The Politics of Technological Change: Case Studies from the Energy Sector

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Agenda

- **Introduction**: Technological change as double-edged sword and the role of politics
- **Overview**: Analyzing the politics of technological change in the energy sector
- **Case study 1**: How technological change affects coalitions in the German energy sector
- **Case study 2**: How technological change influences energy efficiency governance in the Swiss building sector
- **Discussion and conclusion**: Contributions to literature and policy recommendations
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Energy technologies are main drivers of economic development

Electrification is an important general purpose technology\(^1\)

![Image of Thomas Edison's Dynamo Room at Pearl Street Station, the first power plant in the U.S.](source: Deutsches Historisches Museum)

Spread of electrification – example of manufacturing

![Graph showing shares of electrified horsepower by manufacturing sector, 1890–1954. Source: Jovanovic & Rousseau 2005](source: Jovanovic & Rousseau 2005)

Technological change = Socio-technical systems\(^2\) & Invention, innovation, and diffusion in/of technologies\(^3\)

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1. David 1991; Jovanovic & Rousseau 2005
2. Geels et al. 2017
3. Jaffe et al. 2002; Utterbeck 1972
But, energy technologies are main drivers of climate change

Electricity production is main responsible of CO₂ emissions

Anthropogenic climate change has dire consequences

1 see for example Steffen et al. 2018; Xu et al. 2020
Policy interventions target technology to address climate change

Countries implement policies to support clean energy tech\(^1\)

Policy has induced deployment & cost drop of renewables\(^2\)

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\(^1\) Rodrik 2014; Mazzucatto 2018; Kivimaa & Kern 2016

\(^2\) Schmidt & Sewerin 2018
Yet, the speed and scope of technological change is not sufficient

Global CO\textsuperscript{2} emissions need to strongly decrease from 2020\textsuperscript{1}

Renewables are key but there is still a long way to go\textsuperscript{3}

\textsuperscript{1} ICPP 2018; UNDP 2019
\textsuperscript{2} ICPP 2018; UNDP 2019

“Carbon law” to reach the Paris goal of limiting warming to well below 2°C: Halving of global CO2 emissions every decade.
Source: Rockström et al. (2017)

Current share of renewables in primary energy in %, and scenarios for reaching the “carbon law” presented on the left: Required doubling of renewable share every 5.4 years.
Source: Rockström et al. (2017)
Politics are key to understand dynamics of technological change

Technological change has often led to political conflict\(^1\)

…and remains contentious, especially in the energy sector\(^2\)

Overarching research question:

How does technological change affect the politics of energy policymaking?

\(^1\) Mokyr 1994; Winner 1980; Acemoglu & Robinson 2006
\(^2\) Meadowcroft 2011; Stokes 2016; Meckling 2015
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Framework to explore the politics of technological change

- Policy → Technological change → Politics → Policy

Costs, Deployment, Jobs → Interests, Ideas, Institutions

Not analyzed
Analytical focus

Interests
- Def: “Distribution of power and resources across social groups” (Hall 1997)
- Examples: Benefits from feed-in tariff / healthcare system, sunk costs into infrastructure such as roads

Ideas
- Definition: “Claims about descriptions of the world, causal relationships, or the normative legitimacy of actions” (Parsons 2002).
- Examples: Political ideologies, academic ideas (Keynesianism)

Institutions
- Definition: “The rules of the game in a society” (North 1990)
- Examples: Feed-in tariff, Swiss Federal Office of Energy, moderator rules in this lecture

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Methodological considerations and research design

About the difficulty to measure politics

Methods to examine «the elephant»

- Multi-methods approach is necessary, combining qualitative and quantitative methodology\(^1\)
  - Qualitative: In-depth case studies, use of expert interviews, policy documents, surveys, network analyses
  - Quantitative: Large-N analyses, use of statistical and mathematical tools

- Plurality of cases is required for robust theory building and testing\(^2\)
  - Jurisdictions: Variation across countries and sub-national / supra-national entities
  - Policies: Variation across instrument types and policy design
  - Technologies: Variation in technology complexity, maturity, and other characteristics
  - Time: Change over time key in technology-politics relationship

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\(^1\) Collier & Elman 2008; King et al. 1994  \(^2\) Seawright & Gerring 2008
Leveraging a plurality of methods and cases*

The role of technological change for/in...

1. **Coalition change in German energy sector, 1983-2013**
   - How does technological change influence advocacy coalition change?

   - How does technological change affect public and private regulation?

3. **Electoral response to coal decline in the US, 2000-2016**
   - Can decline in coal mining jobs explain changing voting behavior?

4. **Party agendas on energy technologies, 1980-2020**
   - How does technological change influence agendas of political parties?

5. **Policy design process of German feed-in-tariff, 2000-2018**
   - How does technological change affect parliamentary debates on policy design?

6. **Public opinion about energy transition in France, 2019**
   - Can exposure to renewables explain variation in public opinion on energy transition?

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*Most of the projects together with colleagues from the Energy Politics Group @ ETH
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How technological change affects coalitions in the German energy sector¹

- Germany as leader of the energy transition or “Energiewende“ (at least historically…)
- Policy-induced technological change: Deployment of renewables, nuclear phase-out, more recently also coal phase-out

- Politics central in the energy transition
- However, systemic mapping of changing politics as a result of technological change is still lacking

Research question: How does technological change influence advocacy coalition change?
Research design

**Case selection**

- Single case study: Extreme case\(^1\)
- Country: Germany
  - Longitudinal analysis of Germany’s energy subsystem actor coalitions

Policy Outcome: Technological change in the energy sector
- Renewables
- Nuclear
- Fossil fuels

**Data**

Statistics on technological change, newspaper articles (more than 3000), protocols of parliamentary debates (30)

**Methods**

Mixed-methods approach: Discourse network analysis & process tracing

\(^1\) In the case typology of Seawright & Gerring (2008)
Methods: Discourse Network Analysis and process tracing

**Step 1:** Identify advocacy coalition and belief change

**Step 2:** Identify role of tech change in coalition change

**Discourse Network Analysis**

- Actors
- Beliefs

**Actor-concept network**

Source: Leifeld (2016)

**Theory-building process tracing**

- Theoretical level
  - Explanatory variable
  - Causal mechanisms
  - Explanandum

- Empirical level
  - Empirical manifestation of variables and mechanisms

Illustration of process tracing methodology

Source: Beach & Petersen (2013)
Step 1: Identifying patterns of advocacy coalition change

1983-1987

1998-2002

2009-2013

Legend
- Renewables coalition
- Coal coalition
- Nuclear coalition
- Industry and utilities
- Technologies
- Unions and NGOs
- Parties and ministries
- Think tanks and research
- Selected actors:
  - 4 - CDU/CSU
  - 15 - SPD
  - 71 - Naturstrom AG
  - 34 - German Hard Coal Federation

Actor A  Actor B
Shared technology belief
Step 1: Identifying patterns of advocacy coalition change

Generalizing from these empirical findings…

<table>
<thead>
<tr>
<th>Time</th>
<th>Actor disappearance</th>
<th>Actor dissociation</th>
<th>Actor association</th>
<th>Actor appearance</th>
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**Step 2: Identifying the role of technological change for coalition change**

Illustrative example:
Belief shift of the Social Democratic Party (SPD) between first and third period regarding different energy technologies

**Resource feedback mechanism**

1984: “We are against the loss of thousands of jobs in coalmines and supply industries.”

2011: “300 000 new jobs have meanwhile been created thanks to the development of renewable energies in Germany.”

**Interpretive feedback mechanism**

1984: “It will never be the case that wind energy will replace any of the existing primary energy sources.”

2011: “We want to enter the era of renewable energies as quick as possible.”
Step 2: Identifying the role of tech change for coalition change

Generalizing from these empirical findings...

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<tr>
<th>Interpretive /Resource</th>
<th>Negative</th>
<th>Positive</th>
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<td>Coalition decline</td>
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<td>Coalition growth</td>
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## Summary and conclusion of case study 1

### Contributions

- Identifying advocacy coalition change in the German energy sector over three decades
  - Developing a typology of four actor movements underlying coalition change
- Explaining coalition change with technological change
  - Developing a typology of how technological change explains actor movements & coalition change through four policy feedback mechanisms
- Drawing on two policy process theories to build theory with the goal to explain the politics behind technological change in the German energy sector

### Policy implications

- As technological change is mostly policy-induced, policymakers should engage in designing “forward looking” policies that lead to policy outcomes which reinforce “green” coalitions

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1 See also Levin et al. 2012; Meckling 2015; Pahle et al. 2018
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How technological change influences energy efficiency governance in the Swiss building sector

- Buildings account for roughly 18% of direct and indirect greenhouse gas emissions
- Their final energy consumption is steadily increasing
- Technology and design solutions for energy-efficiency improvements are available
- Multiple barriers for their timely adoption exist including high upfront cost, high transaction cost, strong lock-in effects, and the landlord-tenant problem
- Different regulatory instruments help to address these barriers

Research question: How does technological change affect public and private regulation?
Research design

**Case selection**
- Country: Switzerland
  - Longitudinal analysis of public and private regulatory instruments
  - Period: 1972 – today
- Policy Outcome: Technological change in building efficiency
  - Insulation technology window
  - Insulation technology walls

**Data**
- Collection of novel data on stringency of public and private regulatory instruments (cantonal heat insulation standards and private efficiency label), expert interviews, efficiency technology data

**Methods**
- Mixed-methods approach
  - Step 1: Collecting data and descriptive statistics on stringency of regulation
  - Step 2: Conducting semi-structured expert interviews and reviewing policy documents to explain changes in regulation
Step 1: Describing changes in public and private regulation

Public regulatory instrument: Stringency of cantonal building standards

Private regulatory instrument: Stringency of Minergie label

Three main observations:

i. Public regulation more stringent over time

ii. Private regulation more stringent over time + more stringent than public regulation

iii. Differences between technologies in public + private regulation
“The [public] standards represent the state of the technology. [...] In some years, they will have developed further and we will need to revise the standards to account for the [new] state of the technology”.

“Minergie was a guiding player that paved the way for cantonal energy legislation. They brought products and technologies into large application that were back then not standard yet. [...] This fueled technological change and led to a technological standard that could be enacted in our Energy Law with a time lag”.
Summary and conclusion of case study 2

<table>
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<th>Contributions</th>
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<td>Demonstrating that public and private regulatory instruments interact over time in a symbiotic relationship enabling the ratcheting-up of overall regulatory stringency</td>
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<td>Explaining the symbiotic interaction with technological change, as the private regulatory instrument triggers technological change enabling public regulation to increase stringency</td>
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<td>Contributing to integrating technological change as a mechanism into theories of regulatory governance.</td>
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<tr>
<td>Our findings suggest that public and private policy could be intentionally mixed to enable ratcheting-up over time.</td>
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<td>However, for such a symbiosis to work regulatory capacity needs to be high and take into account the characteristics of target technologies, i.e. technology-smart governance is required.</td>
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Recap: Framework to explore politics of technological change

1 Building on Schmidt & Sewerin 2017; Coleman 1990; Hall 1997; Heclo 1994
2 Hall 1993; Béland 2010
3 Olson 1967; Moe 2010
4 Hall & Soskice 2001; Thelen 2004
### Contributions to literature and policy recommendations

#### Empirical contributions
- My thesis investigates how technological change affects politics, which is rarely done by political science literature that usually focuses on other issues.
- Identifies several mechanisms through which technological change affects politics: In this presentation: Constellation and relative strength of advocacy coalitions & changes in regulatory stringency.
- Looks at different political phenomena to get a better understanding of «politics».

#### Theoretical contributions
- Contributes to endogenizing technology in political science literature.
- Combines several theories to explain the politics – technology link.

#### Policy recommendations
- A better understanding of politics as enabler / key roadblock to the transition to clean energy technologies may provide inroads for policymakers to accelerate and deepen the transition.
Limitations and venues for future research

Covered only parts of «politics»

Some venues to fill these gaps

- Use of different methods
  - More quantitative analyses, text as data

- Expand empirical and conceptual focus
  - Other techs (Carbon removal)
  - Other feedback (Including from natural systems, behavioral change)
  - More countries, jurisdictions
  - Other «political phenomena» such as social movements
Thank you for your attention!

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References


IPCC. 2018. *Global Warming of 1.5 °C - SR15*.


References


Annex I