The German Energiewende
German Renewable Energy Policy

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International Climate Initiative (BMU)
Overview

- Drivers and Targets of Germany’s Energy Policy
- German RE Policies
- Recent Development of PV in Germany
- Integrating RE into the Energy System
- Perspectives on the EEG Surcharge
- Impacts and Perspectives
2.10. EU-27 Development of Import Dependence up to 2030 (Baseline Scenario)

Source: European Commission DG TREN, PRIMES
Top 5 Countries for Renewable Energy Investment, 2011:

1. China (52 bn $)
2. USA (51 bn $)
3. Germany (31 bn $)
4. Italy (29 bn $)
5. India (12 bn $)

Source: REN21, GSR 2012
Driver: Climate Protection

The graph shows the difference in global temperatures from 1860 to 2000, with a focus on recent decades. The data indicates a steady increase in temperature, with different lines representing different periods. The rate of increase is also indicated, showing a faster rise in recent years.
The three pillars of the German Energy Transition

- **Renewable Energies**
  - Increasing investment in RE
  - Grid integration of RE

- **Grid expansion**
  - Additional transmission capacity
  - Balancing demand and supply between regions
  - Increasing storage capabilities

- **Energy efficiency**
  - Decreasing energy consumption
  - Demand Side Management / Smart Grids
# The Energy Transition: Targets

<table>
<thead>
<tr>
<th>Climate</th>
<th>Renewable energies</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gases (vs. 1990)</td>
<td>Share of elec.</td>
<td>Overall share</td>
</tr>
<tr>
<td>2020</td>
<td>- 40%</td>
<td>35%</td>
</tr>
<tr>
<td>2030</td>
<td>- 55%</td>
<td>50%</td>
</tr>
<tr>
<td>2040</td>
<td>- 70%</td>
<td>65%</td>
</tr>
<tr>
<td>2050</td>
<td>- 80-95%</td>
<td>80%</td>
</tr>
</tbody>
</table>

**Climate**
- **Greenhouse gases (vs. 1990):** Reduce emissions by 40% by 2020, 55% by 2030, 70% by 2040, and aim for 80-95% by 2050.

**Renewable energies**
- **Share of elec.:** Increase to 35% by 2020, 50% by 2030, 65% by 2040, and 80% by 2050.
- **Overall share:** Increase to 18% by 2020, 30% by 2030, 45% by 2040, and 60% by 2050.

**Efficiency**
- **Primary energy cons.:** Decrease to -20% by 2020.
- **Energy productivity:** Increase to 2.1%/a by 2050.
- **Building modernization:** Double from 1% to 2% by 2050.
Share of Renewable Energy in Electricity Generation in Germany (2011)

Brutto-Stromerzeugung nach Energieträgern 2011

Brutto-Stromerzeugung 2011 in Deutschland: 612 Mrd. Kilowattstunden*

- Erdgas: 14%
- Steinkohle: 19%
- Erneuerbare: 20%
- Kernenergie: 18%
- Braunkohle: 25%
- Heizöl, Pumpspeicher und Sonstige: 5%

- Wind: 8%
- Biomasse: 5%
- Wasser: 3%
- Photovoltaik: 3%
- Siedlungsabfälle: 1%

Quellen: BDEW, AG Energiebilanzen
Stand: 14. Dezember 2011

* vorläufig
### Renewable energy sources and their share of the energy supply in Germany

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Share of RES in total gross electricity consumption</td>
<td>7.8</td>
<td>4.3</td>
<td>14.0</td>
<td>11.0</td>
<td>10.0</td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
<td>minimum 35.0</td>
</tr>
<tr>
<td>Share of RES in total energy consumption for heat</td>
<td>20.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of RES in fuel consumption for road traffic in transport sector (2)</td>
<td>0.9</td>
<td>5.5</td>
<td>4.5</td>
<td>4.5</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of RES in total final energy consumption (electricity, heat, fuels)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Share of RES in total primary energy consumption (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Sources: Targets of the German Government, Renewable Energy Sources Act (EEG); Renewable Energy Sources Heat Act (EEWärmeG), EU-Directive 2009/28/EC; 2) Total consumption of engine fuels, excluding fuel in air traffic; 3) Calculated using efficiency method; source: Working Group on Energy Balances e.V. (AGEB); RES: Renewable Energy Sources;

Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Brigitte Hiss; as at: July 2012; all figures provisional.
Drivers and Targets of Germany’s Energy Policy
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Cornerstones of the Renewable Energy Sources Act

- Guaranteed grid access for RE; priority transmission and distribution

- Fixed price ("tariff") for every kWh produced for 20 years.

  Tariffs are set technology-specific and specific with regard to further provisions (e.g. site, system services, ...)

- Annual degression of the tariffs

- Equalization of additional costs for electricity from RE between all grid operators and electricity suppliers (2011: ~ 3,5 ct/kWh); independence from public budget.

- Regular monitoring & evaluation; accompanying research.
German RE Policies - Electricity

Development of electricity generation from renewable energy sources in Germany since 1990

- **Hydropower**
- **Wind energy**
- **Biomass** *
- **Photovoltaics**

* Solid and liquid biomass, biogas, sewage and landfill gas, biogenic share of waste; electricity from geothermal energy not presented due to negligible quantities produced; 1 GWh = 1 Mill. kWh;

source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Christoph Edelhoff; as at: March 2012; all figures provisional

GWh


EEG: January 2009
EEG: April 2000
EEG: August 2004
Amendment to BauGB: November 1997
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Price development of PV Modules

October 2012

Legend:
- **Kristallin**
- **Dünnsschicht**
- Source PVexchange

- Deutschland
- China
- Japan

- CdS/CdTe
- a-Si
- a-Si/μ-Si

Price development graph for PV Modules showing trends from January 2010 to January 2012.
Photovoltaics in Germany - Development & EEG adjustments

Installed capacity and energy supply from photovoltaic installations in Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity supply [GWh]</th>
<th>Installed capacity [MWp]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2,000</td>
<td>19,000</td>
</tr>
<tr>
<td>2001</td>
<td>4,000</td>
<td>11,683</td>
</tr>
<tr>
<td>2002</td>
<td>6,000</td>
<td>6,583</td>
</tr>
<tr>
<td>2003</td>
<td>8,000</td>
<td>4,420</td>
</tr>
<tr>
<td>2004</td>
<td>10,000</td>
<td>3,075</td>
</tr>
<tr>
<td>2005</td>
<td>12,000</td>
<td>2,220</td>
</tr>
<tr>
<td>2006</td>
<td>14,000</td>
<td>1,282</td>
</tr>
<tr>
<td>2007</td>
<td>16,000</td>
<td>556</td>
</tr>
<tr>
<td>2008</td>
<td>18,000</td>
<td>313</td>
</tr>
<tr>
<td>2009</td>
<td>20,000</td>
<td>162</td>
</tr>
<tr>
<td>2010</td>
<td>22,000</td>
<td>76</td>
</tr>
<tr>
<td>2011</td>
<td>24,000</td>
<td>64</td>
</tr>
<tr>
<td>2012</td>
<td>26,000</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); 1 GWh = 1 Mill. kWh; 1 MW = 1 Mill. Watt; image: BMU / Bernd Müller; as at: March 2012; all figures provisional
<table>
<thead>
<tr>
<th>start of operation</th>
<th>Installed Capacity Roof-Top</th>
<th>Free-Field-Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>up to 30 kW</td>
<td>up to 100 kW</td>
</tr>
<tr>
<td>as of 1.1.2012</td>
<td>24,43</td>
<td>23,23</td>
</tr>
<tr>
<td></td>
<td>not applicable</td>
<td>up to 1.000 kW</td>
</tr>
<tr>
<td>as of 1.4.2012</td>
<td>19,50 (&lt;10kW)</td>
<td>18,50 (&lt; 40kW)</td>
</tr>
<tr>
<td>New! Market integration model</td>
<td>tariffs paid for x% of annual production</td>
<td></td>
</tr>
</tbody>
</table>
EEG 2012 – PV degression

- Overall cap of 52 GW
  Solar PV: Expiration of EEG PV support
  But: continuation of priority feed-in

<table>
<thead>
<tr>
<th>Year</th>
<th>Corridor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>2500-3500</td>
</tr>
<tr>
<td>2013</td>
<td>2500-3500</td>
</tr>
<tr>
<td>2014</td>
<td>2100-3100</td>
</tr>
<tr>
<td>2015</td>
<td>1700-2700</td>
</tr>
<tr>
<td>2016</td>
<td>1300-2300</td>
</tr>
<tr>
<td>2017</td>
<td>900-1900</td>
</tr>
</tbody>
</table>

- per year:
  - 29% above 7.500 MW
  - 26% above 6.500 MW
  - 23% above 5.500 MW
  - 19% above 4.500 MW
  - 15% above 3.500 MW
  - 11.4% Target Corridor
  - 9% up to 2.500 MW
  - 6% up to 2.000 MW
  - 0% up to 1.500 MW
  - -6% up to 1.000 MW

- per month:
  - 2.8%
  - 2.5%
  - 2.2%
  - 1.8%
  - 1.4%
  - 1.0%
  - 0.75%
  - 0.5%
  - 0%
  - -0.5%
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Electricity markets

Baseload futures market (delivery in 2013)
Grid expansion

Grid development plan 2012

Enhancing Flexibility

- Grids
  - Netzausbau für großräumigen Stromaus tausch (Baustein 1)
  - Flexible thermische Kraftwerke (2)
  - Reduktion „must-run“ (4)
  - Einspeisemanagement Wind & PV (6)

- Generation
  - Flexible Nachfrage durch Lastmanagement (3)

- Storage
  - Power-to-heat statt Einspeisemanagement (reduziert „must-run“) (5)
  - Pumpspeicher D/Alpen/Norwegen (5)
  - Power-to-Gas (5)

- Grid expansion
  - Flexible thermal power plants; feed-in management
  - Demand side/Load management
  - Power to heat
  - Pump storage
  - Power to Gas
Challenges

To move the transition forward successfully, we…

➢ … enable the electricity system to cope with large amounts of intermittent supply
➢ … increase flexibility of supply and demand
➢ … ensure supply security during times of low RE through management measures
➢ … address the medium-term challenge of electricity market design (e.g. closer-to-real-time trading to reduce forecasting error)
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Electricity consumer price

EEG costs in 2011: 3.53 ct/kWh

Source: BDEW
Development of the EEG Surcharge 2012 and Expectation for 2013

Entwicklung der reinen Umlage und der Steigerungsfaktoren 2012-2013

- Reine Förderkosten
- Rückgang Börsenstrompreis
- Marktprämie
- Industriepreis
- Liquiditätsreserve
- Nachholung aus 2012

5.21 ct/kWh

- Compensation 2012
- Exemption energy intensive industry
- Reduction of EEX prices
- Support costs

October 2012
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Benefits of RE Deployment

Employment in Germany's renewable energy sources sector

- **Wind energy**
  - 2004: 7,300 jobs
  - 2007: 14,200 jobs
  - 2009: 160,500 jobs
  - 2011: 160,500 jobs

- **Biomass**
  - 2004: 7,600 jobs
  - 2007: 13,300 jobs
  - 2009: 339,500 jobs
  - 2011: 381,600 jobs

- **Solar energy**
  - 2004: 7,800 jobs
  - 2007: 14,500 jobs
  - 2009: 339,500 jobs
  - 2011: 381,600 jobs

- **Hydropower**
  - 2004: 9,500 jobs
  - 2007: 25,100 jobs
  - 2009: 101,100 jobs
  - 2011: 124,400 jobs

- **Geothermal energy, ambient heat**
  - 2004: 14,200 jobs
  - 2007: 13,300 jobs
  - 2009: 339,500 jobs
  - 2011: 381,600 jobs

- **Publicly assisted research and administration**
  - 2004: 1,800 jobs
  - 2007: 10,300 jobs
  - 2009: 7,500 jobs
  - 2011: 8,100 jobs

**Increase:** approx. 138%

Figures for 2010 and 2011 are provisional estimate; deviations in totals are due to rounding.

Source: O’Sullivan (DLR), Edler (DIW), Nieder (ZSW), Rüther (ZSW), Lehr (GWS), Peter (Prognos): "Bruttobeschäftigung durch erneuerbare Energien im Jahr 2011 – eine erste Abschätzung", as at: March 2012; interim report of research project „Kurz- und langfristige Auswirkungen des Ausbaus erneuerbarer Energien auf den deutschen Arbeitsmarkt“; image: BMU / Christoph Busse / transit
Benefits of RE Deployment

Trends in investments in renewable energy sources and their induced share in the electricity sector in Germany

Source: BMU-KI III 1 according to the Centre for Solar Energy and Hydrogen Research Baden-Wuerttemberg (ZSW); 2004 and 2005 estimated; image: BMU / Dieter Böhme; as at: July 2012; all figures provisional
Benefits of RE Deployment

Greenhouse gas emissions avoided via use of renewable energy sources in Germany 2011

Total greenhouse gases avoided 2011 (electricity/heat/transport):
approx. 130 million t CO$_2$ equiv., incl. greenhouse gases avoided due to RE-electricity with EEG remuneration:
approx. 70 million t CO$_2$ equiv.

GG: Greenhouse gas; RE: renewable energy; deviations in the totals are due to rounding; geothermal energy not presented due to negligible quantities of electricity produced;
Source: Federal Environment Agency (UBA) according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: H.G. Oed; as at: July 2012; all figures provisional
Conclusions

- Renewable energies have experienced a **strong growth**
- The reasons: **ambitious targets**, **efficient policies** and instruments, long-term planning security
- **Benefits** of renewable energies: **technological innovation**, climate protection, job creation, economic growth, avoided energy imports
- **Crucial next steps:**
  - cost efficiency, particularly regarding solar PV
  - market and grid integration of renewable energies
  - expand grid and storage capacities
  - sustainable and efficient use of bioenergy
  - cooperation among EU Member States and globally
Thank you for your attention!

More Information:
www.bmu.de/english
www.erneuerbare-energien.de/english
RE cost estimations – A sensitive and open debate

- Prognosis of costs for RE expansion vary in a wide range (development curve, climax - height and year)

- Differences due to different assumptions: scenarios for RE expansion, development of spot market price for electricity, ..

- Additional influences on RE costs and electricity price: „compensation approach” for energy-intensive industries, future Feed-in-Tariffs and instruments, Merit-Order-Effect
German RE Policies - Electricity

EEG costs in 2011: 3.53 ct/kWh

Cost components for one kilowatt-hour of electricity for household consumers

Source: BMU-KI III 1 according to Institut für neue Energien Teltow (IfnE) and Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW); Image: Deutsche Bundesbank; as at: July 2012; all figures provisional
Current Status – RE Contribution to Energy Mix

Renewable energy shares of total final energy consumption in Germany 2011

Total: 8,692 PJ

- **RES-share 2011:** 12.5 %
- **Biomass**: 8.4 %
- **Wind energy**: 2.0 %
- **Photovoltaics**: 0.8 %
- **Solar thermal and geothermal energy**: 0.5 %
- **Hydropower**: 0.7 %
- **Other energy resources (e.g. hard coal, lignite, mineral oils, natural gas) and nuclear energy**: 87.5 %

1) Source: Working Group on Energy Balances e.V. (AGEB); 2) Solid and liquid biomass, biogas, sewage and landfill gas, biogenic share of waste, biofuels; Source: BMU-KI III 1 based on Working Group on Renewable Energy-Statistics (AGEE-Stat) and Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW), according to AGEB; RES: Renewable Energy Sources; deviations in the totals are due to rounding; 1 PJ = 10^{15} Joule; as at: July 2012; all figures provisional.
Merit order curve (with wind & PV)

- Lower price / lower profit contribution
- Demand
- Wind & PV
Merit order curve (conventional)

- **Price**
- **Demand**
- **Profit contribution**

The graph illustrates the merit order curve for conventional power generation, showing the relationship between production capacity and cost. Different energy sources are indicated by their respective colors and labels.