Beyond patents: renewable energy innovation in Germany

Dr. Karoline S. Rogge | SPRU, University of Sussex and Fraunhofer ISI

Presentation at IRENA’s Innovation Week, Deep Dive Session “From Science to Innovation”
May 12, 2016
Agenda

1. Rapid technological change
2. Policy mix for stimulating innovation
3. Importance of credible political will for innovation
4. Conclusions
RAPID TECHNOLOGICAL CHANGE IN RENEWABLE POWER GENERATION TECHNOLOGIES OVER LAST FEW DECADES
Multiple indicators for measuring innovation & technological change

- Scientific publications
- Patents
- Innovation expenditures
- Product and process innovations
- Cost development
- Diffusion
- ...
- Innovation system (actors, networks, institutions)
- System innovation (socio-technical change)
Patent applications...
... strong increase for PV and wind, but recent slow down;
German patents developed above the general patenting trend

- DE no 1 (top 4 include US, DK, CN)
- Strong increase of Asian countries (CN, JP, SK)

- DE no. 4 (after JP, US, SK)
- Catching up of Asian countries (SK, CN)
Scientific publications... 
... risen sharply for photovoltaics: China, USA and South Korea leading, Germany among top 5 (with JP)
Cooperation in innovation system... 
... between various actors has increased greatly and supports innovation through resulting intensive knowledge exchange.

1999–2001

Photovoltaics

2004–2006

Dr. Karoline S. Rogge

May 12, 2016
Product and process innovations...

... in 2011-13 many German manufactures introduced product and process innovations, innovation expenditures in 2014 -30%

During the three years 2011 to 2013, did your company introduce new or significantly improved products or processes in the renewable energy branch?

<table>
<thead>
<tr>
<th>Product innovations</th>
<th>Process innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>Onshore wind</td>
<td>Onshore wind</td>
</tr>
<tr>
<td>Offshore wind</td>
<td>Offshore wind</td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>Photovoltaics</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>Hydro</td>
<td>Hydro</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
</tr>
<tr>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>81</td>
<td>19</td>
</tr>
<tr>
<td>63</td>
<td>38</td>
</tr>
<tr>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>78</td>
<td>22</td>
</tr>
<tr>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>63</td>
<td>38</td>
</tr>
<tr>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>69</td>
<td>31</td>
</tr>
<tr>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>(n=349)</td>
<td>(n=347)</td>
</tr>
<tr>
<td>(n=62)</td>
<td>(n=61)</td>
</tr>
<tr>
<td>(n=24)</td>
<td>(n=24)</td>
</tr>
<tr>
<td>(n=132)</td>
<td>(n=132)</td>
</tr>
<tr>
<td>(n=85)</td>
<td>(n=85)</td>
</tr>
<tr>
<td>(n=22)</td>
<td>(n=22)</td>
</tr>
<tr>
<td>(n=24)</td>
<td>(n=23)</td>
</tr>
</tbody>
</table>
POLICY MIX FOR STIMULATING RENEWABLE ENERGY INNOVATION
Public R&D funding ("tech push")... helps explain only part of Germany's success with renewable energy innovation: long history, strong increase in past 10 years
Market formation! ("demand pull")...

... EEG from 2000 with its predictable, technology-specific incentives & foreign equivalents, investment <-> cost reductions
Consistent instrument mix matters...  
...manufacturers see strongest support through nuclear phase-out, followed by combination of R&D funding, training & EEG

Please state how much you think these political instruments and measures support the expansion of renewable electricity generation in their current form?

- Phase-out of nuclear energy by 2022: \(\bar{\theta} = 4.2\) (n=385)
- Public R&D/innovation funding: \(\bar{\theta} = 3.4\) (n=360)
- Promoting the training of skilled workers for the Renewable Energies: \(\bar{\theta} = 3.3\) (n=340)
- Renewable Energy Sources Act: \(\bar{\theta} = 3.3\) (n=378)
- Energy Industry Act (EnWG) and other policy initiatives to expand the grid: \(\bar{\theta} = 2.9\) (n=309)
- Federal Nature Conservation Act and its implementation: \(\bar{\theta} = 2.5\) (n=301)
- EU Emissions Trading System: \(\bar{\theta} = 2.3\) (n=371)
- Political framework conditions for fossil electricity generation: \(\bar{\theta} = 2.3\) (n=365)

Dr. Karoline S. Rogge
May 12, 2016
IMPORTANCE OF CREDIBLE POLITICAL WILL FOR RENEWABLE ENERGY INNOVATION
Early warning signs...  
... declining patent applications in wind and PV: correspond to reduction in attractiveness of policy mix (Photon & Wind Power Monthly)

PV Policy-Mix-Indicator negative since 2010
Credible political commitment! … declining innovation expenditures by manufacturers: correspond to reduction of political will between 2012-14

How strong do you think the political will was/is of the respective German government at the following points in time regarding the promotion of renewable electricity generation?
CONCLUSIONS
Policy implications for stimulating renewable energy innovation

- Understand and design **policy mix as a whole** - backing only one instrument will not achieve desired result

- Aim for **credible and internally consistent** policy mix - strong political will for green transformation clarifies future market developments needed for long-term investments in innovation

- Work towards **greater supranational coordination** of policy mix as green change increasingly global process

- Orient political discussion towards **benefits** – such as export opportunities, jobs, international climate protection, sustainable development
Interested in finding out more?

- GRETCHEN report with all figures and further references available at project website:

  „Green change: renewable energies, policy mix and innovation“

- Further information available online: [www.project-gretchen.de](http://www.project-gretchen.de)
Thank you!

Looking forward to your comments and questions!

Contact: k.rogge@sussex.ac.uk

Acknowledgment
This presentation is based on a research project funded by the Federal Ministry of Education and Research (BMBF) under the funding label Econ-C-026, whose support is gratefully acknowledged. The author is responsible for the content of this presentation.