Wuppertal Institute
for Climate, Environment
and Energy

# Sustainable energy for the future: The integration of ressource efficiency and renewables is the key

**Prof. Dr. Peter Hennicke**
**Wuppertal Institute**

**Keynote Speech at the CIPRA Conference, September 15**
**Bovec, Slowenja**

# Thesis

**Economic and environmental crisis are interlinked – so must be the solutions**

**Decoupling well being from the use of nature by fostering resource efficiency**

**The natural scarcities of today can stimulate the markets of the future**

- Decoupling in the North creates "Lead Markets for GreenTech" ("Green New Deal")
- Decoupling in the South must support sustainable development and poverty alleviation
- Advanced technologies avoid "lock in" effects into resource intensive infrastructure
- "Efficiency + renewables" is the success formula in the power, transportation and building sector

**The „Resource efficiency revolution" needs a supportive framework**

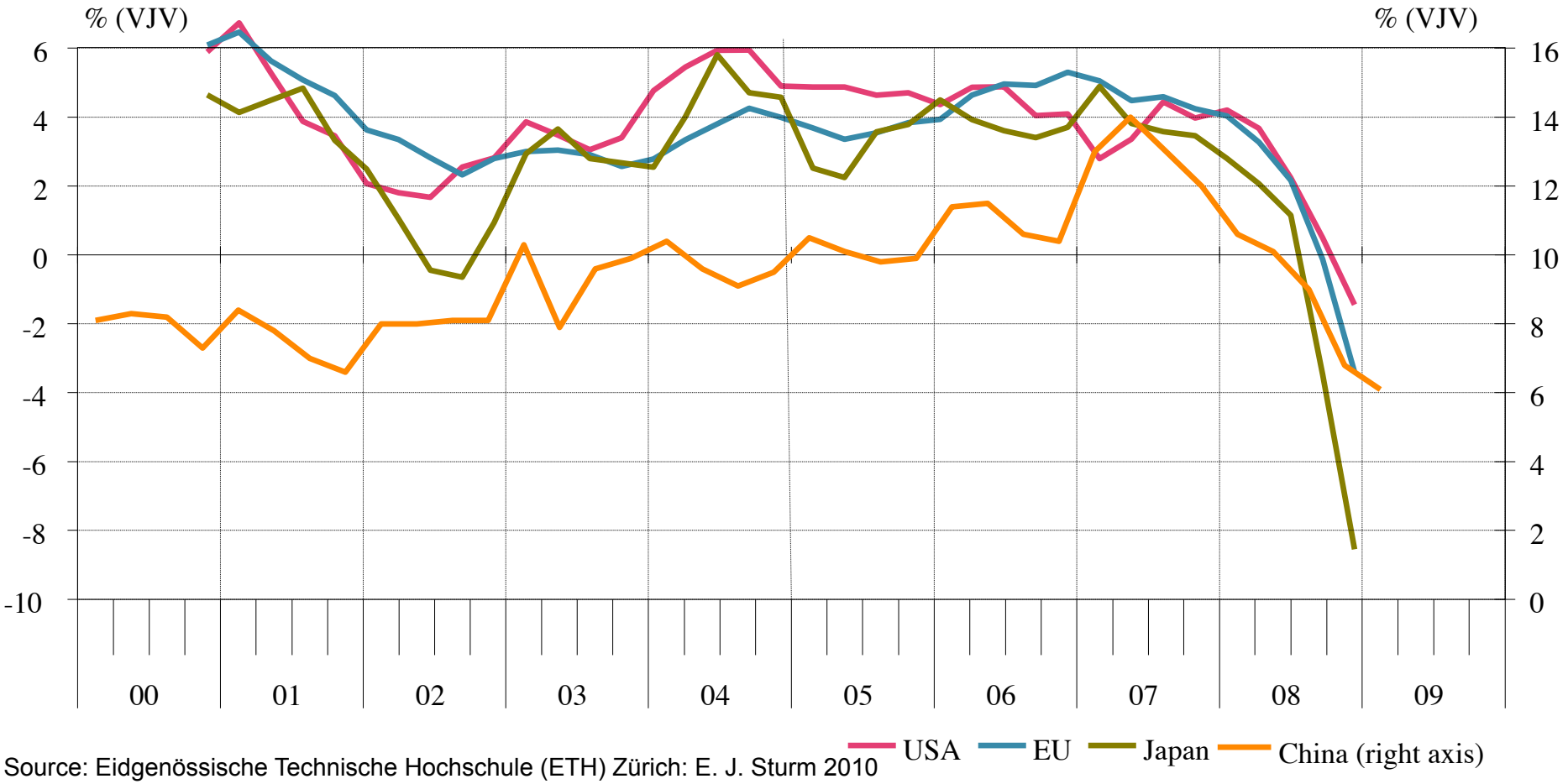
- A vision (e.g. „2000 Watt per capita societies")
- Quantified targets (e.g. 3x20% EU-goals)
- Ecological Industrial Policy (e.g. an innovative Policy Mix)

**Technical decoupling must be embedded in a social transformation process**

- Too much efficiency gains are "eaten up" by rebound effects and consumerism
- A global dialog on "New models of wealth" is needed

# The global economic crisis

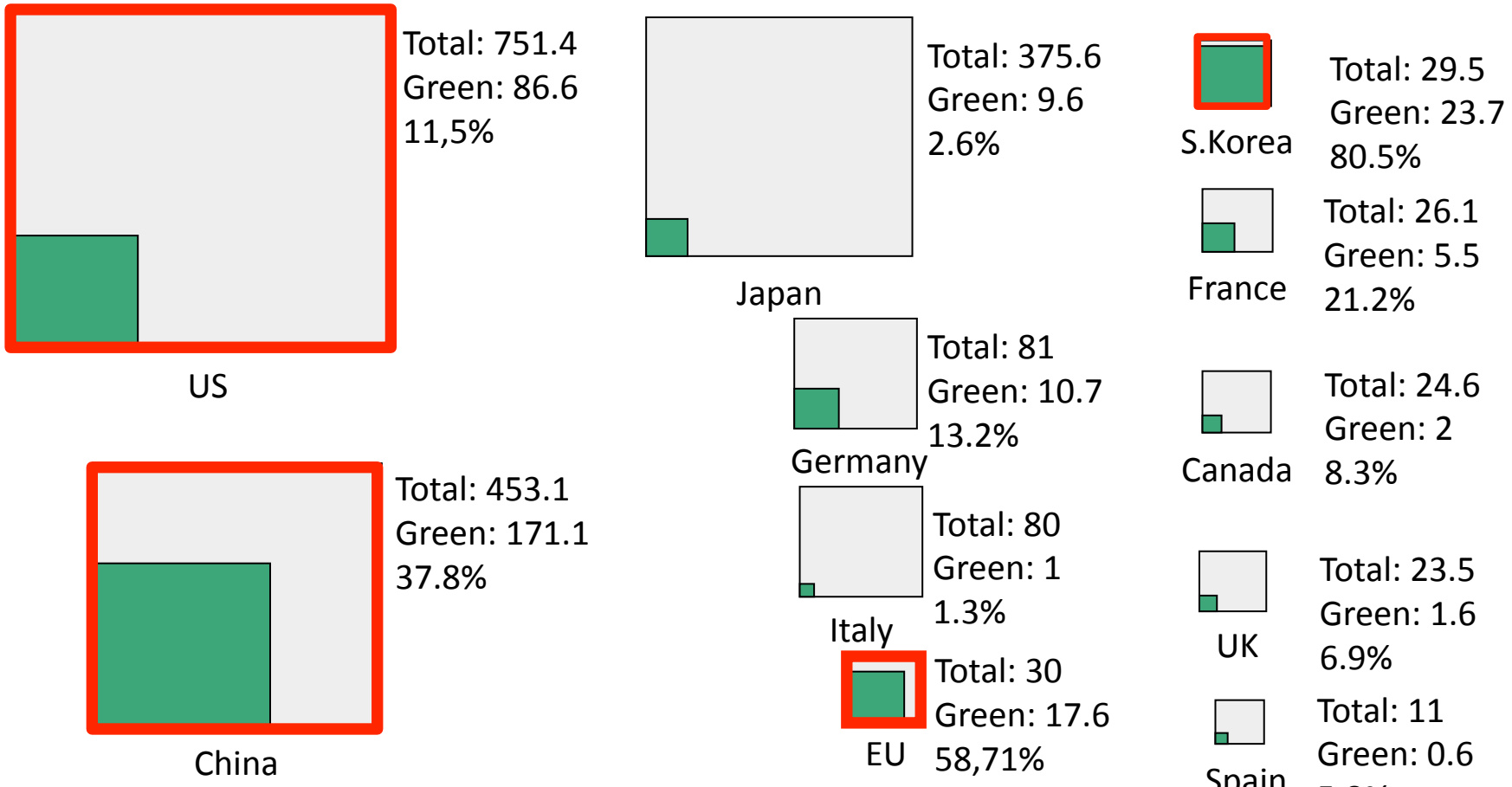
## What‘s next? Greece, Portugal, Italy, Japan, US?




Source: Eidgenössische Technische Hochschule (ETH) Zürich: E. J. Sturm 2010

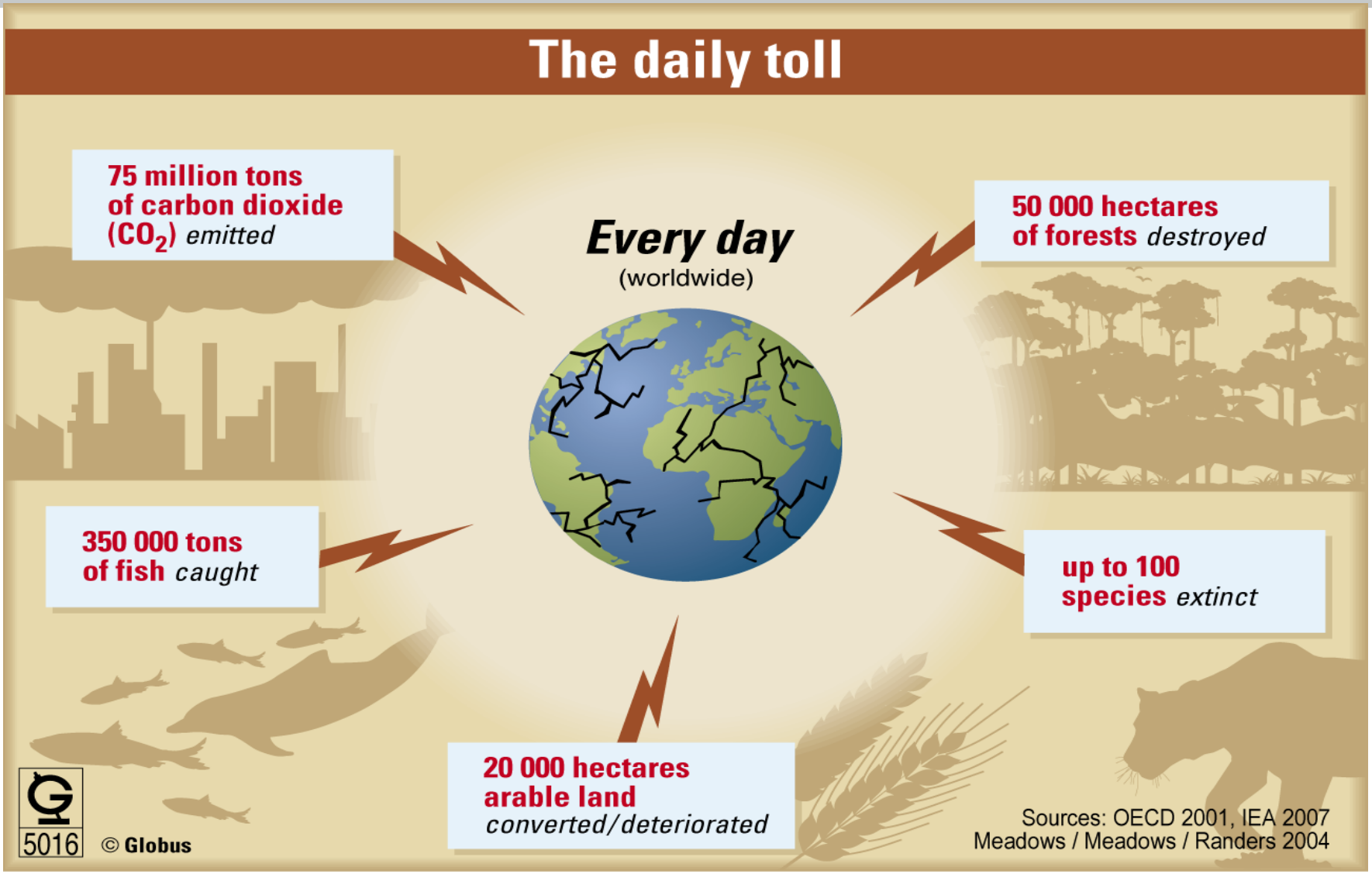
# “Green Share” of “Recovery Packages” 2008/2009

**A paradigm shift to an integrated strategy against the economic and ecological crisis?**




Source: Bernard et al 2009; Schepelmann et al 2009

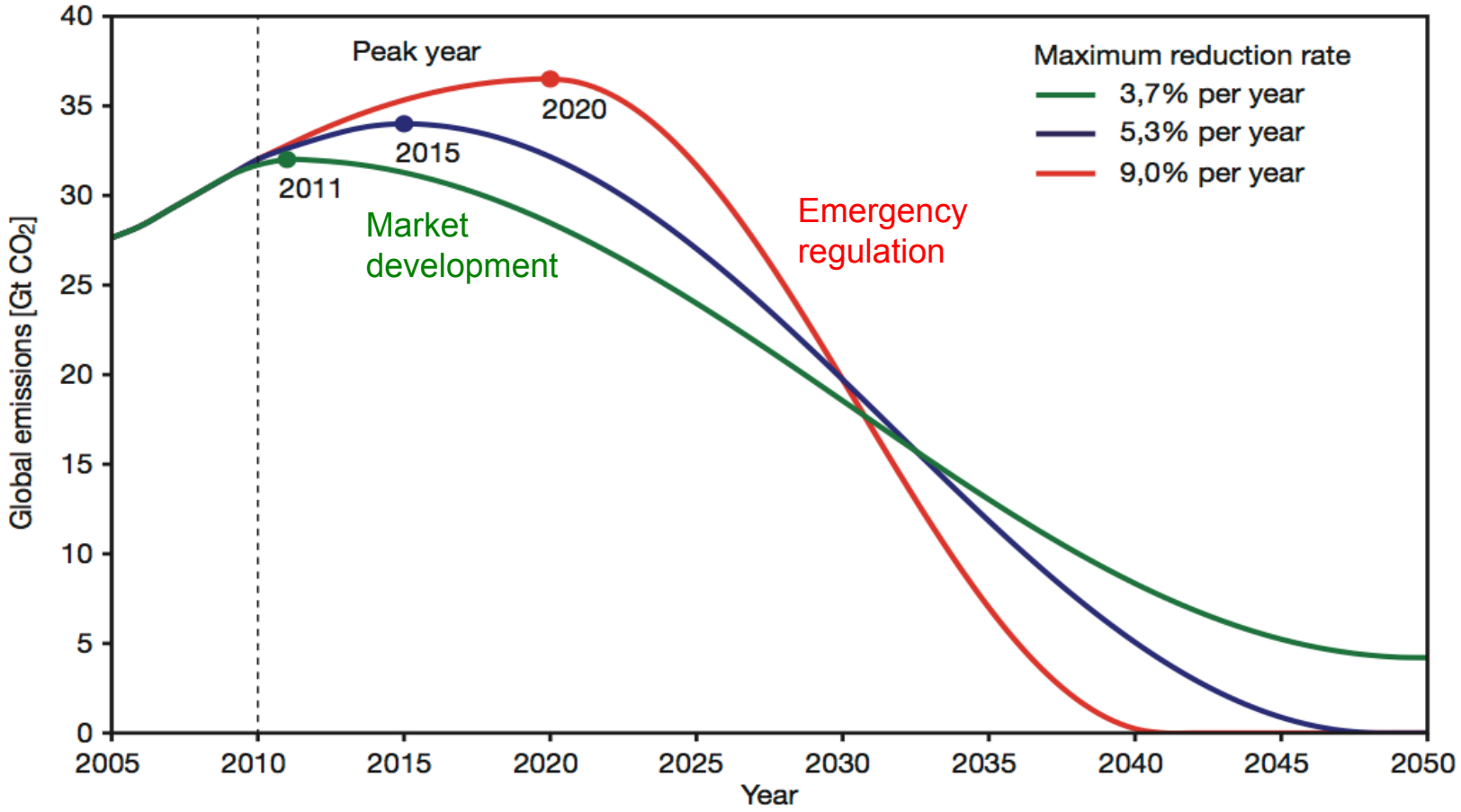
# The ecological crisis – beyond “planetary boundaries”




Source: Nature 2009

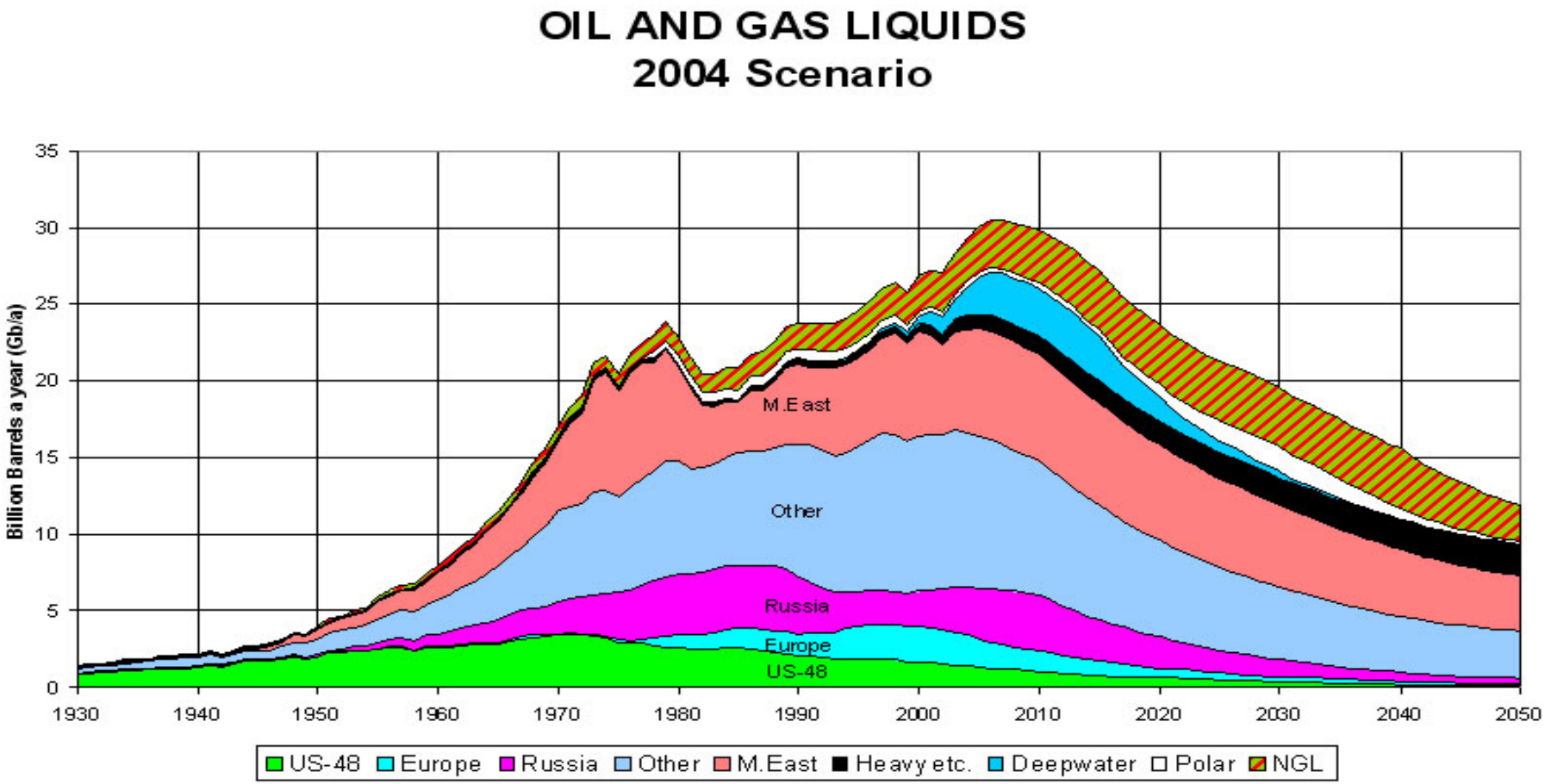
# We are running out of time!

**If GHG-emissions don‘t peak soon**
**an emergency program will be necessary to stay below the 2°-goal**




Source: WBGU 2010

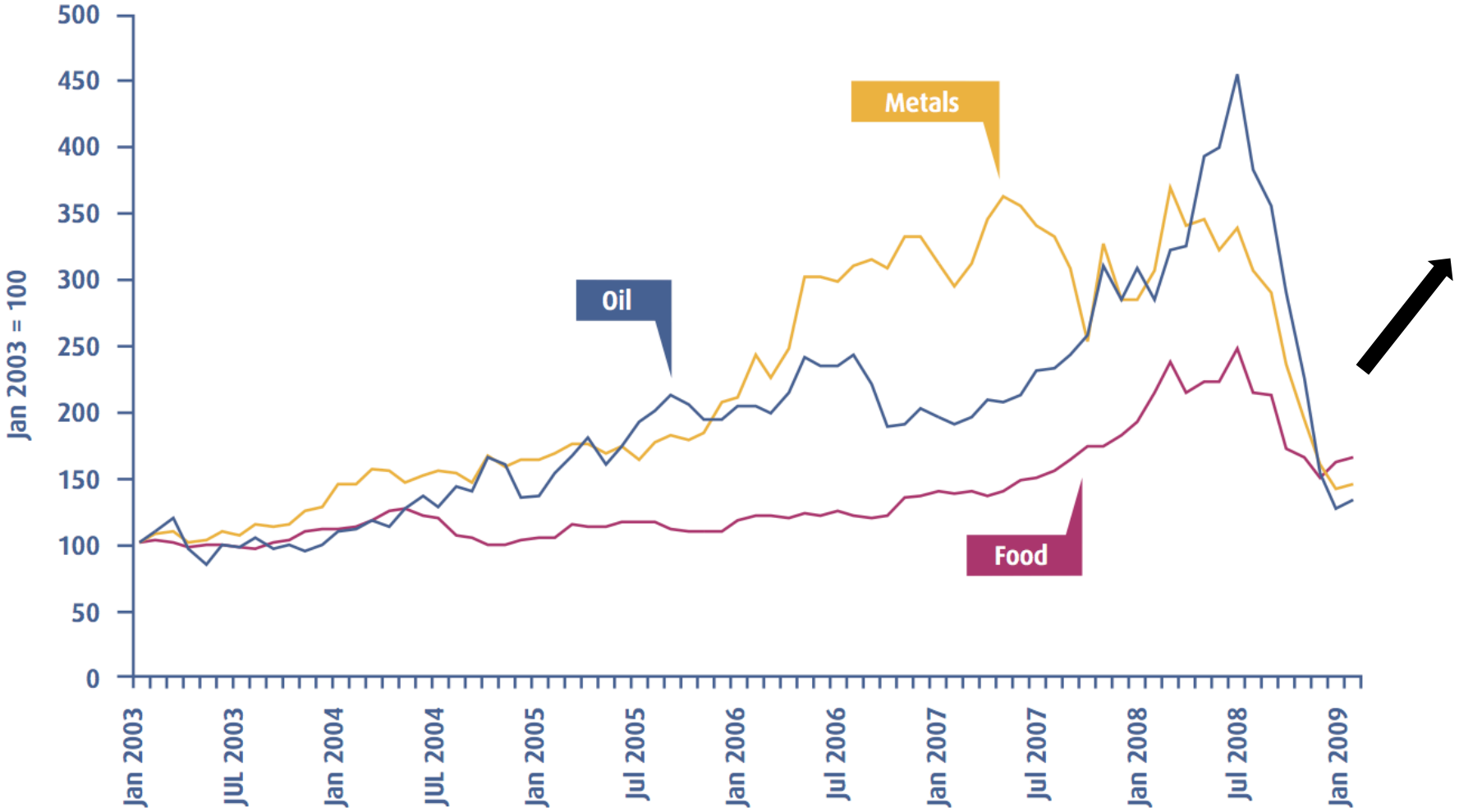
# Dramatic range in the future: Oil Price between 54 to 248 $/ b? „Peak of oil“ in 2010?




Source: The Association for the Study of Peak Oil&Gas (ASPO): Oil and Gas Liquids 2004 Scenario, updated by Colin J. Campbell, 2004-05-15, in: www.peakoil.net, Recherche v. 08.07.2004

# Global prices of raw material 2003 – 2009:

## Steep increase – deep fall due to the crisis – and tomorrow?




Source: Jackson, Prosperity without growth 2009

# Timeline of „critical metals“

## Essential e.g. in ICT-technologies, batteries, renewables and catalysts

| timeline | Metal |
|---|---|
| **Short-term (within next 5 years)**<br>**+ rapid** demand growth<br>**+ serious** supply risks<br>+ moderate recycling restrictions | Tellurium<br>Indium<br>Gallium |
| **mid-term (till 2020)**<br>**+ rapid** demand growth<br>**and**<br>**+ serious** recycling restrictions<br>**or**<br>+ moderate supply risks<br>+ moderate recycling restrictions | Rare earths<br>Lithium<br>Tantalum<br><br>Palladium<br>Platinum<br>Ruthenium |
| **Long-term (till 2050)**<br>+ moderate demand growth<br>+ moderate supply risks<br>+ moderate recycling restrictions | Germanium<br>Cobalt |

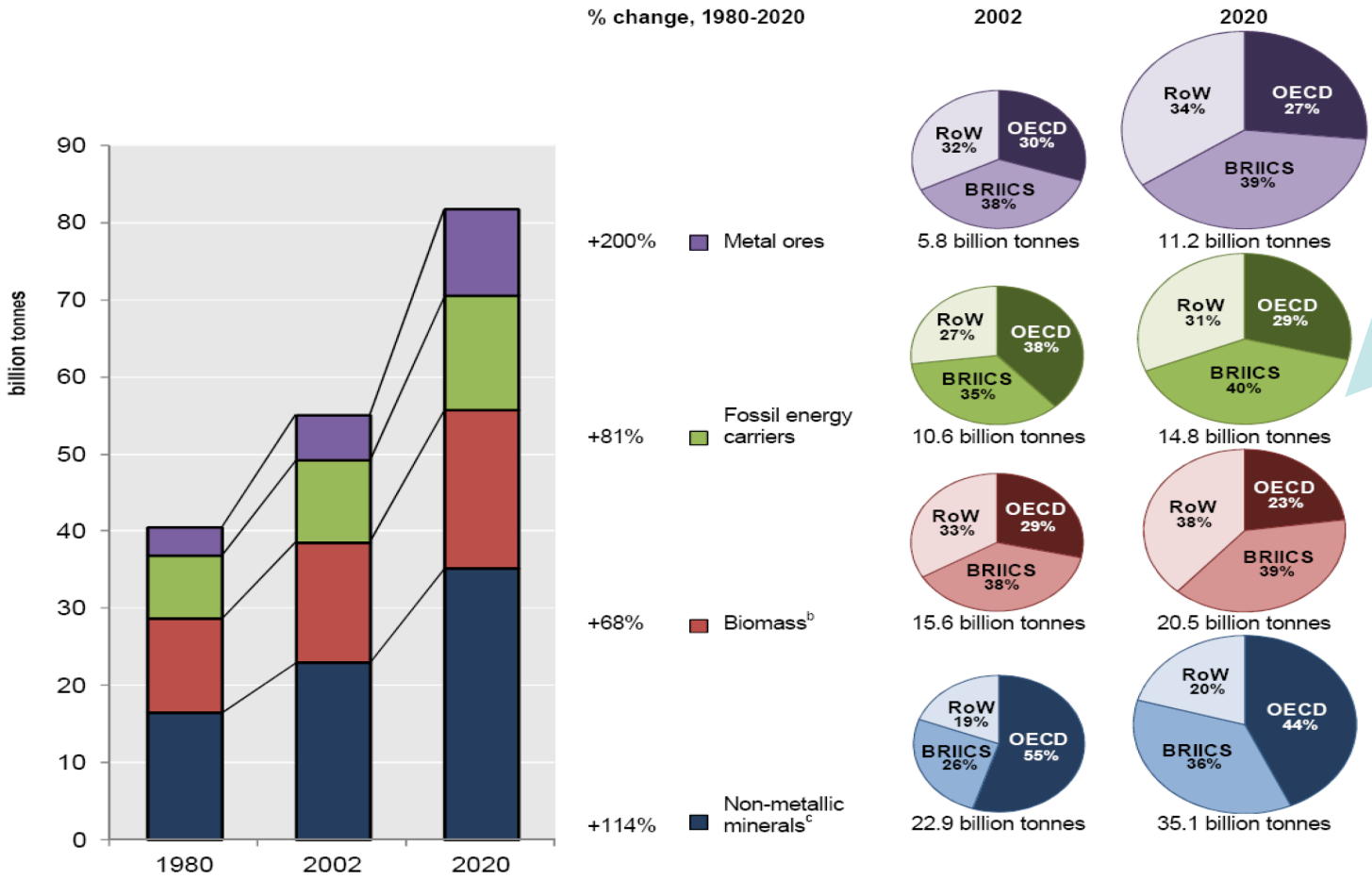
**„..there is increasing evidence that resources in general, or at least some specific resources, may become quite scarce in the coming years“**

Source: T. E. Graedel, Yale University 2008

Source: UNEP/Öko-Institut 2009

# The trend of resource use is clearly unsustainable

## Fostering resource productivity (e.g. recycling) is a must!



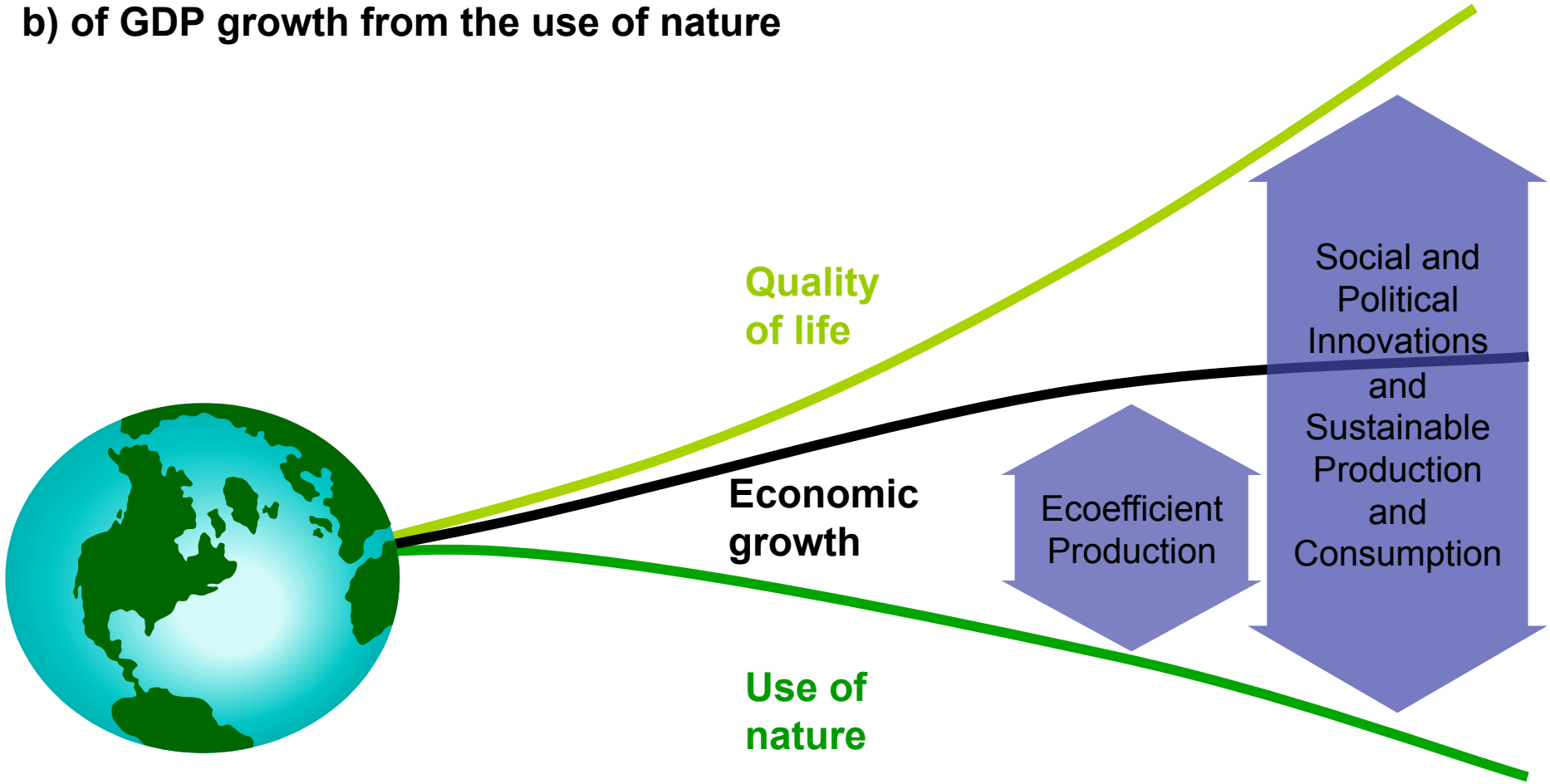

**„99% of important high-tech metals are thrown away after use instead of being recycled. Only 18 metals have recycling quotas above 50%“**

Source: UNEP 2011

Source: Giljum et al 2008

# The Challenge: *Double* Decoupling

**a) of the quality of life from GDP growth and**
**b) of GDP growth from the use of nature**



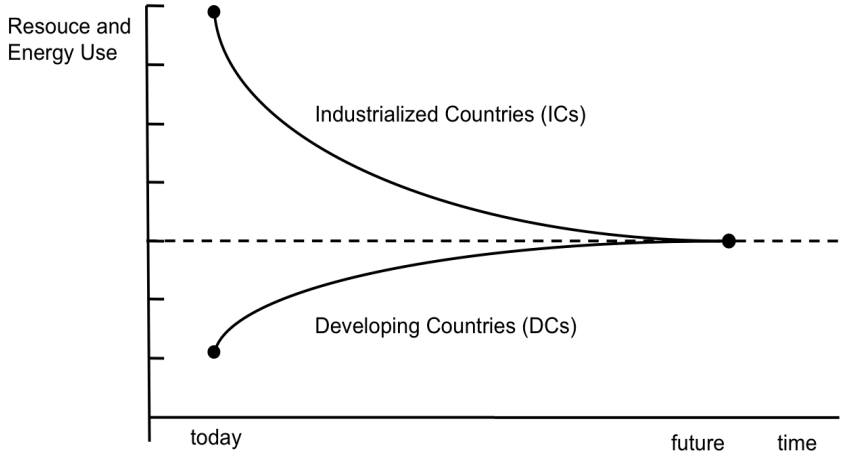

Source: Wuppertal Institute 2009

# Decoupling is possible by fostering energy efficiency - as a bridge to the solar age!

# The vision: “2000 W per Capita Society”: R&D initiative of Swiss Research Institutes

## “A question of equity and justice: Reduction and Convergence”!

- **A “2000W per Capita Society”** in OECD-countries is feasible; 2000W/cap (= 65 GJ/cap) corresponds to **1/3 of today‘s European per capita energy use;**
- **World average** in the last two decades (=70 GJ/ cap): The future convergence value?
- Enabling a GDP growth up to 2050, the “2000W per Capita Society” **implies a factor 4 increase of energy and material efficiency**
- Needed: **change of innovation systems**, exploitation of **long re-investment cycles**, **sustainable patterns** of consumption and production




- Industrialized countries **reduce** their resource use more than it **increases** in developing countries.
- **Convergence value** should be compatible with the carrying capacity of the biosphere.

Source: Swiss “White Book for R&D of energy-efficient technologies” March 2004

# The way to Sustainable Energy Systems:

## Common, but differentiated challenges for IC and DC

**Industrialized Countries (IC)**

- **Absolute decoupling**: Reduce per cap energy consumption by 50-75%, but increase well-being
- **Support ecological modernisation**, closed loop economies, service orientation, life style changes…..

**Developing Countries (DC)**

- **Relative decoupling:** Reduce **growth rates** of energy consumption by more efficient use; increase living standards, alleviate poverty, foster rural electrification
- **Combine** advanced end use efficiency with renewables ("leap frogging")

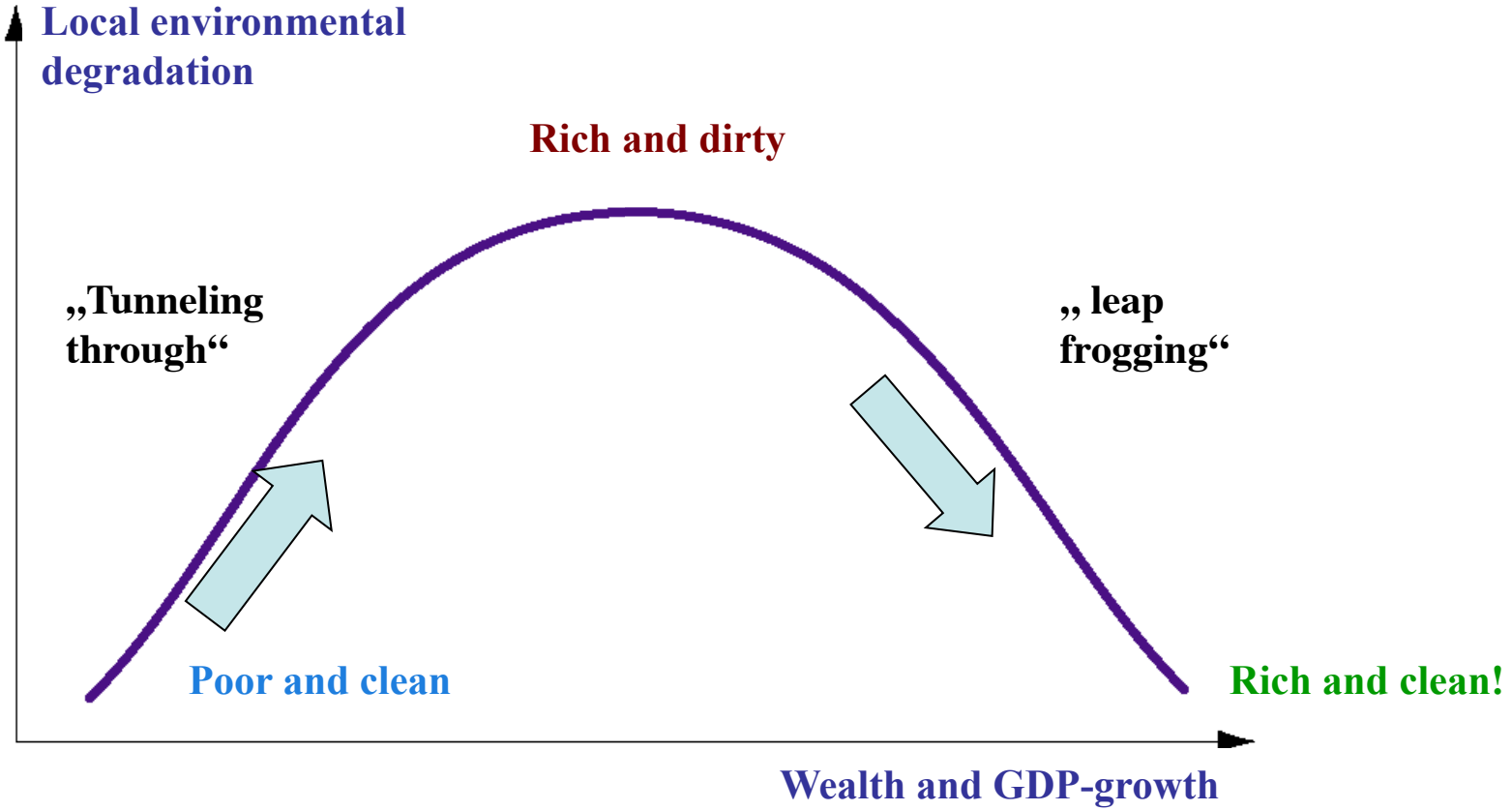
**Common challenges:**

- **Avoid lock-in into outdated technologies:** The reference should be the sustainable future and not the unsustainable past
- **Foster Institutional change**: decentralisation, liberalisation, democratisation
- Raise **resource productivity**

Source: Hennicke 2010

# An outdated development concept is symbolized by the Kuznets Curve of environmental degradation

## „First rich then clean“?




Source: Weizsäcker 2007

# The underlying research and scenario base of the presentation

**A comparison of different longterm scenarios helps to reduce uncertainty**

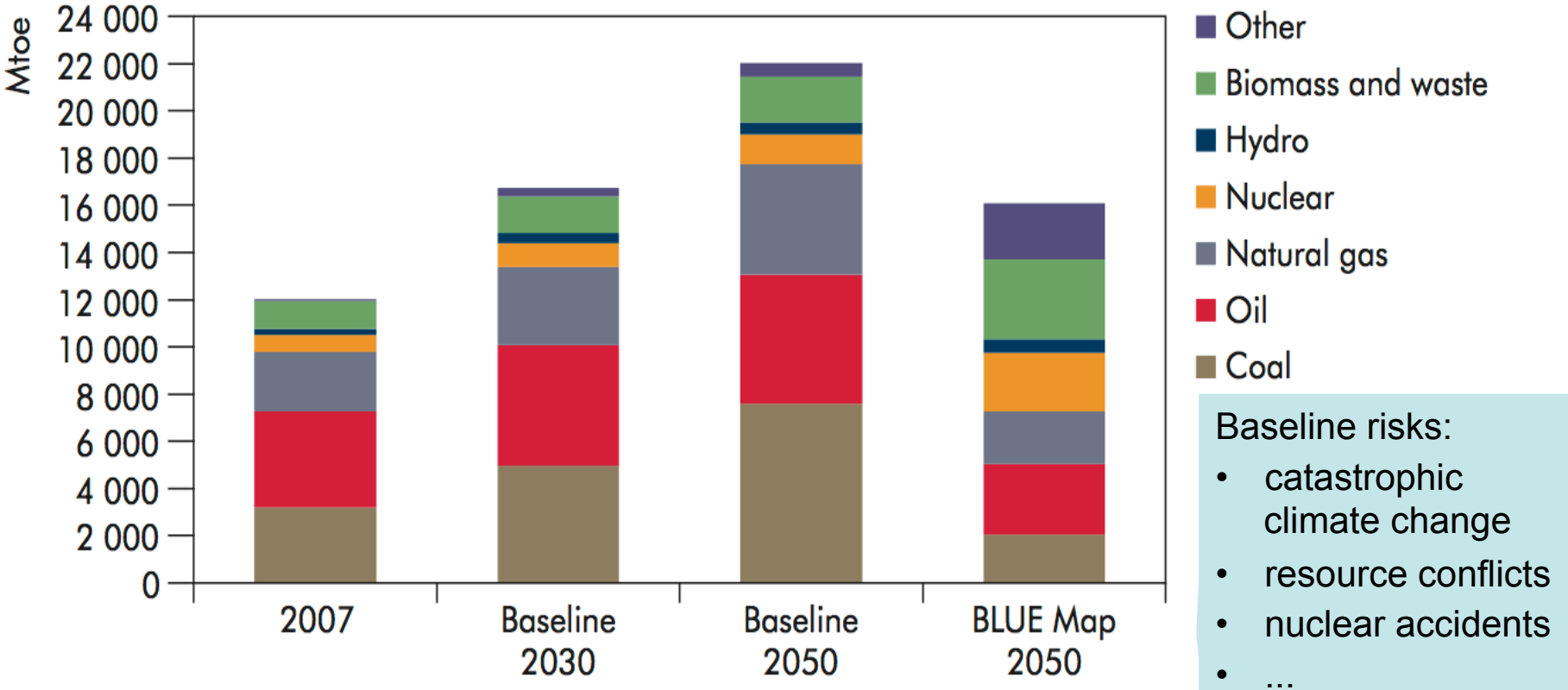
- IEA (2010): World Energy Outlook (WEO)
- IEA (2010): Long Term Technology Perspectives (LTP)
- IEA (2011): Clean Energy Progress Report
- IEA (2011): Are we entering a golden age of gas?
- IPCC (5/2011): Abu Dhabi Session of the WG III of the IPCC
- EREC/Greenpeace (2010): Energy (R)-evolution
- Ecofys/WWF (2011): The Energy Report. 100% Renewable Energy by 2050
- Germany 2010/2011: Comparison of 10 latest energy scenarios (up to 2050)

# Time for change - optimistic global technological perspectives for sustainable energy up to 2050

**„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**).**

# BAU (Baseline) would be a disaster…

**…but alternative road maps exist – world primary energy in the IEA scenarios: "Primary energy use more than double in the Baseline scenario between 2007 and 3025, with a very high reliance" (IEA)**



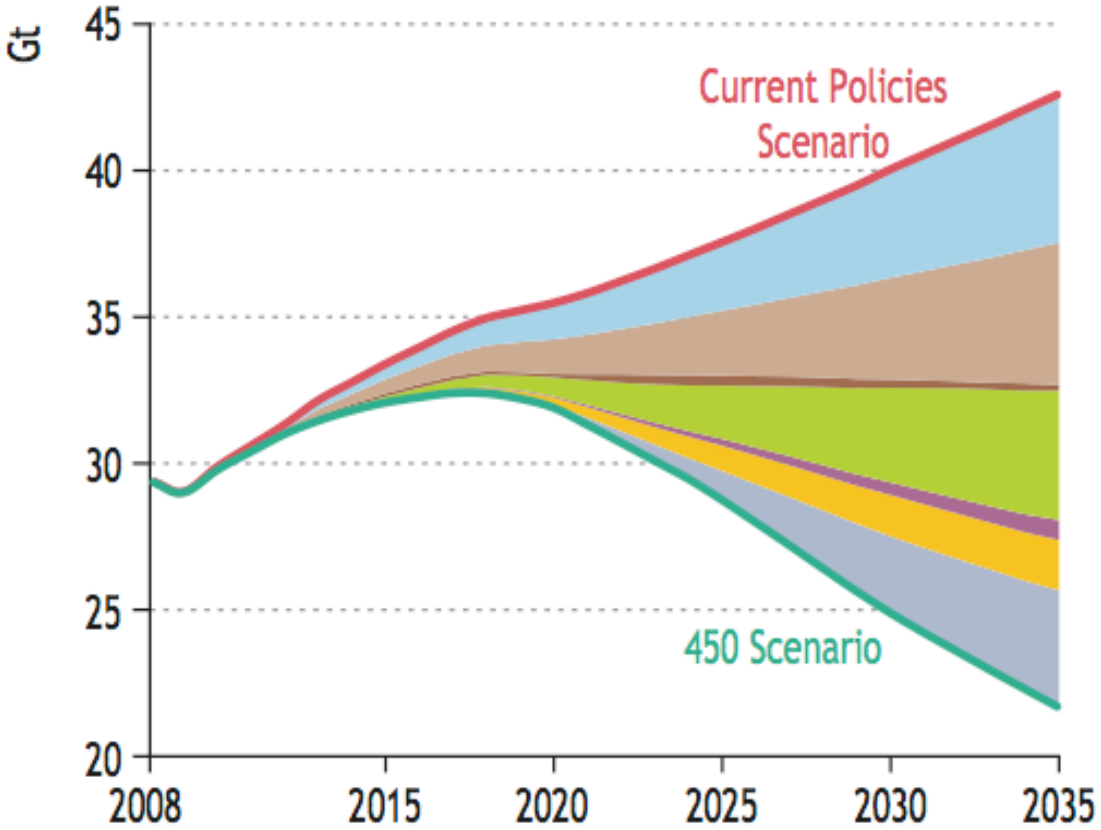

Source: IEA, Energy Technology Perspectives 2010

Baseline risks:

- catastrophic climate change
- resource conflicts
- nuclear accidents
- ...

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

**…what about the social embeddedness of technologies?**

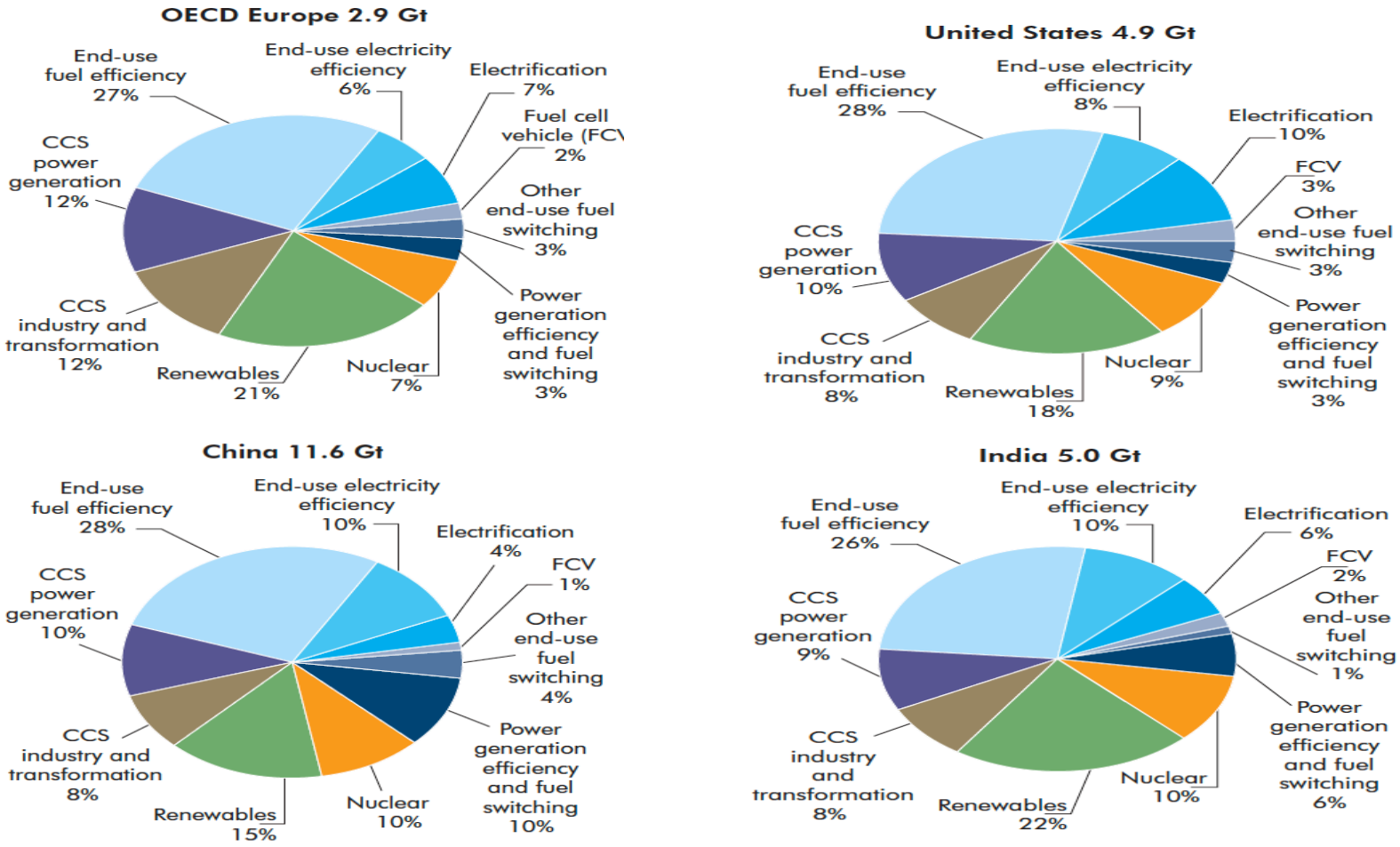



| | Abatement | | |
|---|---|---|---|
| | 2020 | 2030 | 2035 |
| Efficiency | 71% | 49% | 48% |
| *End-use (direct)* | *34%* | *24%* | *24%* |
| *End-use (indirect)* | *33%* | *23%* | *23%* |
| *Power plants* | *3%* | *2%* | *1%* |
| Renewables | 18% | 21% | 21% |
| Biofuels | 1% | 3% | 3% |
| Nuclear | 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

# Different mix of $CO_2$ abatement options between countries with one exemption: energy efficiency is key!

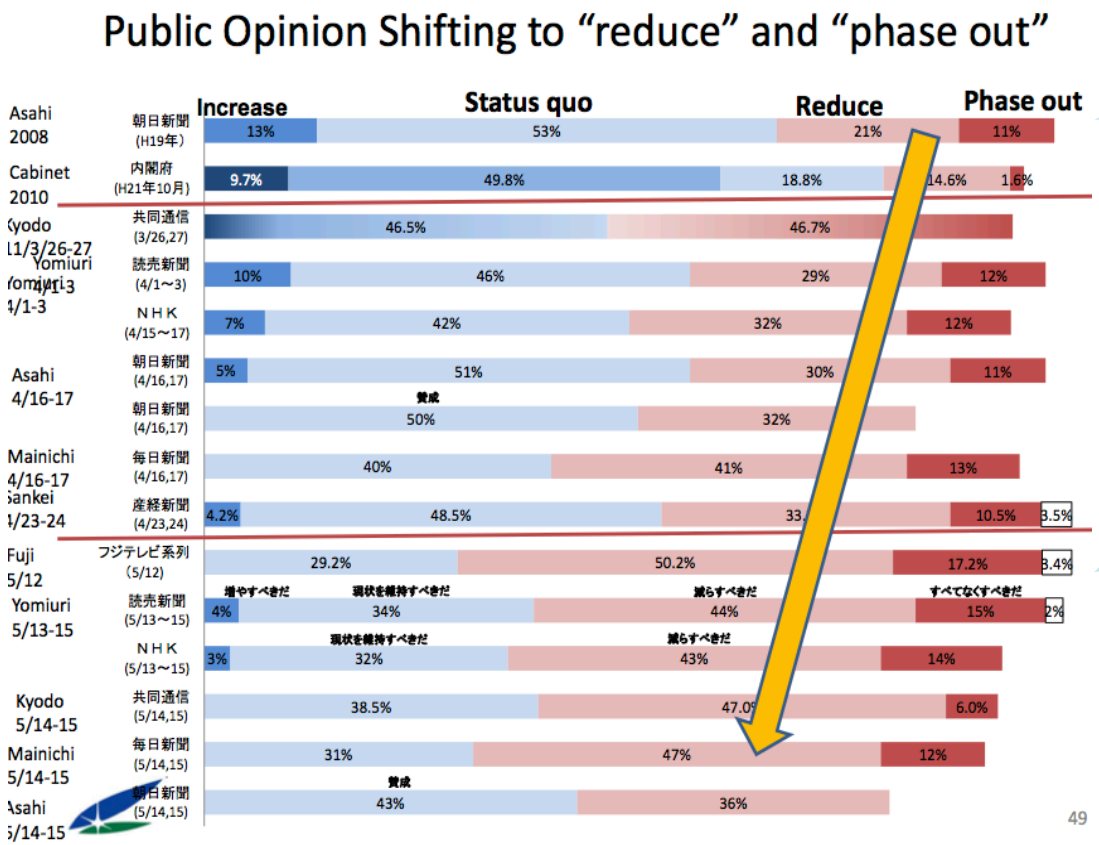
## The mix of $CO_2$ abatement options needed to realize the BLUE Map scenario




Source: IEA/OECD Blue Map scenario, 2050 in: Energy Technology Perspectives 2010

# How much nuclear after Fukushima?

## The shift of public opinion in Japan




Source: Suzuki 2011

- **"..74% says agree to phase out nuclear power in the Future…")**

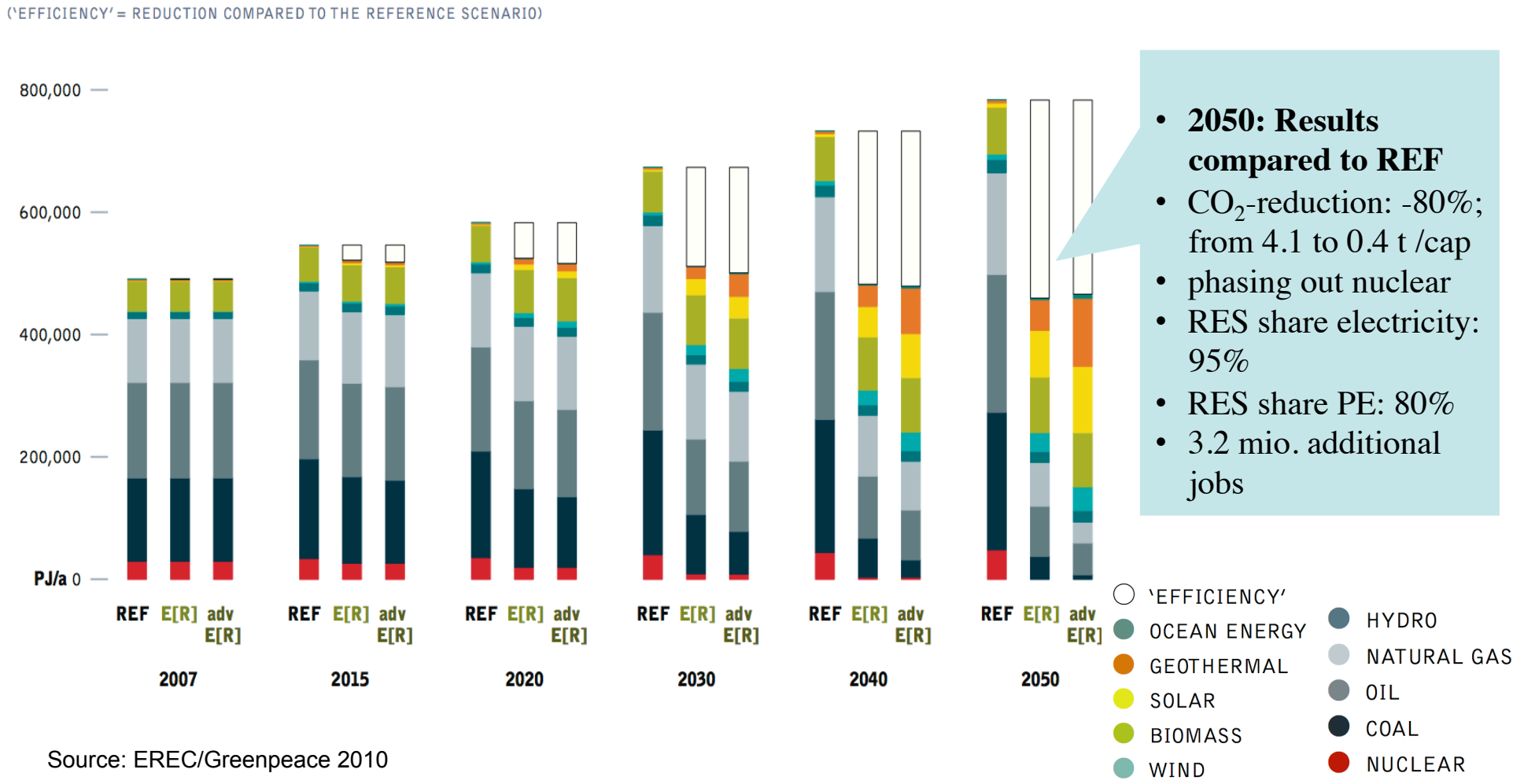
Source: Asahi Poll, 06.06.2011

- **35 Nuclear units out of 54 „are now shutdown"**
- **Current energy policy(14 more reactors, 50% nuclear share by 2030) „will be scrapped"**

Source: Tatsujio Suzuki (3.7. 2011) Vice Chairman Japan Energy Commission

# Efficiency makes deployment of renewables easier:

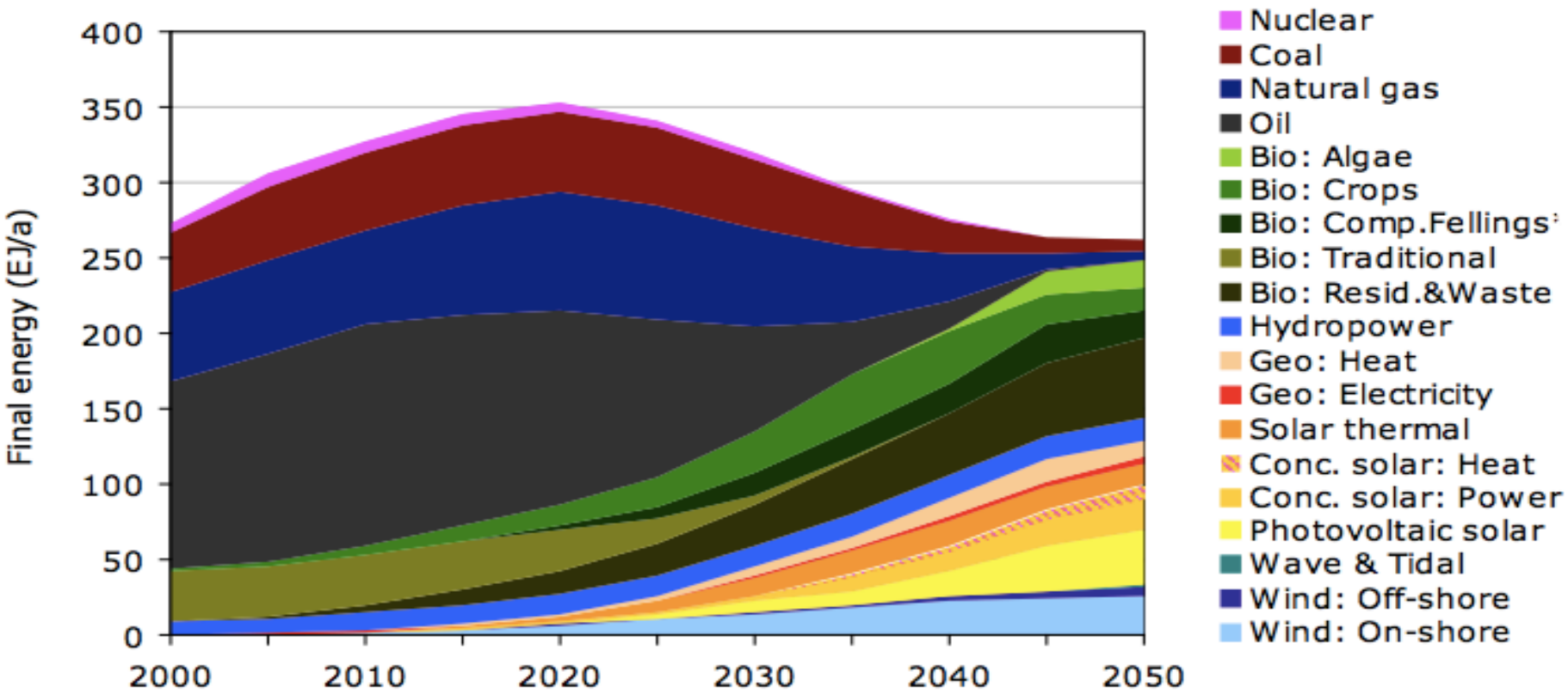
## Global primary energy in the Advanced (R)-evolution Scenario




- **2050: Results compared to REF**
- $CO_2$-reduction: -80%; from 4.1 to 0.4 t /cap
- phasing out nuclear
- RES share electricity: 95%
- RES share PE: 80%
- 3.2 mio. additional jobs

Source: EREC/Greenpeace 2010

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

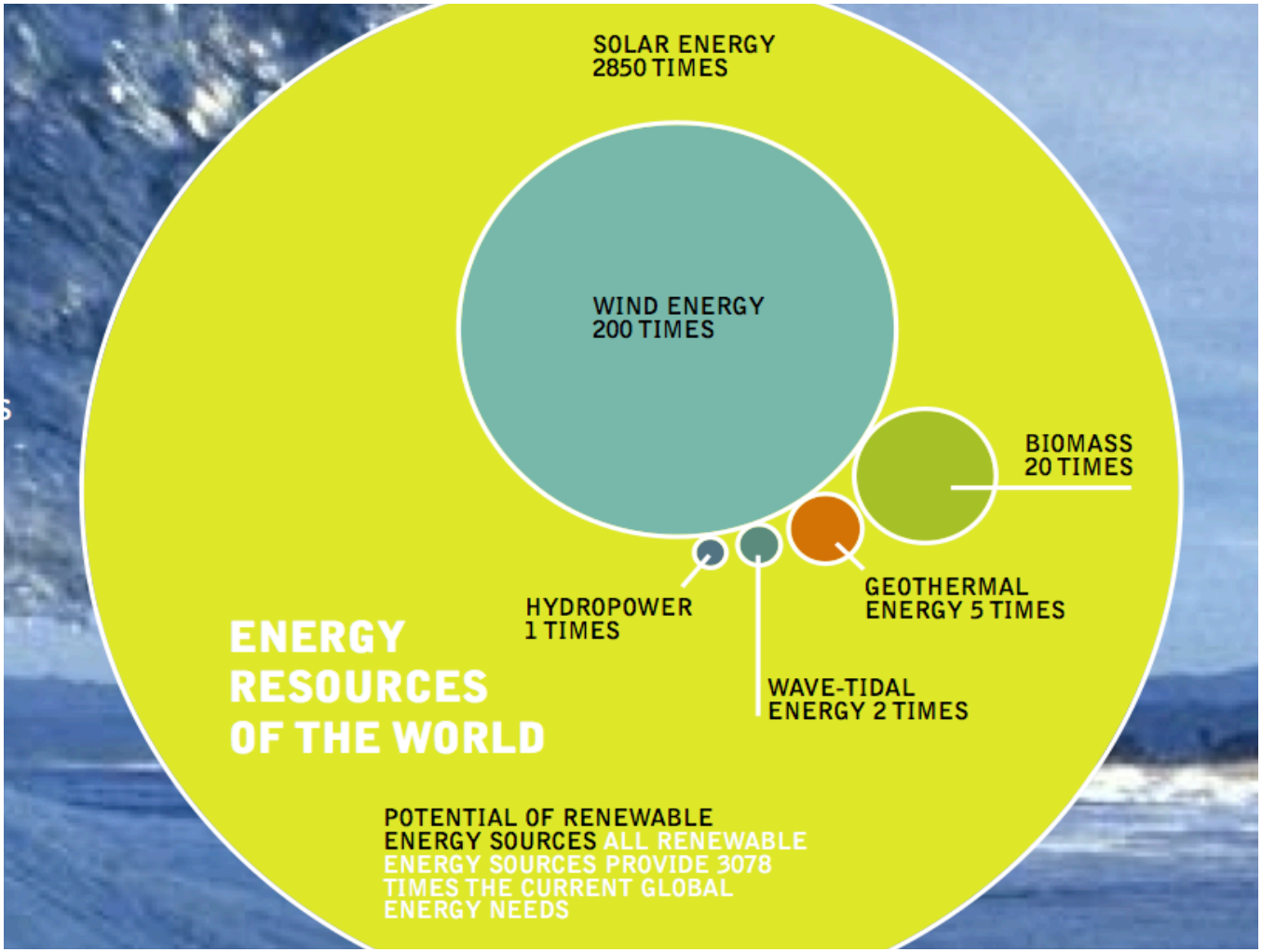



- In 2050, energy demand is 15 % less then in 2005; nuclear phase out; CCS after 2025/30 only marginal
- As far as possible electrical energy is used; bioenergy for trucks, ships, aeroplanes, industrial processes
- By 2050 €4 trillion/a saved compared to BAU; around 2050 savings outweigh investments

Source: WWF/Ecofys 2011

**Renewables are abundant, but as long as fossil fuels are cheaper global climate protection will fail!**

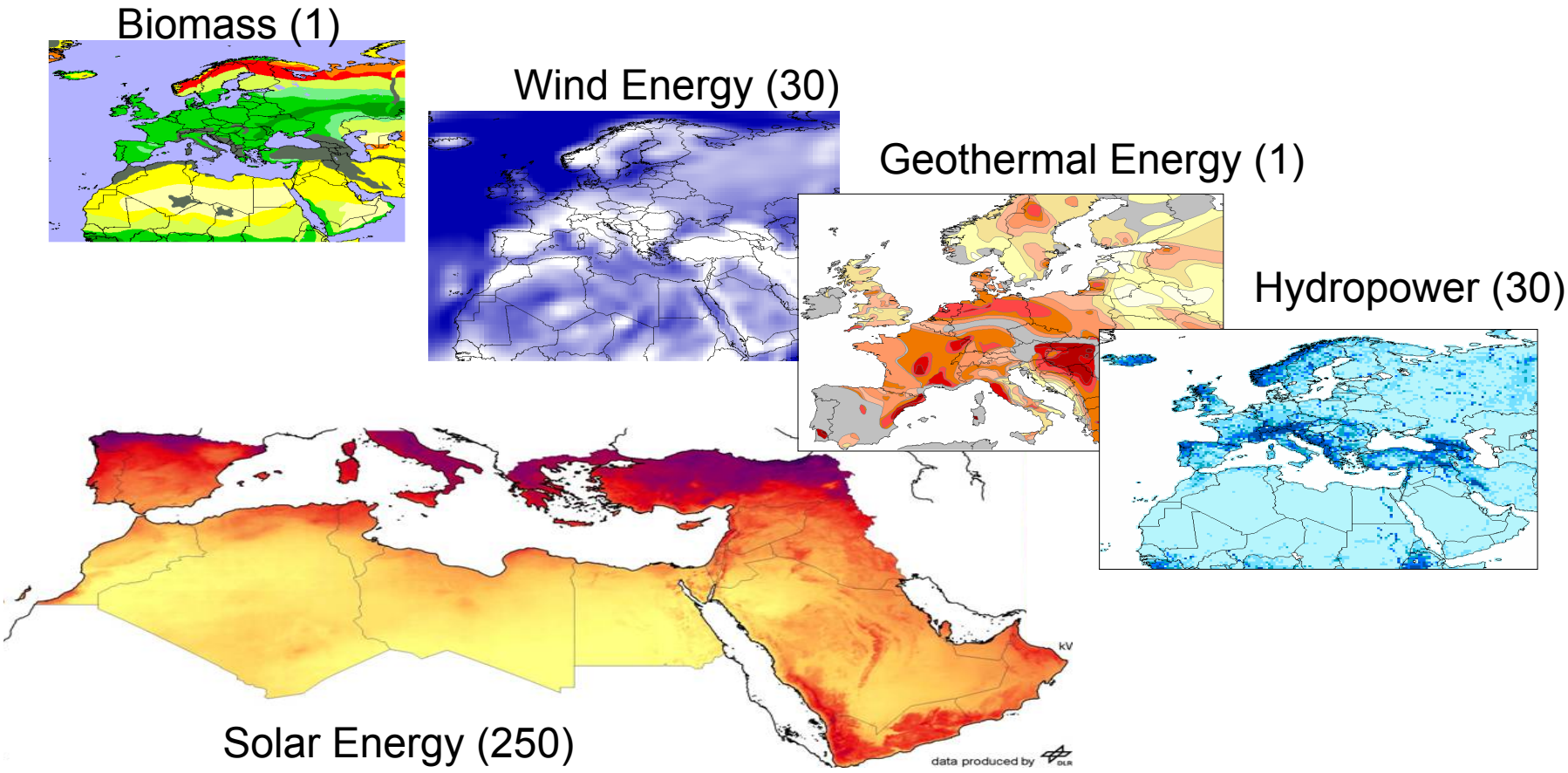
# Potential of renewable energy sources compared to current global energy needs




Source: WGBU 2011

# Identify priorities I: Renewable energy resource mapping

**Typical Area Yield in million kWhel/km²/y**




Source: DLR 2011

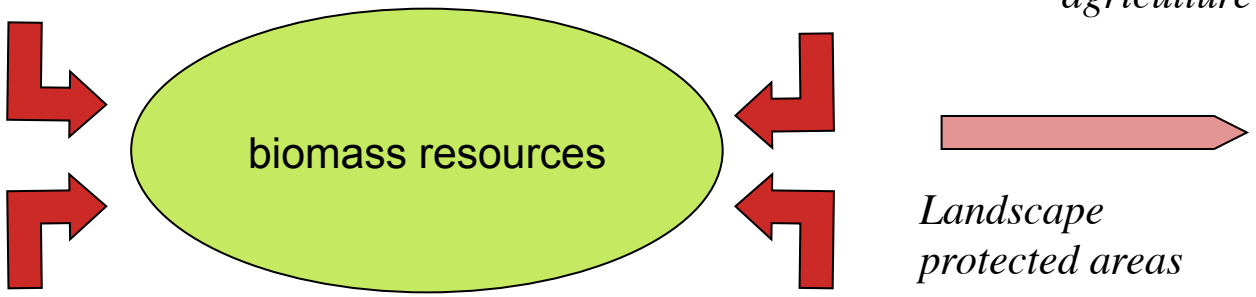
# Identify priorities II: Competition for food, raw materials and mobile/stationary biofuels - with limited biomass resources

**Detailed energy system analysis, science based priorities and longterm strategies are needed!**

**Industrial resources**
- textile industry
- chemical/pharmacy
- automobile industry
- etc.

**Biofuels**
- Ethanol and Bio-Diesel
- Hydrogen
- BTL (Sunfuel)
- etc.

*Ecological agriculture*




*Landscape protected areas*

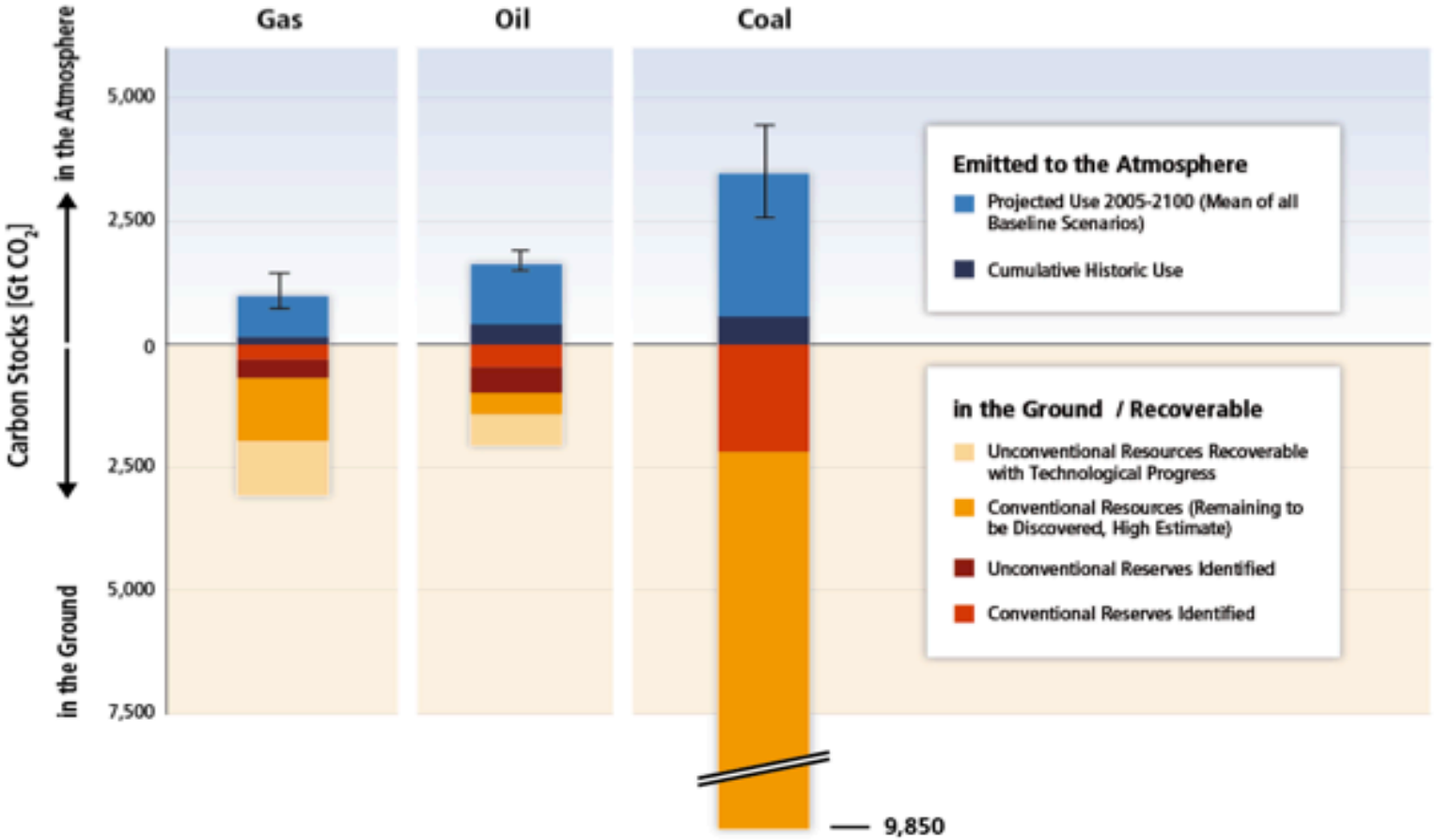
**Electricity supply**
- condensating power plants, co-firing
- co- and trigeneration
- innovative gasification plants

**Heat supply**
- pellet heating systems
- district heating
- etc.

Source: DLR 2011

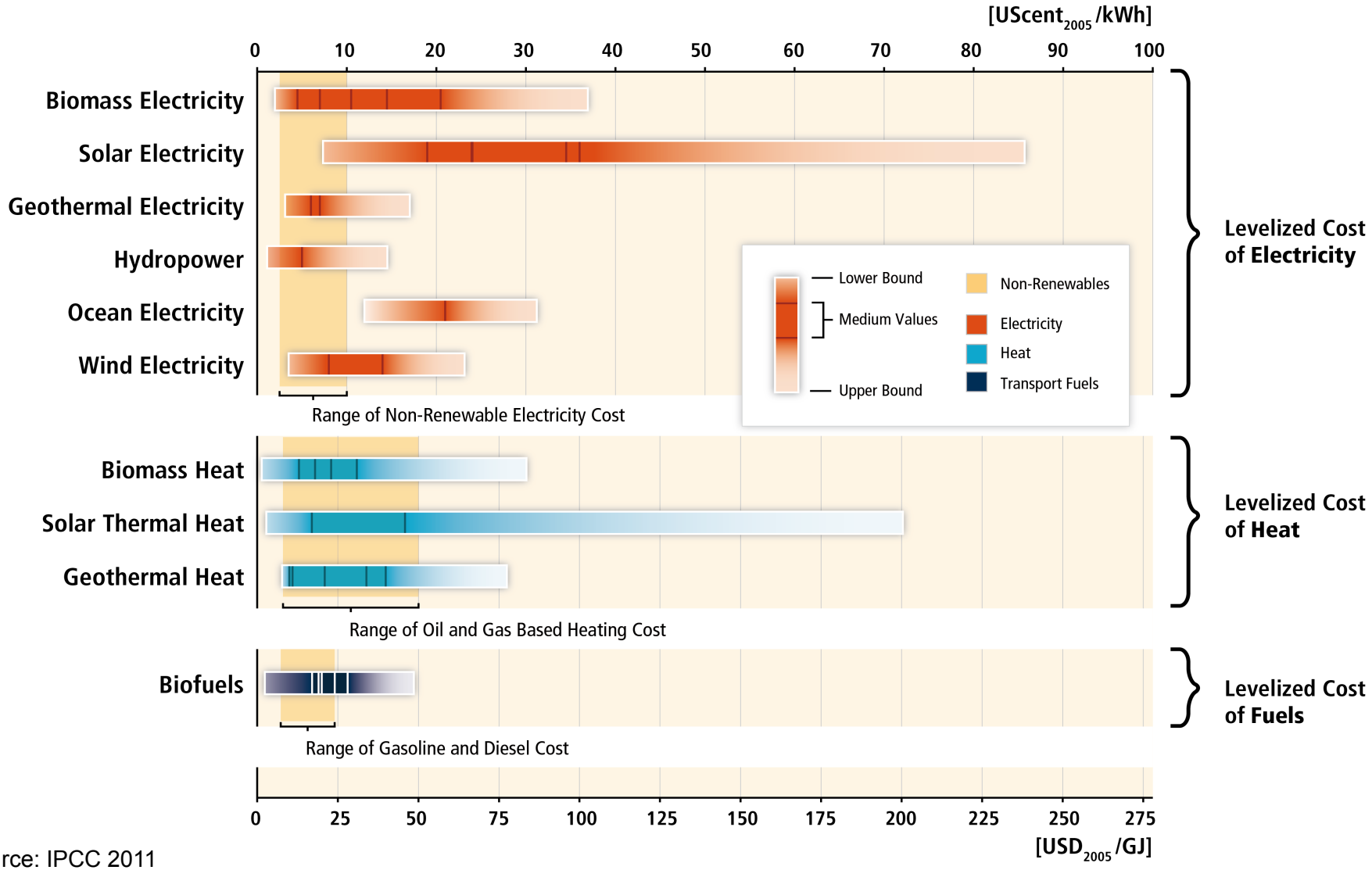
# Potential GHG emissions from remaining fossil resources could result in GHG concentration levels far above 600ppm

## Climate mitigation allows to burn only 1/3 of recoverable fossil resources



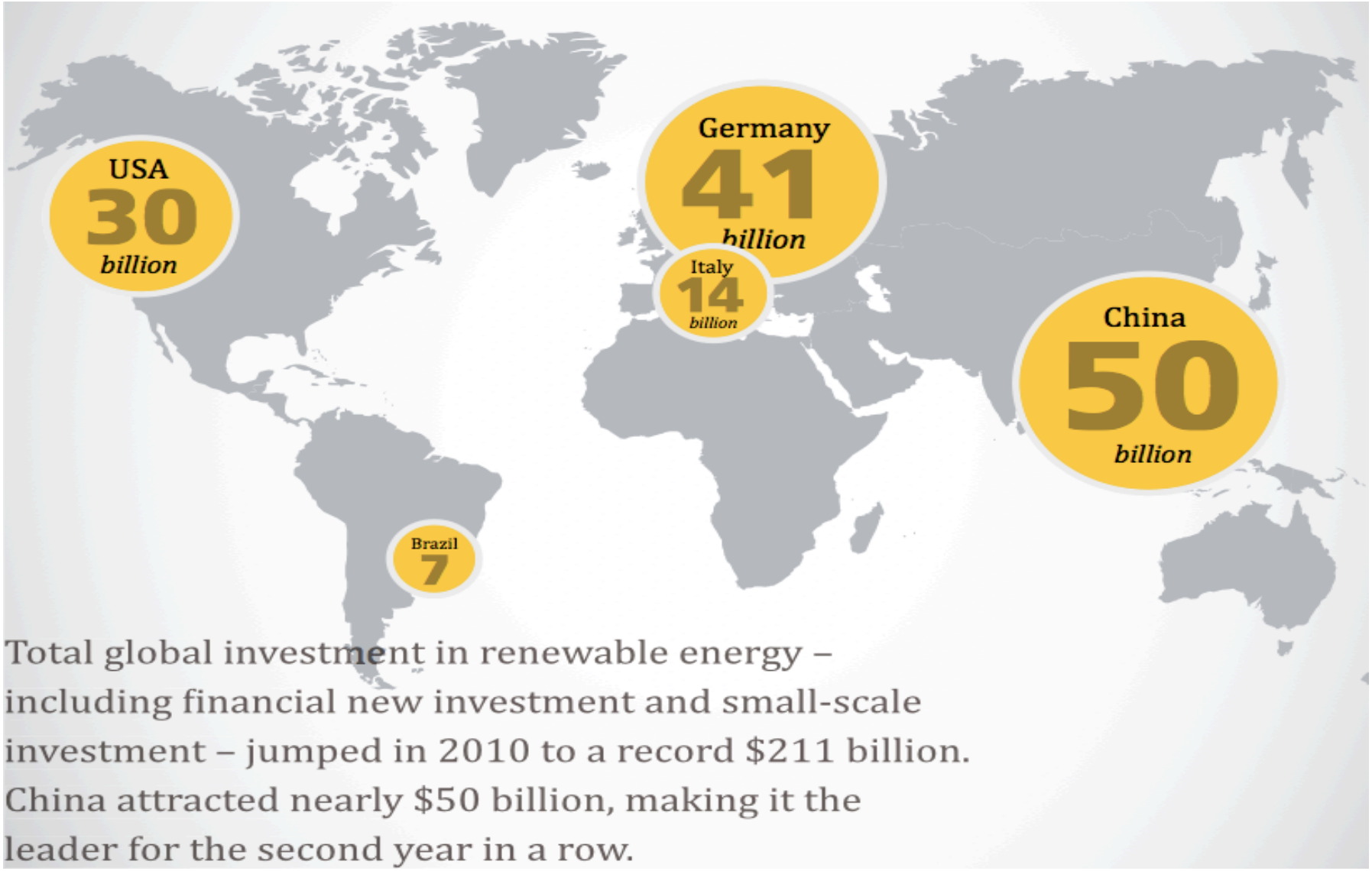

Source: Intergovernmental Panel on Climat Change, WHO and UNEP 2011

# Costs of renewables are still higher than existing energy prices but in various cases renewables are already competitive

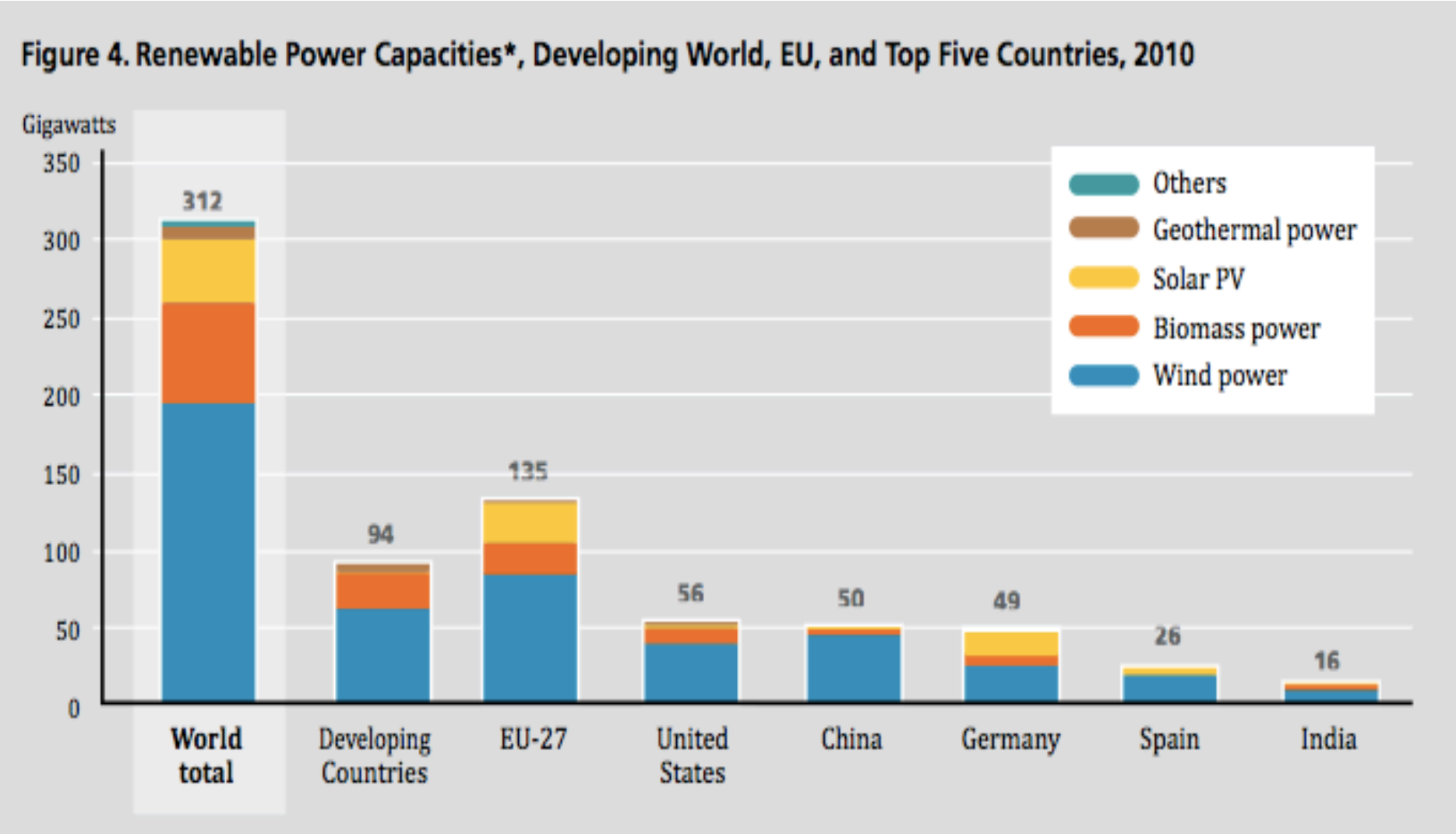



Source: IPCC 2011

# Investments in renewable energy jumped to a record – China took the lead in 2010

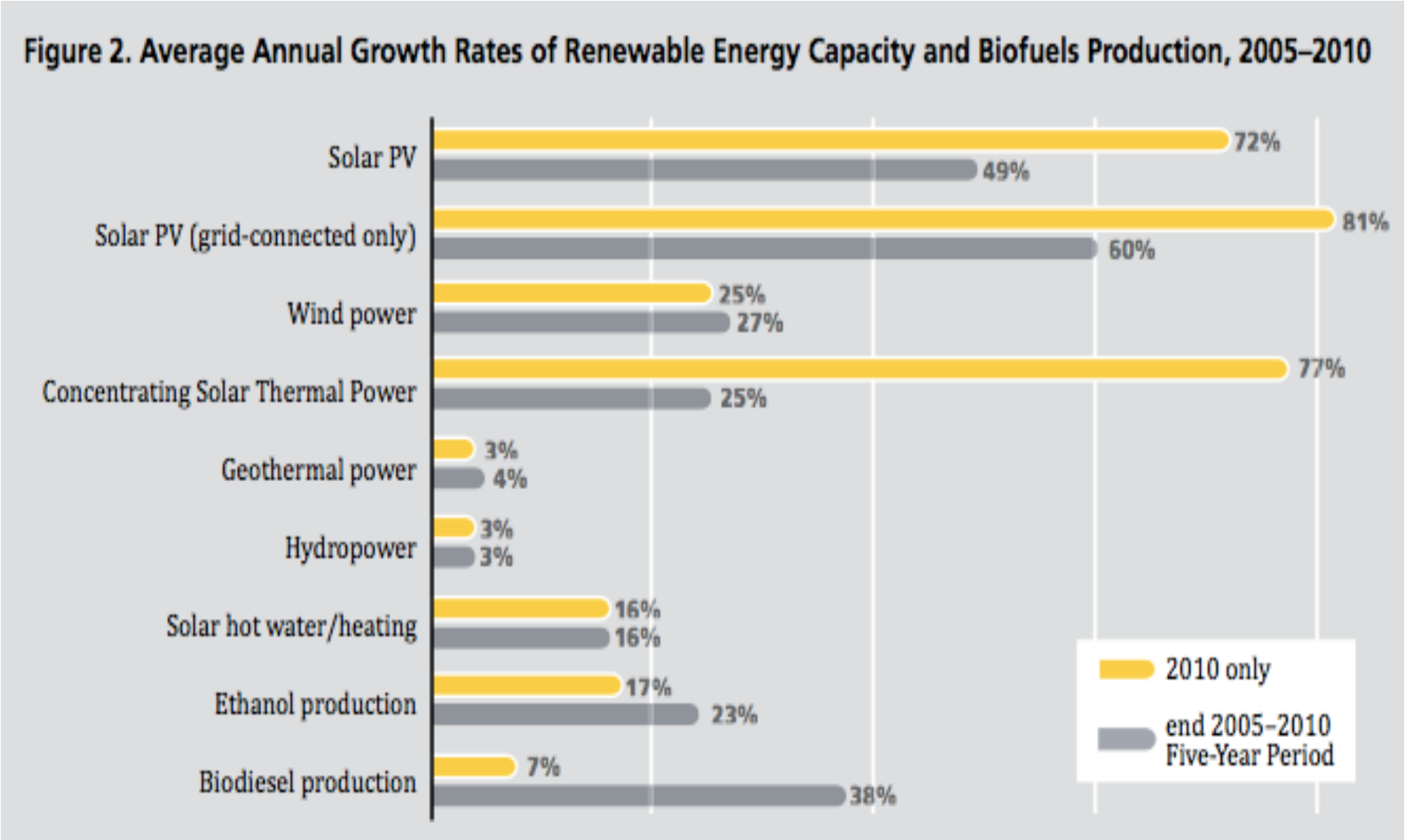


# Renewable Power Capacities: EU-27 still dominant, but US and China are catching up very rapidly!




**Source: REN21, Global Status Report 2010**

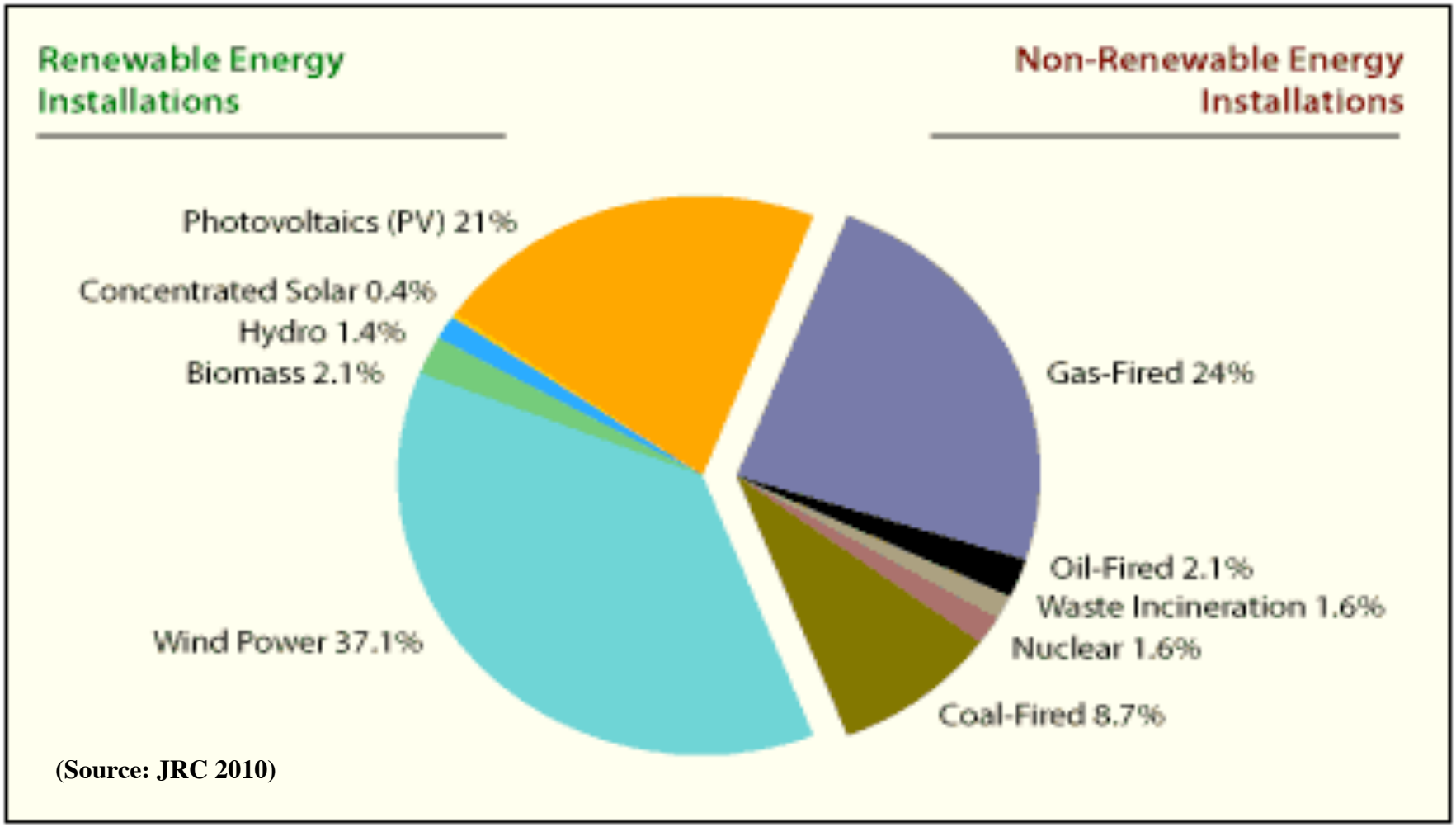
# Global growth rates of renewable energy capacity and biofuels production are accelerating!




**Source: REN21, Global Status Report 2010**

# Newly installed capacities (GW) of renewable power production in EU27 (2009)

## 62% for renewable energies!



# Indicators of a succesful global development of renewable energies

| SELECTED INDICATORS | | 2008 | → | 2009 | → | 2010 |
|---|---|---|---|---|---|---|
| Global new investment in renewable energy (annual) | *billion USD* | 130 | → | 160 | → | **211** |
| Renewables power capacity (existing, not including hydro) | *GW* | 200 | → | 250 | → | **312** |
| Renewables power capacity (existing, including hydro) | *GW* | 1,150 | → | 1,230 | → | **1,320** |
| Hydropower capacity (existing) | *GW* | 950 | → | 980 | → | **1,010** |
| Wind power capacity (existing) | *GW* | 121 | → | 159 | → | **198** |
| Solar PV capacity (existing) | *GW* | 16 | → | 23 | → | **40** |
| Solar PV cell production (annual) | *GW* | 6.9 | → | 11 | → | **24** |
| Solar hot water capacity (existing) | $GW_{th}$ | 130 | → | 160 | → | **185** |
| Ethanol production (annual) | *billion liters* | 67 | → | 76 | → | **86** |
| Biodiesel production (annual) | *billion liters* | 12 | → | 17 | → | **19** |
| Countries with policy targets | # | 79 | → | 89 | → | **96** |
| States/provinces/countries with feed-in policies[1] | # | 71 | → | 82 | → | **87** |
| States/provinces/countries with RPS/quota policies | # | 60 | → | 61 | → | **63** |
| States/provinces/countries with biofuels mandates | # | 55 | → | 57 | → | **60** |

**Source: REN21, Global Status Report 2010**

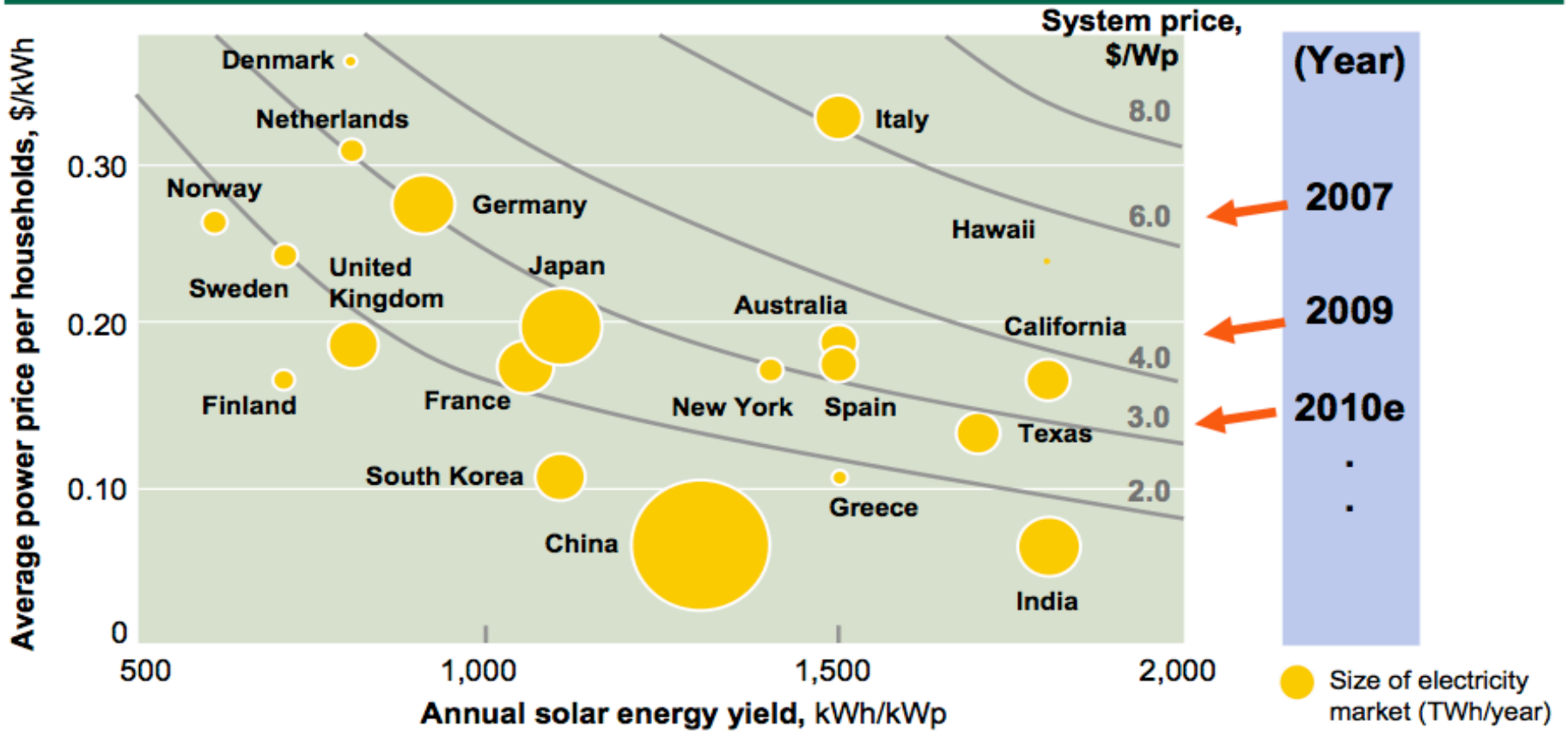
# Estimated world wide (gross) jobs caused by renewable energies

| Industry | Estimated jobs worldwide | Selected national estimates |
|---|---|---|
| **Biofuels** | > 1,500,000 | Brazil 730,000 for sugarcane and ethanol production |
| **Wind power** | ~ 630,000 | China 150,000 / Germany 100,000 / United States 85,000 / Spain 40,000 / Italy 28,000 / Denmark 24,000 / Brazil 14,000 / India 10,000 |
| **Solar hot water** | ~ 300,000 | China 250,000 / Spain 7,000 |
| **Solar PV** | ~ 350,000 | China 120,000 / Germany 120,000 / Japan 26,000 / United States 17,000 / Spain 14,000 |
| **Biomass power** | - | Germany 120,000 / United States 66,000 / Spain 5,000 |
| **Hydropower** | - | Europe 20,000 / United States 8,000 / Spain 7,000 |
| **Geothermal** | - | Germany 13,000 / United States 9,000 |
| **Biogas** | - | Germany 20,000 |
| **Solar thermal power** | ~ 15,000 | Spain 1,000 / United States 1,000 |
| **Total estimated** | **> 3,500,000** | |

**Source: REN21, Global Status Report 2010**

# "CONSUMER GRID PARITY" WILL BE REACHED IN MANY LARGE MARKETS BEFORE 2012

## Consumer Grid Parity Analysis per Country



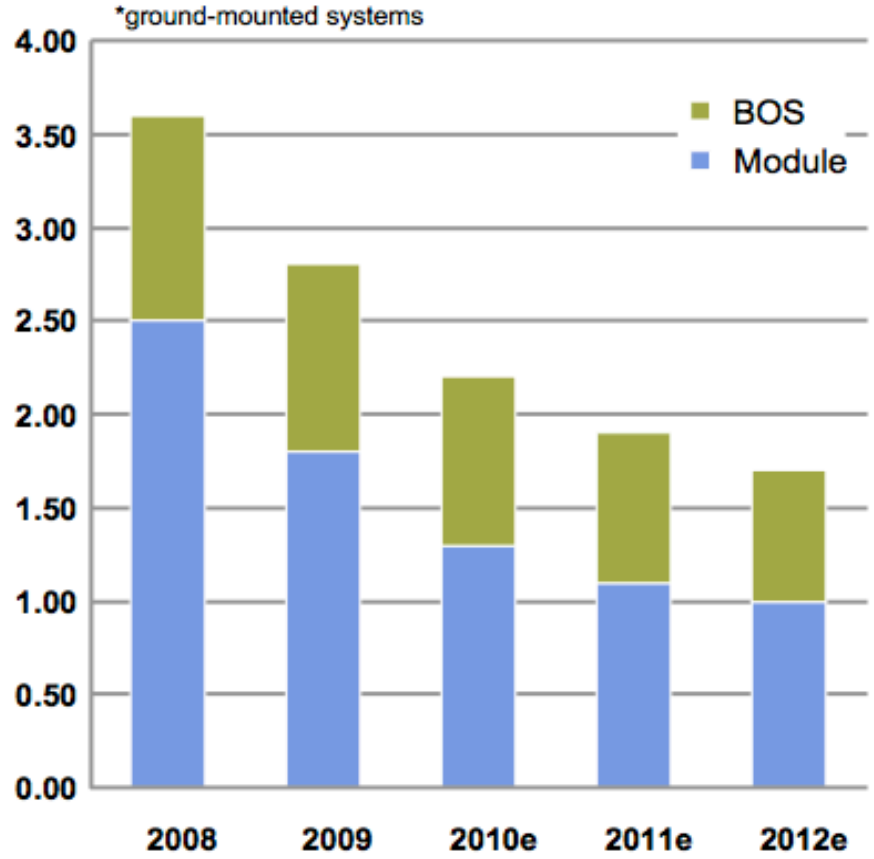

Source: McKinsey 06/2008; WACKER analysis

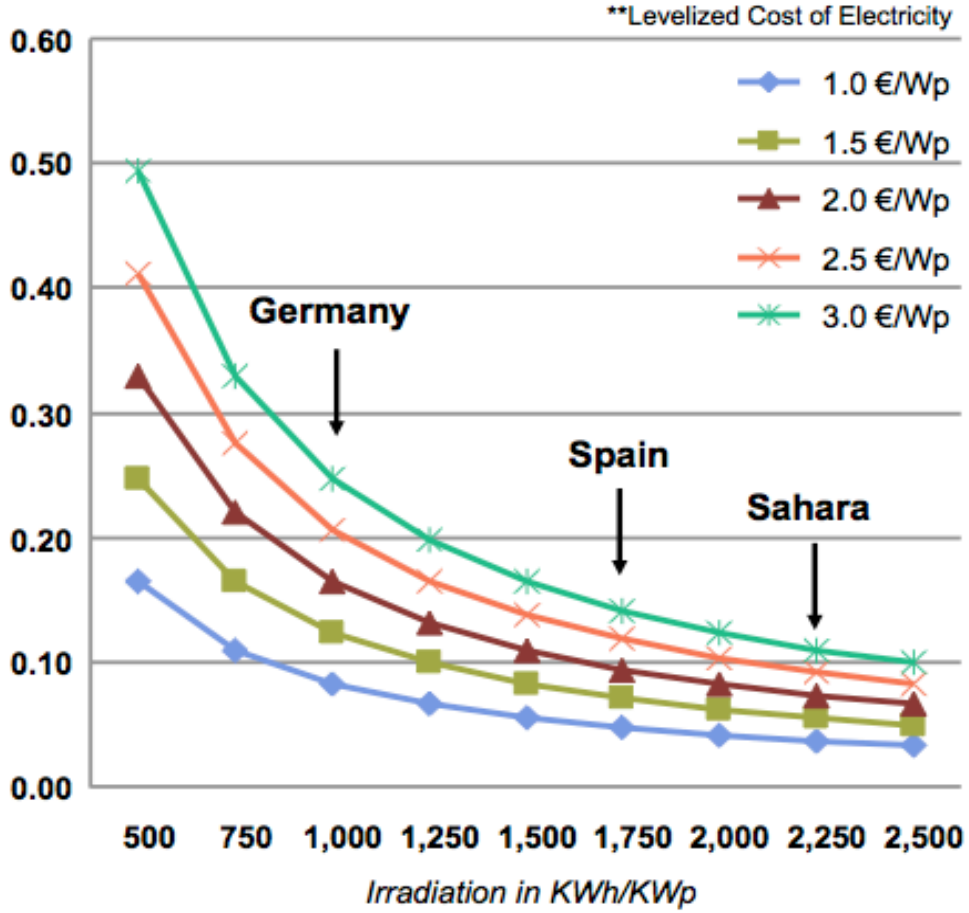
WACKER POLYSILICON

**PV Conference, Zurich**
WACKER, February 2010, slide 16

# 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

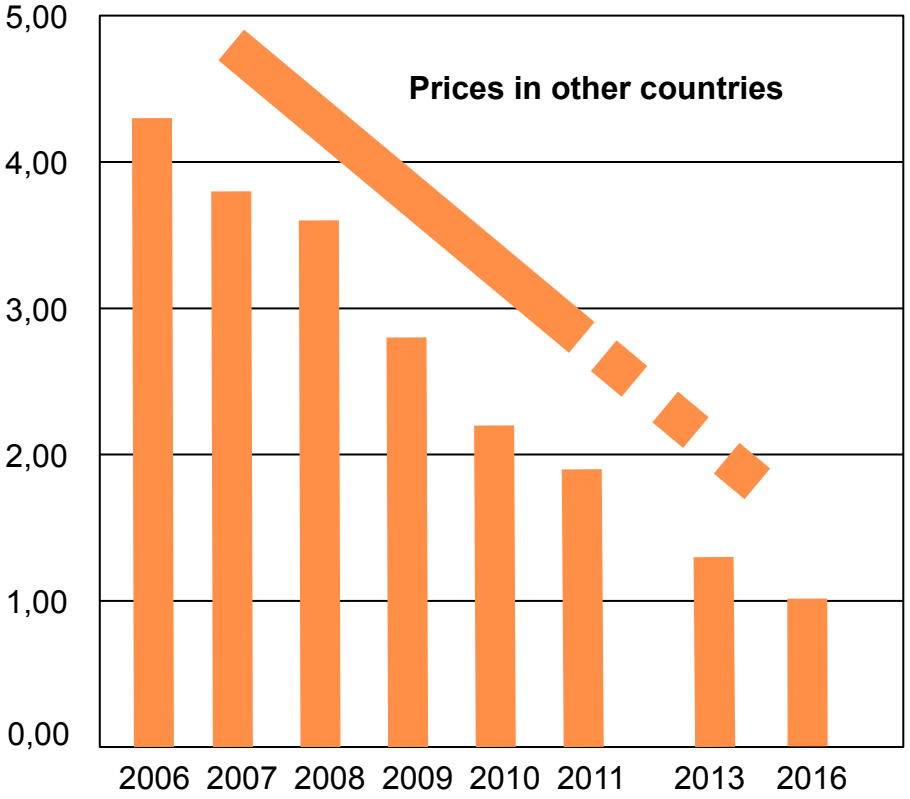
WACKER POLYSILICON

**Supplying a Growing Industry**
Wacker Chemie Investor Relations @ PVSEC Valencia 2010, slide 20

# Halving systemcosts of PV in the last 4 years – below grid parity for households after 2011

## PV Systemcosts (€/Wp)

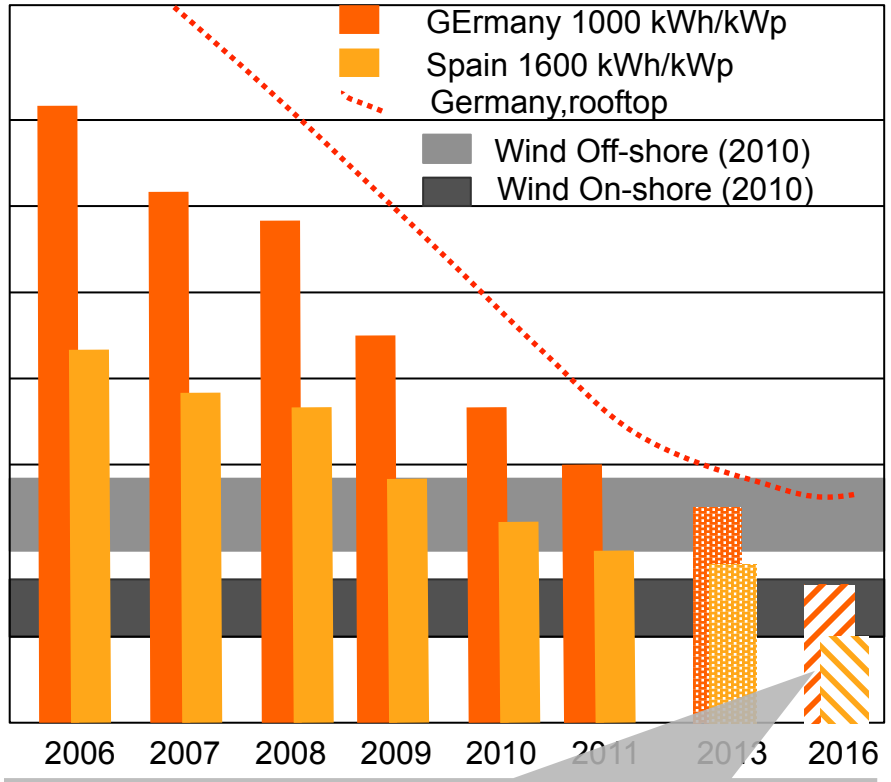
Germany, ground-mounted)




## PV LCOE (€cent/kWh)

**(levelized costs: „necessary feed in renumeration“)**

(Germany, ground-mounted)

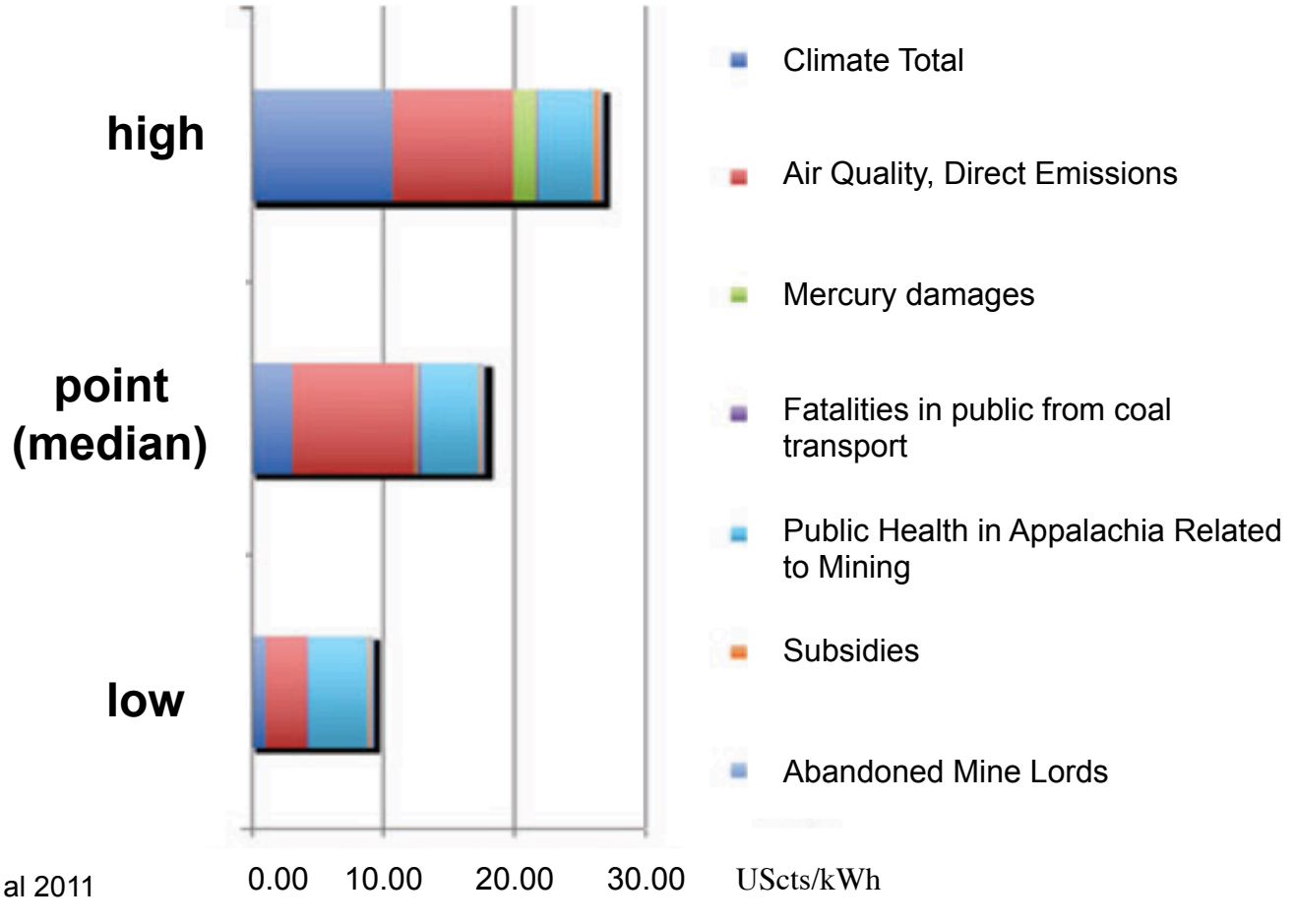



**In 2016 a feed-in renumeration of 8ct/kWh in Germany and 5 ct/kWh in Spain is enough (incl.6% ROI)**

Quellen: LBBW 02/2009, Industrieankündigungen, WACKER Analysen

# External costs of electricity from coal in the US

**Three mutually reinforcing strategies for climate mitigation:**
**Internalize external costs – reduce costs of renewables – foster efficiency**

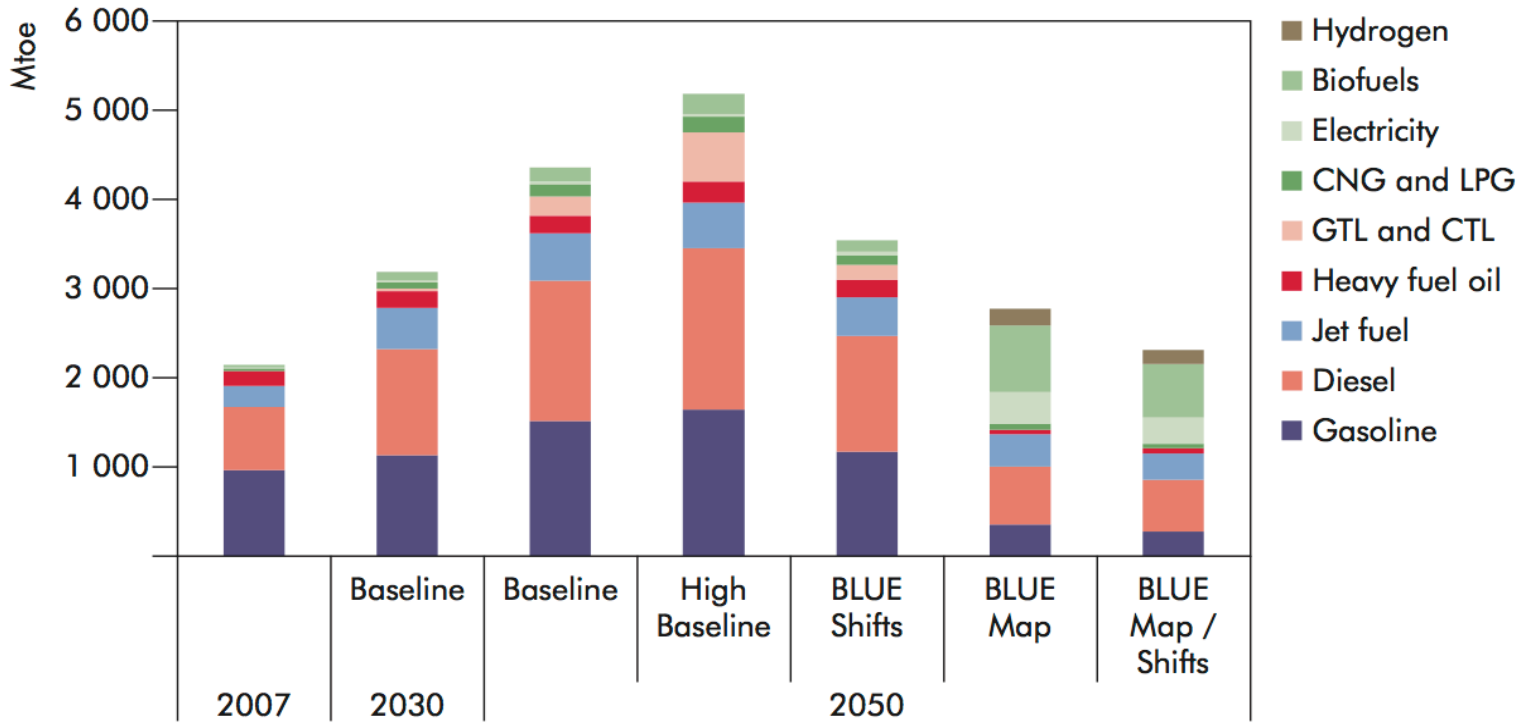



Source: Harvard University, Epstein et al 2011

**A shift to „green power“ is on the way, but „sustainable mobility“ and „green buildings“ are still visions for the future!**

# Huge challenges for the transportation sector – many uncertainties!

## Global transportation sector by fuel type in the IEA Scenarios: The BLUE Scenario cuts energy use by almost half compared to Baseline in 2050, and cuts fossil fuel use to less than 50% of energy use

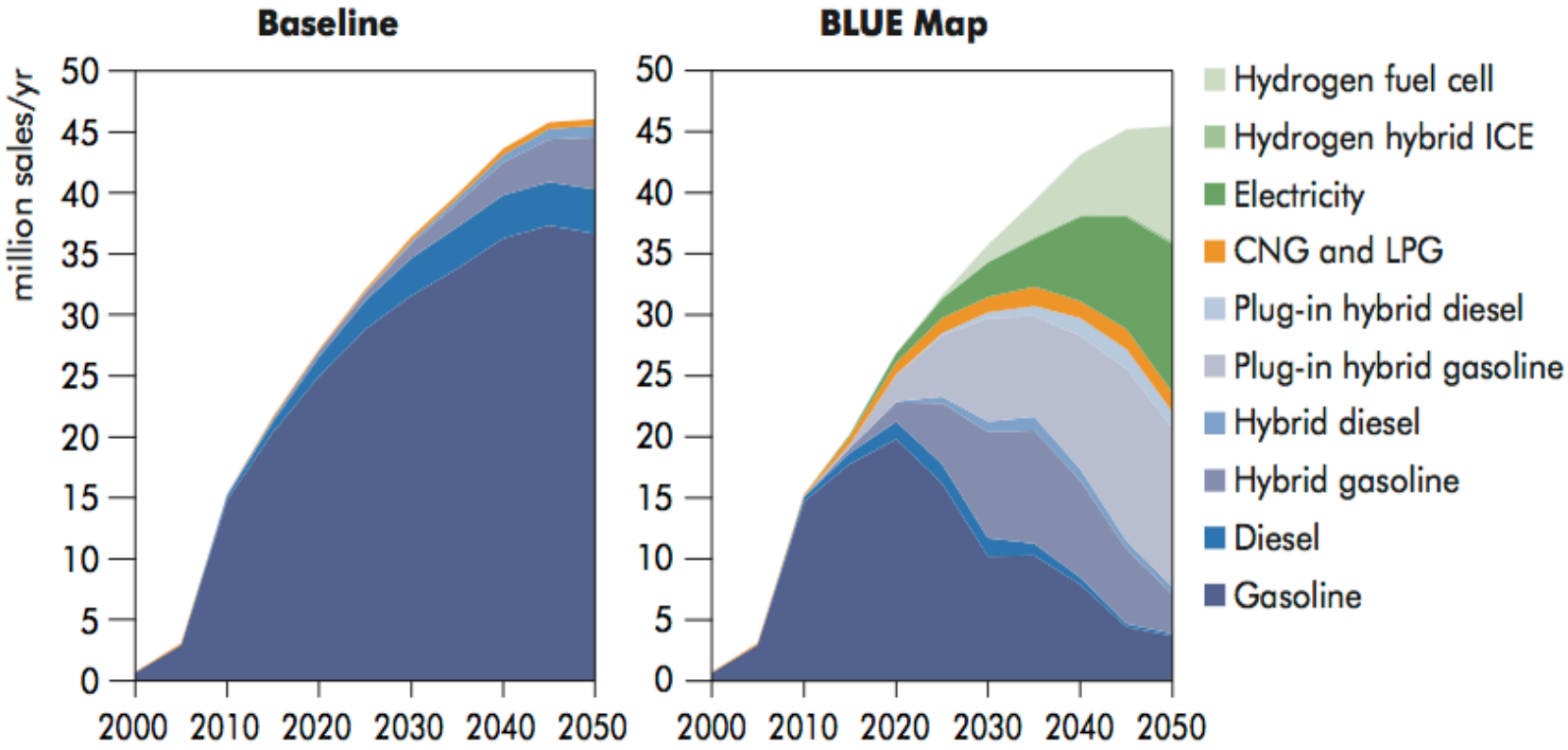



*Note:* Unless otherwise indicated, all material derives from IEA data and analysis.

Source: IEA, Energy Technology Perspectives 2010

# A mobility revolution in China?

**Car sales explosion and diversified technical fuel options according to the IEA BLUE Map scenario: rapid introduction of new generations of advances vehicles in China?**

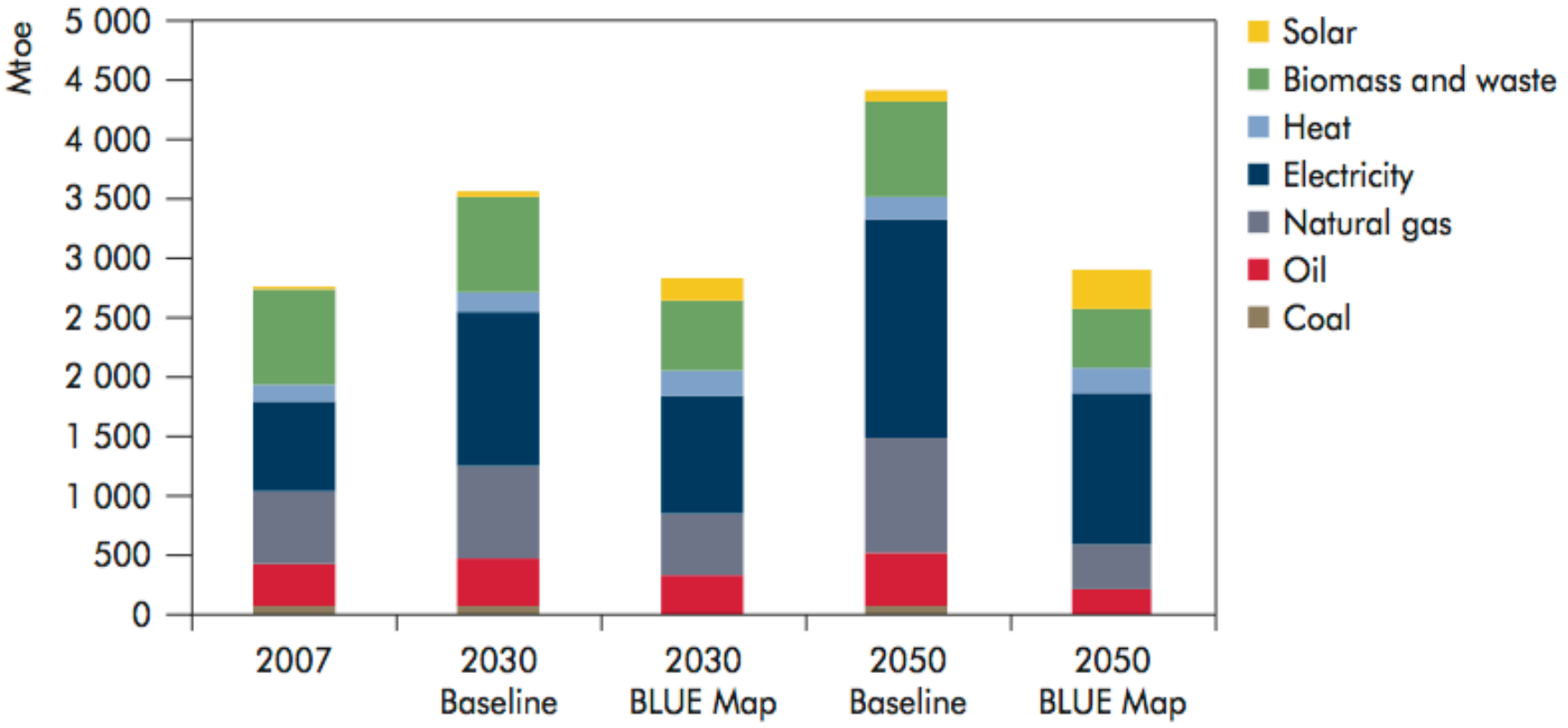



Source: IEA, Energy Technology Perspectives 2010

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

# Stabilizing energy consumption in the global building sector ?

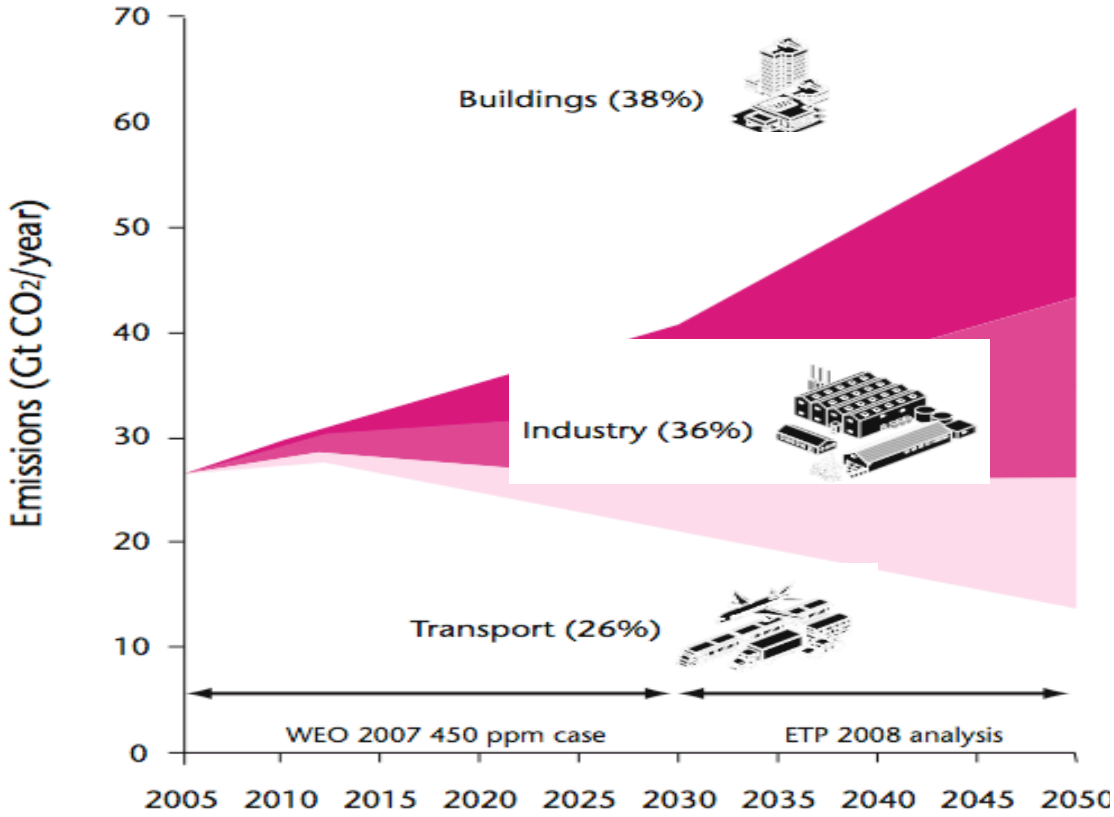
**In the IEA Blue Map scenario energy consumption in the building sector is only 5% higher in 2050 than in 2007**




Source: IEA, Energy Technology Perspectives 2010

# The implementation gap

## Buildings have to contribute 38% of $CO_2$ reduction in 2050



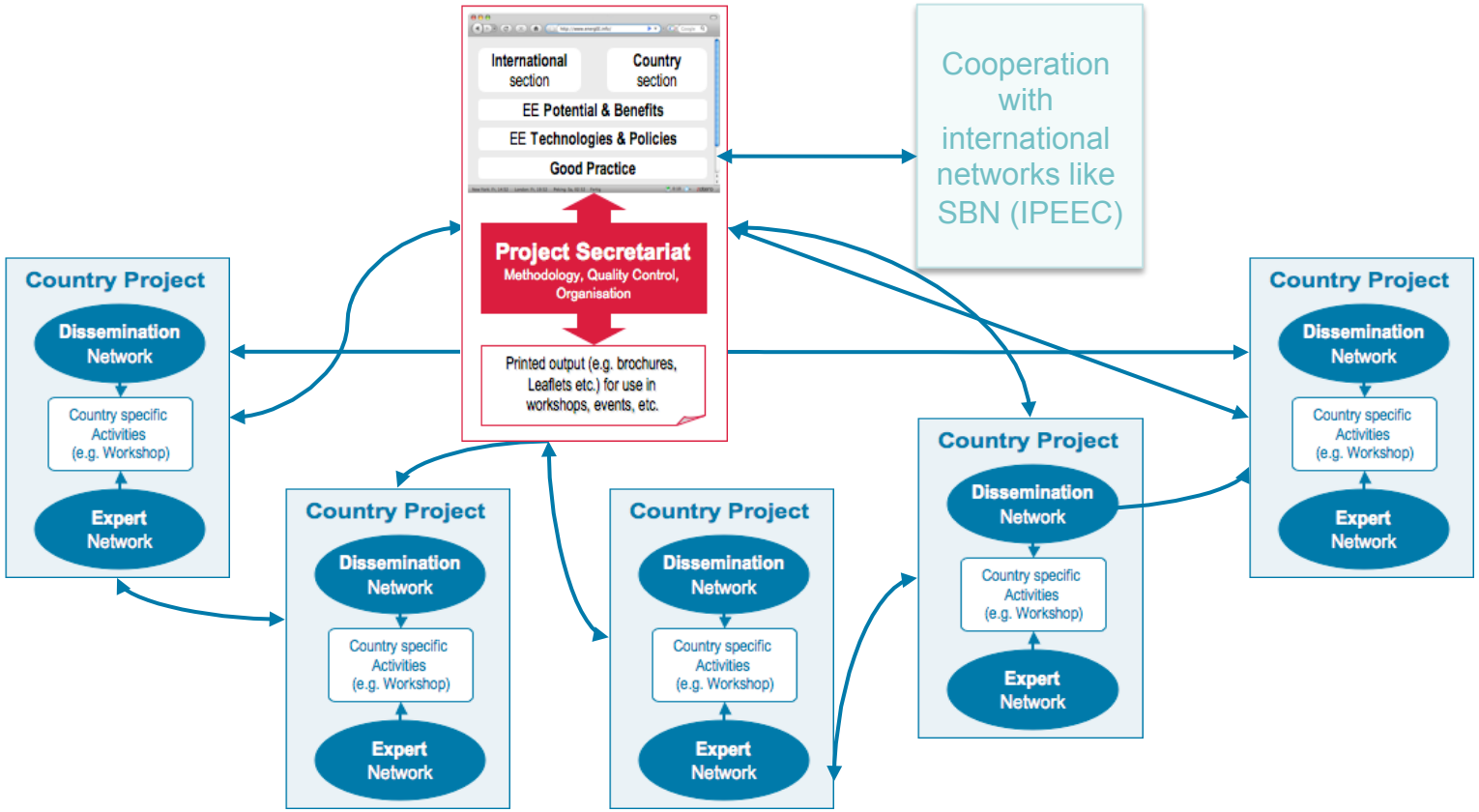

- **This will only happen, if innovative policies and measures are used**. ***Because:*** the sector has complex structures and lots of barriers.

- **Knowledge exists but is not easily available ("closing the knowledge gap")** ***In particular:*** for emerging economies and developing countries

Source: IEA 2008

# International bigEE network

## Starting with China and India, next South Africa....




Source: Wuppertal Institute, bigEE 2011

# bigEE – range of topics

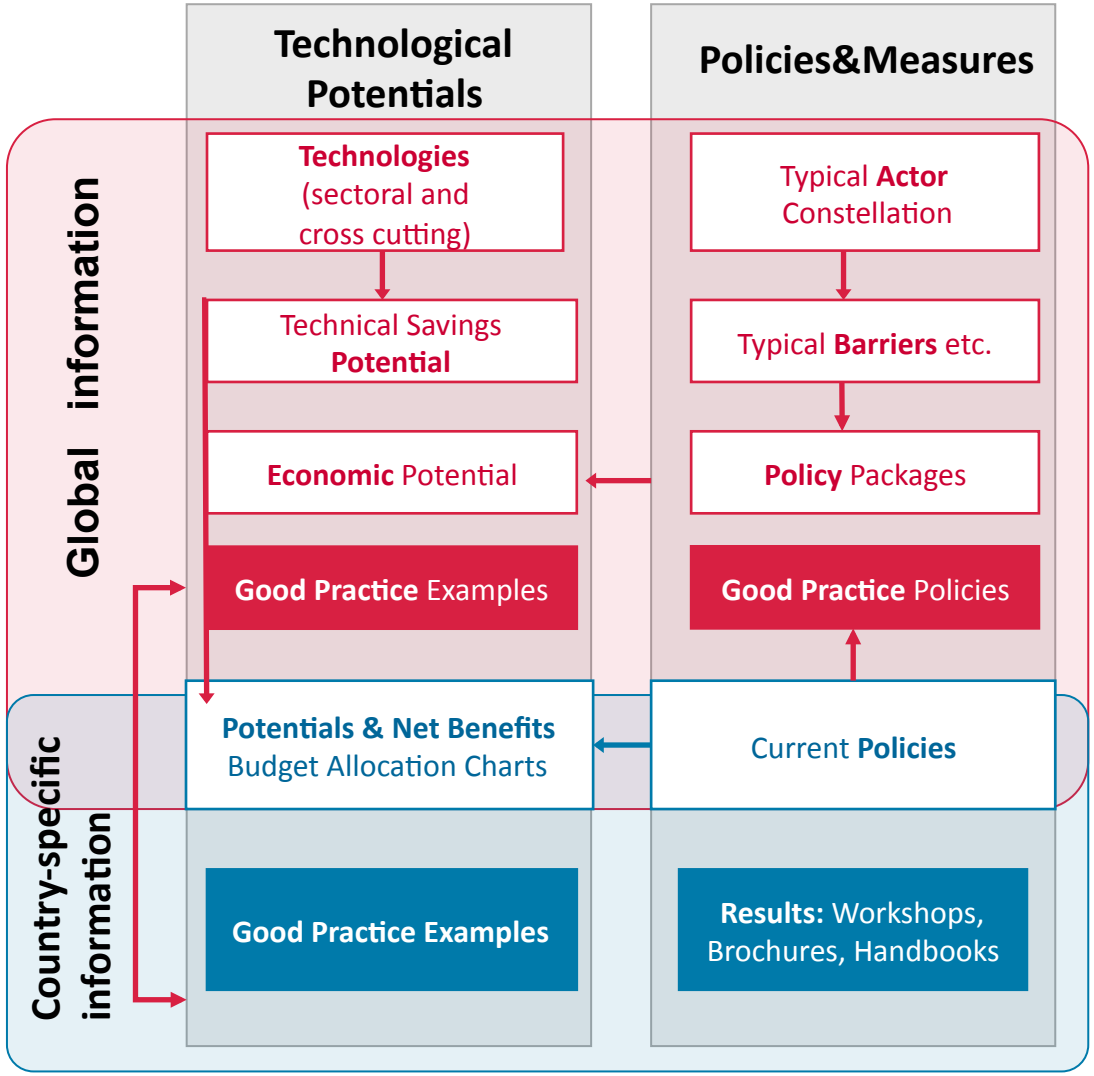
bigEE

**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

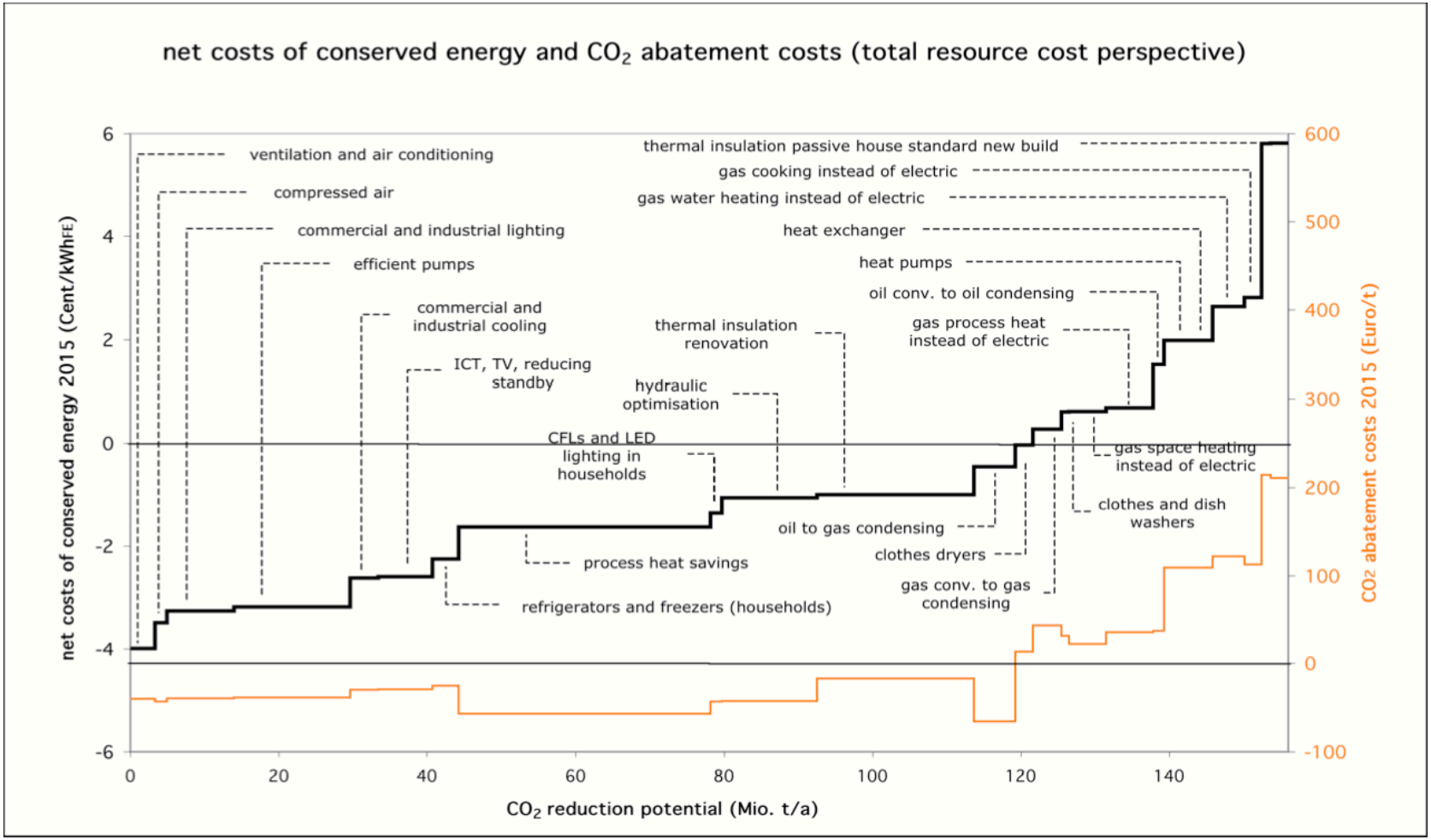
**at**
- international and
- national levels.




Source: Wuppertal Institute, bigEE 2011

# Motivate and prioritize strategic policy decisions by „Budget Allocation Charts (BAC)“

## Example for Germany




Source: Wuppertal Institute 2006

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

# “Revolutionary Targets” (Chancellor Merkel) of the German Energy Concept

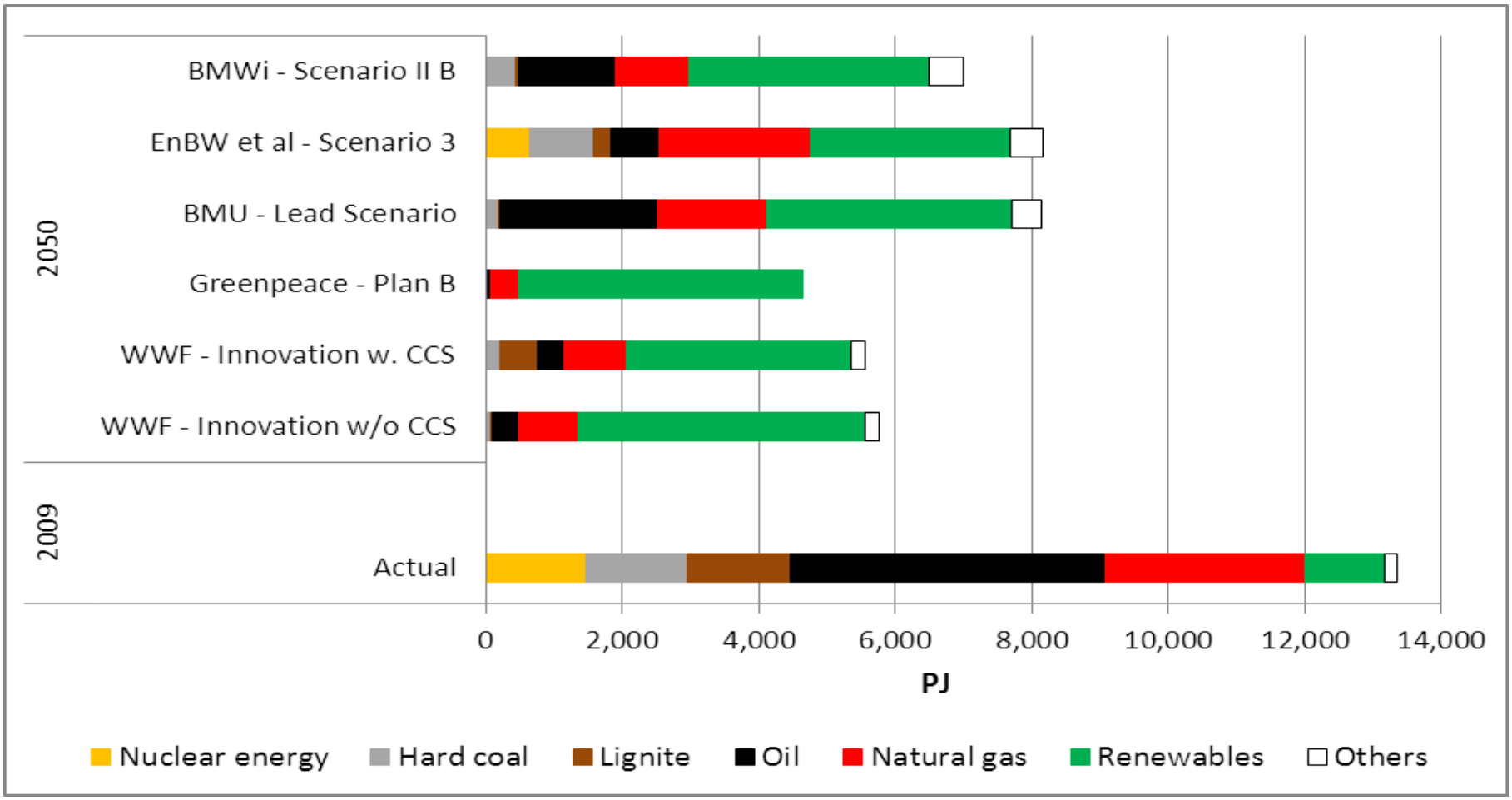
## How will it be implemented? Is it transferable to other countries - including the phasing out of nuclear?

| 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 | | | | |
| **Reduction** of the **Final Energy Consumption** in the **Transport Sector** [base year 2005] | -10% | | | -40% |

Source: Federal German Government 9/2010

# Primary energy supply in 2009 and 2050 according to recent scenarios for Germany

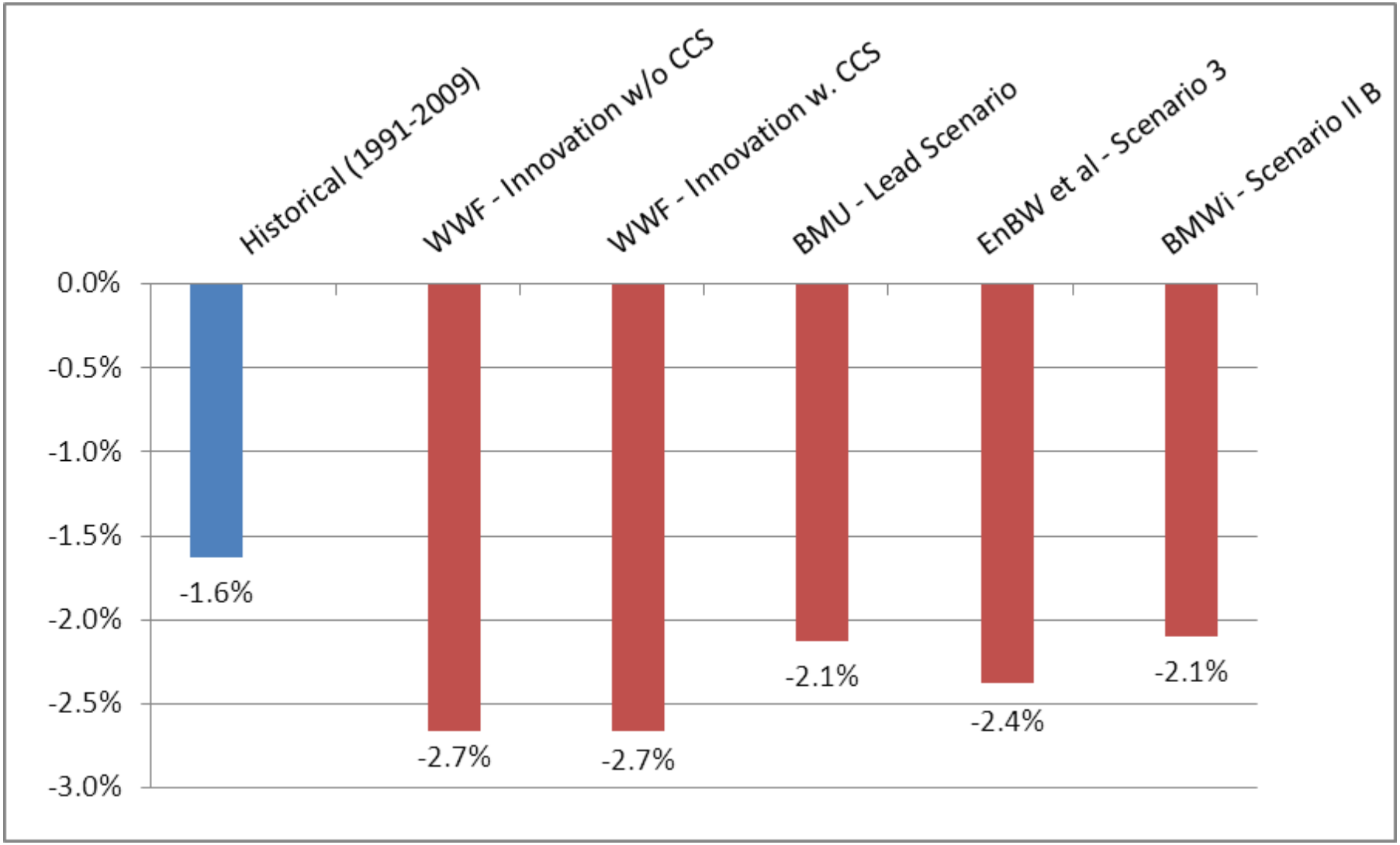
## The roadmap for decoupling exists, but the “Efficiency Master Plan” is missing




Source: AG Energiebilanzen 2010; Samadi 2011

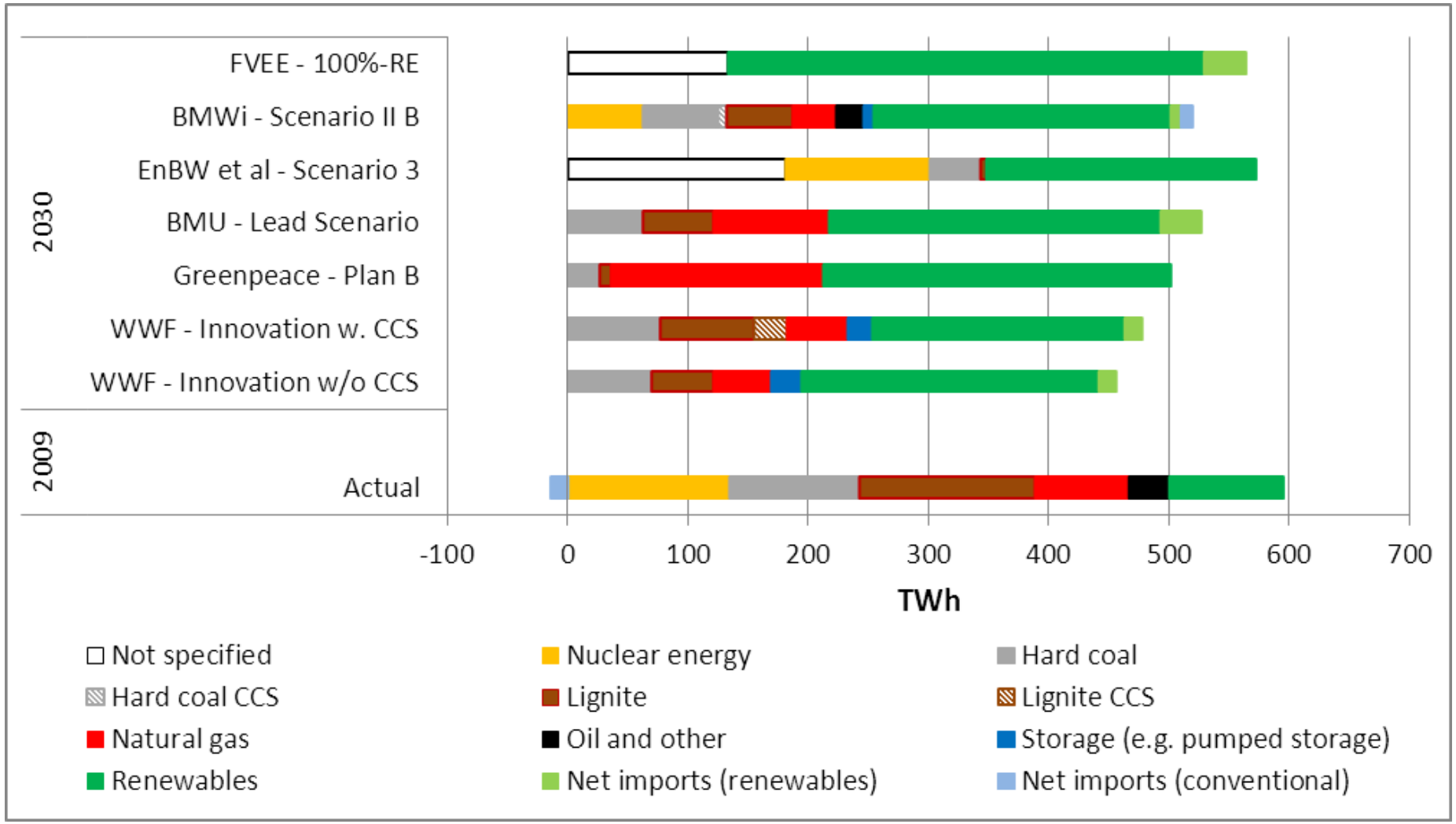
# Average annual change in energy intensity between 1991 and 2009 (actual) and until 2050 according to various scenarios

**(Sources: AG Energiebilanzen 2010, Federal Statistical Office 2010, energy scenario studies as provided)**



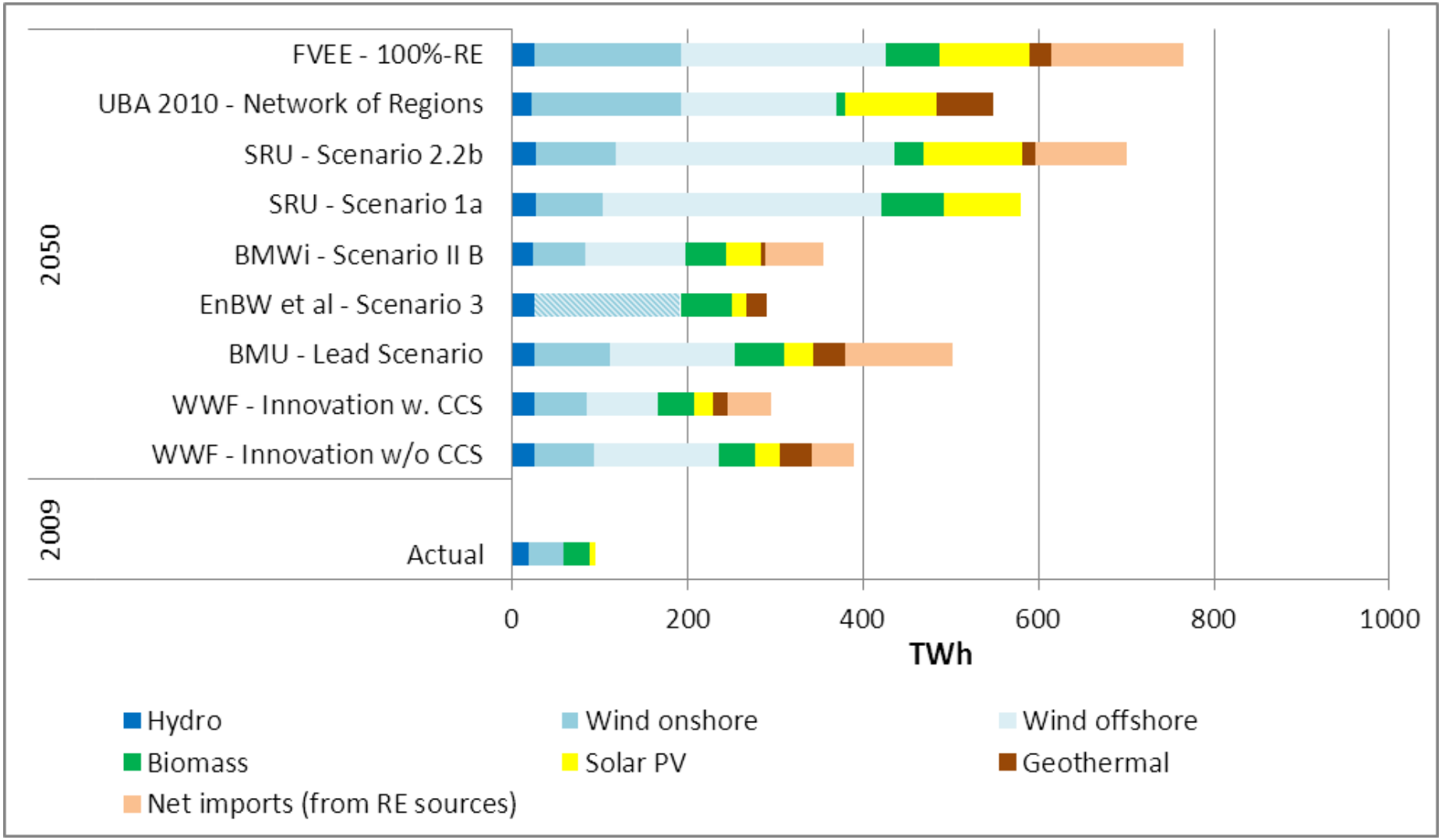
# Electricity demand by sources covering it in 2009 (actual) and in 2030 according to various scenarios

**(Sources: AG Energiebilanzen 2010, scenario studies as provided)**



# Electricity generation from renewables by source in 2009 (actual) and in 2050 according to various scenarios

**(Sources: BMU 2010, energy scenario studies as provided)**



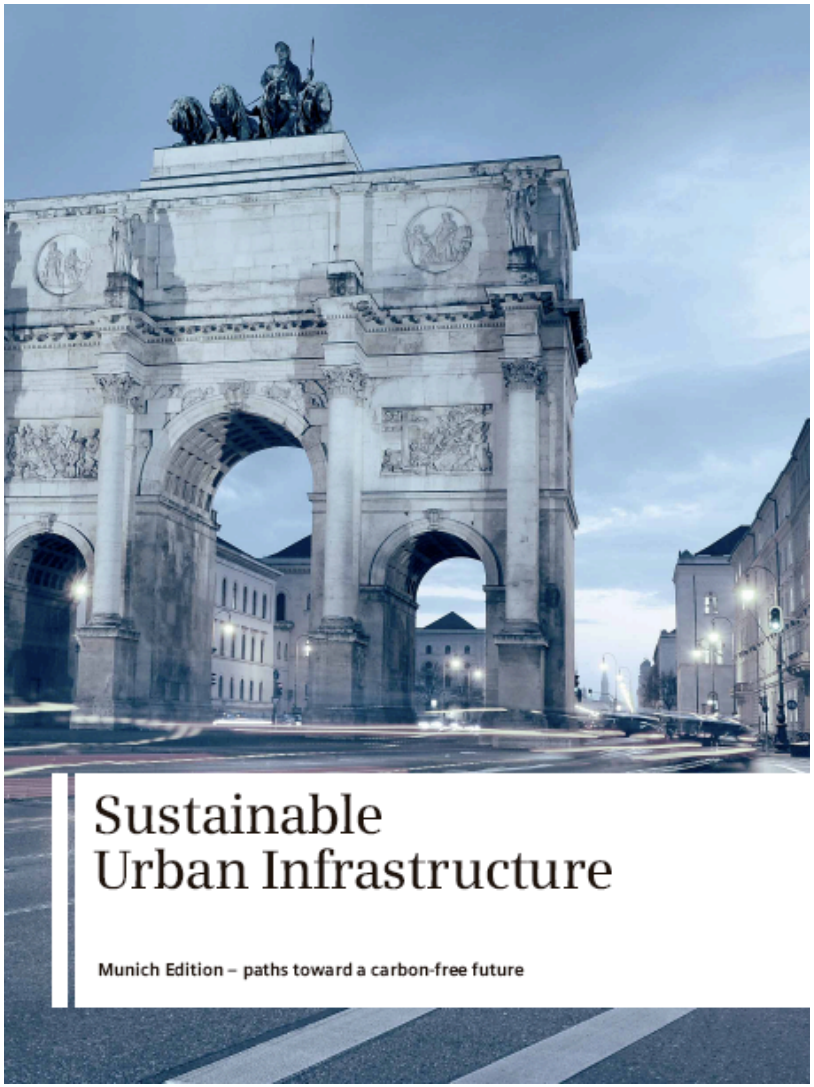
# „The Sun Ship“ in Freiburg/Germany:

## Worldwide first „Plus Energy“ Office Building

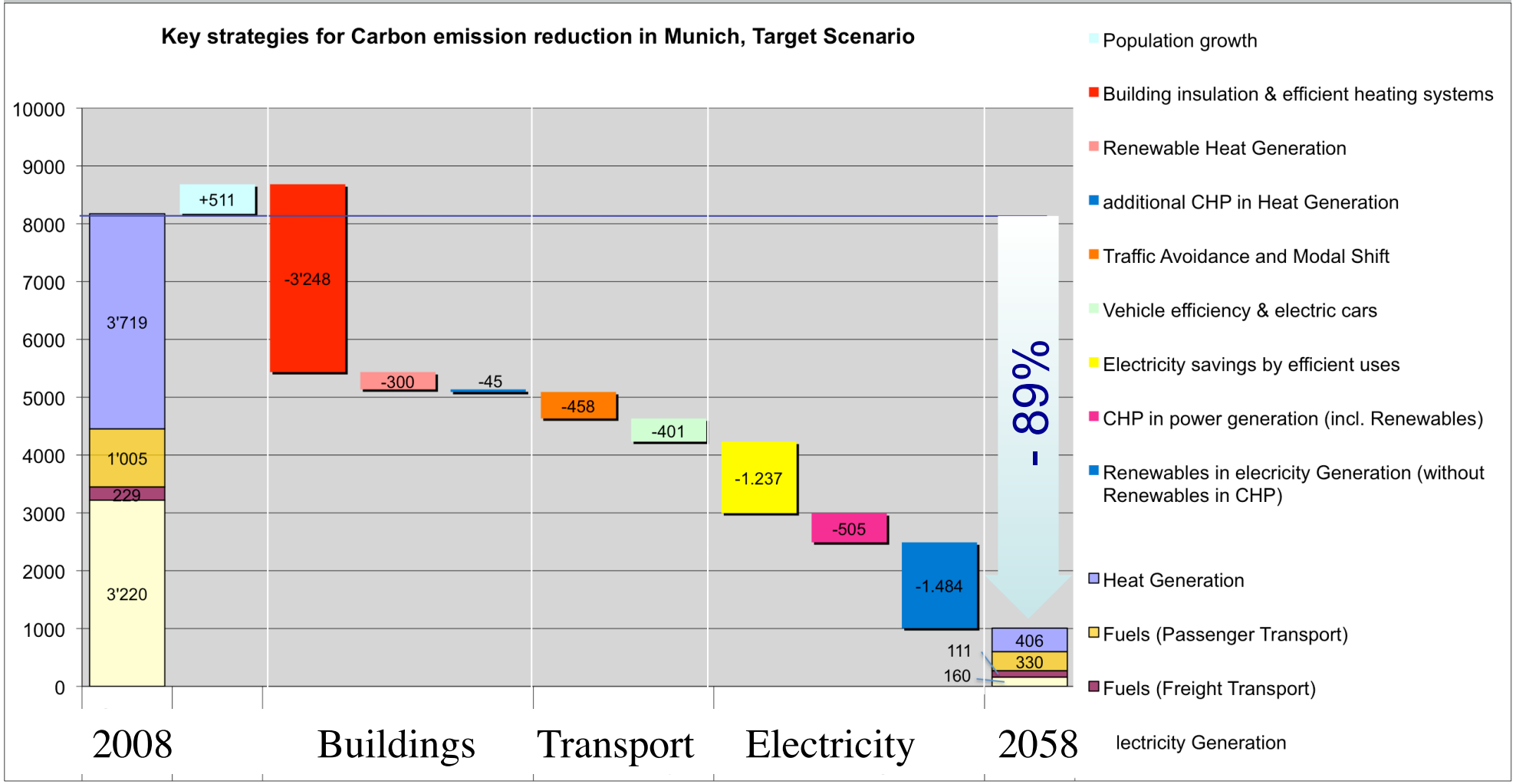
Source: „Plusenergiehaus®“; Disch 2007

# 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**



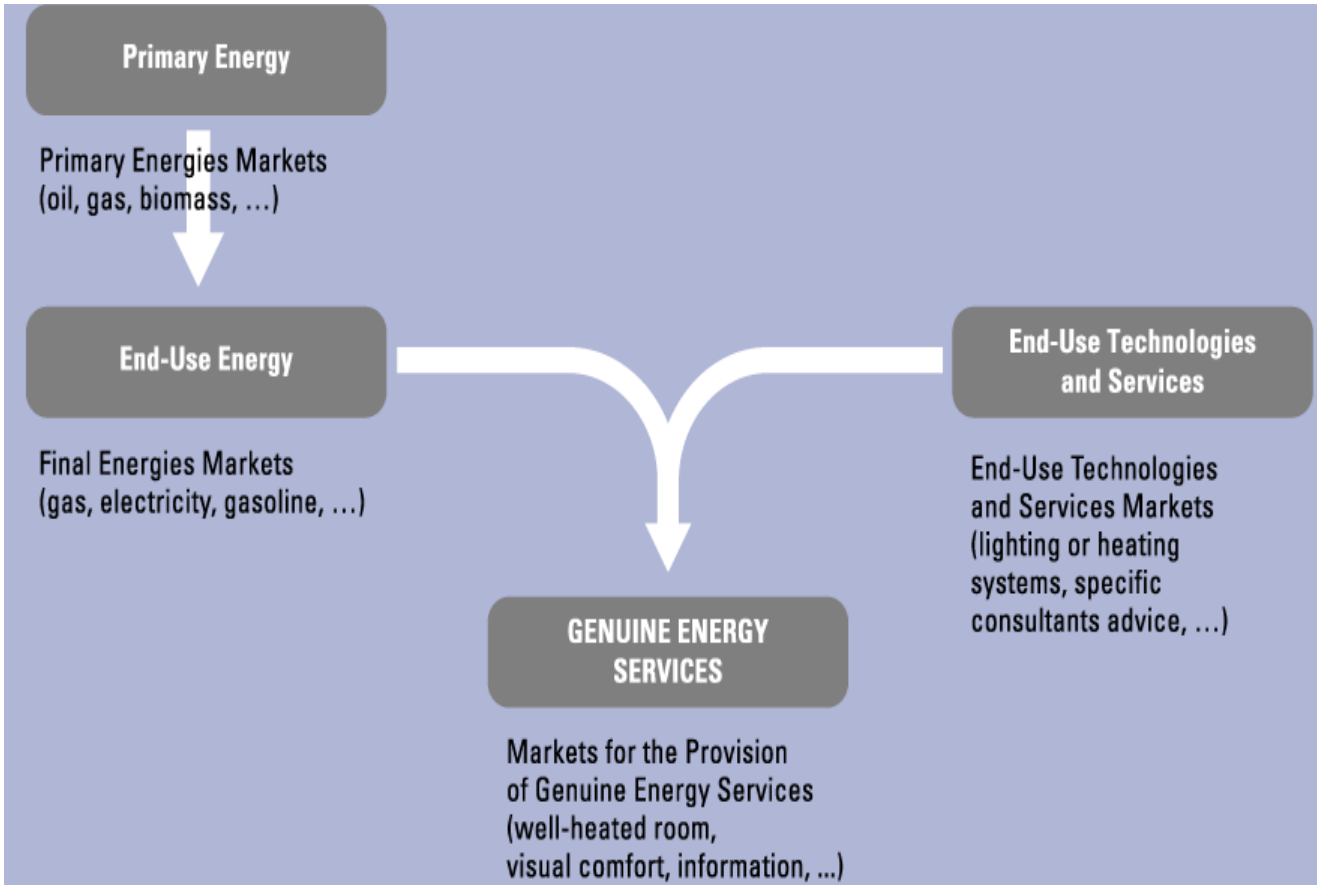
# Key options to reduce $CO_2$ by 90% in Munich




Source: Wuppertal Institute 2009

# The goal of market transformation

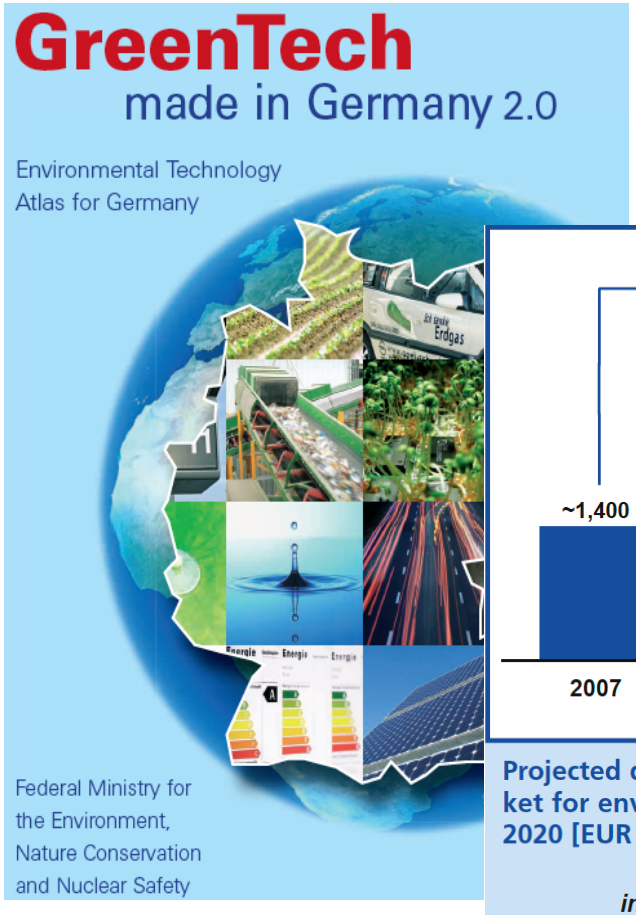
**Least cost energy services instead of cheap and risky kilowatthours! Market reforms should include the supply and demand side!**

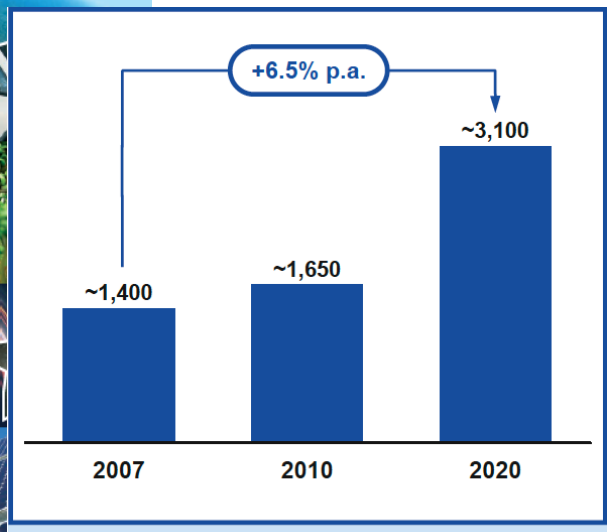



Source: Thomas 2007

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

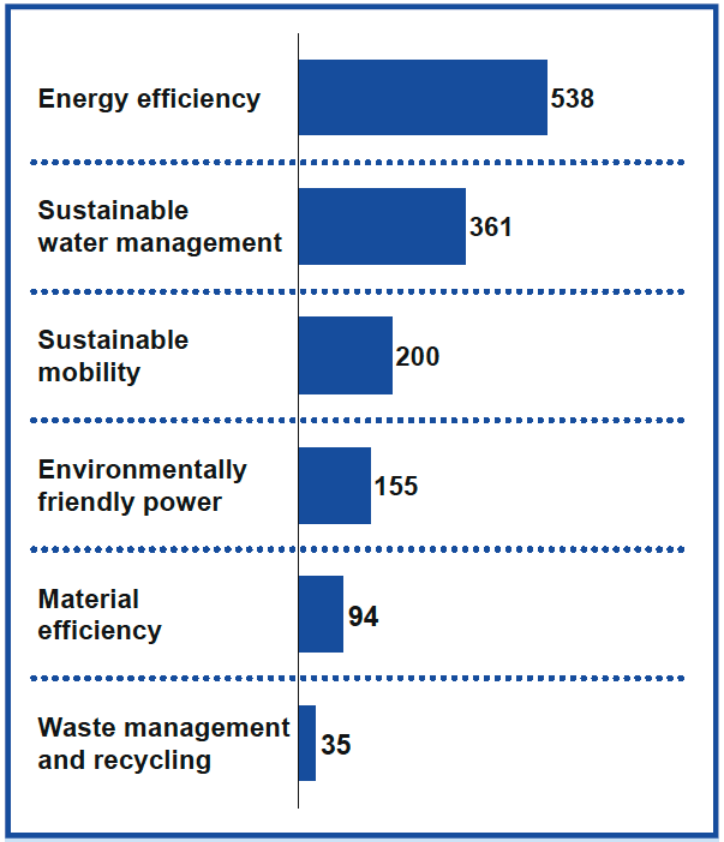
## Six selected Lead Markets




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

*Source: Market studies, interviews with experts, Roland Berger*



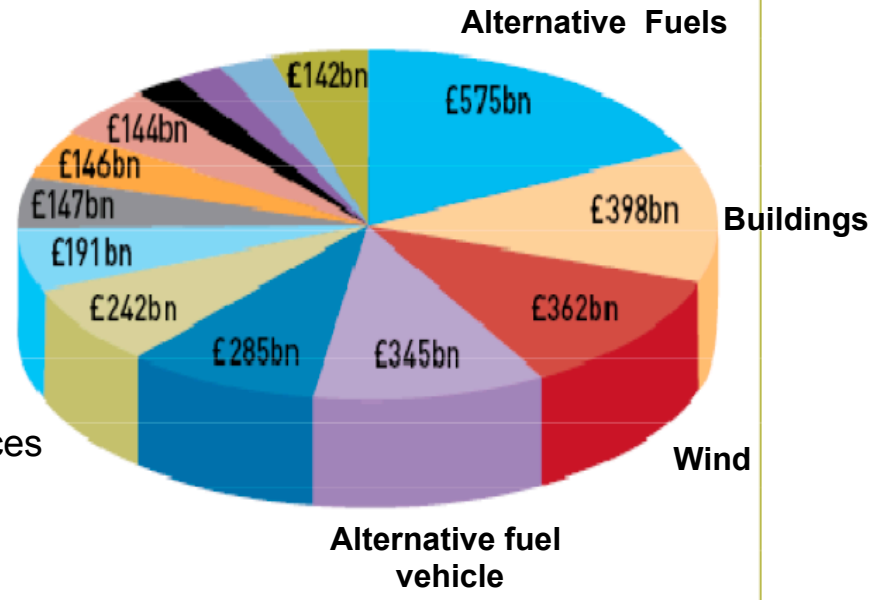

Global market volume for environmental technologies in 2007 [EUR bn]

*Source: Market studies, interviews with experts, Roland Berger*

# Estimated global value of low-carbon and environmental goods and services 2008/2009: 5100 bn €

Global low-carbon and environmental goods and services by sub-sector 2008/09, £ bn.

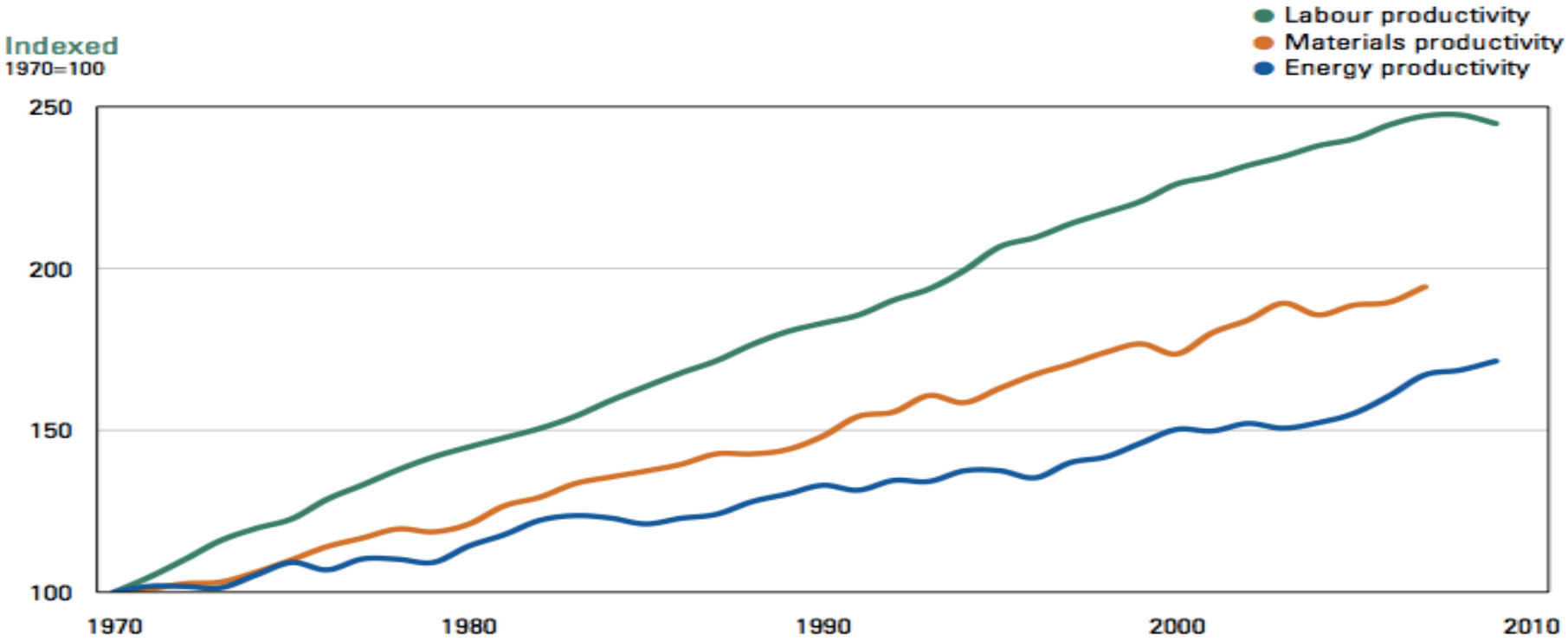
- Alternative Fuels
- Building Technologies
- Wind
- Alternative Fuel Vehicle
- Geothermal
- Water Supply and Waste Water Treatment
- Recovery and Recycling
- Photovoltaic
- Waste Management
- Biomass
- Energy Management
- Carbon Finance
- Additional Energy Sources
- Other




Source: Innovas Low carbon and Environmental Goods & Services : an industry analysis 2009

# Material- and energy productivity lacks behind labour productivity

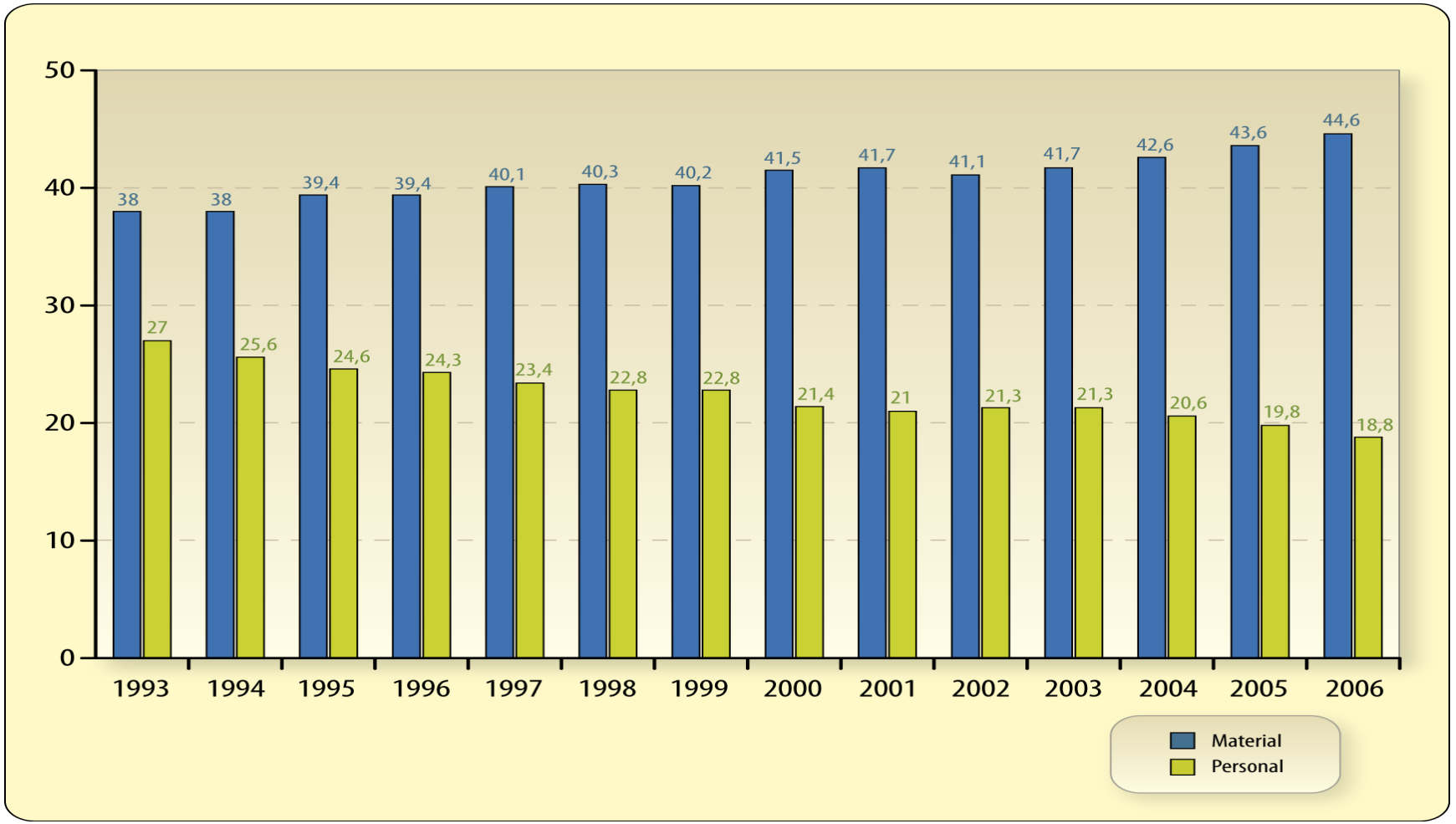
## „Green technical progress“ makes tons and kilowatt-hours redundant not people!




Note: Labour productivity in GDP per annual working hours; material productivity in GDP per domestic consumption (DMC) and energy productivity in GDP per total primary energy supply (TPES).

Source: EEA 2011

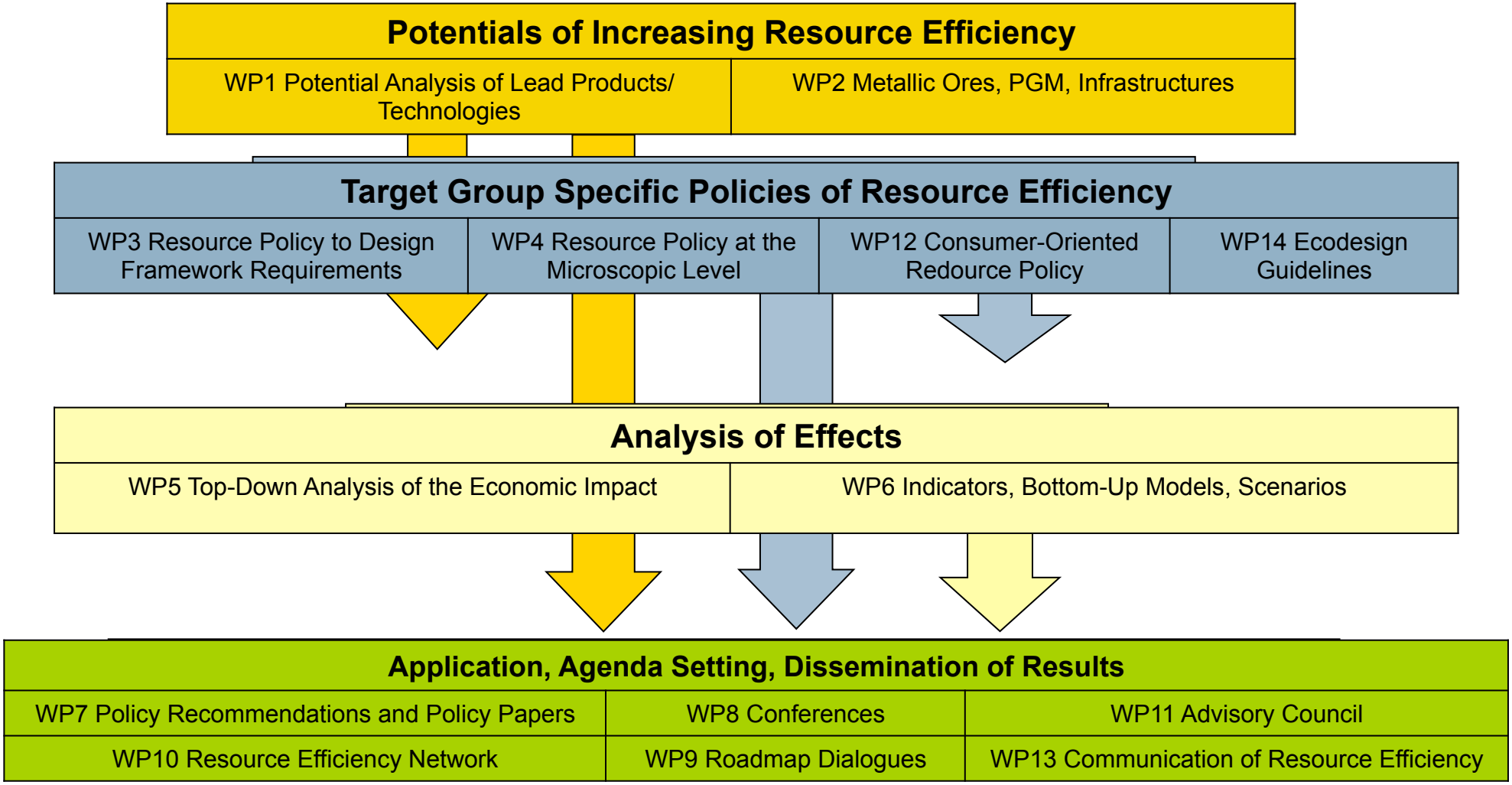
# **High shares of material** (blue) **costs compared to wages** (yellow) **in relation to total costs in German industry**




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

# “Material Efficiency and Resource Protection”: A project to support German “Ecological Industrial Policy”




Source: Wuppertal Institute and 30 partners; on behalf of the German Ministry of Environment (2007-2010)

# 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

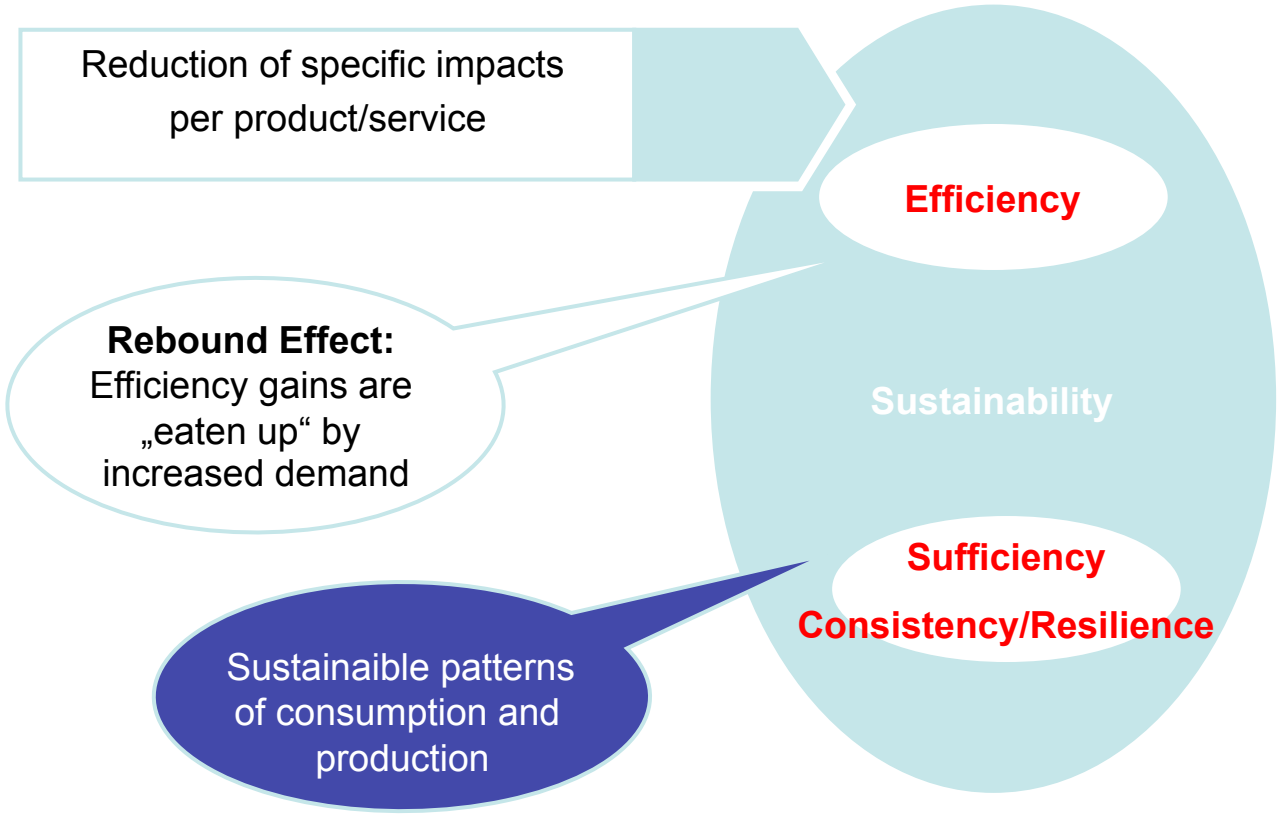
  3. Reduction of resource costs increase competitiveness

Source: Distelkamp / Meyer / Meyer 2010

# Is efficient sufficient?

# 25% less energy/raw materials per $ GDP are “eaten up” by 82% global economic growth!

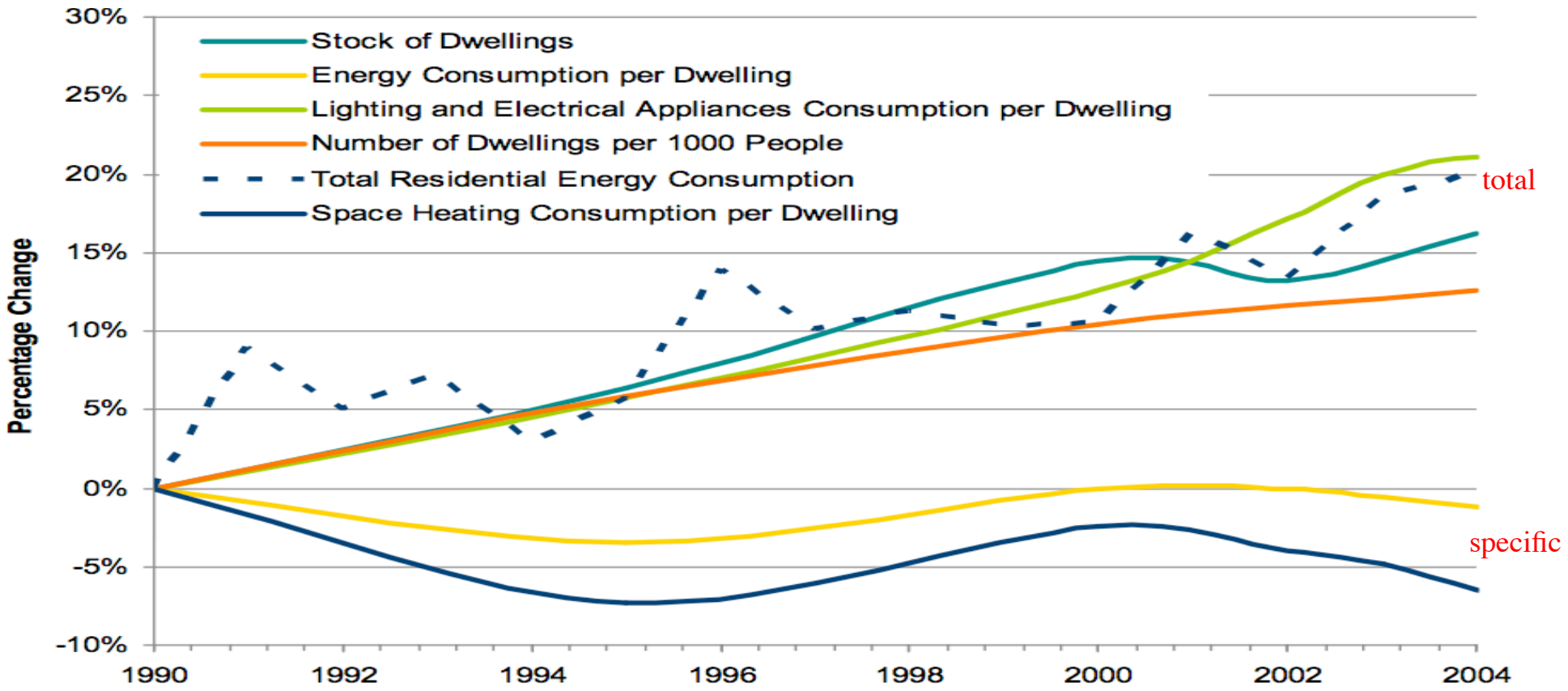
## Only an integrated approach “efficiency + sufficiency + consistency” leads to sustainable development




Source: Wuppertal Institute 2009

# More dwellings and more consumption of appliances have overcompensated the specific efficiency gains in buildings!

## Trends in EU Housing Efficiency, 1990-2004




Source: Is efficient sufficient? ECEEE 2010

# Luxury eats up efficiency

**Each American, European oder Chinese a  Sony „home cinema“?**

## How Far Will the Trend Toward Larger Screen Sizes Go?

Sony now recommends a *minimum* screen size of 46 inches for “your largest TV viewing room” and a screen size of “40 inches or smaller” for bedrooms and kitchens!


„Sometimes...average  power use per new TV...even exceeded where it had been in the 1940s area of CRTs and vacuum tubes“ (C.Calwell, 2010, S.21)

# Prestige eats up efficiency!

- VW Käfer, 1955, 730 kg, 30 HP,
  110 km/h,
  7,5 1/100km

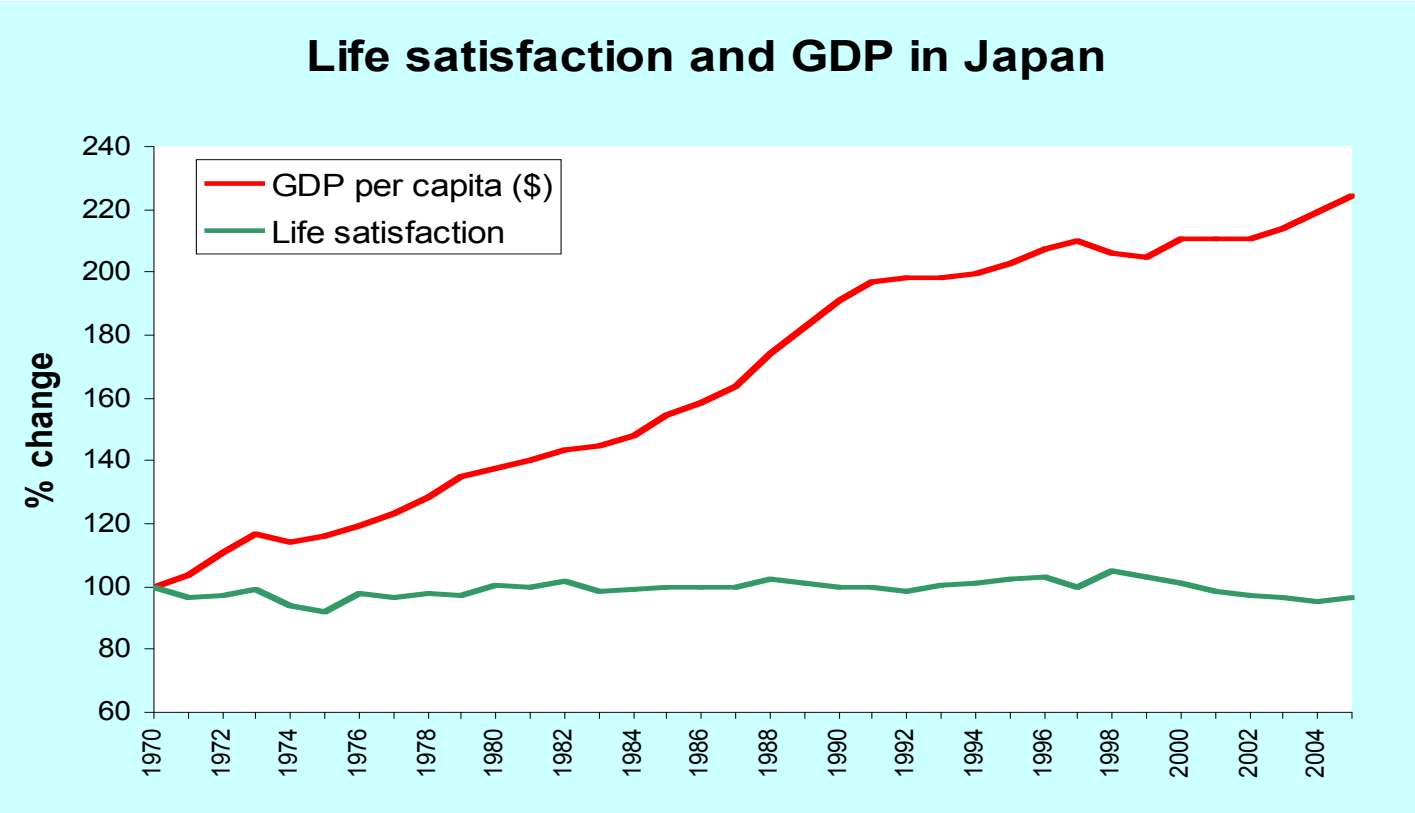
- VW New Beetle, 2005,
  1200 kg, 75 HP,
  160 km/h,
  7,1 l/100km

*Average HP of German Car Fleet*
*1973: 60HP -> today: 103 HP !*

**Source: Wuppertal Institute 2008**

# Since the 1970th GDP and Life Satisfaction is delinking

## A dialog on sustainable patterns of consumption is needed!




Source: Wuppertal Institute 2009

# Global increase of the “new consumer classes”:

## Copying the unsustainable consumption patterns of the North? Globalisation of Consumerism?

| Country | Members of CC 2002 (in millions) | Share of total population (in %) |
|---|---|---|
| USA | 242.5 | 84 |
| **China** | **239.8** | **19** |
| **India** | **121.9** | **12** |
| Japan | 120.7 | 95 |
| Germany | 76.3 | 92 |
| **Russian Federation** | **61.3** | **43** |
| **Brazil** | **57.8** | **33** |

The share of worldwide “consumer classes” ( CC > 7000 US$ yearly nominal income) will raise from 1.7bn to 2bn in 2015



especially in transition countries large backlog demand

Source: Bentley 2003: Leading consumer classes in countries 2002

Wuppertal Institute
for Climate, Environment
and Energy

**Thank you for your attention!**

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http://www.wupperinst.org