

Acknowledgement:

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Gerhard Stryi-Hipp from German PV Industry

# Photovoltaics in Germany

**9<sup>th</sup> China National PV Conference**

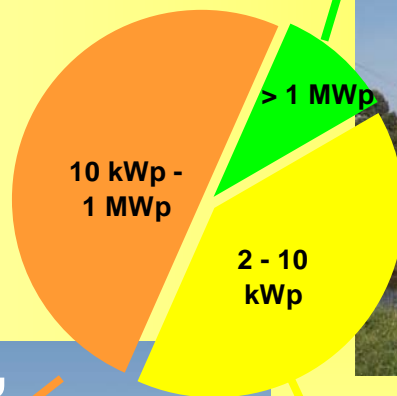
**Chengdu, Sichuan**

Nov. 3-7, 2006

Frank Haugwitz

# Use of Photovoltaics in Germany

- More than 200,000 PV systems installed
- 98% of systems grid-connected



10% ground mounted large PV systems > 1 MWp



50% multi family houses, public and social buildings, farms, commercial plants 10-1000 kWp



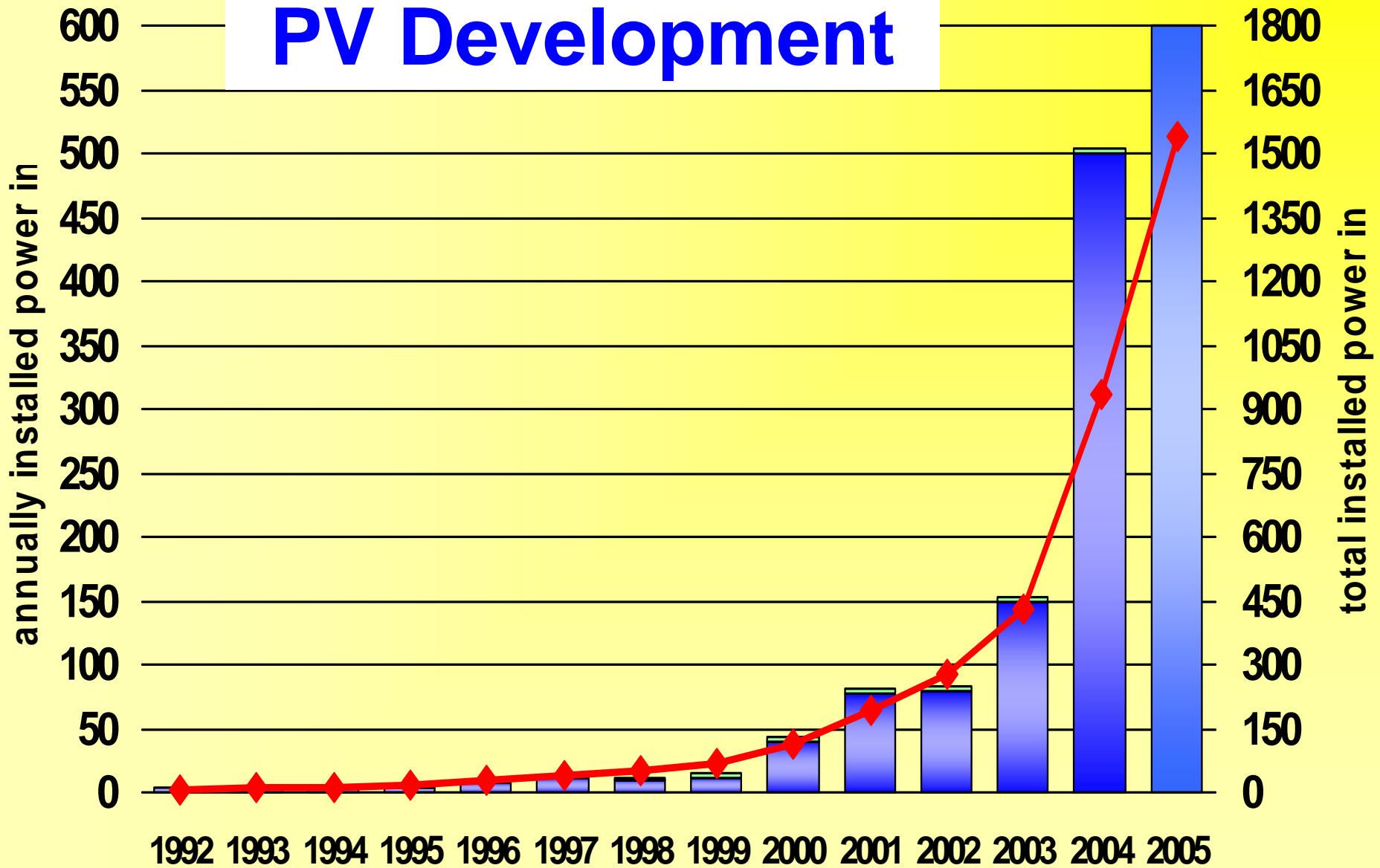
40% small PV systems on private residential homes 1-10 kWp



# Data: German PV Market 2005

<b>Newly installed power</b>	<b>600 MWp (el)</b>
<b>Newly installed solar area</b>	<b>5 400 000 m<sup>2</sup></b>
<b>Total installed power</b>	<b>1 500 MWp (el)</b>
<b>Total installed solar area</b>	<b>13.5 Mio m<sup>2</sup></b>
<b>No. of newly installed systems</b>	<b>75 000</b>
<b>No. of total systems installed</b>	<b>200 000</b>
<b>Turnover 2005</b>	<b>3 000 Mio €</b>
<b>Employees</b>	<b>30 000</b>
<b>Market growth 2005</b>	<b>+20%</b>
<b>Market growth 2006 est.</b>	<b>+10%</b>

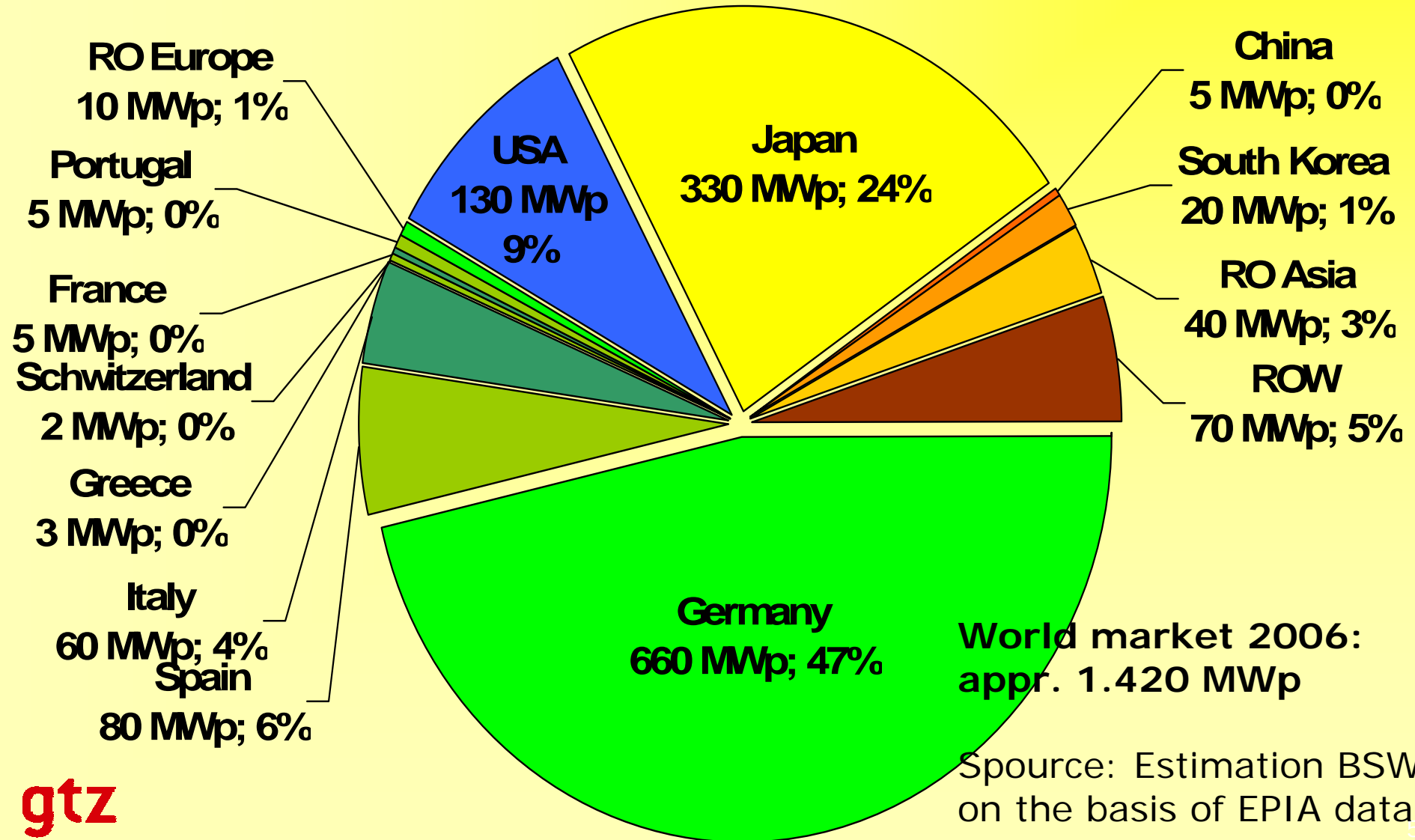
# PV Development



■ annually installed grid-connected ■ annually installed off-grid ◆ total installed

# Germany Biggest PV-Market

Estimation PV market 2006



# History of the German PV Market

## 1991: Electricity Feed-In Act

- Right of (1) of grid access, (2) feed-in of solar electricity and (3) refund payment at fixed prices (approx. €ct8.5 [\$ct11] per kWh)

## 1991 - 1995: 1,000 Roofs Program

- Verification of PV systems' grid compatibility

## 1995 - 1999: Consolidation

- Only regional support programs, demo plants, development of the cost-covering refund payment system

## 1999 - 2003: 100,000 Roofs Program

- Low-interest loans for 300 MWp of installed capacity

## 1/4/2000: Renewable Energy Sources Act (EEG)

- Solar electricity feed-in tariff of €ct51 [\$ct64] per kWh

## 1/1/2004: Amendment to EEG

- Feed-in tariff of €ct45.7–62.4 [\$ct57–78] per kWh

# Subsidy Programs and Market Development

		100,000 roofs program: Low-interest loans	Renewable Energy Sources Act (EEG): Feed-in tariff [€ct/\$ct per kWh]	Annually installed PV capacity	Annual market growth
<b>0</b>	<b>-1998</b>	-	€ct 8.5/\$ct 10.6	5-10 MWp	
<b>I</b>	<b>1999</b>	<b>0% interest</b>	€ct 8.5/\$ct 10.6	<b>12MWp</b>	
<b>II</b>	<b>2000</b>	<b>1.9%</b>	€ct 50.6/\$ct 63.2	<b>40MWp</b>	<b>+ 233%</b>
	<b>2001</b>	<b>1.9%</b>	€ct 50.6/\$ct 63.2	<b>78MWp</b>	<b>+ 95%</b>
	<b>2002</b>	<b>1.9%</b>	€ct 48.1/\$ct 60.1	<b>80MWp</b>	<b>+ 3%</b>
	<b>2003</b>	<b>1.9%</b>	€ct 45.7/\$ct 57.1	<b>150MWp</b>	<b>+ 88%</b>
<b>III</b>	<b>2004</b>	-	€ct 45.7 – 57.4 \$ct 57.1 – 71.7	<b>500MWp</b>	<b>+ 233%</b>
	<b>2005</b>	-	€ct 43.4 - 54.5 \$ct 54.2 - 68.1	<b>600MWp</b>	<b>+ 20%</b>
	<b>2006</b>	-	€ct 40.8 - 51.8 \$ct 51.0 - 64.8	<i>660MWp</i>	<i>+ 10%</i>

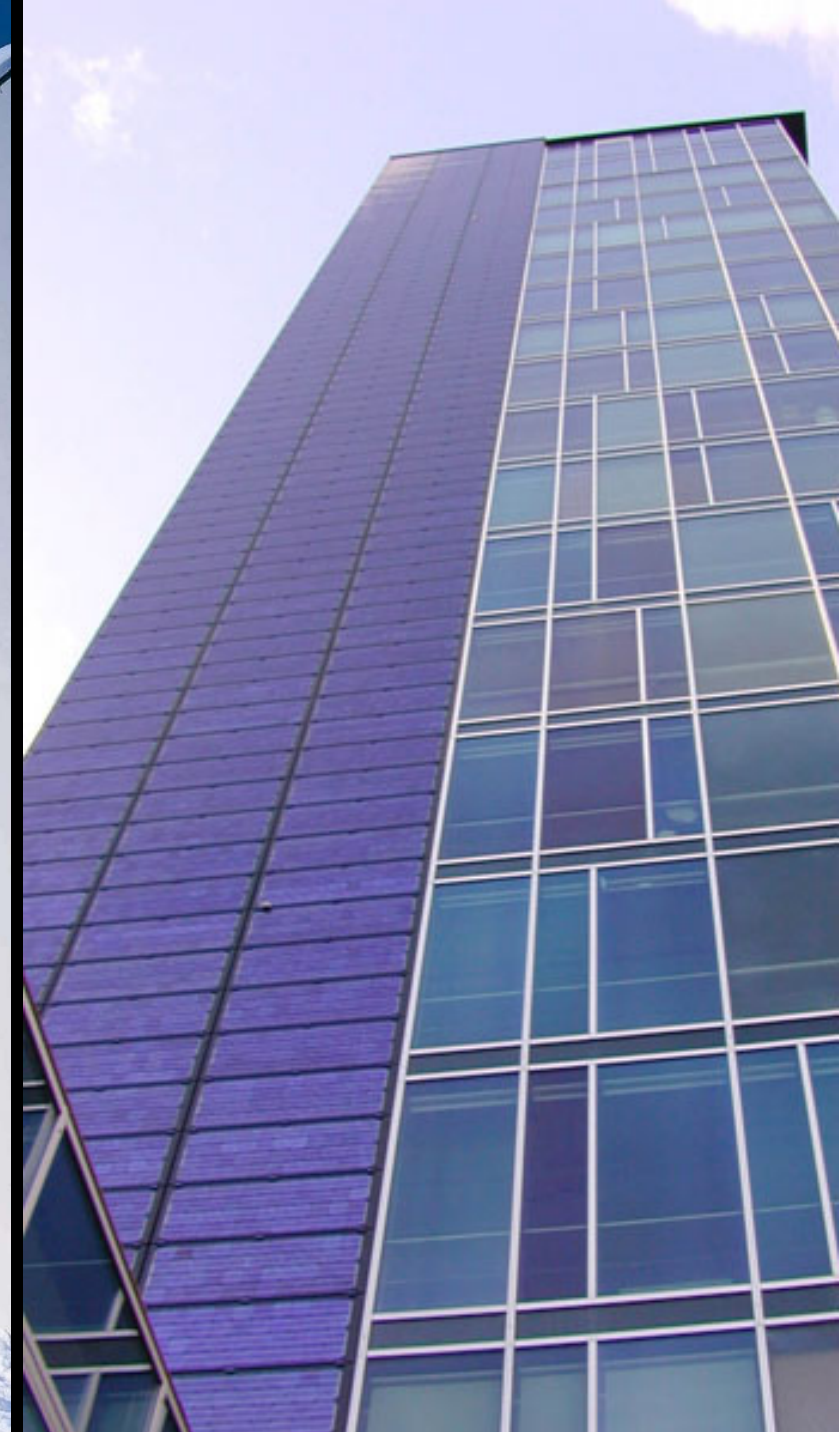
# EEG: Photovoltaic Feed-in Tariffs

Feed-in tariffs for PV systems installed in 2006, payed over 20 years

Feed-in tariff per kWh	up to 30 kWp	30–100 kWp	from 100 kWp
on buildings and noise protection walls	€ct 51.80 \$ct 64.8	€ct 49.28 \$ct 61.6	€ct 48,74 \$ct 60.9
Façade-integrated	+ €ct 5 / \$ct 6.25		
Open land (ground-mounted)	€ct 40.81 / \$ct 51.0		



# Façade-integrated PV systems



# Large Roof-Mounted PV-Systems



Image: Solar-Fabrik



Image: BP

**400 kWp on the Freiburg Trade Fair Building**

**3.7 MWp on a factory building in Dingolfing**

# High solar fraction in new buildings

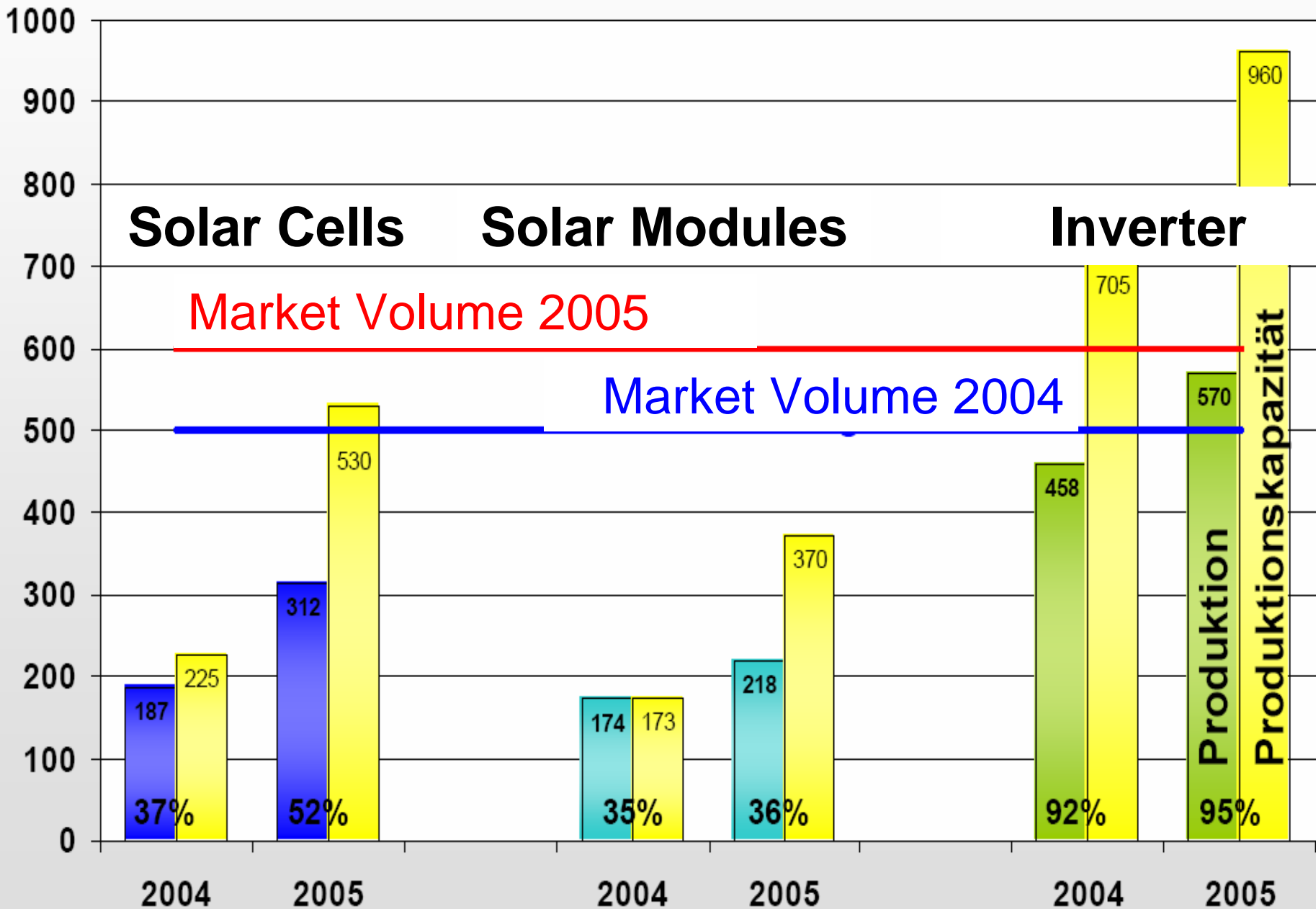
Private house, 100% heated by renewables, 70% by solar



# Successful PV Market and Industry Development

- > € 10 billion invested in PV systems
- > € 1 billion invested in manufacturing plants
  - About 40 companies produce silicon, wafers, cells, modules and inverters
  - Modern and automated production lines
  - Strong technological development and increased R&D activities
- Strengthened photovoltaics market structures
  - 30,000 jobs have been created
- Drop in costs for PV systems
  - approx. 25% from 1999 to 2003
  - 60% from 1991 to 2003
- Increased export ability through increased production capacity<sub>12</sub>

# Production Capacity & Output 2004-2005



# The Latest News

- August 06: 5,1 € / Wp (System Price)
- October 06: 400 MWp of Modules on stock worth € 2 billion  
20-30% Price Reduction expected in coming months
- Nov. 06: 4,1 € / Wp (System Price) negotiated
- Solarworld Ltd. will sell wafers for 350 Mio. € to China until 2018

# Conclusions

- The German PV market is growing very fast
- Driver of the German market is the feed-in tariff for solar electricity
- European Countries follow a similar market development approach as Germany
- German companies are heavily investing in new production facilities
- The limitation of PV modules is caused by limited Silicon availability, new Silicon production lines are under construction
- To date strong domestic market focus, but this will change in the near future

# **Thank you for your attention !**

**German Development  
Cooperation (GTZ) China  
Renewable Energies in Rural Areas Program  
Tel: 0086 (0) 10 – 8532 3489 Ext. 26  
Fax: 0086 (0) 10 – 8532 3481**

**Frank.Haugwitz@gtz.de**

**[www.gtz-renewable-energy-program.org.cn](http://www.gtz-renewable-energy-program.org.cn)**