

German American Chambers of Commerce
4th Germany California Solar Day
May 27th, 2008, San Francisco



Development of the Photovoltaic Industry in Germany



Gerhard Stryi-Hipp

Managing Director

German Solar Industry Association (BSW-Solar)

Stralauer Platz 34, 10243 Berlin, Germany

Tel. +49 30 2977788 0, Fax +49 30 2977788 99

www.bsw-solar.de, stryi-hipp@bsw-solar.de



BSW - Bundesverband Solarwirtschaft German Solar Industry Association

TASK Represent the German solar industry
in the solar thermal energy and photovoltaics sectors

VISION A worldwide sustainable energy supply provided by
solar energy

ACTIVITIES Lobbying, political advice, public relations, market
observation, standardization

TIME Over 25 years of activity in the solar energy sector

MEMBERS More than 600 solar producers, suppliers, wholesalers,
installers and other companies active in the solar
business

HEADQUARTERS Berlin

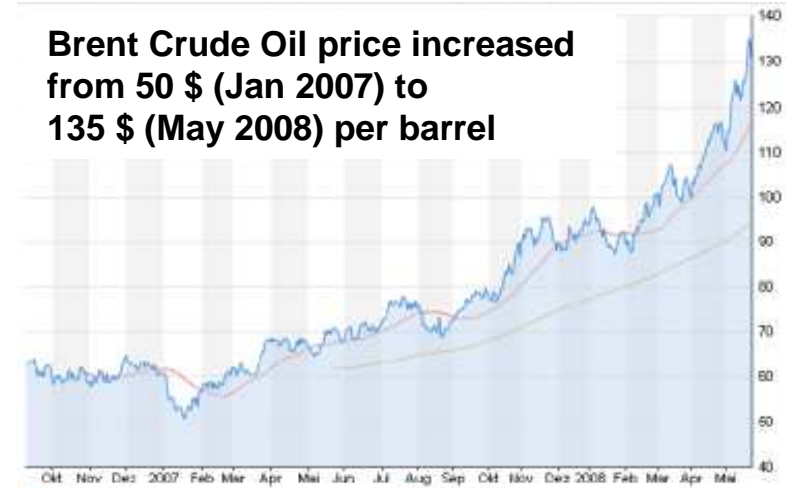
Strongly growing problems of our fossil-nuclear energy supply system

- **Security of supply:**
critical, due to strong growing energy import dependency – especially from problematic regions
- **Fossil and nuclear energy sources are finite:**
Growing demand and limited resources the reason for exploding energy prices
- **Climate change:**
Caused by human energy consumption climate change is a reality as the UN-IPCC report has proven

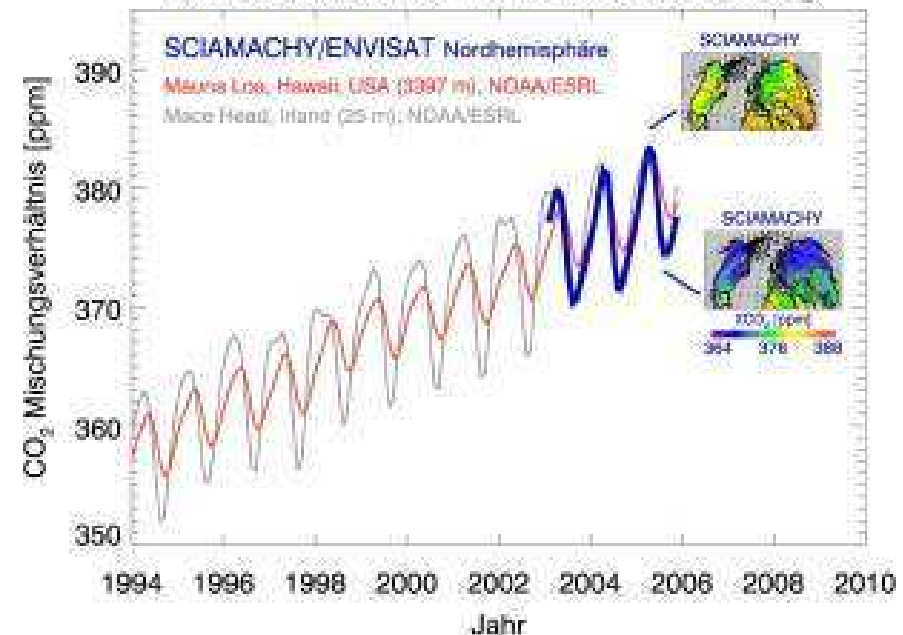
„We should leave oil before it leaves us“

Fatih Birol, chief economist IEA, March 2008

Brent Crude Oil price increased from 50 \$ (Jan 2007) to 135 \$ (May 2008) per barrel



Atmosphärisches Kohlenstoffdioxid (CO₂)



CO₂-Concentration is growing continuously (IPCC 2007)

The sustainable solution: Mix of Renewable Energies

Only Renewable Energies

- are everlasting
- are „domestic“ energy sources
- are sustainable
- do not harm the climate
- are becoming cheaper and cheaper
- increase domestic and regional added value
- are creating jobs



Quelle: Aus BMU, Daten EE, Juni 2007

Challenges for RES are

- **the financing of investments** as long as RES are more expensive than fossil and nuclear energy
- **the reconstruction of the energy supply system** to a distributed generation system based on RES



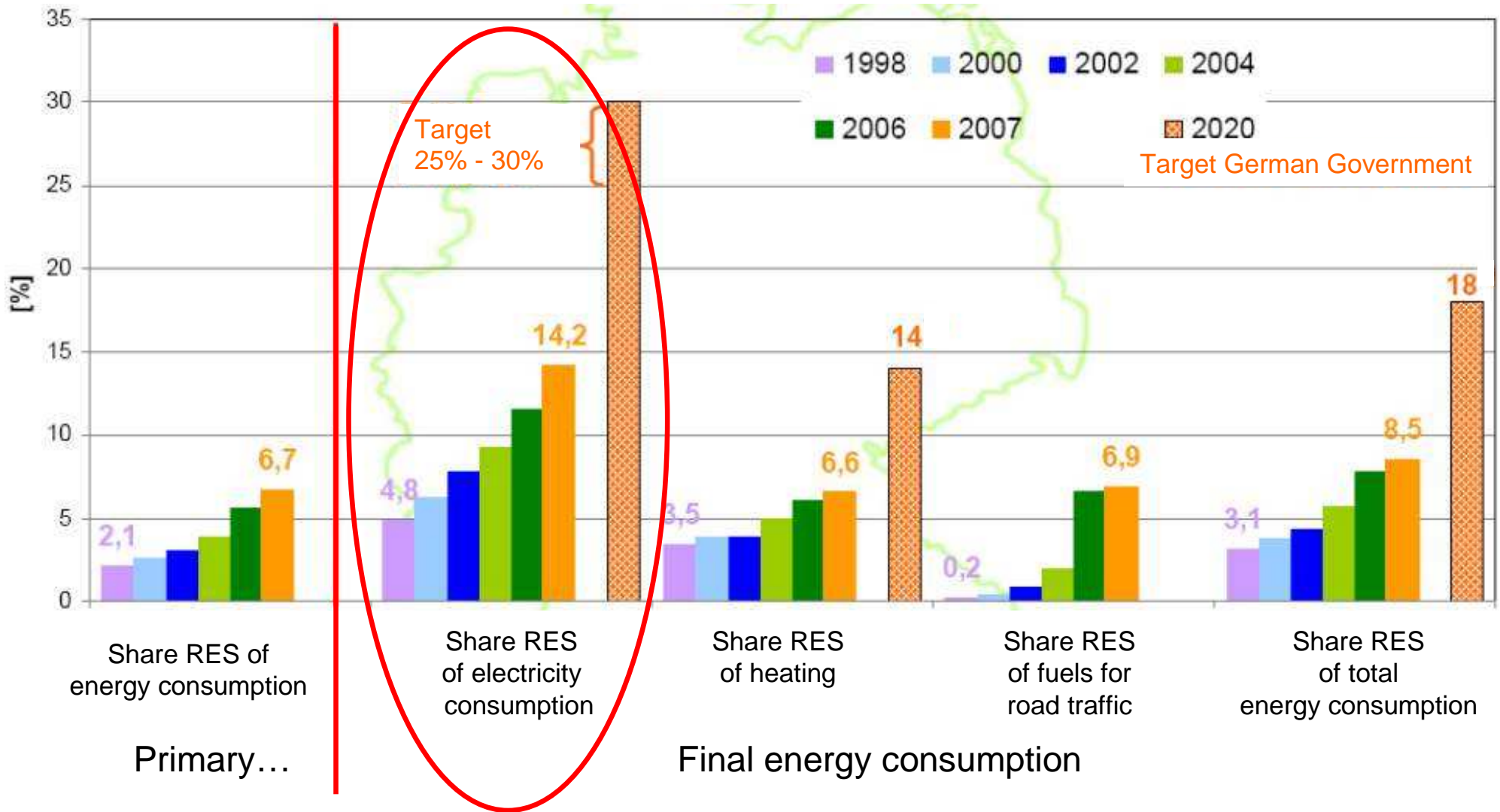
Quelle: Solarwatt



Quelle: Wagner & Co

A clear Renewable Energy Policy is needed

Example Germany: Continuously growing share of RES



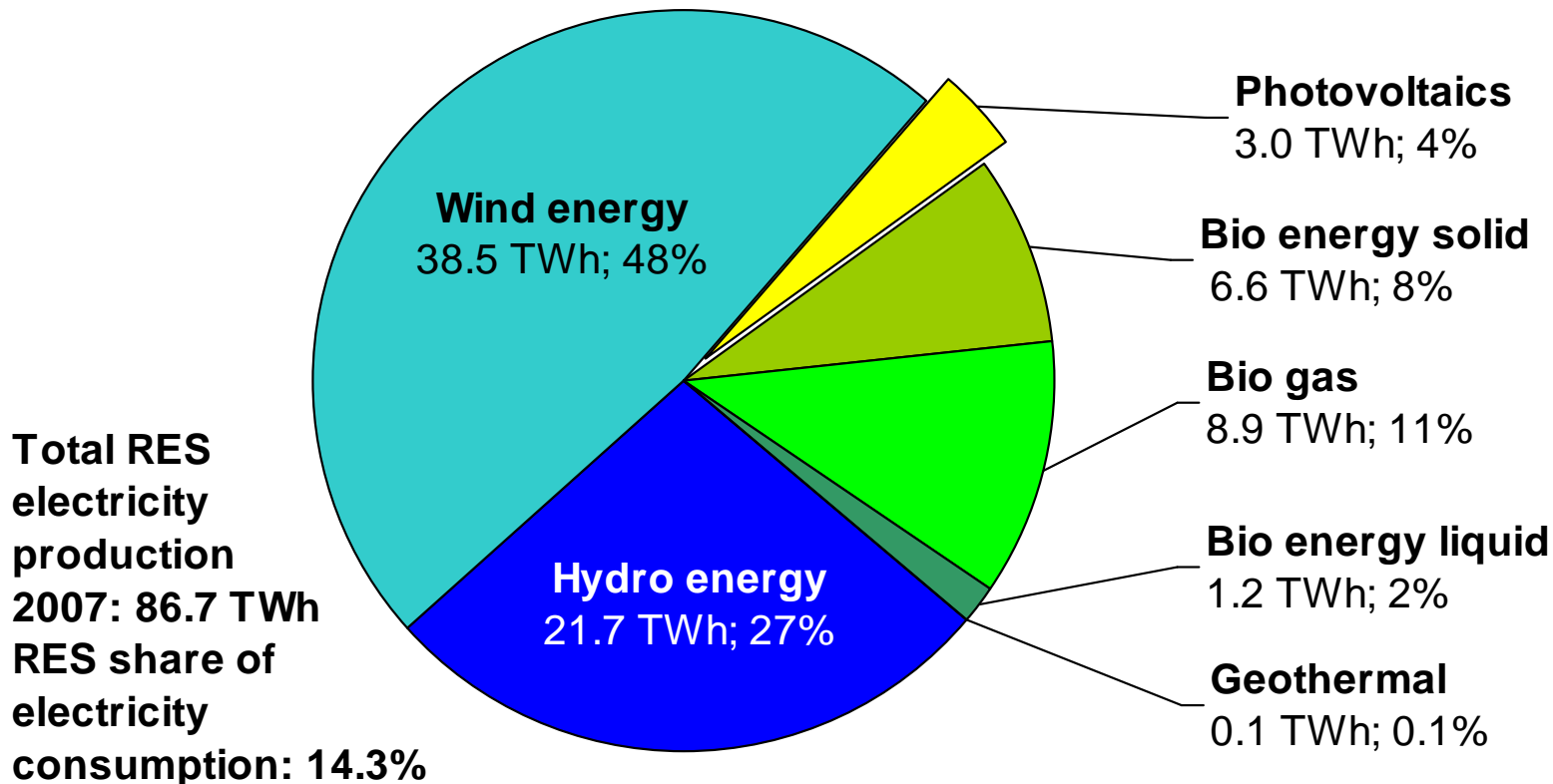
Source: German Federal Ministry for Environment, March 2008

Share of Solar Electricity in Germany

Share of PV electricity

- of electricity consumption 2007: **0.6% (2006: 0.44%)**
- of renewable energy electricity 2007: **3.5% (2006: 3.1%)**

Distribution of Renewable Energy Electricity Production in Germany 2007



Source: BEE, Jan 2008

Why do we need Photovoltaics?

PV is the most fascinating way to produce electricity

Advantages

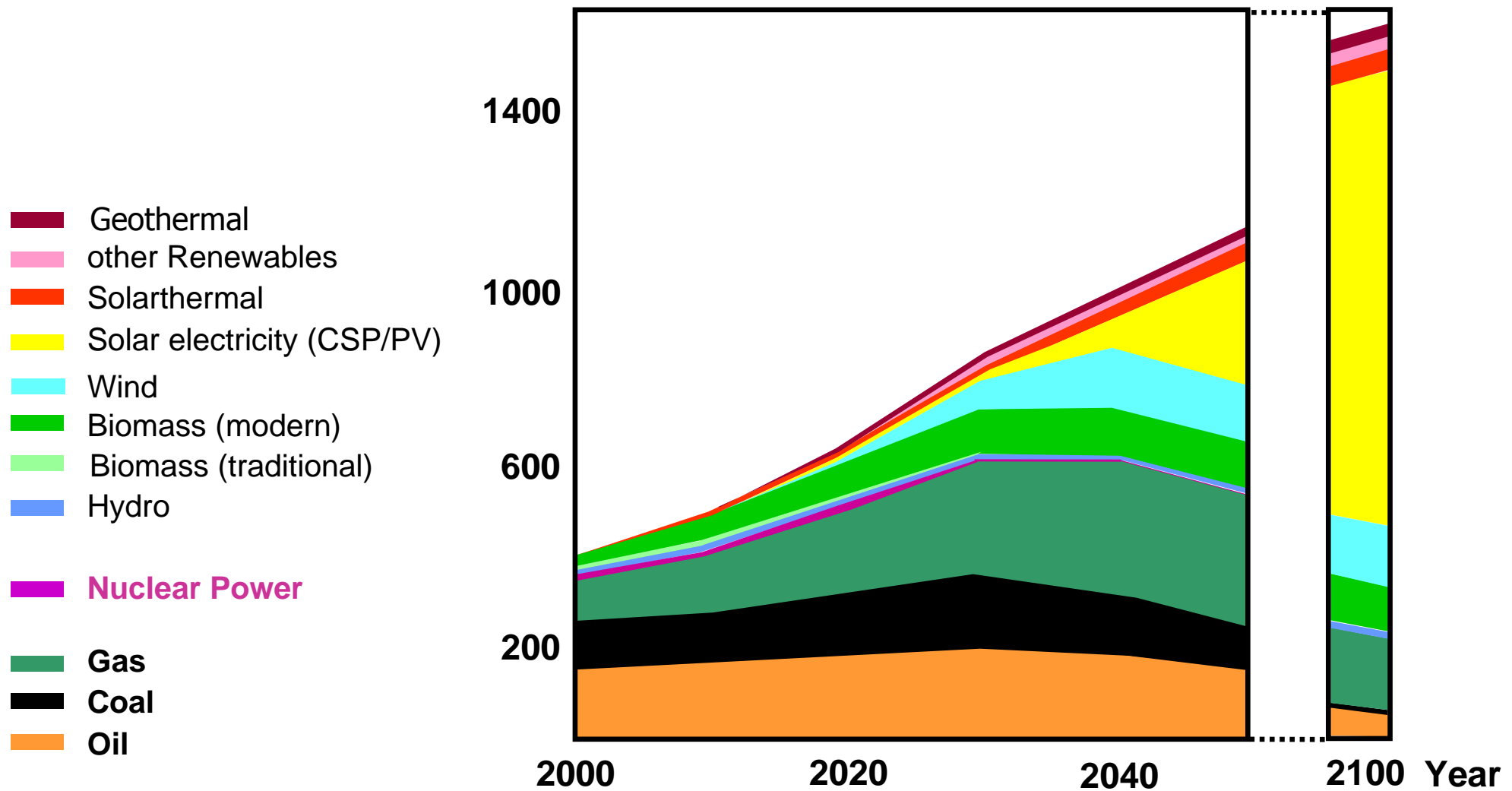
- PV can be used **everywhere** worldwide
- PV can be used **grid connected** and **off-grid**
- PV can be used in **every size**
- PV needs only **one initial investment**
- PV **does not harm** the environment
- **PV has the biggest potential among all RES**

Challenge: Today, PV is **often the most expensive** way to produce electricity using RES, but PV has the **highest cost reduction potential**

=> PV has to be developed today in order to have
(1) enough solar capacity available in one decade
(2) at a competitive price

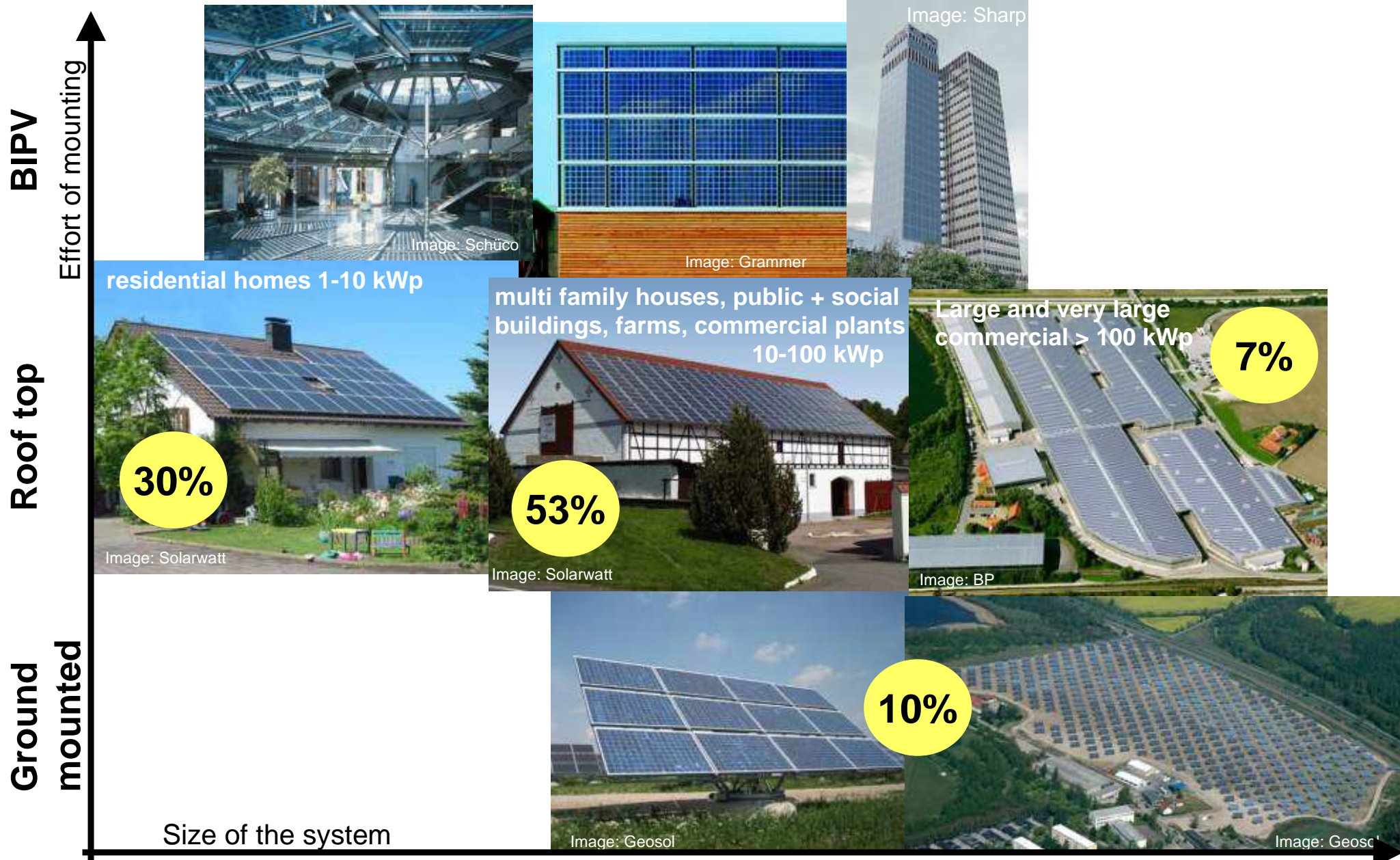


World Energy Consumption – Solar is needed

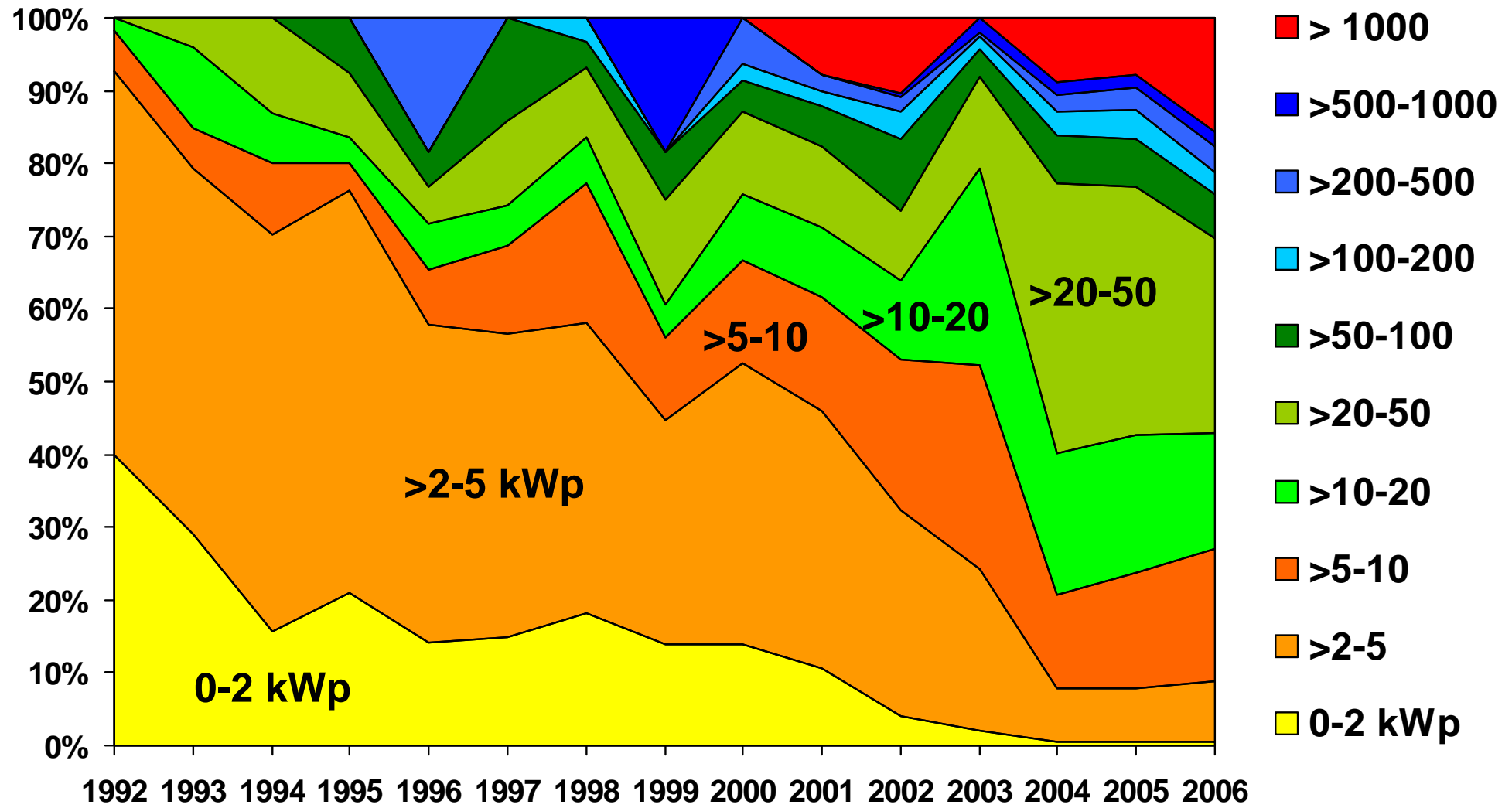


Source: WBGU, German Advisory Council on Global Change (2006)

Germany: Market segments of on-grid PV Systems



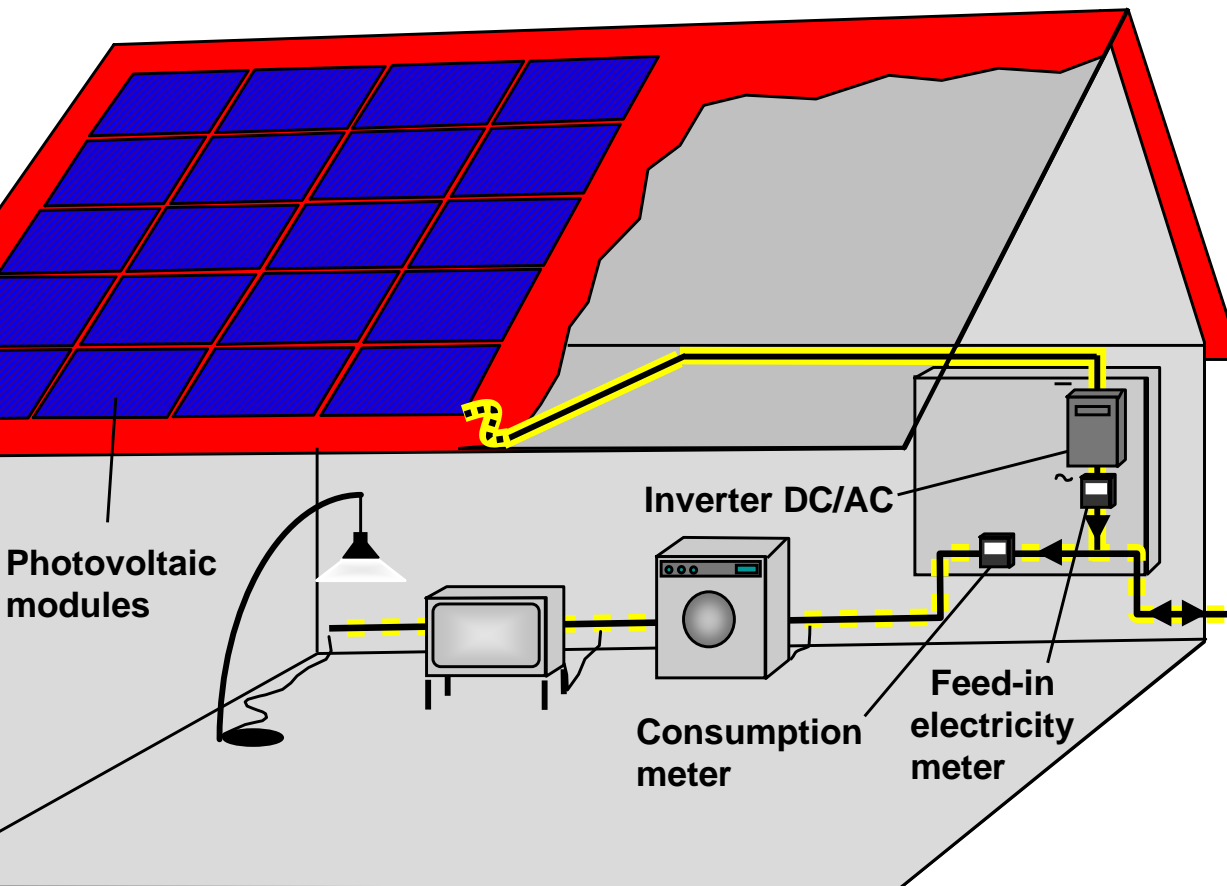
Market share of PV systems in different size ranges



Source: BSW-Solar, calculated from data of 2.2 GWp PV systems from EnBW, EON, RWE, Vattenfall

Grid connected PV Systems in Germany

Each kWh of solar electricity produced is fed into the grid, sold to the utility and payed at a fixed price



Typical data of a small PV system (per kWp)

Investment costs: **4,500 €**
(6,525 \$)

Annual production of solar electricity: **900 kWh/a**

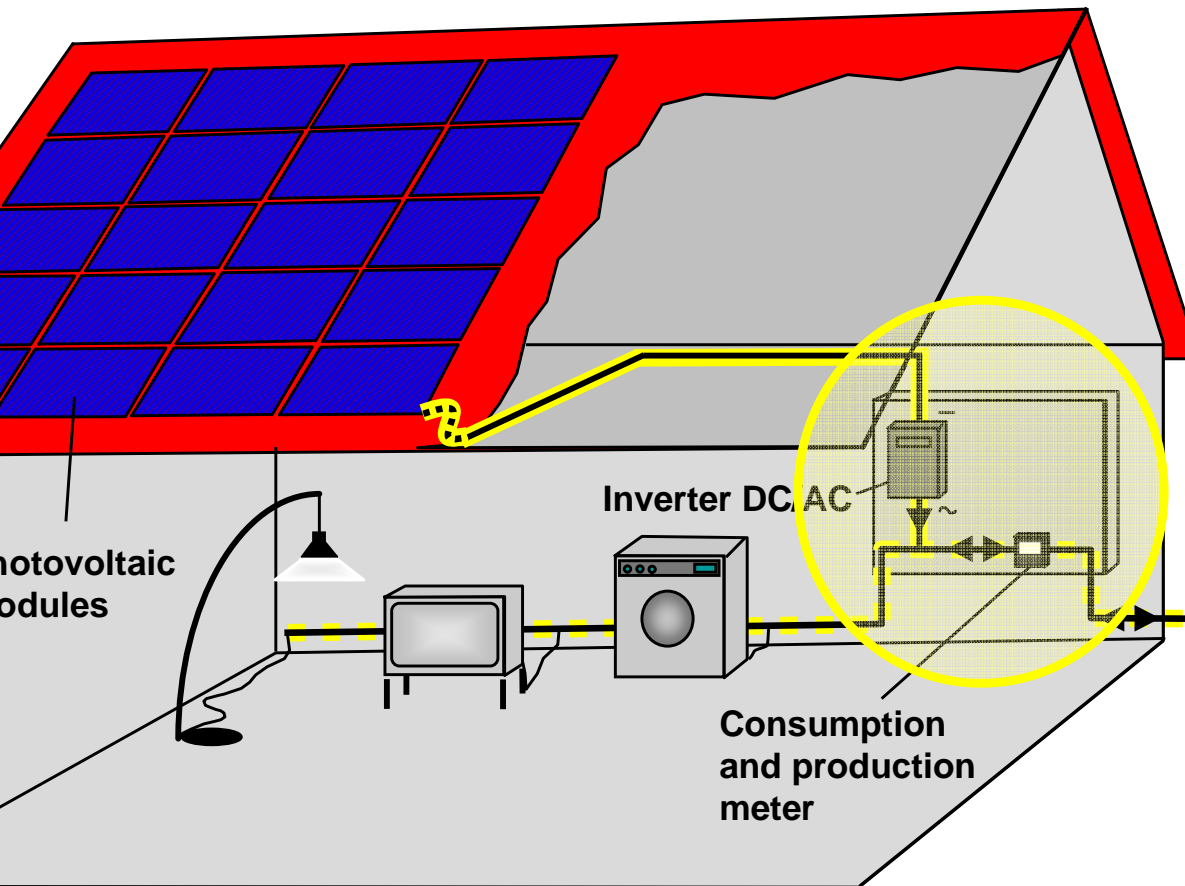
Feed-in tariff: **0.467 €/kWh**
(0.67 \$/kWh)
payed over 20 years

Feed-in payment: **420 €/a**
(610 \$/a)

Interest rates (KfW): **5.2%/a eff**

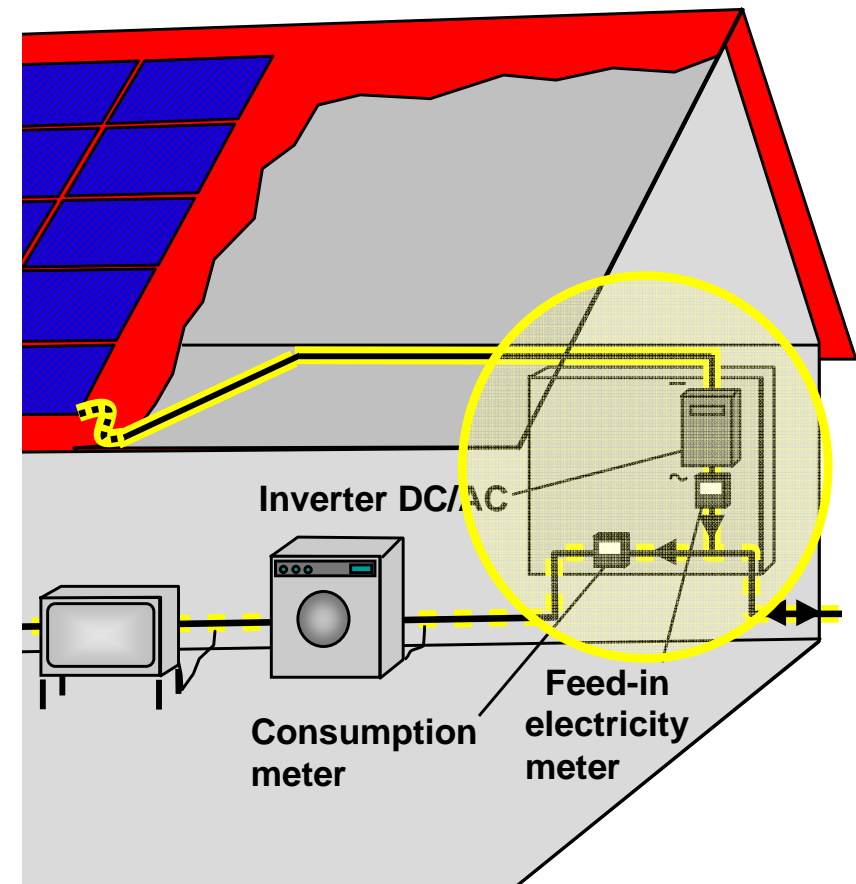
1 \$ = 0.69 €

Two ways of connecting PV systems to the grid



USA: Net-metering

Solar electricity is used for own consumption first
And only excess electricity is fed into the grid



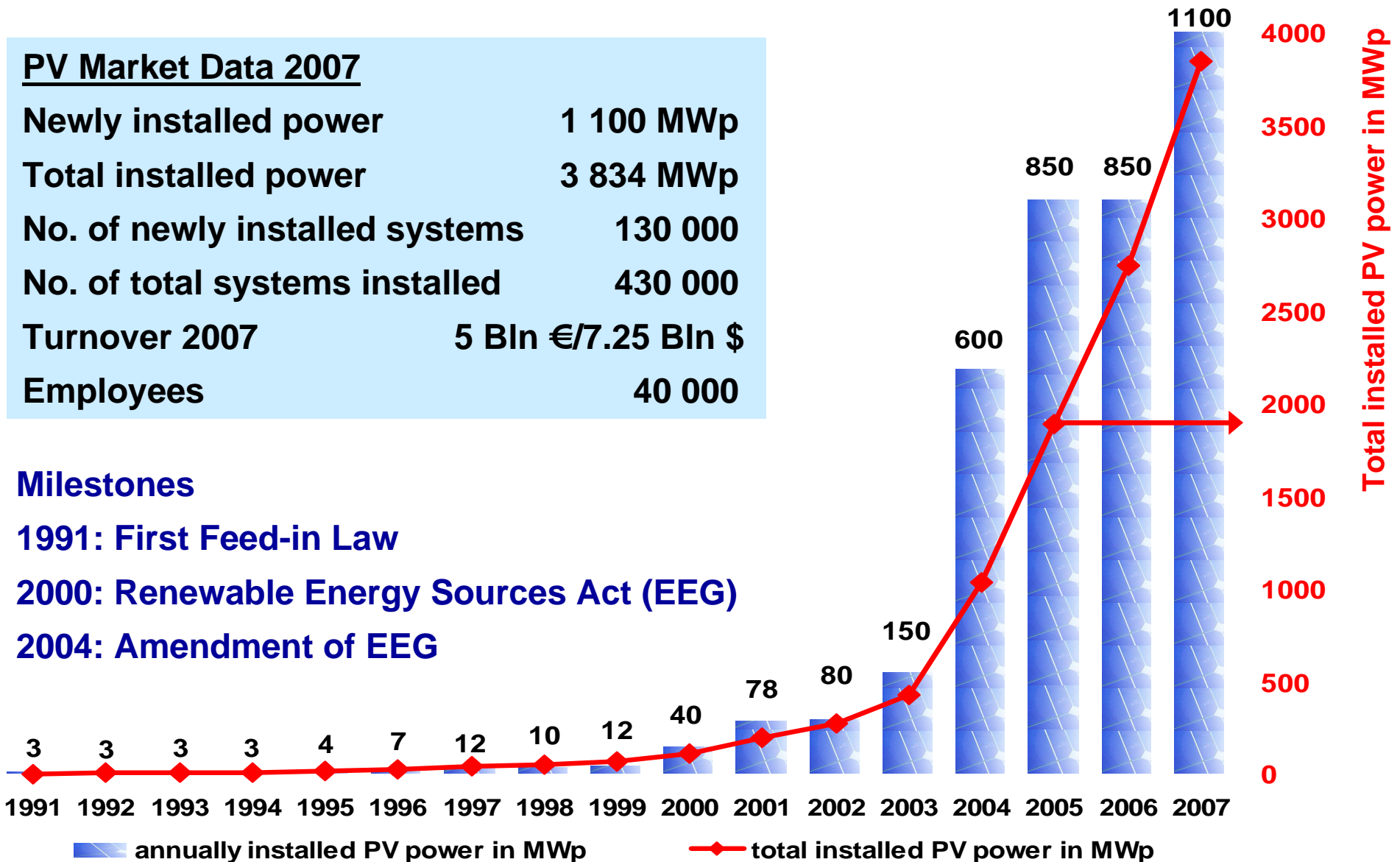
Germany: Feed-in tariff

Solar electricity is exclusively
fed into the grid

Development of the German PV market

PV Market Data 2007

Newly installed power	1 100 MWp
Total installed power	3 834 MWp
No. of newly installed systems	130 000
No. of total systems installed	430 000
Turnover 2007	5 Bln € / 7.25 Bln \$
Employees	40 000



Milestones

1991: First Feed-in Law

2000: Renewable Energy Sources Act (EEG)

2004: Amendment of EEG

Photovoltaic market deployment strategy

Phase 1 until 2020:

- Build up PV markets and capacities
- Reduce PV costs

=> The number of markets where PV is cost competitive is growing steadily

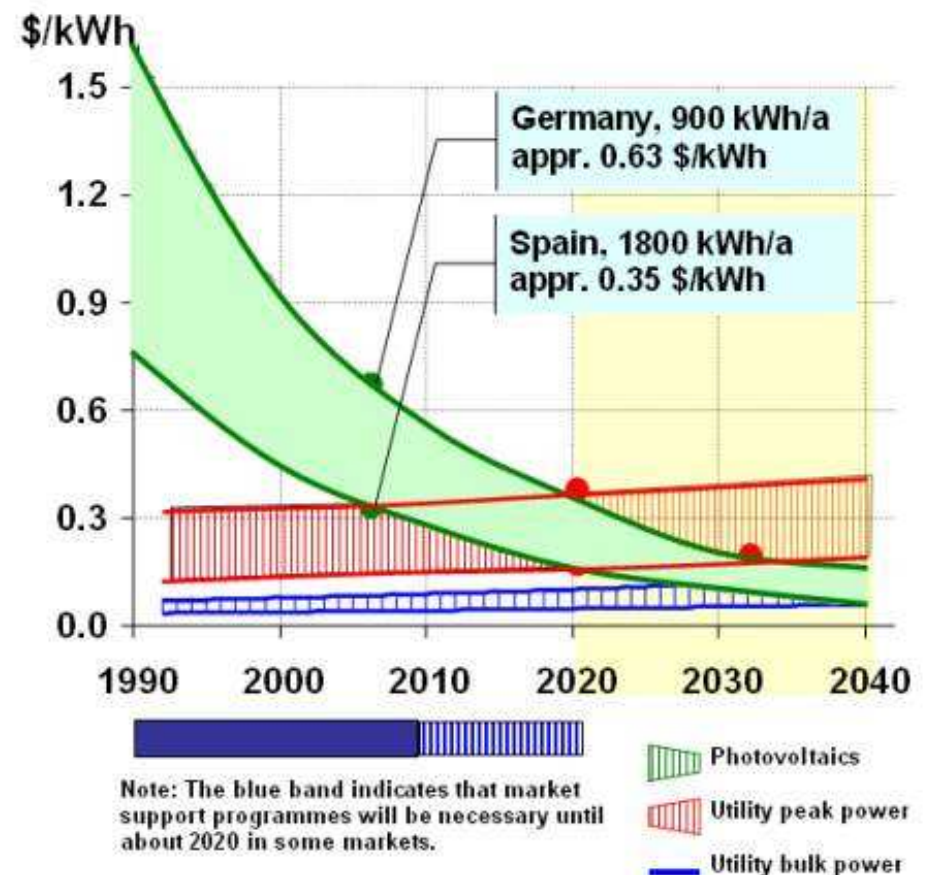
=> Support instruments are necessary

Phase 2 beyond 2020:

- Fast increase of the use of PV
- PV to become a crucial pillar of electricity production

PV competitiveness

cost development in different regions and electricity rate development

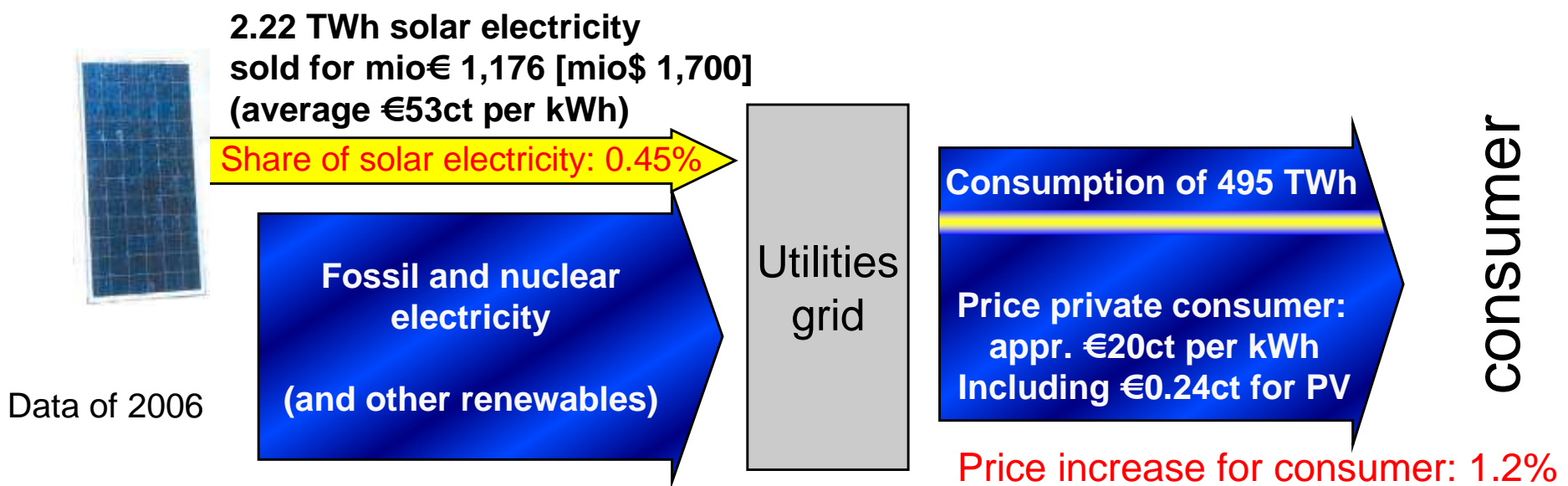
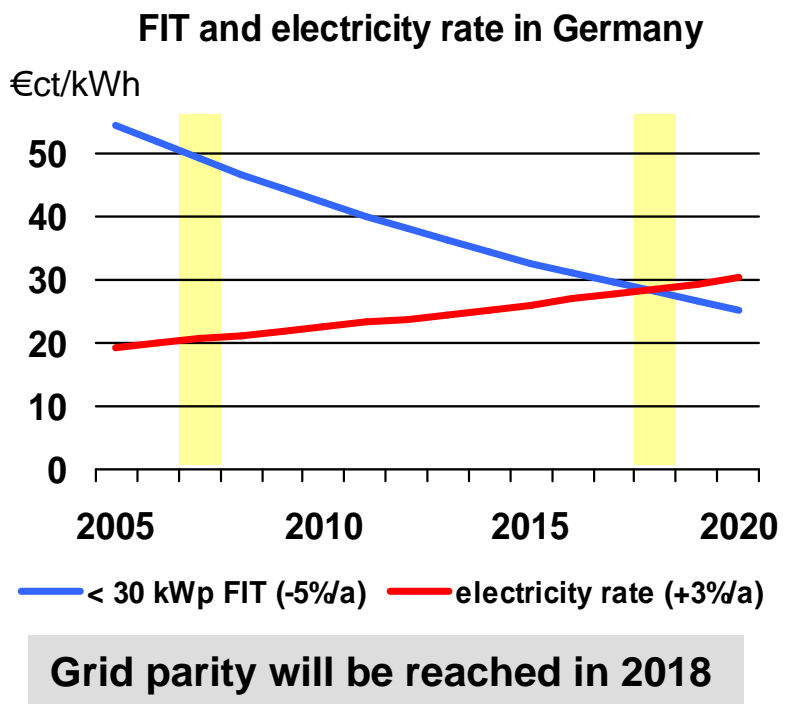


Source: Schott Solar

How does the German feed-in law (EEG) work

Principles

- **Priority connection** for all PV systems granted
- Each solar kWh **has to be bought** by the utility
- **Fixed feed-in tariff payment over 20 years**
- **Reduction of the feed-in tariff each year by 5%** for newly installed PV systems



Feed-in tariffs in Germany 2008

for PV systems installed in 2008,
guaranteed over 20 years

Feed-in tariff per kWh	< 30 kWp	30–100 kWp	> 100 kWp
on buildings and noise protection walls	€ct 46.75 \$ct 67.8	€ct 44.48 \$ct 64.5	€ct 43.99 \$ct 63.8
Façade-integrated	additional €ct 5 \$ct 7.25		
Open land (ground-mounted)	€ct 35.49 \$ct 51.5		



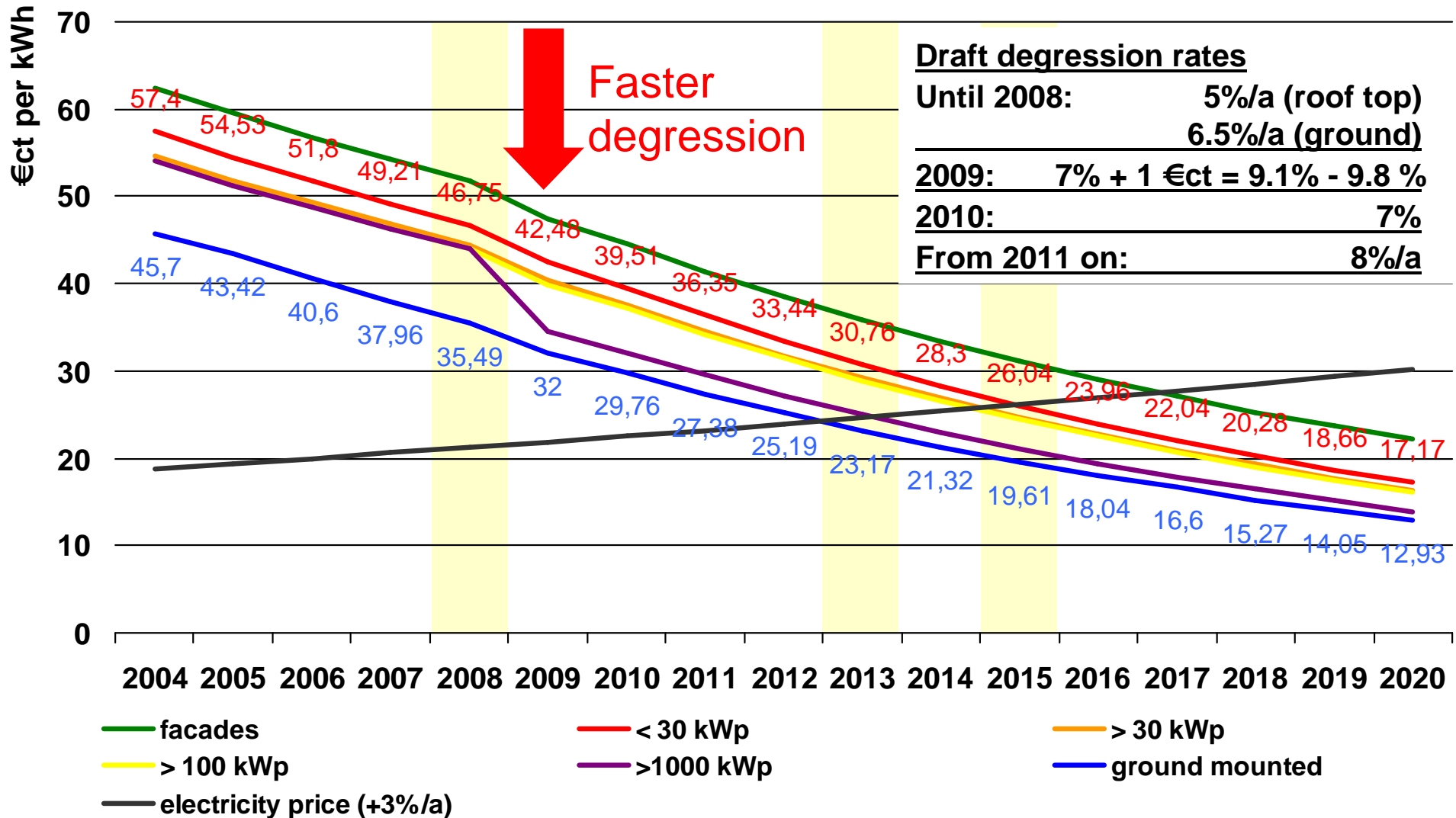
Image: Solar-Fabrik



Image: Degussa

EEG-Amendment draft of the German Government from Dec 2007 proposed higher depression rates for PV feed-in tariffs

Final decisions on the new feed-in tariffs will probably be taken in summer 2008



Small, medium and large rooftop installations



Image: SMA



Image: Frankensolar



Image: Wagner & Co



Image: Solar-Fabrik

Examples for ground mounted PV systems



Photovoltaic market entrance strategy

1. Create PV demand by:

- Granting the right of solar electricity production and grid connection
- Making solar electricity production financially attractive

2. Building up:

- PV market
 - PV production
 - Installation capacities
- Reduction of costs**
Less energy imports
Creation of jobs

3. PV will become:

- **Cost-competitive**
- **An important pillar of the sustainable energy system**

First results

- **More than €15 billion have been invested in PV systems since 2000**
- **More than €3 billion have been invested in manufacturing plants since 2000**
- **Drop in costs for PV systems of**
 - approx. 25% from 1999 to 2003
 - approx. 5% annually since mid 2006

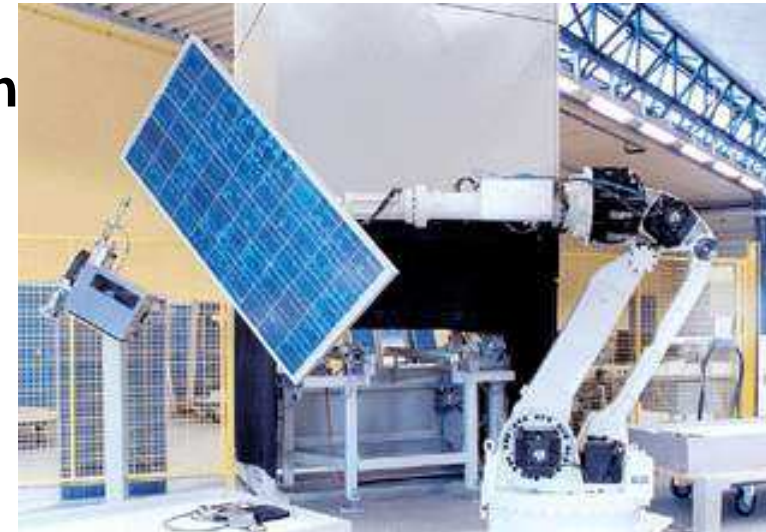
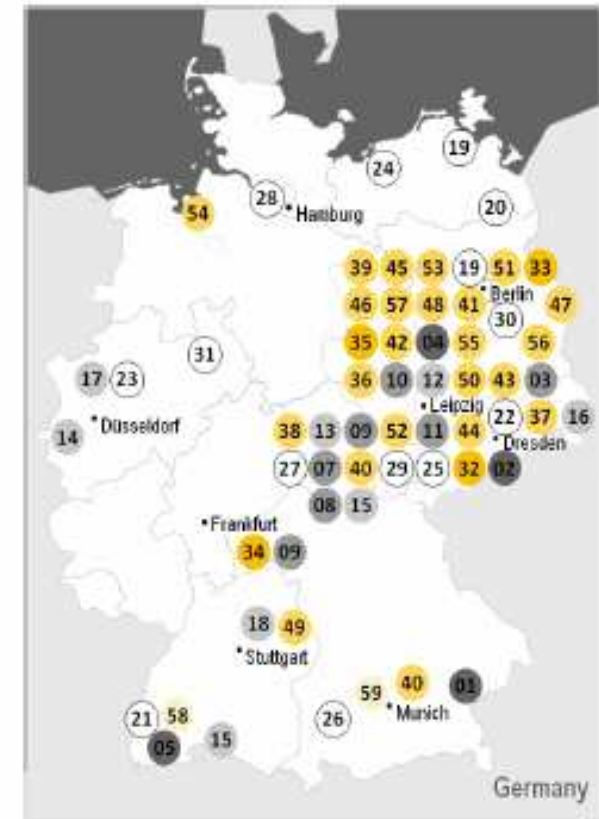


Image: Aleo

Production follows the market: PV Producer in Germany

Value chain	No.	Company	Location	Capacity 2008 [MWp]	Current Empl.
Silicon	1	Wacker Chemie	Burghausen	10,000t	960
	2	Scheuten Solar World Solizium	Freiberg ¹	1000t	n/a
	3	Sunway s	Spreewitz ¹	1000t	n/a
	4	PV Silicon	Bitterfeld-Wolfen ¹	900t	15
	5	Joint Solar Silicon	Rheinfelden ¹	850t	n/a
	6	City Solar	Bitterfeld-Wolfen ¹	n/a	25
Wafers	7	PV Silicon ²	Erfurt	290	140
	8	ASi Industries ³	Amstadt	180	220
	9	Wacker Schott Solar	Alzenau, Jena ⁴	160	120
	10	Q-Cells	Thalheim ⁴	80	10
	11	WPI Wafer Production Int. ²	Leipzig	n/a	n/a
Cells	12	Q-Cells	Thalheim	875	1460
	13	Ersol Solar Energy	Erfurt, Amstadt	220	350
	14	Solland Solar Cells	Aachen	170	200
	15	Sunway s	Konstanz, Amstadt	115	130
	16	Arise Technologies	Bischofswerda	35	10
	17	Scheuten Solar Cells	Gelsenkirchen	35	80
	18	Solarwatt	Heilbronn	25	60
	Modules	19	Solon	Berlin, Greifswald	260
20		Aleo Solar	Prenzlau	170	425
21		Solar-Fabrik	Freiburg	130	270
22		Solarwatt	Dresden	110	350
23		Scheuten Solar Technology	Gelsenkirchen	90	140
24		Solara Sonnenstromfabrik	Wismar	80	130
25		Heckert Solar	Chemnitz	60	80
26		Webasto Solar	Landsberg/Lech	35	20
27		Asola	Erfurt	30	80
28		Solamov a	Wedel	10	30
29		GSS	Löbichau	10	30
30		PVflex Solar	Fürstenwalde	5	30
31		Schüco Solar	Bielefeld	5	n/a

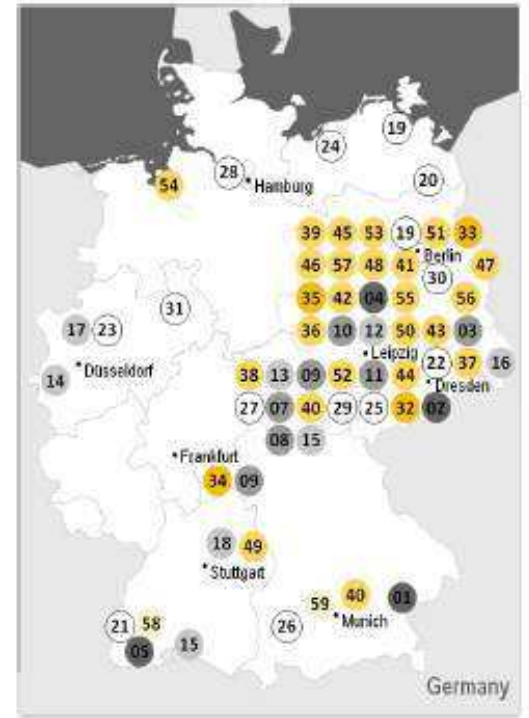


- 1) Planned/under construction
 - 2) Excluding ingots
 - 3) Subsidiary of Ersol
 - 4) Subsidiary of Q-Cells
 - 5) Subsidiaries of Solarworld:
Deutsche Solar, Deutsche Cell, Solar Factory
 - 6) Wafer production by Wacker Schott Solar No.9
- Source: Invest in Germany, March 2008.

Source: Invest in Germany, March 2008

Production follows the market: PV Producer in Germany

Fully Integrated	32	Solarworld ⁶	Freiburg	450/300/250	900
(Wafers/Cells/Modules)	33	Conergy	Frankfurt (Oder)	300/275/250	370
	34	Schott Solar	Alzenau	160/275/200	1000
	35	EverQ	Thalheim	100/100/100	450
Thin Film					
Poly-Si	36	CSG Solar	Thalheim	20	140
a-Si a-Si/ μ -Si	37	Sunfilm	Großröhrsdorf ¹	60	10
	38	Ersol Thin Film	Erfurt	40	130
	39	Malibu	Osterweddingen ¹	40	n/a
	40	Schott Solar	Jena, Putzbrunn ¹	30	160
	41	Inventux	Berlin ¹	30	n/a
	42	Brilliant 234. ⁴	Thalheim	25	60
	43	EPV	Senftenberg ¹	25	n/a
	44	Signet Solar	Mochau ¹	20	10
CIS CIGS CIGS _{Se}	45	Johanna Solar Technology	Brandenburg	30	100
	46	Solibro ⁴	Thalheim ¹	30	20
	47	Odersun	Frankfurt (Oder), Fürstenwalde ¹	30	80
	48	Global Solar Energy	Berlin ¹	30	n/a
	49	Würth Solar	Schwäbisch Hall	30	220
	50	Avancis	Torgau ¹	20	60
	51	PVflex Solar	Fürstenwalde	10	30
	52	Solarion	Leipzig	10	20
	53	Sulfurcell	Berlin	5	60
	54	CIS-Solartechnik	Bremerhaven	Pilot	20
CdTe	56	First Solar	Frankfurt (Oder)	160	500
	57	Calyxo ⁴	Thalheim	25	40
CPV	58	Concentrix Solar	Freiburg	10	40
	59	SolarTec	Munich	10	50

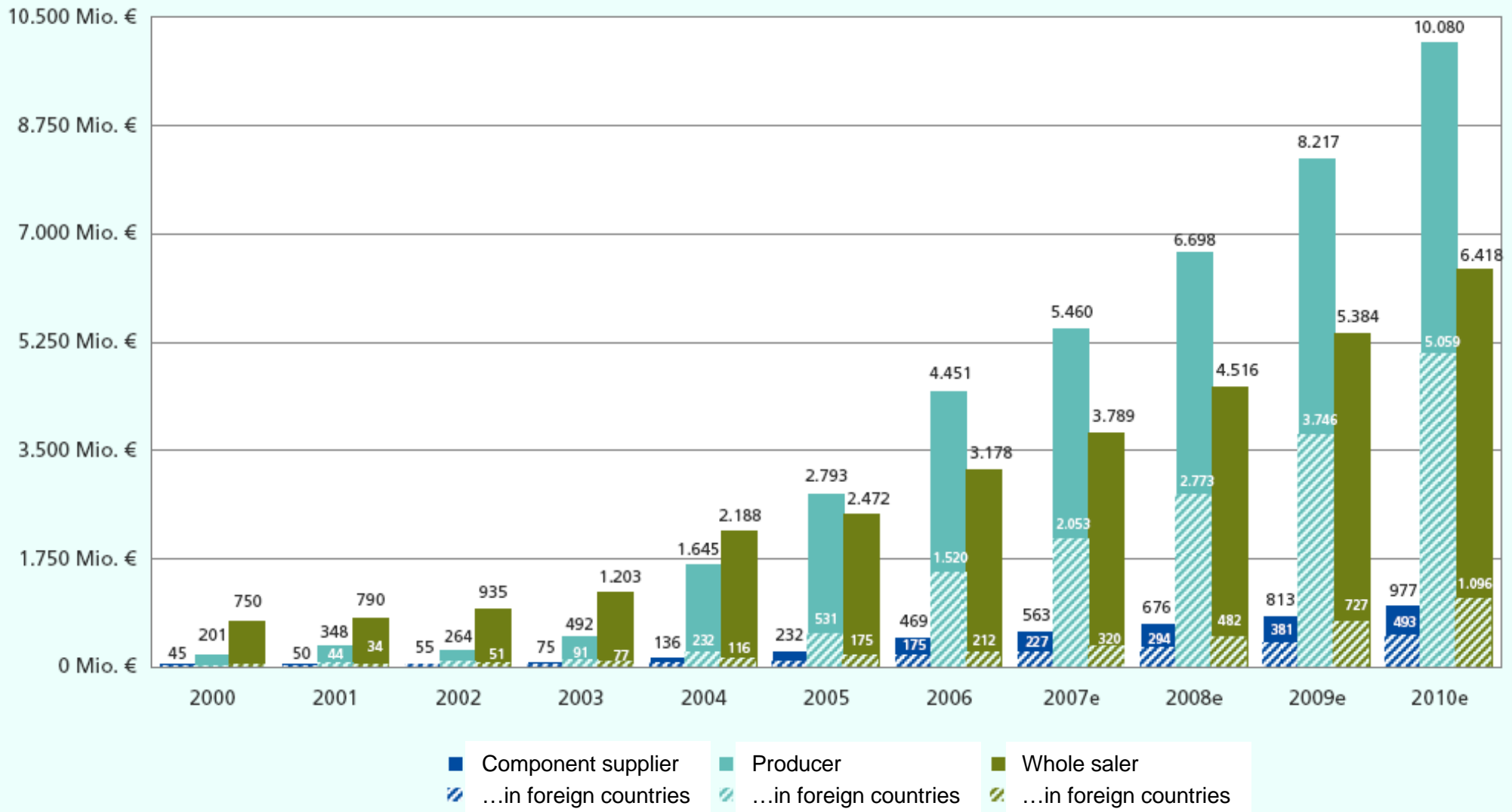


- 1) Planned/under construction
 - 2) Excluding ingots
 - 3) Subsidiary of Ersol
 - 4) Subsidiary of Q-Cells
 - 5) Subsidiaries of Solarworld:
Deutsche Solar, Deutsche Cell, Solar Factory
 - 6) Wafer production by Wacker Schott Solar No.9
- Source: Invest in Germany, March 2008

Source: Invest in Germany, March 2008

Sales volume of the German PV industry

Quelle: EuPD Research 2008

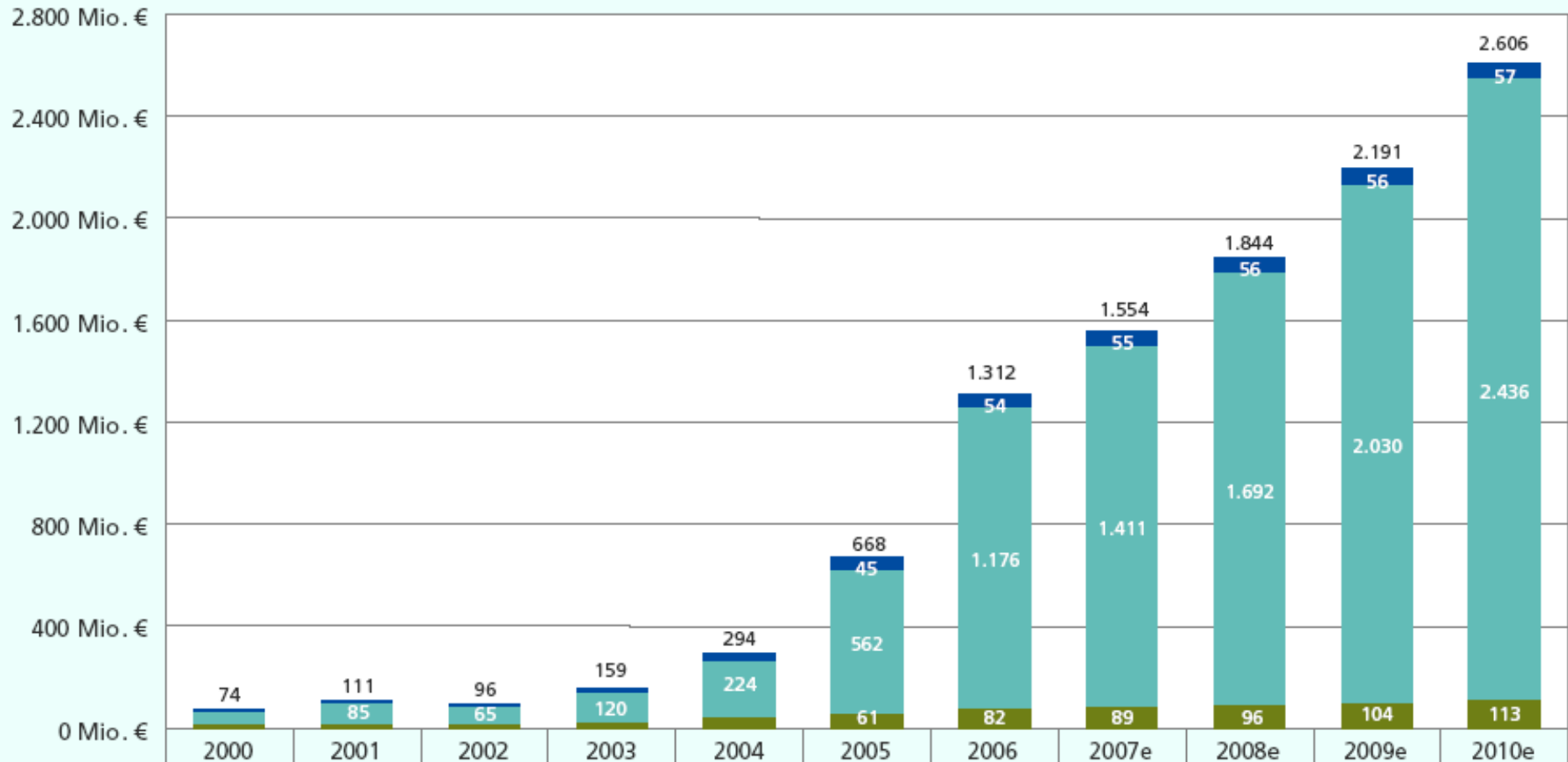


Source: Standortgutachten EuPD Research/ifo 2008

Investments of the German PV industry

Quelle: EuPD Research 2008

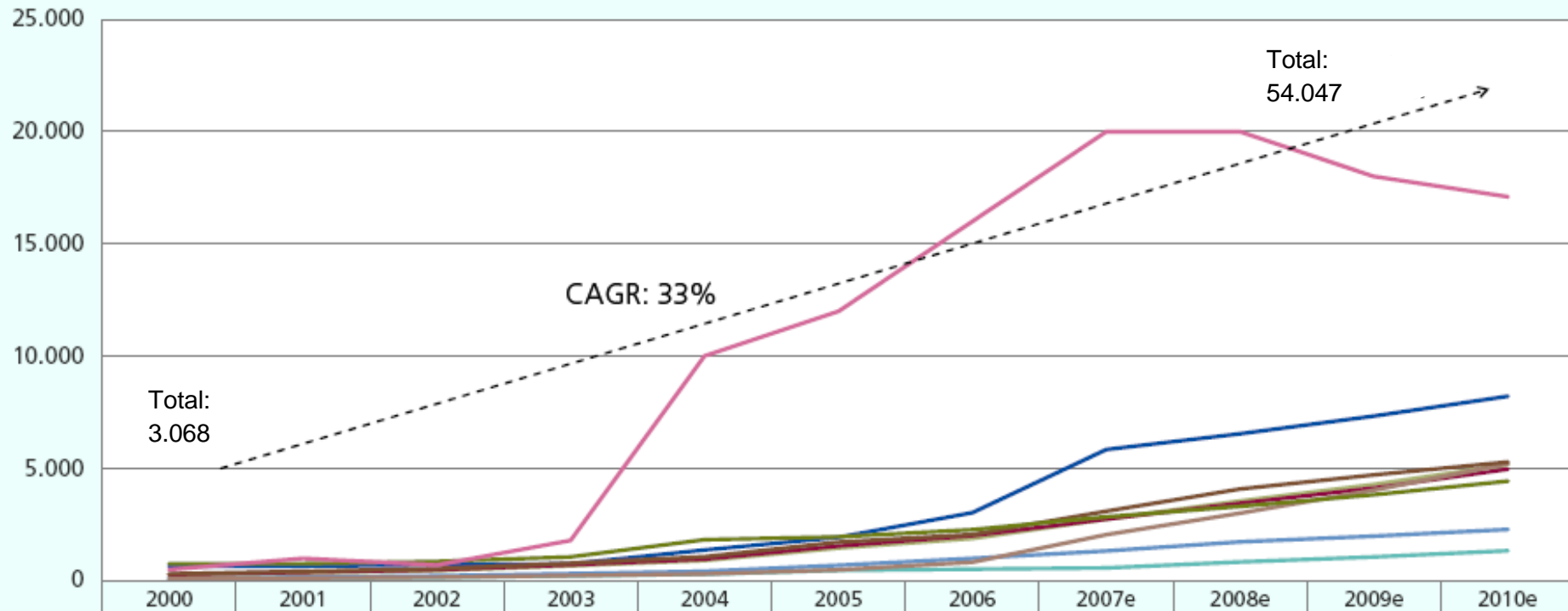
New investments (without replacement investments)



Source: Standortgutachten EuPD Research/ifo 2008

Jobs in the German photovoltaic sector

Quelle: EuPD Research 2008

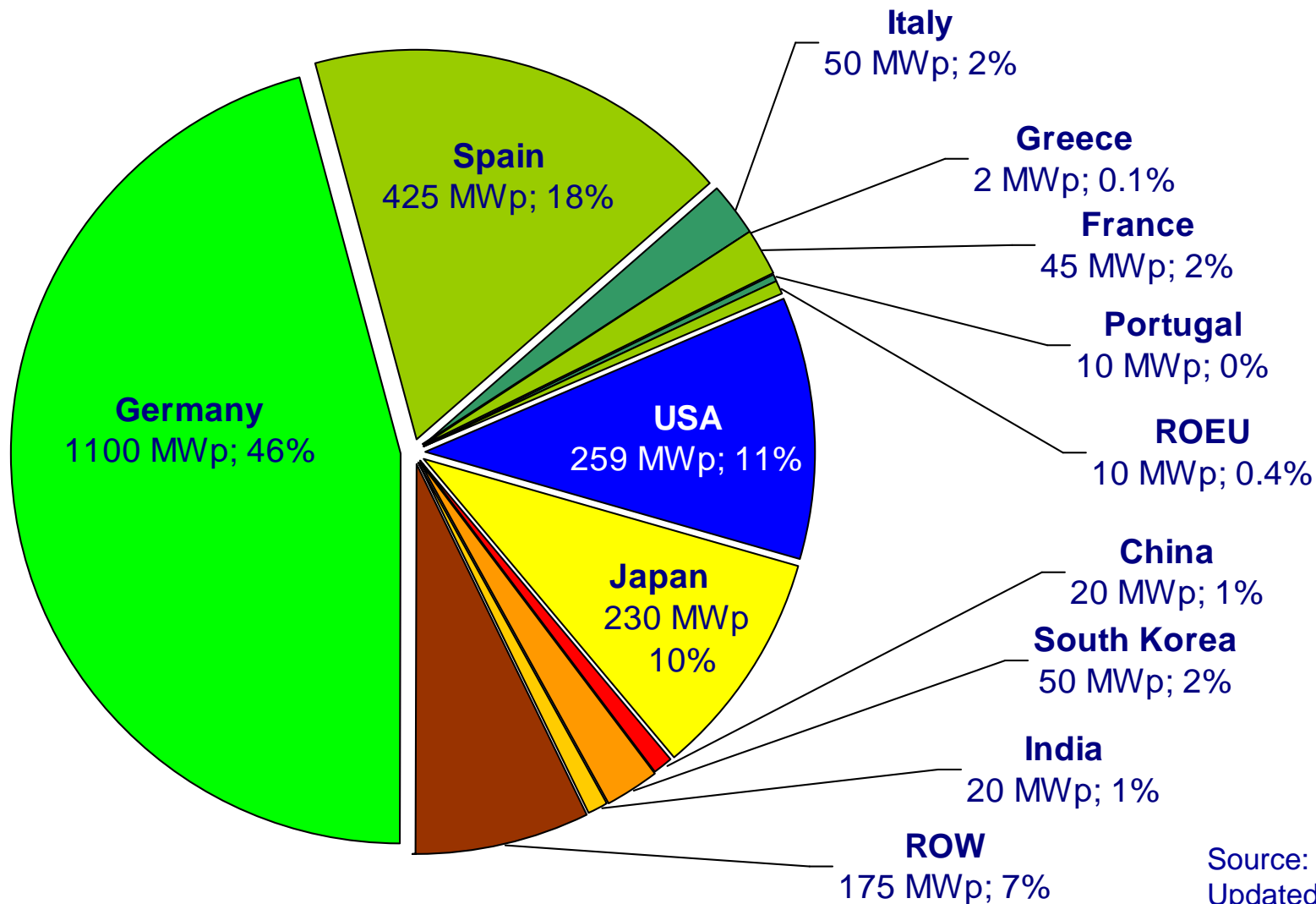


	2000	2001	2002	2003	2004	2005	2006	2007e	2008e	2009e	2010e
Supplier	666	666	713	761	1.379	1.937	3.036	5.847	6.551	7.339	8.222
Silicon	84	119	151	217	295	475	531	576	844	1.064	1.348
Wafer/Ingots	122	173	219	316	428	690	996	1.332	1.732	1.992	2.286
Cells	260	368	465	671	909	1.465	1.877	2.742	3.549	4.283	5.168
C-modules	275	389	492	710	962	1.550	2.022	2.740	3.443	4.132	4.966
Thin film modules	88	124	157	226	307	495	828	2.057	3.014	4.036	5.210
BOS	306	433	548	790	1.071	1.727	2.067	3.105	4.086	4.722	5.299
Wholesaler	769	769	865	1.057	1.825	1.960	2.278	2.861	3.314	3.840	4.448
Craftsmen	500	1.000	700	1.800	10.000	12.000	16.000	20.000	20.000	18.000	17.100
Total	3.068	4.041	4.310	6.548	17.176	22.298	29.633	41.260	46.533	49.408	54.047

Source: Standortgutachten EuPD Research/ifo 2008

Photovoltaic World Market

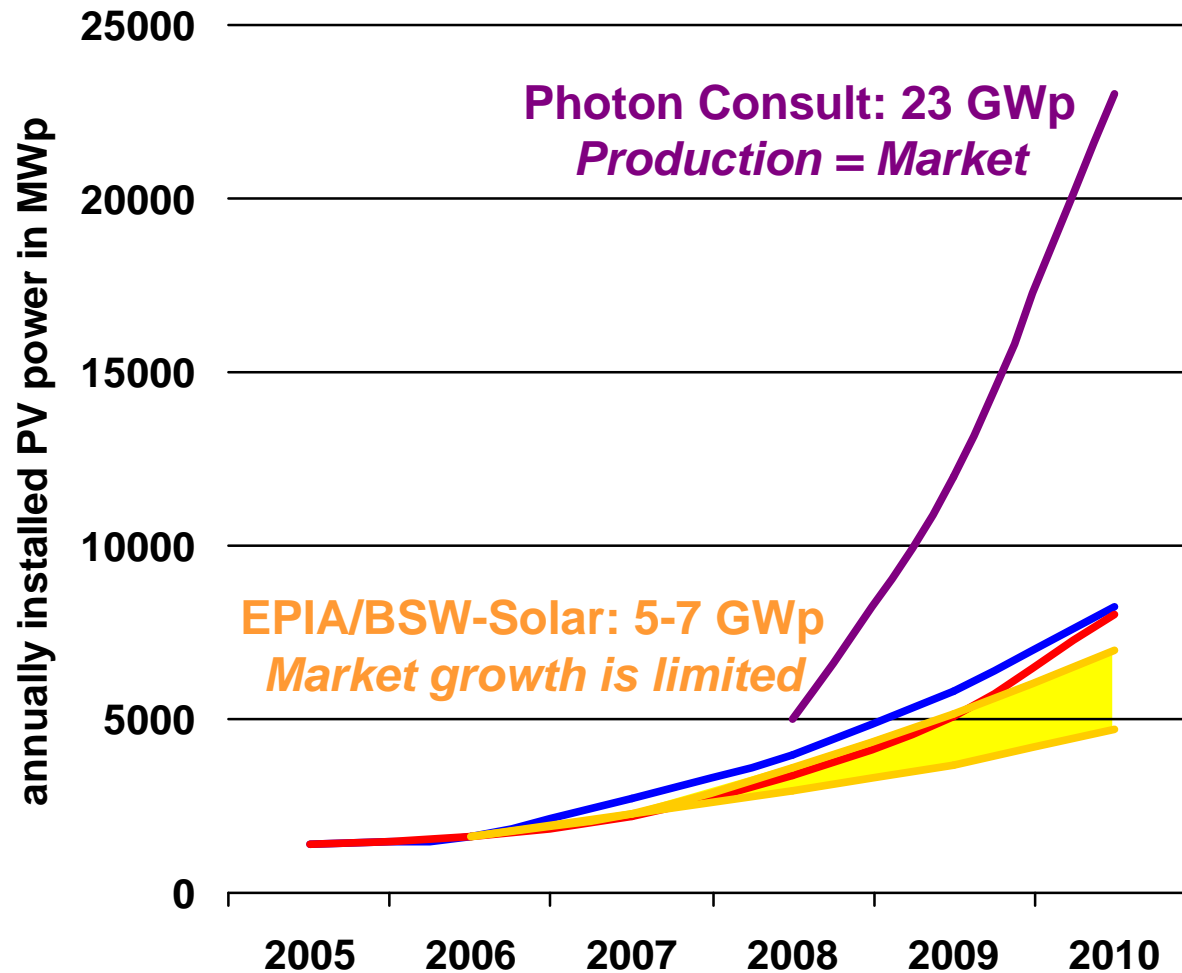
Newly installed PV Power in 2007: 2.4 GWp



Source: EPIA, ASIF, BSW
Updated February 2008

PV World Market Development Scenarios

Huge differences of predicted market volumes in 2010

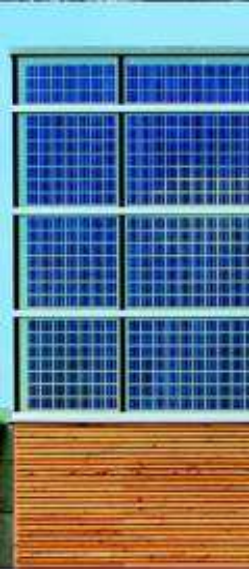


In the coming years the supply of silicon and therefore PV modules will grow faster than the demand. BSW-Solar agrees on the expectation of EPIA of a PV world market between 4.7 and 7 GWp in 2010.

- Photon Consult 2008
- Sarasin 2007
- LBBW 2007
- EPIA 2007 max
- EPIA 2007 min

Conclusions and Outlook

- Photovoltaics has a great potential – but it is necessary to build up market and industry today
- The German PV market grew in 2007 by 30%
- A PV market growth > 20% is expected in 2008
- Driver of the market is the feed-in tariff system (EEG)
- An amendment of the EEG is under discussion, the parliament will decide on it in June 2008, the degression rate is expected to grow
- There are already more than 40.000 jobs created in the PV sector in Germany
- The German PV industry is investing strongly in new production capacity and innovative technologies





PV facade with green solar cells, sports stadium Tübingen

Thank you very much for your attention!