

An empirical exploration into the role of phase-out policies for low-carbon energy transitions: the case of the German *Energiewende*

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Empirical motivation: Findings on policy support for renewables expansion

Please say how much you think these policy instruments and measures support the expansion of renewable electricity generation in their current form.

Please answer using a scale from 1 to 6 - 1 means “no support at all” and 6 “fully supports”. (Other possible answers: don’t know, no information)

- Renewable Energy Sources Act (**EEG**)
- Public **R&D/innovation funding**
- Energy Industry Act (EnWG) and other policy initiatives to **expand the grid**
- Promoting the training of **skilled workers** for the renewable branch
- Federal **Nature Conservation** Act and its implementation
- **EU Emission Trading** System for the reduction of greenhouse gas emissions
- Policy framework conditions for **fossil** electricity generation
- Phase-out of **nuclear** energy by 2022

Theoretical motivation: Transformative policy mixes need to address ‘creative destruction’

- Destruction:**

Relative neglect of regime destabilization

- Creation:**

So far focus on niche creation

DESTRUCTION FUNCTIONS (REGIME DESTABILISATION)	TYPES OF POLICY MEASURES ADDRESSING THE FUNCTION
Control policies (D1)	Emission regulations, carbon taxes, technology bans, etc.
Significant changes in regime rules (D2)	E.g. structural reforms in legislation, significant new overarching laws.
Reduced support for dominant regime technologies (D3)	Removal/reduction of subsidies and R&D funding, technology bans, etc.
Changes in social networks, replacement of key actors (D4)	E.g. creation of new powerful committees with involvement of niche actors
CREATION FUNCTIONS (NICHE CREATION)	TYPES OF POLICY MEASURES ADDRESSING THE FUNCTION
Knowledge creation, development and diffusion (C1)	R&D funding schemes, innovation platforms, demonstration subsidies, etc.
Establishing market niches/ market formation (C2)	Regulation, tax exemptions, public procurement, deployment subsidies
Price performance improvements (C3)	Deployment and demonstration subsidies enabling learning-by-doing
Entrepreneurial experimentation (C4)	Advice systems for SMEs, incubators, low-interest company loans, venture capital, etc.
Resource mobilisation (C5)	R&D and deployment subsidies, venture capital, educational policies, etc.
Support from powerful groups / legitimisation (C6)	Innovation platforms, foresight exercises, labelling etc.
Influence on the direction of search (C7)	Targeted R&D funding, regulations, tax incentives, voluntary agreements, etc.

^{SPC} Key: C = creative measure D = destructive measure

Source: Kivimaa P, Kern F (2016). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Research Policy, 45(1) pp. 205-217. (Open access)



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Research Case: German *Energiewende*

Quick overview of policy evolution and renewables expansion

Timeline: *EEG, nuclear phase-out, targets*

- **2000:** Renewable Energy Sources Act (EEG)
(Chancellor Schröder + Green Party)
- **2002:** Decision on nuclear phase out by 2022
(Chancellor Schröder + Green Party)
- **2010:** Decision on the exit from the nuclear exit and ambitious targets
for decarbonisation, renewables and energy efficiency
(Chancellor Merkel + Liberal Party)
- **2011:** Fukushima (March 11-16)



Immediate shutdown of 8 nuclear power plants

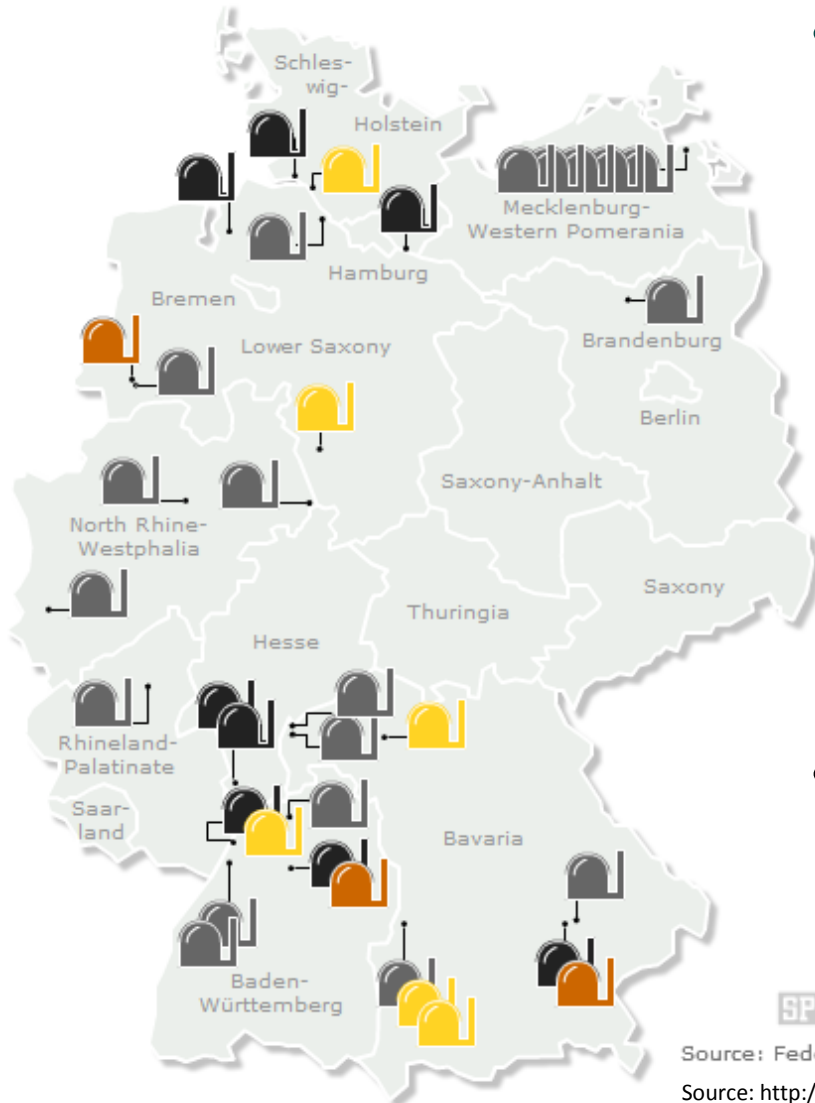


Then: Exit from the exit from the exit

- **March 27, 2011:** Merkel's party loses elections in Baden-Württemberg - Green Party gets 24.2%, leads federal government



- **June 2011:** decision to phase out remaining 17 nuclear power plants by 2022 (Chancellor Merkel + Liberal Party, cross-party support)



SPIEGEL ONLINE

Source: Federal Office for Radiation Protection

Source: <http://www.spiegel.de/flash/flash-24364.html>



Decommissioned or decommissioning decision made

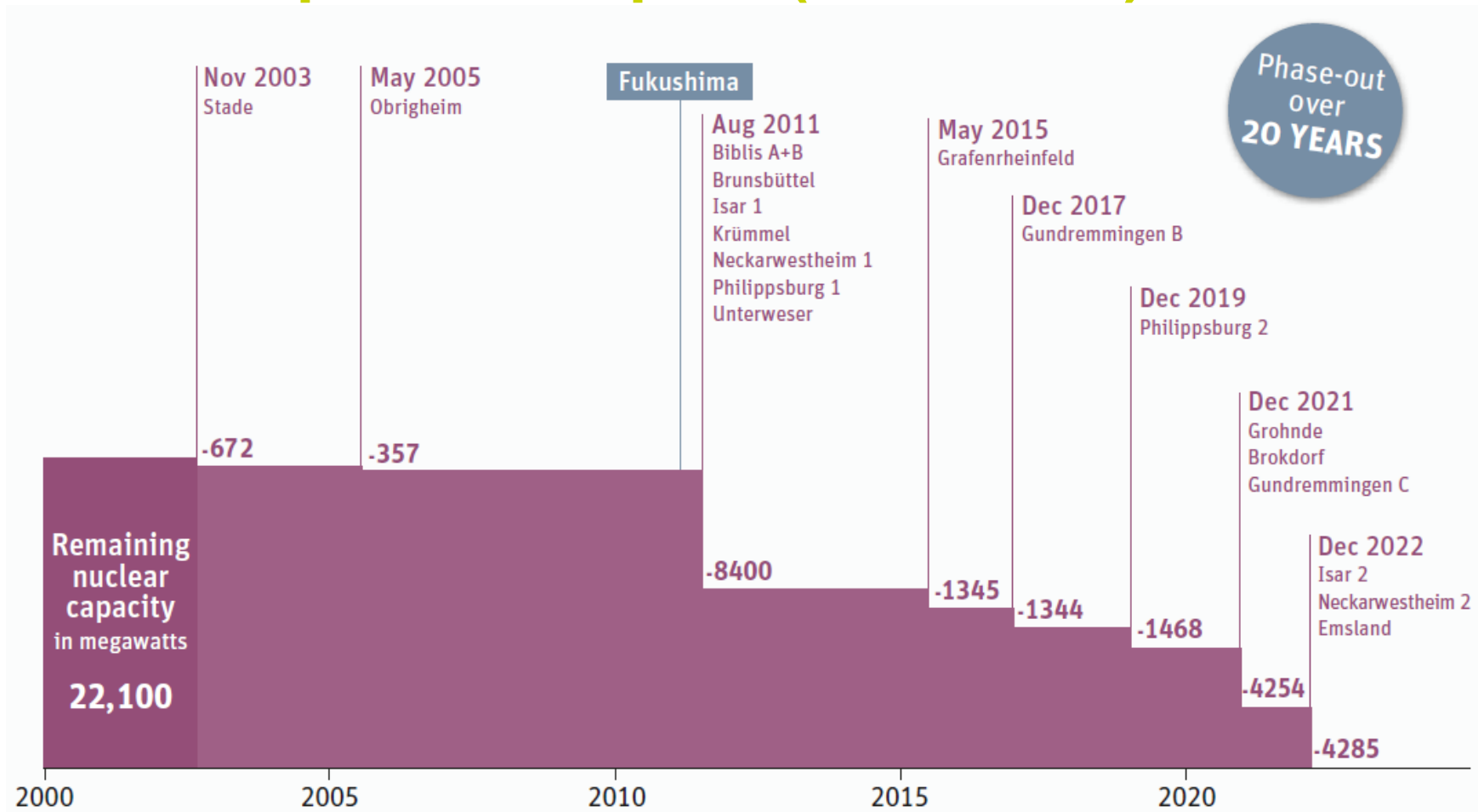


To be taken offline for the time being

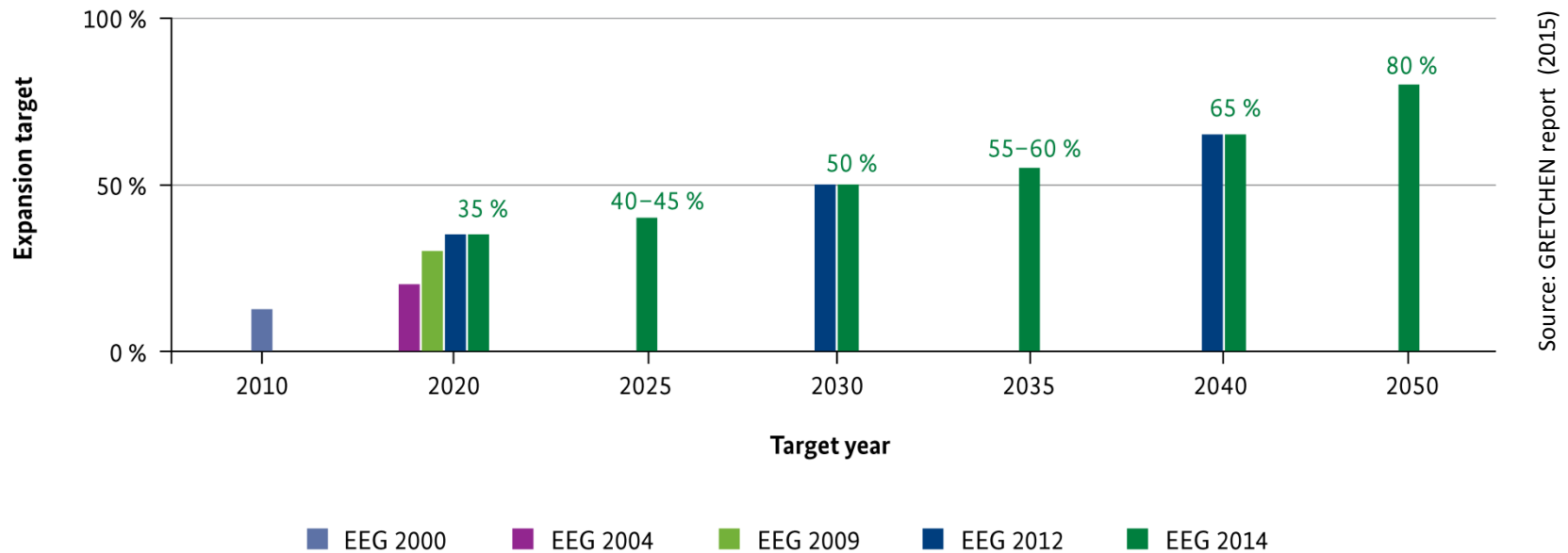


In operation

Nuclear phase-out path (2000-2022)

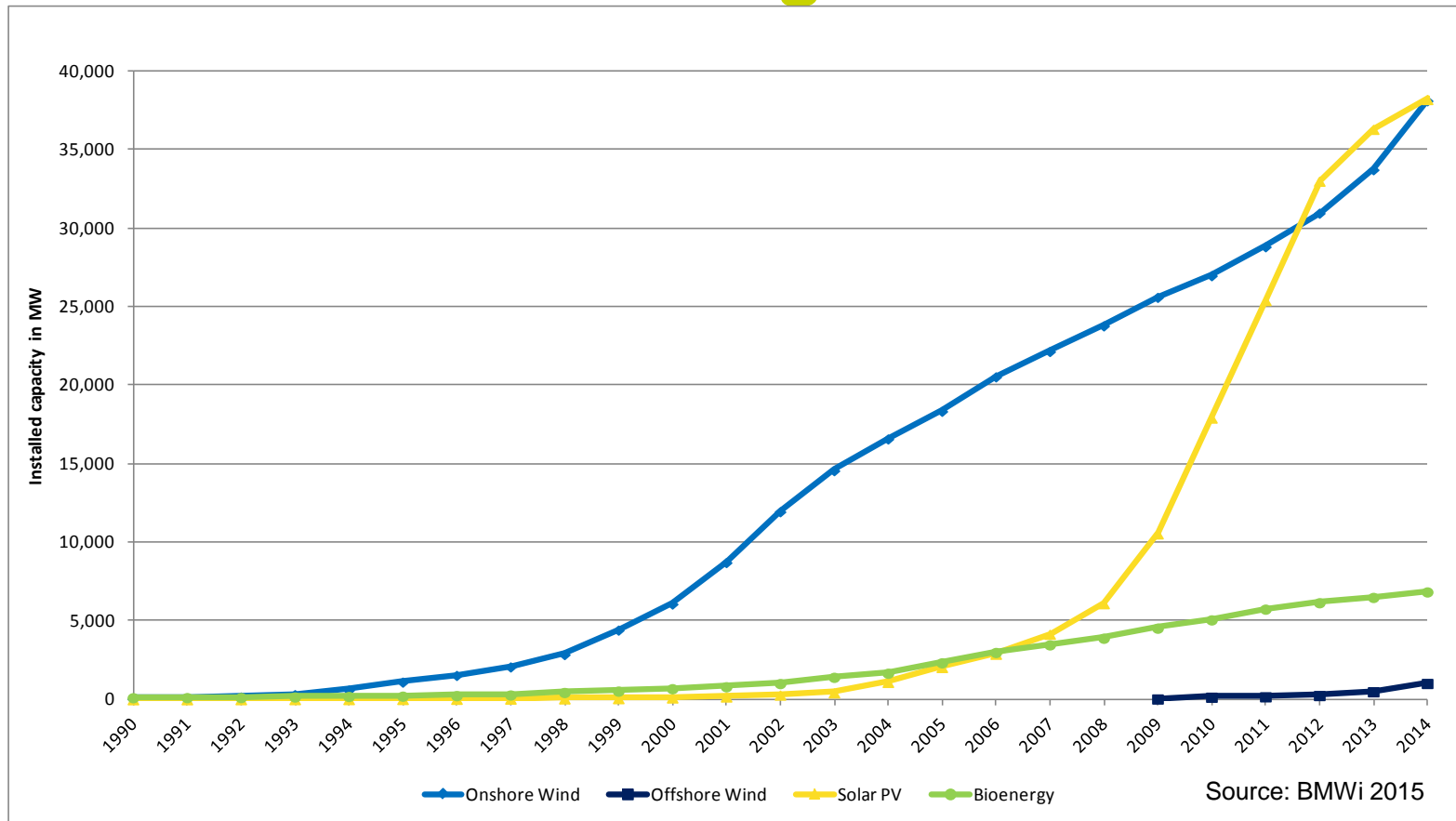


Policy Strategy: German RE expansion targets for electricity



- Increasing ambition of expansion targets (EEG 2000-2012)
- Introduction of long- and medium-term targets (EEG 2012/14): 80% RES generation by 2050 (ca. 33% in 2015)

Installed electricity generation capacity from renewable energies





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Methodology: Company Survey

Enabling novel insights on renewable energy innovation

Overview of company innovation survey

- CATI of German manufacturers of renewable power generation technologies
- Questionnaire builds on CIS, but new questions for policy mix
- Conducted: April-Juli 2014
- Response rate: ca. 36% (n=390)
- Factor and regression analysis



For details, see Rogge 2015, available at www.project-gretchen.de

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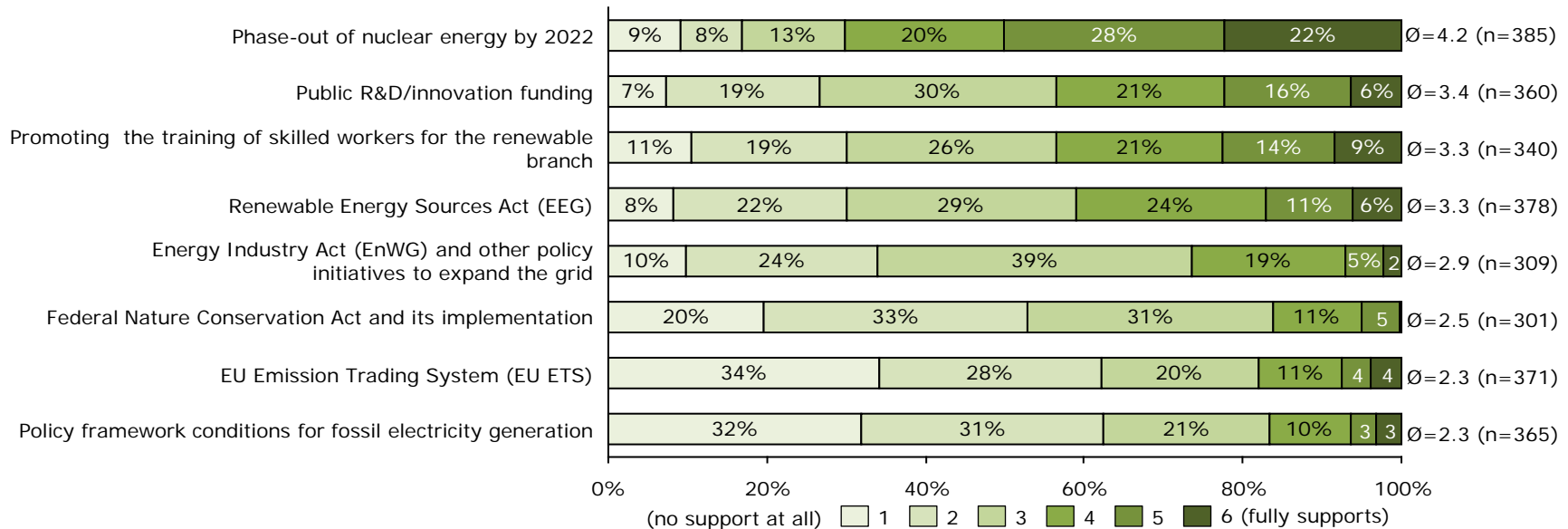
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Findings: Impact of phase-out policies for low-carbon energy transitions

Part 1: Diffusion

Which instruments support RE most?

Support of the expansion of renewable electricity generation through:



- **Destruction:** Nuclear phase-out supports the expansion of renewable energies the strongest (control policy)
- **Creation:** Public R&D/ innovation funding, training of skilled workers and the EEG are considered equally important instruments (TP, S, DP)



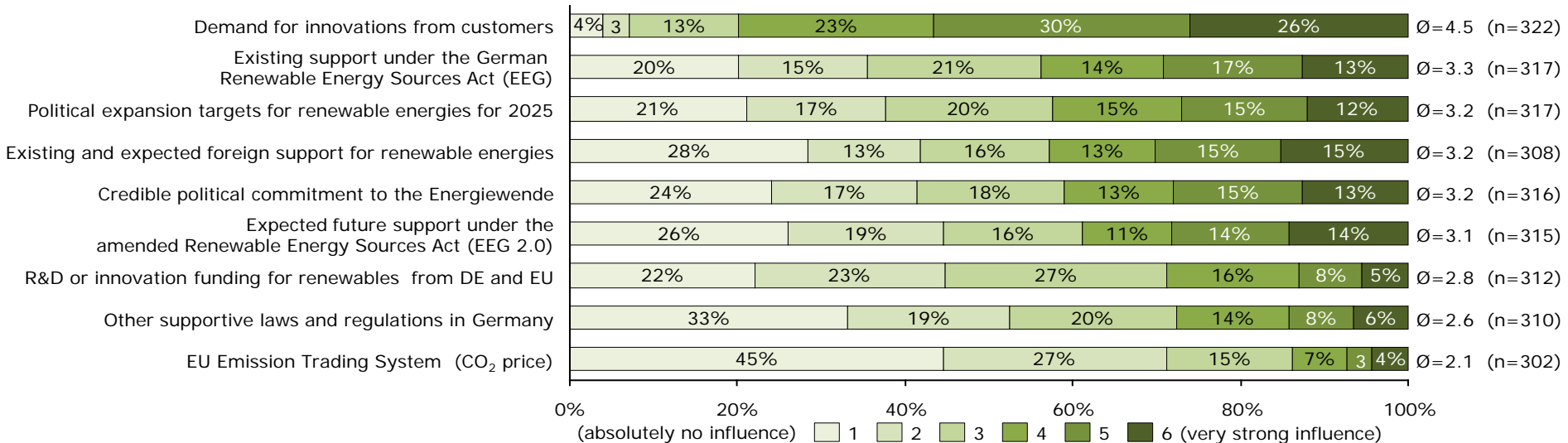
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Part 2: Innovation

What drove companies' innovation activities?

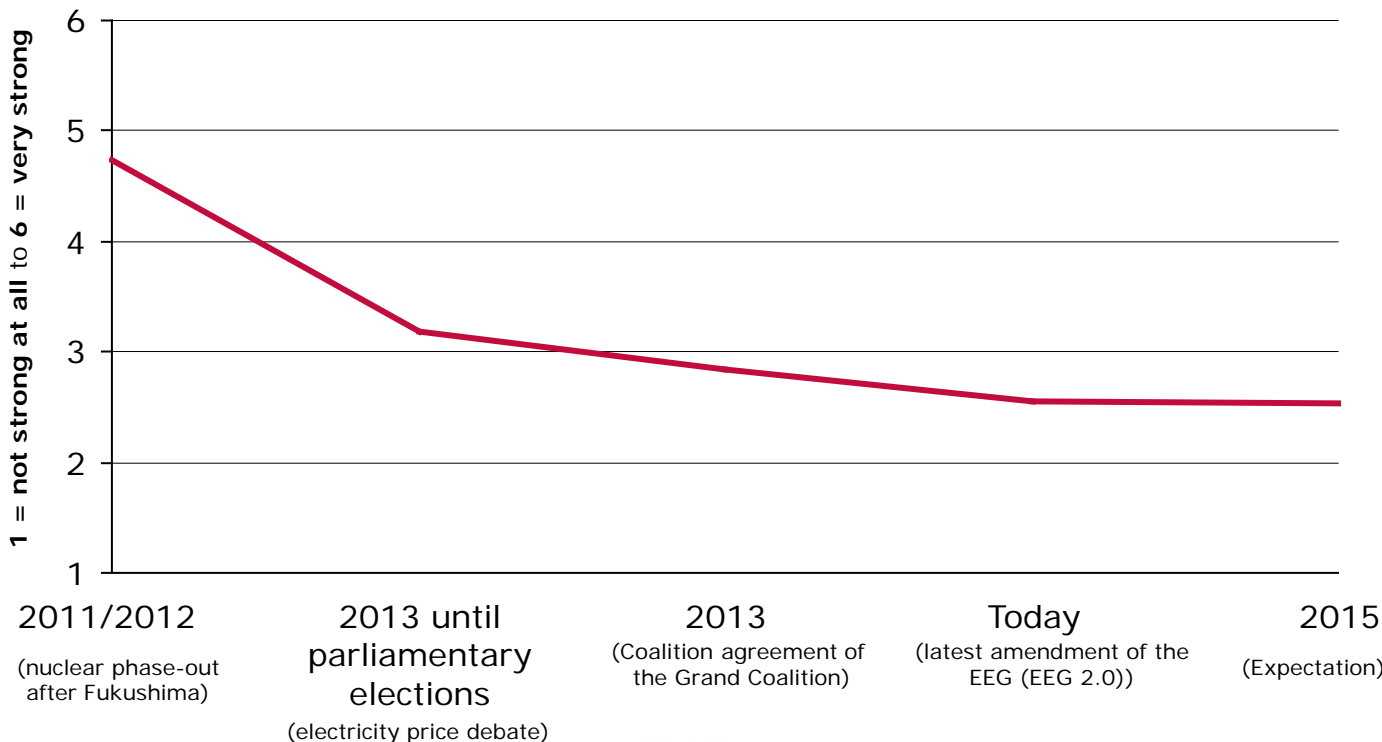
Influence of demand and political factors on innovation activities in the RE branch (2011-13)



- Policy mix drives innovation by generating **demand** for RE
- *Domestic and foreign demand pull* instruments influential (today's and expected), but equally important also *2025 targets* and *credible commitment to Energiewende* (more than R&D support)

And nuclear? Have to take a step back... ...and take a look at policy mix credibility

Strength of the respective German government's political will at five points in time regarding the promotion of renewable electricity generation – across all technologies... (n=368)



- Perceived political will to expand renewable power generation was at its **peak during the nuclear phase-out after Fukushima** and has decreased ever since.
- In 2014/2015, some stabilization, albeit at a low level.

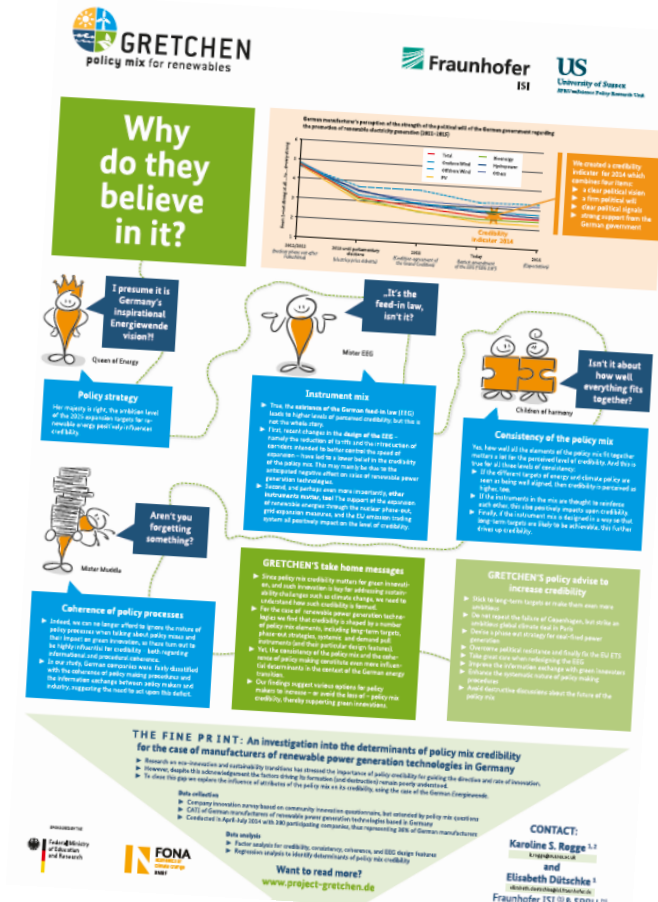
Is the credibility of the policy mix relevant for innovation? Yes!

- Regression analysis indicates that the following aspects of the policy mix play a statistically significant role for the level of innovation expenditure by manufacturers of renewable energy power generation technologies:
 - **Demand pull:** Changes in domestic and foreign demand (stimulated by various demand pull instruments, incl. EEG)
 - **Technology Push:** Public R&D funding of previous years (from DE and EU)
 - Policy mix **consistency:** Alignment of political instruments with expansion targets
 - ➔ • **Credibility:** Credible political commitment to the *Energiewende*

Source: Rogge and Schleich (2015): [Do policy mix characteristics matter for \(eco-\) innovation?](#)

And what determines credibility? The nuclear phase-out, among other factors

- **Destruction policies:**
 - Nuclear phase-out
 - EU ETS
- **Creation Policies:**
 - Long-term targets
 - EEG and (neg.) 2014 design changes
 - Grid expansion
- **Broader policy mix:**
 - Targets supported through instruments (policy mix consistency)
 - Coherence of policy processes





Policy implications and outlook

The German nuclear phase-out drives renewable energy innovation and diffusion in Germany – so what?

Policy implications

- Understand and design **policy mix as a whole** – backing only one or few instruments (carbon price, R&D funding) 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
- Introduce novel or strengthen existing **destruction policies** to supplement creation policies – great potential to increase credibility of decarbonization targets (e.g. Paris Agreement) and thereby to accelerate low-carbon energy innovation (e.g. coal phase-out, more stringent EU ETS)

Outlook

Limitations

- Explorative study (one country, one point in time)
- Indirect link of nuclear phase-out and innovation

Future Research

- Inclusion of destruction policies in empirical work (e.g. surveys, modeling)
- Design and adoption of phase-out policies (e.g. coal)

References

- GRETCHEN report available at project website:

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

- Available online:
www.project-gretchen.de



Thank you!

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