University Paris-Dauphine – Energy transitions in France, Germany and Europe

The Transformation of Germany's Energy System – Not a Sprint, but a Marathon!

30 May 2013


Quelle: Runnerstribe.com

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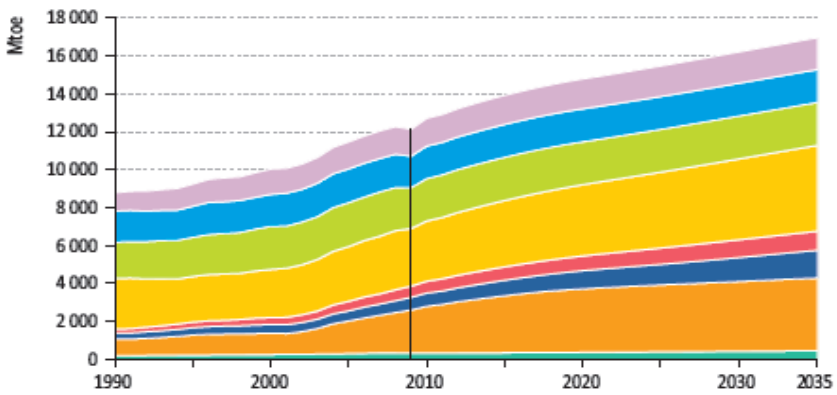
Global Challenges in Energy Policy

Figure 2.8 • World primary energy demand by region in the New Policies Scenario



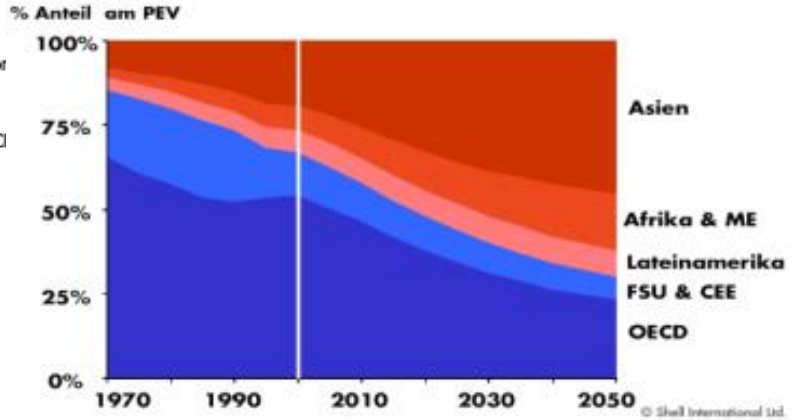
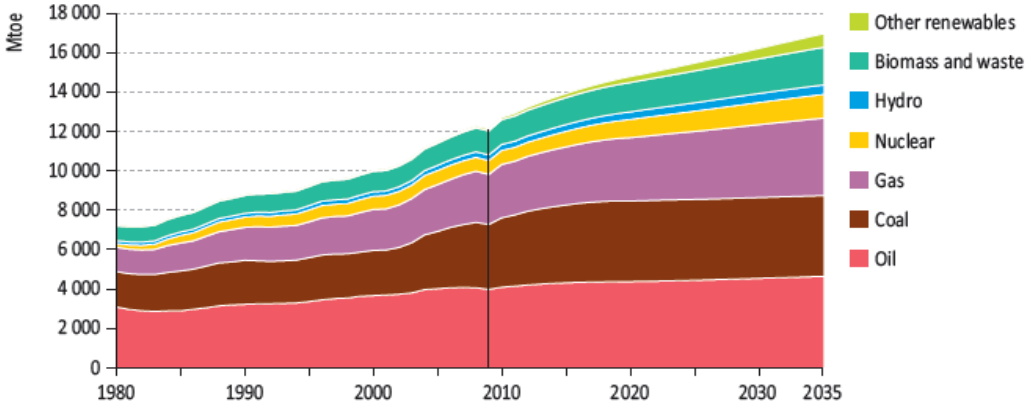
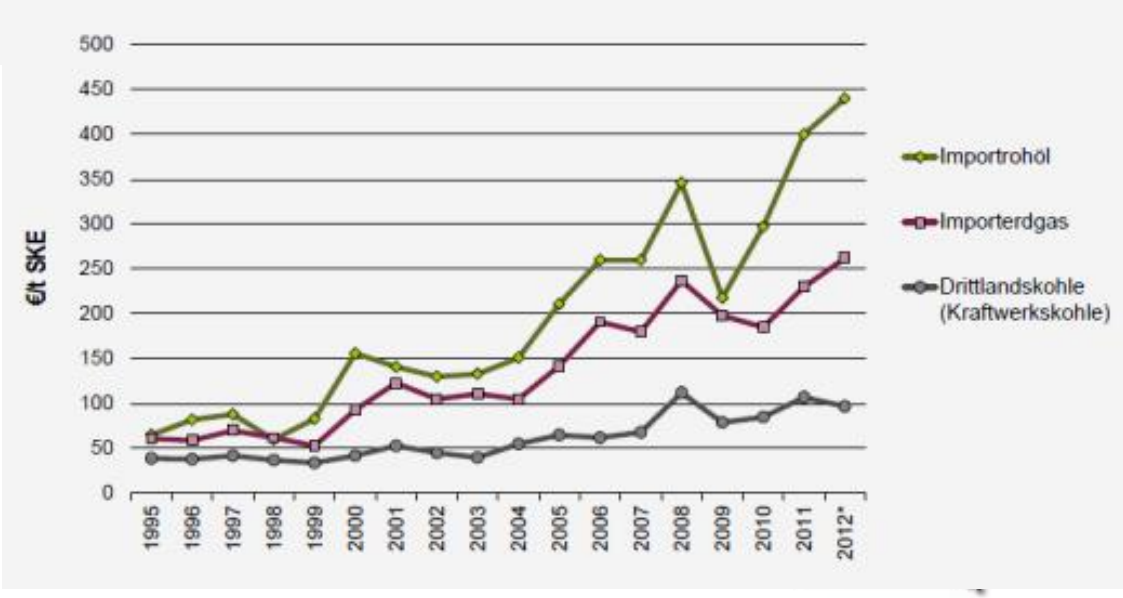


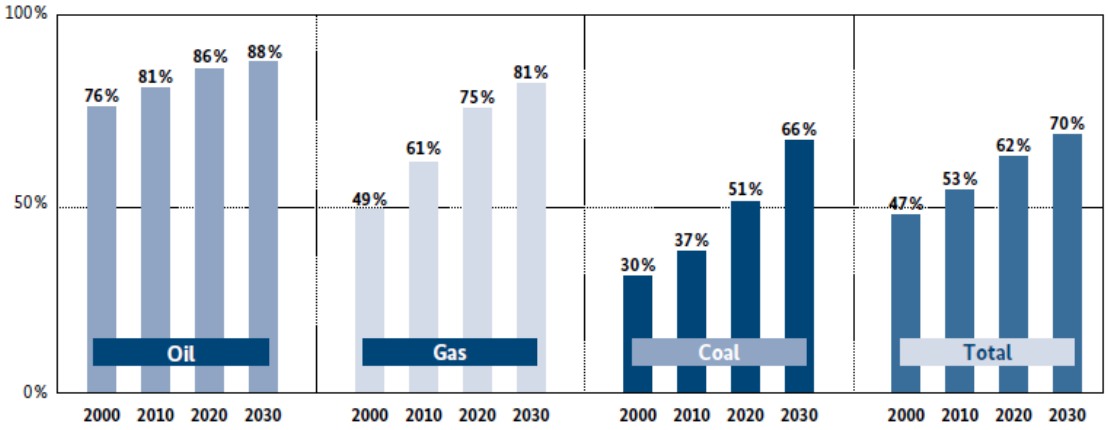
Figure 2.6 • World primary energy demand by fuel in the New Policies Scenario



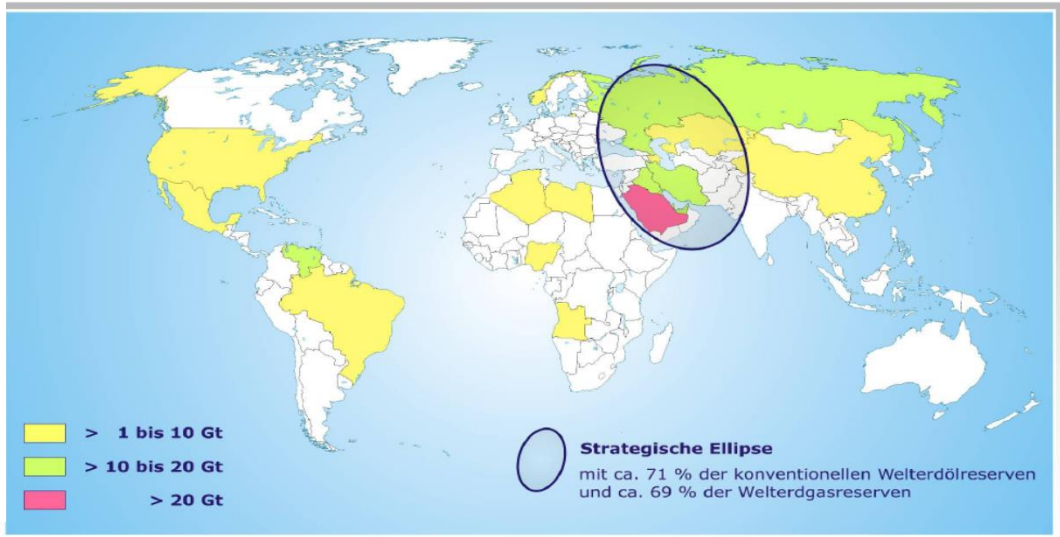


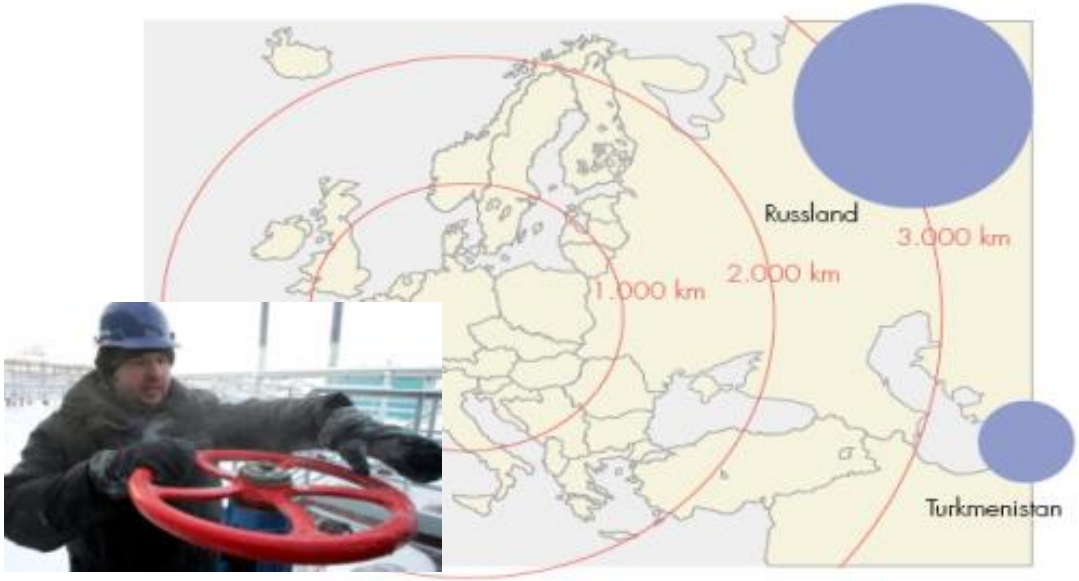
Global Challenges in Energy Policy

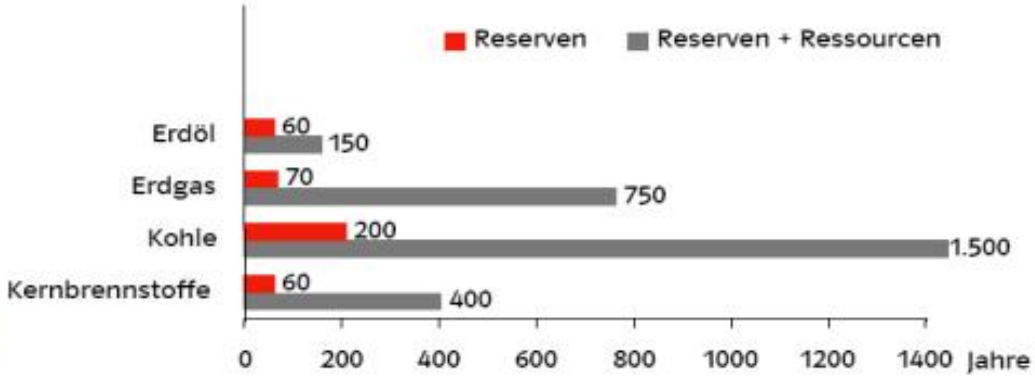
Figure 1: EU dependence on imports will increase significantly for all the relevant energy sources
Share of imports in overall energy consumption



Source: European Commission







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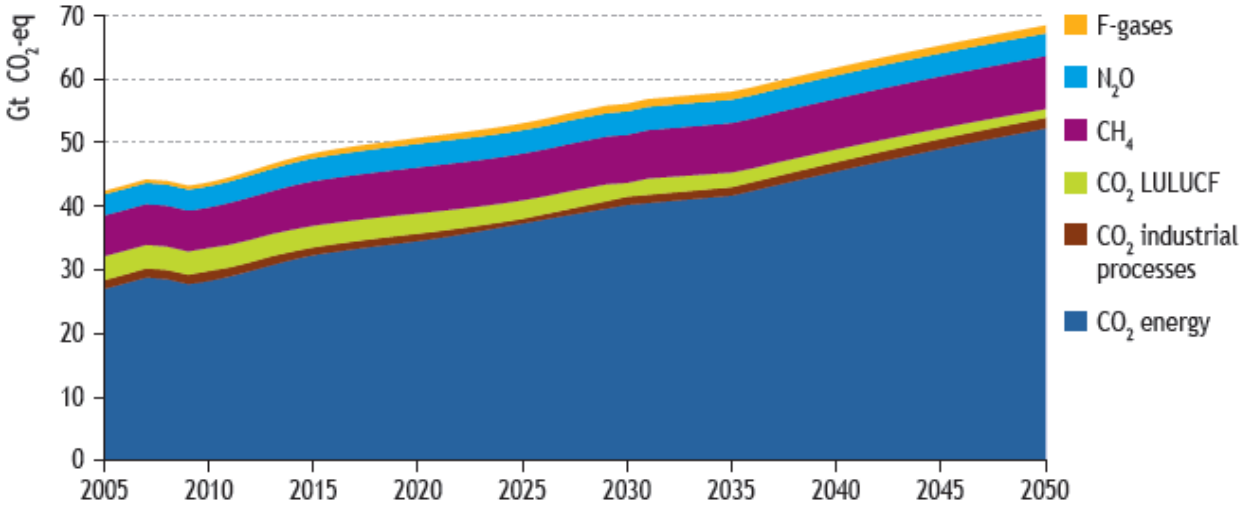
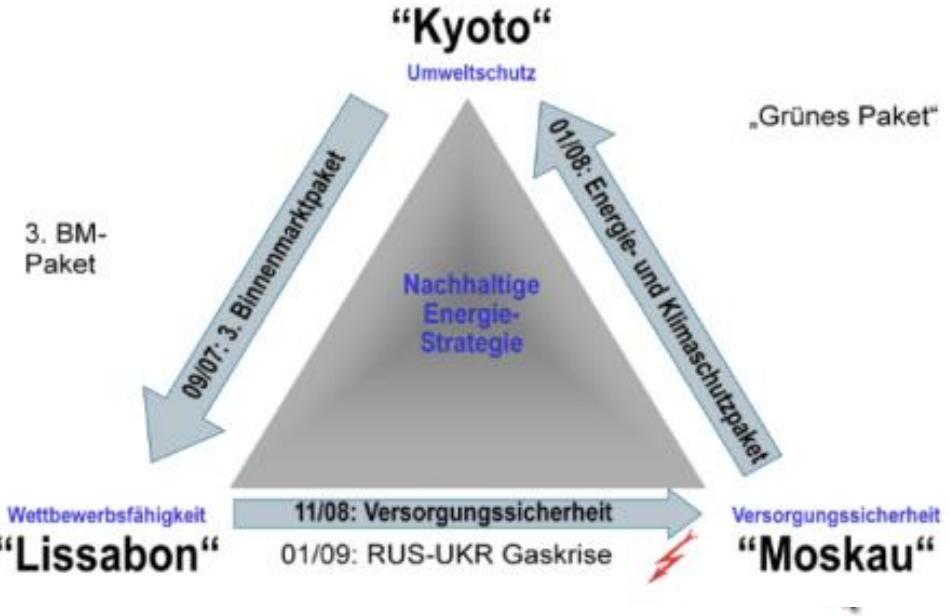
Global Challenges in Energy Policy

Worldwide Development of greenhouse gas emissions till 2050





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The Energy Concept…

… meets the global challenges in energy policy.

…is the most ambitious strategy for the transformation and decarbonization of the energy system.

Targets of the Energy Concept

	2020	2030	2040	2050	Acchieved so far
Reduction of Primary Energy Consumption (compared to 2008)	**- 20 %**			**- 50 %**	**- 3,3%**
Reduction of final energy consumption in transport (compared to 1990)	- 10 %			- 40%	+ 7,5 %
Reduction of gross electricity consumption (compared to 2008)	- 10 %			- 25 %	- 0,7 %
CO2- Reduction (compared to 1990)	- 40 %	- 55 %	- 70 %	- 80 - 95 %	- 23 %
Share of Renewables in gross final energy consumption	18 %	30 %	45 %	60 %	12,2 %
Share of Renewables in gross electricity consumption	35 %	50 %	65 %	80 %	23,1 %

Further Objectives: Improvement of the energy productivity by 2,1% per annum (since 1990: +38 %; currently 0,9% p.a.) and the doubling of the rate of modernisation to 2% p.a.

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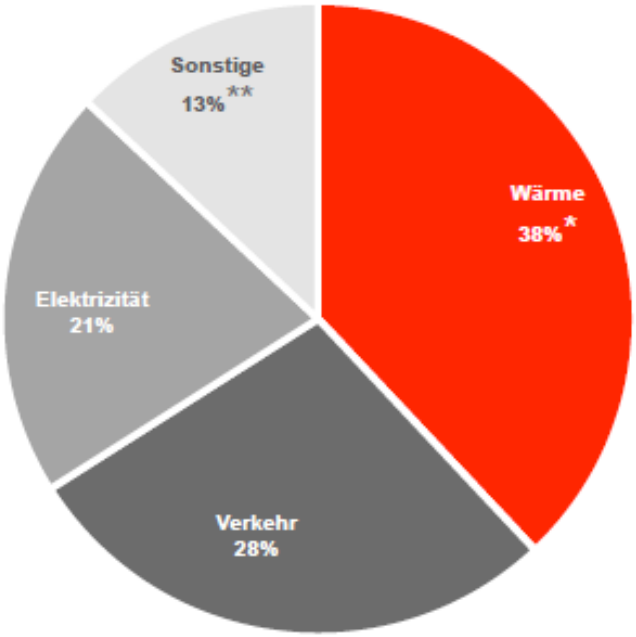
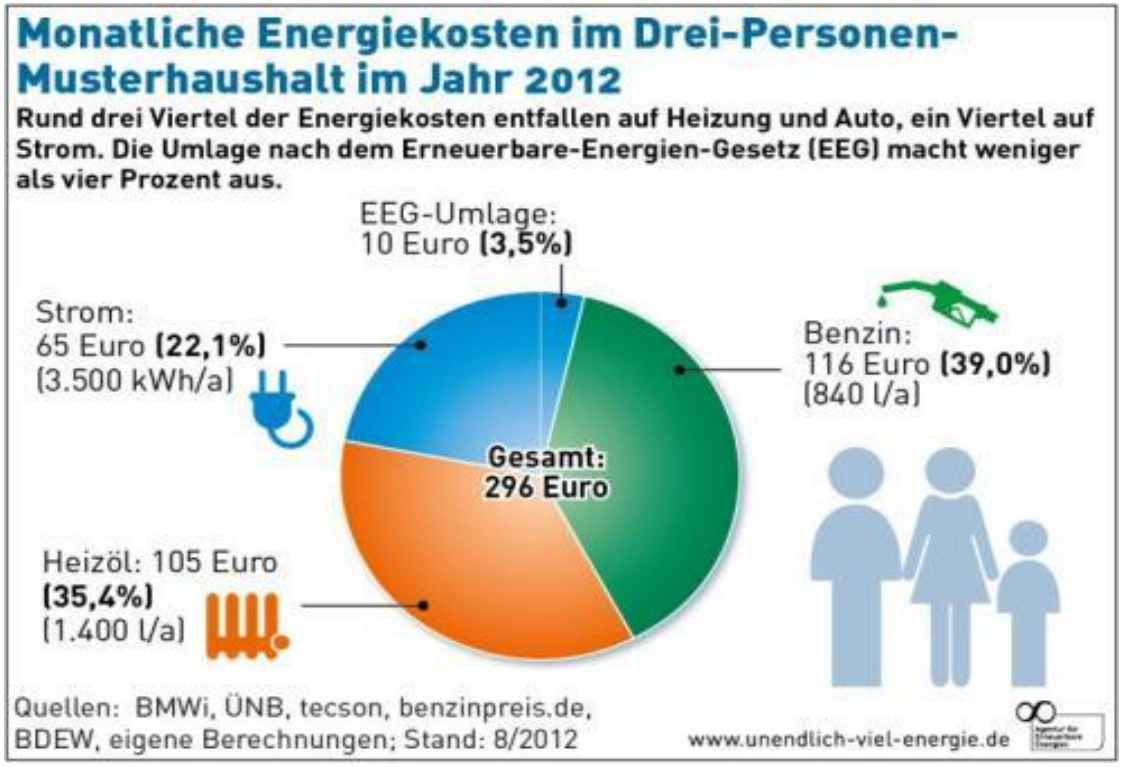
The energy concept adresses all sectors: Electricity, buildings and transport

Energy consumption in the different sectors in per cent





* Gebäudebeheizung, Warmwasser (ohne Prozesswärme)
** insbes. industrielle Prozesse, mechanische Energie etc.

Quelle: Viessmann 2013.

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Vital Challenges for a succesful transformation

(1) Increase energy efficiency in all sectors

(2) Developing energy infrastructure – Electricity transmission grid and storage facilities

(3) Supply security and grid stability

(4) Preservation of Germany‘s industrial competitiveness

(5) Facilitate the market integration of renewable energy sources

(6) Monitoring of trends in energy prices

(7) Coordination between the federal government and the Laender

(8) Further integration of the European Internal Energy Market

Vital Challenges for a succesful transformation

(1) Increase energy efficiency in all sectors

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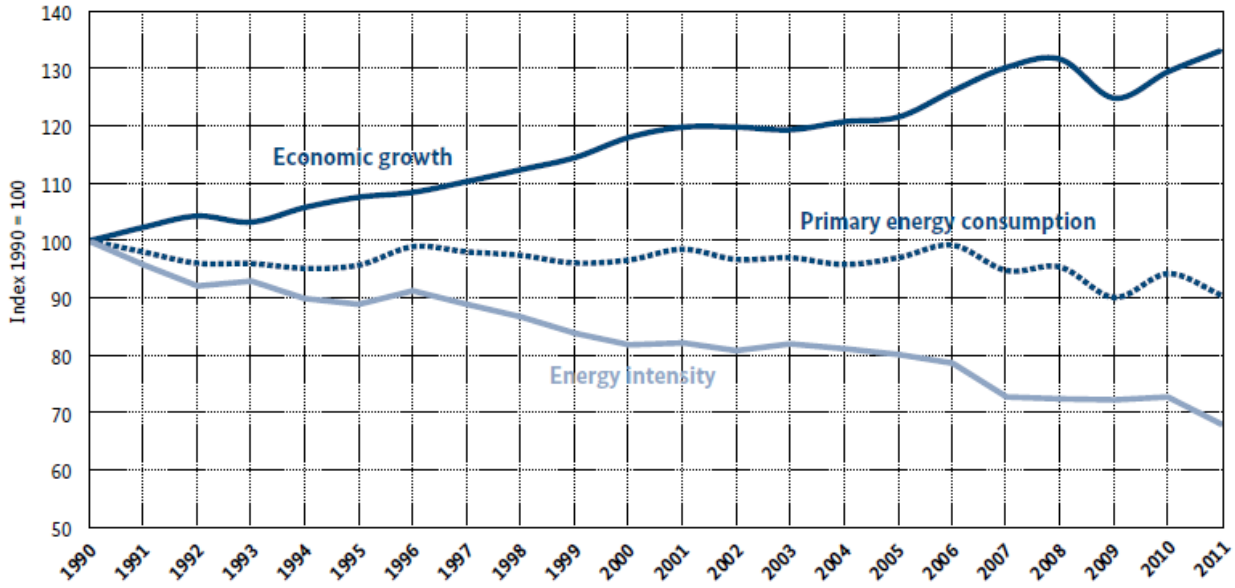
Energy efficiency in the german economy: So far, so good!

- While the GDP increased 30% (since 1990), the primary energy consumption decreased for 6,8% (Temperature-corrected 10%) and the final energy consumption reduced 5%.

Economic growth, but less energy consumption

Figure 2: Decoupling of economic growth and energy consumption



Source: Federal Ministry of Economics and Technology

Since 1990:

Energy intensity:
Improved **1,7% per annum**

Developement of final energy consumption:
total: **- 5 %**
Industry: **- 15%**
Commercial: **- 22%**
Private: **+ 9%**

Quelle: BMWi 2012

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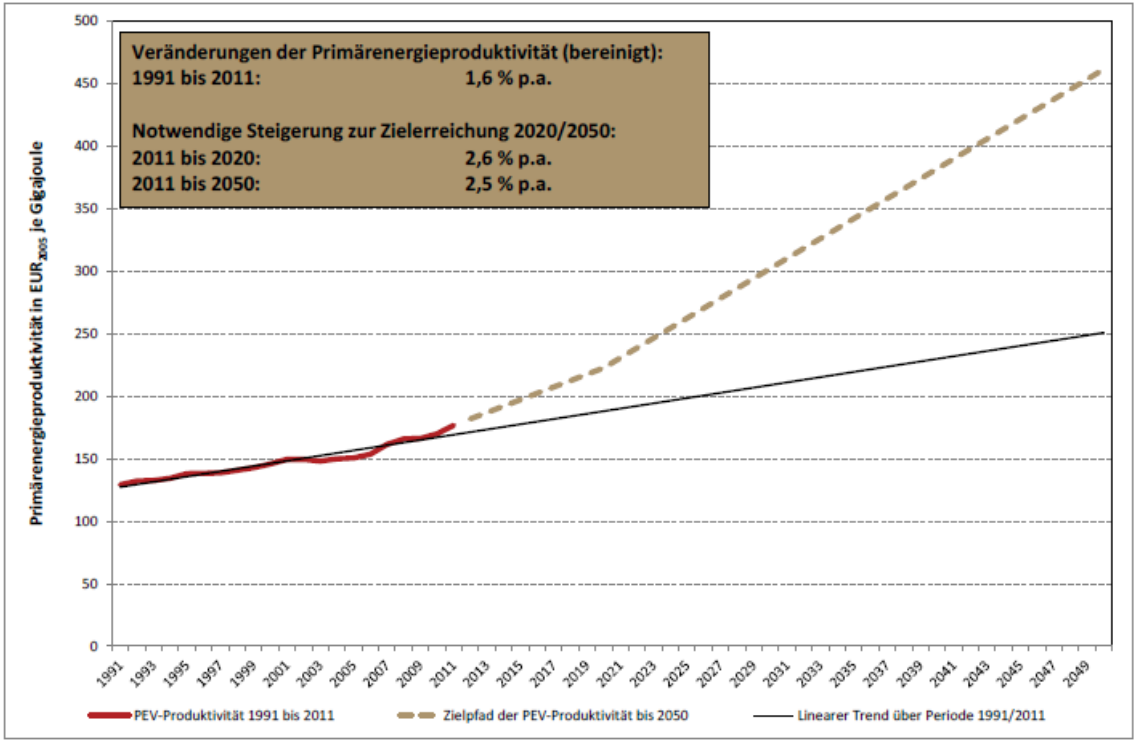
Increase energy efficiency in all sectors

Energy concept – Efficiency targets and Status Quo		
	2020	Status Quo
Reduction of primary energy consumption	-20,0%	-3,5%
Improvement of the Energy productivity (per annum)	2,1%	0,9%
Reduction of heat required	-20,0%	-1,0%
Doubling of the rate of modernisation	2,1%	0,9 - 1,3 %

Development of primary energy consumption from 1990 till 2011 and targeted path till 2050



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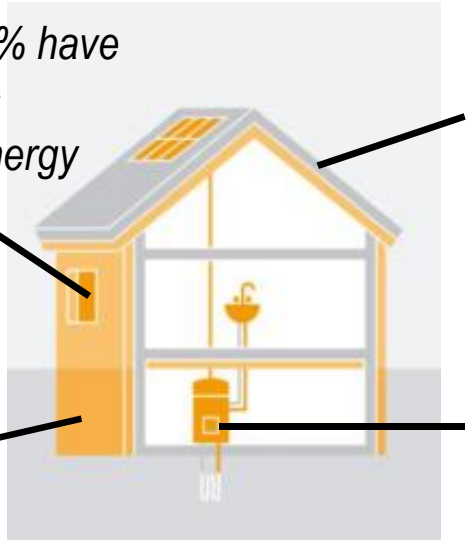
Energy efficiency in the building sector – high potentials

- Nearly 40 per cent of Germany‘s final ernergy consumption are consumed in the building sector
- With 19,6 Mio. housing units there is a huge potenital for increasing energy efficiency

Non-insulated buildings waste energy



Quelle: Dena 2012

- The strategic approach must be a combination of support and regulation:
  - Regulatory law sets high standards in cases, where it is technological and econimical feasible
  - Incentives for the energetic modernisation of buildings are set with support programms

Vital Challenges for a succesful transformation

(1) Increase energy efficiency in all sectors

(2) **Developing energy infrastructure – Electricity transmission grid and storage facilities**

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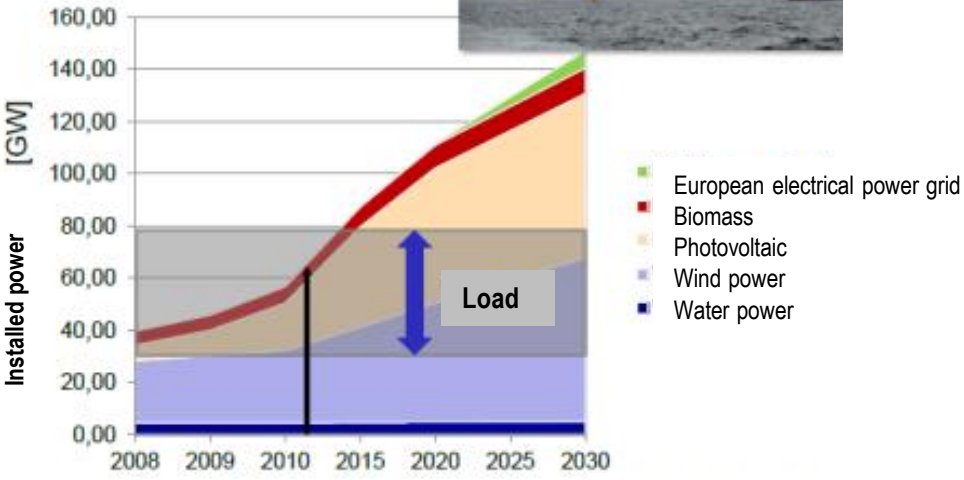
Developing the electricity transmission grid

Existing fossil and nuclear power generation are mainly concentrated in the west and the south of Germany (near to the load centres).



Quelle: IEH – Universität Stuttgart

With the immense development of renewable energies in the north the center of power generation relocates in this region.

This trend will increase with the development of the offshore wind parks.

The transport capacity of the existing transmission grids is limited – especially from North to South and from East to West .

Quelle: Umweltbundesamt (UBA) 2012, Stand 31.12.2011

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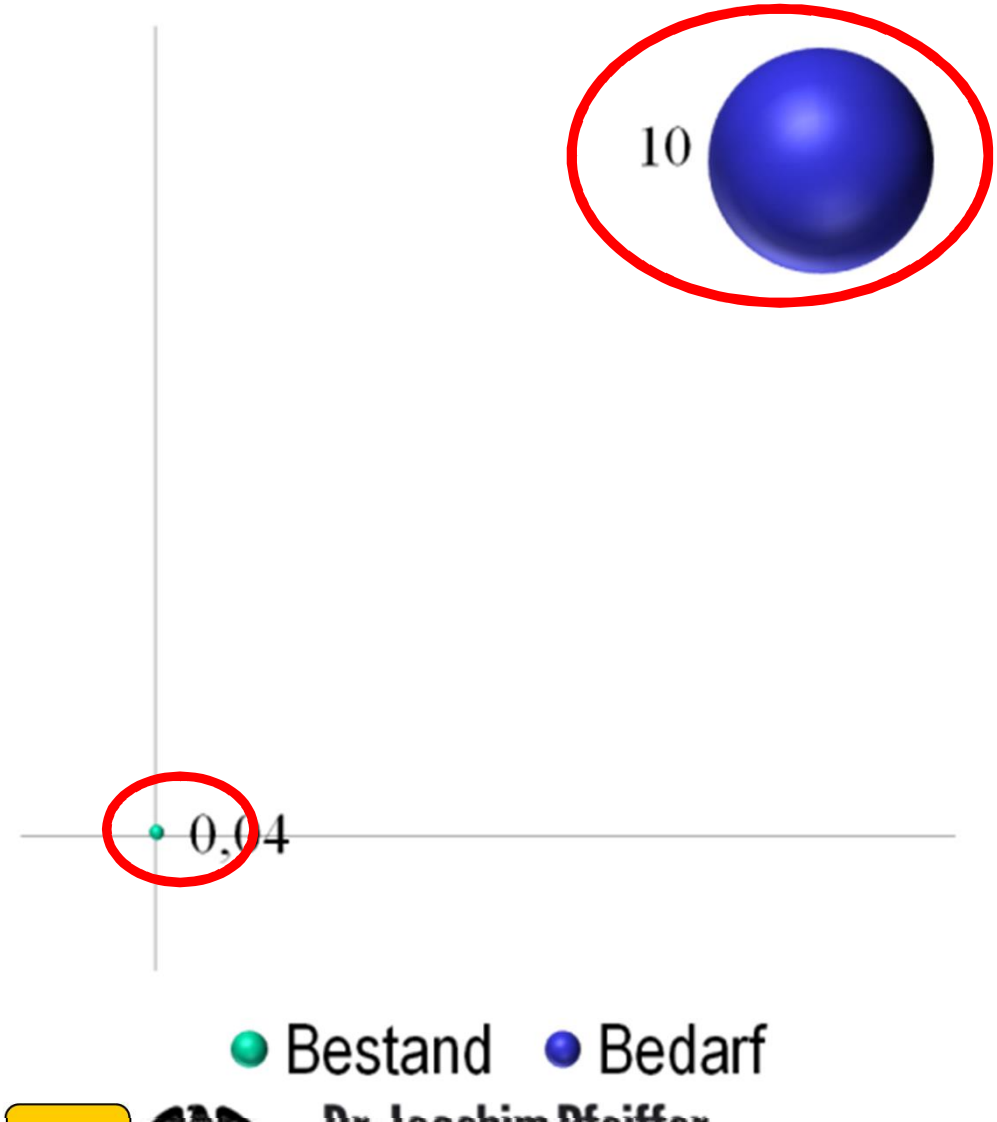
Developing storage facilities



- Status Quo:
  - the current storage capacity in Germany ist circa 0,04 TWh
  - existing storage facilities cover Germany‘s demand for electricity for about 30 minutes
- The necessary storage capacity is circa 10 TWh. This is 250 times of todays capacity.

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Vital Challenges for a succesful transformation

(1) Increase energy efficiency in all sectors

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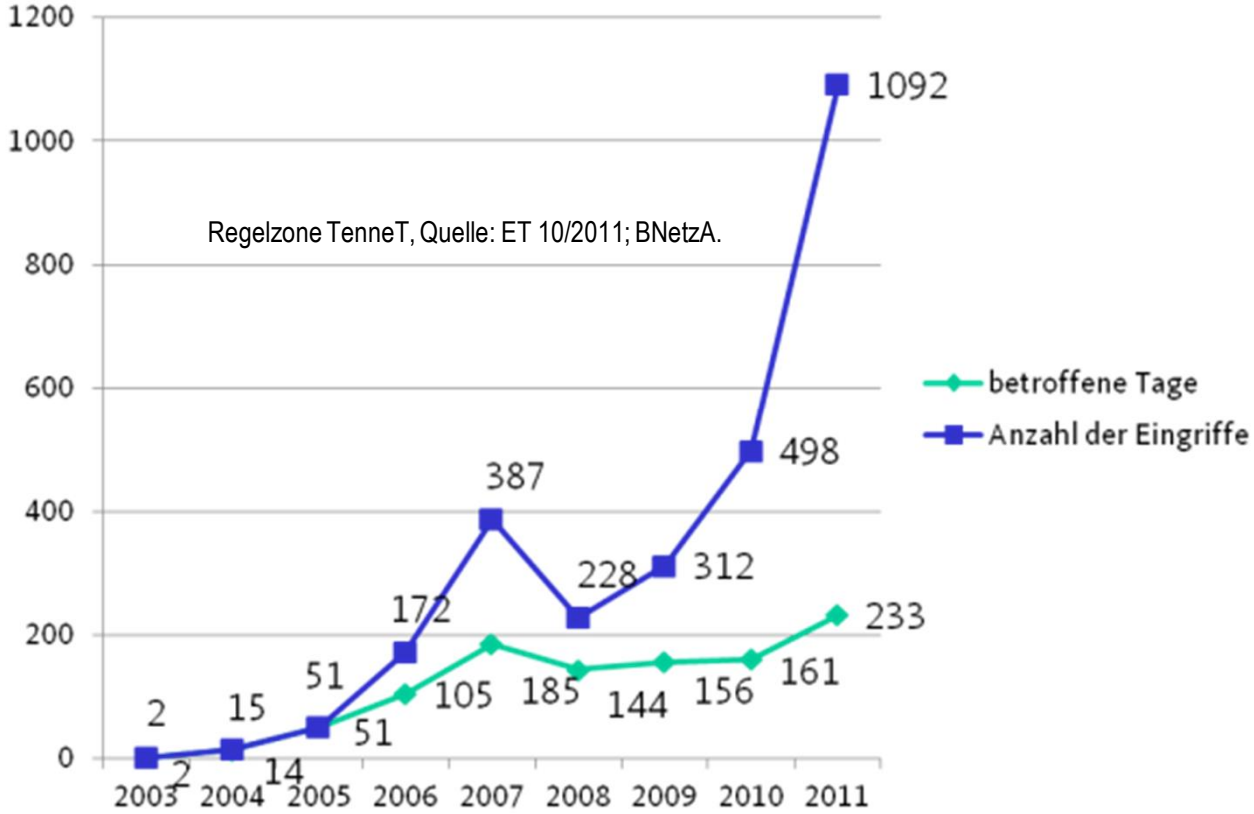
(3) **Supply security and grid stability**

Supply security and grid stability

With a changing pattern of power generation, interference in the grid ist becoming necessary

- Federal Network Agency (BNetzA) in August 2011:
  1.009 MW reserve capacity in Germany and 1.075 MW in Austria
- in Dezember 2011 for the first time an austrian reserve power station had to intervene
- Demand Response Management („Verordnung Abschaltbare Lasten)



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Vital Challenges for a succesful transformation

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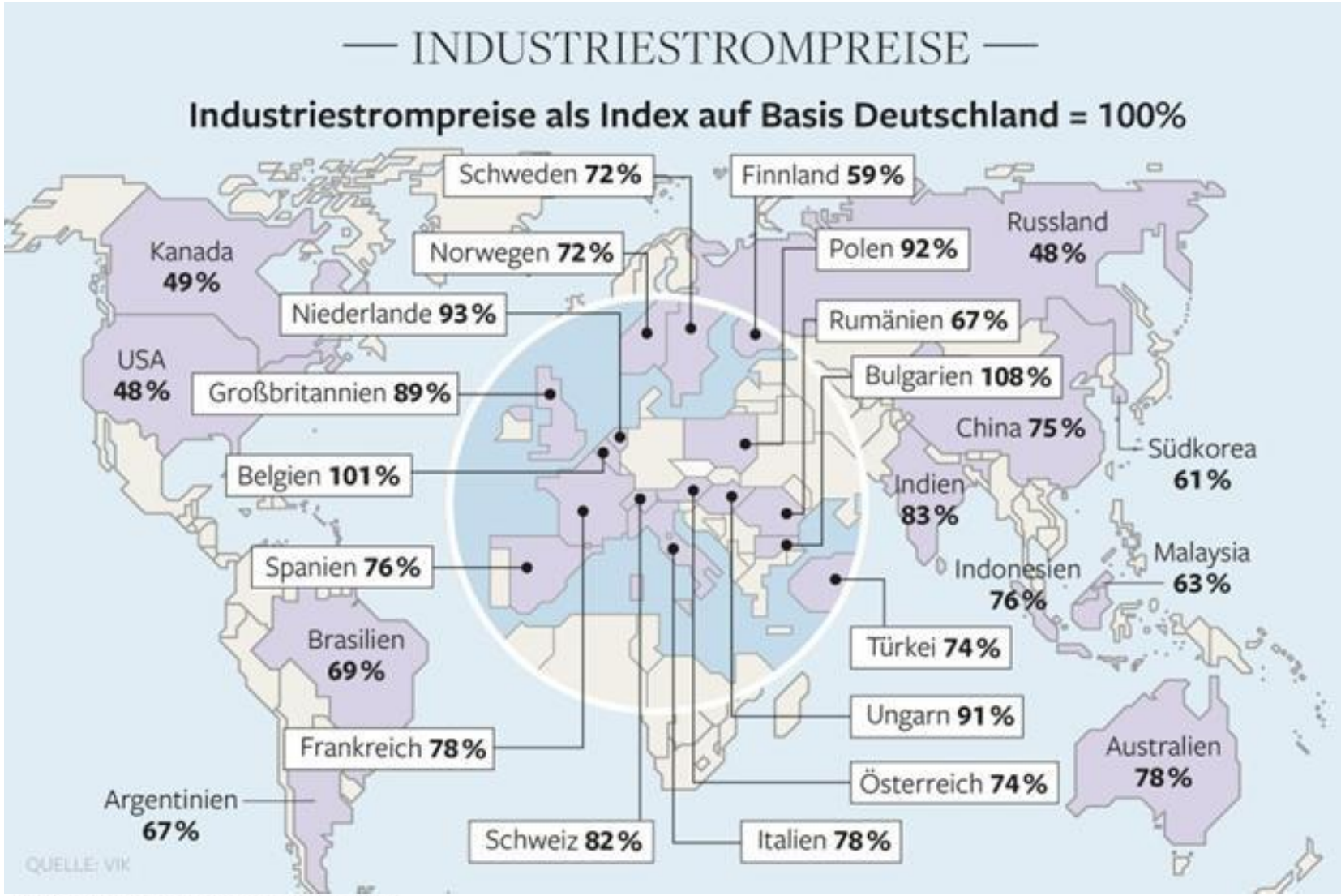
(3) Supply security and grid stability

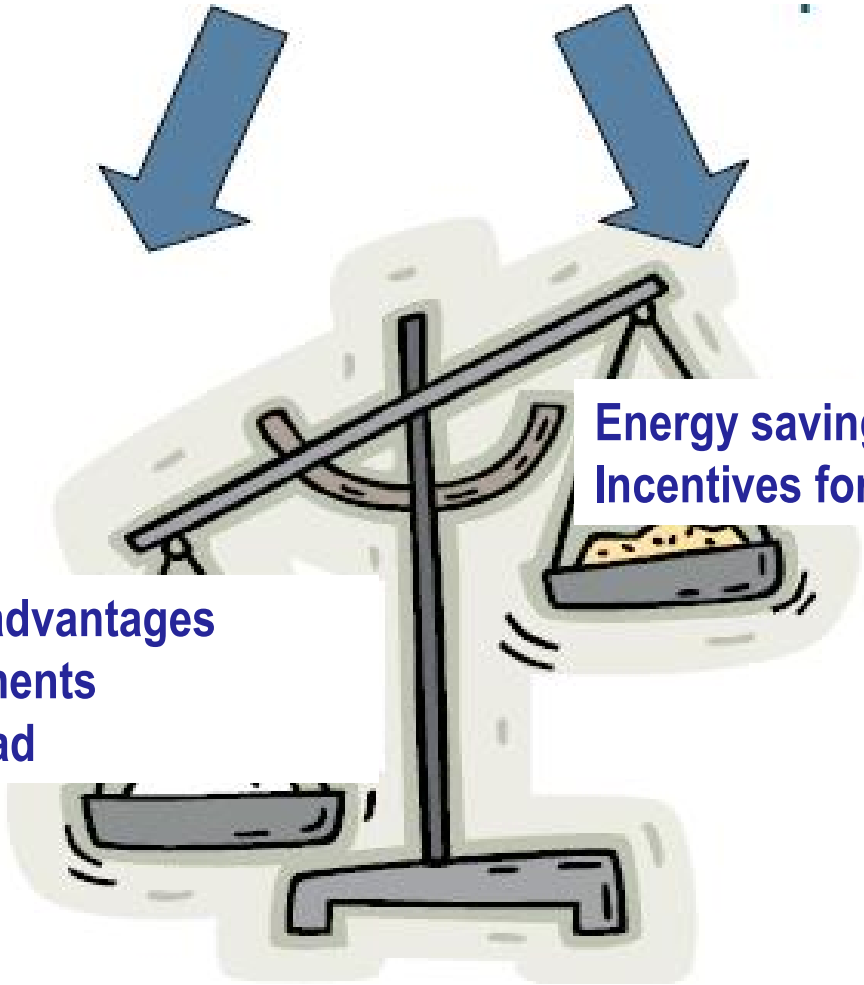
(4) **Preservation of Germany‘s industrial competitiveness**

Preservation of Germany‘s industrial competitiveness

- Compared to the european and the global level, the industrial electricity price is very high in Germany



High energy costs – What are the possible consequences?



Energy saving
Incentives for innovations

Competitive disadvantages
No more Investments
Relocating abroad

Quelle: BMWi 2013.

Vital Challenges for a succesful transformation

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(5) **Facilitate the market integration of renewable energy sources**

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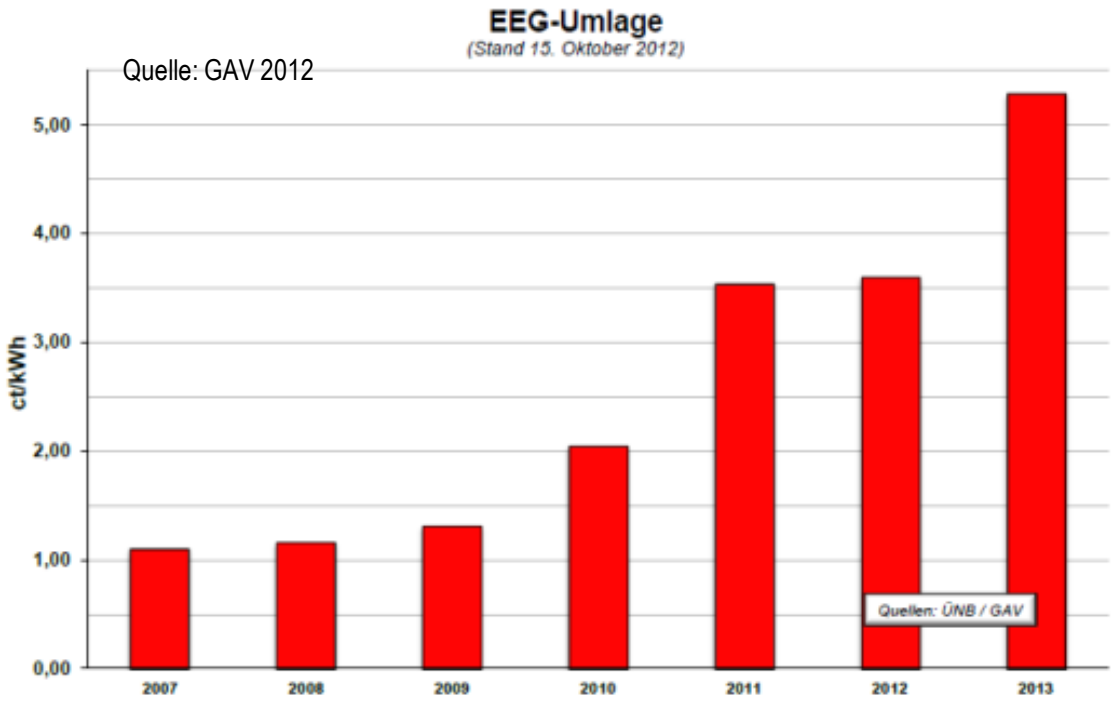
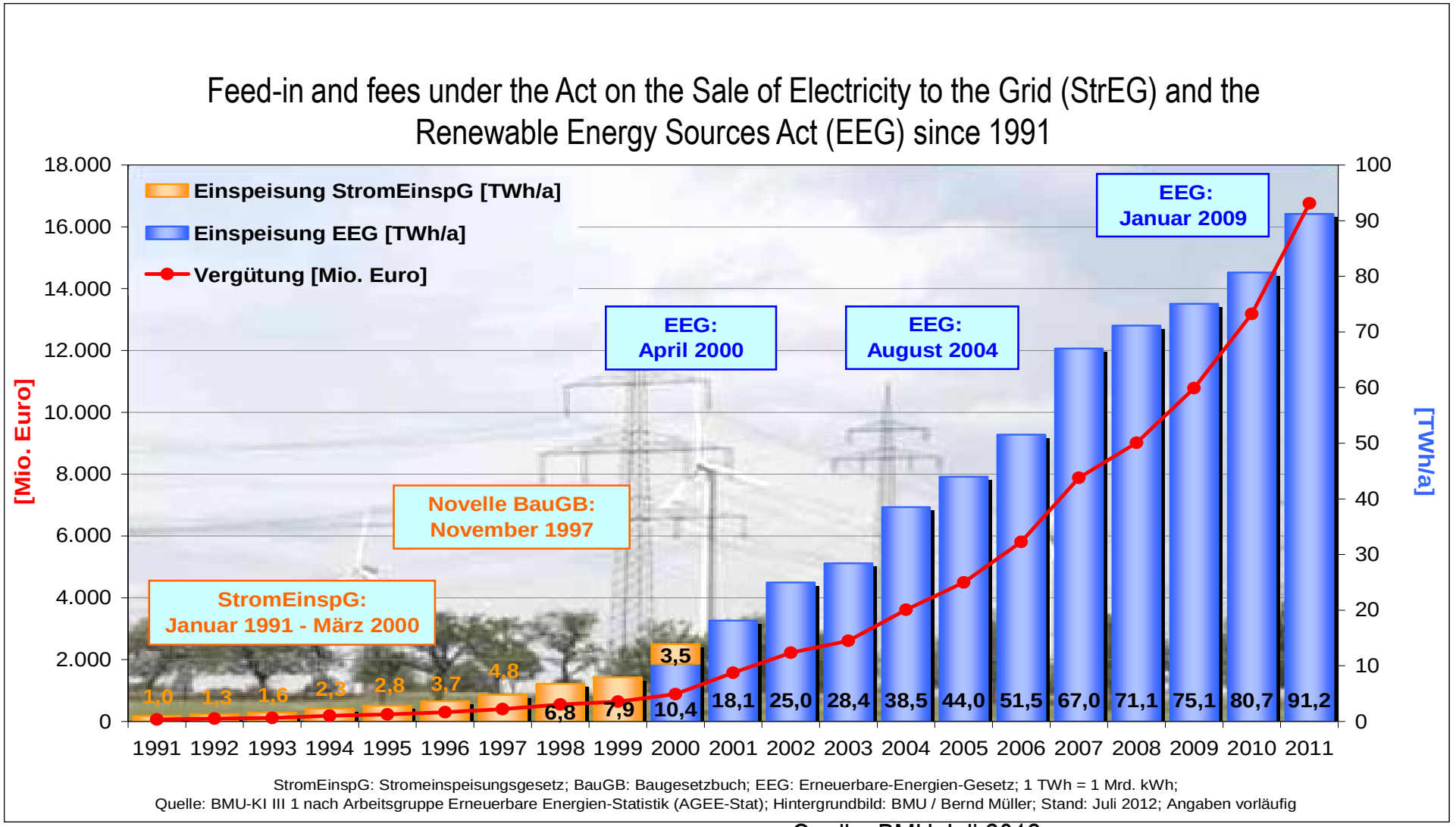
Facilitate the market integration of renewable energy sources



EEG – Distribution of costs in 2013

- 2013: forecasted feed-in-payment of 18,5 billion Euro stand vis-à-vis ca. 2,6 billion Euro revenues from sales.

Development of renewable energy sources – Costs



Quelle: BMU Juli 2012.

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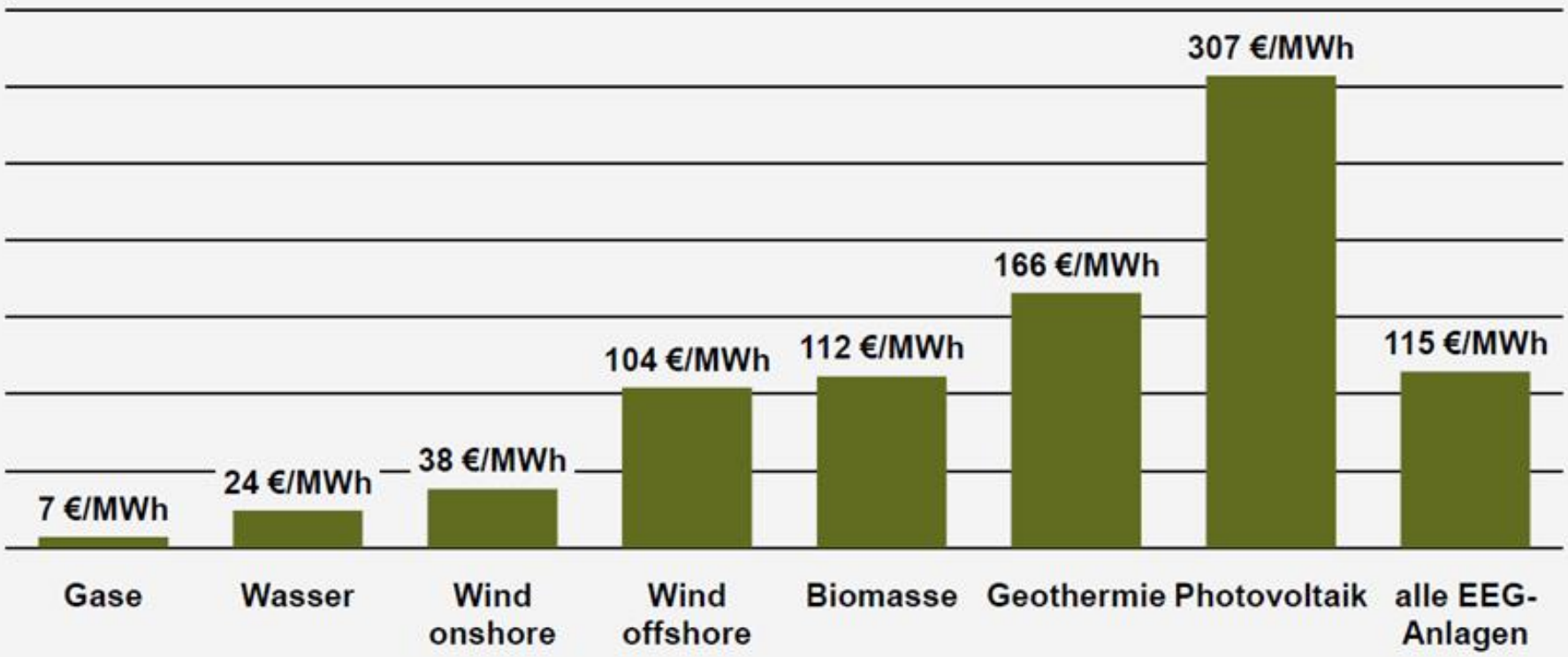
Promotion of renewables according to energy sources

Costs per MWh for all consumer for the contribution to the Renewable Energy Law in 2012 – Distribution according to energy sources



* EEG-Auszahlungen abzgl. Vermarktungserlöse abzgl. vermiedene Netzentgelte
Quelle: BDEW (eigene Berechnungen auf Basis der Prognose zur Berechnung der EEG-Umlage 2012 der Übertragungsnetzbetreiber vom 14.10.2011)

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Quelle: BDEW Dezember 2011.

Vital Challenges for a succesful transformation

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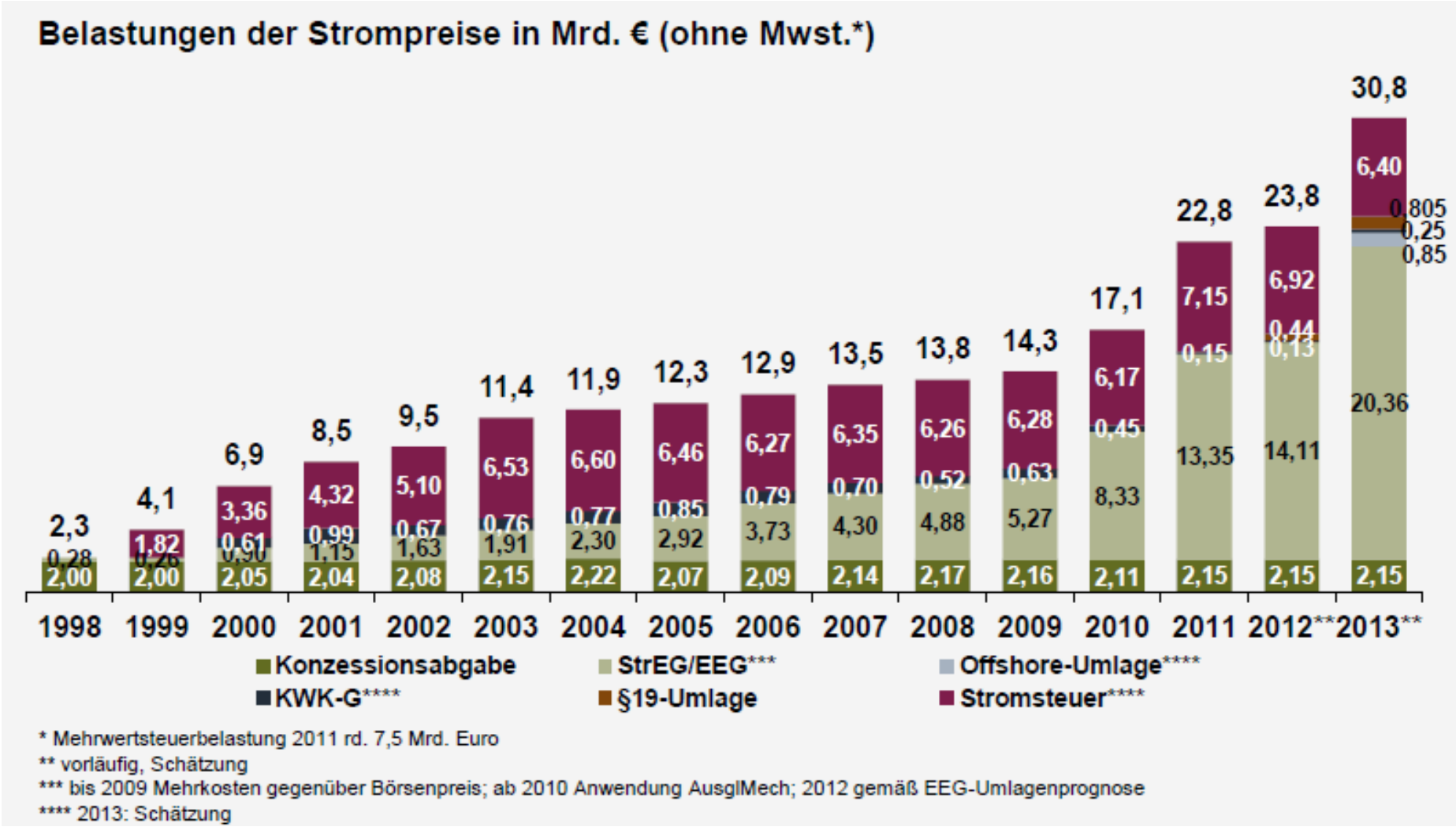
(6) **Monitoring of trends in energy prices**

State-induced burdens as an increasing component of the electricity price



Quelle: BDEW 2012

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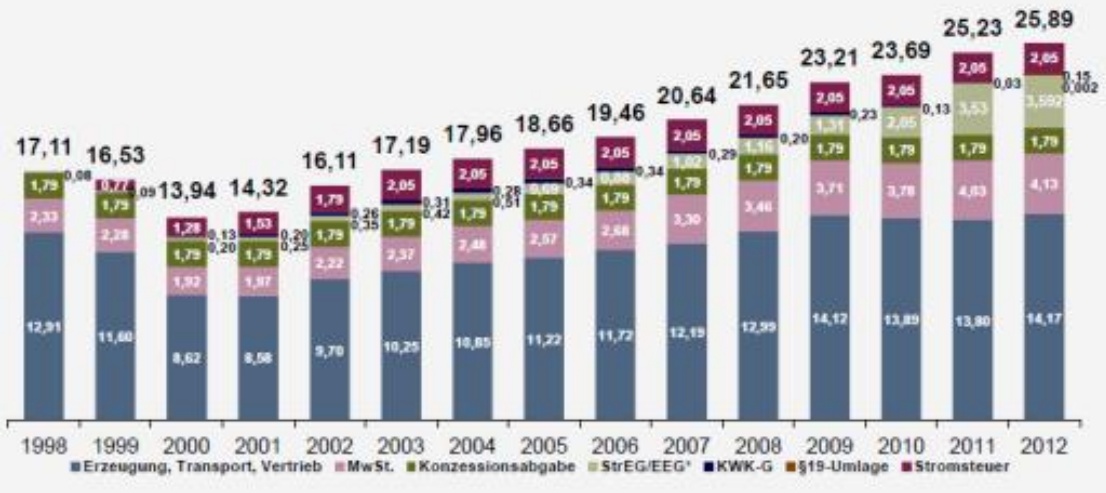
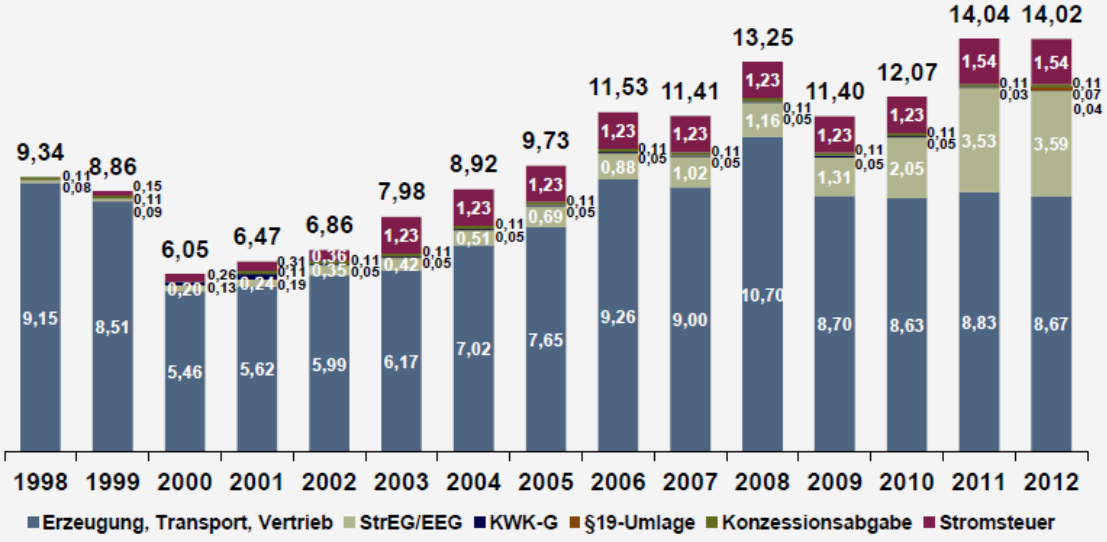
The electricity price as an alarm signal

Average electricity price for a 3-person-household in ct/kWh (3.500 kWh/year)



Average electricity price for the Industry in ct/kWh



Quellen: VEA, BDEW; Stand: 10/2012

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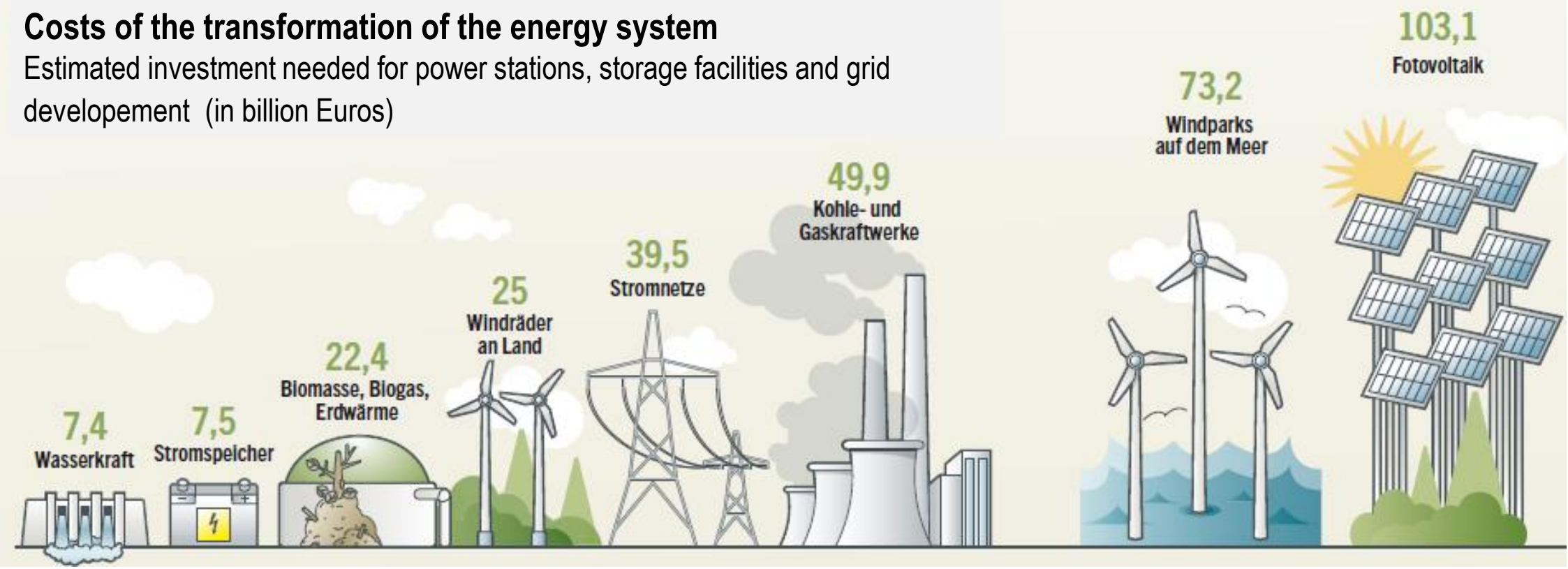
Costs of the transformation of the energy system

Estimated investment needed for power stations, storage facilities and grid developement (in billion Euros)



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Quelle: Wirtschaftswoche März 2012.

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(7) **Coordination between the federal government and the Laender**

Coordination between the federal government and the Laender

Renewable targets of the Laender

alle Angaben in GW	Photovoltaik	Wind onshore	Wind offshore	Sonstige EE	Summe EE
Baden-Württemberg	8,0	4	0	1,8	13,8
Bayern	14,0	4,3	0	4,6	22,9
Berlin	0,2	0,1	0	0,2	0,5
Brandenburg	3,3	7,5	0	0,4	11,2
Bremen	0,0	0,2	0	0,0	0,2
Hamburg	0,0	0,1	0	0,2	0,3
Hessen	3,8	3,3	0	0,3	7,4
Mecklenburg-Vorpommern	0,5	3,5	3,5	0,4	7,9
Niedersachsen	3,7	14,2	12	1,2	31,1
Nordrhein-Westphalen	5,5	10,3	0	0,9	16,7
Rheinland-Pfalz	2,7	4,5	0	0,3	7,5
Saarland	0,7	0,5	0	0,0	1,2
Sachsen	1,0	1,6	0	0,3	2,9
Sachsen-Anhalt	1,5	6,0	0	0,3	7,8
Schleswig-Holstein	2,0	13	3	0,4	18,4
Thüringen	1,7	5,4	0	0,4	7,5
Deutschland gesamt	***48,6***	***78,5***	***18,5***	***11,7***	***157,3***

Quelle: Dena 2012

- 16 „little energy“ concepts do not work out: This is inefficient and bears hight costs
- The renewable energy targets of the Laender exceed the ambitious ojectives of the federal government 60 per cent!

- Coordination is necessary: **pull together**!

Vital Challenges for a succesful transformation

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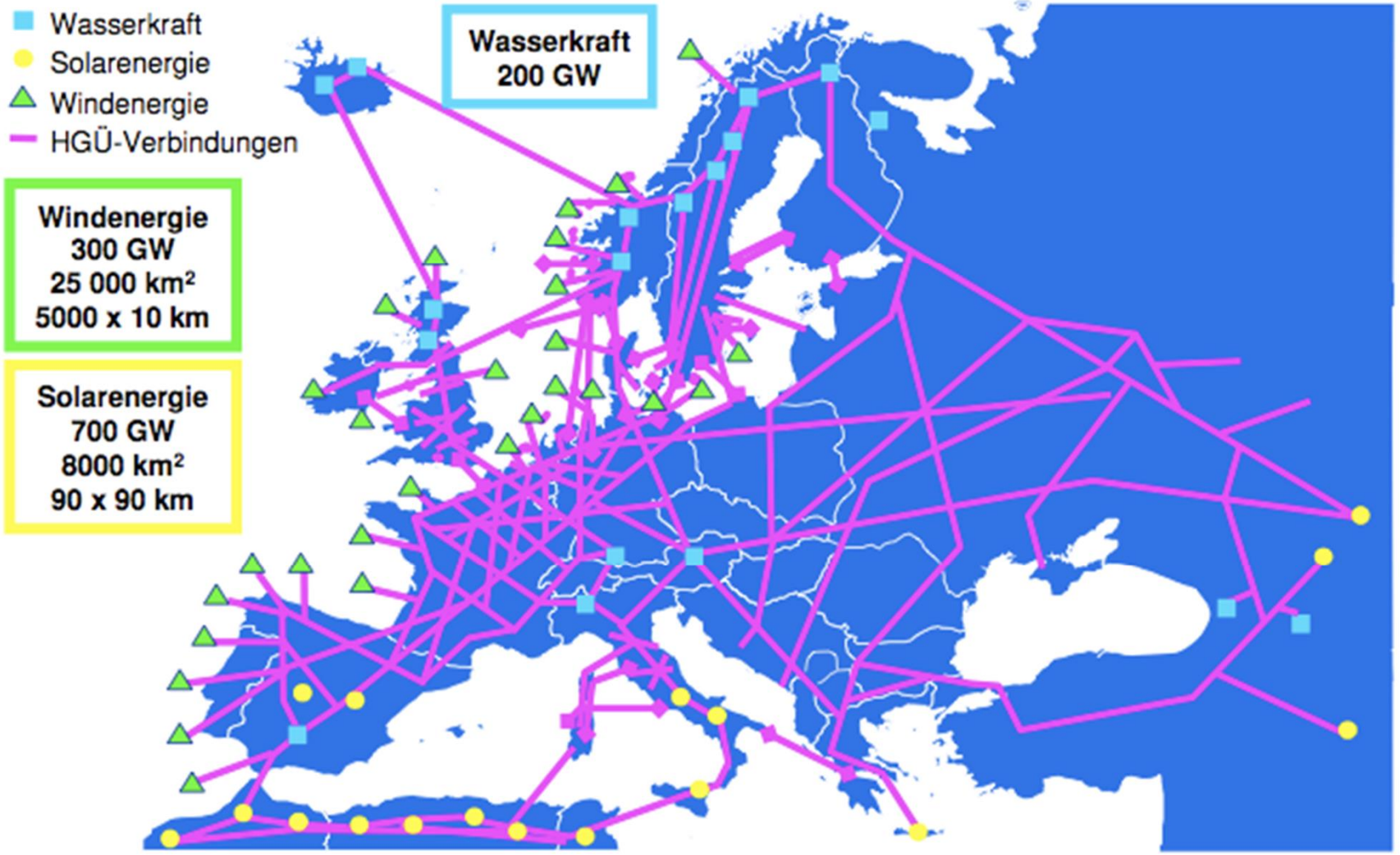
(7) Coordination between the federal government and the Laender

(8) **Further integration of the European Internal Energy Market**

European Perpective – Forecast für Europa 20xx



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Résumé

- The transformation of the energy system has to be market-driven to become a succesfull project.
- A secure, clean and affordable energy supply is crucial for the future development and peformance of Germany and the European Union.
- Energy policy must – at least – have an european focus.
- Therefore, it is mandatory…
  - …to complete the integration of energy markets to an European Internal Energy Market
  - …to develop a consistent external energy policy on EU-level
- Vital challenges and chances are:
  - the further improvement of energy efficiency,
  - the developement of energy infrastructure and,
  - a coordinated and economic feasible development of renewable energy sources on the european level.
- The further integration of european energy policy is crucial for the future success of Europe.

Thank you for your attention!

30 May 2013

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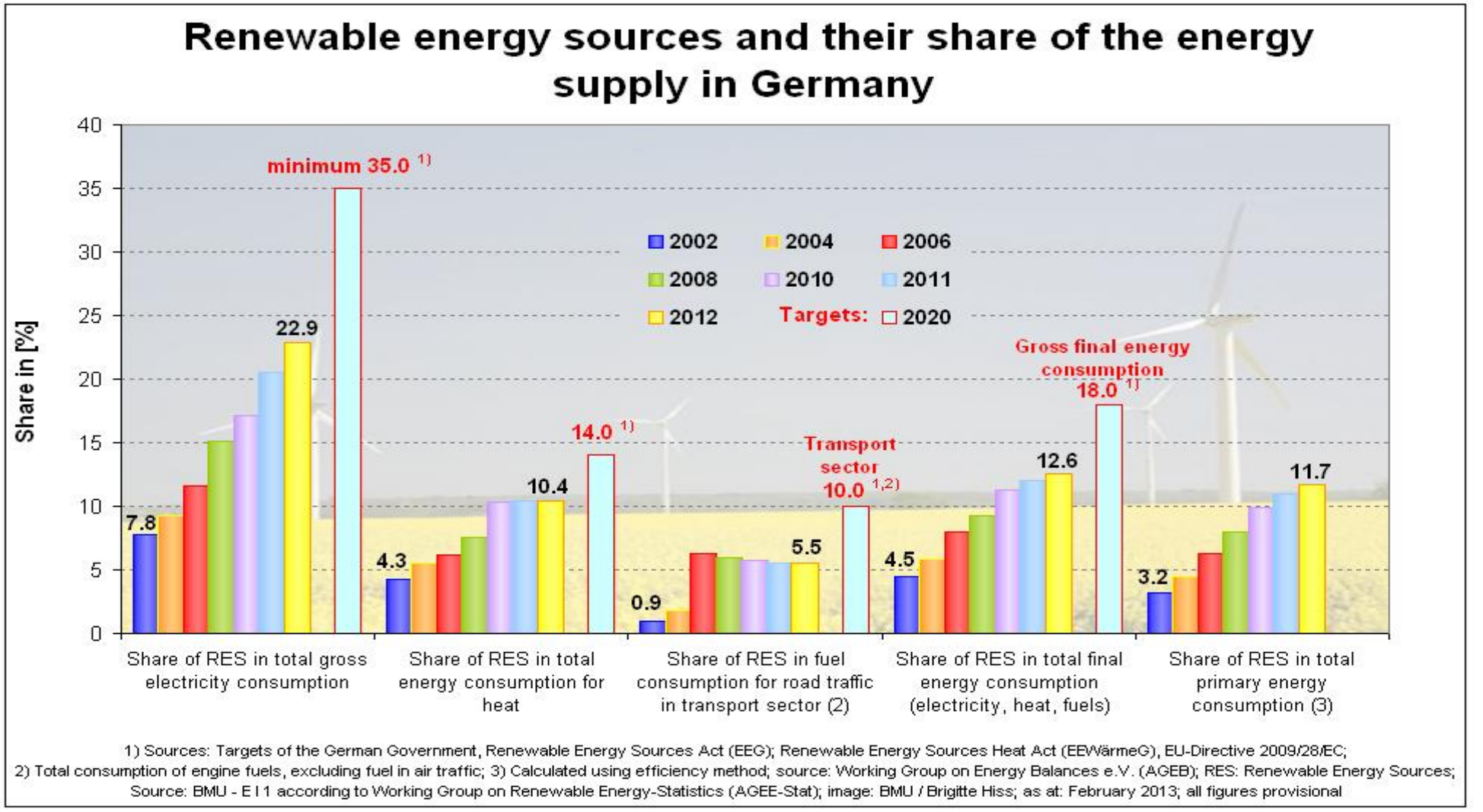
Back-Up I

The Transformation of the Energy System



Quelle: BMU 2013.

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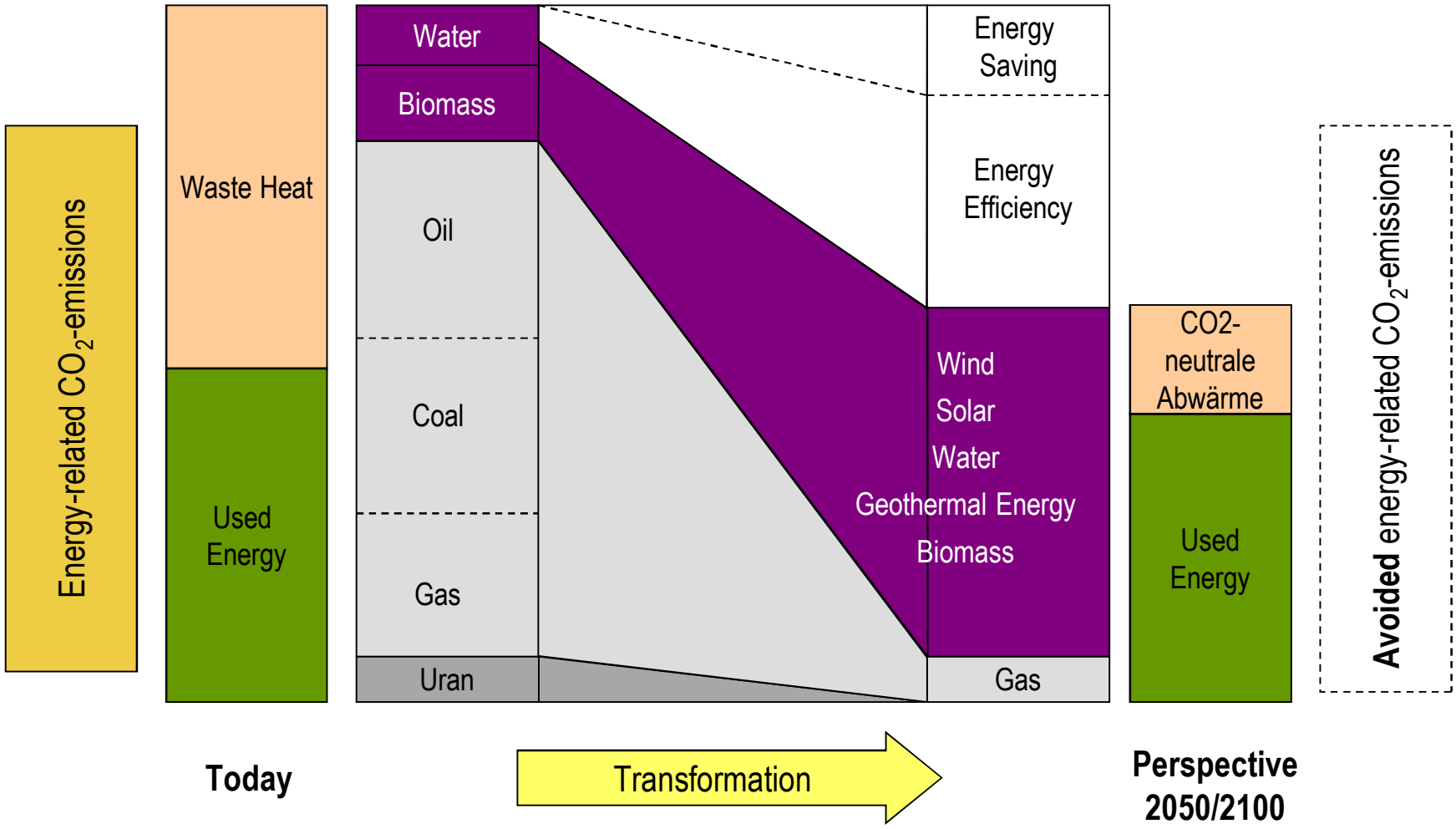
The Transformation of the Energy System



Quelle: Robert Bosch GmbH 2013.

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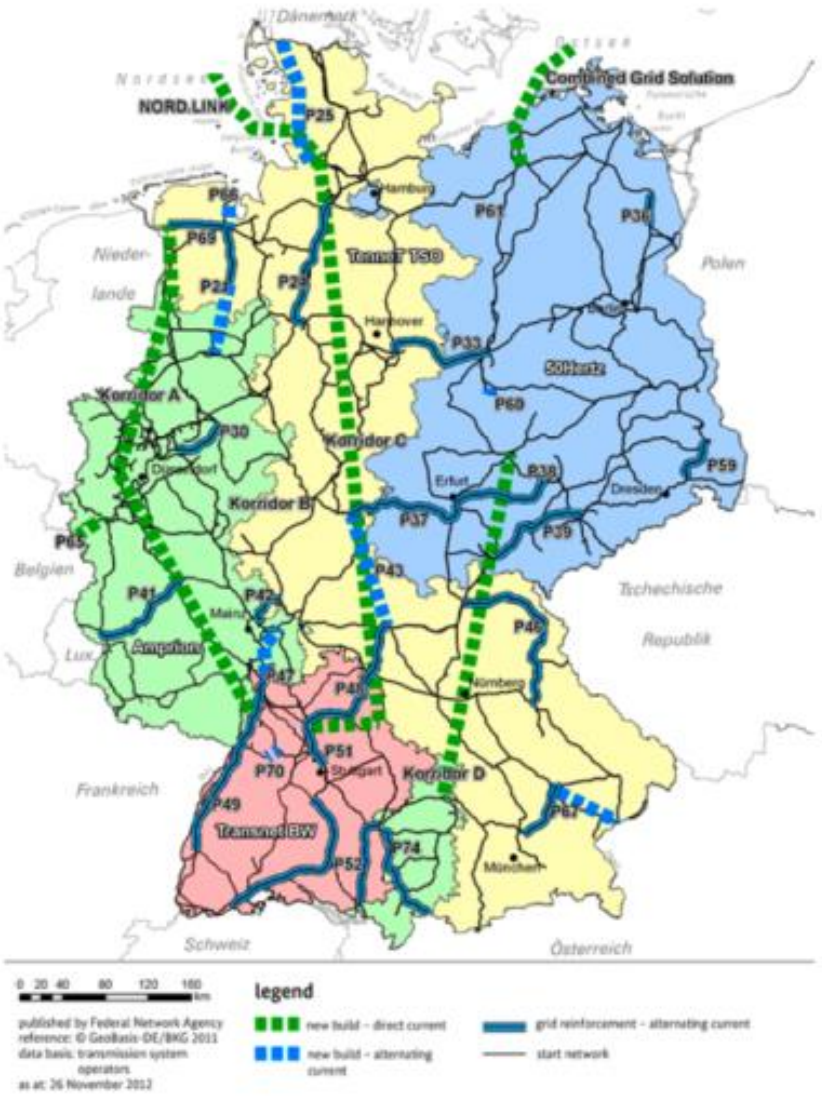
Developing the electricity transmission grid

Grid development plan: approval by the Federal Network Agency



High-voltage electricity grid (Federal Requirement Plan Act – BBPlG)

- Optimization and modernization: 2.900 km
- New power lines: 2.800 km
- Estimated investiment: 20 billion Euro

Distribution grid

- New power lines: 135.000 km to 200.000 km
- Estimated investiment: 27,5 to 42,5 billion Euro

Grid connection of offshore wind farms

- till 2022 :13 GW (rd. 13 billion Euro)
- till 2030: 25 GW (25 billion Euro).

Smart Grids (5 billion Euro)

Grid connection to Norway (2 billion Euro)

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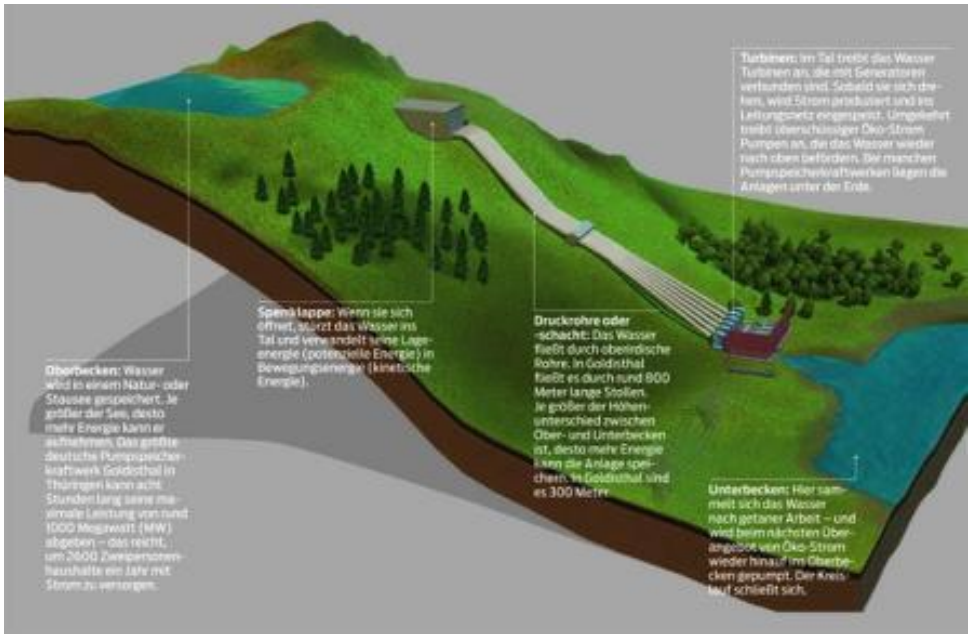
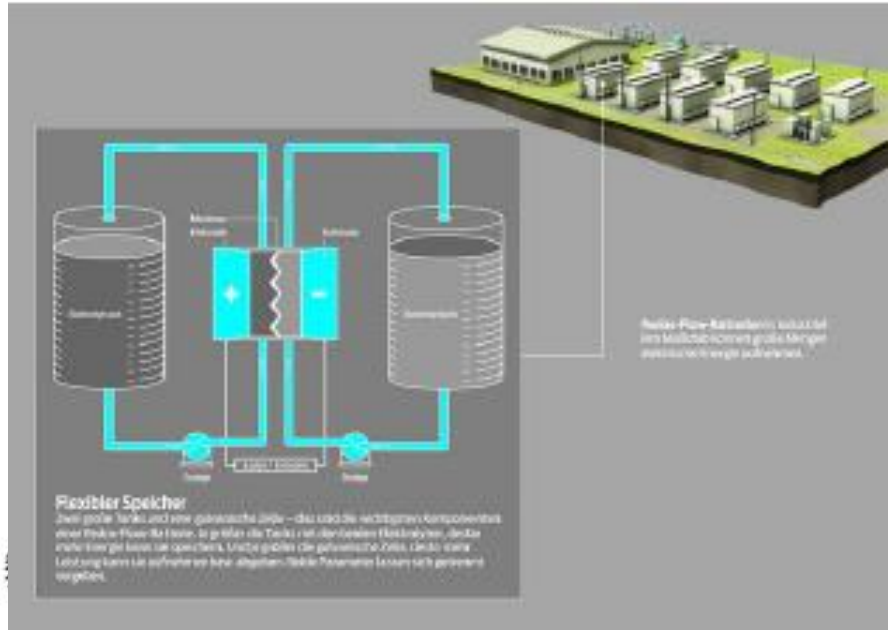
Developing storage facilities





Supply security and grid stability

Development of supply security in Germany – electricity and gas

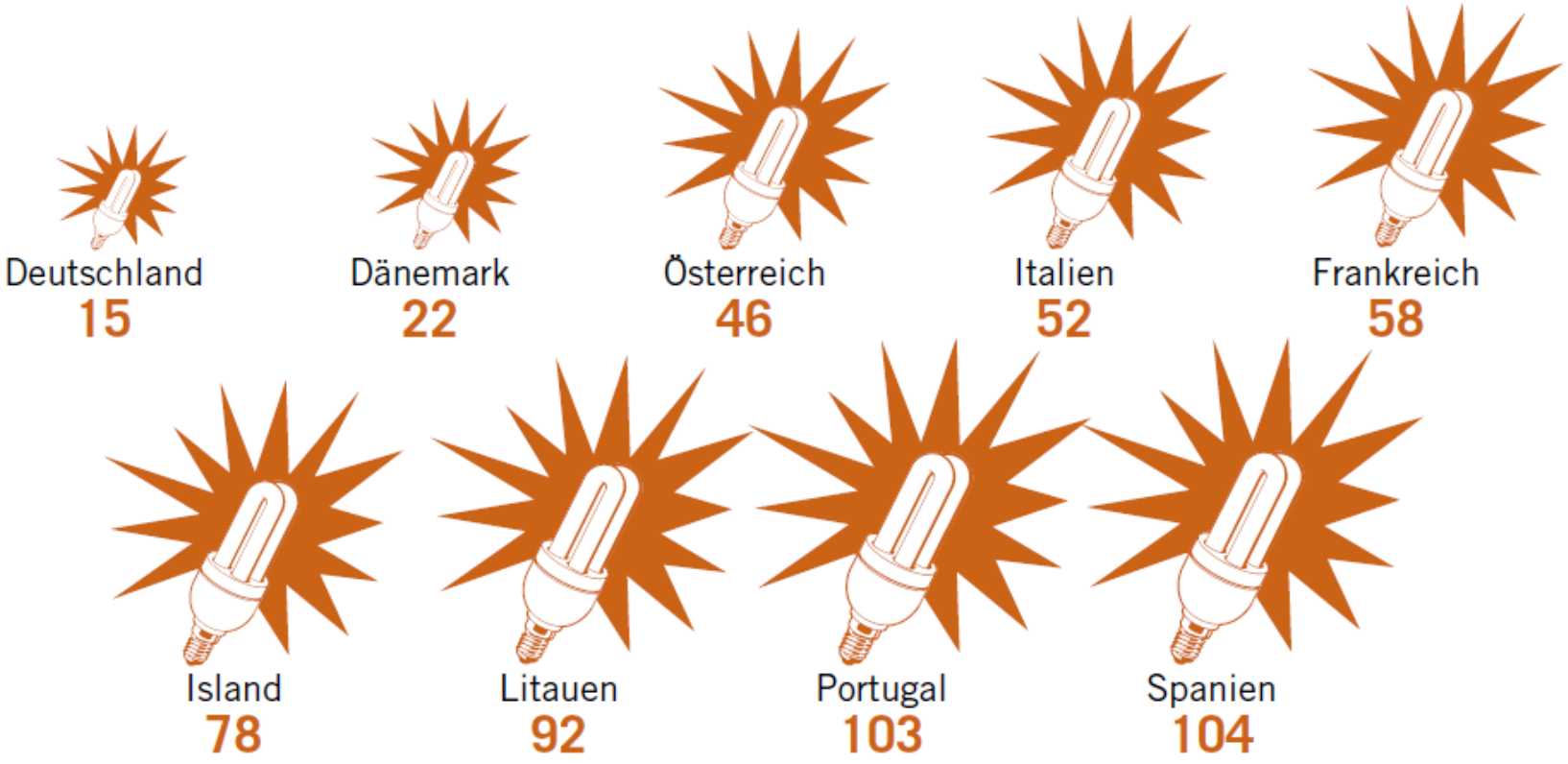
	Entwicklung in Deutschland		
	SAIDI-value* Gas (min/a)	SAIDI-value* Strom (min/a)	Outage power supply
2011	1,99	15,31	206673
2010	1,25	14,90	206300
2009	1,88	14,63	199000
2008	1,02	16,89	208100
2007	4,07	19,25	235800
2006	2,09	21,53	228000

Quelle: BNetzA; eigene Darstellung.

- Saidi-value: average outage duration for each customer served
- Supply security in Germany is on a very high level.
- But: SAIDI-Wert considers only outages longer than **3 minutes**

Supply security and grid stability

Outages in power supply – 2010



Stand: Deutschland 2010, übrige Länder 2007; Quellen: Bundesnetzagentur, Rat der europäischen Energieregulierungsbehörden

Quelle: INSM 2012.

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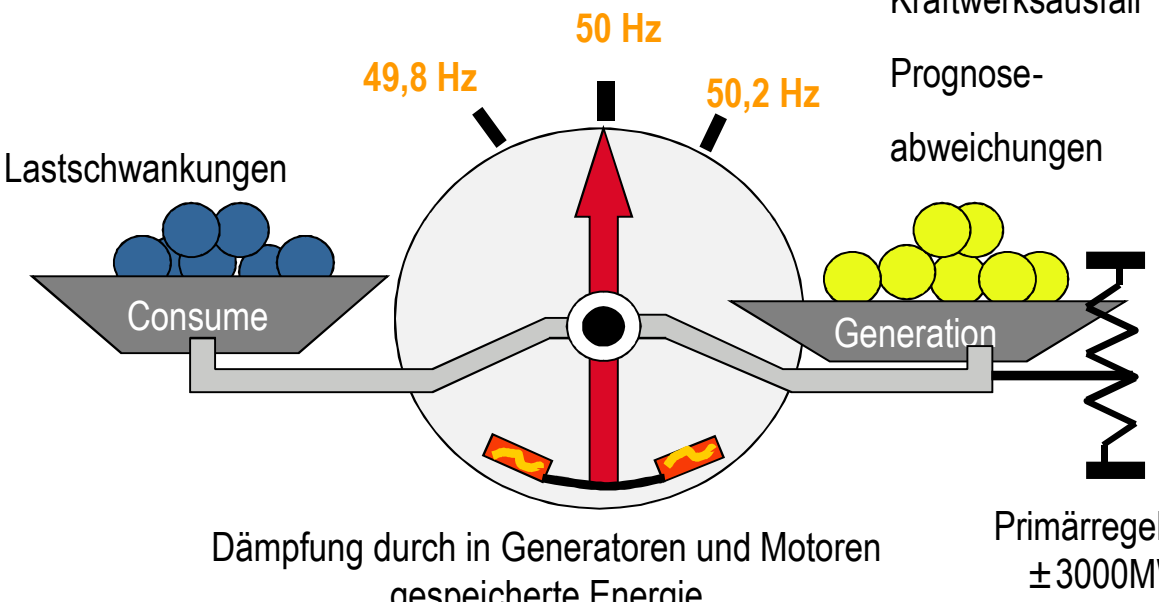
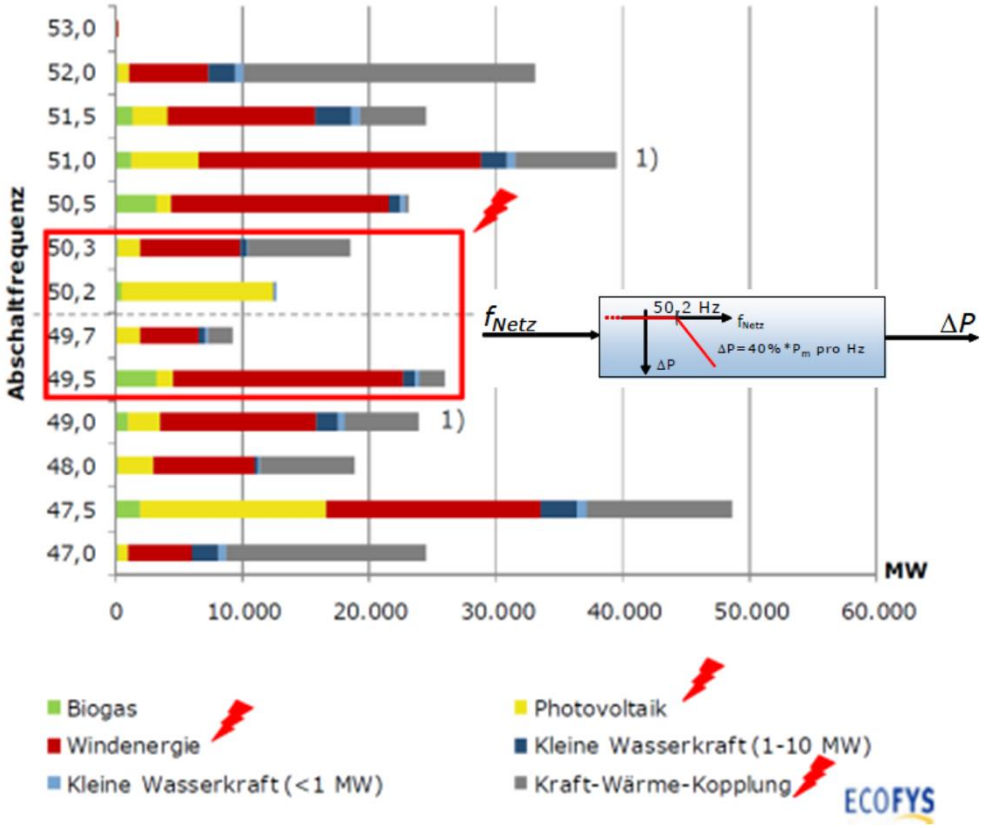
Challenge: Supply security and grid stability

- 50,2 Hz-Problem: Till the end of 2012 over 32 GW Photovoltaic have been installed
- High volatility because of wind a solar power





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Industry – vital for Germany‘s economic performance

- 1/4 of gross value added is produced by the industrial sector
- 5,6 Mio. people work in the industrial sector
- 2/3 of Germany‘s economic growth was produced by the industrial sector in the recent two years

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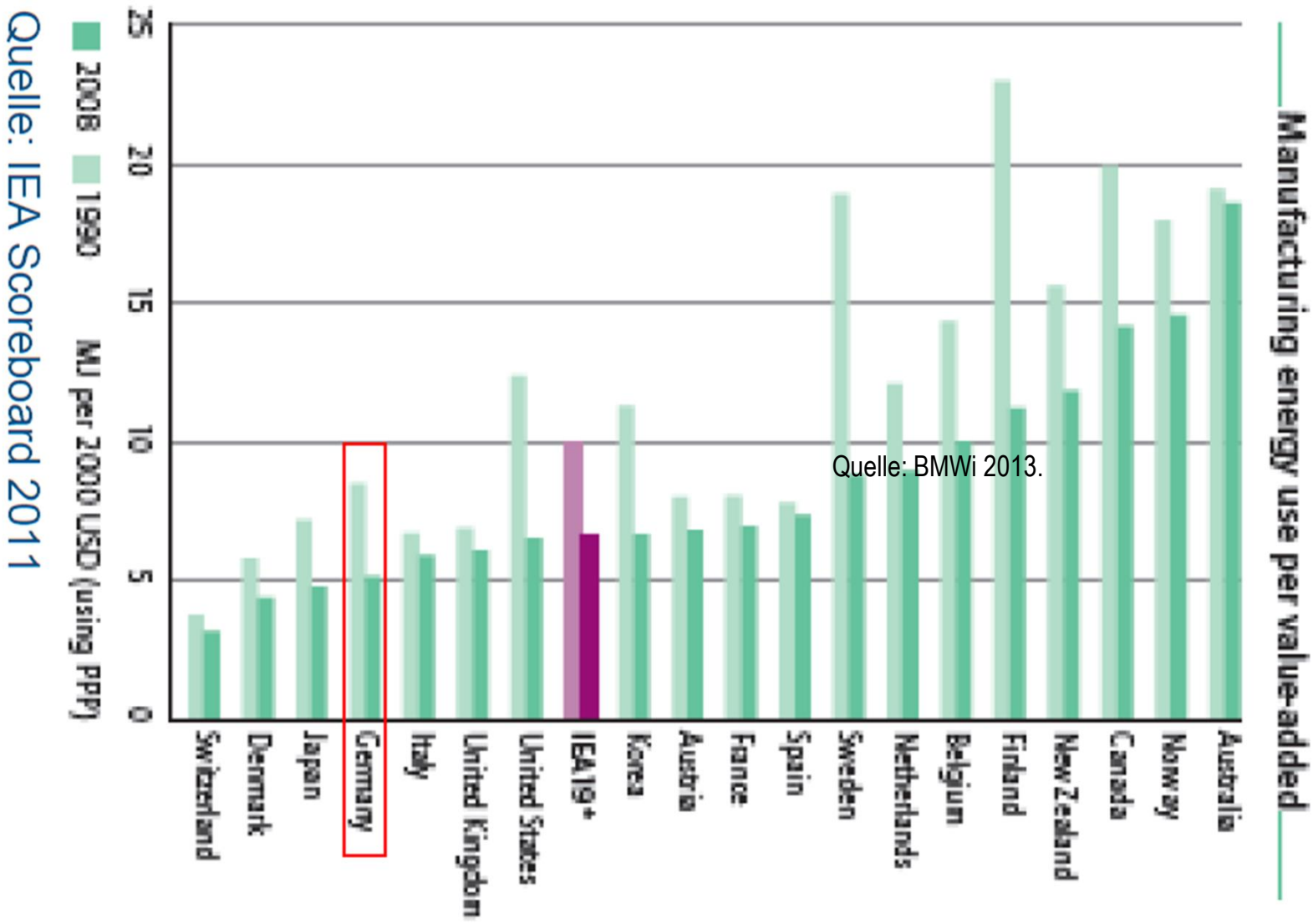
Energy efficiency in the industrial sector – A comparison



Quelle: IEA Scoreboard 2011

Quelle: BMWi 2013.

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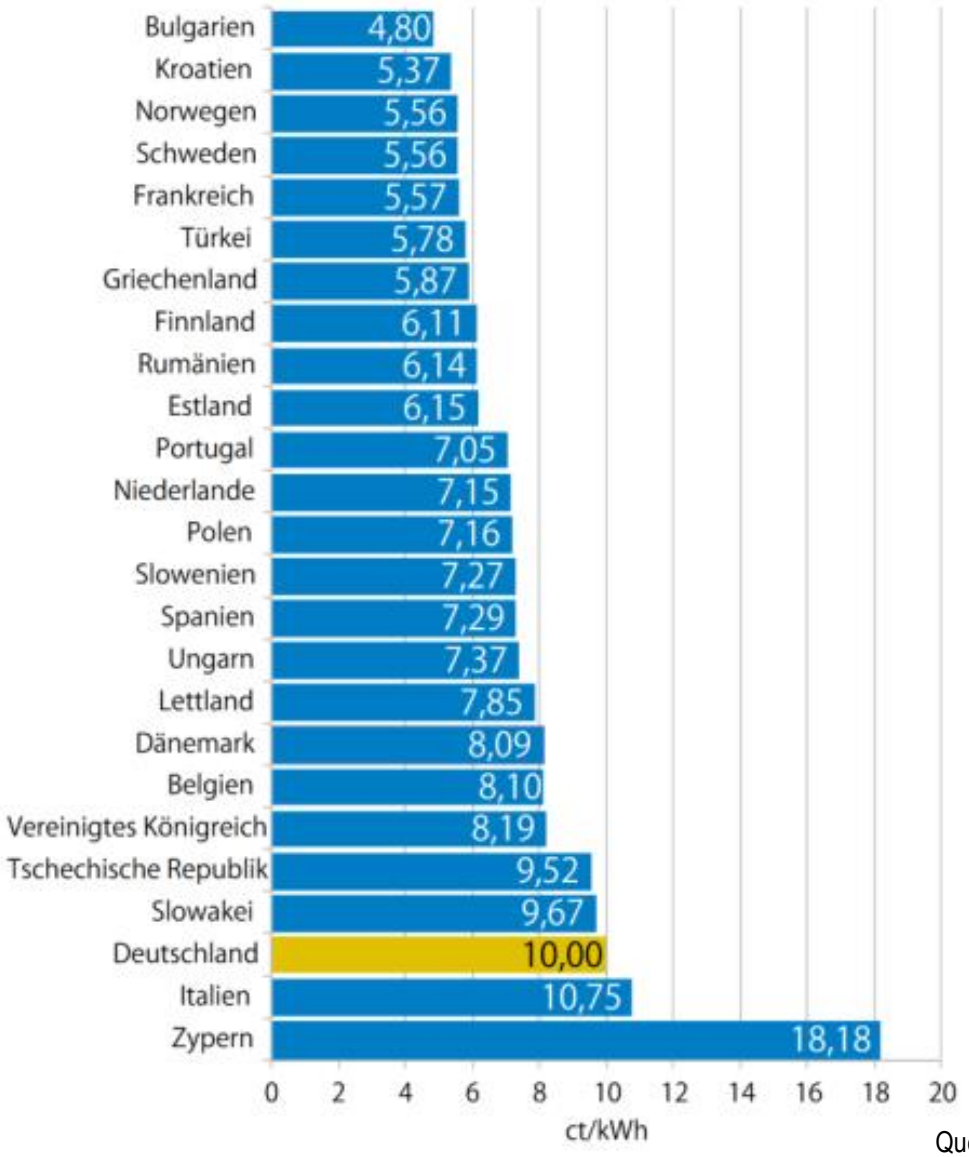
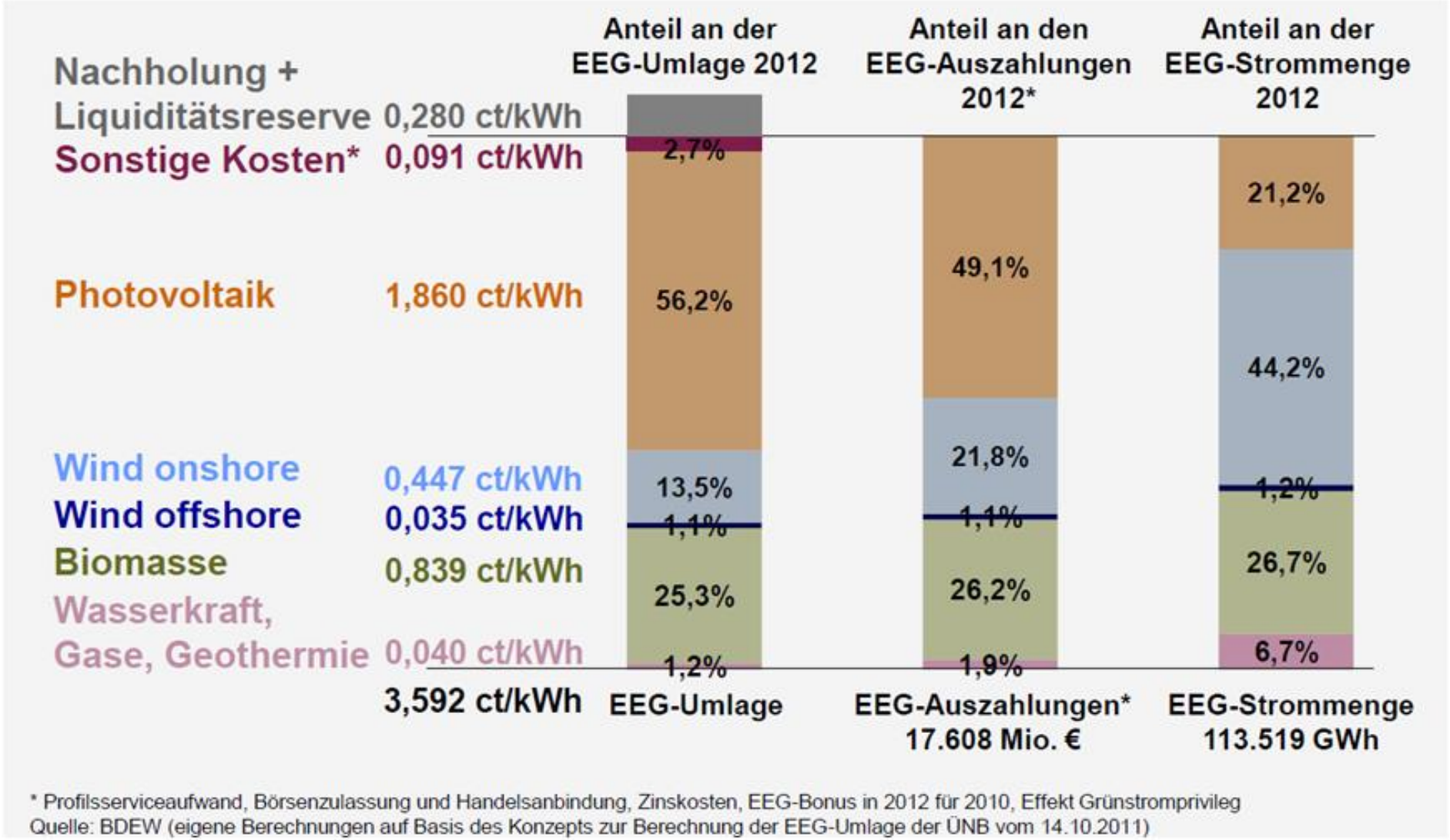
Preservation of Germany‘s industrial competitiveness



Quelle: VIK 2012

Gesamtpreise einschließlich Steuern (ohne MWSt.)

Renewable Energy Sources Act (EEG) 2012: Distribution of costs according to energy sources



* Profilsserviceaufwand, Börsenzulassung und Handelsanbindung, Zinskosten, EEG-Bonus in 2012 für 2010, Effekt Grünstromprivileg
Quelle: BDEW (eigene Berechnungen auf Basis des Konzepts zur Berechnung der EEG-Umlage der ÜNB vom 14.10.2011)

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Quelle: BDEW Dezember 2011.

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Installed power and power generation

Wind

Photovoltaik

Biomasse und
sonst. erneuerbare Energien

Öl, Pumpspeicher und Sonst.

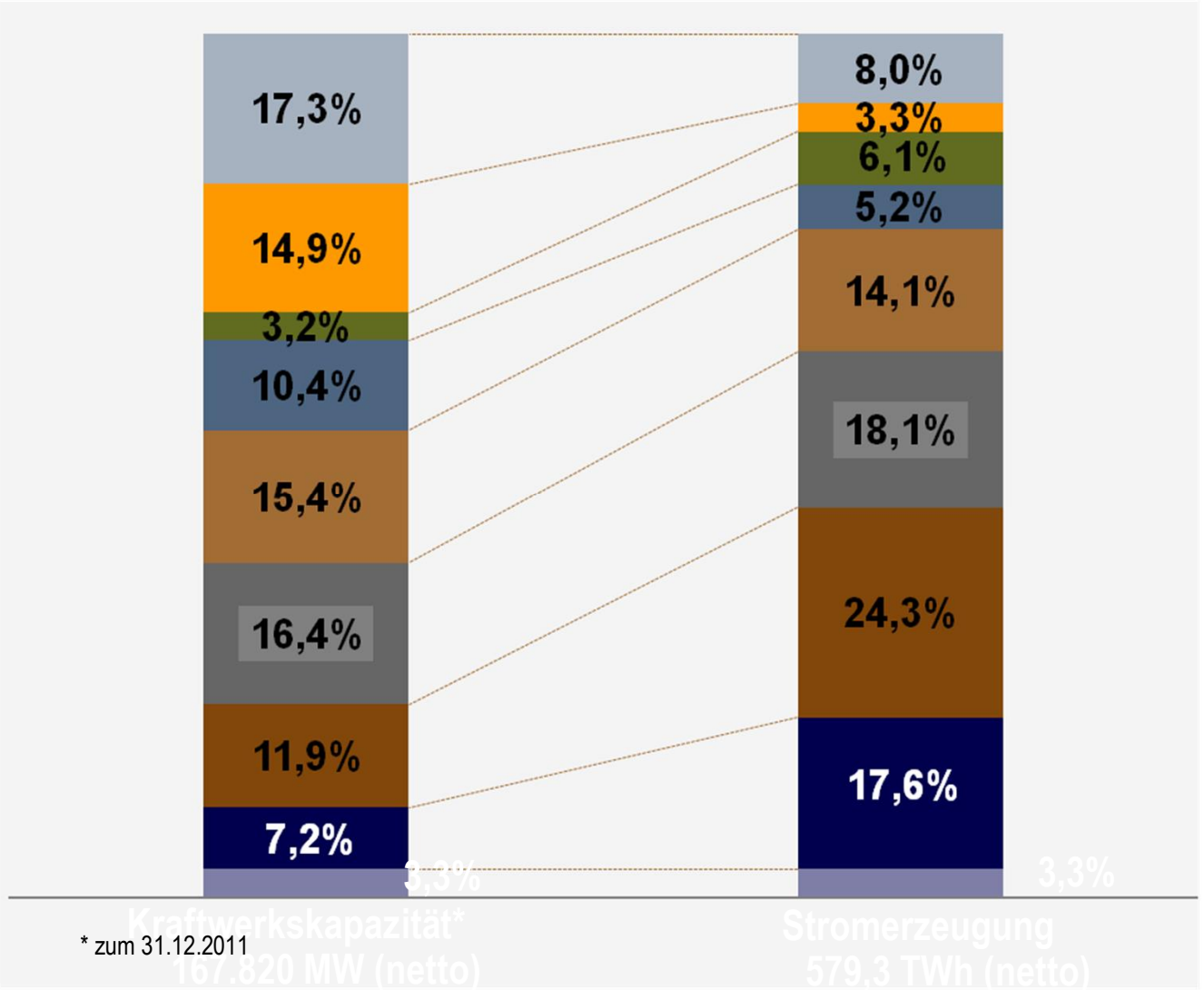
Erdgas

Steinkohle

Braunkohle

Kernenergie

Wasserkraft (ohne Psp.)



* zum 31.12.2011

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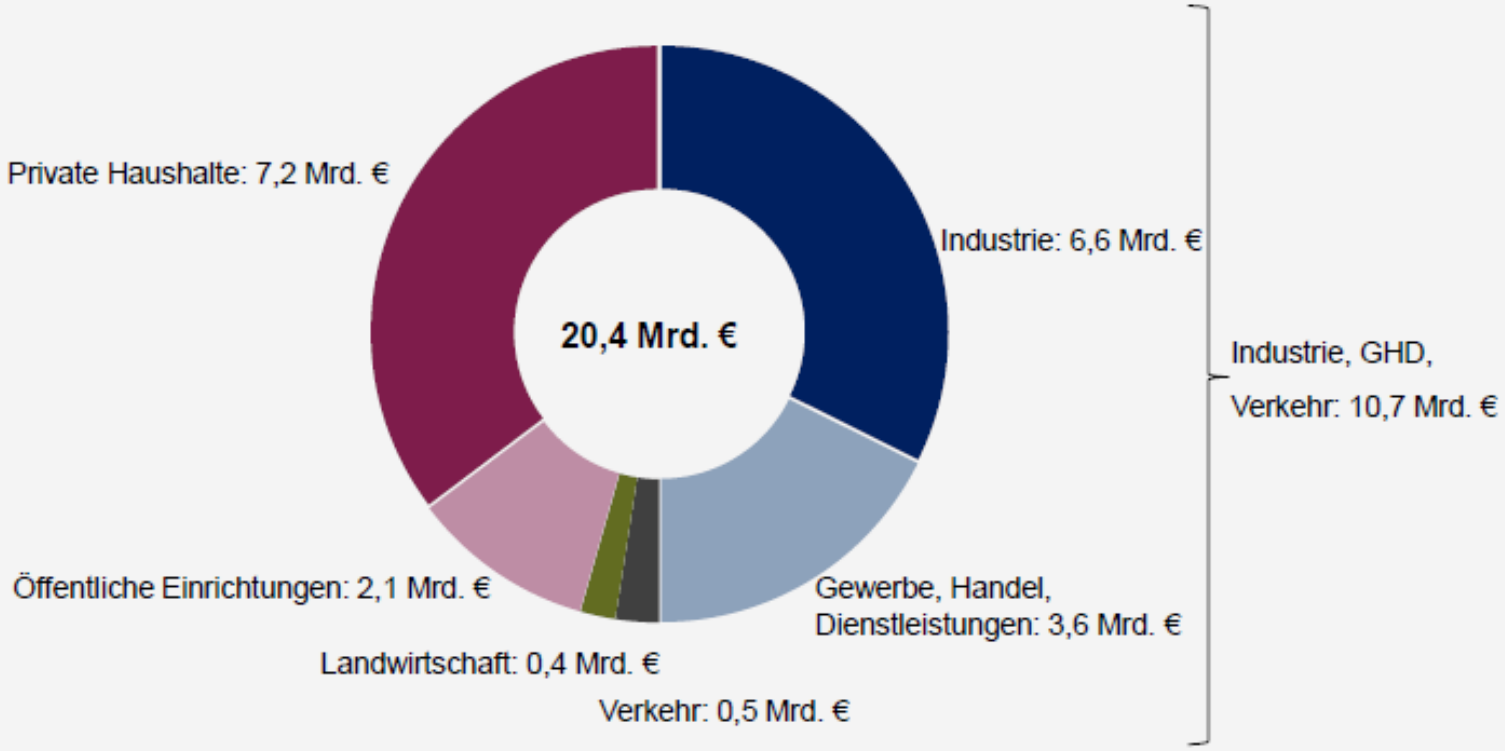
The Contribution to the EEG by consumer groups in 2013

In 2013 the consumer has to bear the costs of 20,4 billion Euro for the EEG



Quelle: BDEW

Burdens for households

	Burdens for households - 2005 bis 2012 (in Ct/kWh)								
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Contribution to the Renewable Energy Act (EEG-Umlage)	0,69	0,88	1,02	1,16	1,31	2,05	3,53	3,59	5,30
Concession fee (Konzessionsabgabe)	1,79	1,79	1,79	1,79	1,79	1,79	1,79	1,79	1,79
Grid utilisation fee (Netznutzungsentgelte)		7,30	6,34	5,92	5,80	5,81	5,75	6,04	6,46
KWK-G	0,34	0,31	0,29	0,19	0,24	0,13	0,03	0,002	0,13
§19-Umlage								0,15	0,39
Offshore									0,25
Capacity reserve (Kaltreserve)									0,05
Summe	**2,82**	**10,28**	**9,44**	**9,06**	**9,14**	**9,78**	**11,10**	**11,57**	**14,37**
Electricity tax	2,05	2,05	2,05	2,05	2,05	2,05	2,05	2,05	2,05
Value added tax (Mehrwertsteuer)	2,57	2,68	3,30	3,46	3,71	3,78	4,03	4,11	4,28
Total (including taxes)	**7,44**	**15,01**	**14,79**	**14,57**	**14,90**	**15,61**	**17,18**	**17,73**	**20,70**

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Objective of the integration of energy markets: The European Internal Energy Market

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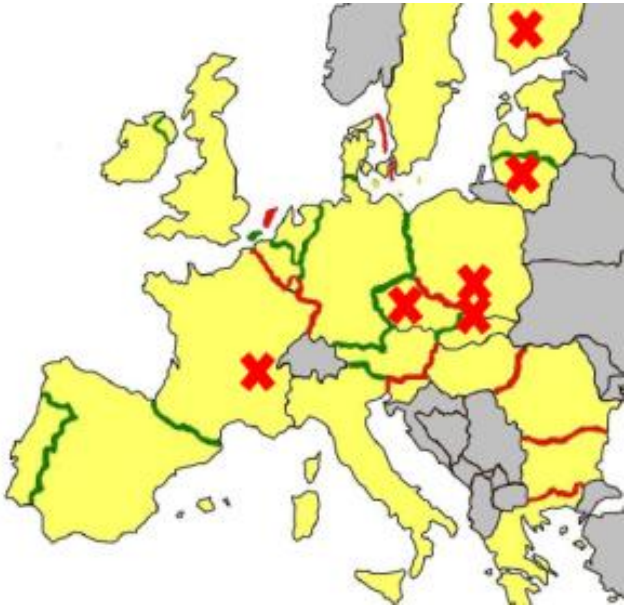
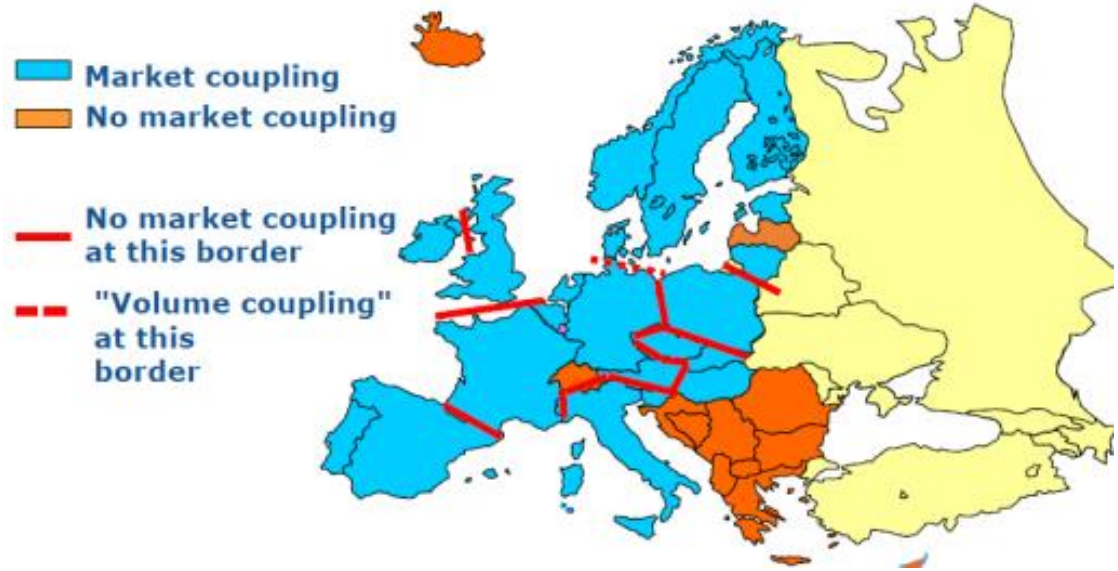
Quelle: EU-Kommission 2012

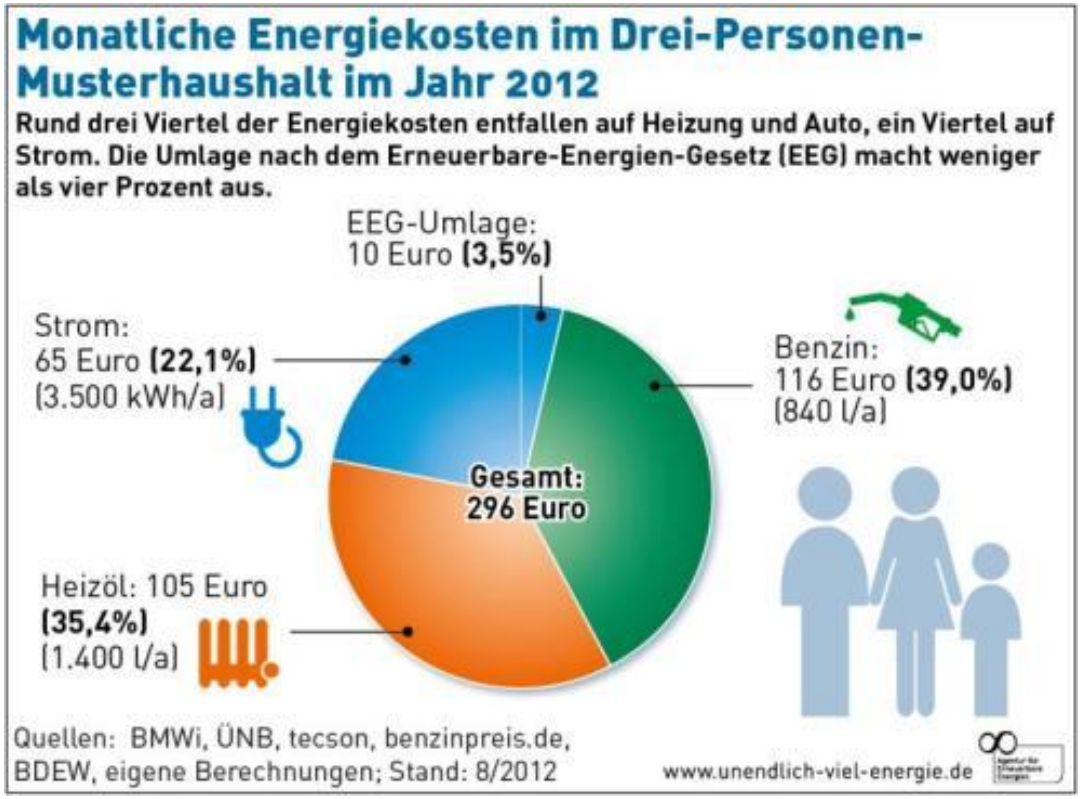
The integration of energy markets – Status Quo

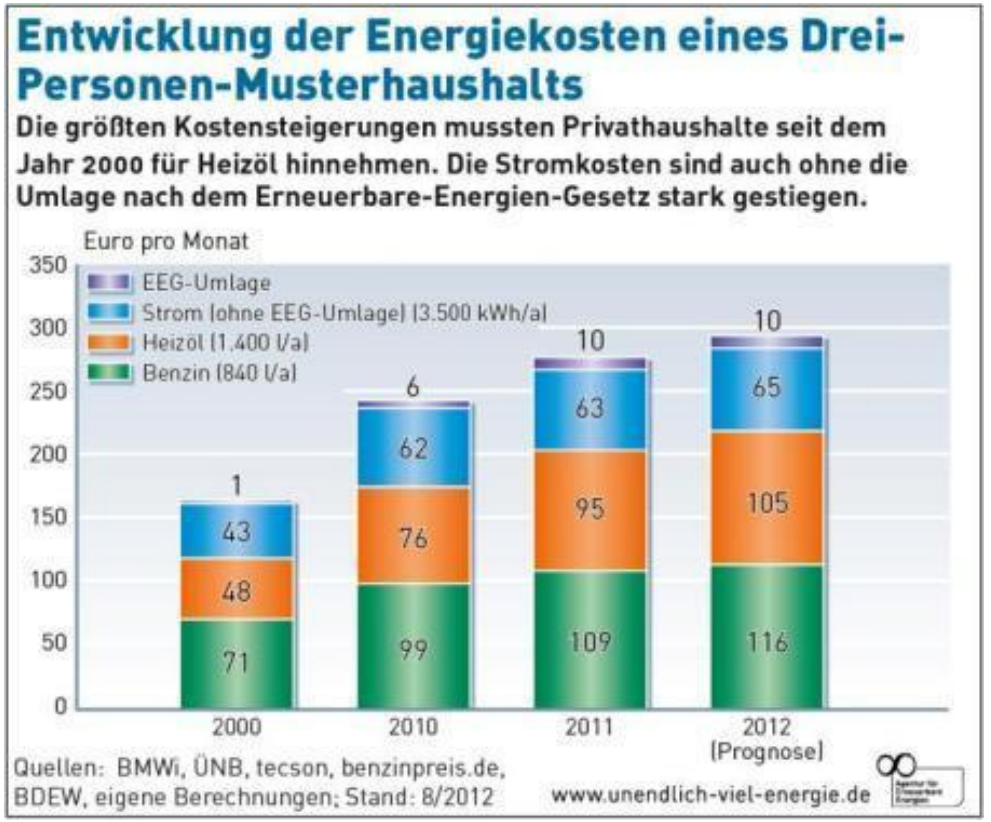




Quelle: EU-Kommission 2012

Compensating the price effect by reducing the consumption



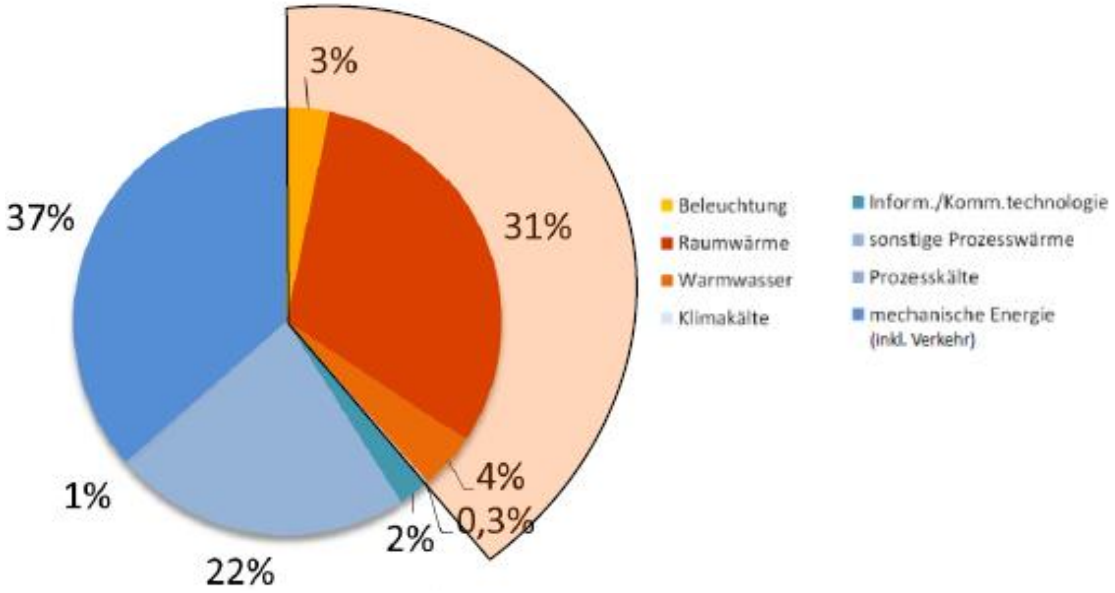


Back-Up II

Energy efficiency in the building sector – high potentials

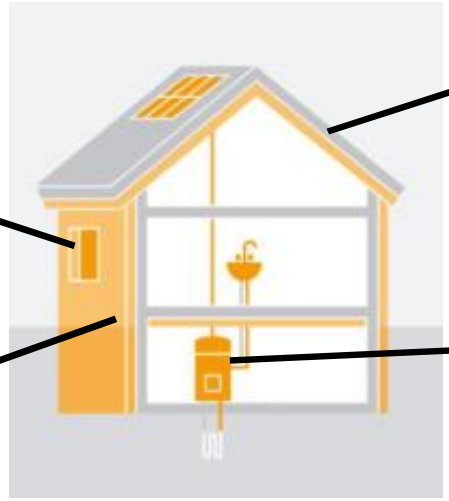
- Nearly 40 per cent of Germany‘s final ernergy consumption are consumed in the building sector

- With 19,6 Mio. housing units there is a huge potenital for increasing energy efficiency



Quelle: Dena 2012

Non-insulated buildings waste energy



Windows: 60 % have low standards concerning energy saving

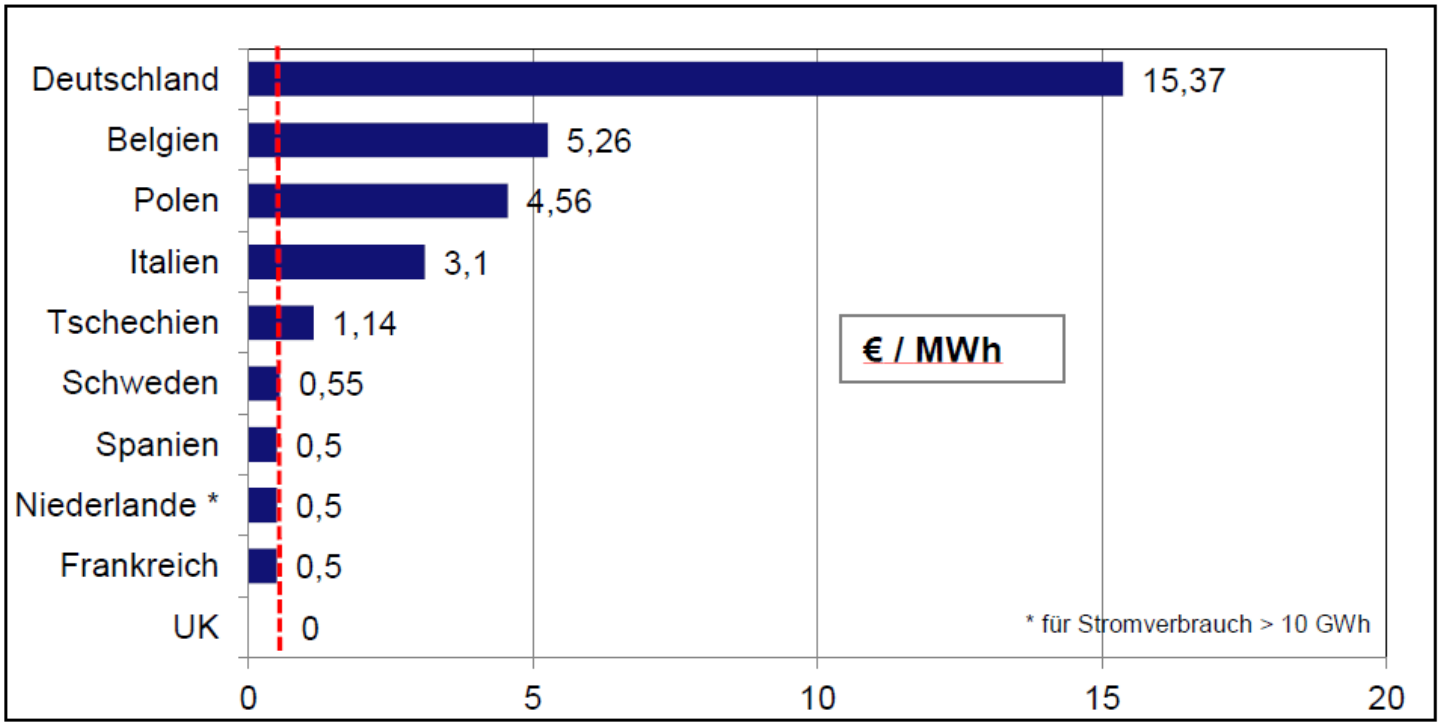
Roof: 30 % are not insulated

Facades: 65 % are non insulated

Heating Boilers: 90 % are older than10 years

Preservation of Germany‘s industrial competitiveness

- German energy tax is 30times higher than average EU



Stromsteuerbelastung der Industrie im EU-Vergleich, ohne Spitzenausgleich in Deutschland (Quelle: EU-Kommission)

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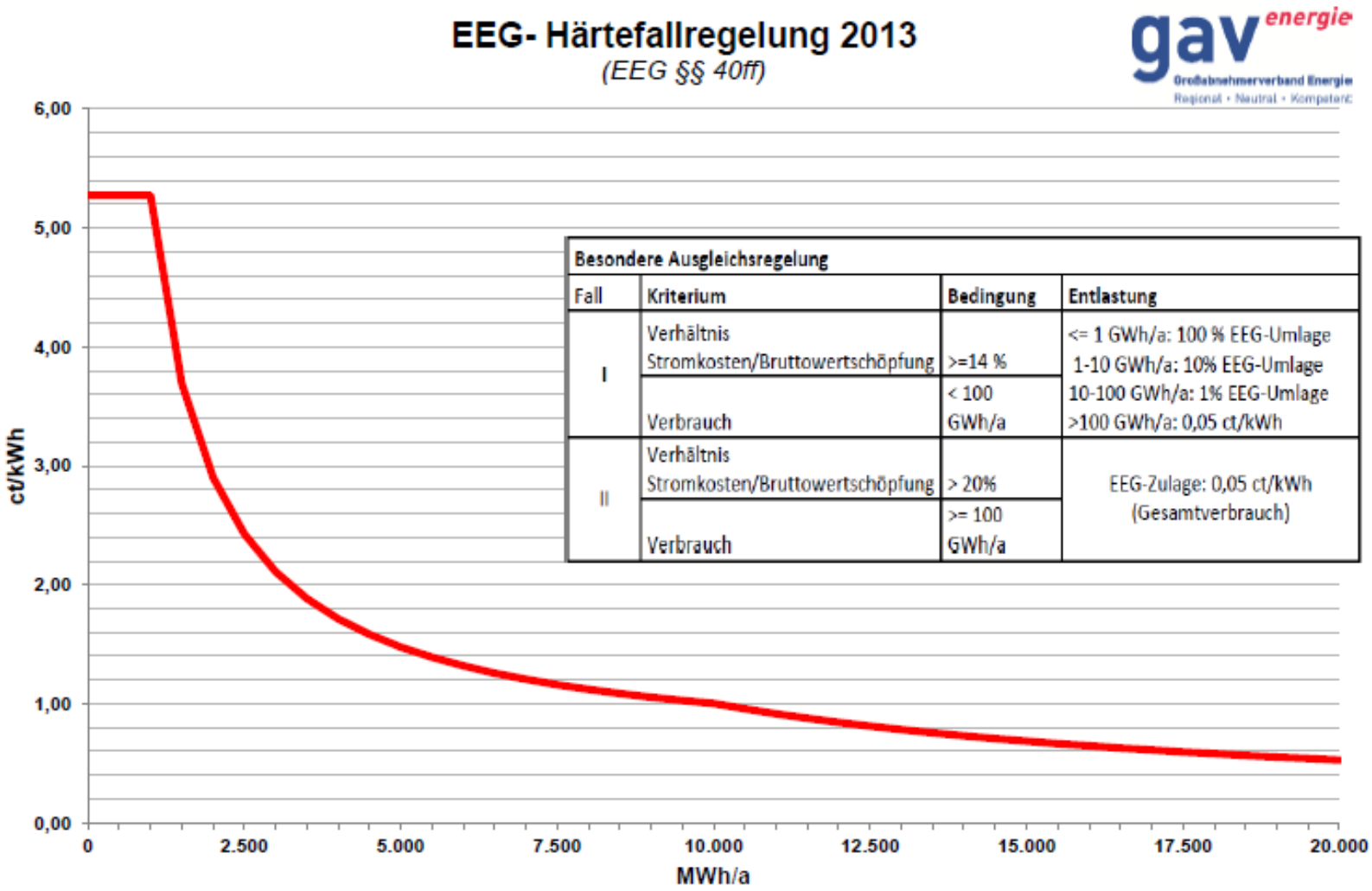

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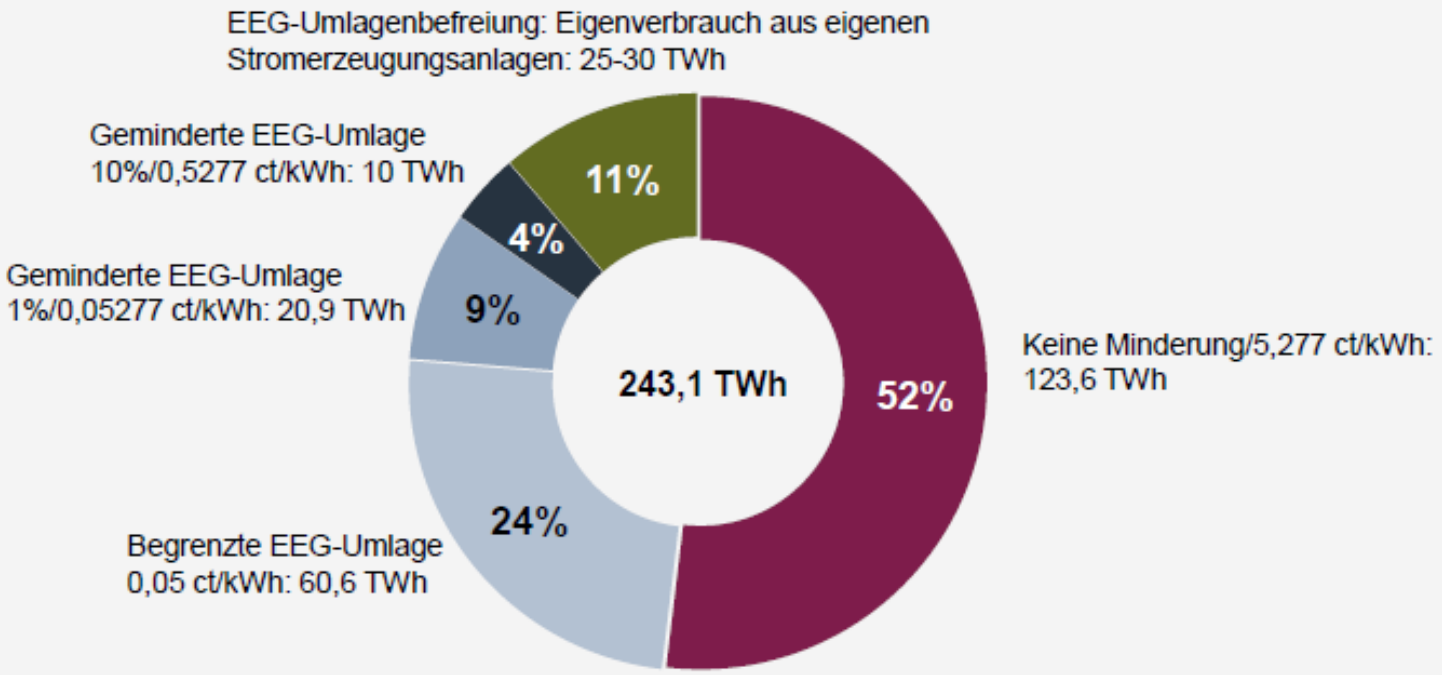
State-induced burdens – Reliefs for the industry

Industriestromverbrauch 2013 gemäß Prognose zur EEG-Umlage 2013: **243,1 TWh**



- **Volle EEG-Umlage für mehr als die Hälfte des Industriestromverbrauchs!**
- **Ohne Besondere Ausgleichsregelung nach §40 EEG 2012 läge die EEG-Umlage 2013 bei 4,23 ct/kWh bzw. um1,05 ct/kWh niedriger.**

Quelle: BDEW

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Preservation of Germany‘s industrial competitiveness

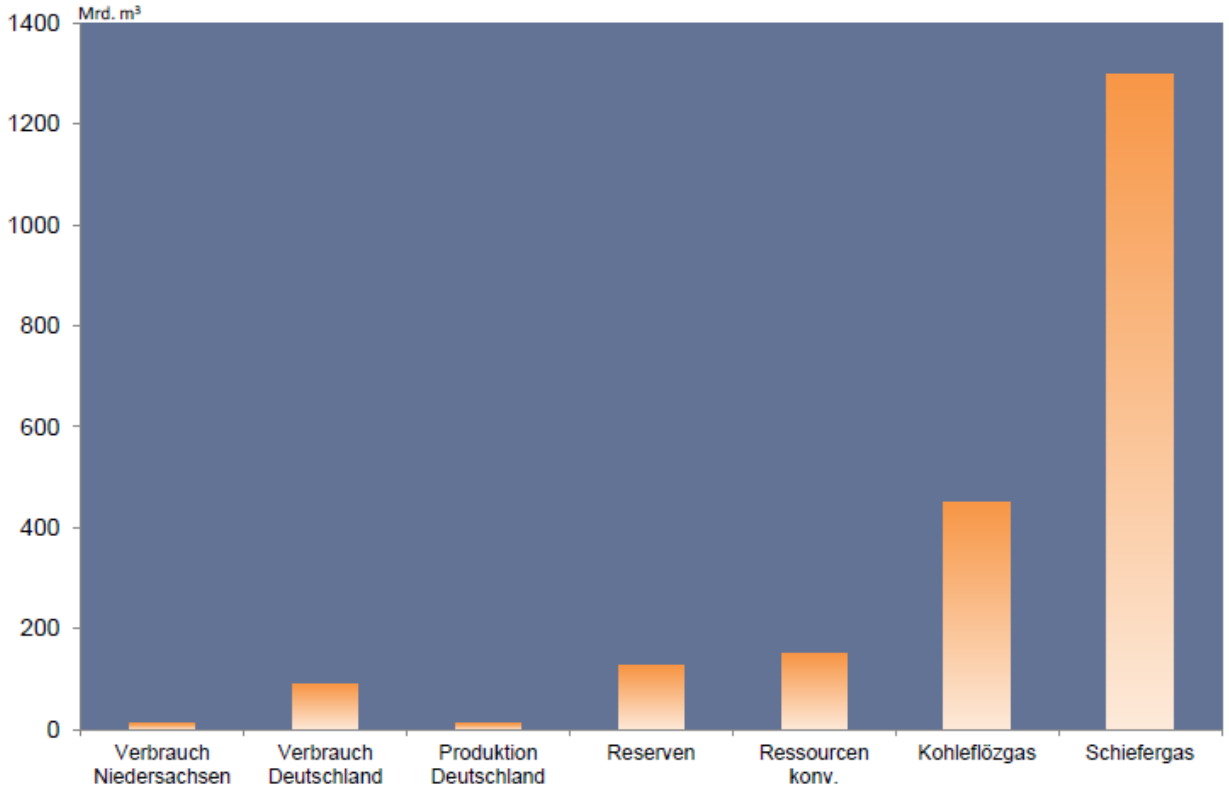
- If there would not be any reliefs, the burdens would rise exorbitantly:

Annual burden for energy intensive companies in Mio. Euro			
Unternehmen	Current EEG-burden	EEG-burden without relief	Increase by factor
Steel producer	80 Mio. Euro	260 Mio. Euro	4
Energieintensive Grundstoffproduktion (1.250 Mio. kWh/Jahr)	715.000 Euro	62,5 Mio. Euro	87
Mittelständisches Papierunternehmen (250 Mio. kWh/Jahr)	125.000 Euro	12,5 Mio. Euro	100

Unconventional gas – Germany

- Estimate by the BGR for Germany: 1.300 Mrd. cbm (covers the annual supply for decades)

Erdgasverbrauch 2011	**86 Mrd. cbm**
Erdgasproduktion in Deutschland 2011	**12 Mrd. cbm**
Reserven (Ende 2011)	**25 Mrd. cbm**
Ressourcen konventionell/TightGas	**150 Mrd. cbm**
Ressourcen Kohleflözgas	**450 Mrd. cbm**
Ressourcen Schiefergas	**1300 Mrd. cbm (Median)**



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Quelle: WEG 2012, BGR 2012.

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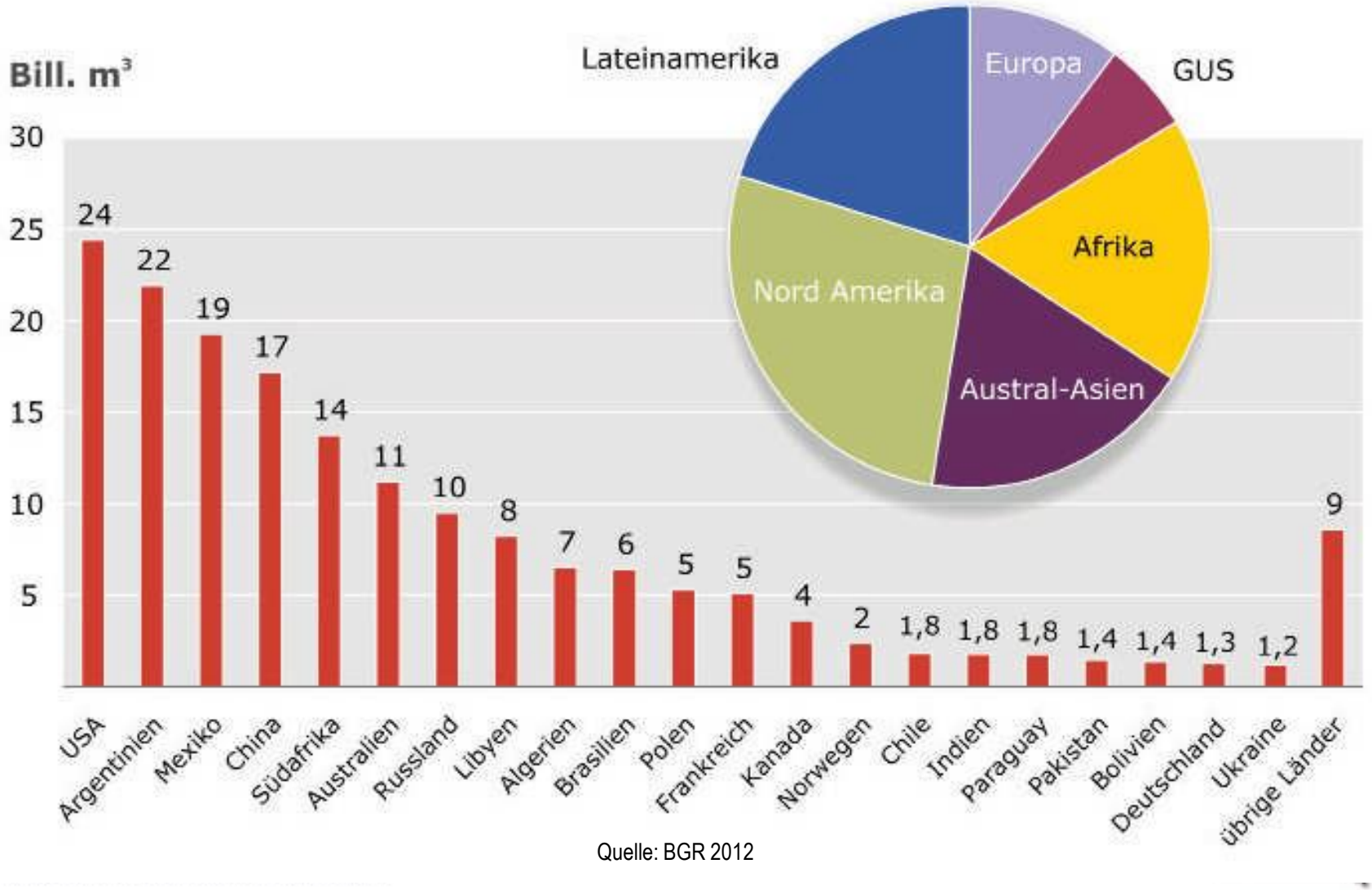
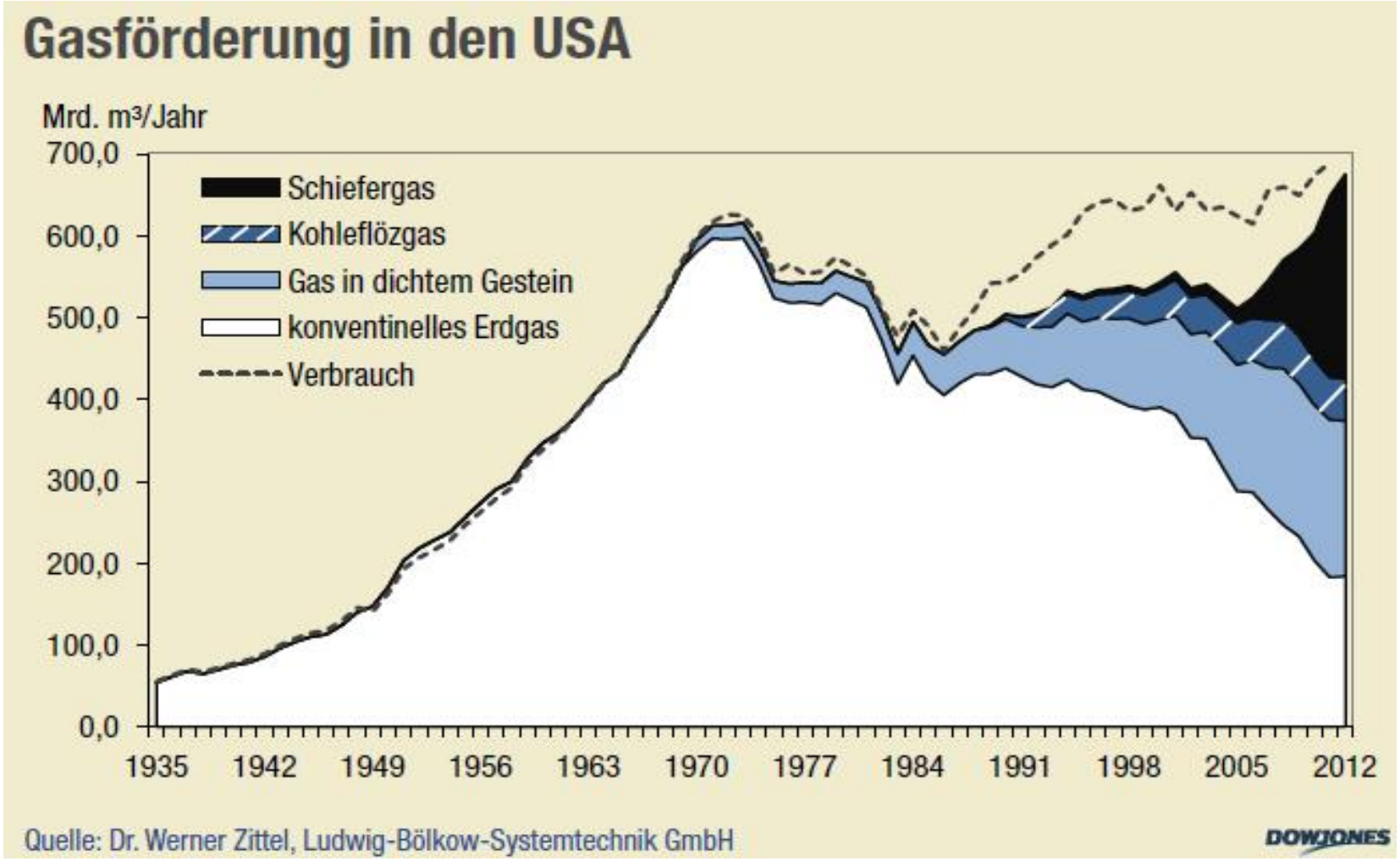
Unkonventional gas – global



Quelle: BGR 2012

Development of gas in the US



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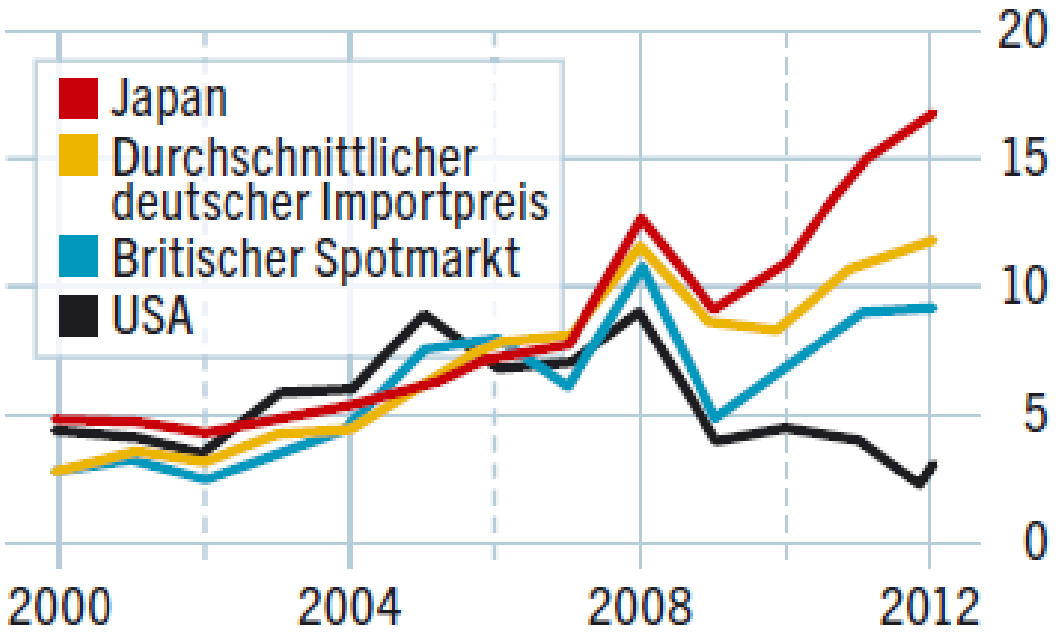
Development of the gas price

Vorteil Amerika

Entwicklung der globalen Gaspreise (in Dollar je Million British Thermal Unit – BTU[1])



[1] entspricht 26,4 Kubikmeter Gas;
Quelle: BP, ICIS Heren

Wirtschafts Woche

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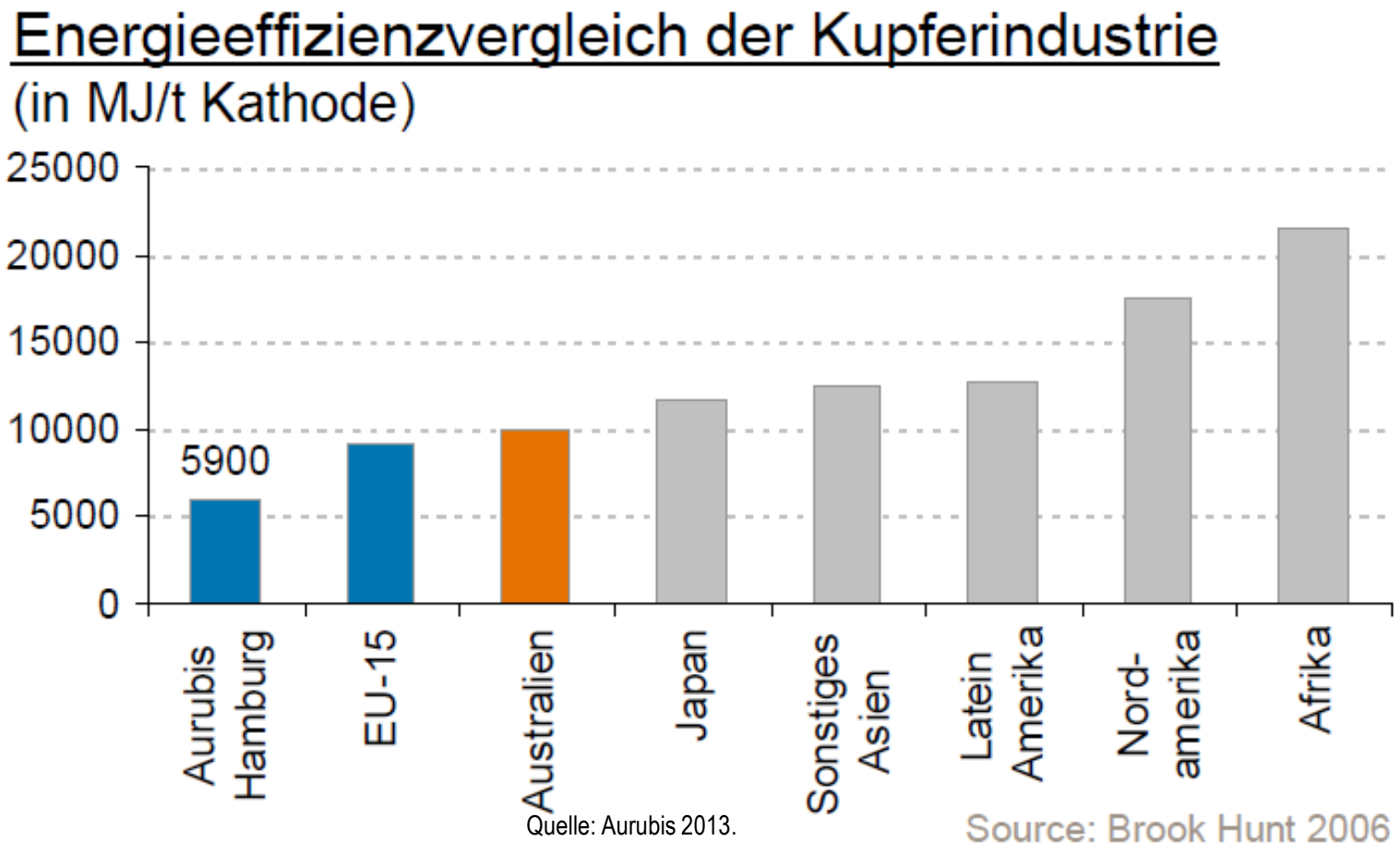
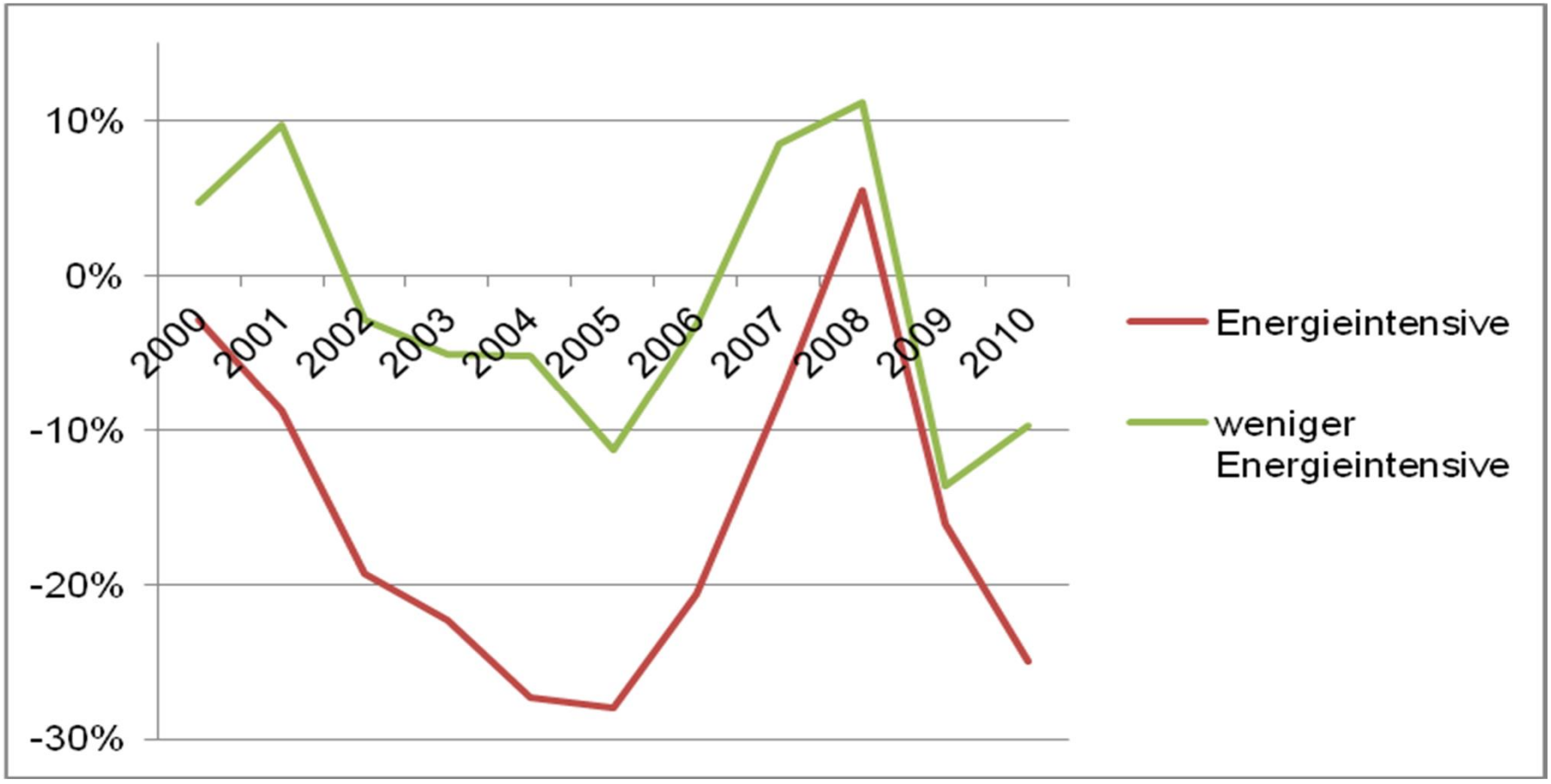
Energy efficiency



Quelle: Aurubis 2013.

Energy intensive industry – Decrease of investment

Development of Investment – Net investment in per cent of gross investment



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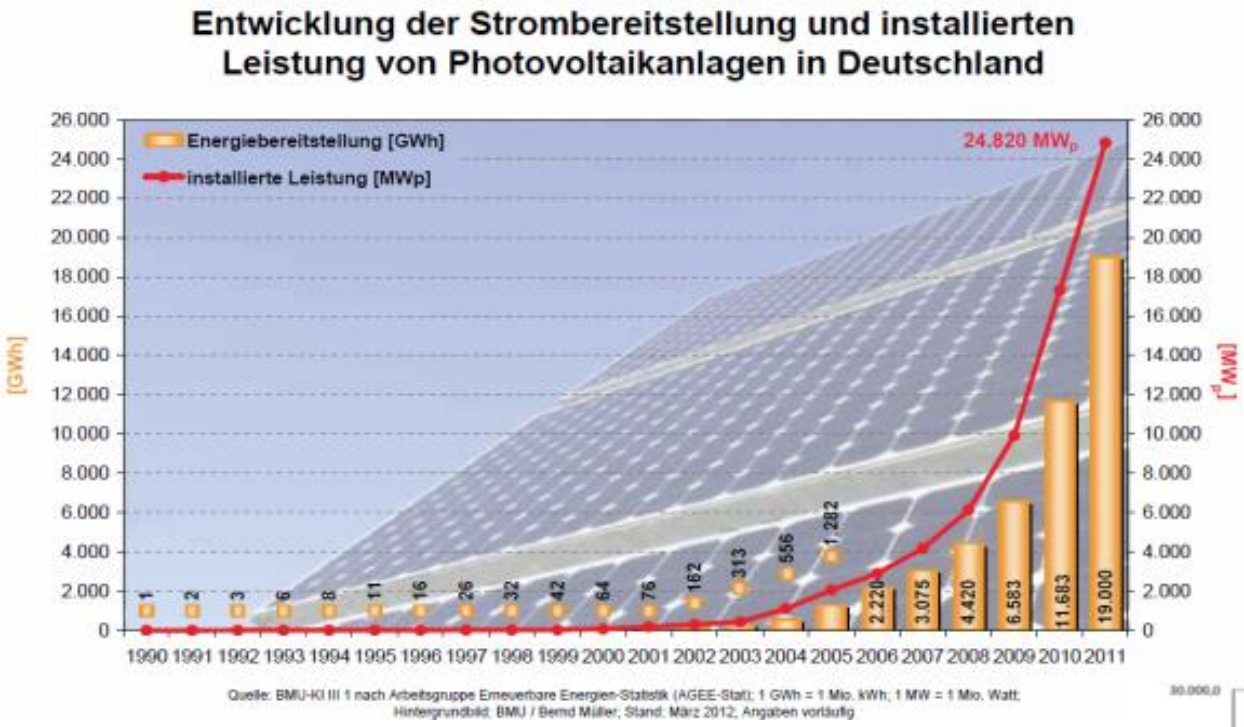
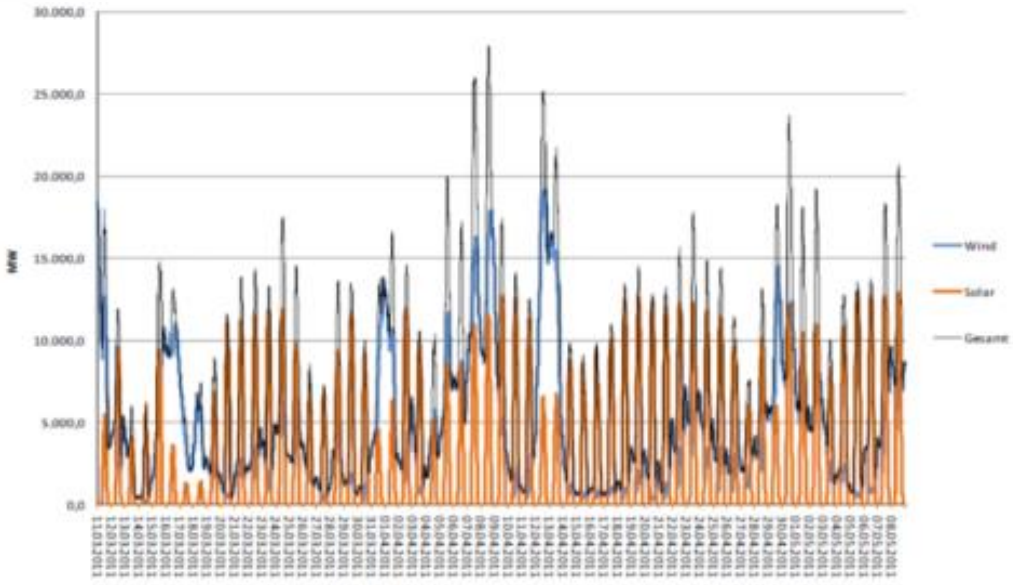
Quelle: IW Köln 2013.

Challenge: Supply security and grid stability





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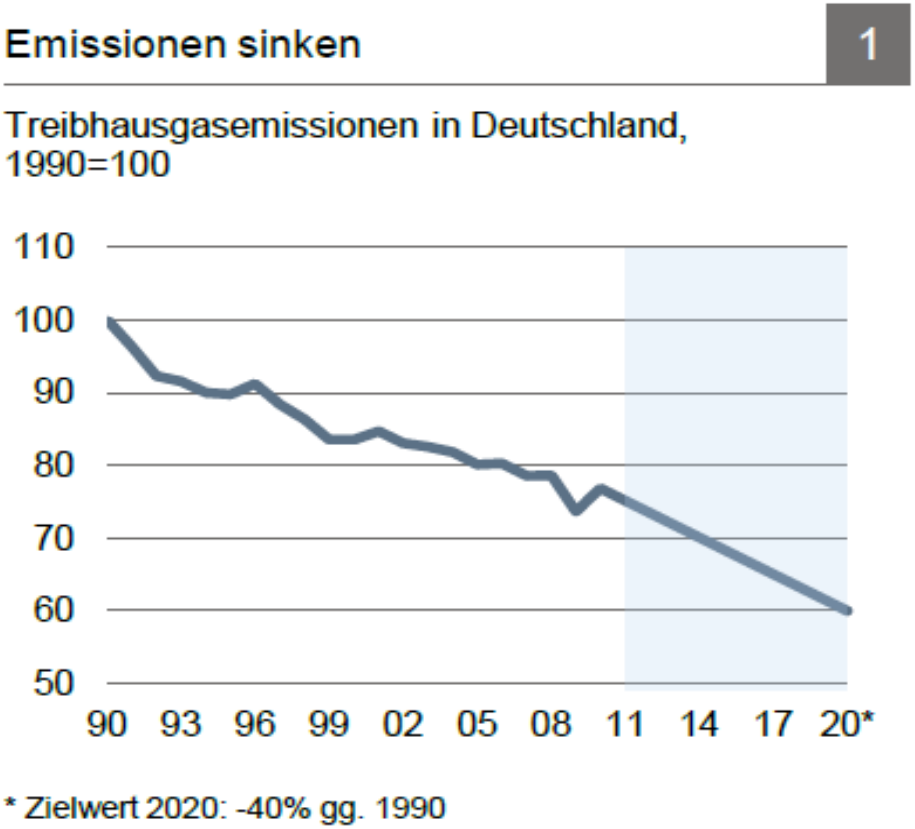
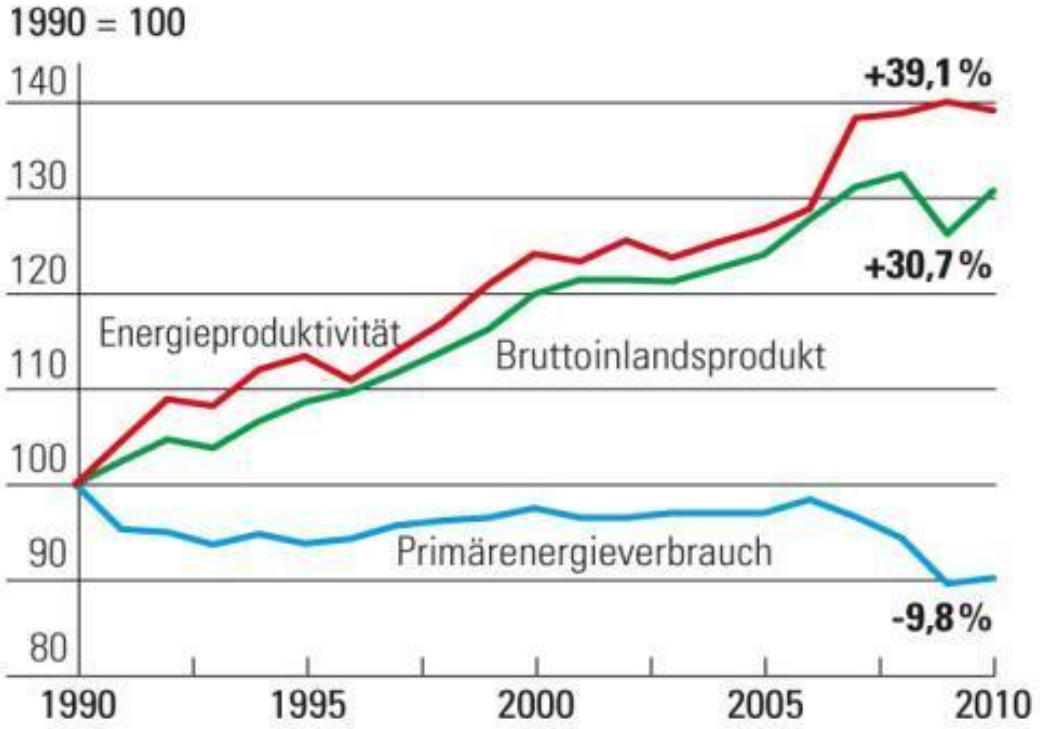
Klima

Economic growth and decreasing emissions



Wirtschaftliche Entwicklung seit 1990



Quelle: BMU/DB Research 2012)

Netz- und Speicherausbau

Netzentwicklungsplan 2012 – Leitszenario B 2022

- NEP: Grundlage für einen Bundesbedarfsplan und damit die wesentliche Grundlage, um den Netzausbau weiter voranzutreiben

Optimierung in bestehenden Trassen: 4.400 km

- AC-Neubau in Bestandstrassen: 2.800 km
- AC-Verstärkungen und AC-Stromkreisauflagen auf Bestandstrassen: 1.300 km
- DC-Stromkreisauflage: 300 km

Netzausbau in neuen Trassen: 3.800 km

- AC-Trassenneubau: 1.700 km
- 4 DC-Korridore:
  - Übertragungsleistung: 10 GW
- DC-Trassenneubau: 2.100 km

Geschätzte Investitionen: 20 Mrd. Euro

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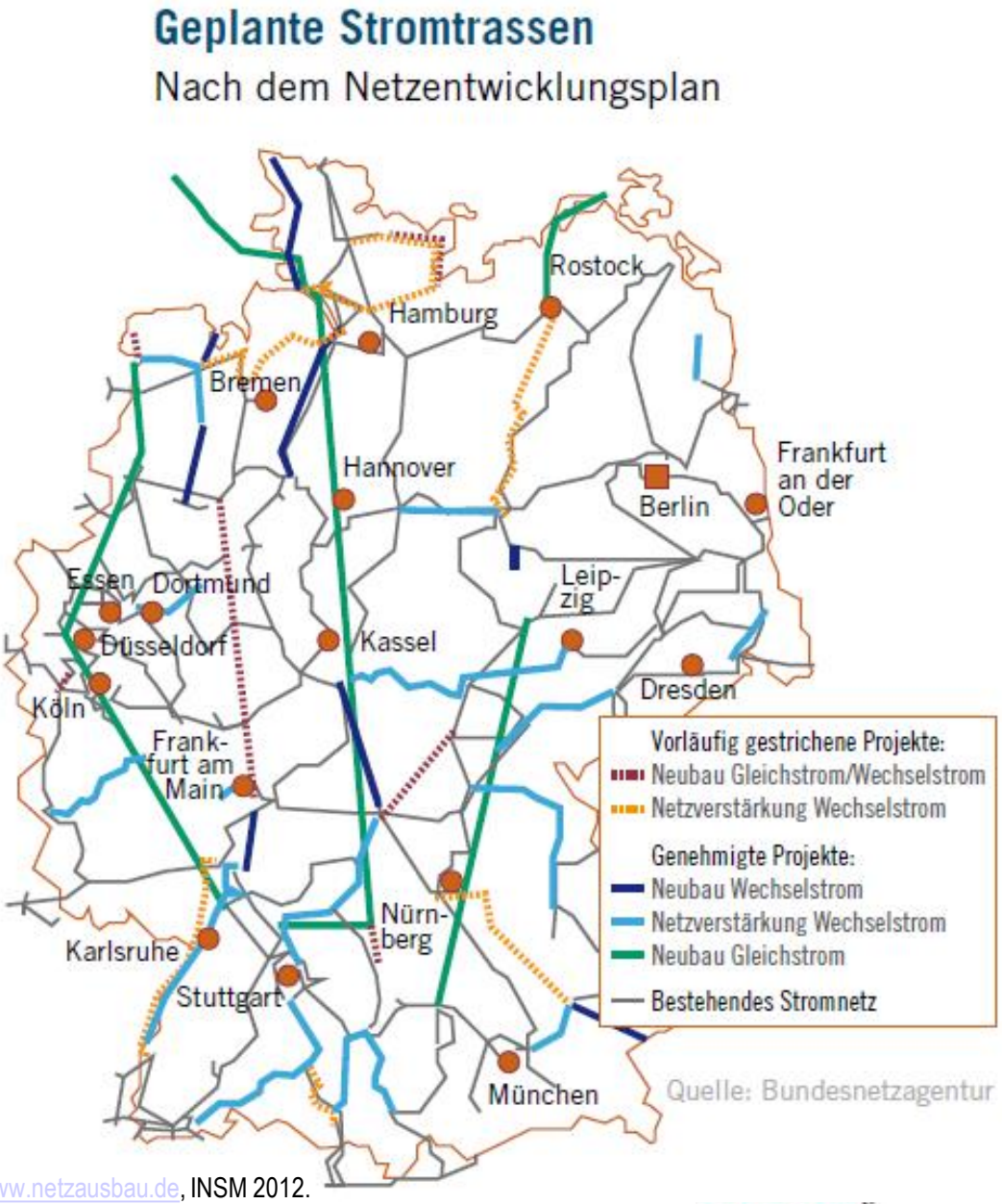
Bundesbedarfsplangesetz – Prüfung des NEP durch BNetzA

- **BNetzA bestätigt 51 der 74** durch die ÜNB vorschgeschlagenen **Maßnahmen**
- Optimierung und Verstärkung der bestehenden Trassen: **2.900 km**
- Netzausbau in neuen Trassen: **2.800 km**
- Zeitliche Priorisierung der notwendigen Maßnahmen durch den Entwurf des Bundesbedarfsplans



Quelle: www.netzausbau.de, INSM 2012.

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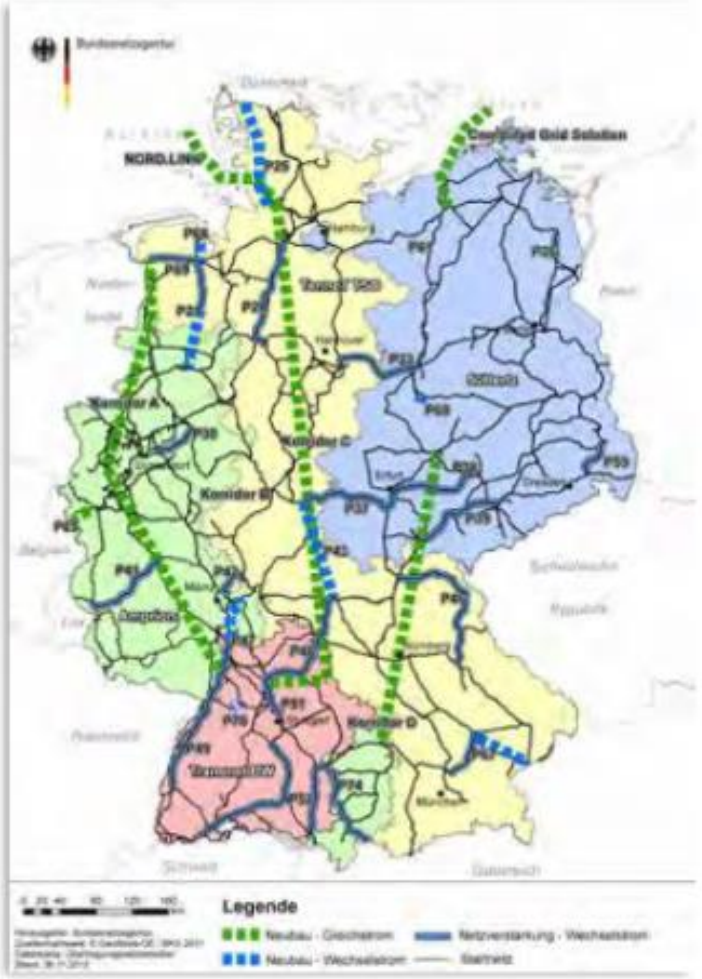
Netzentwicklungsplan und Bundesbedarfsplangesetz



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Quelle:
www.netzausbau.de

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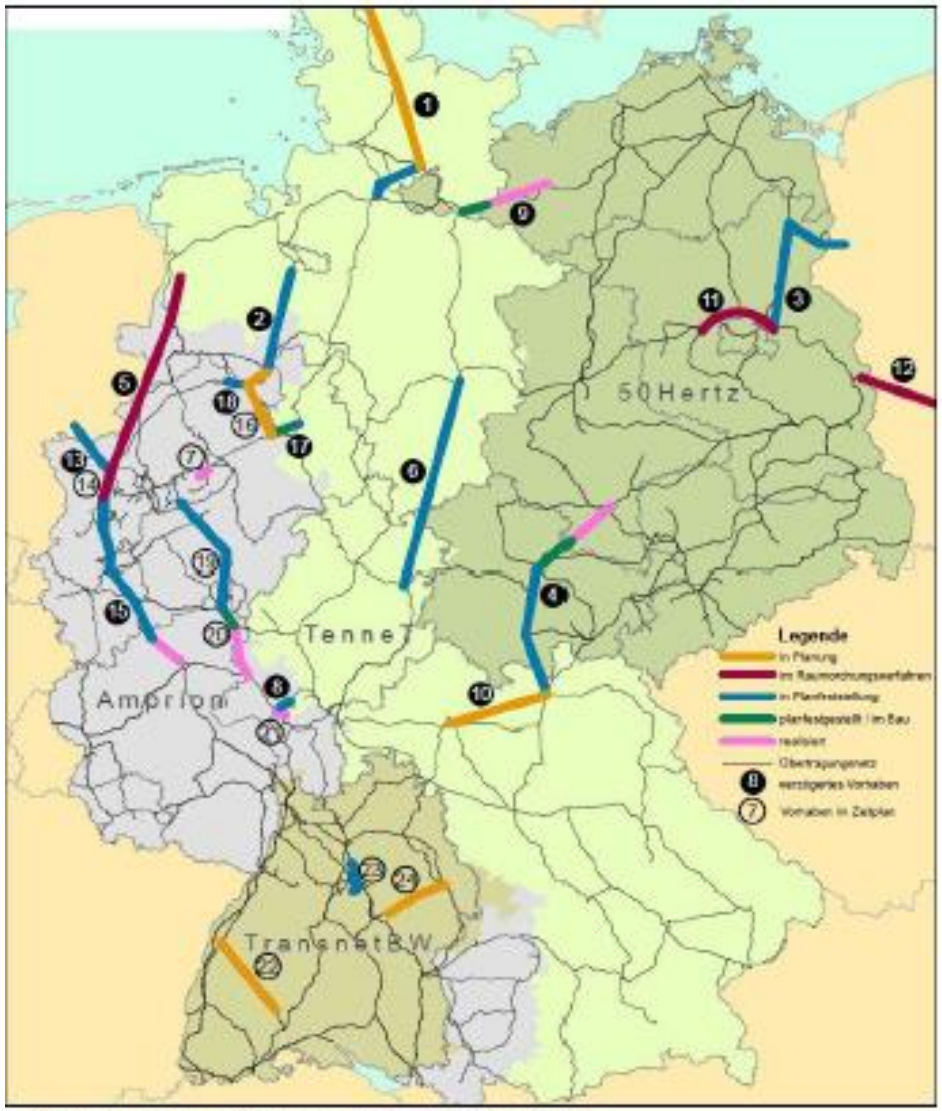
Herausforderung Netzausbau – Bestandsaufnahme



Quelle: Bundesnetzagentur, Stand August 2012

- **Stand August 2012: 214 km (ca. 12 %) der 1.834 km der 24 EnLAG-Leitungen realisiert.**
- 2 Trassen bereits realisiert und in Betrieb, 4 in Teilabschnitten fertig gestellt.
- 16 Vorhaben in unterschiedlichen Stadien der Genehmigungsverfahren
- ÜNB erwarten die Fertigstellung der ersten Hälfte der Leitungsvorhaben bis 2016 (963 km von 1834 km).
- **15 der 24 Vorhaben im Zeitverzug, Verzögerung zwischen 1 - 5 Jahren!**

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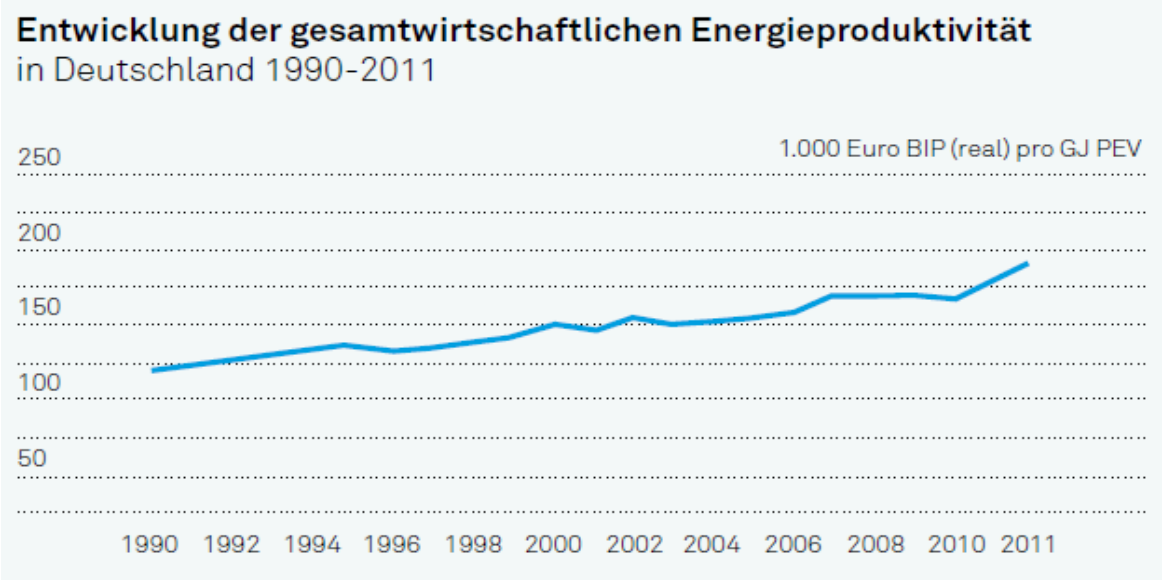
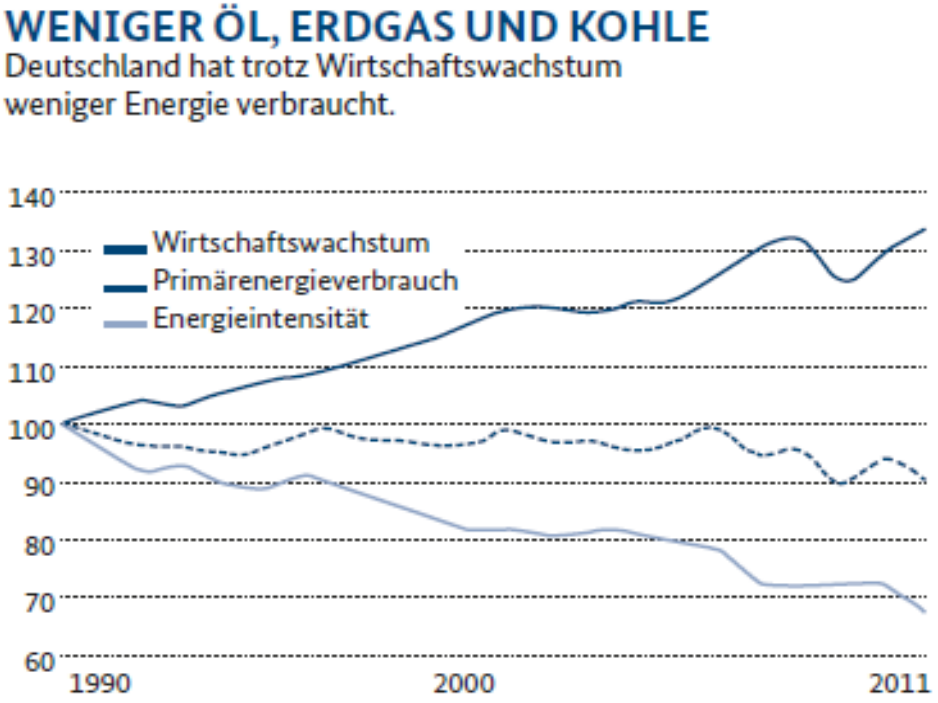
Energieeffizienz

Entwicklung der Energieproduktivität in Deutschland

1990 = 100





Quelle: AG Energiebilanzen, BMWi, 2012

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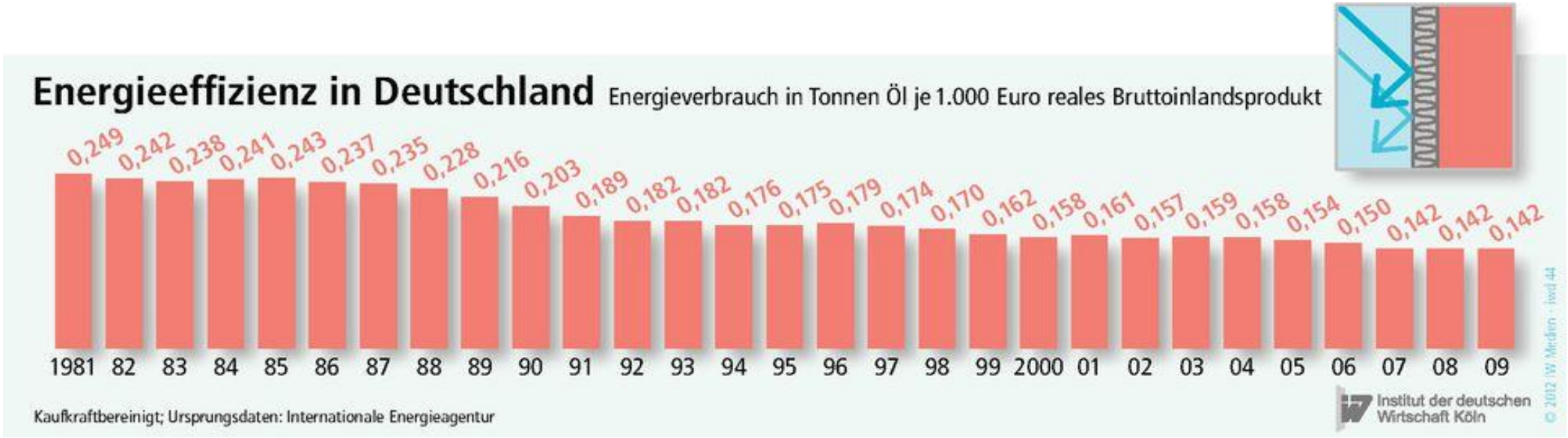
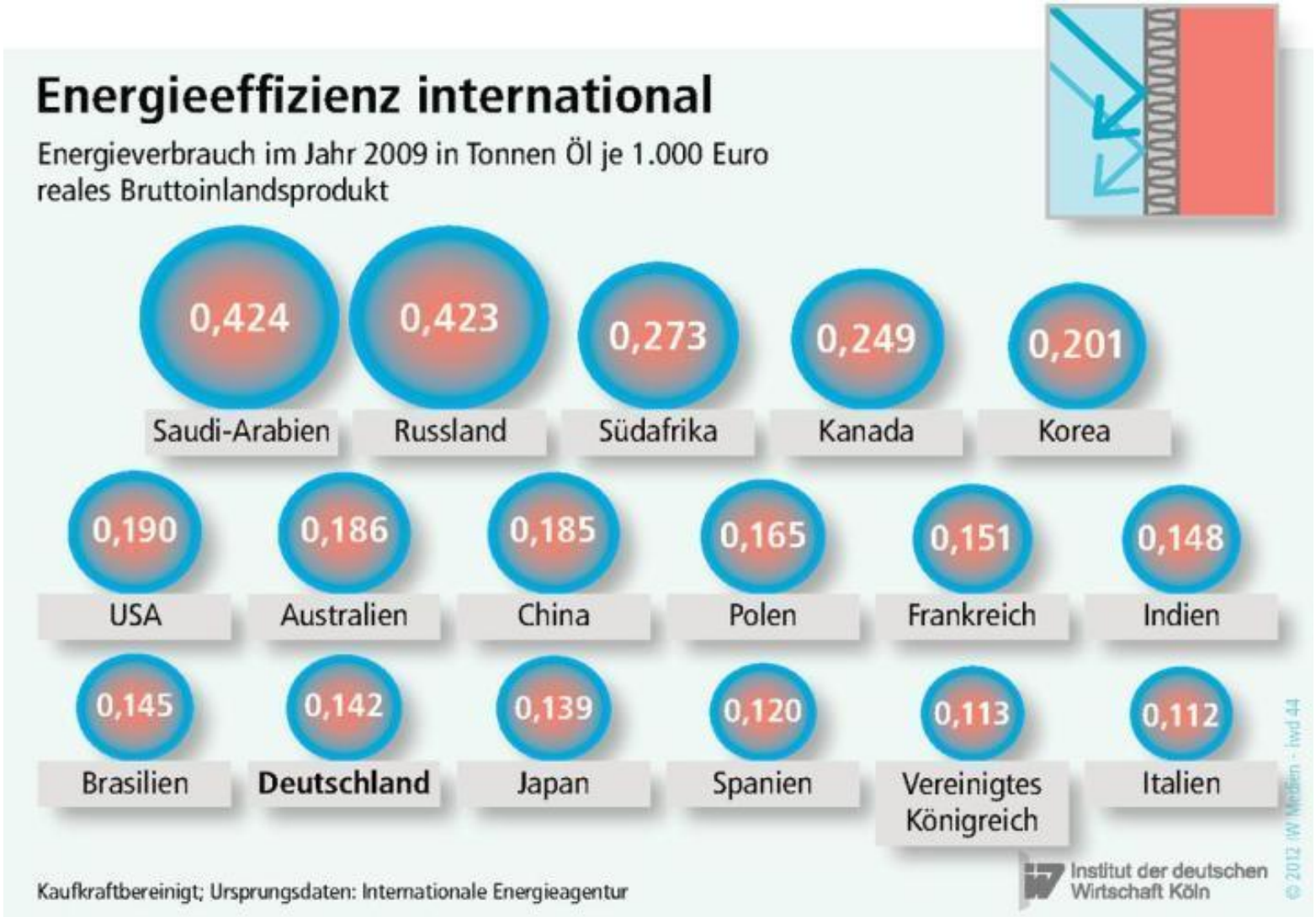
Entwicklung der Energieeffizienz Deutschland

- Der Energieverbrauch wurde vom Wirtschaftswachstum entkoppelt

- Heute benötigt man hierzulande, nur halb so viel Energie um eine Einheit BIP herzustellen wie vor 30 Jahren.



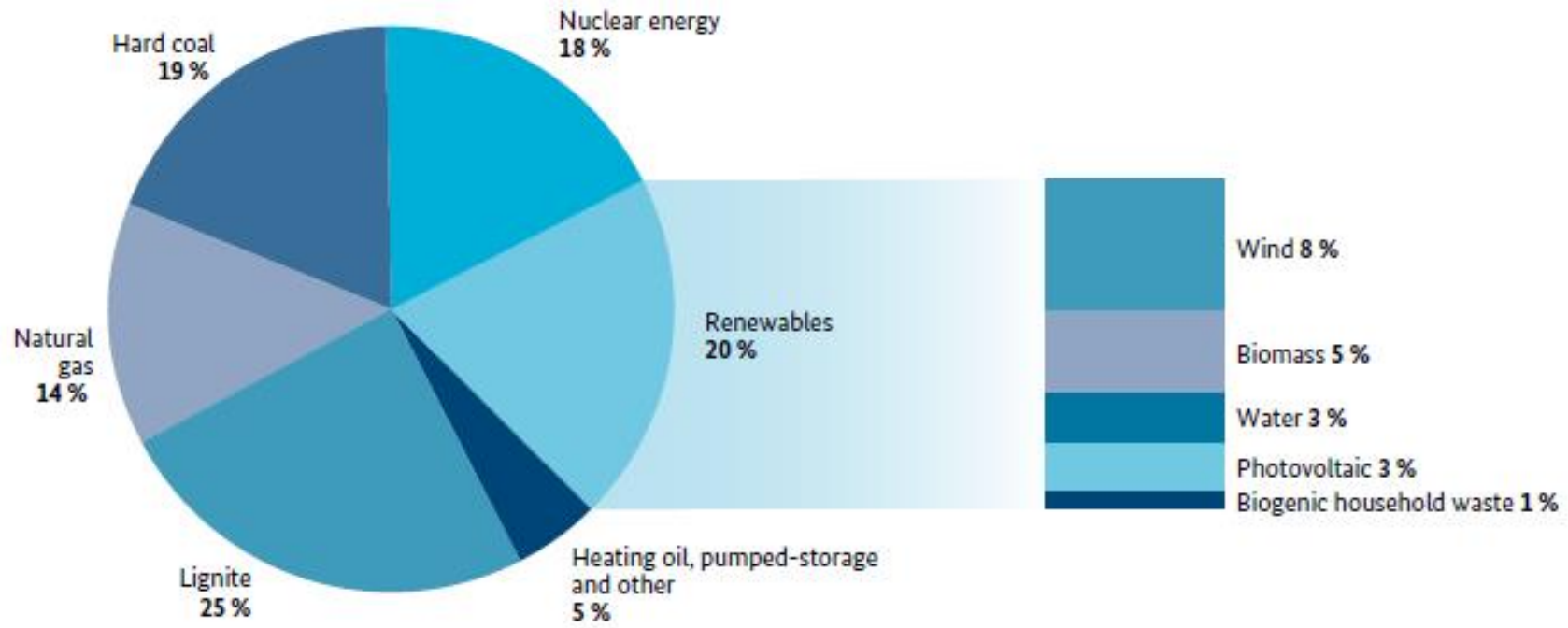
Energieeffizienz im internationalen Vergleich



Erneuerbare Energien

The Transformation of the Energy System

Figure 1: Gross power production in Germany in 2011 (612 TWh)*



* Provisional figures (as at 14.12.2011), estimated in some cases. Totals deviate due to rounding.

Sources: Working Group on Energy Balances (AGEB), German Energy and Water Industry Association (BDEW)

Quelle: BMU 2012.

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Offshore-Wind – Eckpfeiler des zukünftigen Enerigemixes

- Offshore-Wind ist beinahe grundlastfähig
- Offshore-Wind weht mit 9-10,5 m/s stärker und konstanter als Onshore-Wind (5-7 m/s)
- Vergleich der Volllaststunden bei erneuerbaren Energien:
  - Offshore-Wind: rd. 4500 Std./Jahr
  - Onshore-Wind: rd. 2600 Std./Jahr
  - Photovoltaik: rd. 1000 Std./Jahr

1 Offshore-Turbine (6 MW)	=	3,5 große Onshore-Turbinen (je 3 MW)	=	216.000 - 270.000m² Photovoltaik* (30-38 x Rasenfläche des Berliner Olympiastadion)

Offshore: 1 * 6 MW*4.500h/a=~27.000 MWh
Onshore: 3,5 * 3 MW*2.600h/a=~27.000 MWh
PV: 0,1 MWh/(m²*a) * 270.000m²=~27.000 MWh (Dach)
PV: 0,125 MWh/(m²*a) * 216.000 m =~27.000 MWh(Freifläche)

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Offshore-Anbindung – Nordsee

In Betrieb
Im Bau

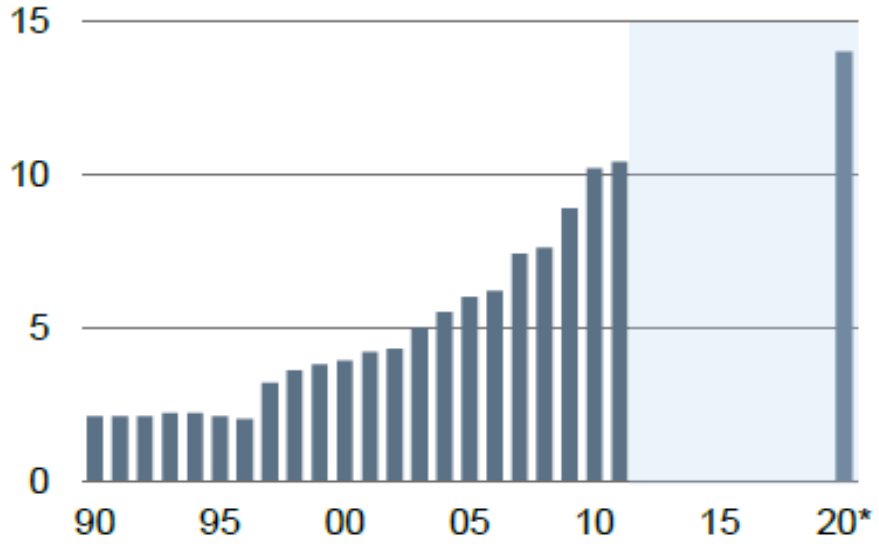
Projekt	MW
alpha ventus	60 MW
BorWin1	400 MW
BorWin2	800 MW
DolWin1	800 MW
DolWin2	900 MW
HelWin1	576 MW
HelWin2	690 MW
SylWin1	864 MW
Riffgat	108 MW
Nordergründe	111 MW
DolWin3	900 MW
SUMME	6.209 MW

Quelle: Tennet 2013.

Entwicklung der EE im Wärmemarkt

Mehr Wärme aus Erneuerbaren 9

Anteil der erneuerbaren Energien an der Wärmebereitstellung in Deutschland, %

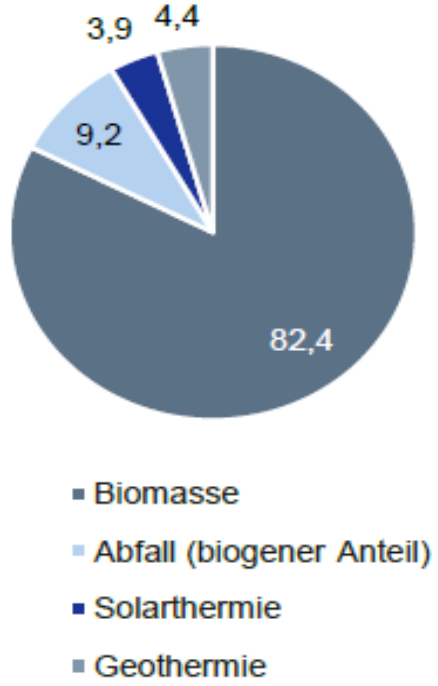


* Zielwert 2020: mindestens 14%

Quelle: BMU

Biomasse im Wärmemarkt führend 10

Anteile* an der Wärmebereitstellung aus erneuerbaren Energien in Deutschland, 2011, %



* Differenz zu 100% rundungsbedingt

Quelle: AG Energiebilanzen

Quelle: BMU/DB Research 2012)

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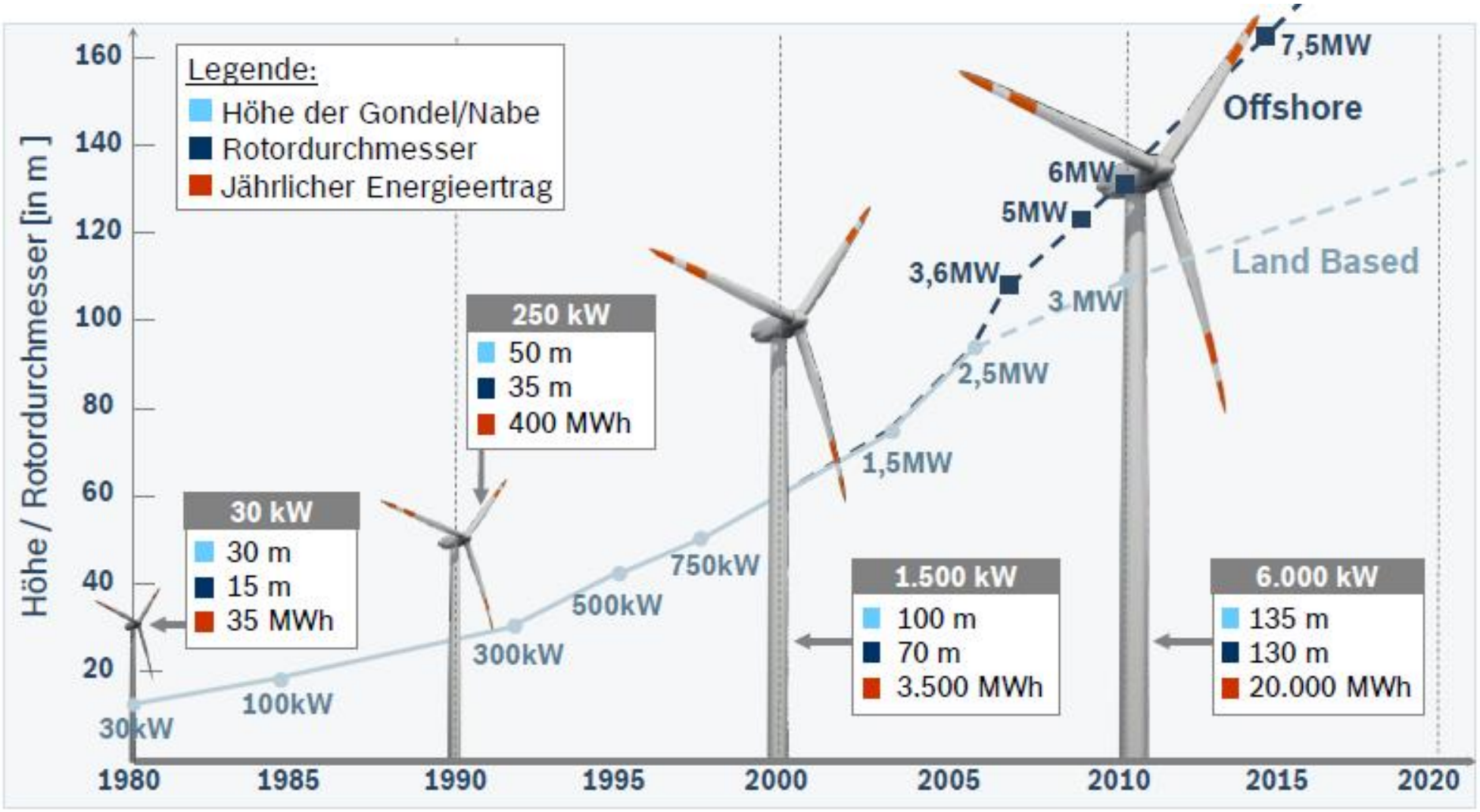
Entwicklung von kommerziellen Windenergieanlagen



Q

Quelle: Robert Bosch GmbH 2013.

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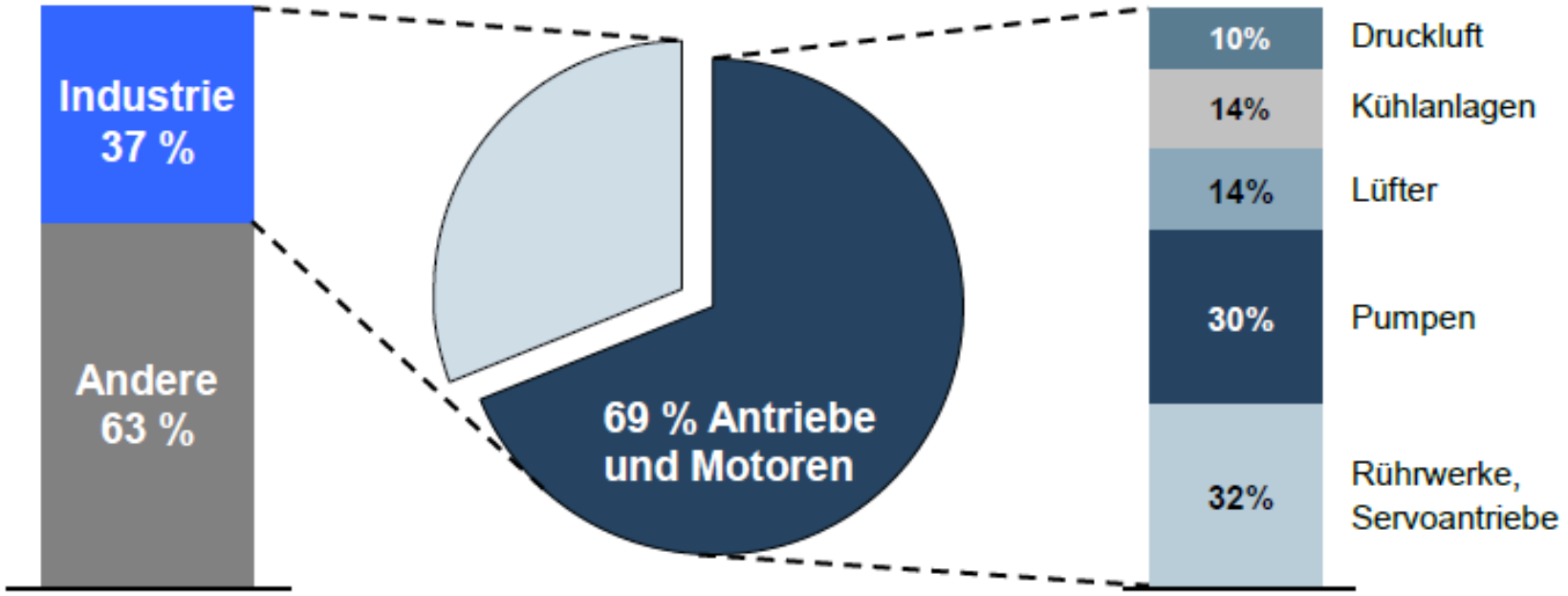
Elektrischen Antriebe im Fokus der Energieeffizienz

Stromverbrauch 2010 in der EU

Gesamt	Industrie	Antriebe und Motoren
2.837 TWh*	1.050 TWh*	724 TWh*
$1.189 \cdot 10^6$ t CO_2**	$440 \cdot 10^6$ t CO_2**	$303 \cdot 10^6$ t CO_2**



Quelle: Robert Bosch GmbH 2013.

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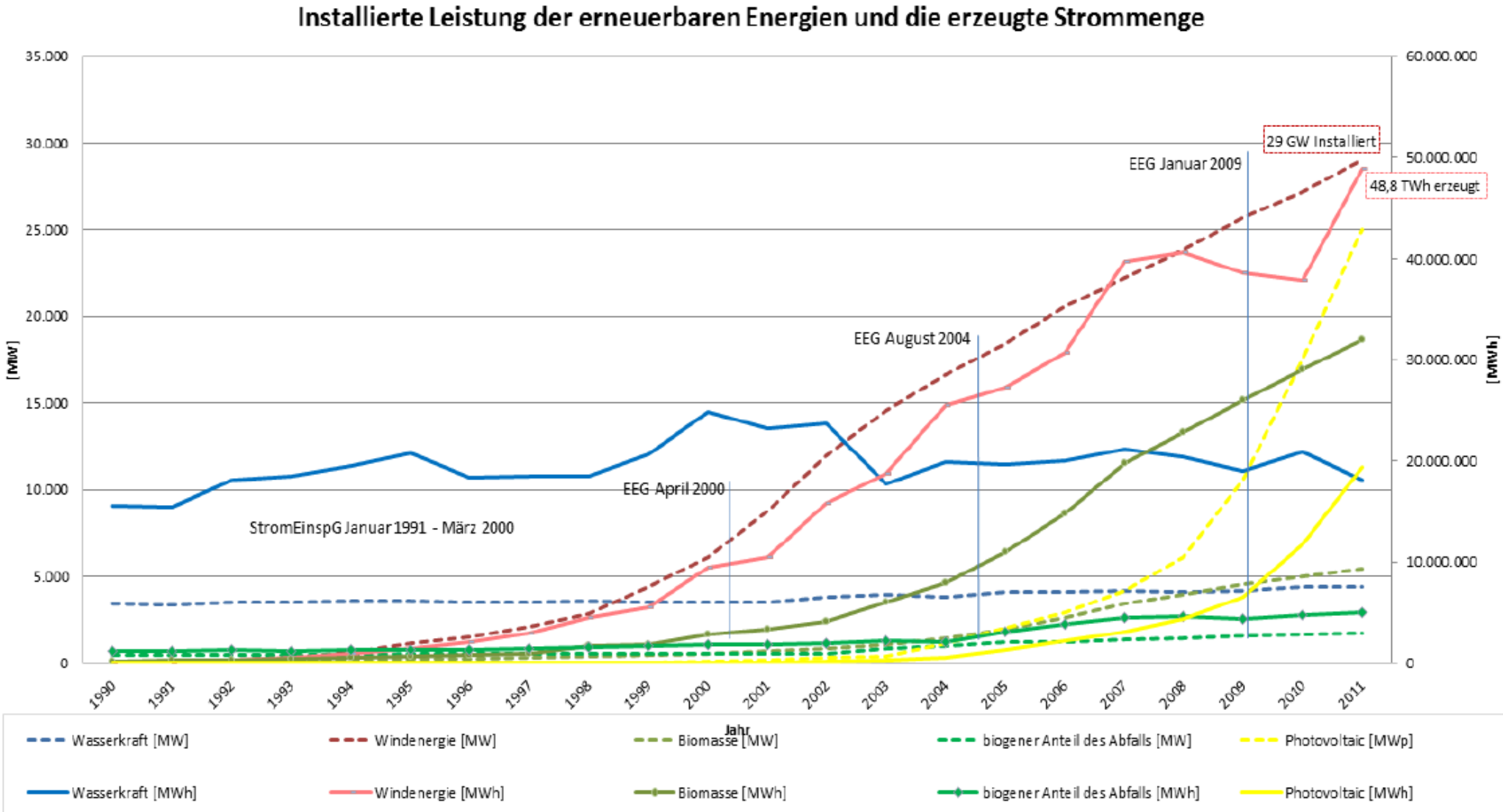
Erneuerbare Energien - erzeugte Energie und installierte Anlagenleistung – Stand 2012



Quelle: Biogasrat 2013.

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Konventionelle Kraftwerke

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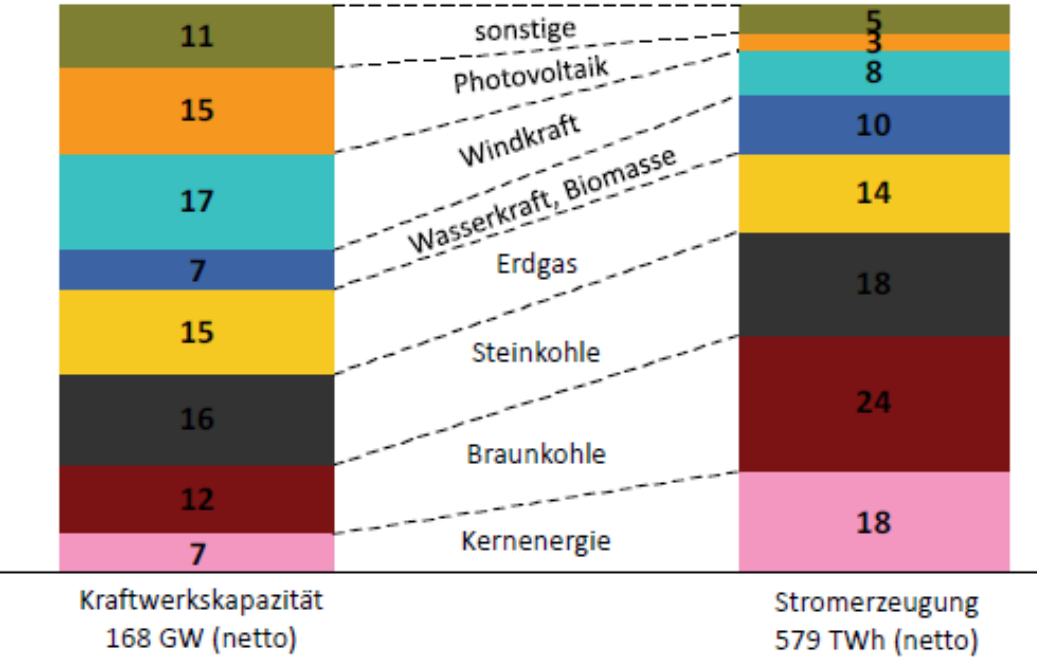
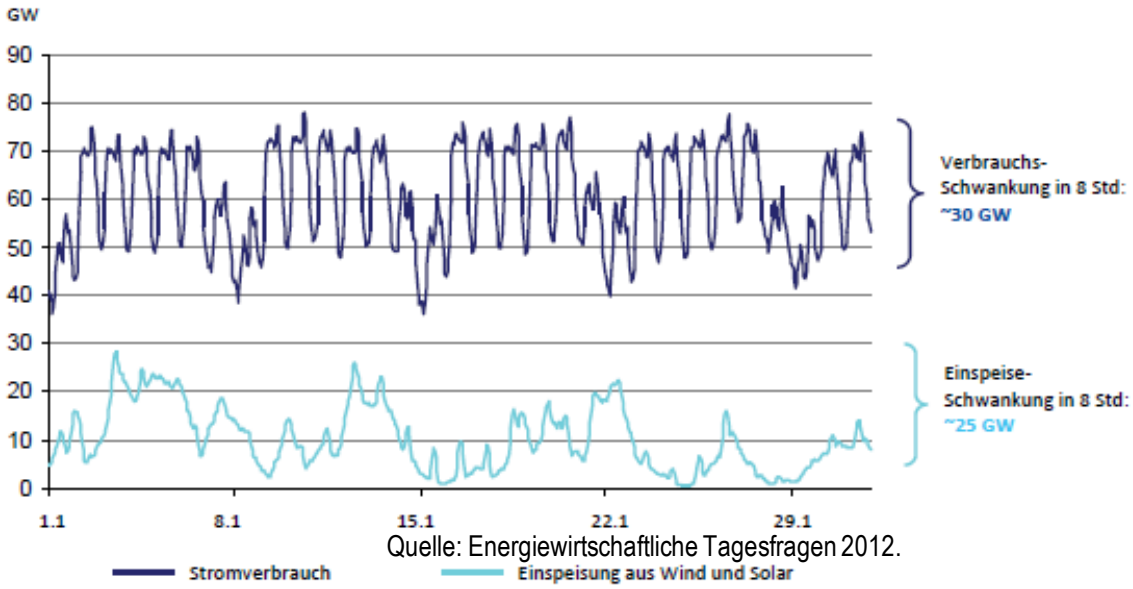
Flexibilität moderner Gaskraftwerke

- Angebotsvolatilität: Erhöhte Schwankungen auf der Einspeiseseite durch EE

Kraftwerkskapazität und Netto-Stromerzeugung 2011



Schwankungen Stromverbrauch und Stromeinspeisung Januar 2012



Quelle: Energiewirtschaftliche Tagesfragen 2012.

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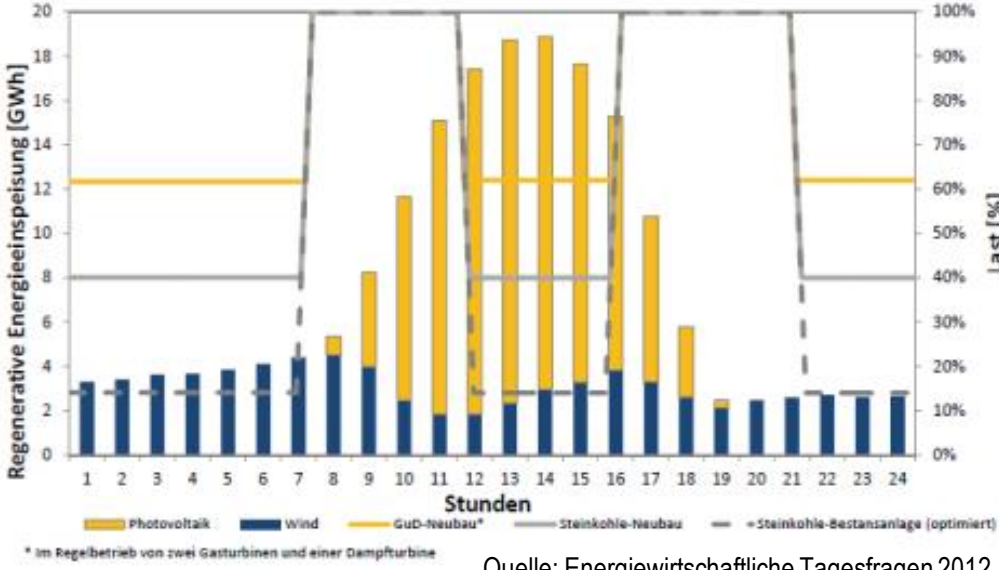
Flexibilität moderner Gaskraftwerke

- Kurzfristiger, flexibler Betrieb von Gaskraftwerke erhöht Versorgungssicherheit

Regenerative Enereieinspeisung und Flexibilitätsdarstellung von Kohle- und Gaskraftwerken im Regelbetrieb



Quelle: Energiewirtschaftliche Tagesfragen 2012.

Flexibilitätsparameter für Kohle- und Gaskraftwerke

Parameter	Einheit	Erdgas GuD-Neubau[1)]	Steinkohle Neubau	Braunkohle Neubau	Steinkohle Bestands-anlage (optimiert)
Leistungsklasse	MW	800	800	1 100	300
Mindestlastpunkt/ Nennlastpunkt (P_{Min}/P_{Nenn})	%	~60	~ 25 bis 40	~ 25[2)] bis 40	~ 20
Durchschnittliche Laständerungs-geschwindigkeit[4)]	%/min	~ 3,5	~ 3[3)]	~ 3	~ 3

1) Im Regelbetrieb von zwei Gasturbinen und einer Dampfturbine
2) Mindestlastpunkt von 25 % durch das BoA plus Design heute möglich, aber bislang nicht realisiert
3) Im unteren Lastbereich von 25 - 40 % gilt ein hiervon abweichender Betriebsgradient
4) Bezogen auf die Nennlast

- Auch in Zukunft ist ein breiter und flexibler Kraftwerkspark unbedingt notwendig, um die Versorgungssicherheit zu gewährleisten.

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Versorgungssicherheit

Versorgungssicherheit – Kosten eines Blackouts

- DE: Im Höchstfall liegen die Kosten eines Stromausfalls bei 750 Millionen Euro je Stunde
- Im Durchschnitt liegen die stündlichen Kosten einer Unterbrechung bei 430 Mio. Euro
- Insbesondere BW, BY und NW betroffen
- Industriesektoren mit den höchsten Unterbrechungskosten sind Fahrzeug- und Maschinenbau.

Durchschnittliche Kosten eines Stromausfalls in den verschiedenen Bundesländer

Quelle: EWI 2013.

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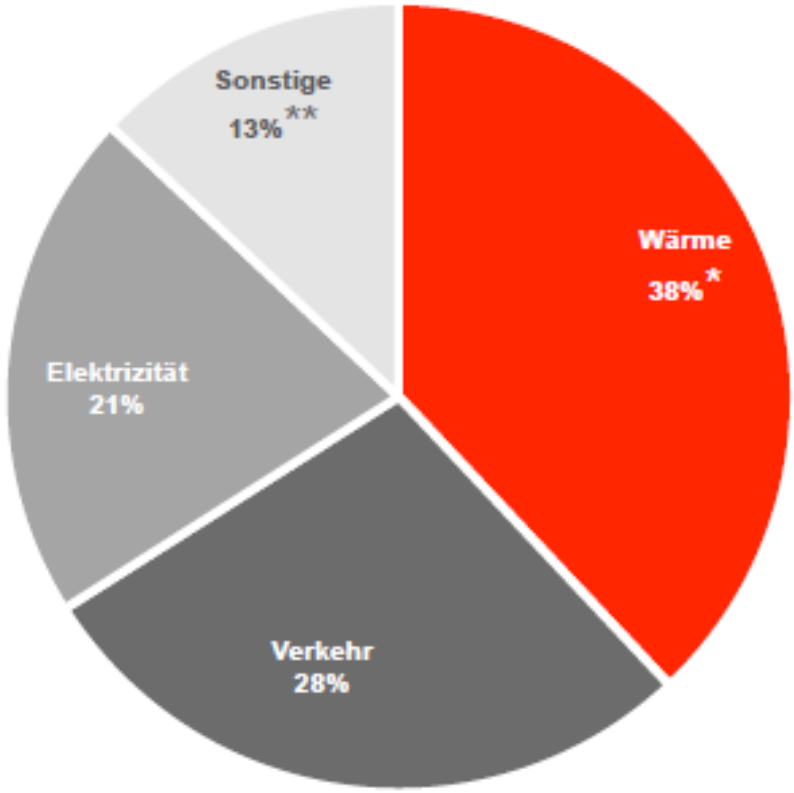
Wärmemarkt

Wärmemarkt ist der größte Energieverbraucher



Quelle: Viessmann, 2013.

* Gebäudebeheizung, Warmwasser (ohne Prozesswärme)
** insbes. industrielle Prozesse, mechanische Energie etc.

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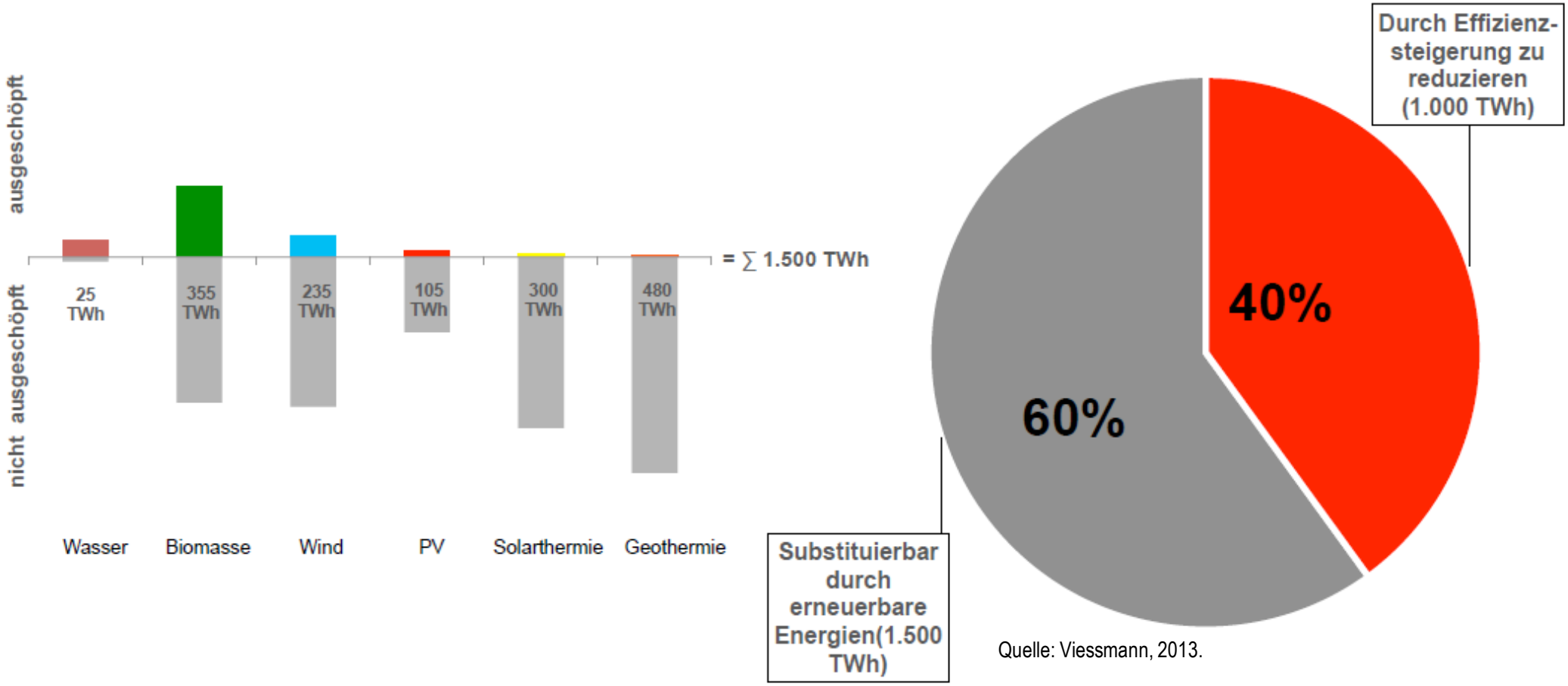
Potential erneuerbarer Energien im Wärmemarkt



Quelle: Viessmann, 2013.

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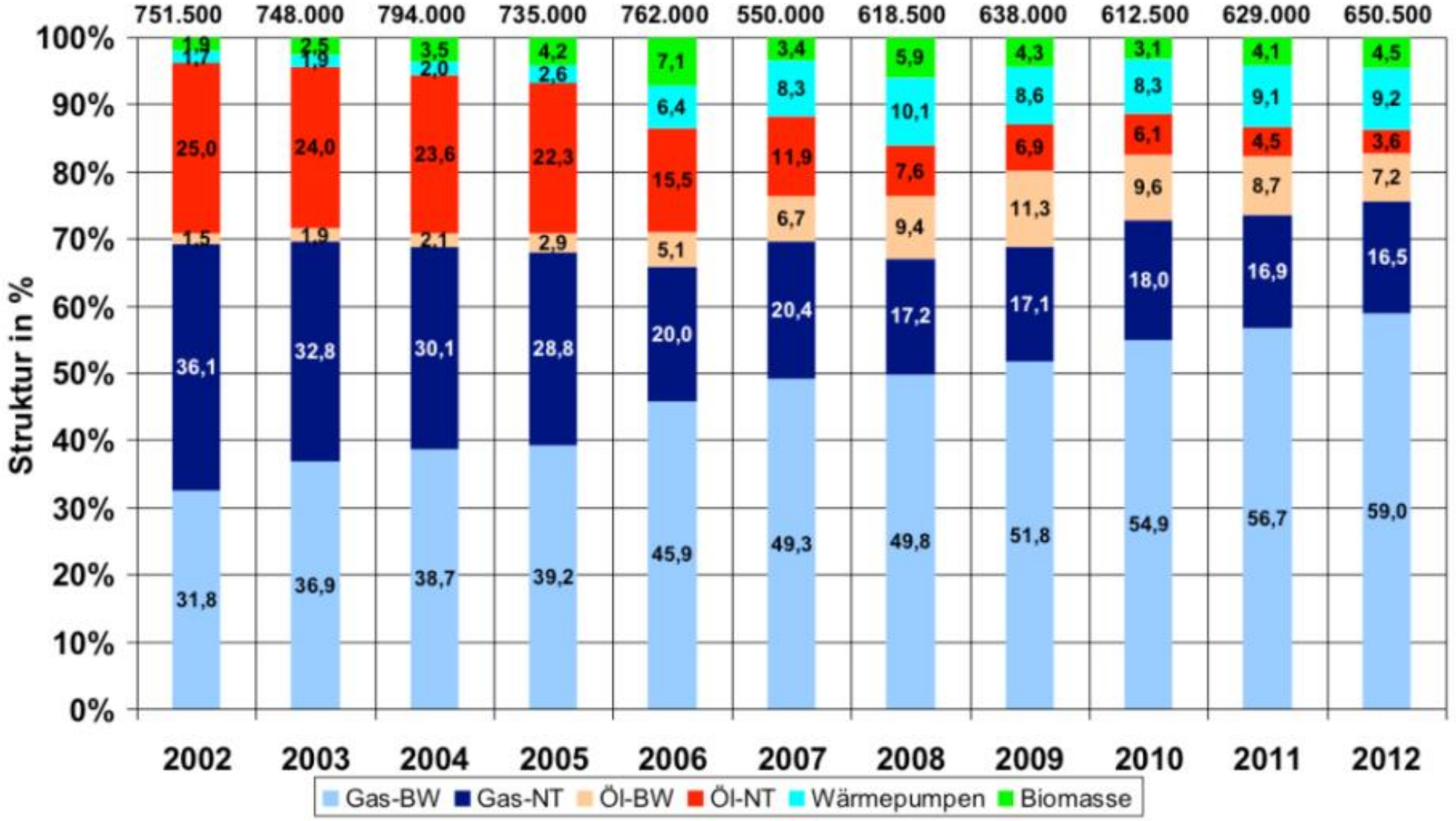
Marktentwicklung Wärmeerzeuger – 2002-2012



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Quelle: Viessmann, 2013.

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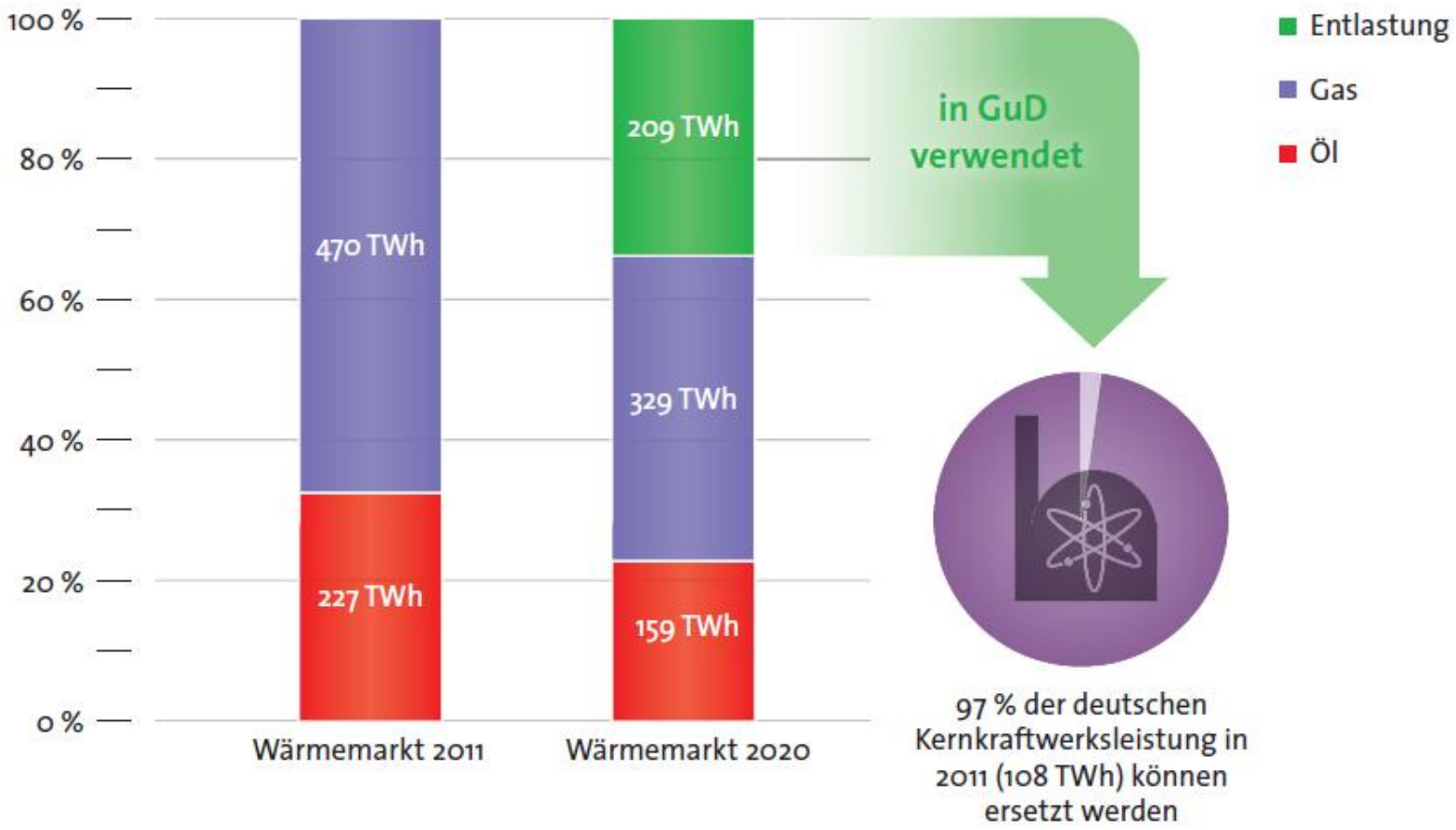
Entlastung des Stromsektors durch Einsparungen

(nur anlagentechnische Erneuerung)



Quelle: Viessmann, 2013.

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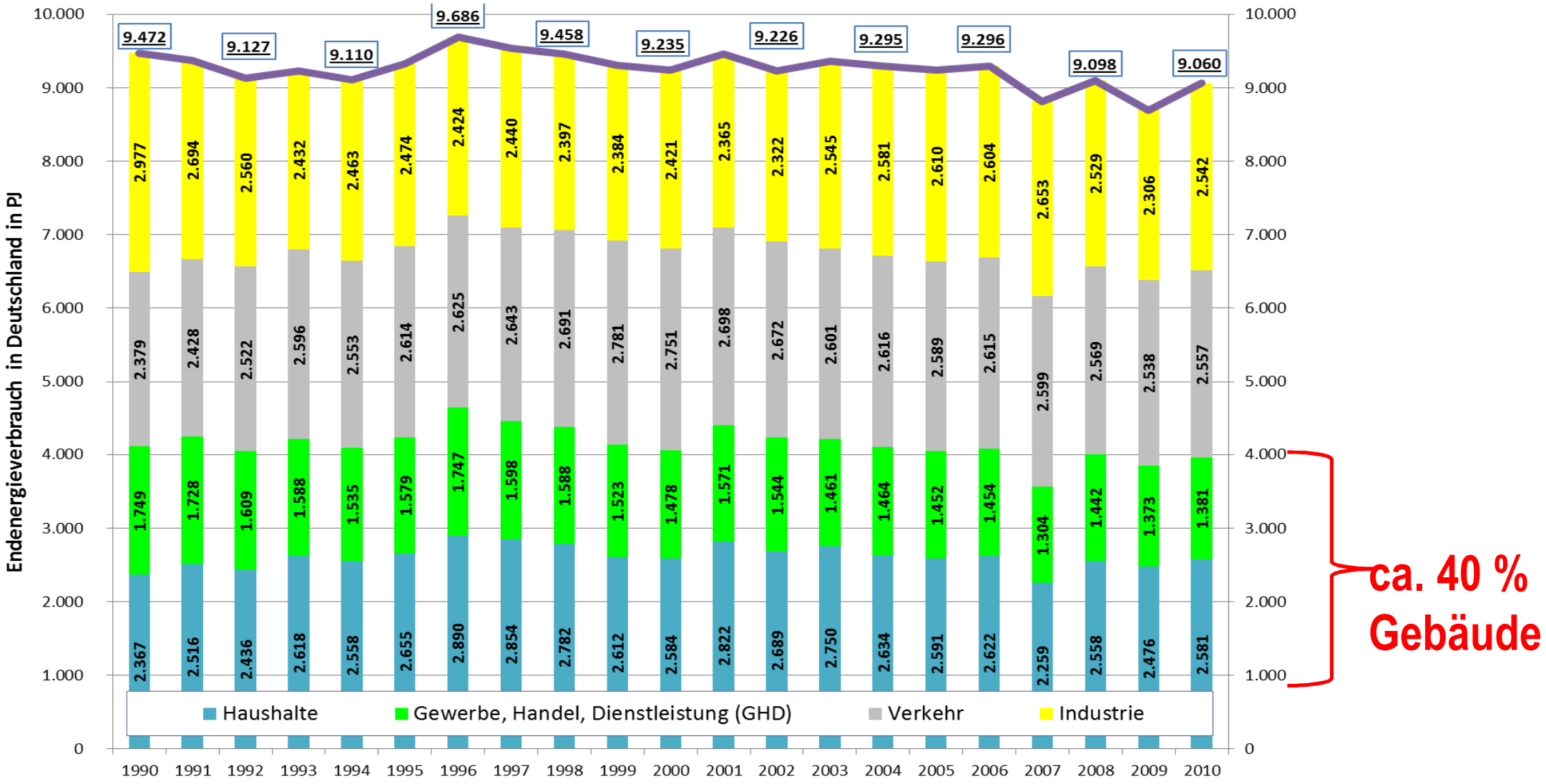
Entwicklung des Endenergieverbrauchs in Deutschland nach Sektoren seit 1990



ca. 40 % Gebäude

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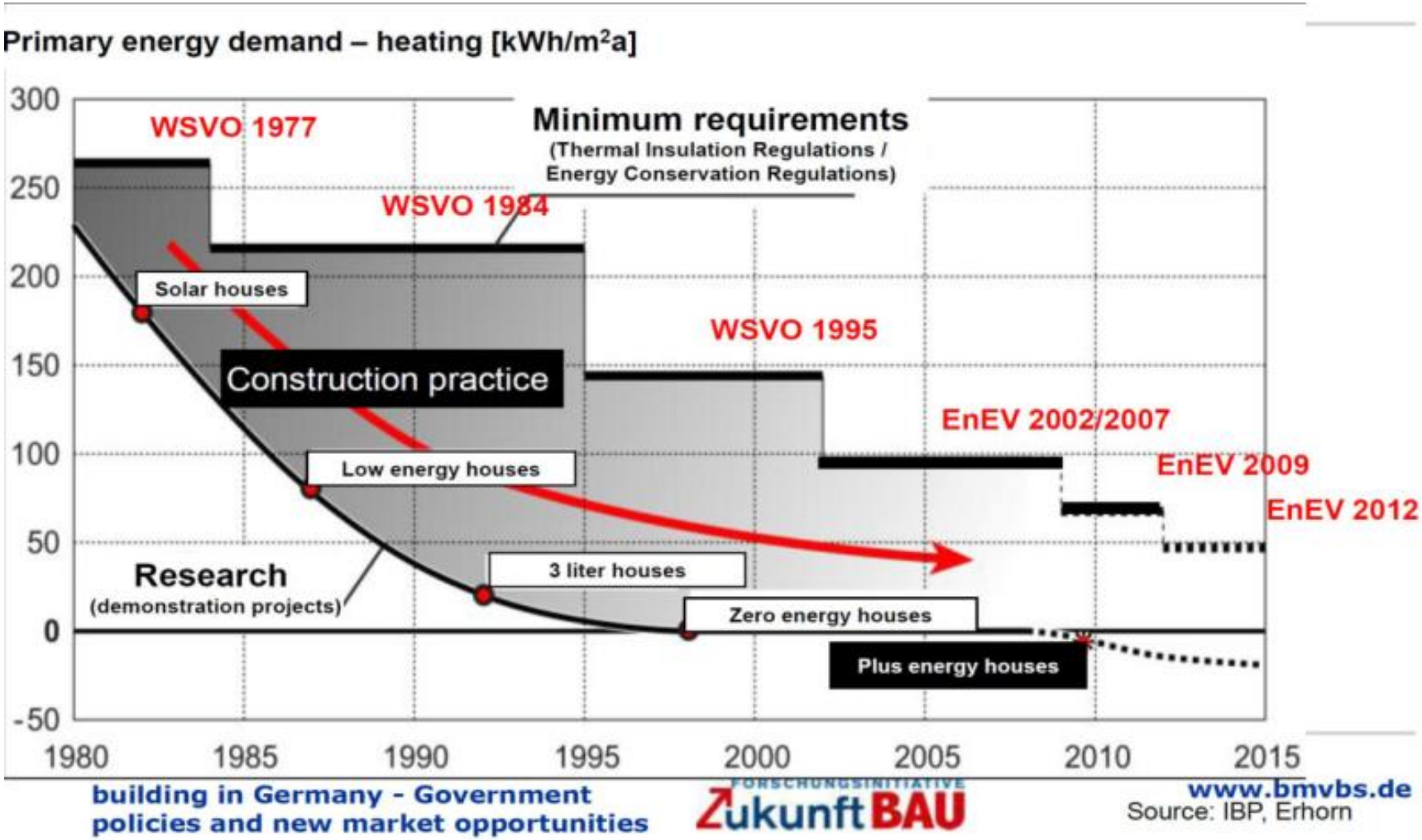
Effizienzsteigerungen im Gebäudesektor



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