Wuppertal Institute
for Climate, Environment
and Energy

The German “Energiewende”:
Nuclear phase out, climate protection and the interaction between science and politics

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Wuppertal Institute

Presentation at the
4th Meeting of the Low Carbon Society Research Network
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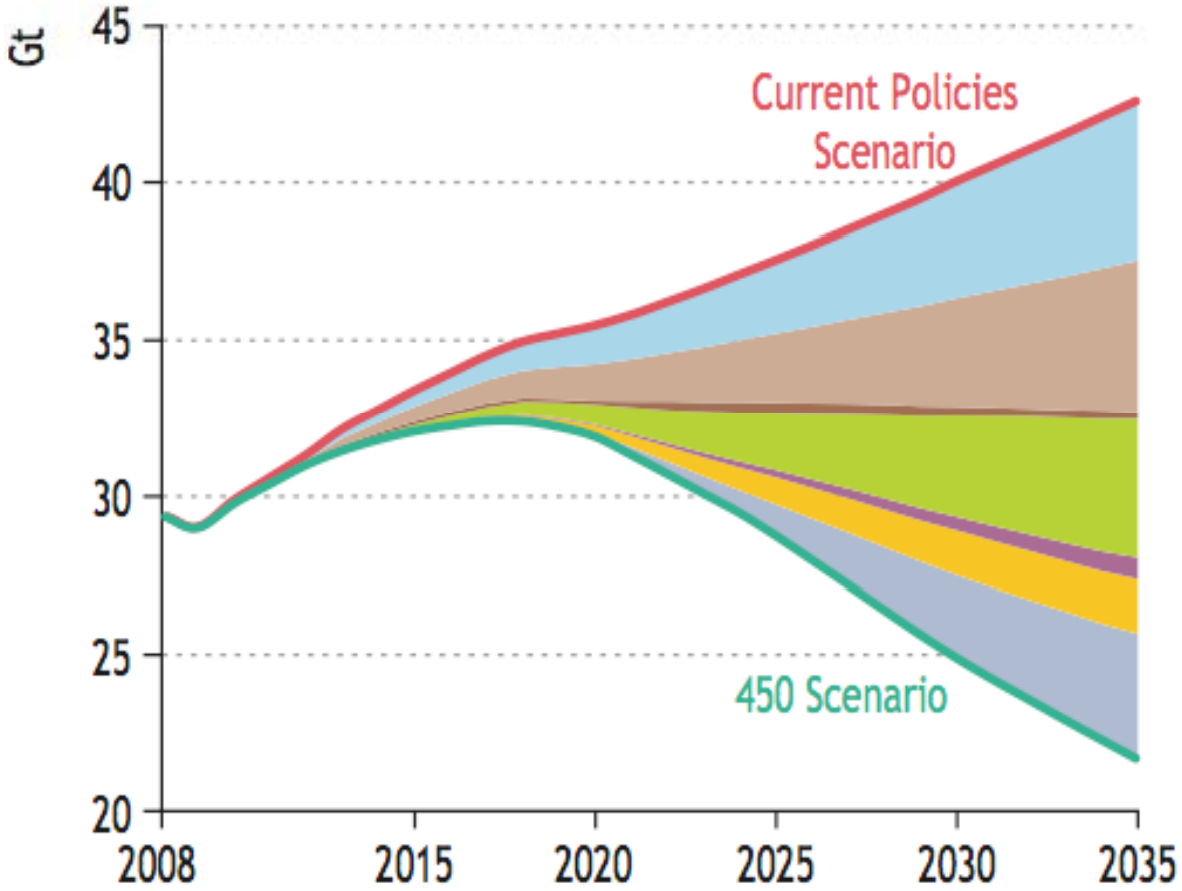
Technologies are available - optimistic perspectives for sustainable energy

„Humanity can solve the carbon and climate problem in the first half of this century simply by scaling up what we already know to do“
(Pacala / Socolow 2004, Princeton University, USA**).**

World Energy Outlook 2010: Efficiency = 50% of the solution, but …

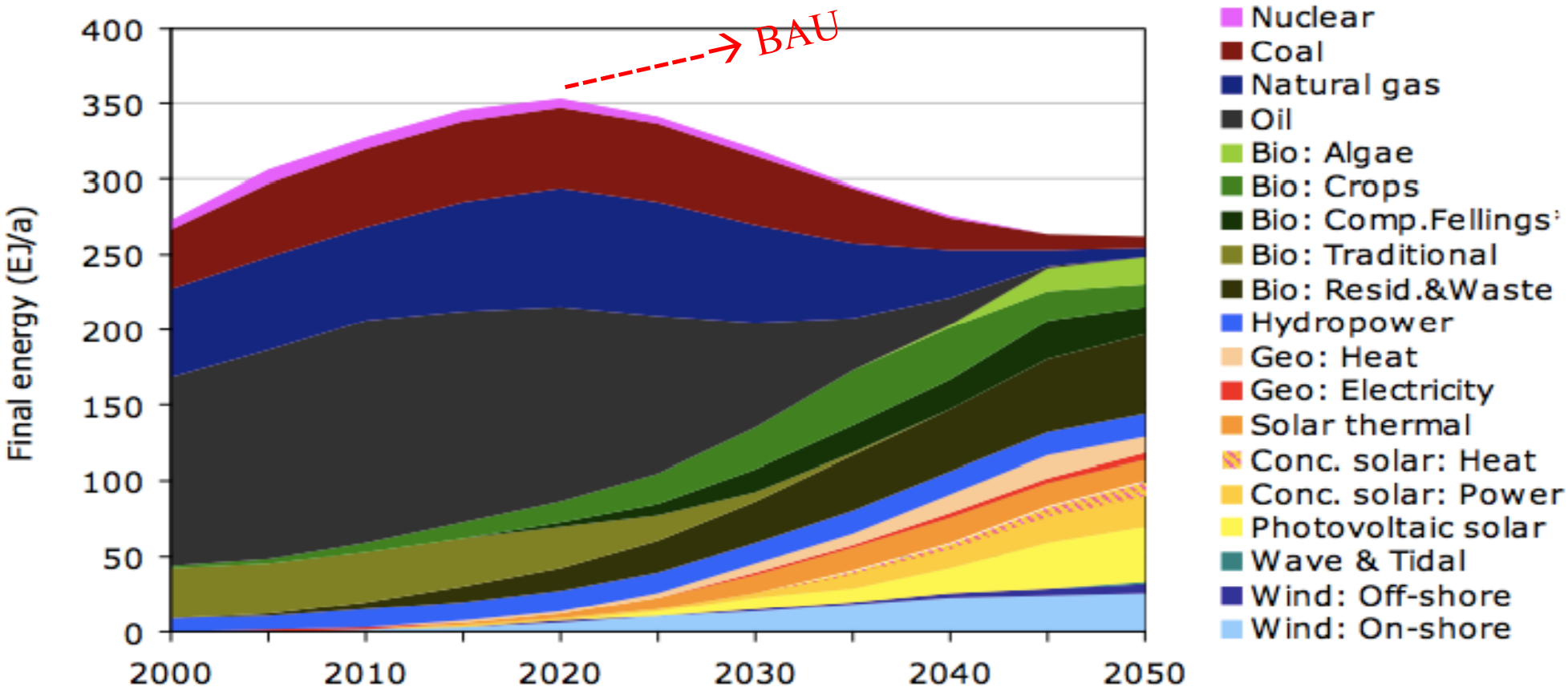
…what about the social embeddedness of technologies?



	Abatement		
	2020	2030	2035
Efficiency	71%	49%	48%
End-use (direct)	*34%*	*24%*	*24%*
End-use (indirect)	*33%*	*23%*	*23%*
Power plants	*3%*	*2%*	*1%*
Renewables	18%	21%	21%
Biofuels	1%	3%	3%
Nuclear	7%	9%	8%
CCS	2%	17%	19%
Total (Gt CO_2)	3.5	15.1	20.9

Source: IEA/OECD, 450 ppm CO2eq scenario to achieve 2° target, 2010

100% renewable global energy in 2050
according to the WWF/Ecofys Scenario



- In 2050, energy demand is 15 % less then in 2005; nuclear phase out; CCS after 2025/30 only marginal
- As far as possible electrical energy is used; bioenergy for trucks, ships, aeroplanes, industrial processes
- By 2050 €4 trillion/a saved compared to BAU; around 2050 savings outweigh investments

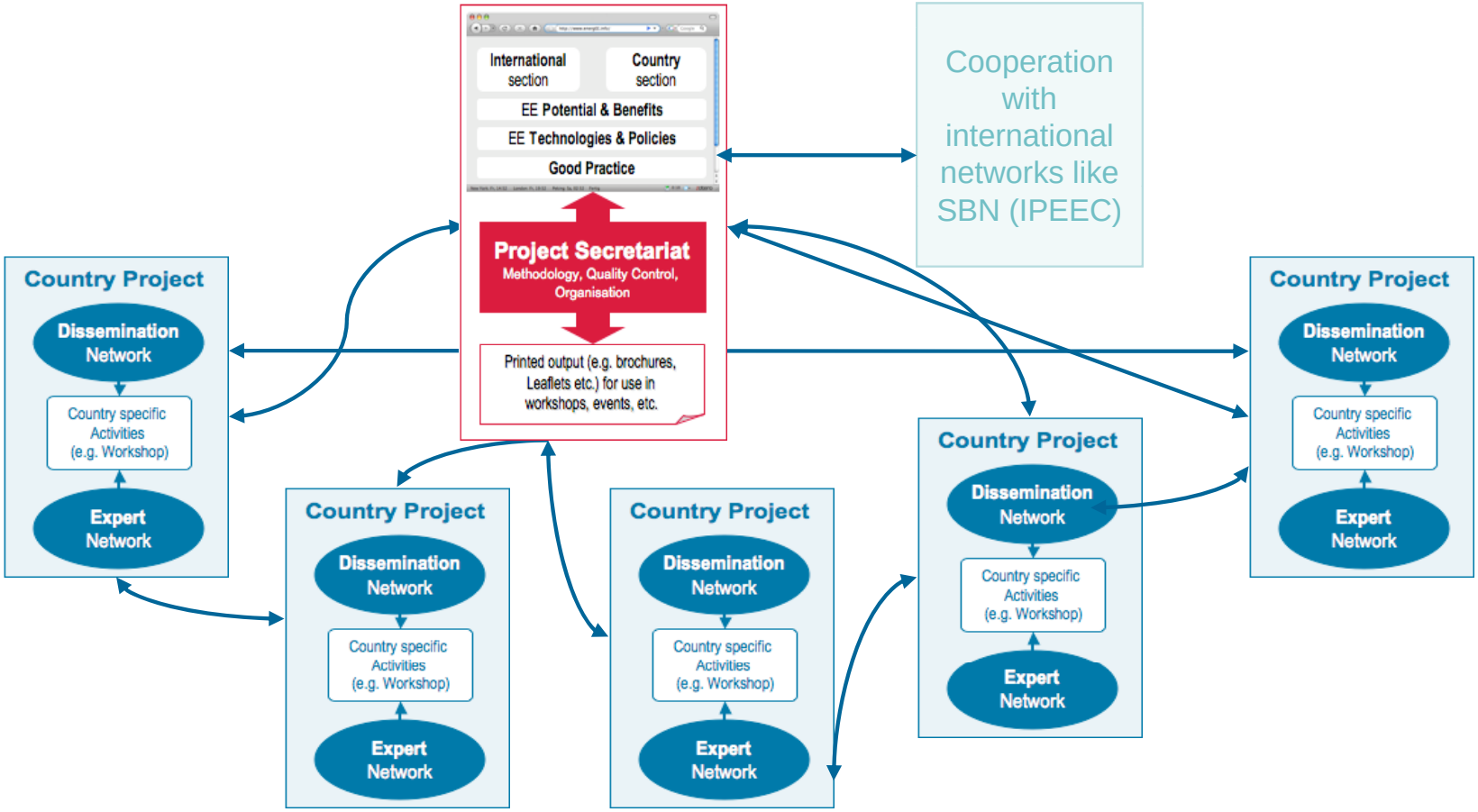
Source: WWF/Ecofys 2011

Buildings have the largest CO_2-reduction potential, but the implementation gap is huge

International bigEE network

A Web Platform to close the knowledge gap!

Starting with China, India, South Africa …..Mexico next?



Source: Wuppertal Institute, bigEE 2011

Scope and structure of the platform

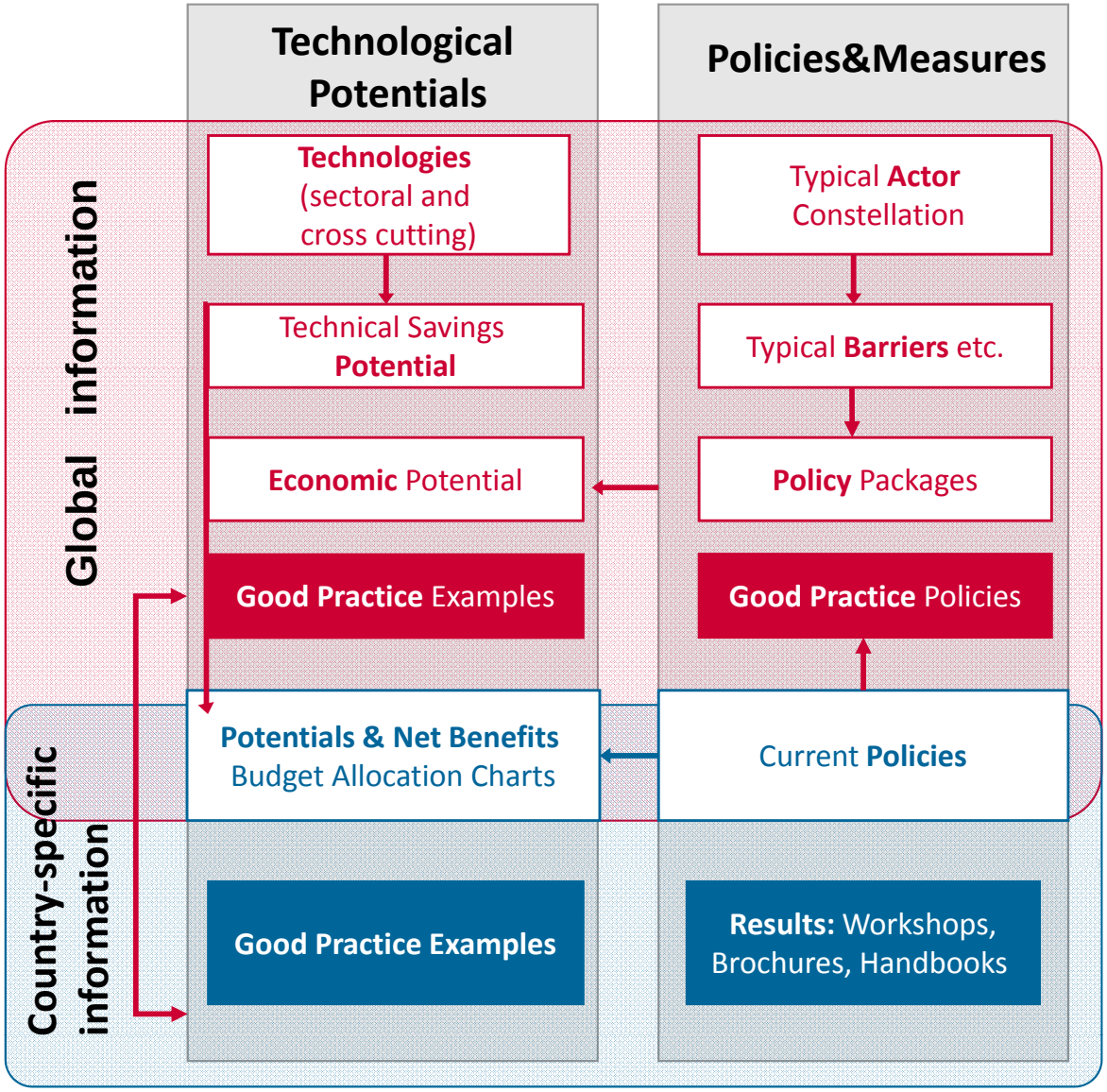
The bigEE web portal covers
- residential buildings
- commercial / public buildings
- industry sector related buildings
- appliances

in four main climate zones:

Including information on
- technologies
- saving options and potentials
- actor constellations
- policies and measures
- good practices

at
- international and
- national levels.

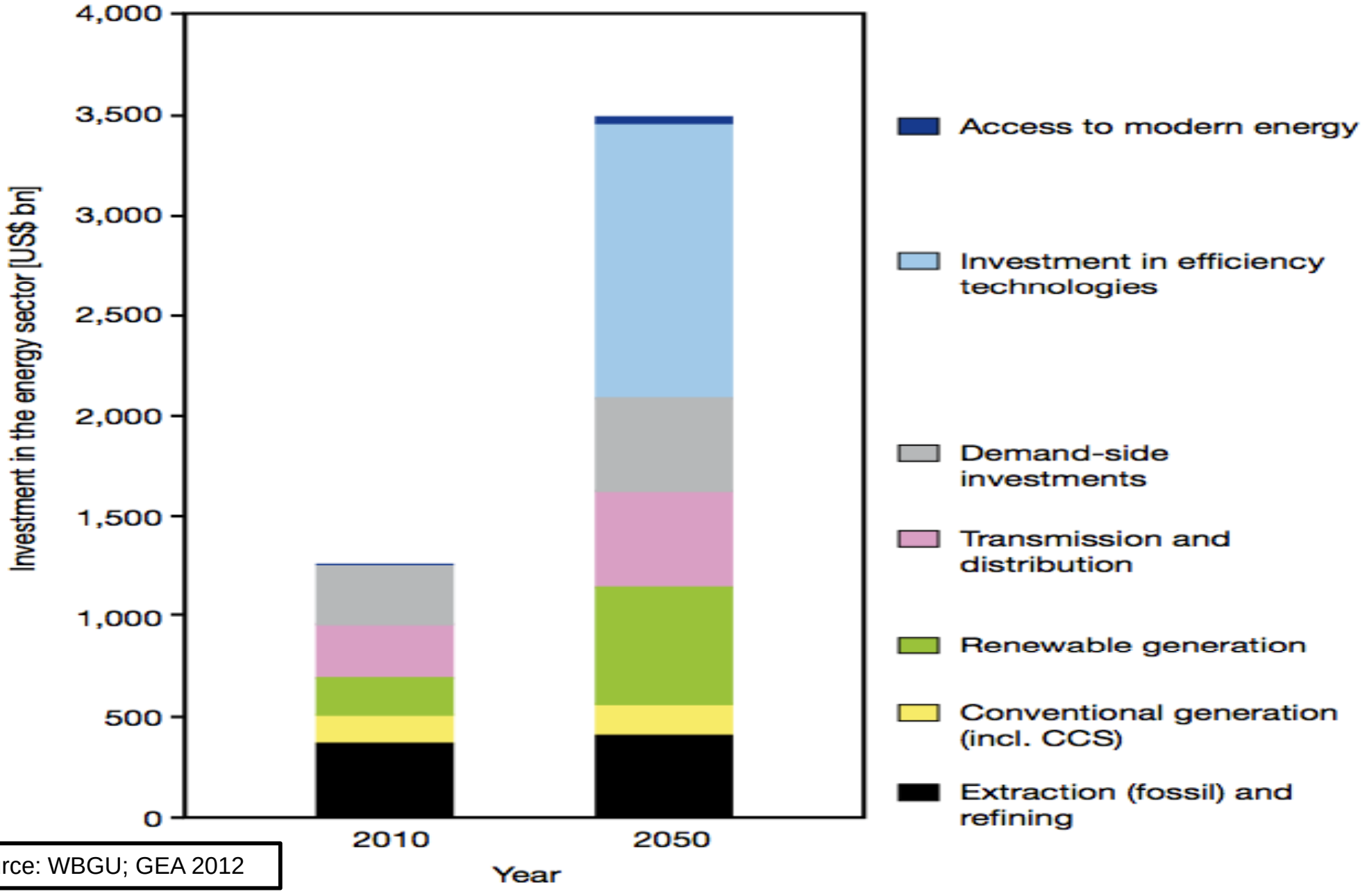
Source: Wuppertal Institute, bigEE 2011



Financing the “Energiewende”:
Reduce subsidies on fossil fuels (775 bn $), internalize external costs (fossil, nuclear) redirect 0,5% of global private capital assets

Worldwide investment in the energy system in 2010 and 2050

(Scenario: no nuclear; universal access to energy; improved energy security; 2^0 C goal)



Source: WBGU; GEA 2012

Global private financial assets: US$ 179,400 billion (McKinsey 2011)

Annual investment requirements for SD and global „Energiewende“: ca. 0.5% of global private capital assests

Type	financial assets	investment horizon	expected returns
Venture capitalists		4-7	<50%
Private equity		3-5	<25%
Insurance companies	US$ 23,000 bill	10-25	7-15%
Pension funds	US$ 28,300 bill	10-25	7-15%
Public capital	US$ 18,700 bill		
Infrastructure funds		10-25	10-20%
Foundations, citizen funds		depending on technology	6-10%
Energy cooperatives (Germany):		number raised from 50 (2001) to 400 (2011)	

Source: German Advisory Council on Global Change 2012

How to build a “lean, green, clean” energy system? Germany as an example?

“Revolutionary Targets” (A.Merkel) of German Energy Concept

How will it be implemented? Is it transferable to other countries ?

Development Path	2020	2030	2040	2050
Greenhouse Gas Emissions	- 40%	- 55%	-70%	- 80 bis 95%
Share of renewable energies in relation to the gross final energy consumption	18%	30%	45%	60%
Electricity generated from Renewable Energy Sources in relation to gross final energy consumption	35%	50%	65%	80%
Primary Energy Consumption [base year 2008] / annual average gain in energy productivity of 2.1 %, based on final energy consumption.	-20%			-50%
Electricity Consumption [base year 2008]	-10%			-25%
Doubling the Building Renovation Rate from the current figure of less than 1 % a year to 2% of the current building stock				-80%
Reduction of the **Final Energy Consumption** in the **Transport Sector** [base year 2005]	-10%			-40%

Source: Federal German Government 9/2010

Four “Enquete-Commisions” of the German Bundestag

A long history of (controversial) scientific political consulting

Features of Enquete-Commissions: about 24 members (50%MPs; 50% experts; public hearings; scientific assessments and reports; more or less impact on public opinion)

- **1981 to 1983: Enquete Commission on “The Future of Nuclear Energy”**
- **1987 to 1995: Two Enquete Commissions on “Preventive Measures to Protect the Earth's Atmosphere” and on “Protecting the Earth's Atmosphere”**
- **2000 to 2002: Enquete Commission on “Sustainable Energy in the Context of Liberalisation and Globalisation”**
- **A shift of scientific and public opinion:**
  - **1981 to 1987: nuclear phase advocated only by a small minority (Öko-Institute/ Freiburg)**
  - **1987 to 1995: heated debates within the research and political community**
  - **2002 ff: a majority of researchers support the “Energiewende” driven by public protests**

Pre-Fukushima: No political consensus on phase-out

Key nuclear phase-out policy decisions between 1998 and 2010

- **2000:** Agreement of SPD/Green government with owners of nuclear power plants about a phase-out until early 2020s

- **2003/2005:** Two nuclear power plants shut down as a result of law

- **Fall 2010:** New government (CDU/Liberals) decides to extend the use of nuclear plants by an average of 12 years against strong protests

Post-Fukushima: Political consensus forming

Key political decisions in 2011 concerning nuclear phase-out

- **March 2011**: Chancellor Merkel states that a re-evaluation of nuclear power after Fukushima accident is needed worldwide

- **June 2011:** Government announces new nuclear phase-out plans
  - Seven oldest reactors shut down
  - One reactor to be shut down each by 2015, 2017 and 2019
  - Three reactors to be shut down by 2021
  - Last (and newest) three reactors to be shut down by end of 2022

- **End of June 2011:** Parliament endorses phase-out law; Social Democrats and Greens support the law →first German nuclear phase-out consensus

Participation of research and the civil society

Fostering the “Energiewende” by four national dialogs and moderated processes

Ethic-Commission 2011:
“Energiewende Deutschlands – Ein Gemeinschaftswerk für die Zukunft”
→ public participation is key!

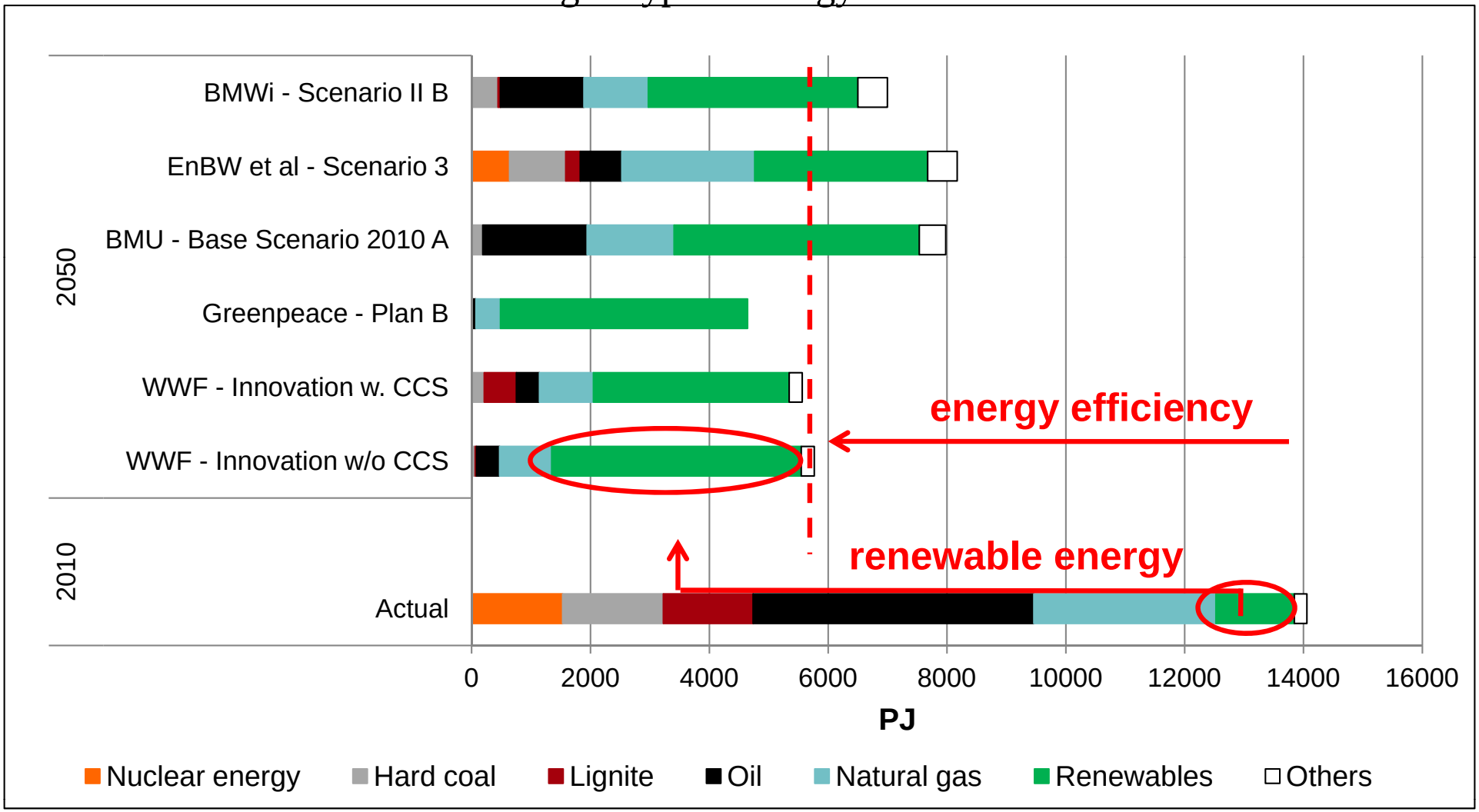
- **Trialogue Energiewende (**Humboldt Viadrina School of Governance**)** since March 2012 / time frame: 1,5 years
- **Platform Energiewende** (Trans-disciplinary Panel on Energy Change; Institute for Advanced Sustainability Studies) since March 2012
- **Agora Energiewende** (Mercator Foundation and European Climate Foundation) since June 2012 / time frame: 4 years
- **Helmholtz-Dialogue** (Helmholtz-Allianz – ENERGY-TRANS-Future Infrastructure of the energy supply) since June 2012 / time frame Helmholtz-Allianz: 5 years
- **Climate protection plan North Rhine-Westphalia** (NRW, Wuppertal Institute), since August 2011 to February 2012

  - General goals: Dissemination, participation, conflict mediation
  - Similar target groups: civil society, industry, policy makers, media
  - Partly including research activities with high budgets
  - Public access/participation differs

Germany on the way to sustainable energy and decoupling?

The Integration of renewables and efficiency is the key to sustainable energy!

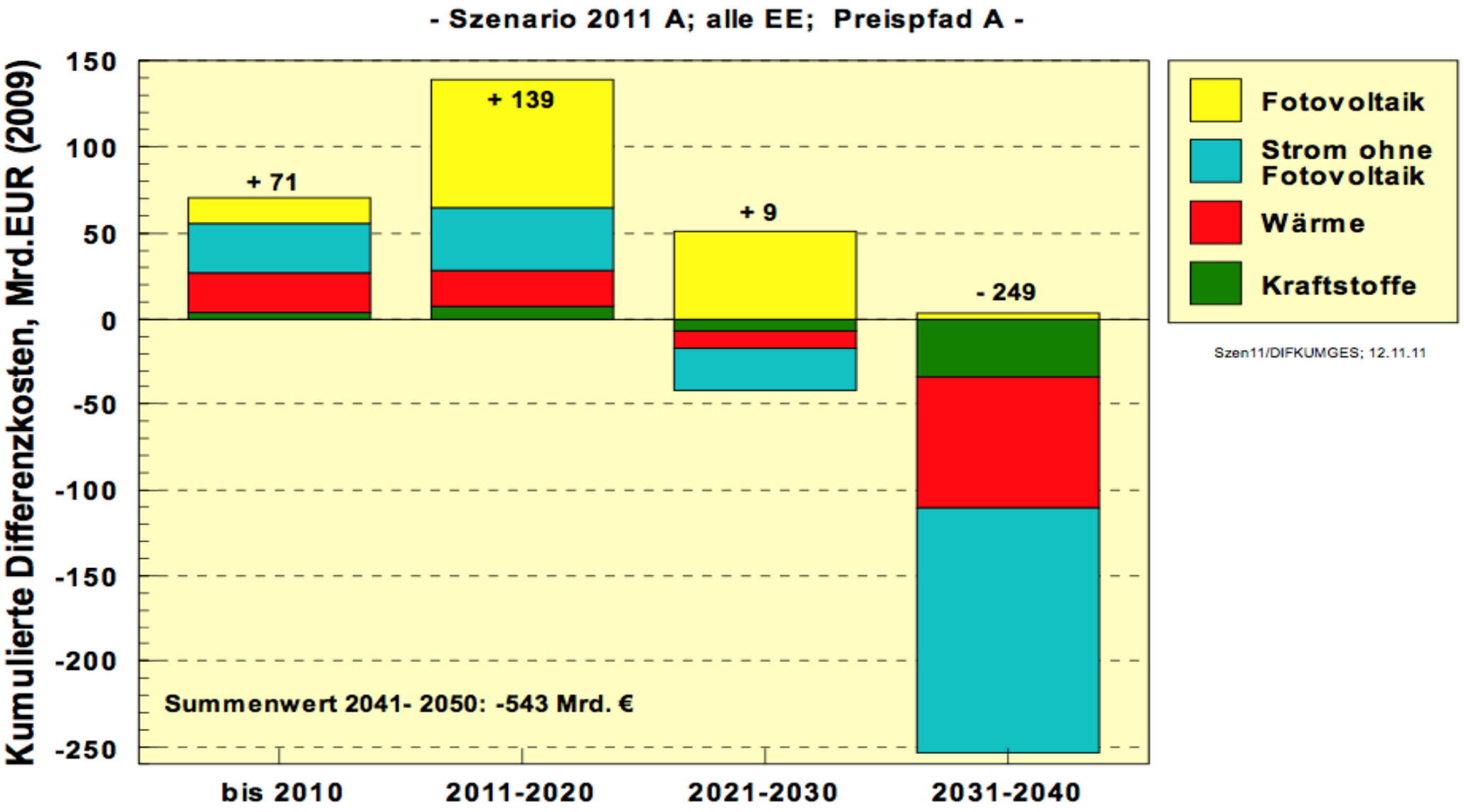
Primary energy supply and mix in Germany in 2010 (actual) and in 2050 according to typical energy scenarios



Source: Samadi 2011, based on data from AG Energiebilanzen 2011 and scenario studies cited

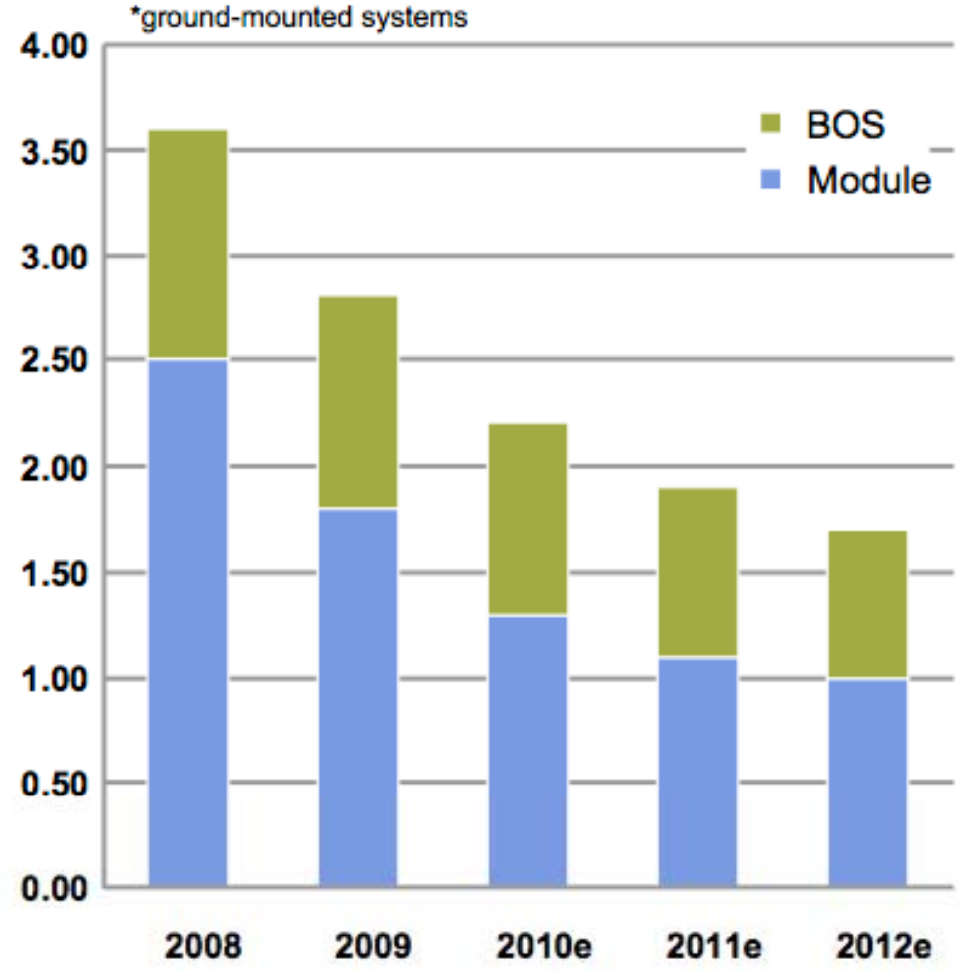
Typical dynamics of the differential costs of the „Energiewende“

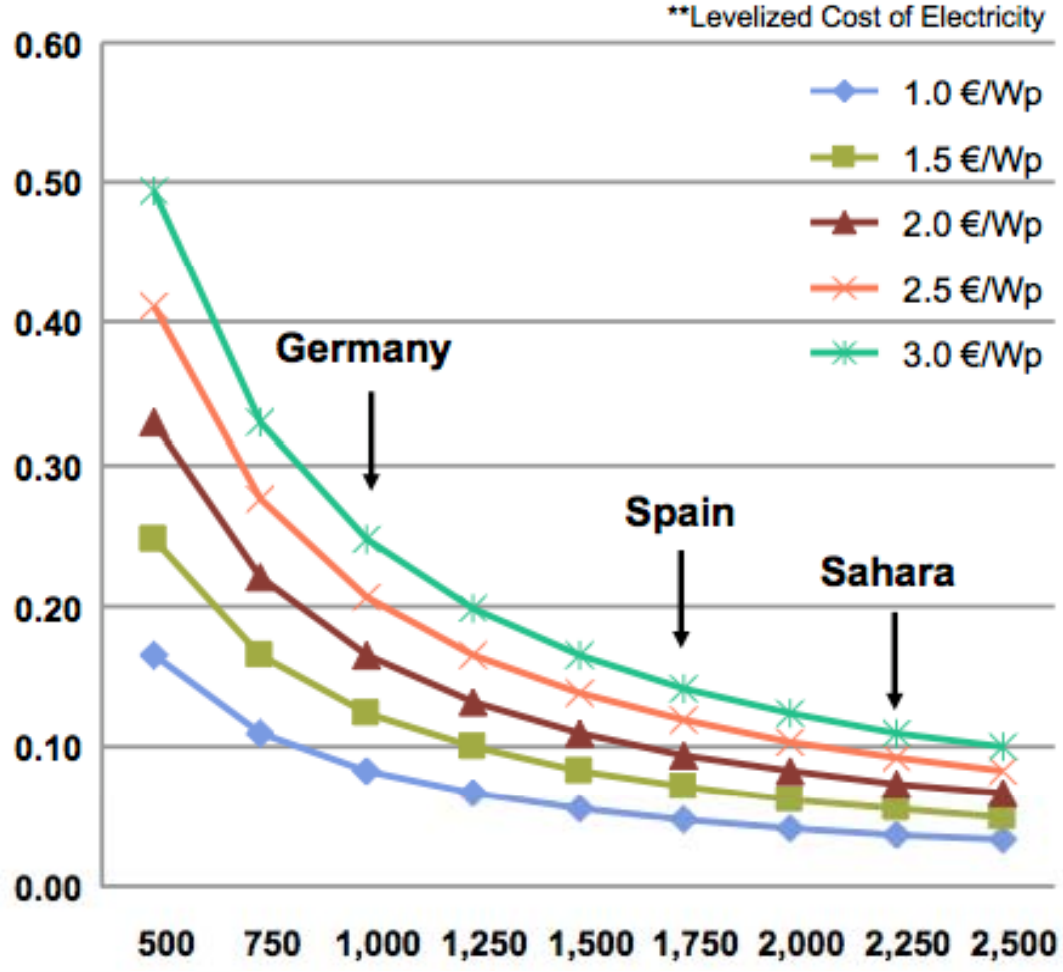
All sectors; according to German BMU „Lead Scenario 2011“



DECLINING SYSTEM PRICES WILL BRING DOWN TOTAL COST OF PV ELECTRICITY

PV System Price Development* (€/Wp) and corresponding LCOE** (€/kWh)

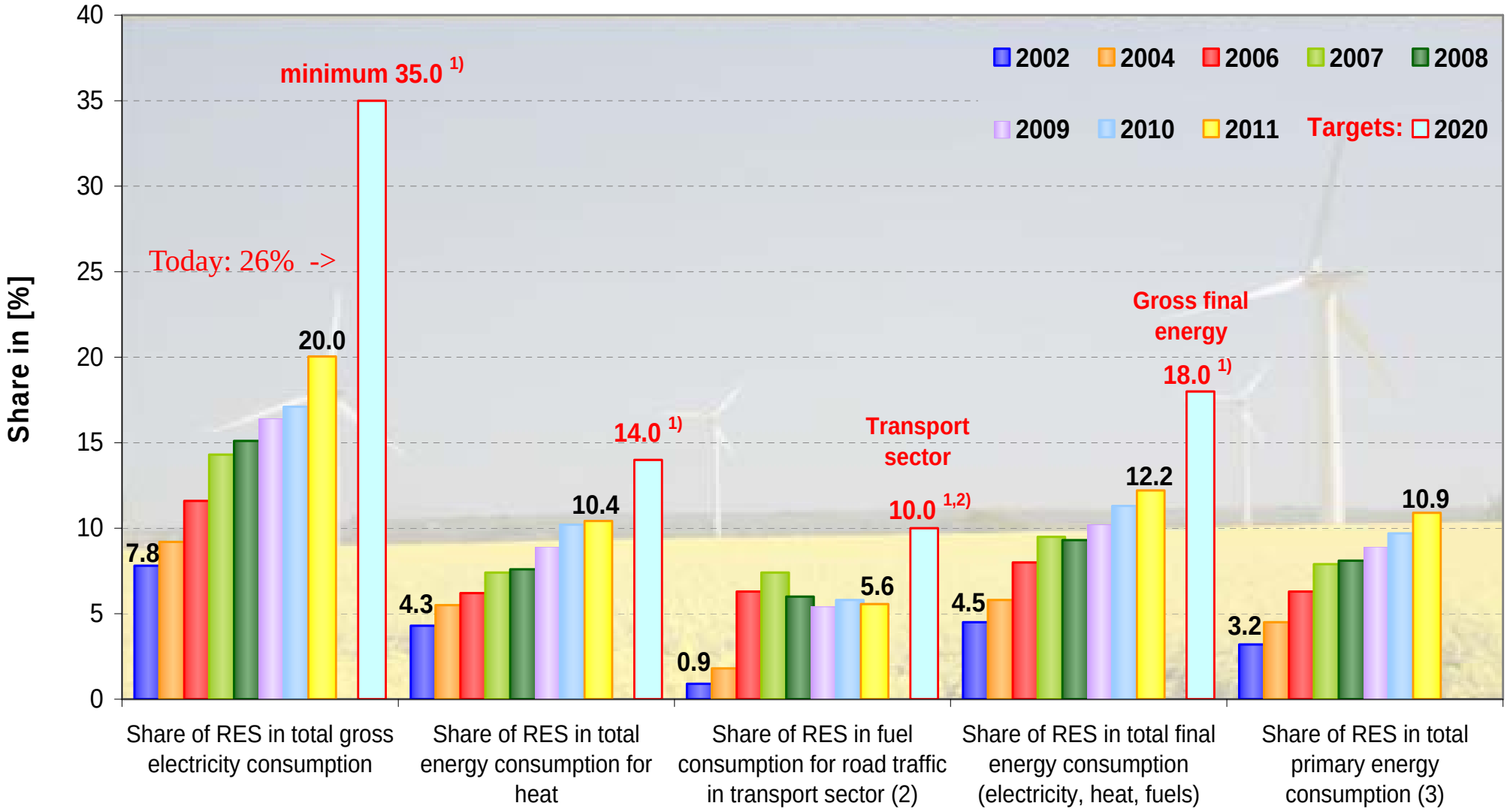




Sources: LBBW 02/2009, industry announcements, WACKER estimates

Current role of renewables in the German energy system

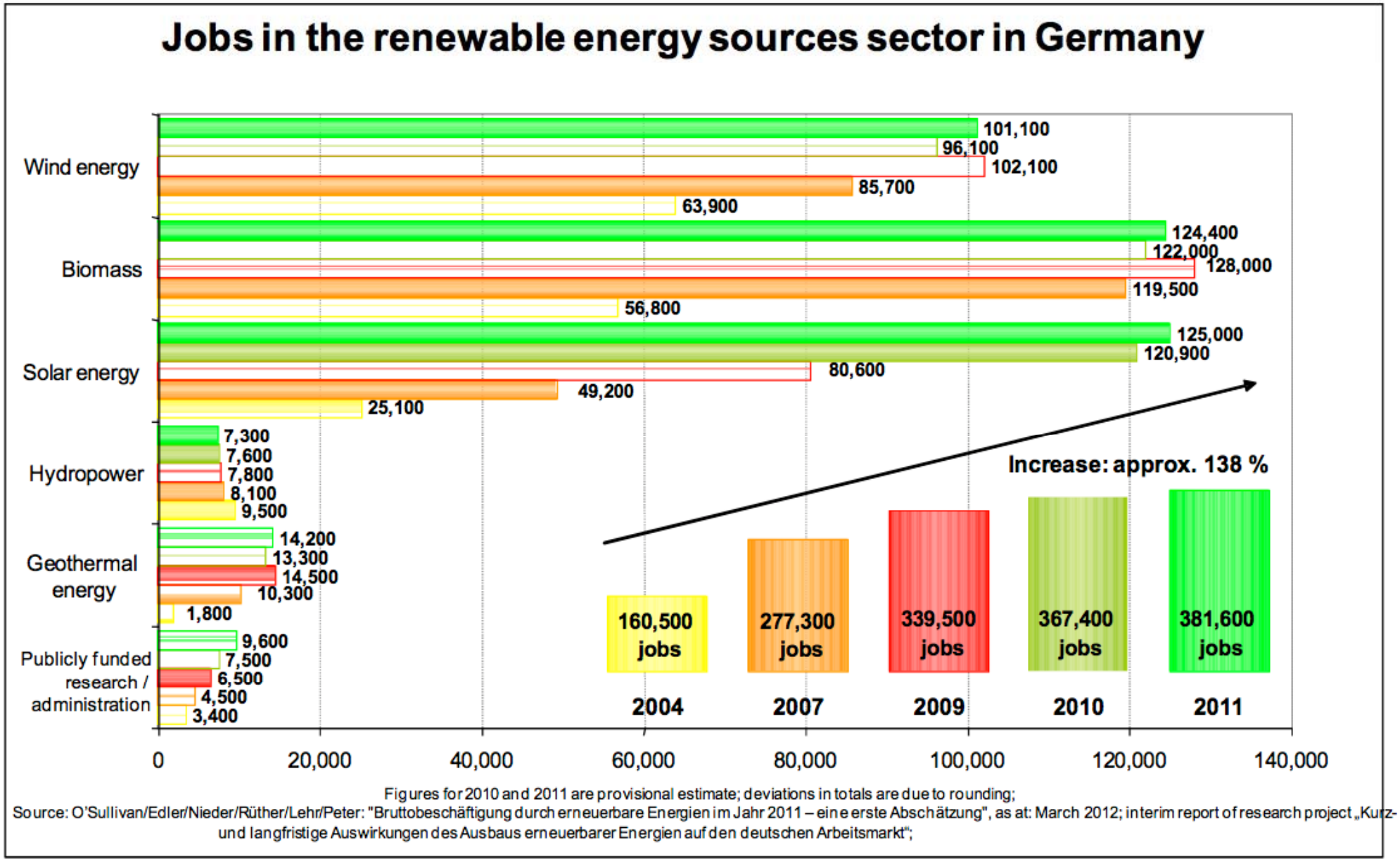
Renewable energy sources as a share of energy supply in Germany



1) Sources: Targets of the German Government, Renewable Energy Sources Act (EEG); Renewable Energy Sources Heat Act (EEWärmeG), EU-Directive 2009/28/EC;
2) total consumption of engine fuels, excluding fuel in air traffic; 3) calculated using efficiency method; source: Working Group on Energy Balances e.V. (AGEB); RES: Renewable Energy Sources;
source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Brigitte Hiss; as at: March 2012; all figures provisional

Renewable energy policy in Germany

Increasing number of people working for renewable energy sector



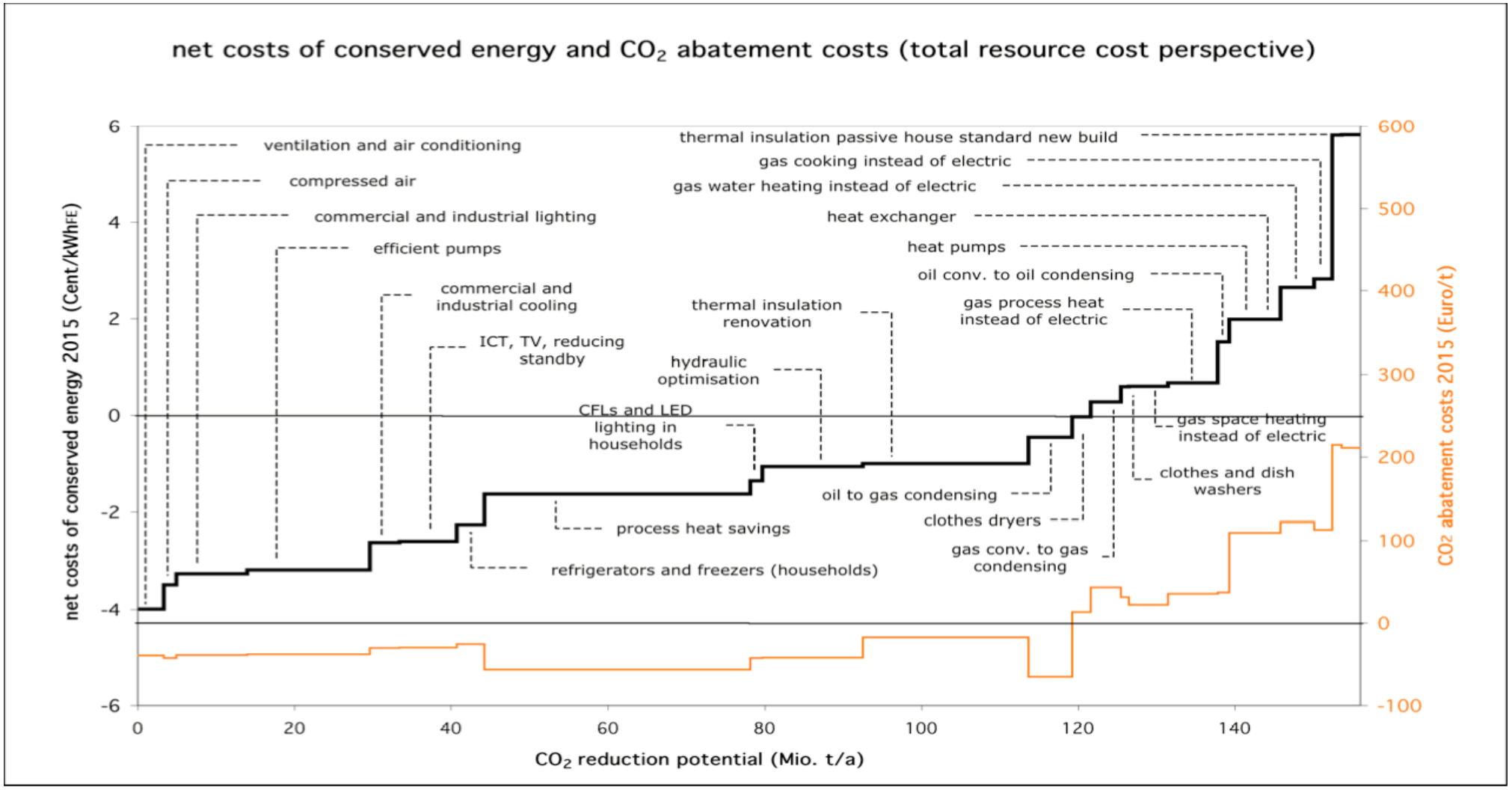
Source: O'Sullivan et al. 2010, 2011, 2012

Giving highest priority to energy efficiency would make the transition to sustainable energy quicker and cheaper

The economics of „Negawatts“ compared to „Megawatts“

Motivate and prioritize by using „Budget Allocation Charts (BAC)“

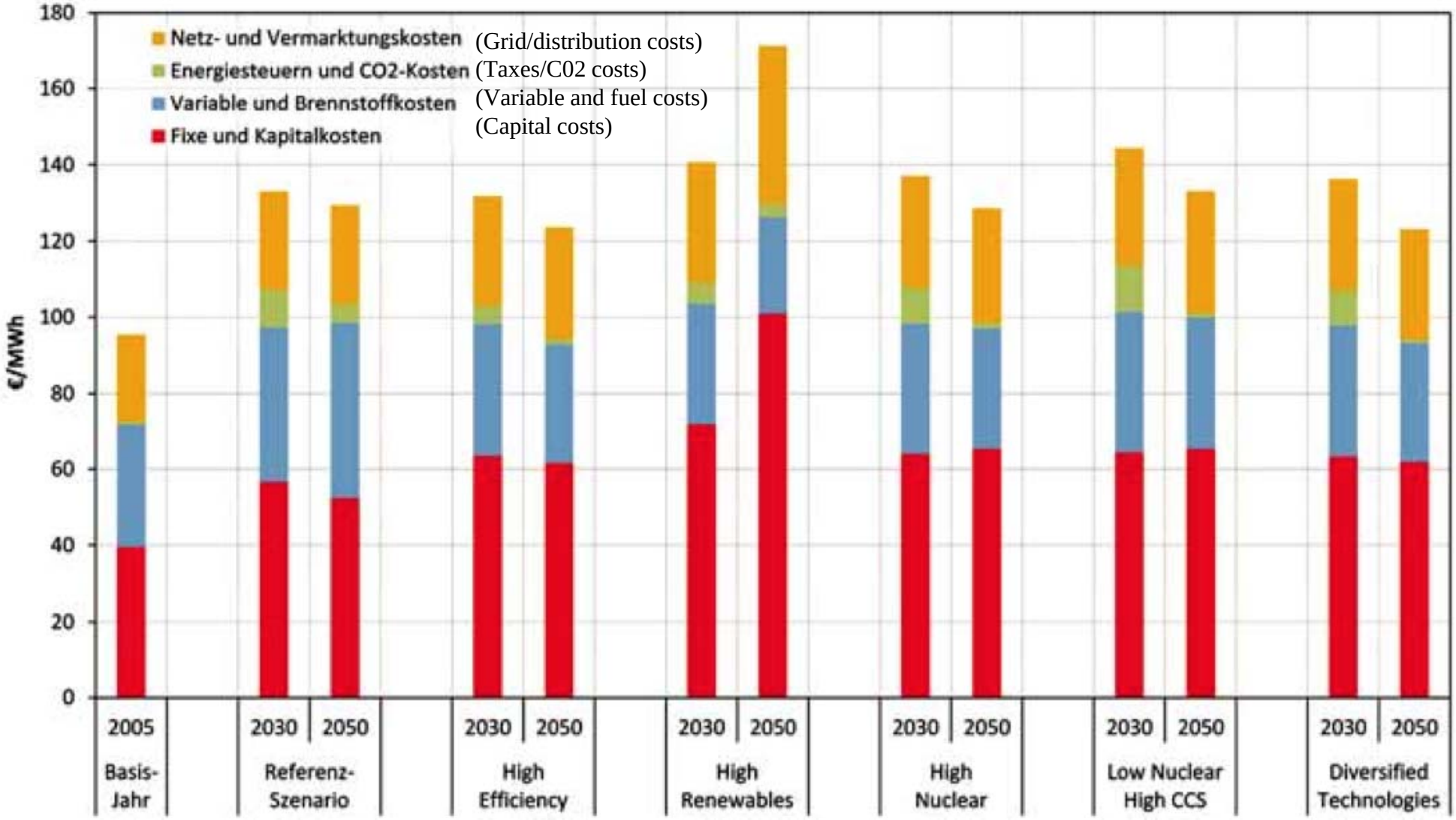
Example for Germany



Source: Wuppertal Institute 2006

Longterm electricity system costs for EU27 -

a factor x higher than for „Negawatts“ (2-8 cts/kWh); EU Roadmap 2050 scenarios

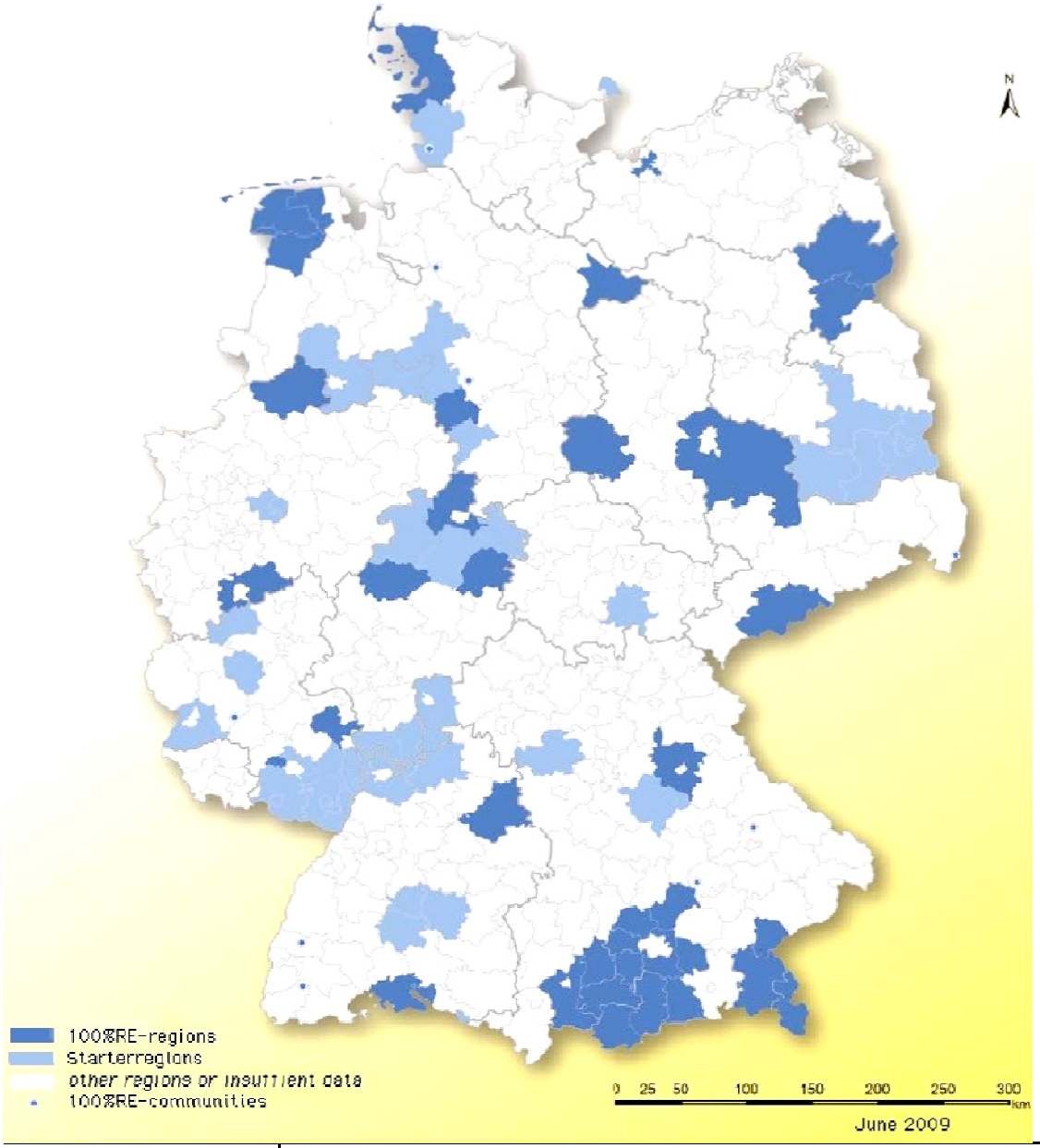


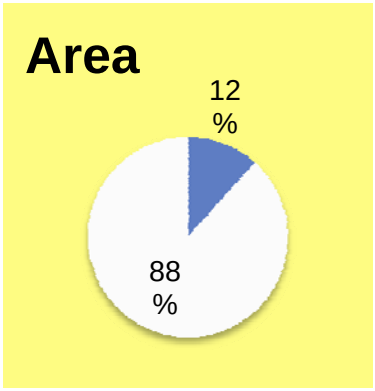
Source: Matthes 2012

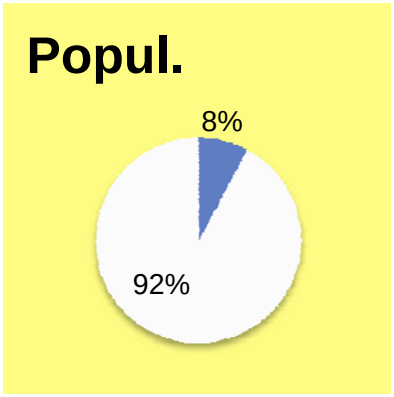
Decentralized power options and new actors (e.g. regional utilities, citizens cooperatives, prosumer) drive the “Energiewende”

Decentralized options support large scale implementation

100%-Renewable-Energy-Regions in Germany





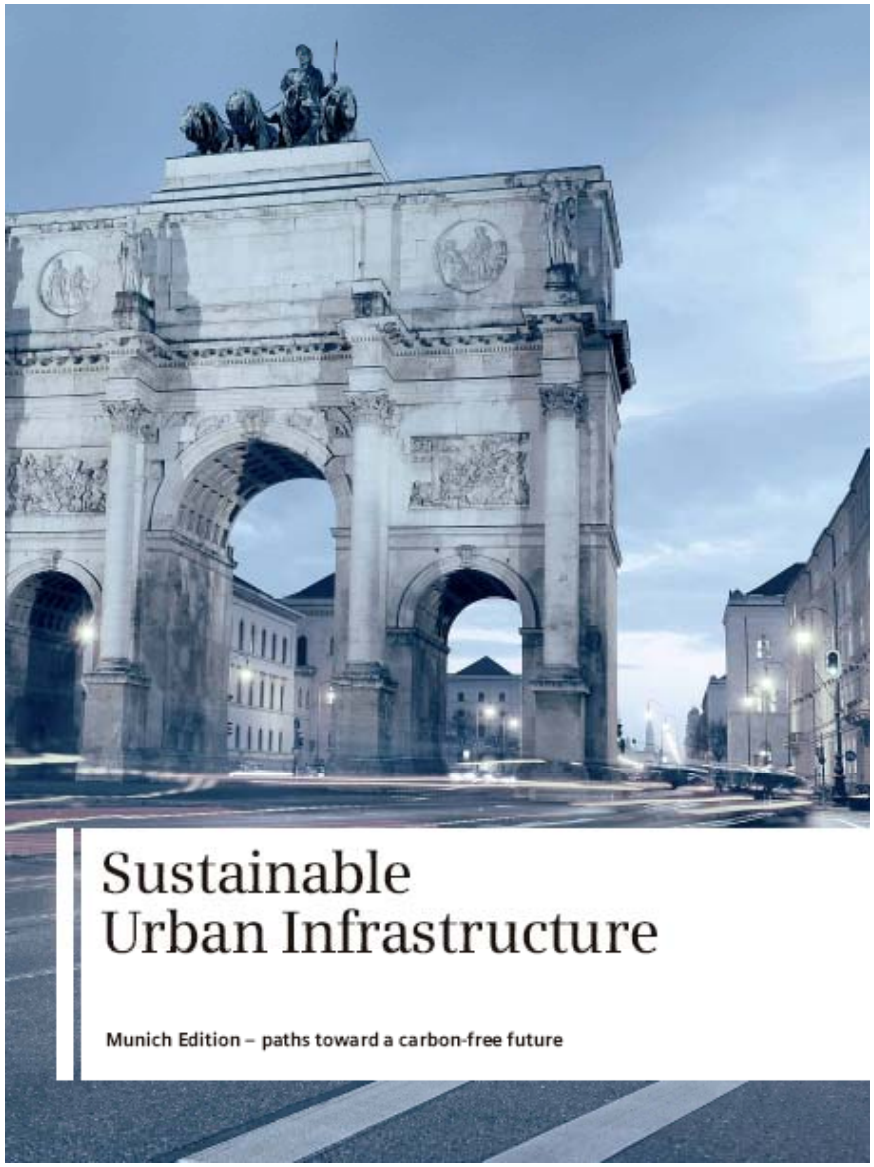


- Political decision towards 100% renewable energy in more than 100 cities or regions
- Aim: Complete change towards renewable energy as well as reducing energy use
- Using regional sustainable energy sources to create regional welfare (income effects)
- Main barriers: co-ordination, local acceptance, lack of funds
- Innovative financing (citizen companies, cooperatives, local funds)

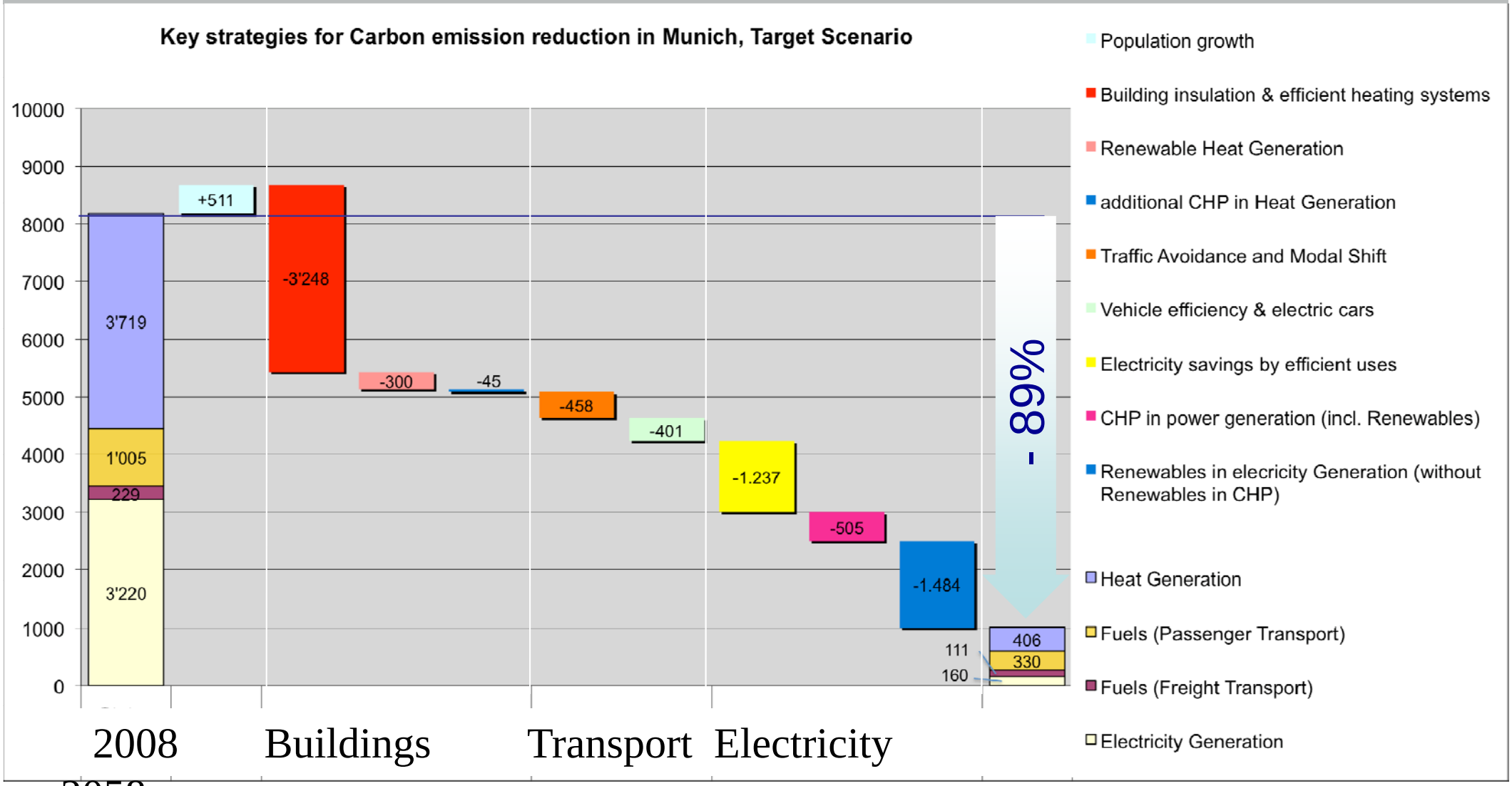
Map: http://www.100-ee.de/. Graphics: Katrin Erfkamp, Wuppertal Institut

Pathway to Carbon Free Cities – The Example of Munich 2058

- **Blueprint for the restructuring of cities**
  - **50% of the worlds population live in cities consuming more than 70% of the energy**
  - **50% of cities in the year 2050 are still to be built**
  - **50% have been already built (including infrastructure)**
- **The „Munich Vision“: Reducing CO_2 at least by 80% (2058)**
- **Study on behalf of Siemens AG**



Key options to reduce CO_2 by 90% in Munich



Source: Wuppertal Institute 2009

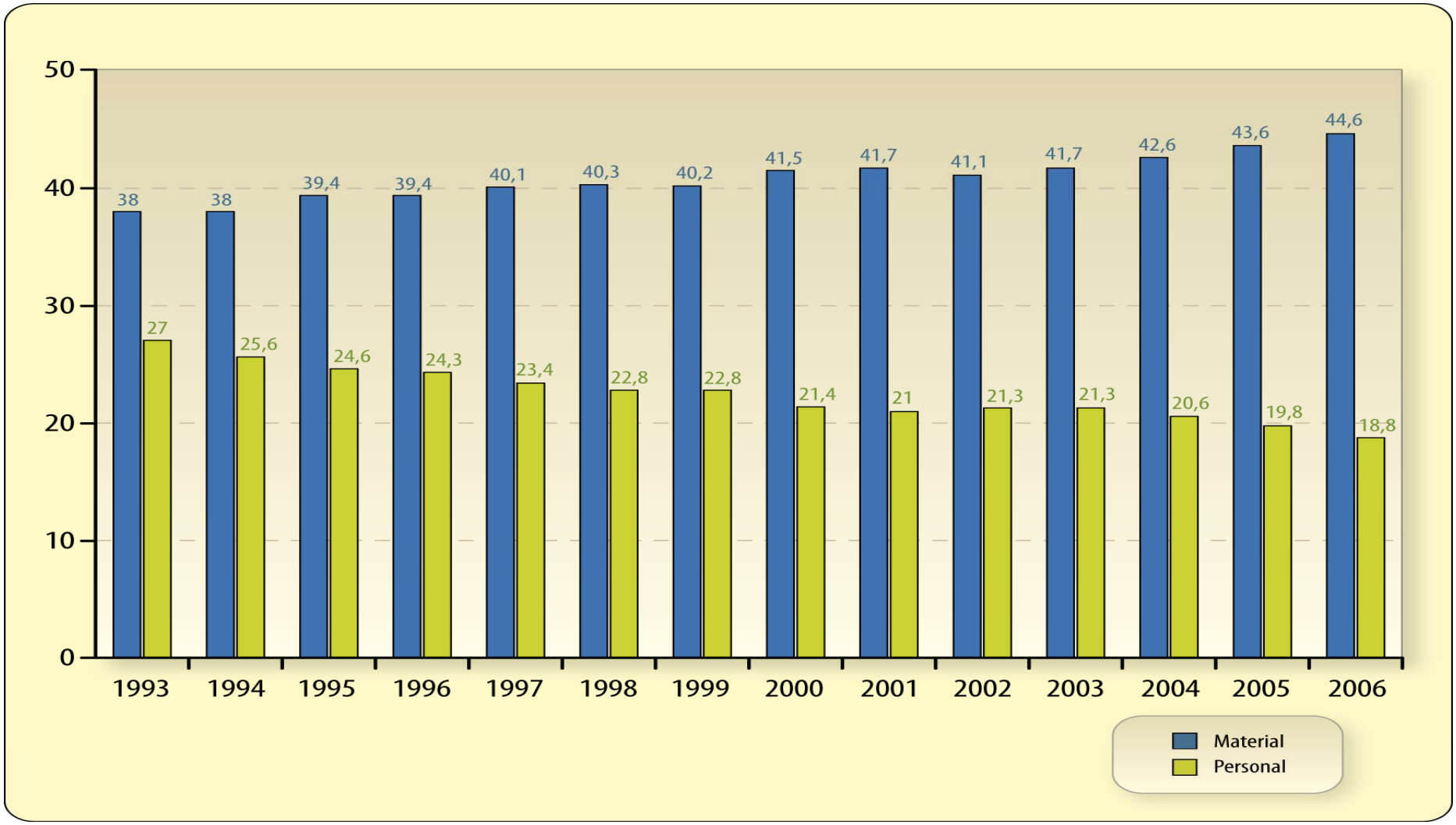
State of the art: Buildings used as power plants

„Plus-Energy“ houses in Freiburg/Germany

Caption: Plus energy houses are designed to produce more energy than they consume in the course of the year.

The benefits of integrated resource and energy efficiency strategies

High shares of material costs (45%: blue)
compared to energy (2-3%) **and wages** (19%: yellow) **for German industry**



Materialkosten = Rohstoffe und sonstige frendbezogene Vorprodukte, Hilfs- und Betriebsstoffe incl. Fremdbauteile, Energie und Wasser, Brenn- und Treibstoffe, Büro- und Werbematerial sowie nichtaktivierte geringwertige Wirtschaftsgüter

Source: Dörner / Hennicke 2009

Modelling a “Resource Efficient Germany”:

Integrated climate and resource protection is a win-win-strategy!

The following effects result of a forced resource efficiency strategy for 2030 in relation to a reference scenario of active climate protection (GHG reduction: 54 %):

- Absolute reduction of material consumption of about – 20 %
- Increase of GDP of about + 14,1 %
- Increase in Employment of 1,9 %
- Reduction of Public Dept of 11,7% (- 251 bn €)
- Conclusion: 1. Absolute decoupling of TMR/GDP is possible

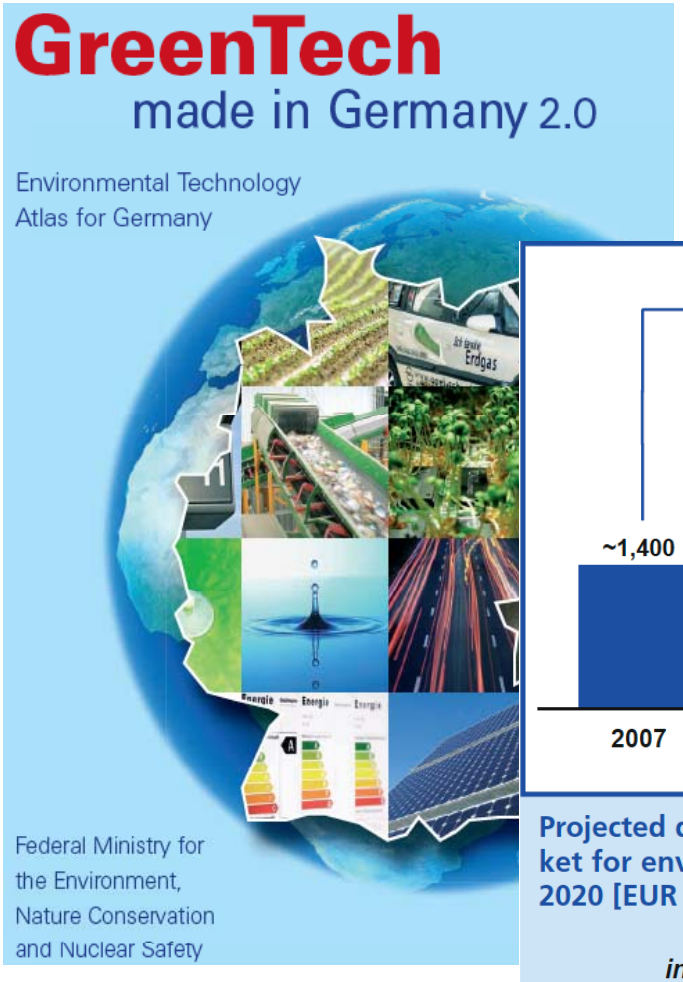
  2. “Industrial ecological policy” must drive innovation

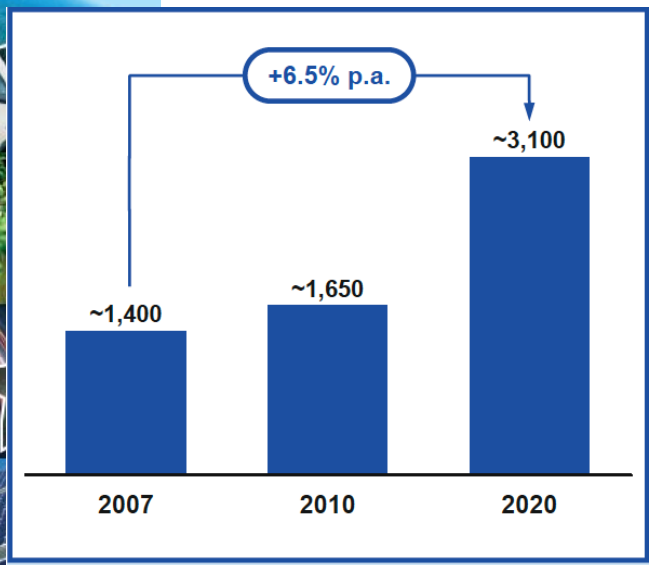
  3. Reduction of resource costs increase competitiveness

Source: Distelkamp / Meyer / Meyer 2010

GreenTech: System solutions to foster resource productivity and to reduce costs

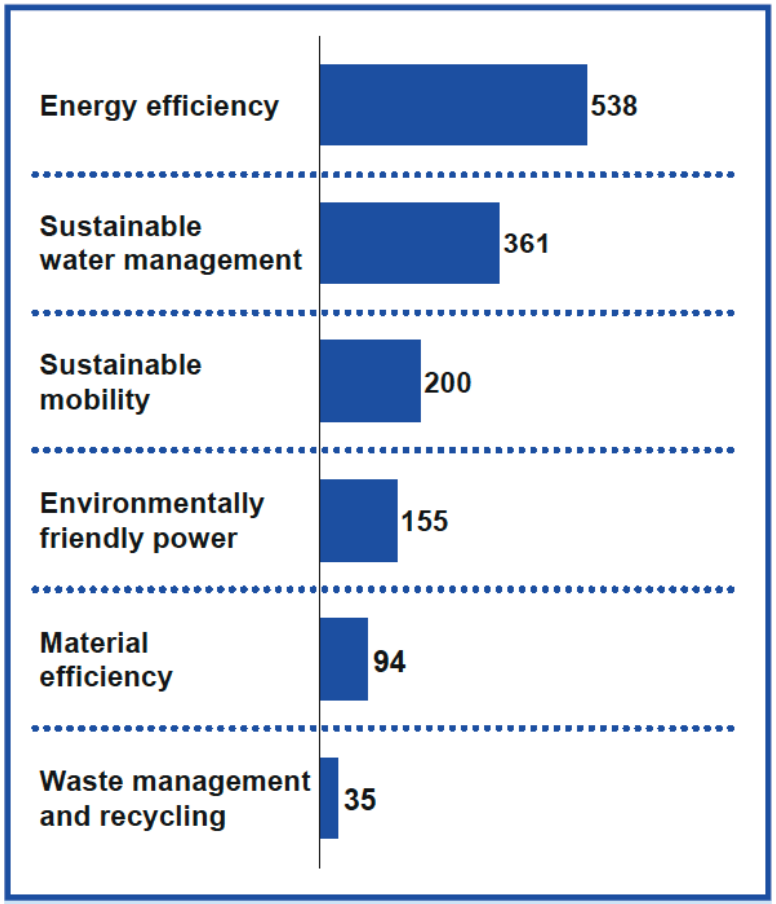
Six selected Lead Markets





Projected development in the global market for environmental technology, 2007–2020 [EUR bn]

Source: Market studies, interviews with experts, Roland Berger



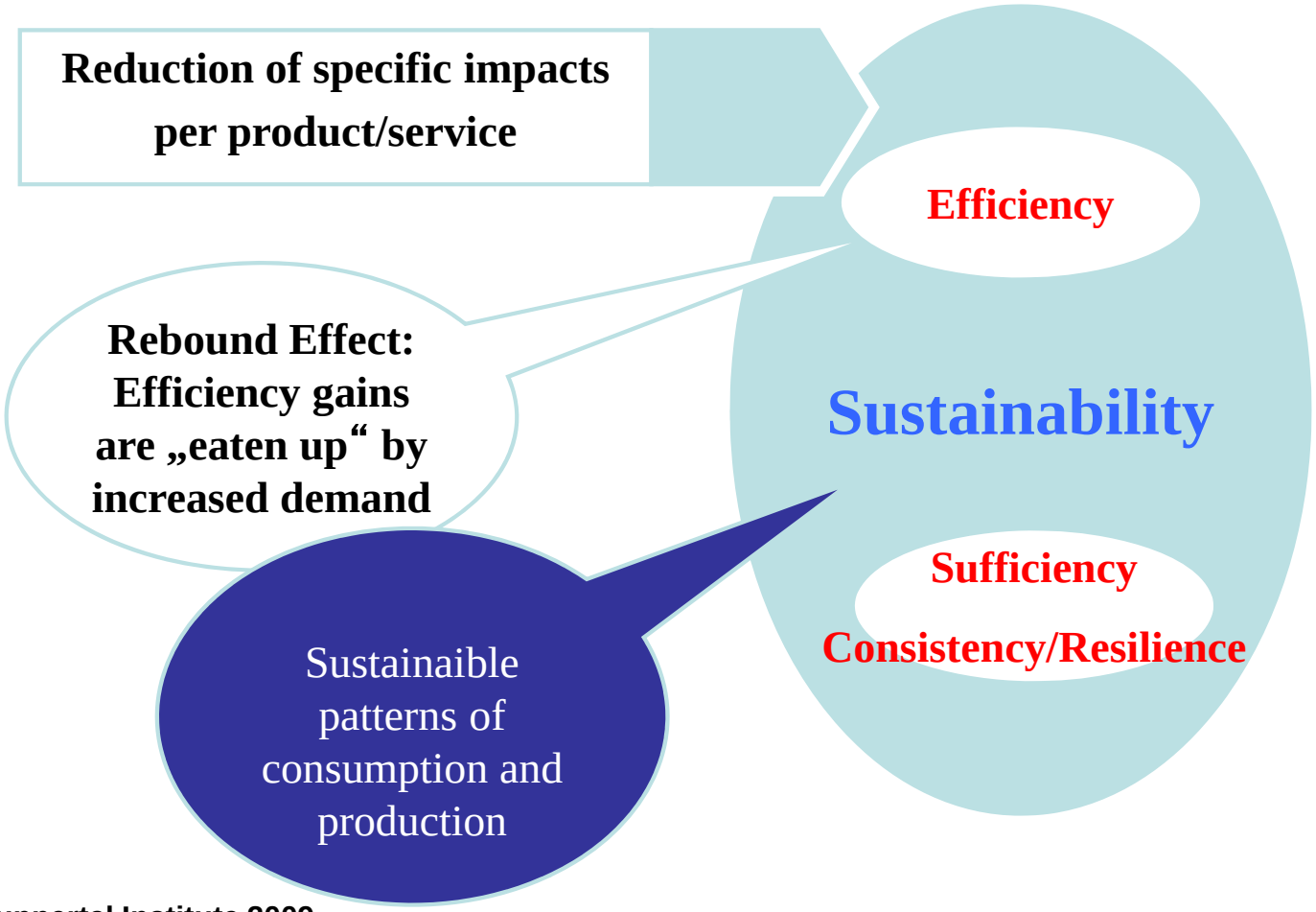
Global market volume for environmental technologies in 2007 [EUR bn]

Source: Market studies, interviews with experts, Roland Berger

“Energiewende”: Driver of the “Great Social Transformation” to sustainable consumption and production?

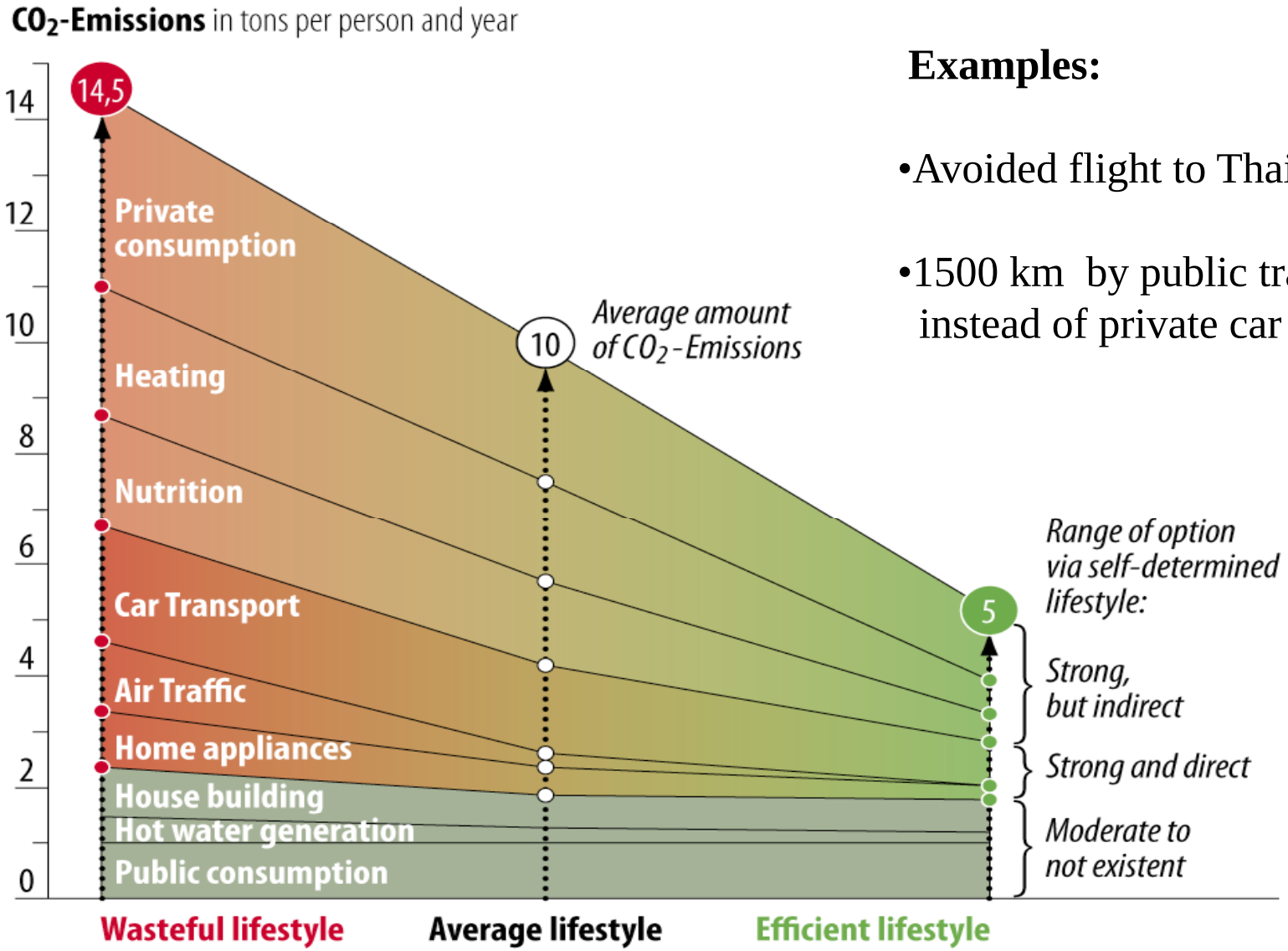
1980-2000: 25% less energy/raw materials per $ GDP – “eaten up” by 82% global economic growth!

The combination “efficiency + sufficiency + consistency” leads to sustainability



Source: Wuppertal Institute 2009

“European Lifestyle”:The scope for different consumption patterns to reduce $C0_2$ in EU 25



Source: Wupperal Institute 2007

Examples:

- Avoided flight to Thailand : - 5t/C02
- 1500 km by public transport instead of private car : - 1.5 t/C02

New smart policy packages needed:
Reduce rebound effects and support life style changes!

- **System adjustments**
  - **Direct:**
    - Binding energy saving targets (EU 2011/2012)
    - Energy efficiency obligations for utilities (EU ESD 2012)
    - Reduction of subsidies and internalizing ext. cost of nuclear/fossil fuels
    - Caps, e.g. dynamic standards for fleet consumption of cars (EU)
    - Bonus/malus regulations e.g. for cars („feebates“)
    - More ambitious targets for EU ETS
    - Progressive standards (e.g. ICT)
    - Ecotax
  - **Indirect:**
    - Structural change to less resource intensive sectors (i.e. services)
    - Promotion of renewable energy in coordination with energy efficiency
    - “ProgRress” (German Program Ressource Effciency)
- **Behavioral change**
    - Sustainable consumption, promotion of common goods, education……
    - Reducing societal disparities (e.g. income, wealth, access)…….

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