Energy Transitions and Sustainability: Exploring the German and Canadian Experiences

Politics and Policies: German Context

Carleton University
29 October 2013

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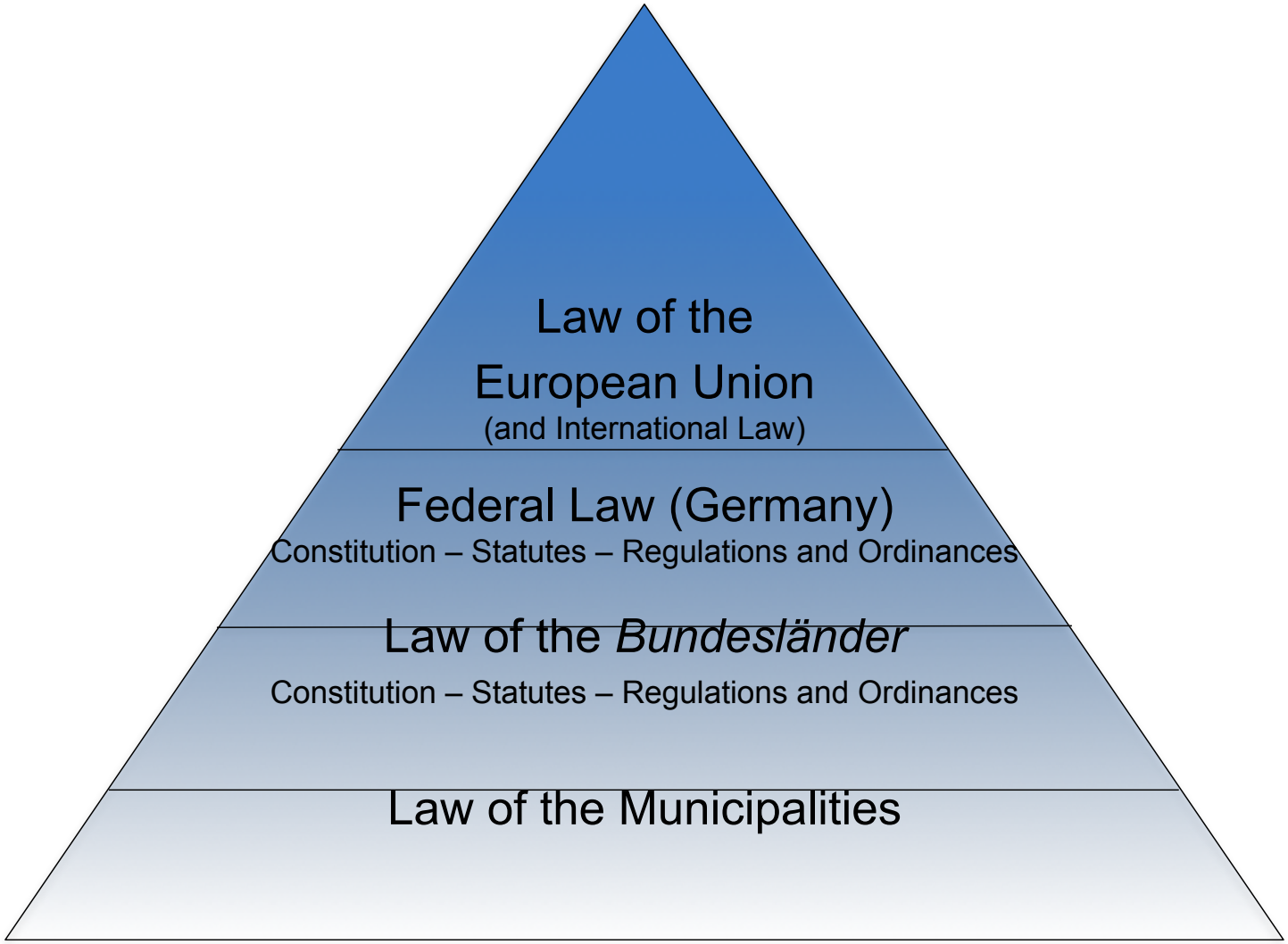
Ecologic Institute

Normative Hierarchy in Germany



Energy and the Environment in Europe: Shared Powers

- Environmental protection and energy as shared competences of the European Union

  Article 4 of the *Treaty on the Functioning of the European Union (TFEU)*: “The Union shall share competence with the Member States in the following principal areas: environment; transport; energy”

- Title XX on the Environment

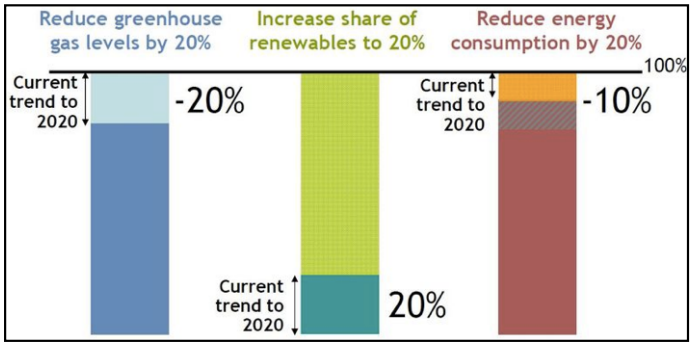
  Article 191 TFEU: “Union policy on the environment shall contribute to pursuit of the following objectives: preserving, protecting and improving the quality of the environment; protecting human health; prudent and rational utilisation of natural resources; promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change”

- Title XXI on Energy

  Article 194 TFEU: “Union policy on energy shall aim to: ensure the functioning of the energy market; ensure security of energy supply in the Union; promote energy efficiency and energy saving and the development of new and renewable forms of energy; and promote the interconnection of energy networks.”

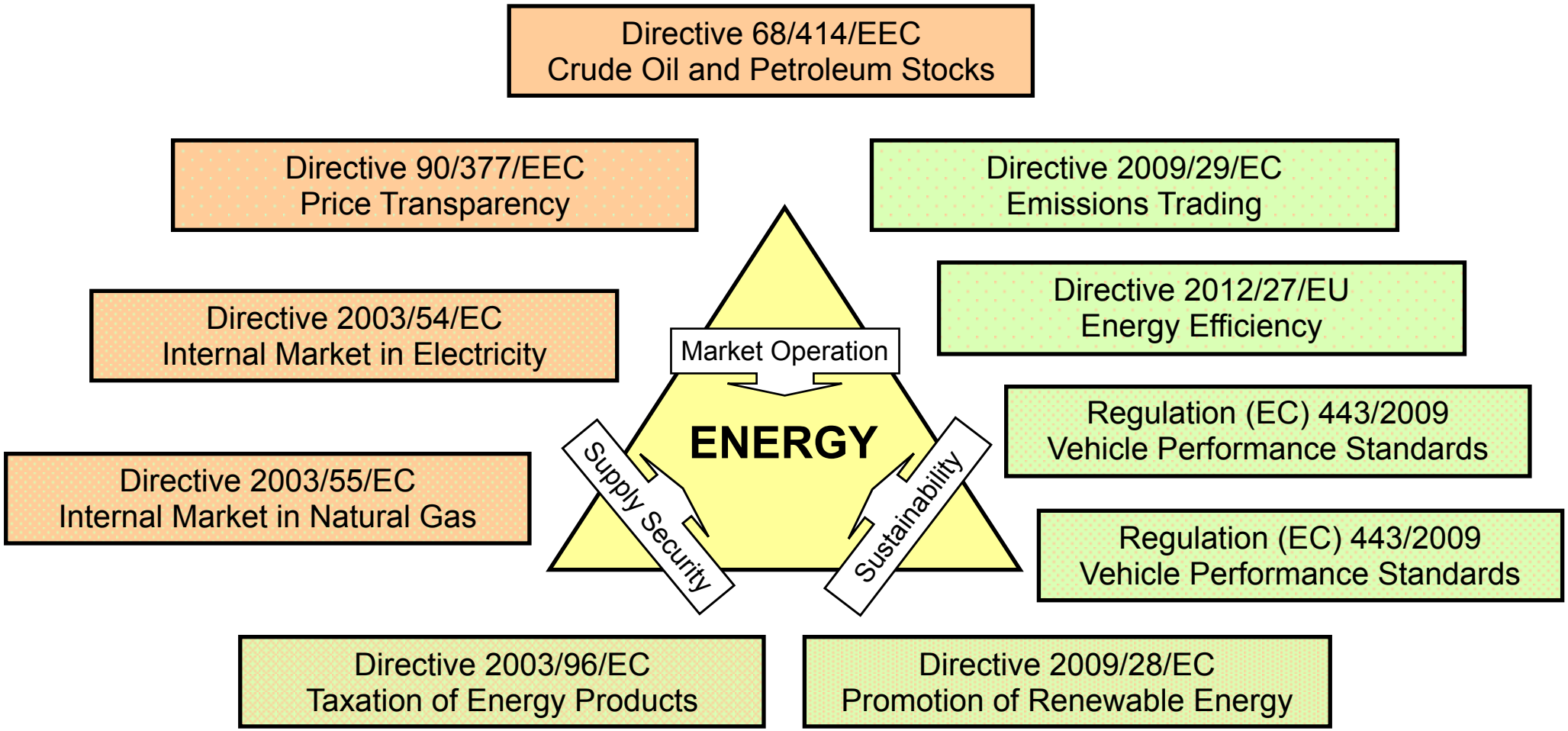
Towards a Common Energy Policy for Europe

- Independent commitment to **reduce emissions** by at least **20%** by 2020 relative to 1990, distributed through an effort sharing decision
- **Conditional commitment** for a **30%** reduction over the same period
- **Energy efficiency** improvement by 20% by 2020
- Mandatory **renewable energy** objective of 20% by 2020, with:
  - differentiation of targets between countries
  - flexibility in target setting within a country
- **Biofuels target** of 10% by 2020

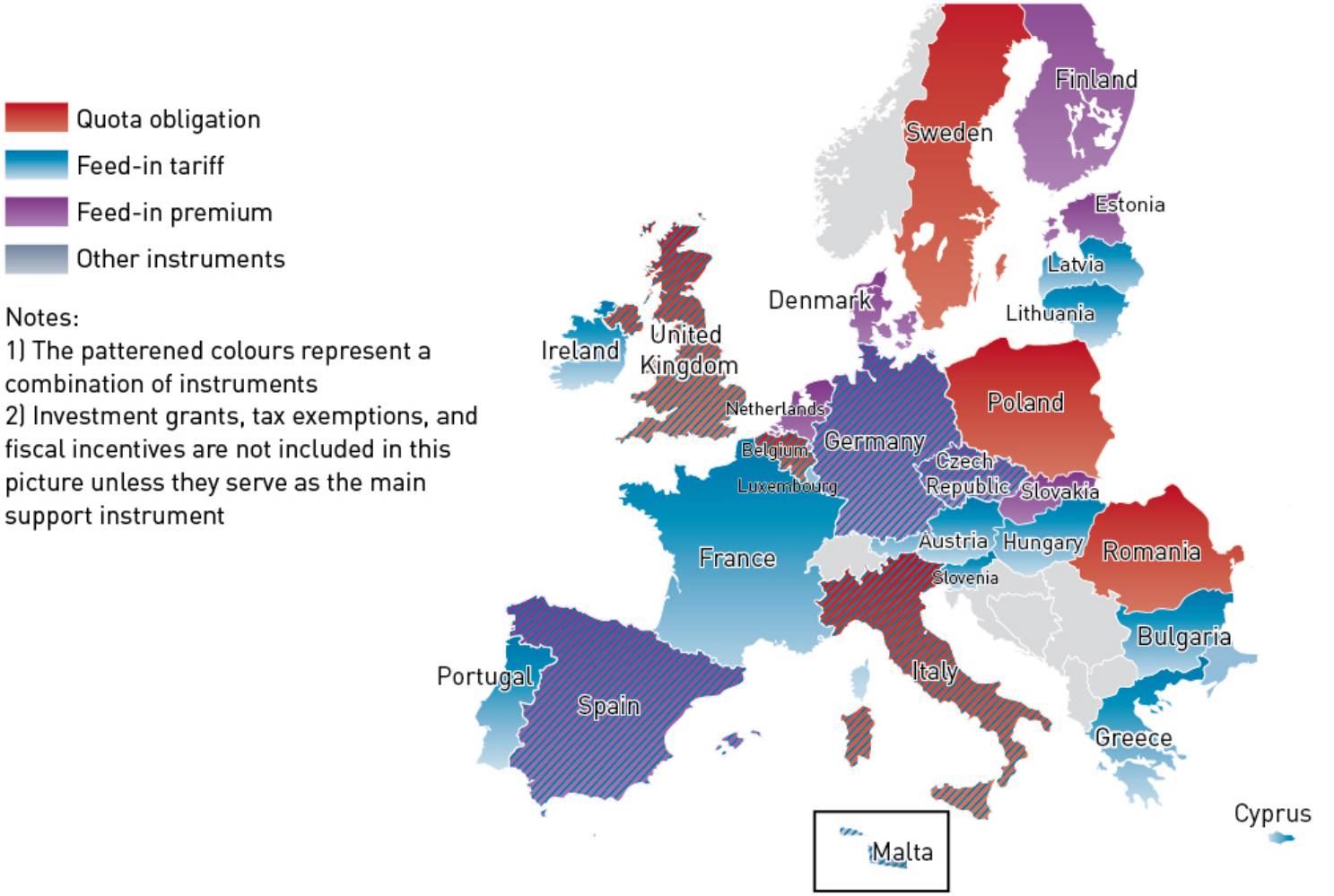


Source: Zeiss, 2012

European Directives on Climate and Energy



Overview of support instruments for electricity from renewable energy sources in EU Member States



German Energy Concept of 2011: Targets and Timeline

	Climate Change	Renewable Energy		Energy Efficiency		
Year	Greenhouse Gases (from 1990)	Share Elec-tricity	Share Total	Primary Energy Use	Energy Productivity	Building Retrofits
2020	- 40%	35%	18%	- 20%	increase by 2.1%/year	doubling of annual increase from 1% to 2%
2030	- 55%	50%	30%			
2040	- 70%	65%	45%			
2050	- 80-95%	80%	60%	- 50%		

(Source: BMU)

Energy and the Environment in Germany: Concurrent Powers

Article 72
[Concurrent legislative powers]

(1) On matters within the concurrent legislative power, the *Länder* shall have power to legislate so long as and to the extent that the Federation has not exercised its legislative power by enacting a law.

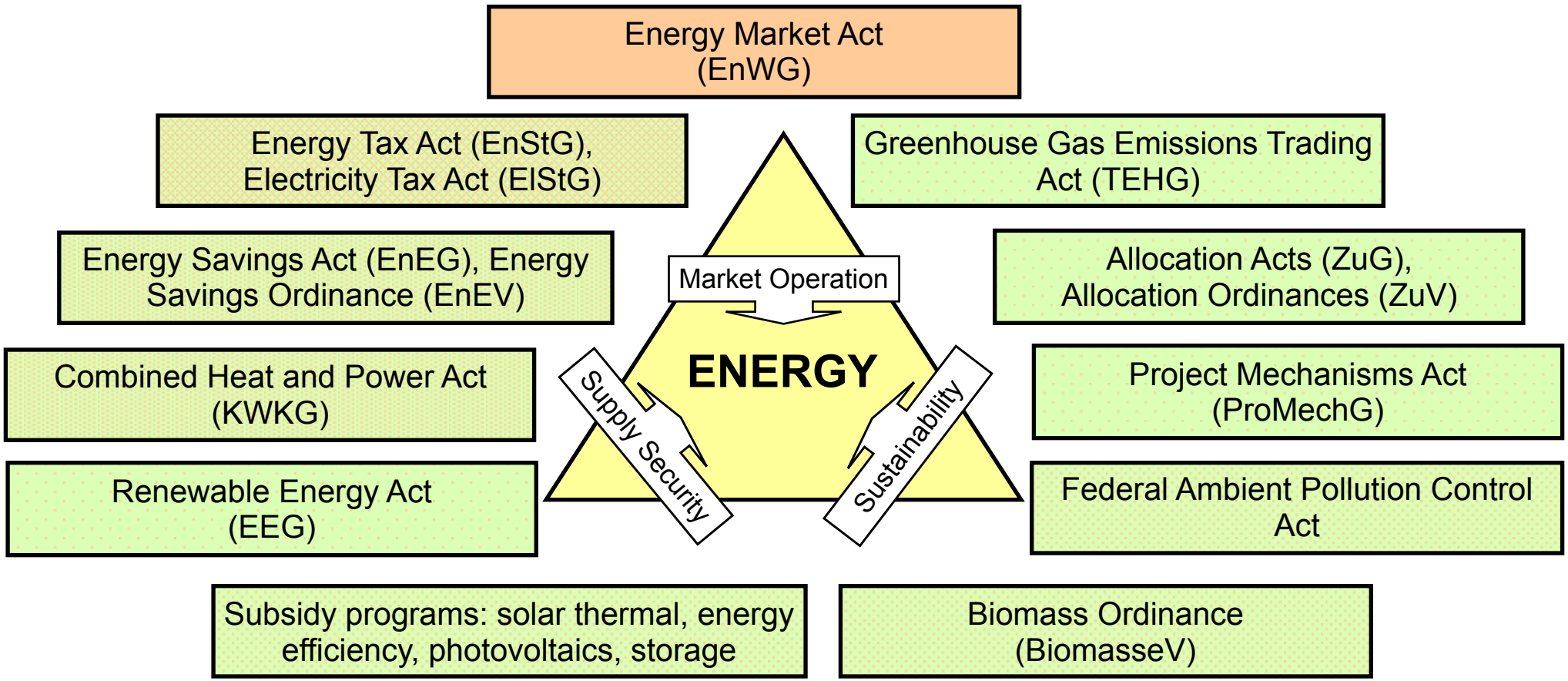
(2) The Federation shall have the right to legislate on matters falling within clauses 4, 7, **11**, 13, 15, 19a, 20, 22, 25 and 26 of paragraph (1) of Article 74, if and to the extent that the establishment of equivalent living conditions throughout the federal territory or the maintenance of legal or economic unity renders federal regulation necessary in the national interest.

Article 74
[Matters under concurrent legislative powers]

(1) Concurrent legislative power shall extend to the following matters: (…)

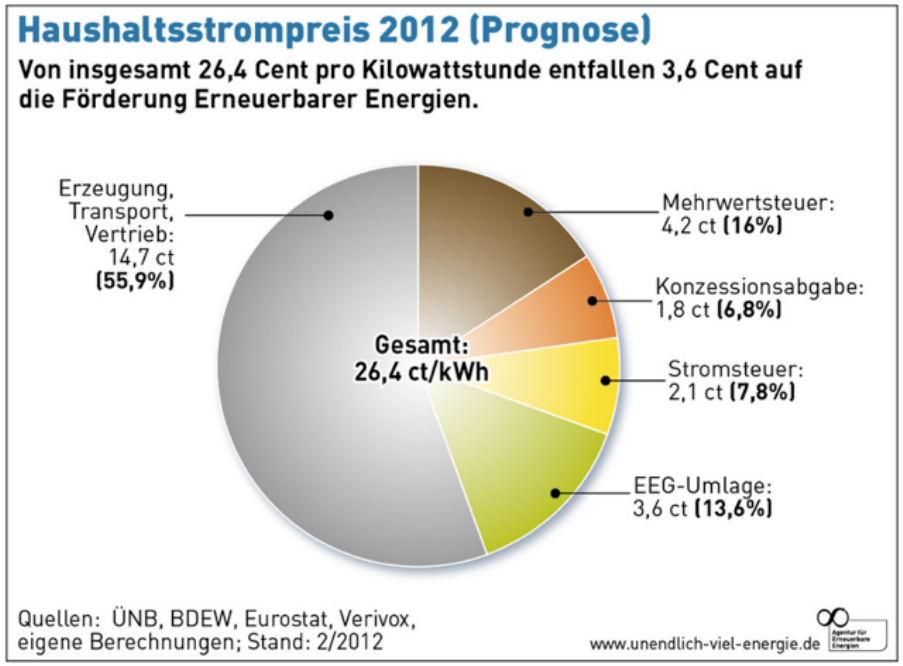
11. the law relating to economic matters (mining, industry, **energy**, crafts, trades, commerce, banking, stock exchanges and private insurance), except for the law on shop closing hours, restaurants, game halls, display of individual persons, trade fairs, exhibitions and markets;

German Climate Policy: Responding to Brussels

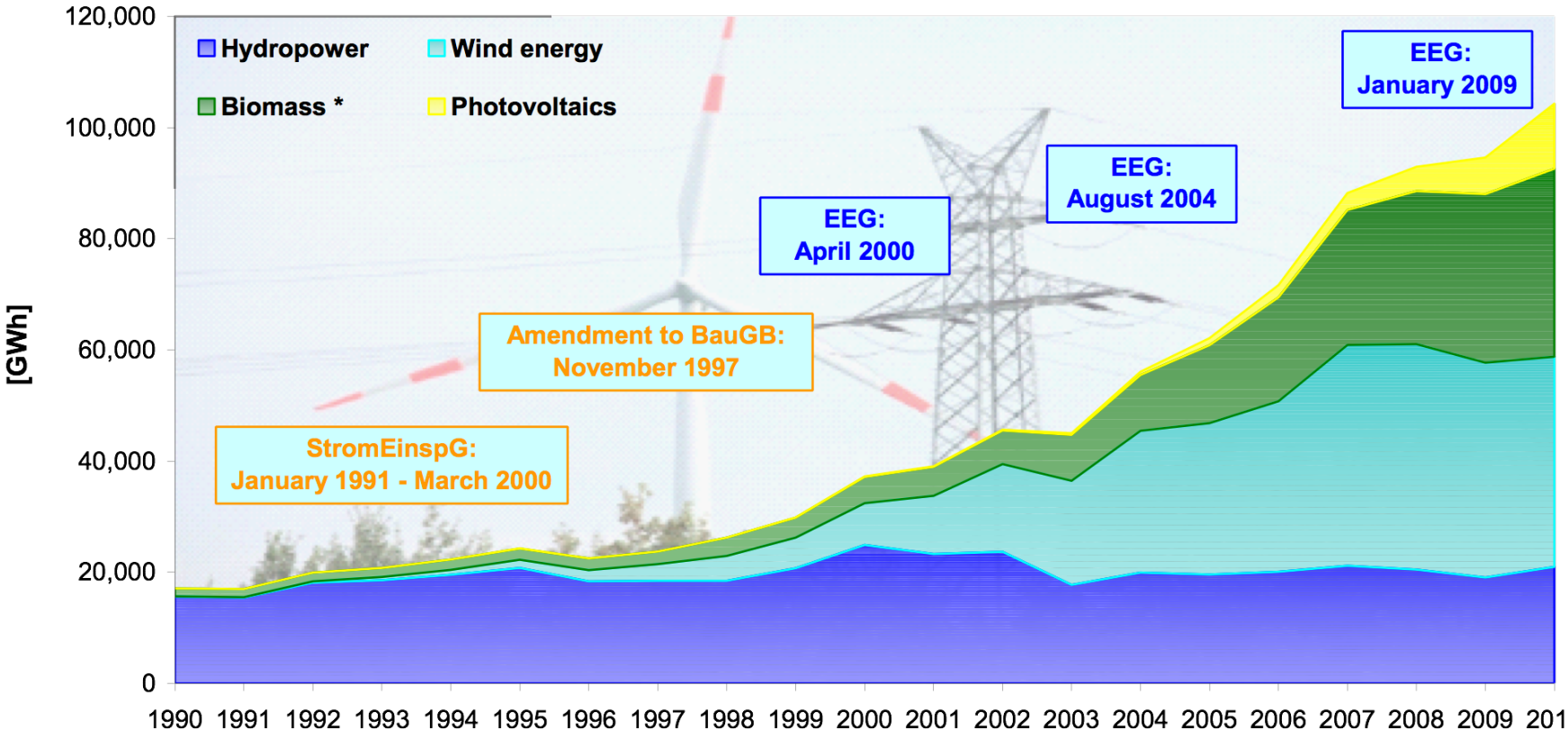


Feed-in Tariff: Prices and Investment

- Net transfer from ratepayers to renewable energy generators, based on **cost differential** between feed-in tariff and average spot market price
- Aggregate transfer currently: approx. € 20 billion
- Feed-in tariff currently (2013) adds approx. 5,3 ct/kWh to retail price
- For an average household (using 3,500 kWh/year) this amounts to € 15.5/month, or € 185/year

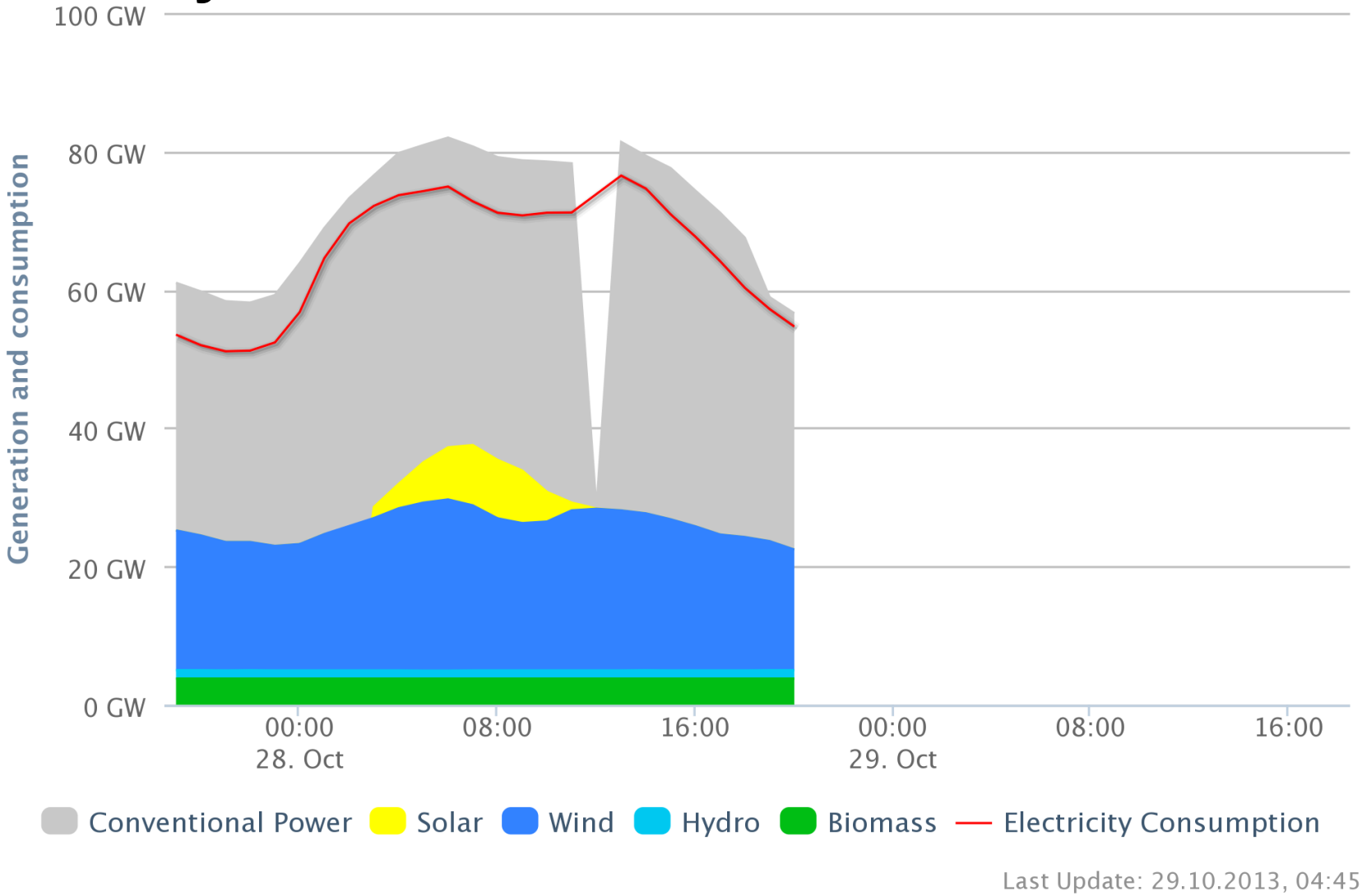


Contribution of renewable energy sources to electricity supply in Germany



* Solid and liquid biomass, biogas, sewage and landfill gas, biogenic share of waste; electricity from geothermal energy not presented due to negligible quantities produced; 1 GWh = 1 Mill. kWh;
StromEinspG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act;
Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Christoph Edelhoff; as at: December 2011; all figures provisional

Electricity Generation and Demand: 28 October 2013

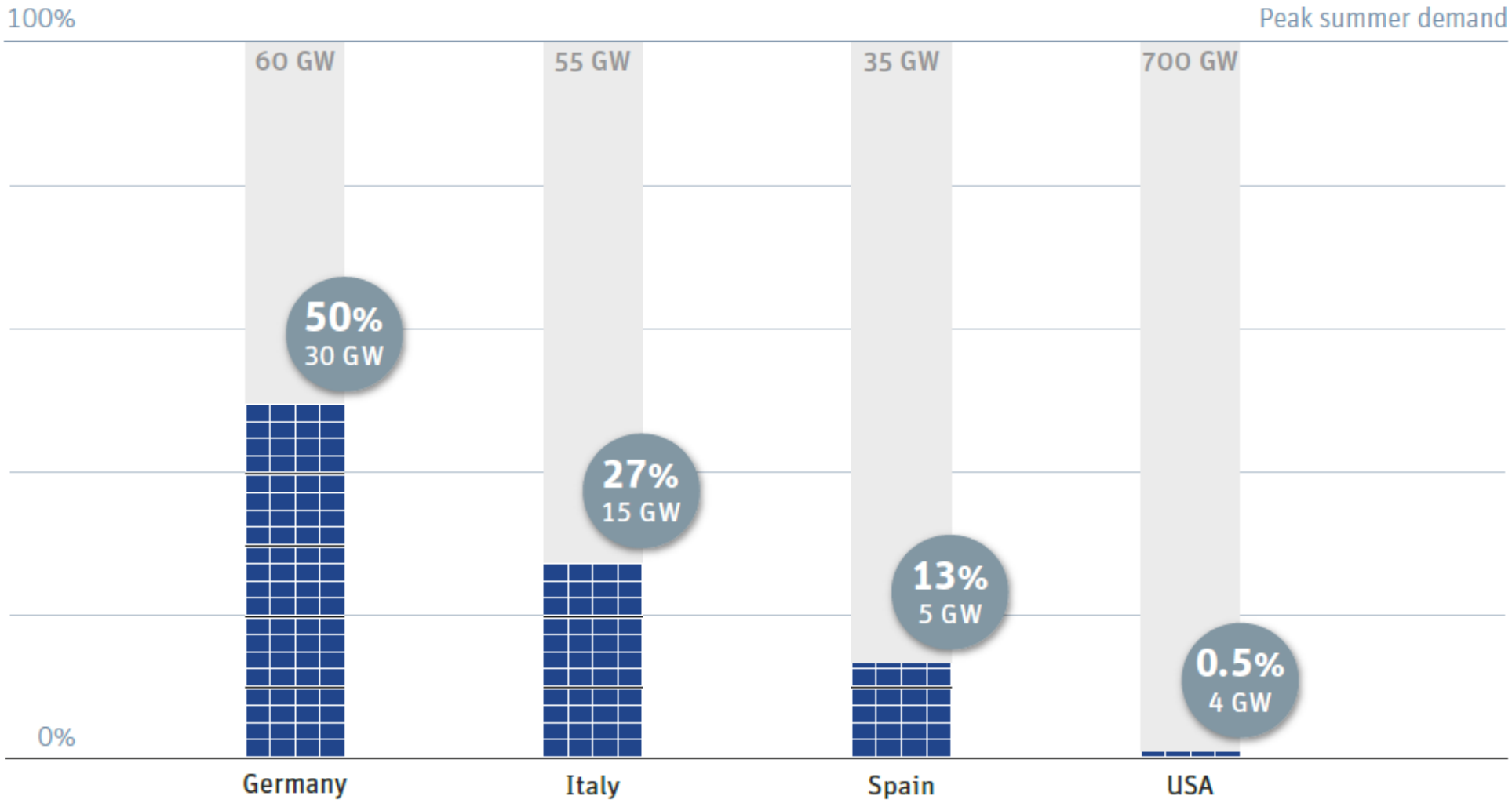


Source: Agora Energiewende

Germany's installed solar PV capacity is already half of power demand

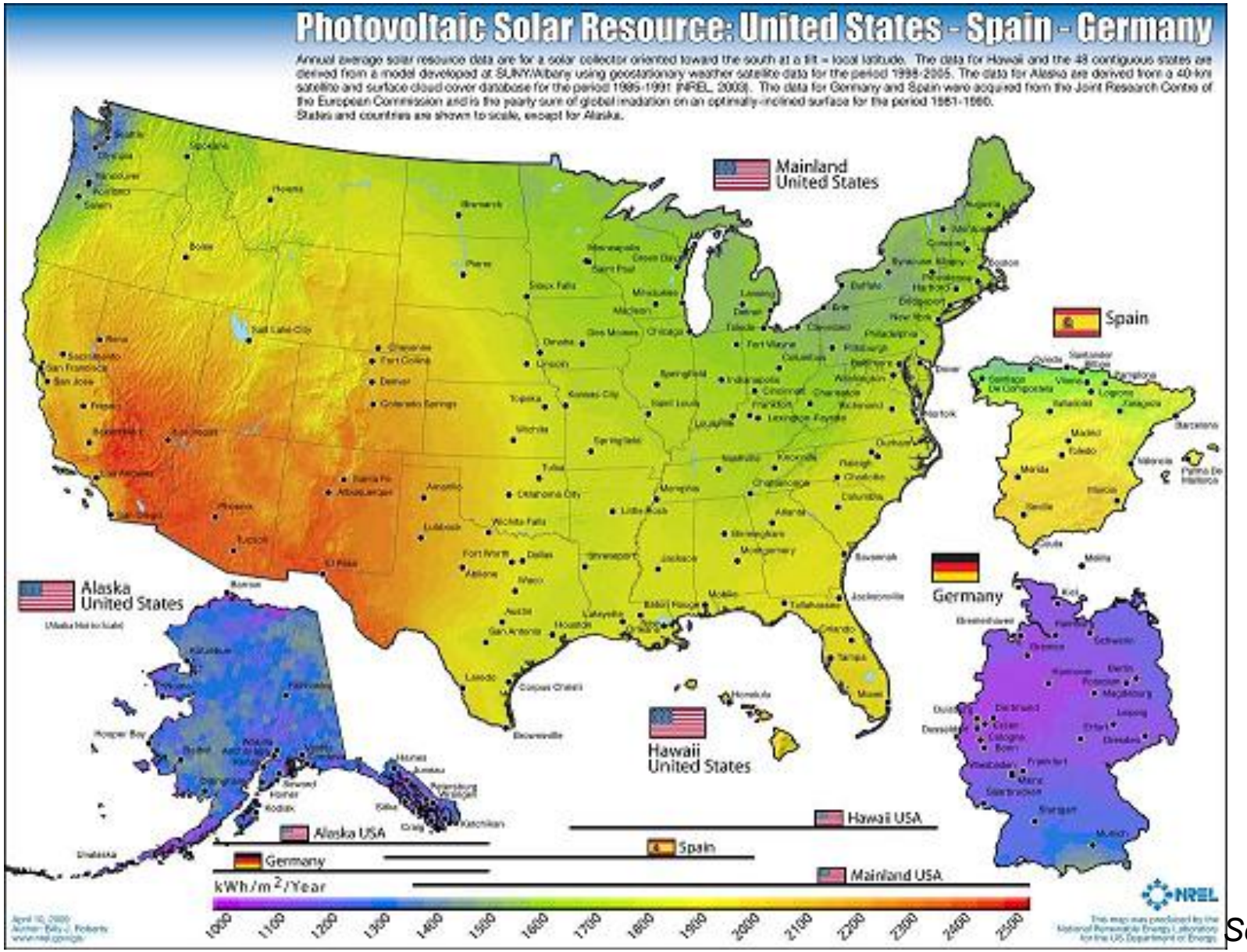
Germany has most solar PV installed in absolute (30GW) and relative terms (50% of peak demand)

Source: REN 21, own calculations



Source: www.energytransition.de

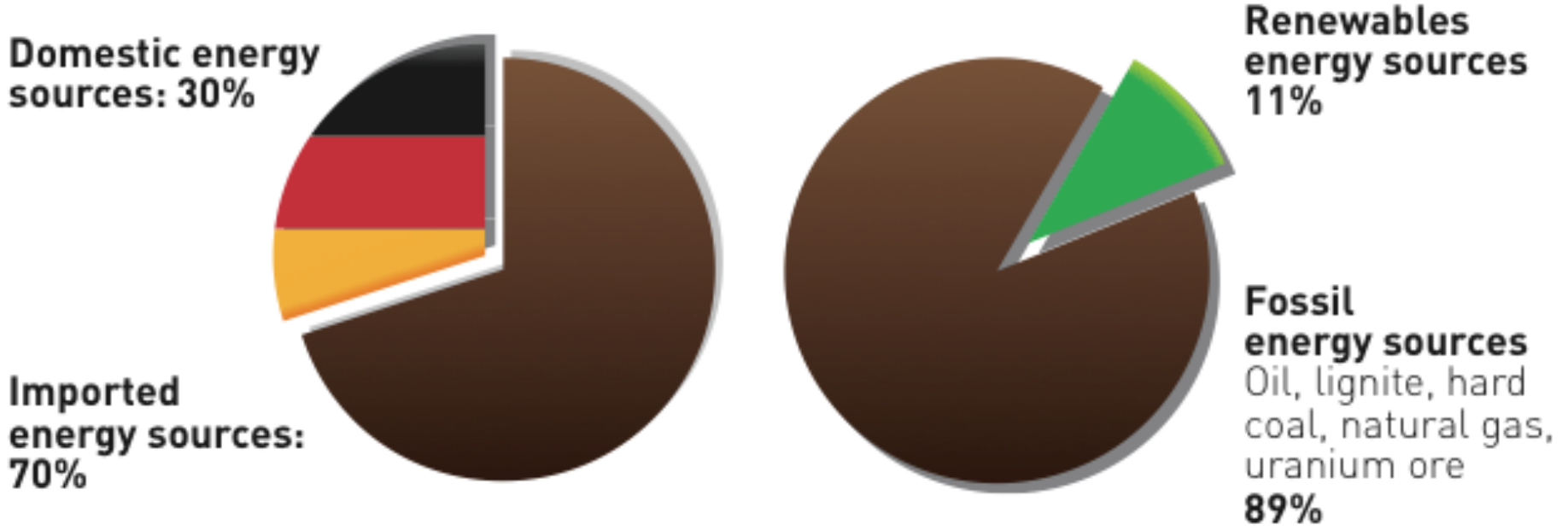
German Energy Transition energytransition.de CC BY SA


Photovoltaic Solar Resource: United States - Spain - Germany
Annual average solar resource data are for a solar collector oriented toward the south at a tilt = local latitude. The data for Hawaii and the 48 contiguous states are derived from a model developed at SUNY/Albany using geostationary weather satellite data for the period 1998-2005. The data for Alaska are derived from a 40-km satellite and surface cloud cover database for the period 1985-1991 (NREL, 2003). The data for Germany and Spain were acquired from the Joint Research Centre of the European Commission and is the yearly sum of global irradiation on an optimally-inclined surface for the period 1981-1990.
States and countries are shown to scale, except for Alaska.
Mainland United States
Spain
Alaska United States
Germany
Hawaii United States
Hawaii USA
Alaska USA
Spain
Germany
Mainland USA
kWh/m2/Year
1000 1150 1300 1450 1600 1750 1900 2050 2200 2350 2500
NREL

Source: NREL

Germany – still highly dependent on fossil energy imports

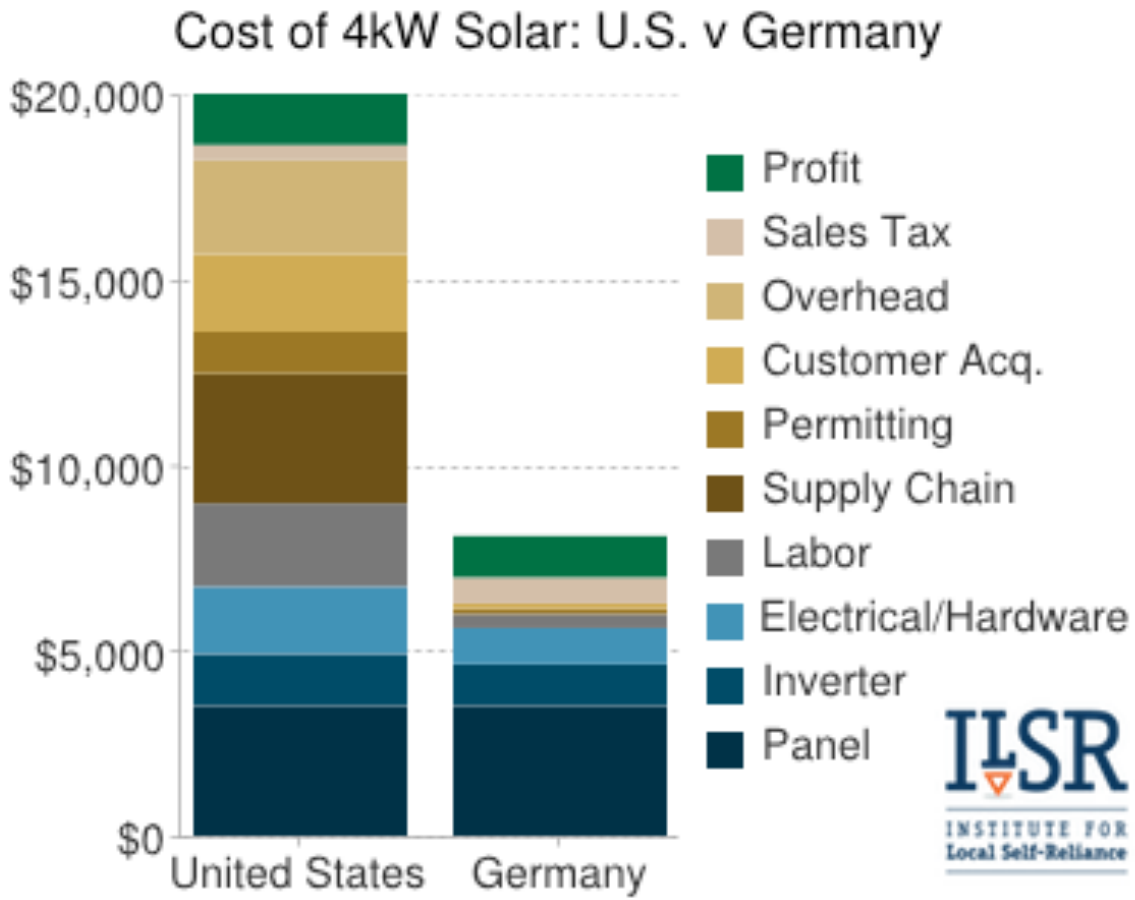
Renewable energies supply some 11 percent of Germany's energy needs



Sources: BMWi, BMU, as of 03/2012

www.unendlich-viel-energie.de

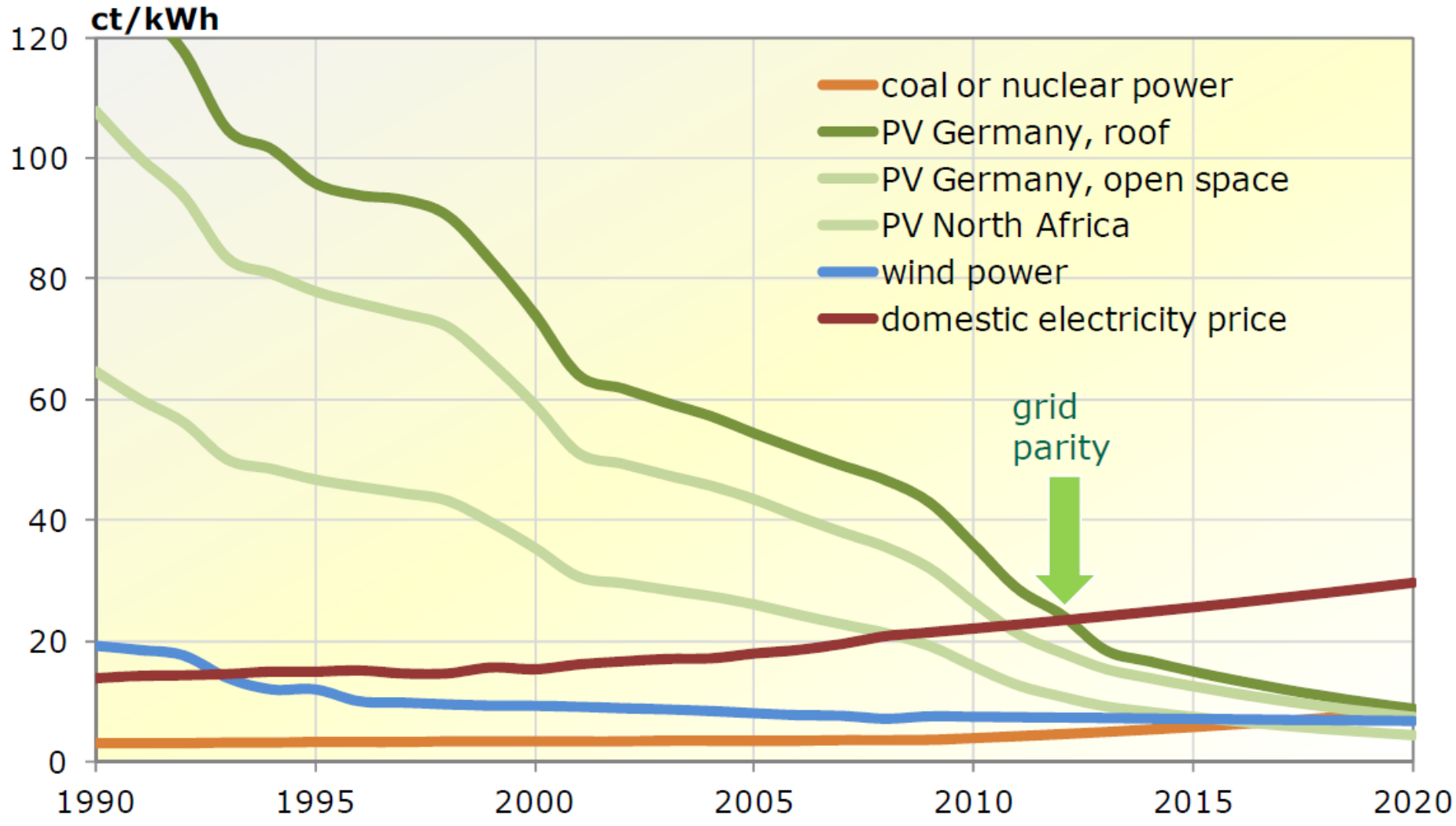
Comparing Costs for Solar PV Installations



July 2012

Source: www.energytransition.de

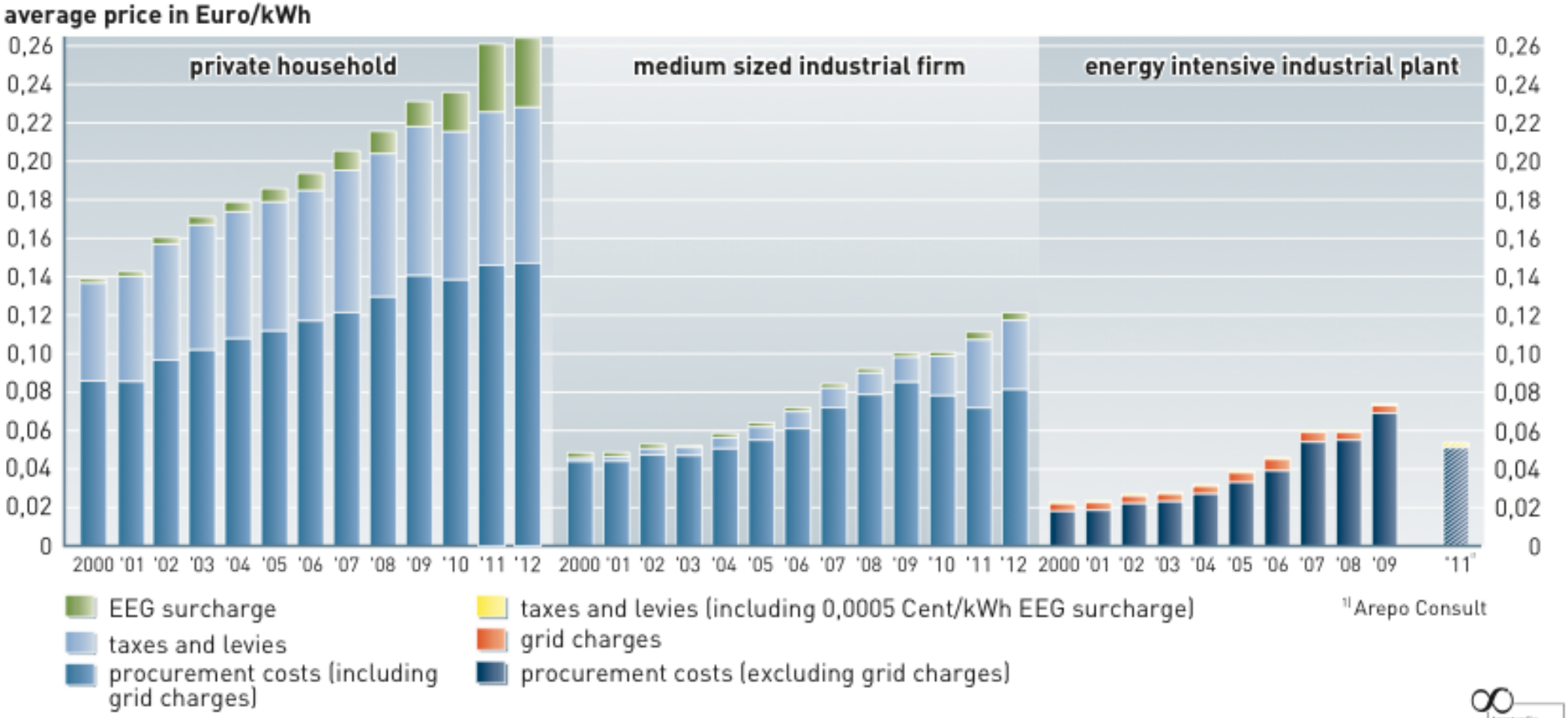
Price Development for Photovoltaic Electricity



Source: HTW Berlin

Comparison of electricity prices

Energy intensive industries profit from low taxes and levies



Source: Frontier econmics / ewi, VIK, own calculations, Arepo consult, as of 04/2012

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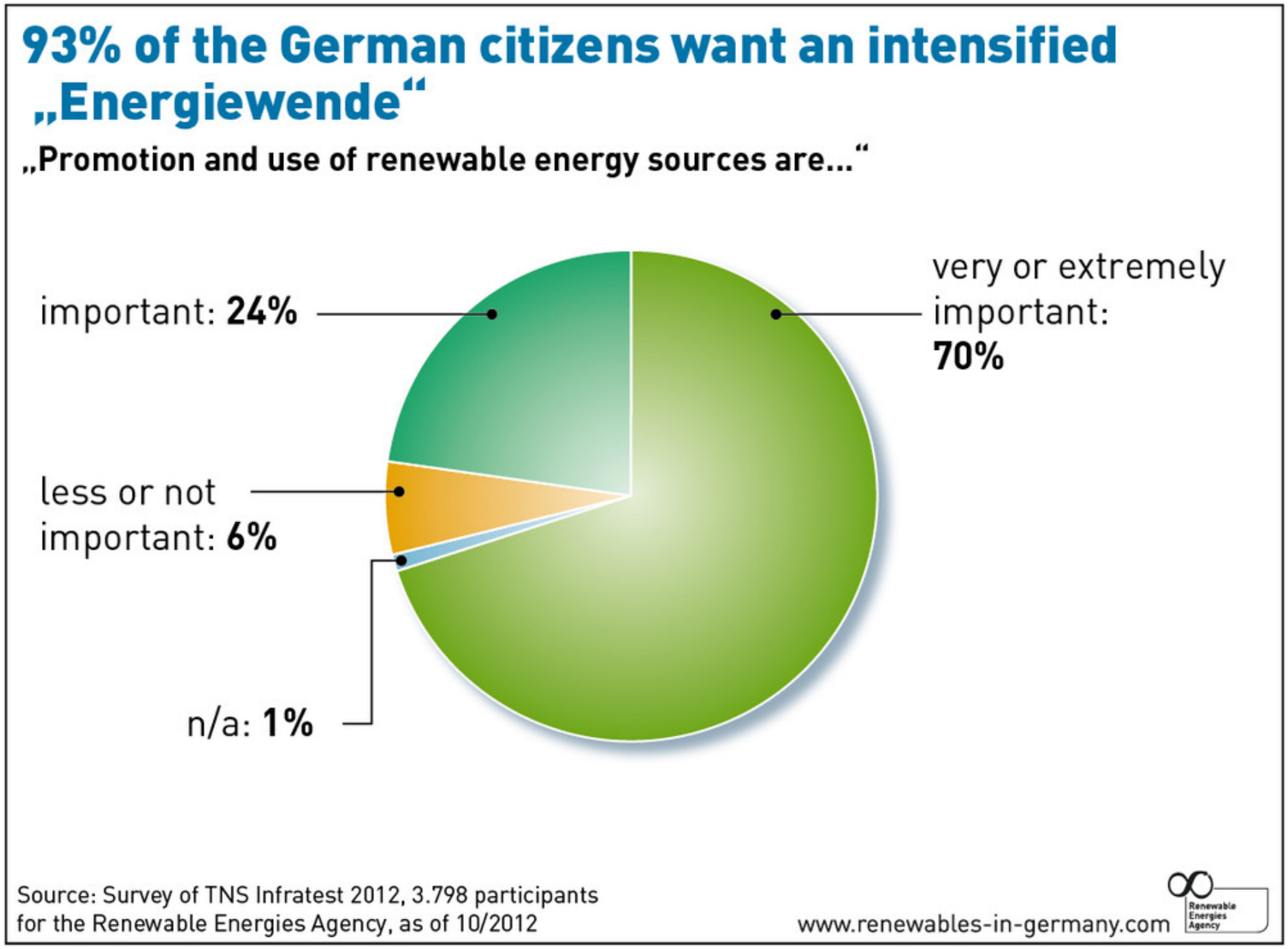
Surveys Confirm Widespread Acceptance of the *Energiewende*



Public Perceptions of Renewable Energy

Survey by Forsa in March 2011:

- 71% of citizens would pay € 20/month for renewable energy promotion

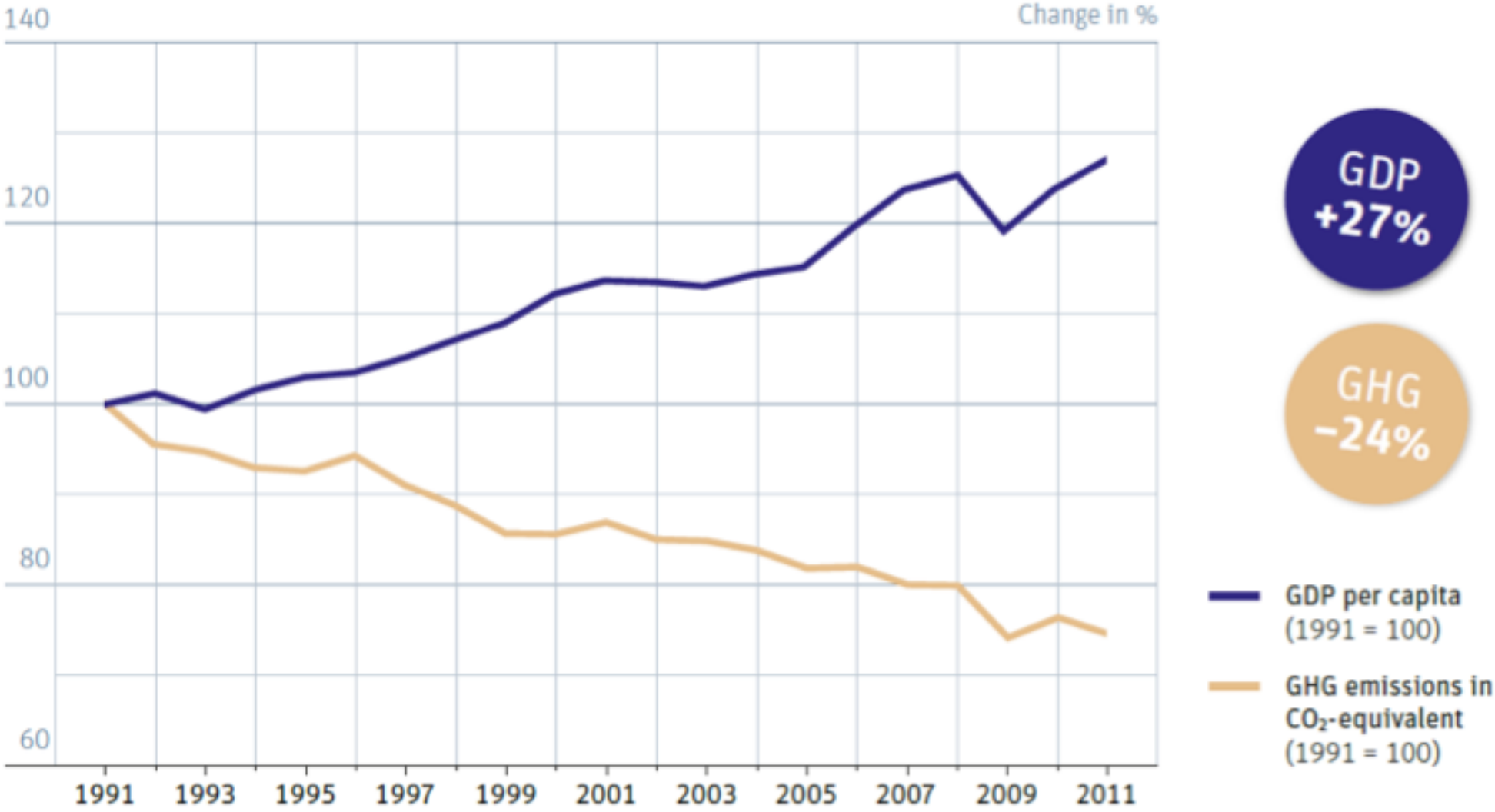
Survey by Lichtblick in April 2012:

- 87 % of Germans approve of the energy concept and believe the transition to renewable energy is successful, and 20% intend to generate part of their electricity themselves by 2020

Survey by Stern in November 2012:

- 64% of respondents still believe the energy transition makes sense, despite the rising cost; but number of those worried it might fail rising

Change of GDP and GHG Emissions, 1990-2011



Source: www.energytransition.de

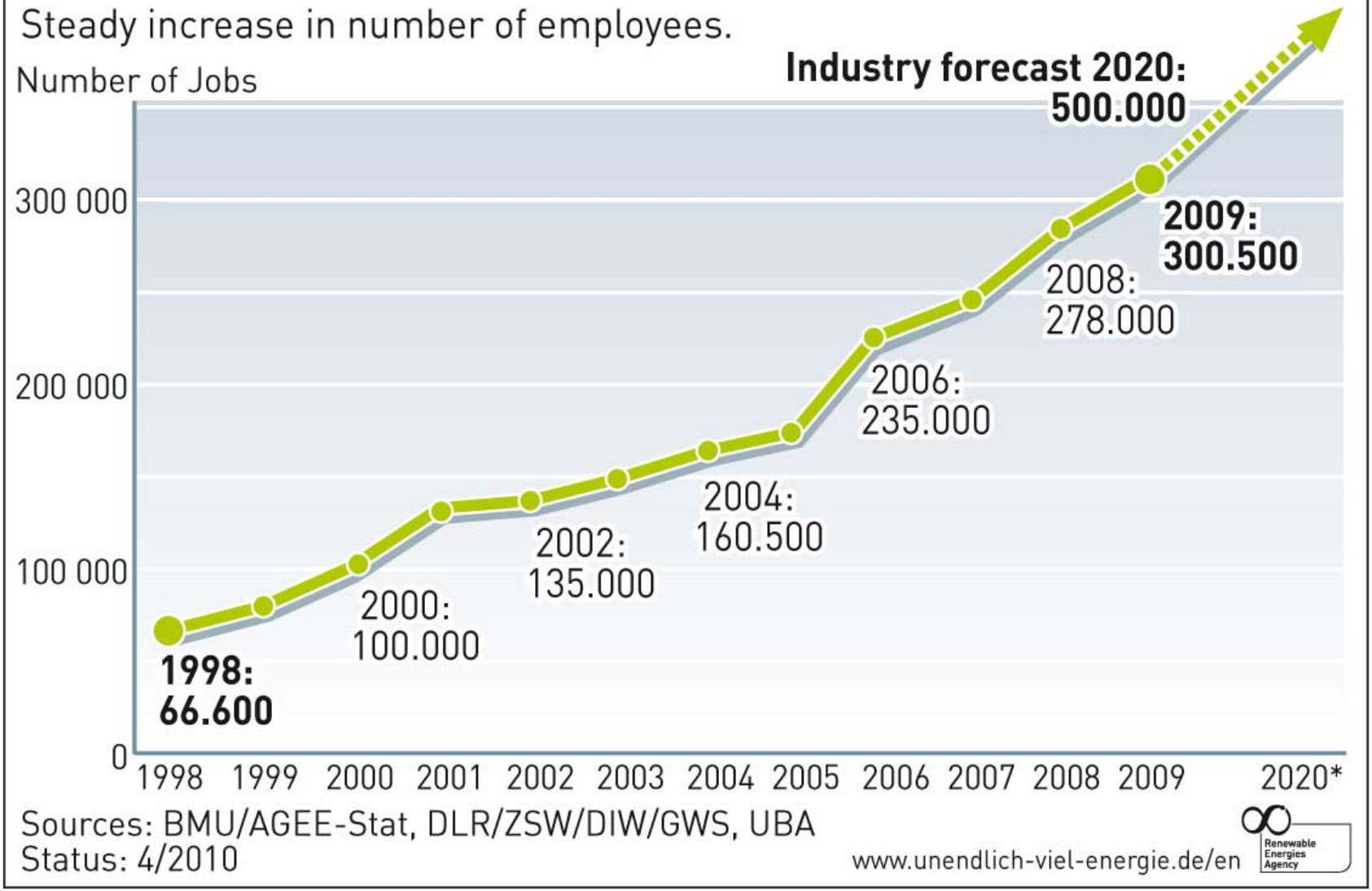
Germany's *Energiewende* Has Not Harmed the Economy

Despite being a highly industrialized economy with a large manufacturing base, Germany has been able to implement its ambitious energy transition without stalling the economy, as many predicted:

- Germany had a record US$ 1.35 trillion in exports and a US$ 242 billion trade surplus in 2012, the second largest since 1950, compared to a US $ 540 billion trade balance deficit for the US
- Germany also has the lowest unemployment rate in 20 years while growing its workforce. Renewable energy has created over 350.000 new jobs, ten times more than coal has employed over the past decade

Development of jobs in the Renewable Energy sector

Steady increase in number of employees.



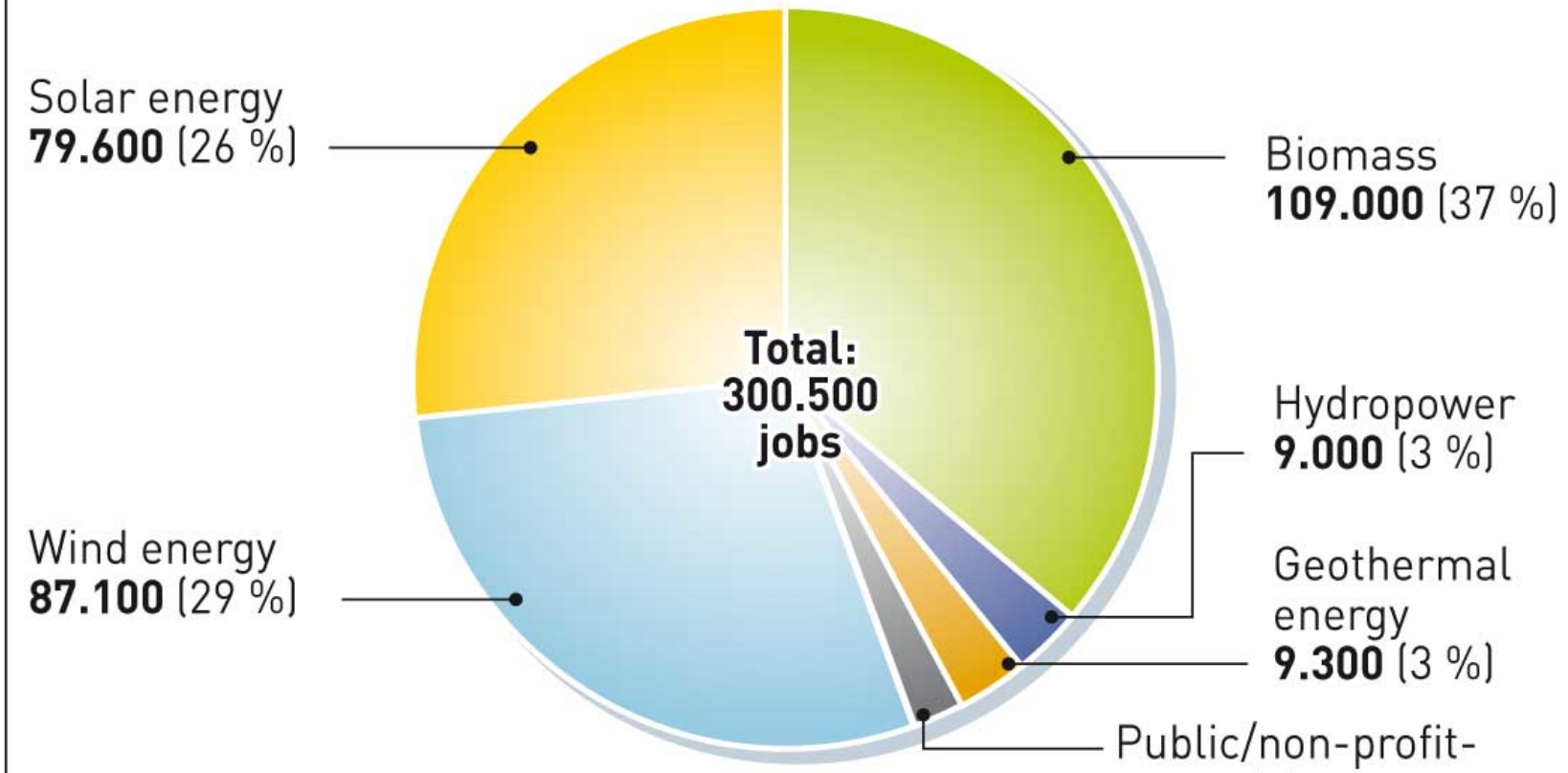
Sources: BMU/AGEE-Stat, DLR/ZSW/DIW/GWS, UBA
Status: 4/2010

www.unendlich-viel-energie.de/en

Renewable Energies Agency

Renewable Energy: 300.000 jobs in 2009

Number of jobs in Renewable Energy industries in Germany

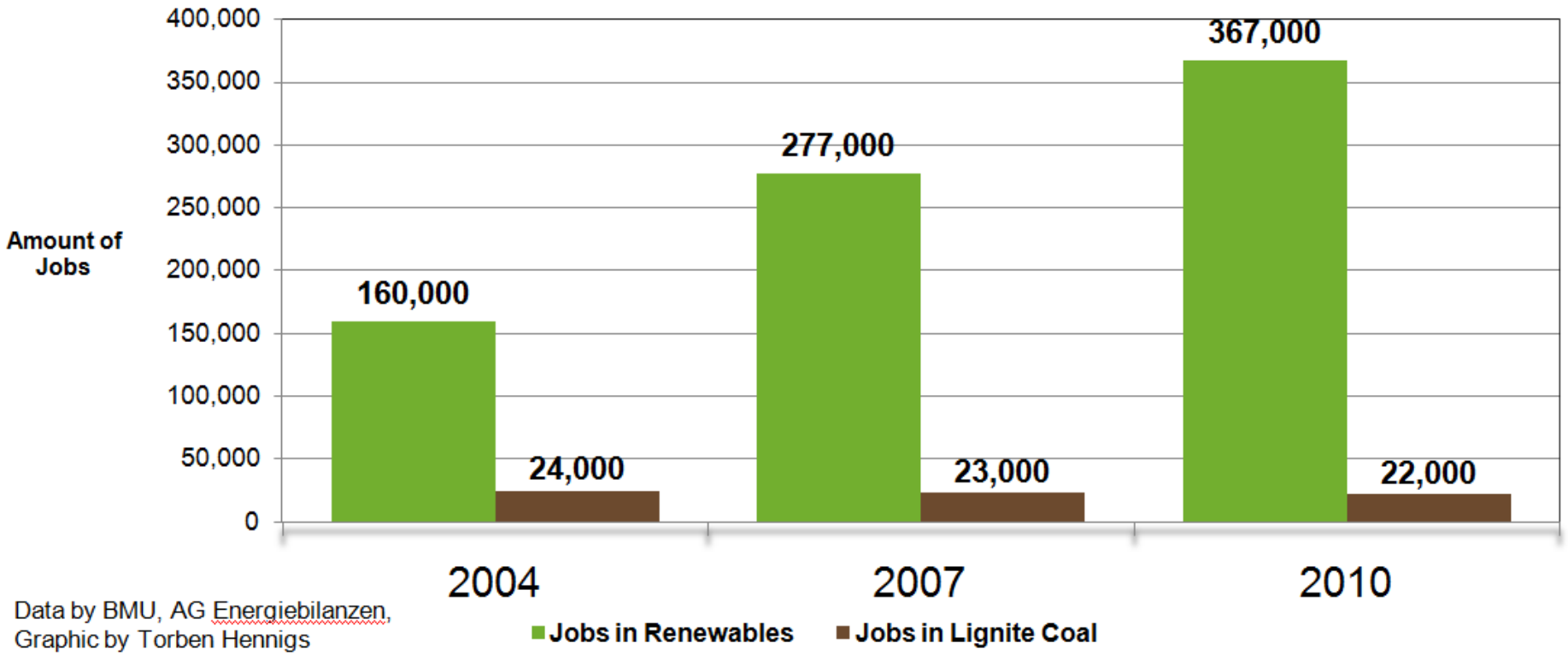


Source: BMU/AGEE-Stat, Status: 4/2010

www.unendlich-viel-energie.de/en

Renewable Energies Agency

Employment Effects: Renewable Energy Sector vs. Lignite Coal Sector (2004-2010)



Data by BMU, AG Energiebilanzen,
Graphic by Torben Hennigs

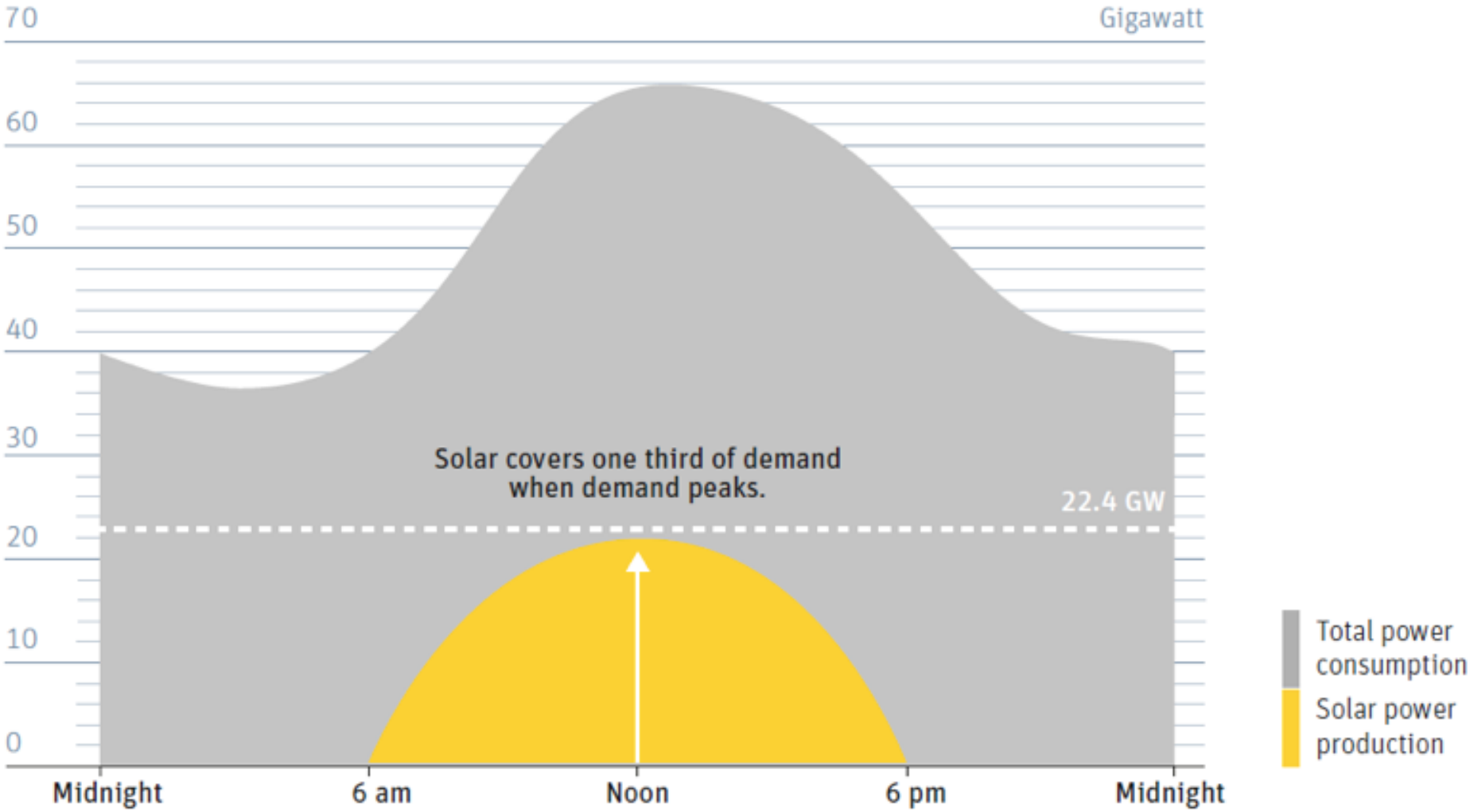
Source: HBF

Merit Order Effect: Renewables Dampen Peak Electricity Prices

- High capital costs of renewables are partly offset by low operating costs
- Marginal cost of solar and, to a lesser extent, wind electricity is near zero
- Peak solar generation in the early afternoon coincides with peak demand
- Average price-dampening effect of 10%, with 40% in peak times
- Spot market prices have fallen by roughly 0.9 ct/kWh, saving industry € 1.6 billion in 2012

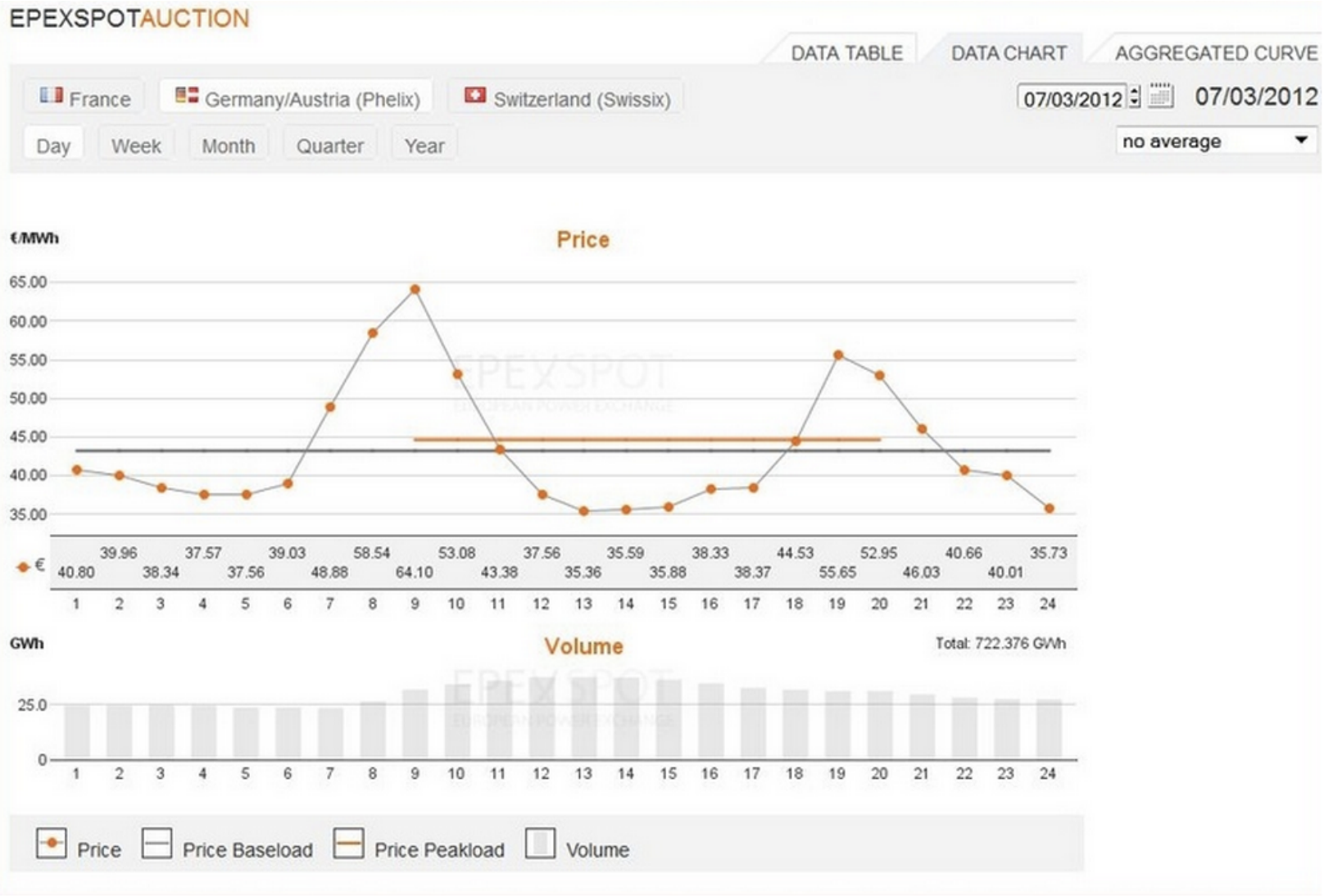
Source: [FÖS 8/2012]

Solar also Helps Meet Peak Demand



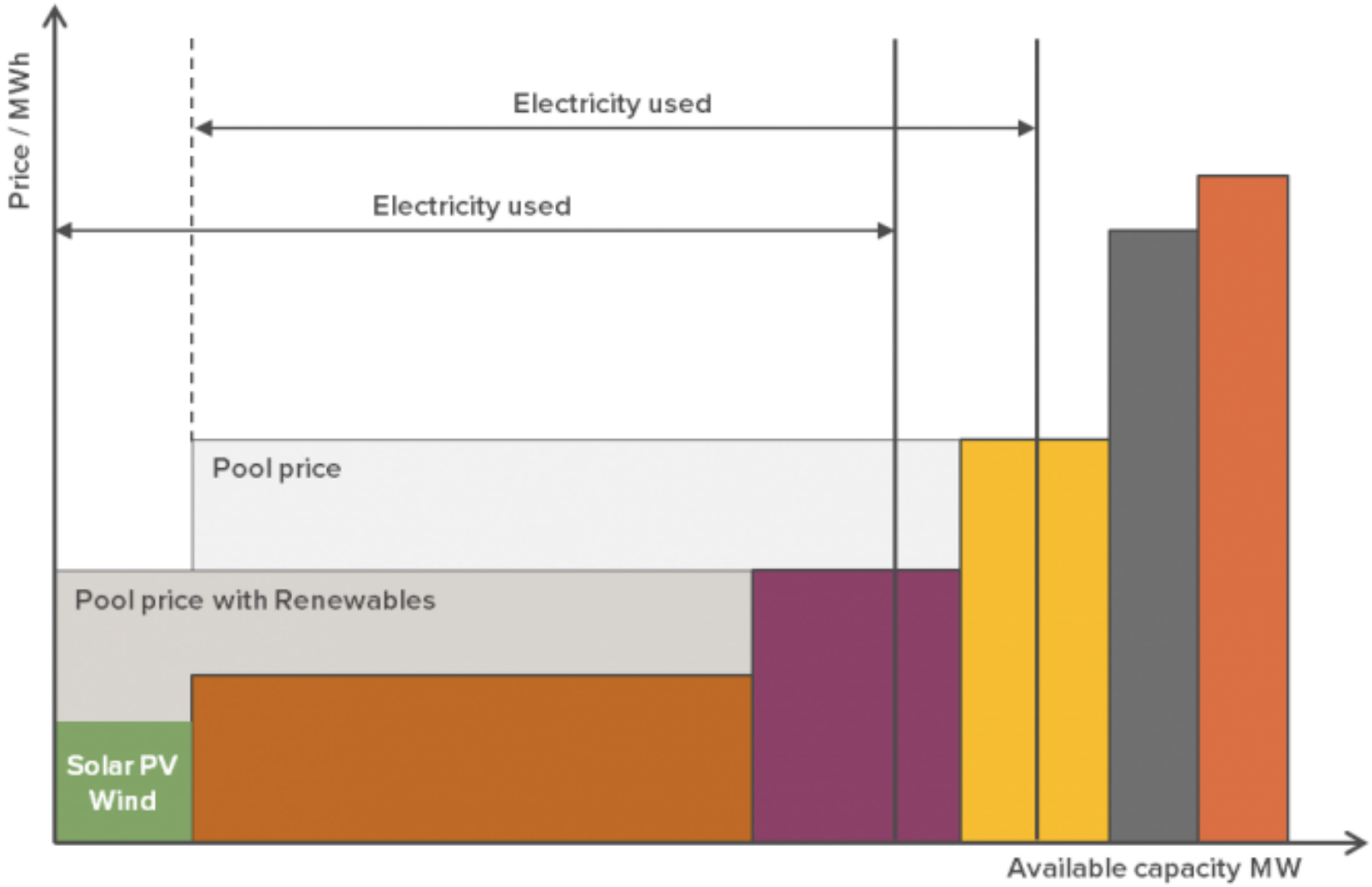
Source: www.energytransition.de

… With a Marked Impact on Wholesale Clearing Prices



Source: European Power Exchange

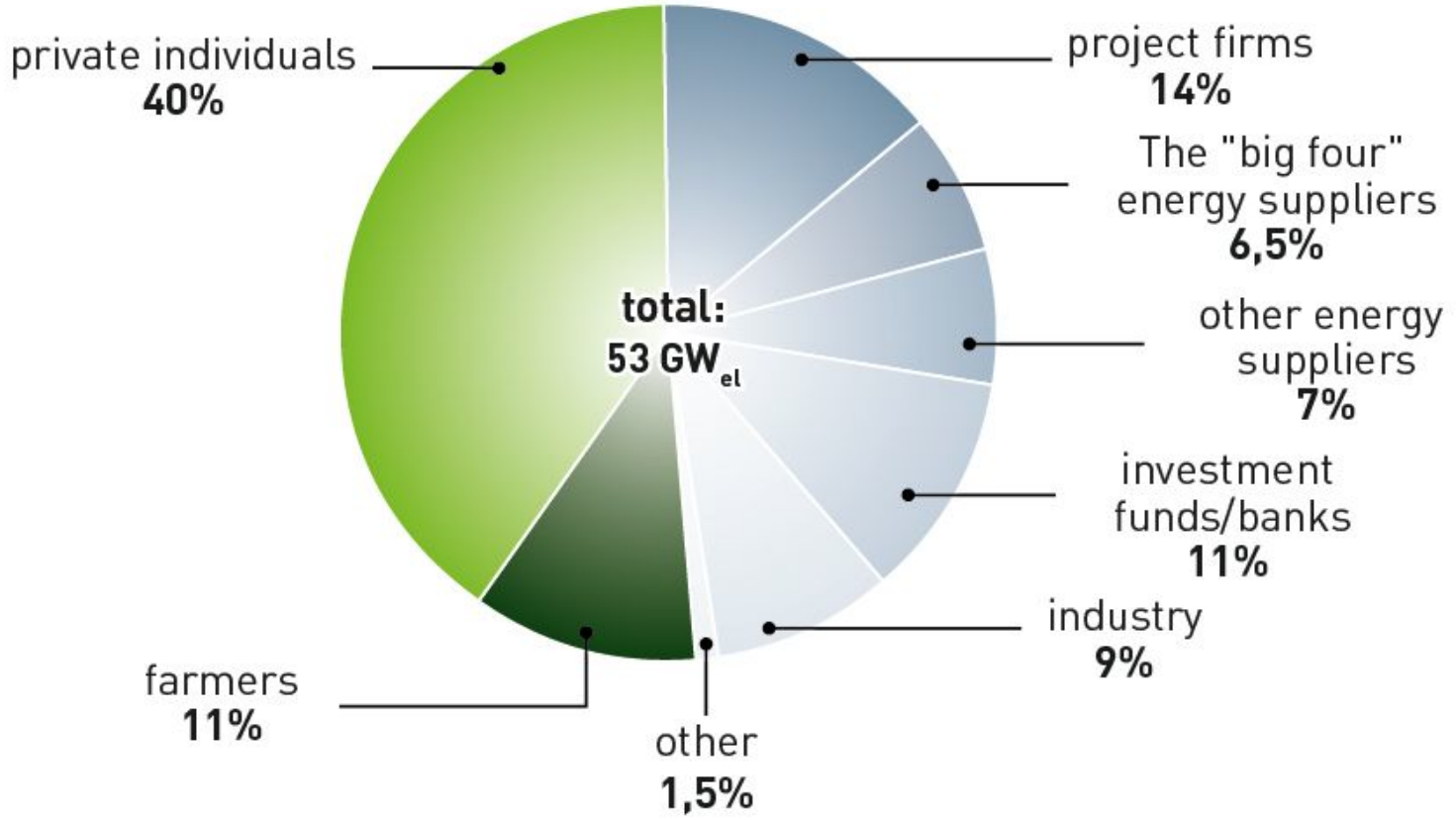
Merit Order Effect further Dampens Electricity Prices



Source: Andersen, 2011

Renewable Energies in the hands of the people

Ownership distribution of installed RE capacity for electricity production in 2010 (53 GW)



source: trend research; latest update: 10/11

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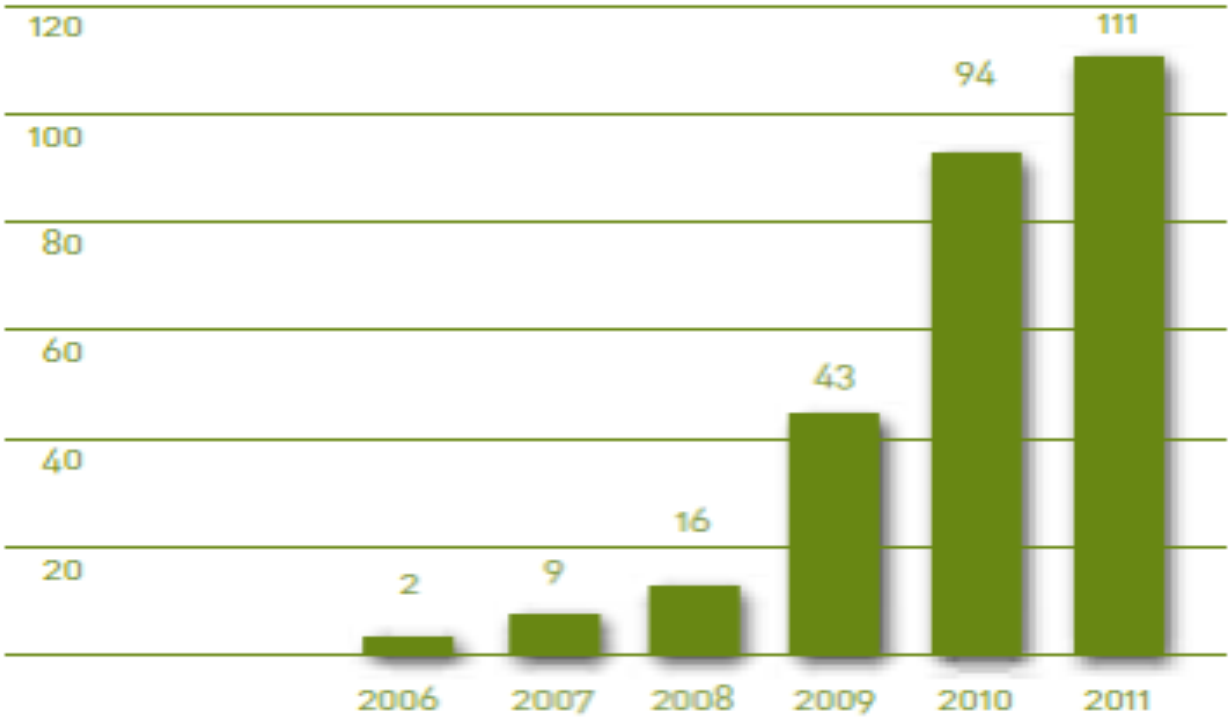
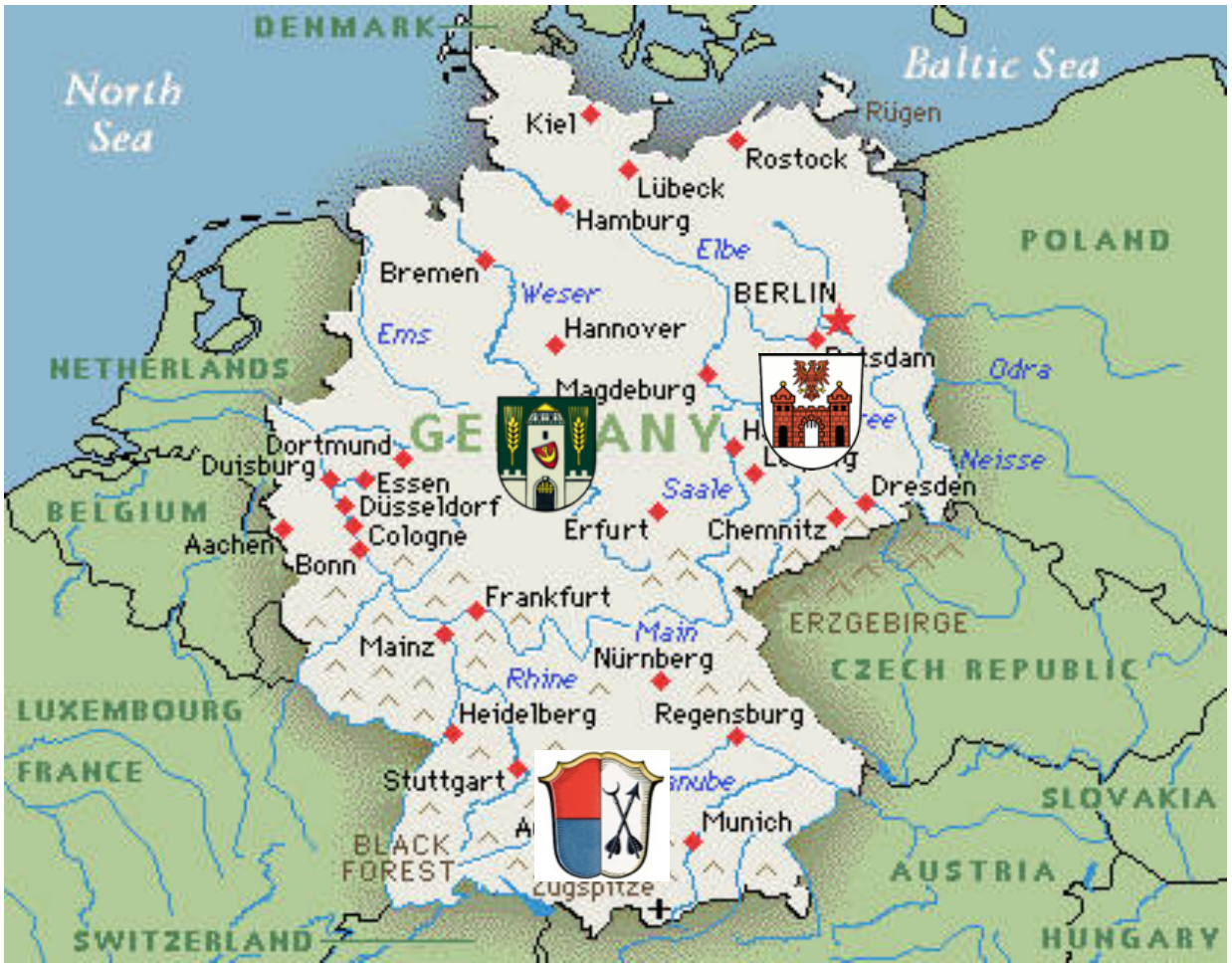
Participatory Effects in Energy Generation

Dynamics at the Local Level: Energy Autonomous Communities 2006-2011



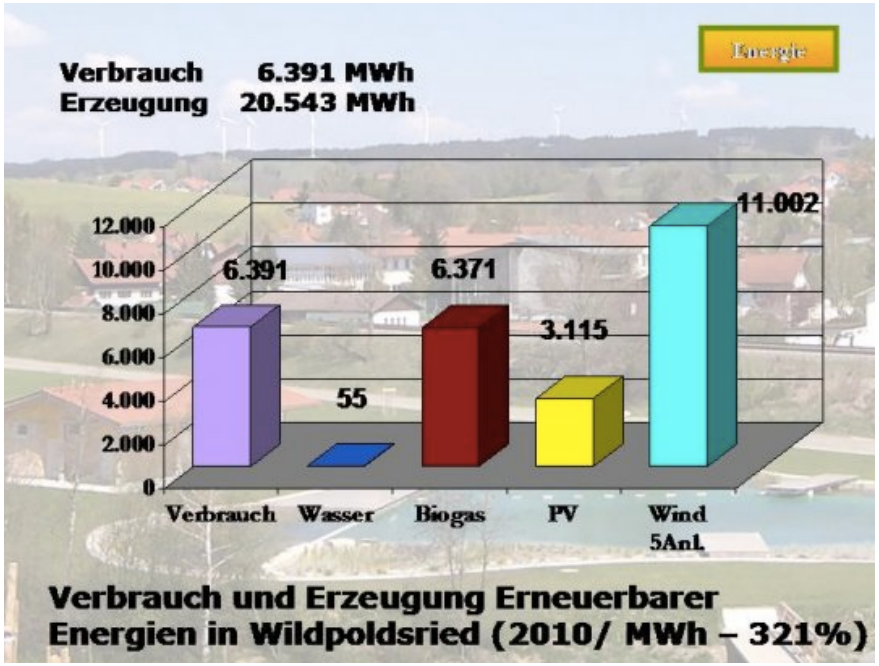
Source: DGRV

Energy-independent Communities: Three Examples



Wildpoldsried, Bavaria

- Launch of “W.I.R.” Initiative in 1999
- Established 2 companies (1999, 2001) to invest in renewable energy
- 4 biogas digesters, 7 windmills, 190 private PV facilities, district heating network, 3 small hydro power plants
- Now produces 321% more energy than it needs and is generating € 4 million (US $5.7 million) annually



http://www.wildpoldsried.de/index.shtml?Energie

Wildpoldsried

- Grußwort Bürgermeister
- Sitemap
- Aktuell
- Ortsvorstellung
- Rathaus
- Wir sind für Sie da!
- Bücherei
- Schule
- Dorfmuseum
- Vereine
- Übernachtung
- Veranstaltungen
- Duranand
- EU-Partnerschaft
- Seniorenwohnungen
- Bürgerstiftung
- Kultiviert
- Gasthof Hirsch
- Immobilienmarkt
- **Klimaschutz**
  - Emeuerbare Energie
  - ↳ Holz als Baustoff
  - ↳ Wasser / Abwasser
  - ↳ WiWaLaMoor
  - ↳ Biogas
  - ↳ Biomasse
  - ↳ dorfheizung
  - ↳ Photovoltaik/Solar/NEH
  - ↳ Brettstapelbauweise

Natürlich energisch!

***W*ildpoldsried**
***I* nnovativ**
***R* ichtungsweisend**

Idealist sein, heißt Kraft haben für andere!
Novalis

Wir in Wildpoldsried haben einige „Idealisten", denen wir es zu verdanken haben, dass in Wildpoldsried regenerative Energien in einer solchen Bandbreite erzeugt werden.

Insbesonders aus dem Bereich der Landwirtschaft kommen eine Vielzahl von Aktivitäten, die sowohl ökologisch als auch ökonomisch vorbildlich sind. Orstansässige Betriebe und Unternehmer ergänzen diese Palette durch innovative Produkte und Dienstleistungen.

Wir stellen Ihnen unsere Projekte vor:

innovativ

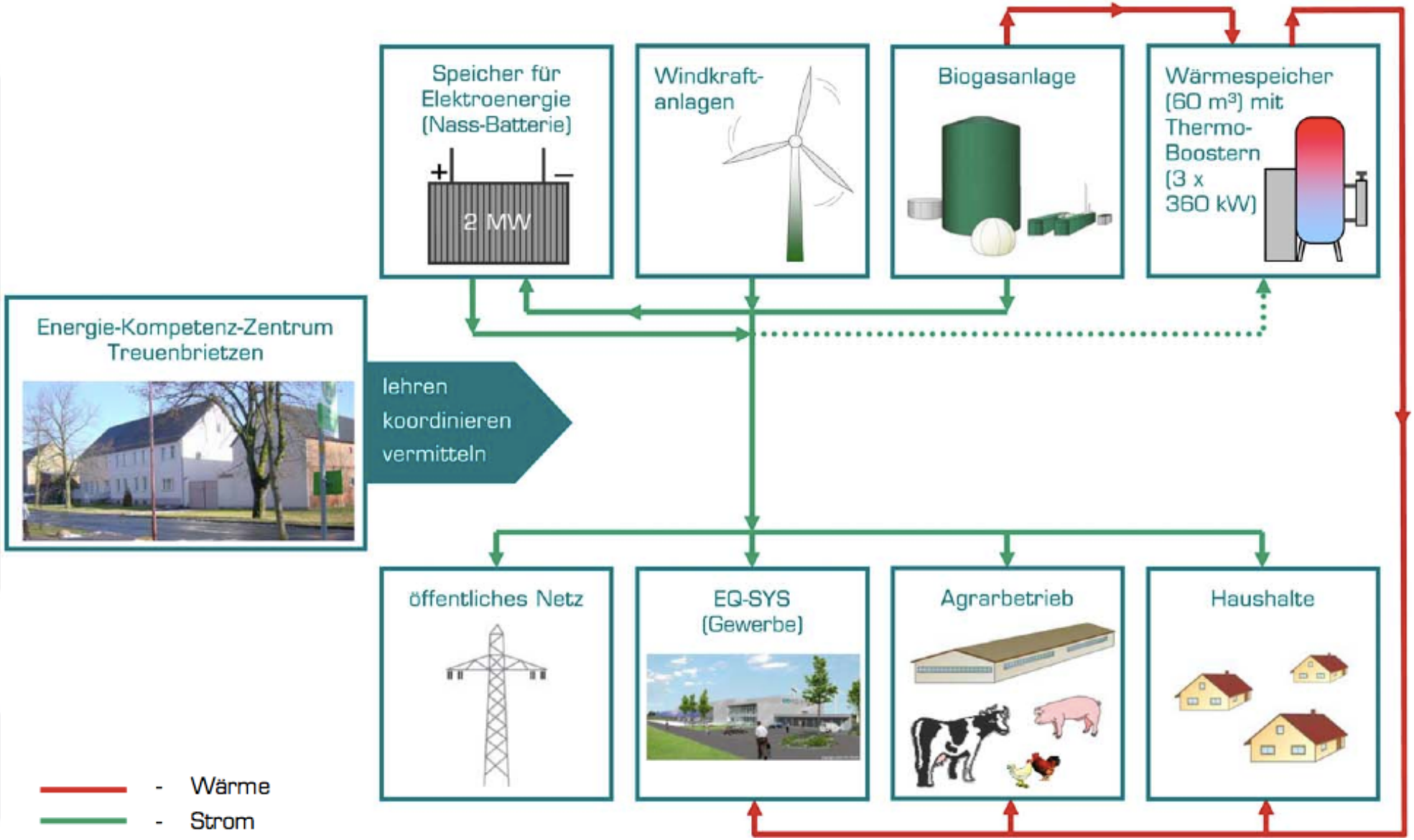
- Biogas
- Biomasse
- Dorfheizung Holzpellets
- Photovoltaik
- Solarthermie
- Wasserkraft
- Windkraft
- Passiv-Haus
- Erdwärme

richtungsweisend

- Projekt IRENE (Integration regenerativer Energien und Elektromobilität
- Energieberatung
- Umrüstung Straßenbeleuchtung
- Dämmung Dächer
- Energiemanagement
- European Energy Award
- Pumpenaustauschaktion
- Strommessgeräte
- Thermografieaktion

Feldheim, Brandenburg

- Launch of Energiequelle GmbH in 2006, advised by
- Individual households are supplied with heat and power from renewable energy power plants at their own doorstep via autarchic local grids
- A wind farm (75 MW) is the backbone of the local power supply grid, whereas heat (500 KW) is supplied by a local biogas plant. Fluctuations in wind power production will be balanced in future by a next-generation Na-S accumulator; a heating plant fired with woodchips is available for additional thermal energy requirements on particularly cold days


Speicher für Elektroenergie (Nass-Batterie)
+
–
2 MW
Windkraft-anlagen
Biogasanlage
Wärmespeicher (60 m³) mit Thermo-Boostern (3 x 360 kW)
Energie-Kompetenz-Zentrum Treuenbrietzen
lehren
koordinieren
vermitteln
öffentliches Netz
EQ-SYS (Gewerbe)
Agrarbetrieb
Haushalte
- Wärme
- Strom

http://www.neue-energien-forum-feldheim.de

- Home
- Control & Laboratory
- Academy
- Self-sufficient village
  - Standort
- Wind energy
- Photovoltaics
- Biogas
- Biomass
- Local heating network
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- Videos
- Contact
- Kontaktformular
- Imprint

The energy self-sufficient village

Energy supply to the energy-efficient village of Feldheim via private local heating and power grids

Success through cooperation

One of the most spectacular concepts for supplying enterprises, private households and local government with renewable energies on a decentralised, self-sufficient basis is currently being implemented in Feldheim, a district in Treuenbrietzen, a town in Brandenburg. The project owes its success to the excellent partnership between the municipality of Treuenbrietzen, the inhabitants of Feldheim and the project developer, Energiequelle GmbH.

The energy self-sufficient village

The individual households in Feldheim, Treuenbrietzen, are supplied with heat and power from renewable energy power plants at their own doorstep via autarchic local grids.

Energiequelle GmbH designed the various components of this concept – which includes cutting-edge, state-of-the-art wind power systems and biogas plants –, installed them as turnkey systems and linked them via the new heat and power distribution system to form a regional energy supply grid.

Reliability under peak loads

The nearby wind farm is the backbone of the local power supply grid, whereas heat is supplied by the local biogas plant. Natural fluctuations in wind power production will be balanced in future by a next-generation accumulator to be installed in a second, expansion phase of the project. A sophisticated heating plant fired with woodchips is available for additional thermal energy requirements on particularly cold days.

Jühnde, Lower Saxony

- Biogas digester with 700 kW (annual output: 5 million kWh), twice the amount required by the community
- Biomass power plant can provide 550 kW when needed (annual thermal output approximately 3. 2 million kWh)
- Participating households (70%+) are saving approx. 750 € annually, the town has generated 680.000 € in revenue with biomass

http://www.bioenergiedorf.de

Background: Phasing Out Nuclear Power in Germany

Nuclear Phase-out Reflects a Longer Trend:

- Nuclear phase-out originally adopted in June 2000 by the (then) newly elected coalition of Social Democrats and Green Party
- Phase-out was later deferred against great protest in the population by the Christian Democratic and Liberal coalition on 28 October 2010

Following the Tsunami at Fukushima on 11 March 2011:

- Within days, on 15 March 2011, all nuclear reactors built before 1981 – eight out of 17 – were temporarily closed
- On 30 May 2011, Germany decided to decommission the nine remaining nuclear power plants by 2022
- Phasing out nuclear power is broadly supported by the population (over 80%), no political party endorses nuclear power anymore

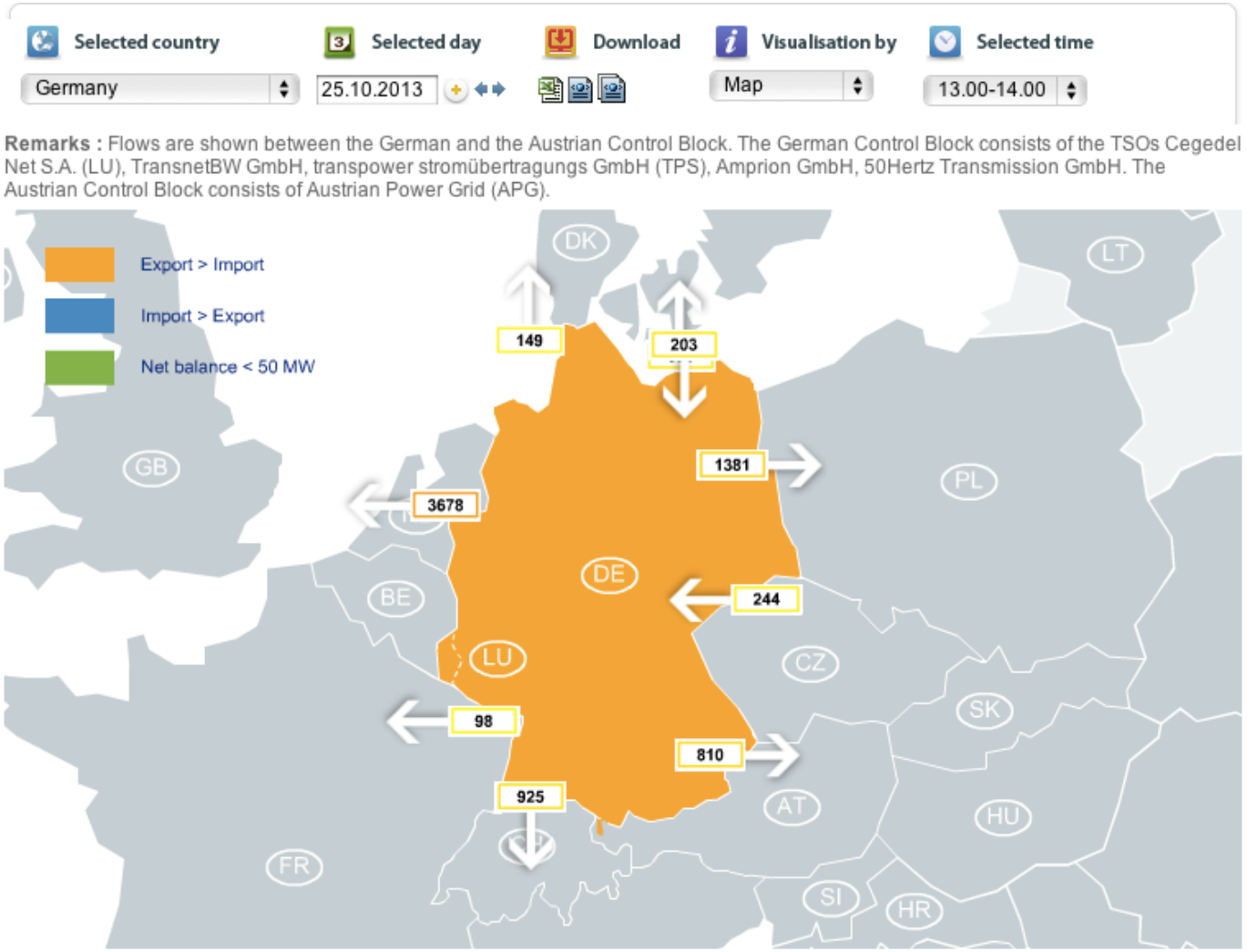
Does Germany Now Import Nuclear Power from France?

Germany's Phase-out Derided for Supposedly Necessitating Imports:

- Already before the nuclear phase-out, Germany traditionally **imported** power in summer (when domestic demand is low) because of cheap surplus power abroad (hydroelectric from Alpine countries, nuclear from France) and **exported** power in winter (when domestic demand is high), when neighboring countries face power shortages: this is an intended function of the international power exchange
- Imports never were caused by German power shortages: in summer, it simply was more economical for Germany to temporarily shut down coal- and gas-fired power plants and import cheaper surplus power from neighboring countries
- Closing nuclear plants in mid-2011 coincided with this phenomenon of rising imports in summer, leading critics to claim Germany increased nuclear power generation in France; but it is actually part of a normal trend
- By early 2012, renewable energy sources already were generating more electricity than the closed nuclear power plants; Germany now exports power both in summer and winter, and remains a net electricity exporter

Source: Loreck et al. 2013

Cross-Border Physical Flows (10/2013)



Source: ENTSOE-E, http://www.entsoe.net/data.aspx?IdMenu=1

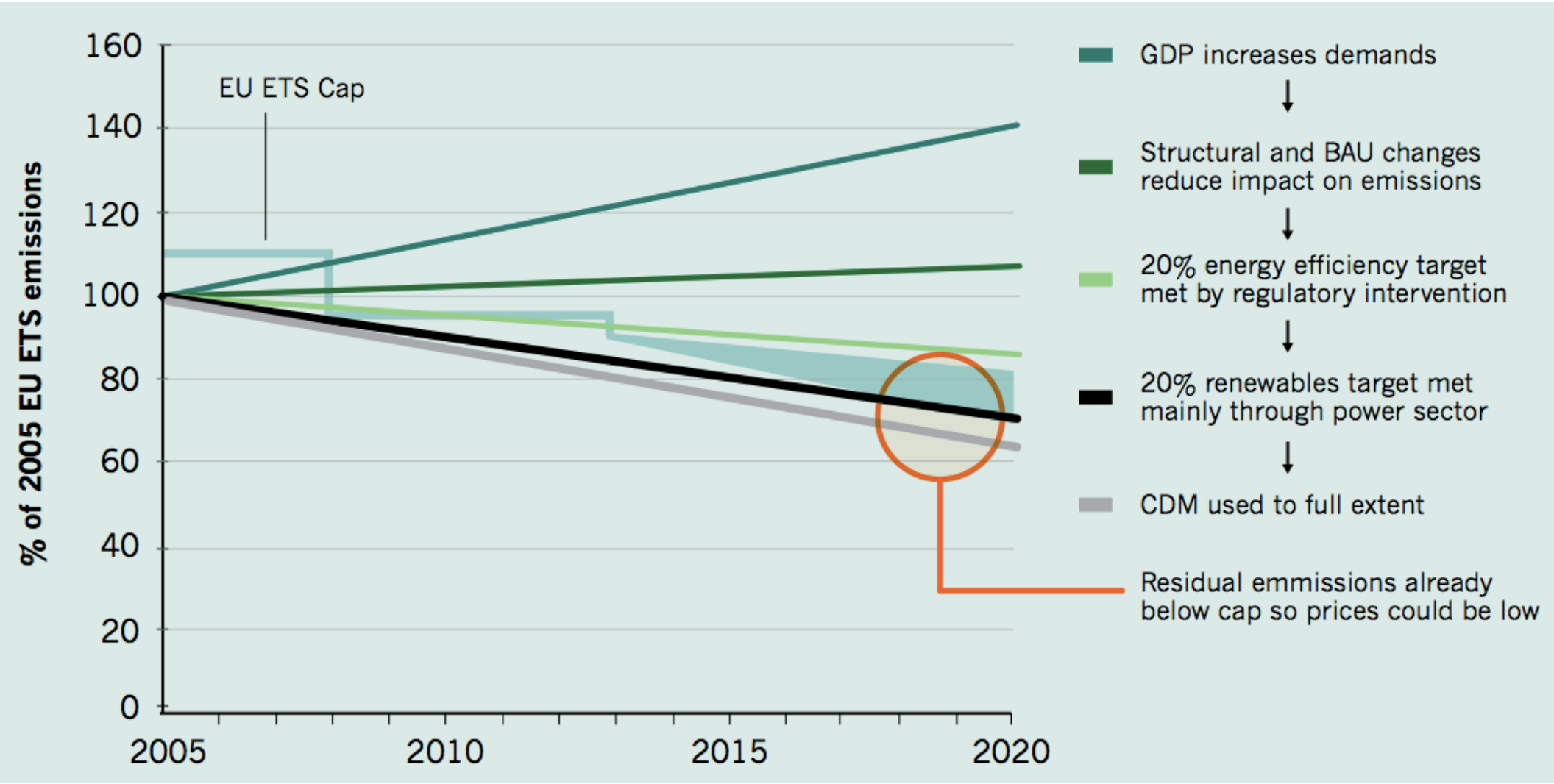
Nuclear Phase-out – Coal Renaissance?

Germany's "Dirty Little Secret"? (The Economist, January 2013):

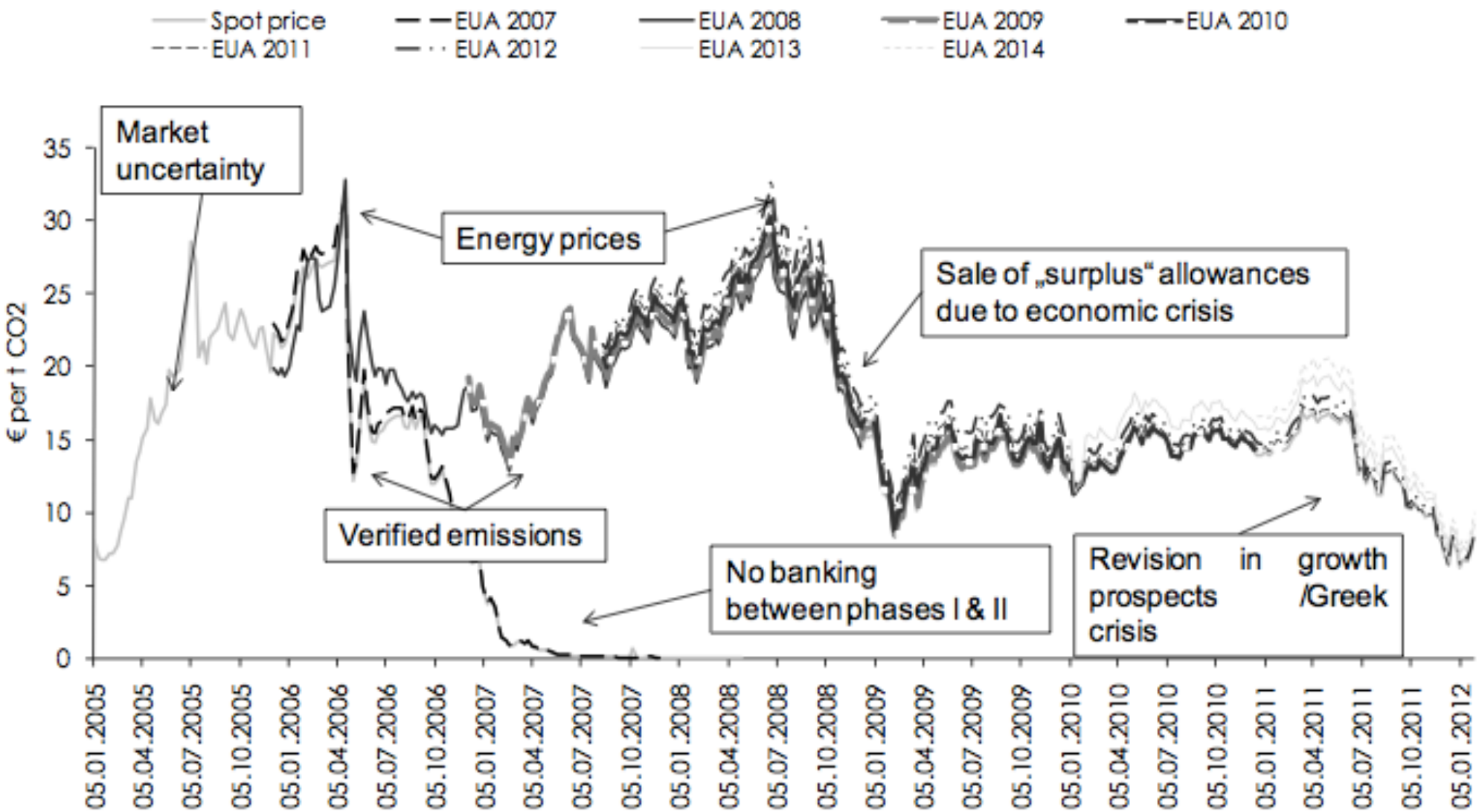
- Rising U.S. coal exports as a result of displacement through natural gas have increased coal supply and depressed coal prices; together with a low price for emission allowances, this has temporarily improved the economic case for coal use *vis-à-vis* other sources of electricity and increased coal use
- A majority of already permitted new coal-fired installations have been abandoned due to the deteriorating business case for coal; a small number of new coal-fired thermal power plants are proceeding, but mostly to replace older, less efficient plants that were to be decommissioned
- But the long term trend clearly shows a substantial decrease in coal fired power plants (from 56.7% of electricity supply in 1990 to 43.5% in 2010)
- Under the binding European cap on emissions, an increase in coal use means emissions have to be avoided elsewhere; rising demand for allowances also places upward pressure on carbon prices, promoting clean energy innovation

- http://www.washingtonpost.com/world/europe-consuming-more-coal/2013/02/07/ec21026a-6bfe-11e2-bd36-c0fe61a205f6_story.html
- http://www.renewableenergyworld.com/rea/news/article/2012/10/german-coal-fired-generation-of-electricity-falls-while-renewable-generation-rises
- http://energytransition.de/2012/09/ii-sub-2-2/

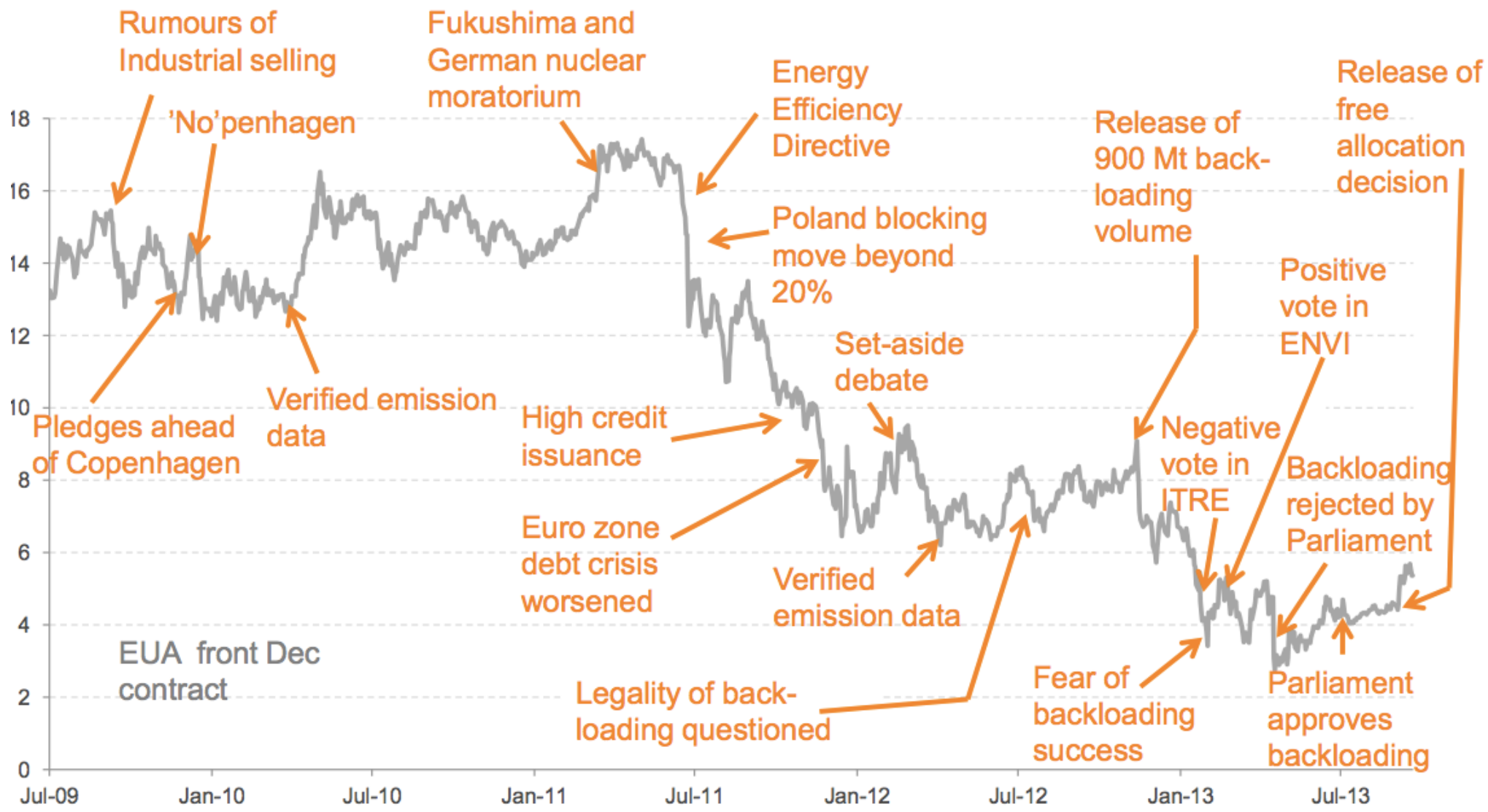
- Long term trend clearly not towards coal
- Short-term trend due to low EUA prices, strong decilne in coal price due to displacement by US shale gas



Source: Climate Strategies 2012

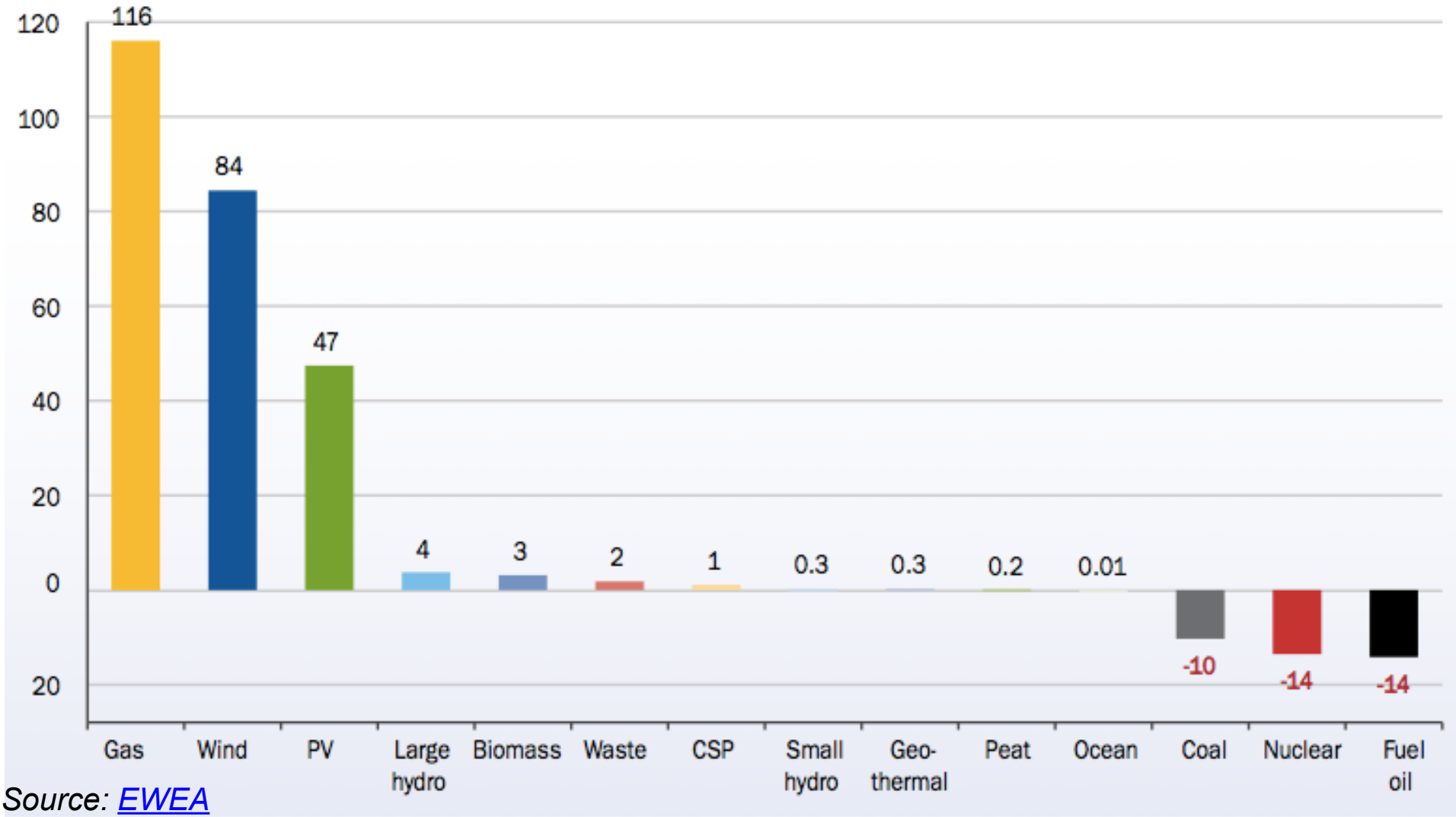


Sources: Kettner et al., Point Carbon



Source: Point Carbon

Net Electricity Generating Installations in EU 2000–2011 (GW)



Source: EWEA

European utilities

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The Economist

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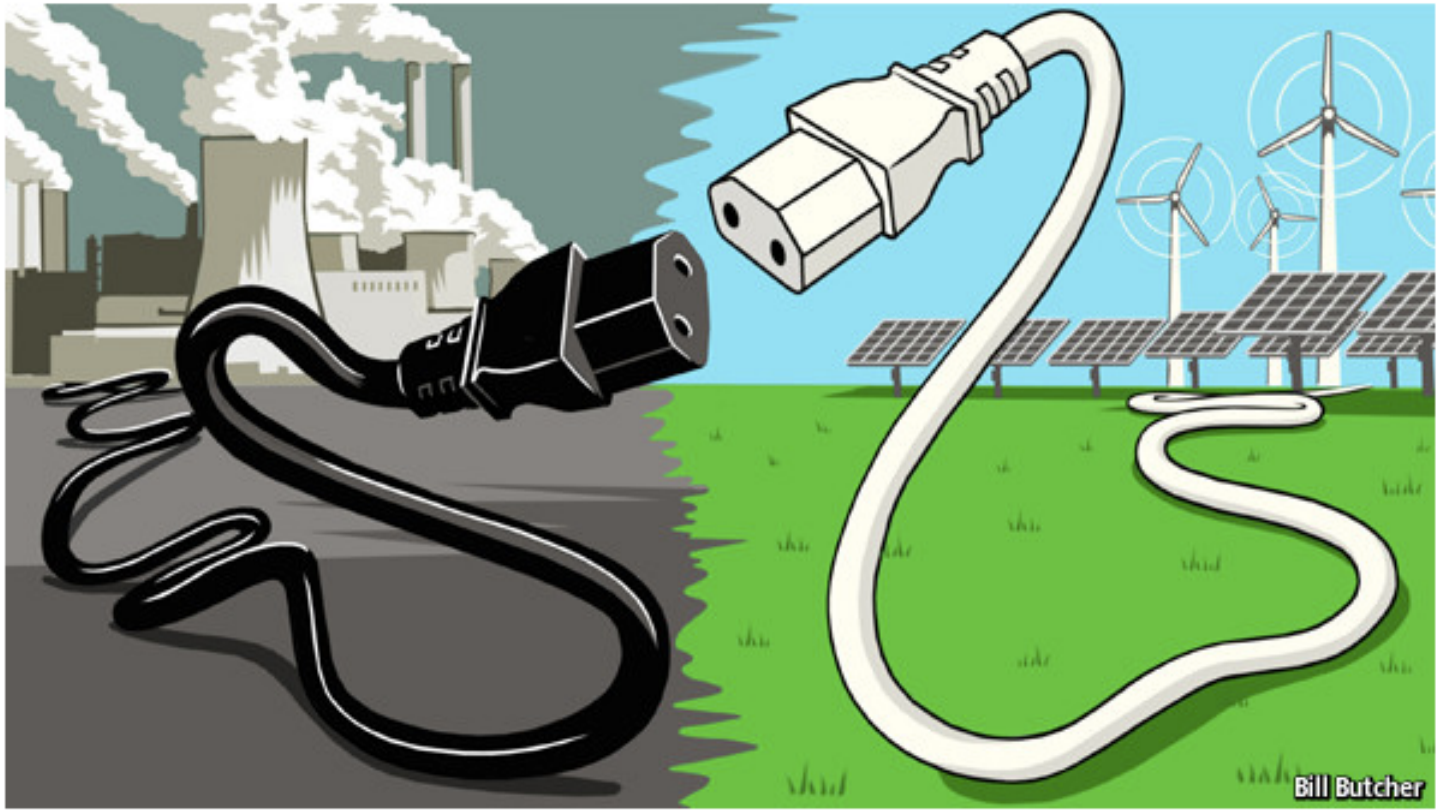
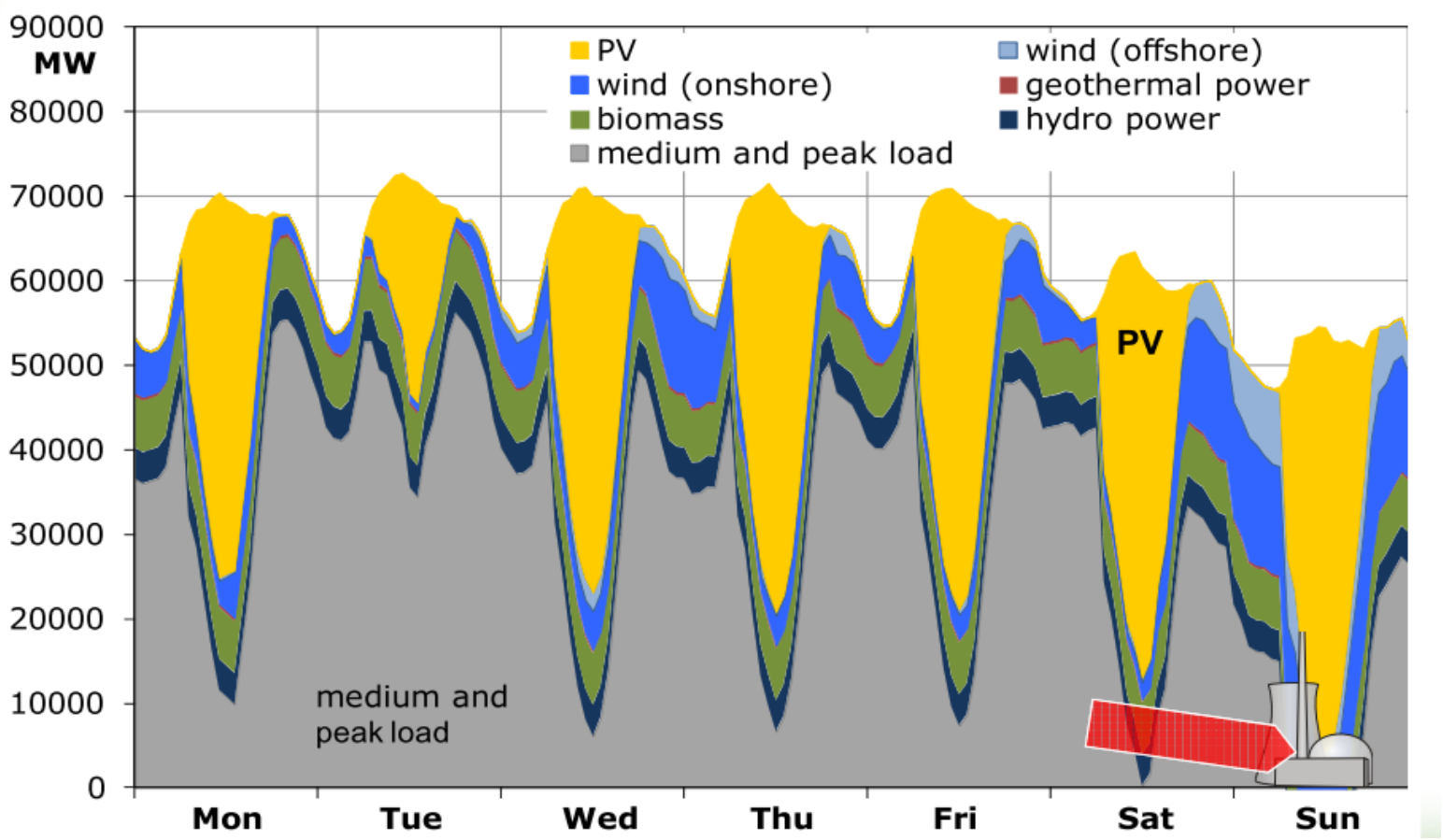


Undermining the Business Case for Incumbents?

Due to the merit-order effect and near-zero marginal cost of variable renewable electricity sources, conventional power is being priced out of the market; this can exacerbate current balancing challenges. But response measures need to be carefully weighed:

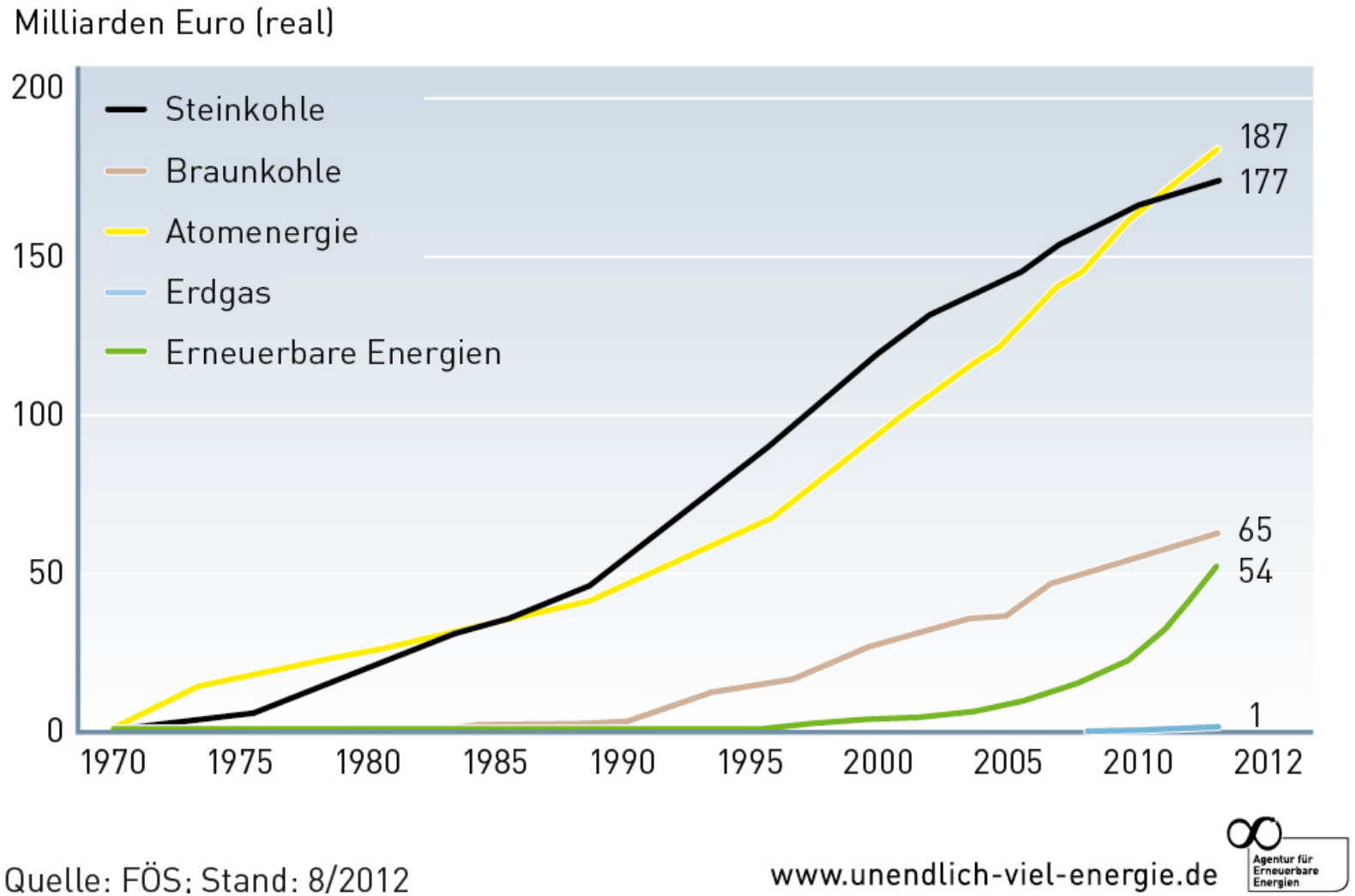
- Capacity-remuneration mechanisms (such as compensation payments for incumbents) have to be applied cautiously to avoid incentivizing expansion of fossil fuel generation capacity
- Investing in improved storage, interconnection and demand-side management (e.g. combined heat and power, which can open new revenue streams – heat – for conventional power generators) are more efficient and sustainable solutions
- But: baseload power will eventually be crowded out in a well-balanced system

A Spring Day in 2020: Baseload Power Crowded Out



Source: HTW Berlin

Cumulative Subsidies for Electricity Generation 1970-2012



Quelle: FÖS; Stand: 8/2012

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Agentur für Erneuerbare Energien

German Energy Transition: Some Takeaways

- A large-scale transition to renewable energy **can** work, and – if designed well – can help strengthen competitiveness, incentivize innovation, growth and employment, all while reducing environmental impacts
- The German experiment is **altering the ownership structure** of the resource 'energy', with a majority of renewable electricity generation owned **by independent generators** (individuals, farms, communities)
- This diversity can actually **stimulate competition** in the electricity market, and contributes to **high acceptance** in the broader public
- **But:** as renewable energy expands, it can give rise to challenges for grid integration and stability: an infrastructure challenge, not an inherent flaw!

Thank You!

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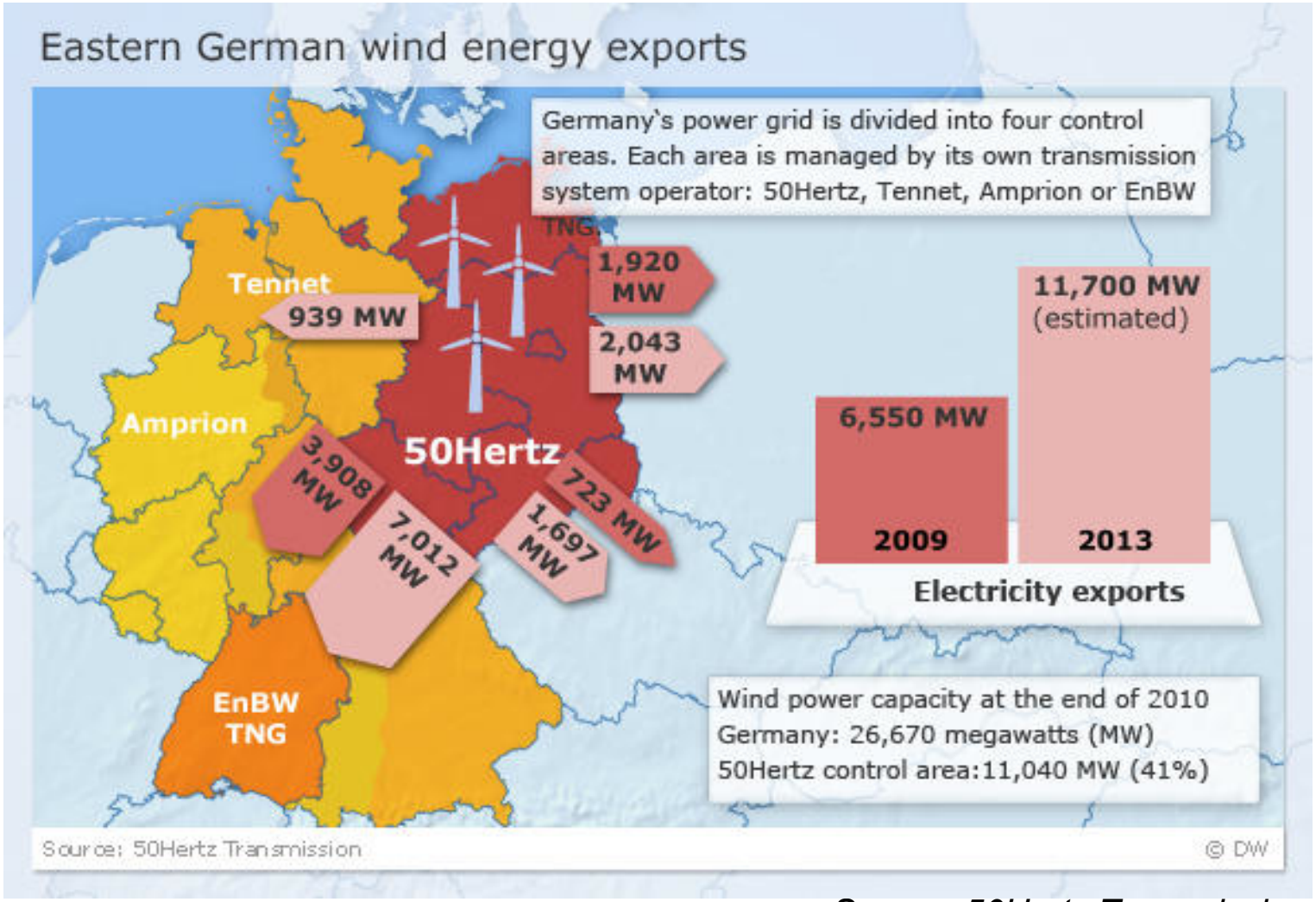
Already a Challenge for the Electricity Grid



Source: 50Hertz Transmission

Grid Expansion as Part of the Solution

Source: Der Spiegel