Renewable Energies and the PV market in Germany

Markus Hempel, China Representative, Germany Trade and Invest

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Germany Trade & Invest
\textbf{The Agency}

\textit{Germany Trade & Invest} is the foreign trade and inward investment promotion agency of the Federal Republic of Germany.

The agency is promoted by the Federal Ministry of Economics and Technology and the Federal Government Commissioner for the New Federal States in accordance with a German Parliament resolution.

\textbf{Activities}

\begin{itemize}
  \item \textbf{For Companies in Germany (Exporters/Investors)}
    \begin{itemize}
      \item Macroeconomic analyses and forecasts
      \item Country and industry analyses (over 125 countries)
      \item International projects and tenders
      \item Foreign economic and tax law
      \item Custom information and tariffs
      \item Practical business tips
      \item Business contacts and addresses
    \end{itemize}
  \item \textbf{For Companies Abroad (Foreign Investors)}
    \begin{itemize}
      \item Identification of attractive markets and investment opportunities
      \item Information about framework conditions in Germany (law, taxes, etc.)
      \item Location information and settlement support
      \item Financing and incentives consultancy services
      \item Partnerships
    \end{itemize}
\end{itemize}
Two headquarters in Germany - 46 locations worldwide.
I. Renewable Energies in Germany

II. Renewable Energy Segments

III. PV: Policy - Market - Industry
Germany World Leader in Renewable Energies

Strong governmental support lead to strong growth in all renewable energies

Development of electricity generation from renewable energy sources in Germany 1990 - 2010

* Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas;
Electricity from geothermal energy is not presented due to the negligible quantities of electricity produced; StrEG: 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 Energies-Statistics (AGEE-Stat); 29.03.2011 | www.gtai.com
Germany World Leader in Renewable Energies

Status Quo in 2010:

- Leading in PV and Wind
- Renewables share of 17% of electric power consumption
- Cut of 120 million tons of CO₂
- € 25,3 billion German industry turnover
- € 26,6 billion of investments (+28% vs. 2009)
- 370,000 employees
- 537 patents registered by German industry

Structure of electricity supply from renewable energy sources in Germany 2010

Total: 101.7 TWh, Share of biomass: 33%

- Wind energy: 35.9%
- Hydropower: 19.4%
- Photovoltaics: 11.8%
- Biogenic solid fuels: 11.9%
- Biogenic liquid fuels: 2%
- Biogas: 12.6%
- Biogenic share of waste: 4.7%
- Sewage gas: 1.1%
- Landfill gas: 0.7%
- Sewage gas: 1.1%
- Hydropower: 19.4%
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- Biogas: 12.6%
- Biogenic share of waste: 4.7%
- Sewage gas: 1.1%
- Landfill gas: 0.7%
- Sewage gas: 1.1%

Notes: ¹ Turnover of manufacturers located in Germany ² Investments in new plants in Germany ³ Figure from 2009; Source: BMU 2010/2011

29.03.2011 | www.gtai.com
Main Objectives

- Offshore wind expansion
- Grid expansion
  - Especially for offshore
  - European grid
  - Smart grids
- Electricity storage technologies
- CO2 capture
- Energy certificates
- Energy saving regulation
  - Building renovation
- Extension of nuclear power plant operation
- E-mobility / Biofuels

<table>
<thead>
<tr>
<th>Climate protection measures</th>
<th>2020</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2 cuts vs. 1990</td>
<td>-40%</td>
<td>-80%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewable share of...</th>
<th>2020</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy consumption</td>
<td>18%</td>
<td>60%</td>
</tr>
<tr>
<td>Electricity consumption</td>
<td>35%</td>
<td>80%</td>
</tr>
<tr>
<td>Heat generation</td>
<td>14%</td>
<td>60%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy efficiency measures</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase of energy productiveness</td>
<td>2.1% p.a.</td>
<td></td>
</tr>
<tr>
<td>Reduction of energy consumption</td>
<td>-50% (2050 vs. 2008)</td>
<td></td>
</tr>
<tr>
<td>Reduction of electricity consumption</td>
<td>-25% (2050 vs. 2008)</td>
<td></td>
</tr>
<tr>
<td>Renovation rate</td>
<td>2% p.a.</td>
<td></td>
</tr>
<tr>
<td>Reduction of energy for transportation</td>
<td>-40% (2050 vs. 2005)</td>
<td></td>
</tr>
</tbody>
</table>
Future of renewables in Germany

Electricity generation potential from renewables until 2050: 100%

Source: ZSW 2010
Environmental & Renewable Energy industries are expected to be one of the mayor industries in the future

Source: BMU 2009, Roland Berger 2009

Prognosis of turnover of major industries in Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Environmental &amp; Renewables industry</th>
<th>Chemical industry</th>
<th>Automotive industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>150 in billion Euro</td>
<td>200 in billion Euro</td>
<td>350 in billion Euro</td>
</tr>
<tr>
<td>2007</td>
<td>200 in billion Euro</td>
<td>250 in billion Euro</td>
<td>400 in billion Euro</td>
</tr>
<tr>
<td>2011</td>
<td>300 in billion Euro</td>
<td>350 in billion Euro</td>
<td>500 in billion Euro</td>
</tr>
<tr>
<td>2017</td>
<td>400 in billion Euro</td>
<td>450 in billion Euro</td>
<td>600 in billion Euro</td>
</tr>
<tr>
<td>2020</td>
<td>500 in billion Euro</td>
<td>550 in billion Euro</td>
<td>700 in billion Euro</td>
</tr>
</tbody>
</table>

Env. & RE industry as a share of all industries

- **2007**: 8%
- **2020**: 14%

Source: BMU 2009, Roland Berger 2009
The Renewable Energy Sources Act (EEG)

EEG: the major market driver, since year 2000

- **Fixed** feed-in tariff for 20 years
- Tariff **level** depends on the type of electricity generation, the first year of plant operation, and the plant’s capacity.
- Electricity grid operators are obligated to make it a **priority** to purchase and transmit electricity from renewable energy sources.
- The **cost** benefits are apportioned to all grid system operators across the country and passed on by them to electricity customers
- No market **cap**
- FiT **degression** enforces yearly price reductions
- Very **unbureaucratic** initiating process
- **Transparent** (public register) and **reliant**

EEG has proven to be highly efficient:

- High installation volume as adequate ROI ensured
- Drives down costs as tariffs lowered

... copied by 52 countries worldwide

Source: BMU 2010
I. Renewable Energies in Germany

II. Renewable Energy Segments

III. PV: Policy - Market - Industry
Industries and Target Segments

Fast growing sectors in the market for renewable energies, closed loop recycling and sustainable water technologies formed a new picture of Germany

**Photovoltaics**
Germany is the largest PV-market in the world and has the highest concentration of PV know how in manufacturing and R&D.

**Energy Efficiency**
Germany is one of the leading markets worldwide in the field of energy efficiency.

**Wind Energy**
Germany by far has the world largest wind industry in the world. The offshore sector offers yet additional and large scale growth opportunities.

**Geothermal**
The German geothermal market is No. 3 in Europe

**Bioenergy and Resources**
Germany is the leading consumer of bioenergy in Europe.

**Solar thermal**
Germany is the largest market for solar thermal energy in Europe and the second largest in the World.

**Fuel Cells and Energy Storage**
Germany is the lead market for fuel cell technology and integration of renewable energies.

**Closed Loop Recycling & Sustainable Water Technologies**
Germany is leading worldwide in those fields.

Foto-Quellen: Helmholtz Centre Berlin for Materials and Energy; © www.schwaebisch-hall.de Copyright Dreadlock/Fotolia; BMU/Rupert Oberhäuser, BSW/Paul Langrock; BMU/Brigitte Hiss; EWE AG / alpha ventus ;Grüner Punkt GmbH, GFZ Potsdam; Schott Solar; ZBT GmbH Zentrum für Brennstoffzellentechnik
The World’s Strongest PV Cluster

Key Industries:
- Wafer-based PV (wafer, cell, module)
- Thin-film PV
- Organic PV
- R&D activities
- Equipment manufacturer
- Producer of solar-glass
- Other material supplier industries
- “Balance of System” component manufactures
- Process engineering

The industry in numbers (2010):
- World’s leading PV market with 7.4 GW of new installations (almost half of the world market)
- Most concentrated know-how:
  - 60 silicon/wafer/cell/module manufacturer (e.g., First Solar, SolarWorld, Bosch Solar)
  - > 100 PV equipment manufacturers (e.g. Roth & Rau, Schmid, centrotherm)
  - > 60 PV R&D institutes (e.g. Fraunhofer, Helmholtz Centre, ZSW)
  - hundreds of material/component producers
- More than EUR 12 billion industry turnover
- 107,800 employees
Key Industries:
- Wind turbine manufacturing
- Supplier industry:
  - Rotor blades and molds
  - Gearboxes and bearings
  - Towers
  - Generators
  - Electrical and control engineering
  - Transmission (cable systems, transformers)
  - Offshore technologies, logistics and services

The industry in numbers (2009):
- No. 1 worldwide in production of wind turbines and components
- Market No.1 in Europe with total installed capacity of 25,777 MW, production of 38 billion kWh in 2009 (share of more than 7.5 % of net energy consumption).
- Stable industry development in 2009 and 15 percent total installed capacity growth.
- Wind industry can call upon an estimated workforce of more than 85,000 employees (BMU 2010a).
- All of the major international turbine manufacturers are represented with production facilities. These include Enercon, Fuhrländer, GE Energy, Nordex, Multibrid, REpower Systems, Siemens, and Vestas.
Renewable Materials and Biomass

Germany: high potential for bioenergy

Key Industries:
- Bioethanol
- Second generation biofuels
- Pellets
- Biomass combustion & gasification
- Biogas purification
- Hydrothermal carbonization

The industry in numbers (2009):
- Industry turnover of 11.4 billion EUR
- Largest consumer of bioenergies within the EU-27
- ~ 10% Export share\(^1\)
- 109,000 Employees
- Leading producer of bioethanol and biodiesel in Europe
- 7% of final energy consumption is provided by bioenergy:
  - 5.5% of final fuel consumption is met through biofuels
  - 5.2% of final electricity and 7.7% of final heat consumption is sourced from bioenergy
- Quadruplicating the capacity of biogas plants between 1999 and 2009

1) 2008

29.03.2011 | www.gtai.com
Germany: Lead market, development platform, and export hub

Key Industries:

- Battery, fuel cell component and system manufacturers
- Technology providers and suppliers for the production, storage and distribution of hydrogen
- Hybrid power plant developers and system providers for the integration of renewable energies (power and heat)

The key numbers (2010):

- **Fuel Cells**: 1. market in Europe and 3. worldwide (for market share, HQ, production sites and R&D expenditures).
- 70% of European fuel cell pilot projects.
- More than 40% of production is exported.
- **Energy Storage**: Europe first region to require storage of renewable energies; Germany with the highest potential
- Estimated hybrid power plant investment: EUR 330 million/a in Germany.
- Germany is both a pioneer and driver in both segments thanks to strong PV and wind clusters and smart grid/Mobility development.
Energy Efficiency Sector

Market leader with the highest volume

The industry in numbers (2007):

- Volume of the world market for energy efficiency EUR 540 billion

- Duplication until 2020 up to EUR 1.03 billion (estimation)

- German companies: EUR 67 billion turnover (incl. „white goods“)

- Technological top position of German companies: 10-15% market share worldwide

Key Industries:

- Thermal Insulation
- Glazing
- Heating and Cooling
- Lighting
- Pumps and compressed air systems
- CHP
The Solar Thermal Sector

Germany: Europe’s largest solarthermal-market

Key Industries:
- Collectors/ absorber
- Solar glass
- Energy Storage
- Control systems
- Large scale plant
- Solar cooling
- Process heat

The industry in numbers (2009):
- N° 1 in Europe
- N° 2 worldwide
- 1.4 million installed solarthermal devices
- Heat generation: 4,750 GWh
- Turnover: EUR 1.4 billion
The Geothermal Sector

One of the largest markets for heat pumps within Europe

The industry in numbers (2009):

- N° 3 in Europe
- 400,000 installed heat pumps
- Heat generation: 5,000 GWh
- Power generation: 19 GWh
- Turnover: EUR 1 billion

Key Industries:

- Heat pump
- Energy Storage
- Control systems
- Kalina/ORC
- Direct heat exchanger
- Drill rigs
Closed Loop Recycling Technologies

Worldwide leader: Turnover of EUR 50 billion

The industry in numbers (2008):

- World`s largest market: Turnover of EUR 50 billion
- World market share: 24% in recycling technologies; 64% in material separation devices
- Number of employees: 250,000
- About 6,000 companies and more than 100 R&D-institutions
- Basic regulatory measures: amongst others Closed Substance Cycle and Waste Management Act

Key Industries:
- Avoidance of waste (product design; process- and material efficiency)
- Re-utilization of waste (complete collection and separation/substantial and energetic utilization– re-entry in the production cycle; waste to energy)
- Environmentally compatible waste management of non avoidable or nor recyclable waste

Source: BMU/Umwelttechnologieatlas 2009
29.03.2011 | www.gtai.com
The German water management as a whole is ranked number one in the OECD-comparison

The industry in numbers (2008):

- Turnover of EUR 35 billion
- 70,000 employees
- World market share: 19% in sustainable water technologies
- 500,000 km sewage system
- Technology leadership
- Basic regulatory measures: e.g. Federal Water Act

Key Industries:

- Water supply- and disposal systems (filter technology; sustainable water management – e.g. rain water preparation)
- Maintenance and design of water distribution networks
- Water efficient use (e.g. preparation of industrial water)
- Protection against floodwaters (coasts and rivers)

Source: BMU/Umwelttechnologieatlas 2009
I. Renewable Energies in Germany

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III. PV: Policy - Market - Industry
A manufacturing location in Germany provides an excellent base for serving the growing European markets:

**Germany:**
- €0.21 - €0.28/kWh depending on type/size
- Quick application process
- Contract duration: 20 years
- No cap

**UK:**
- €0.33 - €0.47/kWh depending on type and size
- Contract duration: 25 years

**Belgium:**
- System of green certificates
- Tariffs vary according to region
- €0.15/kWh - €0.45/kWh (Flanders)
- Contract duration 20 years

**France:**
- €0.352-€0.46/kWh (BIPV <36kWp), €0.3035/kWh (rooftop <36kWp), €0.2885/kWh (rooftop <100kWp), €0.12/kWh (>100 kW and ground-mounted systems)
- Cap 2011: 500 MW
- Contract duration: 20 years

**Portugal:**
- €0.35 - €0.55/kWh depending on size/type
- Contract duration: 15 years or 21GWh/MW
- Cap: 150MWp (ground-mounted) and 50MWp (BIPV)

**Spain:**
- €0.298/kWh (rooftop ≤20kWp), €0.209/kWh (rooftop >20kWp), €0.138/kWh (ground-mounted)
- Power plant limit size: Rooftop 2MWp; ground-mounted 10MWp
- Contract duration: 25 years
- Cap: 481 MWp (2010); 2011 cap tba

**Czech Republic:**
- €0.305/kWh (<30kWp), €0.236/kWh (30-100kWp), €0.22/kWh (>100kWp)
- Solar tax: 26-28% (2011-2013)
- Contract duration: 20 years

**Italy:**
- €0.346 - €0.47/kWh depending on size/type
- 2% degression rate per year
- Contract duration: 20 years
- Cap :1,200MWp
- New regulation & tariffs from June 2011

**Bulgaria:**
- €0.41/kWh (≤5kW), €0.37/kWh (>5kW)
- Contract duration: 25 years

**Greece:**
- €0.55/kWh (rooftop ≤10 kWp)
- Degression of 5% p.a. 2012-2019
- Tariff of €0.37-0.47/kWh depending on size and location
- Contract duration: 20 years, linked to inflation

**Turkey**
- €0.01/kWh for 10 years
- Bonus between €0.02-0.18/kWh for locally produced components
- Cap: 600MWp until end of 2013

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Sources: BMU 2011 and countries’ respective energy acts 2010/2011
Feed-in tariffs subject to change; *Exchange rate (USD-Euro) from 19.01.2011
# German PV Feed-in Tariff

## EEG amendment\(^1\) July 2011

<table>
<thead>
<tr>
<th>System size</th>
<th>Rooftop installations</th>
<th>Field installations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 30 kW</td>
<td>30 – 100 kW</td>
</tr>
<tr>
<td></td>
<td>100 – 1,000 kW</td>
<td>≥ 1,000 kW</td>
</tr>
<tr>
<td></td>
<td>All sizes</td>
<td>All sizes</td>
</tr>
<tr>
<td></td>
<td>All sizes</td>
<td>All sizes</td>
</tr>
<tr>
<td></td>
<td>On conversion area(^2)</td>
<td>On other area</td>
</tr>
<tr>
<td></td>
<td>All sizes</td>
<td>On cropland</td>
</tr>
</tbody>
</table>

### Degression rate

- **January 1st 2011**: 13%
- **July/Sept.\(^3\) 1st 2011**: 0% or 3% or 6% or 9% or 12% or 15% *
- **January 1st 2012**: 9% +/- X% **

### Feed-in tariff \(^4\) (€ct/kWh)

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>33.03</td>
<td>28.74</td>
<td>24.43 - 28.74</td>
<td>21.84 - 26.15</td>
</tr>
<tr>
<td>2011</td>
<td>31.42</td>
<td>27.33</td>
<td>23.23 - 27.33</td>
<td>20.77 - 24.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.98 - 25.86</td>
<td>19.66 - 23.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18.76 - 22.07(^3)</td>
<td>16.77 - 20.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17.94 - 21.11(^3)</td>
<td>16.04 - 19.21</td>
</tr>
<tr>
<td>2012</td>
<td>29.73</td>
<td>25.86</td>
<td>21.36 - 25.54</td>
<td>19.66 - 23.54</td>
</tr>
<tr>
<td></td>
<td>25.37</td>
<td>22.07</td>
<td>21.87 - 26.44</td>
<td>19.38 - 23.52</td>
</tr>
<tr>
<td></td>
<td>24.26</td>
<td>21.11</td>
<td>22.75 - 27.55</td>
<td>20.69 - 24.82</td>
</tr>
</tbody>
</table>

### Degression rate adjustment

- * At July/September\(^3\) 1st 2011 following degression rate depending on volume of newly installed PV capacity based on early 2011 projection (March - May multiplied by 4):
- ** At January 1st 2012 degression rate of 9% and if difference between volumes of Oct. 2010 - Sept. 2011 and of early 2011 projection an adjustment of X% to balance following percentage points:

<table>
<thead>
<tr>
<th>Volume (MWp)</th>
<th>Degression Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3,500</td>
<td>0%</td>
</tr>
<tr>
<td>3,500 - 4,500</td>
<td>3%</td>
</tr>
<tr>
<td>4,500 - 5,500</td>
<td>6%</td>
</tr>
<tr>
<td>5,500 - 6,500</td>
<td>9%</td>
</tr>
<tr>
<td>6,500 -</td>
<td>12%</td>
</tr>
<tr>
<td>&gt; 7,500</td>
<td>15%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume (MWp)</th>
<th>Degression Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3,500</td>
<td>&quot;Own-Consumption-Bonus&quot;&lt;br&gt;0-30% of generated electricity: FIT minus 16.38 €ct/kWh</td>
</tr>
<tr>
<td>3,500 - 4,500</td>
<td>3%</td>
</tr>
<tr>
<td>4,500 - 5,500</td>
<td>6%</td>
</tr>
<tr>
<td>5,500 - 6,500</td>
<td>9%</td>
</tr>
<tr>
<td>6,500 - 7,500</td>
<td>12%</td>
</tr>
<tr>
<td>&gt; 7,500</td>
<td>15%</td>
</tr>
<tr>
<td>&gt; 3,500</td>
<td>30-100% of generated electricity: FIT minus 12.00 €ct/kWh</td>
</tr>
</tbody>
</table>

### Notes:

1. Decided by German parliament February 2011; to be revised again at end of 2011; EEG = Renewable Energy Sources Act;  
2. Fallow land with ecological impact from former military, commercial, public or traffic use or area within 110m from autobahn or railroad  
3. Field installation's tariffs are reduced at Sept. 1st 2011  
4. The tariff of the year of installation is paid for 20 years.  

Source: German parliament resolution from July 2010; Tariffs of July 2011 and January 2012 according to parliament resolution from July 2010.
Demand almost doubled

The German PV Market: Comparison 2009 vs. 2010

**Installed PV capacity by month [in MWp]**

<table>
<thead>
<tr>
<th>Month</th>
<th>2010: 7.4 GWp</th>
<th>2009: 3.8 GWp</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>2,109</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>663</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>327</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>363</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>291</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>497</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>1,461</td>
<td></td>
</tr>
</tbody>
</table>

Source: Federal Network Agency 2011
The German PV Market

Annual PV installations [MWp] in Germany will exceed those in other main markets for years to come:

Source: Bank Sarasin, Nov. 2010

Latest forecasts for annual installations in Germany in 2011:

7.2 GWp (HIS iSupply, March 2011)
8.2 GWp (Solarbuzz, Feb. 2011)
7 GWp (EuPD, Feb. 2011)
5-6 GWp (Jefferies & Company, Jan. 2011)
Required system prices for attractive returns after 2012 are within reach.

The German PV Market: Grid-parity in 2012/2013

Sources: BMU 2010, BSW 2010, Eurostat 2010, Deutsche Bank Securities Inc. 2010

* Model calculation for rooftop systems >30kWp, <100kWp; based on 802 kWh/kWp (Frankfurt), 100% financing, 6% interest rate, 20 year term, 2% p.a. O&M costs

The Principle of the „Own-Consumption Bonus“

Funding through feed-in tariff system AND cost savings on grid energy: Rooftop systems ≤ 500kWp may generate income of > 37 ¢/kWh in 2011

Feed-in tariff: 28.74 to 26.24 ¢/kWh

„Own-Consumption-Bonus“: 15.43 to 9.86 ¢/kWh
PLUS cost savings

Energy from grid: Costs ~ 22 ¢/kWh

Notes: 1) Depending on size of system according to feed-in tariff classification (example based on FIT before July 2011) | 2) Applicable for rooftop systems ≤ 500kWp only | 3) Depending on electricity retail price of respective utility company.

Source: German parliament resolution from July 2010
Systems up to 30kWp are dominating the market, with systems below 10kWp accounting for 43% of the total number of installations.

<table>
<thead>
<tr>
<th>Installed capacity in 2010 [in MWp]</th>
<th>Number of PV systems installed in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL: 7.4 GWp</td>
<td>TOTAL: 249,845 installations</td>
</tr>
<tr>
<td>35%</td>
<td>84%</td>
</tr>
<tr>
<td>19%</td>
<td>0.2%</td>
</tr>
<tr>
<td>23%</td>
<td>3%</td>
</tr>
<tr>
<td>23%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Source: Federal Network Agency 2011; Images: Solarwatt, BP, Geosol
Note: Figures do not sum to 100%, because of rounding
The German PV Market: Customer Preference

Buying decision - Premium modules favored

### Largest segment: Private users¹

<table>
<thead>
<tr>
<th>Year</th>
<th>Private</th>
<th>Commercial</th>
<th>Farmers</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>31.8%</td>
<td>30.9%</td>
<td>27.8%</td>
<td>9.5%</td>
</tr>
<tr>
<td>2010</td>
<td>36.0%</td>
<td>32.2%</td>
<td>23.8%</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

#### Private users favor premium modules²

<table>
<thead>
<tr>
<th>Category</th>
<th>Premium</th>
<th>Medium class</th>
<th>Low price</th>
<th>No product class assignable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private users</td>
<td>50.2%</td>
<td></td>
<td>37.7%</td>
<td>7.7% 4.4%</td>
</tr>
<tr>
<td>Commercial customers</td>
<td>23.8%</td>
<td>45.1%</td>
<td>19.4%</td>
<td>11.7%</td>
</tr>
<tr>
<td>Farmers</td>
<td>17.6%</td>
<td>31.2%</td>
<td>33.3%</td>
<td>17.9%</td>
</tr>
</tbody>
</table>


29.03.2011 | www.gtai.com
The German PV market is far from saturation

Regional distribution of newly installed capacity 2010¹

- **Market size**: Over 201,000 ha of PV-suitable residential rooftops²

- **Market growth potential**: A potential rooftop PV capacity of at least 120 GWp.

- **Experience**: More than 840,000 PV systems have already been installed.³

- **A mature sales structure**: Highly experienced system integrators and project developers facilitate easy market entry and enable rapid market growth for module manufacturers.

Sources: 1) Federal Network Agency 2011; 2) IEA 2004; 3) BSW 2011

29.03.2011 | www.gtai.com
German PV Industry

Leading PV Cluster

Source: Germany Trade & Invest as of August 2010
PV Manufacturing in Germany

Germany offers unique advantages - especially for module manufacturing

Higher selling prices
- "Made in Germany" premium brand: easier access to private customers (>35% market share and growing)
- Direct link to customer (e.g. "transparent factory" concept) satisfying more differentiated markets (e.g. BIPV)
- Distinction against competitors at home

Shorter time to market
- Short reaction time, just-in-time delivery, optimized supply chain - especially in volatile market
- Close proximity to other European markets

Optimized costs
- Less transportation costs
- Reduced long-term transport inventories
- Moderate production costs, cash grants of up to 50% available

Lowered risks
- Reduced price risks
- Eurozone: single currency means no exchange rate risk
- Potential trade barriers eliminated
- Lobby power

Many Partners
- Access to large local supplier base for materials (e.g. glass)
- Cooperation with utilities, test houses, banks, insurances, system integrators, proj. developers, R&D institutes
Location Factors in Germany

Germany provides an outstanding investment environment for PV companies

- High level of education & training
- World’s leading PV market
- R&D and high-tech leader
- World’s best infrastructure
- Proximity to equipment suppliers
- High investment and R&D incentives
- “Made in Germany” quality
- High productivity
- Reliable investment environment
- Stable labor costs & flexible working time
- Strong governmental support

Strong governmental support

High level of education & training

World’s leading PV market

R&D and high-tech leader

World’s best infrastructure

Proximity to equipment suppliers

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High investment and R&D incentives

“Made in Germany” quality

High productivity

Reliable investment environment

Stable labor costs & flexible working time
Germany Trade & Invest has successfully supported some of the most renowned PV companies in their location decisions.

<table>
<thead>
<tr>
<th>Country of Origin</th>
<th>USA</th>
<th>USA</th>
<th>France</th>
<th>Norway</th>
<th>Canada</th>
<th>UAE</th>
<th>Norway</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size and Type of Facility*</td>
<td>100 MWp Integrated Factory (Ribbon-Si)</td>
<td>446 MWp Module Factory (CdTe)</td>
<td>500 MWp Module Factory (CIGS)</td>
<td>120 MWp Module Factory (a-Si/µc-Si)</td>
<td>80 MWp Cell Factory (c-Si)</td>
<td>180 MWp Module Factory (a-Si/a-Si)</td>
<td>PV Glass Processing Factory</td>
<td>100 MWp Cell Factory (c-Si)</td>
</tr>
<tr>
<td>Investment Volume*</td>
<td>€ 180 Mil.</td>
<td>€ 275 Mil.</td>
<td>€ 25 Mil.</td>
<td>€ 210 Mil.</td>
<td>€ 95 Mil.</td>
<td>€ 50 Mil.</td>
<td>€ 140 Mil.</td>
<td>€ 24 Mil.</td>
</tr>
<tr>
<td>Job creation1</td>
<td>1200</td>
<td>650</td>
<td>50</td>
<td>200</td>
<td>240</td>
<td>160</td>
<td>170</td>
<td>65*</td>
</tr>
</tbody>
</table>

*) As planned by company
1) Current number of employees
2) GTAi support: from start of project to construction
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