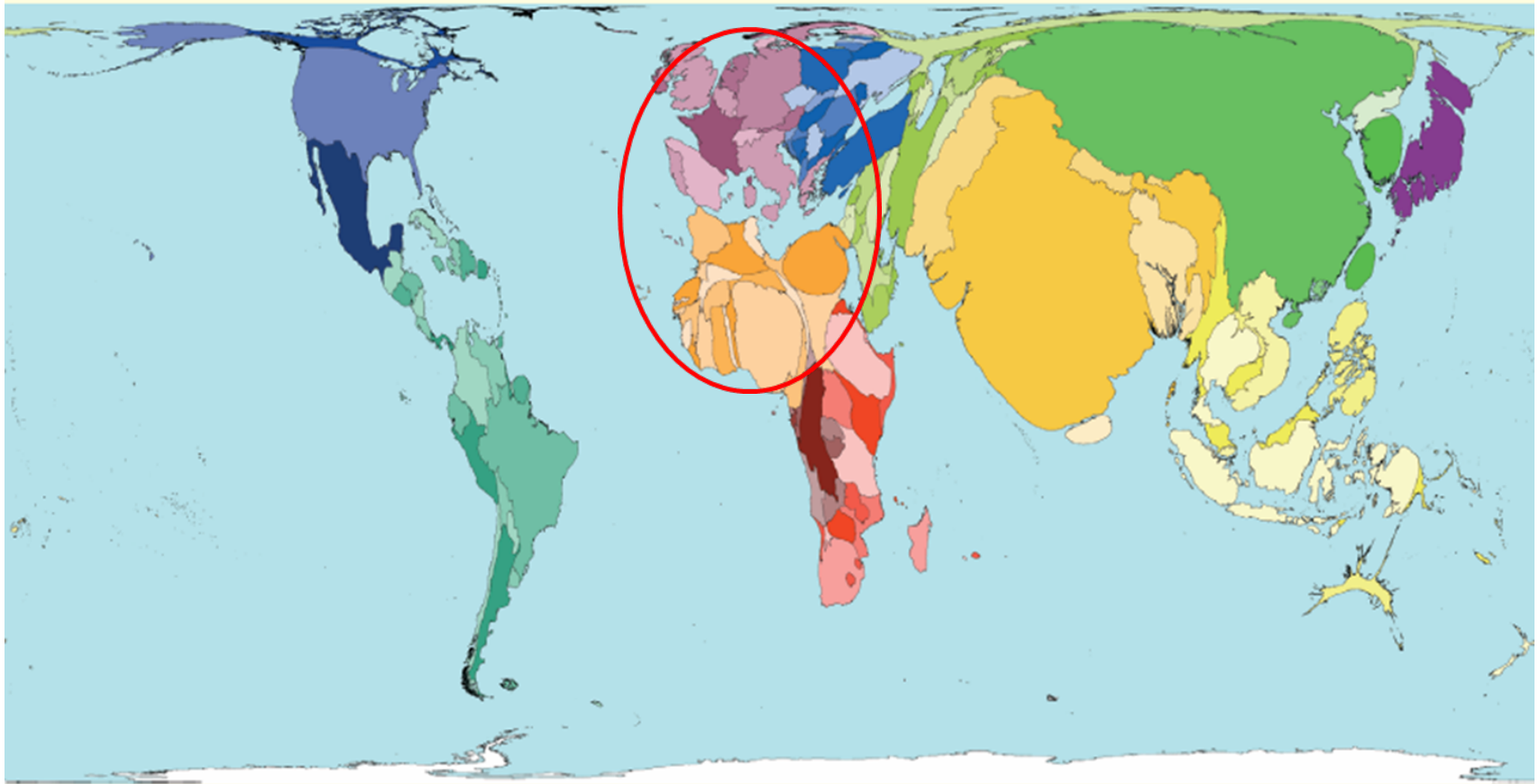


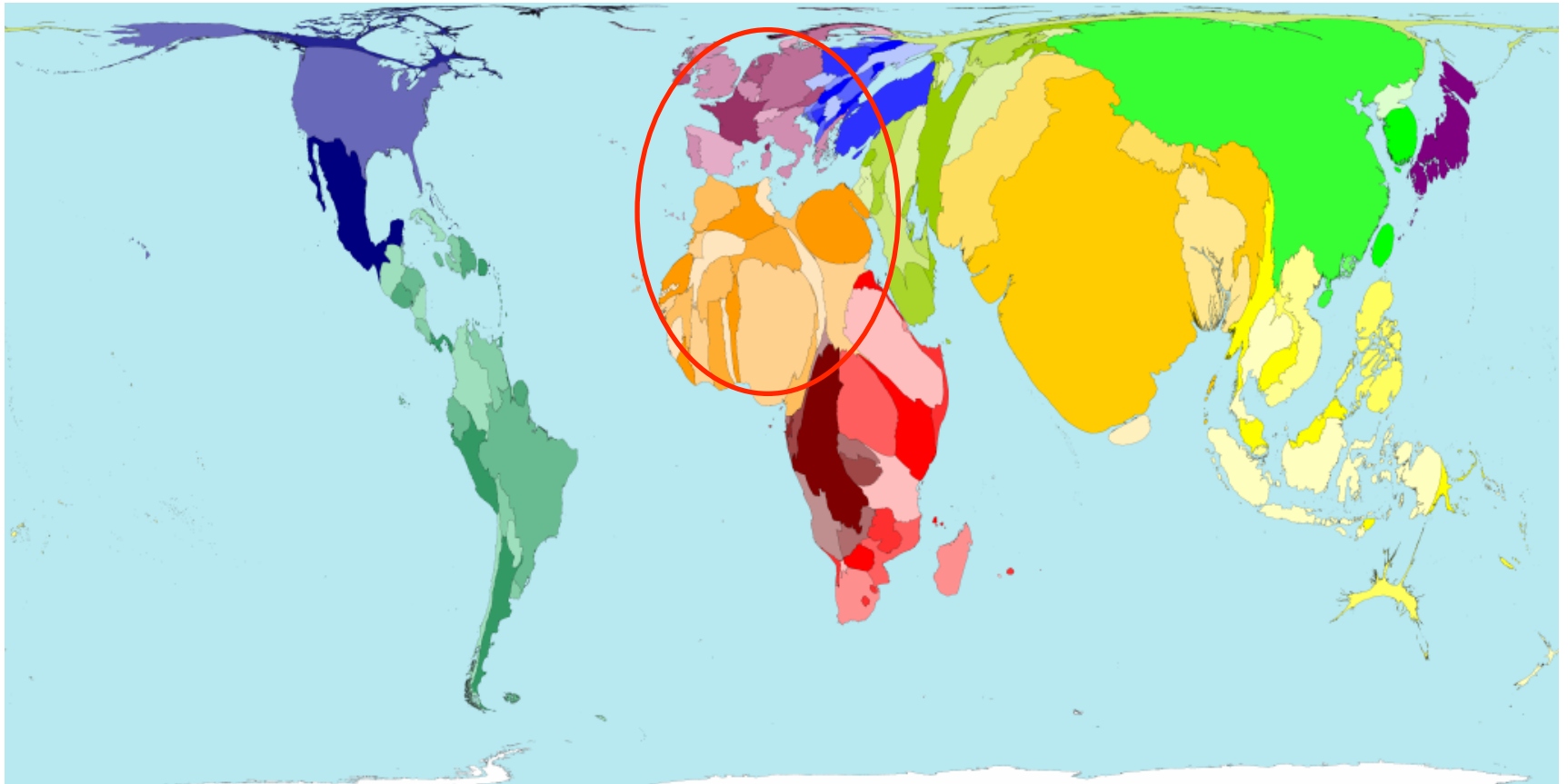


# Prof. Dr. Dr. h.c. Klaus Töpfer

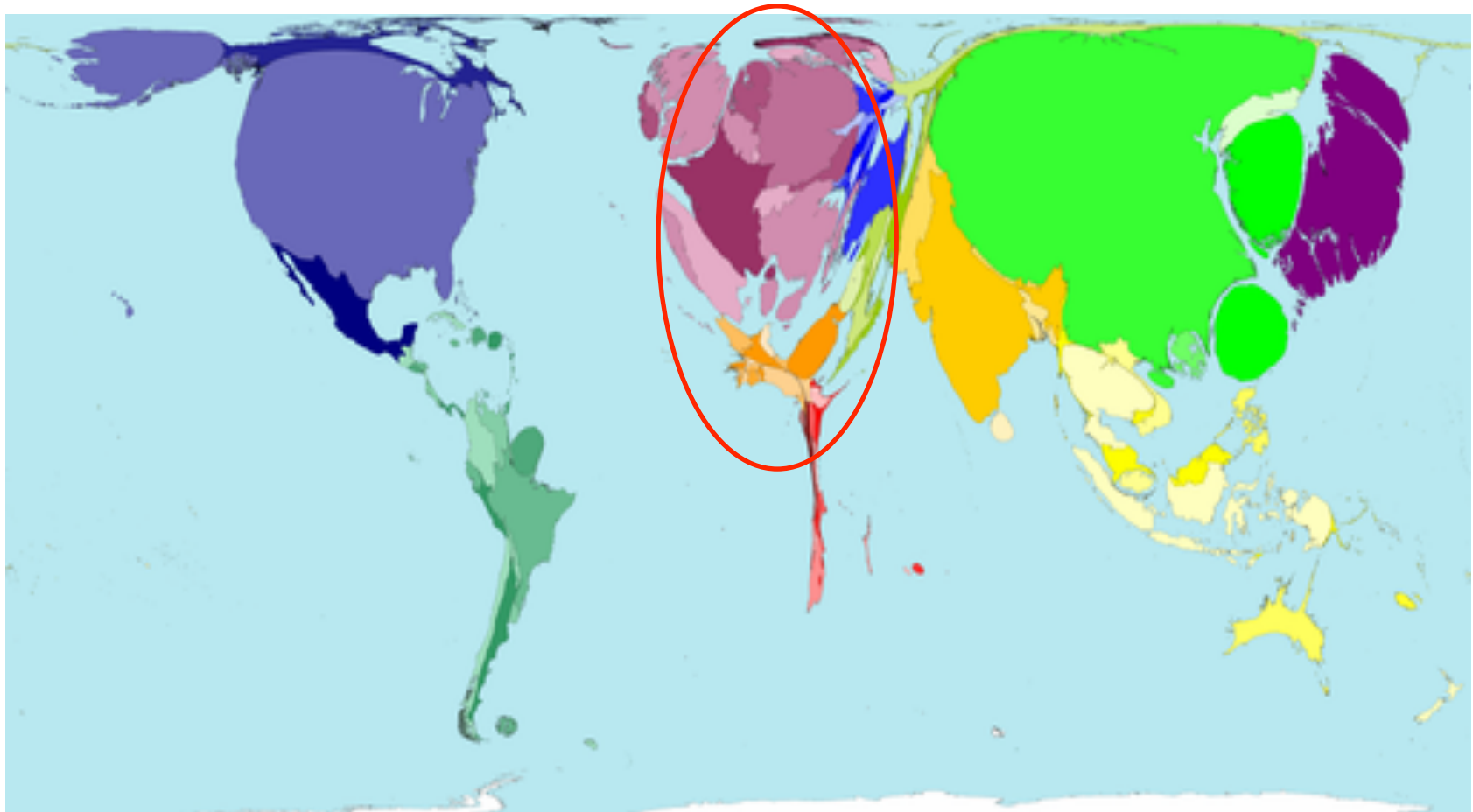
# Population (2000)

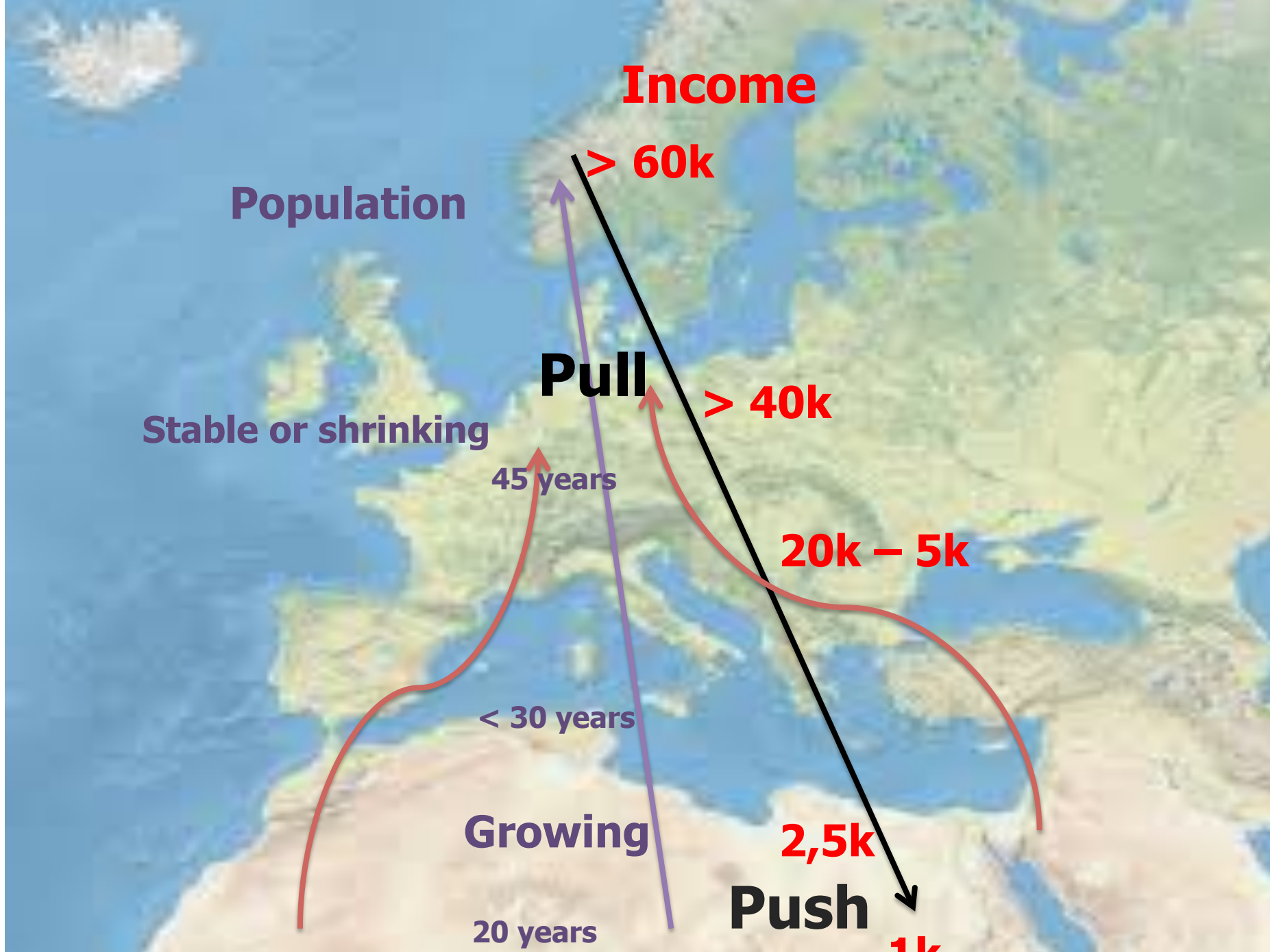


# Population (2050)



# Wealth in 2015 (BIP in US\$; here still as a *projection*)





# The same points...

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... presented in a different way (source Worldmapper)

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**“Global Sustainability: A Nobel  
Cause”,**  
Potsdam, Germany, 8-10 October 2007

## The dream that failed

The Economist 26 years ago: was „to get plenty of nuclear plants built, and then to accumulate, year after year, a record of no deaths, no serious accidents – and no dispute that the result is cheaper energy.





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The Economist (10 March 2012):

„In liberalised energy markets, building nuclear power plants is no longer a commercially feasible option: they are simply too expensive“

„But nuclear energy, which has received large subsidies in the past, has not displaced much in the way of fossil fuels either. And nuclear is getting more expensive whereas renewables are getting cheaper.“

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“...which are currently based almost exclusively on fossil fuel resources and unsustainable use of traditional fuels.”

---

“Is there a “third way” between environmental destabilization and persisting underdevelopment?”

## Option 1: Cleaning of fossil fuels

- particulates,
- SO<sub>2</sub>,
- NO<sub>x</sub>,
- CO<sub>2</sub>?
  - CCS
  - CCU

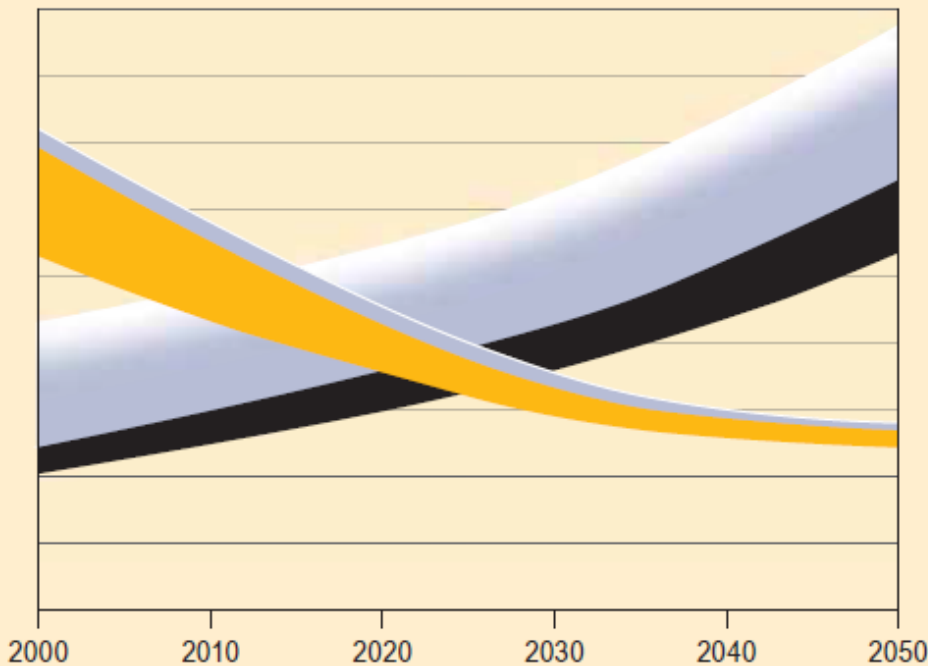
- 
- Option 2: Efficiency & Productivity

- 
- Option 3: New sources of energy

# Learning curve of renewable costs

## Development of costs for renewable and conventional energy sources

Specific energy costs






### Renewable energies

- Young technologies: strong technological progress and large economies of scale
- Unlimited, widespread availability
- Globally applicable, can not be misused, practically no hazards
- Low external costs (system manufacture)

### Fossil and nuclear energies

- Limited resources, unequal regional distribution
- Prices rising over longer term
- Expensive and high-risk nuclear technologies (breeders) required to substitute fossil resources
- Nuclear energy is not globally available; high potential for misuse and high-risk
- External costs: prohibitive in the long term for fossil energies (climate change); potentially prohibitive for nuclear energies

-  Renewable energies
-  Fossil and nuclear energies
-  External costs

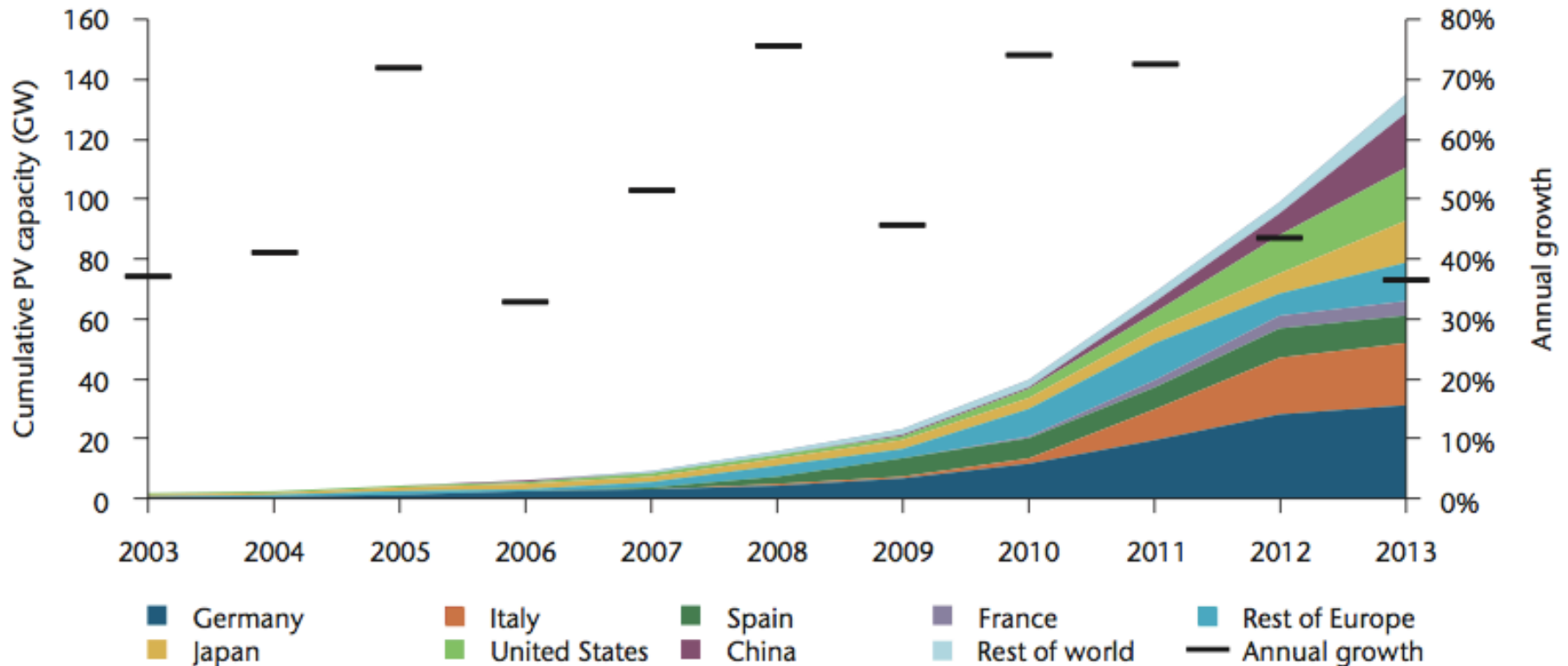
Renewable energy sources provide the cheapest energy in the long run.

Source: DLR

Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2011) Renewable Energies Perspectives for a Sustainable Energy Future

# Global installed *PV-Capacities* 2003 - 2013

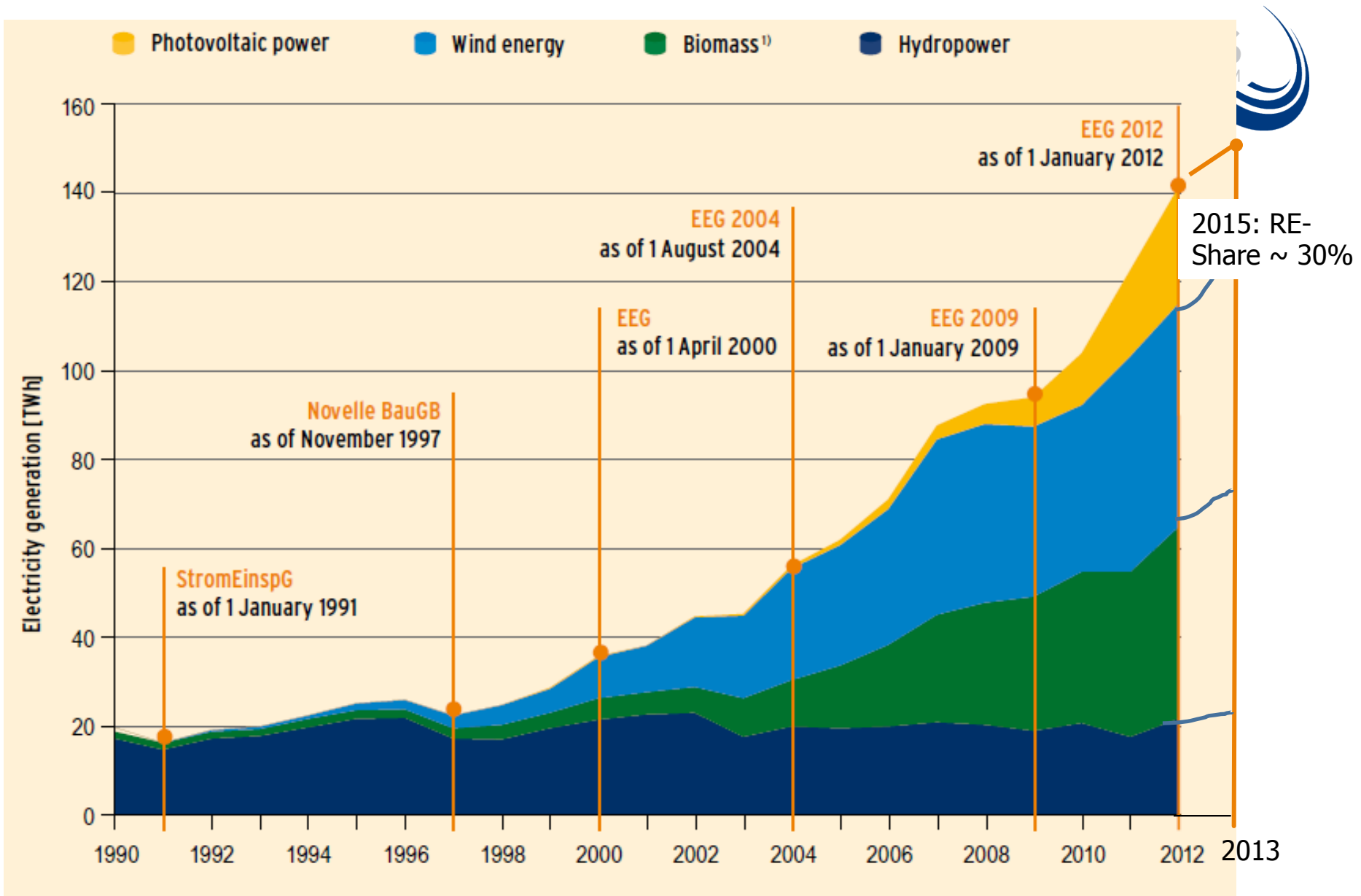
Figure 1: Global cumulative growth of PV capacity



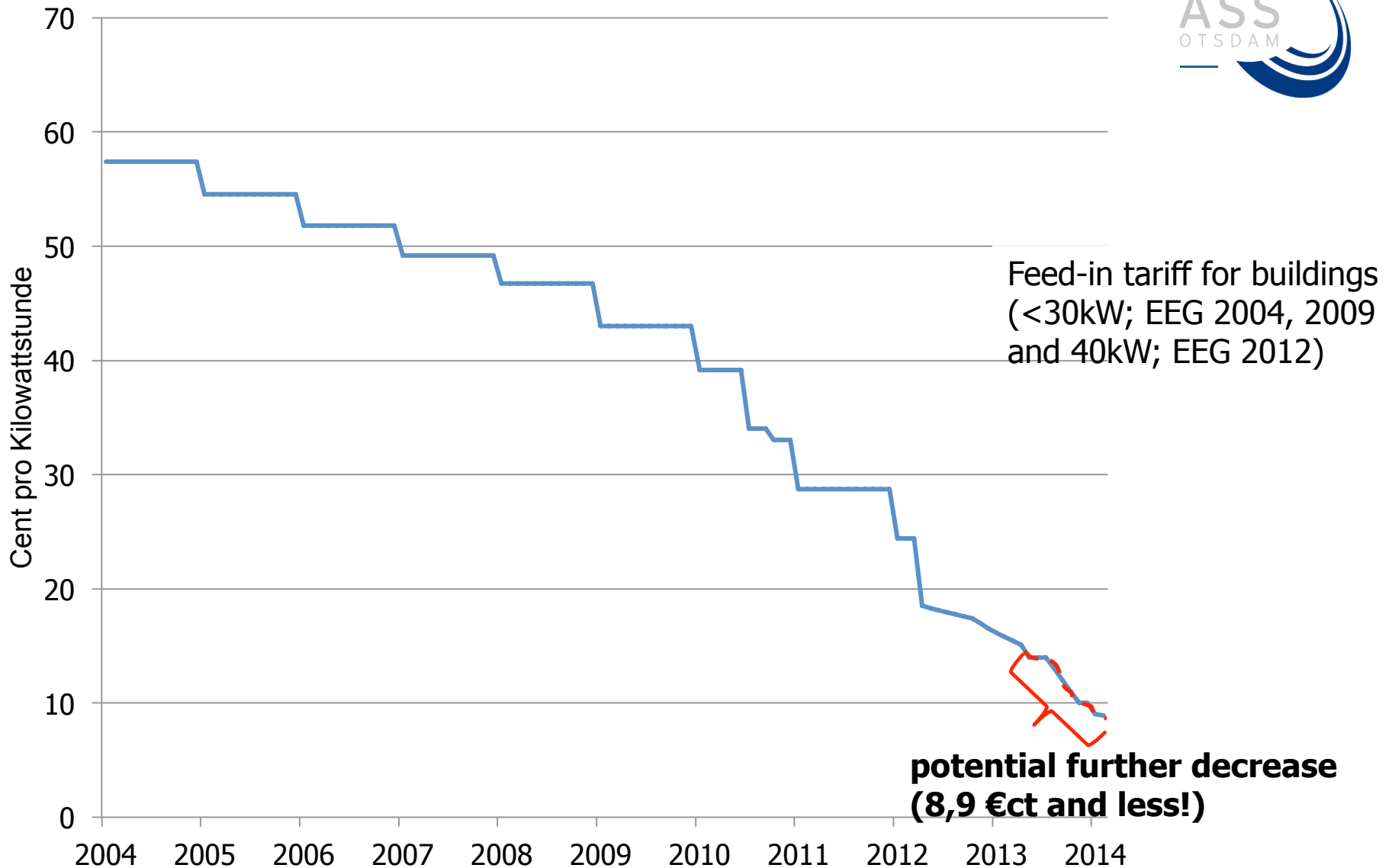
Source: Unless otherwise indicated, all tables and figures derive from IEA data and analysis.



# German Renewable electricity generation – development 1990 - 2013



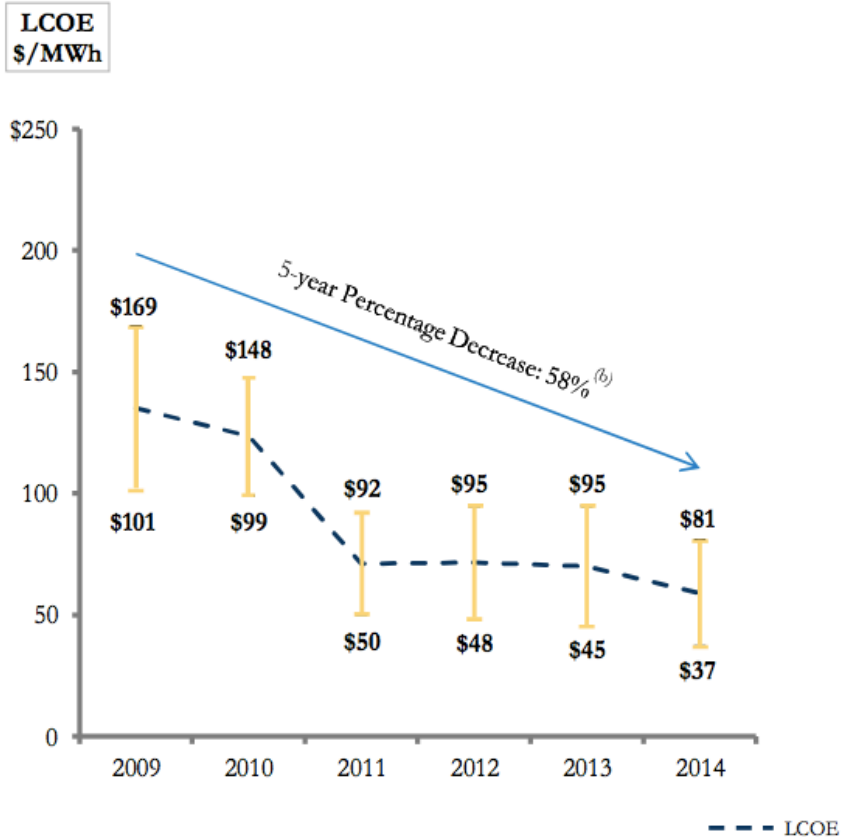
# Feed-in tariffs PV in Germany - development



Source: Renewable Energy Sources Act)

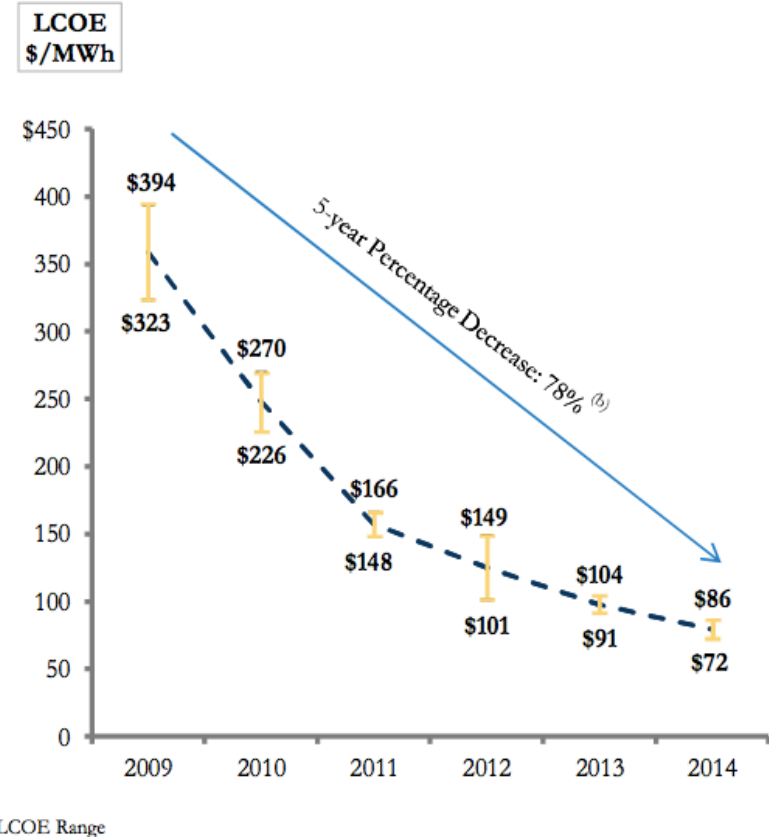
# Development of costs for electricity from Wind and Solar PV USA 2009 - 2014

WIND LCOE

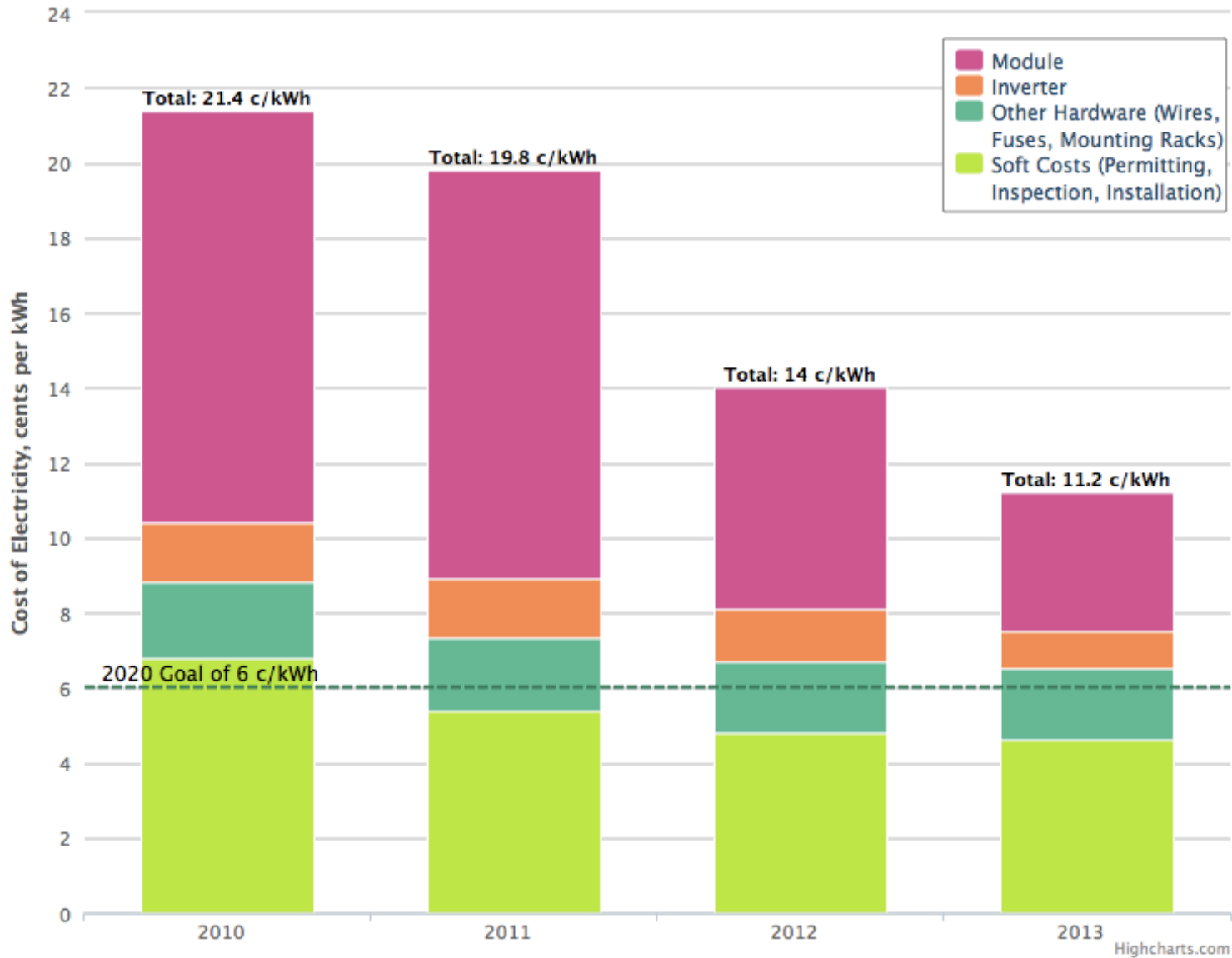


Source: Lazard estimates.

SOLAR PV LCOE<sup>(a)</sup>



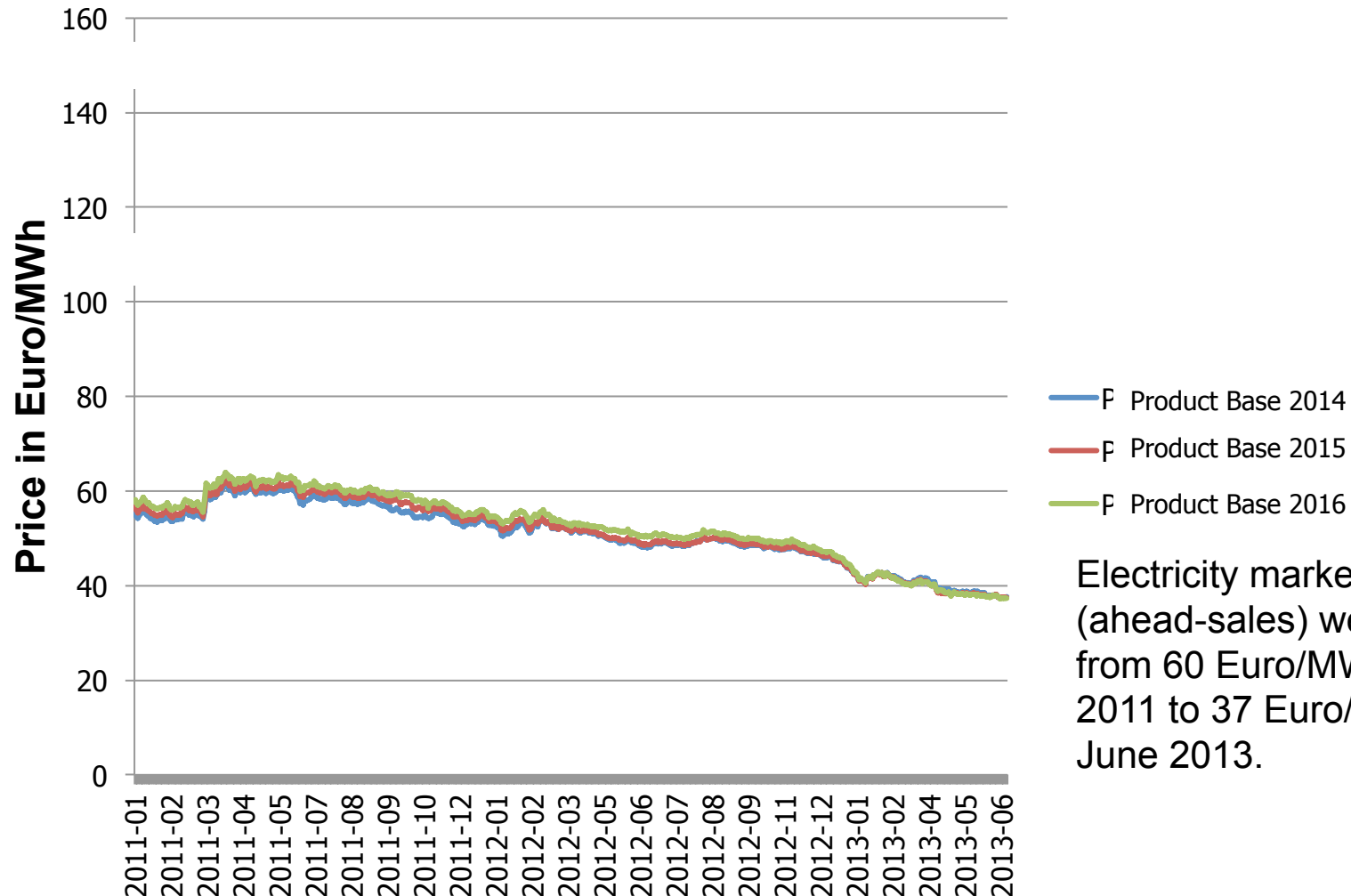
# The Falling Price of Utility-Scale Solar Photovoltaic (PV) Projects



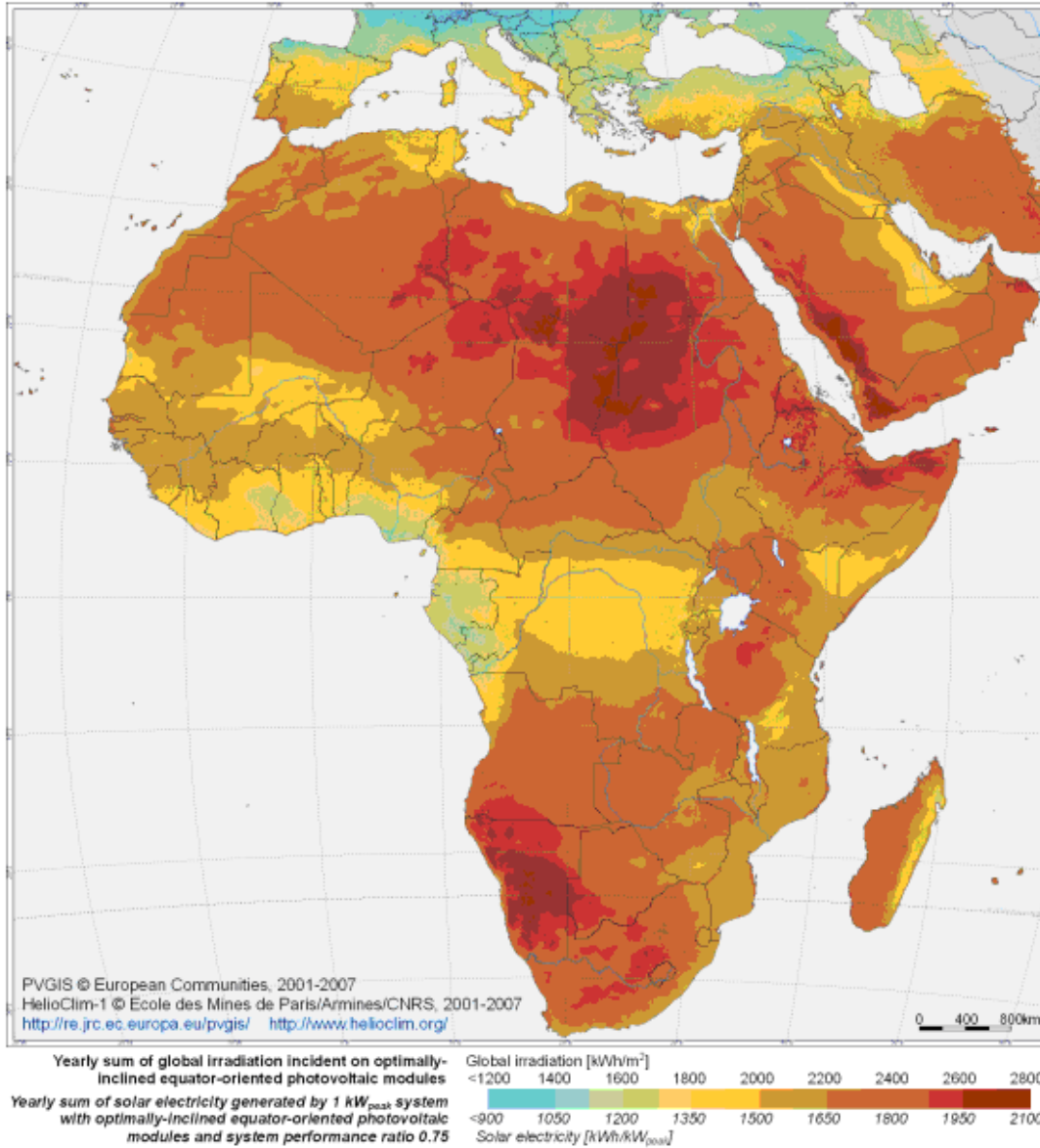
Data courtesy of National Renewable Energy Lab. Chart by Daniel Wood.

(Quelle: <http://energy.gov/maps/falling-price-utility-scale-solar-photovoltaic-pv-projects>, 02/2014)

# Electricity prices (EEX – electricity exchange)



Electricity market prices (ahead-sales) went down from 60 Euro/MWh in 2011 to 37 Euro/MWh in June 2013.

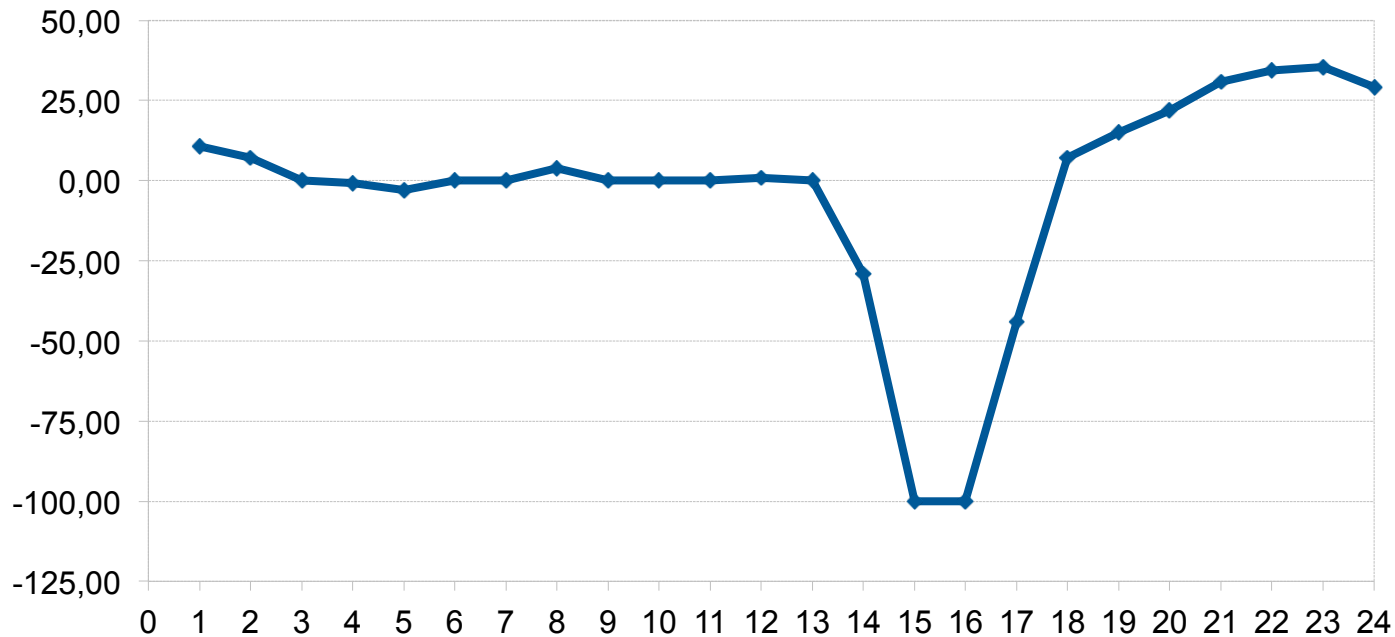


## Solar electricity potential in Africa

Source: <http://acpobservatory.jrc.ec.europa.eu/content/photovoltaic-potential-africa>

# Negative electricity prices – example june 2013

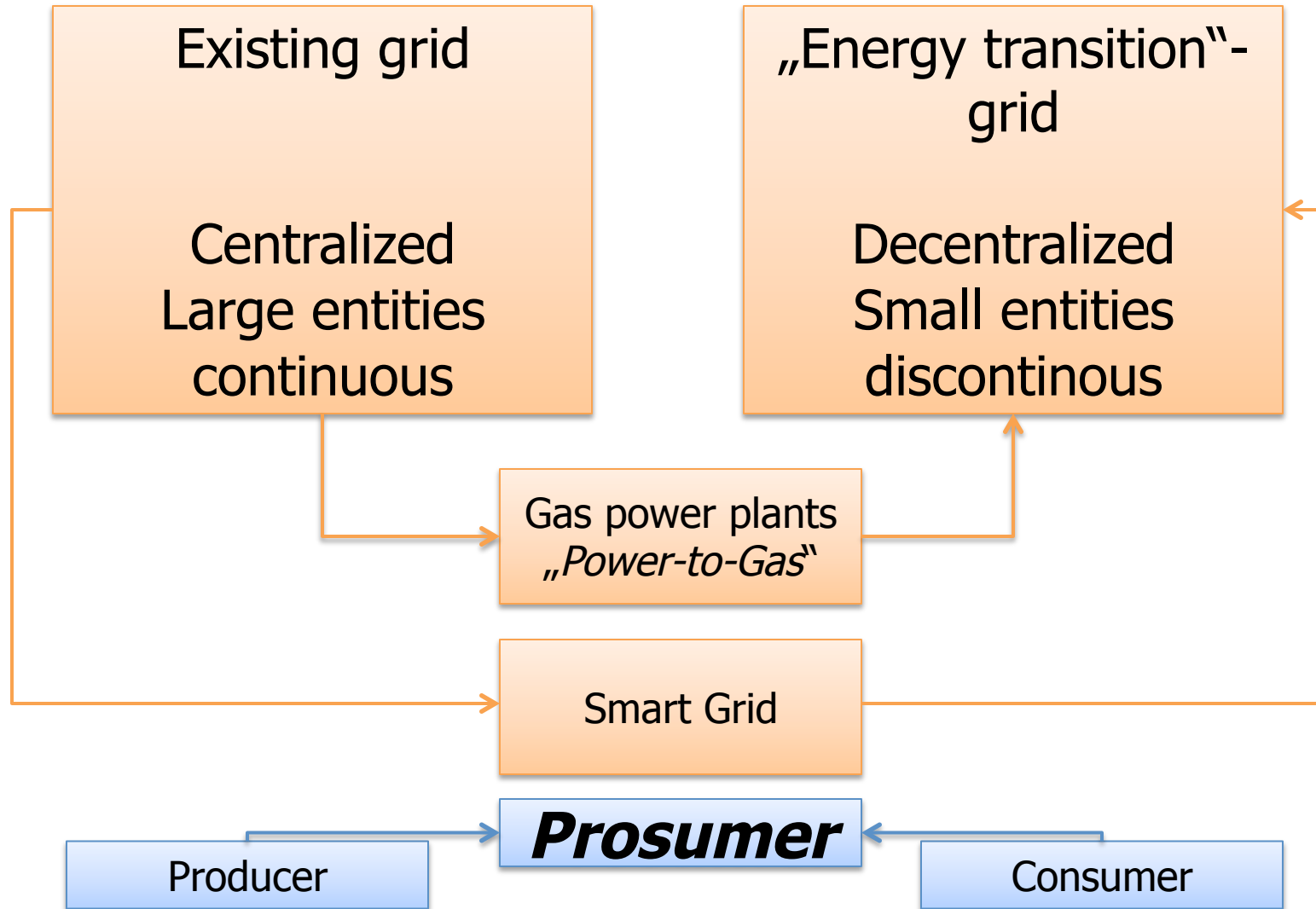
Price in Euro per Mwh (24 hrs.products on 16.06.2013, source: EEX.de)



- 
- Option 4: Flexibility



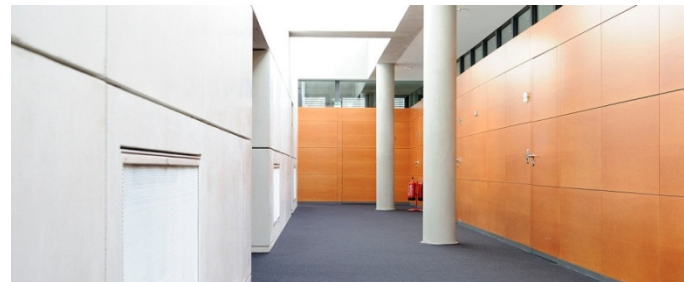
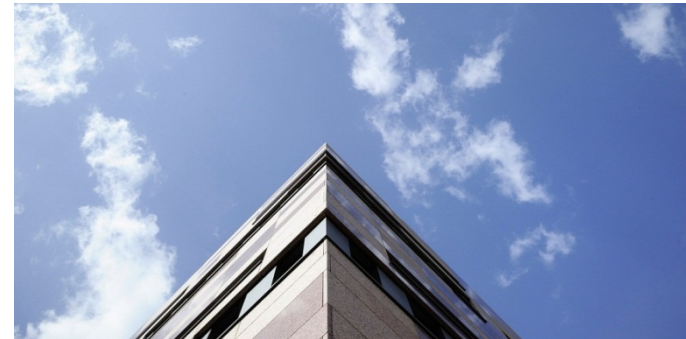
# Consequences for the Electricity structure

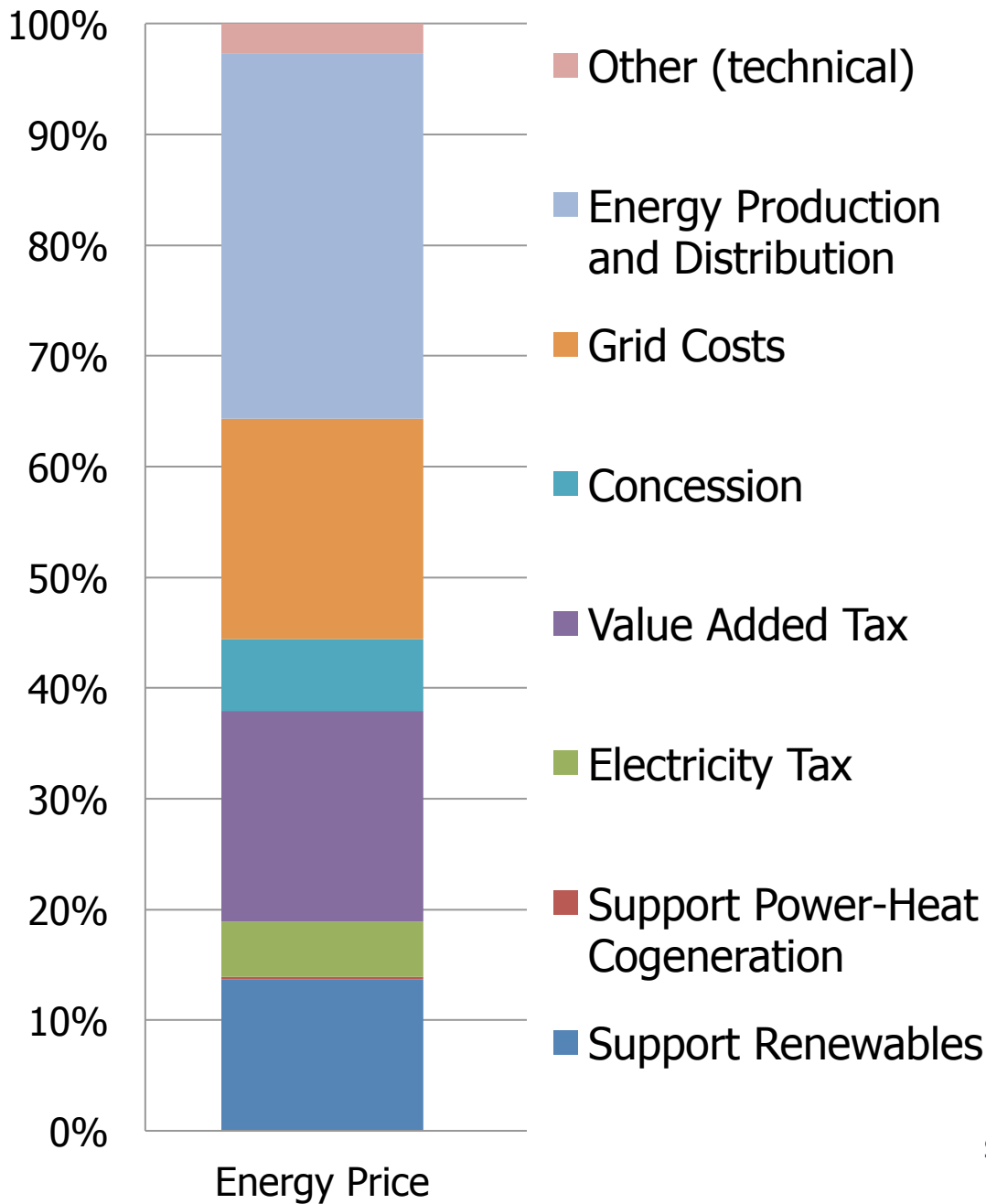


“This implies, in particular, that the *scientific community engages* in a strategic alliance with the leaders, institutions and movements representing the worldwide civil society.

”

# Thank you for your attention!





## Composition of electricity prices in Germany

Source: <http://www.energie-verstehen.de> and BDEW

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“Climate protection ambitions appear to be on a collision course with the predominant growth paradigm that disconnects human welfare from the capacity of the planet to sustain growth.”

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“Ensuring that an estimated nine billion people can live a decent life requires, above all, access to affordable, sustainable and reliable energy services,...”