„Which power market design for the Energiewende?“

Presentation for the European Climate Foundation

Uwe Leprich
Institut for Future Energy Systems (IZES)
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Uwe Leprich

- Professor at the business school of the University of Applied Sciences in Saarbruecken since 1995
- At the same time scientific head of the Institute for Future Energy Systems (IZES), a university based research institute focussing on renewable energies, energy efficiency and decentralised power generation
- Author and co-author of several books and articles liberalised electricity markets, feed-in law regulations and instruments for promoting renewable energies in the heat market.
- Alternate member of the Administrative Board of ACER (Agency for the cooperation of Energy Regulators)
- Spokesman of the Renewable Energy Research Association since December 2012
IZES gGmbH

Management
Dr. Michael Brand, Dr. Frithjof Spreer

Scientific Director
Prof. Dr. Uwe Leprich

Applied Research and Development

Energy Markets
Prof. Dr. Uwe Leprich

Material Flow Management
Prof. Frank Baur

Buildings
Prof. Dr. Horst Altgeld

Technology and Scientific Infrastructure

Technical Innovations
Dr. Bodo Groß

Solar Power / Test of Solar Collectors and Systems (TZSB)
Danjana Theis

Social-Scientific Energy Research
Prof. Dr. Petra Schweizer-Ries
1. The German „Energiewende“

2. How does the electricity system look like in the medium run?

3. System design instead of market design: How to finance the future electricity system?

4. Resume
### Targets of the Energy Concept 2010

As cornerstones of the German „Energiewende“

<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 electr.</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>

Source: Schafhausen 2011

[Leprich, March 6, 2013, Berlin]
Leitstudie 2011 as compass for the Energiewende

Figure 4: Development of final-energy consumption by sector, and of consumption in conversion (total = primary energy) in Scenario 2011 A

Source: DLR/WES/INE 2012
The power system as the centerpiece of the Energiewende

Energy related CO2 emissions in Germany 2010 (forecast)

Source: UBA 2011
Leitstudie 2011: Gross Electricity Generation

Scenario 2011 A

- Gross electricity production, TWh/yr

- Source: DLR/IW/INE 2012

[Leprich, March 6, 2013, Berlin]
Figure 19: Cumulative system-analytical differential costs of entire provision of energy from renewables in Scenario 2011 A for 10-year segments and price path A
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The triangle of electricity policy for 2020

35% (39%) Renewables

Framework conditions
- 3 further NPPs off-grid
- no significant storage expansion
- Grid restrictions eliminated?

10% (0%) Reduction

25% (28%) CHP

[ Leprich, March 6, 2013, Berlin ]
The VRES (wind, PV, water) will cover up to one half of the total power generation – due to that reason they determine the rationality of the system.

### Uncertainties

- Will the government hold on to the renewable energy targets?
- Will the current storage capacities be sufficient for that?
- Will the grid extension keep up?

**Variable Renewable Energy Sources**

- 52 GW PV
- 50-70 GW Onshore
- 5-7 GW Offshore

[Leprich, March 6, 2013, Berlin]
By the way:

The development of wind and PV is increasingly less justified with CO2 reduction targets, but increasingly with

• reduction of import dependency
• increase of added domestic value
• job creation
• stabilization of electricity prices in the long term
• export opportunities of the system
• etc.
Facilities for System Services are network-related facilities, usually large power plants.

System Services
- reactive power
- voltage control
- re-establishment of power
System Part #3

Infrastructure as a system requirement

- Communication Networks
- Distribution Networks
- Data Networks
- Gas Networks
- Transmission Networks
- Heat Networks
- HVDC Networks
- Feed-In Networks

VARIABLE RENEWABLE ENERGY SOURCES

Facilities for

[Image: Diagram showing various networks and systems related to infrastructure as a system requirement.]
System Part #4

Flexibility Options

Facilities for
Variable Renewable Energy Sources
System services

V R E S
The future electricity system

4 technical system components:

- VRES
- FfSS
- FO
- Grids
Flexibility perspective: a combined electricity-heat-system

Quelle: DLR/IWE/IFNE 2012

A lot of flexibility is needed for the coverage of the residual load!
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Lead question
How can the VRES be refinanced?

1st segment

Variable Renewable Energy Sources
Hypothesis: the markets will not do it!

Market prices are declining; one of the reasons is the merit order effect which will continue
Hypothesis: the markets will not do it!

Market values are even declining more!

Source: Kopp et al. 2012
The best remuneration mechanism so far is the FIT

Of course the German Feed-in law (EEG) has to be developed further:

- Signals for a more system oriented design of the RES plants
- Eventually locational signals
- Better market access to the dispatch markets, especially the balancing markets
- Eventually suppliers with more responsibilities for VRES integration
- ...

[Leprich, March 6, 2013, Berlin]
Lead question

How can the FfSS be chosen by competition and replaced by RES in the medium run?
The financing of the FfSS and the role of RES

- balancing power is financed through the balancing markets
- other system services are financed through the network charges for the high voltage grid
- RES have usually been operated according the „generate and forget“ rule
- now they have to switch to „operate and serve“ in order to replace the fossil and nuclear FfSS
Lead question

How can the dispatch markets better adapt to the VRES?
Better harmonisation between the dispatch markets and the VRES

- Fristen zwischen Auktionierung und Lieferzeitpunkten im day-ahead-Markt sollten verkürzt werden.
- Auch im day-ahead-Handel sollten viertelstündliche Gebote möglich gemacht bzw. generalisiert werden.
- Stärkung des intraday-Handels z.B. durch morgendliche Auktionen für die zweite Tageshälfte.
- Die Minutenreserveauktionen könnten ebenfalls teilweise im intraday-Handel stattfinden.
- Insgesamt müsste der Spotmarkt aufgewertet werden.

[ Leprich, March 6, 2013, Berlin ]
Lead question
How can the CM be designed to allow competition between the FO?
The design of capability mechanisms ...

- is really complicated
- is very difficult with respect to timing
- should avoid large free-rider effects
- should be compatible with the necessities of the system transformation and climate policy
- …
Actual flexibility options which have been politically implemented

- **grid**: grid extensions and upgrades as the most cost effective FO
- **CHP**: the amended law gives clear signals for more flexibility through investment support for heat storages
- **biomass**: the EEG gives clear signals for more flexibility through a flexibility premium
- **load management**: the load management ordinance supports industrial and commercial LM efforts
- **electrical storages**: there will be a support programme for storages in combination with PV on the roofs

…”

[Leprich, March 6, 2013, Berlin]
System design: interdependencies between the system segments

Variable Renewable Energy Sources

Wholesale markets Dispatch markets Balancing markets

Facilities System services Capability mechanisms
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Resume

- The center of the German Energiewende is the electricity system
- The future electricity system will be dominated by variable renewable energies; they will define the rationality of the system
- To finance the future electricity system one has to differentiate between four segments; however these segments have interdependencies
- The selection of the necessary flexibility options will be the key question with respect to competition. It’s answer will decide whether and how the liberalisation paradigm will adapt to the VRES dominated future electricity system
Thank you very much for your attention!

Institut für ZukunftsEnergieSysteme (IZES)

Altenkesselerstr. 17, Gebäude A1
66115 Saarbrücken
Tel. 0681 – 9762 840
Fax 0681 – 9762 850
email: leprich@izes.de
Homepage www.izes.de