Correction to: Identifying the ‘Fukushima Effect’ in Germany through policy actors’ responses: evidence from the G-GEPON 2 survey

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Abstract The nuclear meltdown in Fukushima, Japan, on March 11, 2011 (“3.11”) prompted global changes in national energy policies. Public discourse created the image that “Fukushima” had prompted Germany’s *Energiewende*, and much research asking why the reaction of decision-makers in Germany was significantly different from those in Japan has been conducted since that time. However, the effect on policy actors themselves in the policy-making network has been overlooked. Taking Germany’s sociopolitical history into account, we question such conclusions and argue that the measurable effect is much less than some conclude. Using an unconventional merged methods research design and innovative survey instrument with a policy-actor-network approach (the G-GEPON 2 Survey), we asked major German policy actors, interest groups, stakeholders and civil society actors about their opinions, attitudes and governmental support regarding energy policy decisions pre- and post-Fukushima. We found that an established institutional landscape of policy actors and their cooperation in policy processes has not been affected by 3.11. New forms of inquiry for policy research show the potential to provide insights into policy processes which were not measurable with traditional single-method inquiries. Furthermore, we have found that emulation of national legal frameworks must consider sociopolitical traditions. We attempt to create new forms of investigation to reveal hidden structures in policy processes which are empirically difficult to grasp.

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For reason beyond the control of the authors or the editors, the article titled “Identifying the ‘Fukushima Effect’ in Germany through policy actors’ responses: evidence from the G-GEPON 2 survey” by Manuela G. Hartwig and Leslie Tkach-Kawasaki (<https://doi.org/10.1007/s11135-019-00857-x>) was published in the regular issue Vol. 53 issue 4 instead of this special issue, where it was originally scheduled to appear. Therefore, the full article is reprinted here.

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Introduction

Even in mixed methods research projects where quantitative and qualitative data sources are at some point integrated in order to find answers to a single research question, survey research in general remains distinguished as either quantitative (mainly random sampling of large numbers of surveys) or qualitative (interviews of a purposively selected sampling frame). This is often for practical and logistical reasons. Before conducting data sampling, the research project's goals and resources are determining factors of the scope of the research design which, in turn, is determined by the research questions. The overarching goal is to achieve a workable data set of one or the other form of inquiry and to insure generalizability of the findings. In other words, the researcher wants to legitimately draw inferences to the entire population, that is, the object of the research, and contribute to theoretical concepts (Marshall 1996; Gobo 2008).

With this paper, we aim to show not only how merged methods of data collection, that is, collecting qualitative and quantitative data simultaneously, can not only enrich the quality of an entire research project, but also can overcome inherent weaknesses found in either form of inquiry. Such weaknesses include a lack of in-depth perspectives, which is often the case with large-scale quantitative surveys (Belli and Callegaro 2009) or ignoring unexpected bias within randomized sampling due to nonresponse selection bias (Bossler et al. 2018). Limitations in qualitative methods involve issues of a lack of generalizability in lengthy interviews with a small set of informants (Gobo 2008; Belli and Callegaro 2009).

The context of this study is the still-ongoing nuclear disaster that happened in March 2011 at the Fukushima Dai'ichi Nuclear Power Plant operated by the Tokyo Electric Power Company (TEPCO) located on the northeast coast of Japan. The devastating catastrophe instigated major long-lasting shifts in society, the economy and policy. The nuclear melt-down forced decision-makers and stakeholders to re-evaluate nuclear energy as a clean energy source worldwide in terms of safety and efficacy. In the first decade of the 2000s, much effort was invested in developing technologies to make nuclear power plants safer, and during the period since the last major nuclear accident at Chernobyl in 1986 (Findlay 2010), nuclear energy had experienced a popularity renaissance in some countries with high energy demand such as China, India, the USA and Japan (Nuttall 2005; Schulz 2011).

Almost two decades ago, Germany's coalition government (1998–2005) comprised of the Social Democrats (SPD) and the Greens (*Bündnis 90/Die Grünen*) passed legislation to strengthen the country's energy transition (*Energiewende*) toward renewable energies as its main energy sources (Schreurs 2014) to become independent from importing other electric energy resources from its European neighbors and Russia (Morris and Jungjohann 2016). Under these regulations, the administration under former chancellor Gerhard Schröder (SPD) set the path toward phasing out nuclear energy by 2022. However, in late September 2010, less than six months before the accident in Japan, under great controversy and opposition from other policy actors, stakeholders and civil society alike, conservative Chancellor Angela Merkel's CDU/CSU administration extended the use of nuclear energy

and postponed the implementation of the nuclear phase-out plans (Schreurs 2014; Morris and Jungjohann 2016).

The Fukushima disaster, however, was a turning point that changed the future of nuclear energy as an electric energy source in many countries. It has become widespread opinion that the nuclear catastrophe prompted Germany's government to pass the Nuclear Energy Act, aiming at total nuclear phase-out by 2022, within only six months after the accident, often neglecting the historical context described above. Certainly, the impact of the nuclear catastrophe is a major event with long-lasting effects on global society. In the words of Chancellor Merkel, Fukushima was a turning point for the world (*Einschnitt für die Welt*).¹ The German government's re-evaluation of nuclear energy and amendments to the Nuclear Energy Act is only few of the Fukushima-related effects that we can observe.

The involvement and opinions of key stakeholders played critical roles in this legislation's enactment. Furthermore, Germany's renewable energy promotion policies are seen as an example for other countries to emulate. Its leading role in environmental and energy policies that tackle climate mitigation led to the spread of the German term for energy transition, *Energiewende*, in international society since 2011.²

Controversial assessments in research since 2011 made pinpointing attitudes among relevant German energy sector actors toward the Fukushima incident and its impact the goal of this research. The combination of the Fukushima nuclear accident itself, the Merkel administration's stance toward nuclear energy and reactions to government policy shifts concerning nuclear energy suggests that Fukushima was an important event that would have a lasting effect on German energy policy attitudes held by governmental, political, civil society and media actors. This leads to the question of the effect that Fukushima had on the attitudes and opinions of leading energy sector actors.

The data set we use to address this question within this paper is the Global Environmental Policy Network (G-GEPON 2) survey that we conducted in Germany from November 2016 to February 2017. Its aim was to investigate the 'Fukushima Effect' from a new perspective. Our goal was to obtain data from policy actors, decision-makers, stakeholders and civil society actors about what has happened since 2010, how Fukushima affected policy-actor networks, opinions and attitudes toward the Merkel administration, as well as energy policy processes, policy instruments and energy sources. Examinations from these perspectives have lasting implications for assessing the long-term impact of this disaster on energy policy from an international standpoint.

This paper analyzes and discusses part of the survey data that specifically provide evidence for the 'Fukushima Effect' from a policy-actor-network perspective. Additionally, the data collection method followed merged techniques which we will explain in more detail in the methodology section. The outline of the paper is as follows. First, we review the literature that investigates the 'Fukushima Effect,' highlighting the research problem and research questions. Second, we discuss the theoretical framework guiding our survey research and continue with explaining climate mitigation mechanisms, as these are

¹ Government policy statement on June 9, 2011, Chancellor Angel Merkel. (Speech transcript accessible through the *Bundestag* archives: <https://archiv.bundesregierung.de/archiv-de/regierungserklaerung-von-bundestanzlerin-angela-merkel-zur-energiepolitik-der-weg-zur-energie-der-zukunft-mitschrift--1008262>).

² The term *Energiewende* has become a key term for global energy transition movements. The international network of the Heinrich Böll Foundation, for example, provides extensive resources and ongoing research on the progress of energy policy transition efforts toward more renewable energy globally: <https://energytransition.org>.

variables in the survey instruments and used as discussion tools for the interviews. The method of data collection and analysis will demonstrate the benefits of utilizing merged methods as a means to test the effectiveness of new research designs to overcome limitations of common empirical methods in the social sciences. This leads to the discussion of the results, and we will conclude with summarizing our findings in the context of the theoretical framework and discuss practical implications that emerged from the G-GEAPON 2 survey.

The ‘Fukushima Effect’

Wolling and Arlt (2014) refer to the phrase ‘Fukushima Effect’ in regard to political consequences and the role of media discourses. Hubbard (2014) uses the term ‘Fukushima Factor’ and looks how political decisions due to Fukushima affect sociopolitical systems. Both terms, ‘Fukushima Effect’ and ‘Fukushima Factor,’ describe a ‘catalyst’ (Hubbard 2014) for change in sociopolitical systems with direct reference to the nuclear accident at the Fukushima Nuclear Dai’ichi Power Plant on March 11, 2011. And it is this catalytic effect of an external, uncontrollable natural disaster that can push-start movements from the status quo and change social and political systems. However, internal factors such as a society’s rules and norms, dominant political institutions, existing legal structures and administrative procedures determine the actual measurable effect. While Germany is internationally known to have had the most drastic political reaction after Fukushima, other countries like Sweden did not appear to be affected by the nuclear disaster at all (Jahn and Stephan 2016). Hindmarsh and Priestley (2016) investigate the ‘Fukushima Effect’ through a geopolitical lens and provide comparative studies, suggesting that other countries such as China, India, Taiwan, South Korea, New Zealand, the United Kingdom, the USA and Finland were affected by the major nuclear fall-out of 2011. In general, the “ripples,” as the authors phrase it, spread internationally, “causing unprecedented safety checks of nuclear power plants worldwide.” They also noted that “Fukushima appears to have slowed down the growth rate of nuclear power” (Hindmarsh and Priestley 2016: 1).

Such discussions about the ‘Fukushima Effect’ range between assessing the immediate and long-term effects on economic or political systems, or between sociopolitical effects and effects on eco-systems. The seemingly rapid decision to phase out nuclear energy by 2022 and further promote renewable energy made by the German government in June 2011, less than six months after the catastrophe, might appear hasty and possibly emotional. Yet these perspectives ignore sociopolitical contexts and pre-established political instruments used for the substantive promotion of renewable energy that started to form in the early 1990s and that were transformed into a sophisticated legal system at the beginning of the 2000s.³

The perception of risks is amplified by public discourse through communication means such as mass media and social media, as well as literary works and other means of communicating issues and image production (Nebehay 2012; Kim and Kim 2017;

³ The literature that discusses the history of the energy policy in Germany is vast. For the interested reader, the authors suggest reports offered by the Federal Ministry for Economy, Trade and Industry (https://www.bmwi.de/Navigation/EN/Topic/topic.html?cl2Categories_LeadKeyword=energiewende) or resources provided by the Heinrich Böll Foundation of their project “Energy Transition. The Global Energiewende” project (<https://energytransition.org>).

Murakami et al. 2017). The uncertainty of risks associated with invisible threats such as nuclear radiation increases fears in societies (Beck 1986; Gerstenberger 2014), and the tenor and images produced influence that perception decisively. From the social construction of invisible threats, governments should protect social life and respond to health risks with regulations and public policies.

Wolling and Arlt (2014) explain Germany's exceptional response to Fukushima through the role of media and emphasize historical contexts of strong anti-nuclear civil society activism since the late 1960s and the country's proximity to Chernobyl. For instance, the 2020 to 2022 threshold for the nuclear phase-out in Germany was already set by the Schröder administration (Wolling and Arlt 2014). The direct and immediate effect of the nuclear fall-out in Chernobyl in 1986 strengthened anti-nuclear voices in Germany. The nuclear fall-out in Fukushima, however, was experienced through media. Nienierza (2014) found that discourses in Germany surrounding both accidents, Chernobyl and Fukushima, were similar. The collective memory may be one reason why Germany's reaction to Fukushima could be considered prominent. Yet, clearly Germany did not physically experience the 2011 catastrophe that occurred more than 9000 kilometers away and differentiates the discourses involving Chernobyl from those focused on Fukushima. While in Japan, radiation exposure and health risk dominate public discourse; in Germany, the discourse related to Fukushima is political (Nienierza 2014).

Despite differences in core concepts for climate mitigation measures, the international environmental regime passed the Paris Agreement in December 2015. The Agreement emphasized national responsibilities by demanding the establishment of national mitigation plans. Indeed, among negative effects, crises also open possibilities and can push technological developments, as undertaken in China, where the Green Revolution after Fukushima resulted in heavy investment in renewable energy technologies, surpassing Germany in renewable electric energy plant implementation by leaps and bounds (Hubbard 2014). The front-runner role associated with Germany's climate mitigation policies, including the promotion of renewable energy technologies, has suffered setbacks not only from fast-moving countries such as China. Indeed, this front-runner position rests more on the combined efforts of the European Union (EU), as the EU shapes the domestic legal framework for environment and energy policy of its member states. In fact, among China and the USA, the EU is also one of the major CO₂ emitters. Schreurs (2016) pointed out that the involvement of these three national- and international-level actors in the ratification of the Paris Agreement was a key factor to its success. However, the agreement's voluntary measures have been criticized as lacking effectiveness, and there have been calls for a stronger legal framework and incentives.

Faced with the challenge of integration, establishing legal frameworks on the domestic level to combine supra-national and national standards takes time (Fischer 2017). Energy and environmental policy in Germany have been historically decentralized. Moe (2015) suggests that the early adoption of the feed-in tariff scheme in the national legal framework to promote renewable energies in 1991 and 2000 is one of the main reasons for the country's leading role. From 2007, a "complex construction" of diverse competencies and regulations has developed on both the European as well as on the national level in Germany. The *Bundestag* (federal parliament) adapted a similar framework to that passed by the EU in 2007 (Fischer 2017). While Fischer (2017) discussed the diminishing role of Germany as an international model, Grasselt (2016) pointed out that the EU's integration policies for climate mitigation since 2012 carry a strong German signature. Germany's driving role in the European integration of energy and

environmental policies is one explanation for why it was seen as a front-runner in such issues surrounding renewable energy promotion policies.

Barriers need to be removed to further subsidize renewable energy technologies. Such barriers include access to the energy market system from an economic perspective, connection to energy grids from a technological perspective or administrative barriers from a policy systems perspective. These are of grave importance for energy suppliers' decision-making on how much to invest in the development of renewable energy power plants (Lüthi and Prässler 2011). Events as drastic as Fukushima are considered to open windows of opportunity for political change (Jahn and Stephan 2016), and the actual 'Fukushima Effect' on Germany's energy policy decisions in the immediate post-Fukushima time period is much less drastic than public discourse might suggest. Jahn and Stephan (2016) argued that the 'problem stream' and the 'policy stream' were already at work when the Fukushima disaster happened, facilitating quick moves in the 'politics stream.' In other words, the window of opportunity was already wide open and many dynamics in Germany's *Energiewende* were at work. That made it seem as if observable reactions in Germany were hasty, lacking consequent consideration or even unjustified. Consensus building and balancing the conflicting political situation caused by Merkel's phase-out postponement prior to the nuclear accident in Japan was what research identified to be the relevant 'Fukushima Effect' in Germany (Jahn and Stephan 2016, S. 162–163).

The scheme that aims at changing the energy supply system of a nation is complex, and in order to achieve transition goals, political decisions must be adapted by energy consumers. Studies that investigate Germany's nuclear phase-out policy following Fukushima in 2011 to phase out all remaining nuclear power plants by 2022 highlight the political power argument. To remain in government, the Chancellor had to act according to the public voice that opposed strongly the previously decided phase-out postponement in late 2010. That several local elections were scheduled throughout that year was a contributing factor to the quick decision-making process to boost the *Energiewende* (Sturm 2017; Jahn and Stephan 2016; Morris and Jungjohann 2016). Jahn and Stephan (2016) suggest that Fukushima did have a significant effect on election outcomes in Germany that year.

Cost-merit is an important criterion used by energy suppliers to make investment decisions relating to energy supply technology (Lüthi and Prässler 2011). The Renewable Energy Act (*Erneuerbare Energien Gesetz*) is a feed-in tariff scheme that subsidizes the connection of renewable energy sources to the energy grid. This scheme is reflected in electricity prices, and generally, every energy consumer pays the tariff. However, many heavy industries with high energy costs are often exempted from paying the tariff and the increase in electric energy charges for consumers is a target of much criticism.

“[T]he costs imposed by the *Energiewende* far outweighed the falling prices on the wholesale markets. [T]o preserve Germany's economic health, which to a large extent depends on exports of industrial goods, the government shielded energy-intensive manufacturing processes, such as chemical, aluminum, paper, and glass production, from EEG-related charges to keep manufacturing companies from migrating to countries with cheaper energy, or simply to protect them from economic failure due to the high price of electricity. As a result, about 40% of the nation's electricity is used by industries that are largely protected from contributing to the *Energiewende* costs—expenses that therefore must be borne by other energy users” (Sturm 2017).

Some expected that the drastic turn of shutting down all remaining nuclear power plants would cause the energy market to destabilize, risk a secure energy supply and weaken Germany's economic performance. Grossi et al. (2017) have shown that a main effect of

Fukushima was indeed a significant increase in costs; however, the existing grid, as well as the geopolitical location and strong connection between European partner countries, is a key for the country's success model (Grossi et al. 2017).

We find that existing research that investigates the 'Fukushima Effect' thus far has not yet looked at the policy-actor-network perspective. Much research discusses effects on policies, policy instruments, social movements, public discourse and even literary works, but none have looked at how the policy-actor network was affected. This leads to our inquiry focusing on what policy actors did after Fukushima. For example, did their positions and policy-making connections change? Did they change their attitude toward the Merkel administration? And how have policy actors in Germany accepted energy cost increases related to the promotion of renewable energies? Carefully crafted over a two-decade period, the system seemed to have convincing long-term benefits that outweighed the short-term interests of policy actors.

What is significant about the effect of Fukushima on Germany's energy policy is the consensus of the government and opposition parties in passing a legal framework for nuclear phase-out and *Energiewende*. We wanted to know how Fukushima affected policy actors' political opinions toward energy policy instruments, as well as decisions made by the *Bundestag* before and after Fukushima. By doing so, we adapt a new paradigm for research design involving a merged method in data collection that addresses the larger question of what makes policy actors change their position. Drastic events such as Fukushima cause changes in political positions. Yet we contend that this did not occur drastically or suddenly following a completely new argument, but rather through revitalizing existing arguments. This highlights the differences between slow and fast processes. Integrating energy and climate policy jurisdictions into the EU was a slow process, compared to Fukushima as an event that prompted a fast process. The existing framework of anti-nuclear policies and renewable energy promotion, as well as the historically strong anti-nuclear stance, was a key for Germany's rapid legislative reform within six months after Fukushima.

This research gives a voice to German policy actors and shows how public discourse and images produced through media channels can be biased, and we emphasize the need for more contextual and in-depth research to overcome such challenges. Identifying the 'Fukushima Effect' on the energy and environmental policy actor network will add substantially to existing discussions on this issue.

Theoretical framework of the survey instrument

The interrelationship described previously between political response to a crisis and public discourse can be explained with the help of Glass (2006). He wrote that "[i]nternal psychological conflict affects political reality through the force of belief systems (which) derive from the complex interplay between the structuralization, or its lack, of the inner self, its affective and developmental foundations, and what the external world produces as data and sensation."

Policy processes and decisions are an interplay of actors and interests based on sharing information and cooperation, support or opposition (Gross and Jansa 2018). Integration within a social network, that is, a set of social relations between actors which are tied together by interdependencies (Knoke and Kostiuhenko 2018), influences individual and collective decisions. Schmidt's (2008) major work provided a theoretical conceptualization

of discursive institutionalism as an institution to which people belong and describes the discourse that institutions create, follow or support, as an independent variable.

The combination of inner core belief systems (Glass 2006) and social environment define which discourses people follow, and discourse repetition strengthens this proclivity. As such, an institution with better resources than others may influence discourse more strongly. In this research, we attempt to create new forms of investigation to reveal hidden structures in policy processes that are empirically difficult to grasp.

Climate mitigation mechanisms: policy instruments

The annual Conference of the Parties to the Kyoto Protocol (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) passed the Paris Agreement in December 2015, recognizing the need to drastically cut carbon emissions among global societies to limit global warming, including strong recommendations for replacing fossil fuels with carbon-neutral energy sources. There were varied responses to this in Germany. Many considered the promotion of renewable energy with the Feed-in Tariff Law, taking Germany's Renewable Energy Sources Act as an example, to be too expensive. Such conflicting opinions reflected disagreements on core concepts that have challenged international climate mitigation policy negotiations since 2011, resulting in different national frameworks.

Policy instruments at various levels provide the framework for the promotion of renewable electric energy sources and are utilized at various levels. Examples of international-level policy instruments include clean-development mechanisms (CDM), joint implementations (JI) or sink mechanisms such as land-use/land-use change and forestry (LULUCF). According to the Kyoto Protocol, CDMs are multilateral mechanisms that “[stimulate] sustainable development and emissions reductions” by realizing projects in developing countries through which industrialized countries earn emission reduction certifications which can be traded in a trading scheme and become market instruments. Countries can either participate directly in CDM projects to earn certificates or participate in the market to buy such certificates (BMUB 2017; UNFCCC 2018). With bilateral JI mechanisms, two industrialized countries which have agreed on an emissions reduction target under the Kyoto Protocol cooperate to realize mitigation projects and earn emission reduction units based on the investment in the partnering country (BMUB 2017). Finally, LULUCF activities in the forestry sector (as a sink system wherein vegetation functions as carbon stocks to absorb and filter out carbon dioxide from the atmosphere, which may include establishing de-forestation limitations and promoting re-forestation, comprising an important target area under the United Nations Framework Convention on Climate Change (UN 1992, 2018).

There may also be regional or domestic instruments such as the European Union Emissions Trading Scheme (EU ETS) and the national legal framework for the promotion of renewable electric energy sources, respectively. Initially conceptualized in response to the 1997 Kyoto Protocol agreement to reduce CO₂ emission, the EU ETS was developed in 2000 and became policy in 2005. This ‘cap-and-trade’ system sets limits on carbon emissions, and the amount of allowable emissions under the cap is reduced over time to ensure emissions reduction. Through this system, companies (mainly those in energy-producing and energy-intensive industries) can trade CO₂ emissions allowances (EU 2018). Such exchanges are intended to share and hopefully decrease costs

Fig. 1 Development of the feed-in tariff in Germany 2000–2018. (Sources: Compiled by the authors based on data available by netztransparenz.de, BMWi, Fraunhofer ISE)

between participating parties. This activity transforms the EU ETS into a market-based policy instrument in which CO₂ emissions become a cost factor.

Finally, national legal frameworks are also possible policy instruments, as they stimulate measures and activities for climate mitigation or regulate where necessary, and provide political order (BMUB 2017). The main instrument of Germany's *Energiewende* is the Renewable Energy Sources Act (*Erneuerbare Energien Gesetz*, EEG). Its passage in 2000 by the Red–Green coalition under former chancellor Schröder replaced the 1991 Electricity Feed-in Law, which was the genesis of the German government's promotion efforts for renewable energies. Furthermore, the Act also provided the framework for the 2022 nuclear phase-out. Since 1991, the law has been revised in 2004, 2009, 2012, 2014 and 2017 (BMWi, Das Erneuerbare-Energien-Gesetz: BMWi 2019). The EEG is a market-regulating policy instrument; that is, electric energy from renewable energy sources is prioritized in the grid, and it also has a role in promoting investment and technological development.

A further important aspect of Germany's national legal framework is the feed-in tariff system. As noted earlier, there has been criticism in the past two decades of this scheme as one that favors heavy industry at the expense of the individual consumer. Since 2000, the costs of the feed-in tariff for consumers have risen from 0.19Ct/kWh to 6.79Ct/kWh in 2018 (netztransparenz.de 2018; BMWi 2014). Government data show a peak increase in the feed-in tariff in the year 2011 compared to 2010 (Fig. 1). The cost-versus-energy-security issue was one of the main arguments emphasized by the major energy industries that led to postponing nuclear phase-out plans as noted earlier. However, the long-term effects and acceptability of burden-sharing, due to the grass-roots anti-nuclear-energy movements effectively fighting for legislation toward renewable electricity since the 1970s, show the effectiveness of the instrument that drives the energy transition, and many countries have tried to adopt similar schemes (Morris and Jungjohann 2016). There is a possible 'Fukushima Effect' occurring here as shown in the rapid increase in connections of renewable electricity to the grid after 2011 compared to previous years.

While aiming to increase renewable energies from 40 to 45% as energy sources for main energy consumption by 2025, Germany will phase out the last of its 17 nuclear power plants by 2022, aim to reduce 40% of CO₂ emissions by 2020 (base year 1990) and wants to reduce 50% of its primary energy use by 2050 by improving energy efficiency (BMWi 2017). Only a combination of different policy instruments and cooperation of different kinds of policy actors, stakeholders and interest groups can achieve these energy transition goals.

In summary, the above-noted policy instruments operate on multiple levels and are quite complex. Their success as policy instruments depends on the cooperation and collaboration of the actors involved as well as actor responses to events that are directly (or indirectly) related to the renewable energy sector. Given the complexity of renewable energy policy in general, actors' perceptions of how events may affect their organizational objectives as well as relationships with other organizations are of primary importance. The survey instrument and methodological approach outlined below were designed to assess these phenomena.

Data and methodology

Policy processes are relational and interactive procedures, and policy outcomes are the result of actors' interactions. Previous research conducted by Hartwig et al. (2014) emphasized the strength of policy networks in investigating actors' attitudes and how attitudes effect policy actor networks. To analyze such processes in more depth, we designed inquiries to measure policy networks. This paper draws on a data set collected using merged data collection methodologies: that is, collecting two sets of data at the same time. Using this merged technique, we collected numerical data based on survey responses and contextual data based on discursive interviews. This technique is referred to as "inter-vey" or "conversational survey" (Gobo 2011). As Sieber (1973:1345) already pointed out, information "gathered in the course of fieldwork can assist in the analysis and interpretation of survey data." Survey results can be validated and interpreted by referring to interview transcriptions or notes taken during the interviews (Sieber 1973). The analysis of the survey data (quantitative) is accompanied by insights from the discursive interviews (qualitative). In the following section, we describe the G-GEPON 2 Survey in more detail, highlight the merits of the merged technique for collecting data and explain the data analysis process.

5.1 The G-GEPON 2 survey

Data for this paper come from the second wave (GEPON 2) of the original GEPON series of surveys.⁴ The Japanese GEPON 2 (J-GEPON 2) was conducted in 2012–2013, and its German counterpart, the G-GEPON 2, was undertaken in Germany between November 2016 and February 2017. The sampling technique was not random, that is, the target population was identified in three steps prior to going out in the field (Okura et al. 2016). As a first step, we updated and cleaned the list of policy actors used for the first GEPON Germany Survey conducted in 2000; then, we added actors who were identified via their

⁴ The first wave of the GEPON series of surveys was undertaken from 1998 to 2004 in Japan, South Korea, Germany and the USA by Yutaka Tsujinaka of the University of Tsukuba.

Table 1 G-GEAPON 2 response rates by category. *Source:* G-GEAPON 2

Organizational type	Target population (N)	Responses (N)	Response rate (%)
International organizations	17	0	0.0
Legislative/political parties	15	5	33.3
Executive and their advisory organizations	25 (27)*	15	55.6
Environmental interest groups	12 (15)*	8	53.3
Corporate interest groups	18 (21)*	10	47.6
Other interest groups	14 (18)*	10	55.6
Research facilities	32 (42)*	19	45.2
Economic corporations	14 (16)*	2	12.5
Mass media	12	2	16.7
Total	159 (183)*	71	44.7 (38.8)*

*The higher figures in brackets represent the total number of identified actors. After consulting with industry experts to separate irrelevant and outdated organizations, our final figures for survey distribution were lower (total of 159 organizations identified as targets)

participation in COP17 and COP21; finally, we confirmed our list with experts in the German energy policy field.

Social network studies struggle with defining network boundaries, a problem that is often rooted in the issue of nonresponse in elite surveying (Gross and Jansa 2018). Even though survey research suggests random sampling for higher validity and generalizability of the findings, sampling errors may occur in how the population list of the sampling frame is constructed (Bossler et al. 2018), and the method of refraining from randomization has the advantage of strengthening theoretical boundaries for policy networks. We too struggled with nonresponse due to the complex survey instrument on the one hand, and reluctance to provide clear answers because of lack of knowledge about certain issues among the experts we interviewed. Discussing the results will show some nonresponse effects.

The original target population consisted of 183 policy actors. We received 71 responses resulting in a response rate of 38.8%. During the post-survey data cleaning, we reduced the list of relevant environmental and energy policy actors from 183 to 159. Organizations that were widely assessed as irrelevant or non-influential were deleted from the list. Table 1 shows the response rates categorized by organizational type.

After identifying policy actors that shape environmental and energy policy-making processes, certain sections of the G-GEAPON 2 Survey were designed to clarify their connections and positions in the policy network, and to investigate to what extent Fukushima had influenced the actor landscape and directions that energy policy has taken since the accident. For instance, we wanted to know how policy actors in Germany reacted to Fukushima, whether they changed their opinions regarding policy instruments or governmental decisions and whether it prompted a change in their relationship to other actors. In general terms, we wanted to discern the 'Fukushima Effect' from the direct perspectives of the policy actors themselves.

5.2 Advantages and disadvantages of a merged data collection technique

The GEAPON survey is a unique instrument. It is a face-to-face survey, and researchers must not only be familiar with the survey instrument but also with interview techniques to

engage the informants in discursive interviews. While working through the extensive questionnaire, researchers must have basic knowledge in political science terminologies, environmental and energy policy frameworks and instruments in order to apply probing techniques. The strength of the sampling method has its weaknesses. As Bossler et al. (2018) noted, errors may arise in different sampling methods, including conducting interviews, and ways need to be determined to account for such errors in a sample.

Preparations before conducting the survey with a merged method must be well defined to maximize response rates as well as data quality. A high response rate is meaningless without quality data. We argue that a merged data collection technique increases such data quality significantly. A survey that targets experts in the field and includes methods to integrate such expert knowledge into a meaningful collection of numerical survey data is vital for a quality study with generalizable results. For dummy questions (yes or no), for example, with an interview transcription, we can add a qualitative analysis where the informants elaborate on their responses and provide information about the scale.

Such qualitative analysis can enrich responses, such as revealing whether target actors cooperate with other policy actors, the nature of their cooperation (strong or weak), the projects that they undertake mutually and their relative power balance. We found that informants tended to share anecdotes and used adjectives to describe their connections and relationships, as well as provide other details in their answers. In a standard quantitative data collection, this vital information would have been lost. This is especially true where the targets are policy actors, with tight schedules and time constraints in terms of interviews involving a complicated survey instrument.

5.3 Measurements

To measure the ‘Fukushima Effect,’ we used the following questions⁵ within the G-GEAPON 2 survey:

5.3.1 Effect on actor landscape and cooperation

- Q11: Did Fukushima prompt starting (A)/terminating (B) exchange or cooperation with another organization?

5.3.2 Effect on attitude toward CO2 reduction targets

- Q14: Did your organization’s opinion regarding CO2 reduction targets change?
- Q16: Which measures do you judge as effective for reducing greenhouse gas emissions before (A) and after (B) Fukushima? (Pick three examples from the list and rank them from 1 [most effective] to 3 [least effective].)
- Q17: Which energy source do you judge as ideal for reducing greenhouse gas emissions before (A) and after (B) Fukushima? (Pick three examples from the list and rank them from 1 [most effective] to 3 [least effective].)

⁵ The questions have been translated into English for the purposes of this paper as the original questions were in German.

5.3.3 Effect on attitude toward promoting renewable energy

- Q33A: Did your organization support the decisions of the federal government to promote renewable energies before (A) and after (B) Fukushima?
- Q33B: Was an increase in electricity prices associated with the promotion of renewable energy acceptable to your organization before (A) and after (B) Fukushima?

5.4 Data analysis process

Descriptive statistics are used to illustrate the 'Fukushima Effect.' First, we look at whether the Fukushima incident prompted policy actors to change their cooperation with other actors; more precisely, to investigate whether the event motivated actors to discontinue or start new modes of cooperation. The objective for looking at the actor landscape is to prove that the measurable effect of 'Fukushima' on environmental and energy policy actors in Germany is negligible.

Second, we investigate changes in actors' opinions regarding effective policy instruments with the aim to reveal how the nuclear fall-out affected renewable energy policy instruments. We believe that this point is particularly germane given the historical political prominence of anti-nuclear sentiment in Germany. The data will show a revitalizing importance of the national legal framework and confer to the global trend toward intensified, inward-looking policy measures.

From measuring the effect on policy instruments, we turn our attention toward the question of whether we can find significant changes in support levels among policy actors toward governmental decisions: for example, whether the Merkel administration could widen their support base for their political decisions. According to the literature, one significant change that happened in Germany was that the catastrophe played a role in finally settling the ongoing dispute about nuclear energy's future in Germany.

Results I

6.1 Effect on policy actor cooperation network

To measure the effect on actor landscape and cooperation, Q11 asked if "Fukushima prompt[ed] starting (A) or terminating (B) exchange or cooperation with other organizations." The interview responses indicated that the Fukushima incident had no significant influence on the policy actor network. Some respondents noted that they started new cooperative relationships after Fukushima. In total, close to one quarter of the organizations that responded to this question (15 organizations out of a sample size of 57) gave positive responses. Fewer organizations (3 out of 56) reported the opposite opinion, namely, termination of cooperation, and in percentage terms, this number appears insignificant. Table 2 summarizes the responses. Although in looking at the total numbers there does not appear to be a significant change in the policy network, the discursive interviews provide further insights into what made the organizations change cooperative relationships.

Overall, 'Fukushima' prompted new cooperative relationships, but also, in some cases, led to terminating relationships. Moreover, in looking at the environmental policy actor network in Germany, Lee & Tkach-Kawasaki (2018) found that similarities in

Table 2 Question 11: responses by actor category. *Source:* G-GEPON 2

	Q11_A Starting cooperation after 3.11			Q11_B Terminating cooperation after 3.11		
	Yes	No	Total	Yes	No	Total
Advisory council	1	3	4	1	3	4
Corporate interest groups	4	6	10	1	9	10
Economic corporation	1	1	2	1	1	2
Environmental interest groups	2	4	6	0	6	6
Governmental body	0	2	2	0	2	2
Labor union	0	2	2	0	2	2
Mass media	1	1	2	0	2	2
Ministry	1	3	4	0	4	4
Other interest groups	0	5	5	0	5	5
Political party	1	1	2	0	2	2
Research facility	4	14	18	0	17	17
Total	15	42	57	3	53	56

organizational type are relevant for such policy actor networks. Drawing on the interview results, it appeared that corporate interest groups and research facilities were more proactive and started new cooperative activities in order to deal with the sudden shift in the policy direction that had been decided less than six months before the nuclear catastrophe in Japan. One advisory council reported to have started cooperation with another organization after 3.11, but also indicated that 3.11 was the main cause for terminating a cooperative relationship. A similar situation was reported by one economic corporation and one of the corporate interest groups. Interestingly, the left-wing political party *Die Linke* reported that the cooperation they started was with the Communist Party of Japan. The advisory council and corporate interest groups in the energy sector emphasized the termination of the cooperation with the German *Atomforum*. Here, we can confirm the ‘Fukushima Effect’ on Germany’s energy policy and where a future without nuclear energy in Germany, which had been expected belatedly, had accelerated.

In terms of long-term effects, environmental interest groups reported starting cooperative relationships with labor unions several years after 2011. This new relationship was prompted by a publication about their climate change statement that was influenced by the nuclear accident in Fukushima. In this statement, the labor union argues for socially acceptable carbon phase-out based on a report that it is prepared in cooperation with independent researchers.

6.2 Effect on attitudes toward CO2 reduction targets

Attitudes to political issues are seen as influential factors that guide policy actors’ cooperative networks and legislation processes (Hartwig et al. 2014). In order to explore this further and complement the broad topic of nuclear phase-out, the survey instrument also inquired as to whether CO2 reduction targets had changed or been reconsidered as a result of Fukushima (Q14). In this regard, there appeared to be no significant change. More than 90% (55 out of the 60 organizations that responded to this question) of the organizations surveyed indicated that Fukushima had no impact on their attitudes toward CO2 reduction

Fig. 2 Q16_A: effective measures to reduce greenhouse gas emissions before and after 3.11. (Source: G-GEAPON 2 Survey)

targets. In contrast, the remaining organizations (5 out of 60) indicated that the events of Fukushima influenced their position toward a higher reduction goal.

Results II

7.1 Effect on policy instruments

As noted earlier, in addition to actor networks and relationships, identifying the key policy instruments that are being used to effect energy policy was one of the main goals of the G-GEAPON 2 Survey.

Figure 2 summarizes the policy instruments that our target population of environmental and energy policy actors judged as effective to reduce greenhouse gas emissions and whether there were discernible changes after the nuclear accident of Fukushima (Q16).

In general, the national legal framework of the Renewable Energy Sources Act and the EU ETS are considered to be the most effective policy instruments to reduce greenhouse gas emissions. The popularity of the EU ETS shown in the survey data is somewhat high, yet there was a strong discourse in the interviews that criticized this mechanism. Even though they chose this as an answer, many respondents indicated that they questioned the functionality of the scheme at the same time.

The CDM is regarded as the third most effective policy instrument. The rather negative opinion about the functionality of EU ETS may be related partly to how the functionality of both the CDM and EU ETS was realized. Mitigation costs would decrease; however, certificate trading between those two schemes would result in an increase in emissions; that is, emissions that are reduced through one scheme are being traded cheaply through the other, thus allowing a certificate holder to produce more emissions. Probing the informants' knowledge, experiences and opinions in this area put the context of the climate mitigation mechanism into a different light. Respondents demonstrated a high regard for the German national legal framework as an effective mitigation mechanism. Before the nuclear

Fig. 3 Q17: effective energy sources to reduce greenhouse gas emissions before and after 3.11. (Source: G-GEPON 2 Survey)

accident, nine organizations judged it as most effective; after Fukushima, the number increased to 25.

We found the responses involving LULUCF to be rather puzzling. According to the G-GEPON 2 responses, before 2011, it was considered a very effective policy instrument, but in the post-Fukushima period, none of the surveyed organizations rated it as their first or second choice in terms of importance. Only five organizations selected it as their third choice either before or after 3.11. The standard measuring methods of CO₂ emissions had excluded land-use and forestry and, because of that, countries like Japan and Germany showed a greater CO₂-reduction rate during the first commitment period of the Kyoto Protocol from 2008 to 2012.

Figure 3 summarizes information about how environmental and energy policy actors evaluated current energy sources regarding their effectiveness to reduce carbon emissions (Q17). The most effective energy source to reduce greenhouse gas emissions in Germany is wind energy, particularly as wind energy was considered an alternative to nuclear energy. After Fukushima, the German government passed legislation to further support the development of on- and off-shore wind energy plants. In addition, after the nuclear accident in Fukushima, photovoltaic, hydrodynamic and biomass energy resources experienced an increase in support. Considered the third most effective energy source, natural gas and crude oil experienced an increase in support. These data represent a focus on renewable energy among policy actors in Germany and confirm an increase in their support after 3.11.

During the interviews, the topic of alternative energy formats was discussed critically. Rather than focusing on their nature, the informants responded to the categories within the survey instrument from which they had to choose. Among those that answered this question, they emphasized the distinction between natural gas and crude oil, or fossil fuels. They would often say gas would be an effective energy source, but because of the categorization conflict, they chose differently.

Fig. 4 Q33_A: support government's decision to promote renewable energies before (inner circle) and after 3.11 (outer circle). (Source: G-GEPO 2 Survey)

Results III

8.1 Effect on policy actors' attitudes toward governmental decisions and policy instruments

Despite the criticism that the Merkel administration received from the public, stakeholders and other policy actors, we observed an increase in support for the government's decision to further promote renewable energies after Fukushima. Figure 4 summarizes the responses concerning support for the government's policies from other policy actors and stakeholders regarding promoting renewable energies before and after the nuclear accident in Fukushima. Surprisingly, research facilities showed a drastic decrease in supporting the government's decisions. In contrast, Fig. 5 shows how opposing attitudes toward governmental decisions among policy actors has changed. While we can observe a decrease in opposition among mass media, political parties and research facilities, some corporate interest groups and environmental interest groups appeared to have developed an opposing standpoint toward the Merkel administration. Among the

Fig. 5 Q33_A: did not support government's decision to promote renewable energies before (inner circle) and after 3.11 (outer circle). (Source: G-GEAPON 2 Survey)

research facility informants in our target population, there were contradictory opinions in terms of support or opposition for the government's renewable energy policies.

One critical point is the issue of cost inequality between consumers and industry. The increase in the feed-in tariff caused an increase in energy costs for consumers but a decrease in energy costs for energy-intensive industries. However, for many, the increase in costs due to the feed-in tariff associated with the promotion of renewable energy is an acceptable investment. Despite such criticism and conflicts in opinions, efforts in investment and promotion can be observed. As Fig. 6 shows, an increase in the acceptability of increased energy costs after the nuclear accident is another measurable 'Fukushima Effect.' We can observe movement between degrees of acceptability among diverse actors. However, corporate interest groups, labor unions, political parties and research facilities that strictly opposed the feed-in tariff did not change their opinion after 2011.

Fig. 6 Q33_B: acceptability of increased energy cost associated with the promotion of renewable energies before and after 3.11. (Source: G-GEPON 2 Survey)

Conclusion

The history of anti-nuclear sentiment and efforts to promote renewable energy technologies from a grassroots level since the 1970s left Germany with strong sociopolitical institutions. While analyses of the G-GEPON 2 Survey data show measurable effects after the nuclear accident in Fukushima in 2011, we urge caution regarding conclusions, arguing that Fukushima prompted the *Energiewende*. What changed after 2011 were public and political discourses, and the term *Energiewende* has become a well-known phrase internationally.

In this paper, we measured several effects based on quantitative and qualitative survey responses. First, one of the most important findings in our research is that the stable cooperative relationship between German policy actors did not change after 2011. Despite public and policy discourses to the contrary, through the interviews, we found that Fukushima did not have such a drastic effect on policy actors. In addition, from our survey results, it is clear that government support increased and opposition decreased after Fukushima among diverse policy actors, interest groups and other stakeholders. In other words, instead of policy division or separation, we found a cohesive continuum among renewable energy sector actors. This is further underscored by our findings that respondents were more accepting of an increase in energy costs associated with the promotion of renewable energies after Fukushima. Finally, although wind energy was already considered to be one of the most effective renewable energy sources for climate mitigation (particularly as an alternative to nuclear energy), it garnered more support in the post-Fukushima era.

In terms of methodology, we found that the inter-vey method proved useful especially in regards to the questions where organizations were asked to provide a priority ranking. We realize that following traditional survey methods for quantitative data collection would have taken less time and been less labor intensive. As such, the decision to integrate discursive interviews was challenging during the data collection phase of our project. However, by combining the quantitative approach with qualitative interview data, we believe that we have been able to gain quality data that have resulted in a fuller and deeper understanding of the German renewable energy sector before and after the Fukushima incident. Moreover,

we believe that with this method, we were able to overcome certain difficulties research from a methodological perspective in terms of identifying and mapping informal policy-making networks (Hartwig et al. 2014).

In conclusion, Germany's approach to renewable energy policy has had implications for other countries. Other national administrations have tried to emulate Germany's national legal framework as they aim to become self-sufficient in electricity consumption by drawing on renewable energy sources such as wind, photovoltaic, hydrodynamic, or biomass energies and completely phasing out nuclear energy.

We suggest that the emulation of legal frameworks such as those of Germany needs to be considered with more caution. In many cases, not enough attention is paid to the genesis, influence and impact of the institutional framework in such emulating countries. Yet, an understanding of sociopolitical and cultural norms is critical in understanding a model determining success or failure. Furthermore, not only the cultural and philosophical context of the model to be emulated, but often, unfamiliarity with sociopolitical, cultural or philosophical origins will most likely result in a dysfunctional system.

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