ETH zürich

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

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Frontiers in Energy Reseach Presentation, 12.05.20

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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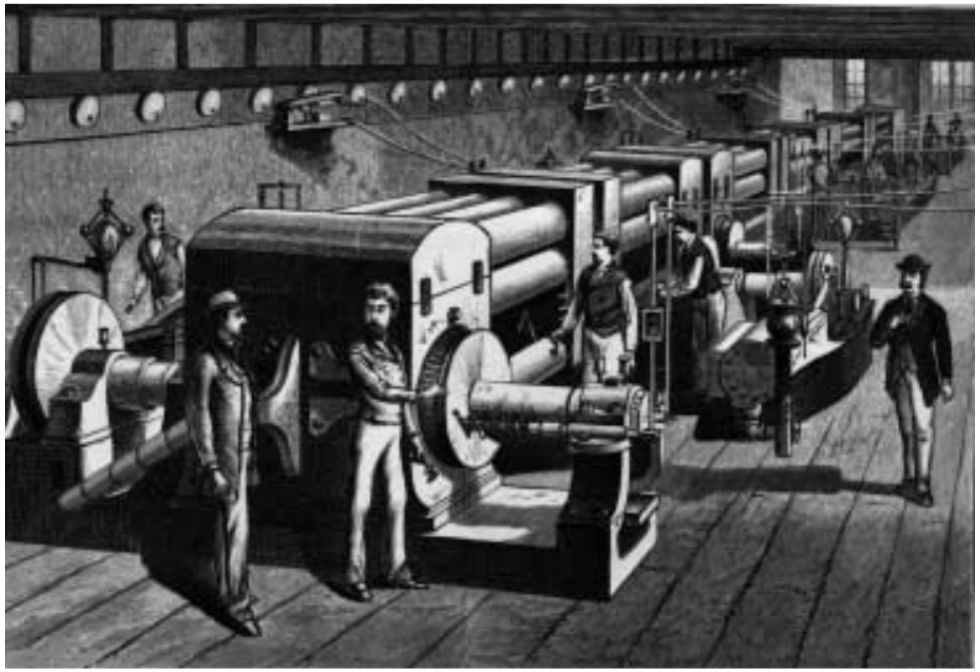
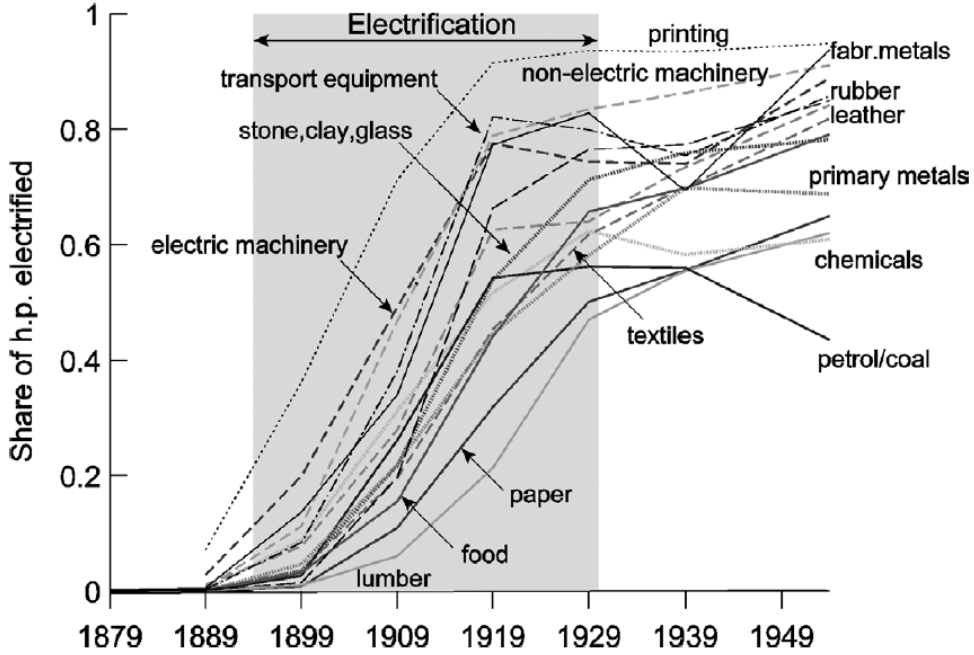
Energy technologies are main drivers of economic development

Electrification is an important general purpose technology[1]



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



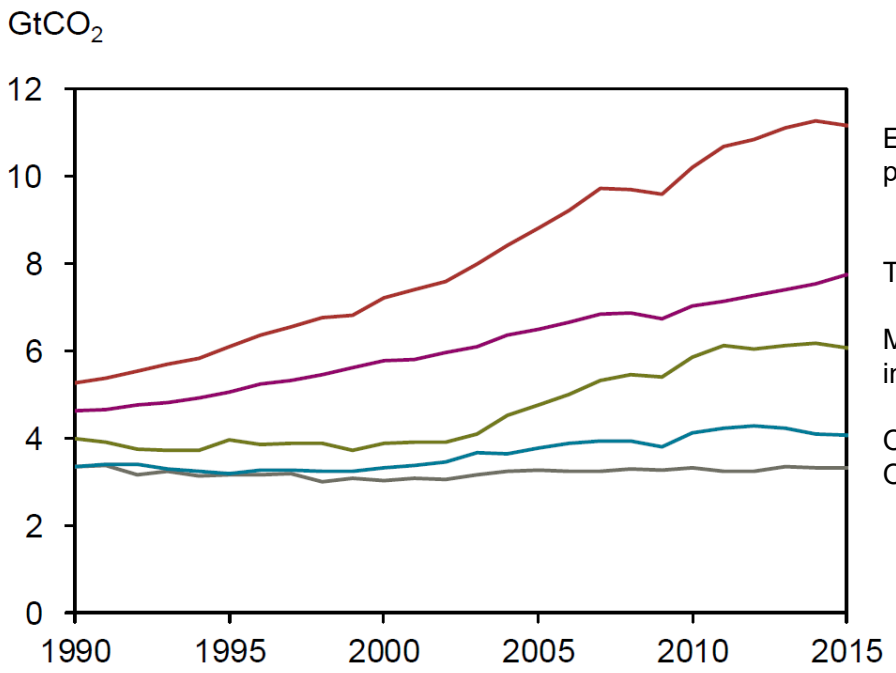
Shares of electrified horsepower by manufacturing sector, 1890–1954.
Source: Jovanovic & Rousseau 2005

Technological change = Socio-technical systems[2] & Invention, innovation, and diffusion in/of technologies[3]

[1] David 1991; Jovanovic & Rousseau 2005 [2] Geels et al. 2017
[3] Jaffe et al. 2002; Utterbeck 1972

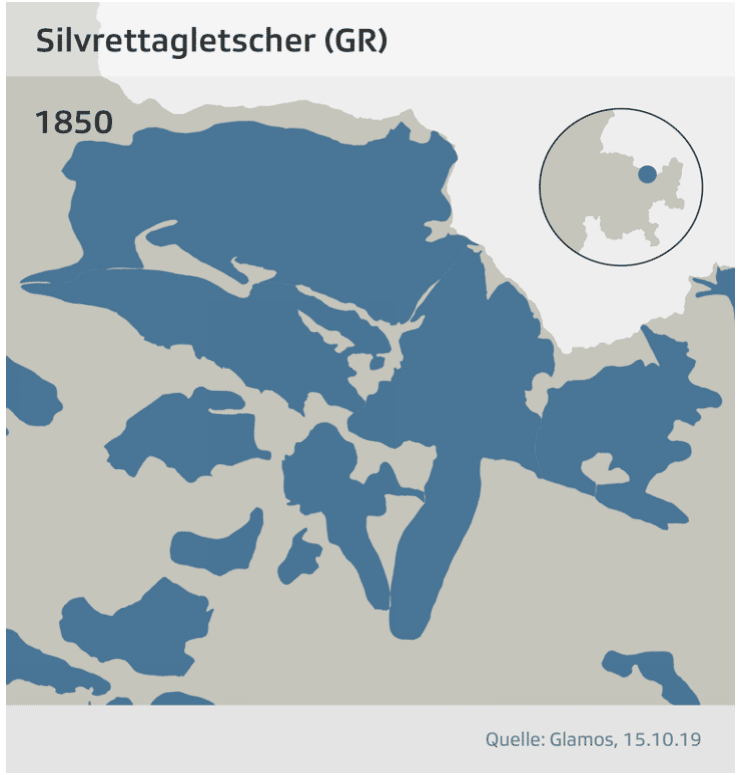
But, energy technologies are main drivers of climate change

Electricity production is main responsible of CO_2 emissions



Annual CO_2 emissions by sector.
Source: IEA data (IEA, 2019)

Anthropogenic climate change has dire consequences[1]

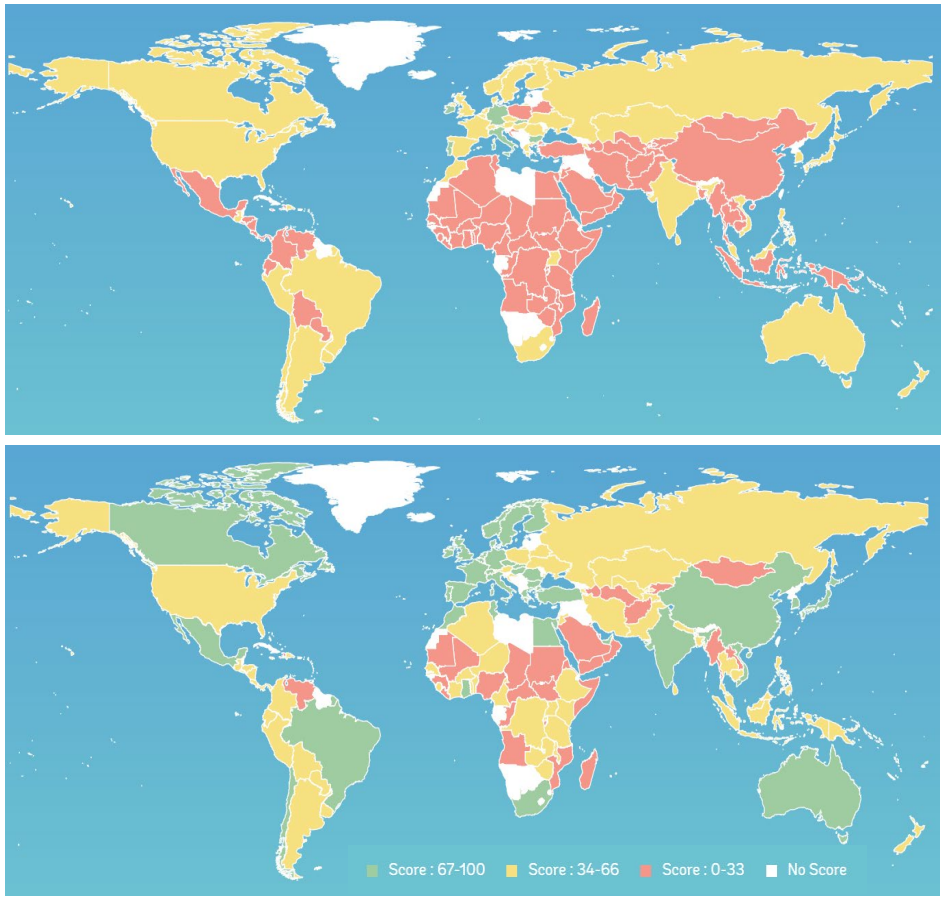


Shrinking size of Silvretta glaciar in Graubünden
Source: SRF News, 15.10.2019

[1] see for example Steffen et al. 2018; Xu et al. 2020

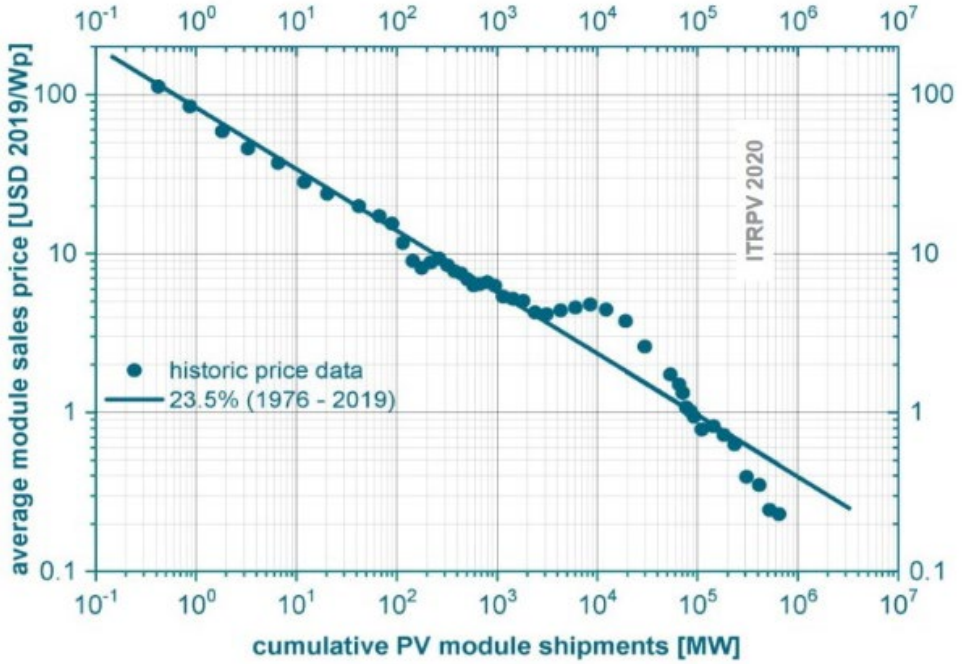
Policy interventions target technology to address climate change

Countries implement policies to support clean energy tech[1]



Expert estimation of country-level policies and regulations for renewable energy.
Source: RISE (Regulatory Indicators for Sustainable Energy) Project

Policy has induced deployment & cost drop of renewables[2]

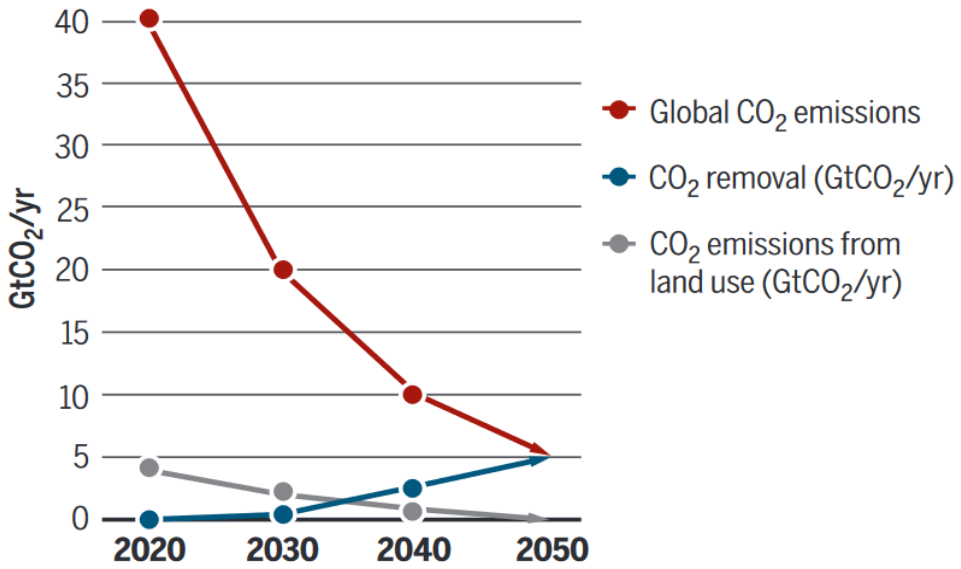


Learning curve for module price as a function of cumulative shipments
Source: ITRPV-Roadmap

[1] Rodrik 2014; Mazzucatto 2018; Kivimaa & Kern 2016
[2] Schmidt & Sewerin 2018

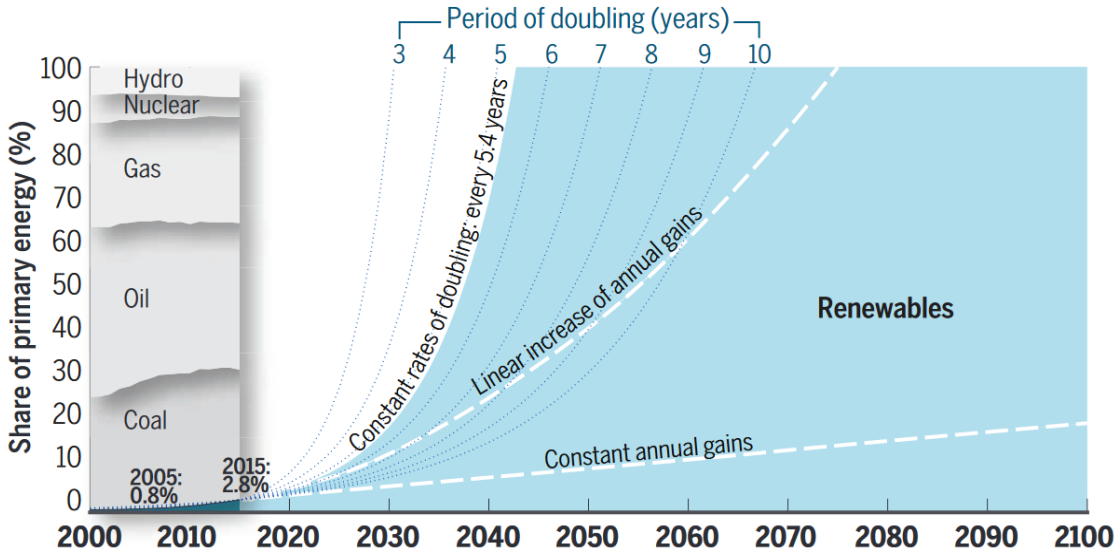
Yet, the speed and scope of technological change is not sufficient

Global CO^2 emissions need to strongly decrease from 2020[1]



"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)

Renewables are key but there is still a long way to go[3]



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]

Fire at Corrodi & Pfister factory in Uster, Switzerland 1832
Source: G. Werner (Swiss National Library).

…and remains contentious, especially in the energy sector[2]

Donald Trump at a rally in West Virginia, 2017
Source: AFP/Getty Images

Overarching research question:

How does technological change affect the politics of energy policymaking?

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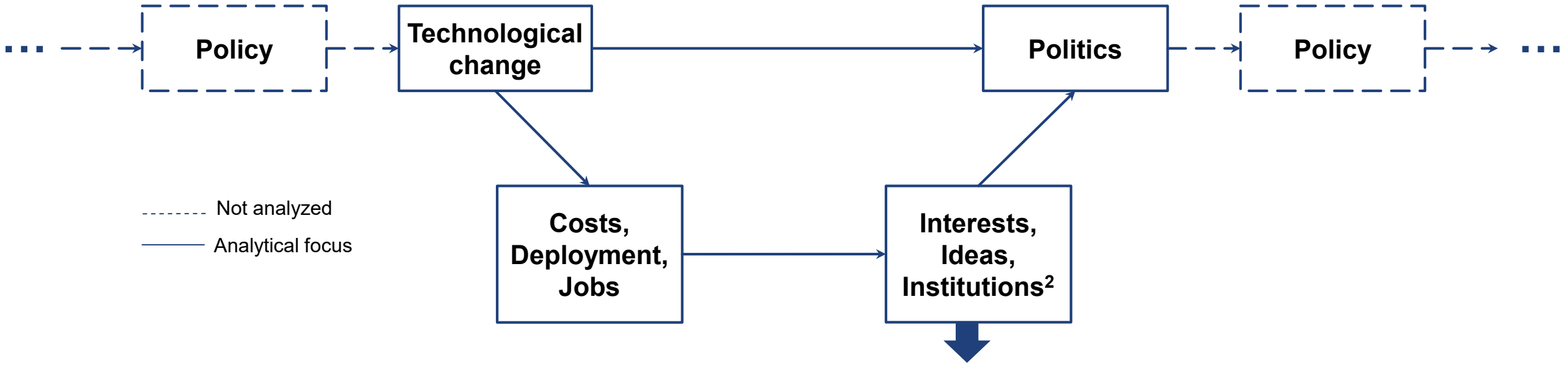
Framework to explore the politics of technological change[1]



Interests[3]

- 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[4]

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

Institutions[5]

- 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

[1] Building on Schmidt & Sewerin 2017; Coleman 1990 [2] Hall 1997; Heclo 1994
[3] Olson 1967; Moe 2010 [4] Béland 2010, Hall 1993 [5] Hall & Soskice 2001; Thelen 2004

Methodological considerations and research design

About the difficulty to measure politics

Blind monks examining an elephant
By Hanabusa Itchō (1652–1724)

Methods to examine «the elephant»

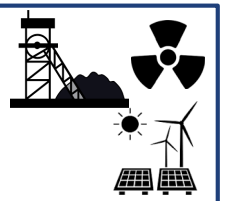
- Multi-methods approach is necessary, combining qualitative and quantitative methodology[1]
  - Qualitative: In-depth case studies, use of expert interviews, policy documents, surveys, network analyses
  - Quantitative: Large-N analyses, use of statistical and mathematical tools
- Plurality of cases is required for robust theory building and testing[2]
  - Jurisdictions: Variation across countries and sub-national / supra-national entities
  - Policies: Variation across instrumenty types and policy design
  - Technologies: Variation in technology complexity, maturity, and other characteristics
  - Time: Change over time key in technology-politics relationship

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?

2

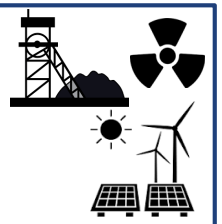
Energy efficiency governance in Switzerland, 1978-2018

How does technological change affect public and private regulation?

Electoral response to coal decline in the US, 2000-2016

Can decline in coal mining jobs explain changing voting behavior?

Party agendas on energy technologies, 1980-2020



How does technological change influence agendas of political parties?

Policy design process of German feed-in-tariff, 2000-2018

How does technological change affect parliamentary debates on policy design?

Public opinion about energy transition in France, 2019

Can exposure to renewables explain variation in public opinion on energy transition?

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How technological change affects coalitions in the German energy sector[1]

- 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
- Howevery, systemic mapping of changing politics as a result of technological change is still lacking

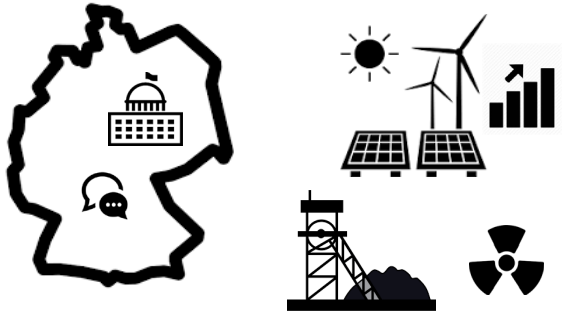
Research question: How does technological change influence advocacy coalition change?

[1] Schmid N, Sewerin S, Schmidt TS (2019) Explaining advocacy coalition change with policy feedback. ***Policy Studies Journal***, Online First

Research design

Case selection

Single case study: Extreme case[1]



Country: Germany

- Longitudinal analysis of Germany's energy subsystem actor coalitions
- Three periods: 1983-1987, 1998-2002, 2009-2013

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

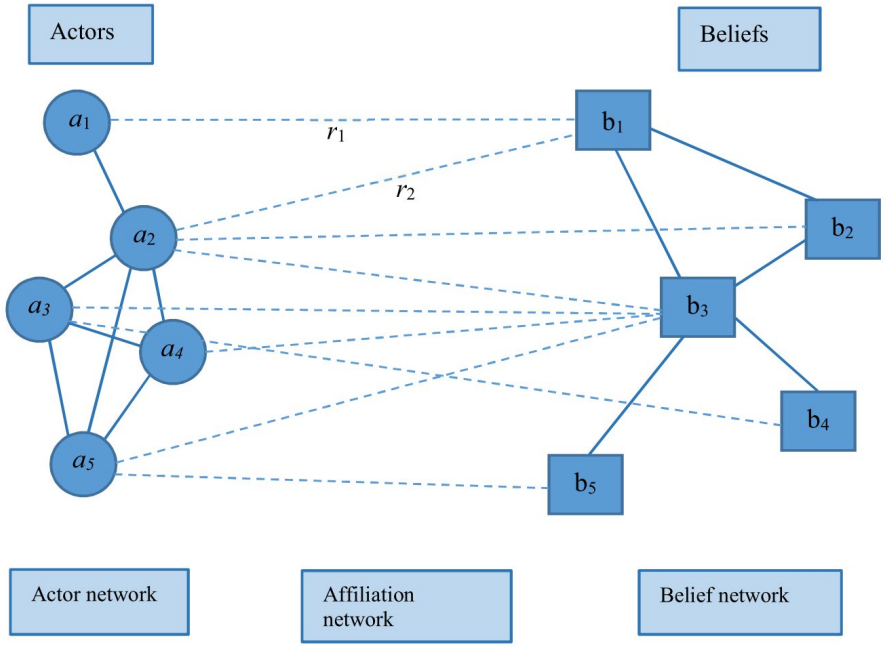
Mixed-methods approach: Discourse network analysis & process tracing

[1] In the case typology of Seawright & Gerring (2008)

Methods: Discourse Network Analysis and process tracing

Step 1: Identify advocacy coalition and belief change

Discourse Network Analysis



Actor-concept network
Source: Leifeld (2016)

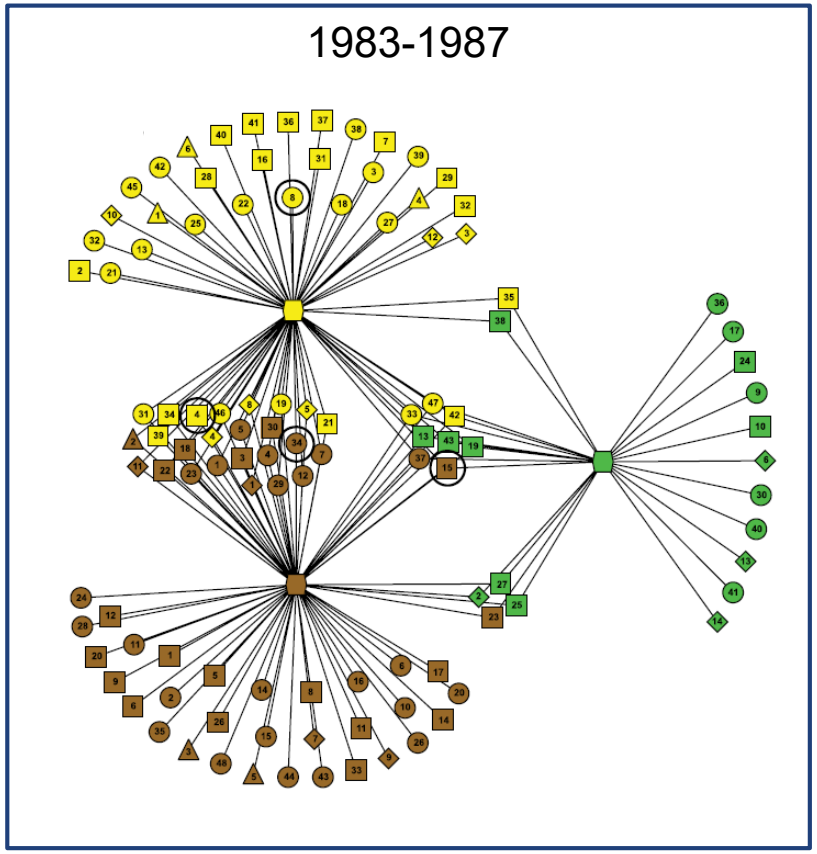
Step 2: Identify role of tech change in coalition change

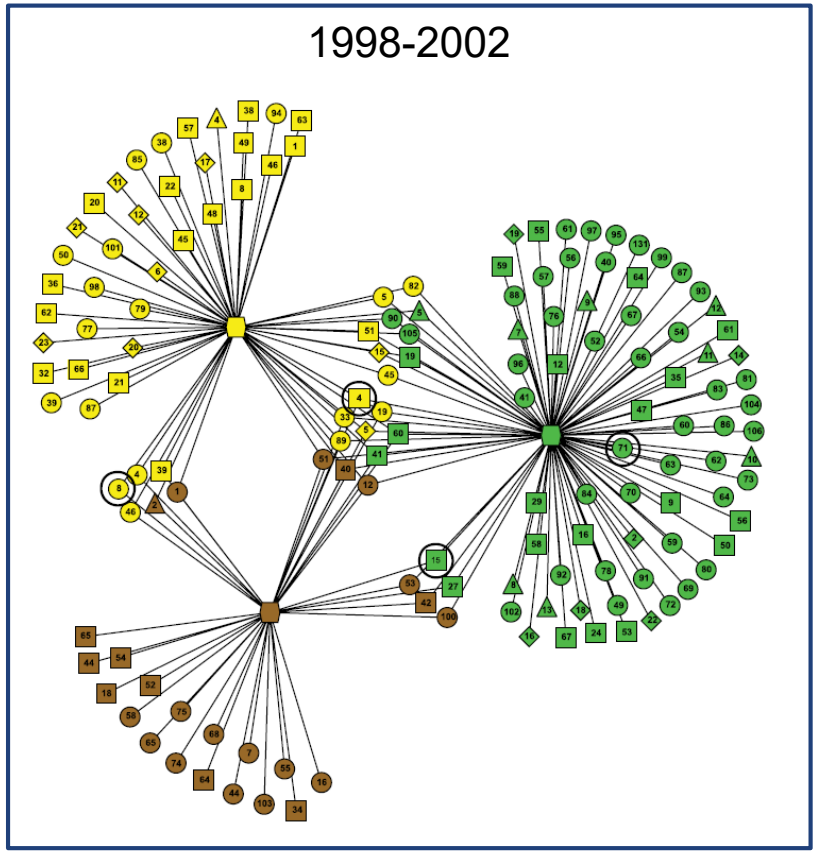
Theory-building process tracing

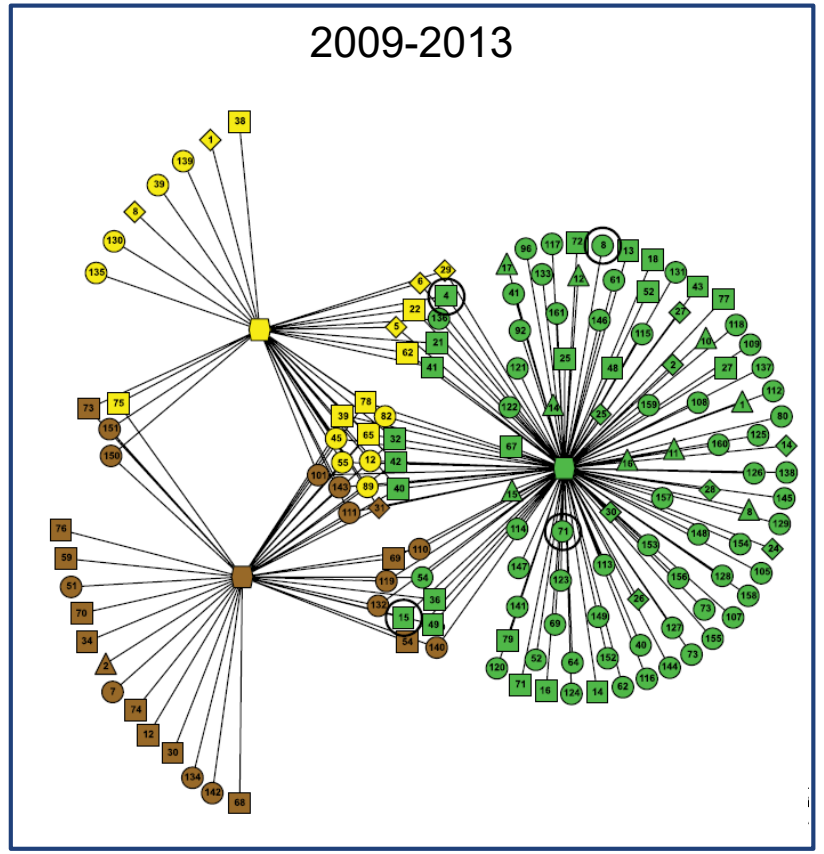
Theoretical level	Explanatory variable →	Causal mechanisms →	Explanandum
Empirical level	Empirical manifestation of variables and mechanisms		

Illustration of process tracing methodology
Source: Beach & Petersen (2013)

Step 1: Identifying patterns of advocacy coalition change







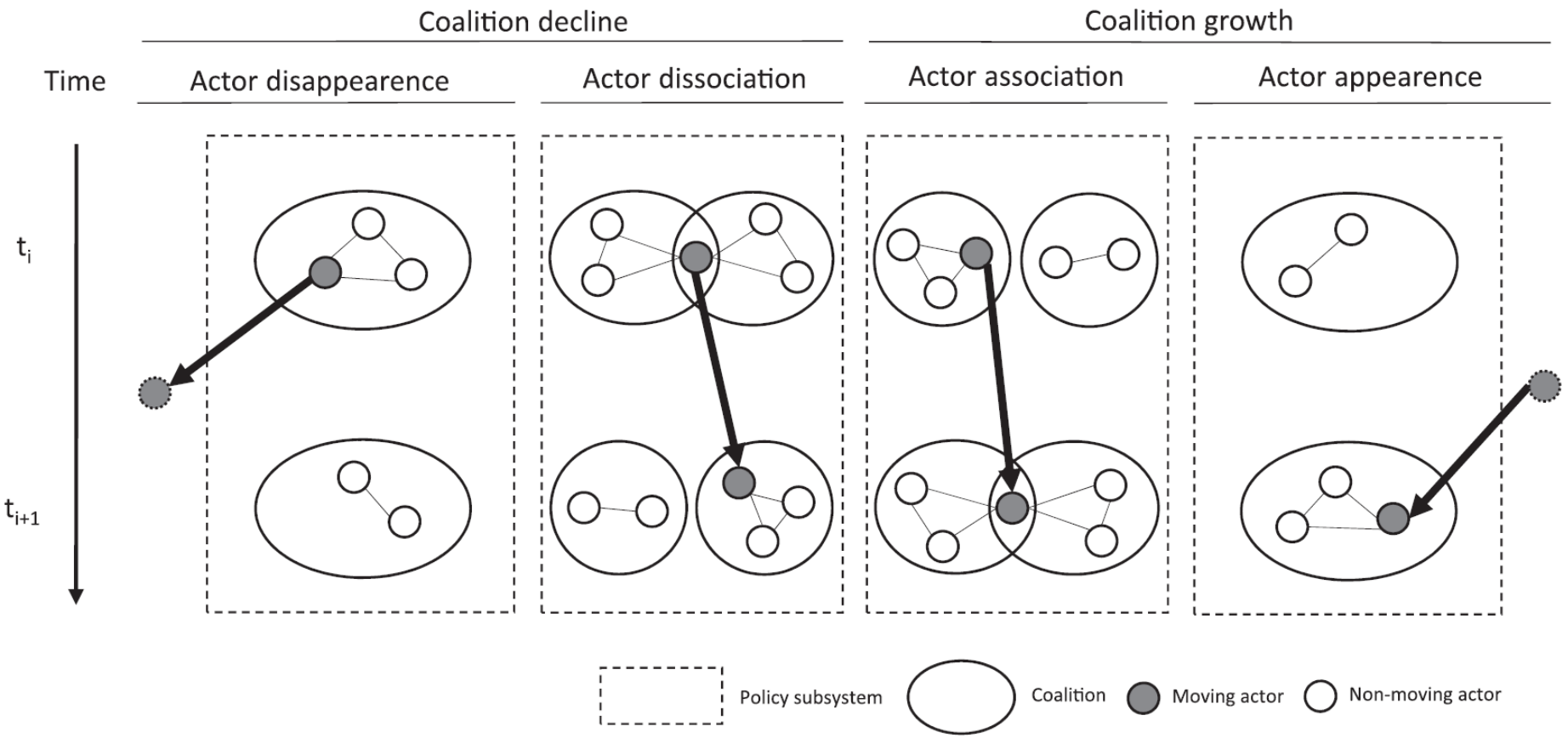
Legend

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

Actor A
Actor B
Shared technology belief

Step 1: Identifying patterns of advocacy coalition change

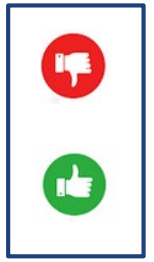
Generalizing from these empirical findings…



Step 2: Identifying the role of technological change for coalition change

Selected results

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."*	

Type of feedback

Directionality of feedback

Step 2: Identifying the role of tech change for coalition change

Generalizing from these empirical findings…

	Negative	***Positive***
Interpretive /Resource	**Actor dissociation**	**Actor association**
Resource /Interpretive	**Actor disappearance**	**Actor appearance**
	Coalition decline	Coalition growth

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[1]

[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[1]

- 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[4] including high upfront cost, high transaction cost, strong lock-in effects, and the landlord-tenant problem
- Different regulatory instruments help to address these barriers

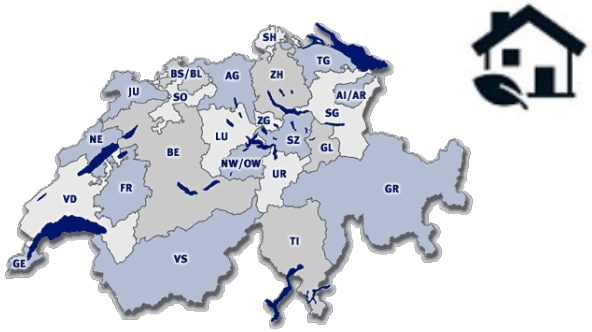
Research question: How does technological change affect public and private regulation?

[1] Schmid N, Haelg L, Sewerin S, Schmidt TS, Simmen I (2020) Governing complex societal problems: The impact of private on public regulation through technological change. ***Regulation & Governance***, Online First

Research design

Case selection

In-depth case study



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

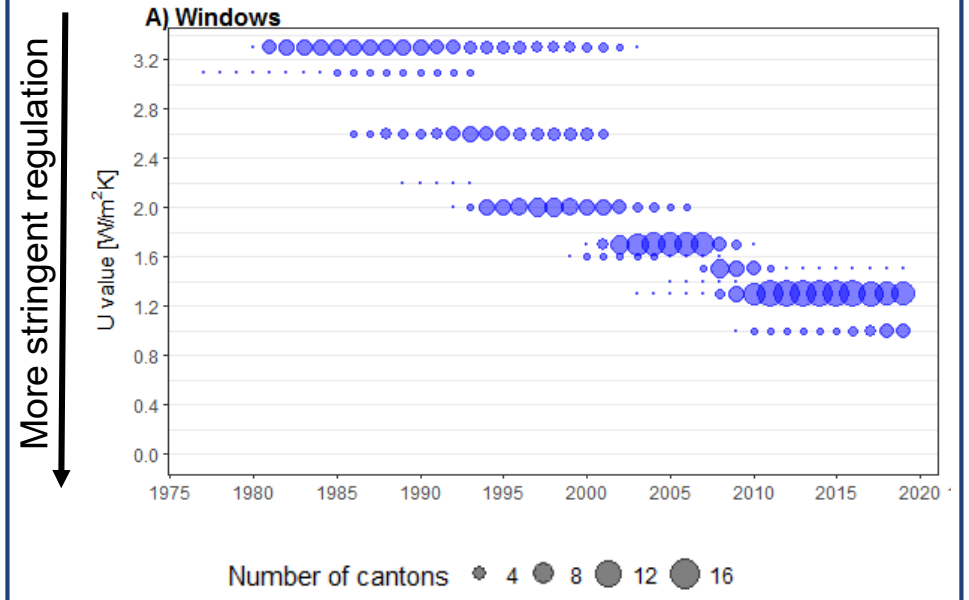
Mixed-methods approach

- 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

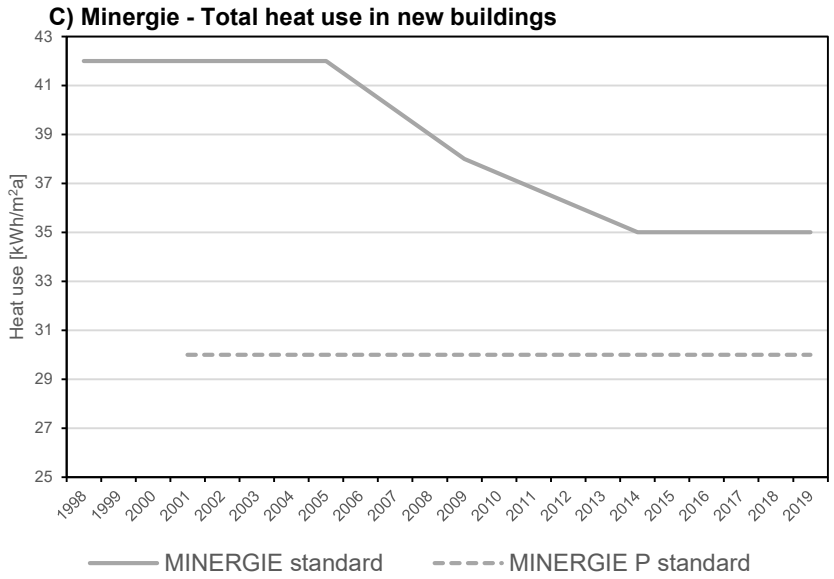
Step 1: Describing changes in public and private regulation

Selected results

Public regulatory instrument:
Stringency of cantonal building standards



Private regulatory instrument:
Stringency of Minergie label



Three main observations

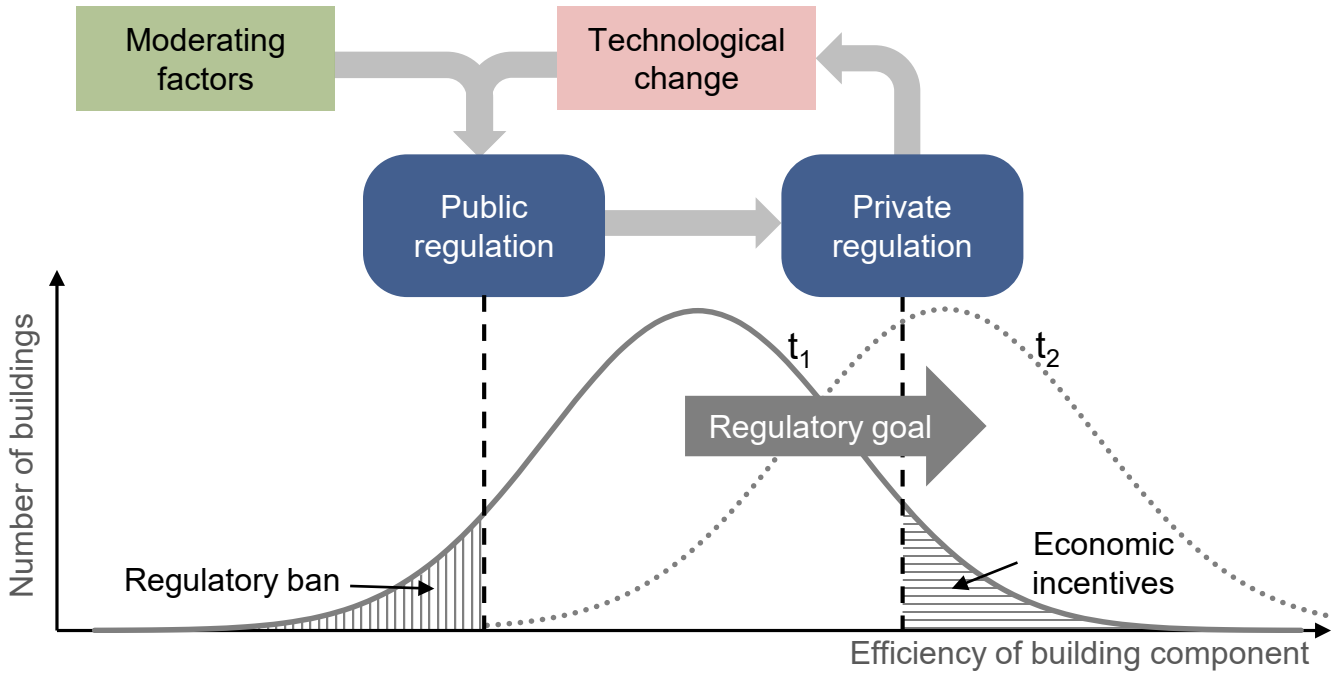
i. Public regulation more stringent over time

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

iii. Differences between technologies in public + private regulation

Step 2: Explaining regulatory changes with technological change

Stylized interaction between regulation and technological change



Illustrative quotes

"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

Contributions	▪ Demonstrating that public and private regulatory instruments interact over time in a symbiotic relationship enabling the ratcheting-up of overall regulatory stringency ▪ Explaining the symbiotic interaction with technological change, as the private regulatory instrument triggers technological change enabling public regulation to increase stringency ▪ Contributing to integrating technological change as a mechanism into theories of regulatory governance.
Policy implications	▪ Our findings suggest that public and private policy could be intentionally mixed to enable ratcheting-up over time. ▪ 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.

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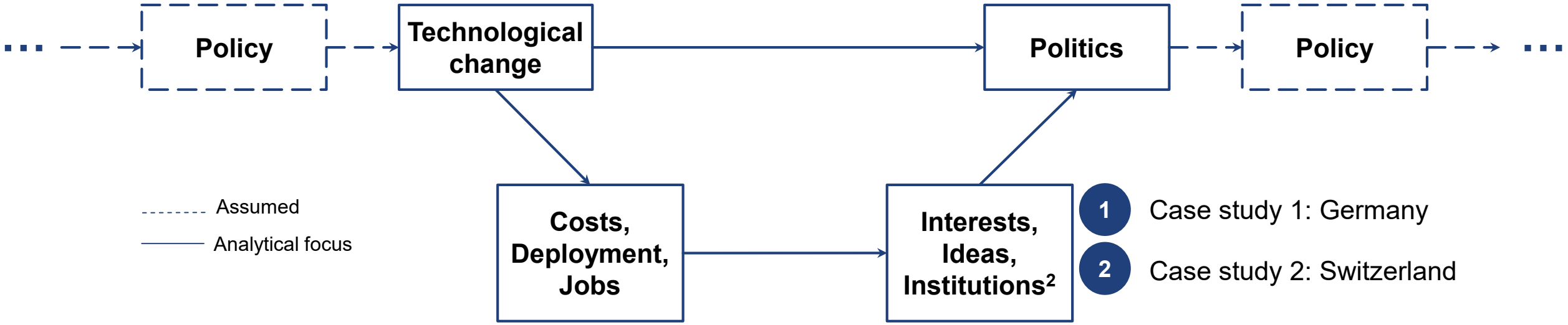
Recap: Framework to explore politics of technological change[1]



[1] Building on Schmidt & Sewerin 2017; Coleman 1990 [2] Hall 1997; Heclo 1994
[3] Olson 1967; Moe 2010 [4] Béland 2010, Hall 1993 [5] 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 policital 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»

Blind monks examining an elephant
By Hanabusa Itchō (1652–1724)

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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I gratefully acknowledge the financial support by the Swiss National Science Foundation Project number PYAPP1 166905.

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Annex I