Virtual Academy for Sustainability

WBGU
German Advisory Council on Global Change

Lecture 4: The Great Transformation: A Heuristic Concept

Episode 1: Key Characteristics of the Global Transformation towards Sustainability

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World in Transition: A Social Contract for Sustainability *supported by*

DBU
Deutsche Bundesstiftung Umwelt

Lecture 4: Overview

Episode 1: **Key characteristics of the Global Transformation towards sustainability**

Episode 2: Drivers of the Low-carbon Transformation

Episode 3: Interview

Learning Outcomes

1. You will understand the reasons for a low-carbon transformation.
2. You are able to name and differentiate different transformations.
3. You have an overview of drivers and barriers to a low-carbon transformation.
4. You will know which parts of the global economy will need to be transformed.
5. You will have some knowledge about central elements of the low-carbon transformation.

„We simply can‘t scale up the existing growth patterns“ (Michael Spence)

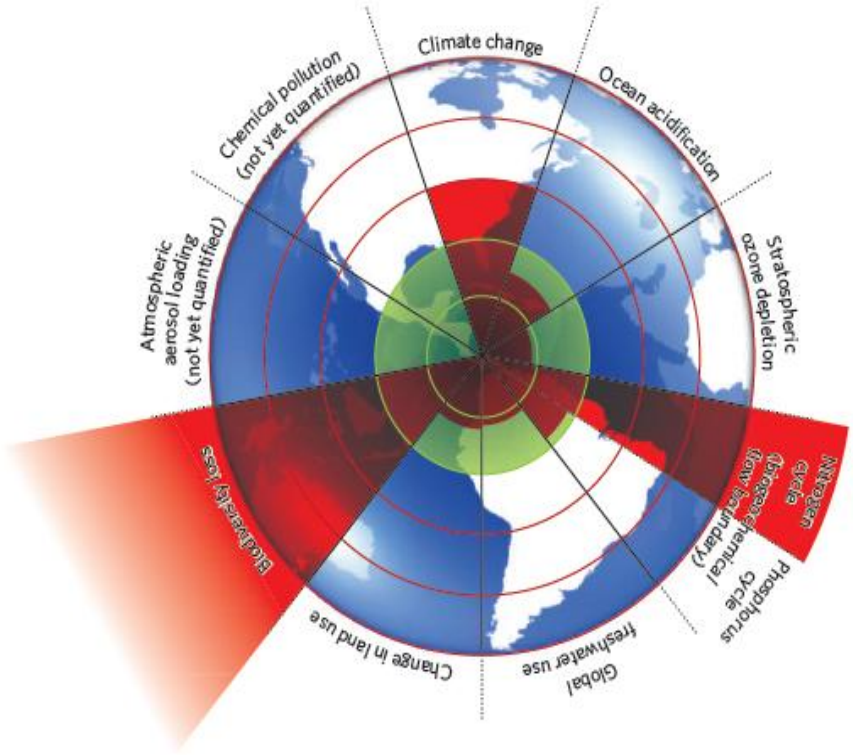
- 9 billion people in 2050
- Global GDP of 60 trillion US $ (2010) … 180 trillion US $ (2030/40)
- Growing global middle classes
- Impacts of dangerous climate change
- 750 Gt (gigatonnes) budget
- Planetary boundaries

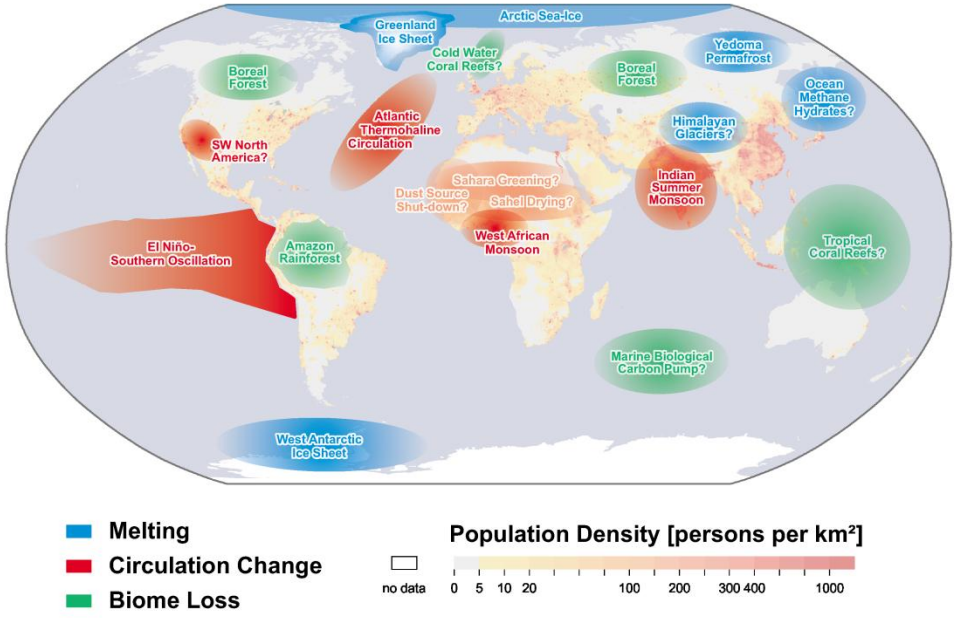
SIZE OF THE MIDDLE CLASS, REGIONS
(millions of people and global share)

	2009		2020		2030	
North America	338	18%	333	10%	322	7%
Europe	664	36%	703	22%	680	14%
Central & South America	181	10%	251	8%	313	6%
Asia Pacific	525	28%	1740	54%	3228	66%
Sub-Saharan Africa	32	2%	57	2%	107	2%
Middle East & North Africa	105	6%	165	5%	234	5%
World	1845	100%	3249	100%	4884	100%

Source: Kharas and Gertz (2010)

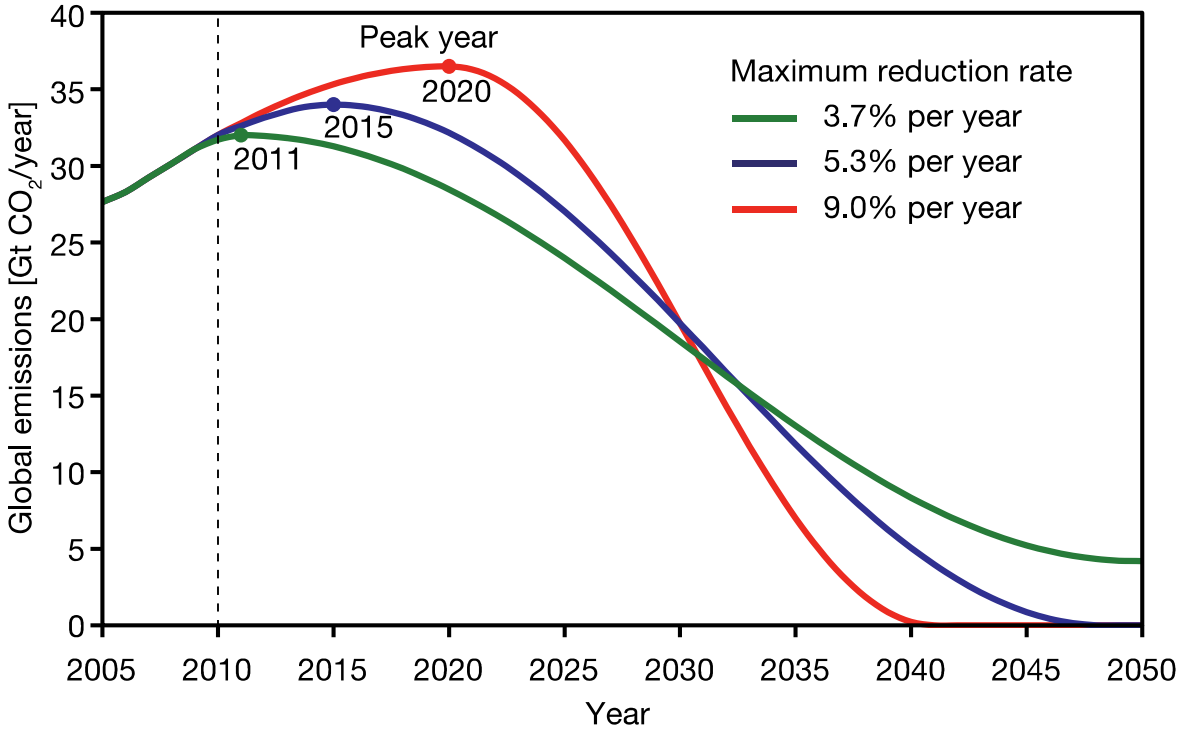
Tipping points and planetary boundaries





Source: Lenton et al., 2008

750 Gigatons – Huge time pressure



Transformation needs to be global:

- 2,5 t per capita p.a. 2010 – 2050, currently 110 countries beyond 2 tons

Great transformations in the history of mankind

History

- Neolithic Revolution … emergence of agriculture
- Industrial Revolution ... the fossil energy era

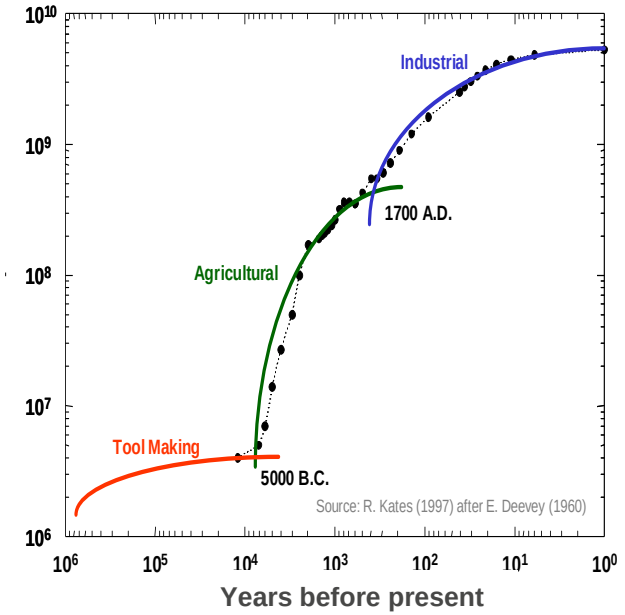
Present Transformation

- Low-carbon „within“ the 750 Gt budget
- Planetary boundaries/ anthropocene
- Global

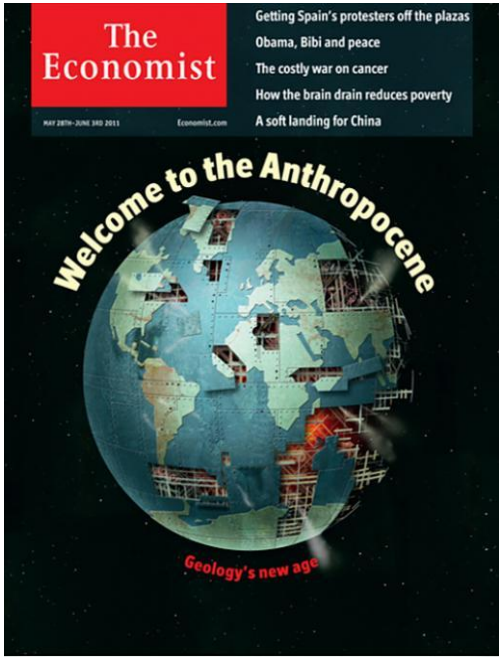
… needs to be managed/ organized:

⟶ new social contract

⟶ new business model for the global economy



The Anthropocence



- Since end of the 20th/beginning of 21st century: Mankind is the dominating geological force in the earth system (Paul Crutzen)

Challenges:

- Earth system responsibility – new world view
  (Factor X > shaping globalisation)
- Time scales (living / future generations, earth system)
- 9 bill. inhabitants, world society, mutual vulnerabilities, wealth creation in the Anthropocene

„Technophysio evolution“

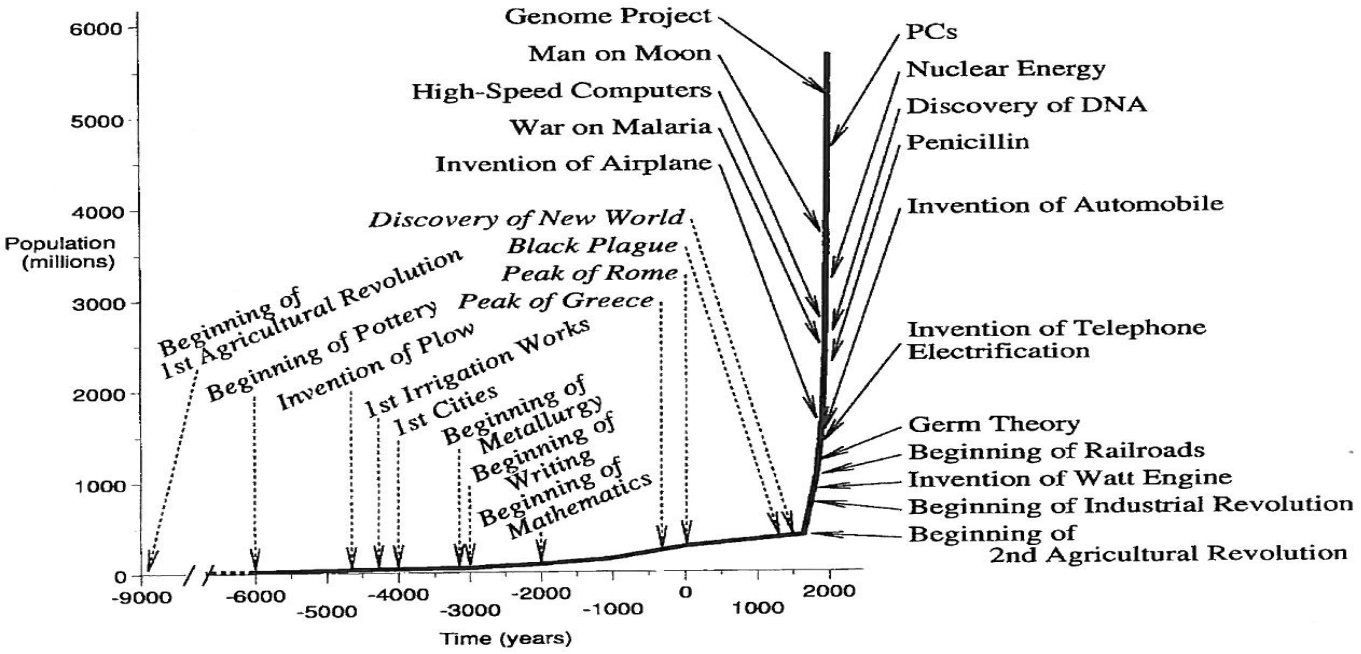


FIGURE 1. THE GROWTH OF THE WORLD POPULATION AND SOME MAJOR EVENTS IN THE HISTORY OF TECHNOLOGY

Notes: There is usually a lag between the invention of a process or a machine and its general application to production. ''Beginning'' means the earliest stage of this diffusion process.
Sources: Carl W. Bishop, 1936; T. K. Derry and T. I. William, 1960; Graham Clark, 1961; B. H. Slicher von Bath, 1963; Stuart Piggott, 1965; Glenn T. Trewartha, 1969; William McNeill, 1971; Jacob Bronowski, 1973; Carlo M. Cipolla, 1974; B. M. Fagan, 1977. See also E. A. Wrigley, 1987; Robert C. Allen, 1992, 1994.

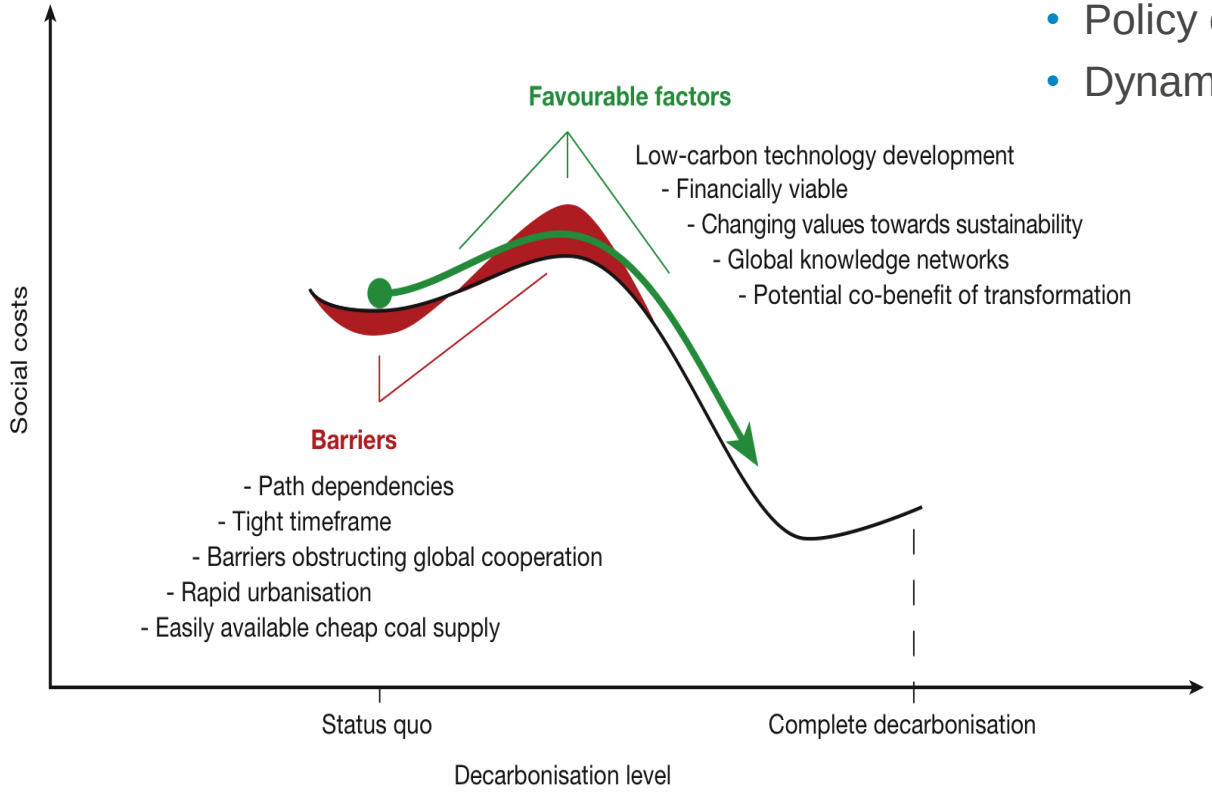
Source: Fogel, 1999

Drivers of transformations – learning from the past

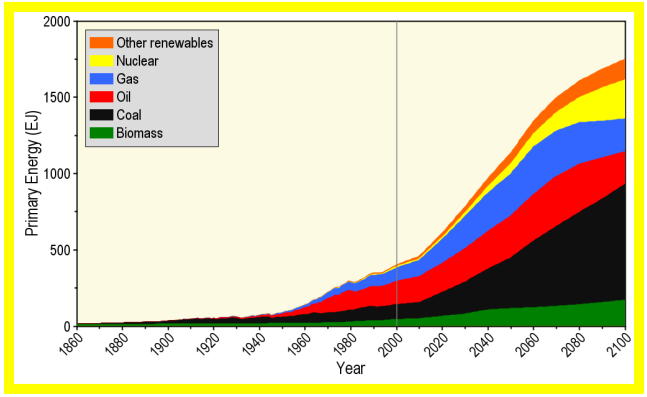
- „Vision“: better future, normative perspectives
  – abolition of slavery, European Union
- „Technology“: Rapid diffusion of innovations
  – IT-revolution
- „Knowledge“: research driven, precautionary principle
  – protection of the ozone layer
- „Crisis“: Structural adjustment programmes, financial market reforms after 2008

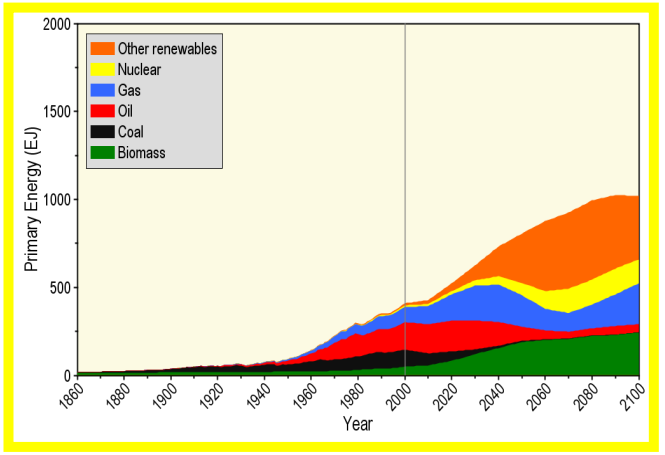
Five good news … five major challenges

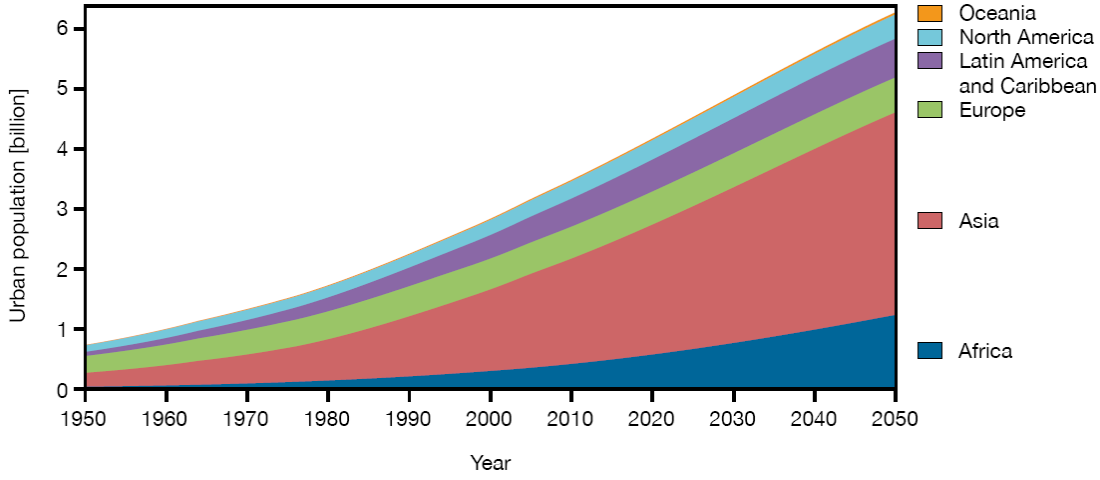
- Technology assessment
- Costs
- Policy options
- Dynamics of the transformation



Three transformation areas: Basic structures of the global economy

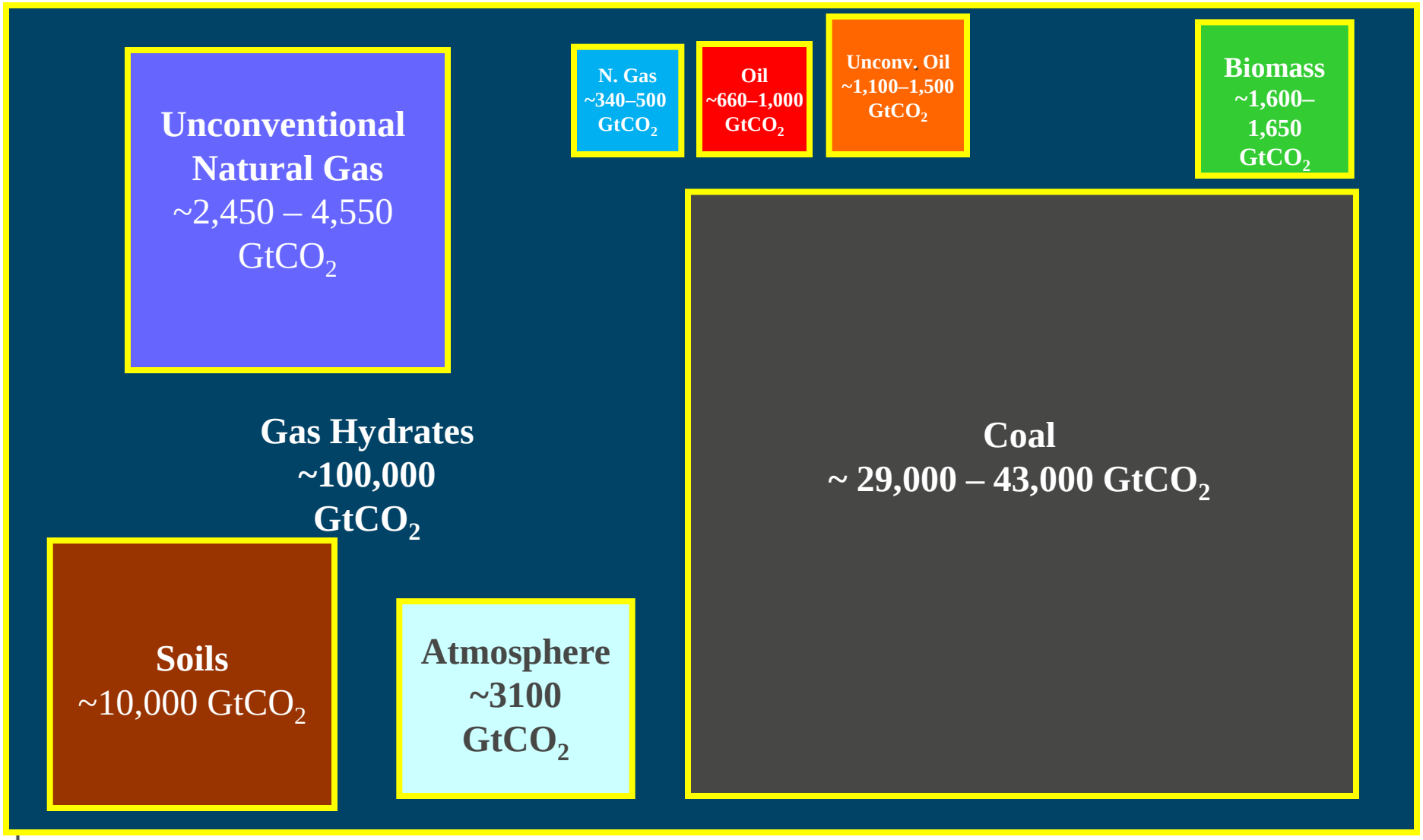






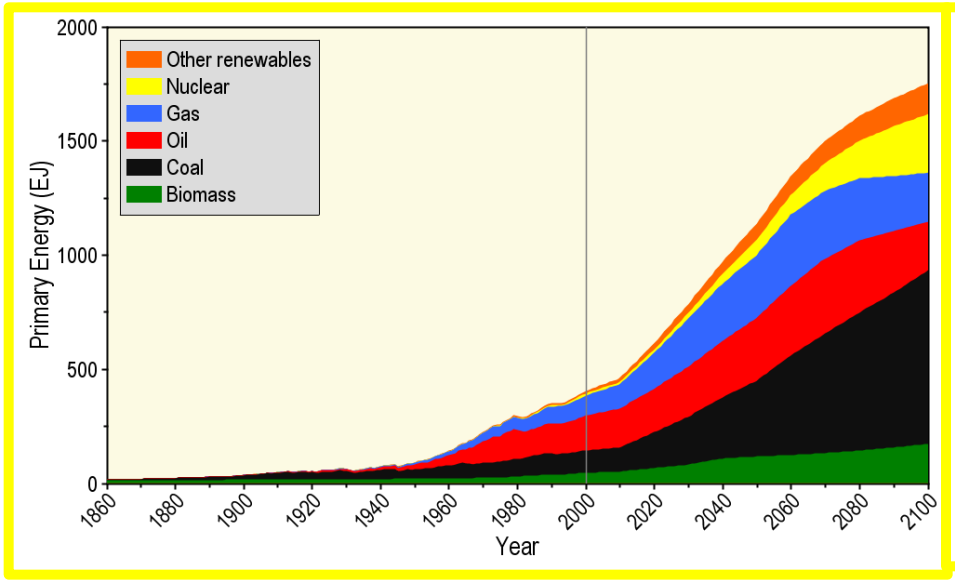
Source: WBGU

What needs to be transformed?

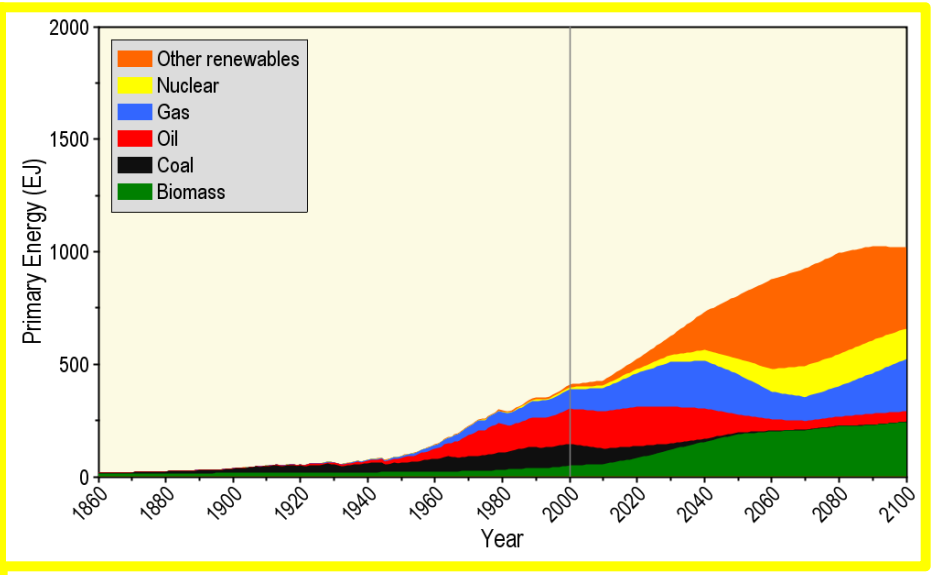


It`s about scale and speed!

6° Celsius path

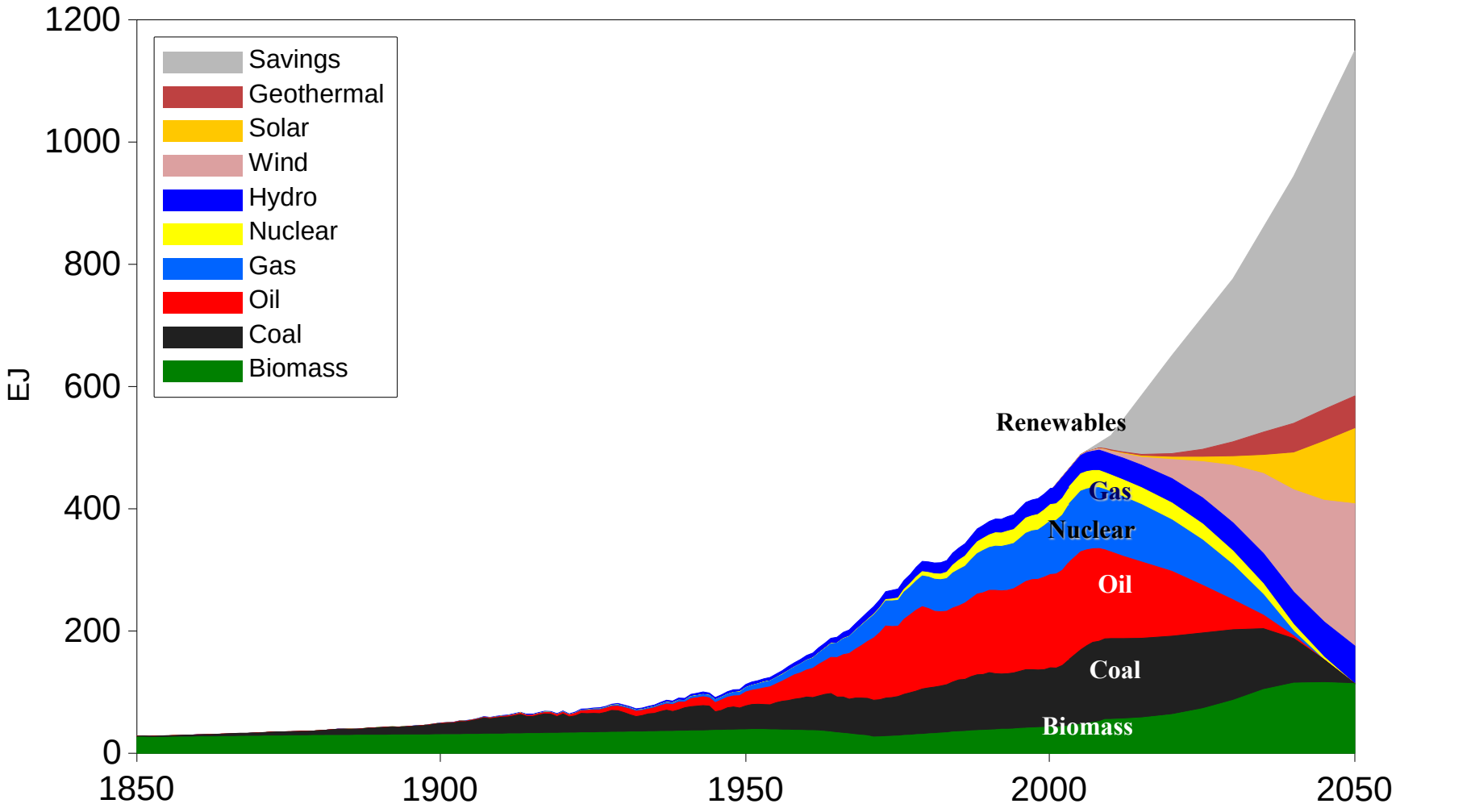


2° Celsius path



- 85/15 … 15/85 (30 % renewable energy by 2030)
- energy efficiency and carbon efficiency need to rise drastically (40 % by 2030)
- stabilize energy consumption: 450-500 EJ (2010: 390 EJ)

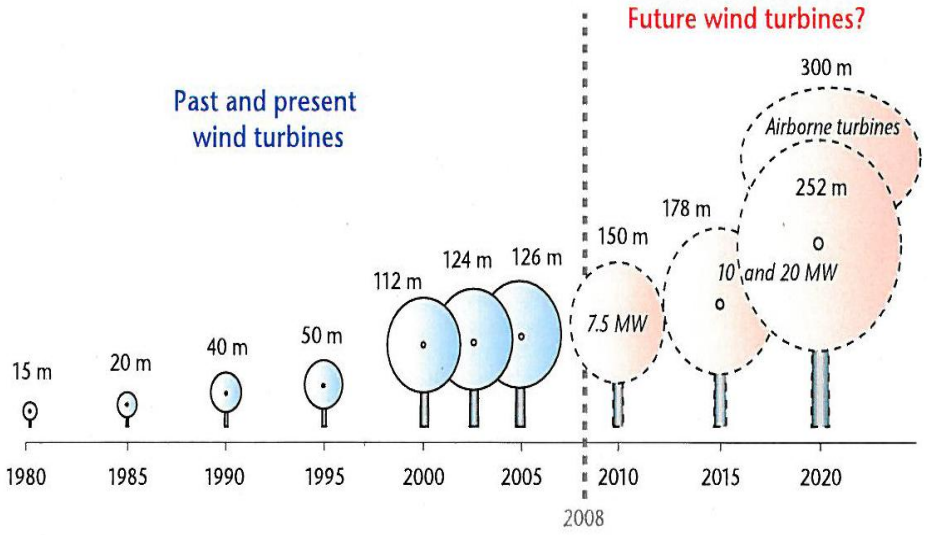
Global primary energy vs. WBGU exemplary pathway



Technologies

Diameter of wind turbines
1990-2020, factor 6

Figure 10: Growth in size of wind turbines since 1980



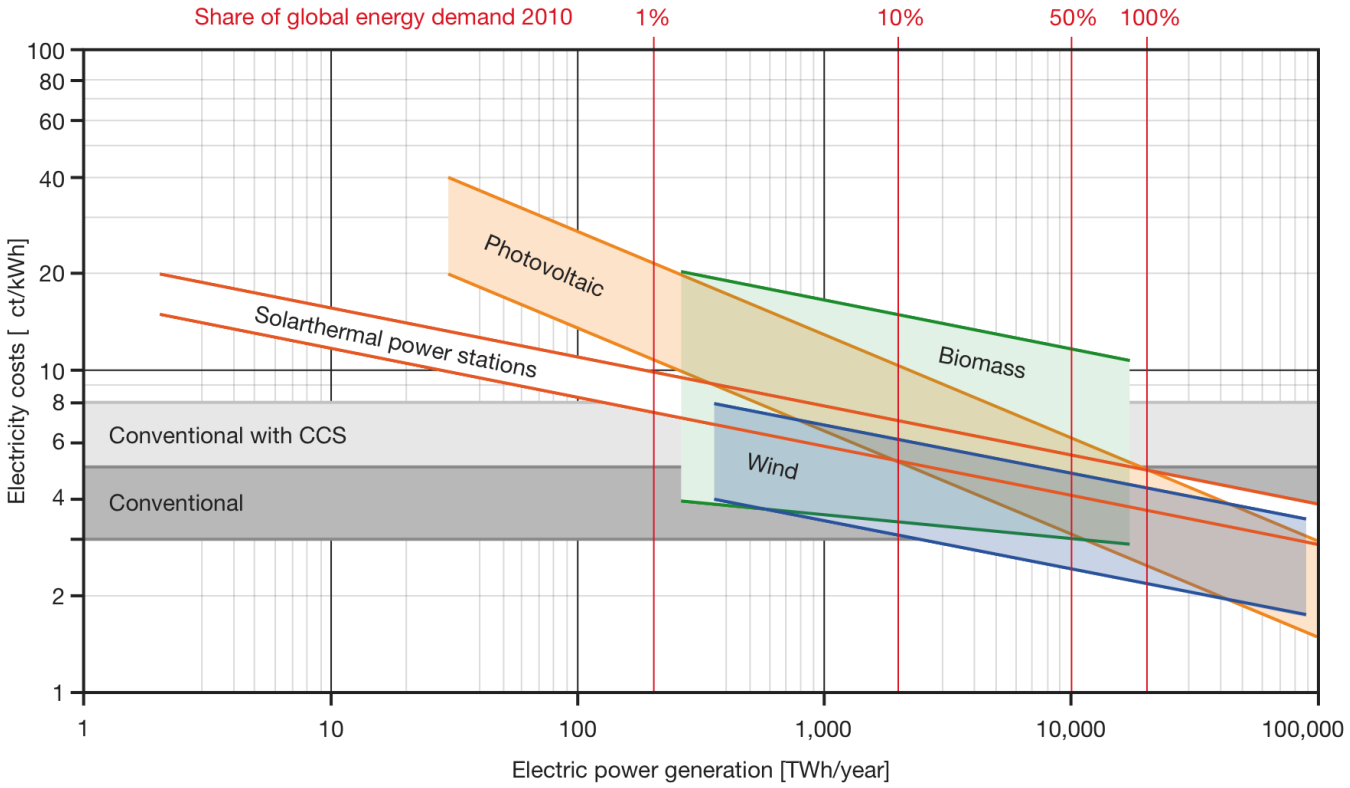
Source: Adapted from EWEA (2009).

Source: Photodisc

Energy & water from deserts

Potential of cost reductions: electricity from renewables

TIPPING POINT: 15-25 %



Efficiency through reconstruction

Before reconstruction

After reconstruction according to passive house principle

over 150 kWh/(m²a)

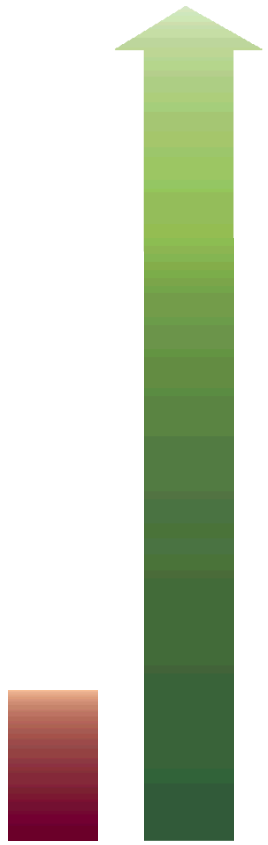
-90%

15 kWh/(m²a)

Source: Fraunhofer-Institut für Bauphysik (IBP), 2012

From urban sprawl to high density cities

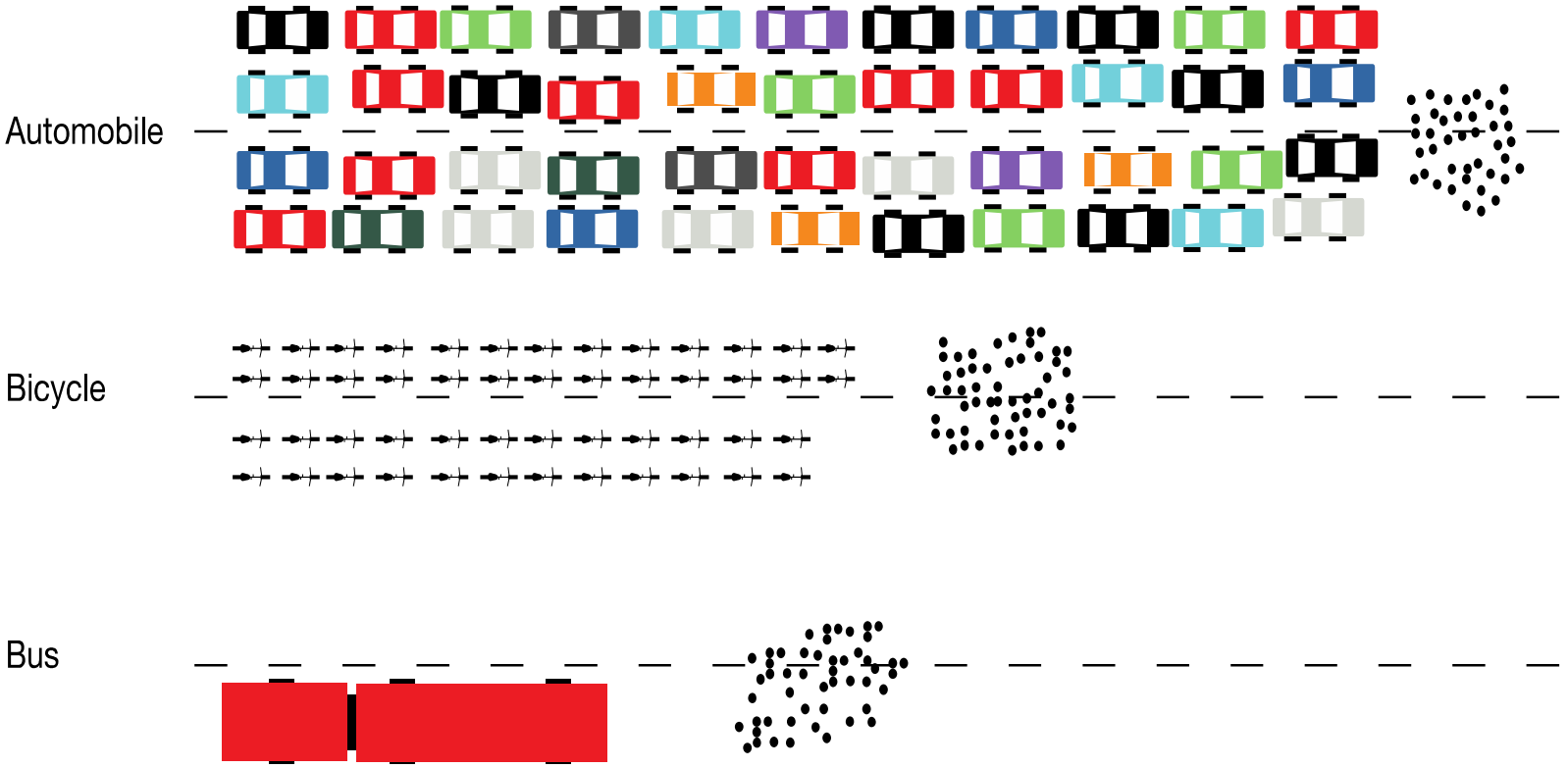
Source: Photodisc



Source: WBGU

Space, cities and energy efficiency

Area occupied by various transport modes



Source: WBGU

Global costs

Study	400-410 ppm	445-450 ppm	500 ppm
RECIPE	0,7-4.0% global GDP 2100	0,1-1,4% global GDP 2100	
ADAM	Max. 2.5 % global GDP 2100		Max. 0.8% global GPD 2100
IPCC AR4		Max. 5,5% global GDP 2100	

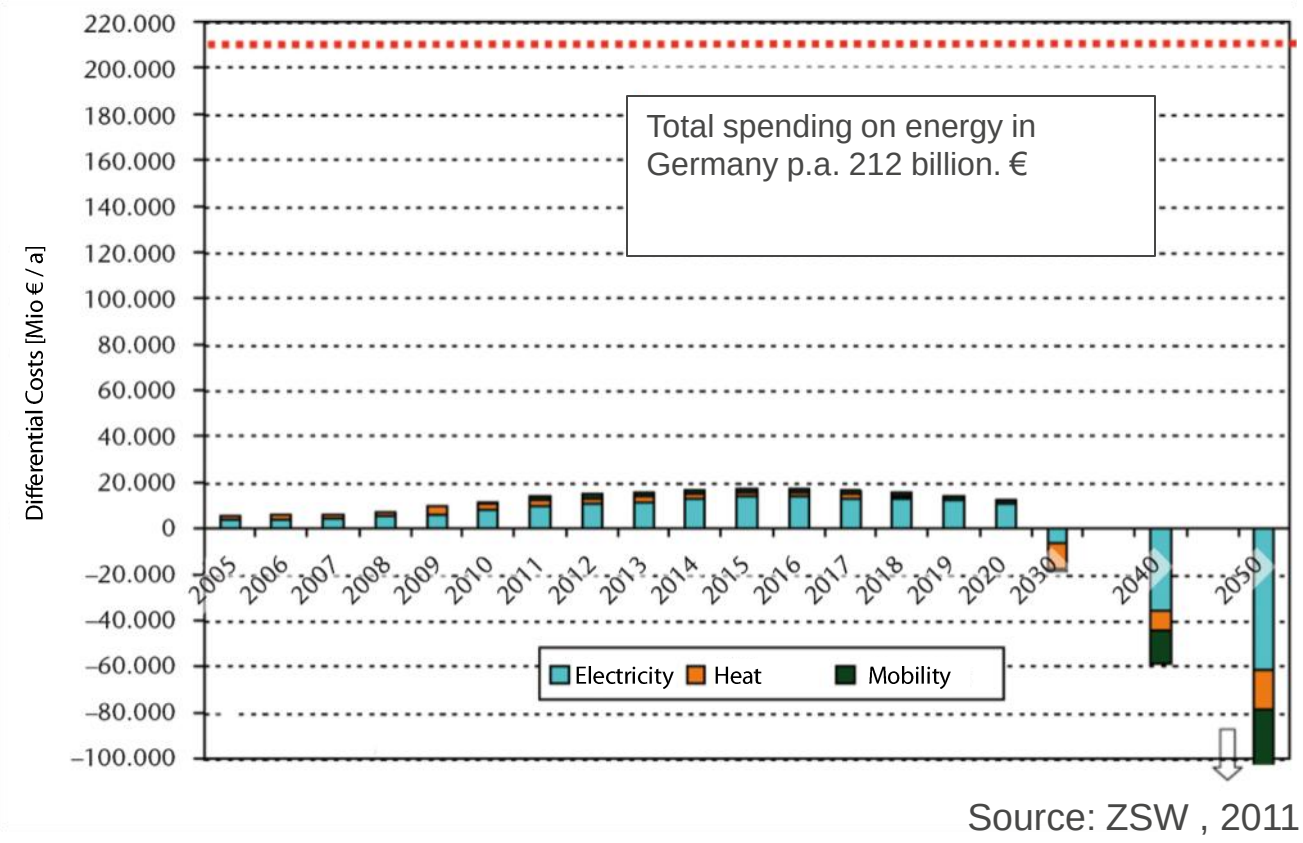
- Key problem: Upfront investments, savings later
- Costs for climate damages not involved
- Global subsidies for fossil energy ca. 0.7%-1.5 % of global GDP
- Increase of investment ratio

Structure of investments (global)

- 20 % energy infrastructure
- 50 % buildings/ transport/ mobility
- 15 % low-carbon R&D
- 15 % land use, industrial sectors

The German case

10 % increases 2010 – 2020 …. decreasing costs after 2020



Source: ZSW , 2011

Exercises for self study

- Planetary boundaries: gain a deeper understanding of the concept and explain how it is related to population numbers and economic growth. Pay special attention the notion of the “carbon budget”.
- Historical transformations: Explain the differences and commonalities of the Industrial Revolution and a low-carbon transformation.
- Transformation in action: why are current trends in urbanisation a problem and what could be done about it?
- What have you been learning about the short-term and the long-term costs of the transformation towards a low-carbon economy?

References

Basic reading:

- WBGU (2011): World in Transition: A Social Contract for Sustainability, chapter 3. Berlin. http://www.wbgu.de/en/home/

Further reading:

- Grin, J., Rotmans, J., Schot, J. (2010) Transitions to Sustainable Development. New Directions in the Study of Long Term Transformative Change. London: Routledge.
- Osterhammel, J. (2009): Die Verwandlung der Welt. Eine Geschichte des 19. Jahrhunderts. Munich: Beck.
- Perez, C. (2002): Technological Revolutions and Financial Capital – The Dynamics of Bubbles and Golden Ages. Cheltenham, UK: Edward Elgar.

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