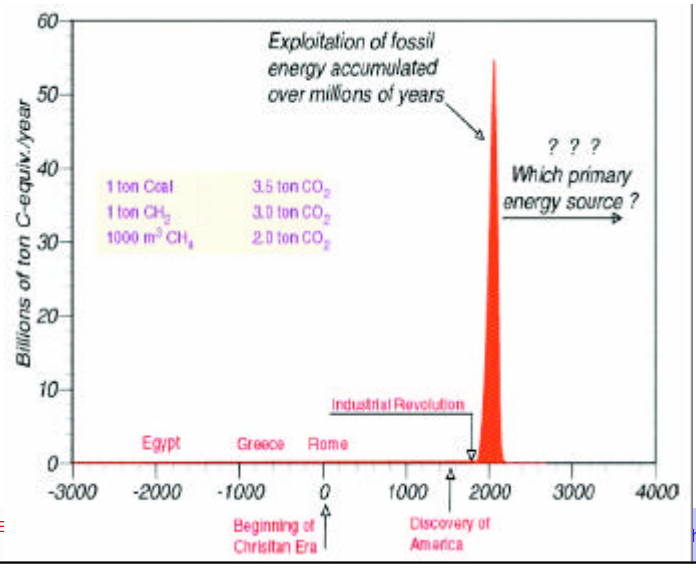
Price for crude oil
The past 12 months



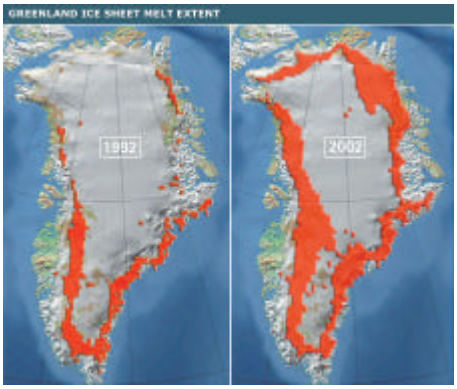
The price for crude oil
The past 20 years



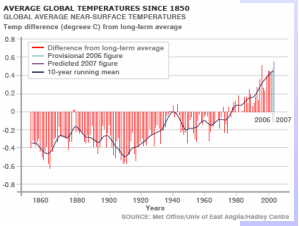
The (short) age of fossile fuels



The challenge of climate change
Global warming – out of control?

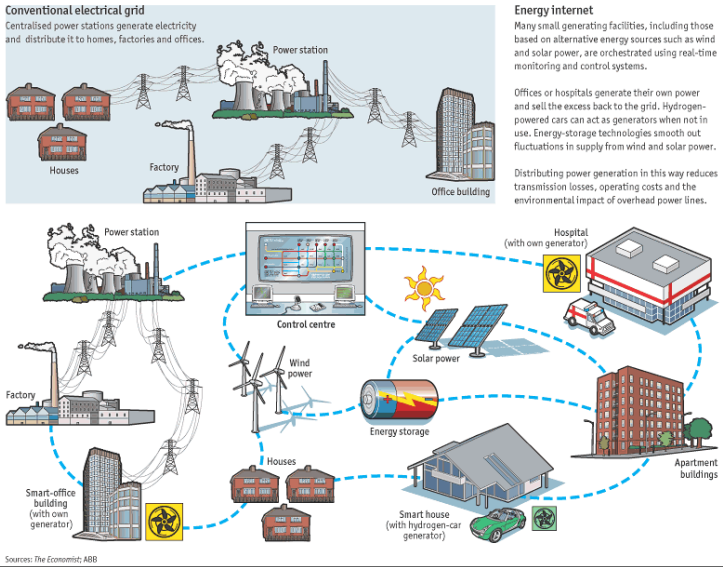


- The warmest years sind 1890
- 2005
  1998
  2002
  2003
  2004
  2006



How future energy systems could look like

The future energy systems
Internet structures for heat and electricity



The transformation of mobility
From transport to mobility

Mobility modules
Instead of vehicles

Mobile and stationary use
Modular structures

The transformation of buildings
Passive-house and plus-energy standards

- Transparent insulation materials
- Thermal and photovoltaic solar

The transformation of electricity and heat technologies

Remaining energy needs

Decentralized
local
renewable

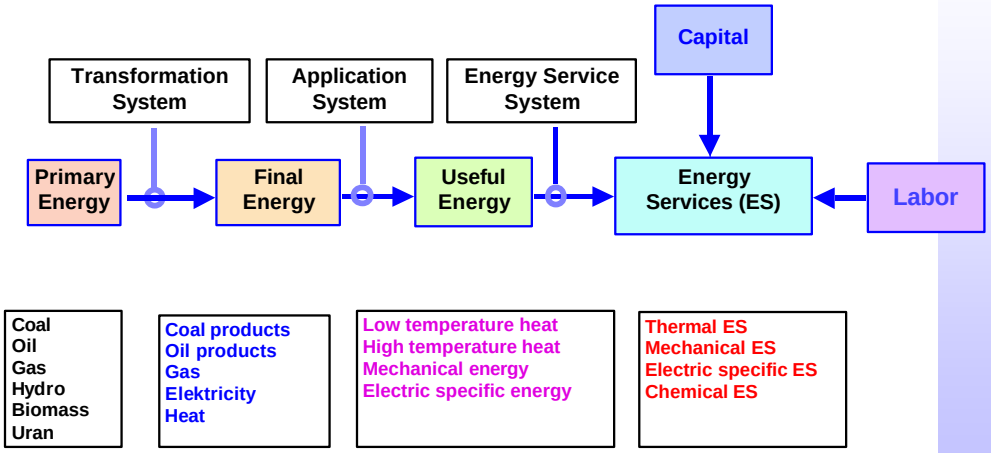
Micro technologies

How to understand energy systems

The incentive
Trying to understand our energy systems

- **Comparative analysis of energy systems**
  - ↗ **Structure**
    - – **Composition of demand and supply**
  - ↗ **Drivers**
    - – **Relation to economic activity**
  - ↗ **Key parameters**
    - – **Elasticities and intensities**
- **Preparation for structural modeling analysis**
  - ↗ **Energy services**
  - ↗ **Final energy consumption**
  - ↗ **Primary energy supply**

Modeling the structure of energy systems



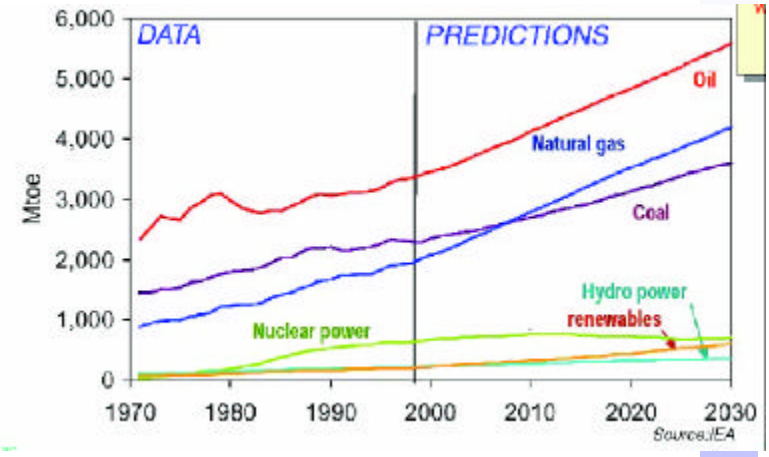
The challenges for energy policy

The fundamental controversies

- The wrong questions
  - How can we substitute the current requirements for energy flows?
- The right directions
  - Check your energy services
    - What will be the future requirements
    - How many are redundant?
  - Check the potentials for raising efficiencies
    - Application technologies
    - Transformation technologies
  - Develop policy guidelines
    - Low carbon
    - Low energy
    - Low distance

IEA: The main stream Business as Usual

- +2% CO2 pro Jahr

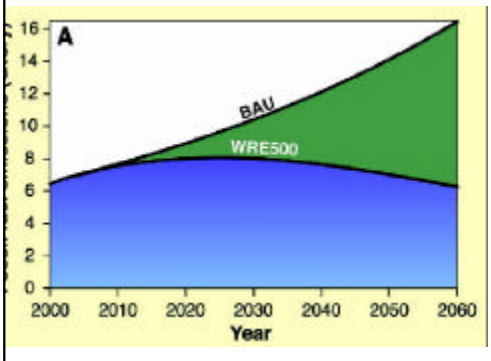


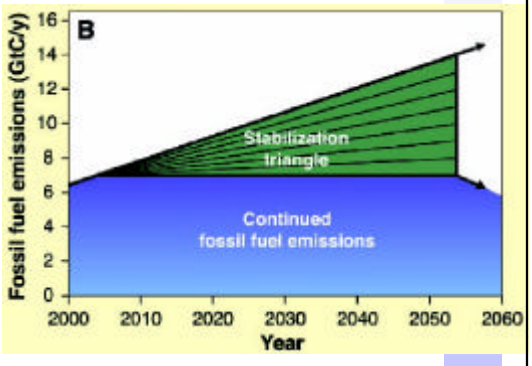
The anti-thesis to the IEA
The Pacala-Socolow proposal

"Humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century and climate problem over the next half-century."

S. Pacala and R. Socolow
Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies
Science, Vol. 305, August 13, 2004.

Current technologies for GHG stabilization in 50 years





Current technologies for GHG stabilization in 50 years

- **Efficiency and conservation**
  - Cars (4x -> 2 billion cars)
    60 instead 30 miles/gallon
    5000 instead 10000 miles per year
  - Buildings
    -25% energy
  - Power plants
    from 40 to 60% efficiency

Current technologies for GHG stabilization in 50 years

- **Decarbonization**
  - Electric power plants
    gas substitutes coal
  - New renewables
    wind, thermal and photovoltaic solar
- **Carbon capture and hydrogen storage**
  - Post-combustion carbon capture and storage in electricity generation
  - Pre-combustion carbon separation and hydrogen storage as substitute for fossil fuels
- **Carbon sinks**

The 3 x 50 strategy

Transition to a 2.000 Watts energy system

	2005	20??	
Energy Services	100,0	150,0	+50 %
Energy Flows	100,0	50,0	-50 %
Of which Renewables	25,0	37,5	+50 %

Thank you.