Behavioral and Institutionalist Perspectives on Preference Formation in a Contested Political Context: The Case of Divesting from Nuclear Power

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The President:

Prof. Dr. Thomas Bieger

In loving memory of Elli Holder.

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Princeton, June 2018
Adrian Rinscheid

Contents

Zusammenfassung

Die vorliegende Dissertation trägt dazu bei, die politischen Dynamiken im Zusammenhang mit Bestrebungen zum Ausstieg aus der Nutzung von als nicht nachhaltig bewertbaren Energietechnologien zu verstehen. Mithilfe von Konzepten aus Politikwissenschaft, Verhaltensökonomie und Psychologie widmen sich in diesem Kontext drei Fallstudien der Untersuchung von Präferenzbildungsprozessen unter politischen Eliten und WählerInnen. Im Mittelpunkt der empirischen Studien stehen Auseinandersetzungen um die Atompolitik. Die Atomenergie ist in vielen Ländern umstritten, sodass Forderungen nach einem Atomausstieg aus Gründen der ökologischen und ökonomischen Nachhaltigkeit möglicherweise weiterhin an Nachdruck gewinnen werden.

In der ersten Studie wird untersucht, wie die nach dem Atomunfall von Fukushima 2011 geäusserten Forderungen nach einem Atomausstieg in verschiedenen Ländern in politisches Handeln umgesetzt wurden. Anhand einer vergleichenden Analyse von Diskursnetzwerken wird gezeigt, dass der kollektive Überzeugungswandel, der in Deutschland zum Atomausstieg führte, einerseits Ergebnis der tief verankerten Opposition gegenüber der Atomkraft war, andererseits aber politischen Unternehmertums bedurfte. In Kanada und Japan hingegen blieb ein Atomausstieg aufgrund der historisch verwurzelten Dominanz atomfreundlicher Interessen aus. Die zweite Studie untersucht die Präferenzbildung von WählerInnen im Rahmen eines Referendums über den Atomausstieg in der Schweiz. Entgegen der in der Wirtschaftswissenschaft verbreiteten Annahme stabiler Präferenzen zeigen die Ergebnisse der Panel-Studie mit über 1.000 WählerInnen, wie sich affektive Bewertungen und Wahrnehmungen von Risiko und Nutzen der Atomenergie im Verlauf der Abstimmungskampagne veränderten. Die Studie belegt auch den in der Psychologie beschriebenen Effekt der ‘asymmetrischen Dominanz’: viele WählerInnen revidierten ihre Zustimmung zum Atomausstieg, als sie mit der als noch weniger wünschenswert empfundenen Aussicht auf Kohlestrom-Importe konfrontiert wurden. Die dritte Studie baut auf diesen Befunden auf, indem sie den verhaltensorientierten Ansatz zur Erklärung von Wahlentscheidungen mit einem machttheoretischen Ansatz verbindet. Hierbei wird gezeigt, dass die Präferenzen der WählerInnen auch von den Interessen etablierter Energieunternehmen beeinflusst werden.

Der vorliegende Band reiht sich in eine noch kleine Anzahl von Beiträgen zur politischen Dimension des Ausstiegs aus Energietechnologien ein. Die Fallstudien liefern eine Mikrofundierung gesellschaftlicher Entwicklungen und zeigen, inwiefern die Pfadabhängigkeit des Energiesektors bei der Präferenzbildung eine Rolle spielt. Darüber hinaus geben sie auch Hinweise zu Faktoren, die einen Ausstieg aus nicht nachhaltigen Technologien befördern können. Hierzu zählen erfolgreiches politisches Unternehmertum sowie Kommunikationsstrategien, die auf positive Emotionen setzen und die Vorteile von Innovation anstelle der Risiken nicht nachhaltiger Systeme betonen.

Summary

This dissertation contributes to understanding the political dynamics in relation to efforts to divest from energy infrastructures deemed unsustainable. Based on concepts from Political Science, Behavioral Economics and Psychology, three case studies examine the formation of preferences for divestment among political elites and voters. The empirical context is provided by recent political processes related to nuclear power. Electricity generation based on nuclear power is contested in many countries, and the question of nuclear divestment is likely to become an even more important topic due to considerations regarding the ecological and economic sustainability of the technology.

The first study investigates how the demands for nuclear divestment that were articulated after the Fukushima nuclear accident in 2011 were transformed into political action in different countries. Using a comparative analysis of discourse networks, the study shows that the collective belief shift that led to a divestment law in Germany was the result of deep-seated anti-nuclear opposition and successful political entrepreneurship, while vested interests and a weak anti-nuclear coalition fostered stability in Canada and Japan. The second study examines preference formation among voters in the context of a referendum about nuclear divestment in Switzerland. Against the assumption still prevalent in mainstream economics that preferences are stable, the findings of a panel study with more than 1,000 voters demonstrate how affective evaluations of nuclear power and perceptions of nuclear risk and benefit were altered during the political campaign. The study also provides evidence for the Asymmetric Dominance Effect described in Psychology and Behavioral Economics. Accordingly, many voters revalued their preference for divesting from the oldest nuclear fleet worldwide once they were confronted with a scenario perceived as even less desirable, namely the prospect of importing coal-based electricity to close the gap left by nuclear power. The third study takes these findings a step further. Linking the behavioral approach with perspectives on business influence in politics, the study shows how voters' preferences about nuclear divestment can be influenced by structurally powerful energy incumbents.

While much research about the political dimension of current energy transitions focuses on the political drivers of and barriers to phasing in new technologies, this dissertation is part of a growing literature dedicated to the political dimension of processes of divestment and phase-out in the energy context. The case studies provide a microfoundation of societal outcomes and demonstrate how the strong path dependencies that characterize the energy sector play out in preference formation. They also provide some indications of how unsustainable energy systems might be challenged: Successful political entrepreneurship and communication that provides positive emotional 'hooks' and brings to the fore the benefits of innovation instead of the (often abstract) risks of unsustainable infrastructures can be conducive to divestment.

Part I

Introduction

1 Why Study Preference Formation in Energy Policy?

Energy is an important topic because it underpins almost every human activity (Skea 2015, 9). As Miller et al. (2013, 135) put it, energy systems form «the heart of the technological arrangements around which contemporary industrial economies are organized». Moreover, many of the most heavily capitalized firms worldwide are active in the energy sector.

Numerous challenges, such as the necessity of securing a steady supply of energy and limiting the environmental consequences of energy production and use, are putting today's energy systems under pressure. Because «current energy systems are simply unsustainable on all accounts of social, economic, and environmental criteria» (Grubler 2012, 8), there is a broad consensus in academia that transitioning to a sustainable energy future is inevitable and urgent (Geels et al. 2017; Hess 2014; Rockström et al. 2017). However, private markets are unlikely to spur a transition on their own (Sovacool 2016, 202), and there is widely diverging understanding among policymakers, citizens, energy companies and other stakeholders as to what the transition to more 'sustainable' energy systems should actually entail. Preference heterogeneity in energy policymaking is amplified by the fact that energy policy is a cross-sectoral issue that has mutually influential relationships with other policy areas such as agriculture, public health, and climate policy (Tosun 2017*a*) and has important implications for national and regional economic development, jobs, and even cultural identities (Morton and Müller 2016). Even if we were to assume that the scientific consensus about the need for a transition to sustainable energy systems was generally accepted by decision-makers, the concrete meaning of such a transition would still be up for debate. This situation is reflected in Meadowcroft's (2009, 327) list of how a transition to a sustainable energy system can be variously understood. Such a transition could mean:

> «(a) movement from a fossil fuel based (or dominated) energy system to a non-fossil fuel based (or dominated) energy system; or
>
> (b) a shift from a carbon emitting energy system to a carbon neutral (or low carbon) energy system; or
>
> (c) a transition from a non-renewable energy system to a renewable energy system. Other alternatives are also possible, for example,
>
> (d) a movement from an insecure (vulnerable) energy system to a secure (robust) energy system. And
>
> (e) a change from centralized energy provision to a decentralized energy system.»

These different types of energy transitions have divergent implications for the role of public policies and for both the necessary investment and divestment processes with regard to particular technologies. One example concerns the role of nuclear power. The technology plays a particularly interesting role in debates about energy transitions as it has been contested for a long time on multiple dimensions in a number of countries, but less so in others. While nuclear power could play an important role in Meadowcroft's options (a) and (b), it would have no place in options (c) and (e). In fact, the governments of several countries (e.g., Canada and the United Kingdom) currently see nuclear power as an essential part of their strategy for decarbonizing the electricity sector (Bratt 2012; Geels 2014), while others (in particular Germany) attach more weight to the risks of nuclear power and are trying to achieve decarbonization *and* nuclear divestment. The entrenched controversy about nuclear power is hence part of what has become one of the most highly contested political issues of these days; namely, how today's energy systems can be prepared for a carbon-constrained future.

While much research about the political dimensions of current energy transitions focuses on the political drivers of and barriers to phasing in new technologies (Aklin and Urpelainen 2013; Jacobsson and Lauber 2006; Laird and Stefes 2009; Lipp 2007; Meckling et al. 2015; Stokes 2013), much less work has been dedicated to examining the political dimensions of the 'flipside' of energy transitions (Turnheim and Geels 2012); i.e., processes of divestment and phase-out. Addressing this research gap, the case studies assembled in this dissertation investigate the formation of policymakers' and citizens' preferences in relation to demands for divesting from nuclear power at the level of national states.[1] Energy policy choices are made on the local, regional, national and international levels, but the level of national states is still the dominant arena in which the majority of consequential policy choices are made—particularly when it comes to nuclear energy. The divergence in national policy trajectories and the high level of contestation between advocates and opponents of the technology make nuclear power a particularly interesting area in which to study processes of preference formation.

The individual papers contained in this dissertation focus on three different, yet complementary lines of inquiry. First, by investigating the preconditions for and processes of preference reversals among political elites, Paper 1 addresses why institutional responses to nuclear accidents differ between countries. Second, while it has already been shown that citizens' preferences with regard to nuclear power are responsive to nuclear accidents (Renn 1990; Siegrist et al. 2014; Verplanken 1989), Paper 2 investigates what explains preference instability among citizens during a political campaign about nuclear divestment. Finally (third), taking the strong vested interests

[1] Throughout the introductory and concluding chapters, I refer to the three papers of this dissertation as 'Paper 1' (Rinscheid, Eberlein, Emmenegger and Schneider 2018), 'Paper 2' (Rinscheid and Wüstenhagen 2018), and 'Paper 3' (Rinscheid 2018). Parts of the introductory and concluding chapters draw on the three papers without explicit citation.

that characterize the energy sector into consideration, Paper 3 gauges the influence that powerful businesses can exert on citizens' preferences with regard to nuclear divestment.

The next section outlines the most important arguments on both sides of the nuclear controversy and briefly puts this controversy into historical context. Section 3 presents an analytical perspective on divestment by delimiting different forms of the phenomenon. It also discusses some important challenges related to political efforts to divest from locked-in energy infrastructures. Section 4 presents some conceptual anchors that guide the three case studies. A short section on research methods (Section 5) is followed by a summary table about the papers (Section 6).

2 Nuclear Power: Arguments and Politics

2.1 Sketching out the Arguments on Both Sides of the Nuclear Controversy

Understanding the issues fundamental to the nuclear controversy is important for the study of preference formation processes in relation to nuclear energy policy. This section first gives an overview of the most salient arguments in favor of nuclear power, then illustrates the most important arguments against it.

Proponents of nuclear energy contend that the technology ensures a reliable supply of 'clean' electricity at a low cost. Security of energy supply was a top priority for decision-makers after World War II in several countries, which led them to allocate considerable resources to nuclear research and development (van de Graaff 2016), despite the reluctance of utilities to adopt a novel and nonproven technology (Glaser 2012, 11). Nuclear power plants require only small amounts of nuclear fuel to reliably generate large amounts of electricity for an extended period of time (Rhodes and Beller 2000). Although most countries do not have their own uranium reserves, many countries in which uranium can be found (e.g., Australia, Canada, and Namibia) can be considered to be relatively stable (see Echávarri 2007, 95). Nuclear advocates frequently point out that, unlike intermittent renewable sources like solar and wind, nuclear power can provide 'baseload' electricity to national grids (Schiermeier et al. 2008, 818). Hence, it is also argued that the reliable electricity supply provided by nuclear power can contribute to eradicating poverty and diseases in developing countries (Echávarri 2007, 93; Rhodes and Beller 2000).

Because nuclear reactors, in contrast to coal- or gas-fired power plants, do not directly emit greenhouse gases and other air pollutants, some promote the technology as a means of mitigating climate change, as well as reducing air pollution (Adamantiades and Kessides 2009; Echávarri 2007; Srinivasan and Rethinaraj 2013). Based on a comparison of nuclear power with fossil fuel-based technologies for electricity generation, some advocates contend that nuclear power

has already «prevented an average of 1.84 million air pollution-related deaths and 64 gigatonnes of CO_2 equivalent [...] greenhouse gas (GHG) emissions that would have resulted from fossil fuel burning» (Kharecha and Hansen 2013, 4889), and that the number of human deaths *avoided* thanks to the use of nuclear power is far higher than the number of human deaths *caused* by the technology (see also Qvist and Brook 2015). Likewise, the World Nuclear Association (2017), an international organization that represents the interests of the global nuclear industry, frames nuclear power as «the single most significant means of limiting the increase in greenhouse gas concentrations». As Farsetta (2008, 39) shows, the depiction of nuclear power as a 'green' technology can be traced back to the early 1990s, when the Nuclear Energy Institute, the main U.S. nuclear industry group, started to frame it as an environmentally friendly, CO_2-free source of electricity.

Nuclear power is often depicted as the most affordable source of electricity (van de Graaff 2016). Moreover, in contrast to fossil fuel-based electricity generation, fuel costs represent only a very small portion of the total electricity generation cost.[2] Hence, nuclear power is claimed to be much more resilient with regard to fuel price volatility than fossil fuels, for which the cost of fuel accounts for 41 percent (coal) and 76 percent (gas) of the total generation cost, respectively (Adamantiades and Kessides 2009, 5150; Echávarri 2007, 91).

Advocates also emphasize that nuclear power is a *safe* technology for generating electricity (e.g., Rhodes and Beller 2000) and repudiate the potential risks based on the argument that the probability of nuclear incidents is negligible. If nuclear accidents occur, supporters of the technology often argue that they represent anomalies. For example, the disasters that happened in 1986 at the Chernobyl nuclear power plant (Soviet Union) and in 2011 at the Fukushima nuclear power plant (Japan) were ascribed to highly specific circumstances, making it almost impossible for such disasters to happen elsewhere. According to this line of reasoning, any remaining safety risks can be eliminated by strengthening oversight and regulatory regimes (van de Graaff 2016, 54-55).

Critics of the technology, on the other hand, argue that nuclear power is both ecologically and economically unsustainable, that its use is obstructing the transition to an energy system based entirely on renewable energies, and that it aggravates the risks of nuclear weapon proliferation (Sovacool et al. 2016, 256). In terms of ecological challenges, nuclear critics point to the severe health risks associated with even low levels of exposure to ionizing radiation (Beyea 2012) and the intricate problems associated with the storage, transport and disposal of radioactive materials, as nuclear waste remains toxic for millennia (van de Graaff 2016, 55). Moreover, regarding the

[2] According to Echávarri (2007, 91), 15 percent of the total levelized generation cost of nuclear power can be attributed to fuel, 59 percent to capital investment, and 26 percent to operations and maintenance. Uranium, in turn, represents only a quarter of the fuel cycle cost. Costs related to the decommissioning of nuclear power plants and the disposal of nuclear waste were not included in Echávarri (2007).

disasters that occurred at Chernobyl and Fukushima as evidence of the risks of the technology, many people are concerned about the dangers of nuclear accidents. Much of the skepticism towards nuclear power is rooted in an intuition captured by Charles Perrow's 'normal accident theory'. Perrow (1999, 43) takes nuclear power plants as an example of a highly complex system, where the interactions of the system components are so tightly coupled that even trivial mistakes (that would probably go unnoticed if they happened in any other organization) can lead to a major catastrophe. According to this perspective, nuclear power plants are inherently unsafe (see also Sovacool 2010, 110).[3]

Even if the likelihood of a nuclear accident is very low, the potential damage of one is extraordinarily high. For instance, the cost of the Fukushima accident is currently estimated by independent experts to reach US$ 453-635 billion (Schneider and Froggatt 2017, 161), which approximately corresponds to the entire gross domestic product of a country such as Norway (lower bound) or Argentina (upper bound) in 2017.[4] The significant potential damage of a nuclear accident is the reason why no private insurance company has ever consented to insure a nuclear power plant against third party claims for accident-induced damages (Feiveson 2009). Therefore, to be able to offer some coverage of nuclear risks nonetheless, 'nuclear pools' have been formed by insurance companies in many countries that operate nuclear power plants to jointly cover (some part of) nuclear risks in an insurance pool.[5] As the required liability is, however, negligible in light of potential damages, the risks posed by nuclear accidents are, by and large, borne by taxpayers (Diekmann 2011; von Hirschhausen and Reitz 2014).

A related economic challenge that nuclear power faces is that it is not able to compete in a free market (van de Graaff 2016, 56). In fact, nuclear power has always been highly subsidized and, as stated by Duffy (2011, 679), «the reality is that in the absence of loan guarantees banks will not lend money to utilities seeking to build nuclear plants». Furthermore, construction of new nuclear power plants is chronically plagued by significant delays, and in contrast to other energy technologies, the cost of nuclear power plant construction has been steadily rising over recent decades (Bupp and Derian 1978; Duffy 2011; Sovacool 2010). This is compellingly demonstrated in Grubler's (2010) case study of the French nuclear power program. As this study shows, real-term construction costs escalated substantially over the course of the French nuclear scale-up, leading to the striking conclusion that «*negative* learning effects» can be involved in building up complex, large-scale energy supply technologies like nuclear power (Grubler 2010, 5174, emphasis added). In some cases, escalating costs have even led to the termination of projects that had

[3] Consistent with Perrow's theory, recent statistical analyses that assessed the probability of major nuclear accidents report that «the number of core-melt accidents that can be expected over time in nuclear power stations is larger than previously expected» (Rose and Sweeting 2016, 113; see also Wheatley et al. 2016).

[4] See http://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx (accessed 15.06.2018).

[5] The website of the Swiss Pool for the Insurance of Nuclear Risks entails a good explanation of how this works: https://nuklearpool.ch/en/about-us (accessed 15.03.2018).

already been completed to a considerable extent, such as in the case of the V.C. Summer nuclear power station (South Carolina, US), where construction stopped in July 2017 after four years of construction following the bankruptcy of the US-based nuclear power company Westinghouse.[6]

Nuclear critics question the promise of nuclear power's contribution to climate change mitigation. As Sovacool's (2008) meta-study demonstrates, nuclear power emits considerable amounts of greenhouse gas-equivalent emissions (e.g., during uranium mining, reactor construction, and plant decommissioning), and Sovacool et al. (2016, 261) show that the technology's carbon footprint is even likely to increase in the future due to the scarcity of high-quality uranium, the mining of which is associated with energy-intensive processes. The role of nuclear power as a 'bridge' to a clean energy future is also frequently challenged by nuclear critics. As the technology ties up huge amounts of capital and does not have the ability to meet volatile demand flexibly, it tends to crowd out environmentally less harmful alternatives like renewable energies and energy efficiency (Cooper 2010; Verbruggen et al. 2014).

In sum, the controversy around nuclear power makes for an interesting setting in which to study how societies cope with a technology that is associated with certain benefits (e.g., electricity supply) but also specific risks (e.g., nuclear accidents), and for investigating how the political preferences of individuals and societies as a whole in relation to technology evolve in political decision-making processes.

2.2 The Nuclear Controversy and Public Policymaking in Historic Context

The controversy surrounding nuclear power started to affect energy policymaking and planning in some countries as early as the 1970s, and beyond that had significant impacts on broader political developments in several European countries (Tosun 2017*a*, 16). Two factors are of paramount importance in this regard: first, the unresolved challenge of nuclear waste disposal and the lack of transparency in planning large centralized nuclear energy infrastructure, especially with regard to specific siting decisions, mobilized many citizens against nuclear power. This was notably the case in countries with relatively closed political input structures such as France (Kitschelt 1986) and Germany (Glaser 2012), but to a considerable extent also in countries with more inclusive structures such as Sweden (Jahn 1992) and Switzerland (Kupper 2003), where such developments led to popular votes about nuclear energy systems.[7] In several countries, anti-nuclear mobilization in conjunction with other new social movements such as the peace

[6] According to the World Nuclear Industry Status Report, construction was 33.7 percent complete when V.C. Summer was abandoned (Schneider and Froggatt 2017, 96).

[7] While a slight majority (51 percent) of voters rejected a proposal to introduce citizen participation in nuclear power plant planning processes in 1979 in Switzerland, a Swedish consultative referendum held in 1980 paved the way for a decision to phase out nuclear power until 2010 (Nohrstedt 2005). The Swedish phase-out policy was reversed in the 2000s after the Center Party gave up its anti-nuclear position (see Jahn and Stephan 2016, 172).

movement led to the emergence of green parties (Kitschelt 1986; Paterson 1989), with important ramifications especially for the German party system (Jahn 1993). In fact, the nuclear controversy was a major driver of the institutionalization of a new societal cleavage centered around «the opposing notions of economic growth and environmental protection» (Jahn 1992, 384; see also Kitschelt 1986 and Tosun 2017*a*).

Second, the nuclear accidents that occurred in 1979 at the Three Mile Island (TMI) nuclear power plant in Pennsylvania (United States) and in 1986 in Chernobyl further fueled the controversy about nuclear power. These events increased public opposition to the technology, influenced energy policy debates and, in some countries, led to important policy changes. The TMI accident had profound effects on media representations of the technology in the US, with the pro-nuclear progress frame being largely replaced by a discourse focused on environmental risks and public accountability, yet did not lead to policy change there (Gamson and Modigliani 1989). While TMI strengthened anti-nuclear movements in Europe, Chernobyl both directly and indirectly served as a catalyst for comprehensive changes in energy policies and systems in many countries. For instance, as a direct consequence of the accident, the majority of Italian voters voted for nuclear divestment until 1990 in a referendum in 1987. In Germany, Chernobyl steered anti-nuclear positions into the political mainstream (Paterson 1989), with the Social Democrats thereafter envisioning a nuclear-free energy future (Sozialdemokratische Partei Deutschlands 1989). Importantly, the accident created the political momentum for the adoption of Germany's first feed-in tariff law for renewable energies in 1990 (Laird and Stefes 2009; Lauber and Mez 2004), which set the stage for subsequent, more ambitious energy transition policies including a nuclear divestment law in 2000 (Stefes 2014, 48). The German feed-in policy for renewable energies not only served as a role model for energy legislation in numerous other countries (Mez 2009, 390), but also nurtured a successful domestic renewable energy industry (Stefes 2010, 159) and, eventually, even contributed to the rise of renewable energy industries in other countries such as China (Hoppmann et al. 2014, 1433).

Elsewhere, such as in Canada (Mez and Doern 2009), Japan (Cherp et al. 2017), China and India (Sovacool and Valentine 2010), TMI and Chernobyl had no direct influence on energy policymaking. In the 2000s, nuclear power even seemed to be increasingly accepted among the public and policymakers in some countries (Bernardi et al. 2018). The accident that occurred at the Fukushima plant in 2011, however, challenged the prospects of the nuclear industry at a time when many proponents had expected a 'nuclear renaissance' (Miller et al. 2013). The subject of worldwide media coverage (Elliott 2013), the accident put nuclear power back on the political agenda, but influenced public opinion (Latré et al. 2017) and political discourses (Shim et al. 2015) in countries differently, leading to diverging political dynamics (Bernardi et al. 2018).

Responses to Fukushima have ranged from a reiterated commitment to nuclear power (e.g., in Russia and the United Kingdom) to nuclear divestment (in Germany),[8] with correspondingly different implications for energy transitions.

The divergence in political outcomes after the Fukushima accident sets the scene for the papers in this dissertation. Based on case studies, all three papers analyze how the demands for divesting from nuclear power that were articulated post-Fukushima were transformed into political action at the national level. The next section attempts at surfacing the phenomenon of divesting from large-scale infrastructures deemed unsustainable.

3 Divesting from Energy Assets: Concepts and Challenges

Using its original meaning, divestment simply refers to the sale of assets. The topic of divestment has recently become imminent in the energy context, where it broadly refers to activities aimed at retiring assets that produce public 'bads' (such as CO_2 emissions in the case of fossil fuels, or radioactive waste in the case of nuclear power). To clarify the scope of this PhD thesis, this section attempts to disentangle the different dimensions of the phenomenon in the energy context.

Figure 1 proposes distinguishing between three types of divestment, which in essence can lead to two different outcomes (the separated areas in the triangle). The first, 'Divestment by private and institutional investors', covers decisions by various types of investors to sell off their (energy-related) assets. Recently, this type of divestment has received wider attention in the context of the fossil fuels divestment movement (Gunningham 2017*a*; 2017*b*). Initiated in 2007 and further institutionalized in 2012 through the foundation of the 350.org campaign by environmental activist Bill McKibben, the focus of this social movement is putting pressure on institutional investors, such as pension funds and university endowments, to divest their holdings in companies active in fossil fuel extraction and production processes, with the ultimate aim of bringing about «a complete break with fossil fuels and disruptive technological change» (Ayling and Gunningham 2017, 135). While the movement has succeeded in persuading hundreds of institutions (investment funds, insurers, major banks, among others) and tens of thousands of individuals to divest from fossil fuel companies (Gunningham 2017*a*, 373), its impact is above all symbolic, as it is «unlikely to have much, if any, direct effect on the valuations of fossil fuel companies» (Ayling and Gunningham 2017, 135). Ultimately, there will always be some investors who quickly fill the gap.

Second, 'Divestment by energy businesses' covers decisions taken by actors directly engaged in the energy business, such as utility companies. Like other private and institutional investors, the former can sell their assets, such as power plants, to another company that continues to operate

[8] In 2010, the German government reversed the decision to divest from nuclear power which was taken in 2000.

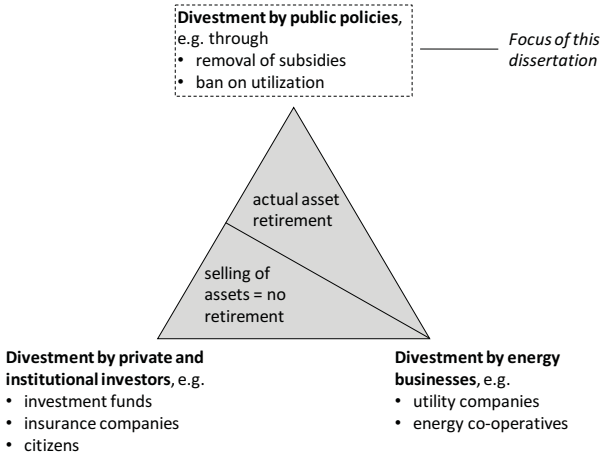

Figure 1. Divestment in the energy sector: Types, involved actors, and effects.

them. One example is Vattenfall's divestment from lignite mines and power plants in Lusatia, one of the German coal regions (Weber and Cabras 2017). However, in contrast to such decisions, utilities sometimes permanently decommission power plants if their continued operation would no longer be profitable. Such a decision was taken by the German utility RWE in 2013, for instance, which led to a notable reduction in its coal- and gas-based power generating capacities and thus had real consequences in terms of CO_2 emission reductions.[9]

The third type, 'Divestment by public policies', comprises public measures that aim at retiring unsustainable assets. This might be achieved by removing vital subsidies, or by enacting bans and regulations that determine the decommissioning of energy assets. A recent example of such politically steered divestment is provided by the Canadian province Ontario, which became the first North American jurisdiction to entirely divest from coal-fired power plants in 2014. In Ontario, a series of regulations led to a reduction in the share of coal in the electricity generation mix from 25 percent to zero in just a decade (Harris et al. 2015). This type of divestment by public policies, and the political dynamics that are associated with it in different institutional settings, are at the heart of this dissertation.

Importantly, the different types of divestment can also be intertwined. An example taken from a different context is the initially investor-driven and later politically backed divestment campaign that helped delegitimize the South African apartheid regime in the 1980s (Teoh et al.

[9]See RWE's official statement: http://www.rwe.com/web/cms/en/110504/rwe/investor-relations/news/news-ad-hoc-statements/?pmid=4009732 (accessed 07.06.2018).

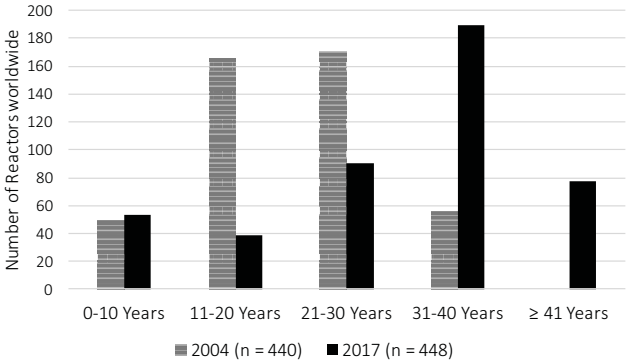

Figure 2. Age distribution of all nuclear power reactors in operation worldwide, 2004 and 2017.
Notes: Data taken from the reports 'Nuclear power reactors in the world' by the International Atomic Energy Agency (IAEA 2005; 2018). As the earliest available edition of this report contains data from 2004, these are taken as a comparison. Note also that the number of reactors in operation in 2017 (448) includes 39 reactors that are considered to be in 'Long-Term Outage' in another flagship publication, the World Nuclear Industry Status Report (Schneider and Froggatt 2017, 28).

1999). In the energy context, divestment decisions that are taken by private companies based on their assessment of the market outlook are virtually always also indirectly influenced by political decisions earlier taken, or expected political developments. For example, in 2013, two months after the Minister for Energy suspended licenses for the construction of three planned nuclear power plants, the Swiss utility company BKW decided to decommission its Mühleberg nuclear power plant in 2019 (Kristiansen 2017, 15).[10]

To clarify the relevance of divestment in the context of nuclear power, Figure 2 shows the age distribution of all nuclear power reactors currently in operation worldwide and compares it with the situation 13 years earlier.[11] While no reactor exceeded 40 years of age in 2004, 77 reactors that were in operation in 2017 were more than 40 years old, and 266 reactors had been operational for more than 30 years. This is interesting, because most nuclear reactors were originally designed with lifetimes of 30 to 40 years (e.g., Echávarri 2007, 90). However, the economic incentive to exceed originally envisaged lifetimes is greater than it is to replace reactors with new units. While no specific deadlines for operating licenses exist in many countries, reactor lifetimes have been extended in others. For example, in the US, 84 of the 99 operating reactors have received authorization from the Nuclear Regulatory Commission to operate for longer than the initially licensed 40 years (Schneider and Froggatt 2017, 37),[12] a procedure that might not

[10] See also https://www.presseportal.ch/fr/download/document/100037297-flyer-stilllegung-kkm-en-def.pdf (accessed 07.06.2018).

[11] 'Worldwide' here refers to all 31 countries in which nuclear power plants are currently operating.

[12] As of June 2017.

be sustained forever and that raises questions about nuclear safety.[13] In the not-so-distant future, many countries will therefore be confronted with the issue of how to politically organize the sunsetting of their nuclear fleets.

3.1 Delimiting Divestment and Phase-out Policies

Although phasing out and divesting from a technology or product refer to related phenomena, I propose to distinguish between the concepts in the context of public policymaking. Both phase-out and divestment policies can take a variety of forms (e.g., bans, regulations), while their intended effect is that the production or use of a specific technology is ultimately discontinued. Importantly, while simple phase-out policies often entail a rule that beginning on a specific date no additional units may be *produced* or *sold*, they do not specify retirement dates (i.e., dates as of which a product or technology unit can no longer be *utilized*). However, retirement decisions may be delegated to a regulatory agency or to companies. One example of an energy technology phase-out is the ban on inefficient incandescent light bulbs. Based on a European Union (EU) Directive, the *manufacture, importation* and *sale* of incandescent light bulbs has been banned in the EU since 2009; a policy that has also been adopted by many other countries. Notwithstanding the policies' success, these inefficient light bulbs are still commonly used for lighting, as their *use* is not regulated by the phase-out policy.

Divestment policies go a step further, as they directly limit the lifetime of existing units, usually by specifying a fixed retirement date. Divestment hence represents a more ambitious form of phase-out. For instance, the example of divesting from coal in Ontario (as mentioned earlier) inspired Canada and the United Kingdom in 2017 to initiate the Powering Past Coal Alliance, a coalition consisting of more than 50 countries, regions and businesses that are committed to the objective of divesting from coal for electricity generation by 2030. However, this commitment still needs to be transposed into national laws and regulations.

The line between divestment and simple phase-out policies is a fine one, but distinguishing between the two is important as proposals in either direction are likely to influence politics quite differently. For instance, nuclear utilities have a strong incentive to lobby against nuclear divestment policies to defend their business of generating electricity with (often fully depreciated) nuclear reactors against the setting of fixed and presumably irreversible end dates. They might be more open, on the other hand, to policies that entail a nuclear phase-out in the longer term, and that merely restrict new-build nuclear. Not only is the economic incentive to invest in retrofitting

[13] Schneider and Froggatt (2017, 39) note that «more pressing questions have been raised about the wisdom of operating older reactors» after the Fukushima disaster. The Fukushima Daiichi units (1 to 4) had operated since the early 1970s, and the operating license for Unit 1 of Fukushima Daiichi «had been extended for another 10 years in February 2011, a month before the catastrophe began» (Schneider and Froggatt 2017, 39).

existing or even building new nuclear power plants low in any case, but a simple phase-out policy would also leave the former more room for renegotiation with the government and open up the possibility to lobby regulatory agencies that are in charge of determining the lifetime of nuclear reactors.

In the context of current energy transition policies, Switzerland has decided to *phase out* nuclear power: The new energy law adopted in 2017 provides that (i) no *new* power plants may be built, and (ii) existing power plants may *operate* as long as they are considered 'safe'.[14] A *divestment* proposal, on the other hand, was rejected in 2016. This policy would have obliged the operators of nuclear power plants to retire the plants at fixed dates (see Papers 2 and 3). In contrast to Switzerland, Germany decided to divest from nuclear power by 2022, shortly after the Fukushima accident (see Paper 1).[15]

3.2 Barriers to Divestment: Path Dependence at the Macro Level...

The challenges of divesting from unsustainable energy assets are inextricably linked to the powerful path dependencies that characterize the energy sector. At the macro level, divestment hence touches on the fundamental question of how societies can escape locked-in, unsustainable socio-technical trajectories. The path dependence of today's centralized fossil fuel and nuclear-based energy systems is rooted in political and investment decisions taken at earlier points in time. With regard to nuclear power, a promise to develop a reliable and domestic source of cheap electricity drove the governments of several countries to intensely finance research into nuclear fission starting in the 1940s and 1950s, which eventually led to the start-up of commercial nuclear power plants. Exceptionally high up-front investment, coordination effects, self-reinforcing expectations and centralized, state-led energy planning—perhaps best exemplified by the French case, where utilities and the industries involved «were extraordinarily well coordinated through the 'invisible hand' of a small technocratic elite» (Grubler 2010, 5175)—gave the selected socio-technological path a competitive advantage and fostered its stabilization over time (see Arthur 1990). Similarly, in the context of fossil fuels, Unruh (2000) points to the complementarities and co-evolution of technologies and institutions that have locked most industrial economies into mutually reinforcing, unsustainable energy systems (see also Kuzemko et al. 2016).

Importantly, the cost of achieving structural changes in the energy sector is concentrated and falls mainly on a relatively small number of utilities that have benefited from previous policy

[14] The temporal implications of this rule are not entirely clear, but according to the Association of the Swiss Nuclear Power Station Operators swissnuclear, nuclear power can be part of the Swiss electricity mix until the mid 2040s, *at least* (http://www.swissnuclear.ch/de/grenzen-der-nachruestung-_content—1–1055–185.html; accessed 28.05.18).

[15] No distinction between divestment and simple phase-out policies is usually made in policy debates, where the term 'phase-out' is generally used to describe policies broadly aimed at discontinuing the production or use of a specific technology. For instance, the German decision to divest drom nuclear power is usually labeled as a 'phase-out'. This, however, blurs the partly different logics and implications of divestment and simple phase-out policies described above.

choices. Therefore, these companies have a strong incentive to politically organize themselves to avert changes. To organize their opposition, the losers of energy transitions often join forces (Kim et al. 2016) and rely on other organizations (trade associations, peak organizations, think tanks, etc.) to amplify their political influence (Barley 2010). The structural inertia of locked-in energy systems is further reinforced by the often strong linkage between incumbent businesses and governments (Levy and Egan 2003; Newell and Paterson 1998; Unruh 2000). Many scholars have therefore called attention to the fact that comprehensive energy transitions require that well-organized political opposition be overcome (Geels 2014; Hess 2014; Kern and Smith 2008; Meadowcroft 2011; Stirling 2014) which might be «possible only in exceptional circumstances» (Kivimaa and Kern 2016, 214).

3.3 ... and Status Quo Bias at the Micro Level

At the (micro) level of individuals, the lock-in effects that characterize the system (macro) level can be reinforced through a type of cognitive bias called *status quo bias*. Research from behavioral economics shows that humans are attached to the status quo when making decisions (Samuelson and Zeckhauser 1988). This phenomenon contributes to explaining consumer inertia and 'conservative' voting behavior that favors the status quo. One reason for status quo bias in consumer and voter behavior is that changes to the status quo are often perceived as uncertain when compared to the known reference point(s), making change a relatively unattractive option for loss-averse individuals (Kahneman et al. 1991). In other cases, status quo bias might be based on individuals' desire to avoid making an effort, or on the perception that choosing the status quo option corresponds to following some kind of recommendation or prevailing social norms (Johnson and Goldstein 2003; Sunstein and Reisch 2014).

In terms of consumer behavior in the energy domain, electricity consumers tend to be reluctant to switch to electricity generated from renewable sources (corresponding to a form of individual-level divestment) if such a switch requires making an active decision. Changes in the choice architecture can help to overcome status quo bias (Sunstein and Reisch 2014). For example, introducing green electricity as the default option for private households' electricity supply has been shown to be a very effective means of substantially increasing the share of renewable electricity (Chassot et al. 2017). As far as voting is concerned, environmental issues tend not to play a very important role in ordinary elections. However, research on voting behavior in direct democratic settings about environmental policies in Switzerland shows that the majority of voters often tend to prefer the status quo over alternative proposals that would enhance ecological sustainability (Rohm and Wurster 2016; Stadelmann-Steffen 2011). What is puzzling about this fact is that awareness about environmental problems among Swiss citizens is generally relatively

high (e.g., Franzen and Meyer 2010). The present dissertation explores the value of the concepts of choice architecture (Paper 2) and of businesses' structural power (Paper 3) in explaining why voters often nonetheless revert to the status quo when taking political decisions.

4 Conceptual Anchors for the Case Studies

In what follows, I sketch out some conceptual anchors for studying the institutional and behavioral factors that drive decision-making in relation to contested policy issues that are characterized by strong path dependencies. While the resulting framework should be applicable to a range of controversial issues related to sectors of the economy where a significant imperative for deep structural change exists, its usefulness will be assessed in the setting of societies' choices with regard to nuclear divestment.

The first pillar is the concept of critical junctures, which is rooted in historical institutionalism. Section 4.1 introduces the concept and briefly critiques the way the literature has dealt with processes of agency and preference formation in critical junctures, a critique that is further developed in Section 4.2.1 and in Paper 1, resulting in a framework that helps explain path-creation processes. Next, Section 4.2.2 uses insights from behavioral decision research to theorize preference formation at the level of voters, and Section 4.2.3 complements this focus by reflecting on the role of energy businesses in influencing voters' preferences. Section 4.3 puts the conceptual elements together and provides a preview of the three case studies.

4.1 Critical Junctures

A promising perspective from which to study the breakdown of path dependence and the origins of new techno-institutional trajectories at the macro level of societies is provided by the concept of critical junctures, which originates in historical institutionalism. According to the path dependence-argument developed by Pierson (2000), critical junctures are episodes or events that set the development of an institution onto a new path, which then ensures, through self-reinforcing feedback, its own reproduction over time. While critical junctures are often triggered through events exogenous to the institution in question, institutions do not deterministically change as a function of events. This is why Capoccia (2015, 168) introduces «'candidate' critical junctures» as a concept to describe situations in which the status quo is challenged, regardless of whether this finally leads to institutional change (such as new laws or regulations).

Critical junctures are characterized by uncertainty about the future and have been described as «institutionally fluid» (Capoccia and Kelemen 2007, 343), meaning that they provide substantially more opportunities for political agents to affect the course of development than during

'settled' times (Capoccia 2015, 150; Mahoney and Thelen 2010, 7). While various scholars have thus pointed to the important role of agency during critical junctures (e.g., Busemeyer 2016; Capoccia and Kelemen 2007; Pierson 2000), the critical juncture framework has still provided no solid theory of action. This is problematic, as institutions do not develop and change without agents playing a purposive role in these processes (see Busemeyer 2016, 38; DiMaggio 1988). According to Campbell (2004, 68-69), historical institutionalists tend to focus their attention «on the key events that start episodes of change», but provide no understanding of the «search process» that follows those events (similar: Capoccia and Kelemen 2007, 342). Paper 1 includes propositions that assist in closing this conceptual gap. Specifically, and as historical institutionalists have pointed out, an empirical focus on the formation of beliefs and preferences might help with understanding the role of agents in critical junctures (Culpepper 2005; Hall 2005; 2010).

4.2 Preference Formation

4.2.1 Institutionalist Perspectives

Several scholars have emphasized the role of cognitive mechanisms in institutional change, such as the evolution of policy actors' beliefs and preferences (e.g., Greif 2006; North 1990).[16] According to what Hall (2005, 136) calls the «eventfulness» of preference formation, actors form beliefs and preferences in an interpretative process by which they weigh prior causal models against new experiences generated by evolving events. This can eventually lead to a reshaping of perceptions and a reconstruction of issues (Dudley 2007, 407). Likewise, policy process models theorize that external events or 'exogenous shocks' (e.g., nuclear accidents in the context of this study) play an important role in the context of preference formation. These can alter the political agenda and hence might pave the way for policy change. This process has been succinctly theorized in the Multiple Streams Approach (Kingdon 1984). Accordingly, a 'focusing event' can open a 'policy window'—a concept very close to the notion of critical junctures—which can be exploited by 'policy entrepreneurs' in that they may capitalize on a favorable political mood to build coalitions for enacting new public policies.[17]

But while there is agreement in the historical institutionalist literature that skilled agents can

[16] According to some classical work (Converse 1964; Paffley and Hurwitz 1985), beliefs can be conceptualized within a hierarchical model. On the most general level are fundamental ontological assumptions about general causal relationships and moral concepts that are crystallized in basic orientations such as the left/right scale. These orientations provide the basis for more specific beliefs, including causal models about specific institutional domains, which in turn constrain specific preferences towards concrete objects, such as policy proposals. Paper 1 examines the evolution of more general beliefs towards a technology—nuclear power—, which is why the paper predominantly relies on the concept of 'beliefs'. Papers 2 and 3 are concerned with voters' specific preferences towards a policy proposal about nuclear divestment, which is why the concept of 'preferences' is at the center of the analysis.

[17] The role of events or 'exogenous shocks' in agenda setting and policy change has been discussed extensively in various frameworks to study policy processes, such as the Advocacy Coalition Framework (Jenkins-Smith et al. 2014) and Birkland's (1998) event-related policy change model.

play key roles during critical junctures, it is less clear why institutional entrepreneurs are successful only in some cases. Paper 1 proposes that *critical antecedents*—causally relevant factors that precede a candidate juncture, such as the main lines of conflict in an institutional field—condition not only how likely it is that some agents re-interpret their beliefs at all, but also who these agents are and how likely they are to trigger a process of collective belief shift (see Slater and Simmons 2010). In particular, focusing events are more likely to lead to individual belief shifts if alternative cognitive maps are readily available—in the present case, alternative visions about energy systems and the role nuclear power plays therein. Taking the relational embeddedness of agents into account, the successful promotion of new cognitive frameworks through a mechanism called 'joint belief shift' is theorized to be more likely if institutional entrepreneurs occupy central network positions (Hall 2016; Mintrom and Vergari 1996). In sum, to understand why candidate junctures become critical inasmuch as they lead to a collective reassessment of beliefs, the concepts of critical antecedents and network centrality are crucial.

4.2.2 Dual-process Models and Beyond: Concepts from Behavioral Decision Research

Historical institutionalist perspectives on preference formation are concerned mainly with explaining how political elites interact in the light of institutional constraints. However, they often tend to neglect the roles of voters and vote-seeking parties (Emmenegger and Marx 2018), which is why the way this literature conceptualizes preference formation at the level of voters is limited. Behavioral approaches, on the other hand, are primarily concerned with how citizens make decisions.[18] As political scientists have recently shown, it can be fruitful to apply concepts from behavioral decision research that originate mainly in individual psychology and behavioral economics to study how voters form preferences and make political decisions (Redlawsk and Lau 2013).

Going back to Adam Smith, behavioral perspectives frequently adopt a dual-process perspective on decision-making (Weber and Johnson 2009, 67). More recently, the behavioral literature has distinguished between rapid psychological processes based on intuition, affect and associations ('System 1'), and slower processes based on rules, analytical calculation and deliberation ('System 2'; Kahneman 2011). While *cognitive* decision processes have also been at the center of analyses of voting behavior for a long time, political scientists interested in how voters make decisions have, until recently, paid scant attention to the *affective* and *emotional* correlates of decision-making (Redlawsk and Lau 2013, 29). Yet, given the evidence amassed in psychological research that many human decisions are the product of both affective *and* cognitive processes (e.g., Epstein 1994; Ferreira et al. 2006), it can be assumed that both components also play a

[18] Insights from behavioral decision research could of course also be used to study how political elites make decisions, but applications in this area are not as common (Redlawsk and Lau 2013).

role in the formation of voters' preferences regarding contested policy issues, such as the use of nuclear power. Furthermore, behavioral approaches give rise to the intuition that the perceived structure of choice alternatives, or *choice architecture*, might influence voters' political preferences in ways consequential for political behavior (e.g., Ok et al. 2015). However, while the concept of choice architecture plays an important role in research on consumer behavior, there has been less appreciation of the concept so far in research on political behavior.

Paper 2 proposes and empirically shows that instability in voters' preferences towards a policy proposal during a political campaign can be the result of their reconsideration of both the affective and cognitive correlates of preferences, and that changes made to the choice architecture can lead to preference reversals among voters.

4.2.3 Who Shapes Citizens' Preferences? The Role of Elites

While the topic has already been alluded to, the socio-political origins of voters' preferences have not been explicitly addressed up to this point. Understanding to what extent certain political forces are able to influence voters' preferences is relevant in gauging the prospect of deep structural changes in various sectors of the economy.

It is not only public opinion researchers in the tradition of Zaller (1992) but also institutionalists like Hall (2005) that view preference construction as a political process in which citizens respond to the cues and information they receive from political elites. In the context of nuclear power, specifically, voters' perceptions of technological risks and benefits (Fischhoff et al. 1978; Tosun 2017*b*) are targeted by a wide variety of actors whose interests are at stake when new public policies are discussed (Perrow 2013, 56). These stakeholders therefore try to enhance voters' attention to 'their' interpretation of the issue in question (Baumgartner et al. 2009, 55). To understand stakeholders' success at manipulating voters in relation to specific issues, it is important to recall the distribution of power in that sector. Importantly, in the energy sector, utilities occupy structurally powerful positions, as they supply electricity, provide critical infrastructures, invest, pay taxes, and provide jobs. Because these actors typically have an interest in preserving the status quo, they can be assumed to use various channels and political allies to influence people's preferences accordingly. As Paper 3 further shows, the path dependence of energy systems can be reproduced and fostered by voting behavior on the micro level if structurally powerful incumbents succeed in credibly conveying the threat that embarking upon a new path entails higher risks than maintaining the status quo.

4.3 Putting it together

Figure 3 puts together the main concepts discussed in this section. On a very general level, all three papers investigate the association between a focusing event and political outcomes in different countries by studying processes of preference formation from complementary perspectives. Because institutional structures determine the relevance of different political arenas for decision-making, the individual papers study preference formation in different arenas. Paper 1 analyzes belief and preference formation among incumbent political elites in three parliamentary democracies (Canada, Germany and Japan). In these countries, political outcomes are, to an important extent, determined by the interactions between policymakers and organized interests such as firms, business associations, etc. Although public opinion to some extent also constrains policymakers in these settings, its role is more limited than in countries with strong direct democratic elements.[19] Paper 1 specifically asks under what conditions a candidate critical juncture opened up by a focusing event enables central agents to trigger a collective belief shift among other policy elites. Covering the stages of the 'policy cycle' of agenda setting and policy formulation through policy adoption, it is argued in Paper 1 that *critical antecedents*—i.e., the causally relevant policy legacies of the past—need to be taken into account when investigating how events shape the political agenda and subsequent policy processes (see also Knill and Tosun 2012, 10). This is particularly important in energy policy, a field characterized by very strong path dependencies. Specifically, Paper 1 argues that processes of individual and collective belief shift are more likely in configurations where the challengers of the status quo are relatively strong.

Paper 2 focuses on a different level of analysis, as it investigates preference formation and its translation into voting behavior among voters in Switzerland, a country with strong direct-democratic instruments where public opinion directly comes to fruition as enacted legislation. While Paper 1 investigates political processes in the direct aftermath of a focusing event, Paper 2 zooms in to the preliminary end of a five-year policy process that started shortly after the Fukushima accident by investigating the dynamics of preference formation during the referendum phase that preceded the popular vote on nuclear divestment in November 2016. The referendum phase is a specific step preceding policy adoption in the direct democratic policy cycle. Paper 2 responds to the call to study how citizens' preferences for energy policies and technologies evolve in real-world politicized contexts (Carattini et al. 2017; Druckman 2013) and sheds light both on affect-cognition-interactions and the role of choice architecture in explaining preference

[19] The median voter theorem (Downs 1957) and normative democratic theory (Page and Shapiro 1983) would predict that governments respond to citizens' preferences, but research on 'policy responsiveness' has shown that the relationship is very complex (Brettschneider 1996; Hobolt and Klemmensen 2005) and that governments are often not overly responsive to public opinion (e.g., Gilens and Page 2014). An illustration of this point with an example from energy policymaking in Germany: Although two thirds of the population opposed the policy, the German government implemented a life-time extension for nuclear power plants in September 2010 (Forschungsgruppe Wahlen 2010).

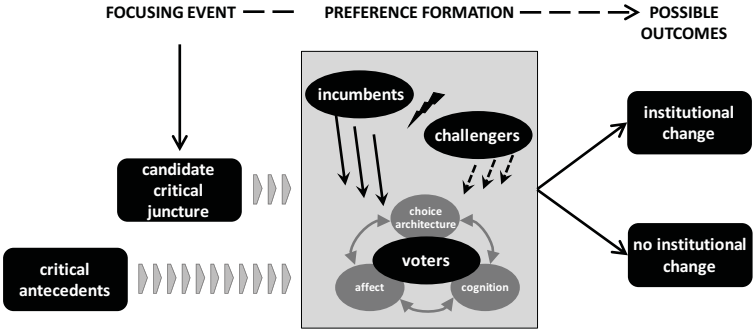

Figure 3. Conceptual anchors and relevant actors in the study of preference formation.

instability.

While the analytical focus of Paper 2 is mainly on the individual-level cognitive and affective underpinnings of political preferences, Paper 3 extends this focus by asking how political elites—more concrete, incumbent businesses and their allies—influence voters during the referendum phase in their formation of preferences. Paper 3 hence connects both levels of analysis that are considered separately in Paper 1 and 2. In particular, Paper 3 attempts to show that the structural power of incumbents can affect voters' preferences for nuclear power, and discusses the implications of this in light of current debates about political power relationships in societies.

5 Methods

The fact that the papers in this dissertation involve different levels of analysis is reflected in the choice of research methods. Papers 1 and 3 analyze the political debate among policy elites. While Paper 1 investigates the policy discourse in three countries before and after the Fukushima nuclear accident, Paper 3 investigates the debate about nuclear divestment in Switzerland during the referendum phase. In both papers, Discourse Network Analysis (DNA) is applied. DNA is a combination of qualitative content analysis of text data and network analysis, which is suited to systematically tracing political debates. Both papers (in particular, Paper 1) include a more comprehensive description of this methodology.

The other level of analysis concerns the role of voters. Based on a survey, Papers 2 and 3 analyze citizens' preferences and voting behavior in the context of the Swiss popular vote to divest

from nuclear power.[20] In the panel survey (henceforth «Chair survey», because it was financed by the Chair for Management of Renewable Energies), citizens from the German- and French-speaking parts of Switzerland were surveyed three times (see Table 1). Participants were drawn from a Swiss online access panel operated by the market research agency Intervista. The statistical target population consists of ca. 70,000 individuals registered in Intervista's online panel. To obtain a representative sample of the Swiss voting population, stratified random sampling with proportionate allocation was applied. While conceptually equivalent to simple random sampling, the technique has several advantages, especially when applied to smaller samples: first, standard errors are usually smaller, leading to more efficient estimators; second, it ensures 'representativeness' (i.e., no segments of the population are over- or underrepresented); and third, precise parameter estimates can be obtained for specific segments (Levy and Lemeshow 2008). The population was stratified with respect to region, gender, education, age and party preference. As a benchmark for stratification, the distribution of socio-demographic characteristics in the Swiss voting population as provided by the Swiss Federal Statistical Office was used (see Table i on page 102).

Respondents were surveyed using computer-assisted web interviews (CAWI). Compared to traditional computer-assisted telephone interviews (CATI) and, in particular, mail-based surveys, online surveys based on large panels have the advantage of being cost-efficient. Moreover, the declining rate of landline telephones leads to the problem of coverage with studies that use CATI, whereas the population of internet users has steadily grown in past years.[21] Surveys based on CATI and random sampling in Switzerland underrepresent voters of right-wing parties while overrepresenting voters of left-wing and green parties (Kriesi 2010), and citizens without a landline connection systematically differ from those with a landline across a range of variables relevant to political behavior (Joye et al. 2012, 100). Moreover, several controlled comparisons have shown that internet-based surveys can be at least as reliable and accurate at estimating parameters of voting behavior as surveys that use more traditional modes of accessing potential respondents (Ansolabehere and Schaffner 2014; Sanders et al. 2007).

Hence, while the data come from a nonprobability sample in the sense that the Swiss voting population is not the *statistical* target population, there are several indications that the inferences presented in Papers 2 and 3 are not only valid for the statistical target population of individuals that have subscribed to the online panel of the market research agency, but have implications for the wider population of Swiss voters. First, Intervista's access pool is entirely actively recruited. Relying on a wide range of sources such as representatively recruited CATIs and on-site surveys

[20] Since space constraints required the overview of the survey to be rather concise in Papers 2 and 3, a brief discussion of the choices made in relation to the sampling strategy and survey mode is provided here.

[21] Between 1995 and 2015, the number of landline connections decreased from 62.1 to 30.8 connections per 100 inhabitants (FSO 2016*b*). In 2016, 91% of Swiss households had an internet connection (FSO 2016*a*).

	mid-October		early November		November 27	
	gfs.bern	Chair survey	gfs.bern	Chair survey	Vote result	Chair survey
approval	57	61	48	50	45.8	45.7
rejection	36	36	46	46	54.2	54.3
undecided	7	3	6	4		

Table 1. Comparisons of results of different surveys with regard to vote intentions and voting behavior.
Notes: Data are percentages. The wording of questions gauging respondents' vote intentions were slightly different between the surveys (but constant across survey waves). Wording of gfs.bern: «If the popular initiative 'For an orderly withdrawal from the nuclear energy program' was put to the vote tomorrow, would you be certainly in favor, rather in favor, rather against or certainly against it?» (gfs.bern 2016*a*; 2016*b*; translated by the author). Respondents could also choose «don't know». Wording of the Chair surveys: «If the popular initiative on the nuclear phase-out was put to the vote today, how would you vote?» Respondents could answer on a five-point scale («definite approval», «rather approval», «don't know», «rather rejection», «definite rejection»). Data for the first gfs.bern survey were collected 3 - 14 October (Chair survey: 10 - 19 October); data for the second gfs.bern survey were collected 2 - 9 November (Chair survey: 3 - 8 November).

hosted on Swiss websites, this ensures that the panel itself closely resembles a probability sample of the Swiss voting population.[22] Second, as a benchmark, respondents' voting intentions in waves 1 and 2 can be compared with data obtained by gfs.bern.[23] Using stratified random samples based on CATI, gfs.bern conducted two cross-sectional surveys among Swiss voters that also included a question on vote intentions (gfs.bern 2016*a*; 2016*b*). Table 1 shows that both surveys, which were conducted almost simultaneously, produced very similar results. Third, the data from the third panel wave perform very well in terms of replicating the actual ballot outcome. Whereas 45.8 percent of voters who participated in the referendum accepted the initiative, 45.7 percent of participating survey respondents did. These cross-checks suggest that any selection bias incurred by survey mode or sampling technique is rather small.

Paper 2 discusses how further potential sources of bias were addressed. Papers 2 and 3 provide descriptive statistics and the wording of questions used in the analyses. While both papers use only a subset of all collected data, a project report contains further descriptive information about the panel survey (see Rinscheid and Wüstenhagen 2016).

6 Overview of the Dissertation Papers

Table 2 provides an overview of the three papers of the dissertation. The concluding chapter will first summarize and reflect on the insights obtained from the case studies, then broaden the focus by discussing the learnings from this dissertation for divesting from fossil fuels. Finally, some ideas for future research related to the socio-political aspects of divestment in the necessary process of rapid decarbonization will be sketched out (Rockström et al. 2017).

[22] See https://www.intervista.ch/uploads/2017/03/intervista_ESOMAR28e.pdf (accessed 17.05.2018).
[23] gfs.bern is a Swiss research institute specialized in politics and communication.

No.	Title	Authors	Objective	Theoretical Foundation	Methods & Data Basis	Publication Status[a]
1	Why do Junctures become Critical? Political Discourse, Agency, and Collective Belief Shifts in Comparative Perspective	Adrian Rinscheid[b], Burkard Eberlein[c], Patrick Emmenegger[d], Volker Schneider[e]	Explaining divergence in institutional responses to the 2011 Fukushima nuclear accident in Canada, Germany and Japan	Historical Institutionalism & Collective Preference Formation	Comparative case study based on Discourse Network Analysis. Data come from newspaper articles (2009–13) dealing with nuclear power policy in Canada, Germany & Japan	Accepted for publication in *Regulation & Governance* (Impact Factor 2016: 2.898)
2	Divesting, Fast and Slow: Affective and Cognitive Drivers of Fading Voter Support for a Nuclear Phase-Out	Adrian Rinscheid[b], Rolf Wüstenhagen[b]	Explaining the collective preference shift during the referendum campaign that led to rejection of the Swiss nuclear divestment proposal (2016)	Behavioral Economics	Statistical analysis of data from an original panel survey with n = 1'014 Swiss citizens	Published in *Ecological Economics* (Vol. 152, Oct. 2018, pp. 51-61)[f] (Impact Factor 2016: 2.965)
3	Business Power and Citizen Preferences in Contested Policy Issues — The Case of Divesting from Nuclear Power	Adrian Rinscheid[b]	Assessing the extent to which incumbent energy businesses and their political allies influenced citizens' political preferences on the Swiss nuclear divestment proposal (2016)	Interest Group Studies & Political Behavior	Mixed-methods study using Discourse Network Analysis (based on Swiss newspaper data) & a statistical analysis of data from an original survey with n = 1'014 Swiss citizens	In preparation for submission to an academic journal

Table 2. Overview of the three papers of the cumulative dissertation.

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[f] see `https://www.sciencedirect.com/science/article/pii/S0921800917313605`

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Part II

Why Do Junctures Become Critical? Political Discourse, Agency, and Joint Belief Shifts in Comparative Perspective

Adrian Rinscheid[*], *Burkard Eberlein*[†], *Patrick Emmenegger*[‡] *& Volker Schneider*[§]

Abstract

Why do junctures become critical in some cases but not in others? Building on the critical juncture framework and perspectives on the formation and diffusion of beliefs, we develop a theoretically parsimonious and empirically traceable account of divergence in institutional outcomes. By illuminating the role of agency and joint belief shifts we further open the 'black box' of critical junctures. In particular, we develop the argument that the role agents play is conditioned by conflict lines that structure an institutional field before a juncture sets in. Empirically, we trace political discourses around the 2011 Fukushima nuclear accident in Canada, Germany, and Japan using Discourse Network Analysis. Through comparative investigation, we show empirically that discursive interactions during potential critical junctures indicate institutional outcomes that are shaped by causally relevant historical legacies.

Keywords: Agency, Critical Junctures, Discourse Network Analysis, Energy Policy, Nuclear Power

1 Introduction

The nuclear accident that occurred in Fukushima, Japan, in 2011 resulted in strikingly different political dynamics in various countries. In some countries that operate nuclear power plants, such as Germany and Switzerland, the accident was followed by legal change codifying a lasting

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turn away from nuclear power. The majority of countries, however, continued to rely on nuclear energy. In Japan, opposition against nuclear power was high shortly after the accident, but the country later reverted to business-as-usual. The divergence in institutional responses to the Fukushima accident (henceforth referred to as "Fukushima") is puzzling, especially in light of the fact that the most far-reaching institutional changes were made in countries located the farthest away from where the accident occurred.

It is a well-established fact that external events such as economic crises or technological disasters increase the likelihood of non-incremental institutional change. Theories of institutional change often emphasize the role of such exogenous shocks, focusing events, or related concepts (Baumgartner & Jones 1993; Collier & Collier 1991; Kingdon 1984). Yet institutional change is obviously not a necessary response to such events, as diverging responses to the current refugee crisis in Europe or to the global economic crisis further illustrate. This prompts the question of how institutional divergence can be explained given a common stimulus.

We build upon the critical juncture framework and perspectives on agency in institutional change to advance an explanation for diverging responses across political systems to the same event. Our distinct conceptual contribution is to open up the "black box" of critical junctures in a comparative framework. Specifically, we contend that external events produce institutional change only under specific conditions. First, we emphasize the role of actor constellations and conflict dynamics that shape an institutional field before the occurrence of a critical juncture. These factors, which we call critical antecedents, determine the resources and strength of the relevant agents, and their position within an institutional field (i.e. their connections to other actors in networks). Second, we identify "joint belief shifts" (Culpepper 2005) as a necessary condition for an event to be followed by institutional change. Joint belief shifts are modeled as a collective reorientation of expectations about the rules of the game, which can be traced back to single agents that succeed in prompting collective adaptations of beliefs among the other actors in an institutional field. Hence, junctures become critical only if preexisting conditions enable agents to incite a collective reorientation of beliefs.

We study these phenomena empirically by tracing the formation and diffusion of beliefs in the arena of political discourse. The discursive arena is key to understanding how issues that gain prominence as a result of external events are transformed into political action. Thus, to make progress toward explaining the variability of the link between external stimuli and institutional outcomes, we conduct a comparative study of the discursive processes that unfold in a potential critical juncture, taking Fukushima as an example. This nuclear accident started in March 2011 when a seaquake near the Japanese east coast caused a tsunami that subsequently hit several nuclear reactors. The accident fueled debates not only about security measures, but

also about the status of nuclear power as a technology for electricity generation. Our approach offers a dynamic and actor-centered micro-foundation to institutional outcomes while capturing cross-unit differences by identifying critical antecedent conditions and productive conditions for institutional change. For our empirical analysis, we combine comparative case studies and discourse network analysis (DNA), which allows us to map and trace the evolution of actors' beliefs and actor constellations over time. In so doing, we sequence and compare political discourses in Canada, Germany, and Japan. The comparative case studies are followed by a discussion of our conceptual framework in light of the empirical analysis, which also sheds light on competing explanations.

2 Institutional Change and Critical Junctures

Rooted in historical institutionalism, critical juncture is an important analytical concept to explain incidences of institutional change and divergence. Critical junctures are episodes or events that set an institution's development onto a certain path, which then ensures, through self-reinforcing feedback, its own reproduction over time (Pierson 2000). Recently, scholars have theorized why some junctures become critical while other moments, in which change would have been possible, do not. Capoccia (2015) described episodes in which institutions are challenged as "candidate junctures." These include instances in which institutional change is enacted (critical junctures), but also "near-miss" junctures, where change does not materialize.

Critical junctures are characterized by uncertainty about the future, a condition that can be exploited by political agents to alter the course of development. During critical junctures there is thus "a substantially heightened probability that agents' choices will affect the outcome of interest" (Capoccia & Kelemen 2007, p. 348). Another line of thought emphasizes the contextual conditions necessary for specific institutional outcomes to occur during candidate junctures. Relevant context factors can be defined as initial conditions that lead probabilistically to an outcome via a specified causal mechanism (Falleti & Lynch 2009, p. 1152). Aggregating these and further conceptual works, Soifer (2012) formalized the causal logic of critical junctures by differentiating between permissive conditions, productive conditions, and critical antecedents. Permissive conditions, such as crises or disasters, are factors that "change the underlying context to increase the causal power of agency or contingency and thus the prospects for divergence" (Soifer 2012, p. 1574). The presence of permissive conditions is the defining element of candidate junctures.

For junctures to become critical, further elements need to be present. Soifer introduced productive conditions as processes that "operate within the possibility space bounded by the permissive conditions" (2012, p. 1575). Hence, while permissive conditions make institutional change possible, productive conditions shape institutional outcomes and, eventually, divergence across

cases. Productive conditions are thus analytically similar to causal mechanisms.

Finally, the possibility space of productive conditions is constrained by critical antecedents. These factors comprise causally relevant factors that characterize an institutional field before a candidate juncture sets in, and "combine in a causal sequence with factors operating during that juncture to produce a divergent outcome" (Slater & Simmons 2010, p. 889). Critical antecedents are key to understanding divergence in outcomes across cases, as cases are likely to vary in relevant causal factors before they begin to diverge.

However, other than noting that critical antecedents influence "the value taken by the productive condition," Soifer's (2012, p. 1575) framework remains unclear about how exactly critical antecedents are connected to productive conditions. Moreover, productive conditions remain black-boxed, and while permissive conditions "increase the causal power of agency or contingency," Soifer (2012, p. 1574) provides no guidance about agency in productive conditions. More conceptual work is thus needed to understand the political processes unfolding during critical junctures.

2.1 Introducing Agency

Conceptually, our key contribution is to show that causally relevant contextual factors (critical antecedents) constrain the role of agency (as part of productive conditions) during candidate junctures. Hence, our approach aims to reconcile conceptualizations of critical junctures that focus on agency and contingency with scholarship emphasizing (political or structural) context factors. By investigating both the conditions for change and the processes through which change is brought about by agents, we also respond to Schmidt's (2011, p. 9) critique that critical juncture approaches still lack a parsimonious theory of when and how actors succeed in altering the trajectory of development.

Agents do not simply appear during critical junctures. Rather, their positions within an institutional field and the main lines of conflict are conditioned by critical antecedents (Slater & Simmons 2010). Hence, when opportunity knocks, the key actors are already in place. While it is theoretically conceivable that new actors appear during a critical juncture, it is unlikely that they have the capacity to enforce institutional change. Institutional entrepreneurs need considerable resources, legitimacy, and a feasible alternative to the institutional status quo to be able to mobilize a coalition big enough to engineer institutional change (Fligstein & McAdam 2012).

Thus, while we welcome an agency-based conceptualization of critical junctures, we do not agree that focusing on critical antecedents promotes "a research program based on the causal predominance of *structural* antecedent conditions" (Capoccia 2015, p. 156). Instead, we contend that critical antecedents are *directly related to agency* by conditioning the key agents, their

position within an institutional field, and the main lines of conflict. Understood this way, critical antecedents make divergent outcomes more or less likely as a function of actors' positions and resources.

A theory of path creation needs to explain how institutional challengers are able to bring about change despite opposition from incumbents. Therefore, we have to account for the process of coalition building during critical junctures (Hall 2016). If institutions are the jointly understood rules of the game (North 1990), the principal determinant of institutional stability is the extent to which beliefs about their functioning and benefits are widely shared among agents (Culpepper 2005). Following scholars that emphasize the cognitive mechanisms behind institutional change, we therefore argue that understanding the role of agents in institutional change benefits from studying their beliefs and preferences.

Along these lines, a convincing approach was proposed by Culpepper (2005) who views institutional change as the outcome of a causal mechanism called joint belief shift. At the core of Culpepper's model are central agents that actively decide to change their beliefs with regard to the institution under examination. If these agents succeed in convincing other key actors that "their old cognitive maps are wrong" and exploit an external shock "to coordinate their future expectations around the new rules of the game," they can induce a joint belief shift that ultimately leads to institutional change (Culpepper 2005, p. 176). A joint belief shift thus consists of two components: an initial belief shift that is limited to a small number of central actors, and the collective extension of this belief shift as a cognitive process, which in Culpepper's model comes about by processes of deliberation.

Importantly, in Culpepper's (2005) model, beliefs refer to the jointly understood rules of the game, thus allowing interdependent actors to develop expectations of how others will act. Therefore, beliefs need not necessarily be the result of personal convictions that the institution is normatively justified or "right." Hence, Culpepper's (2005) model is flexible enough to accommodate situations in which actors publicly stick to the rules of the game, although they would in fact prefer institutional change. Put differently, it is possible that strategic actors are simply waiting for an opportunity to defect from the status quo. However, institutional change materializes only if this initial defection is followed by a joint belief shift, which prompts a significant number of actors to adapt their expectations about the rules of the game.

While Culpepper's (2005) model is helpful, we go beyond it in three important ways. First, the model starts from a small number of well-connected actors that defect from the institutional status quo. But it does not provide an explanation of who these actors are and why they defect in the first place. Here, we emphasize the causal relevance of critical antecedents, which, we argue, play an important role in bringing about belief shifts. Critical antecedents determine the main

lines of conflict, the distribution of resources, and the availability of cognitive alternatives prior to the permissive condition. Importantly, critical antecedents not only determine the institutional challengers, but also allow us to identify whether and which incumbents are likely to deviate from the status quo, and thereby to catalyze a joint belief shift. In particular, being exposed to alternative beliefs about the institution in question prior to the external event should make individual belief shift more likely. In addition, for the collective extension of belief shift, network positions and resources matter: the more resources agents control, and the better they are connected among incumbents, the more likely they are to trigger a joint belief shift.

Second, Culpepper (2005) portrays the collective nature of belief shift as a process of rational deliberation, asserting that actors promoting a departure from the status quo "use key events to convince each other of the validity of a common new roadmap – taking the events as evidence that the world has changed" (Culpepper 2005, p. 181). This implies a considerable time lag between the first, individual belief shift and subsequent collective dynamics. However, external shocks often lead to uncertainty, but not to rational deliberation among affected actors (Boin et al. 2009). Hence, we argue the dynamics of joint belief shift rather resemble phenomena studied in the literature on herding and information cascades. If an agent experiences belief shift and communicates this shift to others, cascade-like dynamics might be triggered if a critical mass of actors change their beliefs (Granovetter 1978). Frequently, these actors will not reassess their cognitive mindsets, but simply imitate others' behavior (Bikhchandani et al. 1992). For such a chain reaction to occur, defecting agents must be well connected in a network. Otherwise, they are not able to carry along other actors before the window for change closes (Easley & Kleinberg 2010). Once a joint belief shift encompasses a critical mass of actors, it can lead to a tipping point, where the dynamic becomes virtually unstoppable and the majority of actors turns away from the institutional status quo (Easley & Kleinberg 2010).

Third, Culpepper (2005) went to great lengths to conceptualize the processes leading to institutional change, but his methodological toolkit to empirically underpin these processes is limited. We offer to overcome this shortcoming by tracing the processes of joint belief shift with a transparent and replicable methodology (see section 3.2). In particular, to account for agency in candidate junctures, we focus on the political arena in which beliefs and preferences are exchanged and (re-)defined, and study the evolution of political discourse in reaction to external events. Thus, our approach takes up Schmidt's (2011) contention that the communication of ideas via discourse is key to explaining institutional change.

2.2 Summary

In sum, we propose a theoretically parsimonious and empirically traceable approach for the analysis of institutional change. It consists of four components (Fig. 1).

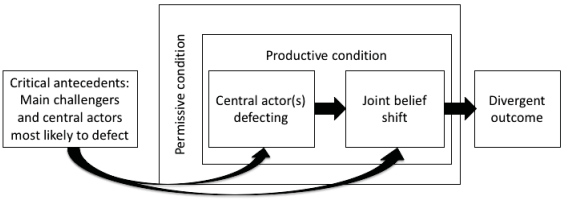

Figure 1. Framework for the analysis of institutional change during critical junctures.

First, we need to identify the permissive condition that increases the causal power of agency and thus the prospects for divergence. Typically, the permissive condition strengthens the institutional challengers vis-à-vis the incumbents.

Second, we need to analyze differences in actor constellations and conflict dynamics before the permissive condition (critical antecedents). Institutional change is only a realistic possibility if reasonably well organized and resourced challengers are present prior to the permissive condition.

Third, turning to the productive condition, we need to examine to what extent central actors shift their beliefs and expectations in response to the permissive condition. Critical antecedents enable the identification of actors most vulnerable to defection, yet central to the maintenance of the status quo.

Fourth, we need to analyze whether and how individual belief shifts trigger collective dynamics. Importantly, critical antecedents inform us about the resources and the capacity to mobilize both challengers and incumbents. If the challenge to the institutional status quo is not sustained for a critical period of time, the incumbents are likely to exercise sufficient pressure on defecting actors to make them comply again.

Thus, a key contribution of our model is to show that the third and fourth components (productive condition) are dependent on the second component (critical antecedents). Critical antecedents play a key role in influencing whether candidate junctures give rise to institutional change once the permissive condition has reached a certain threshold and thus opened the window for change.

3 Comparative Case Studies: Policy Discourses and Responses to Fukushima

3.1 Case Selection

To assess our theoretical arguments empirically, we analyze political discourses relating to Fukushima in Canada, Germany, and Japan. Three reasons guide our case selection. First, following Soifer (2012), the permissive condition must be present in each case to comparatively test critical juncture arguments. Therefore, we assess whether Fukushima, the permissive condition, was noticed in the three countries. Figure 2 shows public attention to nuclear power in Canada, Germany, and Japan using a google trends search for two keywords in each country. In line with the observation that the "world's media were transfixed" by Fukushima (Downer 2014, p. 287), Figure 2 highlights that nuclear power was a topic of wide search activity shortly after the accident in all three countries.

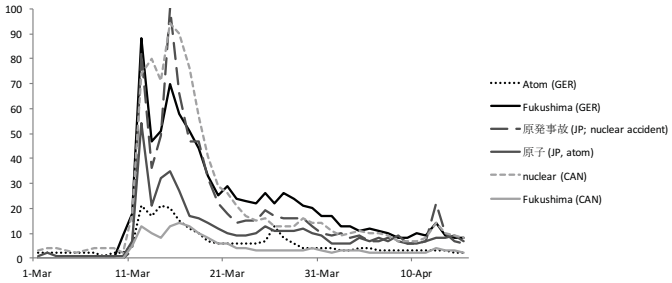

Figure 2. Public attention to nuclear power in Canada, Germany, and Japan.
Note: The diagram illustrates search interest on google for terms related to nuclear power (1 March – 15 April 2011). The value '100' is the peak popularity across all terms and was reached by 原発事故 ("nuclear accident") on 15 March 2011, in Japan. *Source*: Google trends.

Second, to rule out rival explanations for institutional divergence, we selected cases that are similar in terms of several relevant characteristics. Canada, Germany, and Japan are not only similar in terms of their level of economic development, but also regarding their technological risk profiles related to nuclear power. A proxy for technological risk is the ratio of installed reactors for electricity generation and the population size of a given country. Figure 3 illustrates that prior to Fukushima, the three countries were not only located at a similar level of risk, but also relied on nuclear power to a similar degree.

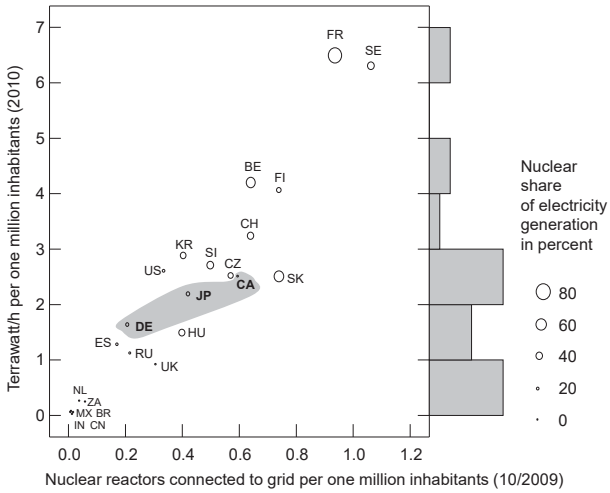

Figure 3. The risk of a nuclear catastrophe.
Note: The figure shows the level of technological risk related to nuclear power for all Organisation for Economic Co-operation and Development countries with nuclear plants connected to the grid (pre-Fukushima). The histogram on the right indicates the number of countries located at specific risk levels. Source: OECD (2010; 2013)

Moreover, countries differ in political, administrative, and infrastructural capacities by which the impacts of disasters can be mitigated and eventually overcome. Table 1 shows indicators measuring institutional and critical infrastructural capacities. Capacity values for these important facets of coping capacity are very similar in all three countries, indicating that they have comparable coping capacities in the case of disasters.

Third, we contrast Germany as a case of institutional change with Canada and Japan as negative cases. This comparative approach yields substantial analytical leverage in explaining why there is no institutional change in instances where such choices are, in principle, available to decision makers.

	Canada	**Germany**	**Japan**
Institutional	2.3	2.4	2.0
Infrastructural	2.3	0.7	1.1

Table 1. Coping capacities in the context of disaster preparedness.
Note: Capacity levels are indicated by values between 1 and 10 (low values indicate well-developed capacity). Source: INFORM Index for Risk Management (values for 2012, the first year of publication; see: http://www.inform-index.org/; accessed 20.07.2017).

3.2 Discourse Network Analysis: Method and Data

Policy actors communicate their beliefs and preferences in the news media. A systematic way to empirically trace the resulting discourse is provided by discourse network analysis (Leifeld 2016; 2017). Applying DNA, we comparatively study actor constellations and conflict dynamics before and after Fukushima. We obtained discourse data from three newspapers: *The Globe and Mail* (Canada), *Süddeutsche Zeitung* (Germany), and *The Japan News* (Japan). All three newspapers were selected according to the "quality press" criterion (Barranco & Wisler 1999); that is, they represent general news-oriented papers of high reputation and are known to be politically moderate. Compared to other data sources, quality newspapers can be assumed to capture the broadest array of actors participating in a political debate. Moreover, as newspapers are published regularly and frequently, they can generate a reliable base for systematic empirical investigations over time. While consideration of a second newspaper for each case might have attenuated any remaining media bias, our analysis would run into problems regarding double coverage of events (Leifeld 2016). Generally, the benefit from adding further sources is limited (Barranco & Wisler 1999).[1]

The unit of analysis is the statement. To document beliefs regarding nuclear power policy, we contentanalyzed all identified articles that were published within the period of investigation. Based on a fine-grained coding manual, each statement was coded manually according to five variables:[2]

- the date when the statement appeared
- the name of the actor who made the statement (considering individual and collective actors)
- the actor's organizational affiliation
- the concrete belief or preference revealed in the statement
- whether the actor approved or rejected the respective claim

In line with our conceptualization of beliefs in reference to the institution under examination, measuring claims does not assume that they reflect actors' "true" convictions about nuclear power. Thus, we remain agnostic about whether the measured claims represent ideational beliefs about nuclear power, strategic preferences, or other constructs. But we assume that these claims can ultimately be interpreted as beliefs about the social rules of the game.

[1] For more detailed information on the methodology, see Appendix A.

[2] See the coding manual (Appendix B). We used "discourse network analyzer" for coding (see https://github.com/leifeld/dna). Four coders were involved. For each case, the main coder was a native speaker.

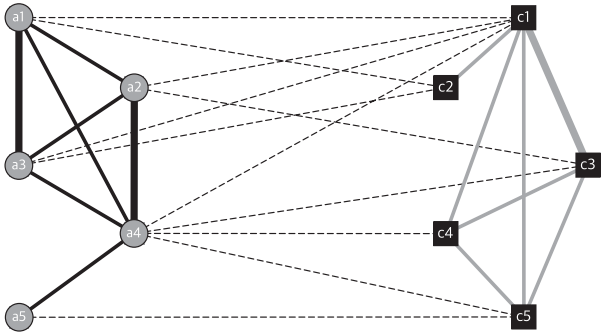

Figure 4. Basic model of Discourse Network Analysis, based on Leifeld (2016).
Note: Circles symbolize actors, boxes indicate concepts. The relations between actors (a1, a2 etc.) and claims or concepts (c1, c2 etc.) represent the affiliation network. For example, the presence of a line between a2 and c3 indicates that actor a2 mentioned the claim c3. Lines between actors (concepts) represent the actor (concept) congruence network.

Figure 4 illustrates the basic discourse network model. Transformations of discourse data can generate various network types. We rely in particular on sequential actor congruence networks to systematically analyze actor configurations and conflict structures over time. These graphs contain a set of actors that are linked based on the similarity of their cognitive maps (see the lines between gray circles in Fig. 4). The more densely connected two actors are (depicted by line width), the more beliefs they share. The same general logic can be applied to claims. In concept congruence networks, concepts (or claims) are interconnected based on their congruence; that is, their being mentioned by the same actors (see the lines between boxes in Fig. 4). As our interest lies more with the frequency of claims than their grouping into clusters, our analysis makes use of simple bar graphs.

Our case studies are based on sequential pre-post-comparisons of policy discourses around the onset of the permissive condition. For each case, we investigate the pre-Fukushima discourse based on one actor congruence network and the corresponding bar graph of claims. To draw meaningful inferences about potential lines of conflict, we had to go back in time to a varying degree. Whereas nuclear power was a much-discussed topic in Germany before Fukushima, the number of claims made in Japan and Canada was lower. Thus, longer pre-Fukushima periods of investigation are necessary for Canada (20 months) and Japan (12 months) than for Germany (6 months). For the post-Fukushima analysis, the case studies are based on two further time slices. The cutoff points (depicted by dashed lines in Figs 5–7) were chosen based on two criteria. First, case-specific relevant political events guide the periodization of discourses in Japan and Germany (see Fig 5 and 7 captions). Second, because of the lack of significant political reactions in Canada,

	Canada	Germany	Japan
Period of Investigation	30 June 2009 – 7 August 2013	1 September 2010 – 1 July 2011	1 March 2010 – 17 December 2012
Articles	45	313	200
Articles/Day	0.03	0.86	0.55
Statements	187	1,203	566
Actors	117	284	172

Table 2. Media coverage of nuclear power policy.

we identified a two-month time window in which the number of claims per day was substantially heightened. During the third period, which starts two months after the accident, the number of claims was again almost as low as before Fukushima (Fig. 6).

While the pre-Fukushima discourse networks illustrate the lines of conflict before the crisis and are thus directly comparable across cases, the comparability of post-Fukushima networks is more limited. However, they are analytically equivalent in the sense that the first post-Fukushima time slice entails the immediate crisis discourse, while the last period captures the policy discourse leading to institutional change (Germany) versus stability (Canada and Japan). In total, our analyses rely on 1,956 statements conveyed in 558 newspaper articles (Table 2). The ratio of articles per day highlights the difference in discourse density across cases, which ranges from 3 (Canada) to 86 (Germany) articles per 100 days. We complement the discourse analysis with in-depth process evidence using primary and secondary sources (e.g. politicians' speeches, published academic articles).

3.3 Japan

3.3.1 Pre-Fukushima Actor Constellation and Conflict Dynamics

Japan's political economy is marked by strong state involvement in economic planning and a sticky form of sectoral differentiation (Lehmbruch 1995). In the institutional field of nuclear power, these characteristics led to close sectoral ties between policymakers, regulators, government agencies, the nuclear industry, and utilities (Kingston 2013). The so-called "nuclear village" had been unchallenged since the 1950s, when Japan started its nuclear power program. Moreover, as the Japanese government has nurtured three global players of nuclear power plant manufacturing (Hitachi, Mitsubishi, and Toshiba) and has the world's largest nuclear research program, the nuclear village was further backed by large numbers of scientists, engineers, and technicians (Valentine & Sovacool 2010), as well as the financial sector, the judicial branch, and the mass media.

Public opposition against nuclear power has generally been low (Tanaka 2004). Valentine and

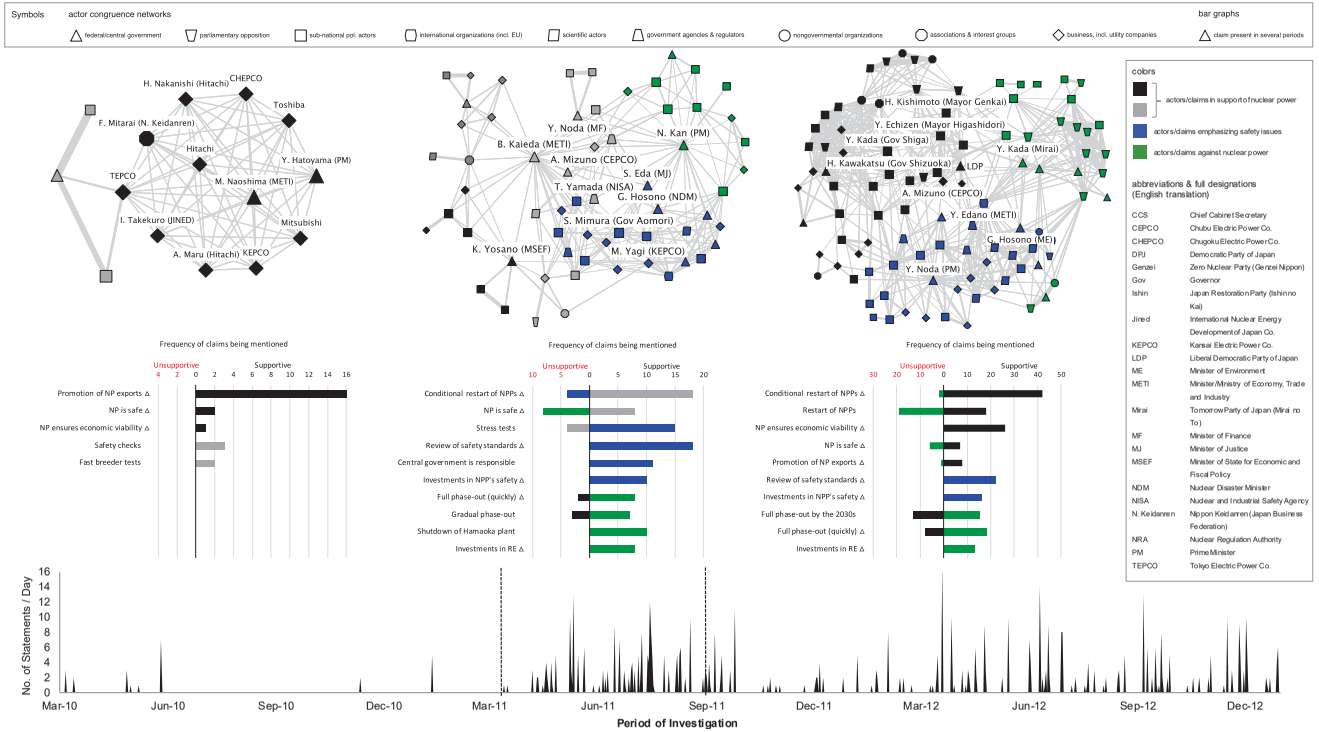

Figure 5. Japan: Evolution of the nuclear power policy discourse.

Note: Networks show actor constellations (first row) and bar graphs show most frequent claims (second row) before Fukushima (left panels, 1–11 March 2010), shortly thereafter (middle, 12 March to 31 August 2011), and during the Noda administration (right panels, 1 September 2011 to 17 December 2012). The cutoff date between phase 2 and 3 corresponds to the change in government. In the network graphs, node size corresponds to closeness centrality. Ten nodes with highest closeness centrality values in the respective time period are labeled. Node colors are based on iterative conductance cutting cluster analysis, applied to the actor congruence networks. Input thresholds: α^*_1: n.a.; α^*_2: 0.25; α^*_3: 0.15. Graph layout is based on stress minimization of graph-theoretic distances; graphs were drawn with visone (Brandes & Wagner 2004). In the bar graphs, claims are arranged in the order of frequency mentioned. Discourse density is depicted at the bottom. The x-axis maps the period of observation, the y-axis entails the number of statements/day. The dashed lines depict the cutoff points for the discourse networks.

Sovacool assert that an ideology of self-sacrifice that centers on economic growth explains the "high degree of apathy toward risky technological developments such as nuclear power" (2010, p. 7976). Although anti-nuclear activists have occasionally been elected as local councillors in municipalities, no well organized challengers to the status quo were present before 2011. These socio-political antecedents are well reflected in the pre-Fukushima actor congruence network (Fig. 5, top left panel). Between March 2010 and March 2011, the political discourse on nuclear power was dominated by a hegemonic coalition. In the actor congruence network, this is reflected in the dense interconnections between almost all actors. While the links between actors indicate that actors share certain beliefs or preferences, the spatial distance between the nodes has no meaningful interpretation (Leifeld 2016).[3]

Represented in the first actor congruence network are important players of the nuclear industry, the utilities, the powerful business federation Nippon Keidanren, and governmental actors. All of these actors shared beliefs in support of the institutional status quo. The most important claim was that Japan should contribute to a nuclear renaissance by exporting its technology. In the corresponding bar graph, this is illustrated by the bar for "Promotion of NP exports." Other claims include the necessity of regular safety checks, calls for testing a prototype fast-breeder reactor, and the reassurance of nuclear power being a safe technology suited to ensure Japan's economic viability.

3.3.2 Post-Fukushima Beliefs and Actor Constellations

To what extent have central actors changed their beliefs and expectations in response to Fukushima? Right after the accident, the actor constellation became more fragmented and the cohesion of the nuclear village was replaced by patterns of conflict between three discourse coalitions (Fig. 5). In the second actor network, the black and gray nodes represent the status-quo-coalition, whose members continued to express beliefs supportive of nuclear power generation, including claims about "safe nuclear power." Some of these actors demanded a rapid restart of reactors suspended in the wake of Fukushima and opposed any nuclear phase-out scenarios (see the corresponding bar graph in Fig. 5). The second coalition, depicted by the blue nodes in the second actor network, represents nuclear proponents calling for stress tests and a review of safety standards. This coalition consisted predominantly of local authorities and big utility companies. The members of

[3] We used the iterative conductance cutting (ICC) algorithm to decompose actor networks into coalitions. This method iteratively splits a network into clusters based on minimum conductance cuts (Kannan et al. 2004). An advantage of this technique is its adaptivity: depending on an input threshold α^* calibrated by the researcher, a graph can be decomposed with varying granularity. Based on in-depth knowledge of the cases under investigation, α^* can be calibrated in an exploratory way. This is particularly useful in combination with DNA, a method with roots in qualitative discourse analysis. In the first actor congruence network, ICC yields two clusters, the members of which are depicted by black and gray nodes, respectively. The actors of both clusters belong to the "nuclear village," but their claims refer to specific subdimensions of the political discourse. In the corresponding bar graph, the colors indicate the cluster from which a claim originates.

this "safety coalition" voiced the majority of claims during this phase.

However, belief shift was confined to a third coalition represented by the green nodes. This group comprised some businesses and political actors from the federal and subnational levels. They contested the nuclear village's core belief of "safe nuclear power," and instead called for a transformation of the energy system, including a nuclear phase-out and investments in renewable energies.

Importantly, among the few actors who challenged the status quo was Prime Minister Kan. He articulated Fukushima's role as a game changer for the first time on 19 April 2011, and reiterated this view in a press conference on 13 July 2011:[4]

> *"Until the experience of the nuclear incident on March 11, my policy on nuclear power had been that it should be utilized, while ensuring safety [...] However, given my own experiences of this large-scale nuclear incident [...], I realized the scale of the risks involved [...] These thoughts led me to conclude that [...] we should reduce our dependence on nuclear power in a planned and gradual manner and aim to realize a society in the future where we can do without nuclear power stations."*

As argued earlier, challengers need to be well connected to trigger joint belief shifts. Formally, such connectedness can be measured by closeness centrality. This measure expresses the number of the shortest paths that lie between a node and all other nodes in a graph. In an actor congruence network, an actor's closeness centrality can be interpreted as her degree of discursive integration: the higher an actor's closeness centrality, the lower the distance of her set of beliefs to the beliefs held by all other actors in the network. Theoretically, we would expect that if actors that experience belief shift have high closeness centrality, they are potentially in a position to convince many other actors in the network that changing the status quo is the "right" thing to do.[5] Based on our first post-Fukushima discourse network, Table 3 lists the 10 most central actors. As the numbers indicate, the Prime Minister's institutional centrality was mirrored by high closeness centrality in the crisis discourse. However, two members of government had even higher centrality values. Further central actors include members of government, representatives from utilities and the nuclear regulator, and a politician from the subnational level.

Despite a high degree of discursive integration, the Prime Minister was not able to unleash collective dynamics of belief shift among incumbents. As Table 3 shows, none of the other central actors substantially changed their beliefs. Remarkably, members of the ruling Democratic Party of Japan (DPJ) were present in all three post-Fukushima discourse coalitions. The antagonism between the most central actor, the Minister of Economy, Trade, and Industry (METI),

[4] http://www.kantei.go.jp/jp/kan/statement/201107/13kaiken.html (accessed 26.06.2018).
[5] See Freeman (1979) on closeness centrality.

Actor	Closeness Centrality	Belief Shift
B. Kaieda (Minister of Economy, Trade & Industry)	2.43	no
G. Hosono (Nuclear Disaster Minister)	2.02	no
N. Kan (Prime Minister)	2.00	yes
S. Mimura (Governor of Aomori)	2.00	no
A. Mizuno (Chubu Electric Power Co.)	1.90	no
M. Yagi (Kansai Electric Power Co.)	1.90	no
S. Eda (Minister of Justice)	1.90	no
T. Yamada (Nuclear and Industrial Safety Agency)	1.89	no
K. Yosano (State Minister for Econ. & Fiscal Policy)	1.86	no
Y. Noda (Minister of Finance)	1.86	no

Table 3. Belief shift among 10 most central individual actors in the post-Fukushima discourse.
Note: Based on 203 statements (12 March to 31 August 2011). The third column indicates whether the respective actor expressed the belief "Fukushima changed the conditions for nuclear power."

Kaieda, and Prime Minister Kan illustrates the contestation within the DPJ. Representing opposing visions of Japan's future energy system, Kan and Kaieda differed in their interpretions of Fukushima. Kaieda connected calls for necessary safety improvements with the claim that nuclear power should remain a major pillar of energy supply, whereas Kan called for immediate stress tests while envisioning a complete nuclear phase-out in the long term.

Importantly, the Prime Minister, who had also been part of the incumbent coalition before, lost his ties to powerful political and business actors of the nuclear village. In this phase, the Liberal Democratic Party (LDP) worked hard behind the scenes to further destabilize the DPJ cabinet. Despite facing a no-confidence vote, Prime Minister Kan managed to organize the passage of a feed-in-tariff bill to promote renewable energies and thus carried through a major policy measure to open up the extremely enclosed power sector. But he had to resign before plans for a nuclear phase-out could be established.

3.3.3 Bottom Line: Continued Polarization and the Last Opportunity for Major Change

During the term of Kan's successor Noda (DPJ), the discourse was marked by continued polarization. While nuclear phase-out demands were still articulated, beliefs in support of the institutional status quo, such as the conviction that "nuclear power ensures economic viability" and demands to restart suspended reactors were appearing more often (Fig. 5, right panel). The last opportunity to exploit the permissive condition for change closed in autumn 2012, when the new Minister for Economy, Edano, worked toward a comprehensive energy policy reform, including a gradual nuclear phase-out. Yet after the plan had been endorsed by the DPJ, Japan's largest business associations lobbied the government not to adopt any concrete measures. Indeed, Prime Minister

Noda backpedaled and postponed the reform. These developments were a significant victory for the incumbents (Kingston 2013). A minor reform was nevertheless enacted in September 2012 when the Diet passed legislation for the establishment of the new Nuclear Regulation Authority. In December 2012, the LDP won the parliamentary elections. With its pro-nuclear program, the return to power of the LDP signifies the closure of the candidate juncture.

3.4 Canada

3.4.1 Pre-Fukushima Actor Constellation and Conflict Dynamics

Canada's political economy is pluralist, including government-industry relations in the energy sector (Eberlein & Doern 2009). The field of nuclear power, however, is an exception. Lodged mainly at the subnational level of Ontario, it is characterized by a tight sectoral alliance between government, industry, scientists, and unions. This actor constellation is similar to the nuclear village in Japan.

While Mez and Doern note that in Canada "nuclear policy was never a central feature of overall national industrial or energy policy nor in any consistent way to national environmental policy" (2009, p. 143), lesser political centrality and contention and a strong regional focus on Ontario should not be mistaken for a lesser nuclear industry. On the contrary, Canada has a long nuclear tradition, through its involvement in American-led wartime atomic bomb research and thanks to its large uranium reserves. From it emerged Canada's home developed Canada Deuterium Uranium (CANDU) reactor. Until recently, nuclear policy evolved exclusively in the public sector as a "partnership between the federal government and the province of Ontario" (Bratt 2012, p. 141). Atomic Energy of Canada (AECL), a federal crown corporation, developed the CANDU reactor, while Ontario, the most populous province, built and operated reactors for electricity generation, in the context of a government-run utility sector – with limited public attention, let alone controversy.

This configuration is reflected in the sparse pre-Fukushima discourse network. The nuclear power policy discourse in Canada was limited to a few actors in the public realm (Fig. 6, left panel). During the 20 months before Fukushima, it was dominated by a powerful pro-nuclear coalition that coalesced around the belief that "nuclear power is safe." In addition to government and industry players, this coalition included nuclear scientists and the union (CNWC) that represents workers in the nuclear industry (2012 2012, p. 25). Canadian public opinion has always been divided about the use of nuclear power. There is a territorial division between a majority pro-nuclear Ontario (56 percent support in March 2010) where the industry and its jobs are concentrated, and the rest of Canada. Quebec shows the lowest level of support at 18 percent in March 2010 (Jenkins Research 2011).

Since the 1970s, there has been an anti-nuclear coalition whose core belief is that "nuclear reactors are unsafe." But this opposition is much less organized and resourced than in Germany and was thus marginalized in the discourse prior to Fukushima. While there is a core of dedicated anti-nuclear groups – the Canadian Coalition for Nuclear Responsibility serving as the umbrella organization – the key actors are found in environmental organizations (Pembina, Sierra Club, and Greenpeace).

Challenges to the dominant pro-nuclear policies emanate more from business arguments than from this environment-political opposition. Firstly, major cost overruns and management failures at the Ontario utility company in the 1990s have plagued the nuclear fleet, tarnishing its image and causing cost increases to consumers. Secondly, the electricity sector restructuring in the early 2000s increased fuel-to-fuel competition, putting into question the commercial viability of further investments into nuclear. In fact, in 2013, the provincial government shelved any plans for nuclear expansion. These developments provide business-case arguments to the nuclear sceptics. At the same time, the decision made by the Ontario government to phase out coal-fired generation makes any move away from nuclear very difficult.

3.4.2 Post-Fukushima Beliefs and Actor Constellations

The first post-crisis time slice ends two months after Fukushima, where the political discourse reached near-pre- Fukushima density levels (Fig. 6). The two-month window after the accident shows a striking densification and an interesting differentiation of the discourse. Clearly, the accident had the effect of elevating nuclear policy to a national issue of debate.

Yet the pro-nuclear coalition remained intact, with the provincial and federal government defending the benefits of nuclear power. Some individual belief shift notwithstanding, there is neither any indication of central actors defecting from the pro-nuclear coalition, nor, consequently, of a joint belief shift. However, a notable change in this actor group is a shift in emphasis regarding the safety topic.[6] Shortly after the accident, the federal industry regulator, the Canadian Nuclear Safety Commission (CNSC), launched a review of all nuclear facilities, which resulted in an action plan to "further strengthen the safety of nuclear power plants."[7] There was also recognition among some government and industry players, including Ontario Power Generation (OPG, which operates most reactors) that "Fukushima has changed the conditions" – although this simply meant to imply that the industry would be held to higher safety standards in the future.[8] On

[6] In the second actor network (Fig 6), the blue nodes represent pro-nuclear actors who urge for a "review of safety standards."

[7] http://nuclearsafety.gc.ca/eng/resources/fukushima/ (accessed 28.06.2018).

[8] See the speech in May 2011 of Wayne Robbins, Chief Nuclear Officer at OPG: http://www.opg.com/news-and-media/Documents/Wayne%20Robbins%20Ontario%20Power%20Summit%20May%2010%202011%20FINAL%20%28u%29.pdf (accessed 28.06.2018).

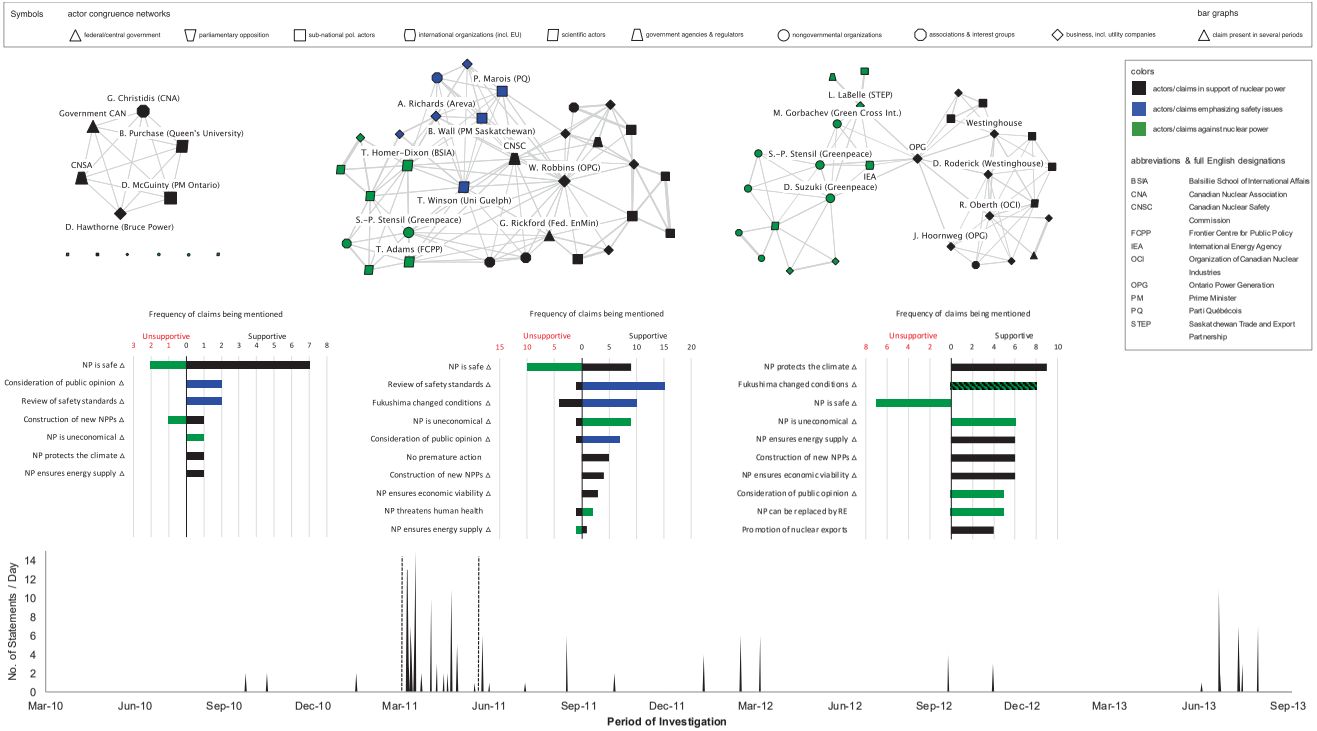

Figure 6. Canada: Evolution of the nuclear power policy discourse.
Note: Networks show actor constellations and bar graphs show most frequent claims before Fukushima (left panels, 30 June 2009 to 11 March 2011), shortly thereafter (middle, 12 March to 12 May 2011), and two months after the accident onwards (right panels, 13 May 2011 to 7 August 2013). Isolates are not labeled. Input thresholds (cluster analysis): α^*_1: n.a.; α^*_2: 0.25; α^*_3: 0.25. Further elements similar to Figure 5.

the skeptical and anti-nuclear side, we see an increase in the number of actors and in the degree of discursive coordination. In addition to the traditional concern about safety, the topic of "nuclear is uneconomical" gained in importance during this phase.

3.4.3 Bottom Line: The Advent of Polarization - But no Joint Belief Shift and Institutional Change

Looking at the last actor congruence network that captures the following two-year long period, we see a clear polarization of the discourse and an emergence of two coalitions. This situation is strikingly different from the pre-Fukushima picture, where the anti-nuclear coalition was marginalized. Post-Fukushima, it includes not only the usual actors from environmental public interest groups and academic supporters, but also connections to the growing renewables industry in Ontario (Canadian Solar) and to the Ontario Ministry of the Environment. Interestingly, OPG is situated as a "policy broker" between the two coalitions and the theme of "Fukushima changed the conditions" operates as a bridge.

This constellation may reflect the rapid expansion of the renewables sector, through generous feed-in tariffs for renewable suppliers. OPG as provincial power producer takes a more balanced view of its generation portfolio, giving a larger role to renewables, while the share of nuclear is projected to drop below 50 percent. That said, given the coal phase-out, nuclear power will cover a large portion of Ontario's electricity needs into the mediumterm. Crucially, the heightened prominence of climate change bolsters the role of nuclear power: "nuclear power protects the climate" becomes the central pro-nuclear claim during this phase. Also, public opinion support in Ontario remains stable even after Fukushima.

To be sure, the new polarization indicates the considerable growth of nuclear sceptics. However, while there has been some adaptation in terms of safety standards, central actors have not shifted their beliefs so that institutional change through cascading dynamics lacked any basis. Bratt therefore noted presciently that Fukushima "does not appear to have altered the nuclear agenda of any of the policy brokers in Canada" (Bratt 2012, p. 292).[9]

3.5 Germany

3.5.1 Pre-Fukushima Actor Constellation and Conflict Dynamics

Like Japan, Germany launched its nuclear program in the 1950s. Publicly financed research centers and big corporations like AEG, Siemens, and ThyssenKrupp led the way in the emerging

[9] Addressing the case of Quebec, Bratt writes: "Only in Quebec was there an apparent policy reversal resulting from Fukushima-Daiichi when the Charest government delayed the refurbishment of Gentilly-2 [. . .]. However, even in Quebec, this simply reflected a stronger antinuclear sentiment that had existed in the province before Fukushima-Daiichi" (2012, p. 291).

industry (Jahn & Korolczuk 2012). While public support for the technology was initially high, it started to wane in the 1970s, when localized anti-nuclear protests that were rooted in the broader environmental movement gained nationwide attention. The anti-nuclear movement even altered the party system, giving rise to the Green Party, which gained representation in Parliament in 1983.

In response to the Chernobyl catastrophe in 1986, the German Social Democratic Party (SPD) became the second political party to challenge the nuclear trajectory (Sozialdemokratische Partei Deutschlands 1989, 40). After having formed the first joint coalition government in 1998, the SPD and the Greens seized the opportunity to carry out a major shift in 2000. According to the so-called *Atomkonsens* (nuclear consensus), an agreement with the utilities, the last nuclear power plant was to go offline in the 2020s.

However, conservatives and liberals remained supportive of nuclear throughout. After retaking office in 2009, they passed an amendment to the Atomic Energy Act in October 2010, which codified the lifetime extension of 17 nuclear reactors. This reversal of the previous phase-out policy implied a notable setback to the ongoing transformation of the energy system (Jahn & Korolczuk 2012).

This decision provides the context for the political discourse around Fukushima. Including six months before the accident, the constellation shown in the first actor congruence network (Fig. 7, top left) mirrors the polarization of the policy sector. Nuclear advocates (located in two cliques in the north-west of the network), such as the big utilities and conservative and liberal politicians, were united by claims that "nuclear power is safe" and demanded a lifetime extension, framing nuclear power as a "bridging technology" into a carbon-free energy system. This coalition was outnumbered by challengers to the status quo. One part of the challenger coalition represents the "traditional" anti-nuclear opposition (depicted by green nodes in Fig. 7), which denounced the strong influence of the nuclear industry in the decision to extend the operating lifetimes. The other part represents a more recent actor group critical of a centralized electricity supply system (orange nodes). This group relies more on business-case arguments. The latter includes public utilities and renewable energy associations, as well as traditional political actors. The discursive dominance of the anti-nuclear coalition reflected the public mood, as two thirds of the population opposed the lifetime extension in September 2010 (Forschungsgruppe Wahlen 2010).

3.5.2 Post-Fukushima Beliefs and Actor Constellations

Turning to the productive condition, we examine the extent to which central actors have shifted their beliefs in response to Fukushima. Table 4 lists the 10 most central participants of the post-Fukushima discourse that had supported the lifetime extension of reactors implemented in Oc-

Actor	Closeness Centrality	Belief Shift
A. Merkel (Chancellor)	1.35	yes
M. Söder (Minister for the Environment, Bavaria)	1.26	yes
C. Lindner (Free Democratic Party)	1.12	yes
S. Mappus (Minister-President, B.-Württemberg)	1.12	yes
N. Röttgen (Minister for the Environment)	1.10	yes
M. Fuchs (Christian Democratic Union)	1.05	yes
H. Seehofer (Minister-President, Bavaria)	1.04	yes
H. Gröhe (Christian Democratic Union)	1.02	yes
G. Westerwelle (Minister for Foreign Affairs)	1.01	yes
V. Bouffier (Minister-President, Hesse)	1.01	yes

Table 4. Belief shift among 10 most central individual actors in the post-Fukushima discourse (only incumbent coalition). *Note*: Based on 456 statements by actors representing the incumbent coalition (12 March to 8 April 2011). The third column indicates whether the respective actor expressed the belief "Fukushima changed the conditions for nuclear power."

tober 2010. During this phase, the discourse was dominated by politicians from the government parties.

Remarkably enough, all central policymakers acknowledged that "Fukushima changed the conditions." Why did so many actors from the conservative–liberal government suddenly start to articulate claims for major institutional change? Assessing the process in more detail, it becomes clear that this development was triggered by Chancellor Merkel. Three days after the earthquake, on 14 March 2011, Merkel announced a moratorium on the lifetime extension, pointing out that:

> *"There is one overriding reason why the government [...] cannot simply proceed with business as usual: the incredible events in Japan teach us that something that was considered impossible by all scientific standards finally happened. They teach us that risks that were considered highly unlikely were in fact not entirely unlikely, but became reality. If [...] in a highly developed country like Japan, the seemingly impossible becomes possible [...], then this changes the situation."* (Merkel 2011, our translation)

Strikingly, there was little disagreement about this reassessment among other government actors. Figure 8 illustrates the diffusion of beliefs skeptical of the institutional status quo among members of the incumbent coalition. Starting on 14 March, it took only three days until such beliefs had been voiced by a large number of previous promoters of nuclear power. The period between the first signal of change, emitted by the chancellor, and the breakdown of incumbents' old cognitive maps was thus remarkably small.

There has been some debate about whether Merkel's decision was informed by a reassessment

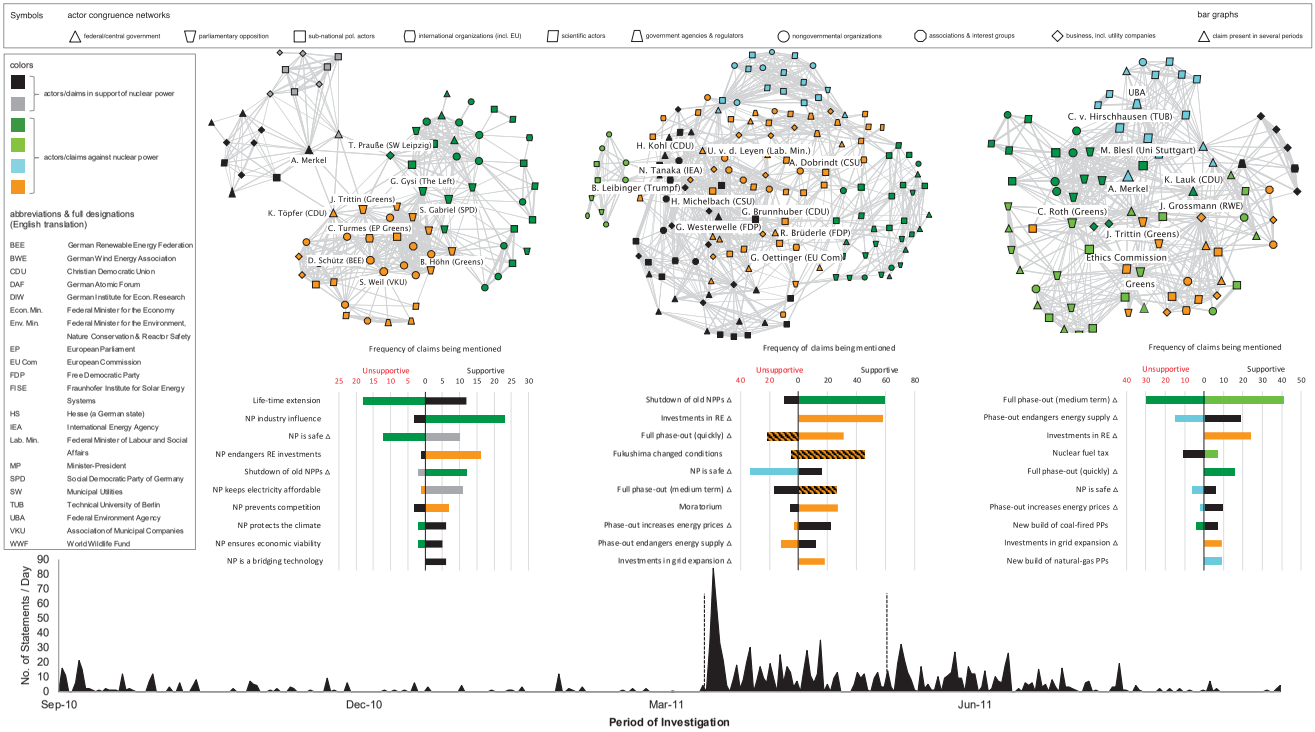

Figure 7. Germany: Evolution of the nuclear power policy discourse.
Note: Networks show actor constellations and bar graphs show most frequent claims before Fukushima (left panels, 1 September 2010 to 11 March 2011), shortly thereafter (middle, 12 March to 18 May 2011), and until the Bundestag's phase-out decision (right panels, 19 May to 1 July 2011). The cutoff date between phase 2 and 3 was chosen because the immediate crisis discourse came to an end with the publication of the final report by the Reactor Safety Commission on 17 May. The third phase entails the discourse until the final phase-out vote on 30 June. Input thresholds (cluster analysis): α^*_1: 0.20; α^*_2: 0.25; α^*_3: 0.25. Further elements similar to Figure 5.

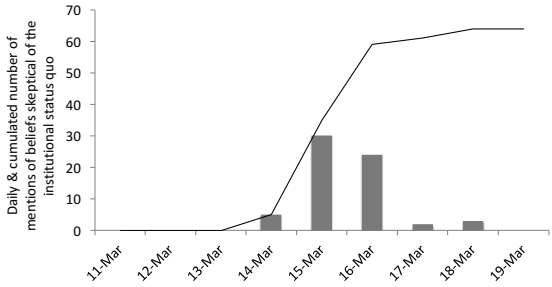

Figure 8. Diffusion of nuclear-skeptic beliefs among members of the incumbent coalition (Germany).
Note: Bars illustrate daily mentions of beliefs skeptical of institutional status quo voiced by members of the pro-nuclear coalition (11–19 March 2011; Süddeutsche Zeitung). The line shows the cumulated mentions of these beliefs.

of the risks of nuclear power versus a reassessment of the risks of electoral punishment (Nullmeier & Dietz 2012). While it is impossible to decipher the true motives of any actor, there can be no doubt that Fukushima shattered the cognitive underpinnings of holding onto the status quo.

What made Merkel's defection from the status quo possible? A focus on actor constellations and conflict lines helps to answer this question. Importantly, the institutional field of nuclear power was heavily contested prior to the permissive condition, and the challenger coalition had been a strong voice in environmental politics for decades. Thus, a feasible and forceful alternative was available. Moreover, in a comparative perspective, the ties between policymakers, regulators, utilities, and the nuclear industry were much looser than, for instance, in Japan. Looking more closely at individual agents, it is of note that the German chancellor was one of the few incumbent actors with direct ties to challengers of the status quo before Fukushima (Fig. 7). In addition, Merkel had rather reluctantly supported the lifetime extension in October 2010. These critical antecedents increased the likelihood for the chancellor to change course. The following paragraphs look more closely at the processes leading up to the enactment of institutional change.

3.5.3 Bottom Line: Collective Dynamics of Belief Shift Lead to Major Institutional Change

According to the bar graph, for the first two months after Fukushima (Fig. 7), preferences for a nuclear phaseout and for investment in renewable energies dominated the discourse, whereas pro-nuclear claims were marginalized.[10] The corresponding actor network illustrates the erosion of the pre-Fukushima bipolarization. During this phase, the discourse became fragmented, as diverse policy proposals emerged that differed with regard to details of the nuclear phase-out

[10] In the second actor graph (Fig 7), orange, green, and blue nodes represent actors calling for institutional change, based on the claims depicted in the corresponding bar graph. Black nodes represent incumbents cautioning against change. The dashed bars (orange/black) illustrate that claims made by proponents versus opponents of institutional change temporarily overlapped.

(e.g. the exact timing). Moreover, pro-nuclear advocates like the chief executive officers of nuclear utilities RWE and E.ON, Grossmann and Teyssen, pursued a double-edged strategy. On the one hand, they acknowledged Fukushima's game-changing character; on the other, they tried to halt the consolidation of pro-change claims by offering arguments about nuclear power's benefits (such as low energy prices). Yet these attempts were unsuccessful for two reasons. Firstly, members of the incumbent coalition, while accommodating utilities' demands not to rush any decisions, still supported a phase-out. Secondly, the chancellor appointed an "ethics commission for a secure energy supply" to address public demands for institutional change (Schreurs 2013). By shifting the decision venue to this expert body, Merkel solidified her belief shift, while simultaneously weakening the last notable voices within the formerly pro-nuclear coalition (Rinscheid 2015).

The last actor network sheds light on the consolidated energy policy consensus. During this period, the discourse comprised many bridging actors connecting the various proposals for the transformation of the electricity generation portfolio. Correspondingly, pro-nuclear claims remained rather marginalized, as can be inferred from the bar graph. Given their pre-Fukushima support for a lifetime extension, the approval of the phase-out by a large majority of conservative and liberal parliamentarians can be seen as the endpoint of a positive feedback process that worked its way through the post-crisis discourse (Baumgartner & Jones 1993). This process resulted in major institutional change on 30 June 2011 when the conservative–liberal coalition government voted to shut down all remaining German nuclear reactors by 2022.

3.6 Case Comparison

Fukushima led to varying dynamics in different countries, both in terms of political processes and institutional outcomes. While the Bundestag set the German energy sector onto a new path by deciding to phase out nuclear power, no far-reaching institutional change occurred in Canada and Japan.[11] At first sight, this divergence is puzzling.

Table 5 reconnects our empirical findings to the concepts introduced in section 2. We posited that the configuration of actors and conflict lines prior to a permissive condition is key to understanding the role of agency during critical junctures and institutional divergence in its aftermath.

Our first actor networks and the corresponding bar graphs reflect the deep-seated structures of the nuclear power policy fields in Canada, Germany, and Japan. In Japanese energy politics, the pro-nuclear cognitive paradigm had been dominant since the 1950s. At its core was the belief in "safe nuclear power" and, given the recent prospects of a "nuclear renaissance," the

[11] While we do not want to downplay the changes that did happen, institutional responses in Canada and Japan are negligble compared to Germany.

	Canada	Japan	Germany
Critical antecedent	No strong anti-nuclear coalition	No strong anti-nuclear coalition	Strong anti-nuclear coalition
Permissive condition	Perception of threat: Fukushima nuclear disaster		
Productive condition	—	Individual, but no collective belief shift	Individual belief shift, resulting in collective belief shift
Outcome	No change	Minor changes, but old cognitive paradigm remains	Major institutional change
End of potential critical juncture	May 2011 (crisis discourse fades away)	17 December 2012 (legislative elections)	30 June 2011 (vote on phase-out law)

Table 5. Fukushima as a (potential) critical juncture in Canada, Japan, and Germany.

hope to exploit the economic opportunities provided by nuclear energy. As it was shared by virtually all actors in the field, this led to a distinct form of regulatory capture (Kingston 2013). The situation was quite similar in Canada with its public sector-led nuclear industry. In both countries, opposition to nuclear energy was low; and the dominance of the "locked-in" socio-technical complexes with their legitimizing cognitive mindsets was not seriously disputed by any resourceful challenger. By contrast, in Germany, a forceful coalition had demanded a nuclear phase-out since the 1970s.

Comparing actor constellations and the availability of cognitive alternatives is not sufficient to explain divergence, but helps to specify the role of agency in critical junctures. We hypothesized that agency would come to the fore as a mechanism called joint belief shift. While Fukushima did not lead to many instances of belief shift in Canada, it shifted beliefs among some members of the incumbent coalition in Japan. Given the incident's severity, this is not surprising, even considering the strong ideational underpinnings of the nuclear village. However, although the permissive condition increased the causal power of agency, a propagation of beliefs challenging the status quo through the discursive arena did not occur. Our analysis suggests that in Japan, critical antecedents constrained the role of agency to an extent that single voices calling for change did not find a receptive audience. In other words, the unitary structure of the energy policy sector prior to Fukushima explains why some individual belief shifts were not sufficient to unleash collective dynamics.

For the case of Germany, our analysis corroborates the hypothesized causal mechanism of joint belief shift. Interestingly, the political dynamics unfolding directly after Fukushima were not fueled by members of the challenger coalition. However, the long-standing institutionaliza-

tion of nuclear-skeptic beliefs and the fact that a resourceful coalition of challengers was ready to act made processes of belief shift among incumbents likely. Thus, the propagation of anti-nuclear beliefs did not emerge out of the blue. While it was rooted in the presence of an anti-nuclear coalition, the joint belief shift was triggered by the German chancellor, a highly central agent representing the incumbent coalition who, notably, already had direct links to the challengers before Fukushima. In refining Culpepper's (2005) argument that joint belief shift implies considerable time lags between early and late adopters, our analysis shows a sudden cascade of change leading to institutional breakdown.

3.7 Competing Explanations

We ruled out several competing explanations by design (see section 3.1). For instance, naïve "techno-deterministic" explanations would attribute institutional divergence to differences in administrative or infrastructural coping capacities or to the level of nuclear risk. However, our selected cases are all very similar in these regards.

Explaining institutional differences with the broader political orientation of governments during the crisis also fails to convince. The party politics argument would lead to the expectation of institutional stability in Germany, because of the decisive pro-nuclear orientation of the conservative–liberal coalition before Fukushima. Moreover, according to this argument, institutional change could have been expected in Japan, given the DPJ's aspiration to reform encrusted structures in Japan's political economy after five decades of almost uninterrupted LDP rule.

The degree of affectedness by the external event can also not account for different institutional outcomes. While only Japan was physically affected by Fukushima, a country located 6,000 miles away enacted far-reaching institutional change. Our argument suggests that this change would not have happened in Germany if the critical antecedent – a strong anti-nuclear coalition – had been absent prior to the permissive condition. However, contrasting with purely historical explanations that take Germany's institutional turnaround in 2011 as an inevitable reaction to Fukushima, our contribution shows how historical legacies condition the role of agency during critical junctures. Thus, our explanation of institutional change goes beyond others (e.g. Jahn & Korolczuk 2012; Stefes 2014) in showing that if institutions change, some actors must have brought about these changes.

One might argue that the divergence between Canada, Germany, and Japan is primarily a result of the power Angela Merkel had within and beyond her party. Indeed, the fact that Merkel was a relatively "strong" chancellor contrasts with the situation in Canada and Japan, two countries with considerably weaker heads of government in 2011. Yet this alternative explanation also fails to convince. First, it provides no explanation for individual belief shift, which we contend is

an important part of explaining divergence in institutional outcomes. Before Fukushima, Merkel had supported nuclear energy. The Atomic Energy Act, which codified the lifetime extension of 17 nuclear reactors, was passed under her watch in 2010. Taking critical antecedents into account, we provide an explanation for Merkel's individual belief shift, which was at least in part a response to the powerful and highly visible German anti-nuclear movement.

Regarding the second part of our productive condition, it is illuminating to confront this alternative explanation with the counterfactual of a strong prime minister after Fukushima in either Canada or Japan. Even if strong heads of government in Canada or Japan had called for change, they would have faced fierce resistance by dominant pro-nuclear coalitions and only weak support by challengers. In Germany, by contrast, the anti-nuclear movement had been influential over decades. Without persistent contestation from a powerful coalition of challengers and without a public receptive to anti-nuclear ideas, even a "strong" head of government would presumably not have been able to trigger a joint belief shift. The fact that the German chancellor faces numerous veto players in decision-making further qualifies the view of a particular chancellor being exceptionally powerful.

4 Conclusion

Our analysis of institutional divergence makes two contributions to the comparative literature. First, while theories of institutional change emphasize the role of critical junctures in explaining change and divergence across cases, we argue that what exactly happens in critical junctures remains undertheorized. We ascribe a robust role to agency in critical junctures and carve out the extent to which critical antecedents shape actors' positions and resources for coalition building. Our analysis suggests that candidate junctures lead to institutional change only if preexisting conditions push central agents to deviate from the status quo and incite a collective reorientation of beliefs. Future research should try to assess the extent to which this finding is generalizable.

Our second contribution is to apply a methodological innovation that can not only identify conflict structures as critical antecedents for institutional change, but also zoom into candidate junctures and hence trace path formation processes empirically. The systematic observation of processes of belief formation as they unfold in the arena of political discourse is helpful in examining when permissive conditions are followed by deep institutional change, and under which conditions they remain "near-misses" (Capoccia 2015). In the assessment of institutional divergence, DNA complements qualitative approaches as it provides a transparent and replicable methodology that combines qualitative content analysis with quantitative structural analysis of actor networks. Superior to purely qualitative approaches, DNA helps to illustrate phenomena that would otherwise be hard to document (e.g. joint belief shifts). As such, it nicely comple-

ments an actor-centered historical institutionalist framework.

More broadly, our paper enriches complex process accounts of institutional change in comparative perspective by offering a novel, historical approach that links micro-level agency and actor positions to macro-level institutional outcomes through fine-grained network analysis. The main limitation of our analysis is perhaps our method of investigating information cascades. Future research could combine DNA with agent-based modelling to assess more rigorously the effects of key agents who shift their beliefs on the system under examination. This would enhance our understanding of why such chain reactions occur in some systems, whereas others remain inert. These suggestions notwithstanding, the evidence of the German case supports our model of herding behavior. This implies that the pendulum could swing back again. As Fukushima becomes superimposed by other issues, a well-connected change agent might incite yet another belief shift.

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Supplementary Materials

Appendix A: Notes on Methodology

Description of Data Sources

The comparison of nuclear power policy discourses in Canada, Germany and Japan relies on newspaper data. Compared to alternative data sources such as actors' position papers, interviews, or testimonies from legislative hearings, newspaper articles "capture a wider variety of political actors" (Leifeld 2013, 195). Moreover, newspapers are published frequently and hence generate a solid empirical base for a systematic investigation. For a discussion of the pros and cons of different data sources for DNA, see Leifeld (2013).

We obtained discourse data from one newspaper for each country: "The Globe and Mail" (Canada), "Süddeutsche Zeitung" (Germany), and "The Japan News" (Japan). All three newspapers were selected according to the "quality press" criterion (Barranco & Wisler 1999); i.e., they represent general news-oriented papers of high reputation and are known as politically moderate. "The Globe and Mail" is a nationally distributed Canadian newspaper based in Toronto (Ontario). In 2010, the newspaper ranked first in Canada in terms of daily readership on weekdays and Saturdays (IFABC 2013). The German speaking "Süddeutsche Zeitung" featured the highest circulation of daily quality newspapers in Germany in 2010 (IFABC 2013). "The Japan News" is the English edition of "Yomiuri Shimbun", which is one of the "big five" national newspapers in Japan, featuring the highest newspaper circulation not only in Japan but worldwide in 2010 (IFABC 2013).

In terms of reliability over time, all three selected newspapers were published continuously and did not experience any substantial editorial changes within the period of investigation, which is conducive to high degrees of reliability (Barranco & Wisler 1999). This also mitigates potential bias from a specific political alignment of a newspaper. While all three newspapers claim to be independent, any bias induced by political orientations should be constant as long as the selected newspaper does not change its political orientation over time (Leifeld 2013).

In choosing one newspaper per case, we follow the argument that "the use of a single national newspaper is particularly cost effective" (Barranco & Wisler 1999, 308) – in other words, the benefits from adding further sources is usually limited. In particular, the selection of more than one newspaper leads to a substantial rise in costs and can bring along "problems with double coverage of events" (Leifeld 2013, 177).

For all three newspapers, electronic full-text archives are available. We retrieved articles from "The Globe and Mail" based on York University's licence for the ProQuest and LexisNexis databases. These services store archives of "The Globe and Mail" articles. For the German and

Japanese newspapers, the respective archives were accessed with a license from the University of Konstanz. For the German newspaper, the search relied on the full-text archive of the "Süddeutsche Zeitung". For "The Japan News", the search relied on LexisNexis.

Coding Procedure

We used the software Discourse Network Analyzer to code all statements.[12] To identify the relevant articles within the electronic newspaper archives, we used a search string including the truncated terms *NPP, Atomic, Nuclear, Energy Policy* and *Fukushima* (for the case of Germany, the respective keywords were *AKW, Atom, Nuklear, Energiepolitik, Fukushima*). In a pretest, these terms had been identified as effective to obtain the full list of newspaper articles with regard to nuclear power policy. The coding process was based on a detailed coding manual (see Appendix B). After completion of the coding process, the encoded statements were automatically transformed into network data by the Discourse Network Analyzer and exported for further processing in visone.[13]

The coding of statements depends to a certain degree on the background knowledge and interpretive abilities of the coders.[14] Therefore, reliability and replicability are major concerns of DNA applications. To rule out as much ambiguity as possible, three measures were taken:

(1) The coding manual was clearly specified in order to leave as little room for speculation as possible. The careful refinement of the manual ensured that remaining vaguenesses could be eliminated to an adequate extent.

(2) The main coders for all three cases were native speakers; i.e. Canadian, German and Japanese. This is a major benefit because the ways how beliefs, preferences, demands and expectations are expressed in the discursive arena are to some extent bound to cultural norms and habits. Native speakers are usually familiar with these particularities. Moreover, all three coders acquired a solid understanding of the field of domestic energy policy before starting to code statements.

[12] see https://github.com/leifeld/dna (accessed 13.12.2017).

[13] see http://www.visone.info (accessed 13.12.2017).

[14] The straightforward expression of beliefs and preferences in the political discourse is not always the case. In fact, a clear statement such as "In my eyes, nuclear power is a risky technology and therefore we should abandon it" seldom occurred. Instead, nuclear policy discourses in Canada, Germany and Japan were characterized by allusions, metaphorical statements or cross references that require background knowledge. As an illustration, consider the following example: "'Anstatt die AKW-Krücken Krümmel und Brunsbüttel endlich vom Netz zu nehmen, spielt Vattenfall wegen knapper Kassen lieber mit dem Risiko', so die atompolitische Sprecherin der Partei, Sylvia Kotting-Uhl." [Translation by the author: "'Instead of taking the nuclear crutches Krümmel and Brunsbüttel finally from the network, Vattenfall prefers playing with the risk because of tight budgets', the nuclear policy spokesperson of the party, Sylvia Kotting-Uhl, said"]. This quite typical example of a statement was coded in the following way: person: Sylvia Kotting-Uhl, organization: Greens; category: "NP is a high-risk technology", agreement: yes. Of course, this way of coding does not preserve the very specific assertion in a one-on-one sense, but it makes an abstraction that is still congruent with the expressed message while at the same time allowing subsumption of related statements under the same concept.

(3) All in all, four coders were involved in the coding process:

For the case of **Japan**, two coders were involved. While a student coder went through all articles in a first iteration, the first author of this paper coded all articles independently from the first coder. Inter-coder reliability was fairly high. With regard to congruence-in-statements (i.e., the decision whether a piece of text constituted a statement or not), percentage agreement reached 99 %; i.e., all statements but one (see Table i). With regard to congruence-in-concepts (i.e., the concrete assignment of a belief or preference to a statement), initial percentage agreement reached 86 %. The two coders discussed all remaining inconsistencies and came to common appraisals in every single case.

For the case of **Canada**, three coders were involved. A student coder did a first analysis of newspaper articles based on a first version of the coding manual. Due to some inconsistencies that appeared in the preliminary data analysis, a second student coder recoded the entire dataset, reaching percentage agreement of 71 % with the first coder in terms of congruence-in-concepts. Finally, the first author of this paper went through all codes again, removing a few remaining inconsistencies.

For the case of **Germany**, the coding was accomplished by a single coder, so that a measure of intercoder reliability could not be computed. The main reason is the extremely high discourse density in Germany. However, following the strategy outlined in Leifeld (2013), a second researcher checked around 40 % of the codes, while not coding any statements independently. In cases of ambiguities, codes were discussed and adjusted, if necessary.

	cases	3^{rd} coder	4^{th} coder
1^{st} coder	JP		99% / 86%
2^{nd} coder	CAN	87% / 71%	
3^{rd} coder	CAN		100% / 93%
4^{th} coder	CAN, GER, JP		

Table i. Inter-coder reliability.
Note: In each cell, the first number refers to congruence-in-statements; i.e., the decision whether a piece of text constituted a statement or not. The second number refers to congruence-in-concepts; i.e. the concrete assignment of a concept (belief or preference) to a statement.

Boundary Specification

The boundaries of social networks are often specified based on either a "realist" or a "nominalist" approach. According to the realist strategy, network boundaries are based on actors' subjective perceptions. This strategy is based on the assumption "that a social entity exists as a collectively shared subjective awareness of [...] the actors who are members" (Laumann et al. 1983, 21). The

realist approach can sometimes be applied to the study of entities that have some form of closed membership.

However, many policy networks are not based on formal membership. This is also the case in the networks investigated in our study. Therefore, we follow the nominalist strategy in defining the network boundaries. This means that the research purpose dictates our boundary specification, and "properties that demarcate the set of integrated actors from the set of nonintegrated actors are defined by the researcher" (Rinscheid 2015). More concrete, our point of departure is that any actor conveying a belief relating to the institutional field of nuclear power policy in one of the newspapers is part of the Canadian, German or Japanese discourse network. However, as we focus on processes of preference formation and interaction patterns among political elites rather than the populace, we exclude statements made by private persons (for instance, people who attend anti-nuclear demonstrations). Moreover, we exclude statements made by individual reporters for three reasons. First, coding journalists' beliefs and preferences would lead to an overrepresentation of reporters' views in the obtained depiction of political discourse. Second, although we selected politically moderate newspapers, their overall political orientations might still bias the discourse representation if journalists' contributions would not be filtered out (Hurka & Nebel 2013). And finally, the precise identification of journalists's policy beliefs is highly challenging in practice. Subjective judgements are often weaved in subtly in journalistic texts, and frequently, it is the tone of a newspaper article that conveys particular beliefs.

On the other hand, our nominalist strategy leads us to include the following types of actors into our network datasets: political actors from all levels of government and opposition; actors representing a country's bureaucratic agencies and regulatory bodies; nongovernmental organizations; actors representing interest groups and business associations; actors representing specific companies such as energy utilities; international organizations; scientists and scientific organizations.

Appendix B: Coding Manual

Introduction

Based on a preliminary, yet in-depth content analysis of 60 newspaper articles (published in 2011) relating to nuclear power policy in Canada, Germany and Japan, a first classification scheme for political claims conveying beliefs and preference was developed. This preliminary scheme was the basis for the first coding iterations with the *Discourse Network Analyzer*. As previously unmentioned beliefs and preferences constantly emerged, the initial coding scheme underwent a number of modifications throughout the coding process. In order to ensure a coherent way of coding, a "multipass coding strategy" was employed; i.e., the coders performed multiple coding iterations and had to "navigate back and forth between the statements" (Leifeld 2013, 177). Since it is barely possible to deduce an exhaustive set of concepts from a given theory, this is a conventional approach in discourse network analysis (Hurka & Nebel 2013, 397). After several coding iterations, similar belief-concepts were aggregated to more comprehensive categories in order to enhance conceptual clarity. The final scheme contains 59 categories (see Table ii).

The following pages contain the final coding manual as it was applied by the coders.

Coding Manual

In order to assess nuclear power policy discourses around Fukushima, the following scheme will be applied (see Table ii). Generally, all statements in newspaper articles that reveal beliefs, regulatory preferences, demands, interests or proposals about nuclear power - in short, *political claims* - of clearly identifiable actors or organizations must be coded. A more detailed description of the coding process is given below.

Please note that only the *italicized* concepts in Table ii are operationalizations of political claims. The concepts **in bold** are encompassing frames under which the concrete claims can be subsumed in order to organize the conceptual muddle. PLEASE DO NEVER USE THE FRAMES IN BOLD WHEN CODING STATEMENTS!

Risk and Resiliency
NP is safe
NP incidents rise public concern
NP threatens national security
Climate Change
NP helps protecting the climate
NP is sustainable
Phasing out NP boosts CO2-emissions
Energy Transition
NP prevents competition
NP prevents innovation
Energy Security
NP ensures energy supply
Phasing out NP endangers energy supply
Phasing out NP creates dependence on other country's NP
NP ensures energy self-sufficiency
Economy
NP ensures economic viability
NP ensures employment
NP is relatively cheap
NP keeps electricity affordable
Phasing out NP increases energy prices
Disaster Communication
Fukushima changed the conditions for NP
NP Policy must acknowledge public opinion
No premature action
Political Demands - general
Full nuclear phase-out
Full nuclear phase-out - gradually
Full nuclear phase-out - quickly
Review of the Nuclear Policy
Moratorium on NP
Referendum on NP
Life-time extension of NPPs
Necessity of NP must be assessed regularly
Political Demands - Safety of Plants
Safety Checks of NPPs [specific NPP might be added]
Stress Tests of NPPs
Review of safety standards for NPPs
Investments in NPPs' safety

Table ii. Coding manual.

Restart of NPPs [specific NPP might be added]
Restart of NPPs if Safety Checks successful [specific NPP might be added]
Shutdown of NPPs [specific NPP might be added]
Political Demands - Priority of NP vs. other forms of electricity production
Investments in renewable energies
NP can be replaced by RE

Table ii. *(continued)* Coding manual.

NP exports should be promoted
Construction of new NPPs [specific locales might be added]
Execution of fast breeder tests
Reduction of the NP share
Suspension of NPP construction
Central Government needs to clarify and ensure safety standards
NP can be replaced by coal-fired power plants

Table iii. Coding manual extension: Japan.

Construction of new NPPs [specific locales might be added]
NP is a bridging technology

Table iv. Coding manual extension: Canada.

NP is a bridging technology
Full nuclear phase-out - EU-wide
Full nuclear phase-out including a revision mechanism
Nuclear Fuel Tax
Feed-in fee for NP
Ban on NP imports
No German solo effort
NP industry heavily influences policy-making
Keeping NPPs as a temporary cold reserve
Shutdown of 7 old NPPs
New build of coal-fired PPs
New build of natural-gas PPs
Investments in combined heat and power
Investments in energy efficiency
Investments in research on RE & storage

Table v. Coding manual extension: Germany.

Coding with the Discourse Network Analyzer

The coding of statements is carried out with the software *Discourse Network Analyzer* (DNA 1.0). The coding procedure of a statement can be divided into several steps:

1. Paste an article that contains at least one political claim with regard to nuclear power policy which is expressed by some actor into your DNA file (*via* article –> add new article). Fill in the publication date in the respective field.

2. Identify all statements that include at least one concept mentioned in Table 1. It is important that the person and/or organization expressing the concept is identifiable. In most cases, not more than one concept will be contained in a statement. Tag the respective statement (*via* format as statement).

3. In the template that will open up, insert the name of the person that expresses the concept, followed by the name of the organization the actor represents (usually in its short form and in brackets; see Table 2). If the statement is conveyed by an organization, insert only the name of the organization.

4. In the next field, insert the full name of the respective organization, preceded by the prefix for TYPE OF ORGANIZATION (see below). IF NEITHER AN ACTOR NOR AN ORGANIZATION IS IDENTIFIABLE, THE STATEMENT MUST NOT BE CODED. ALSO, IF STATEMENTS ARE ASSIGNED TO ABSTRACT ACTORS LIKE COUNTRIES, THEY MUST NOT BE CODED.

For example, the following statement should NOT be coded: “Japan meanwhile is planning to build three nuclear power plants at Yonggwang on the Korean Sea.”.

5. In the field “category”, insert the concept that applies from Table 1.

6. At the end, please indicate whether the actor agrees to the concept or not. Simply choose from the drop-down menu.

NOTE: PLEASE ASSURE NOT TO MISSPELL ANY DATA ENTRY. THIS IS VERY IMPORTANT SINCE THE SOFTWARE WILL NOT BE ABLE TO ANALYZE THE DATA PROPERLY IF ACTORS OR CONCEPTS ARE NOT SPELLED CORRECTLY.

Types of Organizations

For the subsequent data visualization and analysis, it is helpful to differentiate between different types of actors. Therefore, the name of the organization a person represents is preceded by a specific prefix indicating these characteristics. The following prefixes should be used:

POL_GOV (pol. actors pertaining to a country’s government / cabinet / the majority party)
POL_OPP (pol. actors pertaining to an oppositional party)
POL_ELSE (pol. actors from the provincial level)
INT_ORG (actors from int. organizations / agencies, incl. EU actors)
NGO (societal actors that do not represent business interests, including religious org.)
SCI (actors from science and academia including expert commissions and consultancies)
BUR (actors from a country’s bureaucracy)
BUS (business actors other than operators of NPPs)
ASS (business associations, interest groups and unions)
BIGU (operators of NPPs)

Coding Examples

first example

’I do not doubt on the safety of nuclear energy’, Hans-Peter Villis said at a press conference.

person H.-P. Villis (EnBW)

organization BigU EnBW

category NP is safe

agreement yes

second example (***double coding of a single statement***)

Merkel said Germany needs to continue using nuclear power while it switches over to renewable power sources to keep energy affordable.

person Angela Merkel (Chanc.)

organization Pol_gov Chancellor

category NP keeps electricity affordable

agreement yes

and

person Angela Merkel (Chanc.)

organization Pol_gov Chancellor

category NP is a bridging technology

agreement yes

third example (***in German, demands background knowledge and interpretive abilities***)

Schmitz: Das war kein Kotau der Bundesregierung vor den Energiekonzernen. Im Gegenteil. Wir hatten uns längere Laufzeiten gewünscht. Aber wir tragen das langfristige Energiekonzept mit.

person R. M. Schmitz (RWE)

organization BigU RWE

category NP industry heavily influences policy-making

agreement no

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Part III

Divesting, Fast and Slow: Affective and Cognitive Drivers of Fading Voter Support for a Nuclear Phase-Out

Adrian Rinscheid[*] *& Rolf Wüstenhagen*[*]

Abstract

Overcoming reliance on non-renewable resources is a key concern of energy transitions worldwide. But as the literature on carbon lock-in has shown, overcoming path dependence is all but trivial. Even well-minded decision-makers tend to relapse into inertia when it comes to making concrete divestment decisions. We investigate one specific case, the 2016 Swiss popular initiative to phase out nuclear power, to explore the cognitive and affective drivers of energy path dependence on the individual level. Within eight weeks of an intense political campaign, support for this initiative dropped from more than 60 to just 45.8 percent of Swiss voters. Based on a representative longitudinal survey (N=1,014), we show that changes in perceived risk and benefit of nuclear power play key roles in explaining fading voter support for nuclear divestment, and that affect is in turn a significant driver of those changes. By framing it as a choice between the lesser evil of nuclear power or importing German coal power, opponents of the phase-out managed to introduce an asymmetrically dominated option into voters' choice set, leading many to change their original voting intentions. Our paper responds to calls for integrating dual-process theories ("thinking fast and slow") into research in Ecological Economics.

Keywords: divestment; nuclear power; voting behavior; dual-process models; affect heuristic; asymmetric dominance effect

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Highlights

- We develop and test a dual-process model of divestment decision-making
- Affect and cognition interact in the decision to support nuclear divestment
- We study preference formation regarding a 'hot' political issue with a panel survey
- Citizens' perceptions of and affect towards nuclear power are highly malleable
- Choice architecture and emotional 'hooks' are key for successful divestment

1 Introduction

The transition to a sustainable energy future requires two distinct processes: *Investing* in new energy technologies (such as solar and wind power), and *divesting* from unsustainable infrastructure of the past. While the former has received a lot of attention in policy circles and academic literature over the last decades, the latter has more recently made it to the headlines in the context of divesting from fossil fuels. Unlike fossil fuels, nuclear power is not a major contributor to climate change, but in the aftermath of the 2011 Fukushima accident and the bankruptcies of Tepco and Toshiba Westinghouse, questions about the ecological and financial sustainability of the nuclear industry have re-emerged with renewed intensity.

One of the countries that have started to rethink the role of nuclear power is Switzerland, where the world's oldest fleet of nuclear reactors contributes about one third of national power generation. Shortly after the Fukushima accident, the Swiss Green Party had launched a popular initiative to divest from nuclear power. The initiative proposed a ban on new nuclear power plants and a timeline for phasing out existing reactors between 2017 and 2029. It was submitted to a popular vote in November 2016. Opinion polls two months ahead of the vote indicated a solid majority of voters in favor of the proposal, but their support continuously faded during the political campaign until the initiative was finally rejected by a majority of voters.[1] What makes several hundred thousand voters[2] change their opinion from supporting to rejecting divestment from nuclear power in just eight weeks?

[1] In another referendum half a year after the nuclear phase-out vote analyzed in this paper, Swiss voters accepted the "Energy Strategy 2050" with a 58 percent majority. This policy package, which had been proposed by the federal government, included a ban on constructing new nuclear power plants, but initial proposals to limit the operating life of existing reactors had been eliminated by the conservative majority in Parliament.

[2] 2.4 million voters participated in the referendum. Based on our survey, 61.2 percent of Swiss voters had supported the initiative eight weeks ahead of the vote, but only 45.8 percent supported it in the popular vote. The 15.4 percentage point decline in support for the initiative thus translates into nearly 370'000 votes. https://www.admin.ch/ch/d/pore/va/20161127/det608.html (accessed 31.08.17).

The current paper draws on recent literature in economic psychology to explore whether dual-process theories of human behavior can shed light on this question. It thereby relates to the wider issue of how fading support for divesting from unsustainable infrastructure can be explained, and possibly prevented. Especially, we seek to explore whether the changes in voting intentions represent a case of the affect heuristic (Finucane et al., 2000; Slovic et al., 2004), which postulates that emotional and cognitive factors interact in decision-making. In contrast to experimental research in the lab or surveys in hypothetical settings, our research approach is unique in that we measure voter preferences and behavior in a real-life setting. A heated political campaign and the fact that voters actually had to come to a binary conclusion (either voting yes or no) create a decision-context that allows for both affective and cognitive considerations to occur.

Our research is part of a lively debate on overcoming path dependence (Goldstone, 1998; North, 1990), status-quo bias (Samuelson and Zeckhauser, 1988), inertia (Henderson, 2006) and procrastination (Andreou, 2007) in the energy sector (Lovio et al., 2011; Simmie, 2012; Wüstenhagen and Teppo, 2006). In a broad sense, path dependence describes the fact that past events have an impact on present choices. On a systemic level, this can lead to phenomena like carbon lock-in (Unruh, 2000), a situation that has been described by former U.S. president George W. Bush as an "addiction to oil". The idea to look at individual-level phenomena like addiction as potential sources of inspiration for explaining and overcoming system-level sustainability challenges has also recently been promoted in this journal (Costanza et al., 2017). We contribute to this debate by looking at the microfoundations of nuclear lock-in.

2 Literature Review and Hypotheses

In traditional models of rational choice, the decision-maker is conceptualized as homo oeconomicus, a perfectly informed actor who rationally calculates the cost and benefit of different choice options and chooses the alternative that maximizes his utility (e.g., Edwards, 1954; Friedman, 1953). While these models tend to overemphasize humans' capacity for systematic information processing and leave little room for unconscious drivers of decision-making such as habits and emotions, behavioral decision research takes the limits of humans' cognitive abilities into account. Behavioral approaches emphasize the context-specific, dynamic and unconscious processes of decision-making. This perspective has been found to be useful in explaining how people actually make decisions (Redlawsk and Lau, 2013; Weber and Johnson, 2009).

In the behavioral literature, an influential conceptualization of information processing distinguishes between cognitive and affective processes (Chaiken et al., 1989; Epstein, 1994). The cognitive system relates to analytic and effortful processes, in which individuals base decisions on their thoughts, beliefs and perceptions related to an object (Weber and Johnson, 2009). While

cognitive factors have, for a long time, been at the center of analysis in decision research, the role of affective processes has become more widely recognized since the 1980s (e.g., Zajonc, 1980). Researchers now acknowledge that in many decision contexts, choices are not only based on what people think or know about an object, but also on how they feel about it (Slovic et al., 2004). The affective system is based on associative, intuitive and less effortful processes that generally occur faster than conscious cognitive processing (Weber and Johnson, 2009), which is why nobel laureate Daniel Kahneman (2011) refers to both systems as "thinking fast and slow". In what follows, we base the development of theoretical expectations regarding fading voter support for nuclear divestment on such a dual-process perspective. We first shed light on the decision context – a popular vote – by theorizing about the stability of cognitive and affective factors during a political campaign (2.1). Subsequently, we derive hypotheses about the direct and indirect influences of cognitive and affective factors regarding fading voter support for nuclear divestment (2.2). Finally, we theorize how changes in the choice architecture can lead to preference reversals (2.3).

2.1 Voters' Evaluation of Nuclear Power in a Contested Political Setting

2.1.1 Perceptions of Nuclear Risk and Benefit

In terms of cognitive factors, prior research on public support of nuclear technology has emphasized the importance of people's evaluation of the risks and benefits of nuclear power. Perceived risks – i.e., concerns about nuclear accidents, radioactive leakage, nuclear waste disposal, proliferation, and other challenges related to the technology – have been shown to negatively influence public acceptance of nuclear power (Peters and Slovic, 1996; Renn, 1990; Tanaka, 2004; Whitfield et al., 2009). In contrast, citizens who perceive the benefits of nuclear power – such as its contribution to security of supply or low electricity prices – to be high, tend to show higher acceptance rates (Corner et al., 2011; Visschers and Siegrist, 2013).

Contrasting with rational choice models of decision-making, behavioral approaches do not assume perceptions and preferences to be stable. During a political campaign, voters are exposed to a variety of views and opinions, and political actors have ample opportunities to influence citizens' perceptions. This has inspired a large number of studies on the effects of political campaigns on opinion formation (Iyengar and Simon, 2000; Kriesi, 2002; Sciarini and Tresch, 2011). We therefore hypothesize that voters' perceptions of risk and benefit can significantly change in the run-up to a direct democratic vote:

H1: Voters' perceptions of nuclear risk and benefit change during a political campaign.

2.1.2 Affective Evaluation of Nuclear Power

Political campaigns are emotionally loaded events, and politicians appeal to voters' feelings and emotions (Brader, 2005). Inspired by psychological research, scholars of political communication have found that messages targeted at voters' feelings can have advantages in gaining voter support over messages targeted at cognitive channels (Abelson et al., 1982; Marcus, 2000; Ragsdale, 1991). However, research on the role of feelings in political controversies related to sustainability and divestment is scarce (Menzel, 2013). We aim to shed light on the role of affect by analyzing to what extent voters' affective evaluations of nuclear power are malleable in the context of a political campaign:

H2: Voters' affective evaluations of nuclear power change during a political campaign.

2.2 Cognitive and Affective Precursors of Fading Voter Support for Divestment

2.2.1 Preference Reversal via the Cognitive Route

Our main objective is to explain why many voters have changed their voting preference regarding the ballot proposition in the run-up to the Swiss referendum. If political actors succeed in changing voters' perceptions relating to the technology's risks or benefits, this might trigger a reconsideration of related voting intentions and thus influence choices made at the ballot box. This perspective ties in with reason-based analysis rooted in cognitive psychology, according to which individuals base their decisions on their perceptions of a problem and evaluate different choice options accordingly (Shafir et al., 1993). Hence, we hypothesize that fading voter support for the proposed nuclear phase-out can be explained by changes in perceptions of nuclear risks and benefits:

H3a: The higher voters' perceptions of nuclear benefits become during a political campaign, the more likely they are to withdraw their support for nuclear divestment.

H3b: The higher voters' perceptions of nuclear risks become during a political campaign, the less likely they are to withdraw their support for nuclear divestment.

2.2.2 Preference Reversal via the Affective Route

In a dual-process perspective, affective evaluations can have a direct influence on decisions that is independent from cognitive processing (Way and Masters, 1996, p. 51). Accordingly, Brader

(2005) shows that political ads that appeal to emotions (such as enthusiasm) directly affect political behavior (such as the intention to participate in a vote). Studying direct democratic votes, Kühne and colleagues (2011) find that emotions evoked by political campaigns can influence voting behavior.

Previous studies demonstrate that acceptance of nuclear power is strongly related to affective evaluations of the technology (Keller et al., 2012; Peters and Slovic, 1996). While negative feelings towards nuclear power such as fear or anger are associated with low acceptance, neutral or positive feelings predict support for nuclear power. With regard to the opinion swing in the Swiss vote, the aforementioned findings suggest that swing voters might have changed their affective evaluation of nuclear power from negative to positive during the campaign. Based on these considerations, we formulate the following hypothesis:

> H4: The more positive voters' affect towards nuclear power becomes during a political campaign, the more likely they are to withdraw their support for nuclear divestment.

2.2.3 Modeling the Interplay of Affect and Cognition: The Affect Heuristic

Apart from the direct influences of affect and cognition on the formation and stability of political preferences, we acknowledge what decision scientists have called the "dance of affect and reason" (Slovic et al., 2004, p. 314). According to this perspective, and compatible with research in evolutionary psychology (Cosmides and Tooby, 2004) and neuropsychology (Damasio, 1994), the affective system provides a basic orienting mechanism that interacts with cognition and thus relates to preference formation in an indirect way. The assumption that affective processing might have a cognitively mediated influence on preference formation and political behavior has been confirmed by political psychologists (Marcus, 2000; Way and Masters, 1996) and scholars of voting behavior (Wirth et al., 2012).

Finucane, Slovic and colleagues have modeled the interaction of affect and cognition as an "affect heuristic". Their model suggests that positive and negative feelings come prior to, and serve as a guide for, judgement and decision-making (Finucane et al., 2000; Slovic et al., 2004). The affect heuristic is based on the puzzling observation that lay people's perceptions of benefits and risks are often negatively related, whereas risk and benefit of many activities tend to be positively related in the real world. For example, in the financial realm, stocks of technology companies offer higher returns, and tend to also be riskier, whereas government bonds provide lower returns, and are usually less risky. In contrast, as Finucane et al. (2000) point out, lay people frequently perceive the risks of beneficial activities to be low, and vice versa. The reason is that they use affective evaluations as a cue or heuristic for making judgements (Slovic et al.,

2004).

Based on these premises, we contend that stability of preferences is a result of an affect-cognition-interaction. More specifically, we hypothesize that feelings towards nuclear power can explain both citizens' perceptions of nuclear benefit and risk:

H5a: Negative feelings towards nuclear power lead to higher perceived risk and lower perceived benefit.

H5b: Positive feelings towards nuclear power lead to higher perceived benefit and lower perceived risk.

2.3 Preference Formation and Choice Architecture: The Asymmetric Dominance Effect

Research on decision-making has demonstrated that in many decision contexts, people pay particular attention to certain reference points, such as the status quo option, when forming their preferences (e.g., Kahneman and Tversky, 1979; Tversky and Kahneman, 1991) – in other words, "the presence of certain types of options may affect the choice behavior" (Ok et al., 2015, p. 299). The initiators of the Swiss nuclear phase-out vote had conceived of their proposal as a decision between two alternative views of the country's energy future: continued reliance on nuclear power versus divesting from nuclear and investing in a cleaner energy supply with renewables and energy efficiency. During the campaign, the opponents of the proposed divestment introduced a third scenario by suggesting that divesting from nuclear would make Switzerland dependent on imports of coal-fired power from Germany and thus lead to unintended effects in terms of climate change mitigation.[3] While rational choice theory assumes that preferences between two decision objects are independent of the presence of a third alternative, there is some interesting evidence in the psychology and behavioral economics literature pointing out that this may not always be the case. Ariely and Wallsten (1995, 223) describe a situation where a person sitting in a restaurant looks at the dessert menu and chooses a crème brûlée over a tiramisu. When the waiter tells him that the special dessert of the day is an orange sherbet, the guest changes his mind and orders the tiramisu. The phenomenon described here is called the asymmetric dominance effect (Huber et al. 1982) or attraction effect (Huber et al. 2014) – introducing a third alternative that is asymmetrically dominated, in the sense that it performs clearly worse on one of the utility dimensions than

[3] While the popular initiative did not include any explicit mention of this option, and one could therefore categorize it as a "phantom alternative" (Doyle et al., 1999), the complexities of interconnected electricity markets make it difficult to exclude the possibility that more imports of coal power might have been an unintended (and perhaps temporary) side-effect of accepting the initiative and implementing the proposed timeline for a nuclear phase-out. However, an in-depth discussion of the factual correctness of both camps' claims would go beyond the scope of this paper.

the originally non-preferred alternative, can shift the preference ordering of the other alternatives (Ariely and Wallsten, 1995; Ok et al., 2015).

In our case, similar to the crème brûlée and tiramisu example, the choice was initially one between nuclear energy and renewable energy. Did the introduction of coal power, a reference point that is asymmetrically dominated by nuclear in that it contributes to climate change by emitting CO_2, influence voters' assessment of the proposed divestment? If so, what we would expect to see is that people who were previously critical of nuclear power and saw renewable energy as a preferable alternative reframed the decision problem as choosing the lesser evil. Introduction of coal as a reference point should thus have reversed the preference ordering between nuclear and renewables:

H6: Introducing an alternative that is asymmetrically dominated by nuclear power increases the probability that voters withdraw their support for nuclear divestment.

Figure 1 summarizes our extended dual-process framework, which we apply to study fading voter support in the context of the Swiss nuclear phase-out referendum.

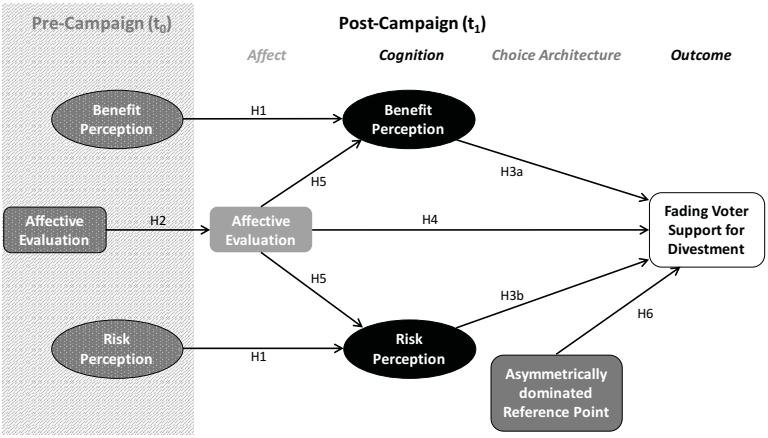

Figure 1. Conceptual model to explain fading voter support for nuclear divestment

3 Material and Methods

3.1 Sampling Strategy and Survey Design

Our analyses are based on a panel survey with Swiss voters. Whereas the development of public preferences over time is frequently studied based on repeated cross-sectional surveys, such a design is not suitable to investigate changes of perceptions, affect and voting intentions on the individual level. For instance, in their otherwise remarkable work, Ansolabehere and Konisky (2014, p. 102) assert that individuals' preferences in the US about energy are fairly stable. However, as their study is based on repeated surveys with varying samples, this conclusion is on rather shaky grounds.

Participants of our study were drawn from a Swiss online consumer panel operated by an experienced market research agency. The panel is entirely actively recruited and includes nearly 70,000 registered individuals.[4] To obtain a representative sample of the voting population from the German- and French- speaking parts of Switzerland, we employed stratified random sampling with proportionate allocation, stratifying the population by region, gender, age, education, and partisan orientation.[5] Respondents were surveyed based on computer-assisted web interviews (CAWI).[6] The pre-vote questionnaire (t_0, n = 1,216) was administered before intensive political campaigns started (October 10 - 19, 2016). The post-vote survey (t_1, n = 1,014) started one hour after the polling stations had closed (November 27) and ended four days later (December 1). The drop-out rate was 16.6 percent.[7] As our sample well represents the Swiss voting population, our analyses are based on unweighted data.

Our data perform well in replicating the actual ballot outcome. Whereas 45.8 percent of voters who participated in the referendum accepted the initiative, 45.7 percent of participating survey respondents did so.[8]

[4] https://www.intervista.ch/en/panel (accessed 12.06.17). While opt-in panels consist of a self-selected sample of volunteers, Intervista's actively recruited panel comes close to a probability sample of the Swiss voting population.

[5] Table i in the supporting information includes the sample distribution of socio-demographic variables and partisan orientation. Because only 6.1 percent of Swiss voters live in the Italian-speaking region of Switzerland, this area was excluded for reasons of research efficiency. https://www.bfs.admin.ch/bfs/de/home/statistiken/bevoelkerung/sprachen-religionen.assetdetail.2220343.html (accessed 23.05.17).

[6] Several controlled comparisons have shown that internet-based surveys can be at least as reliable and accurate in estimating parameters of voting behavior as surveys using more traditional modes (Ansolabehere and Schaffner, 2014; Sanders et al., 2007), which makes us confident about using CAWI as survey mode.

[7] A comparison of respondents who participated only at t_0 but not at t_1 (n = 202) to those participating in both waves (n = 1,014) shows no systematic differences with regard to most variables, such as education, gender, political orientation and place of residence. The only socio-demographic variable that influences dropout is age: nonrespondents at t_1 were considerably younger (M = 44.91, SD = 16.20) than those participating in both waves (M = 49.59, SD = 16.96). Moreover, a systematic relationship exists between initial vote intention and dropout. Whereas 17.7 percent of those indicating a yes-preference at t_0 dropped out of the sample, dropout amounts to 13.2 percent among respondents indicating a rejection at t_0 ($\chi^2(1) = 4.228$, p = 0.04).

[8] Similar to other post-referendum-surveys, our survey produces an overestimation of voter turnout (88.4 percent vs. 45.3 percent in reality). This is not surprising, as "turnout gaps" are a typical phenomenon of post-election studies (Selb and Munzert, 2013). The magnitude of the gap in our data is comparable to turnout gaps documented in panel studies in the

We implemented several measures to address sources of bias. First, to mitigate self-selection into the survey, respondents were only informed about the survey topic after having accepted to participate. Second, our first questionnaire included an attention test, and 54 persons who did not pass the test were automatically excluded from further participation. Third, 15 speeders who failed to provide meaningful responses were excluded.[9]

We informed respondents that the same person should fill in the questionnaires in both survey rounds. Datasets were linked based on a 9-digit identifier and information on age and gender. Datasets for seven respondents were deleted as it could not be ensured that the same individual had filled in the questionnaires. Respondents were incentivized according to the standards of Swiss market research, receiving shopping vouchers worth one Swiss Franc per five minutes of inquiry.

3.2 Measures and Aggregation Techniques

3.2.1 Outcome Variable

To construct our main dependent variable – fading voter support for nuclear divestment – we used two questions. First, at t_0 we asked *"If the popular initiative on the nuclear phase-out was put to the vote today, how would you vote?"*. We provided a five-point scale ranging from *"certainly in favor"* to *"certainly against"*. Second, the survey at t_1 contained an inquiry about respondents' participation in the vote. In case of affirmation, they were asked *"How did you vote?"*. Respondents could indicate *"yes (in favor of the nuclear phase-out)"* or *"no (against the nuclear phase-out)"*, including a *"no response"* option. We constructed a binary variable, indicating whether respondents had sticked to their original vote intention or not. Respondents who did not participate in the vote were neither coded as stable nor instable.

The sankey diagram depicted in Figure 2 visualizes our main dependent variable. It illustrates initial voting intentions and reported voting behavior of survey respondents, as well as the extent to which support for the phase-out proposal faded between t_0 and t_1. Whereas 61.2 percent of respondents participating at t_0 had initially planned to support the initiative, only 45.7 percent of respondents who participated in t_1 and casted a vote finally voted "yes". On the other hand, 36.2 percent were initially against the initiative, but 54.3 percent of respondents who participated in the referendum voted "no". To shed light on fading voter support for nuclear divestment, we compare respondents who were in favor of the phase-out throughout the referendum campaign (n=379; flows from *„Certainly* [Rather] *in favor"* to *„Yes"*) to those who were initially in favor of

context of other Swiss referenda (Hänggli et al., 2012).

[9] For discussion of excluding speeders, see Greszki et al. (2015).

the initiative but finally rejected it (n=148; flows from *„Certainly* [Rather] *in favor"* to *„No"*).[10]

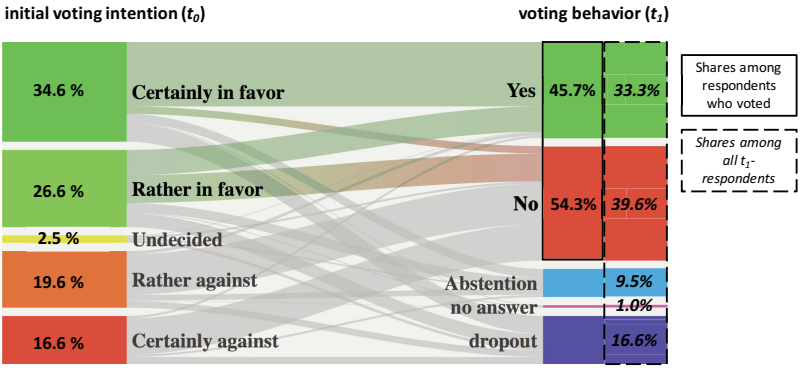

Figure 2. Initial voting intentions and actual voting behavior

3.2.2 Explanatory Variables

In terms of cognitive evaluation of nuclear power, we measured perceived risk and benefit with four survey items per construct (see Table 1). The items were partly adopted from scales used by Siegrist et al. (2014) and mirror the multifacetedness of risk and benefit perceptions. All items were measured on 5-point scales (from *"fully disagree"* to *"fully agree"*). To track individual-level changes in perceptions over time, all items were used identically at t_0 and t_1. We also allowed respondents to provide *"no answer"* to avoid forcing participants to give potentially meaningless answers for certain aspects on which they could not form an opinion.

Confirmatory factor analysis (CFA) was used to investigate whether the survey items are valid representations of the underlying latent constructs. We used regression analysis to obtain scores representing the two latent factors on the individual level, taking the salience of items into account (i.e., assigning greater weight to items with higher factor loadings). Based on the full information maximum-likelihood method, indicators of risk and benefit perception were estimated also for respondents with missing values, using all available information from answered items.[11] As can be seen in Table 1, all factor loadings are in the range of .5 to .9, which supports the validity of

[10] Table ii in the supporting information presents initial voting intentions and reported voting behavior of all respondents.

[11] At t_0, 8.8 percent (n = 107) of respondents did not complete all items gauging risk perception, and 14.3 percent (n = 174) did not complete all items on benefit perception. At t_1, 8.5 percent (n = 86) of respondents participating in both survey waves did not complete all items gauging risk perception, and 12.0 percent (n = 122) did not complete all items on benefit perception.

Latent Factors and *Observed Variables*		Cronbach's Alpha t_0/t_1	Standardized factor loadings t_0/t_1
Risk Perception			
R1	*"I am worried about the risks of nuclear power plants in Switzerland." (*)*	.802 / .832	.69 / .73
R2	*"The catastrophe risks in new nuclear power stations are very small." (*) (-)*		.82 / .84
R3	*"The use of nuclear energy burdens future generations."*		.58 / .70
R4	*"Swiss nuclear power plants must be shut down before they come to a tragic end."*		.82 / .80
Benefit Perception			
B1	*"Even after withdrawing from using nuclear power, the power supply in Switzerland will be ensured at all times." (-)*	.871 / .880	.76 / .77
B2	*"Without nuclear power, the standard of living in Switzerland would decline"*		.76 / .76
B3	*"The continued operation of Swiss nuclear power plants is of utmost importance for security of supply and grid stability."*		.89 / .92
B4	*"Thanks to nuclear power, Switzerland is independent from foreign countries."*		.68 / .71

Table 1. Survey items and results of two-factor CFA for risk and benefit perception.
Note: Items translated from German. Items marked with stars (*) adopted from Siegrist et al. (2014). (-): negative item, recoded.

our final two- factor model.[12] For both constructs, Cronbach's alpha is in the recommended range between .7 and .9, indicating high reliability of both scales.[13] According to various fit indices (see Schreiber et al., 2006, p. 330), the hypothesized model fits our data well ($\chi^2(16) = 26.31$, $p = .05$, Comparative fit index (CFI) = .998, Root mean squared error of approximation (RMSEA) = .025).

Affect, in our context, is defined as a feeling state that – consciously or not – assigns a positive or negative quality to a specific object (Slovic et al., 2004, p. 312). We measured affect towards nuclear power following the procedure proposed by Peters and Slovic (1996), which is based on the method of continued associations, adapted for use in an online survey. After having elicited their voting intention/behavior at t_0 and t_1, respectively, respondents were asked *"What is the first thought or image that comes to your mind when thinking about 'nuclear energy'?"*. Next, participants were asked to evaluate their feelings with regard to the reported associations on a semantic differential affect scale from –3 (*"very negative"*) to +3 (*"very positive"*). This procedure generated affective evaluations for 1,005 respondents.

[12] All factor loadings are significant at the $p < .001$ level.
[13] The supplementary materials include a correlation matrix of all items measuring perceived risks and benefits (Table iii).

To assess whether the asymmetric dominance effect can explain parts of fading voter support for nuclear divestment, we asked respondents at t_1 whether they perceived imports of coal power to be imminent in case the nuclear phase-out would be accepted. The item was measured on a 5-point scale (*"fully disagree"* to *"fully agree"*).[14]

3.2.3 Control Variables

In the first questionnaire, we gathered information on sociodemographic characteristics such as respondents' age, gender, education, and place of residence. Based on the latter, the binary variables "Language Region" and "Danger Zone" were generated. "Language Region" indicates whether respondents live in the German- or French-speaking part of Switzerland. "Danger Zone" indicates whether a participant's place of residence is within a radius of 20 kilometers from one of the four nuclear power plants. This radius corresponds to the legally defined 'danger zone', where a serious accident could pose a threat to the population which requires protective measures.[15]

We also included partisan orientations, as it can be assumed that these are systematically related to both preference instability and perceptions of risks and benefits. Partisan orientations were assessed in the first questionnaire by the question *"Which political party best represents your political views?"*. Participants could choose among the seven major parties and the category "others". We generated two binary variables, one capturing citizens leaning towards one of the three major parties that supported the popular initiative ("Left Partisans"), and the other one capturing citizens leaning towards one of the four parties that opposed the initiative ("Right Partisans").

Finally, the strength of preferences at t_0 was taken into account: voters with a 'weak' preference for nuclear divestment at t_0 ("*rather* in favor") were assigned a 1; while those with a strong preference ("*certainly* in favor") were assigned a 0. Our expectation was that weak initial preferences might be a predictor of withdrawing support for nuclear divestment.[16]

[14] Item wording (translated from German): *„Prematurely phasing out nuclear power makes imports of dirty coal power from foreign countries imminent"*.

[15] https://www.admin.ch/opc/de/classified-compilation/20091050/index.html (accessed 02.05.17).

[16] See Table iv in the supporting materials for descriptive statistics of all variables used in the analyses.

4 Empirical Analysis and Results

4.1 Changes in Cognitive and Affective Evaluation of Nuclear Power

4.1.1 Changes in Risk and Benefit Perceptions

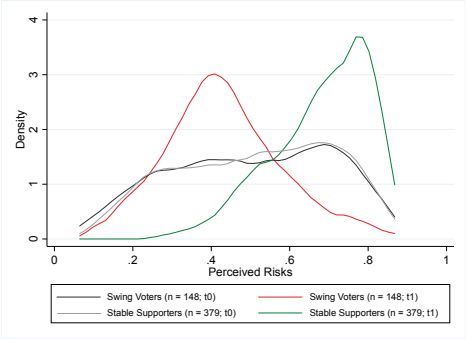

Figure 3. Perceptions of nuclear risk, pre-campaign (t_0) and post-campaign (t_1).
Note: The density plots are based on logistically transformed factor scores. Higher values correspond to higher risk perception. Means (M) and Standard Deviations (SD): Swing Voters: $M(t_0) = .50$; $SD(t_0) = .20$; $M(t_1) = .43$; $SD(t_1) = .15$. Stable Supporters: $M(t_0) = .51$; $SD(t_0) = .19$; $M(t_1) = .68$; $SD(t_1) = .12$.

To recall, our first hypothesis states that perceptions of risks and benefits can be altered during a political campaign. In a first step, we shed light on this hypothesis by inspecting the distributions of risk and benefit perceptions, focusing on the subgroups of stable supporters (n = 379) and voters who revoked their initial preference for a phase-out (n = 148). Figures 3 and 4 show density plots based on the overall perception scales obtained through CFA. Comparing the area below the light gray line in Figure 3 with the area delimited by the green line suggests that risk perceptions of voters with stable preferences increased in the run-up to the referendum. Conversely, as the areas below the dark gray and red lines show, voters with fading support for the phase-out proposal perceived nuclear risks to be markedly smaller at t_1 than at t_0. These findings are substantiated by Wilcoxon signed-rank tests. Comparing the evolution of risk perceptions over time shows systematic differences for both stable supporters ($z = 10.32$; $p < .001$) and swing voters ($z = -2.49$; $p = .01$). Another way to look at these data is by comparing the groups at both points in time. While the groups did not differ in terms of risk perception at t_0 (Wilcoxon-Mann-Whitney test: $z = .54$; $p = .59$), the difference was substantial and statistically significant at t_1 ($z = 12.74$; $p < .001$).

The pattern is mirrored for benefit perceptions (Figure 4). While benefit perceptions of voters with stable preferences decreased in the run-up to the referendum ($z = -11.45$; $p < .001$), voters

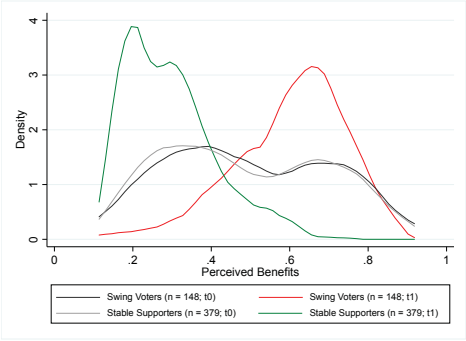

Figure 4. Perceptions of nuclear benefit, pre-campaign (t_0) and post-campaign (t_1).
Note: Similar to Figure 3. Higher values correspond to higher benefit perception. Swing Voters: $M(t_0) = .50$; $SD(t_0) = .20$; $M(t_1) = .60$; $SD(t_1) = .14$. Stable Supporters: $M(t_0) = .49$; $SD(t_0) = .20$; $M(t_1) = .30$; $SD(t_1) = .11$.

with preference reversals perceived nuclear benefits to be higher at t_1 than at t_0 (z = 4.66; p < .001). Again, both groups did not systematically differ in terms of benefit perceptions at t_0 (Wilcoxon-Mann-Whitney test: z = -.43; p = .67), but right after the vote benefit perceptions among stable supporters were significantly lower than among swing voters (z = -15.29; p < .001).

4.1.2 Changes in Affective Evaluations

At both t_0 and t_1, a majority of voters connected their associations relating to nuclear power with negative feelings (55.6 percent at t_0; 51.3 percent at t_1). Figure 5 shows affective evaluations of voters with stable support for nuclear divestment at t_0 and t_1, while Figure 6 depicts affect for voters with fading support. Affective evaluations of voters with stable support became more negative in the run-up to the referendum (Wilcoxon signed-rank test: z = -7.63; p < .001). Voters whose support for the divestment faded, on the other hand, significantly shifted away from negative towards neutral or positive affective evaluations (z = 2.68; p = .007), providing support for hypothesis 2. Moreover, while stable and swing voters did not systematically differ at t_0 (Wilcoxon-Mann-Whitney test: z = -.19; p = .85), those with stable preferences had significantly more negative feelings toward nuclear power at t_1 than those with instable preferences (z = -9.74; p < .001).

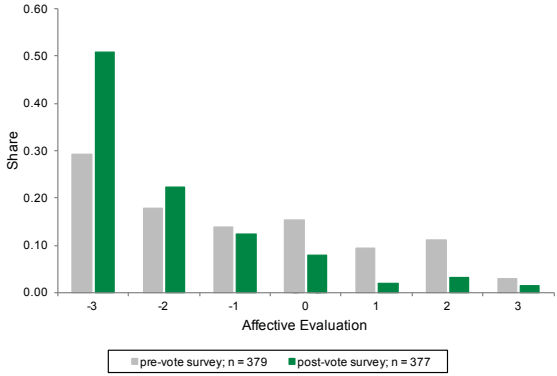

Figure 5. Affect towards nuclear power, stable supporters, pre-campaign (t_0) and post-campaign (t_1).
Note: -3 corresponds to a very negative evaluation, 0 corresponds to a neutral evaluation, and +3 corresponds to a very positive evaluation. $M(t_0) = -.97$; $SD(t_0) = 1.83$; $M(t_1) = -1.98$; $SD(t_1) = 1.40$.

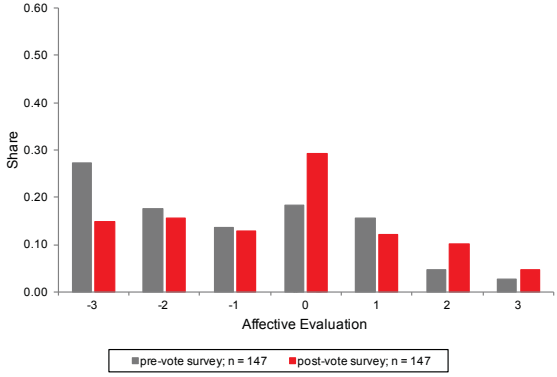

Figure 6. Affect towards nuclear power, swing voters, pre-campaign (t_0) and post-campaign (t_1).
Note: Similar to Figure 5. $M(t_0) = -.97$; $SD(t_0) = 1.72$; $M(t_1) = -.42$; $SD(t_1) = 1.70$

4.2 Explaining Fading Voter Support for Divestment

4.2.1 Direct Influence of Cognition and Affect

We use logistic regression analysis to jointly test hypotheses 3 and 4 about the cognitive and affective drivers of fading support for divestment from nuclear power. The outcome variable takes on the value 0 for voters supporting the phase-out throughout and 1 for voters who revoked their support during the campaign. The main predictors in Model 1 (Table 2) are the scales for risk

and benefit perceptions obtained through CFA, and our measure of affective evaluation.[17] Given that the model controls for lagged values of perceptions and affect, the coefficients indicate the influence of *changes* of perceptions and affect on preference stability (Finkel, 1995, p. 15). Our panel data hence allow for stronger causal inferences than would have been possible with a mere cross-sectional survey.

The coefficients for both risk and benefit perceptions at t_1 are in the expected direction and statistically significant: higher risk perceptions decrease the likelihood of revoking support for nuclear divestment, while higher benefit perceptions increase the likelihood of revoking support. These findings corroborate both hypotheses 3a and 3b: in the run-up to the referendum, changes in voters' perceptions about nuclear power clearly influenced their voting behavior.[18] Looking at the affective correlates of preference instability, in turn, we do not find the expected direct effect. Changes in voters' feelings about nuclear power did not directly translate into changes in voting intentions. We thus reject hypothesis 4.

4.2.2 How Affect Shapes Cognition

Apart from the direct influence of affective evaluations on voting behavior, we were interested in the interplay of affect and cognition (hypothesis 5). Models 2 and 3 therefore assess how risk-benefit-perceptions are formed based on ordinary least squares regression, with affective evaluation of nuclear power being the main predictor. To adequately address the fact that hypotheses 5a and 5b distinguish between two qualitatively different states (negative vs. positive affect), we transformed the affect variable into two dichotomous measures: "Negative affect" takes on the value 1 if affect at t_1 is -2 or -3, and 0 otherwise, while "Positive affect" takes on the value 1 if affect at t_1 is 2 or 3, and 0 otherwise.

In both models, affective evaluations are a strong and significant predictor of risk-benefit-perceptions.[19] This finding supports the affect heuristic, which asserts that people rely on gut feelings when forming perceptions (Finucane et al. 2000). Negative feelings towards nuclear energy are associated with higher perceived risks and lower perceived benefits, while positive feelings relate to higher perceived benefits and lower perceived risks. The influence of affect on

[17] The number of observations in Model 1 is 523, as four respondents from the subsample of individuals who were initially in favor of divestment and participated in the referendum did not provide answers to the question measuring affect in both panel waves.

[18] In a series of additional exploratory analyses, we interacted the cognitive variables with stable socio-demographic factors and partisan orientations. We find considerable stability of cognitive effects across different model specifications and no significant interaction effects. Subgroup analyses indicate that risk perceptions slightly fail to reach statistical significance as a predictor of preference instability among respondents under 30, highly educated respondents and left party supporters.

[19] Table 2 shows the results for the full sample (n = 1,014), as we assume these relationships to hold not only for citizens who had, at some point in time, a preference for nuclear divestment. Replications based on the subsample of initial supporters of nuclear divestment yield similar results (see Table v in the supplementary materials). Table v also contains replications of models 2 and 3 with the original, 7-point affect scale. No matter whether the original scale or the dichotomized measures are used, the results remain substantively the same.

	(1) Withdrawal of Support		(2) Perceived Risks	(3) Perceived Benefits	(4) Withdrawal of Support	
	logit coeff. (standard errors)	marg. effects (standard errors)	coefficients (standard errors)	coefficients (standard errors)	logit coeff. (standard errors)	marg. effects (standard errors)
Perceived Risks	-1.377***	-0.099***	–	–	-1.362***	-0.090***
	(0.297)	(0.019)			(0.319)	(0.019)
Perceived Risks (t_0)	-0.332	-0.024	0.029	–	-0.449	-0.030
	(0.280)	(0.020)	(0.025)		(0.300)	(0.020)
Perceived Benefits	2.901***	0.208***	–	–	2.304***	0.152***
	(0.363)	(0.018)			(0.400)	(0.022)
Perceived Benefits (t_0)	-0.187	-0.013	–	0.013	-0.219	-0.014
	(0.291)	(0.021)		(0.025)	(0.305)	(0.020)
Affect	0.035	0.003	–	–	-0.000	-0.000
	(0.113)	(0.008)			(0.124)	(0.008)
Affect (t_0)	0.006	0.000	–	–	-0.068	-0.004
	(0.121)	(0.009)			(0.132)	(0.009)
Negative affect	–	–	0.670***	-0.647***	–	–
			(0.052)	(0.053)		
Positive affect	–	–	-0.456***	0.442***	–	–
			(0.064)	(0.065)		
Coal Power	–	–	–	–	0.859***	0.057***
					(0.208)	(0.013)
Young	-0.371	-0.027	-0.108	0.011	-0.587	-0.039
	(-0.461)	(0.033)	(0.063)	(0.064)	(0.486)	(0.032)
Elderly	0.037	0.003	-0.065	0.082	-0.128	-0.008
	(0.392)	(0.028)	(0.051)	(0.052)	(0.425)	(0.028)
Gender (Female)	-0.543	-0.039	0.015	0.065	-0.383	-0.025
	(0.348)	(0.025)	(0.046)	(0.046)	(0.376)	(0.025)
Education	0.163	0.012	-0.005	-0.019	0.110	0.007
	(0.095)	(0.007)	(0.013)	(0.013)	(0.102)	(0.007)
Danger Zone	0.487	0.035	0.003	-0.014	0.446	0.029
	(0.493)	(0.035)	(0.062)	(0.062)	(0.537)	(0.035)
Language Region (French)	-0.112	-0.008	0.125*	-0.086	-0.232	-0.015
	(0.410)	(0.029)	(0.055)	(0.055)	(0.438)	(0.029)
Left party supporter	-0.448	-0.032	0.160	-0.200*	-0.404	-0.027
	(0.730)	(0.052)	(0.099)	(0.099)	(0.810)	(0.053)
Right party supporter	-0.478	-0.034	-0.317**	0.432***	-0.381	-0.025
	(0.721)	(0.052)	(0.095)	(0.095)	(0.798)	(0.052)
Strength of initial preference	-1.092**	-0.078**	–	–	-1.007**	-0.066**
	(0.362)	(0.025)			(0.390)	(0.025)
Constant	0.610	–	-0.179	0.101	-1.868	–
	(1.382)		(0.166)	(0.168)	(1.655)	
Log-likelihood	-123.39				-108.77	
R^2	0.60		0.40	0.42	0.64	
N	523	523	1,005	1,005	499	499

Table 2. Multivariate results.
Note: Coefficients are from logit models for withdrawal of support for nuclear divestment, and from ordinary least squares for risk and benefit perceptions. Standard errors in parentheses. R^2 values for logit regressions are McFadden's pseudo R^2 scores. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the stability of support for nuclear divestment thus appears to be mediated entirely through its impacts on perceptions of nuclear risk and benefit. Apart from the affect heuristic, voters seem to make use of their partisan orientations as a second heuristic when forming their perceptions, as three out of four coefficients for partisan orientations attain statistical significance.

The coefficients for the lagged dependent variables provide further evidence for the malleability of perceptions during political campaigns. Risk and benefit perceptions measured seven weeks before the vote do not predict risk and benefit perceptions measured on the voting day, which corroborates hypothesis 1.

4.3 The Influence of Choice Architecture

4.3.1 How the Prospect of Coal Power Leads to Fading Support for Nuclear Divestment

Hypothesis 6 states that the introduction of coal, as an asymmetrically dominated reference point with regard to nuclear power, might have played a role in the process of fading voter support for nuclear divestment. We shed light on the asymmetric dominance effect by replicating Model 1, but introducing the perceived relevance of coal power as an additional predictor. As can be seen in Table 2 (Model 4), this variable indeed exerts a statistically significant influence on the dependent variable: voters who believed a premature nuclear phase-out would make coal imports imminent were significantly more likely to withdraw their support for divestment.[20] The analysis thus lends support to the effectiveness of the asymmetric dominance effect. There are no significant changes regarding the coefficients of other variables which could have been brought about by introduction of this additional variable, albeit the decrease of the coefficient of benefit perception is worth noting. This indicates that by introducing the issue of potential imports of coal-based power, the opponents of the divestment initiative added another facet to the perceived benefits of nuclear power, while the prospect of coal imports is unrelated to perceptions of nuclear risk.

4.3.2 Asymmetric Dominance and Emotions towards Different Energy Sources

As an additional exploratory analysis of the asymmetric dominance effect, we compare respondents' emotions towards three different energy sources: nuclear, solar, and coal power. Emotions towards these energy sources were gauged at t_1 on a 9-point scale (ranging from –4 to +4).[21]

Figure 7 illustrates mean values of emotional appraisals of swing voters and stable supporters

[20] As 24 individuals did not provide an answer to the question tapping perceptions of imports of coal power, the number of observations in Model 4 is reduced to 499.

[21] Participants were asked to indicate whether they experienced one or several of the following emotions towards the respective energy technology: enthusiasm, joy, satisfaction, curiosity (positive emotions); fear, anger, fury, disgust (negative emotions). To generate an overall score, the number of reported negative emotions was subtracted from the number of reported positive emotions.

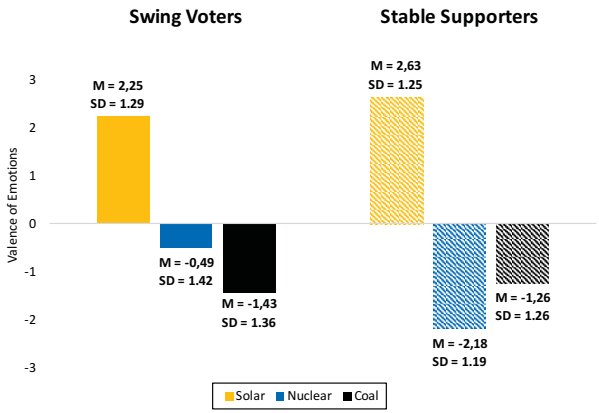

Figure 7. Emotions towards coal, nuclear and solar: swing voters vs. stable supporters.

of nuclear divestment. The results show that solar power evokes very positive emotions among both groups. Both nuclear and coal receive more negative than positive ratings, but the majority of swing voters indeed perceives nuclear power to be the "lesser evil", as it elicits on average less negative emotions than coal. These findings suggest that the asymmetric dominance effect also has a bearing on the affective system.

5 Discussion

5.1 Summary and Main Contributions

Transitioning to a sustainable energy future requires not only investments in new technologies, but also divesting from unsustainable infrastructure of the past. A popular vote on the Swiss nuclear phase-out initiative provided a unique setting to study divestment decision-making in real time. Within just eight weeks ahead of the vote, about 370'000 voters changed their opinion from supporting divestment to rejecting it. Based on a large-scale panel survey, we have shown that an interplay of cognitive and affective factors have led to this opinion swing. Figure 8 summarizes our main findings.

Our analysis supports the idea that people rely on an affect heuristic in forming preferences towards a proposed divestment. In our case study, the opponents of divestment managed to alter affective evaluations of nuclear energy, which resulted in shifting perceptions of risk and benefit and thereby indirectly affected voter behavior. Furthermore, fading voter support for divestment was amplified by introducing an asymmetrically dominated reference point, which made some

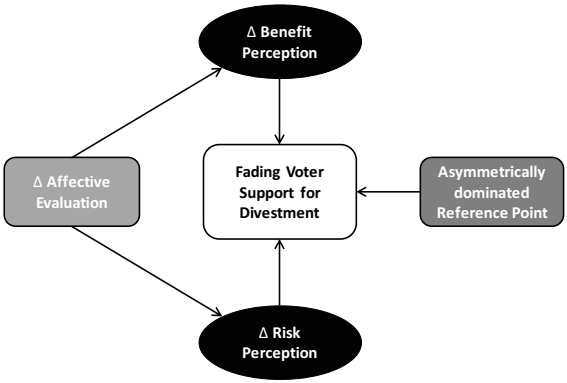

Figure 8. Main findings.

voters choose the initially rejected option as the 'lesser evil'. Our analysis suggests that the affect heuristic can be boosted in campaign communications by incumbents if they successfully introduce an asymmetrically dominated alternative (or "phantom alternative", Doyle et al., 1999).

While our research provides rich empirical evidence for the challenges of divestment decision-making, it also offers some hints for designing successful pro-divestment campaigns. First, our findings support the idea that emotions matter in environmental decision-making (Menzel, 2013). The good news, however, is that solutions to key sustainability challenges, such as solar power, evoke positive emotions among a wide range of voters. Leveraging these positive emotions can increase the chances of successful divestment campaigns. Second, our results provide startling evidence of how risk and benefit perceptions are driven by affect. The attempts by generations of climate change researchers to convey rational knowledge of climate risk and the potential economic benefits of climate change mitigation will therefore fall short of being behaviorally relevant unless they are coupled with relevant emotional hooks. Such affective cues can either be positive (such as pride to leave a healthy planet to future generations) or negative (such as disgust of continued reliance on polluting energy sources). Finally, our study highlights the importance of choice architecture and framing (Druckman, 2011; Sunstein and Reisch, 2014; Thaler and Sunstein, 2008). Divestment campaigners need to be mindful of incumbents' attempts to lure decision-makers' attention away from positive solutions by framing the status quo as a 'lesser evil' compared to an even less desirable, albeit perhaps only hypothetical, choice option. With sufficient resources at hand, pro-divestment communicators might try to use the asymmetric dominance effect in their favor by suggesting a second, more radical divestment proposal, and positioning a moderate proposal as the 'lesser evil' from skeptical decision-makers' point of view.

5.2 Limitations and Further Research

In contrast to many studies that elicit citizens' preferences about energy policies and technologies in politically 'neutral' times or based on lab experiments, we have investigated preference formation about divestment in a real-world politicized setting. While this has important benefits, we also acknowledge that observational studies have certain limits. In particular, we cannot be certain whether the hypothesized relationships are indeed causal. While we are confident about the theoretical soundness of our assumptions, lab experiments would be a plausible next step to study the interplay of affect and cognition in a more fine-grained manner. For instance, future research could try to „zoom in" on the mechanisms of interaction between affect and cognition in an experimental setting (e.g., using the Implicit Association Test or Functional Magnetic Resonance Imaging). Moreover, it would be interesting to explore the dynamics of affect-cognition-interactions in other areas of sustainable behavior, such as divestment from coal or overcoming diesel lock-in, and choice situations other than voting behavior.

Another limiting factor of our study is the fact that the direct democratic setting in Switzerland is a rather idiosyncratic one, and that the dynamics of preference formation might follow different patterns in systems where citizens do not have the opportunity to cast a vote on a variety of political questions. Hence, our findings might not be easily transferable to other cases. Nevertheless, we expect our study to have broader implications that go beyond the specific case dealt with. Public opinion plays an utterly important role also in other countries that currently contemplate divesting from unsustainable infrastructure, as the important role of the energy sector (as a provider of jobs, taxes and a driver of investment) makes moves towards divestment highly contested (McKnight and Hobbs, 2013). Further research could focus more on the societal forces that ultimately shape citizens' preferences about divestment in the energy sector as well as sustainability more broadly – in particular, to what extent organized interests are able to influence citizens' affect and cognition and, thereby, contribute to advancing (or slowing down) the transformation of today's economies.

Like breaking societal addictions, overcoming path dependence is a subtle interplay between phenomena on the individual, group, organizational, and societal levels. Our research is one of the first to connect individual-level changes in affect and cognition to a society-level outcome (divestment from nuclear power), but more research would be welcome to make sure we understand how the different levels interact – i.e., how and to what extent fast and slow brain processes interact, and how this relates to the speed of organizational and societal transformations towards sustainability.

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Supplementary Materials

Variable	t_0 (n = 1,216)	t_1 (n = 1,014)	Respondents at t_1 vs. dropouts	CH voting population
AGE				
18-29	19 %	17 %	t(1214)=3.56,	18 %
30-44	22 %	22 %	p = 0.00.	26 %
45-59	29 %	29 %		28 %
60+	30 %	32 %		28 %
GENDER				
♂	50 %	50 %	$\chi2(1)=0.042$, p=0.84.	49 %
♀	50 %	50 %		51 %
REGION (EXCL. TICINO)				
Western Switzerl. (French-speaking)	24 %	24 %	$\chi2(1)=1.581$, p=0.21.	25 %
Alps & Prealps	23 %	23 %	$\chi2(1)=1.939$, p=0.16	24 %
Swiss Plateau West	23 %	23 %	$\chi2(1)=2.467$, p=0.12	22 %
Swiss Plateau East	30 %	30 %	$\chi2(1)=1.069$, p=0.30	29 %
EDUCATION				
low/medium	63 %	63 %	$\chi2(7)=9.681$, p=0.21.	62 %
high	37 %	37 %		38 %
PARTISAN ORIENTATION				
Swiss People's Party (SVP)	29.4 %	29.7 %	$\chi2(1)=0.174$, p=0.68	29.4 %
FDP.The Liberals (FDP)	16.4 %	16.6 %	$\chi2(1)=0.184$, p=0.67	16.4 %
Conservative Democratic Party (BDP)	4.0 %	3.9 %	$\chi2(1)=0.531$, p=0.47	4.1 %
Green Liberal Party (GLP)	5.1 %	4.9 %	$\chi2(1)=0.355$, p=0.55	4.6 %
Christian Democratic People's Party (CVP)	11.7 %	11.7 %	$\chi2(1)=0.020$, p=0.89	11.6 %
Green Party (GPS)	7.4 %	6.8 %	$\chi2(1)=3.170$, p=0.08	7.1 %
Social Democratic Party (SP)	19.8 %	20.3 %	$\chi2(1)=0.947$, p=0.33	18.8 %
Others	6.2 %	6.1 %	$\chi2(1)=0.030$, p=0.86	8.0 %

Table i. Sample distribution of socio-demographic variables and partisan orientations.
Note: Information on socio-demographic characteristics of the Swiss voting population was obtained from the Swiss Federal Statistical Office. The distribution of partisan orientation corresponds to the results of the 2015 parliamentary election to the lower chamber (National Council). The t-test (age) and $\chi2$-tests assess whether non-response at t_1 is systematically related to the values of the respective variable. The $\chi2$-test for level of education is based on a fine-grained ordinal scale with 9 categories, hence df = 7.

		Post-vote survey (t_1, n = 1'014)				
		Approval („Yes") (n=405)	Rejection („No") (n=481)	abstention (n=118)	no answer (n=10)	dropout (n=202)
Pre-vote survey (t_0, n = 1'216)	*Certainly in favor* (n = 421)	273	31	38	4	75
	Rather in favor (n = 324)	106	117	40	4	57
	Undecided (n = 31)	3	9	7	-	12
	Rather against (n = 238)	13	171	24	2	28
	Certainly against (n = 202)	10	153	9	-	30

Table ii. Initial voting intentions (t_0) and reported voting behavior (t_1).
Note: The shaded cells indicate the subset (n = 527) of respondents who were initially in favor of nuclear divestment, responded to both survey waves, and participated in the popular vote.

	B1	**B2**	**B3**	**B4**	**R1**	**R2**	**R3**	**R4**
B1		.70	.68	.54	-.48	-.50	-.55	-.43
B2	.69		.69	.55	-.43	-.50	-.54	-.42
B3	.72	.71		.62	-.51	-.61	-.63	-.44
B4	.56	.54	.66		-.38	-.47	-.47	-.31
R1	-.49	-.47	-.59	-.47		.57	.57	.38
R2	-.53	-.56	-.66	-.51	.63		.60	.37
R3	-.57	-.53	-.62	-.48	.58	.59		.47
R4	-.48	-.47	-.53	-.47	.52	.47	.56	

Table iii. Correlation matrix of items measuring perceived risks and benefits.
Note: Values indicate correlation coefficients of items measuring risk and benefit perception at t_0 (above diagonal) and t_1 (below diagonal).

	Mean	Standard Deviation	Min	Max	n
Voting intention (t_0)	3.40	1.54	1 (certainly against)	5 (certainly in favor)	1,013
Voting behavior (t_1)	0.46	0.50	0 (No)	1 (Yes)	886
Stability of support	0.72	0.45	0	1	527
Strength of initial preference (t_0)	0.51	0.50	0 (weak preference)	1 (strong preference)	1,013
PERCEPTIONS					
Perceived Risks (t_0)	0.00	0.90	-1.90	1.55	1,014
Perceived Risks (t_1)	-0.02	0.90	-2.05	1.40	1,014
Perceived Benefits (t_0)	0.00	0.91	-1.52	1.80	1,014
Perceived Benefits (t_1)	0.01	0.92	-1.48	1.72	1,014
Imminence of Coal Power (t_1)	3.54	1.32	1 (fully disagree)	5 (fully agree)	962
AFFECT & EMOTIONS					
Affect towards nuclear (t_0)	3.18	1.84	1 (very negative)	7 (very positive)	1,009
Affect towards nuclear (t_1)	3.34	1.95	1 (very negative)	7 (very positive)	1,005
Emotions towards solar (t_1)	2.29	1.40	-4	4	1,014
Emotions towards nuclear (t_1)	-0.77	1.87	-4	4	1,014
Emotions towards coal (t_1)	-1.40	1.37	-4	4	1,014
SOCIO-DEMOGRAPHIC VARIABLES					
Age	49.59	16.96	18	89	1,014
Gender	0.50	0.50	0 (male)	1 (female)	1,014
Education	6.69	1.78	2 (compulsory education)	9 (University / higher education)	1,014
Danger Zone	0.16	0.37	0	1	1,014
Language Region	0.23	0.42	0 (German)	1 (French)	1,014
POLITICAL ORIENTATION					
Left party supporter	0.32	0.47	0	1	1,014
Right party supporter	0.62	0.49	0	1	1,014

Table iv. Descriptive statistics of variables used in the analyses.

	(2A) Perceived Risks	(2B) Perceived Risks	(3A) Perceived Benefits	(3B) Perceived Benefits
	coefficients (standard errors)	coefficients (standard errors)	coefficients (standard errors)	coefficients (standard errors)
Perceived Risks (t0)	0.005	0.033	–	–
	(0.033)	(0.025)		
Perceived Benefits (t0)	–	–	-0.020	0.017
			(0.033)	(0.025)
Affect	–	-0.244***		0.227***
		(0.013)		(0.013)
Negative affect	0.505***	–	-0.509***	–
	(0.066)		(0.067)	
Positive affect	-0.274*	–	0.302*	–
	(0.120)		(0.121)	
Young	-0.102	-0.086	0.136	-0.010
	(0.080)	(0.062)	(0.081)	(0.063)
Elderly	-0.032	-0.038	0.045	0.061
	(0.059)	(0.050)	(0.069)	(0.051)
Gender (Female)	-0.036	-0.001	0.113	0.079
	(0.059)	(0.045)	(0.060)	(0.045)
Education	0.009	-0.007	-0.035*	-0.017
	(0.017)	(0.013)	(0.017)	(0.013)
Danger Zone	-0.008	0.026	-0.020	-0.034
	(0.084)	(0.060)	(0.085)	(0.061)
Language Region (French)	0.059	0.130*	0.002	-0.091
	(0.072)	(0.054)	(0.072)	(0.054)
Left party supporter	-0.029	0.167	-0.121	-0.210*
	(0.117)	(0.096)	(0.119)	(0.098)
Right party supporter	-0.366**	-0.269**	0.421***	0.388***
	(0.118)	(0.093)	(0.119)	(0.094)
Constant	0.269	0.822***	-0.297	-0.827***
	(0.215)	(0.167)	(0.216)	(0.170)
R^2	0.24	0.43	0.32	0.44
N	524	1,005	524	1,005

Table v. Alternative model specifications.
Note: Coefficients are from alternative model specifications with ordinary least squares for risk and benefit perceptions. Models 2A and 3A are based on the subsample of initial supporters of nuclear divestment. Models 3A and 3B use the original, 7-point affect scale instead of the dichotomized versions. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Part IV

Business Power and Citizen Preferences in Contested Policy Issues — The Case of Divesting from Nuclear Power

Adrian Rinscheid[*]

Abstract

This study links voter-centered and interest group perspectives on policymaking to assess the role structurally powerful businesses can play in contested political issues. Revisiting the literatures on preference formation and on the foundations of business influence in politics, incumbent businesses are theorized to strategically use their structural power to influence voters' preferences. The conceptual framework is applied to an unexpected outcome of a direct democratic vote in Switzerland, where the majority of voters rejected a proposal to divest from nuclear power despite a significant decline in public support for nuclear power after the Fukushima accident. To empirically trace the role incumbent businesses played in the formation of voters' preferences, the study uses Discourse Network Analysis and a statistical analysis of survey data. The findings suggest that incumbent businesses used their structural power strategically to shape voters' preferences. The study stimulates the debate about political power relationships in societies. It also contributes to research on citizen preferences in the important field of energy policy, and enriches the nascent debate about divesting from unsustainable energy infrastructure.

Keywords: preference formation; structural power; discourse network analysis; energy policy; nuclear power; divestment

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This paper is referred to as "Paper 3" in Part I and V of this dissertation.

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1 Introduction

In their aspiration to influence public policies, organized corporate interests use a variety of strategies including persuasion and mobilization of voters (Kollman 1998; Walker and Rea 2014). While empirical researchers have started to systematically examine organized interests' communication behavior in public policy debates (Eising et al. 2015; Klüver et al. 2015), the question as to what extent organized interests are actually successful in influencing citizens when they form political preferences has rarely been taken up (De Bruycker 2017, 780). Reaching back to the classics of pluralism and elitism, answering this question is of fundamental concern for our understanding of political power relationships in societies (Pierson 2016).

An interesting field to study organized interests' influence on citizen preferences is energy policy, because its future direction is currently one of the most hotly contested political issues in many countries (Druckman 2013). Although there is broad academic consensus that transitioning to a sustainable energy future is inevitable and urgent (Grubler 2012; Meadowcroft 2009; Sovacool 2016), this consensus travels only to some of the relevant actors from business and politics. An important reason is that transforming energy systems requires divesting from unsustainable infrastructure; that is, assets that produce public bads. Retiring such legacy assets might be desirable from a societal point of view, but it incurs (perceived) losses for their owners—for instance, electric utilities—which makes it unlikely for them to support these measures. Political controversies relating to the retirement of legacy assets are therefore good opportunities to study the extent to which actors that have benefited from previous policies undertake efforts to influence citizens' preferences for new policies, and whether these attempts are successful. I hence propose to study in detail the contestation around a specific divestment proposal, namely the Swiss popular initiative to divest from nuclear power, which was rejected by a majority of the Swiss electorate in November 2016.

Conceptually and empirically, the investigation links two levels of analysis that are often treated as 'separate arenas' and hence rarely analyzed in an integrated framework. The first is rooted in the study of business influence in politics. A core insight this perspective offers is that incumbent businesses, based on their control over important economic resources, enjoy a «privileged position» in the political system (Lindblom 1977). The state's dependence on private sector profitability gives large businesses in particular the ability to influence political decisions. This structural power often comes along with resource advantages and privileged access to decision-makers, which amplifies business influence in policymaking (Newell and Paterson 1998). Along these lines, business and government have been found to constitute a «symbiotic relationship» (Lindblom 1977, 179-180). While this perspective is helpful in understanding how businesses and interest groups can shape political outcomes in arenas 'shielded' from voter influence, it is

largely quiet about situations when the most essential ingredient of democracy comes on stage: the citizen.

The second level concerns the role of citizens—in particular, as voters. While the behavioral political science literature has produced a vast body of work on the link between voting behavior and political outcomes, voters' preferences are often assumed rather than ascertained, which is why organized interests and a concept like business power typically have no place in these accounts (Hacker and Pierson 2010, 167). In the field of energy policy, social science research on citizens' preferences is scarce (Druckman 2013). Regarding nuclear power, researchers have studied citizen preferences by examining the role of cognitive (Whitfield et al. 2009) and affective (Peters and Slovic 1996) factors, but have not conceptualized nuclear energy as a political question. Preferences are treated as essentially stable, or malleable only by nuclear accidents, if at all. Little attention has been paid to the socio-political sources of people's perceptions and preferences, especially in concrete decision contexts—a perspective that would acknowledge preference construction as a dynamic process. This is surprising, as it is known that business interest groups spend considerable amounts of money to influence public preferences and discourses on nuclear power, for instance by commissioning studies that deliberately underestimate the costs associated with building and operating nuclear reactors (Gilbert et al. 2017; Shrader-Frechette 2011).

Although much research assumes that vested interests are an important driver of citizens' preferences, studies of interest group influence, on the one hand, and of voters' preference formation, on the other, have rarely crossed the bridge between each other.[1] Hence, rather than studying politics either as an «organised combat» between organized interests or as an «electoral spectacle» (Hacker and Pierson 2010), I follow Emmenegger and Marx' (2018) suggestion to integrate behavioralist and interest group perspectives and to study politics as an «organised spectacle». Such an integration is useful as it draws attention to the process of how citizens' preferences are constructed in light of the legacies of past policy struggles. In relation to the case study conducted here, it helps to understand why the Swiss rejected the divestment proposal despite high initial approval rates. To foreshadow, the empirical analysis indicates that arguments in favor of the status quo, which are reflections of business's structural power, had a significant impact on voters' acceptance of the proposal to divest from nuclear power and contributed to its failure at the ballot.

[1] For notable exceptions, see Nicholson (2011) and Weber et al. (2012).

2 Nuclear Power: Politics and Preferences

The use of nuclear power for electricity generation is the «longest standing controversy in energy politics» (Tosun 2017, 15). Starting in the 1950s, many countries developed ambitious nuclear programs. After initial euphoria, public acceptance in several countries started to decrease, caused partly by the accidents at Three Mile Island (United States, 1979), in Chernobyl (Soviet Union, 1986) and later Fukushima (Japan, 2011). Moreover, localized protests against specific siting decisions led to the emergence of anti-nuclear social movements in several countries. In Switzerland, opposition against a planned nuclear power plant in the canton of Aargau marks the launch of the anti-nuclear movement in the 1970s.[2] Since then, a nuclear-free energy system based entirely on renewables has been promoted by left-wing parties, civil society organizations, some local electricity providers and 'green' businesses, whereas incumbent businesses from the energy sector and beyond, industry associations and right-wing parties have been supportive of the technology.

The Swiss nuclear divestment proposal. Triggered by the Fukushima crisis, the Green Party launched a popular initiative in 2011, which proposed to restrict the lifetime of nuclear reactors to 45 years. The proposal implied retirement of three of the five reactors in 2017, and the remaining ones in 2024 and 2029. After a contested campaign, the proposal was rejected by 54.2 percent of voters participating on November 27, 2016. The rejection of a ballot proposition is not surprising per se, but the outcome is puzzling because studies assessing public opinion on nuclear power after Fukushima consistently showed that a majority of Swiss citizens was opposed to the technology (Kristiansen et al. 2016; Siegrist et al. 2014; Visschers and Siegrist 2013; WIN-Gallup International 2011). Moreover, data collected based on a large probability-based random sample less than one year before the vote demonstrate that almost three out of four voters had been in favor of divesting from nuclear power according precisely to the plan proposed by the Green Party (FORS-Selects 2017, 119), and even six to eight weeks before the vote, the ballot proposition had been supported by almost 60 percent of the electorate (gfs.bern 2016*a*; Rinscheid and Wüstenhagen 2018).[3] In addition, as the proposition was already the seventh popular vote on nuclear power since 1979, voters' opinions could be assumed to be settled. According to our survey discussed below, even on the voting day only 38 percent of voters indicated to be not concerned about the risks of Swiss nuclear power plants. I contend that explaining this puzzle needs to take the role of business and organised interests in citizens' preference formation into account.

[2] Nuclear power accounts for roughly one third of Switzerland's electricity generation.

[3] Table i in the supplementary materials contains detailed information on these and two further opinion polls assessing support for nuclear divestment among Swiss citizens post-Fukushima.

3 Business Power and Preference Formation

In contrast to the traditional mainstream assumption, most individuals do not have clear-cut preferences on most issues (Weber and Johnson 2009). Instead, they «carry around in their heads a mix of more or less consistent 'considerations'» (Zaller and Feldman 1992, 585), and while some of these considerations can be congruent, others might be mutually conflicting. For instance, in the context of a popular vote on nuclear power, a voter might consider electricity costs, job security in the electricity sector, and the state of the natural environment as relevant choice parameters. If the person appreciates low costs, secure jobs, and a healthy environment, she has to assign weights to these aspects to come to a decision. This is a complex task, highlighting that citizens' preferences are not predetermined by exogenous interests (Emmenegger and Marx 2018). Crucially, such a setting sets the stage for political actors including business interest groups who have an interest in shaping voters' preferences by strategically (re)framing an issue (Chong and Druckman 2007*b*). Preference construction in contested policy issues is hence an 'organised spectacle' in which citizens respond to the frames and cues they receive from political elites (Emmenegger and Marx 2018). To understand why energy incumbents were able to affect citizens' preferences to the point that the status quo finally prevailed in the Swiss case, I revisit the literature on the foundations of business power in politics.

The sources of business's power in politics. Going back to Lindblom (1977), research on the role of business influence in politics distinguishes between instrumental and structural power as sources of influence. Instrumental power entails a range of strategies that businesses employ to influence public policymaking, such as lobbying, campaign contributions, and commissioning research projects. A firm's structural power, on the other hand, is the result solely of its position in the economy (Culpepper 2016, 459). Firms, according to this view, influence political decisions «whether they want to or not», because their «sheer existence [...] leaves them no alternative» (Bachrach 1967, 80). In the energy sector, big utilities are structurally powerful not only because they provide jobs, invest, and pay taxes, but also due to their role as providers of critical infrastructures and electricity as a basic public service. What is more, through ownership, many countries (such as Switzerland through some cantons) are strongly involved in the energy business of big utilities. The mutual dependency between the state and the energy sector increases the risk of regulatory capture (Newell and Paterson 1998, 687), which contributes to the position of energy incumbents being structurally powerful. However, it is important to note that not all businesses are structurally powerful. While the literature on business's structural power tends to underemphasize the specific configurations that characterize many business sectors, structural power is often distributed unequally. In the energy sector, the structural position of incumbent

businesses (e.g., big utilities that operate nuclear power plants) differs considerably from the less privileged newer firms that challenge the status quo and hence expect to win from new policies. In keeping with the conventions of the literature, I refer to business's structural power when in fact it would be more precise to talk about the structural power of incumbents.

In the study of why and how businesses sometimes get the policies they want, structural power is often assumed to constrain policy-makers' room for maneuver automatically, because the latter need to be attentive to the impacts their policies have on employment, inflation, and voters' personal income (Przeworski and Wallerstein 1988, 12). Extending an emerging line of inquiry that combines structural power with agency in explaining business influence (e.g., James 2017), I argue that structural power has been largely overlooked in political settings with high public contestation, such as in the context of direct democratic votes. In contrast to vote-seeking politicians, many voters are likely not aware of business's structural position. Being confronted with a policy proposal that would incur costs, businesses can therefore be expected to publicly signal that such a policy would imply tangible threats of direct relevance for voters. In the context of nuclear divestment, an obvious candidate is compromised security of electricity supply. Whether such concerns are justified will not be resolved here, but what matters are voters' beliefs, which are socially constructed (Emmenegger and Marx 2018, 5). This view on structural power provides a strong role for agency by recognizing that structural power can be deliberately used by businesses as a strategic resource (see also Culpepper and Reinke 2014). In this sense, structural power in direct democratic decisions becomes effective only if it is «transmitted through instrumentalist and discursive channels» (Levy and Egan 1998, 353).

In terms of using these channels, business can allocate resources to advertisements and media campaigns. While it is «not entirely clear how much influence this money buys for business interests» (Walker and Rea 2014, 286), it is known that spending *against* a policy proposal generally yields considerably higher returns than spending in favor (Lupia und Matsusaka 2004). Experimental research, however, shows that organized interests' ability to affect voters' preferences on ballot propositions can be very limited (Nicholson 2011). The reason is that voters predominantly attend to arguments put forward by actors whom they perceive to be credible (Page et al. 1987; Weber et al. 2012), an asset not necessarily held by 'big businesses'. Hence, in referendum campaigns, businesses need credible allies to communicate their arguments. They typically find these in political parties, taking advantage of the fact that voters often use information about parties' positions as simplifying heuristics when forming preferences on specific political issues (Kriesi 2005). Businesses and parties hence engage in a mutually beneficial resource exchange: while businesses provide campaign finance, expertise, lucrative appointments, and other benefits, parties «provide the public faces of the campaign» (Emmenegger and Marx 2018, 6). In Switzerland,

this exchange of resources is institutionalized in the system of party financing. As (especially the right-wing) parties depend largely on donations,[4] material incentives to yield to business interests are probably stronger than elsewhere. In a referendum campaign, business's structural power can thus be expected to be amplified through (right-wing) political parties.

Empirical implications. I argue that the structural power of business can influence citizens' preferences regarding public policies, but that instrumental forms of power are required for structural power to become effective in this regard. This perspective entails several empirical implications for explaining the failure of the Swiss nuclear divestment proposal. First, incumbent businesses are expected to publicly express arguments that reflect their structural position in the economy. Second, they line up with political parties to have their arguments amplified in the media arena. Third, voters' partisan orientations work as a prism through which they assess the arguments uttered by different organized interests. Accordingly, combining the structural power argument with the partisan heuristic, voters leaning towards right-wing parties can be expected to endorse incumbents' arguments against nuclear divestment. Finally, as a manifestation of business's structural power in the form of voting behavior, the most salient arguments put forward by incumbents against nuclear divestment are expected to be strong predictors of vote choice (Emmenegger and Marx 2018). By empirically investigating each of the four steps, the following analysis will help to understand the failure of the Swiss divestment proposal and stimulate the discussion about business's ability to shape public perceptions.

4 Empirical Analysis

Levels of Analysis

Conceptually integrating interest group arguments with a behavioralist perspective on citizen preferences implies that the empirical investigation needs to be attentive to different levels of analysis. The first and second step focus on the political debate between supporters and opponents of the divestment policy as it unfolded in the media arena. To assess incumbents' efforts to shape the public debate before the vote, I use Discourse Network Analysis (DNA). Combining elements of qualitative content analysis with quantitative network analysis, DNA helps to assess the salience of arguments and the dominance of actors in a debate, and to systematically identify actor constellations, such as incumbents' connections to political parties (Leifeld 2017). Steps

[4] Switzerland is one of the few democracies without a system of public financing or any reporting obligations for parties. Moreover, no disclosure rules exist for spending in referendum campaigns. Both the total budgets and the share of 'external funding' (i.e., excluding membership fees and a minor public contribution for officeholders) vary substantially between parties. The right-wing parties *Swiss People's Party* (SVP) and *FDP.The Liberals* (FDP) are both much better endowed and more dependent on external funding than the other parties (Frey 2015).

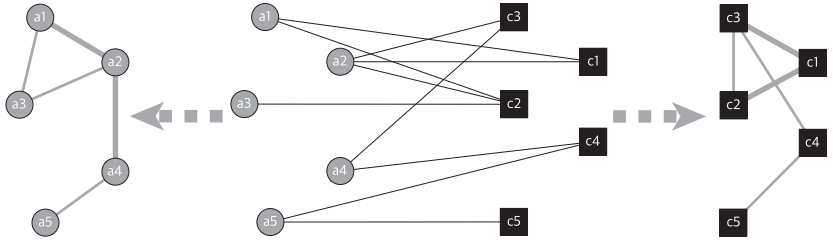


Figure 1. Basic model of a discourse network. Own depiction, based on Leifeld (2017).
Note: Circles symbolize actors and boxes symbolize arguments. The network in the middle represents an *affiliation network*. Here, the presence of a line indicates that a certain actor (say, a2) mentions the linked argument (say, c3). The left network illustrates the corresponding *actor congruence network*. Here, two actors are connected if they share at least one argument in the affiliation network (a1 and a2 both mention c1 and c2). The more densely connected two actors are (depicted by line width), the more arguments they have in common. The right network represents the corresponding *concept congruence network*, where two arguments are connected if they are mentioned by the same actor (c4 and c5 are both mentioned by a5).

three and four relate to another level of analysis: to gauge the influence partisan orientations and specific arguments played in voters' preference formation, data from a post-vote survey will be analyzed.

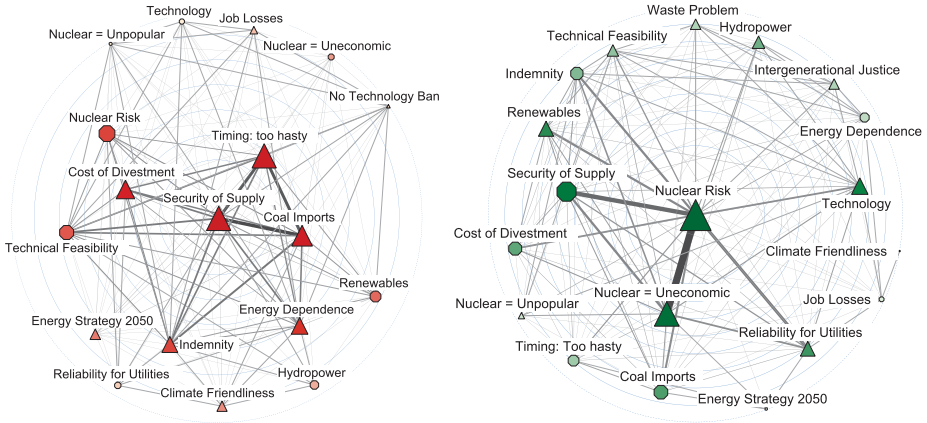
Discourse Network Analysis

The first step in DNA is a qualitative content analysis.[5] To document which actors participated in the political discourse preceding the referendum and which arguments they used, I content-analyzed all editorial contributions dealing with the ballot proposition that were published between September 05 and November 20, 2016, in 22 Swiss newspapers.[6] In Switzerland, newspapers reach more citizens than other media, and Swiss interest groups consider newspapers to be more important for their communication activities than other channels (Jentges et al. 2013). Based on the resulting dataset, different types of network graphs can be generated (see Figure 1).

The Arguments in the Political Debate. In 395 newspaper articles covered by the media sample, 20 different arguments relating to the proposition were voiced by 269 actors. The distribution of observations is relatively balanced, with 689 mentions of arguments supporting and 751 men-

[5]The supplementary materials (Appendix C) entail detailed information on the coding procedure and the codebook.

[6]Fifteen of these newspapers appear in German, and seven in French. As only 6.1 percent of the Swiss population lives in the Italian-speaking region, this area was excluded. All newspapers are listed in Table ii in the supplementary materials. The breadth of the sample minimizes the risk of overlooking arguments that might have played an important role in voters' preference formation. The articles were compiled and generously provided by the Research Institute for the Public Sphere and Society at the University of Zurich.



(a) Arguments used by the anti-divestment coalition.

(b) Arguments used by the pro-divestment coalition

Figure 2. Concept congruence networks of opponents and supporters of nuclear divestment. *Note*: Triangles symbolize affirmative use of an argument; octagons symbolize negative use. Node size, color saturation and network centrality all indicate the relative frequency with which an argument was used. «Security of Supply» (120 mentions by opponents) and «Nuclear Risk» (173 mentions by supporters) were the most frequently used arguments. Graphs drawn with visone 2.17 (centrality layout).

tions of arguments rejecting the proposition. Table iii in the supplementary materials details the six most frequently used arguments.

As can be seen in the concept congruence networks in Figure 2, both supporters and opponents of the proposition used a broad range of arguments. The networks illustrate the overall salience of arguments during the campaign and elucidate to what extent certain arguments were used in conjunction with others. Figure 2a confirms a central theoretical expectation regarding energy incumbents' structural power: claims that retiring the nuclear reactors would endanger electricity supply were of utmost importance in the campaign. The argument was promoted especially by big nuclear utility companies like Axpo and their interest representations, such as Economiesuisse, the umbrella organisation for the Swiss business sector. It was also used by the Federal Councillor for Energy, Doris Leuthard, and other members of the right-wing parties.

Two other arguments that appear central in Figure 2a are variants of the same theme. First, the status quo-coalition denounced that the divestment plan, which provided for a gradual phase-out until 2029, was too 'hasty' and would lead to 'chaos'. Second, a domestic phase-out would necessitate large-scale electricity imports, with most of the electricity coming from Germany, a country with a share of 40 percent electricity being generated by coal-fired power plants. This would have impaired the carbon footprint of the Swiss electricity sector. In addition, opponents argued that divesting from nuclear power would be 'too costly'.

The four arguments appearing most central in Figure 2a were also part of a large-scale print

and online advertising campaign. Figure 3 shows an example of a poster that combines the four most central arguments in an emotionally appealing way by conveying the threat of supposedly imminent blackouts. While concrete numbers relating to spending on elections and voting campaigns are one of Switzerland's best kept secrets, the amount of newspaper advertisements gives some indication on the extent to which instrumental channels have played a role in the referendum outcome. According to data from *Année Politique Suisse*, divestment supporters placed 360 advertisements, while opponents had higher visibility with 555 advertisements (APS 2016). In addition, there is evidence that—for the first time in a Swiss referendum campaign—targeted online campaigning by the anti-divestment campaign contributed to reaching a sizeable number of voters.[7]

The pro-divestment camp, on the other hand, focused mostly on the risks posed by nuclear reactors, followed by the argument that nuclear power is economically not viable (see Figure 2b). Moreover, divestment supporters emphasized that retiring the nuclear reactors would actually *strengthen* security of supply, as the failure-prone Swiss reactors would be replaced by an electricity supply system in which fluctuations would be better manageable.

Figure 3. Poster against the ballot proposition. http://www.ausstiegsinitiative-nein.ch (retrieved on 23.11.2016).

Mapping the Actor Constellation. Figure 4 illustrates the actor configuration in the run-up to the vote. In this graph, two circles are linked if the actors which they represent share at least one argument. Closely connected clusters of circles represent coalitions of actors that share similar arguments. The coalition on the left of Figure 4 comprises 119 divestment supporters, while the coalition on the right includes 108 opponents. The latter was dominated by the big utilities and several interest groups representing incumbent interests (purple circles). Moreover, these actors were well connected with the right-wing parties opposing the proposal (blue circles). This mirrors Gava and colleagues' (2017, 85) finding that Swiss business groups representing key economic sectors, such as energy production, have extensive interest affiliations with the parties of the political right. Due to the historically shaped ties between businesses, their interest associations and the political right, Emmenegger and Marx' (2018, 8) even argue that right-wing parties «do not have to be convinced to support business; to some extent they *are* business». By endorsing pro-nuclear arguments put forward by energy businesses during the ref-

[7] See "Jetzt dreht Economiesuisse mit Facebook 'Battlegrounds'.". http://www.tagesanzeiger.ch/schweiz/standard/Jetzt-dreht-Economiesuisse-mit-Facebook-Battlegrounds/story/27219149 (retrieved on May 3, 2018).

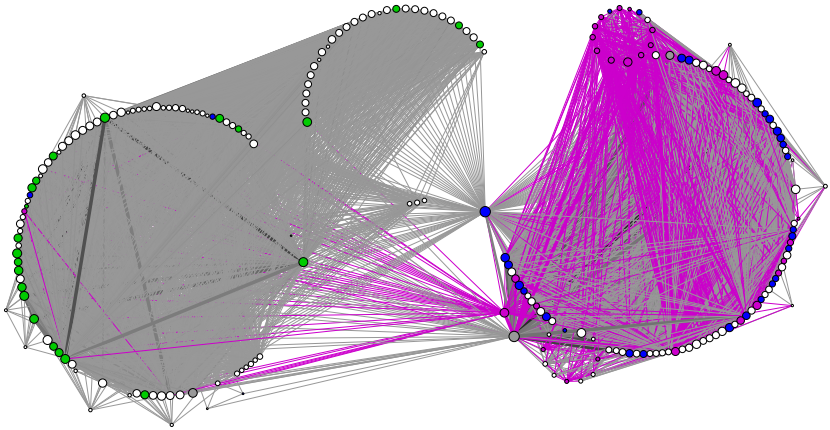


Figure 4. Actor congruence network.
Note: Circles represent actors, size corresponds to degree centrality, and link width reflects the number of shared arguments used by connected actors. Purple circles represent actors from the nuclear utilities and their interest representations, blue circles represent politicians from the parties opposing the referendum, and green circles represent politicians from the parties supporting the referendum. All links adjacent to purple circles are also purple. Journalists are excluded from this network. Graph drawn with visone 2.17 (circular layout).

erendum campaign, right-wing parties lent credibility to incumbents' claims. Amplifying these arguments, they ultimately served as the transmitters of business's structural power in the media arena.

Voting Behavior

The third and fourth steps address the question whether partisan orientations can explain voters' endorsement of arguments related to nuclear divestment, and, ultimately, the explanation of voters' preferences against divestment. The analysis is based on a post-vote online survey, fielded between November 27 (voting day) and December 1, 2016, on a representative sample (n = 1,014) taken from the German- and French-speaking parts of Switzerland.[8] Using stratified random sampling, participants were drawn from an actively recruited Swiss online access panel.

Variables. To assess the role of arguments, the survey included six statements on nuclear divestment and asked for participants' agreement (measured on a five-point scale from «fully disagree» to «fully agree»).[9] These statements correspond to the six arguments that appeared most frequently in the public debate (see Figure 2). Table 1 shows the frequencies.

[8]The survey, which was funded by the University of St. Gallen and administered by Intervista, was part of a panel study consisting of three waves.

[9]Table iv in the supplementary materials shows the original wording of survey items.

Argument & survey item	Obser-vations	*Fully disagree*	*Rather disagree*	*Neither nor*	*Rather agree*	*Fully agree*
Nuclear Risk: *«The Swiss nuclear power plants must be shut down before it comes to a tragic end.»*	984	11%	17%	14%	27%	31%
Security of Supply: *«Even after divesting from nuclear power, electricity supply in Switzerland will be ensured at all times.»*	955	13%	25%	12%	30%	21%
Coal Imports: *«Prematurely phasing out nuclear power makes imports of dirty coal power from foreign countries imminent.»*	962	10%	16%	13%	32%	29%
Timing: Too hasty: *«We should not make a rash phase-out decision, which would mean replicating Germany's mistakes.»*	944	19%	14%	14%	28%	25%
Nuclear = Uneconomic: *«Adhering to an old technology does not advance Switzerland as an innovation location.»*	971	6%	13%	19%	30%	32%
Cost of Divestment: *«Phasing out nuclear power would produce unnecessary costs due to the premature dismantling of our safe nuclear power plants.»*	959	21%	17%	11%	30%	20%

Table 1. Six arguments on nuclear divestment (frequencies in percent).
Note: «Security of Supply» was recoded for the subsequent analysis, reflecting that the argument was more frequently used by divestment opponents (see Table iii).

The dependent variable of step 4 is support for nuclear divestment at the ballot. Of the 896 respondents who confirmed their participation in the vote, ten did not remember their decision or refused to answer the question on voting behavior. Of the remaining 886, 45.7 percent reported they had accepted the divestment proposal, whereas 54.3 percent indicated rejection. These data perform well at replicating the actual ballot outcome, as 54.2 percent of Swiss voters who participated in the referendum rejected the proposal.[10]

Partisan orientation was measured by the question «Which political party best represents your political views?». Dummy variables differentiate between citizens leaning towards parties supporting the divestment proposal and leaning towards parties that opposed it, respectively. Controls include age, gender, education, location of voters in terms of linguistic region and whether they live within a radius of 20 kilometers around a reactor, and, as a proxy for environmentally-friendly

[10] Alas, the survey overestimates turnout (88.4 percent versus 45.3 percent official turnout). Such turnout gaps are a phenomenon typical of post-election studies, and the gap size identified in this study is comparable to that of other Swiss panel studies (e.g., Sciarini and Kriesi 2003). The reasons are threefold: besides overrepresentation of politically interested citizens in political surveys and vote misreporting (Selb and Munzert 2013), politically active citizens are more likely to participate in a multi-wave survey (Sciarini and Kriesi 2003).

behavior, the number of cars in a repondent's household (Thalmann 2004).[11]

Models and Results. Table 2 shows the estimates of a series of ordered-probit models to explain voters' endorsement of arguments related to nuclear divestment. The findings lend considerable support to the expectation articulated in section 3: supporting a right-wing party consistently predicts endorsement of the four arguments against nuclear divestment put forward by energy incumbents and their allies in the public debate.[12] This finding does not hold, however, for the contestation of pro-divestment arguments put forward by supporters of the ballot proposition. In the public debate, divestment opponents tried to downplay the risks of nuclear power and contested the claim that nuclear power is uneconomic; nevertheless, leaning towards a right party is not a significant predictor of rejecting these arguments. On the other side, there is not much evidence for an effect of the partisan heuristic among left party supporters (except for the risk-argument).

Finally, I test whether the most salient arguments of the public debate—in particular those reflecting energy incumbents' structural position in the economy—predict voting behavior. Table 3 contains the results of a probit regression, with support for the divestment proposal being the outcome variable. According to Model 1, all six arguments introduced earlier are significant predictors of vote choice. Adding partisan orientations does not affect this finding (see Model 2 in Table viii in the supplementary materials). As no effect can be detected for partisan orientations, their impact on voting behavior appears to be mediated through their influence on the approval of specific arguments.

How large are the effects of endorsing specific arguments? Figure 5 shows predicted probabilities for voting in favor of divestment conditional on the approval of arguments, holding all other regressors constant at their means. The argument about the timing of the proposed divestment turns out to have the largest effect on support. For a voter fully disagreeing with the statement that the phase-out would be hasty, the predicted probability of voting in favor of the proposition is 83.0 percent, whereas for a voter fully agreeing with this statement, the predicted probability drops significantly to 12.4 percent—a difference of 70.6 percentage points. Regarding the security of supply argument, the predicted probability of voting in favor drops from 74.2 to 9.9 percent; for the cost argument, it drops from 75.0 to 14.2 percent; and for the argument about electricity imports based on coal-fired plants, it drops from 71.6 to 24.1 percent. Interestingly, the argument that had the highest overall salience in the public debate—the risks of nuclear power—is the least important in explaining citizens' voting behavior. The difference in predicted

[11] Table v in the supplementary materials entails descriptive statistics of all variables used in the analyses.

[12] As Table vii in the supplementary materials shows, this effect is mainly driven by supporters of the Swiss People's Party (SVP) and FDP.The Liberals (FDP).

	Arguments against divestment								Arguments in favor of divestment			
	Security of Supply		**Coal Imports**		**Timing: Too hasty**		**Cost of Divestment**		**Nuclear Risk**		**Nuclear = Uneconomic**	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Right Party Supporter	.750**	.284	.588*	.292	.788**	.300	.618*	.305	-.146	.287	-.405	.291
Left Party Supporter	-.128	.285	-.443	.293	-.302	.301	-.423	.306	.637*	.290	.572	.294
Cars	.018	.041	.045	.042	.013	.043	.059	.043	-.061	.042	.027	.042
Young	-.118	.100	-.017	.101	.030	.103	.073	.101	.089	.101	.063	.102
Elderly	.110	.084	.240**	.086	.226**	.086	.365**	.086	-.199*	.084	-.074	.085
Female	-.040	.075	-.116	.076	-.036	.077	-.158*	.076	.160*	.075	.050	.076
Residence within Danger Zone	.101	.102	.226*	.105	.083	.106	.013	.103	-.125	.103	.055	.103
French-Speaking	-.145	.090	.004	.091	.019	.091	-.179	.092	.175	.090	.455**	.094
Higher Education	-.025	.081	.058	.082	-.098	.082	-.051	.082	.005	.081	.079	.082
Pseudo R^2	*.053*		*.073*		*.076*		*.079*		*.049*		*.070*	
N	*847*		*851*		*836*		*846*		*865*		*856*	

Table 2. Ordered probit regressions explaining agreement to arguments.
Note: Entries are coefficients and standard errors (SE). Significance levels: *.05, and **.01. The coefficients and standard errors for cut points of all models are contained in Table vi in the supplementary materials.

	Model 1 (1=support for divestment)	
Variable	Coefficient	SE
ARGUMENTS AGAINST DIVESTMENT		
Security of Supply	-.484**	.093
Coal Imports	-.319**	.101
Timing: Too hasty	-.527**	.093
Cost of Divestment	-.436**	.088
ARGUMENTS IN FAVOR OF DIVESTMENT		
Nuclear Risk	.237**	.085
Nuclear = Uneconomic	.367**	.105
CONTROLS		
Cars	-.131	.112
Young	.728**	.251
Elderly	.137	.226
Female	.164	.189
Residence w. Danger Zone	-.609*	.295
French-Speaking	-.365	.219
Higher Education	-.452*	.212
Intercept	3.575**	.778
Pseudo R^2	*.772*	
N	*743*	

Table 3. Probit model explaining support for nuclear divestment.
Note: Entries are probit coefficients and standard errors (SE). Significance levels: *.05, and **.01.

probabilities of voting in favor of divestment, contingent on endorsing this argument, amounts to 34.5 percentage points.

5 Discussion

This paper has started with the observation that in the study of public policies, relatively little work has investigated the extent to which organized interests affect citizens' political preferences. While structural power arguments tend to neglect voters, voter-centered perspectives often neglect the socio-political factors that shape these very preferences. By systematically assessing how voters' preferences were constructed in the context of a popular vote, the study links behavioralist and interest group perspectives and sheds light on the argument that citizens' preferences can be affected by business's structural power.

The Swiss popular initiative to divest from nuclear power entailed major consequences for only a small number of firms, but these occupy crucial positions in the economy. Of course, the utilities and their allies had strong incentives to shape the public debate. Although a majority of voters had endorsed the popular initiative until shortly before voting day, the proposal was finally rejected. The analysis shows that structurally powerful incumbents were able to raise concerns that have a direct bearing on voters. These arguments, which were amplified especially by right-

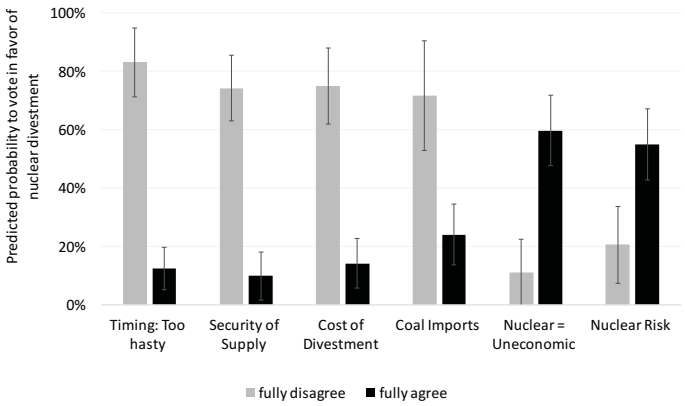


Figure 5. Predicted probabilities (with 95% confidence intervals) for voting in favor of nuclear divestment, conditional on the approval of arguments. The values are based on Model 1 (Table 3).

wing parties, can be interpreted as reflections of incumbents' structural position in the economy. While the research design does not allow to test the cognitive mechanisms, the analysis provides suggestive evidence that voters affiliated with right-wing parties considered these arguments to be credible, and hence rejected the ballot proposition.

The most effective anti-divestment argument was that retiring nuclear power plants 'hastily' (i.e., until 2029) would lead to 'chaos'. Often backed by reference to physical and economic 'laws', relentlessly pushing this argument led to a majority of voters finally being misinformed. Probing their understanding of the ballot proposition, only a third of survey participants could answer a factual question about its temporal implications.[13] These findings mirror earlier analyses of power and knowledge in nuclear energy politics that identify «the ways incumbent interests configure 'scientific' knowledges such as to condition wider social expectations over what is 'realistic' or 'unrealistic'» as a pivotal lever for influencing energy policies (Stirling 2014, 86). Incumbents also claimed that retiring nuclear reactors would lead to massive imports of 'dirty' electricity. By strategically framing nuclear power as a cornerstone of an effective national climate policy, they colonized a topic 'owned' by the pro-divestment coalition and expressed concern about the common good—a strategy recently dubbed «corporate citizenspeak» (Nyberg and Murray 2017). The fact that the coal argument had a considerable impact on voting behavior also points to the dilemmas of sustainable energy transformations. In today's carbon-constrained

[13] Item wording (ranslated): «If the nuclear divestment initiative were to be implemented, 50 percent of Swiss electricity production would have to be replaced by other sources within the next two years.» Results: «Certainly incorrect»: 12.8 percent / «Rather incorrect»: 21.4 percent / «Rather correct»: 33.9 percent / «Certainly correct»: 14.0 percent / «Don't know» / no response: 17.9 percent. In fact, around 15 percent of Swiss electricity production would have been to be replaced by other sources within two years after the vote, and less than 40 percent by 2029.

world, proponents of nuclear divestment need a well-crafted plan for replacing nuclear power with carbon-free sources.

It is important to note that the popular initiative was part of a broader process of reconfiguring Swiss energy policy. In 2011, the government had launched a comprehensive policy package aimed at transforming the Swiss enery system. The «Energy Strategy 2050», which entails a nuclear phase-out but no divestment,[14] was adopted by Parliament in September 2016 and obtained a popular majority in May 2017. Could the erosion of citizens' preferences for nuclear divestment be simply due to a learning effect; i.e., that voters became aware about the alternative proposal to phase out nuclear power provided by the Energy Strategy during the campaign in autumn 2016? The data suggest that this is unlikely, as the Energy Strategy did not play a prominent role in the discussions about nuclear divestment in 2016 (see Figure 2). Why did energy incumbents manage to induce a collective preference shift in the context of nuclear divestment, but not in the case of the Energy Strategy? The comparison points to business polarization as an important moderating factor of business influence: whereas incumbents and right-wing parties had been united in their fight against nuclear divestment, only some smaller pro-nuclear interest groups, sectoral associations and the Swiss People's Party campaigned against the Energy Strategy. Meanwhile, energy incumbents like Axpo and Alpiq, the Association of Electricity Companies, and some of the parties that were against the divestment initiative supported this comprehensive policy package.

By exploring the political dynamics of nuclear divestment in Switzerland, the study responds to calls for devoting more attention to the political dynamics of energy transformations (Stokes and Breetz 2018) and contributes to the emerging debate about divesting from unsustainable energy infrastructure (Geels et al. 2017). But the study's implications are not unique to the energy sector. Similar mechanisms have been shown in the politics of taxation, where business's structural power can explain voters' preferences against higher taxes on the super rich (Emmenegger and Marx 2018). The analysis demonstrates that to play out in contested political issues with high levels of public involvement, business's structural power requires agency. Without transmission through instrumentalist channels (i.e., campaigns that use credible actors to make incumbents' arguments heard), structural power will be ineffective. Structural and instrumental power, though conceptually distinct, can hence be intertwined empirically (Culpepper 2015; Emmenegger and Marx 2018).

Single-case studies raise issues of external validity. Switzerland represents an idiosyncratic institutional structure, as no other country calls its citizens to the ballot as frequently. In fact, institutions moderate the strategies adopted and influence exerted by businesses and organized interests (Woll 2006). Nevertheless, the findings entail broader implications because direct demo-

[14] According to the Energy Strategy 2050, nuclear power plants may be operated as long as they are considered 'safe' (while prohibiting construction of new ones)—in contrast, the divestment initiative included specific retirement dates.

cratic provisions are increasingly being extended in many parts of the world. Not only does direct democracy open another pathway for instrumental power to influence public policymaking, but also is it no guarantee that structural power loses significance. Even if business's structural power becomes less pronounced in the traditional sense of agenda control, it can become relevant as a resource that can be strategically exploited to influence voters and, ultimately, outcomes. Apart from that, business's structural power can also have important political consequences by pushing public preferences in desired directions without elections taking place at all, as the well-documented business campaign against Australia's Minerals Resource Rent Tax in 2010 demonstrates (Nyberg and Murray 2017).

The question whether organized interests are able to influence voters relates to the fundamental power relations in societies, notably what Lukes (2005) introduced as the «third face» of power. Emphasizing ideational elements, this dimension of power directs attention to the possibility that particular societal actors might be able to shape others' «perceptions, cognitions, and preferences in such a way that they accept their role in the existing order of things» (Lukes 2005, 28). Taking the energy field as an example of a sector where entire societies are structurally dependent on a small number of businesses, this study suggests that their structural position in the economy might enable some businesses to inculcate beliefs in others that further their own interests, but are not necessarily to society's advantage (Pierson 2016, 127). While Pierson rightly notes the methodological challenges of this research agenda, the fact that the notion of power is absent from most studies assessing voters' preferences about public policies should not urge us to «shift[...] from a focus on individual behavior to one of strategic interaction among elites» (Pierson 2016, 137). Instead, I contend it to be more productive to connect both perspectives, and to empirically assess how power relations play out in the individual-level process of preference construction. Future research should employ experimental methods and panel data to more clearly demonstrate the causal influence of business's structural power.

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Supplementary Materials

Appendix A: Tables related to the empirical analyses

Study	Fieldwork	Sample and survey mode	Question wording (translated)	Frequencies
Wüstenhagen & Chassot (2014)	January 15-24, 2014	n = 1,264 Swiss consumers; non-probability- based but representative sample (excluding Italian-speaking region); online survey	«In a referendum, I would vote for the gradual phase-out of nuclear energy until 2034.»[(a)]	Yes: 77%
Ebers & Wüstenhagen (2015)	February - March, 2015	n = 1,246 Swiss consumers; non-probability- based but representative sample (excluding Italian-speaking region); online survey	«In a referendum, I would vote for the gradual phase-out of nuclear energy until 2034.»[(a)]	Yes: 71%
FORS-Selects (2017)	October 18, 2015 - March 31, 2016	n = 4,903 Swiss citizens; based on a probability-based random sample; telephone survey (computer-assisted)	«A popular initiative calls for the phasing out of nuclear energy by 2029. Do you endorse this?»[(b)]	Yes: 43.8%; Rather yes: 29.9%; Rather no: 14.4%; No: 11.9%
gfs.bern (2016*a*)	October 3-14, 2016	n = 777 Swiss citizens; based on a probability-based random sample; telephone survey (computer-assisted)	«If the popular initiative 'For the orderly phase-out of nuclear energy' would be put to the vote tomorrow, would you vote certainly in favor, rather in favor, rather against or certainly against?»[(c)]	Certainly in favor / Rather in favor: 58 %; Don't know: 7%; Rather against / Certainly against: 36%

Table i. Public opinion on divesting from nuclear power in Switzerland before the referendum campaign.
Original question wording (in German):
[(a)] «Bei einer Volksabstimmung würde ich für den schrittweisen Ausstieg aus der Atomenergie bis ins Jahr 2034 stimmen.»
[(b)] «Eine Volksinitiative verlangt den Ausstieg aus der Atomenergie bis 2029. Befürworten Sie dies?»
[(c)] «Wenn morgen schon über die Volksinitiative 'Für den geordneten Ausstieg aus der Atomenergie' abgestimmt würde, wären Sie dann bestimmt dafür, eher dafür, eher dagegen oder bestimmt dagegen?»

Newspaper	language	type
20 Minuten	German	tabloid newspaper (free)
20 minutes	French	tabloid newspaper (free)
24 heures	French	subscription newspaper
Aargauer Zeitung	German	subscription newspaper
Basler Zeitung	German	subscription newspaper
Berner Zeitung	German	subscription newspaper
Blick	German	tabloid newspaper
Blick am Abend	German	tabloid newspaper (free)
Die Weltwoche	German	news magazine (weekly)
Le Matin	French	tabloid newspaper
Le Matin Dimanche	French	Sunday tabloid newspaper
Le Temps	French	subscription newspaper
L'Hebdo	French	news magazine (weekly)
(Neue) Luzerner Zeitung	German	subscription newspaper
Neue Zürcher Zeitung	German	subscription newspaper
NZZ am Sonntag	German	Sunday newspaper
Schweiz am Sonntag	German	Sunday newspaper
Sonntags-Blick	German	Sunday tabloid newspaper
SonntagsZeitung	German	Sunday newspaper
Südostschweiz	German	subscription newspaper
Tages-Anzeiger	German	subscription newspaper
Tribune de Genève	French	subscription newspaper

Table ii. Newspaper sample for the Discourse Network Analysis.

Argument	No. of mentions (divestment opponents / supporters)	Line of reasoning put forward by the coalition using the argument more often
Nuclear Risk	229 (56 / **173)**	*Globally, CH has the oldest fleet of commercial nuclear power plants. In recent years, there were several unplanned reactor outages due to security concerns. The likely consequences of a nuclear disaster are exacerbated by the fact that CH is a small, but very densely populated country.*
Security of Supply	183 **(120** / 63)	*Nuclear energy is the only low-carbon energy source that reliably supplies electricity at any time and independent of weather conditions. If CH phased out its reactors, more than 30 % of its electricity production would be lost.*
Coal Imports	129 **(97** / 32)	*If CH phased out NP, dependence on imported coal power would rise massively. Importing dirty coal power would seriously deteriorate the carbon footprint.*
Timing: Too hasty	124 **(104** / 20)	*The proposal demands a chaotic shutdown of nuclear reactors. The time frame is unrealistic, because the transformation of the energy system takes longer than foreseen by the exit plan. ND must be planned carefully. More time is needed to prepare for phase-out, decommissioning and dismantling.*
Nuclear = Uneconomic	114 (8 / **106)**	*The market signals are clear: given low electricity prices, power generation based on nuclear reactors will be a losing game for years to come. The operators of nuclear power plants are already bankrupt on the balance sheet, and the financial risks of a nuclear power plant are tremendous. Economic risks will further accumulate with increasing age of nuclear power plants.*
Cost of Divestment	107 **(78** / 29)	*ND will cost billions of Swiss francs. It necessitates investments in new power plants and the grid. Additional electricity imports will raise transmission costs. It also means new costs for decommissioning and disposal. Ultimately, higher electricity prices burden businesses and households.*

Table iii. The six most frequently mentioned arguments in the nuclear divestment discourse.
Notes: CH = Switzerland; ND = Nuclear Divestment; NP = Nuclear Power.

Short label	Questionnaire item (German)	Questionnaire item (French)	English translation
Nuclear Risk	*«Die Schweizer AKW müssen abgeschaltet werden, bevor es ein tragisches Ende nimmt.»*	*«Les centrales nucléaires suisses doivent être arrêtées avant qu'une catastrophe ne se produise.»*	*«The Swiss nuclear power plants must be shut down before it comes to a tragic end.»*
Security of Supply (*)	*«Auch nach dem Ausstieg aus der Atomenergie ist die Stromversorgung in der Schweiz jederzeit sichergestellt.»*	*«Même après la sortie de l'énergie nucléaire, l'approvisionnement en électricité sera assurée en permanence en Suisse.»*	*«Even after divesting from nuclear power, electricity supply in Switzerland will be ensured at all times.»*
Coal Imports	*«Bei einem verfrühten Atomausstieg droht der Import von dreckigem Kohlestrom aus dem Ausland.»*	*«En cas de sortie précoce du nucléaire, il existe le risque d'une importation d'électricité sale produite à partir du charbon.»*	*«Prematurely phasing out nuclear power makes imports of dirty coal power from foreign countries imminent.»*
Timing: Too hasty	*«Wir sollten nicht mit einem überstürzten Atomausstieg die Fehler Deutschlands wiederholen.»*	*»Nous ne devrions pas répéter les erreurs de l'Allemagne avec une sortie précipitée du nucléaire.»*	*«We should not make a rash phase-out decision, which would mean replicating Germany's mistakes.»*
Nuclear = Uneconomic	*«Das Festhalten an einer alten Technologie bringt den Innovationsstandort Schweiz nicht voran.»*	*«Rester fixé sur l'ancienne technologie ne fera pas avancer la Suisse en tant que site d'innovation.»*	*«Adhering to an old technology does not advance Switzerland as an innovation location.»*
Cost of Divestment	*«Der Atomausstieg würde unnötige Kosten durch den verfrühten Rückbau unserer sicheren AKW verursachen.»*	*«La sortie du nucléaire générerait des coûts inutiles dû au démantèlement précoce de nos centrales nucléaires sûres.»*	*«Phasing out nuclear power would produce unnecessary costs due to the premature dismantling of our safe nuclear power plants.»*

Table iv. Questionnaire items to gauge citizens' opinions on important arguments used during the political campaign. *Note*: (*) This item was adopted from Siegrist et al. (2014).

Note: A potential limitation concerns the wording of the item used to measure agreement to the assertion that the divestment proposal was «too hasty», as it simultaneously mentioned that a quick phase-out would mean «replicating Germany's mistakes». Some respondents might have indicated agreement with the item while actually agreeing more with avoiding Germany's mistakes than with seeing the timeframe as overly ambitious. This is particularly relevant given that the aspect of timing turned out to be the argument with the strongest impact on voting behavior. Encouragingly, however, there is further evidence that the timing was indeed *the* central reason for many to reject the divestment proposal. In the questionnaire, before answering to the provided arguments analyzed earlier, participants were asked to freely indicate the reasons why they had supported or rejected the popular initiative. Consistent with the analysis above, the most

frequently mentioned reason to reject the proposal (by 34 percent of No-voters) was the 'overly ambitious' timeframe, while only one participant mentioned Germany as a bad example for energy policymaking. This suggests that agreement to the survey item was in fact driven mainly by the timing component of the argument.

	Min	Max	Mean	Standard Deviation	n
Voting behavior	0 (Rejection of ballot proposition)	1 (Acceptance of ballot proposition)	0.46	0.50	886
Arguments					
Nuclear Risk	1 (fully disagree)	5 (fully agree)	3.50	1.38	873
Security of Supply	1 (fully disagree)	5 (fully agree)	2.80	1.37	855
Coal Imports	1 (fully disagree)	5 (fully agree)	3.55	1.34	859
Cost of Divestment	1 (fully disagree)	5 (fully agree)	3.11	1.48	854
Nuclear = Uneconomic	1 (fully disagree)	5 (fully agree)	3.69	1.22	864
Timing: Too hasty	1 (fully disagree)	5 (fully agree)	3.28	1.47	843
Partisan Orientations					
Right Party Supporter	0 (No)	1 (Yes)	0.62	0.48	896
Left Party Supporter	0 (No)	1 (Yes)	0.36	0.48	896
Socio-demographics					
Cars	0	7	1.21	0.89	888
Young	0 (older than 34)	1 (younger than 35)	0.15	0.36	896
Elderly	0 (younger than 60)	1 (older than 59)	0.34	0.47	896
Female	0 (male)	1 (female)	0.49	0.50	896
Residence within Danger Zone	0 (No)	1 (Yes)	0.16	0.37	896
French-speaking	0 (German)	1 (French)	0.23	0.42	896
Higher Education	0 (less than high school)	1 (high school or higher)	0.37	0.48	896

Table v. Descriptive statistics of variables used in the analyses.

	Nuclear Risk		Security of Supply		Coal Imports	
Cuts	Coefficient	SE	Coefficient	SE	Coefficient	SE
Cut 1	-.845	.333	-.628	.330	-1.081	.333
Cut 2	-.167	.333	.233	.330	.379	.332
Cut 3	.247	.334	.578	.330	.020	.332
Cut 4	.984	.333	1.465	.331	.934	.333
	Timing: Too hasty		Nuclear = Uneconomic		Cost of Divestment	
Cuts	Coefficient	SE	Coefficient	SE	Coefficient	SE
Cut 1	-.587	.343	-1.187	.340	-.851	.347
Cut 2	-.110	.343	-.456	.337	-.296	.346
Cut 3	.317	.343	.178	.337	.045	.347
Cut 4	1.143	.344	1.046	.338	.955	.347

Table vi. Coefficients and standard errors for cut points of ordered probit regressions explaining agreement to arguments (see Table 2)

Appendix B: Robustness checks for the analysis of voting behavior

A. Ordered probit regressions explaining agreement to arguments, disaggregating partisan orientations

The ordered-probit models in Table vii replicate the models contained in Table 2 of the main manuscript, but disaggregate the two partisan variables into seven variables capturing the main parties campaigning in favor or against the ballot proposition:

- SVP, FDP, BDP and CVP opposed the popular initiative,
- GLP, SP and GP campaigned in favor.

The results show that the four arguments against nuclear divestment were in particular endorsed by voters leaning towards SVP and FDP, while the coefficients for the remaining (center-)right parties (BDP and CVP) obtain significance only in two cases, respectively.

The results also show an interesting differentiation on the pro-divestment side. While being a supporter of the GLP predicts neither approval of pro-divestment arguments nor rejection of incumbents' arguments against divestment, being a GP supporter is a strong predictor with regard to all six arguments.

	Arguments against divestment								Arguments in favor of divestment			
	Security of Supply		**Coal Imports**		**Timing: Too hasty**		**Cost of Divestment**		**Nuclear Risk**		**Nuclear = Uneconomic**	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
SVP Supporter	.755**	.165	.765**	.167	.950**	.173	.789**	.172	-.526**	.168	-.891**	.171
FDP Supporter	.624**	.175	.593**	.178	.786**	.182	.812**	.183	-.578**	.178	-.899**	.181
BDP Supporter	.249	.242	.440	.245	.588*	.258	.550*	.246	-.177	.244	-.538*	.245
CVP Supporter	.321	.181	.363*	.182	.382*	.187	.319	.187	-.140	.184	-.538**	.187
GLP Supporter	-.163	.223	-.183	.220	-.025	.227	-.176	.230	.330	.229	.176	.236
SP Supporter	-.267	.171	-.445**	.171	-.359*	.177	-.330	.177	.349*	.176	.069	.178
GP Supporter	-.737**	.215	-.853**	.209	-.733**	.216	-.786**	.218	.489*	.214	.534*	.227
Cars	.022	.042	.047	.042	.019	.043	.070	.043	-.069	.042	.020	.042
Young	-.119	.101	-.019	.101	.033	.103	.071	.101	.094	.101	.073	.102
Elderly	.087	.087	.239**	.090	.215*	.090	.320**	.090	-.161	.088	-.022	.088
Female	-.006	.076	-.079	.077	-.003	.077	-.123	.076	.129	.076	.020	.077
Residence within Danger Zone	.123	.103	.260*	.106	.089	.106	.036	.104	-.141	.103	.034	.104
French-Speaking	-.122	.091	.040	.092	.058	.092	-.159	.093	.177	.091	.440**	.095
Higher Education	-.001	.084	.086	.085	-.082	.085	-.054	.084	-.003	.084	.077	.085
Cut 1	-.726	.235	-1.083	.237	-.511	.241	-.796	.243	-1.207	.238	-1.542	.247
Cut 2	.148	.235	-.369	.235	-.027	.242	-.234	.243	-.520	.237	-.804	.243
Cut 3	.500	.235	.036	.236	.412	.242	.115	.243	-.101	.237	-.164	.242
Cut 4	1.405	.238	.965	.237	1.259	.244	1.044	.244	.641	.237	.711	.243
Pseudo R^2	*.063*		*.082*		*.088*		*.088*		*.054*		*.075*	
N	*847*		*851*		*836*		*846*		*865*		*856*	

Table vii. Ordered probit regressions explaining agreement to arguments, disaggregating partisan orientations.
Note: Entries are coefficients and standard errors (SE). Significance levels: *.05, and **.01.
Abbreviations: SVP = Swiss People's Party; FDP = Free Democratic Party; BDP = Conservative Democratic Party; CVP = Christian Democratic People's Party; GLP = Green Liberal Party; SP = Social Democratic Party; GP = Green Party.

B. Probit model explaining support for nuclear divestment, including partisan orientations

Model 2 in Table viii extends Model 1 (see Table 3 in the main text) by including partisan orientations as an additional predictor. The results are virtually unchanged, and partisan orientations are not a direct predictor of voting behavior.

	Model 2 (1=support for divestment)	
Variable	Coefficient	SE
ARGUMENTS AGAINST DIVESTMENT		
Security of Supply	-.480**	.093
Coal Imports	-.310**	.102
Timing: Too hasty	-.510**	.094
Cost of Divestment	-.431**	.088
ARGUMENTS IN FAVOR OF DIVESTMENT		
Nuclear Risk	.231**	.086
Nuclear = Uneconomic	.349**	.107
PARTISAN ORIENTATIONS		
Right Party Supporter	-.138	.846
Left Party Supporter	.088	.848
CONTROLS		
Cars	-.143	.113
Young	.724**	.252
Elderly	.128	.227
Female	.136	.192
Residence w. Danger Zone	-.607*	.296
French-Speaking	-.332	.221
Higher Education	-.474*	.214
Intercept	3.637**	1.136
Pseudo R^2	*.773*	
N	*743*	

Table viii. Probit model explaining support for nuclear divestment, including partisan orientations.
Note: Entries are probit coefficients and standard errors (SE). Significance levels: *.05, and **.01.

C. Heckman-selection strategy to jointly model participation in the vote and voting behavior

The core aim of the statistical analysis presented in the paper is explaining citizens' preference for/against nuclear divestment. Since the survey data convey this quantity of interest in the specific form of voting behavior, a more extended modeling exercise would also take participation in the popular vote into account. To address the selection problem that arises if two outcomes are jointly determined, a Heckman-selection strategy may be used. This procedure involves two steps, both based on regression analysis: first, the selection model models the process by which survey participants decide to participate in the ballot, and second, the outcome model models support for nuclear divestment as a function of both independent variables and the estimates of step one. In other words, the procedure jointly estimates the probability to participate in the vote (step one) and to cast either a «yes»- or a «no»-vote (step two; see Carattini et al. 2017; Johnston 2013).

Participation

In Table ix, the columns labeled «Selection Model» present the estimates for participation in the popular vote. According to both Selection Models, the number of cars in a household and being younger than 35 are significantly associated with lower turnout. Neither partisan orientations nor agreement with specific arguments about nuclear divestment are systematically related to turnout rates. Given that the models cover only 82 non-voters, respectively, precautions should be taken when interpreting these findings.

Voting behavior

In Table ix, the columns labeled «Outcome Model» present the estimates for supporting the nuclear divestment initiative at the ballot. Outcome Model 1 corresponds to Model 1 (Table 3 in the main text), and Outcome Model 2 corresponds to Model 2 (Table viii in the supplementary materials). Importantly, the results of the Outcome Models are in line with the findings from the simpler probit model discussed in the paper.

	Outcome Model 1 (1 = support for divestment)		Selection Model 1 (1 = vote participation)		Outcome Model 2 (1 = support for divestment)		Selection Model 2 (1 = vote participation)	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
ARGUMENTS AGAINST DIVESTMENT								
Security of Supply	-.477**	.099	.078	.067	-.471**	.096	.079	.067
Coal Imports	-.313**	.105	.069	.073	-.302**	.106	.077	.073
Timing: Too hasty	-.524**	.095	.009	.068	-.505**	.097	.014	.068
Cost of Divestment	-.437**	.088	-.067	.069	-.431**	.088	-.063	.069
ARGUMENTS IN FAVOR OF DIVESTMENT								
Nuclear Risk	.237**	.085	.031	.062	.231**	.085	.028	.062
Nuclear = Uneconomic	.370**	.104	.065	.064	.351**	.106	.058	.064
PARTISAN ORIENTATIONS								
Right Party Supporter					-.113	.843	.296	.376
Left Party Supporter					.123	.848	.444	.379
CONTROLS								
Car ownership	-.137	.113	-.134*	.066	-.151	.113	-.135*	.066
Young	.707**	.264	-.316*	.154	.698**	.264	-.325*	.155
Elderly	.149	.228	.282	.158	.142	.228	.261	.159
Female	.156	.191	-.158	.125	.125	.191	-.170	.127
Residence within Danger Zone	-.615*	.294	-.163	.159	-.613*	.294	-.171	.160
French-Speaking	-.358	.221	.085	.166	-.323	.221	.100	.168
Higher Education	-.436*	.219	.271	.142	-.456*	.219	.259	.143
Intercept	3.490**	.866	.918	.521	3.505**	1.222	.573	.631
N (censored / uncensored)	*825 (82/743)*				*825 (82/743)*			

Table ix. Heckman-selection probit models explaining support for nuclear divestment.
Note: Entries are Heckman probit coefficients and standard errors (SE). Significance levels: *.05, and **.01.

Appendix C: Coding procedure and codebook for the Discourse Network Analysis

A first version of the codebook was developed by a close reading of 50 newspaper articles appearing in 10 newspapers that were published at the beginning, in the middle, and at the end of the referendum campaign. The resulting preliminary coding scheme was the basis for the first coding iterations of the entire newspaper dataset. Previously unmentioned arguments emerged repeatedly, necessitating the initial coding scheme to be modified several times during the coding process. To ensure a coherent way of coding, a multipass coding strategy was employed by performing multiple coding iterations and navigating «back and forth between the statements» (Leifeld 2013, 177). The final codebook (see below) contains 20 arguments.

The unit of analysis in DNA is the statement. Using the software software *Discourse Network Analyzer* (Leifeld 2012), each statement containing an argument in relation to nuclear divestment within the period of observation was coded manually according to six variables:

1. the date when the statement appeared,
2. the newspaper in which it appeared,
3. the name of the actor making the statement,
4. the organizational affiliation of the actor,
5. the specific argument revealed in the statement,
6. whether the actor approved or rejected the argument.

The following table briefly sketches the categories relevant for the last two variables (specific argument / approval or rejection). It also indicates the regular expressions that were used within the coding software. These are a means to render the coding procedure semi-automatic (Leifeld 2012), but they do not compensate for in-depth reading of all articles.

Argument (short)	Argument (extended)	Regular Expression (German / French)
Cost of Divestment	= yes: nuclear divestment leads to unnecessary costs (e.g., decommissioning costs; rising electricity prices; investments in new electricity generation capacity and the grid)	- Kosten, teuer - coût, coûteu[...], cher
Coal Imports	= yes: nuclear divestment leads to imports of coal-based electricity	- Kohle, dreck - Charbon, sale
Climate Friendliness	= yes: nuclear power does not emit CO_2 and helps Switzerland maintain a small carbon footprint	- Klima, Klimaschutz, Erwärmung - Climat, climatique, réchauffement
Timing: Too hasty	= yes: implementing the nuclear divestment initiative will lead to chaos because it provides for a hasty phase-out	- Schnell, voreilig, überstürzt, verfrüht - Rapide, vite, précipité, précipitamment, prématuré
Security of Supply	= yes: implementing the nuclear divestment initiative will put security of electricity supply at risk	- Versorgungssicherheit, Versorgung, Lücke, Flatter, Band, Netz - alimentation, sécurité, approvisionnement, pénurie, fluctuant, ruban, réseau
No Technology Ban	= yes: the nuclear divestment initiative means prohibiting nuclear power as a technology. There should be no bans on technologies	- Technologie, verbot - technologie, interdiction
Energy Dependence	= yes: implementing the nuclear divestment initiative will increase Switzerland's energy dependence from other countries	- abhängig, Ausland, Deutschland, deutsch, Frankreich, französ[...] - dépendan[...], étranger, Allemagne, allemand, France, français
Indemnity	= yes: implementing the nuclear divestment initiative will lead to claims for damages by the nuclear utilities, which will be costly	- erpress[...], Schadenersatz - extorque[...], chantage, pression, dommage, indemnisation
Job Losses	= yes: nuclear divestment destroys jobs	- Arbeitspl[...], Job - travail, emploi
Energy Strategy 2050	= yes: nuclear power will be phased out anyway according to the Energy Strategy 2050	- Energiestrategie 2050 - Stratégie énergétique 2050
Nuclear Risk	= yes: nuclear power is hazardous, which is why the power plants should be phased out	- Risiko, abschalt[...], Gefahr, Unfall, sicher - risque, arrête[...], danger, accident, incident, sécur[...]
Nuclear = Uneconomic	= yes: nuclear power is a losing game, so the power plants need to be retired as quickly as possible	- wirtschaftlich, Verlust, rentabel - perte, rentable
Intergenerational Justice	= yes: nuclear power is a problem in terms of intergenerational justice	- Generation, gerecht, kommend, künftig - Équité, justice, intergénération[...], génération, future, prochain, suivant
Technical Feasibility	= yes: phasing out nuclear power plants according to the popular initiative is technically feasible	- machbar, verzicht[...], möglich - faisab[...], renonce[...], possible, réalisable

Table x. Codebook used for the Discourse Network Analysis.

Argument (short)	Argument (extended)	Regular Expression (German / French)
Technology	= yes: a nuclear phase-out would be a driver of alternative technologies	- intelligent, smart, grid, Entwicklung - intelligent, smart, grid, développement
Waste Problem	= yes: nuclear waste is a big societal problem, which will be aggravated by not divesting from nuclear	- Abfall, Müll - déchet
Nuclear = Unpopular	= yes: nuclear power is unpopular. As the people do not like the technology, the plants should be phased out	- Akzeptanz, unbeliebt - acceptabilité, impopulaire
Reliability for Utilities	= yes: divesting from nuclear would lead to reliability for the electricity sector	- Verlässlichkeit, verlässlich - fiabilité, fiable
Hydropower	= yes: divesting from nuclear would be beneficial for Swiss hydropower	- Wasserkraft - hydraulique, hydroélectricité
Renewables	= yes: nuclear power plants can be retired because renewable energies can already now fill the gap	- erneuerbar - renouvelables

Table x. *(continued)* Codebook used for the Discourse Network Analysis.

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Part V

Concluding Remarks

The preceding chapters have assessed processes of preference formation in relation to nuclear energy policy from different perspectives. This concluding chapter wraps up and discusses the findings of the three case studies. Moreover, it provides an outlook on promising lines of research regarding the topic of divestment from fossil fuels.

1 Discussion of Case Study Findings

As the introductory chapter has shown, the question of nuclear divestment is likely to become an even more important topic over the coming years: the global fleet of nuclear power plants is ageing, concerns about nuclear safety have come to the fore again since Fukushima, and economic challenges related to the construction of new reactors seem to prevent a 'nuclear renaissance' from happening. Given this outlook, what insights can we gain from the three case studies on political processes and preference formation in Japan, Canada, Germany and Switzerland?

Figure 1 provides a schematic overview of the findings.[1] The central puzzle addressed by Paper 1 was the question why a focusing event (Fukushima) led to strongly diverging political dynamics in different countries (Canada, Germany and Japan). Building on the critical juncture framework, it was argued that, first, explanations of institutional change need to be attentive to the role of agency, and, second, the political legacies define the bounds of the possibility space of agency in an institutional field. The critical difference prior to Fukushima concerning nuclear energy policy between Germany, on the one hand, and Canada and Japan, on the other, was the existence of a strong challenger coalition in Germany. While challengers did not play an important role in the immediate crisis discourse, the availability of nuclear-skeptic beliefs already prior to the critical juncture made it more likely for incumbents to revise their cognitive maps regarding nuclear risks and benefits. Crucially, the empirical analysis shows how individual reconsiderations of nuclear power-related beliefs led to collective dynamics of belief shift and, ultimately, to the adoption of a law to divest from nuclear power. These processes involved purposive agency and political entrepreneurship (e.g., framing Fukushima as an event that changed 'fundamental certainties'; shifting the decision venue). In the other cases, a challenger coalition was almost nonexistent or considerably weaker, a condition that constrained the possibility space for purposive agency. While some central agents changed their beliefs in Japan, this did not lead to collective dynamics. In Canada, the challenge to pro-nuclear beliefs was even more limited.

[1] Figure 1 is not intended to provide an exhaustive depiction of pathways to institutional change versus stability, but visualizes the findings from the case studies conducted in Papers 1 - 3.

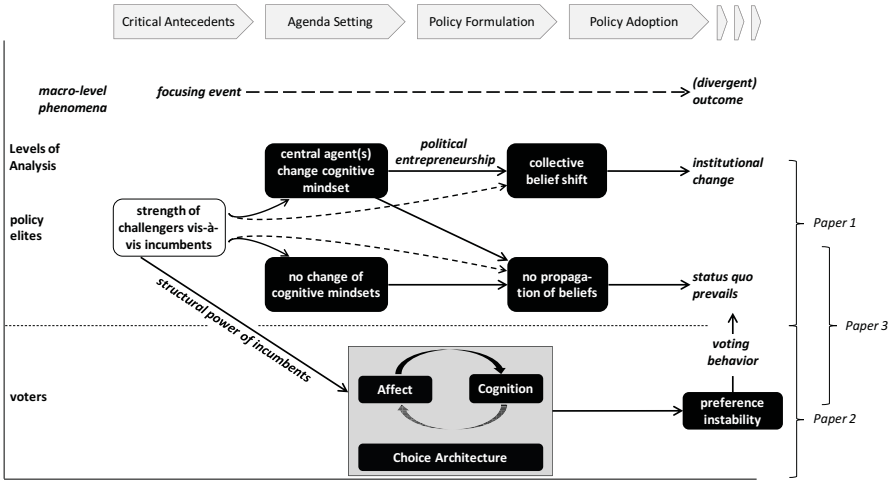

Figure 1. Pathways to institutional divergence: Preference formation within and across different political arenas.

Of course, the small number of cases does not allow to put the conceptual approach developed in Paper 1 to a more formal test. However, the empirical illustrations are a first step in responding to Fioretos et al.'s (2016, 15) call to develop a more actor-centred version of historical institutionalism. Future applications (and refinements) of the model could be helpful in providing a counterbalance against the structuralist bias of this literature, which has so far mainly been concerned with explaining how institutions structure individual behavior rather than how actors shape institutions.

While Paper 1 shows that political entrepreneurship can be conducive to overcoming unsustainable energy systems and facilitating divestment from energy infrastructure, Paper 3 demonstrates how powerful incumbents can contribute to preventing a divestment policy from being enacted even in a country with a history of strong anti-nuclear mobilization (Switzerland). To carve out the role of incumbent businesses in debates about nuclear power, Paper 3 to some extent oversimplifies the very complex interplay between elite discourses, the media, and public opinion. As Gamson and Modigliani noted some time ago, citizens may form their preferences based on public debates, but they are not «simply a passive object» on which organized interests and the media «work their magic» (Gamson and Modigliani 1989, 10). While this is true, previous research assessing direct democratic voting in Switzerland across many cases has found compelling evidence of «campaign effects»; i.e., opinion change induced by referendum campaigns (e.g., Kriesi 2002; Lachat 2007; Sciarini and Tresch 2011). In line with this literature, Paper 2 demonstrates that the perceptions and affective evaluations of nuclear power as well as the voting

intentions of many voters changed during the campaign preceding the Swiss divestment vote. Political predispositions also played a role insofar as they partly influenced voters' perceptions and their approval of arguments put forward in the political debate, but they did not directly translate into voting behavior.[2] This broadly mirrors Sciarini and Tresch's (2011) analysis of campaign effects in direct-democratic votes in Switzerland.

In particular, Sciarini and Tresch (2011) show that highly intense and 'one-sided' campaigns lead to higher campaign effects. While the nuclear divestment vote was clearly preceded by an intense campaign (e.g., fög 2016), its classification in terms of campaign direction is less obvious.[3] However, as Papers 2 and 3 show, specific strategies used by structurally powerful incumbents and psychological mechanisms that work at the level of voters can still lead to considerable campaign effects, even if campaigns are not strictly 'one-sided' according to definitions employed in the literature. A powerful strategy that incumbents can use is to point to potential 'perverse' effects of a policy proposal (see also Emmenegger and Marx 2018). Along these lines, Swiss energy incumbents did not emphasize negative effects for their own revenues, but raised concerns about the potential impact of nuclear divestment on the Swiss commitments with regard to climate change mitigation—a topic they had not discovered before the divestment campaign—, besides appealing to tangible short-term concerns (security of electricity supply, electricity cost). As other scholars have shown too, groups that aim at preserving the status quo sometimes «simply need to create enough doubt and concern about the measure to dissuade a majority of the electorate from supporting the new policy» (Gerber 1999, 62). In the energy policy context, the strategy of creating doubt about the feasibility of transitioning to an energy system based on renewable sources has also been applied elsewhere (Lauber and Jacobsson 2016). Due to psychological processes that work at the level of voters, this strategy can be seen as a promising winning formula to ensure enough public support for inertia. In particular, loss aversion may make many individuals receptive to such 'perverse effects arguments', and «phantom alternatives» (Doyle et al. 1999) can lead voters to revalue a rather unpopular status quo, which can result in the effect of asymmetric dominance described in Paper 2. Moreover, as a result of cognitive myopia, individuals are inclined to prioritize tangible short-term considerations over more abstract long-term goals, a tendency that can be reinforced by a discourse focusing on immediate (like electricity cost) instead of long-term (like long-term financial sustainability) concerns (see Weber 2017).

[2] Partisan orientations did not significantly predict voting behavior in any statistical model (see Table 2 on page 93, Table viii on page 136, and Table ix on page 138).

[3] Sciarini and Tresch (2011, 342) rely on information about campaign advertisements as a proxy for campaign direction, coding a campaign as one-sided if at least two thirds of all advertisements advertise one side of the issue. In the nuclear divestment case, 60.7 percent of newspaper advertisements were against the proposal (see page 115). Moreover, (only) 52.2 percent of arguments mentioned in (editorial) newspaper coverage were against the proposal (see page 113). While the campaign would hence be classified as 'balanced' according to Sciarini and Tresch's (2011, 342) operationalization, the status quo-coalition did have some advantages in coverage.

These findings can also advance research in Environmental Psychology and Ecological Economics. Different from studies in these fields that investigate citizens' acceptance of nuclear power during politically «neutral times» (Carattini et al. 2017, 98), the formation of citizens' preferences in politicized settings such as a direct democratic vote has not been an object of study previously. Although this is perhaps not a big surprise to researchers of direct democratic voting behavior, the preference instability among many Swiss voters demonstrates that citizens' energy-related preferences are much more malleable than assumed by the conventional economic view, which (still) treats preferences as stable (e.g., Ansolabehere and Konisky 2014). Understanding the potential political barriers is crucial in the development of any political strategy to divest, and public opinion is an important political resource likely to be shaped and exploited by status quo-oriented actors.

All in all, and echoing Geels' (2014, 36) concern that «policymakers (and many academics) have high (probably unrealistic) hopes that 'green' innovation will be sufficient» to transform today's energy systems, the case studies show how the strong path dependencies that characterize the energy sector can bias preference formation toward the status quo. These path dependencies not only condition the extent to which agents are able to incite 'collective belief shifts' among political elites committed to the status quo, but also affect the preferences of citizens. This is relevant because a lack of public support, together with opposition by incumbents, may jointly slow down the divestment processes needed to sustainabilize current energy systems also in other contexts. However, to put the failed Swiss divestment proposal into context and keep some hope alive regarding the ability of societies to align their energy systems with long-term challenges, it needs to be pointed out that the structural power of incumbents has its limits. While incumbents certainly contributed to the rejection of the divestment proposal, many of them supported the less ambitious but still significant Swiss «Energy Strategy 2050», including a nuclear phase-out and an expansion of renewable energies.

2 Research Outlook

The three case studies of this dissertation contribute to the emerging academic debate about divesting from unsustainable energy infrastructure (Geels et al. 2017; Heyen et al. 2017; Kivimaa and Kern 2016; Turnheim and Geels 2012) and add a political perspective that sheds light on processes of preference formation among political elites as well as voters. While nuclear divestment was the empirical focus of all studies, another important divestment context in the energy sector concerns the use of fossil fuels. The Paris climate agreement, which entered into force in 2016 and has since been signed by 195 countries, aims at limiting anthropogenic global warming to well below 2° Celsius compared to pre-industrial levels. As a study published in *Nature* shows,

80 percent of the world's coal reserves, a third of oil reserves, and 50 percent of gas reserves must remain in the ground in order to reach the agreed 2° target (McGlade and Ekins 2015).[4] Hence, global efforts to divest from these «unburnable fossil-fuel reserves» (Jakob and Hilaire 2015) are the *sine qua non* for having a chance to keep climate change manageable. Already in 2008, climate scientists had called for a complete divestment from coal-fired electricity by 2030 (Hansen et al. 2008), a necessity also reiterated by a recent «Roadmap for Rapid Decarbonization» (Rockström et al. 2017).

Some have argued that decarbonization can be achieved by building «winning coalitions» for the transformation of energy systems that thrive on smartly sequenced «green industrial policies» (Meckling et al. 2015).[5] In fact political coalitions have spurred governments around the world to introduce policy support for the phase-in of new technologies especially in the electricity sector. This has opened up new business opportunities, enabled substantial investments, and led to a steady increase of electricity produced from renewable sources like wind and solar, with the result that 12.1 percent of electricity worldwide was generated from 'new' renewable sources in 2017 (up from 5.2 percent in 2007; see UNEP & BNEF 2018, 32).[6] In some cases, a changing market environment favoring renewable over non-renewable energy technologies has also led firms to divest from fossil fuels. However, two thirds of global electricity generation are currently based on coal and gas (IEA 2018). Electricity generation based on fossil fuels is still expanding globally (Davis and Socolow 2014), and simply adding sustainable capacity does not lead to decarbonization—despite somewhat very optimistic claims that such a strategy could «effectively lead energy systems out of carbon lock-in» (Meckling et al. 2015, 1171).

Figure 2 shows that divestment, in the sense of actual asset retirement, does not happen automatically, just as investment in renewables goes up. Although renewable sources globally accounted for 61 percent (or $265 billion) of the added net power generation capacity in 2017 (up from just under 20 percent in 2007), global investments in fossil fuels still amounted to $103 billion (UNEP & BNEF 2018, 32). These investments stand in sharp contrast to aspirations for decarbonizing current energy infrastructures, as the latter would necessitate achieving zero capacity growth immediately, while starting to divest from existing systems at the same time. However, instead of replacing old infrastructure and institutions with new ones, most governments engage in 'policy layering' by implementing support schemes for sustainable technologies, but avoiding

[4] Or, at least, the CO_2 emissions associated with the combustion of fossil fuels must be *kept out of the atmosphere*.

[5] Research on the politics of energy transitions has identified several factors that explain why jurisdictions adopt policy innovations to spur investment in sustainable technologies. For example, the diffusion of policies to promote renewable energies can be the result of international policy coordination (Busch and Jörgens 2012; Schaffer and Bernauer 2014) and cultural-political proximity of states (Matisoff and Edwards 2014). Political institutions (Schaffer and Bernauer 2014) and ideologies (Matisoff 2008; Stokes and Warshaw 2017; Wiener and Koontz 2010; Yi and Feiock 2014) influence the adoption of green energy policy innovations, as do interest groups (Cheon and Urpelainen 2013; Jenner et al. 2012).

[6] 'New' renewable sources include renewable energies excluding large hydropower.

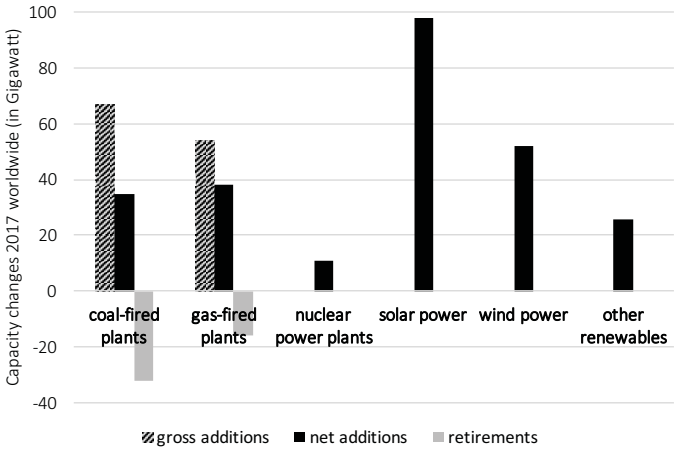

Figure 2. Investment and divestment in different electricity generating technologies: Global capacity changes, 2017.
Notes: Data taken from UNEP & BNEF (2018, 33-34). Net additions are gross additions *minus* retirements. While gross capacity additions equal net additions for renewable energies, reliable numbers for gross addition and retirement of nuclear capacity for 2017 are not yet available. The report published by UNEP & BNEF (2018) provides a rough estimate of net additions.

to dismantle existing fossil fuel systems (Laird 2016; Stokes and Breetz 2018). Clearly, the «flip-side of energy transitions» (Turnheim and Geels 2012) deserves more attention in future research, in particular with regard to fossil fuels.

What can we learn from the case studies associated with this dissertation for political efforts to retire fossil fuel infrastructures? There are some important similarities regarding the technical and sociopolitical roles of nuclear power and fossil fuels in current energy systems, as pointed out by Lovins already in 1976. In contrast to renewable energies, conventional electricity generation technologies are highly complex and depend on centralized infrastructures that entail serious environmental risks (Lovins 1976). Associated with both nuclear and fossil fuel-burning power plants is a low diversity of involved actors, which is why economic and political power is not dispersed as in the context of decentralized energy systems, but concentrated and in the hands of a small number of actors with often strong ties to governments and regulators (Burke and Stephens 2017; Lauber and Jacobsson 2016). These commonalities indicate that some of the challenges with regard to divestment are similar for fossil fuels and nuclear power. In particular, there is one simple lesson to learn: while vested interests have limited abilities to obstruct investments in green innovations, their position in the economy makes them a powerful veto player with regard to infrastructure divestment. Policymakers need to be aware that the contestation of the incumbent regime will be particularly strong when the question is not one about doing «'different' business,

but rather 'dissipating' business» (Rowlands 1995, 137).

However, the condition of carbon lock-in can be assumed to be even more difficult to overcome than nuclear lock-in. Several reasons account for this. First, the nature of risks associated with nuclear power and fossil fuels differs in important ways. Climate change is a slow-moving, «creeping» and hardly visible policy problem (Schneider et al. 2013). While the risks of nuclear power do also have a creeping component (nuclear waste), major nuclear accidents occasionally elevate the topic on the political agenda. These focusing events can favor the appearance of political entrepreneurs and cause actors to reassess their beliefs and preferences, but the slow-moving nature of climate change has so far failed to produce disruptions on a similar scale.[7] Second, divestment from fossil fuels does not only affect electricity generation, but is relevant also for the transportation and building sectors, which makes the scope of the challenge bigger. Third, in contrast to retiring nuclear power plants, divesting from fossil fuels has more direct ramifications for individual behavior, which is why citizens' preferences—expressed both as voters and consumers—probably play an even more important role.

To conclude, several ways forward shall be proposed for approaching the topic of divestment from unsustainable energy infrastructure from perspectives on preference formation. At the micro level, the role of citizens in energy politics is an area that should be tackled by future research (see Tosun 2017*a*), and citizens' preferences for divestment are particularly understudied. Because energy system change poses specific challenges for regional economic development, e.g. for regions that rely on coal mining, it is important to develop decarbonization pathways that cushion these often regionally concentrated consequences to ensure public acceptability. Research on citizens' preferences for the specific design of policies that take these considerations into account would be beneficial for developing such pathways.

Taking the approach used in Paper 3 to the next level, a better understanding is needed of the frames and cues that move citizens' preferences and emotions in the realm of energy policy and technology. Both panel and experimental studies would be helpful in this regard. Moreover, the 'supply' side of framing needs more scholarly attention, in particular as part of incumbents' political efforts to slow down changes, but also in terms of advocacy efforts to speed up energy system change. Recent advances in the large-scale analysis of text data based on machine learning and computational methods are just one promising method that has recently been pioneered in the context of studying the power of the American climate change counter-movement and could also be applied in the context of energy system change. These analyses compellingly demonstrate the influence of incumbent actors on preference formation via the news media and bureaucratic politics (Farrell 2016*a* and 2016*b*).

[7] Although extreme climate events have already increased in many regions (Diffenbaugh et al. 2017), it is difficult to attribute any single event to anthropogenic climate change (Trenberth et al. 2015).

In the introductory chapter, the distinction between divestment and phase-out was made to point to the subtle but important difference between politically limiting further investment in a technology (phase-out) and imposing concrete retirement schedules (divestment). Acknowledging this distinction is of major importance for gauging the prospects of current decarbonization efforts and understanding the different political dynamics associated with phase-out and divestment. An energy strategy that merely provides for limited investment in fossil fuels (such as the agreement to phase out fossil fuel use by the end of the century taken by the G7)[8] might be politically feasible but is by no means appropriate to achieve any meaningful climate stabilization targets. The distinction is hence closely tied to questions about the speed of energy system change. Climate scientists (e.g., Rockström et al. 2017) agree that the world might currently be in a critical phase for initiating deep decarbonization that should not be missed out. It is important to better understand the processes of belief updating and preference formation among political decision-makers that are currently charged with deciding on the legal frameworks of energy technology use for the coming decades (see Bosetti et al. 2017). Moreover, an important line of inquiry would be to examine the political configurations in which divestment can gain solid support by broad advocacy coalitions, and to investigate how resistance by structurally powerful and myopic incumbents can be overcome. Here, more case studies of both successful and failed political efforts to divest would be welcome to better carve out the factors conducive to divestment.

[8] see https://www.theguardian.com/world/2015/jun/08/g7 (accessed 15.01.2018)

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