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Experiences with Solar Roof Programme in Germany

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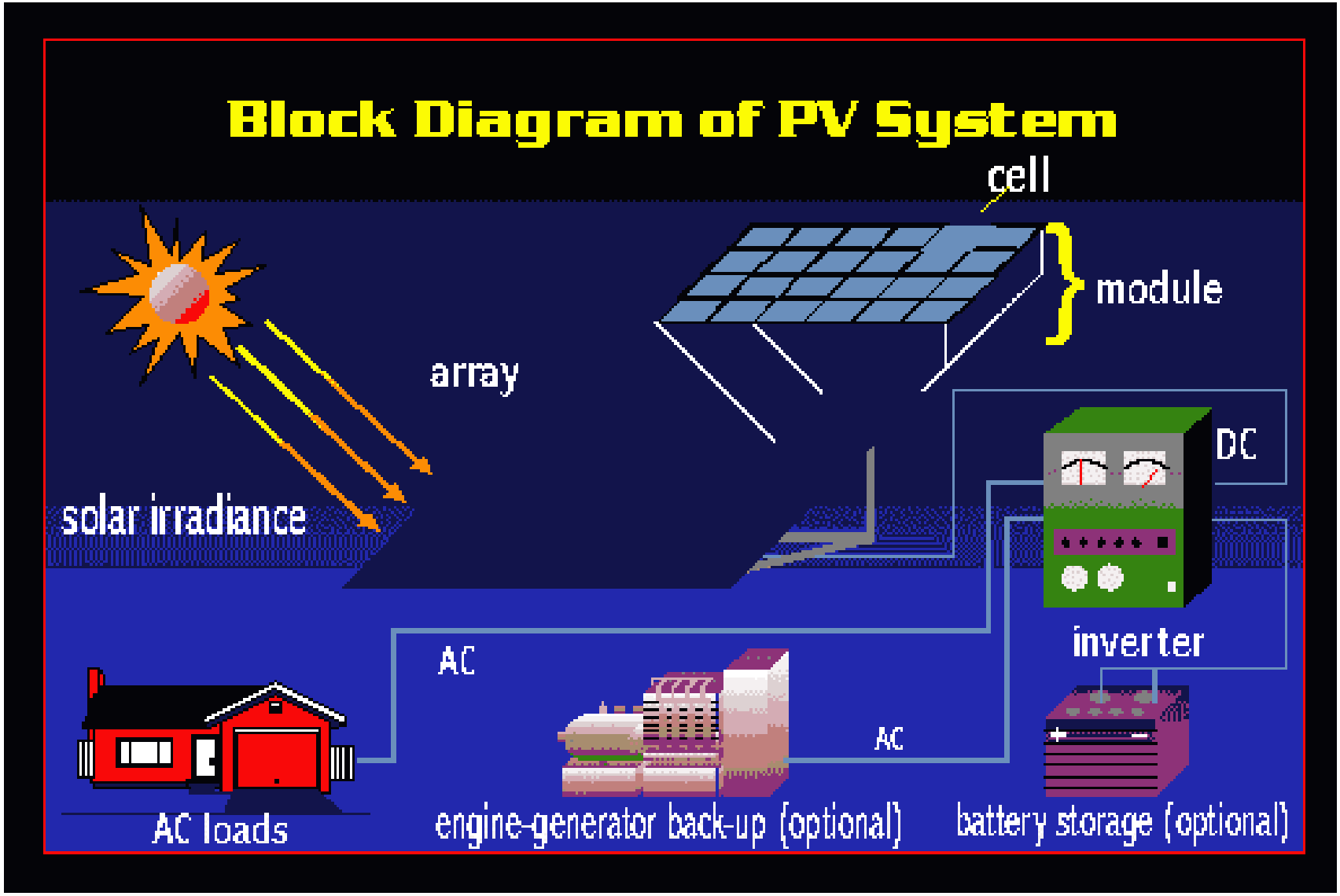

Block Diagram of PV System
cell
module
array
solar irradiance
DC
inverter
AC
AC
AC loads
engine-generator back-up (optional)
battery storage (optional)

ded Deutscher Entwicklungsdienst

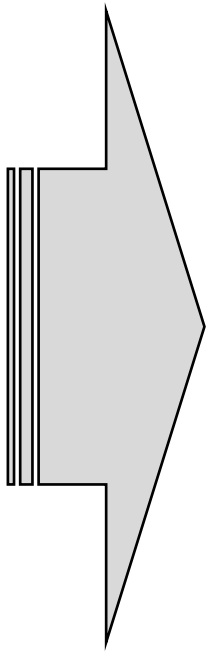
German Development Service

gtz

German Technical Cooperation

inWent Internationale Weiterbildung und Entwicklung gGmbH

Capacity Building International, Germany



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Indo-German Energy Programme (IGEN)

COOPERATION REPUBLIC OF INDIA FEDERAL REPUBLIC OF GERMANY

Energy Efficiency
Ministry of Power (BEE/CEA)

- EE in thermal Power plants
- Implementation of Energy Conservation Act
- Capacity develop-ment for EE for state designated agencies
- Clean Development Mechanism CDM
- Indo-German Energy Symposium

- Excellence Enhancement Center
- Trigeneration (TRIGEN)
- Support and Permanent office IGEF

Renewable Energy
Ministry of New and Renewable Energy

Rural / poverty focused

- **IGEN-Renewable Energy (RE) Component**
  BMZ (5 M€)
  (10/2010- 09/2013)
- **Renewable Energy Supply for Rural Areas (RESRA)**
  BMU (2.5 M€)
  (10/2008- 10/2014)

Industrial / urban

- **Commercialisation of Solar Energy in Urban and Industrial Areas (ComSolar)**
  BMU (4.9 M€)
  (12/2009- 12/2013)
- **SolMap-Solar Mapping and Monitoring**
  BMU (1.6 M€)
  (11/2010- 02/2014)

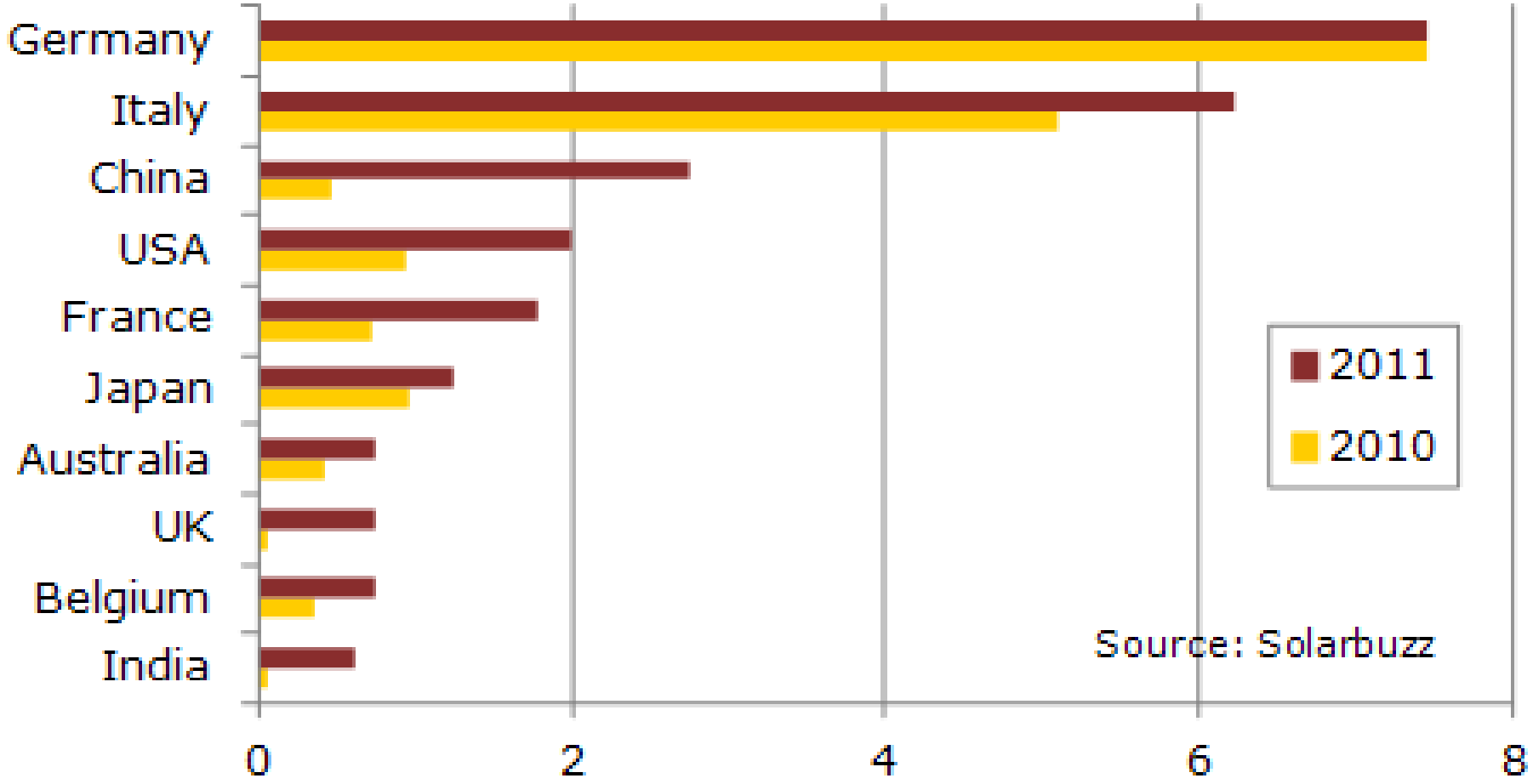
support

Indo-German Energy-Forum (IGEF)
MoP (CEA, BEE), MNRE
BMWi, BMZ, BMU, (BMBF, AA, BMVBS)

IGEF Sub-Group 2: "Renewable Energy"

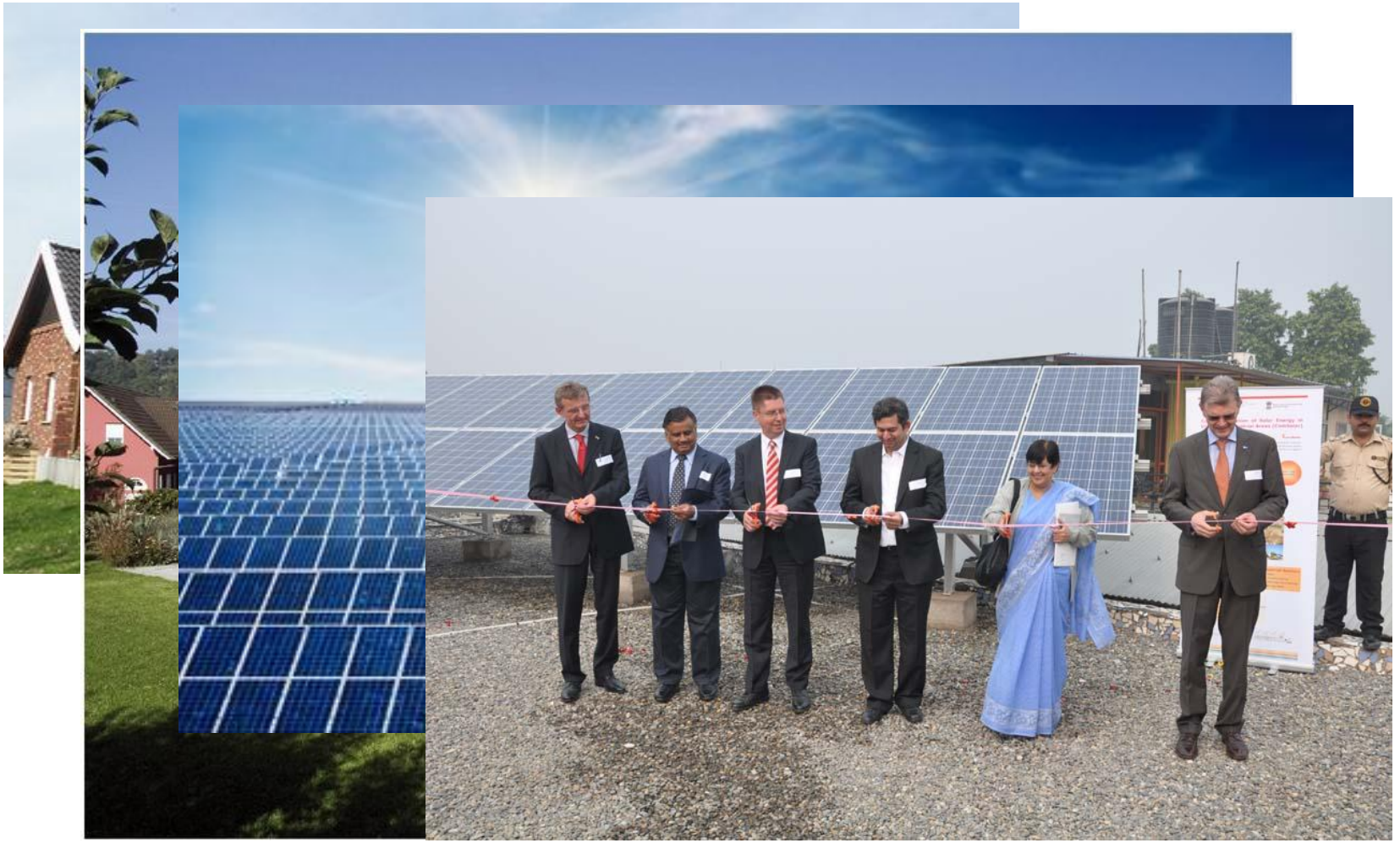
support

Global solar PV Installations



A German rooftop array with the German Chancellery in the background.

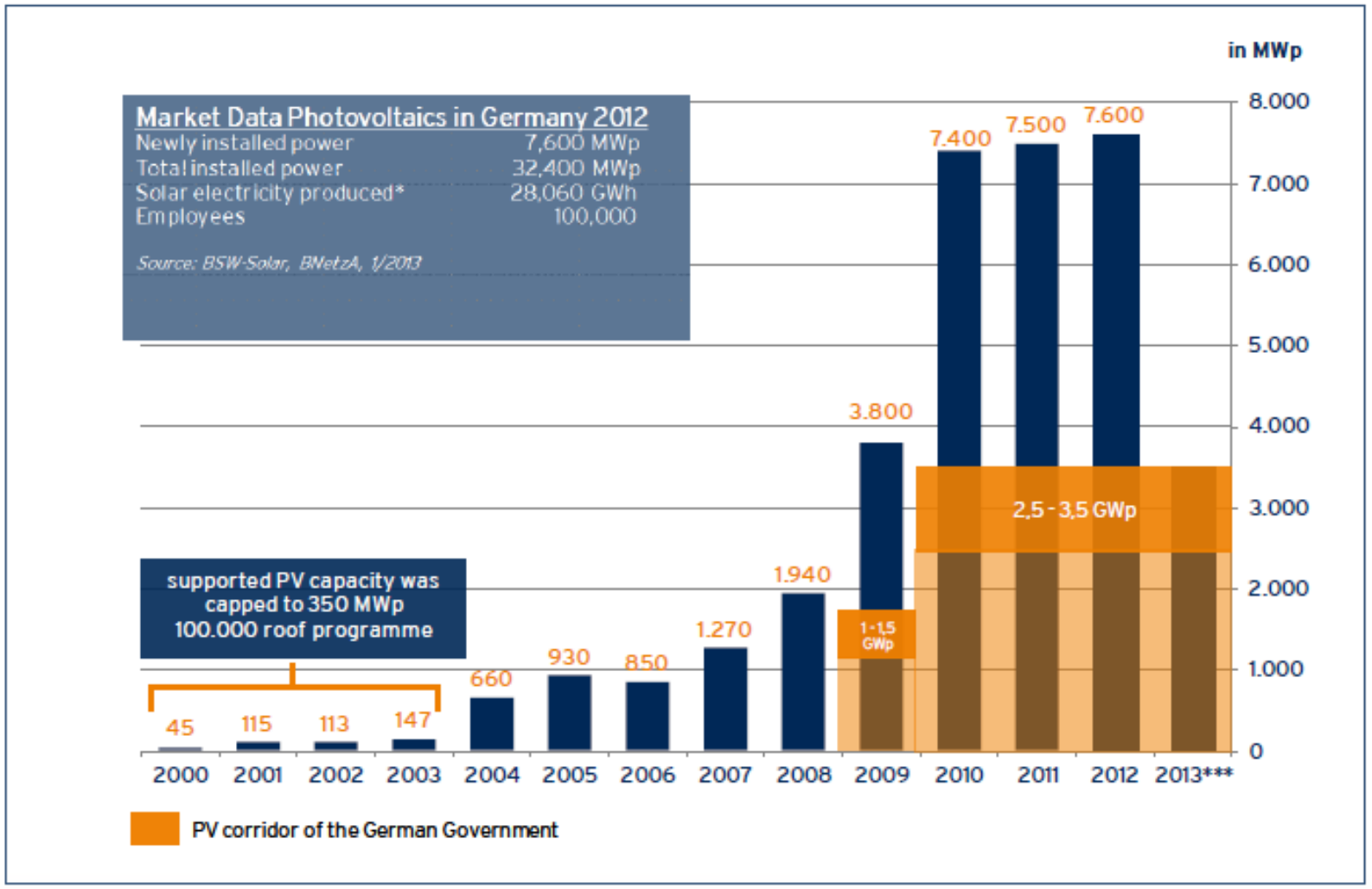
Waldpolenz solar park in Germany



Large solar PV plants in Germany

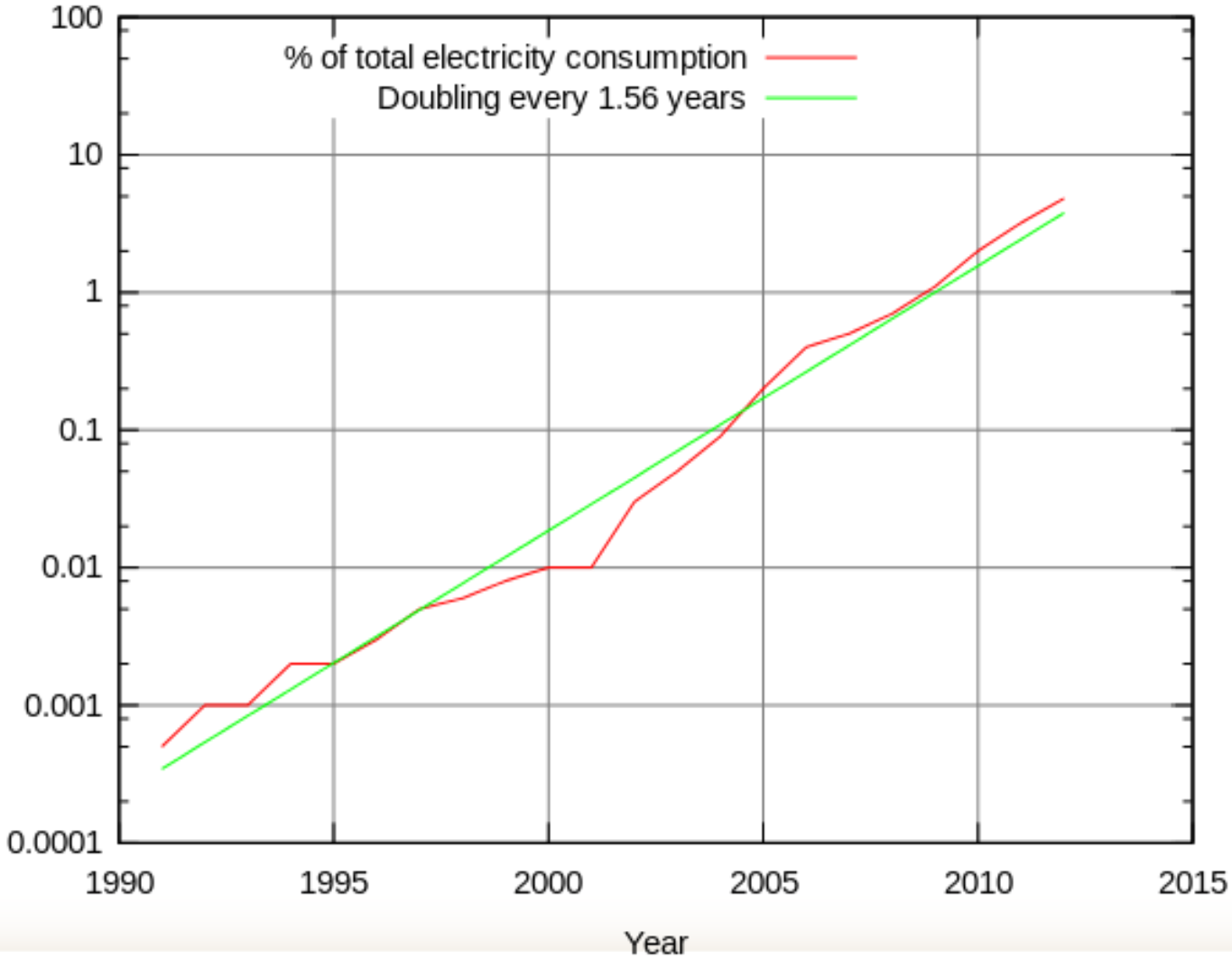
PV Power station	Nominal Power[24] in MW_p	Annual Yield in GWh	Capacity factor	Notes
Neuhardenberg Solar Park[23][25]	145			Completed September 2012
Templin Solar Park[23][26]	128.48			Completed September 2012
Brandenburg-Briest Solarpark	91			
Solarpark Finow Tower	84.7			Completed in 2010, 2011
Finsterwalde Solar Park	80.7			Phase I completed 2009, phase II and III 2010 [27][28]
Senftenberg Solarpark[29]	78			Phase II and III completed 2011, another 70 MW phase planned
Strasskirchen Solar Park	54	57[23]	0.12	
Lieberose Photovoltaic Park	53	53[30]	0.11	2009 [31][30]
Tutow Solar Park	52			Tutow I completed in 2009, II in 2010, III in 2011
Kothen Solar Park	45			2009
Waldpolenz Solar Park	40[32]		0.11	550,000 First Solar thin-film CdTe modules. Completed December 2008 [33][32]
Fürstenwalde Solar Park	39.64	36.5		2011
Reckahn Solar Park	36			2011
Lauingen Energy Park	25.7	26.98[34]		Completed in 2010
Pocking Solar Park	22			
Mengkofen Solar Park	21.7			
Rothenburg Solar Park	20			

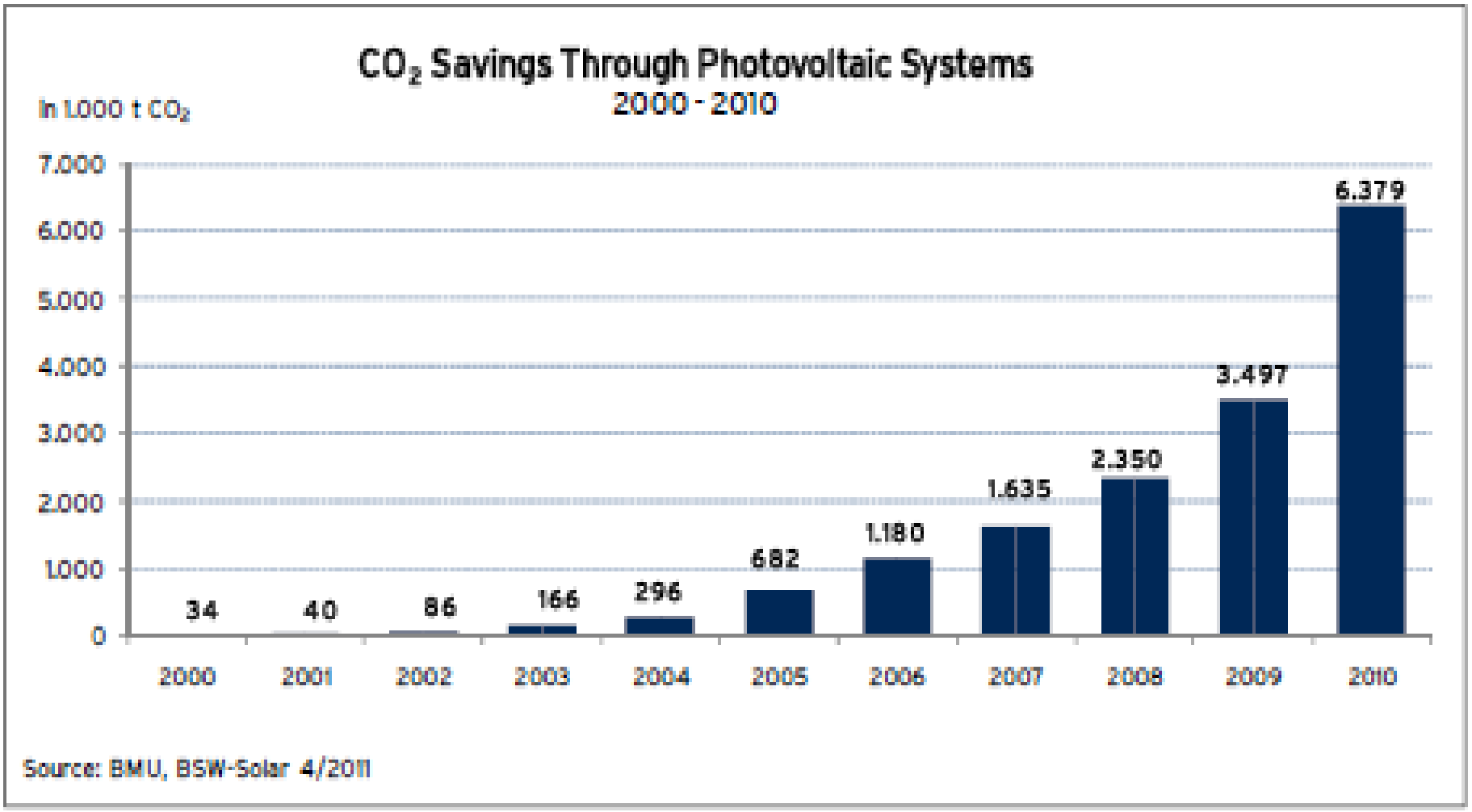
Development of German PV market



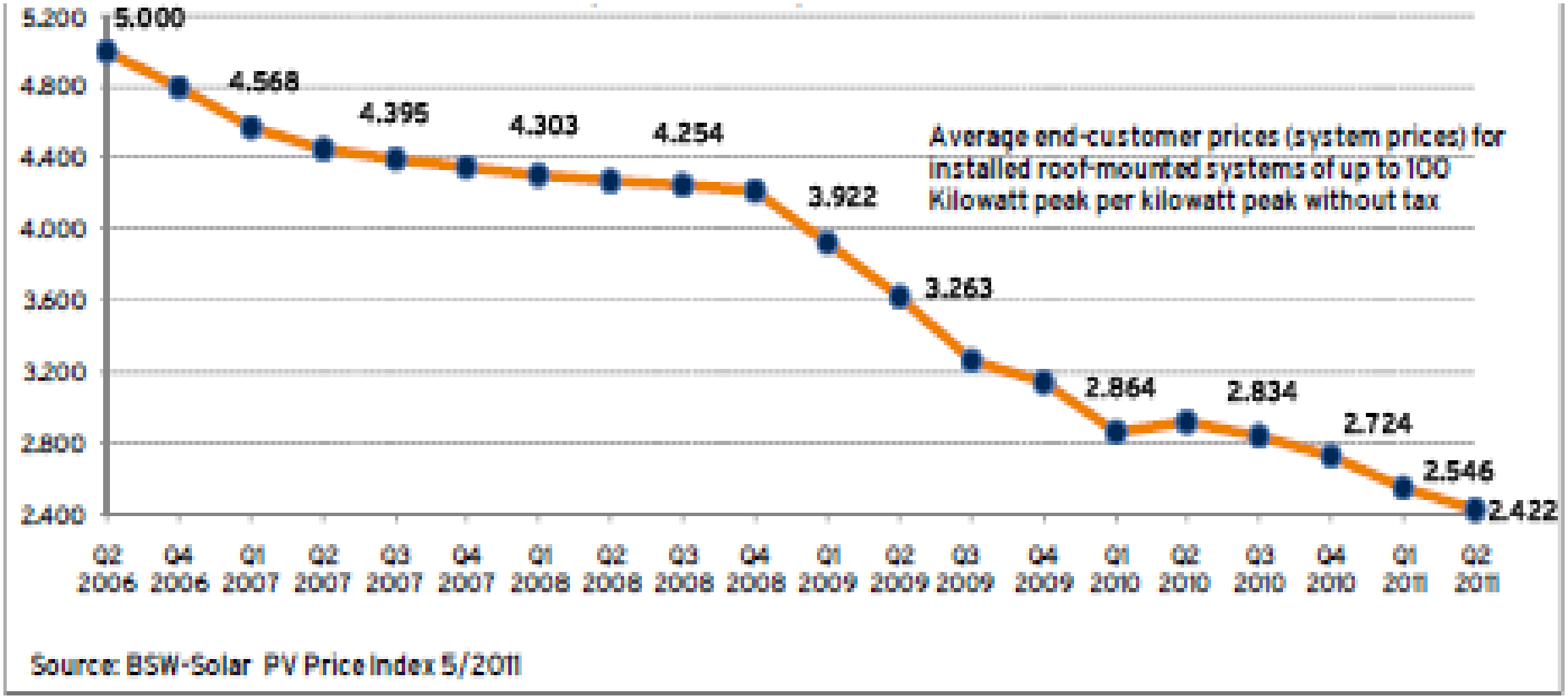
Solar power covers annual electricity demand of over 3.4 million households

Solar PV % of annual electricity consumption



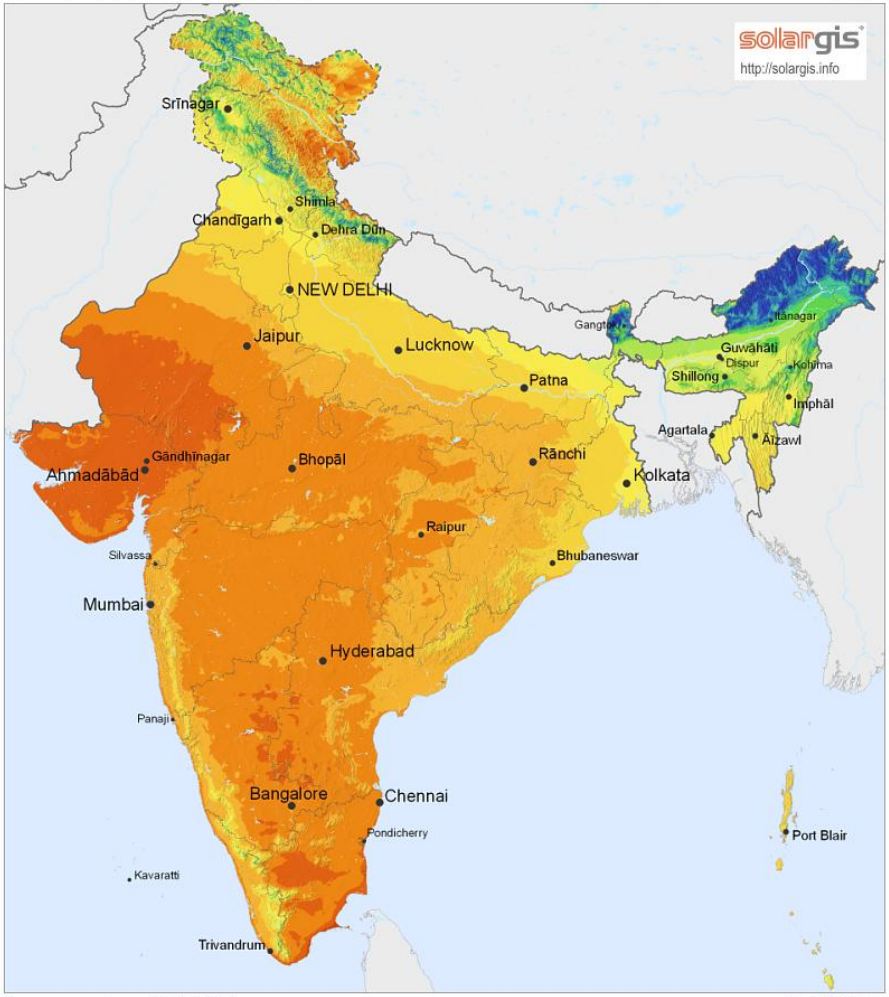

CO_2 Savings Through Photovoltaic Systems
2000 - 2010
In 1.000 t CO_2
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0
34
40
86
166
296
682
1.180
1.635
2.350
3.497
6.379
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Source: BMU, BSW-Solar 4/2011

Price of solar PV systems in Germany (€/kWp)

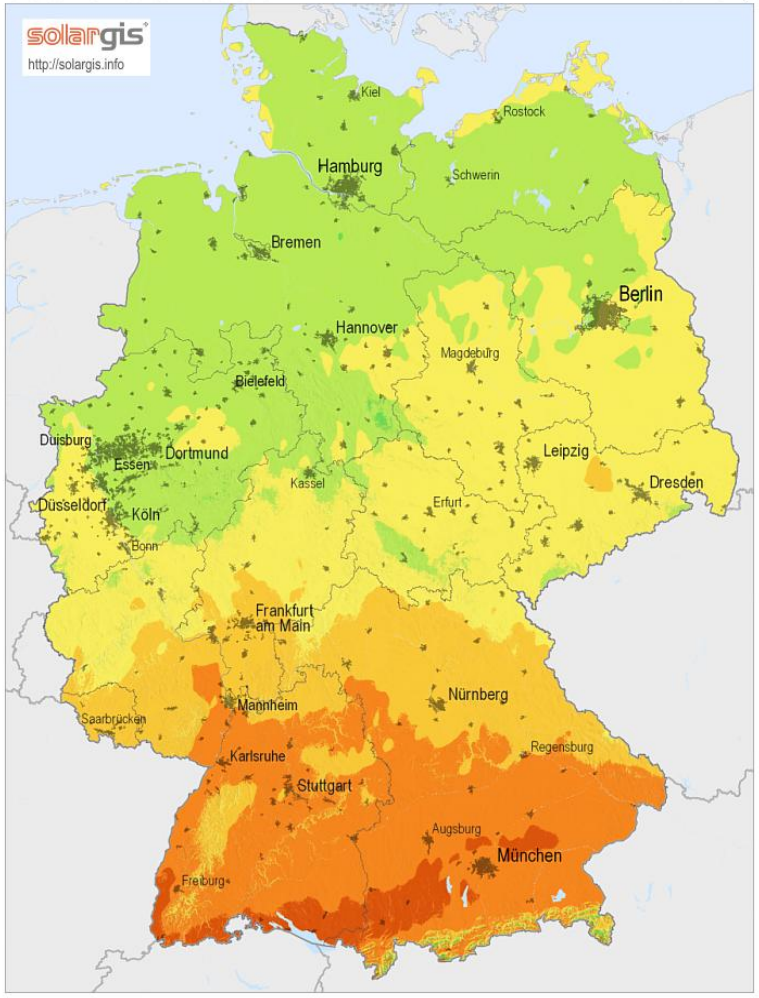


Global solar irradiation

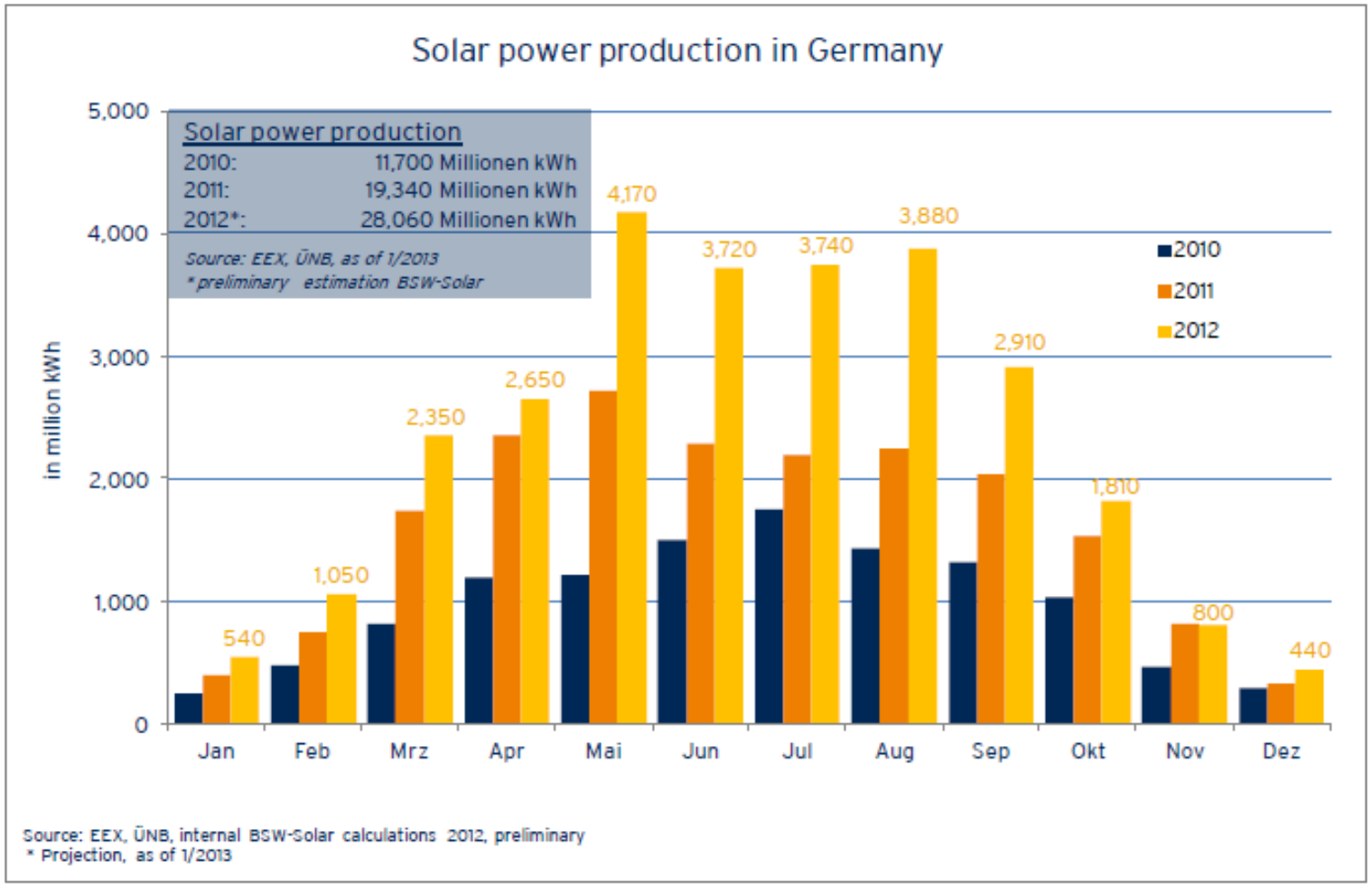
Global horizontal irradiation — India



Global horizontal irradiation — Germany

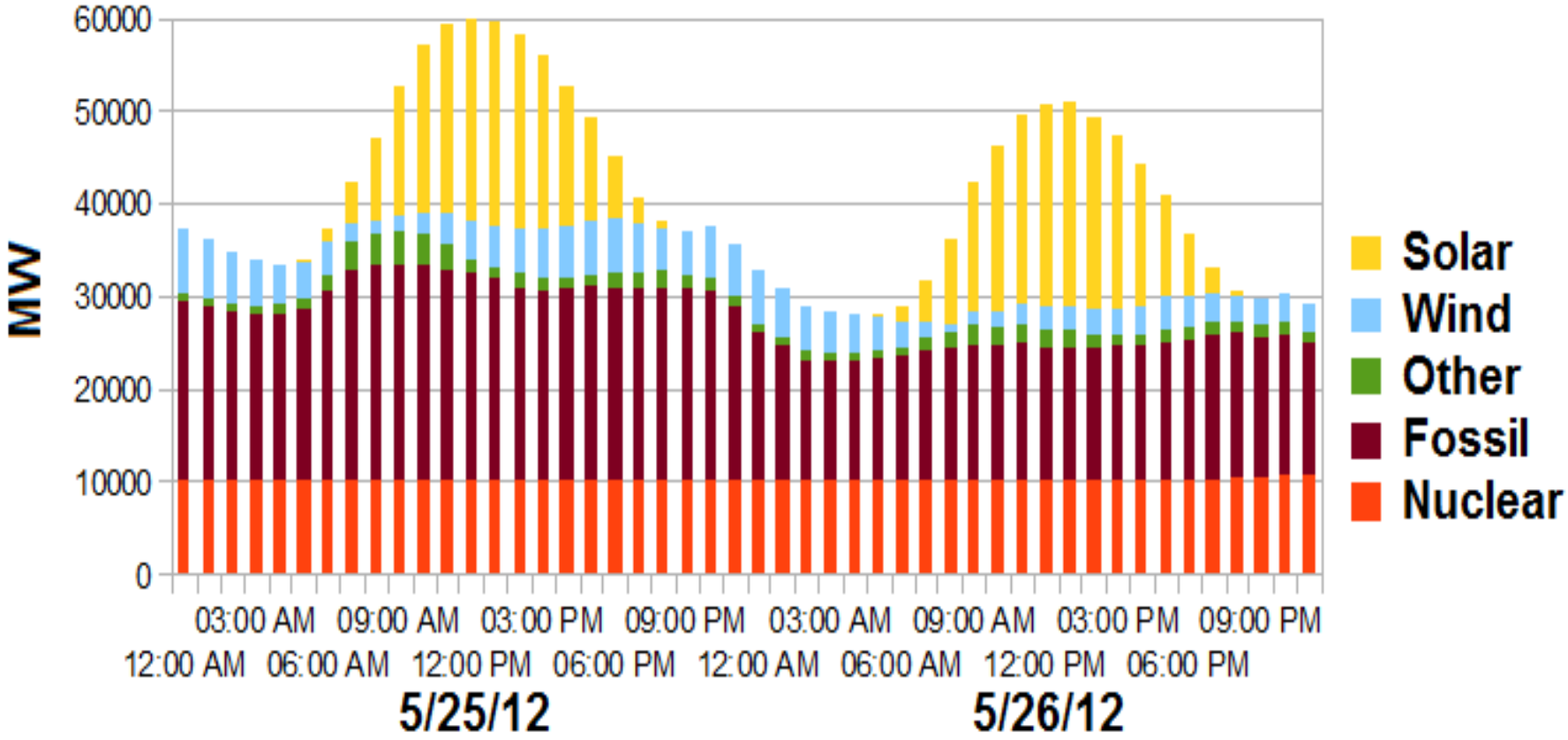


PV Power production grows 45% yoy



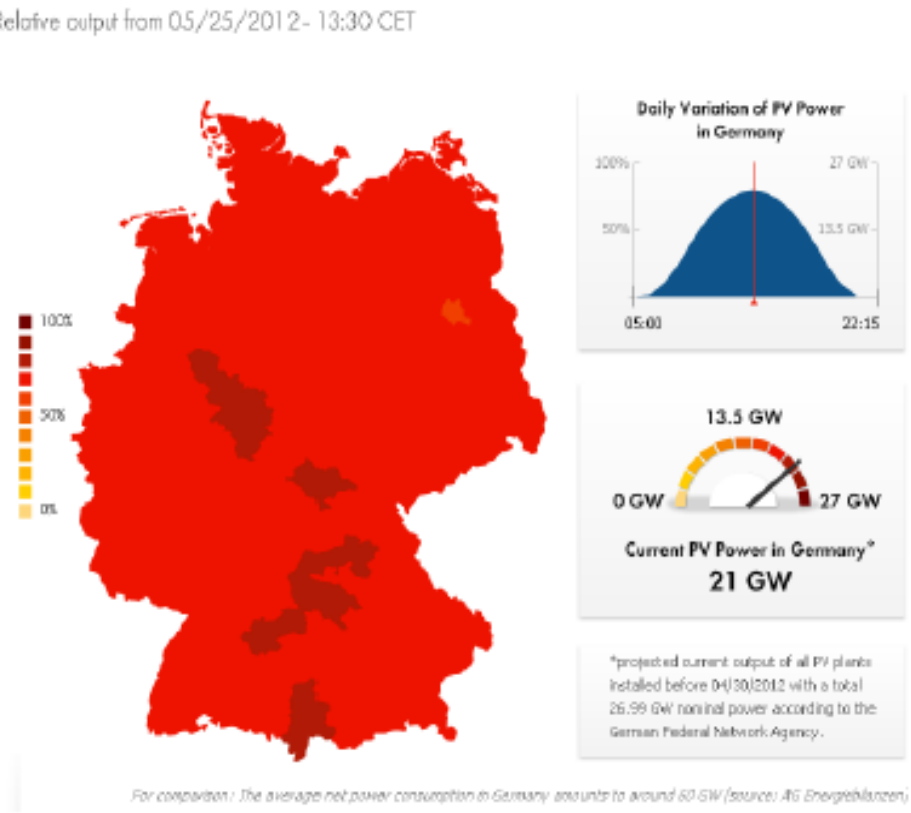
➲ 28 TWh solar power have been produced in Germany

German electricity generation



World record in solar power production

- Solar delivered even in winter when Germany exported solar power to our neighbor France (February)
- Solar power production world record happend in Germany in May 2012: 22 GW - up to 40% of power demand - covered from solar PV



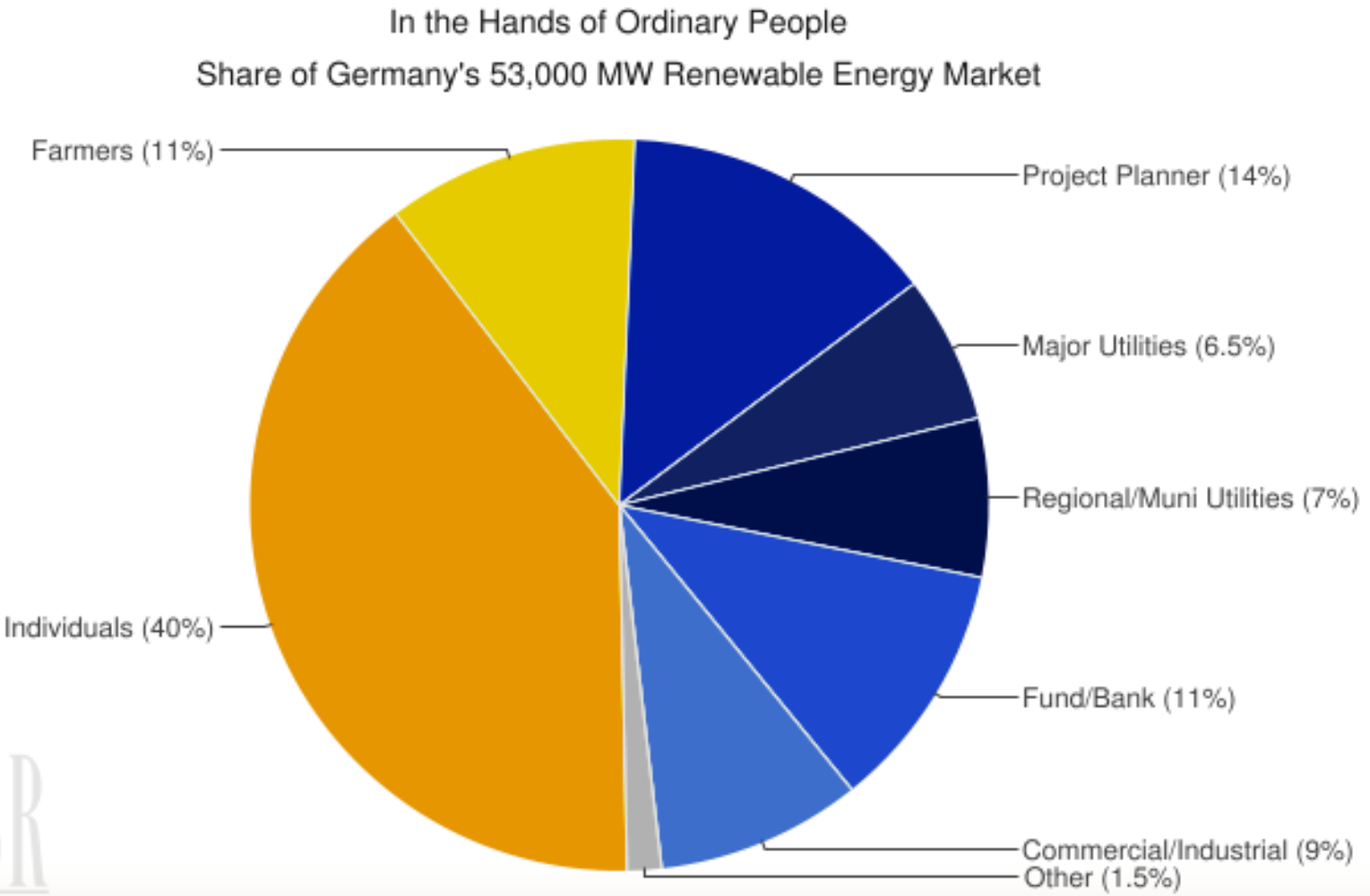
Global solar irradiation in Germany

Solar PV market segments Germany (2011)

Share of Germany's Renewable Energy market



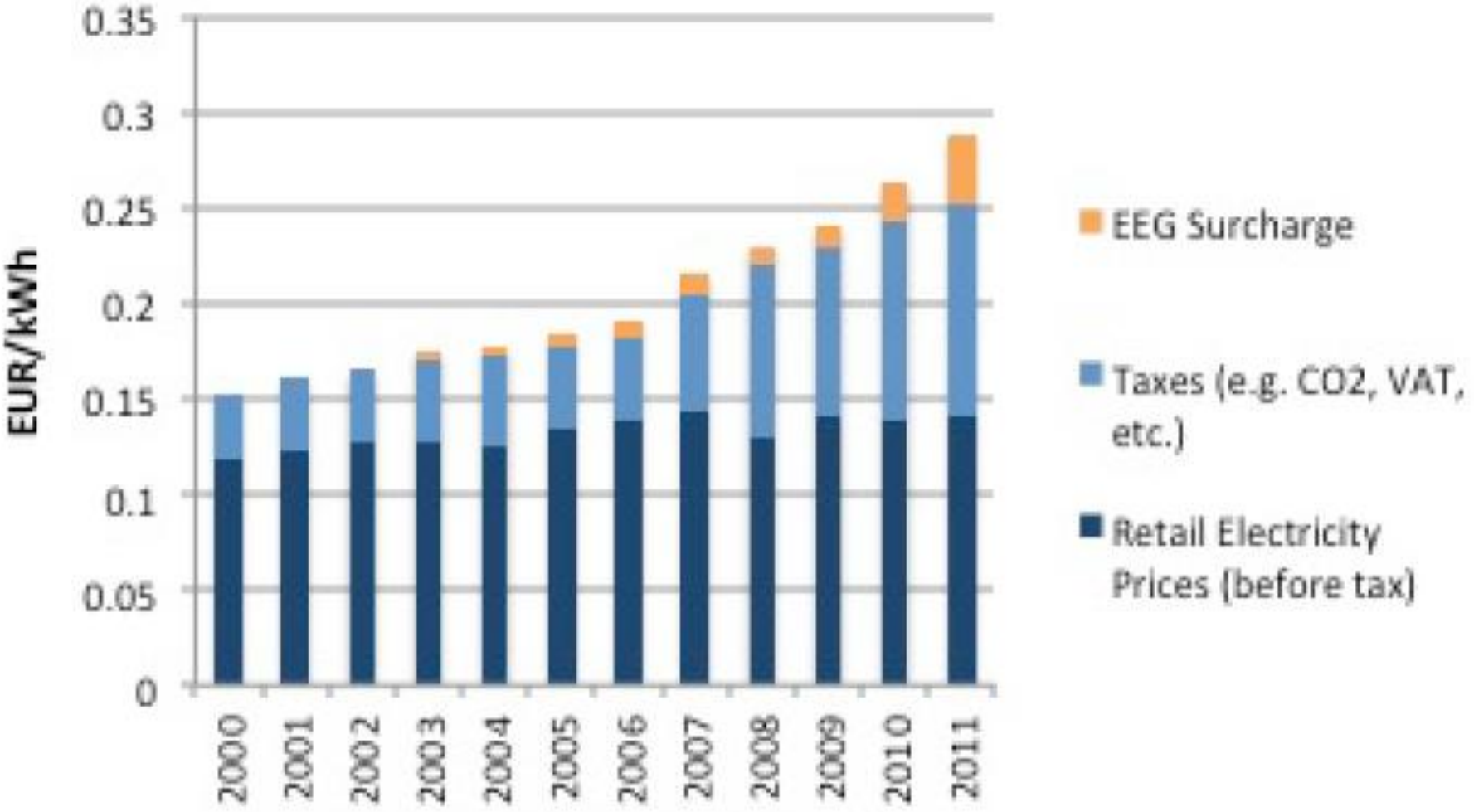




FIT for solar electricity €-ct/kWh

type		2004	2005	2006	2007	2008	2009	2010	Jul 2010	Oct 2010	2011
Rooftop mounted	up to 30 kW	57.4	54.53	51.80	49.21	46.75	43.01	39.14	34.05	33.03	28.74
	between 30 kW and 100 kW	54.6	51.87	49.28	46.82	44.48	40.91	37.23	32.39	31.42	27.34
	above 100 kW	54.0	51.30	48.74	46.30	43.99	39.58	35.23	30.65	29.73	25.87
	above 1000 kW	54.0	51.30	48.74	46.30	43.99	33.00	29.37	25.55	24.79	21.57
Ground mounted	contaminated grounds	45.7	43.4	40.6	37.96	35.49	31.94	28.43	26.16	25.37	22.07
	agricultural fields	45.7	43.4	40.6	37.96	35.49	31.94	28.43	-	-	–
	other	45.7	43.4	40.6	37.96	35.49	31.94	28.43	25.02	24.26	21.11

Household electricity rates



Basic mechanism of German RE law

Priority treatment	▪ Priority access regarding grid connection ▪ Electricity feed-in priority ▪ Purchase obligation of electricity produced
Feed-in Tariff	▪ Provisions of a constant tariff for each kWh of electricity produced for a period of 20 years ➢ Advantage: Stepwise decrease and the goal of final phase-out of FiT acts as an incentive for RE-industry to become competitive within a given period of time ▪ Tariff differentiated by plant size and technology ➢ Advantage: Targeted promotion of certain RE-technologies
Remuneration system	▪ TSOs sell green electricity on spot market to the market price ▪ DSOs claim the remuneration from TSOs. TSOs claim differential expenses from utilities. Those collect them from their end customers. ▪ Expenses are distributed via a common price surcharge per kWh

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Thank you!