

History of RE subsidy in Germany

Electricity Markets, Summer Semester 2016

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Why RE support at all?

- Variability (unpredictable revenue leads to investor risk)
- Technology immaturity (needs support in early stage of learning curve)
- Externalities not seen by the market (lower pollution, CO2 emissions,...)
- High ratio of capital costs to marginal costs requires measures to reduce investment risk

Types of support schemes for renewables

- No support at all (in some markets with good wind speeds, wind power generation can survive on the sport market without any subsidy at all)
- Feed-In Tariff (FIT, most popular form of RE subsidy)
- Contract for Difference (variation on the FIT, where market price is topped up to a set strike price)
- Quotas
- Carbon taxes

Purpose and aim of the EEG

Section 1

Purpose and aim of the Act

(1) The purpose of this Act is to enable the energy supply to develop in a sustainable manner in particular in the interest of mitigating climate change and protecting the environment, to reduce the costs to the economy not least by including long-term external effects, to conserve fossil energy resources and to promote the further development of technologies to generate electricity from renewable energy sources.

(2) In order to attain the purpose of subsection 1, this Act aims to increase the share of electricity generated from renewable energy sources to at least 80 percent of gross electricity consumption by 2050 in a steady and cost-efficient manner. To this end, the share is to amount to:

1. 40 to 45 percent by 2025 and
2. 55 to 60 percent by 2035.

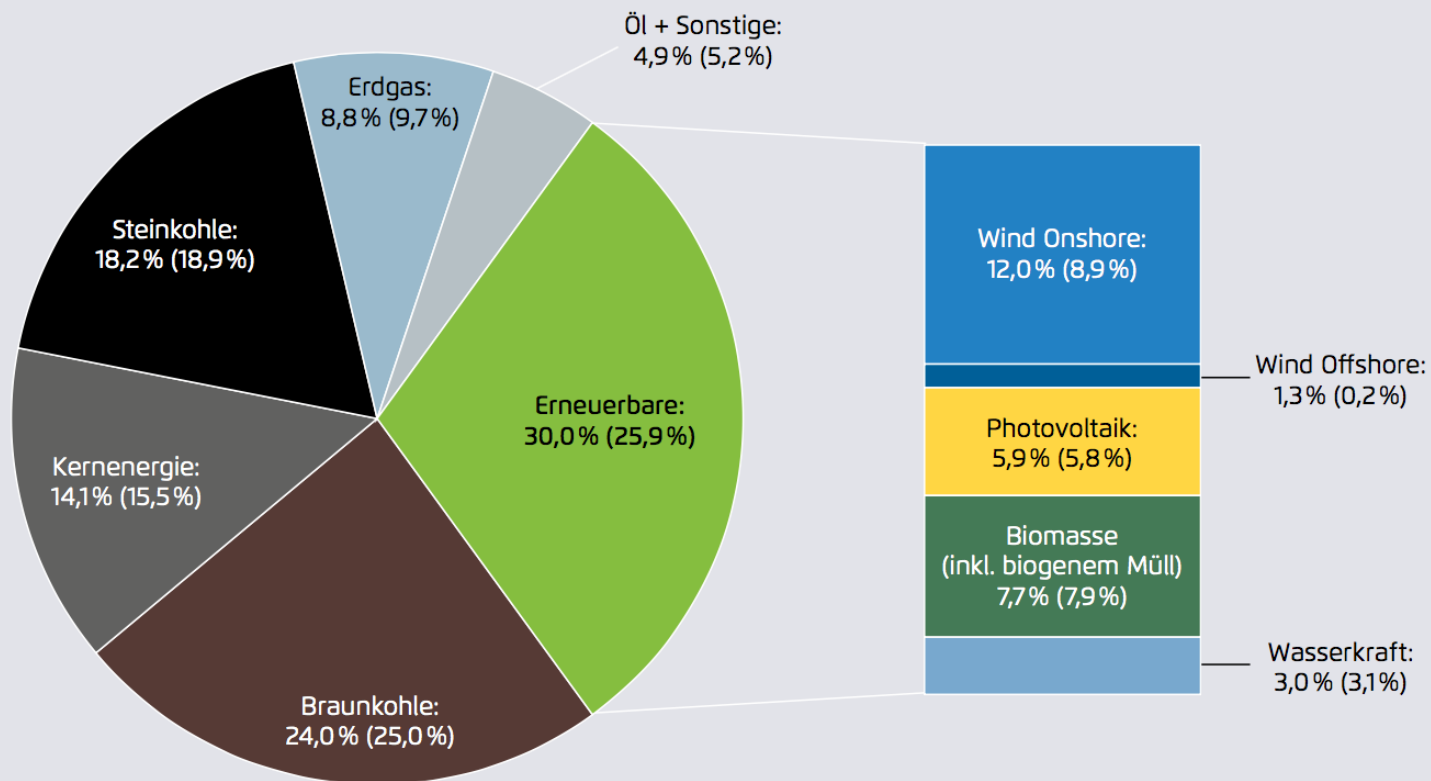
(3) The aim pursuant to subsection 2 sentence 2 number 1 also serves to increase the share of renewable energy sources in terms of total gross final energy consumption to at least 18 percent by 2020.

[Source: BMWi, EEG 2014, unofficial translation]

„Strommix“ in Germany 2015

Erneuerbare Energien produzieren 30 Prozent des deutschen Stroms: Strommix des Jahres 2015
(Werte für 2014 in Klammern)

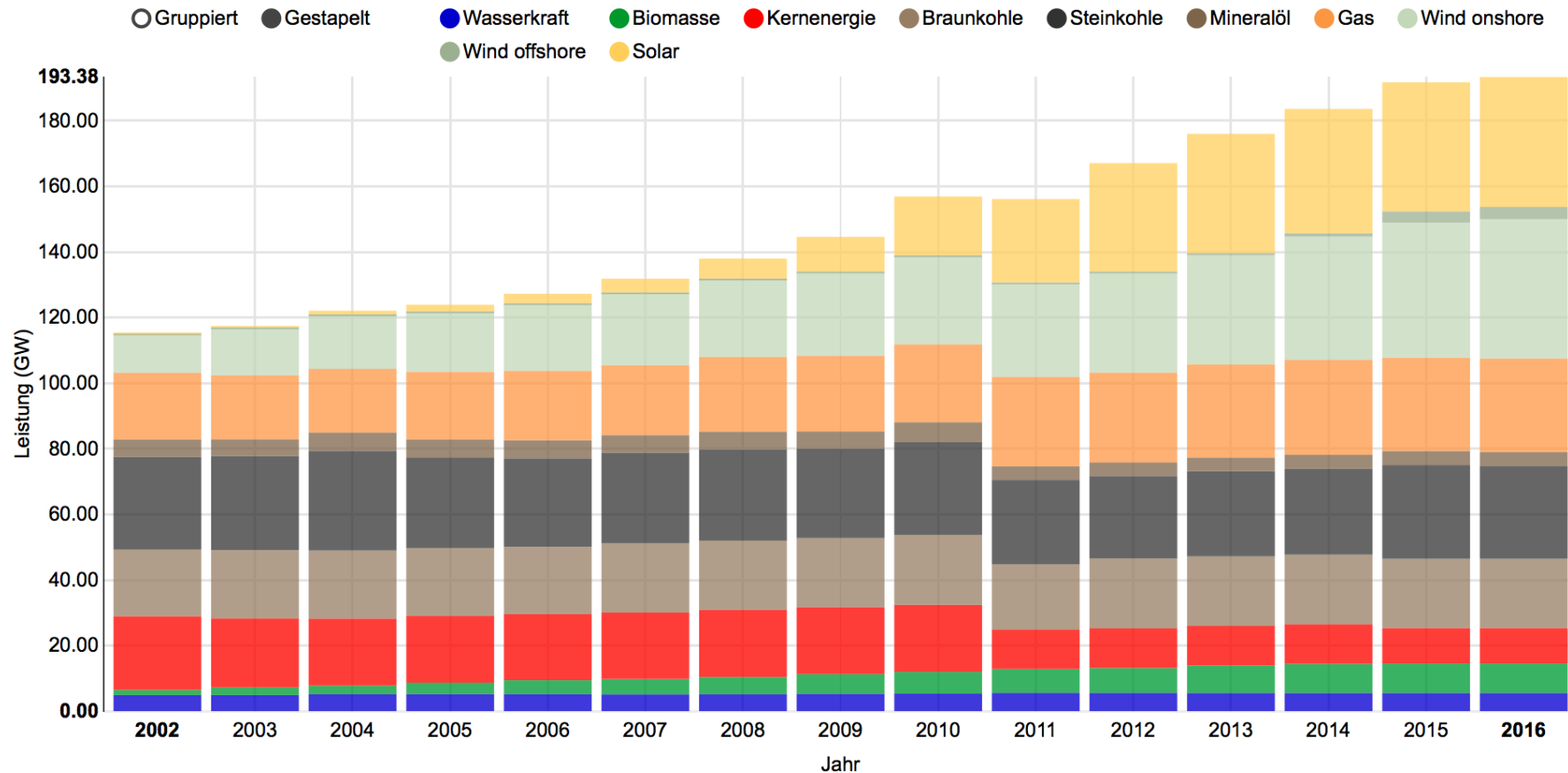
Abbildung 1



AG Energiebilanzen 2015a

[Source: Agora Energiewende]

Installed capacities



Solar: 39.6 GW, Wind onshore 42.5 GW, Wind offshore 3.7 GW

Stromeinspeisegesetz (1991)

- „Electricity Feed-in Law“
- Originally mainly conceived for a few hundred MW of small hydropower
- Utilities are required to a) connect renewable generators to the grid and b) buy the electricity at a rate based on the average tariff for final customers (90% for wind and solar)
- Update 1998: Limited to a share 5% of all output

Feed-in tariffs

Type	Tariff 1991	Tariff 1999
Basis (average price)	9.44 ct/kWh	9.39 ct/kWh
wind / solar (90%)	8.49 ct/kWh	8.45 ct/kWh
hydro, biogas (<0.5MW), biomass (75-80%)	7.08 ct/kWh	7.51 ct/kWh
hydro, biogas (0.5MW<5MW) (65%)	6.13 ct/kWh	6.10 ct/kWh

„1000 roofs programme“

- up to 70% investment aid for the installation of 1-5 kWp roof-mounted installations
- 1990-1995: more than 2000 installations, on average with 2.64 kWp, installation costs of about 12400 €/kWp
- feed-in tariff for solar in 1991: 8.49 ct/kWh

„100000 roofs programme“

- Roof-mounted installations with more than 1 kWp
- Low interest loans for investors (citizens, small businesses), provided by the KfW
- Target of 350 MW reached in 2003
- New feed-in law in 2000: EEG

EEG (2000)

- „Renewable Energy Sources Act“
- Prioritisation of grid-supplied electricity from renewable sources
- Rates of the tariff scheme guaranteed to investors for 20 years (with degressive steps for plants coming on line after 2002)
- Dramatic increase in rates for solar
- Nation-wide cost sharing arrangement

EEG 2000 applies to:

- Hydrodynamic power (<5 MW)
- Wind energy
- Solar radiation energy (<5 MW for installations on buildings, <100 kW else)
- Geothermal energy
- Biogas (<5 MW), gas from mines
- Biomass (<20 MW)

Type	Tariff 1999	EEG 2000
hydro, biogas (<0.5 MW)	7.51 ct/kWh	7.67 ct/kWh
hydro, biogas (<5 MW)	6.10 ct/kWh	6.65 ct/kWh
biomass (<500 kW)	7.51 ct/kWh	10.23 ct/kWh
biomass (<5 MW)	7.51 ct/kWh	9.21 ct/kWh
biomass (> 5 MW)	-	8.79 ct/kWh
geothermal (<20 MW)	-	8.95 ct/kWh
geothermal (>20 MW)	-	7-16 ct/kWh
wind (first 5 years)	8.45 ct/kWh	9.10 ct/kWh
wind (after 5 years, depending on yield)	8.45 ct/kWh	6.19 ct/kWh
solar (<5 MW for installations on buildings, <100 kW else)	8.45 ct/kWh	50.62 ct/kWh

Degression of rates for new installations

- Biomass: 1% annual decline after 2002
- Wind: 1.5% annual decline after 2002
- Solar: 5% annual decline after 2002
Upper limit: Total installed capacity of 350 MW

EEG (2004)

- Target: Share of renewables in electricity production at least 12.5% by 2010 and at least 20% by 2020
- Target of 350 MW solar capacity reached in 2003
- End of the 100000 roof programme
- Many specifications, still strong support for solar

Type	Tariff 1999	EEG 2000	EEG 2004
hydro (<0.5 MW)	7.51 ct/kWh	7.67 ct/kWh	9.67 ct/kWh
biogras (<0.5 MW)	7.51 ct/kWh	7.67 ct/kWh	7.67 ct/kWh
hydro, biogas (<5 MW)	6.10 ct/kWh	6.65 ct/kWh	6.65 ct/kWh
biomass (<150 kW)	7.51 ct/kWh	10.23 ct/kWh	11.5 ct/kWh
biomass (<500 kW)	7.51 ct/kWh	10.23 ct/kWh	9.9 ct/kWh
biomass (<5 MW)	7.51 ct/kWh	9.21 ct/kWh	8.9 ct/kWh
biomass (> 5 MW)	-	8.79 ct/kWh	9.4 ct/kWh
geothermal (<5 MW)	-	8.95 ct/kWh	15 ct/kWh
geothermal (<10 MW)	-	8.95 ct/kWh	14 ct/kWh
geothermal (<20 MW)	-	8.95 ct/kWh	8.95 ct/kWh
geothermal (>20 MW)	-	7.16 ct/kWh	7.16 ct/kWh

Type	Tariff 1999	EEG 2000	EEG 2004
wind (first 5 years)	8.45 ct/kWh	9.10 ct/kWh	8.70 ct/kWh
wind (after 5 years, depending on yield)	8.45 ct/kWh	6.19 ct/kWh	5.50 ct/kWh
wind offshore (first 12 years)	8.45 ct/kWh	9.10 ct/kWh	9.10 ct/kWh
wind offshore (after 12 years, depending on yield)	8.45 ct/kWh	6.19 ct/kWh	6.19 ct/kWh
solar (minimum)			45.7 ct/kWh
solar (on buildings, <30 kW)	8.45 ct/kWh	50.62 ct/kWh	57.4 ct/kWh
solar (on buildings, <100 kW)	8.45 ct/kWh	50.62 ct/kWh	54.6 ct/kWh
solar (on buildings, >100 kW)	8.45 ct/kWh	50.62 ct/kWh	54.00 ct/kWh

EEG (2009)

- Target: Share of renewables in electricity production at least 30% by 2020
- Restructuring of the act (66 instead of 22 paragraphs, much more details)
- Feed-in management
- Degression of solar tariffs (depending on installed capacity), bonus for own consumption

Solar rates

	Dachanlagen			
Jahr der Inbetriebnahme	≤ 30 kW (ct/kWh)	ab 30 kW (ct/kWh)	Ab 100 kW (ct/kWh)	Ab 1.000 kW (ct/kWh)
	8% p.a. in 2009/2010 9% ab 2011	8% p.a. in 2009/2010 9% ab 2011	10% p.a. in 2009/2010 9% ab 2011	25% in 2009, 10% in 2010, 9% ab 2011*
2008	46,75	44,48	43,99	43,99*
2009	43,01	40,91	39,58	33,00
2010	39,57	37,64	35,62	29,70
2011	36,01	34,25	32,42	27,03
2012	32,77	31,17	29,50	24,59
2013	29,82	28,36	26,84	22,38
2014	27,13	25,81	24,43	20,37
2015	24,69	23,49	22,23	18,53

Solar rates depression

8. solar radiation

a) from installations in accordance with section 32

aa) shall be 10.0 per cent in the year 2010,

bb) shall be 9.0 per cent from the year 2011 onwards, and

b) from installations in accordance with section 33

aa) with a maximum capacity of 100 kilowatts

aaa) shall be 8.0 per cent in the year 2010,

bbb) shall be 9.0 per cent from the year 2011 onwards, and

bb) with a capacity of over 100 kilowatts

aaa) shall be 10.0 per cent in the year 2010,

bbb) shall be 9.0 per cent from the year 2011 onwards.

(2a) The percentages under subsection (2) no. 8 above

a) shall increase by 1.0 percentage point as soon as the capacity of the installations registered with the Federal Network Agency within the previous twelve months as per 30 September of the previous year in accordance with section 16(2) second sentence exceeds

aa) 1,500 megawatts in the year 2009,

bb) 1,700 megawatts in the year 2010, and

cc) 1,900 megawatts in the year 2011;

b) shall decrease by 1.0 percentage point as soon as the capacity of the installations registered with the Federal Network Agency within the previous twelve months as per 30 September of the previous year in accordance with section 16(2) second sentence falls below

aa) 1,000 megawatts in the year 2009,

bb) 1,100 megawatts in the year 2010, and

cc) 1,200 megawatts in the year 2011.

Feed-in management

(1) Notwithstanding their obligation in accordance with section 9, grid system operators shall be entitled, by way of exception, to take technical control over installations connected to their grid system with a capacity of over 100 kilowatts for the generation of electricity from renewable energy sources, combined heat and power generation or mine gas, if

1. the grid capacity in the respective grid system area would otherwise be overloaded on account of that electricity,
2. they have ensured that the largest possible quantity of electricity from renewable energy sources and from combined heat and power generation is being purchased, and
3. they have called up the data on the current feed-in situation in the relevant region of the grid system.

(1) The grid system operator whose grid system gives rise to the need for the assumption of technical control under section 11(1) shall compensate those installation operators who, on account of the measures under section 11(1), were not able to feed in electricity to the extent agreed upon. Where no agreement has been reached, the lost tariffs and revenues from the use of heat less the expenses saved shall be paid.

EEG (2012) / Photovoltaiknovelle

- Further decrease of solar tariffs, cap at 52 GW installed capacity, depression rates depending on annual installations
- Increase in rates for offshore wind
- Direct selling vs. marketing (market premium model)

Solar rates

	Mindest-Solarstromvergütung in Ct/kWh						
Inbetriebnahme	Anlage auf/an Gebäuden oder Lärmschutzwänden ⁽¹⁾					Anlagen auf Freiflächen bis einschl. 10 MW z.B. auf Gewerbeflächen, längs von Autobahnen und Schienenwegen, Konversionsflächen ⁽⁸⁾	Erneuerbare- Energien- Gesetz (EEG)
	≤10kW	>10-40kW (2)	>40-1MW (2)	>1MW-10MW	Nicht Wohngebäude im Außenbereich		
1.4.2012	19,50	18,50	16,50	13,50	13,50	13,50	EEG, PV-Novelle 2012
1.5.2012 ⁽³⁾	19,31	18,32	16,34	13,37	13,37	13,37	EEG, PV-Novelle 2012
1.6.2012	19,11	18,13	16,17	13,23	13,23	13,23	EEG, PV-Novelle 2012
1.7.2012	18,92	17,95	16,01	13,10	13,10	13,10	EEG, PV-Novelle 2012
1.8.2012	18,73	17,77	15,85	12,97	12,97	12,97	EEG, PV-Novelle 2012
1.9.2012	18,54	17,59	15,69	12,84	12,84	12,84	EEG, PV-Novelle 2012
1.10.2012	18,36	17,42	15,53	12,71	12,71	12,71	EEG, PV-Novelle 2012
1.11.2012 ⁽⁴⁾	17,90	16,98	15,15	12,39	12,39	12,39	EEG, PV-Novelle 2012
1.12.2012 ⁽⁴⁾	17,45	16,56	14,77	12,08	12,08	12,08	EEG, PV-Novelle 2012
1.1.2013 ⁽⁴⁾	17,02	16,14	14,40	11,78	11,78	11,78	EEG, PV-Novelle 2012
1.2.2013 ⁽⁵⁾	16,64	15,79	14,08	11,52	11,52	11,52	EEG, PV-Novelle 2012
1.3.2013 ⁽⁵⁾	16,28	15,44	13,77	11,27	11,27	11,27	EEG, PV-Novelle 2012
1.4.2013 ⁽⁵⁾	15,92	15,10	13,47	11,02	11,02	11,02	EEG, PV-Novelle 2012

Market premium (optional)

- Incentive for generators of renewable energy to participate directly in the market
- Plant operators market their energy directly via the power exchange on the free energy market
- Market premium offsets the difference between the market revenue and the subsidised purchase price under the EEG (contract for difference)
- The generator creates additional revenue if it is able to sell above the monthly average price

Evolution of the German FIT System for PV from 2000 to beginning of 2012.

Phase	Prevalent issues in socio-technical system	Time of policy change	Parties in government	Changes in policy design	Effect on socio-technical system
1	• Lack of maturity and high cost of PV technology • Lack of mass market for PV • Insufficient financial incentive for power producers of PV • Market power of large utilities • Market support as chance to build PV industry and create jobs	2000	SPD and Green	• Introduction of Renewable Energy Sources Act • Technology-specific but size-independent remuneration of 51 EUR cents/kWh over 20 years • Maximum size of 5 MW for building integrated plants, 100 kW for others • Fixed degression of 5% p.a. • Ceiling for cumulative installed capacity at 350 MW • Exclusion of utilities with share of EEG electricity > 50% in overall sales from having to pay EEG apportionment ('Grünstrom-privileg')	• First boost in deployment (cumulative capacity of 186 MW installed in 2001) • No. of jobs grows slowly to 4000 in 2001 • Rise in annual PV difference costs²¹ from 19 M EUR in 2001 to 37 M EUR in 2001
2	• Market support as chance to build PV industry and create jobs • Market support as chance to increase exports • High cost and rising electricity prices (problematic especially for energy-intensive industry)	2002	SPD and Green	Ceiling for cumulative installed capacity raised to 1000 MW	• Strong rise in deployment (cumulative capacity of 4170 MW installed at the end of 2007) • Reduction of PV system price from 6 EUR/Wp in 2002 to 4.3 EUR/Wp in 2008 • Strong rise in no. of jobs to 40,400 in 2007 • Rise in annual PV difference costs to 1.47 bn EUR in 2007
		2003	SPD and Green	• Reduction of EEG apportionment (0.05 EUR cents/kWh) for large electricity consumers facing international competition with a consumption > 100 GWh, electricity cost per gross value added > 20% • Removal of ceiling for cumulative installed capacity and plant size • Increase in remuneration for roof-top PV to 54.7 EUR cents/kWh	
		2004	SPD and Green	• Changes in redistribution mechanism of EEG apportionment • Adjustment of criteria for reduction of EEG apportionment for large electricity consumers to consumption > 10 GWh, electricity cost per gross value added > 15%	

[Source: Hoppman et al. (2014)]

3	• High cost for society and rising electricity prices • Excess remuneration and windfall profits for PV industry • Increasing competition from China • Risk of hurting domestic industry	2009	CDU and SPD	• Dynamic degression of remuneration depending on deployment (basic degression of 8–10% for 2010 $\pm$ 1 percentage point if annual installed capacity < 1000 MW or > 1500 MW)²² • Requirement to install remote control and power measurement unit for plants > 100 kW • Option of self-consumption (25.01 EUR cents/kWh) or direct marketing to third parties²³	• Further increase in deployment (cumulative capacity of 24,678 MW installed at the end of 2011) • Slowing market growth • Rise in no. of jobs to 150,000 in 2011 • Rise in annual PV difference costs to 6.8 bn. EUR in 2011 • Strong reduction of PV system prices from 4.3 EUR/Wp in 2008 to 2.05 EUR/Wp at the end of 2011
		2010	CDU and FDP	• Basic degression for 2010 changed to between 8% to 13% depending on system size • Dynamic degression rate for 2011 raised (basic degression of 9% $\pm$ up to 4 percentage points depending on deployment in 2010) • Additional one-time reductions of remuneration by 10% (July) and 3% (October) • Reform of distribution mechanism underlying EEG apportionment	
		2011	CDU and FDP	• Adjustment of degression for 2011 by 3%, 6%, 9%, 12% or 15% depending on deployment in March to May 2011 (target corridor of 2.5–2.5 GW newly installed capacity per year) • Adjustment of degression for 2012 (9% basic degr., reduction or increase dep. on deployment in 2011)	
4	• Increased power intermittency and power regulation • Risk of reduced grid stability • Lack of market integration • High cost for society and rising electricity prices	2012	CDU and FDP	• Alternative between limiting inverter power to 70% of PV plant capacity or installation of remote control for plants < 30 kW • Remuneration for self-consumption depending on system size (max. 12.36 EUR cents/kWh) • Further extension of reduction in EEG apportionment for large electricity consumers: criteria adjusted to consumption $n > 1$ GWh, electricity cost per gross value added > 14% • Limitation of 'Grünstromprivileg' (see Phase 1) to 2 EUR cents/kWh • Introduction of market premium as incentive for direct marketing	?

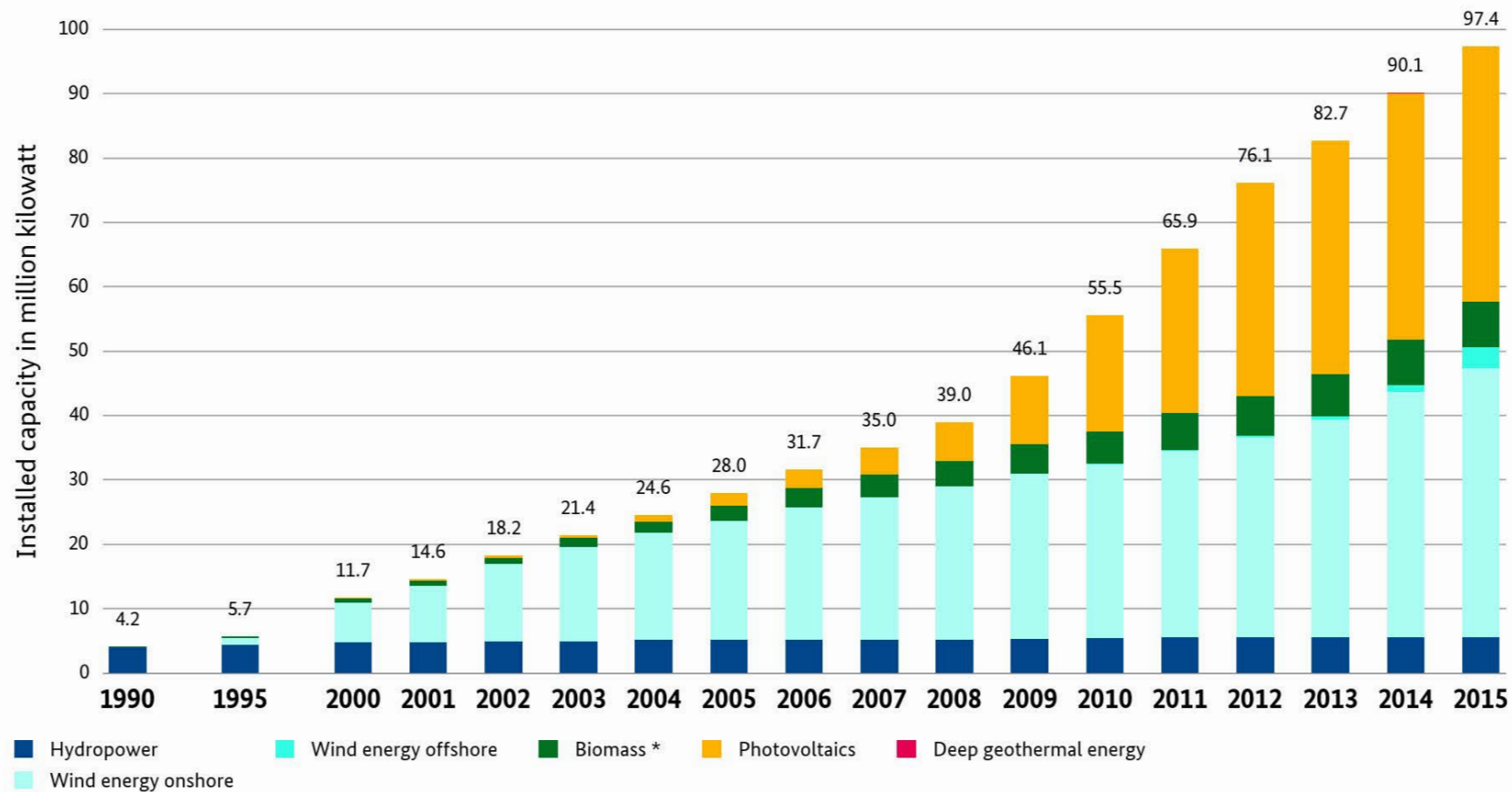
[Source: Hoppman et al. (2014)]

EEG 2.0 (2014)

- direct marketing for most new installations
(>500 kW after 08/2014; >100 kW after 01/2016)
- Pilot bidding process for solar farms
- Reduction of privileges

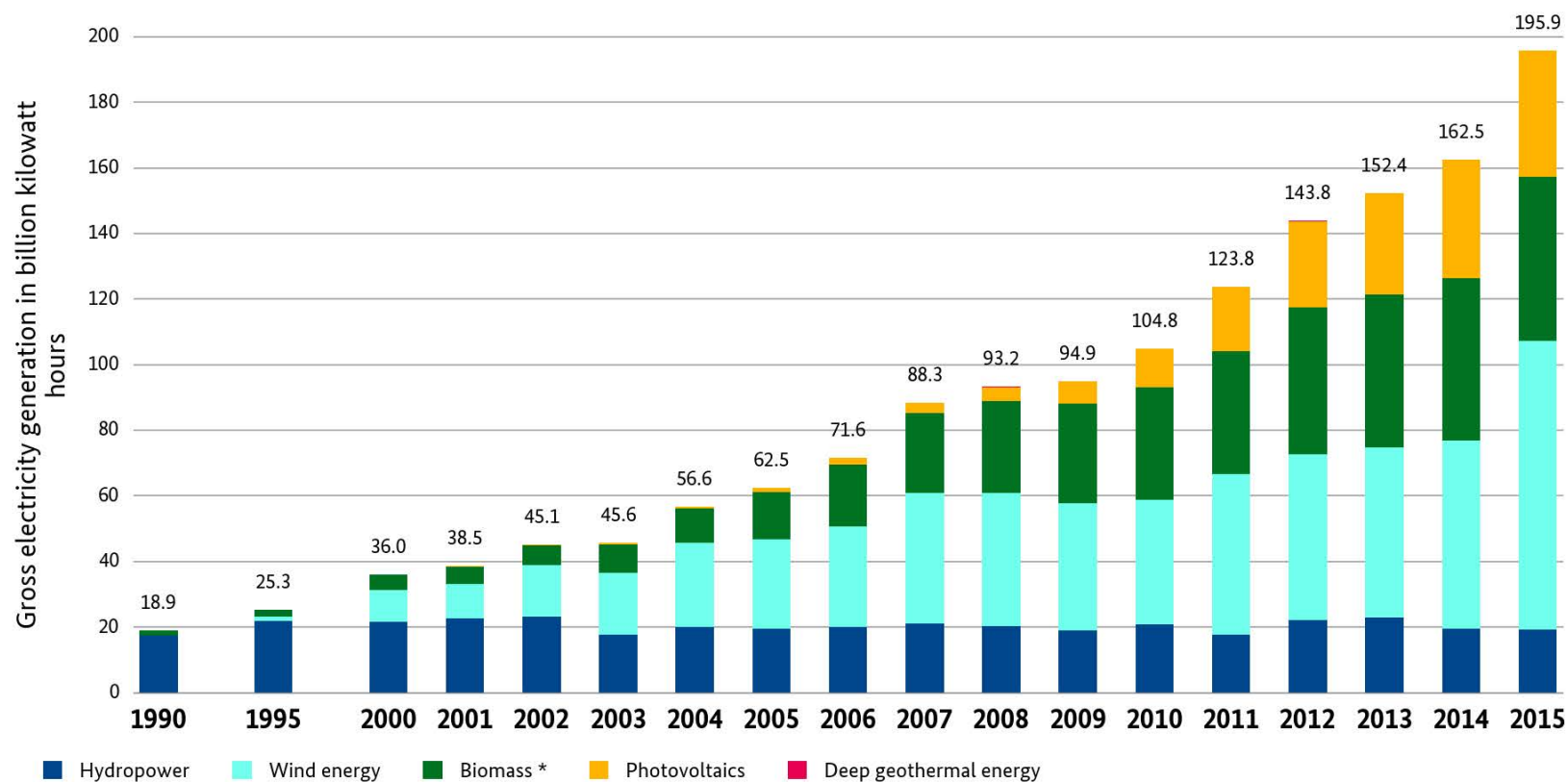


Development of installed capacity for renewables-based electricity generation in Germany



* incl. solid and liquid biomass, biogas incl. biomethane, landfill gas and sewage gas, excl. biogenic fraction of waste; BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2016; all figures provisional

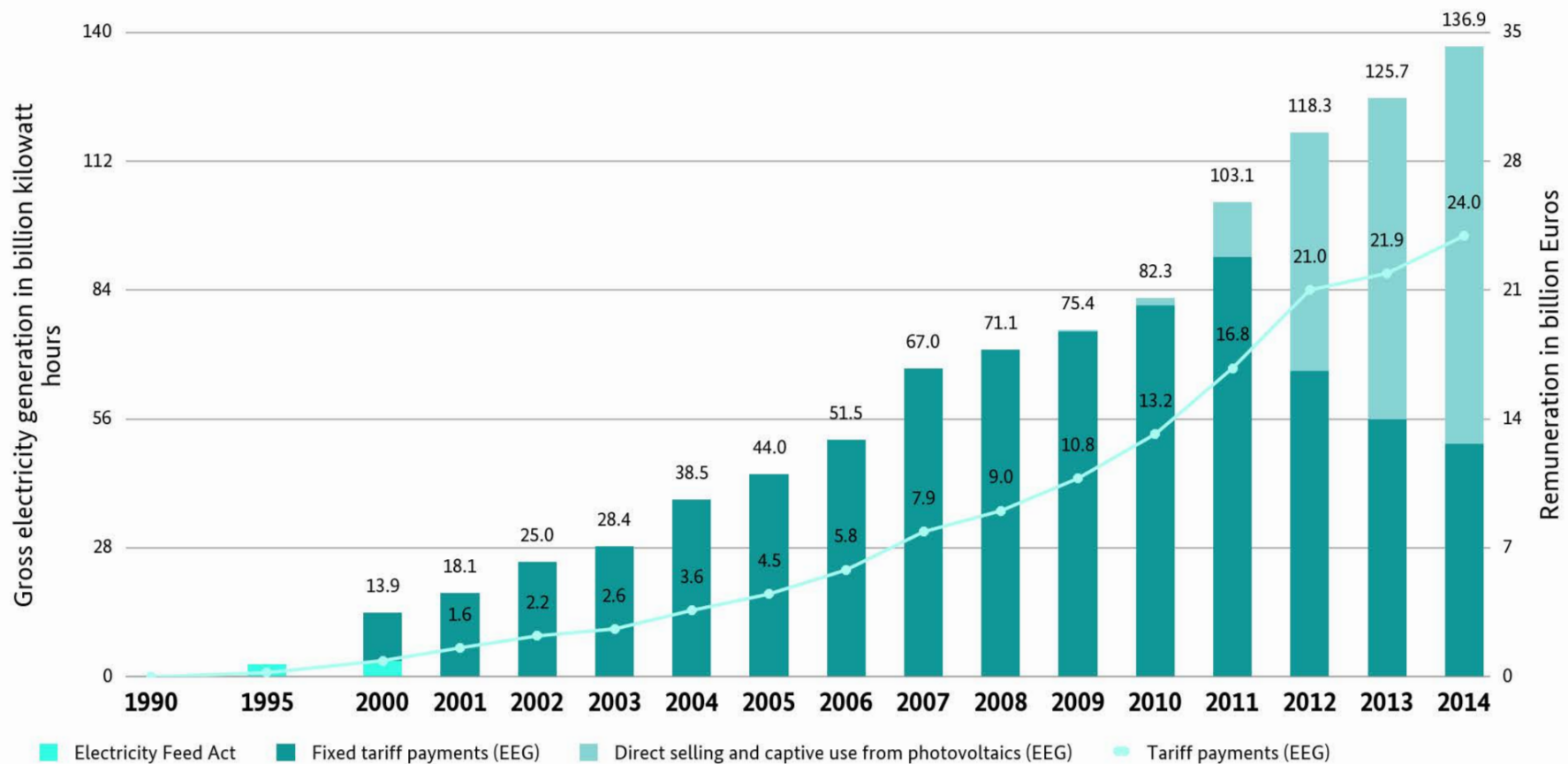
Development of renewables-based electricity generation in Germany



* incl. solid and liquid biomass, biogas incl. biomethane, sewage gas and landfill gas as well as the biogenic fraction of waste, from 2013 incl. sewage sludge; BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2016; all figures provisional



Feed-in and fees under the Electricity Feed Act and the Renewable Energy Sources Act (EEG)



BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2016; all figures provisional

EEG-Strommengen in Gigawattstunden

Stand: 15. Oktober 2015

in GWh	Nachträgliche Jahresabrechnung															Prognose ¹⁾	
	2000 ²⁾	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wasserkraft ³⁾	4.114	6.088	6.579	5.908	4.616	4.953	4.924	5.547	4.982	5.024	5.665	4.843	5.417	6.265	5.645	6.281	6.246
Deponie-, Klär- und Grubengas ³⁾					2.589	3.136	2.789	2.751	2.208	2.083	1.963	1.815	1.769	1.776	1.648	1.694	1.608
Biomasse	586	1.472	2.442	3.484	5.241	7.367	10.902	15.924	18.947	23.021	25.155	27.977	34.321	36.258	38.313	38.363	40.239
Geothermie					0	0	0	0	18	19	28	19	25	80	98	159	180
Windenergie an Land	5.662	10.509	15.786	18.713	25.509	27.229	30.710	39.713	40.574	38.610	37.619	48.314	49.949	50.802	55.907	67.061	75.949
Windenergie auf See										38	174	568	722	905	1.449	11.231	15.380
Solare Strahlungsenergie	29	76	162	313	557	1.282	2.220	3.075	4.420	6.583	11.729	19.599	26.128	29.607	33.001	36.106	36.826
Summe	10.391	18.145	24.970	28.417	38.511	43.967	51.545	67.010	71.148	75.377	82.331	103.135	118.330	125.694	136.061	160.895	176.427

¹⁾ Prognose der Übertragungsnetzbetreiber auf Grundlage der Ausgleichsmechanismusverordnung und auf Basis wissenschaftlicher Gutachten.

²⁾ Rumpffahr: 01.04.2000 bis 31.12.2000

³⁾ Deponie-, Klär- und Grubengas erstmals 2004 gesondert aufgeführt

Quellen: ÜNB 2015a, ÜNB 2015b und eigene Berechnungen

EEG-Gesamtvergütungszahlungen in Millionen Euro ¹⁾

Stand: 15. Oktober 2015

in Mio. Euro	Nachträgliche Jahresabrechnung															Prognose ²⁾	
	2000 ³⁾	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wasserkraft ⁴⁾	298	442	477	427	338	364	367	418	379	382	421	231	428	513	490	561	587
Deponie-, Klär- und Grubengas ⁴⁾					182	219	196	193	156	143	83	36	52	58	115	119	115
Biomasse	55	140	232	327	508	795	1.337	2.162	2.699	3.700	4.240	4.476	6.265	6.788	7.234	7.184	7.584
Geothermie					0	0	0	0	3	4	6	4	6	19	24	39	44
Windenergie an Land	515	956	1.435	1.696	2.300	2.441	2.734	3.508	3.561	3.389	3.316	4.165	4.936	4.895	5.423	6.440	7.206
Windenergie auf See										6	26	85	120	155	253	2.092	2.886
Solare Strahlungsenergie	15	39	82	154	283	679	1.177	1.597	2.219	3.157	5.090	7.766	9.202	9.485	10.412	10.816	10.733
Summe	883	1.577	2.226	2.604	3.611	4.498	5.810	7.879	9.016	10.780	13.182	16.763	21.008	21.913	23.950	27.251	29.154
davon Vergütungs- und Prämienzahlungen der Übertragungsnetzbetreiber	883	1.577	2.226	2.604	3.611	4.498	5.810	7.879	9.016	10.780	13.182	16.763	19.118	19.637	21.394	23.713	25.542

¹⁾ Summe aus Vergütungs- und Prämienzahlungen sowie Einnahmen aus Vermarktung der Strommengen nach § 34 EEG (Marktprämie)

²⁾ Prognose der Übertragungsnetzbetreiber auf Grundlage der Ausgleichsmechanismusverordnung und auf Basis wissenschaftlicher Gutachten.

³⁾ Rumpffahr: 01.04.2000 bis 31.12.2000

⁴⁾ Deponie-, Klär- und Grubengas erstmals 2004 gesondert aufgeführt

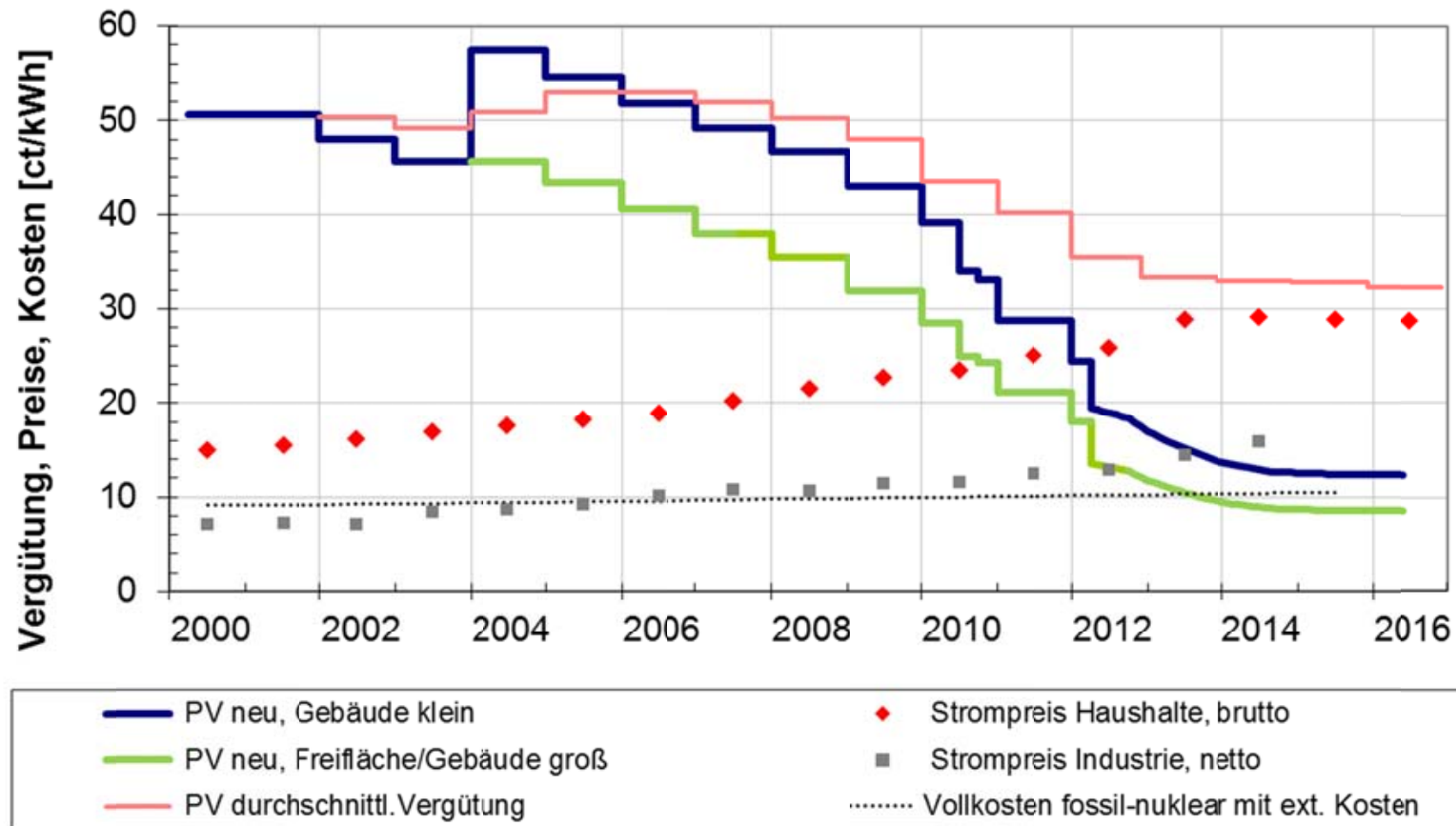


Abbildung 5: EEG-Vergütung von PV-Strom nach dem Datum der Inbetriebnahme für neue Anlagen, durchschnittliche EEG-Vergütung von PV-Strom für Anlagenbestand [BDEW2], Vollkosten der fossil-nuklearen Stromerzeugung [IFNE], Strompreise aus [BMWi1], teilw. geschätzt

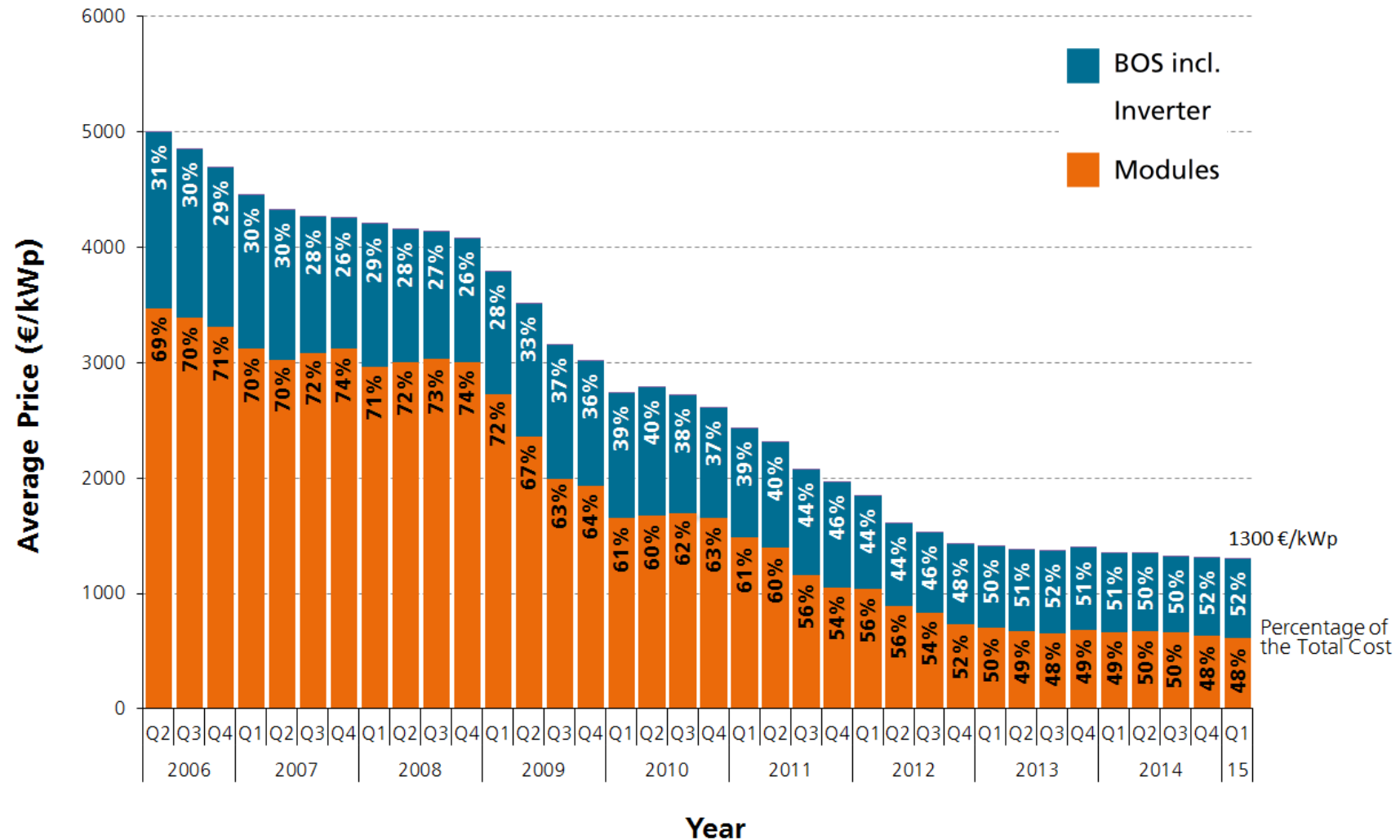


Abbildung 3: Durchschnittlicher Endkundenpreis (Systempreis, netto) für fertig installierte Aufdachanlagen von 10-100 kW_p, Daten von BSW, Darstellung PSE AG

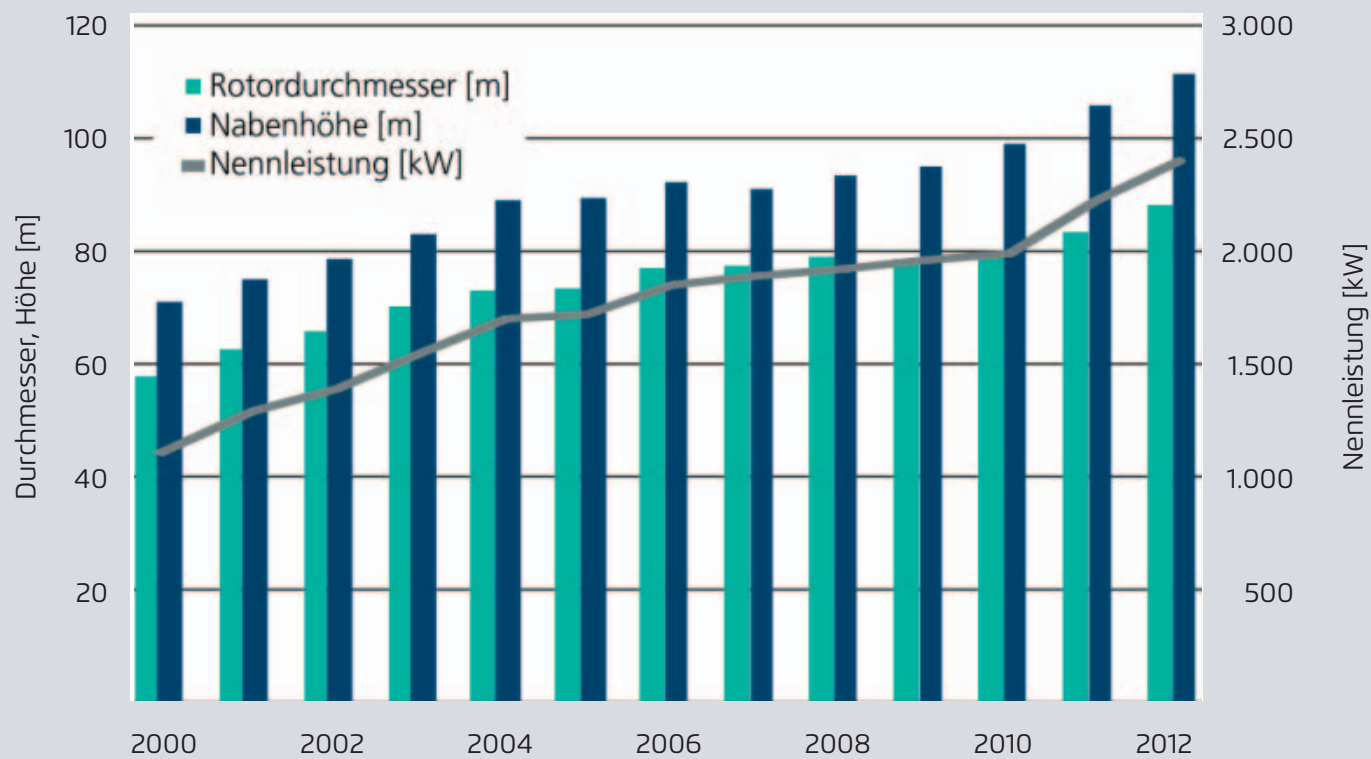
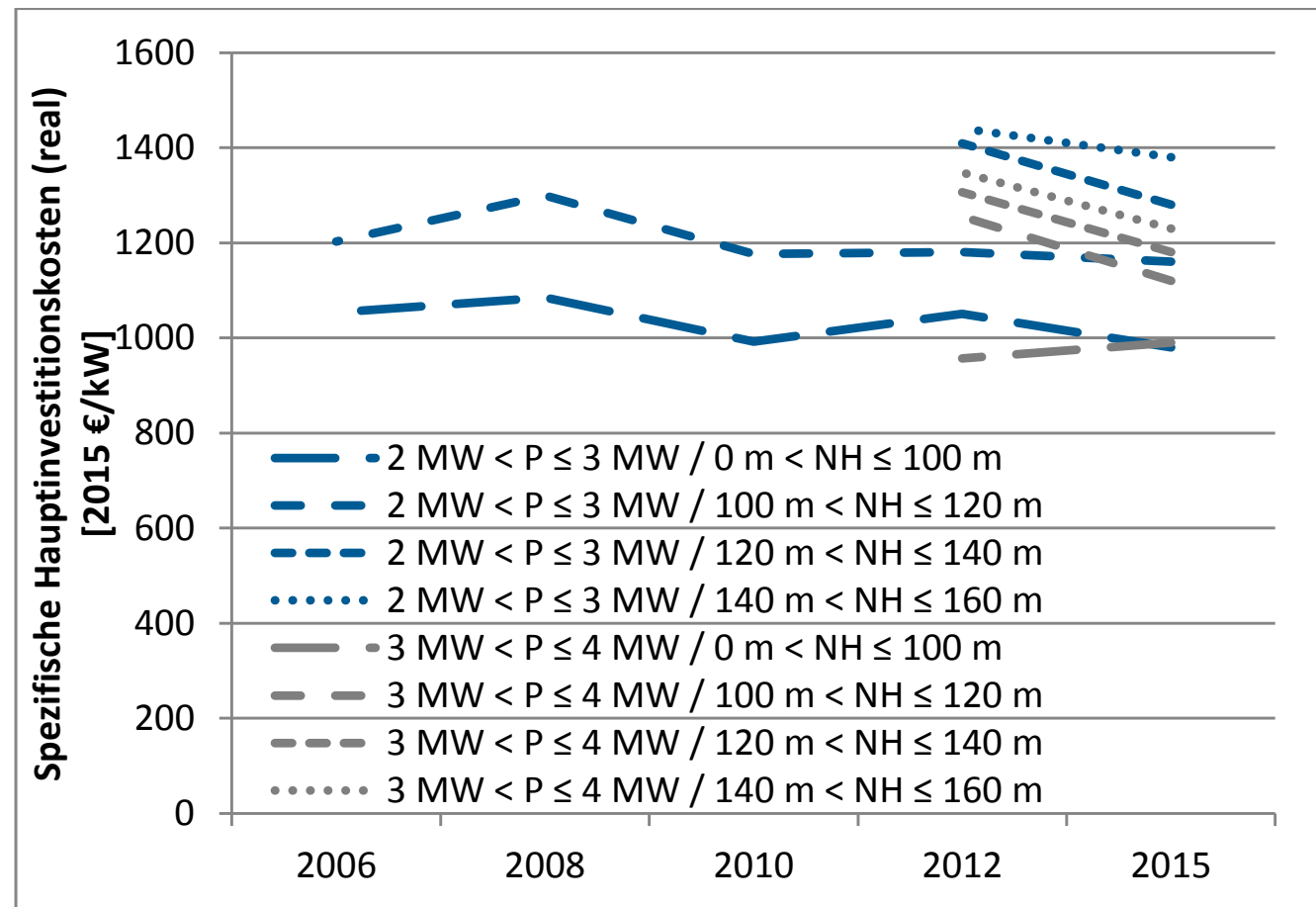


Abbildung 4:
Zeitliche Entwicklung
der spezifischen Haupt-
investitionskosten je
kW von Windenergie-
anlagen der Leistungs-
klassen von 2-3 MW
und von 3-4 MW (infla-
tionsbereinigt)
[DWG 2008, DWG 2011,
DWG 2013]



EEG (2016)

- Target: Share of renewables 40-45% by 2025, 55-60% by 2035 and a minimum of 80% by 2050
- Focus on onshore/offshore wind and solar
- From 2019 (?), auction system for most renewable technologies (pay as bid, maximum price published in advance)
- Deployment corridor met by auctioning a specific amount of capacity volume each year
- Feed-in tariffs for small installation <750 kW (?)
- Biomass also included in auctions (150 MW first three years, then 200 MW)

EEG (2016) - wind

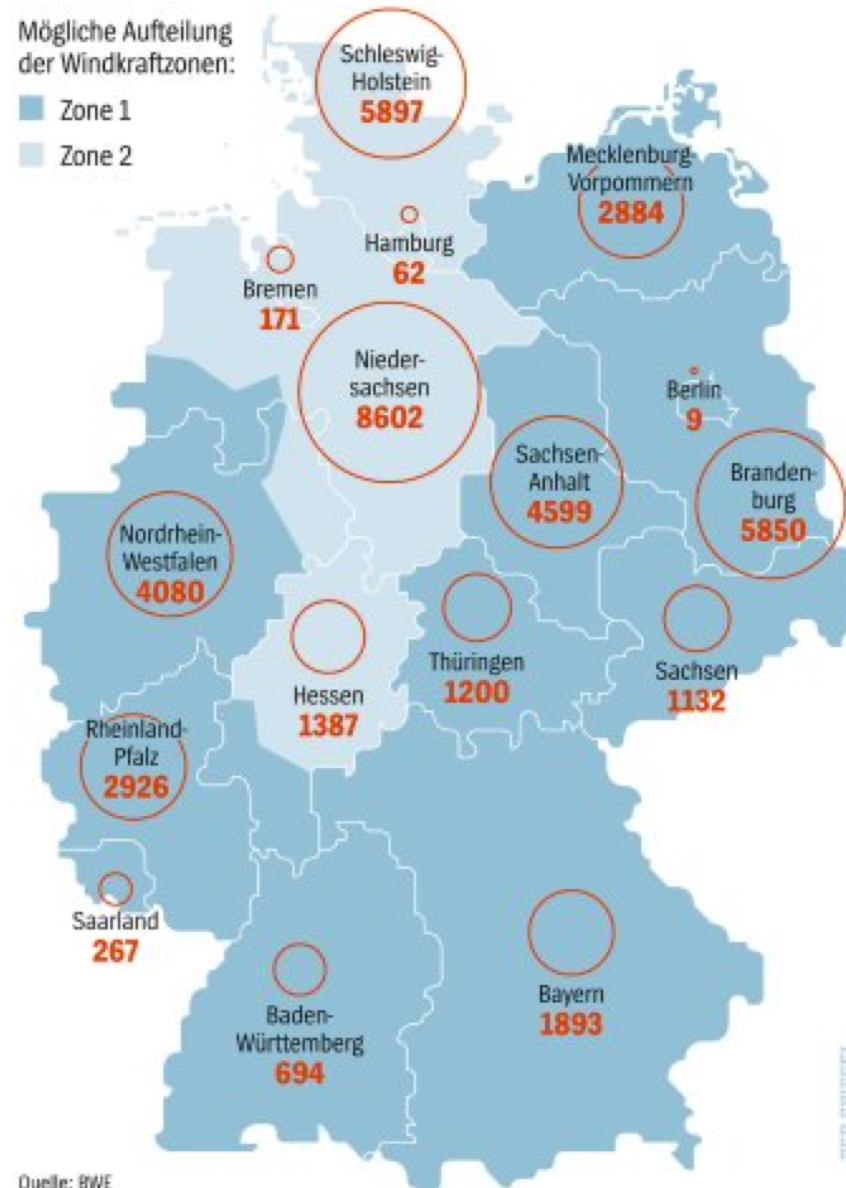
- Degression of 5% in 2017 for onshore wind (?)
- Annual increase for onshore wind 2800 MW (2900 MW after 2020)
- Target for offshore: 15 GW in 2030, centralised auctions after 2025, transitional model 2021 - 2024

Onshore-Windenergieanlagen

Installierte Nennleistung in Megawatt, 2015

Mögliche Aufteilung
der Windkraftzonen:

- Zone 1
- Zone 2



Quelle: BWE

DER SPIEGEL

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