Short-, Mid-Term and Long-Term Challenges to meet German RE Expansion Plans

Revision 2013 – Creating a New Renewable Energy Future

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Introducing Remarks

• Germany`s Energy Transition, in particular expansion of RE, under strong considerations;
• Transition is running: 1) success factor RE share on electricity market 2012 22 % (2000 6 %); some days about 50 %; 2) progress on heat market and energy saving; 3) stagnation in transport sector; 4) some delays on energy efficiency and saving
• however: usually only bad news are communicated such as „cost out of control“, „grid expansion fails“, „RE cannot guarantee energy security“ etc.
• electricity flows with neighbouring countries: surplus abroad 17 TWh (2012), in NDL, AUT and SUI (2011 only 6 TWh);
• at present: several controversial discussions in Germany on how to design next steps, even within Ministries, Parliament, political Parties, business sector, researchers or NGO;
• however: strong consensus to proceed on „Energy Transition“ and outstanding role of RE in principle due to several rationales:
Strong Rationales for Energy Transition will overcome short-term Distortions (1)

- sustainable energy security (RE main pillar future energy supply)
- "peace dividend" by RE
- reducing fossil energy imports: financial resources - 6 bn € 2011 - can be used for domestic economic value
- positive economic and social impacts in terms of investments and employment effects: 22,9 bn € investments; 380,000 jobs (2011)
- exploring forecasted market potentials of RE technologies world wide (IPCC, IRENA SE4All et.al.)
Strong Rationales for Energy Transition will overcome short-term Distortions (2)

- reducing cost of inaction (in terms of current OECD activities) or hidden costs of fossil and nuclear power: 80 € per tonne CO$_2$. RE cost avoidance by 10 bn € 2011

- reducing more and more serious climate change impacts, in particular natural weather disasters influenced by climate change impacts

- climate change: RE by far strongest pillar for previous and future German GHG-reductions (39% of 27% GHG reduction in 2011)
German GHG Emission Trend 1990 – 2011

on track to meet Kyoto target (21%): 2011: - 27%
Ownership of RE installations in Germany [2009]

- Regional utilities: 2%
- Small local utilities: 3%
- International utilities: 3%
- "Big 4" utilities: 7%
- Industrial companies and other companies: 7%
- Farmers [biogas, PV]: 9%
- Funds / banks [bioenergy, wind onshore]: 11%
- Project developers [wind]: 15%
- Private owners [PV, wind onshore]: 42%

Source: trend:research, 2010: "Anteile einzelner Marktakteure an Erneuerbaren Energien Anlagen in Deutschland"

the unknown economic benefit:

2011 50% of investments by small investors
# The German Energy Transition: Pillars and Targets

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<th>Climate</th>
<th>Renewable energies</th>
<th>Efficiency</th>
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<td>Greenhouse gases (vs. 1990)</td>
<td>Share of elec.</td>
<td>Overall share</td>
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<td>2020</td>
<td>- 40%</td>
<td>35%</td>
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<td>2030</td>
<td>- 55%</td>
<td>50%</td>
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<tr>
<td>2040</td>
<td>- 70%</td>
<td>65%</td>
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<td>2050</td>
<td>- 80-95%</td>
<td>80%</td>
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German governmental plan for the future energy mix

**Targets for 2050**
- Primary energy reduction by 50%
- Min. 60% RES on primary energy
- Min. 80% RES on electricity production

After the disaster in Fukushima, the German government decided to fade out nuclear power until 2022.
Future development of RE until 2050

Development of electricity generation from renewable energies in Scenario 2011A

Source: DLR [134]
Cross-Linking of Energy Sources
Short-term Challenges: Cost Dimension (1)

• cost dimension has to be considered differentiated

• short-terms distortions, in particular by PV, increasing compensation mechanism and decreasing market price for electricity (due to growing amount of RE on electricity markets)

• various policy measures to limit costs, in particular PV FIT;

• further surcharge cost limitations under consideration, e.g. list of exempted companies, “freezing” FIT,
Cost components for one kilowatt-hour of electricity for household consumers

Production, distribution, transport
KWKG
EEG
Concession levy
Electricity tax
Sales tax

Source: BMU - E I 1 according to Institut für neue Energien Teltow (IfnE) and Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW); Image: Deutsche Bundesbank; as at: December 2012; all figures provisional

EEG costs in 2012: 5,277 ct/kWh

3,53 €Ct/kWh
Electricity markets

Baseload futures market (delivery in 2013)
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
Short-term Challenges: Cost Dimension (2)

• well known increasing cost curves of limited fossil fuel resources

• estimated mid- and long-term decreasing cost curves of RE technologies; already achieved 90 % cost reduction for PV and 50 % for wind turbines (1990);

• from 2020 grid parity for wind (onshore), PV and bioenergy is expected;

• hidden costs of nuclear energy often not included in any cost analysis, e.g. disposal of nuclear waste or actual risk assurance
Future estimated cost development of RE

Cumulative system-analytical differential costs of electricity, heat and fuel supply from renewable energy sources

Note: Compared with a fossil energy system, assuming a future increase in fossil fuel prices in line with price path A: "Marked".
1) Scenario 2011A for 10-year periods

Source: DLR [134]
System Integration of RE: Short-term Challenges (EEG 2012)

- **Market Integration of RE**: “direct sale mechanisms” and “Flexibility Premium” instead of FIT (widely used for wind and PV “parks”)

- **Feed-in management**: RE supply already exceeds electricity demand in certain hours; need for
  - All RES-plants need to be ready to reduce feed-in in case of oversupply
  - Compensation for foregone income
  - PV: Technical requirements vary with plant size

- **Grid code** was changed: more complex frequency management for all RES:
  - Retrofit of more than 300,000 PV systems (>10 kWp capacity), 3 to 4 years, approx. 200 Mio. Euros
  - Technical standards in energy sector need to be further developed!
System Integration of RE

Mid-term Challenges: flexible capacity markets

• designing the electricity market for the feed-in and safe supply of fluctuating power generation from wind and PV

• need of flexible thermal power plants, in particular high efficient gas-fired power plants

• very limited generation times require new financial mechanism, e.g. capacity payment or capacity markets
System Integration of RE: Mid-term Challenges: Grid Expansion

• Upgrading the electricity grid infrastructure: Expansion of the transmission & distribution grids

• **Overlay grid**: North-south routes to carry electricity from wind farms in the north to the consumption centres in the south

• **National grid development plan** according to 3d energy package to be submitted on 3 June 2012

• About 25 bn Euro investments are expected till 2030 to reinforce and connect RES to distribution networks

• Enhancing public acceptance of grid expansion, overcoming administrative hurdles and long procedures

• Creating sufficient incentives for investors (9 % profit on equity), consideration to participate municipalities and citizens
Grid expansion

Grid development plan 2012
NEP 2012, Stand: August 2012,
www.netzentwicklungsplan.de
4000 km new grids

Grid onshore 20 Mrd. €,
Offshore 12 Mrd. €
3.800 km new grids,
(1.700 AC and 2.100 DC)
4.400 km Upgrading
Support Programmes: Storage

- Storages needed from 2020 onwards

- Research & Development Initiative: 200 Mio. Euro

- New Support Programme for small battery systems in combination with PV-systems:
  - 50 Mio. Euro per year
  - KfW loan programme, subsidies for batteries
  - Start: beginning of 2013
Research and Development: BMU calls for tender, close to applications, including companies

Funds deployed for ongoing projects in 2011

Wind
44.0 Mio. €
34.0 %
Photovoltaics
38.8 Mio. €
30.0 %
Other
9.6 Mio. €
7.4 %
RE system optimisation
12.8 Mio. €
9.9 %
Solar thermal power stations
6.1 Mio. €
4.7 %
Low-temperature solar thermal
6.5 Mio. €
5.0 %
Geothermal
11.6 Mio. €
9.0 %

Overall Federal Government 6th Energy Research Programme

• € 3,5 Mrd. for the next 3 years for innovative energy research
• Budget for renewable energies 1,3 Mrd. €
System Integration of RE: Long-term Challenges

• base load power plants for electricity supply (nuclear, coal) will no longer exist, base load of 20-30 GW will be provided by combined power and heat generation;

• expansion of storage technologies: batteries, pumped storage hydro, “power-to-heat” (heat-pumps, “power-to-gas” including hydrogen: focus of current R & D projects;

• new applications have to extended, in particular electro mobility (use of surplus energy from RE, introducing RE in the transport sector);

• smart grid und smart communities for using surplus RE, and reaching more energy efficiency and saving

• load management to avoid peak loads, in particular in industry and commerce, but also in homes ("learning from Japan").
Long-term Goals of Renewable Energy Regulation

- Decrease share of subsidized electricity over time
- Feed in tariffs adjusted to total cost of electricity of PV
- Efficient Integration into the grid without affecting stability
- Equitable Burden Distribution
- Market Integration
- Burden Sharing
- Price Adjustment Mechanism
- Grid Integration

111 GW Installed RE-Capacity
Conclusions

1. continuation of RE development will be the major pillar of German Energy Transition, in particular wind and PV;

2. future role of RE requires a wide variety of economic and technical requirements, in particular capacity markets, grid expansion, storage technologies, new applications;

3. (exaggerated) cost challenges are a short-term issue to be overcome;

4. challenges are well understood and in different stages of action including responsibilities for policy, business, scientific community and civil society;

5. Energy Transition is one of the most important major German post-war „Challenges“.
Thank you for your attention!

More Information:
www.bmu.de/english
www.erneuerbare-energien.de/english