The German “Energiewende” – Climate Change, Renewables, Energy Efficiency

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… *in short*

- **The overarching target is Climate Change**
- **Decision to base energy system on Renewables and Efficiency**
- **Phase out of nuclear until 2022**

- **Very ambitious targets**
- **Concrete and very comprehensive set of measures (166 P&M's)**
- **Transparent Monitoring Scheme**

- **Constant adaption needed: a learning process**

Challenges

To move the transition forward successfully, we…

- **… enable the electricity system to cope with large amounts of intermitting energy supply by photovoltaic and wind on shore**
- **… increase flexibility of supply and demand**
- **… ensure supply security during times of low RE through management measures**
- **… address the medium-term challenge of electricity market design (e.g. closer-to-real-time trading to reduce forecasting error)**

A learning system

Energiewende faces challenges that can not be solved alone

1. Renewable energies:

- continuous expansion
- reducing support costs
- enhancing market integration

2. Energy efficiency:

- reducing energy consumption
- increasing energy security

3. Grid infrastructure:

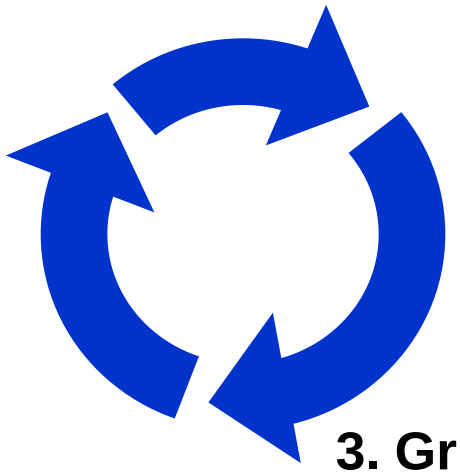
- Temporary loop flows
- expansion and modernisation
- integration of RE

4. Flexibilisation of the whole system

- flexible ***demand***
- flexible power plants
- complete new concepts and smart solutions

5. Keeping costs accepatable

- avoiding new subsidies
- balanced approaches
- fair effort sharing



What are we talking about?
Energy Structures in Germany

Primary Energy Balance in Germany

Energy Sources	2011 in TJ	%
Oil	4.549	33,9%
Hard Coal	1.685	12,6%
Lignite	1.568	11,7%
Natural Gas	2.760	20,6%
Nuclear Energy	1.182	8,8%
Hydro and Wind	236	1,8%
Other Renewables	1.213	9,0%
cross border net exchange	-18	-0,1%
others	236	1,8%
total	14.012	

Quelle: BMWi (2011) *Energiedaten - Nationale und internationale Entwicklung,* Tabelle 4

Power Generation in Germany 2012

Energy Sources	Power generation in TWh	%	2012 against 2011	ranking
Hard Coal	118,0	19,1%	+ 0,5%	3
Lignite	158,7	25,7%	+ 2,5%	1
Natural Gas	69,8	11,3%	- 2,5%	5
Nuclear	99,4	16,1%	-6,3%	4
Oil	9,3	1,5%	+0,2%	7
Renewables	136,5	22,1%	+5,7%	2
Wind	45,7	7,4%	+1,4%	
Hydro	21,0	3,4%	+0,1%	
Photovoltaic	27,8	4,5%	+2,6%	
Biomass	35,8	5,8%	+1,3%	
garbage	4,9	0,8%	+/- 0	
others	25,9	4,2%	-0,1%	6
total	617,6			

Quelle: BMWi (2011) *Energiedaten - Nationale und internationale Entwicklung* Tabelle 22

That means: The Energy Concept includes all sectors – it is not only power related!

- 2/3 of German Primary Energy balance is heat and transport
- 1/3 of German Energy balance is electricity
- 8 – 10 % of the German Energy Balance is nuclear power

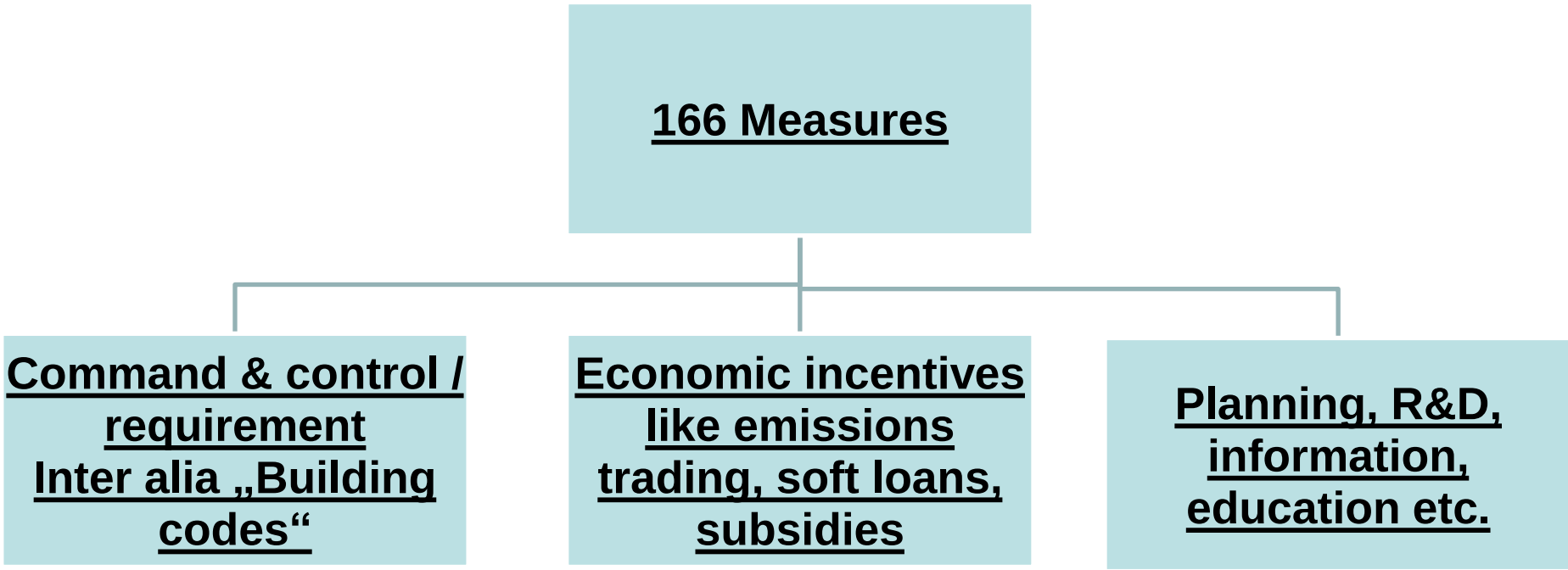
Three main elements

- **Ambitious targets and interim targets**
- **Catalogue of policies and measures covering all types of instruments**
- **Annual, transparent Monitoring**

The *Energiewende: Targets*

	Climate	Renewables		Efficiency				
	Green house gases (vs. 1990)	power	Primary energy	Primary energy	power	Energy productivity	transport	buildings
2020	- 40 %	35%	18%	- 20%	-10%	increase to 2,1%/a	-10 %	Double 1 ---2 % Refurbis-ment p.a.
2030	- 55 %	50%	30%					
2040	- 70 %	65%	45%					
2050	- 80-95%	80%	60%	- 50%	-25%		- 40 %	

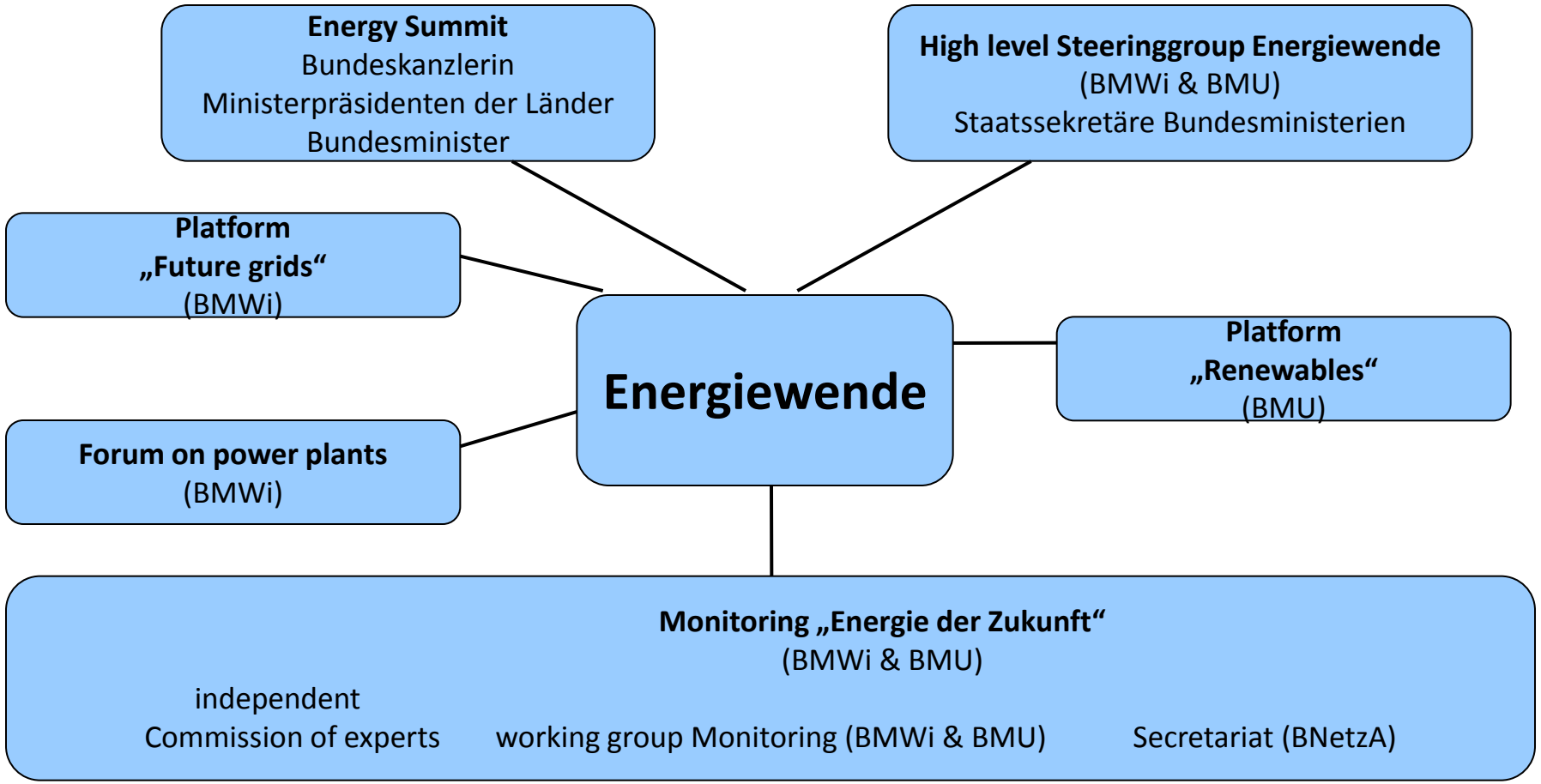
Policies & Measures



Packages of Policies an Measures

- **Building sector: Building codes + economic incentives + soft measures + R&D**
- **Industry: emissions trading + economic incentives + soft measures (inter alia: EMS) + R&D**
- **Small Consumers: economic incentives + soft measures (inter alia: EMS)**
- **Energy Supply: emissions trading + CHP Act + EEG + economic incentives + R&D**
- **Transport: CO_2 limits (g/km) – electric mobility + alternative fuels + modal split**

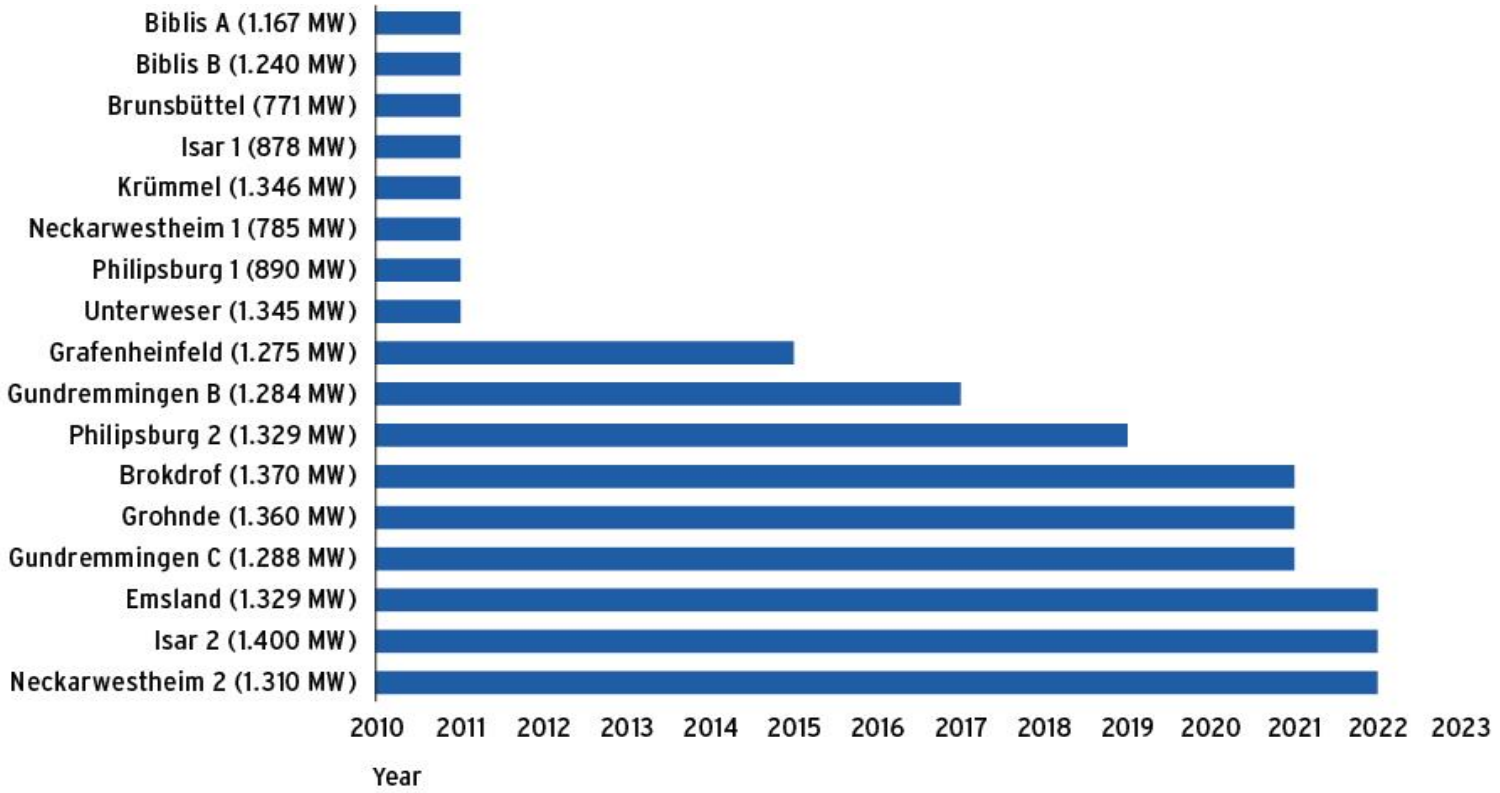
Management Structures of the „Energiewende“



The rationale…

- Climate friendly energy future
- Driving innovation: achieving „system competence“
- Renewable sources of energy and energy efficiency are the future lead markets
- Acting now: Avoids lock-in effects (!), promoting future technologies and drives economic growth
- The future competetiveness will be decided by efficiency
  - The cheapest unit of electricity is the one avoided
  - in 2050 we want to use ½ of energy for one unit of our GDP
- Reducing dependence on energy imports: already in 2011, Germany saved 25 bn €/pa of fossil fuel imports
- Long term: cost efficient, low carbon energy system

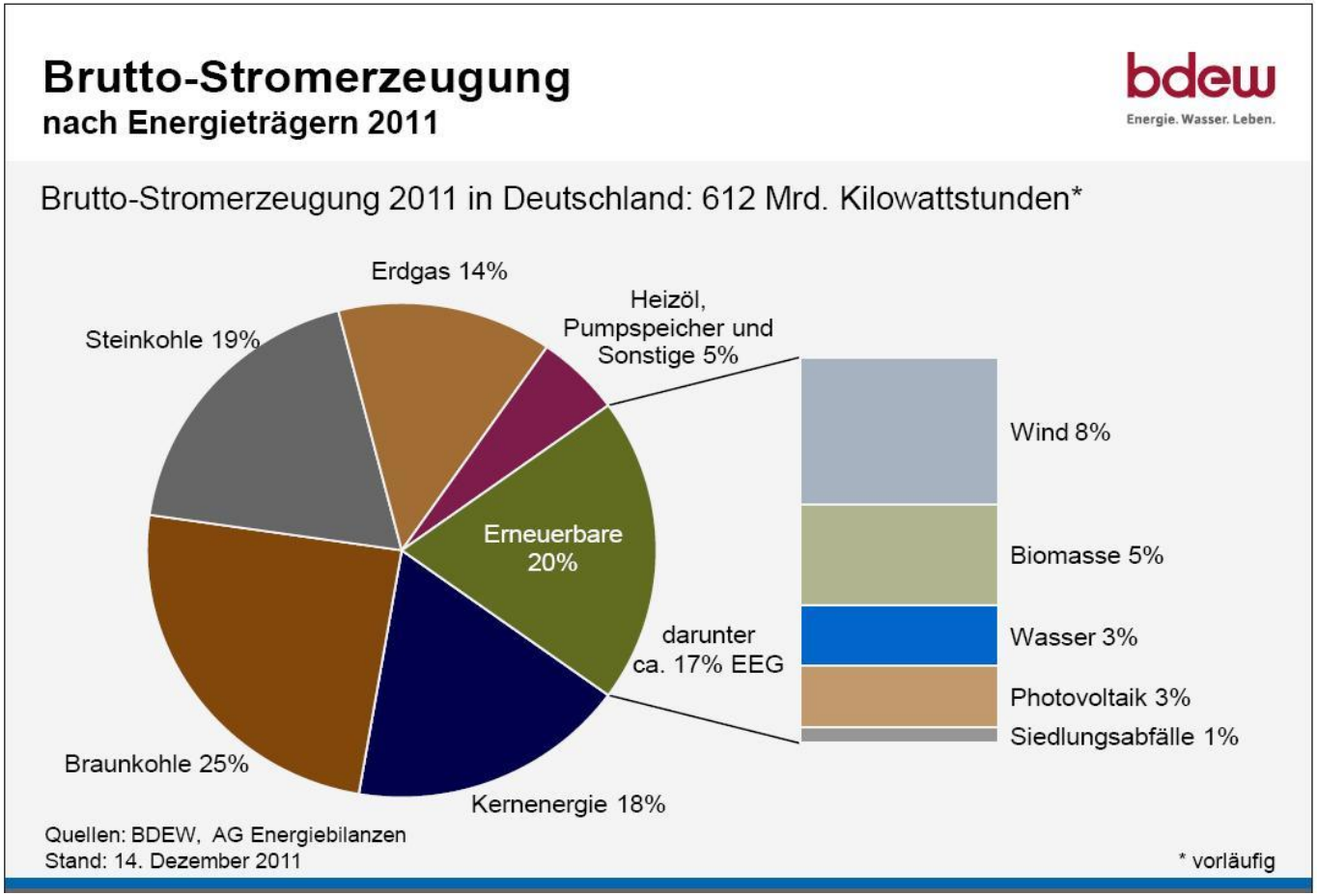
Phase-out data and remaining nuclear capacities



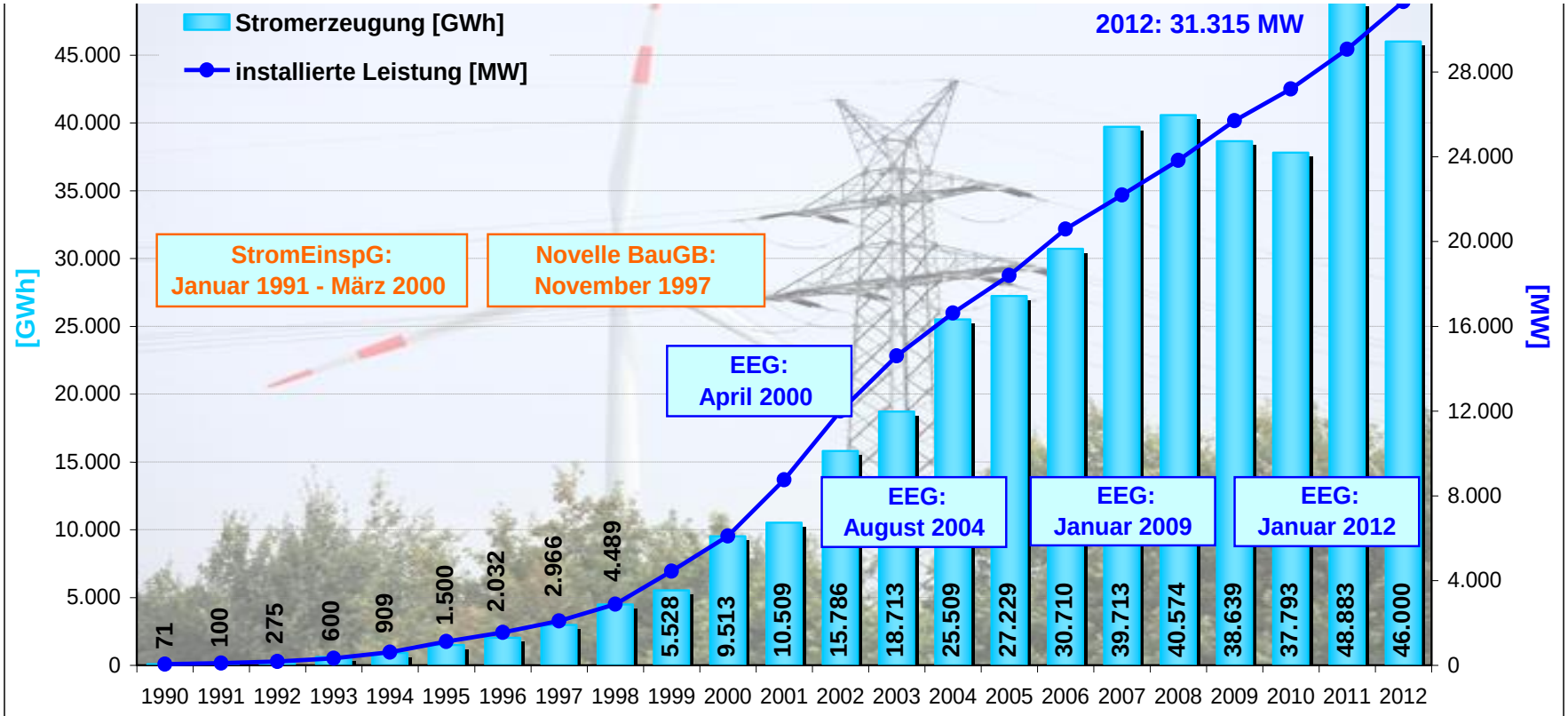
	2011	2015	2017	2019	2021	2022	total
Capacity taken off grid in MW	8.422 *	1.275	1.284	1.329	4.018	4.039	20.367

* 2.1 GW already removed from the grid since 2008

2011: Renewable Sources of Energy surpassed nuclear and became second largest energy source for electricity

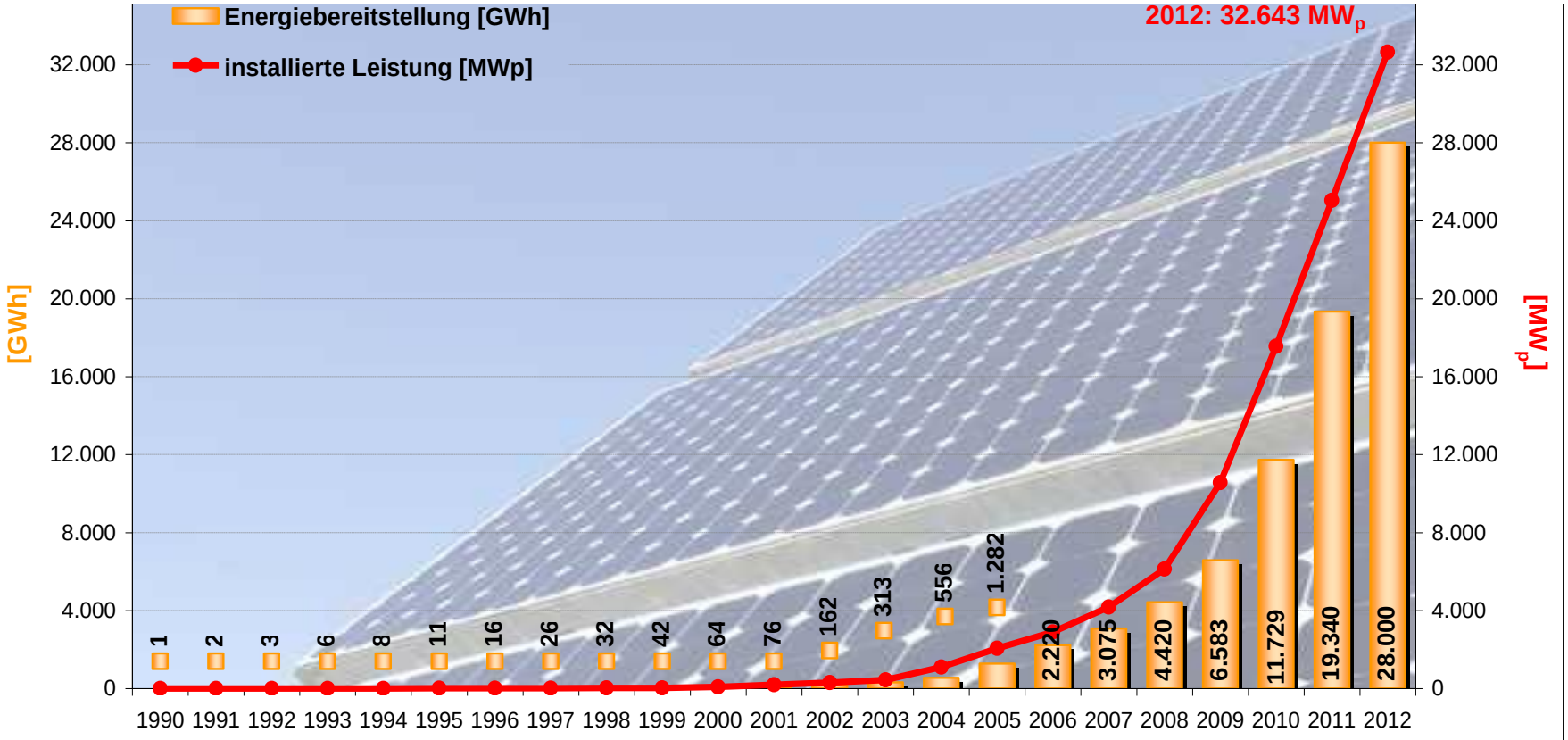


Installed wind capacity in 2012: 32 GW



Quellen: C. Ender, Internetauftritt Deutsches Windenergie-Institut (DEWI): "Windenergienutzung in Deutschland - Stand: 31.12.2012";
StromEinspG: Stromeinspeisungsgesetz; EEG: Erneuerbare-Energien-Gesetz; BauGB: Baugesetzbuch; 1 MW = 1 Mio. Watt; 1 GWh = 1 Mio. kWh;
BMU - E I 1 nach Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat); Hintergrundbild: BMU / Christoph Edelhoff; Stand: Februar 2013; Angaben vorläufig

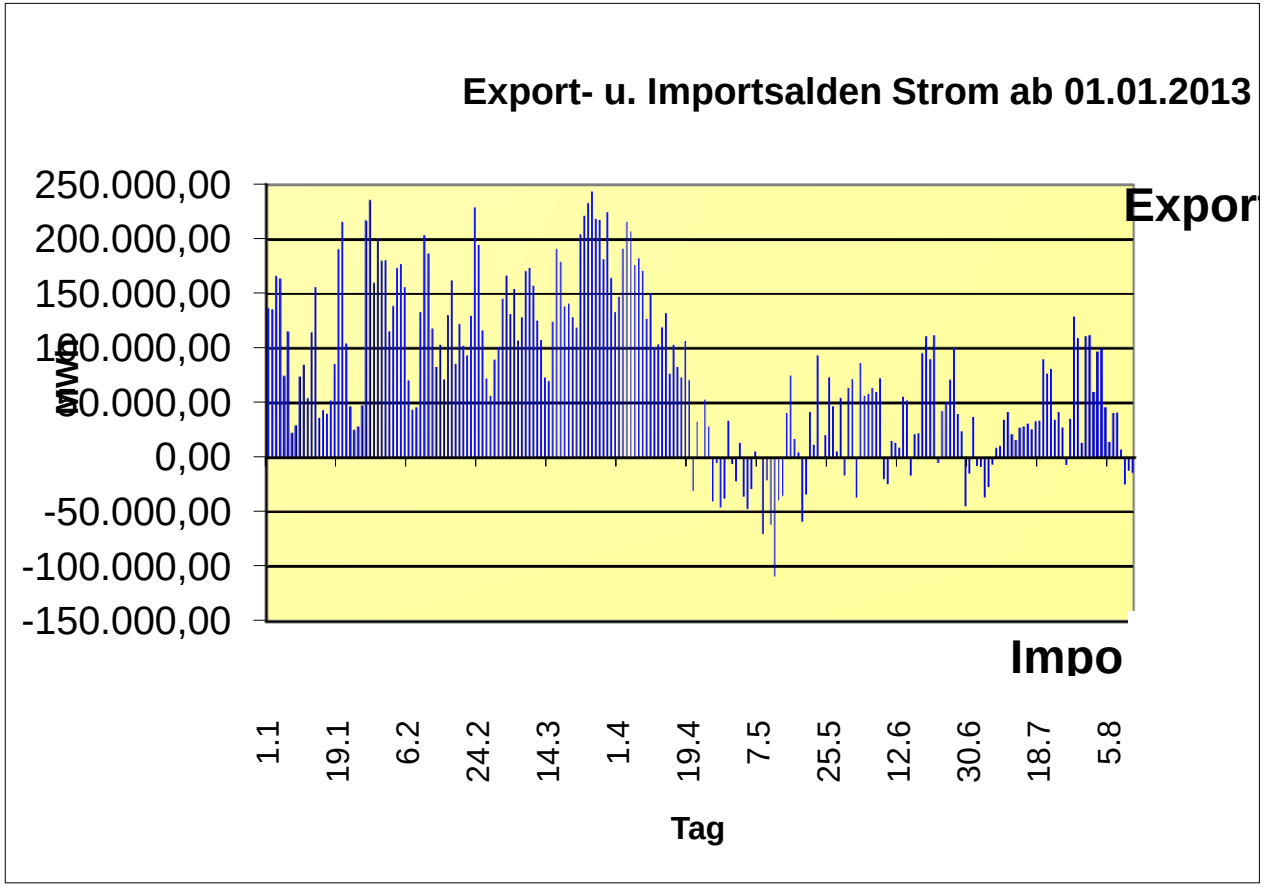
Installed PV capacity in 2012: 32 GW



Quelle: BMU - E I 1 nach Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat); 1 GWh = 1 Mio. kWh; 1 MW = 1 Mio. Watt;
Hintergrundbild: BMU / Bernd Müller; Stand: Februar 2013; Angaben vorläufig

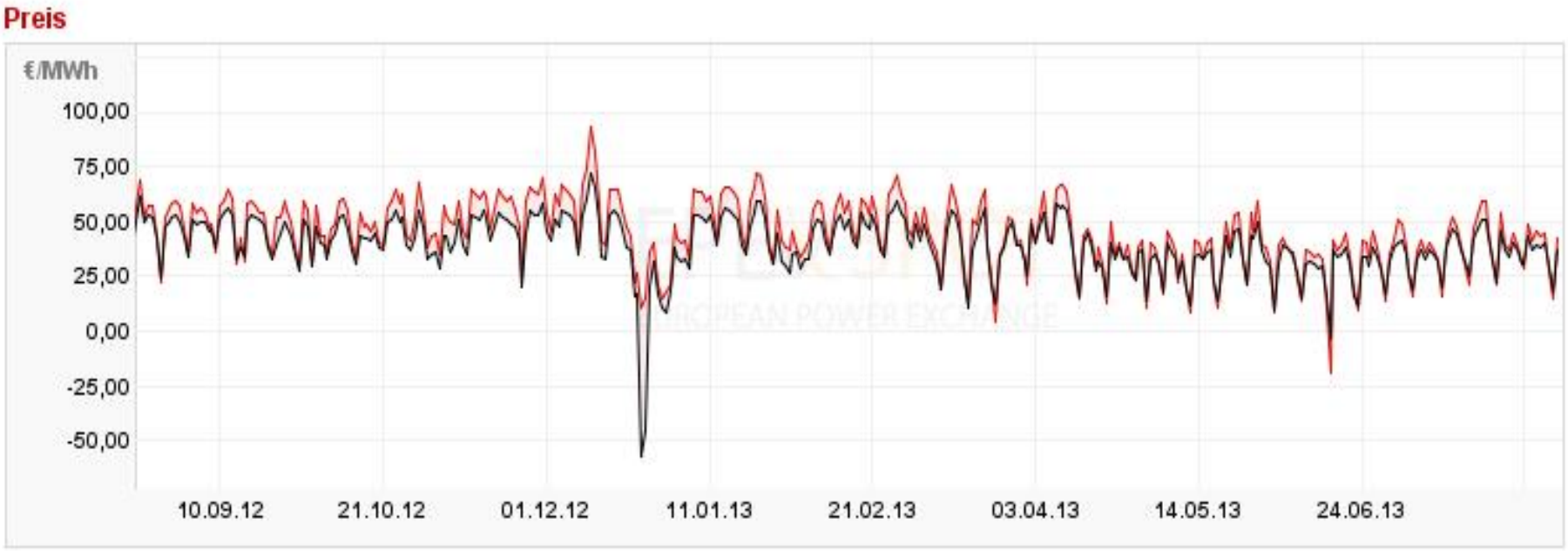
Germany remains net exporter – 23 TWh in 2012

- Imports / Exports 2013

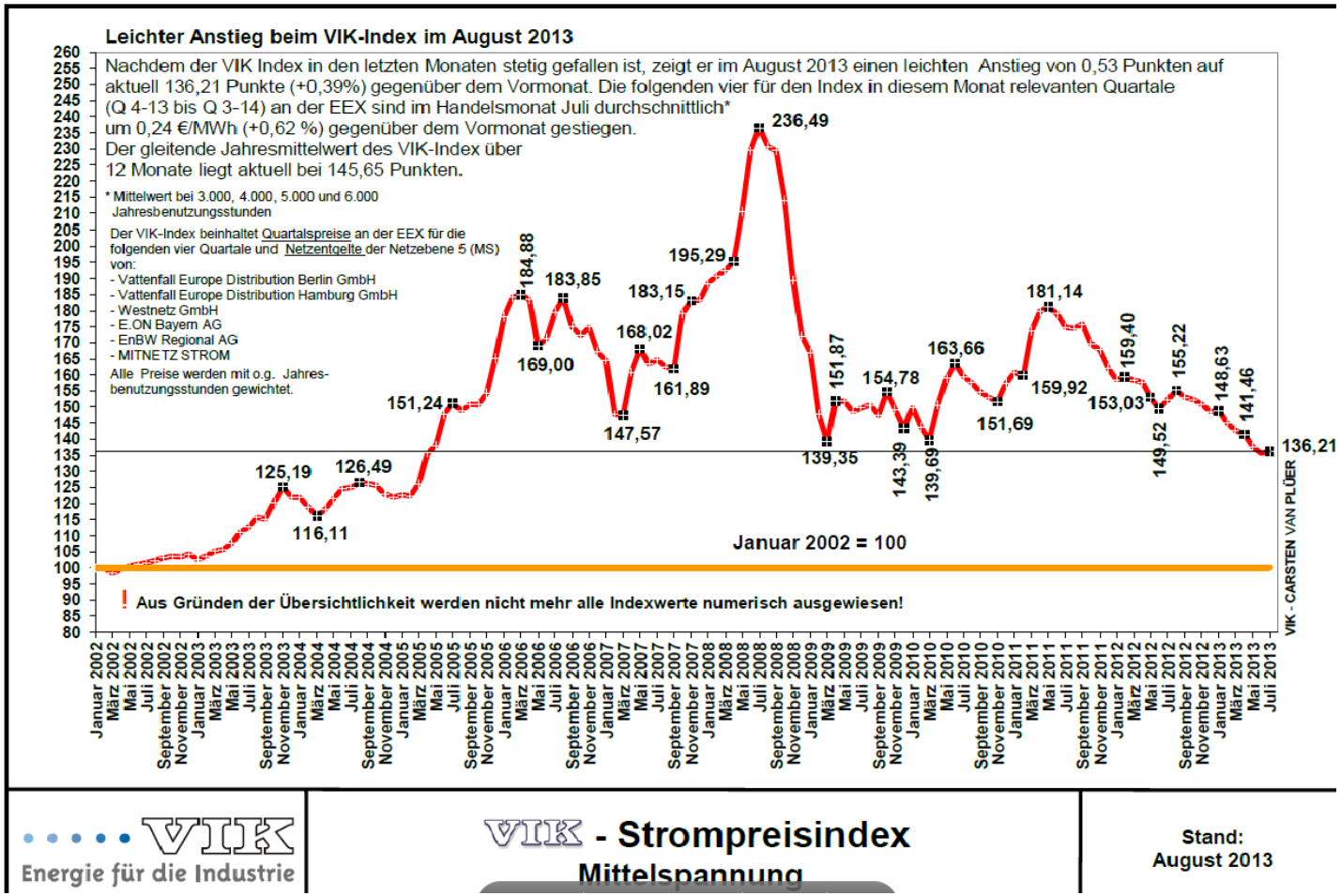


Average spot market price has remained stable but low; higher amplitudes mainly in time of surplus of wind

Higher amplitudes, particularly in times of low demand and strong wind



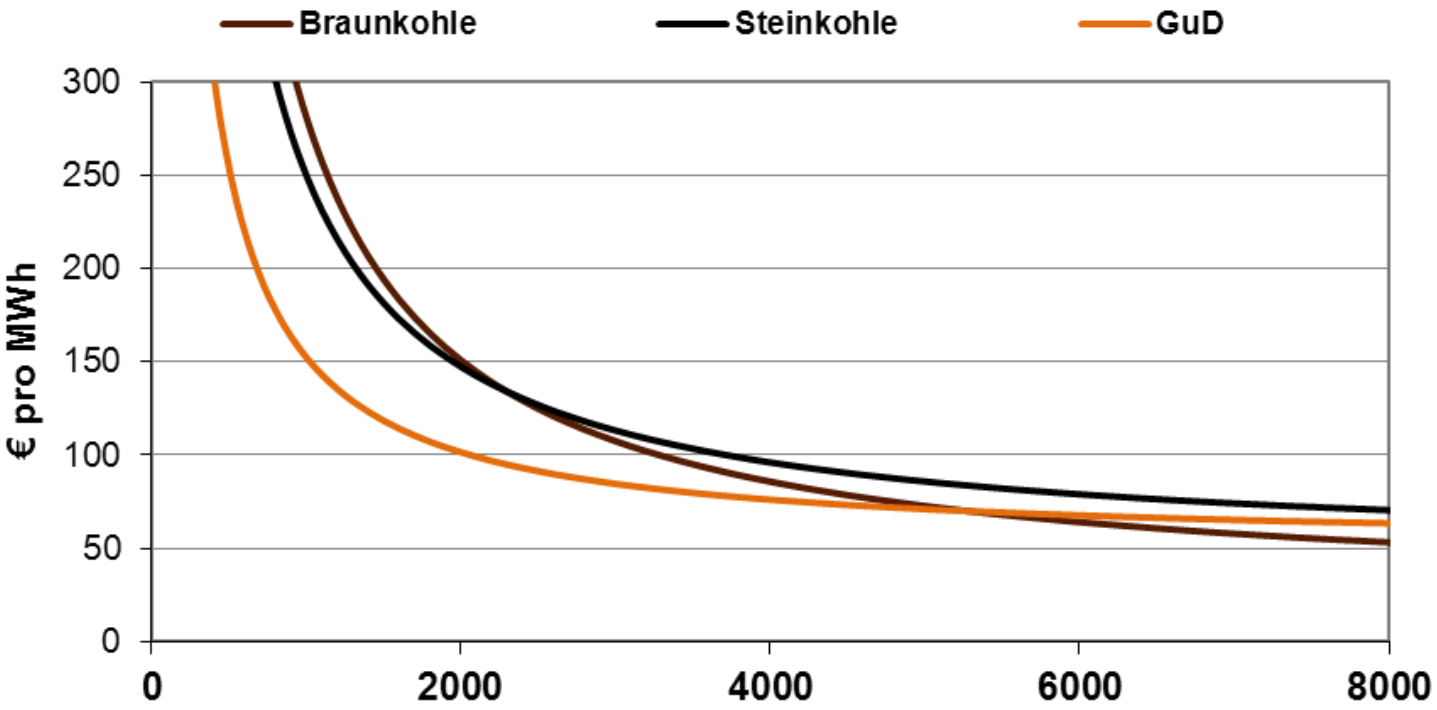
Power prices for German Industries



Wholesale power market price will further decline

Preis

Vollkostenkurven 2011



- weitere Annahmen:
  - Zinssatz für Annuität 8,5%
  - Brennstoff und CO_2-Preise basieren auf Mittelwerten der Spotpreise für 2011
    - CO_2 - EUA
    - Gas - NCG
    - Steinkohle - McCloskey Marker NWE
    - Braunkohle - interne Abschätzung

Power Market Design

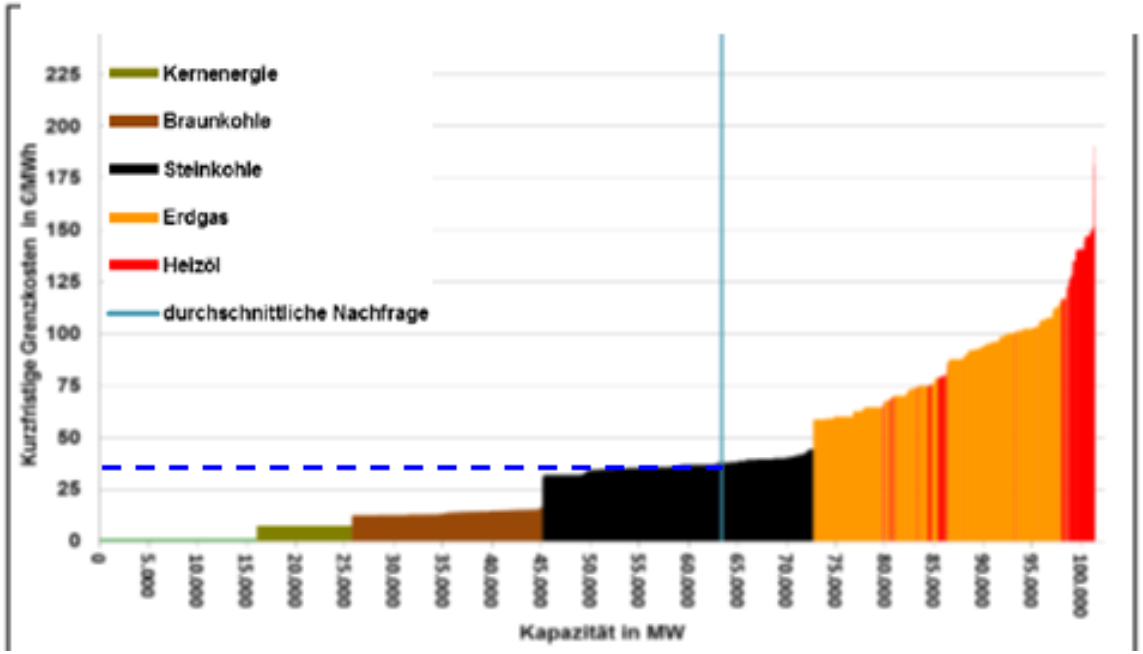
- At the moment there are lots of uncertainties into the system (world energy prices, technologies, grid expansion, over capacity, load management, emissions trading etc.)
- Fundamentally the electricity market is funtioning – problem: marginal cost pricing? – the merit order effect!
- Power price at the exchanges are low and does not provide adequate price signals for new capacities – even existing power plants are faced with economic problems – result of the „merit order effect“ of rrenewable power and the inflexibility of the conventional power generation
- „energy only market“ has to be modified – but at the moment there is no need for new institutions like capacity markets – we do not need a revolution – what is needed is an evolution of the existing structures

Paradoxon of the Merit order effect

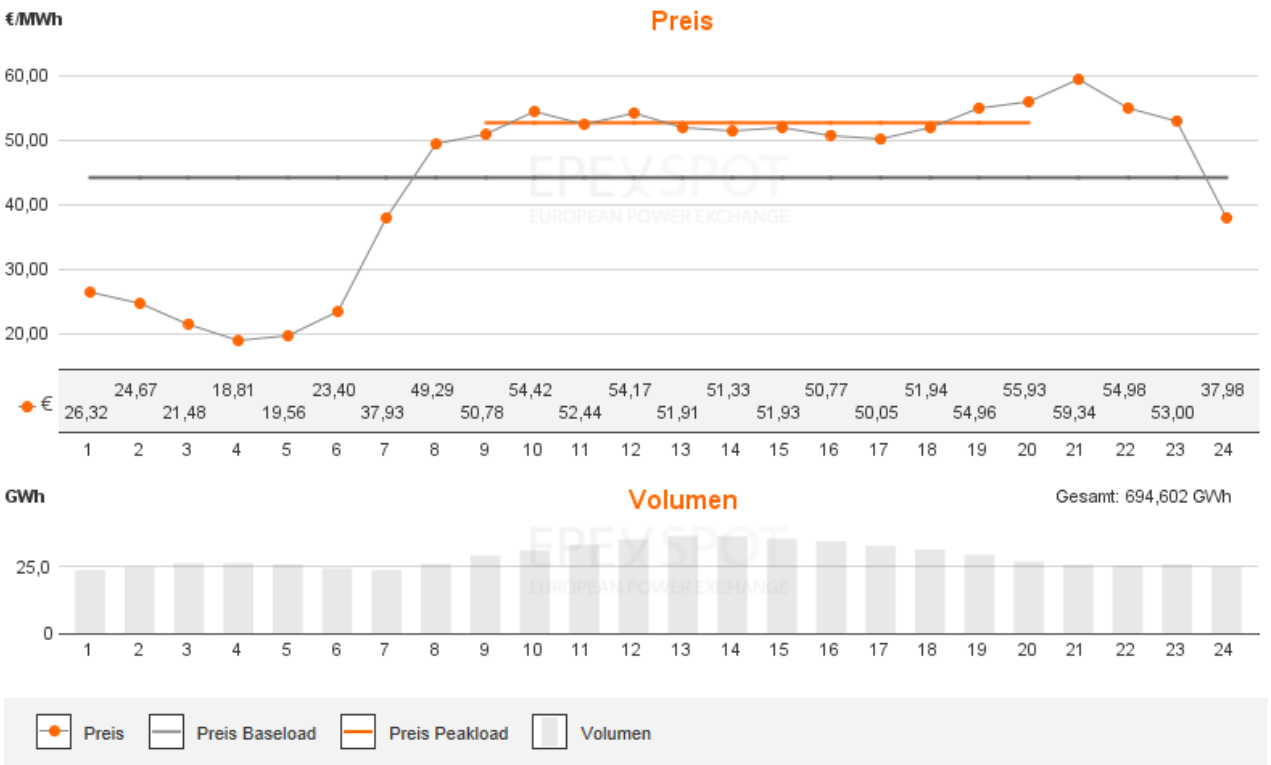
- part of the support costs come from the lowered wholesale power market price
- RES-E lower the wholesale power market price but thereby increases overall support costs (=support payments minus market price for RES-E)
- reduction of the wholesale power price will be granted only gradually towards final consumers
- but since 2009 electricity prices for industry has come down by 2 ct/kWh!
- industry really starts to profit

Merit-Ordereffekt

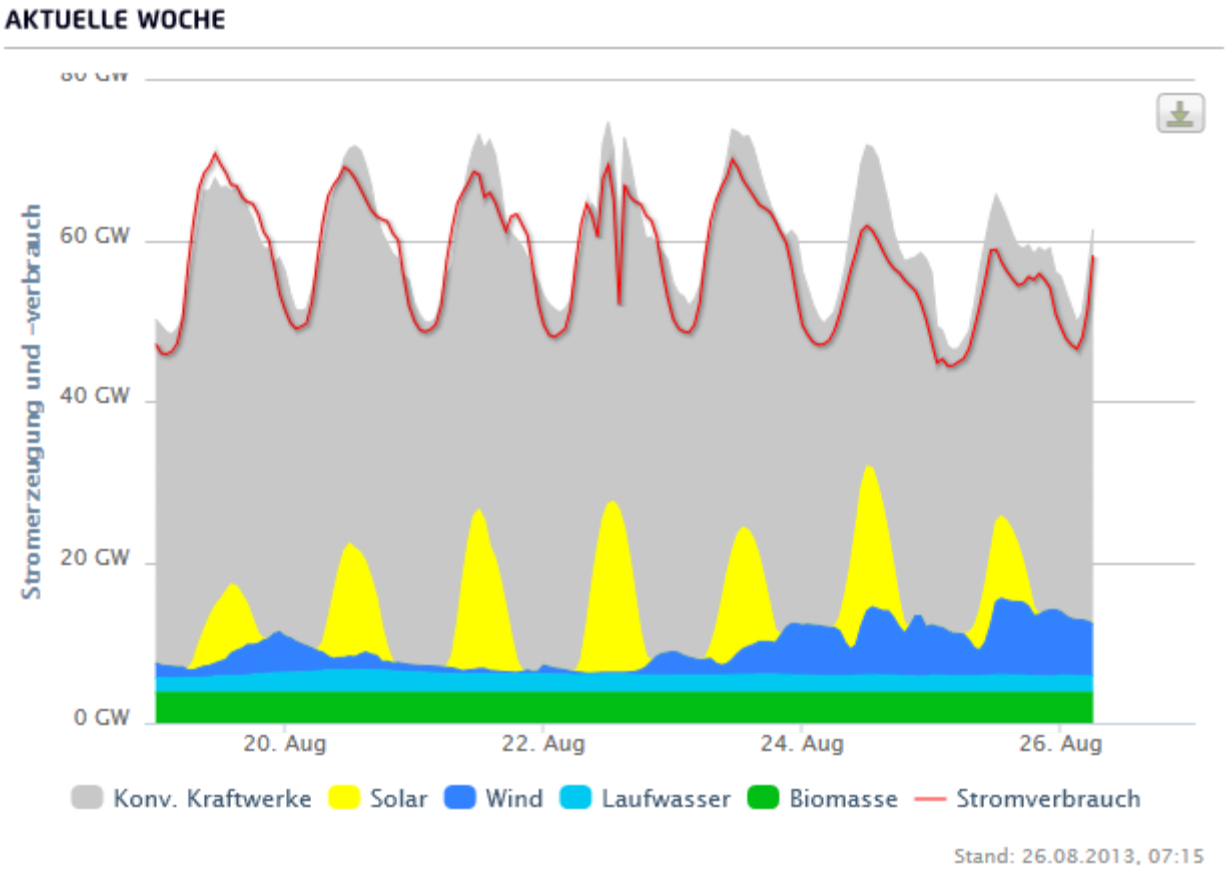
- Niedrige Preise wg. Überkapazität Kernenergie & Kohle, EE-Einspeisung, unwirksamen Kohlenstoffmarkt mit niedrigen CO_2-Preisen



Price Trends

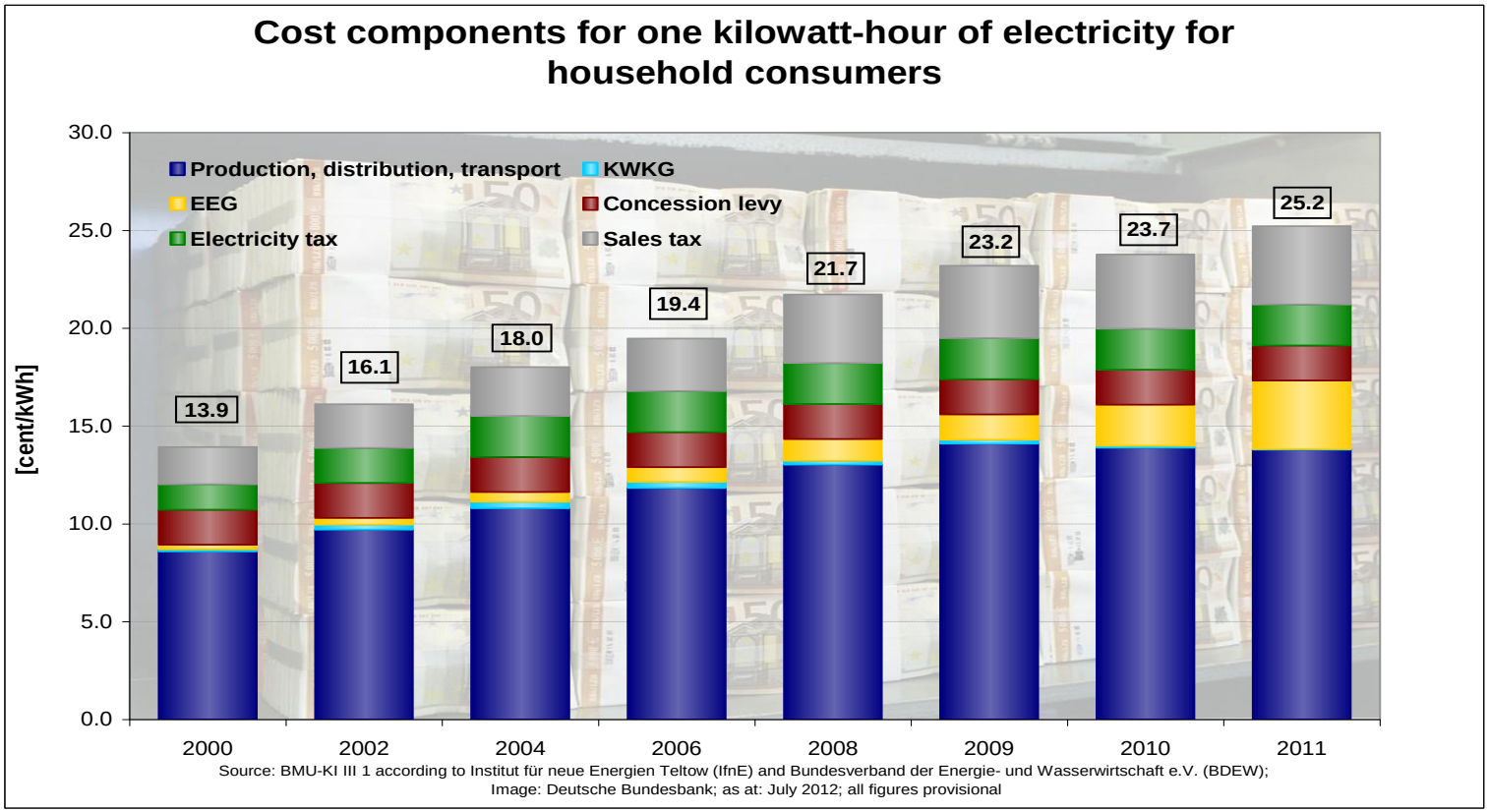


Supply and demand



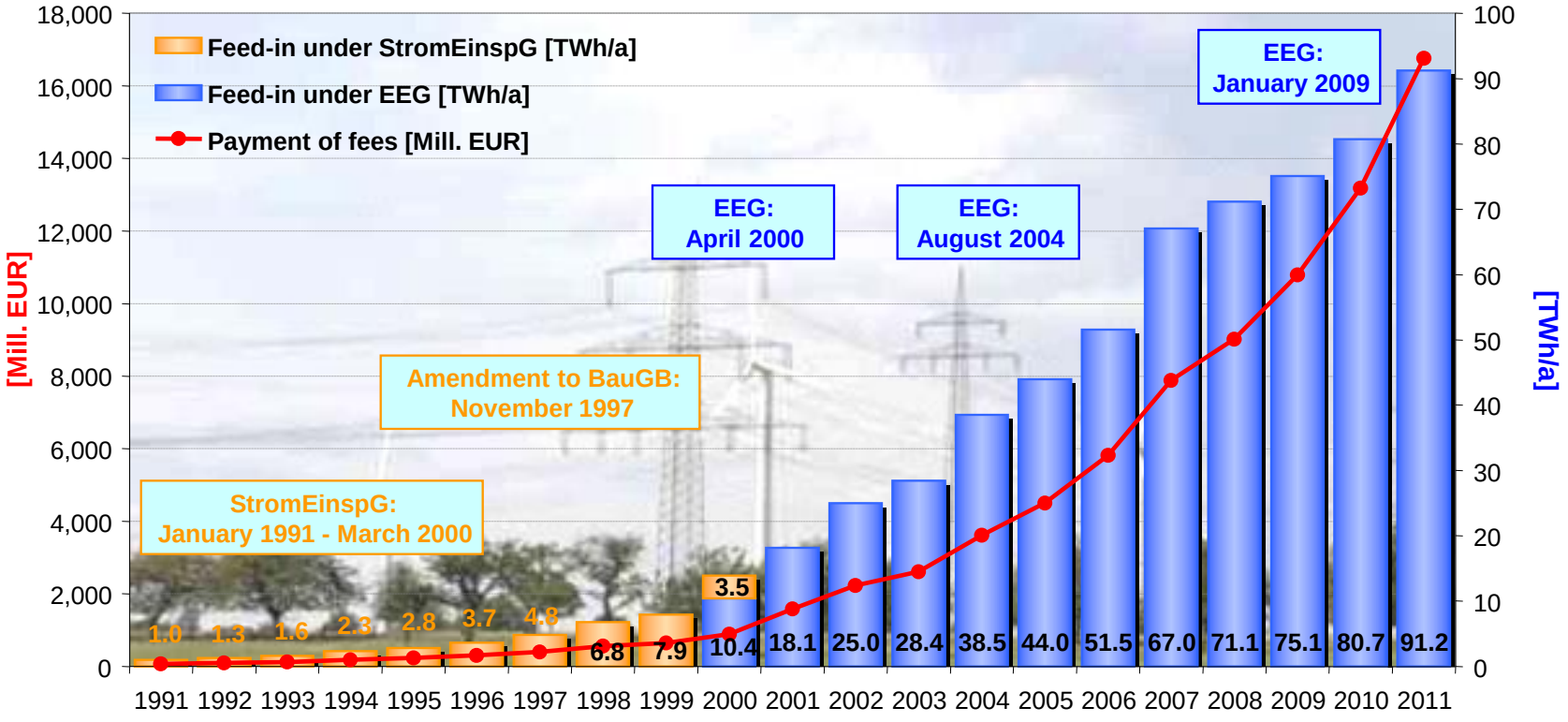
German RE Policies - Electricity

EEG costs in 2012: 5,277 ct/kWh



Germany has paid a lot for RES technology progress

- Overall support costs in 2012: 17 bn €/a
- costs must be kept under control



StromEinspG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act; 1 TWh = 1 Bill. kWh;
Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Bernd Müller; as at: July 2012; all figures provisional

Investments paid off: PV costs came down more than 50% since 2006

Since of 1 April of 2013 Germany pays only between 0,11 and 0,16 €/kWh for PV

Dünnschicht

Source PVexchange

Consequence from cost perspective

- **In the long run: there is no alternative to investing in RES and efficiency, the matter is only how much one wants to rely on it**
- **But costs are nevertheless crucial for public acceptance and adabtability of the system and ist actors**
- **cost control**

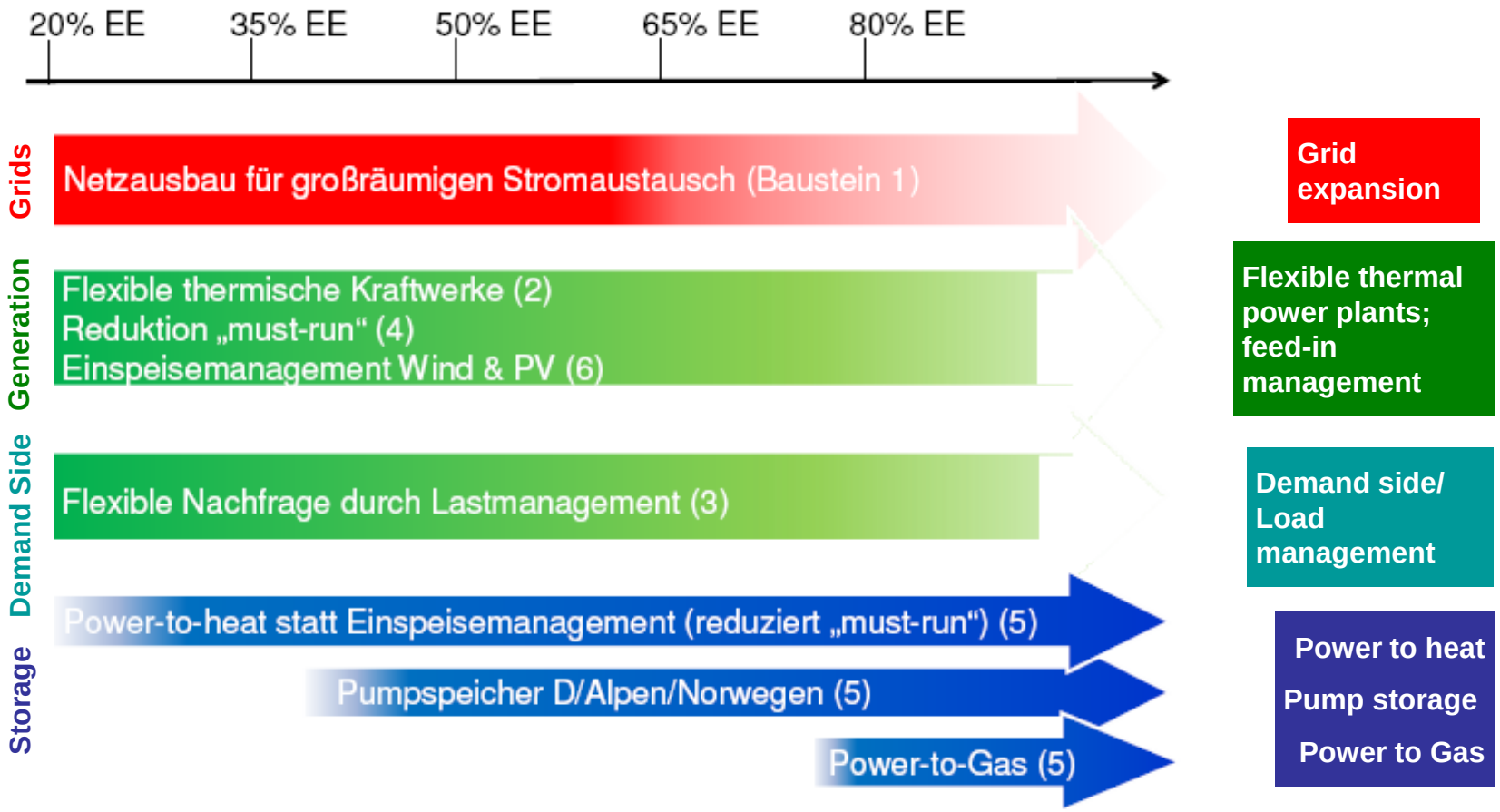
Market integration of Renewable Power

- In summer 2011 Germany started a transition process – numerous things and structures are changing
- The EEG structure (20 year guaranteed feed-in-tariffs, principle of priority feed in) has been very successful in the initial phase
- By the end of 2012 we had 23 % of renewable power – now the integration of renewable power into the energy system and the markets is the issue – renewable power generation has to become more cost efficient
- Consensus on the need to amend the EEG – but the is the political will to keep basic structures
- Some elements like the „market premium“ could be used
- But it is not only a challenge for the renewables – the conventional power generation has to change too – more flexibility and higher efficiency

Market integration of Renewable Power

- In addition a lot of so called „flexibility options“ on the supply side as well as on the demand side have to be used
- The „Winterreserve“ is an interim solution to build a bridge to collect more information and experiences to be able to develop the existing structures
- In order to safeguard the power supply security during the transition process a „stratecic reserve“ – alongside the „normal power market“ should be developed and implemented

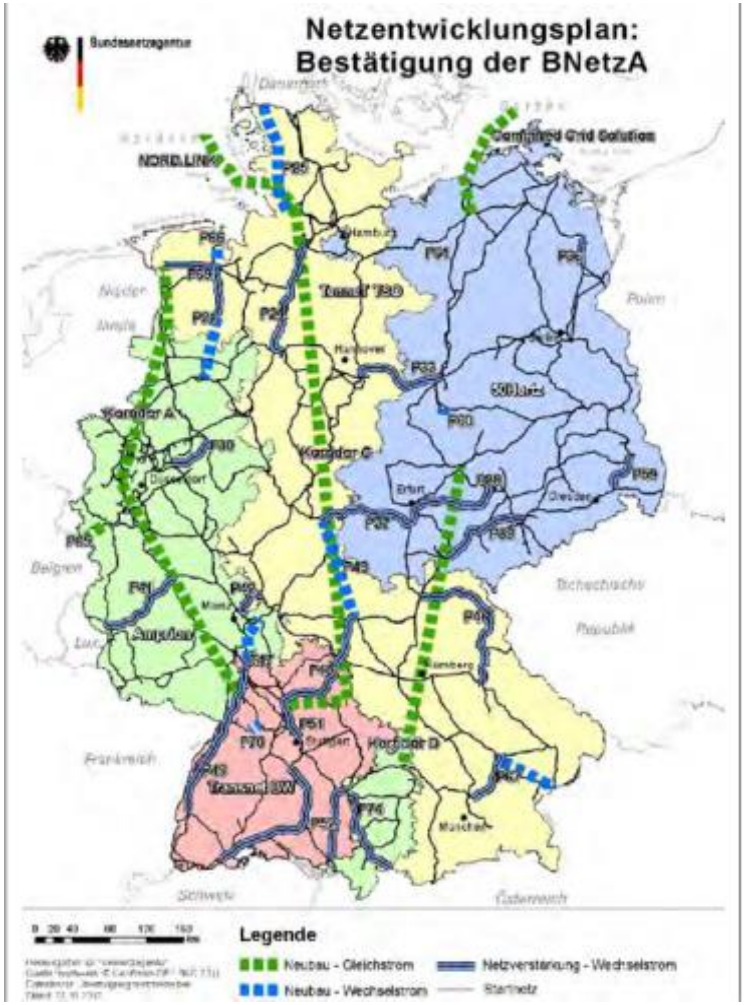
Enhancing Flexibility



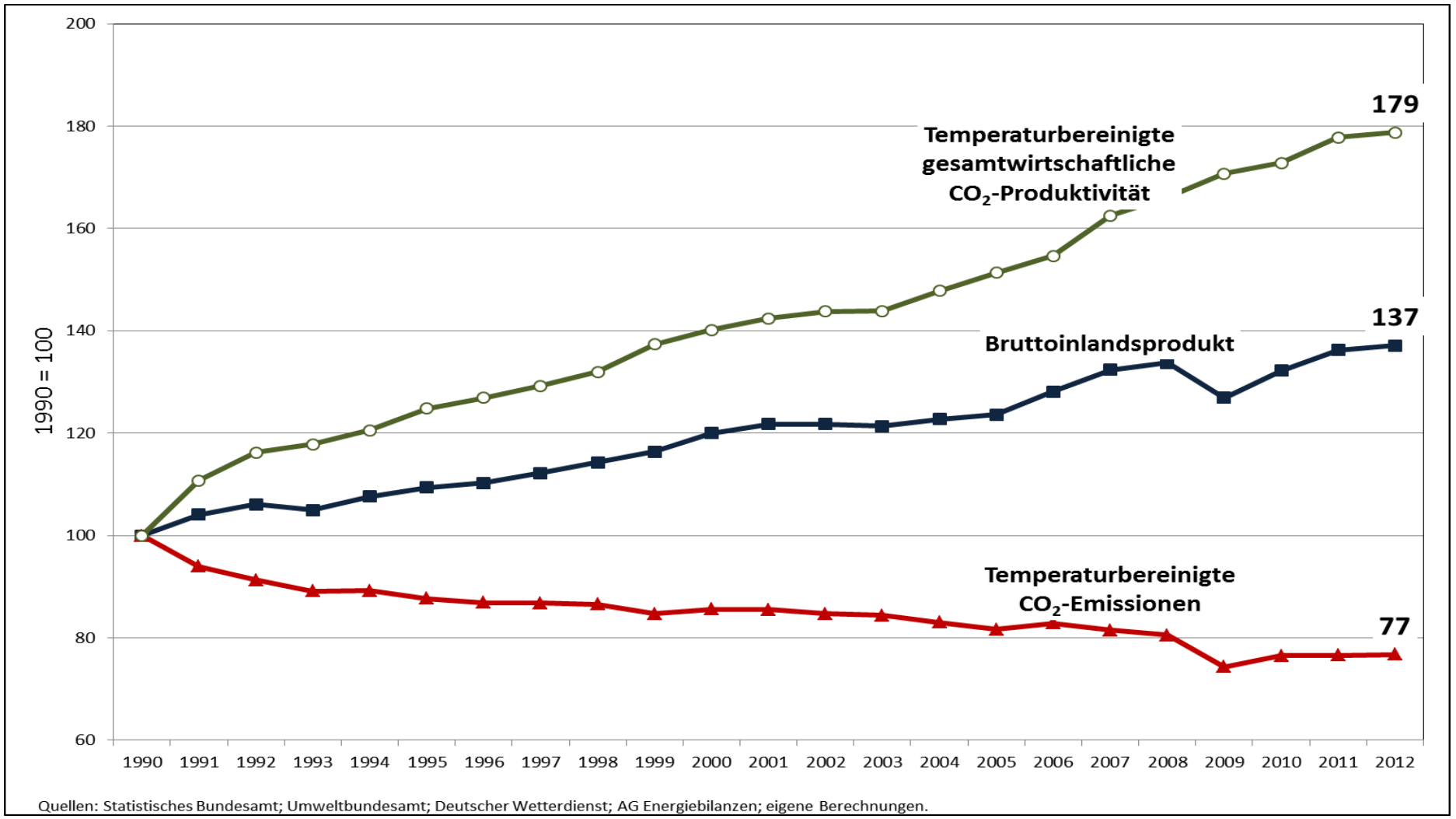
Grid expansion

Grid development plan 2012

NEP 2012, Stand:August 2012,
www.netzentwicklungsplan.de

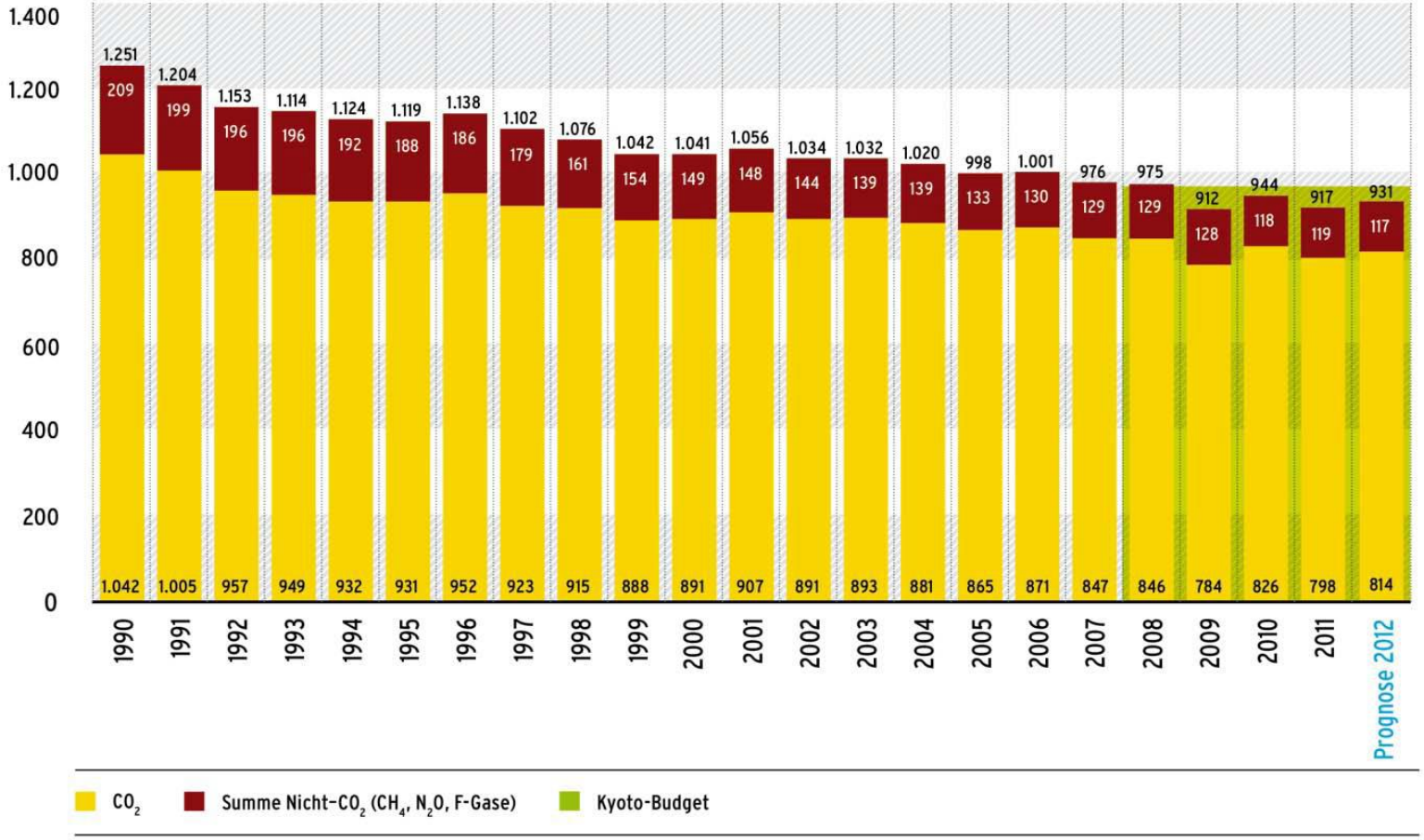


Decoupling

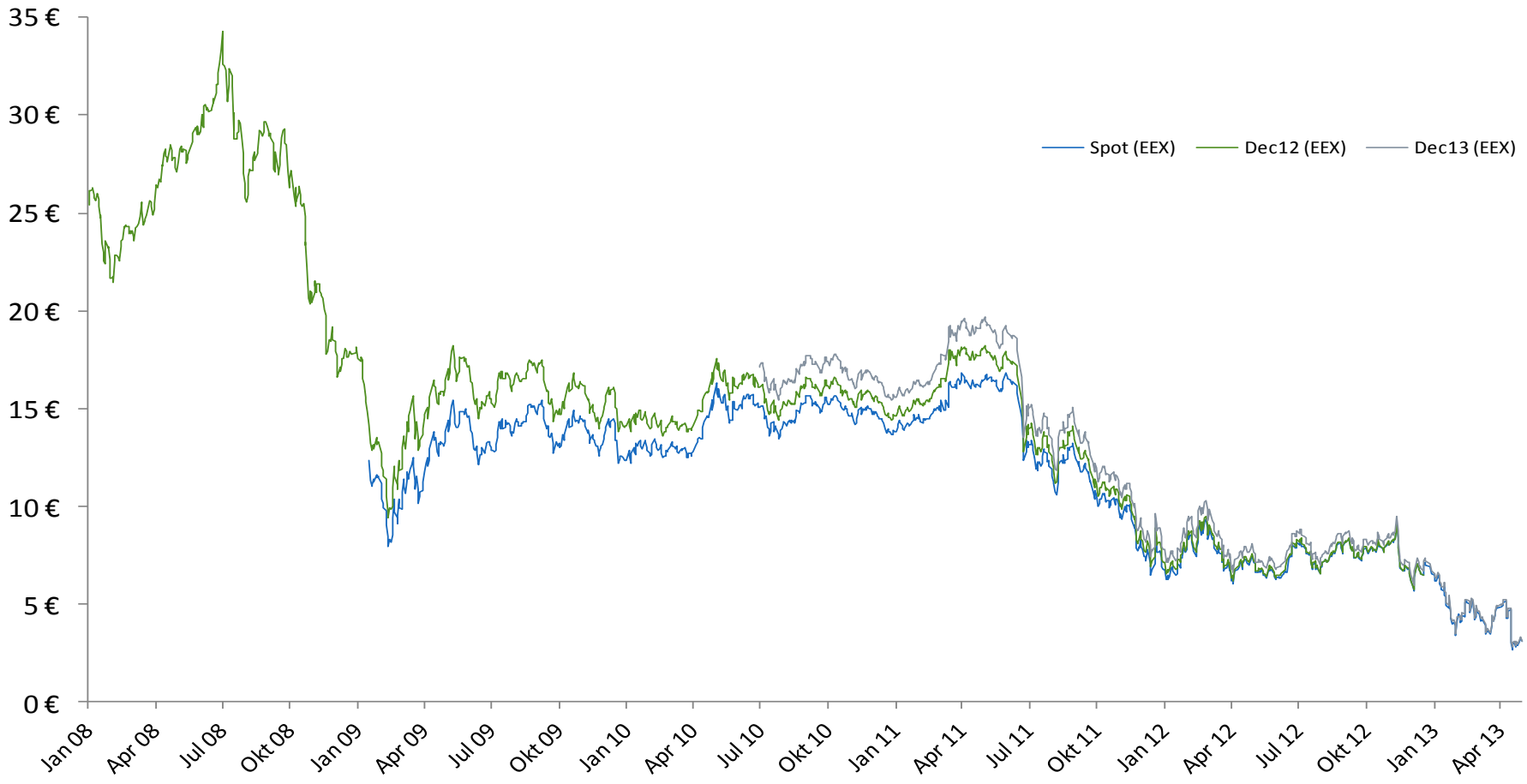


Quellen: Statistisches Bundesamt; Umweltbundesamt; Deutscher Wetterdienst; AG Energiebilanzen; eigene Berechnungen.

Treibhausgasmissionen in Deutschland 1990 bis 2011 & Prognose 2012 in Mio. Tonnen CO_2-Äquivalente



EUA-prices


35 €
30 €
25 €
20 €
15 €
10 €
5 €
0 €
Spot (EEX)
Dec12 (EEX)
Dec13 (EEX)
Jan 08
Apr 08
Jul 08
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Jan 13
Apr 13

- *The integration of Germanys Energiewende into the EU*

Implications of the Energiewende for our neighbours

The Energiewende…

…is not a "closed shop"

… calls for intensified cooperation and coordination

- **Renewables generation in Germany is being balanced in the European grid**
- **Electricity flows lead to challenges for grid stability (in particular "loop flows")**
- **Grid extension most pressing issue in the EU context**
- **Integration of renewable is not a "one way road"**
- **On the other side, RES generation in Germany**
  - **contributes to energy security across Europe by diversified, indigenous energy sources**
  - **helps reducing wholesale power market prices across EU**
  - **supports innovation and reduces technology costs for all**

Which way to follow in the EU?

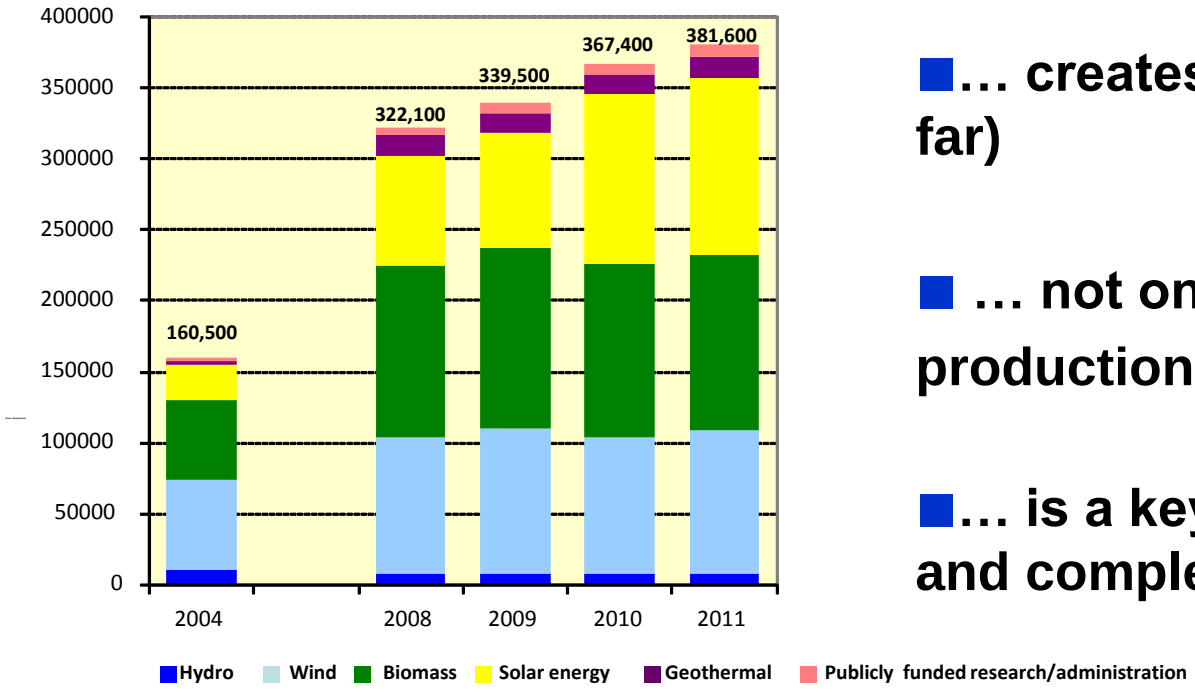
- **Energy mix remains national responsibility; MS will follow different approaches**
- **But we need coordination and convergence of energy policies – otherwise uncoordinated impacts**
- **We need to agree on „no-regrets“**
- **aim for synergies where „no-regrets“ exists**

Expansion of Electricity Grids

- **Grid extension in Germany:**
  - **reduce loop flows for neighbors**
  - **new North-South-lines in Germany**
- **Cross-border challenges:**
  - **developing an efficient and modern grid**
  - **reducing negative cross-border effects**
- **Common interest in a modern grid infrastructure**
- **Strengthening EU support for cross-boarder lines: CEF**
- **Enormous benefits from bilateral and regional cooperation on expanding electricity grids**

Jobs and innovation

Development of gross employment in the renewable energies sector



The transformation of our energy system …

- **… creates new jobs (380.000 so far)**
- **… not only in the direct RES production but in the overall system**
- **… is a key driver for innovation and complete new concepts**

Conclusions

- The German energy transformation is a concrete programme and it is happening (continuous monitoring)
- Renewable energies have experienced a strong growth
- The reasons: ambitious targets, efficient policies and instruments, long-term planning security
- Benefits of renewable energies: climate protection, job creation, economic growth, avoided energy imports
- Crucial next steps:
  - cost efficiency, particularly regarding solar PV
  - market and grid integration of renewable energies
  - expand grid and storage capacities
  - sustainable and efficient use of bioenergy
  - cooperation among EU Member States and globally

Thank you for your attention!

More Information:

www.bmu.de/english

www.erneuerbare-energien.de/english