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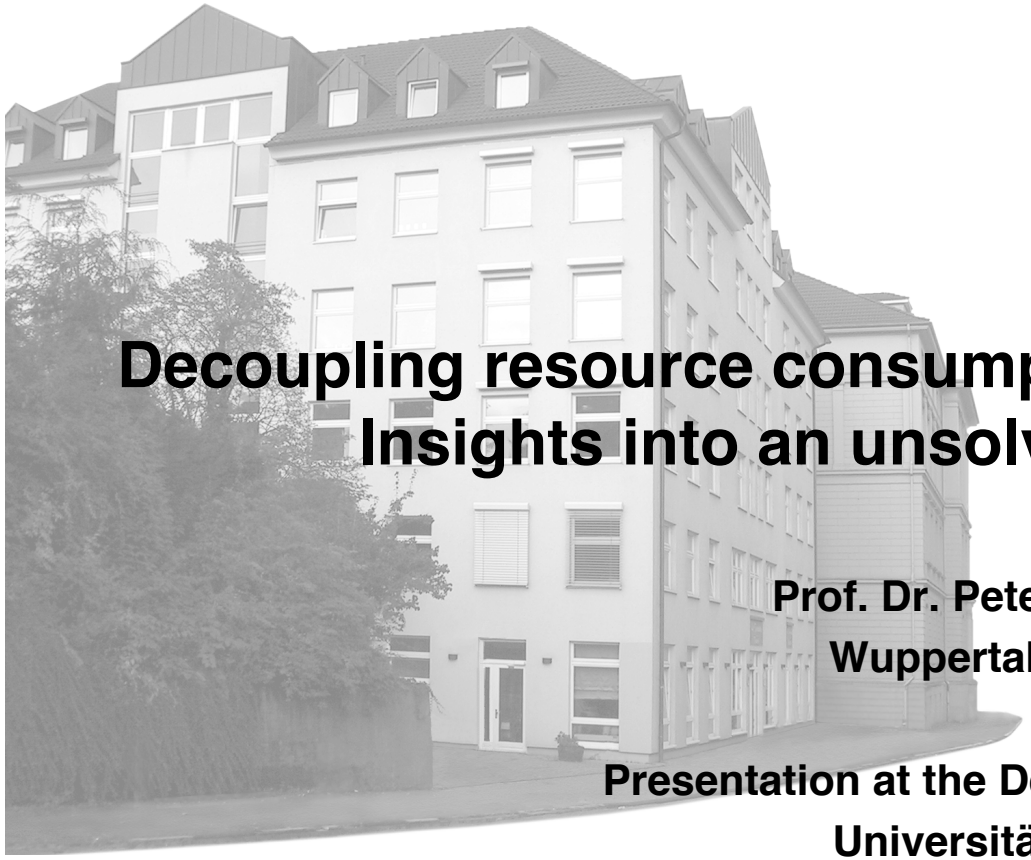


Decoupling resource consumption and economic growth: Insights into an unsolved global challenge

Prof. Dr. Peter Hennicke
Wuppertal Institute

Presentation at the Degrowth Conference
Universität Leipzig
4.9.2014

Thesis

The global necessity of decoupling well being from the use of nature

- Staying within „planetary boundaries“ is impossible without decoupling: the energy sector is key
- „Absolute“ decoupling in ICs and „relative“ decoupling in DCs including global lifestyle changes
- Rapid growth of “Lead markets for GreenTech” (e.g. efficiency, renewables) drive decoupling
- A “resource efficiency revolution” is necessary to compensate growth effects

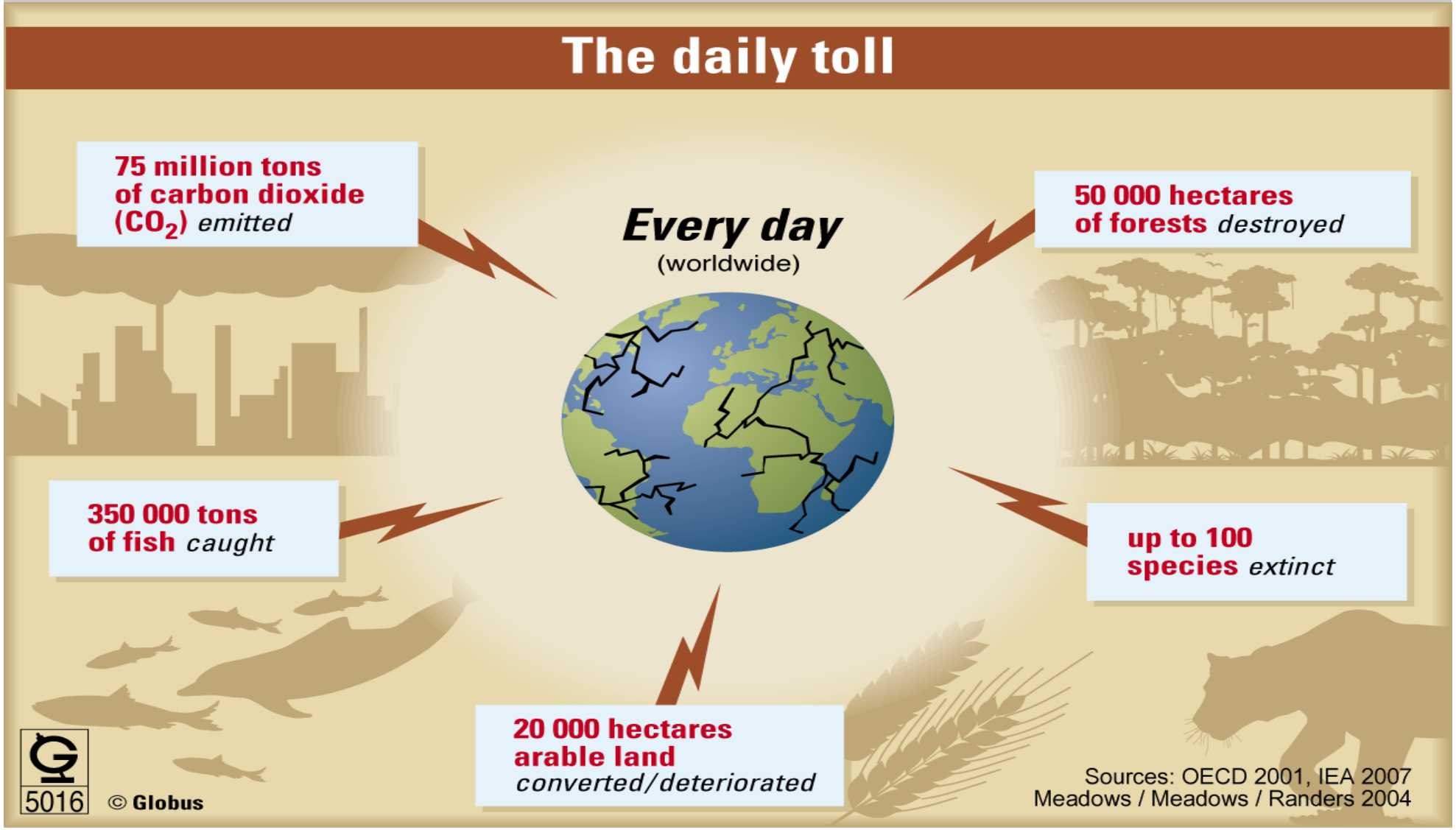
The “Energiewende”: An enabling process for decoupling and a “greener” society

- Ambitious government policies, expert consensus, economic co-benefits are crucial
- Pioneering work for systems transition (e.g. fluctuating power, decentralisation) is needed
- Social acceptance depends on citizens partizipation and costs distribution (sectors; time scale)
- Renewables on track, but efficiency and sufficiency policies are lacking behind

The “Great Transformation” (WBGU): Social learning by transforming the energy system

- Re-socialisation of energy by polycentric governance
- Binding national/EU targets, cities transition, 100% RE-villages etc.: „let a hundred flowers bloom“
- Prevent that efficiency gains are “eaten up” by rebound -, lifestyle - and growth effects

Beyond “planetary boundaries”: The ecological crisis

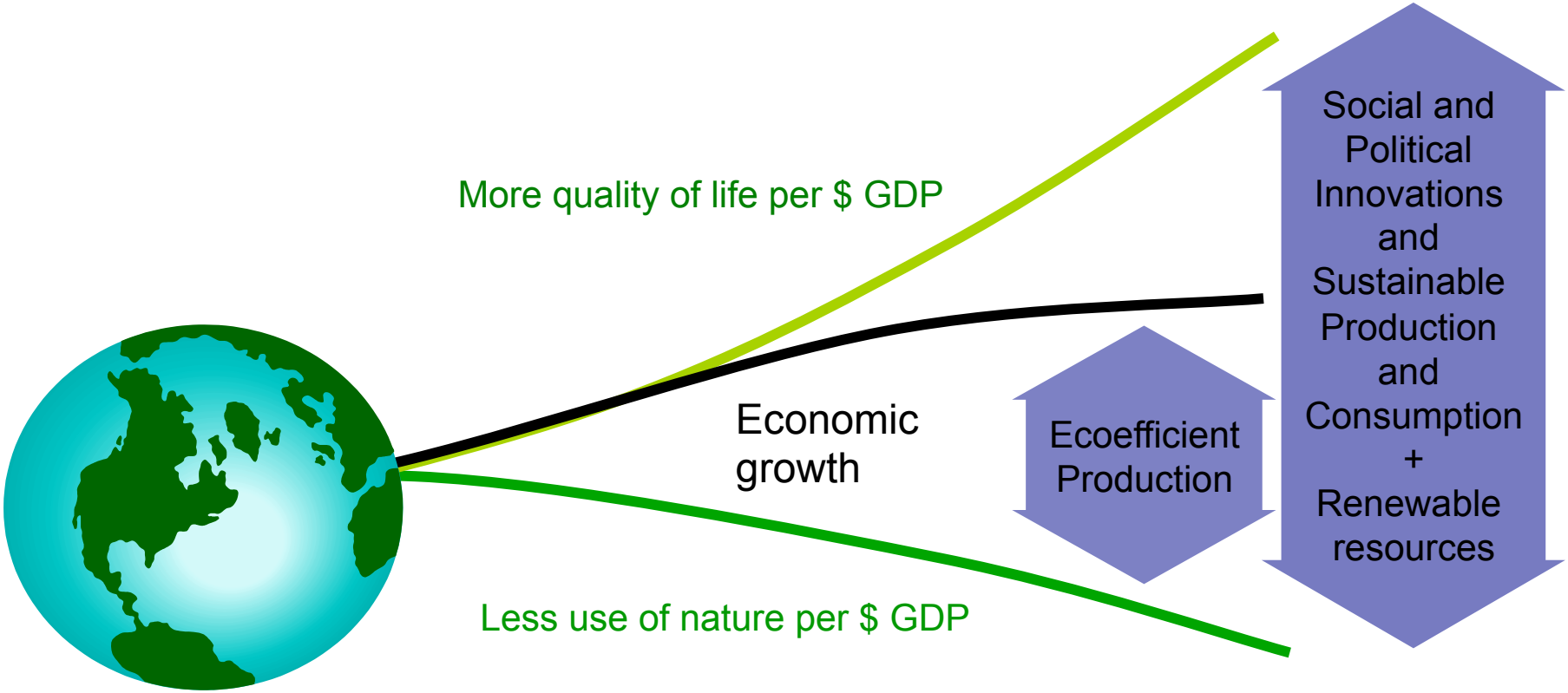


Source: Nature 2009

The necessity of decoupling seems to be clear, but the strategies how to achieve it have to be debated

Necessary condition for a sustainable “Green Economy”:
Combined strategies in industrialized countries for absolute decoupling

a) of quality of life from GDP (e.g. developing new models of wealth)
b) of GDP from resource consumption (e.g. fostering resource productivity; ecoefficient production)
c) of resource consumption from environmental impact (e.g. recycling/circular/green economy)



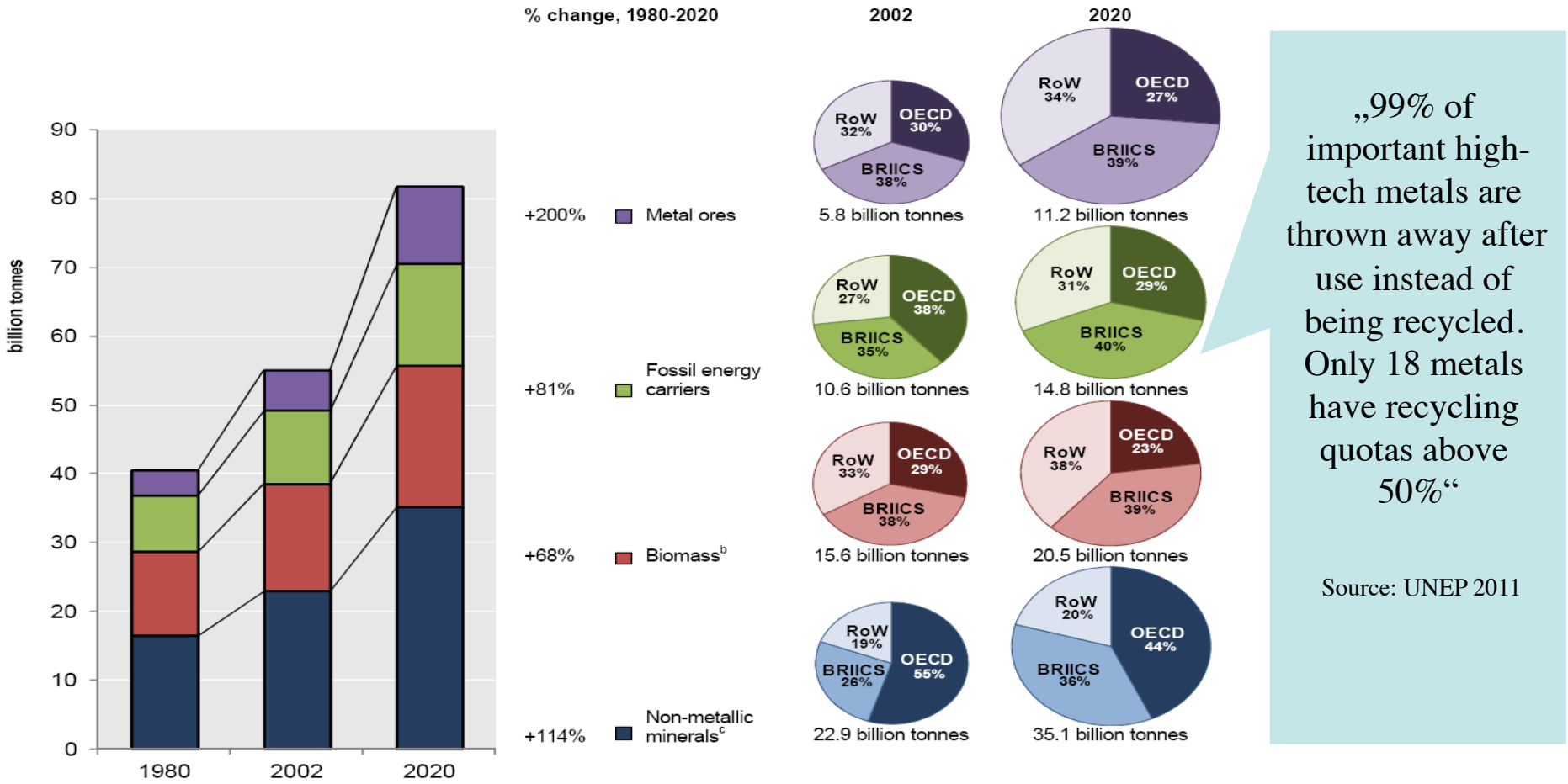
Source: Wuppertal Institute 2009

“Perverse decoupling” of GDP growth and life satisfaction

- For 17 OECD countries GDP/capita and Genuine Progress Indicator (GPI)/capita developed in parallel from 1950 until about 1978, but then decoupled
- What does a “green economy” mean? What “green” sectors should grow and what “brown” sectors should be reduced?
- How much “green growth” is necessary at what development stage? What policies are suitable to invert the “perverse decoupling” of GDP growth and life satisfaction?
- What are the technical, societal and structural “leap frogging” options not only from the “North” to the “South”, but the other way around as well

“Peak everything”?

Fostering resource productivity (e.g. recycling,circular economy) is a must!



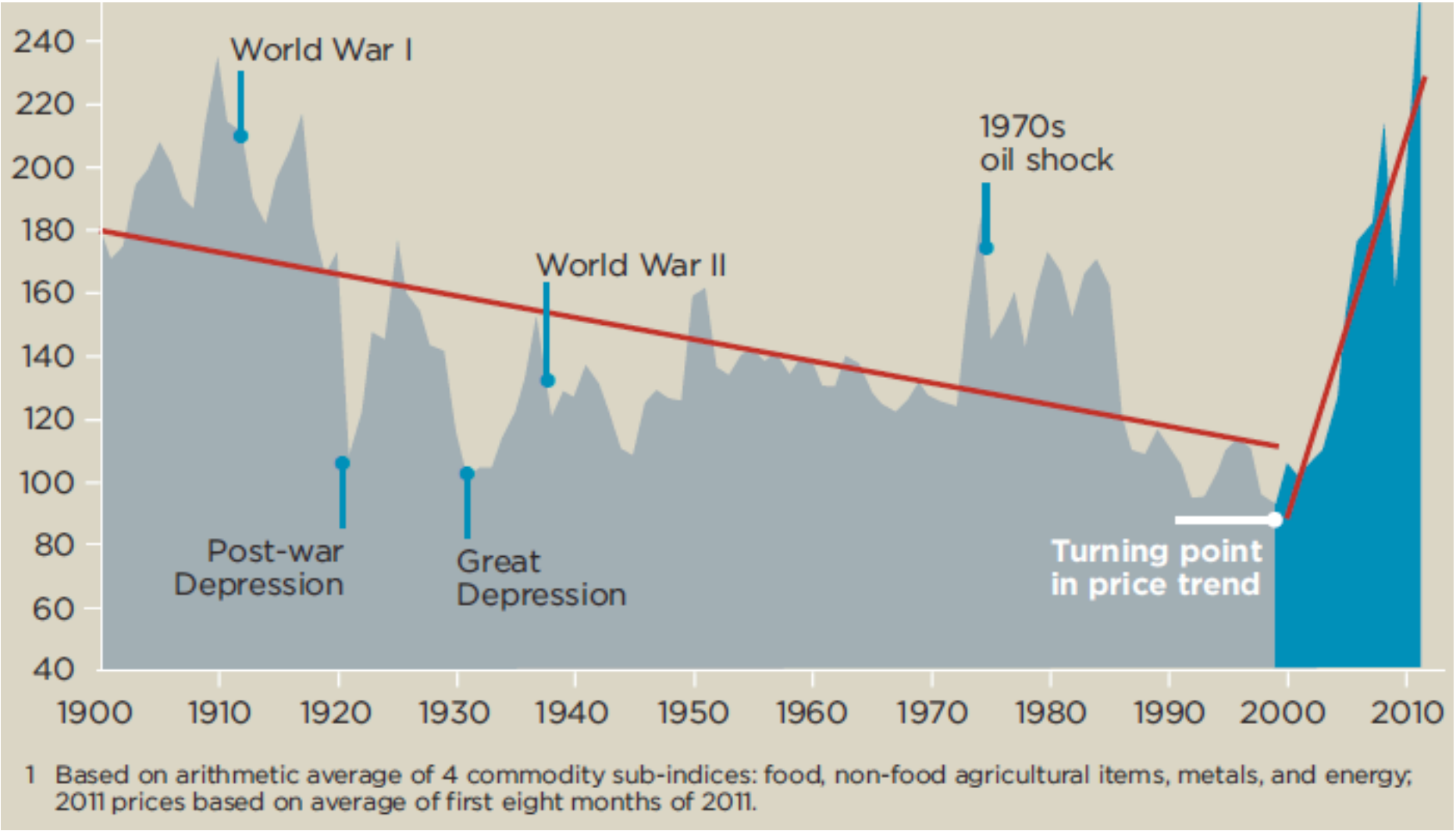
„99% of important high-tech metals are thrown away after use instead of being recycled. Only 18 metals have recycling quotas above 50%“

Source: UNEP 2011

Source: Giljum et al 2008

A trend of increasing commodity prices since 2000

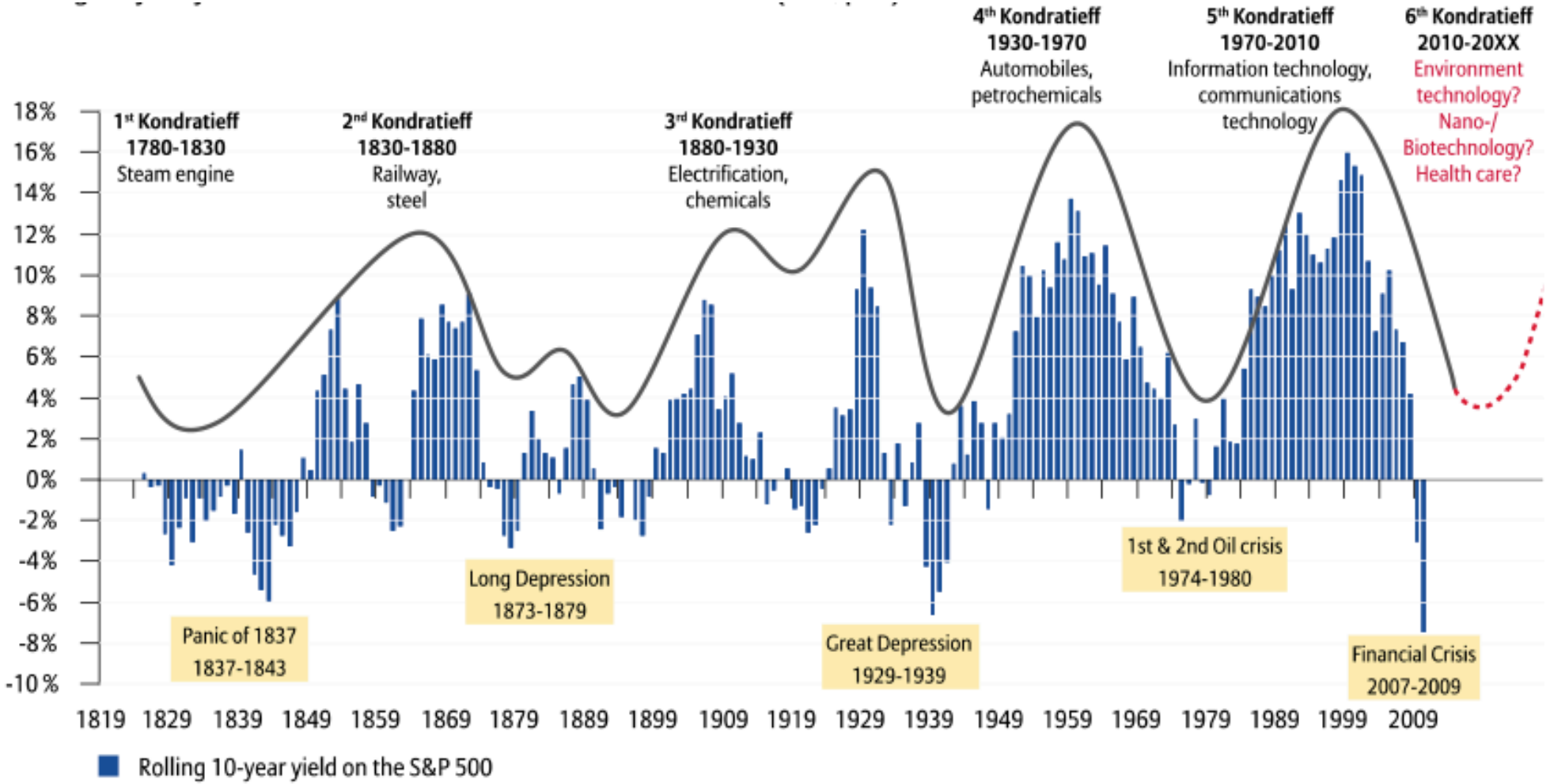
Indicators of physical scarcity and driver of lead markets for „GreenTec“?



Source: Ellen MacArthur Foundation 2013

Does the growing scarcity of natural capital stimulate...

a new Kondratieff-cycle or a paradigm shift to green technical/social progress?



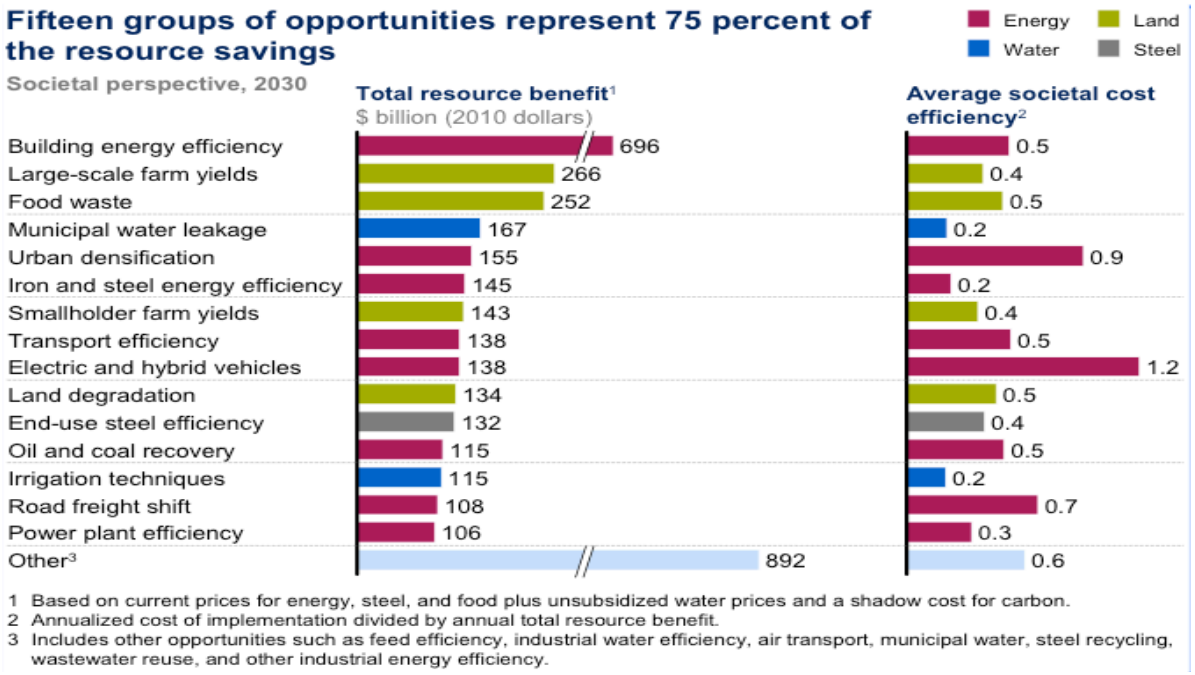
Source: Allianz Global Investors, 2010

The promising cost/benefit ratios of resource efficiency

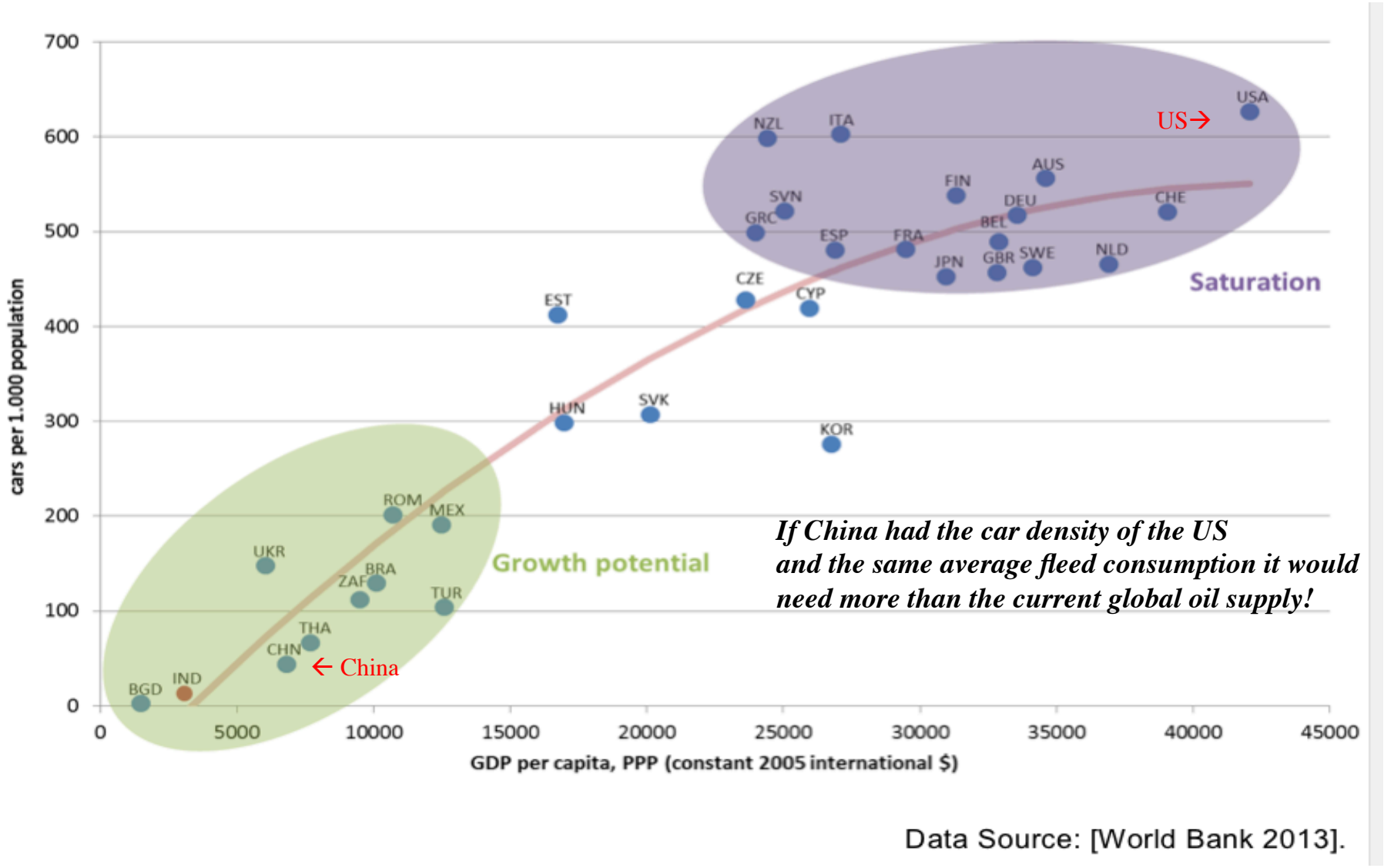
(McKinsey 2011)

- Understanding how to improve resource efficiency in a smart way catering to specific sectors is crucial to achieving economy-wide absolute decoupling
  - Combating food waste, through e.g. education and food waste prevention campaigns
  - Promoting material recycling in construction through e.g. a C&D landfill ban
- Interventions not only needed in resource intense sectors, e.g. aiming for service-based economies might shift resource-intensive activities elsewhere

➢ **The focus of a decoupling transition must be to develop an economic system capable of providing a high standard of living to its citizens based on a sustainable level of primary resource use.**

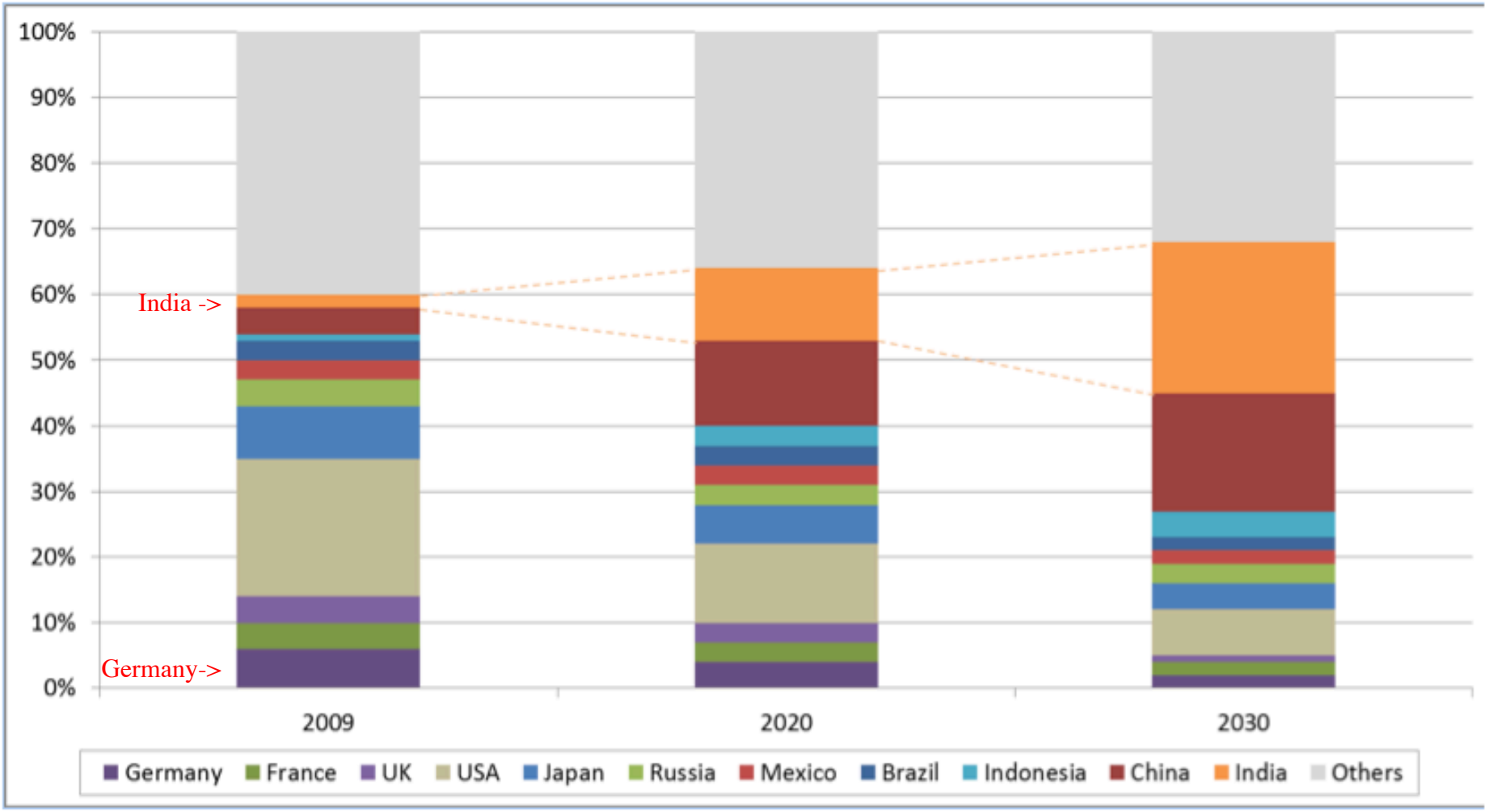


Unsustainable Trends: Private car ownership –
growth potential and saturation level (2010)



Data Source: [World Bank 2013].

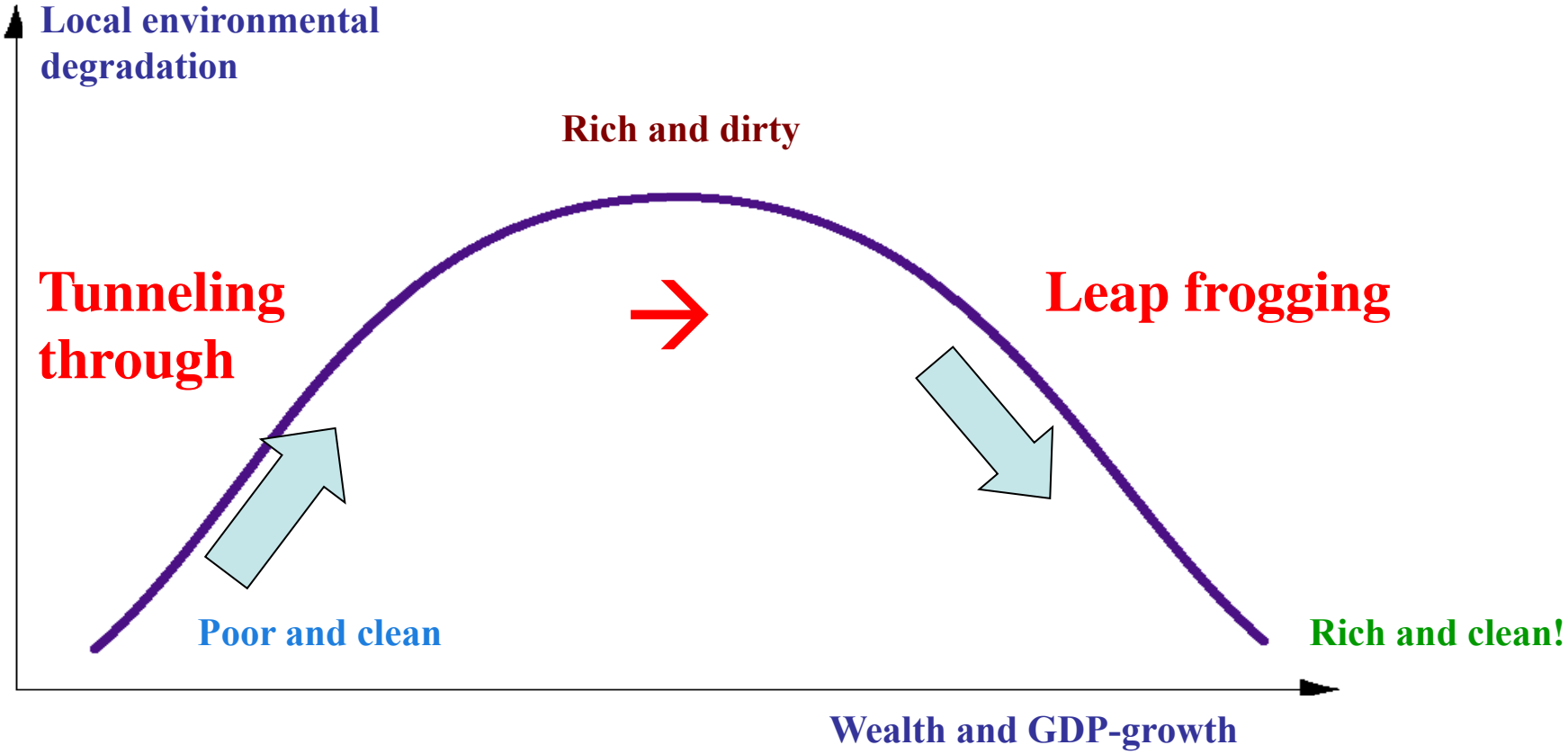
Global share of middle class consumption
in different countries 2009-2030



Data Source [Kharas / Gertz, 2010].

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

„First rich then clean“?

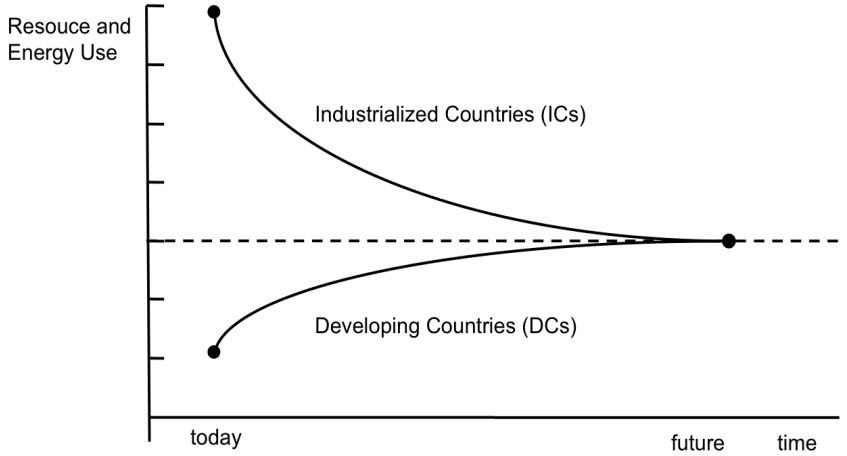


Source: Weizsäcker 2007

A global energy vision: “2000 W per Capita Society”
R&D initiative of Swiss Research Institutes

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

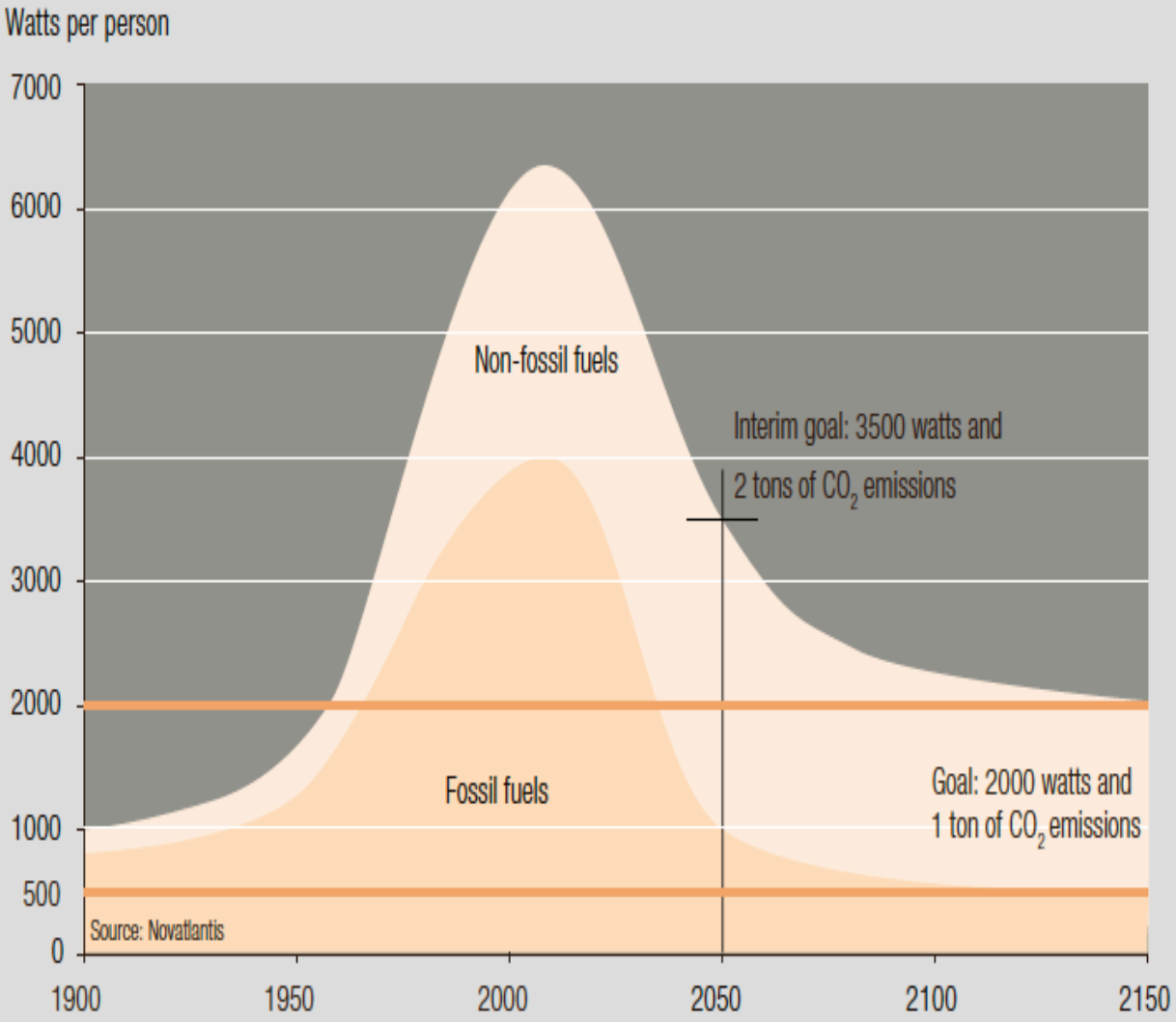
- **A** “**2000W per Capita Society”** in OECD-countries is feasible; 2000W/cap (= 65 GJ/cap) corresponds to **1/3 of today‘s European per capita energy use;**
- **World average** in the last two decades (=70 GJ/cap): The future convergence value?
- Enabling a GDP growth up to 2050, the “2000W per Capita 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

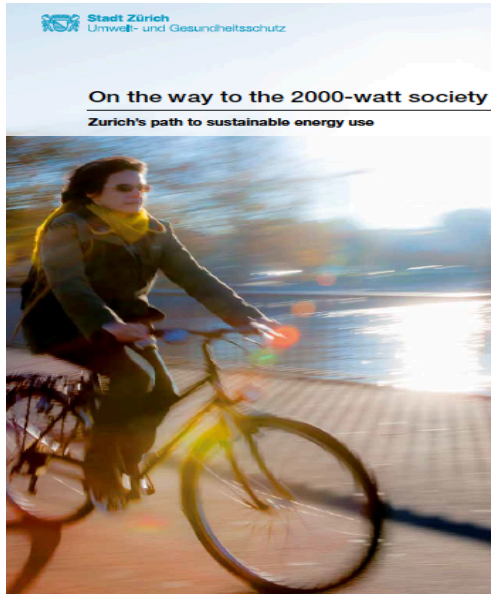


- Industrialized countries **reduce** their resource use more than it **increases** in developing countries.
- **Convergence value** should be compatible with the carrying capacity of the biosphere.

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

340 Swiss „energy cities“ on the way to a „2000-watt society“
The example of Zürich





On 30 November 2008, the City of Zurich made a ground-breaking decision. Over three quarters of the electoral roll voted in favour of Zurich doing the following:

- Committing to sustainable development.
- Reducing its energy consumption to 2000 watts per person.
- Reducing its annual CO_2 emissions to one tonne per person by 2050.
- Promoting renewable energies and energy efficiency.
- Not renewing its investments in nuclear power plants.

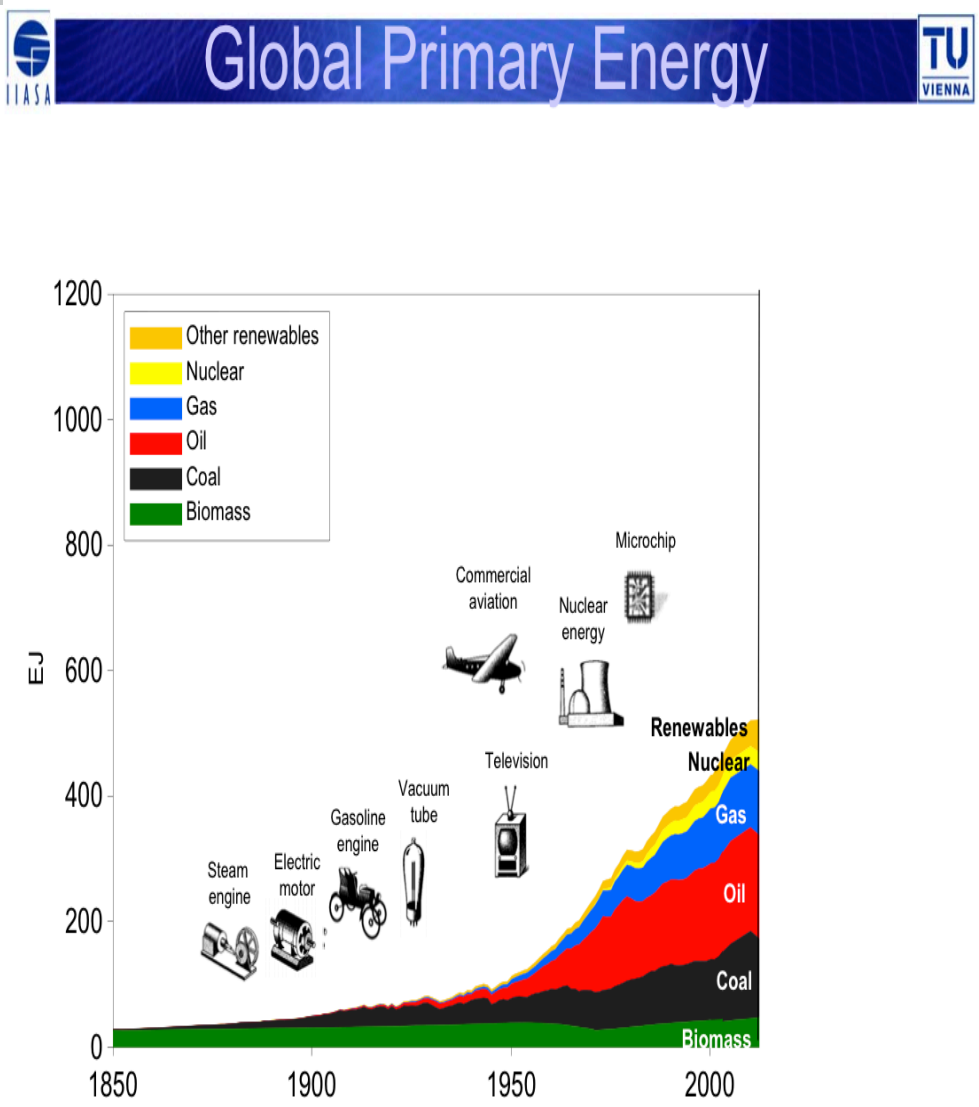
With this strategy, Zurich wants to contribute to combating human-induced climate change, but there are also social, economic and ethical arguments which speak in favour of lower energy consumption. As a 2000-watt society, Zurich is better equipped for times of scarce and expensive energy resources, but the fact that the goals are set in the municipal code does not mean that they have yet been achieved. This requires effort on the part of the city administration, the residents and the local economy, but also good cooperation with political bodies at higher levels, namely the canton and the Federal Government.

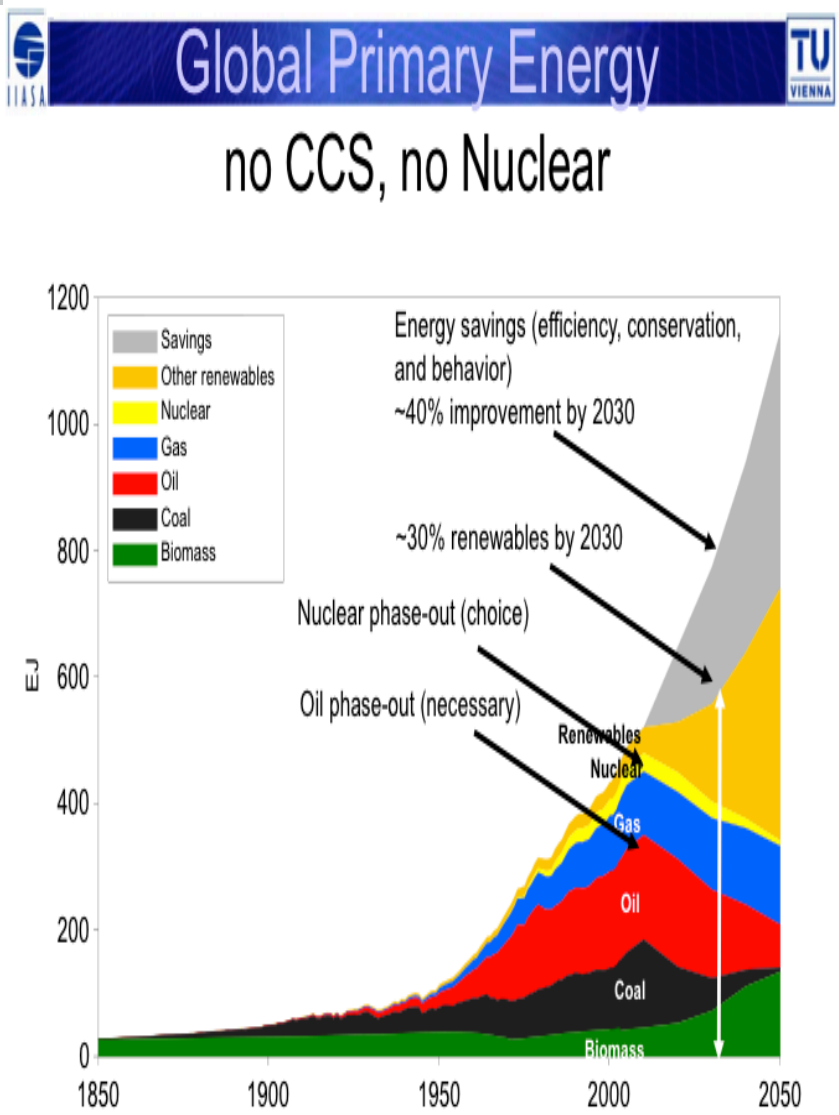
Technologies to support global “energy decoupling” are available – promising perspectives for sustainable energy

„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**).**

The short history of abundant fossil (nuclear) fuels

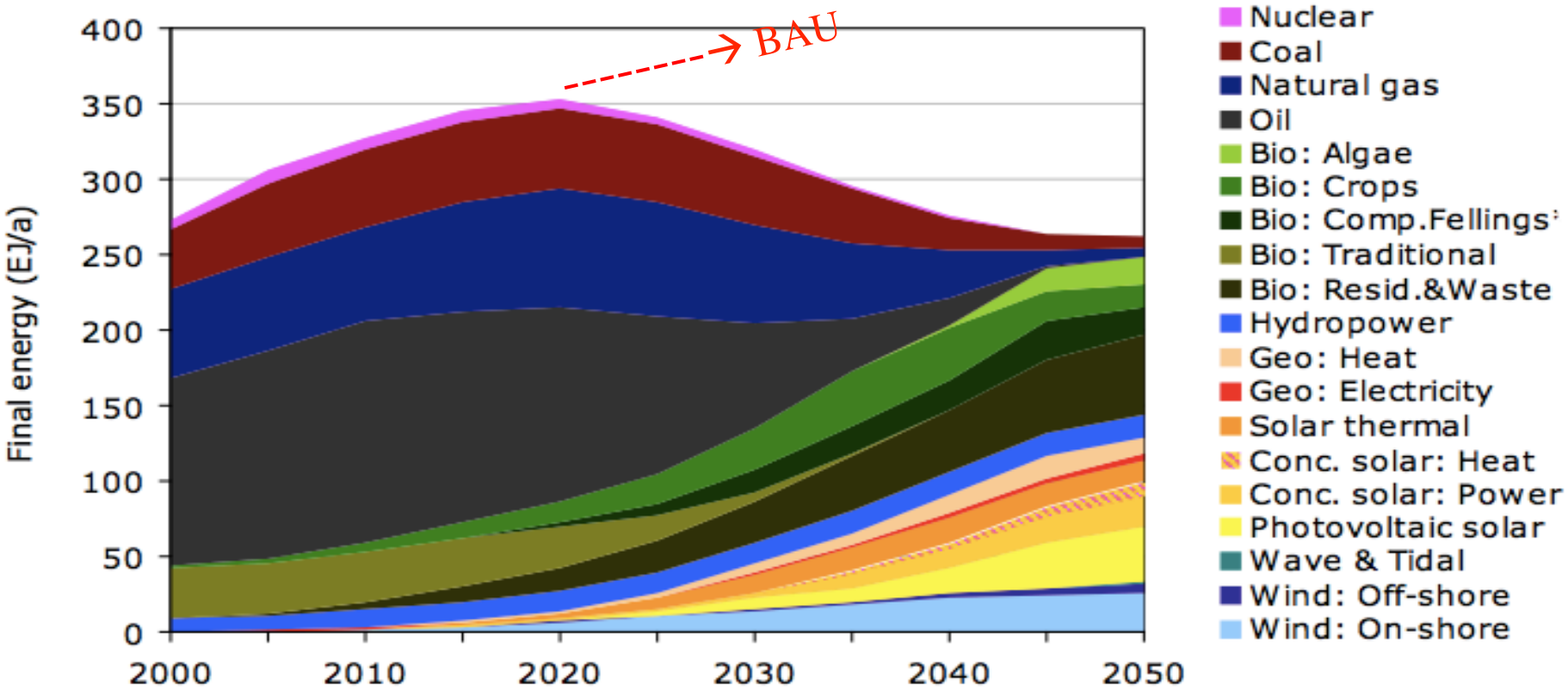
Rapid growth after second World War – step wise phase out after 2010?





Source: GEA 2013; Riahi et al, 2011

100% renewable global energy in 2050
- only in combination with an efficiency revolution (WWF/Ecofys Scenario)

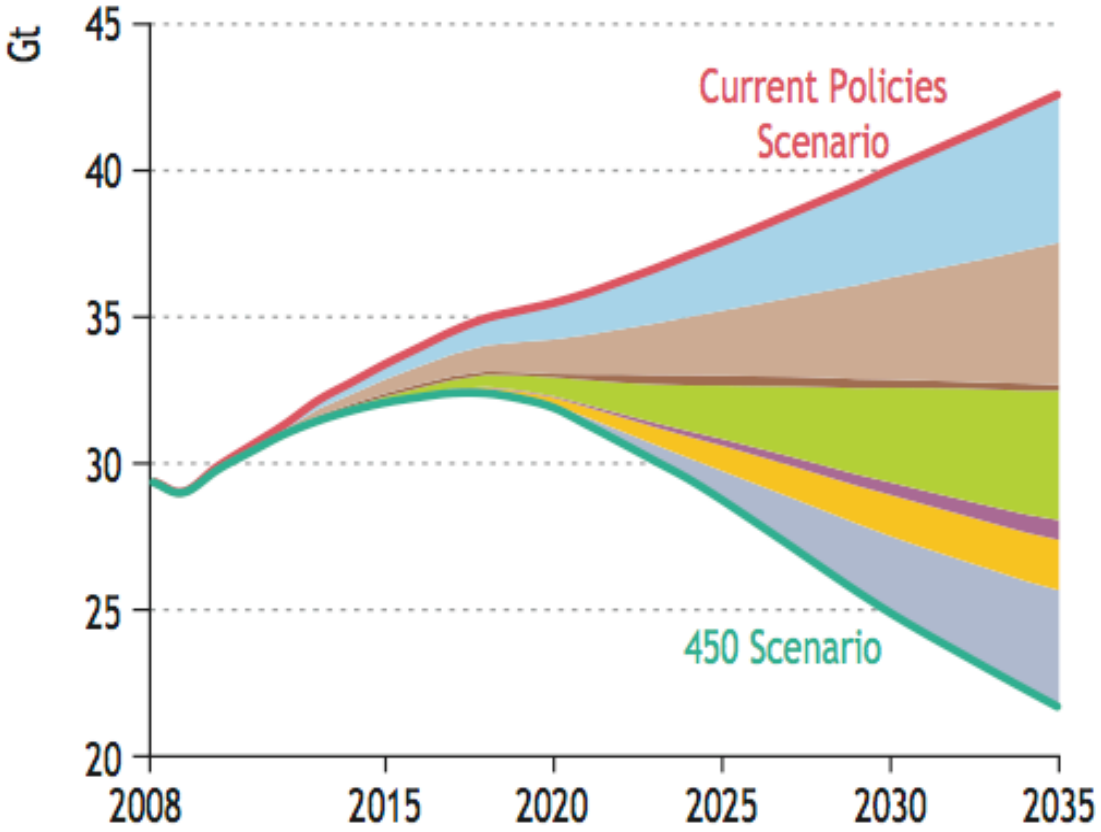


- In 2050, energy demand is 15 % less then in 2005; nuclear phase out; CCS after 2025/30 only marginal
- As far as possible electrical energy is used; bioenergy for trucks, ships, aeroplanes, industrial processes
- By 2050 €4 trillion/a saved compared to BAU; around 2050 savings outweigh investments

Source: WWF/Ecofys 2011

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

…but what about the social embeddedness of technologies?

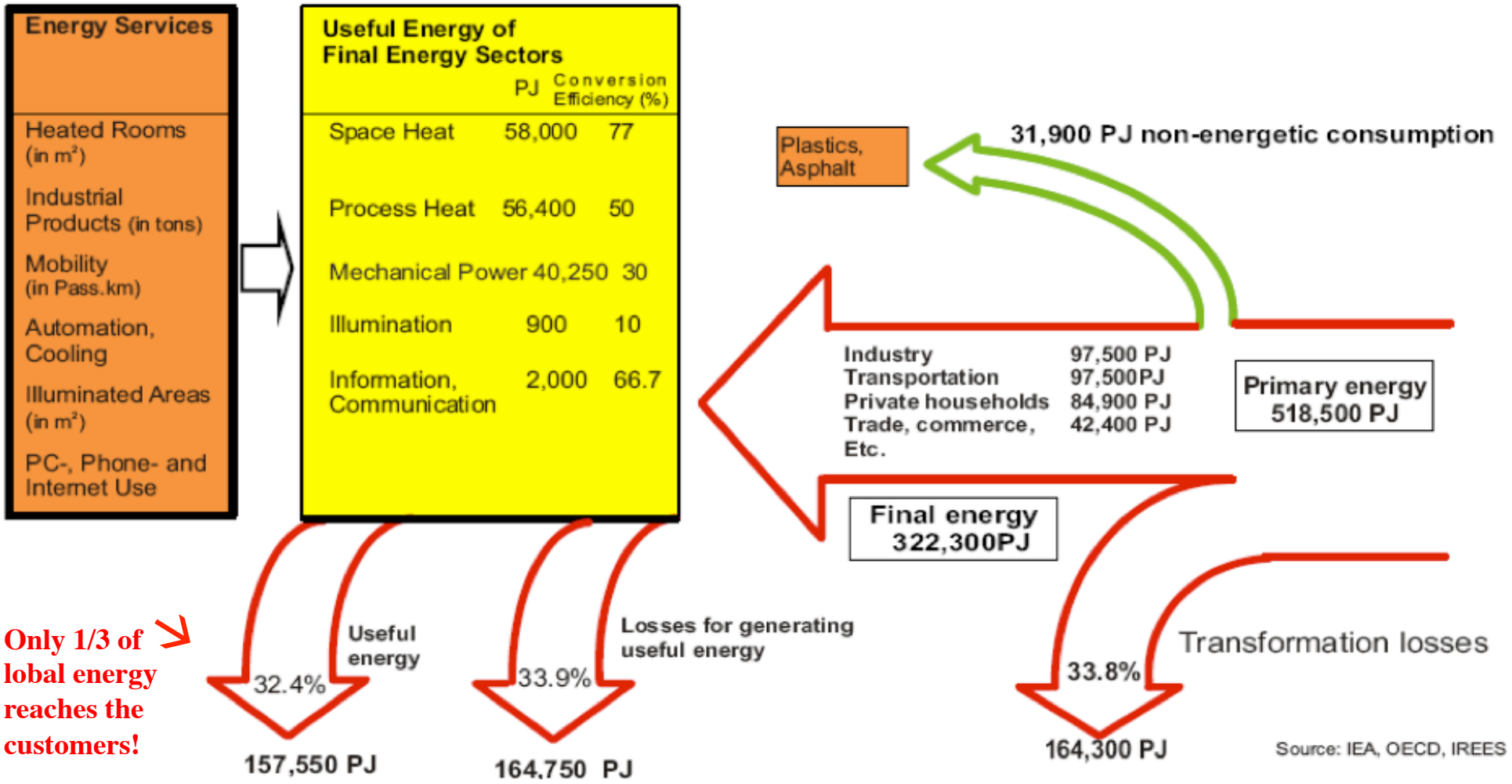


	Abatement		
	2020	2030	2035
Efficiency	71%	49%	48%
End-use (direct)	*34%*	*24%*	*24%*
End-use (indirect)	*33%*	*23%*	*23%*
Power plants	*3%*	*2%*	*1%*
Renewables	18%	21%	21%
Biofuels	1%	3%	3%
Nuclear	7%	9%	8%
CCS	2%	17%	19%
Total (Gt CO_2)	3.5	15.1	20.9

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

Global energy flow diagram (2010)

First stop the losses, than add new (renewable) energies!



Source: Jochen/ Reitze 2013

The German “Energiewende”: Social learning from a longterm transformation process to “sustainable energy for all”?

“Revolutionary Targets” (A.Merkel) of German Energy Concept
Government decision in September 2010

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%

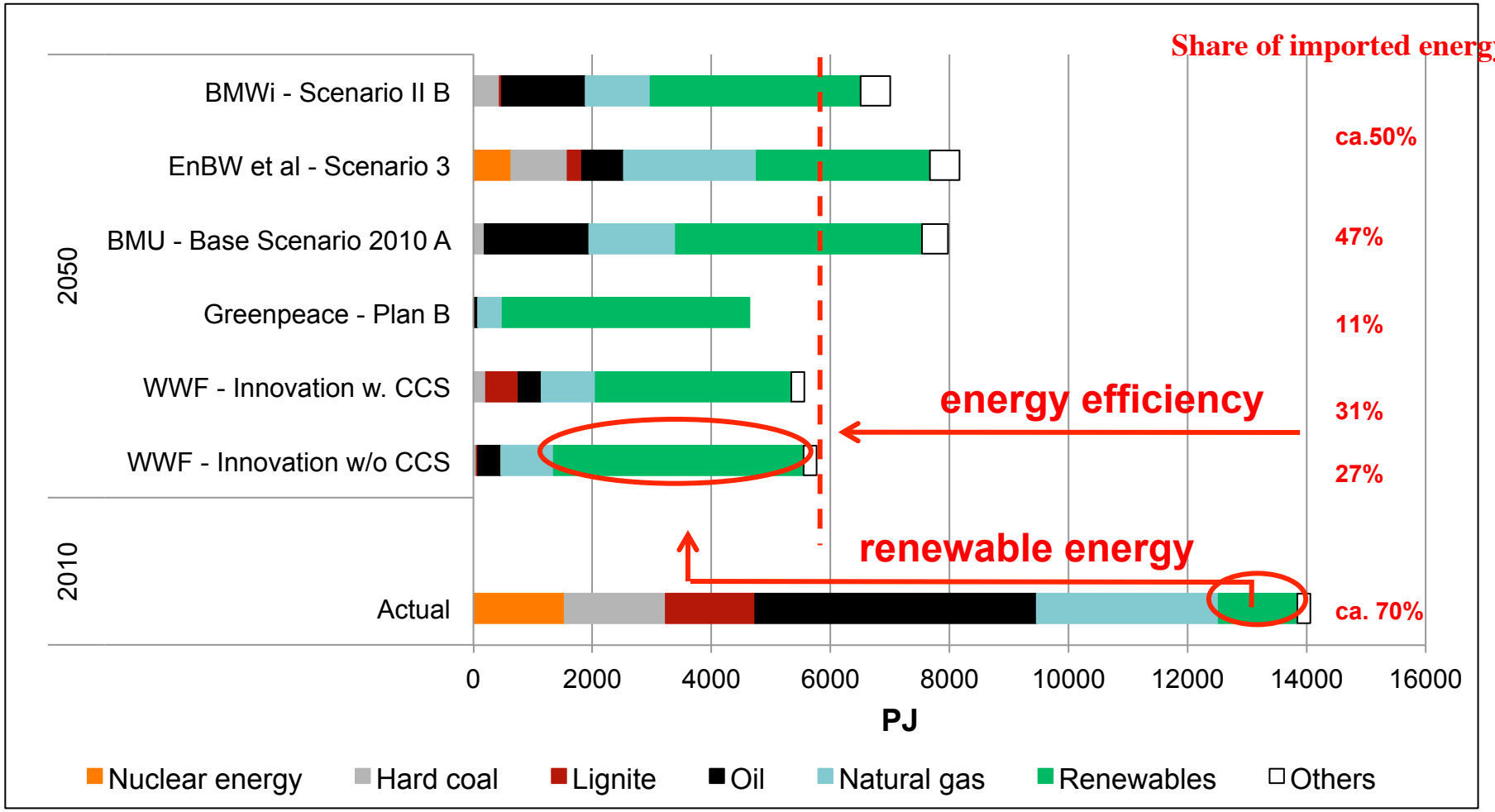
Average increase of energy productivity up to 2050: 2,1%/a

Source: Federal German Government 9/2010

Germany: A pathway to sustainable energy is possible

Decoupling and reducing energy import dependency (2012: import costs 105 bn€)

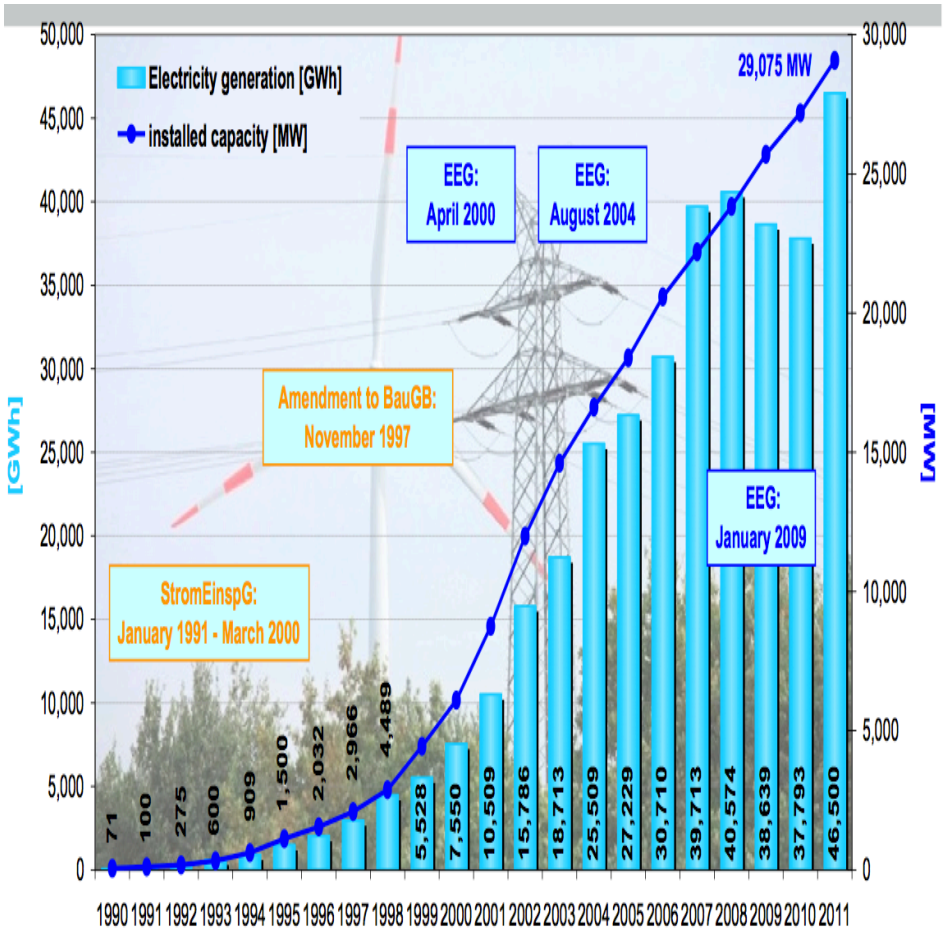
Primary energy in Germany in 2010 and in 2050 according to typical energy scenarios

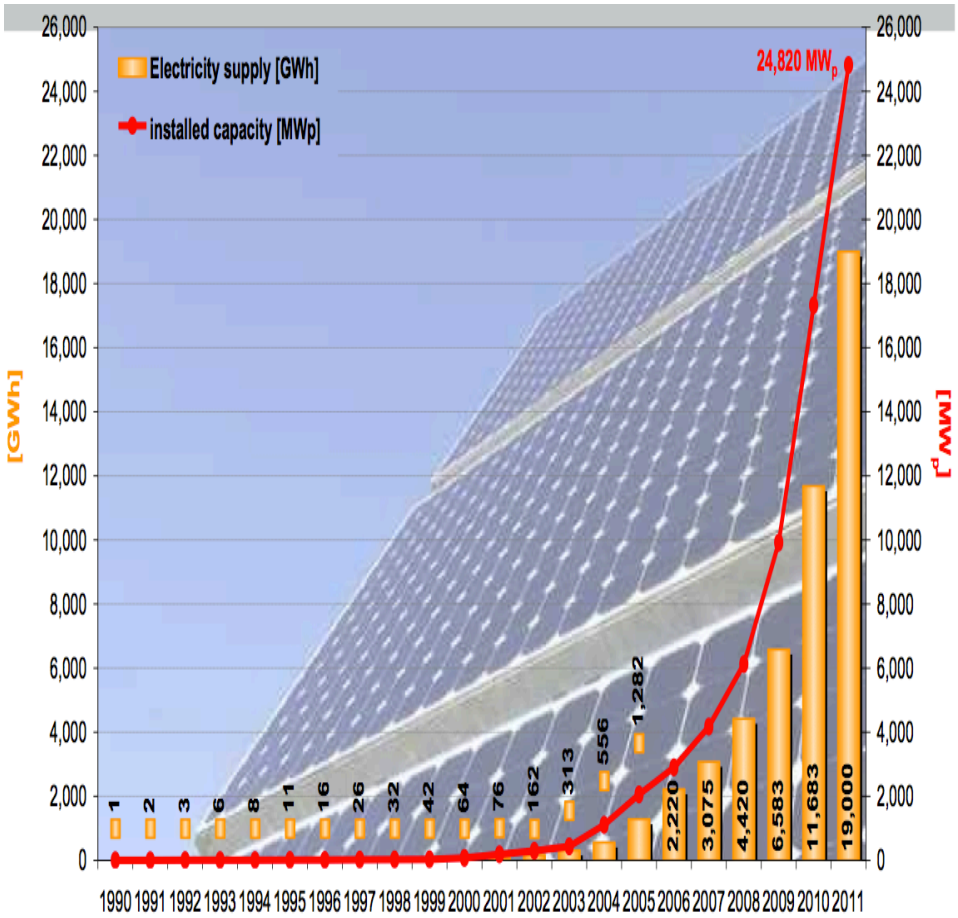


Source: Samadi 2011, based on data from AG Energiebilanzen 2011 and scenario studies cited

Feed-in law opens the markets for green electricity

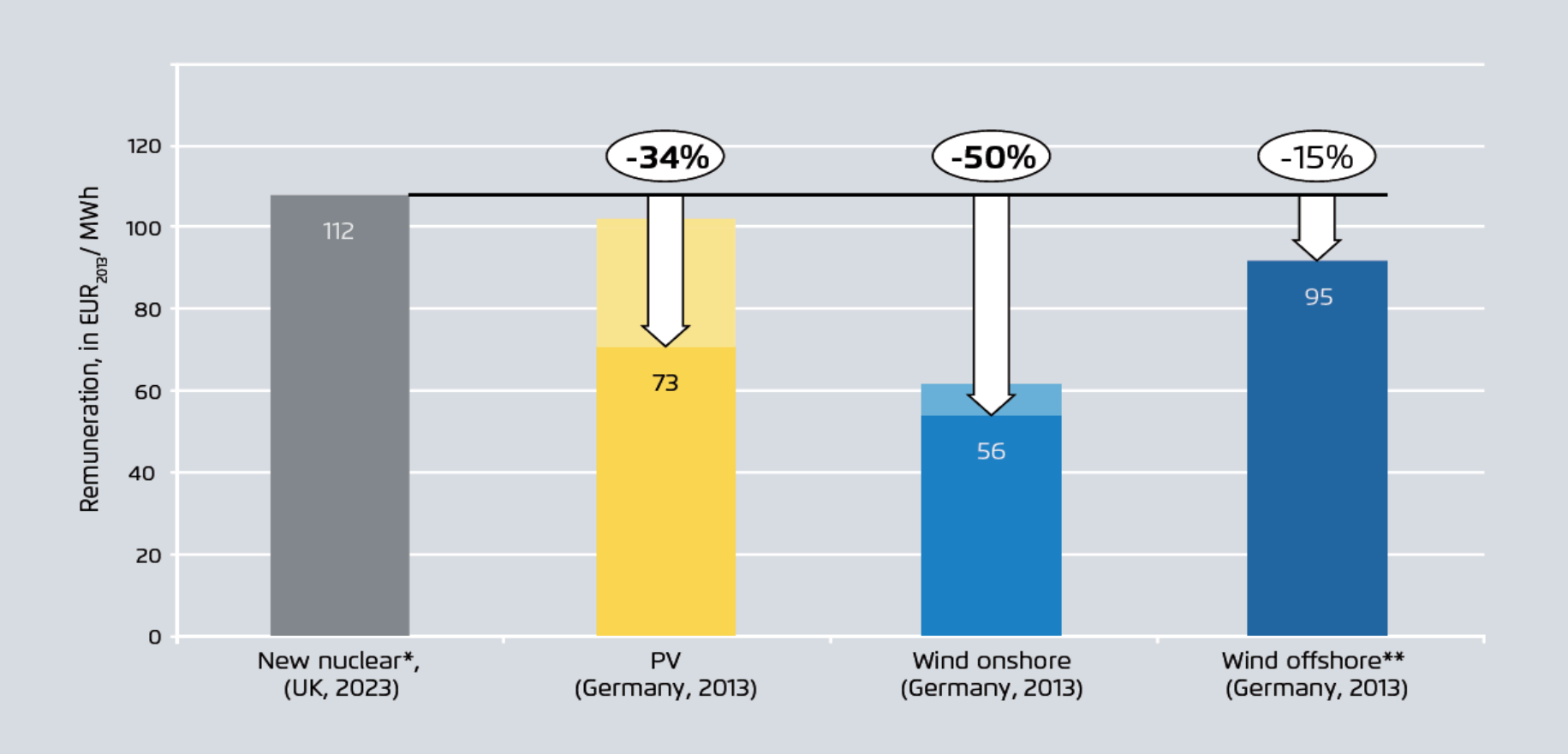
Steep learning curves and cost degression for wind and PV power in Germany





Source: BMU 2012

Comparison of renumeration of nuclear power in the UK
In comparison to PV and wind in Germany

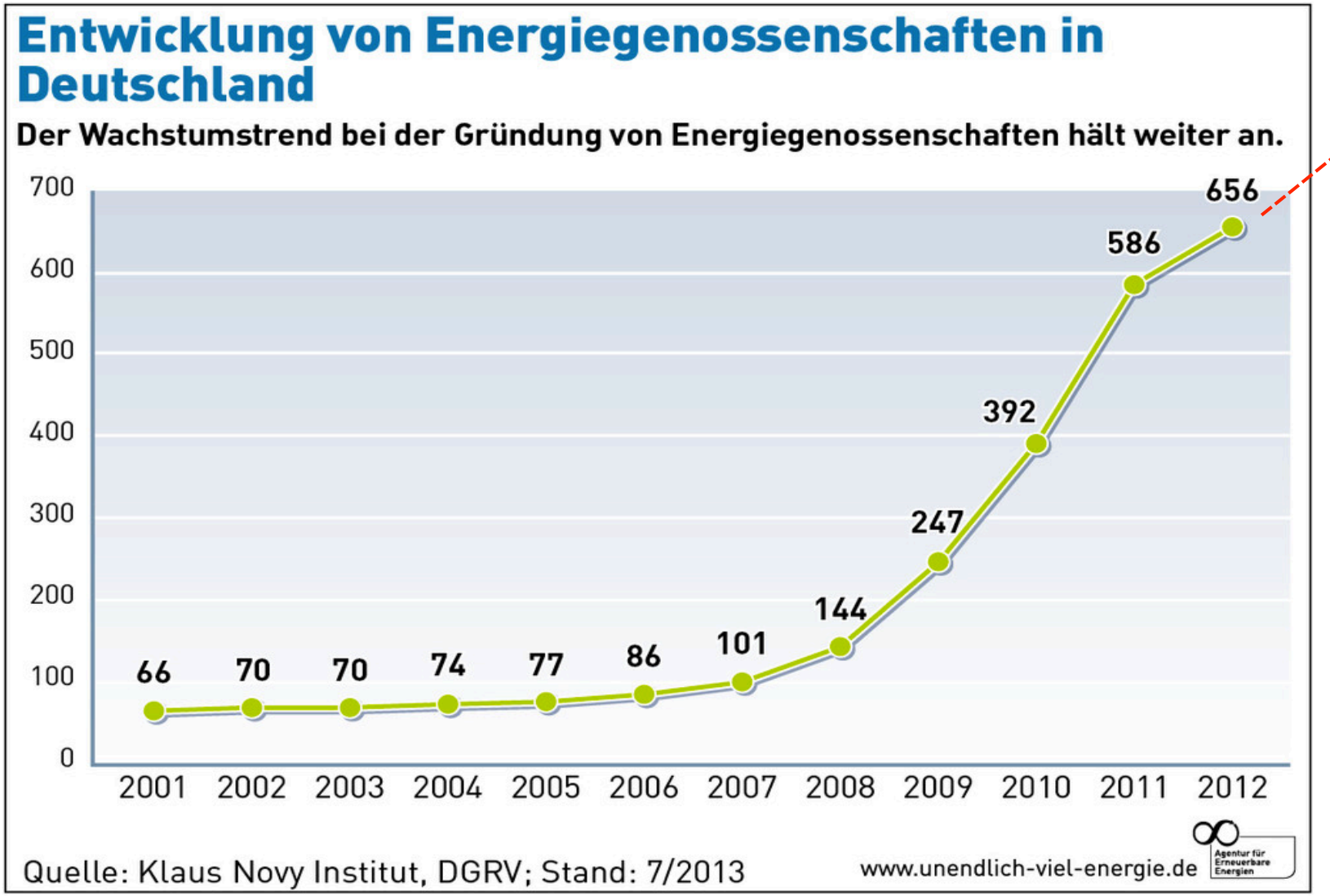


DECC 2013; ECB 2014a; EEG 2012; Prognos AG 2013; UK Government 2013a; calculations by Prognos AG; * Hinkley Point C agreement ** Offshore wind 2013 without grid costs; in Germany, the regulatory approach excludes grid costs from being covered by the remuneration. Offshore grid costs are estimated to be between 25 and 35 EUR/MWh, depending on the distance to shore.

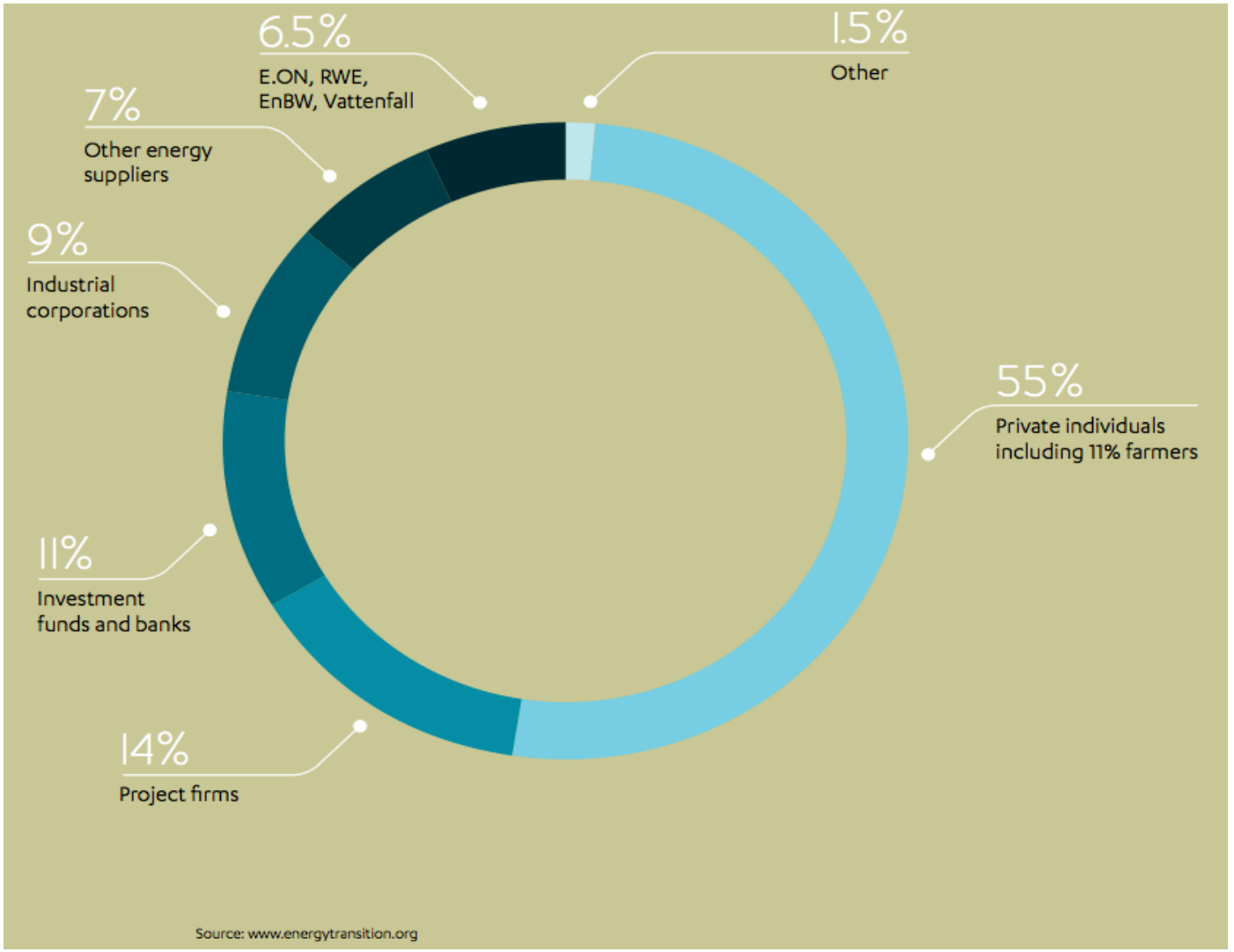
Source: Agora/ Prognos 2014

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

Increasing number of energy cooperatives in Germany



Ownership of installed renewable power capacities in Germany 2010



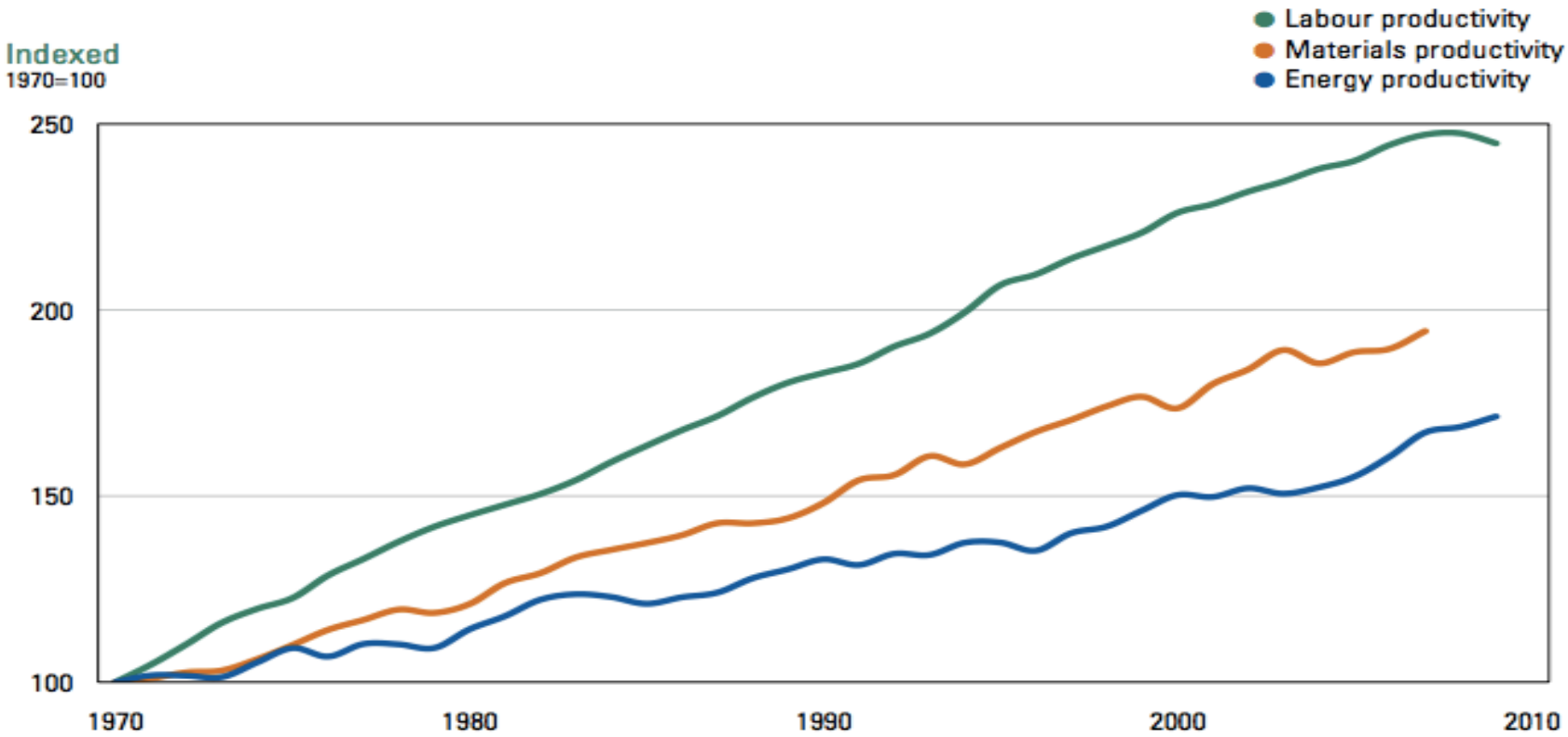
Source: Greenpeace International 2013

The benefits of integrated resource and energy efficiency strategies

“Make tons and kilowatt-hours redundant not people”!

(E.v.Weizsäcker)

Material- and energy productivity lacks behind labour productivity

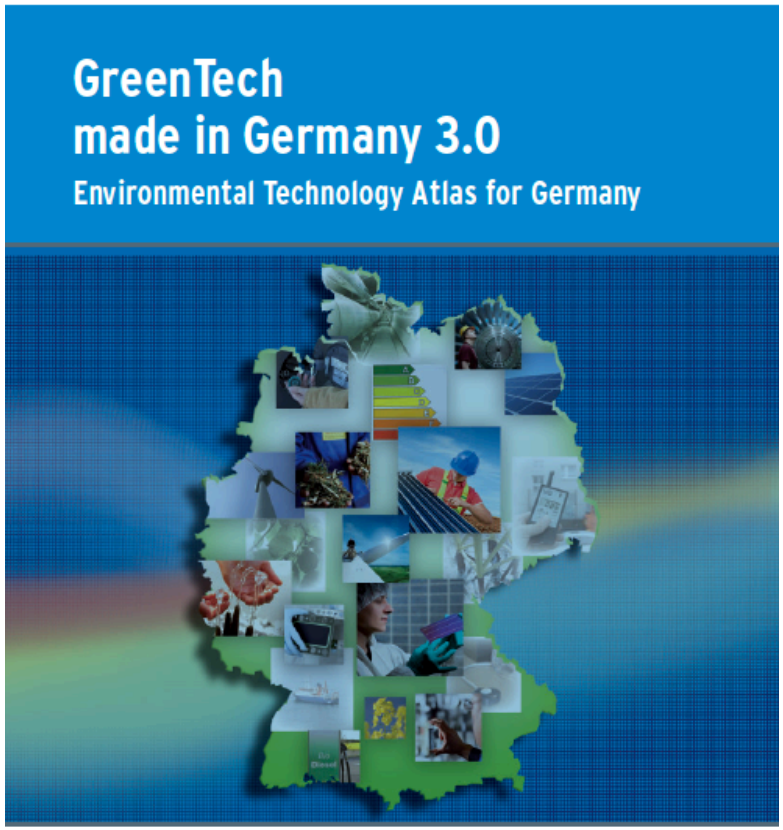


Note: Labour productivity in GDP per annual working hours; material productivity in GDP per domestic consumption (DMC) and energy productivity in GDP per total primary energy supply (TPES).

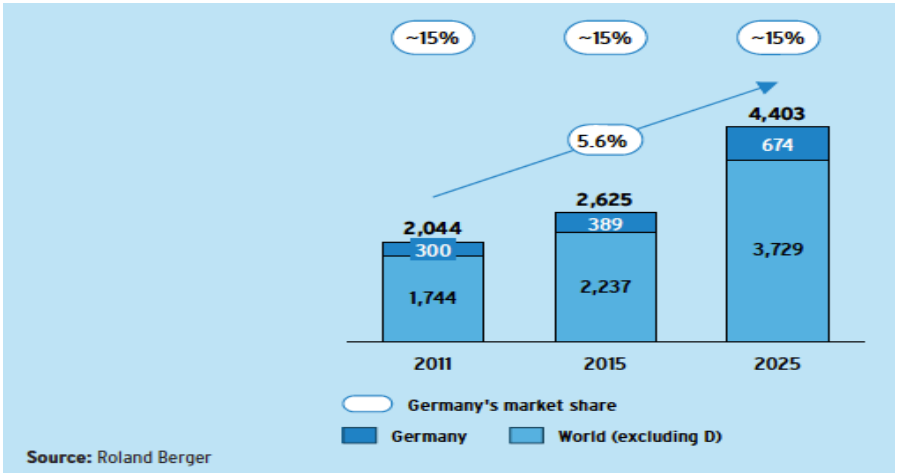
Source: EEA 2011; data for EU

Global „lead markets“ are driving the „Energiewende“

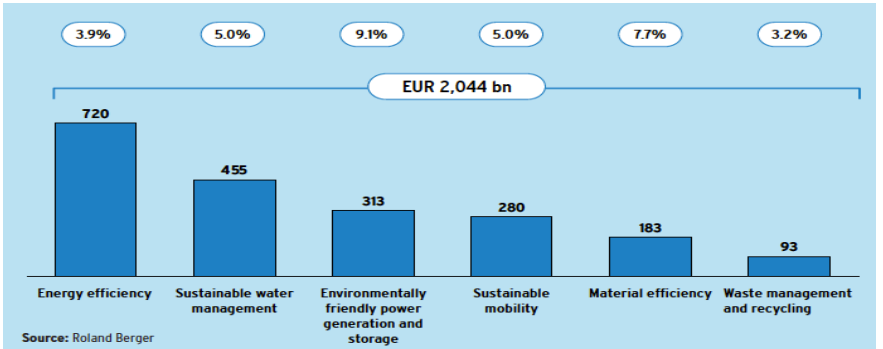
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



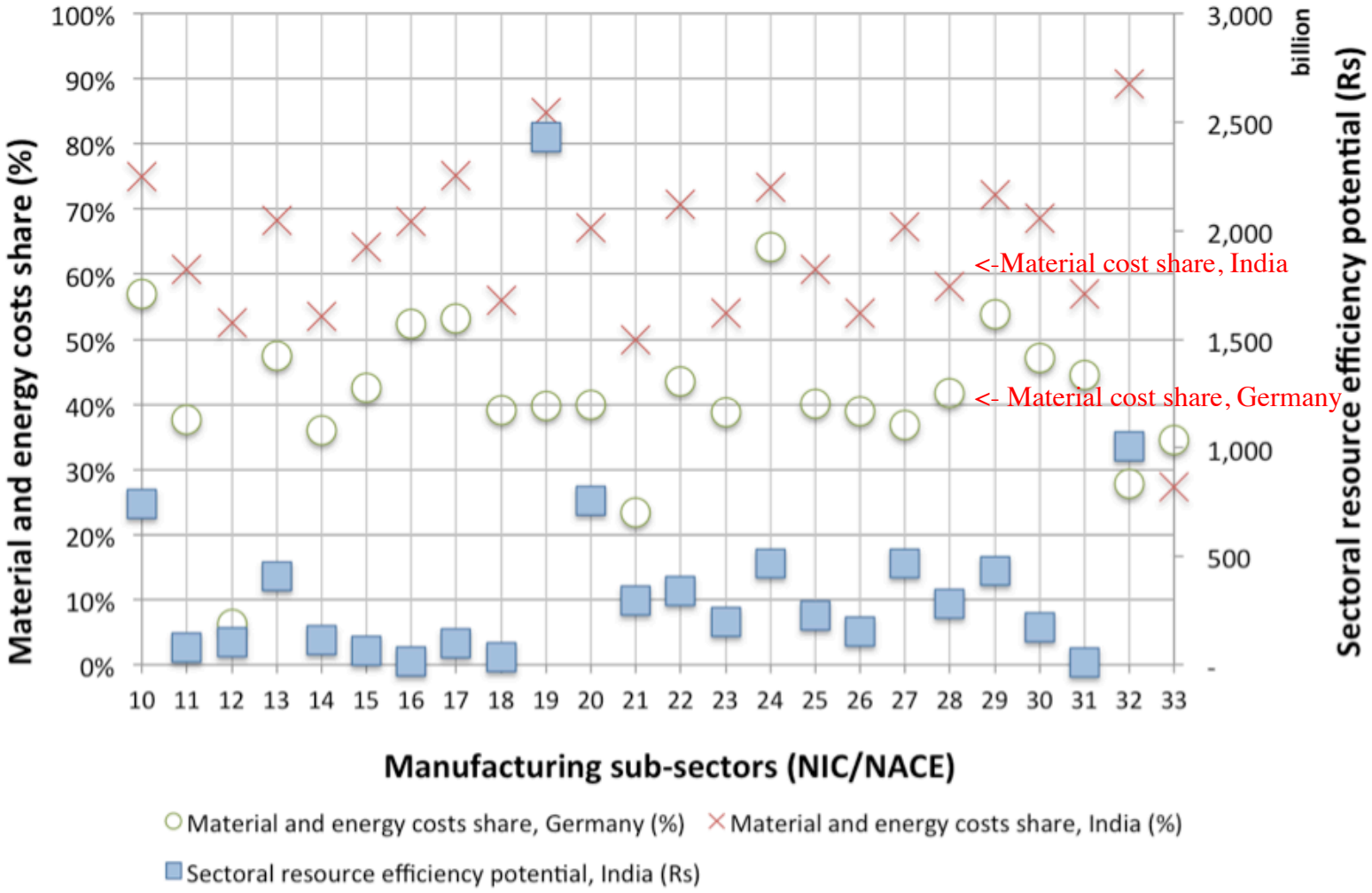
Global growth of environmental lead markets



The most attractive global lead market: Energy efficiency (+ renewables)



Resource efficiency potentials
in Indian manufacturing subsectors compared with Germany



Source: Own calculation based on [Destatis, 2012; Government of India, 2012a]

Source: IFEU et al 2013

The German Resource Efficiency Programme (ProgRess)

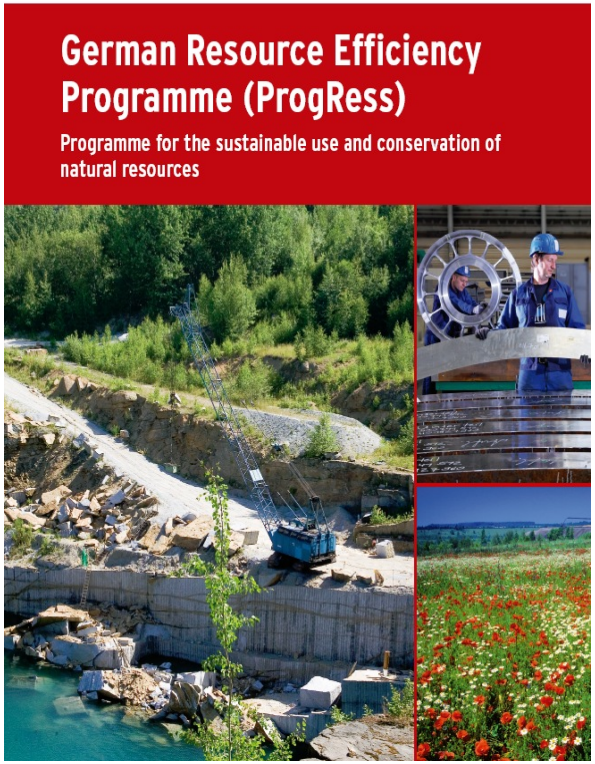
Goals:

- Decouple economic growth from resource use
- Reduce environmental impacts of resource use
- Improve the sustainability and competitiveness of the German industry

Impacts along the whole value chain:

- raw materials supply
- production and product design
- consumption
- closed cycle management

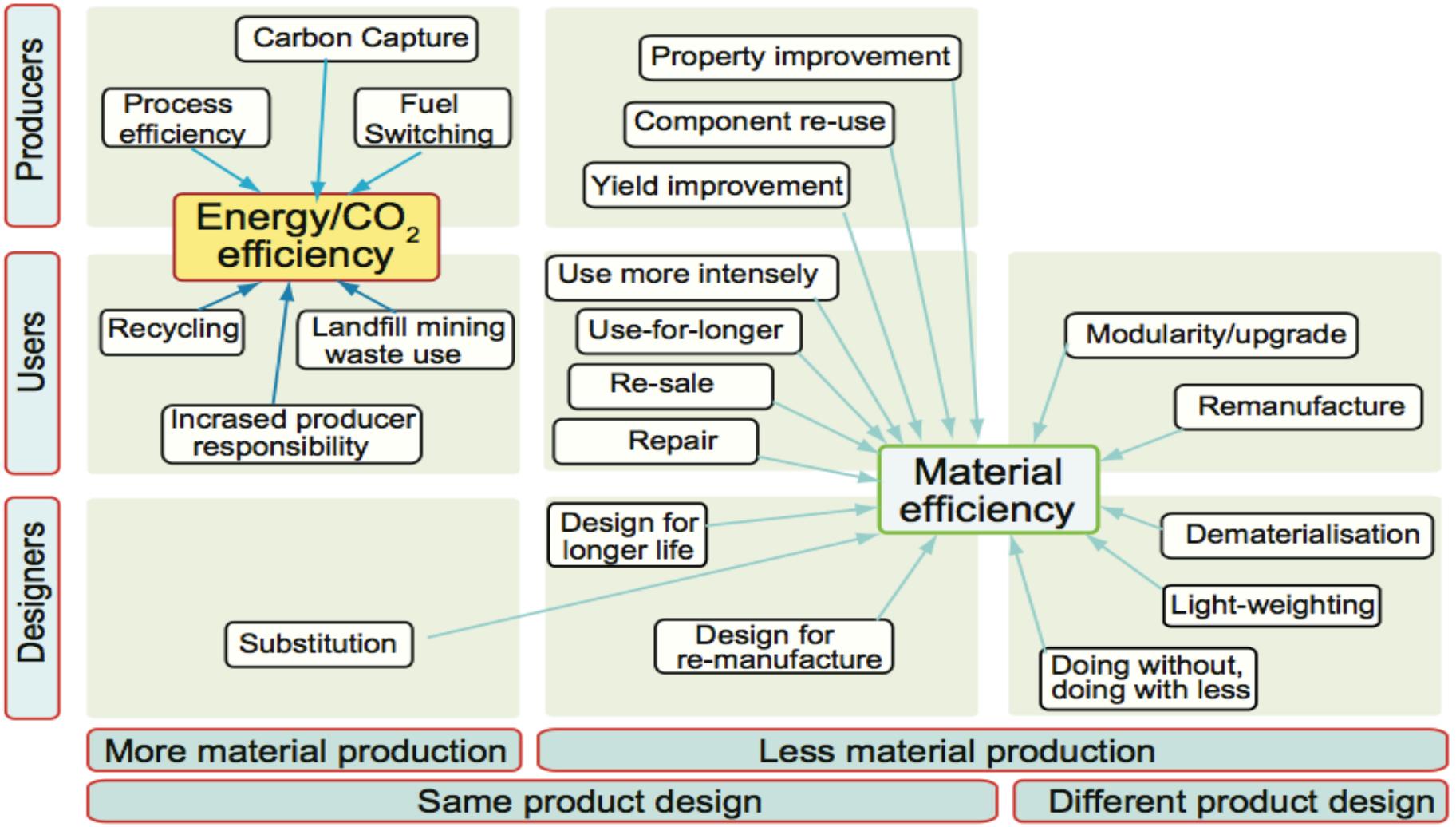
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



Source: C. Manstein/ UBA 2012

Complex strategy options, but:

Combining P&M for energy and material efficiency creates many synergies



Source: Allwood et al, 2011

Modelling a “Resource Efficient Germany”:

(P&M: Recycling quotas, building material tax, audits/incentives for SMEs)

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

A "KNIFE-EDGE"- PROBLEM OF ABSOLUTE DECOUPLING:
ECONOMIC GROWTH – LABOUR/RESOURCE-PODUCTIVITY – JOBS

Definitions:
Labour productivity (LP) = Gross Domestic Product (GDP)/Jobs (J)
Resource productivity (RP) = Gross Domestic Product (GDP)/Total Material Requirement(TMR)
Energy productivity (EP) = Gross Domestic Product (GDP)/Energy (E)

Necessary conditions for sustainable development - more jobs, less use of nature :

Only if the growth rate of GDP > growth rate of LP → Employment increases

Only if growth rate of GDP < growth rate of RP (or EP) → Resource use (or energy) decreases

Thus to meet the necessary condition of sustainable development:

Growth rate of LP < Growth rate of GDP < Growth rate of RP (example: 1,5% < 2% < 2,5%)

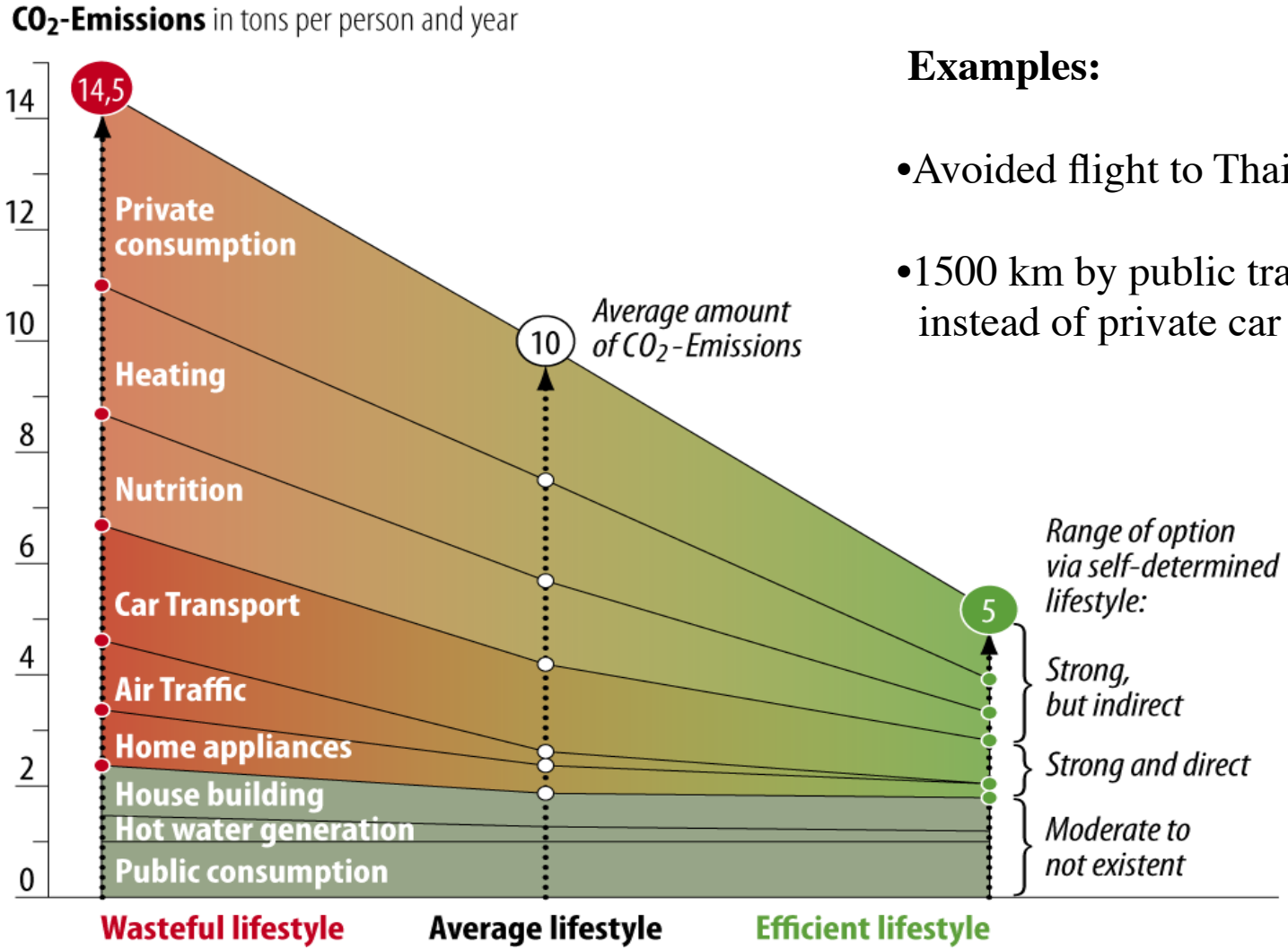
German "Energiewende –Scenarios" (2050): BIP: ca.1% (exogenous); EP: 2,1% (endogenous); LP:?

Options to solve the "knife-edge"-problem with absolute decoupling e.g.:
- Efficiency revolution plus sufficiency policies
- Decrease of labour time and new models of labour

Source: Hennicke 2014

Technical solutions must be embedded into new patterns of sustainable consumption and production

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



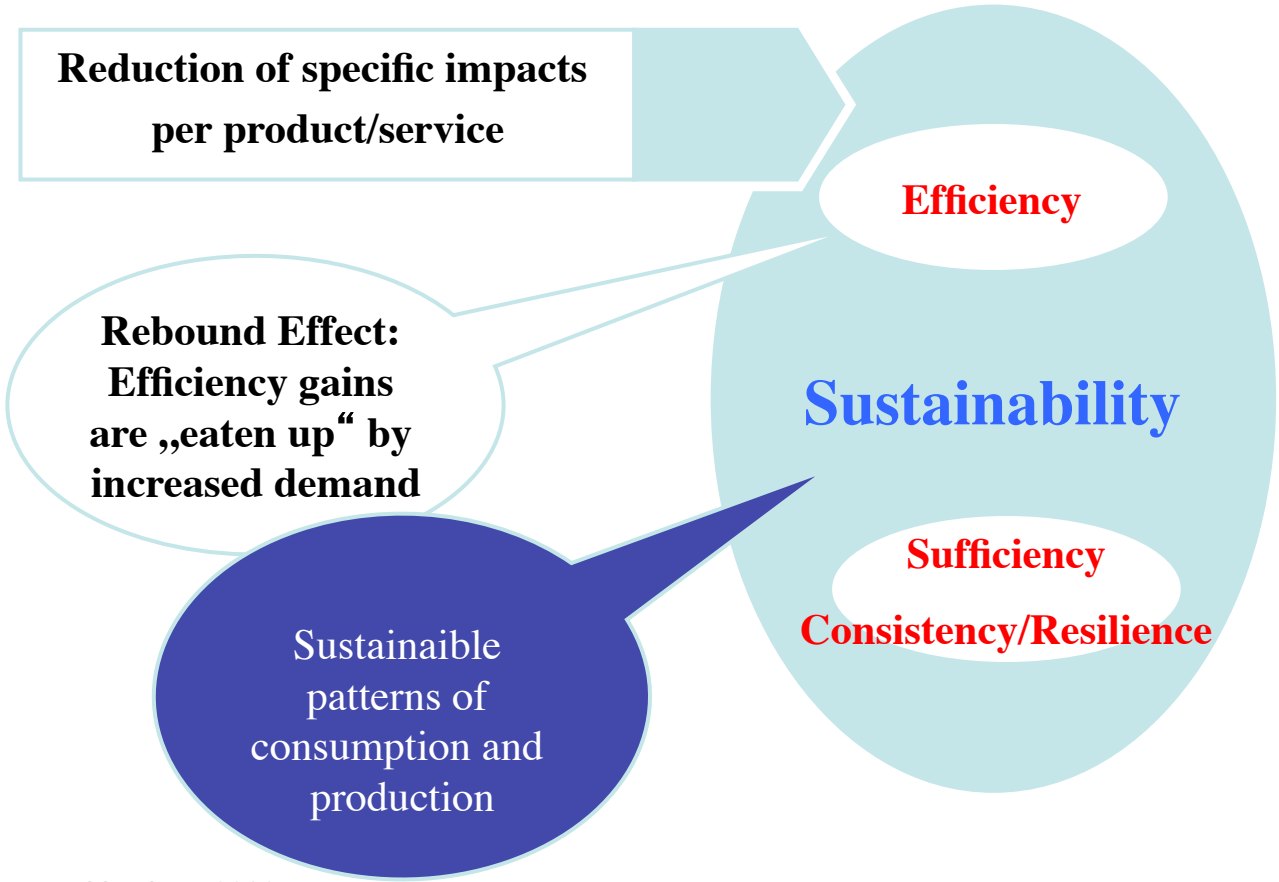
Source: Wupperal Institute 2007

Examples:

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

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

„Prestige eats up efficiency“

VW Käfer, 1955,
730 kg, 30 HP, 110km/
7, 5 l/100km

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

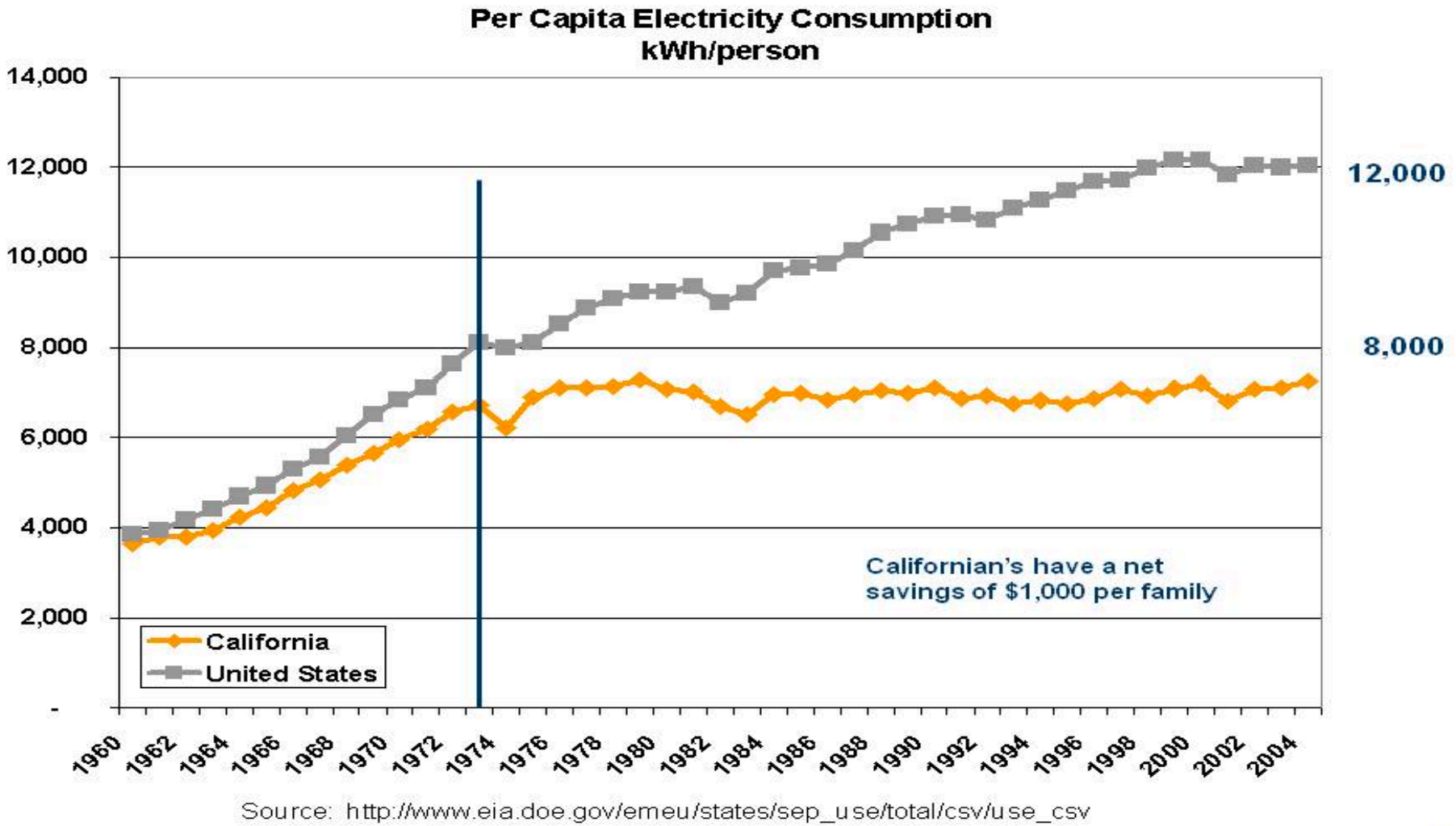
Average HP of the German car fleet

Quelle: WI 2008

1973: 60HP → today: more than 100 HP !

Ambitious energy efficiency policies work

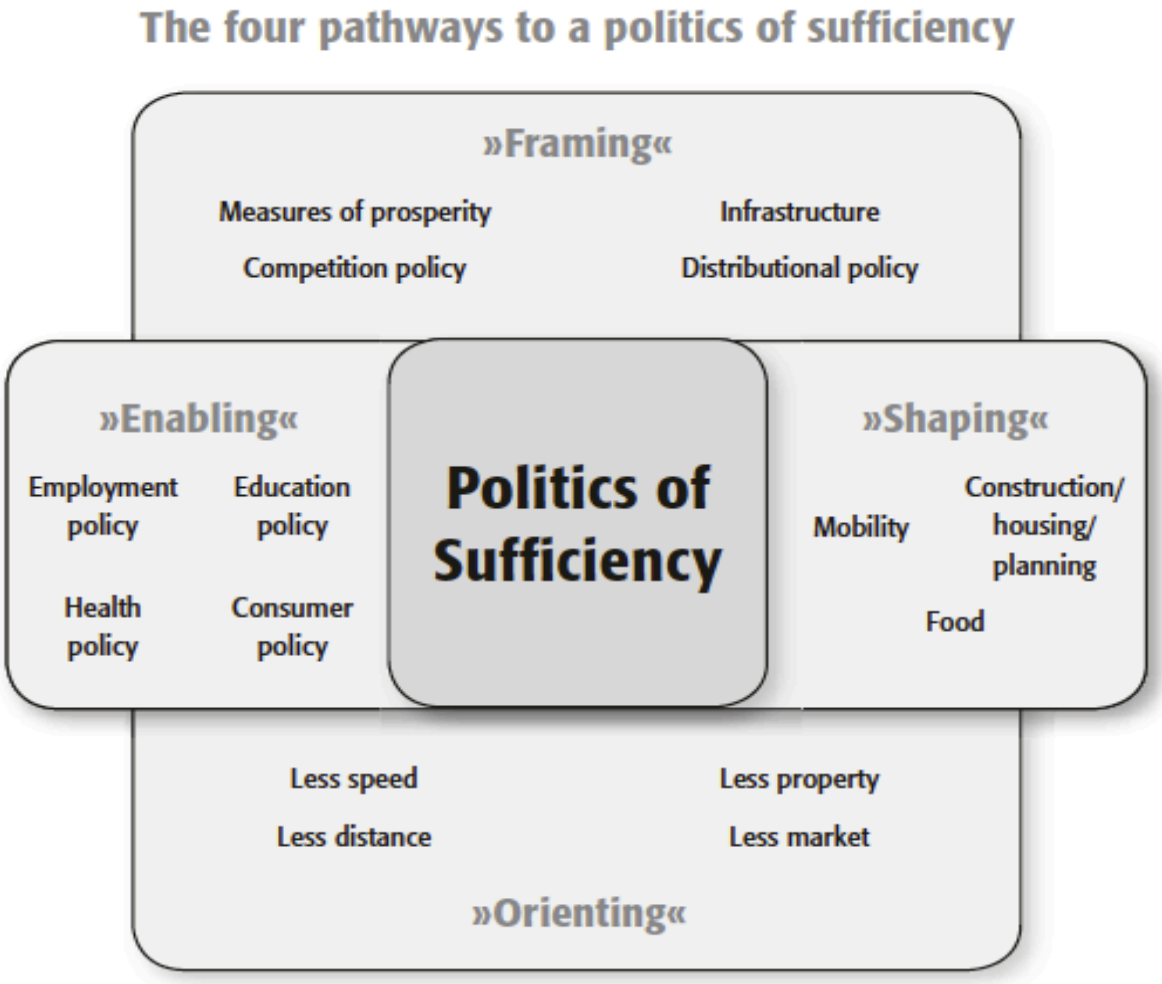
Significant less electricity consumption/cap in California compared to US average



Source: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv

Sufficiency politics are key for social transformation

But: highly complex, reluctant politicians, currently weak decoupling potential



Source: Schneidewind/ Zahrnt 2014

Combine efficiency and sufficiency policies -
to reduce rebound effects and encourage life style changes!

„The older I get the more I like regulation“

(Eoin Lees, Former Head of Energy Savings Trust/ UK)

- **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)…

Summary

- Physical and economic decoupling is indispensable for climate and resource protection and - according to scenarios – a technically feasible strategy

- There is scientific evidence that up to 2050 developed countries can reduce their per cap energy (material) consumption by a factor 3 to 4 (absolute decoupling)

- In comparison developing countries can (at least) halve their growth rates of energy/ material consumption (relative decoupling)

- Concerning economic development, decoupling is based on rapidly growing „green“ (e.g. renewables) and on shrinking „brown“ (e.g. fossil fuel) sectors

Summary

- To foster economic structural change to „resource light“ sectors/patterns by ecological industrial policy is the challenge for intervention not „De-growth“
- To mitigate unintended „growth, lifestyle and rebound effects“ the „efficiency revolution“ must be combined with suffciency policy
- A transition to sustainable production and consumption patterns is needed globally, including rich sectors in the North and in the South
- Economic growth is driven by „push and force“ of capital exploitation and competition, thus being no target but the resultant of a transformation process
- „Transformation“ is only a buzzword if the system status (capitalism) and the system target (socialism??) of a „Great Transformation“ had not been analyzed

Wuppertal Institute
for Climate, Environment
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Thank you for your attention!

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