Rural Clean Energy Tour of Germany

Sept. 22-29, 2012

- Organized by the **Heinrich Böll Foundation**
- Part of their **Climate Network initiative**
- Funded in part by the **European Union**
- **Tour Goals**:
  - Foster a transatlantic exchange on energy and climate issues
  - Provide American stakeholders with an in-country opportunity to learn about German renewable energy policy and projects

Meeting Participants

- German Federal Ministries
  - Environment, Nature Conservation and Nuclear Safety
  - Economics and Technology
- Members of German Parliament
- Cooperative leaders and project developers
- Mayors, local business owners, and community leaders
- Farmers and facility operators
- Renewable energy consultants

Berlin - September 23-25
Germany

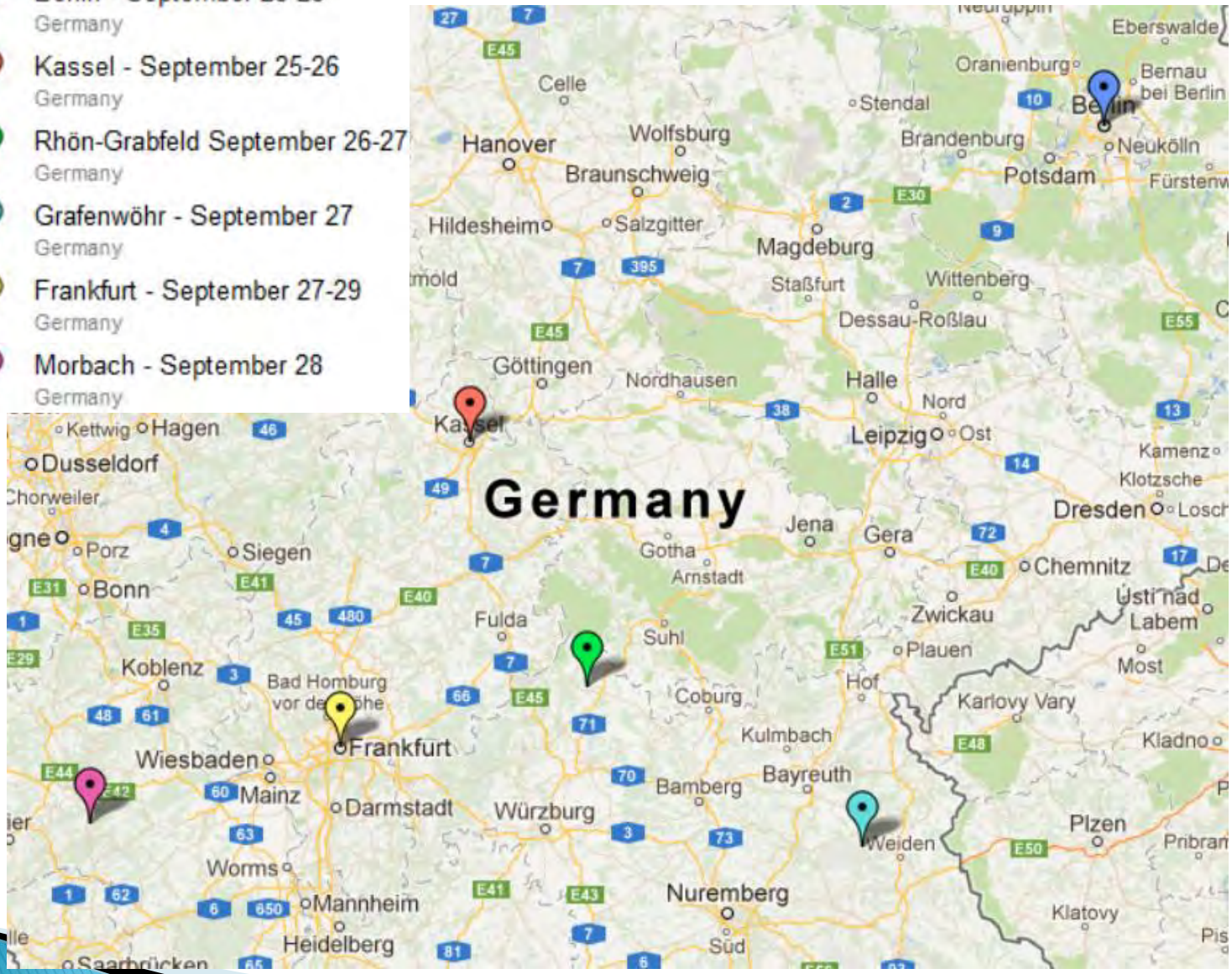
Kassel - September 25-26
Germany

Rhön-Grabfeld September 26-27
Germany

Grafenwöhr - September 27
Germany

Frankfurt - September 27-29
Germany

Morbach - September 28
Germany



European Union Climate and Energy Policy: '20-20-20' by 2020

EU member states have agreed to:

- Reduce greenhouse gas emissions by 20% compared to 1990
- Increase the share of renewable energy in overall energy consumption to 20%
- Improve energy efficiency by 20%

Underlying strategy: Pan-European infrastructure network and regional /continental energy market

Source: The European Commission

Why is Germany moving aggressively toward renewable energy?

1. Climate protection
2. Global markets for green technologies
3. New and well-paying jobs
4. Supply security

→ **To make Germany one of the most efficient and climate-friendly economies in the world**

A Very Brief History of German Renewable Energy Policies

- **2000: Renewable Energy Law (EEG) – 12.5% of electric generation from renewables by 2010**
  - Established current feed-in tariff based on technology cost, reduction in rate over time, and obligation to purchase from local producers
  - 12.5% goal achieved in 2007 (three years early)
- **Sept. 2010: Energy Concept – *Energiewende* – ambitious goals for all sectors, reaching to 2050**
- **June 2011: Energy Package – phaseout of nuclear power by 2022, plus efficiency laws and specific steps for grid expansion**

A Tale of Two Capitol Buildings

The Reichstag: World's Greenest Parliament

Rooftop solar panels and a basement CHP unit, fueled by rapeseed oil, produce half the building's electricity (with the remainder from renewable sources off-site). Excess heat is pumped to an underground aquifer for storage.

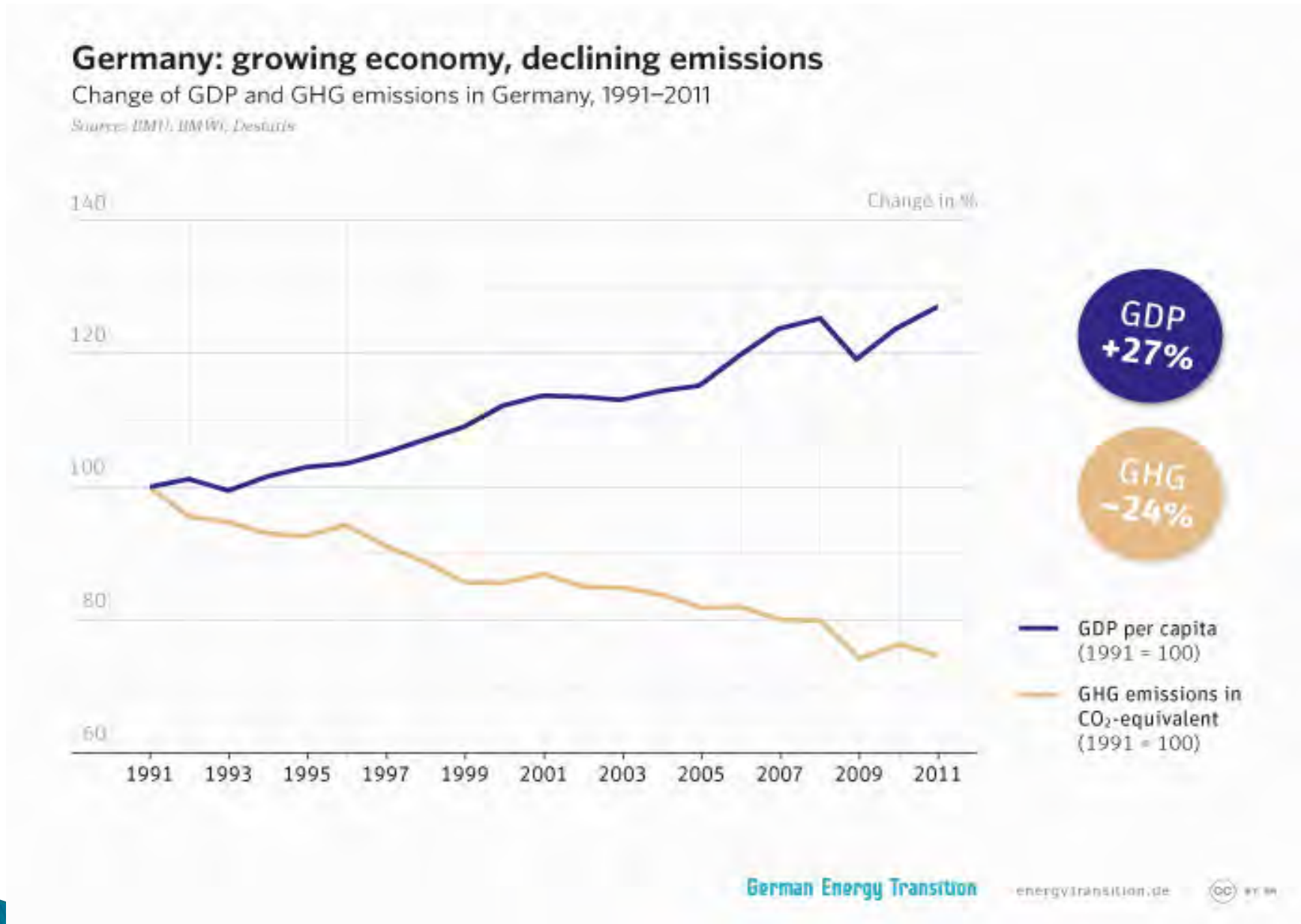
US Capitol: Noxious Fumes and Fine Particulates

An off-campus plant, built in 1910 and fueled by West Virginia coal and natural gas, provides heat and air conditioning. Neighbors complain about the yellow smokestacks, but efforts to "green the Capitol" have failed.

Goals of German Energy and Climate Policy

- Reduction in
  - GHG emissions (40% by 2020, 80% by 2050)
  - Primary energy consumption (20% by 2020, 50% 2050)

- Increase in
  - Renewable electric power (35% by 2020, 80% by 2050)
  - Renewable energy in all sectors (18% 2020, 60% 2050)
  - Energy productivity (2.1%/year compared to energy consumption)


Germany: growing economy, declining emissions
Change of GDP and GHG emissions in Germany, 1991–2011
Source: BMU, BMWi, Destatis
Change in %
140
120
100
80
60
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
GDP +27%
GHG −24%
GDP per capita (1991 = 100)
GHG emissions in CO₂-equivalent (1991 = 100)
German Energy Transition
energytransition.de

Information from:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

The *Energiewende*

Targets

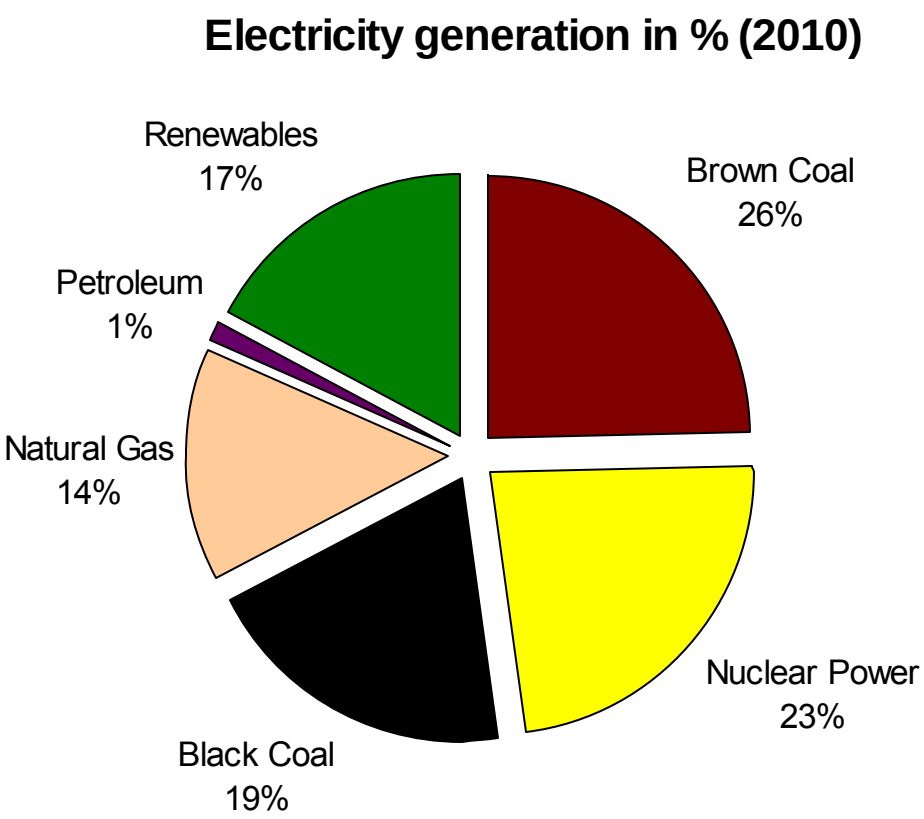
	Climate	Renewable energies		Efficiency		
	Greenhouse gases (vs. 1990)	Share of elec.	Overall share	Primary energy cons.	Energy produc-tivity	Building moderni-zation
2020	- 40%	35%	18%	- 20%	Increase to 2.1%/a	Double 1% → 2%
2030	- 55%	50%	30%			
2040	- 70%	65%	45%			
2050	- 80-95%	80%	60%	- 50%		

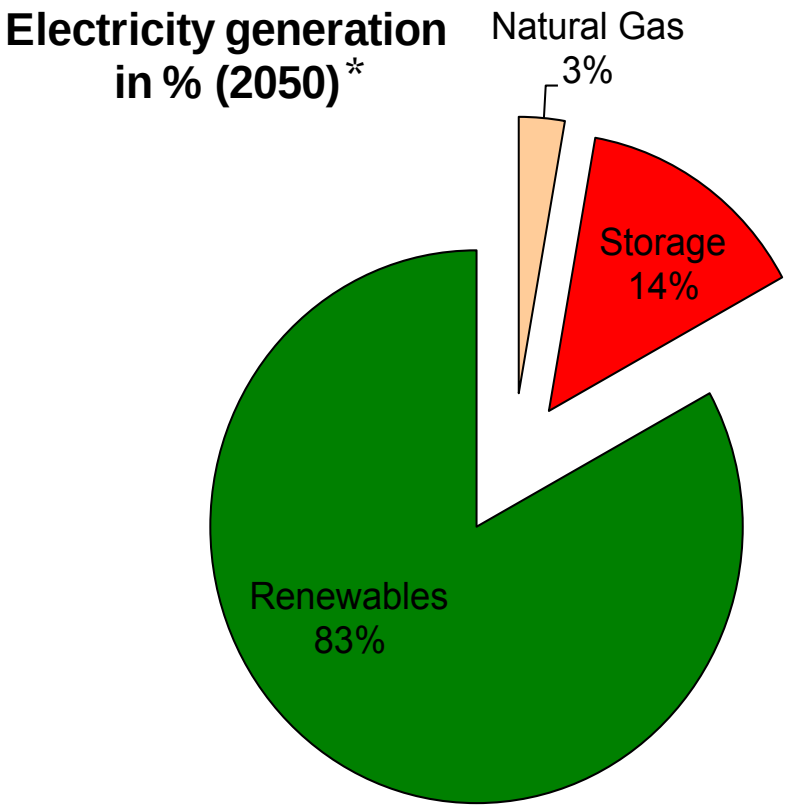
Renewable Targets Within "Overall Share"

- Transportation: 10% renewable by 2020
  - In 2010, biofuels were supplying 5.8% of fuel for transportation.
  - Germany is aiming for 1 million electric cars by 2020, with smart grid integration.

- Heating: 14% renewable by 2020
  - Currently at 10%
  - Renewable Energy Heat Act of 2009 sets targets, strategies, funding.

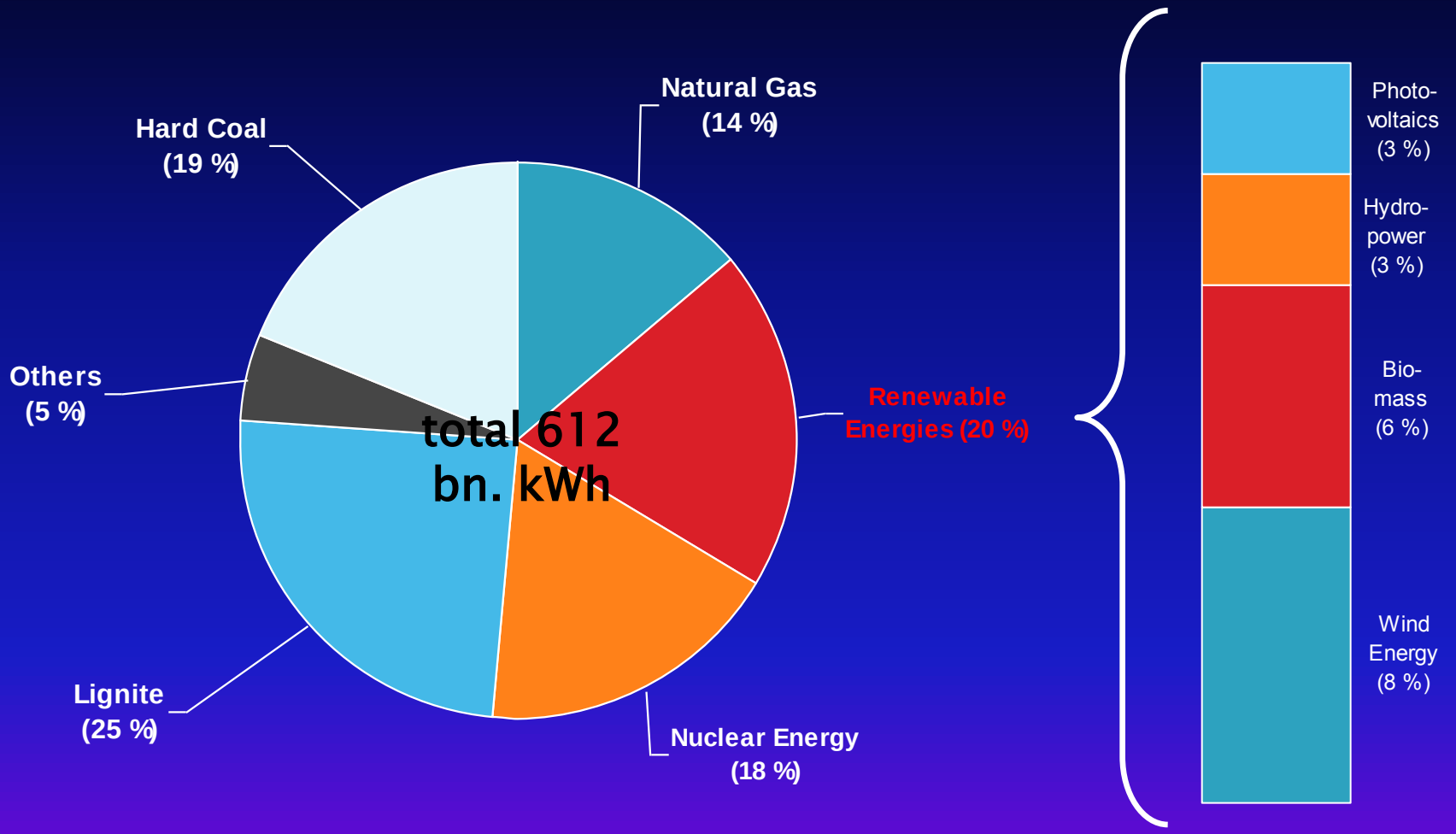
Electricity Mix in Germany, 2010 – 2050



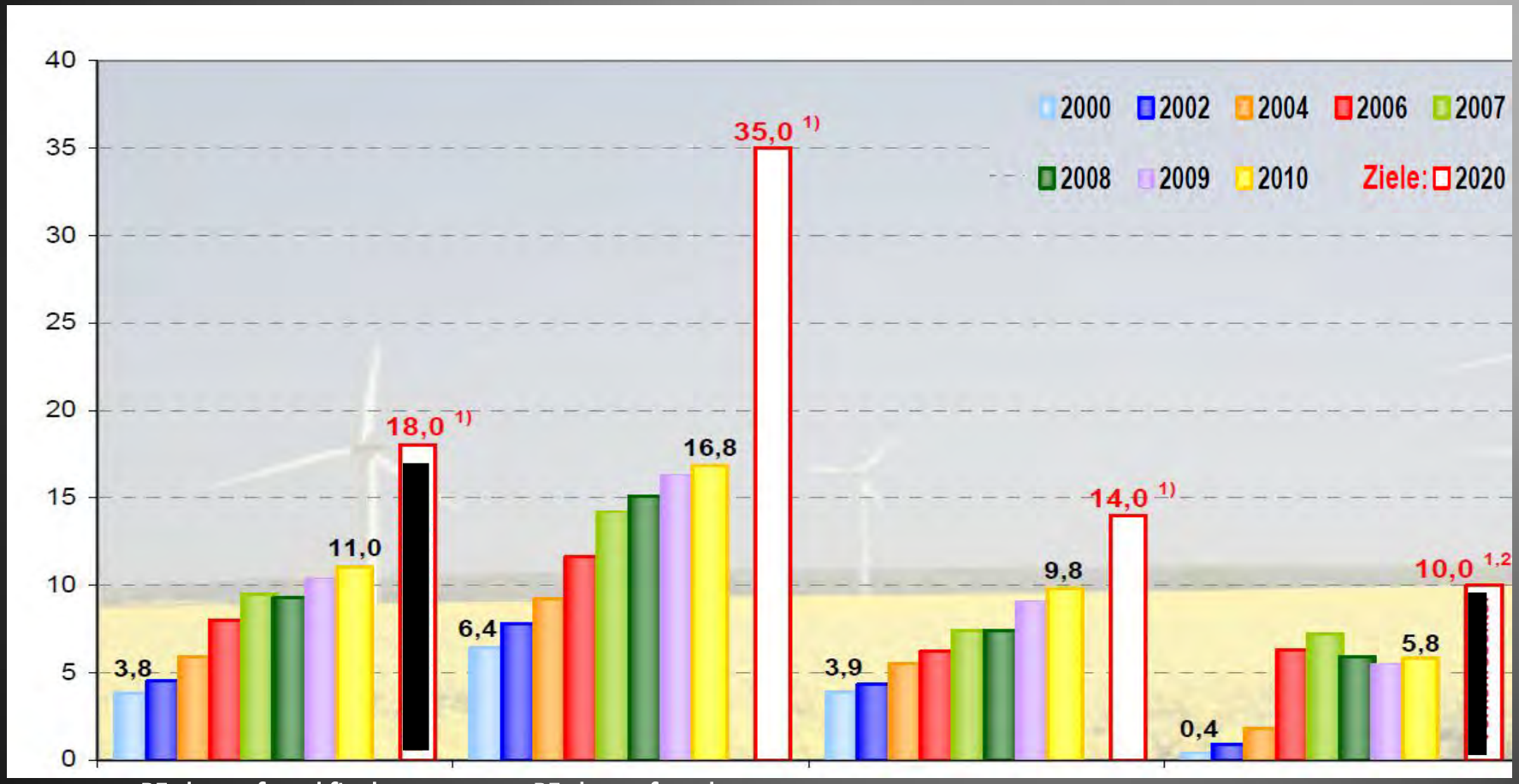


(*) „Modell Deutschland“, Scenario without CCS: Prognos & Ökoinstitut, 2010 commissioned by WWF

Electricity Mix in Germany, 2011



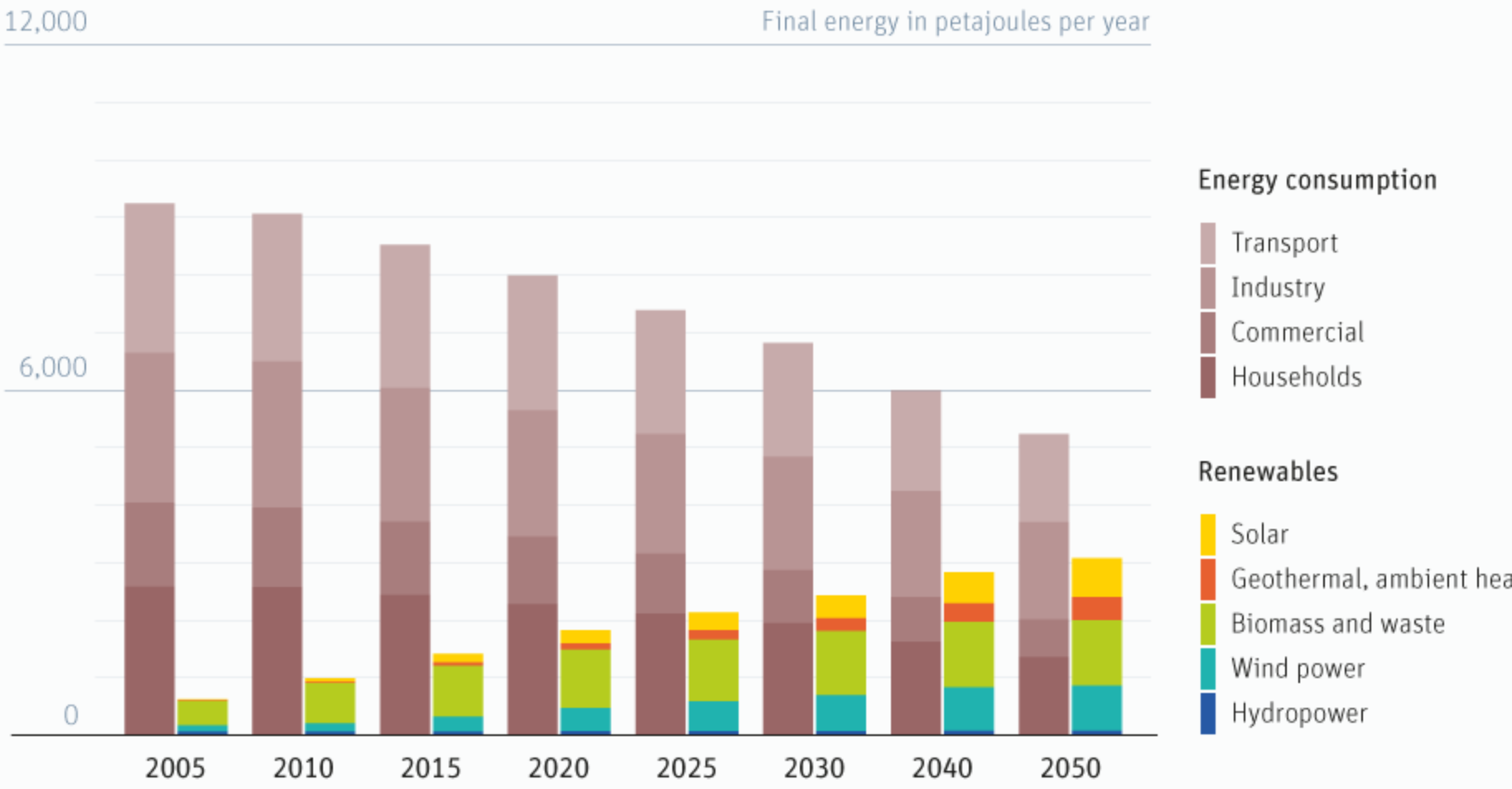
The *Energiewende* Is on Track



Germany's plan: ramp up renewables, drive down energy consumption

Final energy supply and demand in Germany 2005–2050, scenario

Source: DLR Lead Study, scenario A



Four Cornerstones for Success

1. Energy Efficiency
2. Feed-in Tariff
3. Grid Expansion and Improvement
4. Public Involvement and Opportunity

1) Energy Efficiency

- Buildings = 40% of German energy use and 33% of carbon-dioxide emissions
- Goal: Cut energy consumption in buildings by 20% by 2020, 80% by 2050 = “climate neutral building” standard
- National plan set every three years
- >300 billion € by 2050 for residential upgrades alone

Some Steps to Efficiency

- Education and information
- Strict energy standards for new buildings, government renovations
- Aim to retrofit 3% of buildings annually (currently1%)
- Energy certificate on display in every public building
- Mandatory labeling at time of sale or rent of any private structure
- Public procurement process w/ life-cycle analysis and energy criteria
- Incentives, not compulsory renovation
- Residential audits subsidized at 60-80%
- Data base of experts, >650 consumer advice offices, €5 fee
- Industry commitment to train advanced labor pool
- Gradually increasing tax on heating fuels to reflect carbon emissions (revenue neutral)
- 100 million €/year available through Energy Efficiency Fund for grants, education, research and development, smart meters
- Efficiency standards for appliances, cars

2) Germany's Feed-in Tariff

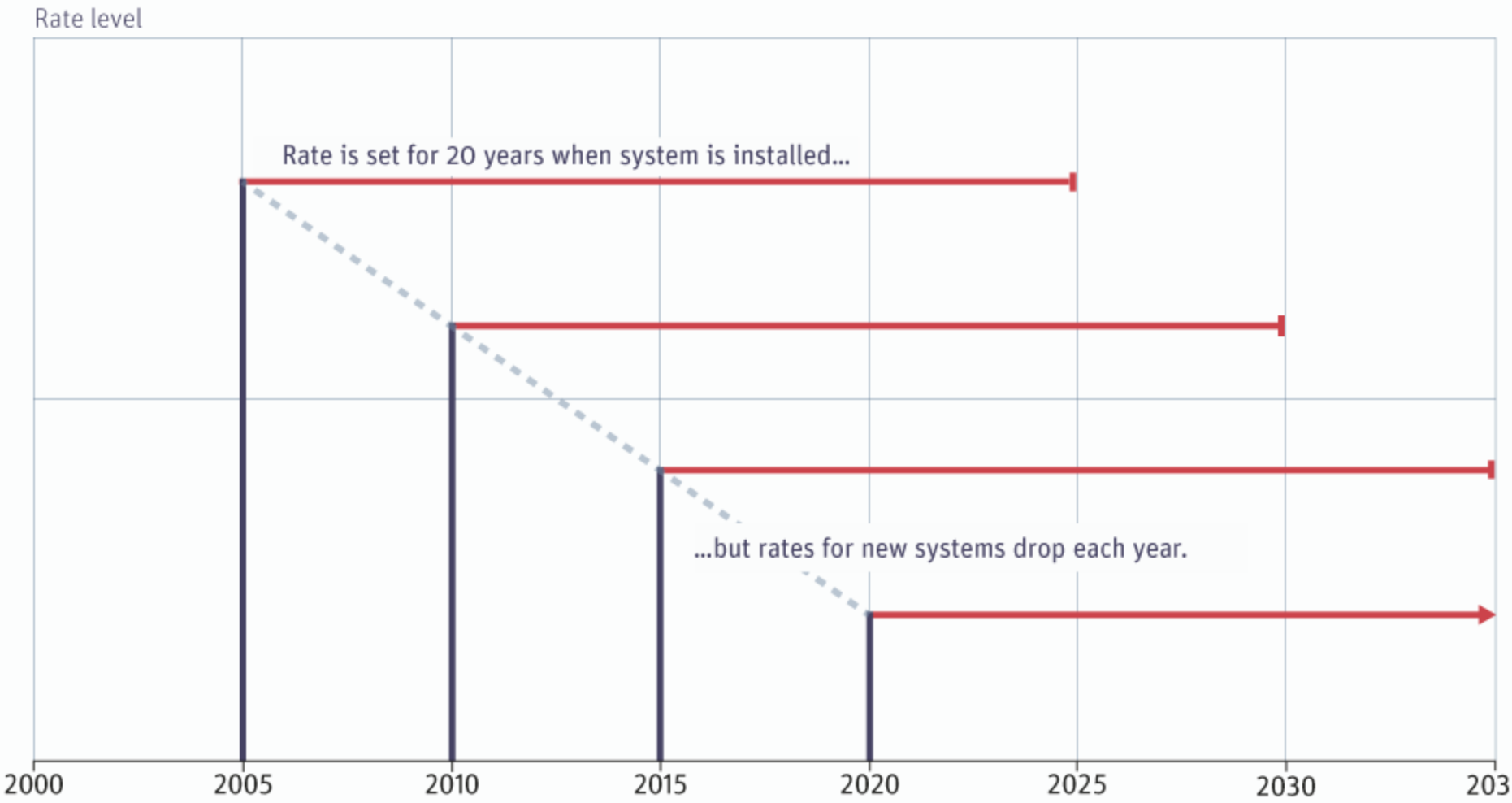
- Introduced by the 2000 Renewable Energy Law

1. Fixed-price tariff for 20 years, technology-specific
2. Guaranteed, priority grid access and dispatch
3. Annual degression of the tariffs
4. Equalization of additional costs for electricity from RE among all grid operators and electricity suppliers (2011: ~3.6 €cents/kWh)
5. Project owners have option to take FiT or sell into market
6. Regular monitoring and reevaluation

Feed-in tariffs provide investment certainly and drive costs down

Simplified generalization of feed-in tariff with 20 year duration

Source: Own estimates based on WFC



Feed-in Tariff (FiT) Examples

	Euro	US Dollar*
Onshore wind (§§ 29, 30 EEG)	**Ct/kWh**	**Ct/kWh**
Basic Fees		
Initial fee (first 5 years from start of operation; plus extension formula time*)	8.93	11.5
Base fee	4.87	6.3
Small-scale up to 50 kW	8.93	11.5

Solar radiation (§§ 32, 33 EEG)	**Ct/kwh**	**Ct/kWh**
Roof-mounted facilities		
Capacity		
Up to 30 kW	24.43*	31.5
Up to 100 kW	23.23*	30.0
Up to 1 MW	21.98*	28.4
Over 1 MW	18.33*	23.6

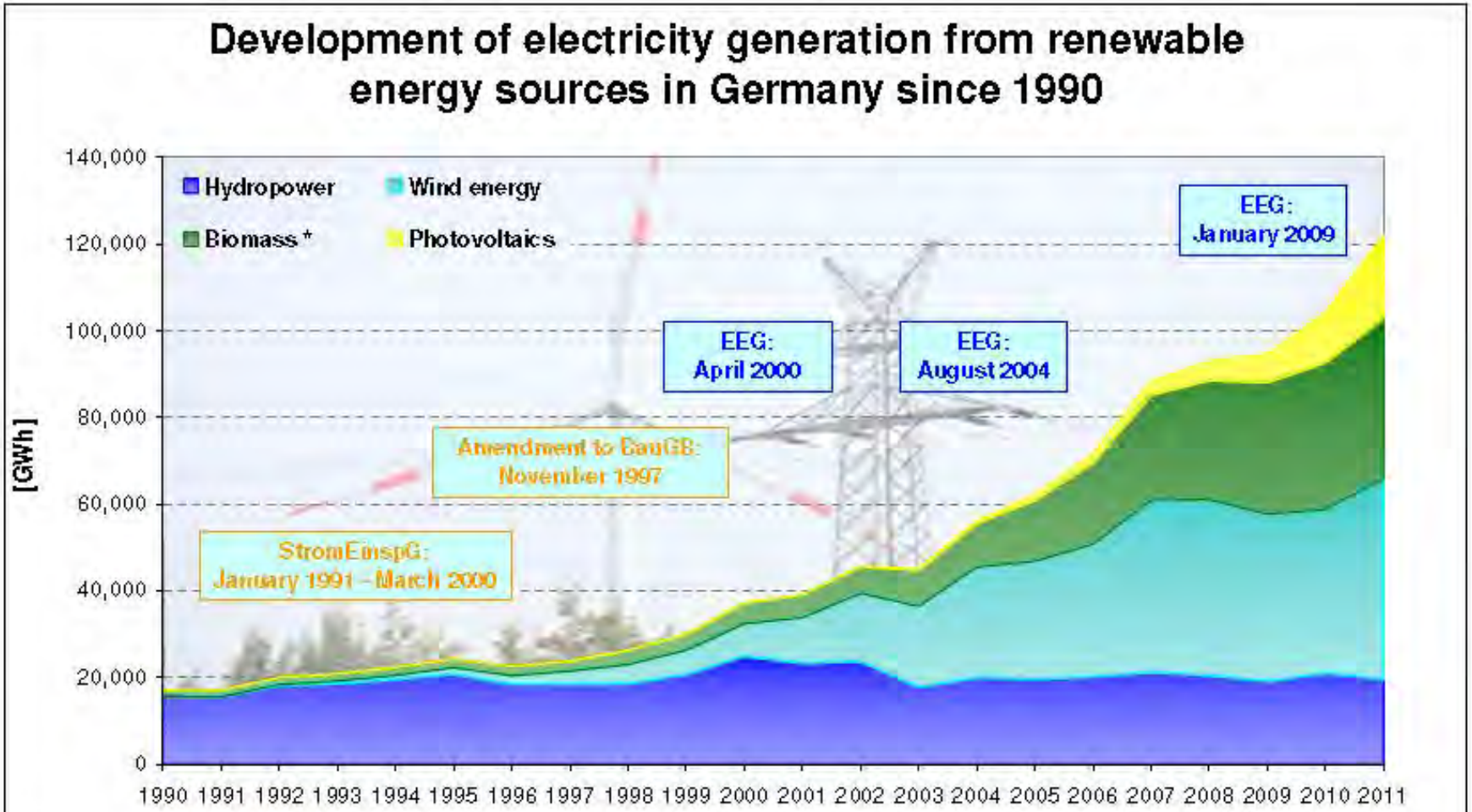
	Euro	US Dollar*
Biomass (§ 27 EEG)	**Ct/kwh**	**Ct/kWh**
Basic tariff		
Up to 150 kW	14.3	18.4
Up to 500 kW	12.3	15.9
Up to 5 MW	11	14.2
Up to 20 MW	6	7.7
Tariff biowaste installations and small manure gas		
Biowaste fermentation up to 500 kWel	16	20.6
Biowaste fermentation up to 500 kWel to 20 MWel	14	18.1
Manure biogas upt to 75 kWel	25	32.3

* Based on 1.29 Euro-to-US Dollar conversion rate on 10/8/2012

FiT Impact: Investment in renewable projects w/ dramatic increases in energy production

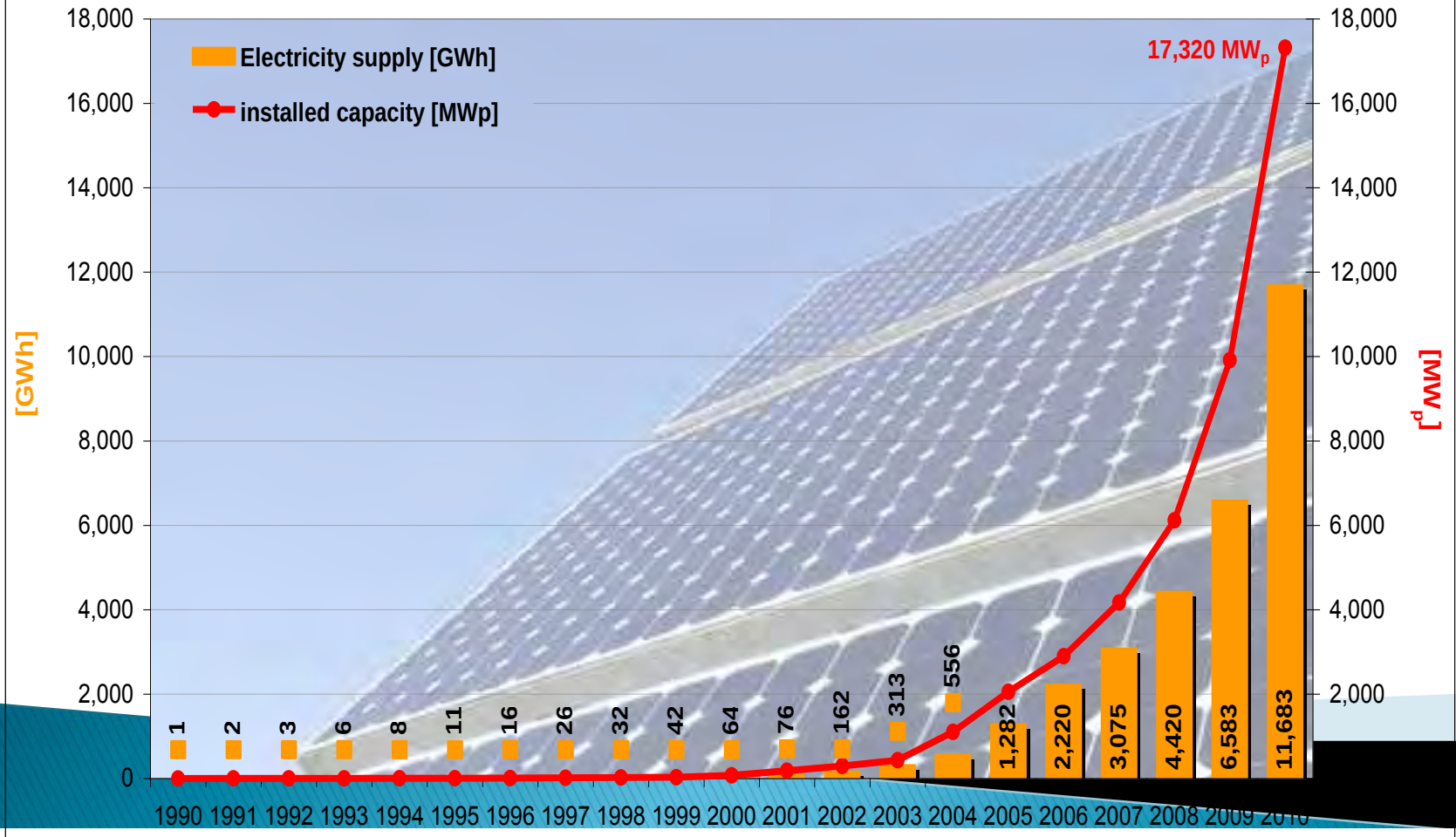
Note: PV nearly matches hydro production in 2011

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



* 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 March 2012; all figures provisional

Installed capacity and energy supply from photovoltaic installations in Germany

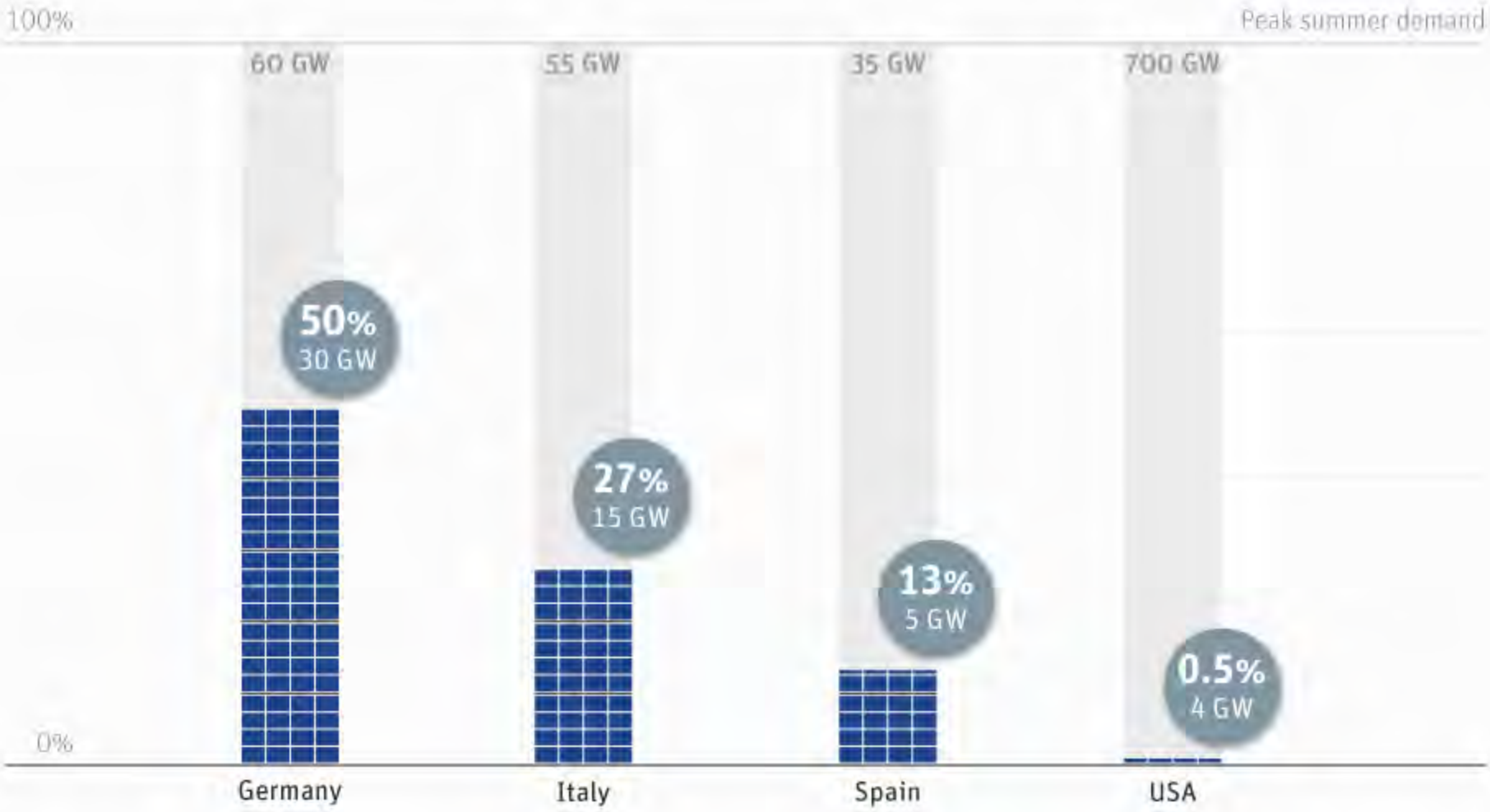


Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat);
1 GWh = 1 Mill. kWh; 1 MW = 1 Mill. Watt; image: BMU / Bernd Müller; as at: July 2011; all figures provisional

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)

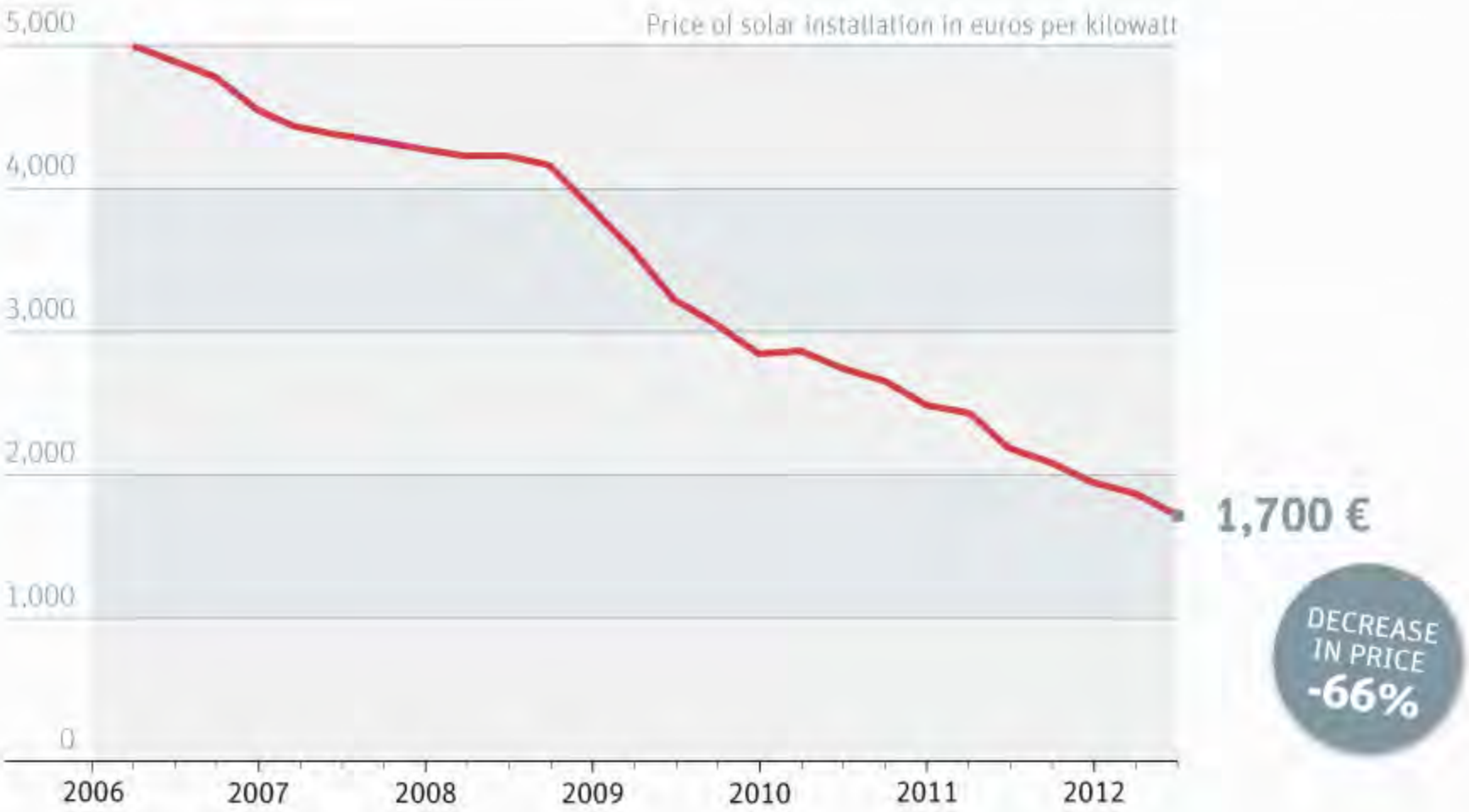
Source: REN 21, own calculations



Installed solar system prices have plummeted by 66% since 2006

Average end-customer system prices for installed rooftop solar of up to 100 kilowatts-peak

Source: EUPD Research and BSW-Solar



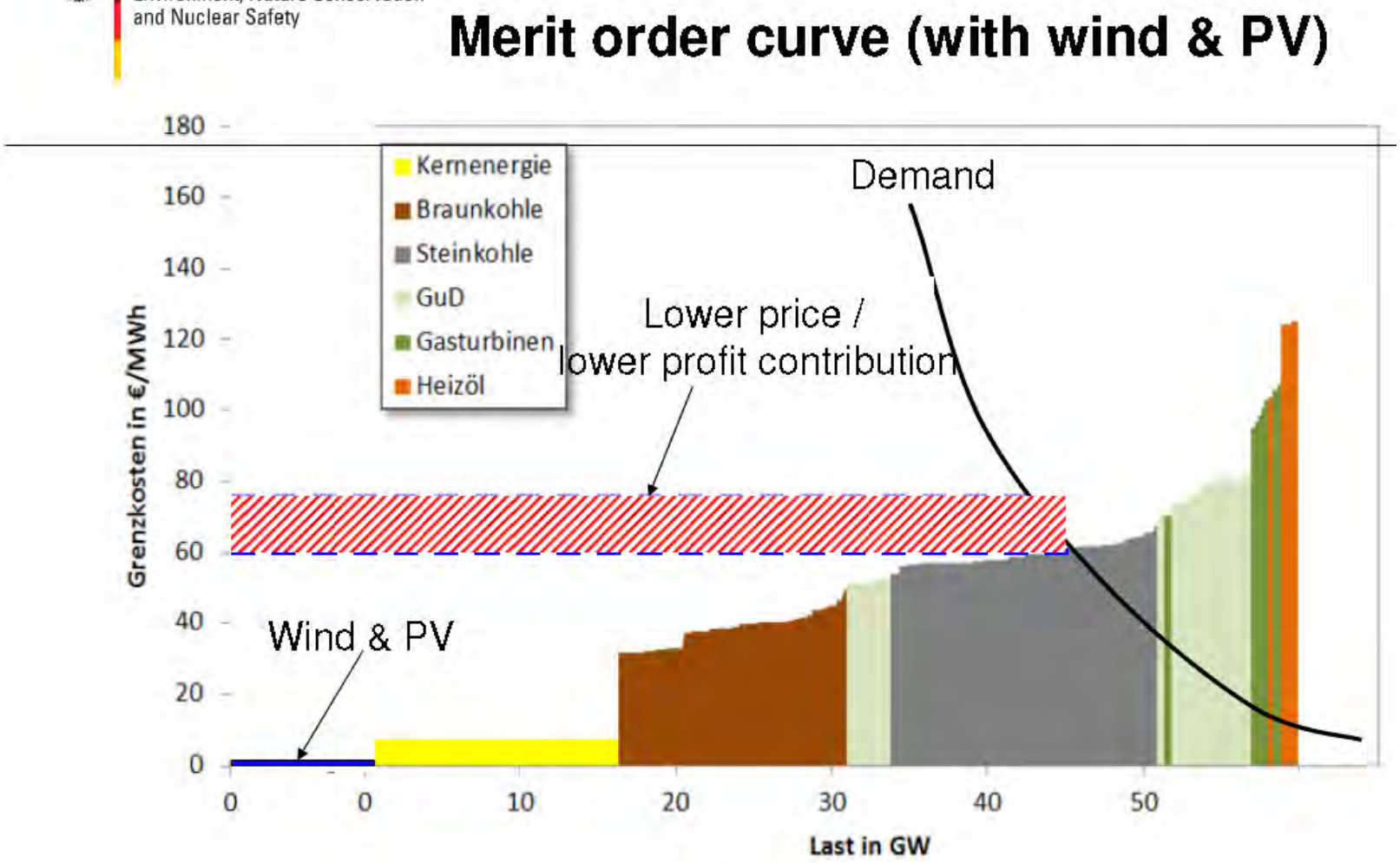
Challenges of the Feed-in Tariff

- Intermittency: steep daily and seasonal curves from solar and wind
- Price-dampening effect on wholesale markets (baseload futures)
- "Merit order curve" for solar and wind can push out gas
- Grid security necessitates gas- and coal-fired power plants and storage technology
- *Price of power*

FiT Impact: Wholesale Prices Go Down

Information from:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



FiT Impact: Retail Prices Go Up with "Apportionment"

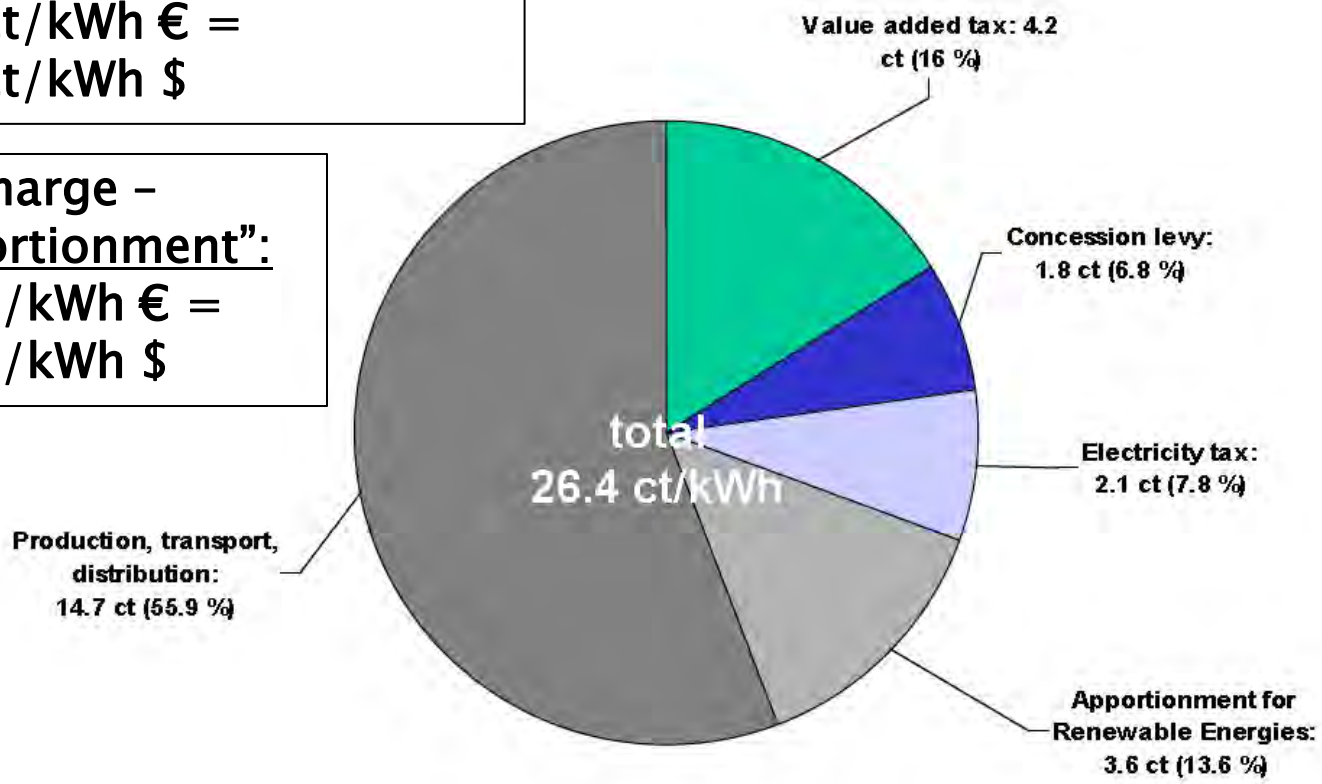
- Residential customers bear the highest impact
- Large energy customers are exempt, to minimize burden on German industry

From Andreas Wieg (DGRV) presentation

Electricity price for private households in 2012

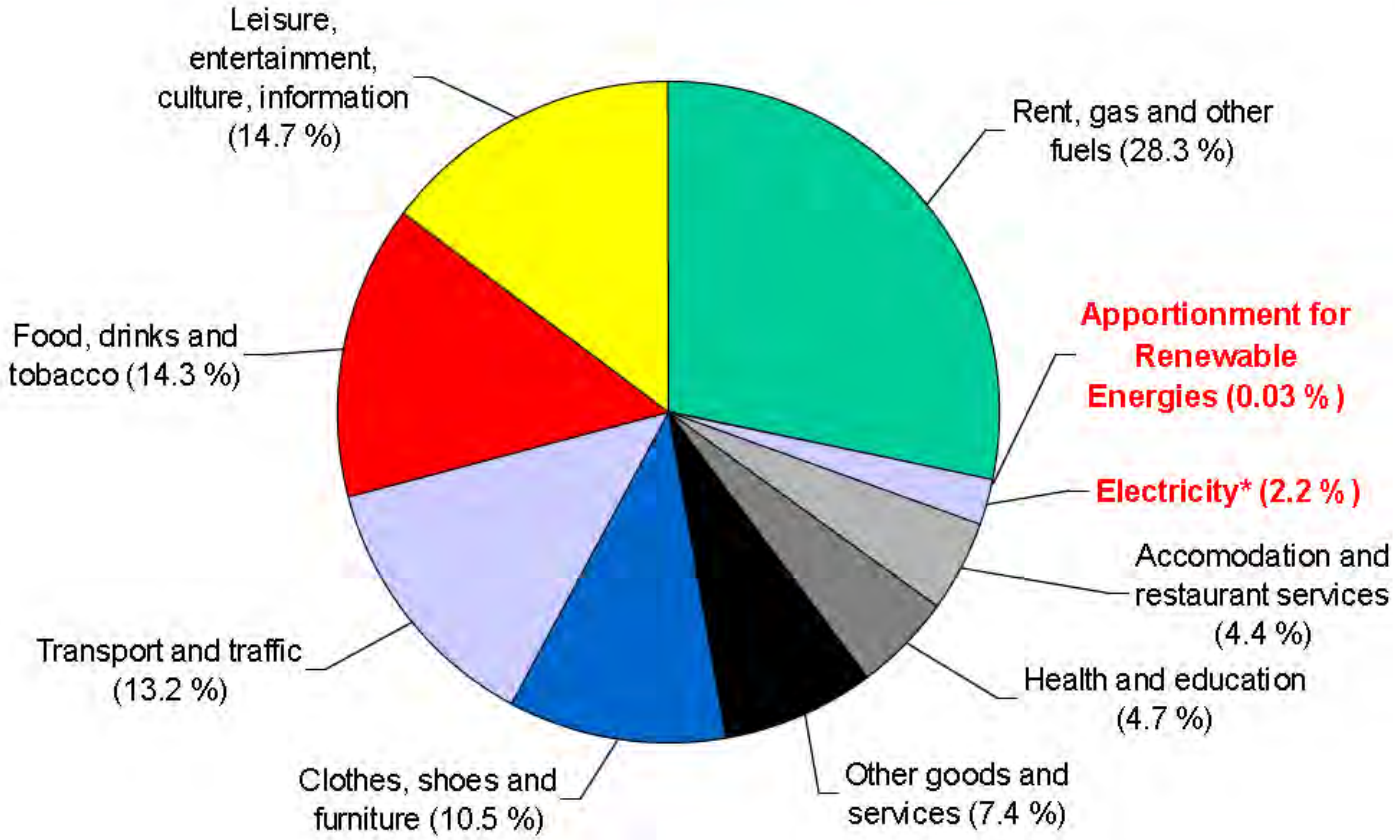
Ave. Res. Rate in Germany:
26.4 ct/kWh € =
34.1 ct/kWh $

FiT Charge – "Apportionment":
3.6 ct/kWh € =
4.6 ct/kWh $



From Andreas Wieg (DGRV) presentation

Expenses of an average private household in Germany 2011/2012



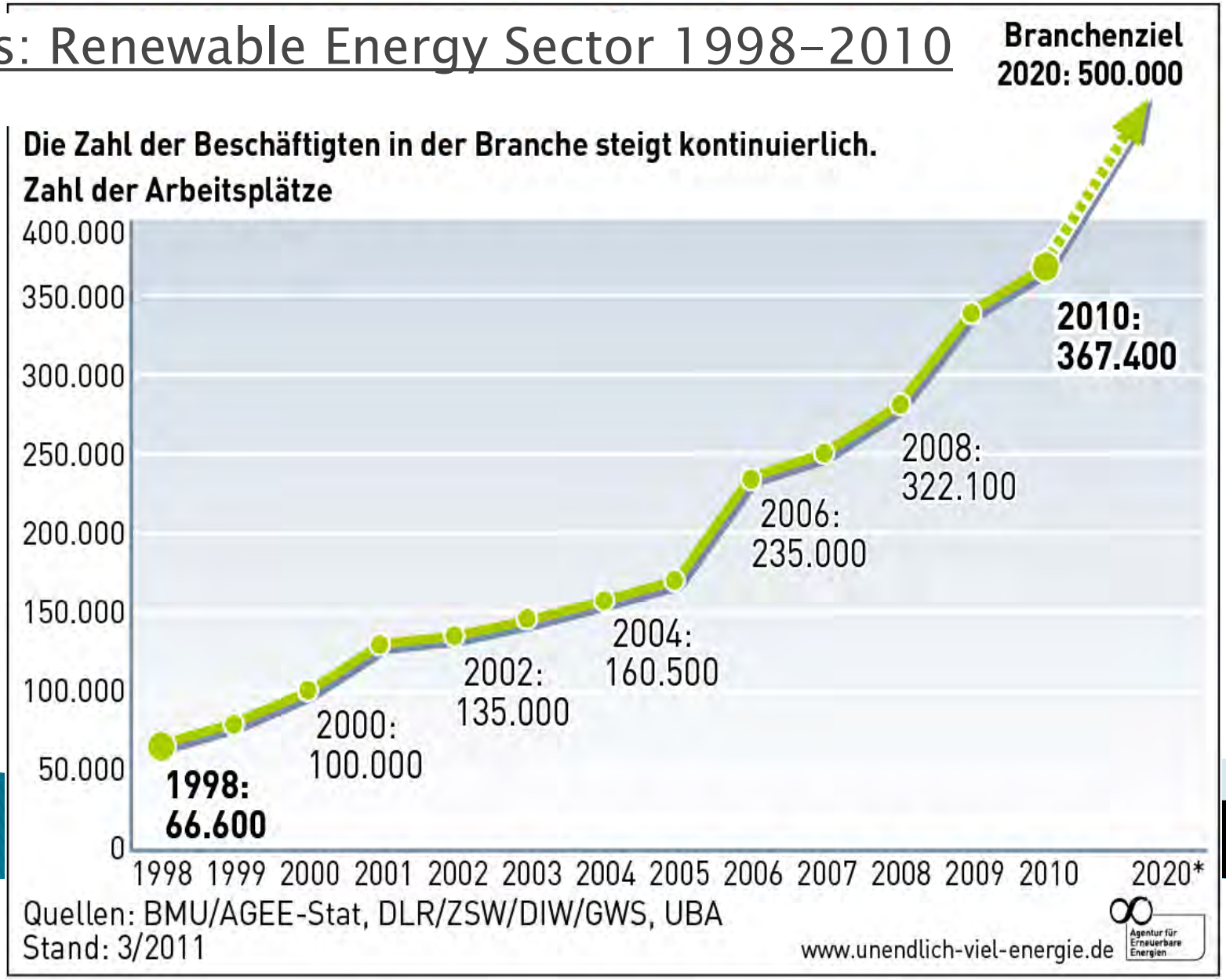
From a Andreas Wieg (from DGRV) presentation

Benefits of the Feed-in Tariff

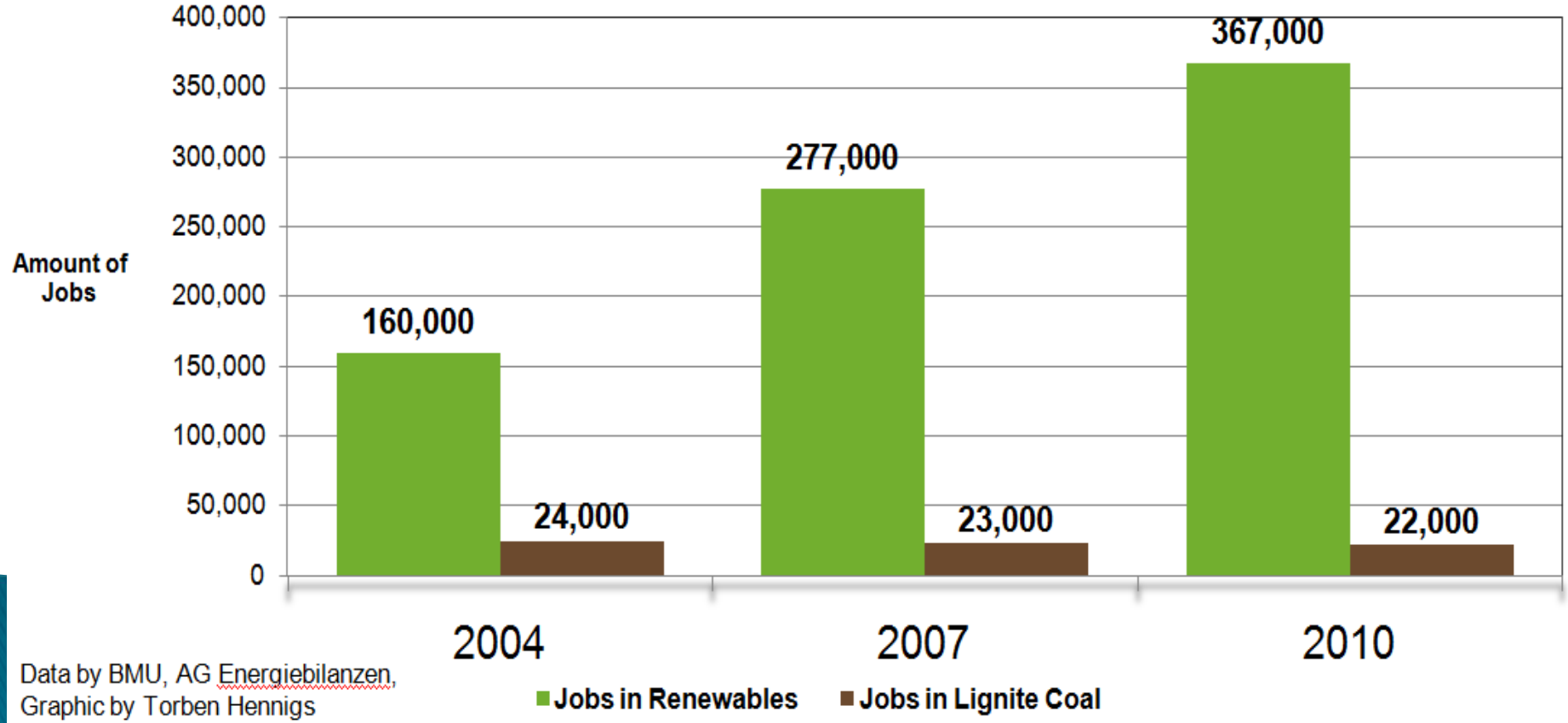
- 382,000 jobs since 2000 (2011 statistics)
- Exclusive use of local or regional companies = jobs in manufacturing, high-tech, installation, maintenance
- Distributed, local generation
- 113 million tons of GHG avoidance so far

If Germany achieves 40% by 2020 = 500,000 more jobs, 22 million € in avoided imports of fossil fuels

Jobs: Renewable Energy Sector 1998–2010



Jobs: Renewable Energy vs. Lignite Coal Germany, 2004-2010



Data by BMU, AG Energiebilanzen,
Graphic by Torben Hennigs

Green Jobs = Jobs for Skilled Employees

A prominent feature of companies in the renewable energy sector is their high proportion of skilled employees.

	Without vocational qualifications	With vocational qualifications	With a university degree
Photovoltaics	5.8 %	81.7 %	34.7 %
Hydro	1.7 %	93.8 %	57.0 %
Wind	0.9 %	79.7 %	27.1 %
Solar thermal	9.5 %	80.3 %	24.4 %
Solar thermal power plants	6.7 %	84.8 %	44.1 %
Deep geothermal	2.1 %	85.6 %	50.4 %
Near-surface geothermal	6.6 %	81.1 %	15.3 %
Biogas	2.5 %	82.5 %	33.1 %
Liquid biomass	0.0 %	92.2 %	57.3 %
Solid biomass	3.1 %	86.5 %	29.7 %
RE overall	**4.1 %**	**82.1 %**	**32.1 %**
Manufacturing jobs	22.7 %	63.2 %	0.6 %
Technical jobs	4.0 %	88.3 %	37.7 %
Total	**15.0 %**	**69.5 %**	**9.9 %**

Challenges Ahead:
"It is not a problem – it is a task."

#1 Constant Eye on Cost

#2 Goals and Steps:

- Expansion of wind energy, on- and off-shore, to 25 GW by 2030
- Expansion of power grids: ~4,500 km of extra-high voltage lines as wind doubles to 51 GW by 2020, plus smaller distributional networks for bidirectional traffic
- Sustainable use of bioenergy in heating, electricity, and fuel
- 25% of electricity from "combined heat and power" plants
- Development of energy storage technology
- Development of carbon "capture and storage" (especially in energy-intensive industrial sectors, and as an export opportunity to coal-reliant countries)
- Doubling in building retrofits
- 1 million electric vehicles by 2020, 6 million by 2030
- Revamping of incentives, subsidies, and taxes

Energy Ownership

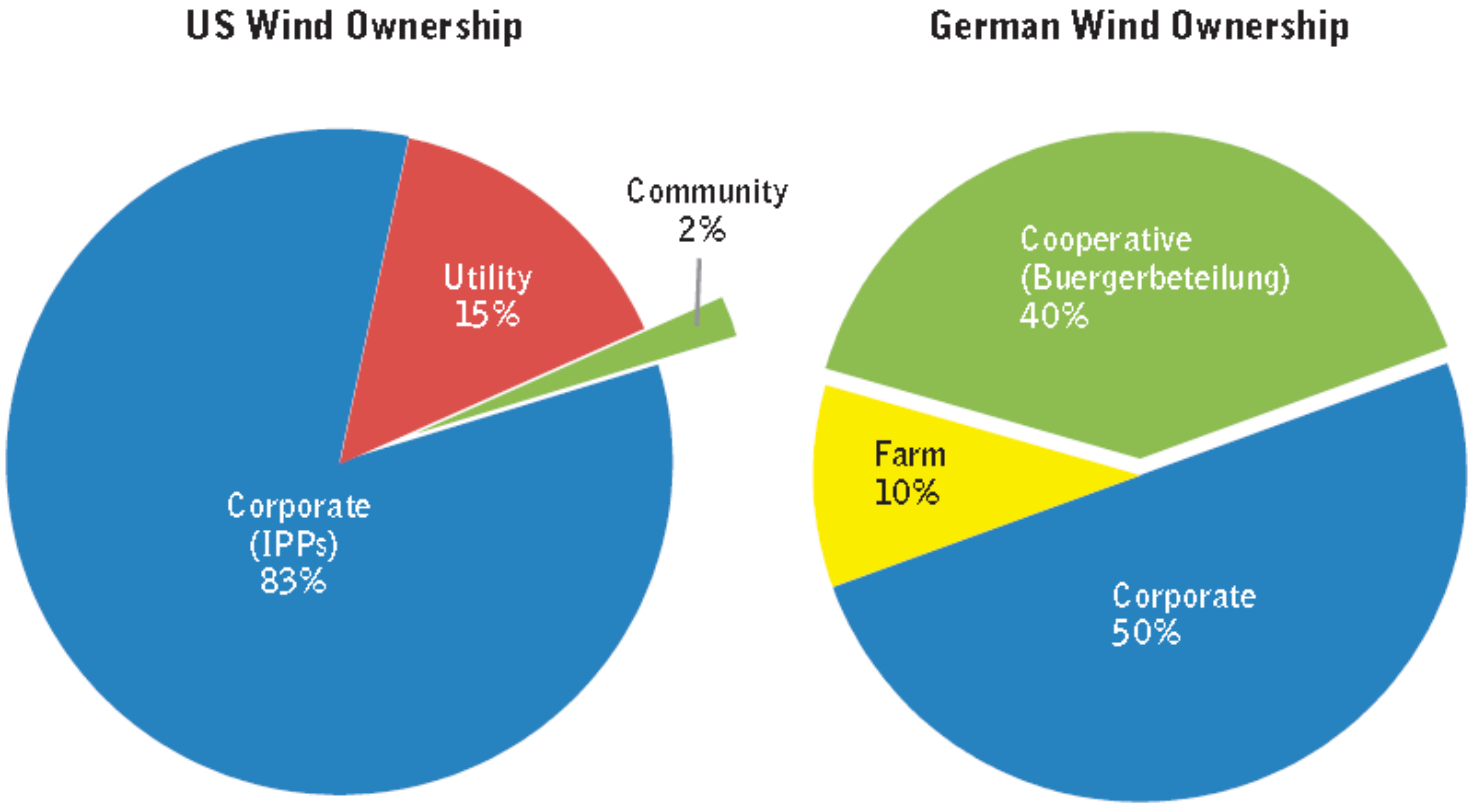
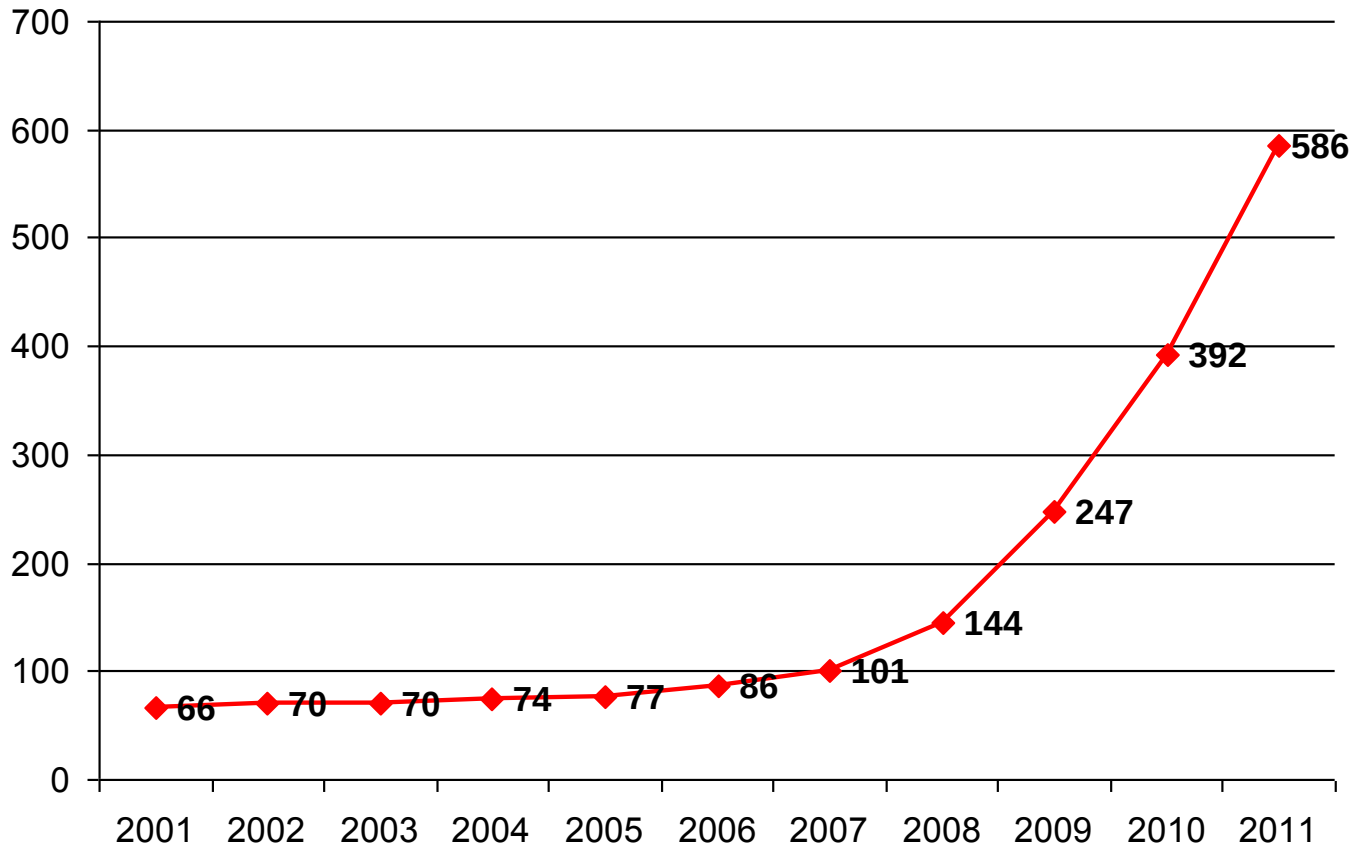


Figure 1: US and Germany Wind Ownership Structures[ii,iii]

ii Gipe, P. (2008). Comments on New Brunswick's Community Wind Initiative. Retrieved from www.windworks.org
iii Wiser, R. and Bolinger, M. (2010). 2009 Wind Technologies Market Report. US Department of Energy.

Courtesy of the National Farmers Union and the Heinrich Böll Foundation

The number of German energy cooperatives has quadrupled during the last three years.



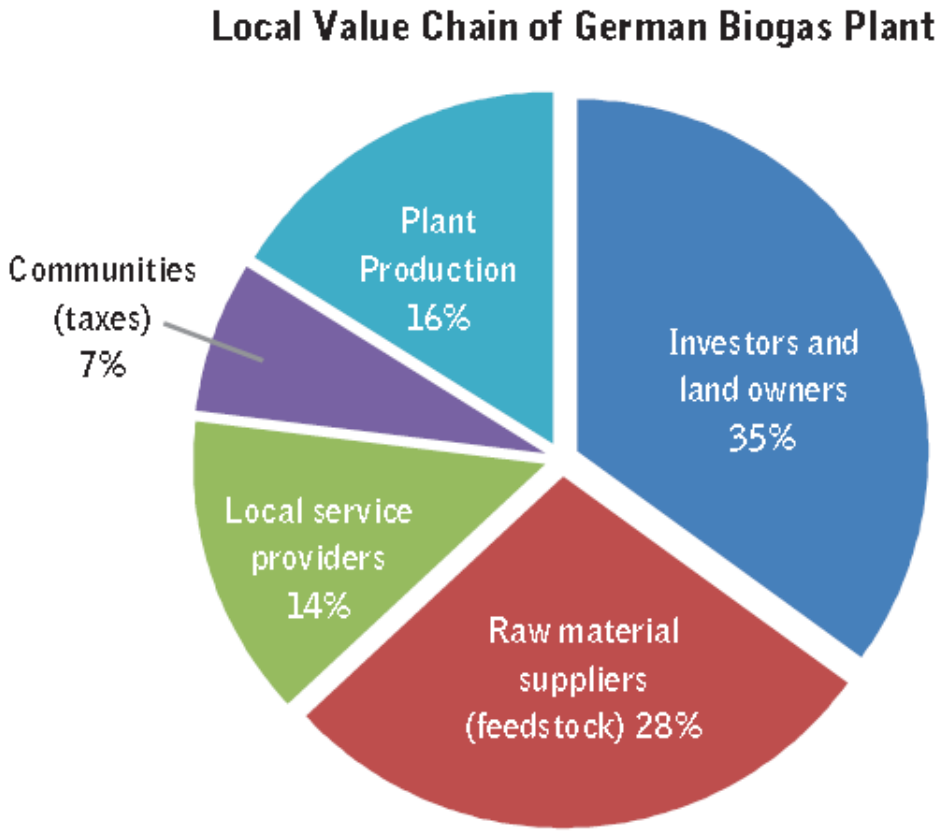
From a Andreas Wieg (from DGRV) presentation

Advantages of Community Renewable Energy Projects

- Rural opportunity
- Local control / local support
- Local financing for local projects
- Keep energy dollars circulating in community
- Job creation plus income for local farmers
- Concentrates small capital for big projects
- Decentralized, on-site, eco-friendly energy
- Independence of big utility companies
- Increased energy security / reduced vulnerability

Coops Keep Money in the Community

- Biogas digester example: even if digester is manufactured elsewhere, 70-80% of revenue remains in the local economy



Information from the National Farmers Union and the Heinrich Böll Foundation

Grossbardorf Energy Coop Systems

- 3.7 million € investment
- Biogas digester – 625 kW electric & thermal district heating system for village and nearby factory
- 2.4 MW solar farm, plus rooftop solar throughout community (e.g., 110 kW roof for soccer grandstands)
- Produces 5x electricity use and .9x heat use in Grossbardorf (pop. 950)

625 kW Digester: Producing electricity and heat for community, serving as a revenue stream for local farmers

Grafenwöhr

- Collection of 19 towns and individuals who invest in renewable energy projects in the region
- Mayors form board of directors
- Collected 9.7 million € already
- 22.3 MW of solar installed
- Large wind project being planned

Ownership Can Make a Difference

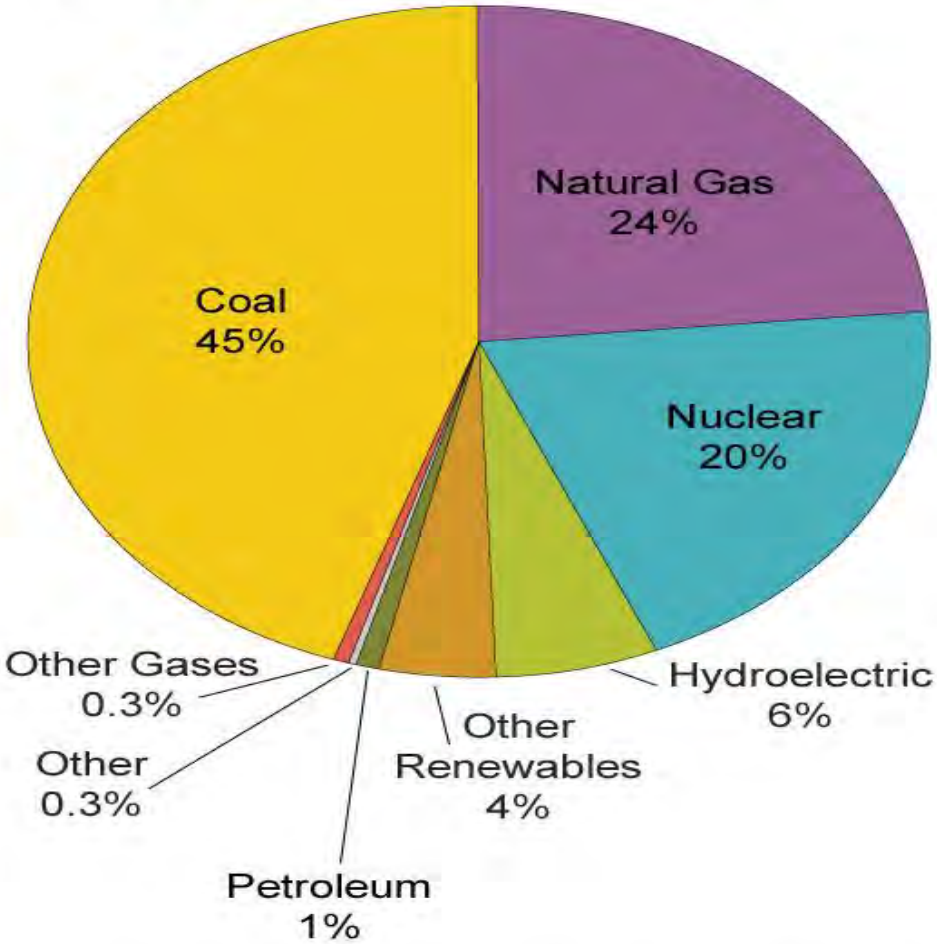
Yours. ☹ VS. Mine. ☺

From a Michael Diestel (of Agrokraft) presentation

http://energytransition.de/

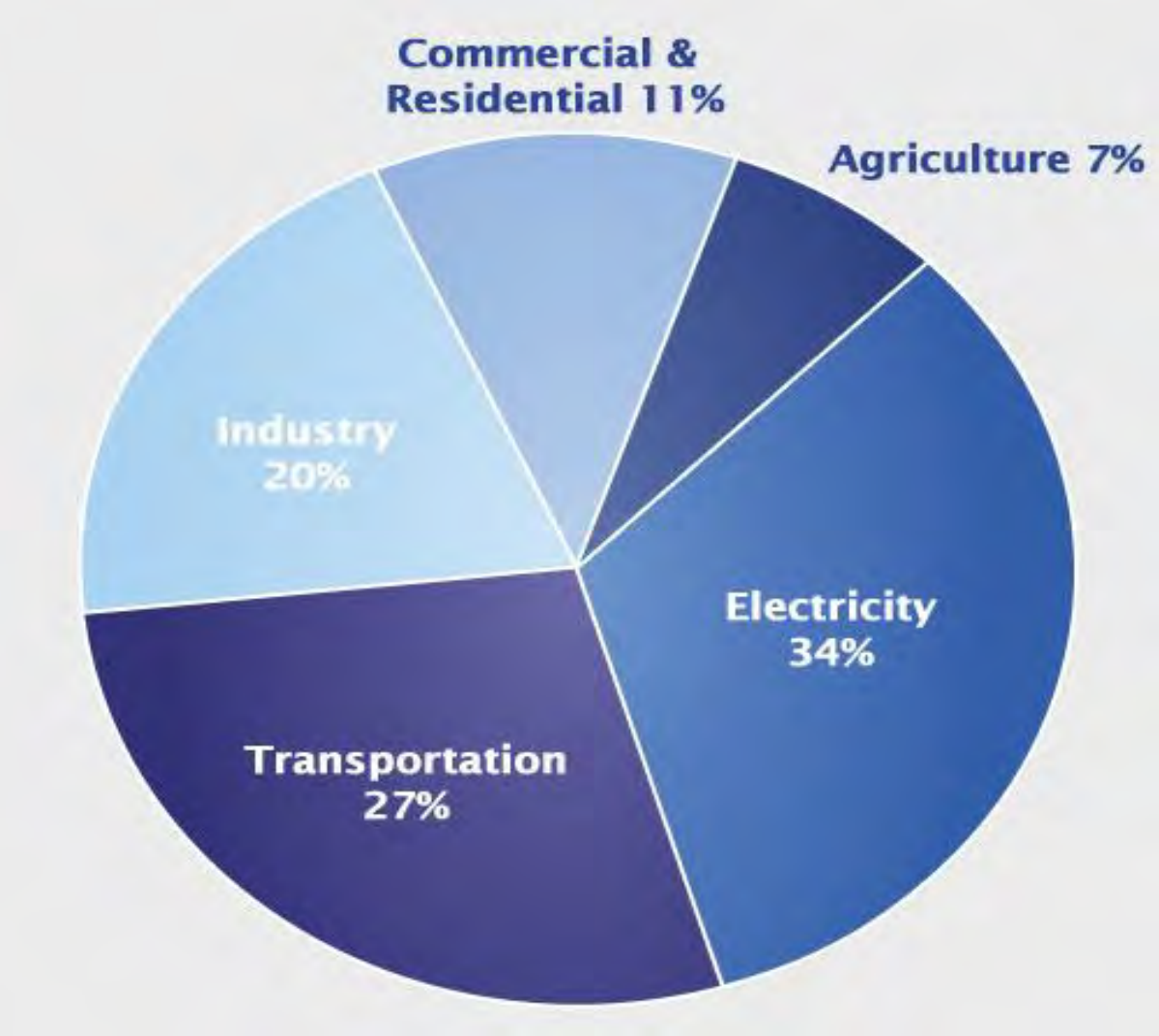
What About America?

U.S. Net Electricity Generation by Fuel, 2010



Source: U.S. Energy Information Administration, *Electric Power Monthly,* Table 1.1, preliminary data.

US Greenhouse Gas Emissions by Sector, 2010



http://epa.gov/climatechange/ghgemissions/sources.html

Vermont Greenhouse Gas Emissions by Sector

Percent of Total Emissions

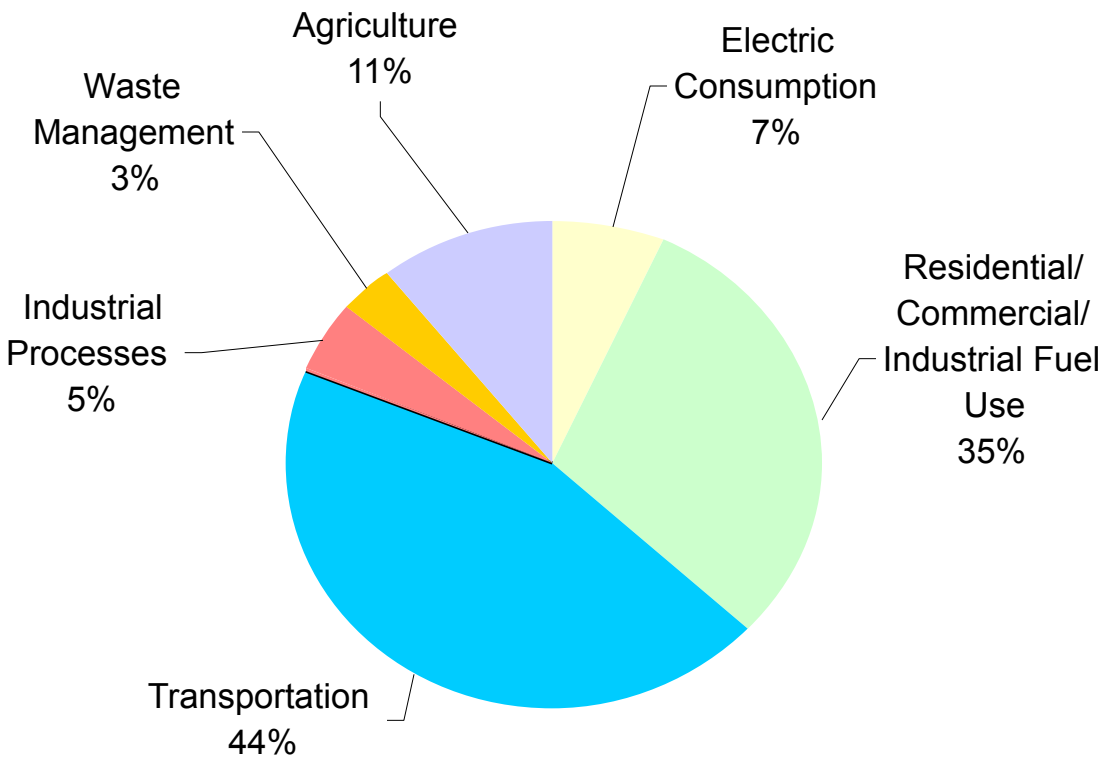
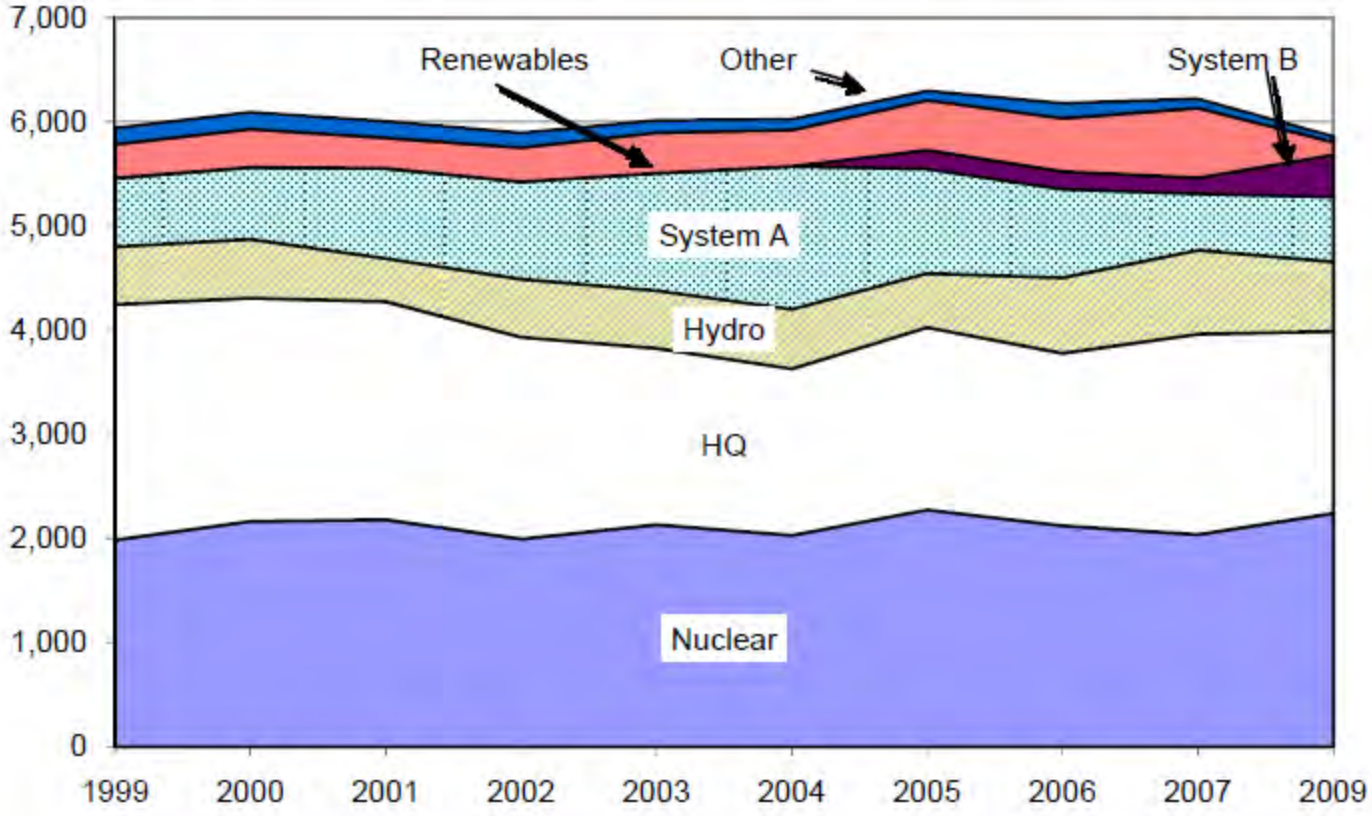
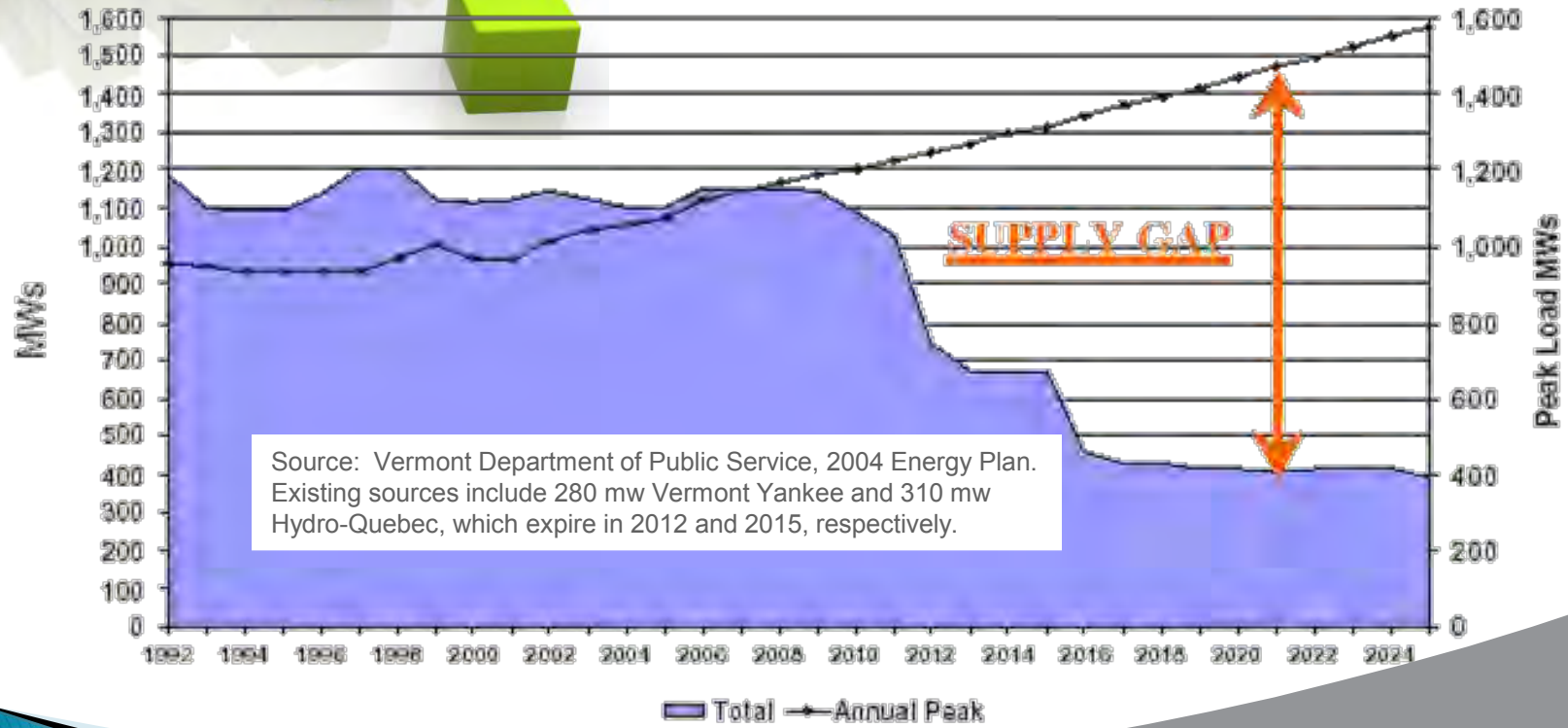


Figure 1.10 Vermont Electric Energy Supply (GWhrs) By Resource, 1999-2009



Source: Vermont DPS

The Challenge:
Supply Gap



Source: Vermont Department of Public Service, 2004 Energy Plan. Existing sources include 280 mw Vermont Yankee and 310 mw Hydro-Quebec, which expire in 2012 and 2015, respectively.

State Energy Policy

Targets Set for Vermont

- Renewable Electric Goal = 75% by 2032
  - 20% new by 2017
  - 55% total renewable by 2017
  - 4% increase every 3 years

Comprehensive Energy Goal = 90% by 2050

Where Are We Statewide?

~16% in-state renewable electric power

- Wind (Kingdom, Sheffield, Georgia)
- Solar (GMP, standard offer projects)
- Landfill methane (Coventry, Moretown)
- Biomass (McNeil upgrade)
- Farm methane
- Small hydro

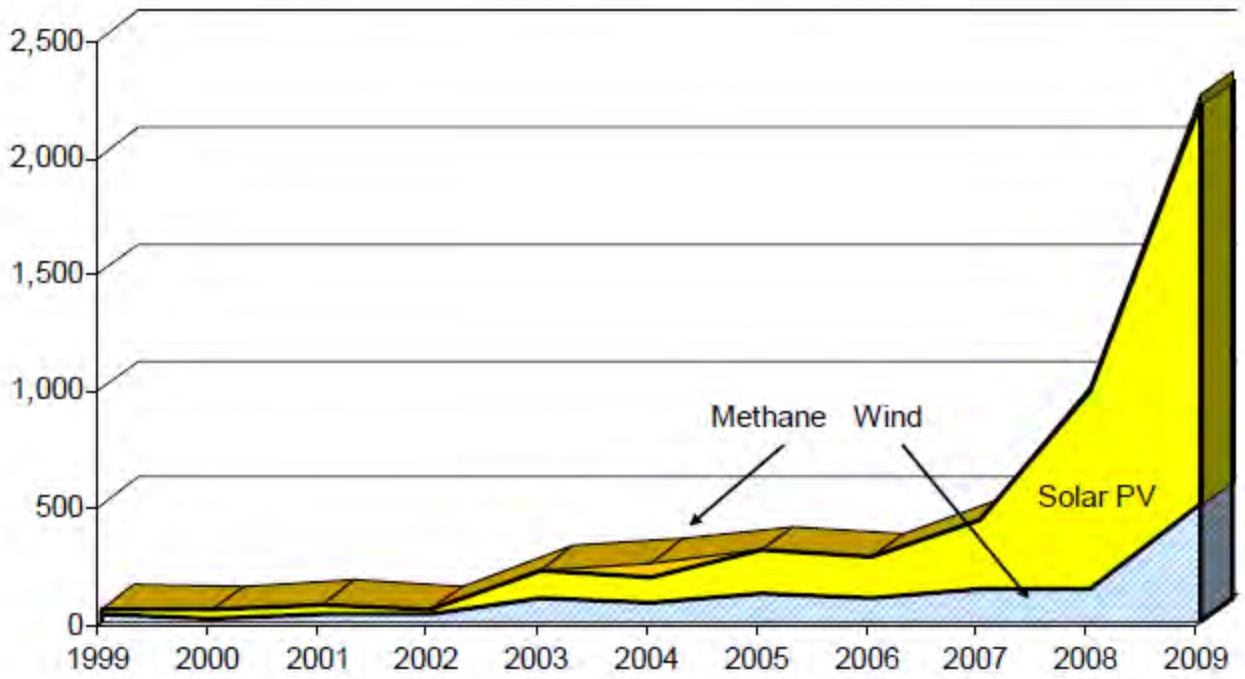
~55% total renewable electric power

- Includes Hydro Quebec, Granite Wind

What Has Vermont Done to Reach Its Goals?

- 1998: Net Metering (today ~2%, mostly solar)
- 1999: Efficiency Vermont (=negative load)
- 2004: 1st renewable electricity goals (SPEED)
- 2005: Clean Energy Development Fund
- 2009: 1st statewide Feed-in Tariff in US ("Standard Offer," 50 MW)
- 2011: PACE for homeowner financing
- 2012: Tax stabilization
- 2012: Expansion of Standard Offer to 127MW

Figure 1.11 Approved Net Metered Capacity, in KW



Source: DPS

What Do We Need to Proceed?

In Vermont, our challenges include:

- 84% reliance on fossil fuels for heat
- Little appetite to identify revenue for retrofits, infrastructure
- Dependency on the automobile in a rural state with little public transportation
- Vocal, local opposition to wind and solar

Like Germany, the US and Vermont need:

- Self-reliant individuals
- Responsive democracy
- National can-do vision