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Growing Institutional Complexity and Field Transition: Towards Constellation Complexity in the German Energy Field

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ABSTRACT By applying a dynamic approach to field-level institutional complexity, we explore how growing institutional complexity affects fields over time. We examine field transition processes, which are shaped by the number of logics, the nature of their relationships and the shifts in dominance. Focusing on Germany's energy field, our analysis identifies a variety of conflicts that arose among up to seven institutional logics in the context of the German energy transition, i.e., the transition towards a low carbon energy market. The paper makes two theoretical contributions to the institutional complexity and field literature. First, we develop a process model explaining the field-level consequences of two different types of growing complexity, namely increasing and accelerating complexity. Second, we identify conflicting logic constellations as a distinct form of complexity that we term constellation complexity. We discuss our contributions in light of the literature on institutional logics and fields and show how applying a dynamic perspective to institutional complexity supports scholars in conceptualizing field transition processes.

Keywords: field transition, institutional complexity, institutional logics, logic constellations, sustainability transition, topic modeling

INTRODUCTION

The presence of conflicting institutional logics is commonly described as institutional complexity (Greenwood et al., 2011). Such situations yield tensions and may thus initiate and facilitate field-level change processes (Micelotta et al., 2017; Zietsma et al., 2017).

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The ways in which fields evolve based on conflicting relationships between logics has received considerable attention in the literature (Thornton and Ocasio, 2008; Thornton et al., 2012). Studies have particularly focused on conflicts that emerge when a new logic enters a field, leading to modified fields and the establishment of new practices, rules, and meanings over time (Reay and Hinings, 2005; Thornton and Ocasio, 1999). This process is commonly described as a competition for dominance between an established logic and a new one. Such processes arise when, for example, a dominant professional logic is replaced by a market logic in a field such as health care, investment or publishing (Lounsbury, 2007; Reay and Hinings, 2005; Scott et al., 2000; Thornton, 2004; Thornton and Ocasio, 1999).

While early work on institutional complexity in fields focused on dominant logics and the conflicts between them, more recent studies have argued that there is a need for a broader perspective on the full range of logics, which includes complementary logics and not just conflicting ones (Besharov and Smith, 2014; Goodrick and Reay, 2011). This literature has shown, for instance, that several logics can exist in parallel over long periods of time, meaning that periods of competition alternate with phases of peaceful coexistence and truce (Dunn and Jones, 2010; Meyer and Höllerer, 2010; Nicolini et al., 2016; Reay and Hinings, 2009). Hence, fields are not just shaped by dominant or conflicting logics; fields are shaped by the 'relative influence of logics' (Goodrick and Reay, 2011, p. 404). Thus, in order to understand field transition processes, we need to consider the entirety of logics and their relations to each other. This has prominently been described as the constellation of logics (Goodrick and Reay, 2011; Jancsary et al., 2017; Sadeh and Zilber, 2019; Waldorff et al., 2013). A perspective centring on the constellation of logics aims to encompass all logics in the field and their conflicts, thereby countering the concern that institutional complexity is often 'underestimated or misinterpreted' (Greenwood et al., 2011, p. 332).

However, if we accept that the entirety of logics influences the complexity of fields, this raises new questions about the dynamics of complexity, such as how fields change when several new logics enter a field rather than just one or when many conflicts, and not just one, occur simultaneously. Furthermore, to better understand the dynamics of field-level institutional complexity, we need to examine what happens to a field when there are parallel changes in the number of logics and their conflicts as well as logic dominance: for example, as a result of what has been called the climate change or environmental logic (Ansari et al., 2013; Gümüsay et al., 2020). In fact, it is not just that institutional complexity can change but that it can do so with varying intensity, for instance, when a cascade of conflicts emerges. In other words, complexity not only manifests to a lesser or greater extent but may also grow to varying degrees. This could be challenging for fields and may facilitate, inter alia, extensive field transition processes such as the restructuring (Faulconbridge and Muzio, 2021; Hinings and Logue, 2017) or 'demise of fields' (Zietsma et al., 2017, p. 409). Against this background, we ask: how does the process of growing institutional complexity affect field transitioning?

To incorporate such a dynamic perspective on field-level institutional complexity, we adopt a longitudinal mixed-methods research design that combines topic modeling (Blei et al., 2003; Hannigan et al., 2019) and qualitative content analysis (Miles and Huberman, 1994). This combination allows us to analyse field data from different angles and to follow institutional logics, their relationships to each other and their relative dominance in the field over time. Empirically, we examine the German energy field. Energy, in many respects, is an important basic good in society. Its provision, however, has become highly controversial, particularly due to carbon dioxide emissions and their impact on climate change (IPCC, 2007) as well as concerns about energy sovereignty in times of conflict. In Germany, additional changes occurred due to the liberalization in the late 1990s, the two nuclear phase-out decisions in 2000 and 2011, and the sharp increase in renewable energies from around 2005, known as the German energy transition. While other fields have also been characterized by growing institutional conflicts – for instance due to an expanding environmental logic – the multitude of developments in the German energy field is remarkable. This makes it an ideal case to study growing institutional complexity and field-level consequences.

Our contribution to theory is twofold. First, we develop a process model of growing complexity and its consequences at the field level. In the process, we distinguish between two processes of complexity growth: increasing and accelerating complexity. Increasing complexity is characterized by a gradual increase in conflicts between logics. Accelerating complexity describes a significant growth in and escalation of complexity and is characterized by the presence of more logics and conflicts in an already complex setting as well as fluctuations in the logic relationships and dominance. Both processes have very different implications at the field level, including in different settings of complexity. Second, we note that accelerating complexity may result in two opposing field-level logic constellations – which we term constellation complexity. The concept of constellation complexity highlights that internally complementary logic constellations can exist within a field, even if these constellations are in conflict with each other at the same time. This may ultimately lead to far-reaching field transition processes, such as field partitioning. Thus, our theoretical contributions help to advance the concept of institutional complexity by developing a dynamic field-level perspective that accounts for different velocities and different degrees of complexity. In so doing, our study responds to recent calls to further develop the concept of institutional complexity (Greenwood et al., 2011; Meyer and Höllerer, 2014; Schildt and Perkmann, 2017) and 'reconnect institutional logics to the study of fields' (Lounsbury et al., 2021, p. 272).

The structure of this article is as follows. We start with the theoretical framework concerning institutional complexity, logics and fields, highlighting the need for a dynamic field-level complexity perspective. We then describe our mixed-methods approach, including case description, data collection and analytical strategy. In the findings section, we present the field transition processes in the German energy field, which we use to derive the process model. Finally, we discuss the study's theoretical contributions, noting limitations and areas for future research.

THEORETICAL FRAMEWORK

Institutional logics are described as 'the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organise time and space, and provide meaning to their social reality' (Thornton and Ocasio, 2008, p. 804). Hence, logics guide, proscribe and prescribe organizational behaviour (Meyer and Höllerer, 2010; Scott, 2014; Thornton et al., 2012). As logics co-occur, they create pluralistic institutional environments that may lead to tensions (Kraatz and Block, 2008). In their seminal work, Friedland and Alford (1991) identified five ideal type institutional logics (the list was later expanded to seven logics; see Thornton et al., 2012). Each logic differs in its unique 'sets of material practices and symbolic constructions' (Friedland and Alford, 1991, p. 248) and is accompanied by logic-specific 'rules of the game' (Thornton and Ocasio, 1999, p. 802).

Institutional logics are thus reflected in different field practices (see also: Goodrick and Reay, 2011; Purdy and Gray, 2009; Smets et al., 2015; Thornton et al., 2012), in 'what people do and how they do it' (Reay and Jones, 2016, p. 6). Goodrick and Reay (2011), for instance, distinguished between pharmacists' advisory work, which is determined by professional associations (professional logic), and the mere sale of medicines (market logic). The practices are evident in communicated patterns and are associated with symbolic constructions, in the form of narratives, stories, motives or specific vocabularies (Friedland and Alford, 1991; Hardy and Maguire, 2010; Reay and Hinings, 2005; Thornton and Ocasio, 2008). Thus, we understand Friedland and Alford's (1991) notion of logics to encompass symbols that are closely related to practices as a 'meaning structure' that gives interpretation and significance to practices in a field (Hardy and Maguire, 2010; Thornton et al., 2012, pp. 10–11 and 150 ff.). In this respect, they act as a rationale for practices and help to make sense of actors' activities (Thornton et al., 2012, p. 2). Furthermore, institutional logics are reflected in a field's formal and informal rules (Thornton and Ocasio, 1999, p. 804), for example, in the framework of the free market, with its open market entry practices and promise of efficient market governance. Another example can be found in Dunn and Jones's (2010) work on the care logic, which is evident in the patient care provided by professional doctors and nurses in accordance with the Hippocratic Oath.

Hence, the diversity and plurality of logics is described on an overarching societal level (Friedland and Alford, 1991; Thornton et al., 2012) and also at the level of fields, which is more specific and context driven. A field is defined as a 'recognized area of institutional life [where] key suppliers, resource and product consumers, regulatory agencies and other organisations that produce similar services or products' interact with each other' (DiMaggio and Powell, 1983, p. 148). McPherson and Sauder (2013), for example, describe how the four logics of criminal punishment, rehabilitation, community accountability and efficiency are used to negotiate decisions in a drug court. Hence, research has shown that fields may not only host many logics but that these can also be in conflict (Smets et al., 2015; Thornton, 2002). This situation is described as institutional complexity, and it prevails whenever there are 'incompatible prescriptions from multiple institutional logics' (Greenwood et al., 2011, p. 317).

A variety of studies have shown that conflicting logics in a field have the potential to change the field, initiating field transition processes (e.g., Lounsbury, 2007; Reay and Hinings, 2005; Reay and Hinings, 2009; Scott et al., 2000; Thornton, 2002, 2004; Thornton and Ocasio, 1999). For instance, Reay and Hinings (2005) have demonstrated how the established field of healthcare became contested due to new laws and a conflict between the logic of medical professionalism and the logic of business-like health care; Thornton (2002) has shown how the market logic replaced the craft logic in the field of academic publishing. These studies have introduced a focus on competition between logics for field-level dominance (Dunn and Jones, 2010; Thornton and Ocasio, 1999). In the field of health care, for example, several studies have shown that patient-focused medical care work in hospitals was partly replaced by more competition-oriented auditing and stricter time management, which was consistent with the increasing importance of the market logic (Reay and Hinings, 2009; Scott et al., 2000). Such dominance shifts are thus important for field transitions. Moreover, the concept of dominance draws attention to an important fact: conflicts between more marginal logics in a field are less likely to induce field transitions than logics that are conflicting and dominating at the same time. In other words, conflicts between logics that are more marginal in the field generate less complexity than conflicts between central logics, because dominant logics guide attention and behaviour within a field (Micelotta et al., 2017; Thornton, 2004; Thornton and Ocasio, 1999). Particular attention has been paid to the question of dominance in longitudinal historical studies. Dunn and Jones (2010), for example, used time-authentic journal publications to measure the frequency (as proxy for dominance) of the care and science logics in medical education and argued that logics may alternate in dominance, which repeatedly shifts their influence on the field (see also Goodrick and Reay, 2011). Shifting dominance, i.e., changes in the prevalence of logics in a field so that a dominant logic becomes subordinate or vice versa, is therefore an important factor to consider when assessing complexity.

The varying nature of institutional complexity is further illustrated by the different number of logics in a field. While initial studies focused primarily on two given logics, Goodrick and Reay (2011) argued that researchers should pay attention to all logics prevalent in a field – both conflictual and complementary (see also, Besharov and Smith, 2014; Jancsary et al., 2017; Meyer and Höllerer, 2010; Raynard, 2016; Sadeh and Zilber, 2019; van Gestel and Hillebrand, 2011). For this reason, Goodrick and Reay (2011) introduced the concept of logic constellations. As the authors put it, such constellations represent the logics in a field and their relations as a kind of network, similar to the 'configuration or position of stars' (Goodrick and Reay, 2011, p. 399). The merits of Goodrick and Reay's (2011) insights is that they make complexity more visible and nuanced in two ways. First, their work makes it clear that logics can be in conflict or harmony. Second, it shows that the presence of more logics can lead to substantially more conflicts among logics and thus more complexity (see also Greenwood et al., 2011). When there are two logics, there is only one relationship that may or may not be in conflict, but with four logics, there are already six relationships and thus potentially up to six conflicts. In conclusion, when assessing logic complexity, it is important to look beyond logic dominance and consider the number of logics and their relationships.

Several authors have noted that the empirical complexity research requires further examination in light of these theoretical advances. In this respect, empirical studies on conflicting logics and institutional complexity have been criticized for their focus on (1) limited conflicts that take place in (2) static settings and arise (3) primarily between two logics (Lounsbury et al., 2021; Meyer and Höllerer, 2014; Schildt and Perkmann, 2017).

Indeed, many – though not all (for exceptions, see e.g., McPherson and Sauder, 2013; Nicolini et al., 2016) – empirical studies of institutional complexity focus on a conflict between two selected institutional logics that struggle for dominance. Research that applies a static perspective on logics in a field is thus unable to capture the dynamics of institutional complexity, as new logics may emerge over time, leading to growing complexity. Such research thus limits our understanding of field transition processes, because it neglects potentially relevant logics.

As a result, there is a need for a dynamic perspective on institutional complexity that points to a variety of logics with different relationships that may change over time: new logics may arise, and complementary logics may become conflicting and vice versa. Such a perspective extends work on logic constellations and complexity: according to a dynamic perspective, institutional complexity may grow in a field due to (1) the number of logics, (2) the nature of their relationships and (3) the shifts in dominance. These three factors are interrelated. For instance, a higher number of logics increases the number of relationships between logics and thus the potential for more complexity. However, the challenge is to capture logics, as they do not appear directly and can only be observed indirectly through their 'material practices, assumptions, values, beliefs, and rules' (Thornton and Ocasio, 2008, p. 804). Accordingly, conflicts between logics also manifest in these elements; that is, in practices (e.g., Reay and Hinings, 2005; Thornton and Ocasio, 1999), in 'formal and informal rules' (Thornton and Ocasio, 1999, p. 804) and in the various symbols that go with them (Meyer and Höllerer, 2010).

The application of such a complexity perspective thus responds to a recent call by Lounsbury and colleagues, which notes the need for more dynamic studies and criticizes the empirical work on institutional logics because, in their view, there is a misleading impression that logics and thus complexity is 'stable and given rather than vibrant, unfolding, and contingent' (Lounsbury et al., 2021, p. 263). For instance, the question of how fields change when several conflicts enter a field has received little attention in empirical studies. In other words, while the literature has studied field transition processes based on singular conflicts and limited complexity, there is a need to study the entirety of logics in a field and consider parallel processes of emerging logics, conflicts and dominance shifts.

Important questions arise from these considerations, such as how (radically) fields change when complexity rises in several factors. This points to an interest in more fundamental ideas about field-level transitions, i.e., the emergence and dissipation of fields and subfields (Buchanan et al., 2022; Faulconbridge and Muzio, 2021; Hinings and Logue, 2017; Zietsma et al., 2017). For instance, in one of the rare empirical articles, Faulconbridge and Muzio (2021) studied how a new field emerged from an established parent field through an endogenous motivated process of field partitioning. Likewise, we need to know more about how fields change when exogenous effects occur, such as when multiple logics or conflicts enter a field. Just as emerging institutional complexity makes it more difficult for organizations to respond (Greenwood et al., 2011), complexity can also strengthen the centrifugal forces in fields and thus further a possible drifting apart and partitioning of a field. However, we know little about this process, partly because the field literature focuses on the emergence of fields but 'there are nearly no explicit studies on the demise of fields' (Zietsma et al., 2017, p. 409). Our research focus on the field-level consequences of growing institutional complexity is thus linked to a range of crucial concerns, such as whether there are different processes of growing complexity and what intensity of complexity is necessary to trigger more fundamental processes of field transition. This also addresses an important research gap as there is a 'lack of theorizing around the issues of field evolution' (Wooten and Hoffman, 2017, p. 137).

RESEARCH SETTING, DATA AND METHODS

Empirical Context and Temporal Bracketing

The German energy field is ideal to study growing institutional complexity and its field-level consequences because it is an increasingly contested field, a field in upheaval (Bontrup and Marquardt, 2010; Patriotta et al., 2011). While modern societies would be unthinkable without plentiful energy sources, energy consumption and generation have become a controversial issue and global challenge due to climate change, environmental catastrophes, geopolitical turmoil, wars and nuclear accidents. In the German energy field, fundamental changes have occurred, and new rules and practices have been introduced. This makes it a particularly interesting case to study with regard to growing institutional complexity. In particular, in 1998 the EU directive on the liberalization of the energy market established economic competition in the formerly oligopolistic field. In parallel, a new government decided to phase-out nuclear energy, which, at that time, accounted for one-third of German electricity generation. Furthermore, the EU emission trading system introduced in 2005 fostered a major expansion of renewable energy, known as the German energy transition (*Energiewende*). Around the same time, the nuclear phase-out debate flared up again and led first to a lifetime extension and then, shortly afterwards in 2011, after the Fukushima meltdown, to a renewed phase-out of nuclear energy. These developments make the energy sector an ideal case to study with regard to field and complexity dynamics, not least because the changes have occurred within a relatively short period of less than two decades.

This is even more remarkable because, previously, the energy field was characterized by high stability. In fact, between the 1930s and the late 1990s, the German energy field consisted of regional monopolies that almost exclusively used fossil and nuclear power as energy sources. To compare the developments and to structure our data presentation, we have adopted the following approach: we grouped the dynamics of the German energy field into two temporal brackets (Langley, 1999). These are Period I: liberalization and nuclear phase-out (1998–2004); and Period II: climate change, lifetime expansion and Fukushima (2005–15). We ended our analysis in 2015 because this was followed by a more stable phase that was predominantly characterized by the expansion targets for renewable energies.

Data Collection

The study analyses the evolving institutional complexity of the German energy field. Here, institutional complexity is represented by three factors: the number of logics, the nature of relationships among logics and the field-level dominance of logics. To capture the changes in these three factors, we applied practices used in historical and longitudinal studies and collected data from different data sources (Dunn and Jones, 2010; Goodrick and Reay, 2011; Patriotta et al., 2011). We primarily drew on print media articles, because they offer a high degree of temporal comparability, but we also considered legislative texts and energy actor reports as additional data. We use the data we collected to identify the different practices in the field, the associated symbols and the written rules within the field. We likewise derived the distinct institutional logics from these, an approach that has been described in theoretical works and is established in empirical studies (e.g., Friedland and Alford, 1991; Goodrick and Reay, 2011; Lounsbury, 2007; Reay and Hinings, 2005; Reay and Jones, 2016; Smets et al., 2015; Thornton and Ocasio, 1999). This approach also allowed us to distinguish logics from each other, as 'distinct logics within a field are associated with distinct sets of practices, symbolic representations' (Thornton et al., 2012, p. 161) and the related rules.

Our central data source was the media, because it provided an overarching field-level perspective and allowed us to compare the changes in the energy field over time. To build our database, we used a keyword search that referred to the German energy field (search string: energy sector, energy industry, energy market). In total, we collected 20,785 articles from 10 widely circulating national newspapers in Germany with varying readership profiles in terms of political orientation (see Table I and Figure 1). We focused on the national quality press with the aim of obtaining a representative sample of the most important and most read newspapers but also of the main political tendencies (conservative, liberal, left-wing).

For us, the key advantage of media articles was that they offered a time-authentic longitudinal data set, which is ideal for tracing the development of fields, for example, in terms of the diversity of practices and their importance over time. In this, we followed previous studies that showed that media articles are a rich source of information and can capture field dynamics in terms of practices, symbols, rules, and the logic associated with them (Croidieu and Kim, 2018; Hardy and Maguire, 2010). Dunn and Jones (2010), for example, used media data to analyse how the care and science logics dominated the US medical education field in different periods.

Nevertheless, we understood that extensive knowledge of the field and triangulation are important for the process of capturing logics (Reay and Jones, 2016). For that reason, we also collected legislative texts and actor reports to aid the identification of logics. Since the energy field in Germany has been highly regulated and formalized for decades, we deemed legislative texts particularly suitable for capturing the 'rules of the game'. As another source of triangulation, we collected reports from different groups of actors: government/administration, civil society/NGOs and industry (Table I). Integrating the additional data allowed us to enrich the analysis and provide a broader and deeper perspective on the development of the German energy field. These data were additional, in that we used them for triangulation but not for the temporal analysis (topic modeling). The main reason for this was because the additional data were irregularly published and thus did not lend themselves to comparison over time, which made it difficult to determine dominance shifts.

Table I. Data sources

Sources	*Evidence*	*Documents*
Media articles	Identification of institutional logics (practices, symbols, rules), relationship of logics, frequency of logics (dominance shifts)	20,785 articles[a] from 10 widely circulating national newspapers in Germany with varying readership profiles in terms of political orientation: • Die Tageszeitung (daily, left-wing): 4381 articles • Die Welt (daily, conservative): 4783 articles • Börsen-Zeitung (daily, liberal-conservative): 2533 articles • Frankfurter Rundschau[a] (daily, left-wing): 4030 articles • Frankfurter Allgemeine Zeitung[a] (daily, conservative): 784 articles • Die Zeit (weekly, liberal): 1437 articles • Welt am Sonntag (weekly, conservative): 1095 articles • Spiegel (weekly, left-wing): 911 articles • Focus (weekly, conservative): 627 articles • Stern (weekly, left-wing): 204 articles
Legislative texts/ Acts	Triangulation and identification of institutional logics	• Energy Industry Act (EnWG), 1935, 1978, 1998, 2005, 2011 • Renewable Energy Source Act (EEG), 2000, 2008, 2014
Administration reports and agreements	Triangulation and identification of institutional logics	• SDP and green party: Coalition agreement, 1998 • Federal Network Agency (BNetzA): Monitoring Report, 2006–15 • Ethics Commission on safe energy supply: Germany's energy transformation, 2011 • Federal Ministry of Economic Affairs and Energy (BMWi): An electricity market for the energy turnaround 2014; white paper, 2015 • Federal government: Agreement on nuclear phase-out, BMBU 2000
Civil society/ NGOs reports	Triangulation and identification of institutional logics	• Greenpeace: Black Book Security of supply, 2006; Investments in renewables by major energy companies, 2007 and 2011; Statement on the planned amendment of the EEG, 2014; Benefits of citizen's energy (tog. with BBEn), 2015 • Heinrich-Böll-Foundation (HBF): Energiewende 2020. The way to a sustainable future, 2000 • IPCC reports (2007, 2013) • Bündnis Bürgerenergie (BBEn): Tenders for renewable energies: Surmountable barriers for civil energy?, 2015 • Hans Böckler Foundation (HBS): Handbook energy policy, 2015 • German Trade Union Association (DGB): Comments climate protection plan 2050, Green book energy efficiency, Energy Industry Act, 2015

(Continues)

Table I. (Continued)

Sources	*Evidence*	*Documents*
Industry reports	Triangulation and identification of institutional logics	• Annual reports; E.ON, RWE, Vattenfall, EnBw, 1998–2015 • German Association of Energy and Water Industries (BDEW): • BDEW: Renewables and the EEG, 2000–15 • BDEW: Competition shaping the transformation process of the energy system, 2015 • BDEW: Position paper – Design of a decentralized service market, 2014 • BDEW: Issues. On the way to new market economy structures, 2013 • BDEW: Competition – Where does the German energy market stand?, 2012

[a]We also collected data from 1996 and 1997 to illustrate the dynamics towards 1998. Please note that one publisher delivered no data before 2002, which means that we have no data for the Frankfurter Rundschau (left-wing oriented) and Frankfurter Allgemeine Zeitung (conservative oriented) for this period.

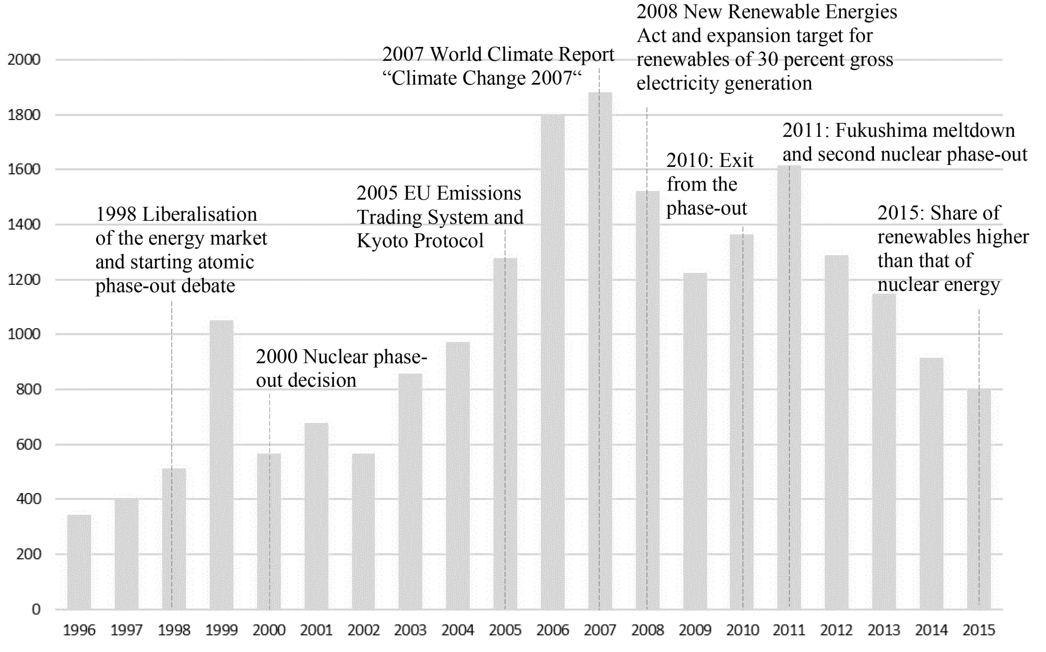

Figure 1. Key events and frequency of media articles

Analysis

We followed a two-step approach to unpack the dynamics of institutional complexity. First, we captured the different institutional logics of the energy field using an inductive approach based on topic modeling of the media data (Croidieu and Kim, 2018; Nelson, 2020). This step aimed to identify the field-level logics based on their different practices, symbols and rules. We describe this coding process in detail below, using the guidelines outlined by Grodal et al. (2021) and Croidieu and Kim (2018). As argued above, we also triangulated the topic modeling results with our additional data. Furthermore, we used the topic modeling findings to determine the frequency of logics over time in order to identify which logics were particularly dominant and constitutive for the field in specific time periods. Second, we used qualitative content analysis to unpack the nature of relationships among all identified logics over time. We built on the idea that tensions between logics – or rather the associated practices, symbols and rules – would be reflected in language: for example, in the articulation of conflicting goals between different practices (Dunn and Jones, 2010; Meyer and Höllerer, 2010; Reay and Jones, 2016). This step aimed to analyse possible conflicts between logics and how they may change over time. For instance, the number of conflicts might have grown, or formerly complementary relationships might have evolved into conflictual ones. Based on both steps, we then traced the various logics and their constellations over time, which ultimately allowed us to visualize institutional complexity and its dynamics.

To analyse the large amount of media data, we chose an unsupervised machine-learning approach: the LDA topic modeling algorithm (Blei, 2012; Blei et al., 2003). Topic modeling is a relatively new method in management studies (Hannigan et al., 2019; Kaplan and Vakili, 2015; Schmiedel et al., 2019). However, recent studies have shown its value by using it to analyse the content of large volumes of text, for example, the content of patents (Kaplan and Vakili, 2015) and websites (Powell et al., 2016). It has also been used to analyse very specific questions – for instance, regarding the field-level practices and related narratives of radio amateurs (Croidieu and Kim, 2018) or the activities and reflections of the Federal Reserve shortly before the financial crisis (Fligstein et al., 2017). Topic modeling is thus a suitable method for extracting the practices and symbols contained in a large amount of text.

From a technical point of view, '[t]opic modeling algorithms are statistical methods that analyse the words of the original texts to discover the themes that run through them, how those themes are connected to each other, and how they change over time' (Blei, 2012, pp. 77–78). This means that each topic consists of a series of words that frequently occur together. Croidieu and Kim (2018) have made use of this property, and, by using the vocabularies approach (Loewenstein et al., 2012), they have shown that topics can be used to infer field practices. Additionally, as topic models are based on probability distributions, each document is characterized by a number of topics with specific weights. This allows topic modeling studies to analyse the frequency of topics over time (Bohn and Rogge, 2022; Croidieu and Kim, 2018; Fligstein et al., 2017). Thus, topic modeling allows 'the researcher to observe paths that fall away as well as paths that become consolidated over time. As such, topic modeling could be vital in understanding the emergence and institutionalisation of new fields' (Kaplan and Vakili, 2015, p. 1454). In our view, this argument also applies more generally to the development of fields and their institutional complexity. This made topic modeling an ideal method to answer the question we raised.

Step One: Capturing Field-Level Logics with Topic Modeling

To perform a topic modeling analysis, researchers must apply several 'rendering' procedures (Hannigan et al., 2019; Schmiedel et al., 2019). We first had to make the texts ‘machine readable’; then, a tokeniser divided the text into single words and we used part-of-speech-tagging and lemmatising (DiMaggio et al., 2013; Schmiedel et al., 2019) to make the texts easier for the algorithm to analyse (for more on best practices for reporting text mining, please see Table A1 in the appendix and Hickman et al., 2022).

After that, we used standard software (Python and the LDA package, see: Hannigan et al., 2019; Nelson, 2020) to calculate 10 models from 10 to 400 topics (10, 25, 50, 75, 100, 150, 200, 250, 300, 400) based on the complete sample of 20,785 newspaper articles (a similar approach is used, for example, by Kaplan and Vakili, 2015). To evaluate which model best represented the data and was most appropriate to answer the research question, we combined quantitative metrics and qualitative evaluation, as suggested by the topic modeling literature (Chang et al., 2009; DiMaggio et al., 2013; Hannigan et al., 2019; Rudiger et al., 2022). We used the log-likelihood method (Blei et al., 2003; Griffiths and Steyvers, 2004) and found that a topic number between 50 and 250 topics best represented the data (please see the appendix for model selection results). In line with DiMaggio et al. (2013), we then evaluated each of the models by comparing the topics and reading text examples. The model needed to be fine-grained enough to capture the theoretical constructs. The smaller models, with 150 or fewer topics, were not able to achieve enough depth because they often grouped different issues, symbols or practices in one topic. By contrast, the model with 250 topics produced more ‘noise’, i.e., topics that could not be interpreted. We thus selected the model with 200 topics because it aligned best with the aims of the study in terms of interpretability (logic of fit in terms of Hannigan et al., 2019).

We used an inductive approach guided by Gioia et al. (2013) to interpret the model, where each of the 200 topics was a distribution of words, which were listed in Excel tables and visualized in LDAvis (see the appendix for two examples and Sievert and Shirley, 2014). We followed the multistep procedure proposed by Croidieu and Kim (2018), and Grodal et al. (2021). According to their suggestions, we also based all coding on an extensive reading of the primary media data and the additional sources (Table I). The coding work aimed to identify the delineated practices, symbols and rules of the energy field and the logics in which they are embedded. All analyses were undertaken in the language of the original data – i.e., in German – and all tables and quotes were subsequently translated into English by the authors.

To code the topics and identify the logics, we embarked on a five-step process. First, two researchers started with an open and inductive coding of all topics and labelled these topics as first-order codes (Gioia et al., 2013). The coding was based on the most frequent words in the topics (top words) and a deep reading of the corresponding text passages from the media data. The interrater reliability of the topic coding between two researchers was 0.83 (Krippendorff’s alpha). This indicated a good match, which can also be attributed to the coders’ intensive engagement with the historical context. Second, we then discussed the first-order coding to clarify the differences and developed a uniform coding scheme. Third, we coded the topics into more general second-order themes, i.e., practices, symbols, or rules of the energy field. For example, topic 68 consisted of words like: ‘radioactive; reactor; Chernobyl; accident; nuclear power plant; security; risk; problem’; we coded this topic as a symbolic expression of the ‘risk of nuclear energy and Chernobyl'. Based on this analysis, in the next step, we focused on data containing practices, symbols or rules (37 topics). In this respect, we focused on the topics relevant to the research question and thus followed the procedures proposed by Croidieu and Kim (2018), who concentrated on 98 of 400 topics relevant for understanding the strategies and practices used to legitimate the US radio field.

Fourth, we triangulated the coding using the additional data. To do so, we read related text passages from the additional data using the top keywords of the topics. The aim of this elaborate procedure was both to validate our coding and to develop a deeper understanding of the mutual connections between our second-order codes: that is, the practices, symbols and rules of the energy field. For example, topic 54 on the expansion of electricity grids was associated with further practices, such as the expansion of production capacity and the establishment of capacity markets to have enough power plants available for emergencies or in particularly cold winters. These practices were in turn supported by the argument that Germany needs an uninterrupted power supply and by the emphasis on possible blackouts (topic 14, coded as symbol).

Fifth, we then clustered the second-order themes on a code map to visualize which practices, symbols and rules belonged together and point to an overarching institutional logic. We used the relating and contrasting coding technique (Grodal et al., 2021), and repeatedly compared the different practices, symbols, and rules to group related second-order themes into logics, because the different codes 'have meaning only in relation to each other' (Grodal et al., 2021, p. 602). As the identification of logics was an iterative process, we repeatedly compared and discussed the coding by going back and forth throughout the process. As a result, we derived seven delineated institutional logics anchored in our data: the security of supply logic, the cost-efficiency logic, the cartel logic, the safety logic, the competition logic, the sustainability logic and the citizen energy logic (Table II). For example, practices such as emissions trading and the expansion of renewables, symbols such as global warming and anthropogenic climate change, and rules and laws that promote sustainability all map onto the sustainability logic. In contrast, the security of supply logic consists of practices, symbols and rules related to grid and capacity expansions and the prevention of blackouts, which is also reflected in the German energy law, which aims to make 'energy supply as secure as possible' [EnWG 1935, 1978, 1998, 2005, 2011]. The security of supply logic thus differs from the other logics. The cartel logic in turn consists of a combination of rules to prevent competition (National Energy Act [EnWG 1935; 1978]), practices to build oligopolies (topic 122) and the related symbols of the market-dominating corporations as the 'Big 4' and 'dinosaurs' of the energy field. This logic contrasts strongly with the competition logic introduced in the 1990s by new EU legislation, with the competition logic being associated with liberalization and free market practices. Table II presents the data structure of our first-order codes, second-order themes and the aggregated dimensions, the latter of which are the distinct field-level logics. The table also summarizes the coding process and includes both topic examples and representative quotes from the media data and the additional data (Table I). Hence, it reflects the extensive data analysis, in which different perspectives were integrated to obtain a comprehensive view of the institutional logics of the energy field.

Table II. Coding of the institutional logics within the German energy field

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 54: powerline; new; network; kilometre; north; expansion; south; TenneT; energy turnaround; route; electricity; construction; power supply line; large; Germany; power line; grid expansion; long; grid operator *'As compensation for investments of around €4 billion in particularly important electricity powerline and transmission networks, operator groups will be able to claim higher network charges in the future'. FAZ, 2010, ID 19847*	Capacity increase and grid expansion	Expanding supply capacities e.g., grid, plant, market (practice)	Security of supply logic
'The uncertainty of the transition period should be addressed by a capacity reserve of fossil-fuel power plants'. Policy, BMWi (2014), 6	Capacity reserve as a form of grid stability		
Topic 14: clock; hour; human; electricity; blackout; night; day; Friday; Sunday; part; street; police; damage; light; electricity supply; minute; statement; long; fire brigade *'The lights go out, blackout, and electricity shortage. all words for the same. No electricity, no action. Especially in a high-tech society in which nothing works from coffee machines to Internet servers and aluminium plants, if the electrons do not flow briskly in the cable'. Frankfurter Rundschau 2008, ID 11083*	Energy blackouts	Uninterruptible power supply (symbol)	
'Sufficient energy generation at any time is indispensable for Germany. Not just for the private households, but especially the industrial production depends on an unwavering energy supply at any time'. Policy, Ethics Commission (2011), 81	Unwavering energy supply is indispensable		
'In order to manage the energy industry as an important basis of economic and social life (…) required to make energy supply as secure and cheap as possible (…) the Government has passed the following law' National Energy Act [EnWG 1935; 1978], 1935–1997 preamble	Security of supply in legislation	Energy supply as secure as possible (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 188: price; per cent; high; user; price increase; customer; electricity; gas; company; year; electricity prices; large; rising; increase; provider; gas price; supplier; January; tariff; soared *'Energy prices have risen to a level that is economically questionable* (…) *It is envisaged that the antitrust law instruments for abuse control will be tightened to ensure effective action by watchdogs against high prices'. Börsen-Zeitung 2006, ID 1275*	Electricity price increases and measures	Measures for cost efficiency and against increasing prices (practice)	Cost-efficiency logic
'Germany's energy supply must remain cheap and reliable, especially in view of increasing wind- and solar energy generation. (…) A number of measures ensure an efficient power supply. These include, for example, the further development of the balancing energy markets and the design of the network charges'. *Policy, BMWi* (2015), 4	Measures for efficient power supply		
Topic 137: energy transition; energy; promotion; renewable; expansion; EEG reallocation charge; costs; electricity; user; clean power; new; apportionment; industry; EEG; cent; high; Federal Government; year; country; strong *'The price of electricity in Germany is already significantly more expensive than in most of its European neighbours.* (…) *Last year, the eco-tax EEG added up to 19.4 billion euros. Record! Statistically, every German citizen subsidized renewable energies with 240 euros'. Focus 2014, ID 9112*	Demand for moderate prices, problematic subventions	German competitiveness and moderate energy prices (symbol)	
'Energy-intensive companies are in a global and European competition (…) To avoid discrimination, the compensating rules must remain.' *Society/NGO, DGB* (2014), 3	Energy prices essential for the German economy		
'In order to manage the energy industry as an important basis of economic and social life (…) required to make energy supply (…) as cheap as possible (…) the Government has passed the following law' National Energy Act [EnWG 1935; 1978], 1935–1997 preamble	Cost-efficiency in legislation	Energy supply as cheap as possible (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 122: VEBA; VIAG; Hartmann; fusion; corporation; VEW; Bayernwerk; RWE; Inc.; Ulrich; energy; German; Preussen Elektra; new; Simson; chemistry; telecommunication; company; revenue; Preussen *'VEBA CEO Ulrich Hartmann forged the world's largest listed energy company through the fusion with Bavarian VIAG. He outstripped the national competition by thousands of kilowatt hours. (…) The new Inc. has a combined turnover of almost 150 billion and over 200,000 employees'. Welt am Sonntag 2000, ID 18479*	Merger large energy companies	Creation of an oligopoly (practice)	Cartel logic
'In 2008 the market power of the four big companies stabilized'. *Policy, BNetzA* (2012), 8	Market power of largest companies		
Topic 84: EON; corporation; RWE; large; German; energy corporation; Bernotat; EnBW; Teyssen; Vattenfall; provider; Germany; Wulf; company; euro; energy supplier; Duesseldorf(adj.); Duesseldorf; electricity; power plant *'After suspicions of electricity price collusion were substantiated this week, there are now calls for tough action against the four electricity giants RWE, Eon, EnBw and Vattenfall'. Tageszeitung 2007, ID 16246*	Largest energy companies	Large national energy champions and their (problematic) role (symbol)	
'National energy corporations have a market dominating position. They dictate the rules to the state… They are like dinosaurs: relics of the past'. *Society/NGO, Greenpeace* (2006) 16–26	National energy corporations as relics of the past		
'… protect [energy industry] against the economically damaging effects of competition (…) the Government has passed the following law' National Energy Act [EnWG 1935; 1978], 1935–1997 preamble	German energy cartel/oligopoly in legislation	Ban of competition in energy law for decades (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 189: new; nuclear power plant; nuclear energy; reactor; nuclear power; phase-out; nuclear power plant; Germany; nuclear energy; German; construction; nuclear power; year; government; nuclear reactor; nuclear currency; secure; Chernobyl; wide; country	Government decision to end nuclear power	Nuclear phase-out (practice)	Safety logic
'The new anti-nuclear law ends a 42-year era. In the future, it will be a matter of phase-out nuclear power. Shutdowns will take place as soon as the respective power plant has used up an agreed residual power quantity. In 2003, the old reactor in Stade will be the first to close, and in around 20 years the last unit of the 19 reactors will do so'. Der Spiegel 2003, ID 2846			
'The risk of nuclear energy can only be solved by an exit'. *Society/NGO, HBF* (2000) 22	Managing risks by phasing out nuclear energy		
Topic 68: radioactive; reactor; Chernobyl; accident; block; facility; radiation; worker; German; international; radioactivity; nuclear power plant; expert; security; risk; problem; association; fuel assembly; material; limit	Risk nuclear energy and radioactive accidents	Nuclear power not safe, risk of meltdown (symbol)	
'Nuclear power? No thanks'. The yellow sticker with the red, laughing sun adorned countless cars in the 1980s. Especially after the Chernobyl reactor disaster, the largest accident to be assumed, in 1986, the majority of Germans would have liked to do without nuclear power for electricity generation'. Stern 2006 ID 13469			
'The Fukushima disaster undermined the trust in the professional judgements regarding the "safety" of reactors'. *Policy, Ethics Commission* (2011), 24	Fukushima as symbol for the risks of nuclear energy		
'Against this backdrop of the German government's decision to end electricity generation from nuclear energy in an orderly manner (…), the German government and utilities agree to limit the use of existing nuclear power plants' BMUB (2000), 3	Limitation of nuclear power	Nuclear phase-out codified by the government (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 100: competition; electricity; market; price; liberalization; electricity market; German; customer; new; supplier; rivalry; free; company; user; monopoly; gas; public utility; provider; network; electricity markets	Liberalization and competition in the energy market	Liberalization activities (practice)	Competition logic
'Thanks to liberalization, the boundaries of the former territorial monopolies are no longer valid. By selling minority shares to interested electricity companies, the smaller companies in particular not only secure their independence, but also ensure competition'. Focus 1999, ID 8658			
'Key elements of the new EnWG are unbundling of grid operation and energy marketing'. *Society/NGO, BNetzA* (2006), 7	Unbundling oligopoly companies		
Topic 135: customer; electricity; supplier; new; provider; change; clean power; supply; Lichtblick; nationwide; user; public utility; contract; favourable; tariff; kilowatt hour; household; electricity supplier; price; German	Easy supplier change	A liberalized market is a better market (symbol)	
'Autumn was considered to be the hot season. At least as far as competition on the electricity market is concerned (…) because then, as Federal Economics Minister Werner Müller dictated it must be possible for private customers to switch suppliers without any problem'. Die Zeit 1999, ID 21449			
'… the main strength of competition is its ability to efficiently manage politically predetermined or actually occurring change processes. The market's own search (…) can satisfy the needs of market actors in a changing environment much better than can be anticipated by central planning (…)'. *Industry, BDEW* (2015) 5	Free market as better market		
'To ensure effective competition, the Federal Ministry of Economics may regulate the design of contracts and establish criteria for determining pass-through charges' *National Energy Act [EnWG]* (1998) 731	Free market in legislation	Competition regulated by law (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 16: certificate; carbon trading; tonne; company; trade; industry; complimentary; EU; costs; price; carbon dioxide; European; right; climate protection; emissions trading; German; national; power plant; emissions allowances; euro *'Trading in CO2 emission certificates is a billion-dollar market in Germany. The International Monetary Fund calls emission certificates the "global currency of the future". With its "Green Energy Package", the EU has formulated goals that will also apply after the Copenhagen conference'. Börsen-Zeitung 2010, ID 1803*	Emissions trading to support climate protection	Activities and investment to reduce emissions (practice)	Sustainability logic
Topic 94: energy; energy turnaround; renewable; Germany; new; energy supply; energy policy; expansion; policy; goal; future; important; political; large; investment; modification; topic; energy efficiency; sustainable; necessary *'We must show that climate protection and prosperity are compatible, said the economics minister on Tuesday after a ministerial meeting in Hamburg. Gabriel's way to do this is to step up the expansion of renewable energies such as solar and wind power'. FAZ 2015, ID 19561*	Expanding of renewables & energy turnaround		
'With CO2-emission-trading and the EU-wide limit of CO2-emissions, the climate goal will be ensured regarding fossil fuels. (…) The supply gap resulting from the phase-out of nuclear energy is to be filled to a large extent by the use of renewable energies…' *Policy, Ethics Commission* (2011) 81–82	Emission trading for CO2 reduction and expending renewables		
Topic 81: global; worldwide; climate change; climate protection; international; country; USA; world; climate; year; China; human; large; state; earth; consequence; degree; global warming; Paris; energy *'Climate change, the world can still be saved. Climate protection, economic growth, population explosion, mankind can afford everything if they immediately rethink their actions'. Die Zeit 2007, ID 20920*	Global warming	Anthropogenic climate change and global climate crisis (symbol)	
'… there has been significant anthropogenic warming over the past 50 years averaged over each continent' Society/NGO, IPCC (2007) 5	Anthropogenic warming		
'The purpose of the Act is to ensure the most secure (…) environmentally compatible and greenhouse gas-neutral grid-based supply of electricity (…) increasingly based on renewable energies'. *National Energy Act* [EnWG] (2007) §1	Environmental protection anchored in legislation	Increasingly climate friendly energy supply (rules)	

(Continues)

Table II. (Continued)

Illustrative examples (Topics and representative quotes)	*First order codes*	*Second order themes (Practices, symbols and rules of the game)*	*Aggregated dimensions (Field-Level logics)*
Topic 120: community; meter; citizen; windmill; public campaign; mayor; countryside; project; high; forest; location; area; region; construction; municipality; area; wind power plant; nature; facility; wind power	Wind power, municipality and community energy	Citizen investment and participation (practice)	Citizen energy logic
'In addition, the EEG has ensured that the expansion is largely self-organized through the obligation to connect renewable electricity producers to the general power grid. (…) the expansion is based on the activities of small and medium-sized wind and solar projects'. Frankfurter Rundschau 2005, ID 9733			
'… the engagement of local communities enables wind farms or photovoltaic. The local participation and their profits have an essential positive influence on the acceptance'. *NGO/BBNe* (2015) 12	Citizen participation		
Topic 6: facility; electricity; roof; sun; large; hour; installation; square meter; in-house; kilowatt; solar power; solar plants; network; small; photovoltaic; solar energy; private; photovoltaic plant; operate; area	Small solar power for everyone	Energy transition 'from the bottom' (symbol)	
'Whereas in the past electricity flowed only from the large power plant to the customer, today the consumer has become a producing consumer who generates his own electricity with subsidized wind farms and solar panels on the roof and sells the surplus to the grid'. Welt am Sonntag (2015) 19,416			
'Citizen-energy means the possibility of a democratization of the capital expenditure within the energy industry, which did not exist before the EEG'. *NGO/Greenpeace & BBEn* (2015) 45	Democratization of the energy market		
'As big energy suppliers prevented small renewable energy companies from feeding the distributing network, these binding rules will regulate the feed into the public network. The law commits network operators to use this electricity and ensures a minimum remuneration to small producers'. Renewable Energy Source Act (EEG) 2014: §11	Regulation feed energy into public network/response for the blockage by the big 4	Law to support small energy producers (rules of the game)	

Step Two: Qualitative Content Analysis to Trace the Relationships between Logics over Time

In the second step, we used qualitative content analysis (Miles and Huberman, 1994) to evaluate the relationships between logics. This is a critical step for capturing the logic constellations and institutional complexity more generally. For this analysis, we again used newspaper articles as an overarching space to detect field-level complexity. Based on the topic modeling findings – that is, the distribution of topics and related logics per document – we filtered all documents for which there was a high probability that at least two logics would be mentioned in the same article (co-occurrence of logics based on a threshold of 0.1). Each document, in other words, consisted of a set of topics that represented different practices, symbols and rules, which in turn belonged to different logics. We then randomly selected 420 articles, each of which contained two different logics, that is, 20 articles per pair. As we found seven logics prevalent in the field, the sample consisted of 21 different pairs, i.e., each logic was combined with each of the other logics.

We carefully read all the articles in the sample and used qualitative content analysis to code the relationships between logics according to the established categories of conflicting or complementary (Besharov and Smith, 2014; Goodrick and Reay, 2011). For example, we coded a conflicting relationship when the texts mentioned critical statements, contradictions, tensions, conflicts or other negative expressions between logics or the associated practices, symbols and rules (see Table III and the examples below). Frequently, our data sources mentioned conflicts between the practices, symbols or rules of different logics, where the fulfilment of one logic implied a rejection of another, for instance, the phasing out of nuclear energy (safety logic) ran contrary to the need for an unwavering energy supply (security of supply logic). Consequently, we classified a relationship between two logics as conflictual if tensions were clearly prominent and occurred many times in the data. On the other hand, we coded relations as complementary when the articles draw a positive connection between two logics, in other words when 'the instantiations of logics imply consistent and reinforcing organizational actions' (Besharov and Smith, 2014, p. 367). We use this coding in the findings to visualize the logic constellations in the energy field – conflicting relationships are shown in red and complementary ones in black (see Figures 2, 3 and 5). Furthermore, there were also instances which we could not assign a relation to either of the two categories. This often occurred when there was no semantic connection between the logics in the articles.

In the following, we provide representative coding examples, focused specifically on the nuclear phase-out and sustainability debates, which are linked to the safety, sustainability and security of supply logics. We coded the following quote as complementary between the safety and sustainability logics.

> If the seven oldest reactors are phased out as planned [safety logic], 60 to 64 million more tons of carbon dioxide [sustainability logic] will be saved in electricity generation over the next three years [complementary], depending on the energy mix, argued the

Table III. Representative quotes of conflicts between institutional logics

Conflicts and contradictions between institutional logics	*Associated arguments*	*Representative quotes (based on the media data; underlined text passages indicate the coding of the logic relationships; coded logics are marked in square brackets)*
Sustainability versus cost-efficiency	Energy transition leads to higher electricity prices	'The Energiewende (energy transition) [sustainability logic] could become *more expensive for electricity customers* than previously expected [cost-efficiency logic] (…) Construction costs of around 30 billion euros are estimated for the new large overland lines alone in the coming years. Another 25 billion could be swallowed up by the distribution networks'. (FAZ, 2012, ID 19700)
Sustainability versus security of supply	Renewables could not provide enough energy and baseload capacity	'Renewable sources such as sun, wind, water, and biomass [sustainability logic] *could not provide* enough energy [security of supply logic], said Dietzel: "Biomass is also finite. We cannot take more from forests and agricultural land than will grow back"'. (Frankfurter Rundschau 2005, ID 9812)
Sustainability versus cartel logic	The increase of renewables endangers the existence of the Big 4, which are important for security of supply	'The energy providers are pushing the pace. Because cheap solar and wind power [sustainability logic] enjoy priority in the grid, many conventional power plants *can no longer be operated profitably*. Nevertheless, they are needed as a safety reserve for grey and windless days. Incentives for the construction of new plants, as discussed in politics, are absolutely necessary. "Who can provide the reserve power plants? These are again the big four" [cartel logic], argued the president of the cartel/antitrust office'. (FAZ 2014, ID 19605)
Safety versus cost-efficiency	Nuclear phase-out leads to rising electricity prices	'E.ON boss Johannes Teyssen (chairman of one of the Big 4), for example, warned against a hasty nuclear phase-out, [safety logic] because work and prosperity *could be endangered by rising* electricity prices. [cost-efficiency logic]' (Die Welt, 2011, ID 7253)
Safety versus security of supply	Nuclear power is needed for security of supply; phase-out as problem	'On the way to a sustainable energy future, however, nuclear power [safety logic] is *needed as an essential element*: because it guarantees security of supply [security of supply logic], and is CO_2-free and inexpensive. (Frankfurter Rundschau, 2010, ID 11631)
Safety versus cartel logic	Nuclear phase-out breaks up the dominant market position of the Big 4	'The German energy turnaround with the nuclear phase-out [safety logic], weak electricity margins, and loss-making gas imports *have led to a slump in profits* for E.ON in 2011. In the end, write-downs led to Germany's largest energy utility being in the red. [cartel logic] (…) E.ON intends to sell assets with a volume of over 5 billion euros in the coming years. According to Schenck, this means that an EBITDA in the high three-digit million euro range will also be lost'. (Börsen Zeitung, 2012, ID 2172)

(Continues)

Table III. (Continued)

Conflicts and contradictions between institutional logics	*Associated arguments*	*Representative quotes (based on the media data; underlined text passages indicate the coding of the logic relationships; coded logics are marked in square brackets)*
Citizen energy versus cartel logic	Citizen energy breaks up the cartels of the big four	'The big four energy suppliers [cartel logic] have *become restructuring cases. The energy turnaround is sweeping over them*. Business with green electricity is decentralized – and rather confusing. Thousands of suppliers cavort here (…) almost half of the 73 gigawatts of green electricity installed in Germany is in the hands of citizens [citizen energy logic]. No matter whether they are farmers who operate small biogas power plants on their farms. Or private individuals who screw solar collectors onto their house roofs. Or local cooperatives that are building their own wind farm and are otherwise dependent on the voluntary work of their members: "*The citizens have broken the oligopoly of the big corporations in the energy market*", says BBEn supervisory board member Marcel Keiffenheim. According to surveys by the association, 4000 wind turbines and 1.2 million solar plants in this country do not belong to the electricity giants, the public utilities or other financially strong investors, but ordinary people'. (Frankfurter Rundschau, 2015, ID 13167)
Citizen energy versus security of supply	A decentralized energy system is additionally dependent on large power plants and cannot guarantee supply on its own	'Decentralized supply structures [citizen energy logic] *do not generally offer greater security from a blackout*. The fact that our power lines are part of a large European network usually guarantees security of supply [security of supply logic], because if one power plant or line fails, electricity from other power plants or via other lines can replace it. (…) We urgently need additional gas-fired power plants and a rapid expansion of the electricity grids, but also of the gas transmission lines. When it comes to gas-fired power plants, (…) Flexible gas-fired power plants and renewable energies are two sides of the same coin. We need electricity even when the sun is not shining and the wind is not blowing – that's not so rare.' (Interview with Bavaria's Economics Minister) (Welt am Sonntag, 2012, ID 19298)

Table III. (Continued)

Conflicts and contradictions between institutional logics	*Associated arguments*	*Representative quotes (based on the media data; underlined text passages indicate the coding of the logic relationships; coded logics are marked in square brackets)*
Citizen energy versus cost-efficiency	Decentralized energy is expensive and leads to increasing prices because it needs new infrastructure	'… the total costs of around 4.5 billion euros per year are justifiable for the task of bringing decentral generated green electricity to the consumer [citizen energy logic]. (…) In fact, the regional distribution networks absorb more than 90 per cent of the decentralized electricity generated by solar and wind power plants. The *problem of having to reconcile strongly fluctuating* wind and solar power with demand arises primarily at this level. Although the *financial and structural problems of grid expansion* at this lowest level are considered by experts to be the real sticking point of the energy turnaround [cost-efficiency logic], they have so far been largely ignored by politicians and the public.' (Die Welt, 2012, ID 7527)
Cartel versus competition	Oligopoly companies will lose market share due to the liberalization	'The new energy law opens up unexpected opportunities for suppliers of green electricity … In the liberalized market, where every electricity customer can choose his own supplier [competition logic], *no opponent of nuclear power and Castor transports will stay with the major electricity suppliers* [cartel logic] in the long term'. (Die Zeit, 1998, ID 21557)

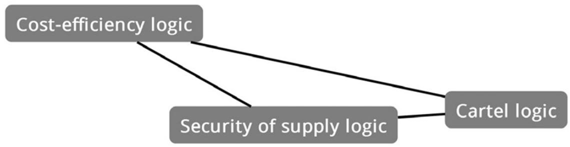

Figure 2. Pre-liberalization period and the interrelated system of three institutional logics – cost-efficiency, security of supply, and cartel (black lines indicate no conflicts)

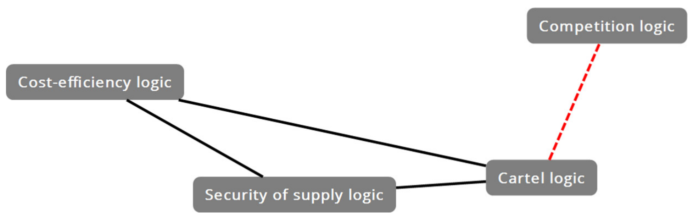

Figure 3. Four institutional logics and increasing complexity, with a conflict between two logics (dotted red lines between the logics indicate a conflicting character, black lines no conflicts) [Colour figure can be viewed at wileyonlinelibrary.com]

> Federal Environment Agency. The conservative liberal coalition is putting Germany's climate targets at risk if it simply extends the operating lives of nuclear power plants. (Die Tageszeitung, 2009)

The next quote is an example of a conflicting relationship between the sustainability and security of supply logics (for more quotes see Table III).

> Renewable sources such as sun, wind, water, and biomass [sustainability logic] could not provide [conflict] enough energy [security of supply logic], said Dietzel: biomass is also finite. We cannot take more from forests and agricultural land than will grow back. (Frankfurter Rundschau, 2005; quoting Mr. Dietzel, SDP)

Overall, the two-step procedure that combined topic modeling and qualitative content analysis allowed us to capture the differences and the growth of institutional complexity over time. Additionally, it provided us with deep insights into the field-level transition process.

FINDINGS

In this section, we explain the dynamics of the field-level complexity in the German energy field. We start by describing the situation at the start of our analysis, when there was a stable and established energy field. We then focus on the first period between 1998 and 2004, where complexity increased due to new conflicts along with the market liberalization and nuclear phase-out. Next, we describe the second period from year 2005 onwards, where complexity accelerated due to the rise of new dominant logics, extensive conflicts, emerging constellations and fluctuating dominance. Lastly, we present the process model of growing complexity and field transition.

Context: Institutional Pluralism with a Triad of Complementary Logics

The energy field in the mid-1990s was characterized by decades of stability within a situation of institutional pluralism. This was based on three complementary logics: security of supply, cost-efficiency and cartel. These three pillars – the so-called energy triangle (Bontrup and Marquardt, 2010) – shaped the field from the 1930s to the 1990s and were embedded in an extensive legal framework (National Energy Act, 1935, 1978 [EnWG 1935, 1978]).

The security of supply logic was one of the basic logics of the energy field. This logic linked the argument that an unwavering energy supply is essential for society and the economy, which makes a constant expansion of capacities necessary (see Table II for all logics and the related practices, symbols and rules). The cost-efficiency logic pertained to the state-directed principle to have affordable energy prices to maintain a cheap energy supply, which was 'essential' for the German economy. The cartel logic referred to an energy market protected against competition. Until the 1990s, the German energy market comprised state-owned, vertically integrated companies with regional monopolies, based on large and centralized power plants with high load capacities using fossil fuels and nuclear power. Altogether, this system of three interrelated logics became the uncontested 'dogma' of the German energy market (Bleicher, 2006, p. 83). This was not only evident in the practices and symbols of the field but was also regulated by law. The National Energy Act stated that the energy market had to be protected against the 'economically damaging effects of competition' to 'make energy supply as secure and cheap as possible' (National Energy Act 1935 [EnWG 1935], preamble). This law applied for more than half a century until the liberalization of the energy market in 1998.

There were, of course, other issues, especially an anti-nuclear and green movement in Germany, beginning in the 1970s. However, these topics were largely ignored in practice. For example, in the 1990s, the share of nuclear power rose to above 30 per cent in Germany, and renewables were underrepresented, with less than 5 per cent of generated energy. The triad of the security of supply logic, cost-efficiency logic and cartel logic thus constituted an interrelated and complementary logic constellation, where the logics and related practices, symbols and rules supported each other (Figure 2).

Period I: Increasing Complexity

The first period between 1998 and 2004 was characterized by the emergence of new logics and conflicts and an increasing complexity of the field. In 1998, the EU directive to liberalize the energy market was transposed into German law. This disrupted the traditional structure of the energy market, in which regional monopolies had existed since the 1930s, and it sparked the conflict between the established cartel logic and the newly introduced competition logic. The logic of competition – referring to deregulation, an unbundling of the oligopolistic companies, and the consumer's right to choose between energy providers – was entirely new for the German energy market. It was based on practices and symbols such as a liberalized free-market structure, the implementation of monitoring measures, a stock market for electricity and the elimination of regional monopolies (see Table II). Unlike the energy law from 1935, which had protected the industry explicitly against the 'damaging effects of competition' (National Energy Act, 1935 [EnWG 1935]), under the new rules, the government was expected to ensure 'effective and genuine competition' (EnWG, 1998) to provide a secure and affordable energy supply. Therefore, the liberalization was intended to instigate a strong shift in the market, shaking up the cartel logic. This resulted in the establishment of hundreds of competitors, from cheap suppliers to bigger companies.

In the immediate aftermath, electricity prices did fall. However, the low 'fighting prices' (Bleicher, 2006, p. 87) and economy-of-scale advantages of the remaining big energy suppliers crowded out the majority of new firms quickly. The obvious conflict between the competition and cartel logics was also reflected in the practices of the previously dominant companies. Having been 'protected' from competition for over six decades, the nine dominant regional utilities responded to liberalization in various ways, first by resisting and later by consolidating their dominant market position via mergers and acquisitions (Bohn and Walgenbach, 2017; Kungl and Geels, 2018). The energy companies used their power and market position to merge into even bigger companies – E.ON, RWE, EnBW and Vattenfall, also known as the 'Big 4' (Bleicher, 2006) – which were then responsible for 90 per cent of domestic electricity generation. By focusing on their core business of producing and selling fossil and nuclear-based energy, the Big 4 leveraged their market power to strengthen their positions vis-à-vis new competitors entering the market – especially on the distribution side.

> The competition will break out faster than its opponents would like. The first independent power generators are already on the market (…) The consequences for Germany's electricity companies and public utilities are cut-throat competition, merciless selection and an unprecedented concentration process, which only the absolute cost leaders will survive. (Die Welt, 1999)

This process was the reverse of what the EU directive on a liberalized energy market had intended. The pre-1998 oligopolistic structure was recreated and perhaps even reinforced (Bontrup and Marquardt, 2010). However, the market liberalization and the related competition logic gave rise to a conflict with the cartel logic and thus resulted in institutional complexity. The level of complexity was still low, and the energy field remained relatively ordered – it had four logics and one conflict, between the competition and cartel logics (Figure 3).

This changed, however, when the SDP and the Green Party made nuclear power one of the main issues in their 1998 election campaign and established the safety logic in the energy field. Both parties emphasized the need for a nuclear phase-out, because 'nuclear power plants have massive security risks and risk of immense damage' (Social Demoratic Party and Green Party, 1998, p. 14). The SDP and Green Party used a range of arguments centring on security issues and defined nuclear power in general as a high-risk technology because of the unanswered question regarding permanent storage facilities for nuclear waste and the risk of a meltdown (Table II).

> Safety first […] Besides the chances that are connected with the nuclear phase-out we must also put more emphasis on safety issues. The nuclear phase-out is not arbitrary. The disposal question is still unanswered, and nowhere in the world is there a nuclear power plant that is really safe. (Die Zeit, 1999; quoting Michael Müller, SDP, member of parliament)

The safety logic was not entirely new in the energy market, as the anti-nuclear movement had existed since the 1970s, and Chernobyl had also triggered a debate about nuclear power. However, a nuclear phase-out only became a politically supported, achievable option after 1998, when the SDP and Green Party won the federal parliamentary election. The safety logic and nuclear phase-out were the dominant topics in 1998 and triggered two central conflicts. First, energy industry actors mentioned that a nuclear phase-out would lead to problems with secure supply, because nuclear power plants delivered approximately 30 per cent of the gross energy generated in Germany (conflict between safety and security of supply logic). Second, a conflict between the safety logics and cost-efficiency logic was postulated because a nuclear phase-out would lead to higher energy prices.

> All nuclear phase-out scenarios to date have been characterised by the lack of a convincing and concrete solution to questions such as, how could we close the gap of a third in public electricity supply after a phase-out. (…) Finally, even a Schröder government is wondering whether renouncing nuclear energy is economically justifiable. On average, nuclear power plants still have an advantage over hard coal of 8 pfennigs per kWh. (Börsen-Zeitung, 1998)

Ultimately a nuclear phase-out was implemented through new regulation to end the use of a nuclear power within the next years (BMUB, 2000).

At the same time, the government decided to expand renewable energy generation to compensate for the planned closures. Sustainability gained momentum and was integrated into the rules of the energy field, as the energy law noted the intention to generate environmentally friendly energy (Energy Industry Act [EnWG], 1998). The practices and symbols related to the sustainability logic consisted of an expansion of renewable energies and general changes to the ways of producing and consuming energy to tackle global warming (Table II). This included a reform of the energy law to bring about a more flexible European energy market and emission trading.

> The use of wind energy to generate electricity has reached a level in Germany that has exceeded all expectations in recent years. (…) The reason for this rapid development is the Renewable Energy Sources Act (EEG), which created planning security for investors with its guaranteed feed-in tariffs. (Frankfurter Rundschau, 2005)

We conclude that, in the period beginning in 1998, there was a significant but rather linear increase in institutional complexity, with six institutional logics. Of these six logics, three were the previously established ones: cartel, cost-efficiency and security of supply.

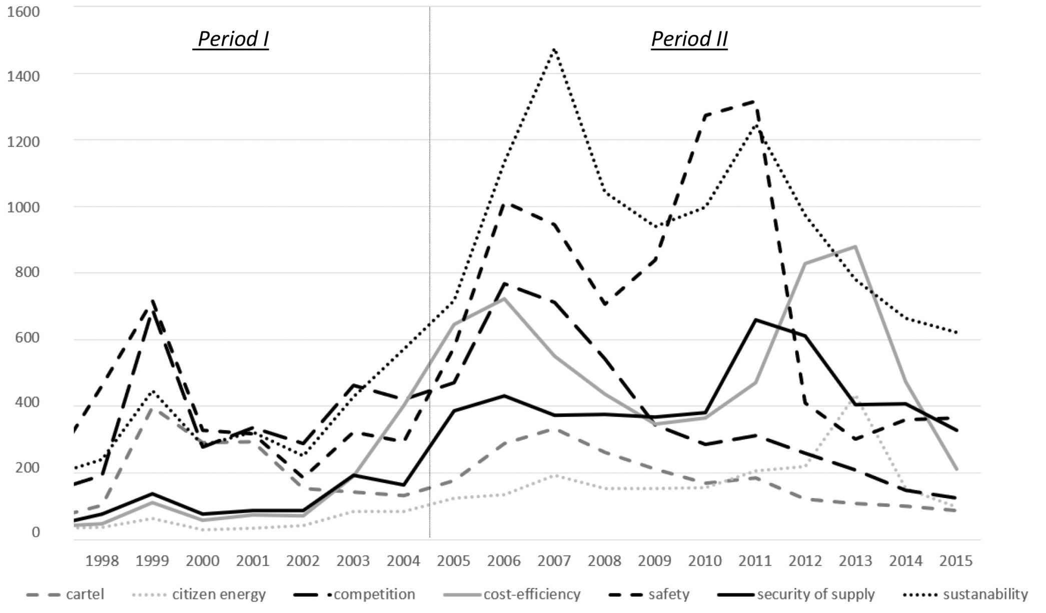

Figure 4. Frequency of institutional logics over time, based on the average topic weights across documents per year (nominated, the base year has an average coverage of 100)

Additionally, there were three logics that gained new momentum: competition, safety and sustainability. Based on our data, we can describe three relationships as conflictual, which leads us to assume that the rise of the number of logics and conflicts prompted a gradual increase in the institutional complexity in the German energy market. The growing complexity was also apparent when we compared the frequency of logics in Period I; for example, the frequency of the competition and safety logic rose and dominated the field-level media discourse (Figure 4, which is based on the topic modeling findings).

The lines in Figure 4 – whose size represents the relative frequency of the logics – indicate the increasing intensity of the public debate on the energy field between 1998 and 2004. As we will present in the next section, however, changes in the dominance were even more intense from 2005 onwards. For example, whereas at the end of the 1990s, safety and competition were the dominant logics, after 2005, sustainability was the most frequently mentioned one. Additionally, the figure shows that Period II was a time of great fluctuation and strongly marked by dominance shifts, as five logics alternated and competed for dominance: sustainability, safety, security of supply, cost-efficiency and competition. We will describe this in detail next.

Period II: Accelerating Complexity

The second period between 2005 and 2015 was characterized by the emergence of new logics and conflicts in an already complex field. It was further marked by a bundling of logics and by fluctuating dynamics. For example, the relationships between logics changed several times, from conflictual to complementary and back again. The dominance also fluctuated, with several logics alternating in a short period of time. Hence, the field was in intense motion. Overall, we characterize the period as one of accelerating complexity, which led to constellation complexity.

In 2005, the first practical consequences of the nuclear phase-out agreement between the government and the nuclear power plant operators from the year 2000 became apparent, as the Stade and Obrigheim power plants were closed. Both shutdowns were the first in a series of planned closures following the nuclear phase-out agreement (BMUB, 2000). As nuclear power accounted for almost one-third of total electricity generation, issues like higher energy prices and possible blackouts became pertinent.

> On the way to a sustainable energy future, however, nuclear power is needed as an essential element: because it guarantees security of supply and is CO_2-free and inexpensive. (Frankfurter Rundschau, 2010)

At the same time, the sustainability logic became the dominant principle in the energy market (Figure 4), which further intensified the conflicts in the field. One reason for this was the entry into force of the EU Emissions Trading System and the Kyoto Protocol in 2005. The pre-existing conflicts thus became even more relevant because a pressure to implement measures – and, for example, to close old coal-fired power plants – emerged. After 2005, the relevance of the sustainability logic increased further with the publishing of the World Climate Report 'Climate Change 2007' and the Cancún Agreements in 2010, which included the formal recognition of the 'below 2°C goal'. In parallel, renewable energies became the fastest growing energy source in Germany, which led to criticism concerning increasing energy prices because of subsidies (conflict between the sustainability logic and the cost-efficiency logic).

> German electricity customers will have to prepare for a strong price increase this year. (…) The reason for this is the so-called EEG law. This legally stipulated support for operators of plants that produce renewable energies is paid by all electricity customers via their normal bill. This applies regardless of whether they purchase green or nuclear power. (Die Welt, 2010)

In general, the relationship between the sustainability logic on the one hand and the security of supply and cost-efficiency logics on the other was contentious and heatedly debated. The most frequently presented argument we found in our data was that renewables were expensive and would not be able to completely substitute for traditional electricity generation, as they would not be able to cover the baseload (conflict between sustainability logic and security of supply logic), while fossil and nuclear power could provide a secure supply regardless of the time of day and the weather conditions.

Additionally, conflicts in the energy field were further exacerbated by the emergence of the new citizen energy logic, which was based on new practices (e.g., small suppliers, smart grids) and symbols (e.g., democratization of the market). The citizen energy logic was rooted in the vision of a completely new energy system based on decentralized energy supply. Consequently, a lot of new market actors, like renewable energy cooperatives or even small individual suppliers of renewable energy emerged. These were often homeowners with solar panels on their roofs. The new 'prosumers' were not only competing with the established large energy companies but also linked their engagement to strong symbols, such as the democratization of the energy system. These highlighted the energy transition as a joint societal issue.

> Citizens are asked to actively and responsively shape the energy transition, e.g., as conscious consumers, producers or investors. (…) The considerable amounts of renewables built by citizens certainly have their share in the 'de-oligopolisation' of the energy market, regarding who owns the production resources and who can command those resources. (Greenpeace and BBEn, 2015)

The citizen energy and sustainability logics were a complementary character and formed a solid pair in this respect. At the same time, however, the complexity in the energy field increased significantly, as the citizen energy logic was in conflict with the security of supply, cost-efficiency and cartel logics (Table III).

To understand how much institutional complexity not only increased but also escalated, we found it useful to consider the tripartite conflicts among security of supply, sustainability and safety logics. All three pointed to inherently opposing core practices: large power plants with high baseload capacity like coal and nuclear power stations (security of supply logic), renewables (sustainability logic) and the nuclear phase-out (safety logic). The relationships between the three logics were highly conflictual. For instance, some argued that, to be consistent with the sustainability logic, nuclear power would be needed, as it would allow reliable and stable energy generation with low carbon dioxide emissions.

> On the way to a sustainable energy future, however, nuclear power is needed as an essential element: because it is secure, CO_2-free and inexpensive. (Frankfurter Rundschau, 2010)

When making this argument, some authors pointed to countries like France, which have a high share of nuclear power, the technology is seen as a kind of renewable energy or at least a substitute (Teräväinen et al., 2011). This was consistent with the argument that the safety logic and the nuclear phase-out were incompatible with the climate protection agenda and the sustainability logic in general (conflicts between safety logic and sustainability logic). Additionally, a key argument in the media debate was that renewables could not provide a secure supply (conflict between sustainability and security of supply logic), while the big nuclear power plants could do so (conflict between safety and security of supply logic). These arguments concerning the relationship among the sustainability, safety, and security of supply logics implied that it would not be possible to be consistent with two of the logics at the same time and certainly not all three.

In addition, complexity also increased due to the fluctuating change processes, a development that was especially relevant for the safety logic and the debate about nuclear power. While the nuclear phase-out was decided in 2000 (with safety being complementary with sustainability but in conflict with security of supply, because closure meant lower power plant capacity, see above), about 10 years later, the new conservative-liberal coalition decided to extend the lifespan of the nuclear power plants (Eleventh Law to the Amendment of the German Nuclear Energy Act, 2010) – in the process also referring to low carbon dioxide emissions. For the big German power suppliers, this meant that their old nuclear power plants were once again considered safe and also environmentally friendly, cheap and capable of guaranteeing the security of supply. However, only some months later, the relationship between the safety logic and the sustainability logic reversed again in the wake of the Fukushima meltdown in 2011. The argument behind this was that nuclear power was unsafe and a nuclear phase-out was necessary to reduce safety risks but also to advance the energy transition because large power plants would slow down the transition. The German parliament again decided to phase out nuclear power, meaning that eight German nuclear power plants immediately lost their operating licences. The other nine power plants were to be shut down within the next 10 years (BMUB, 2011). Thus, Fukushima triggered another radical change that prompted the prioritization of the safety logic and the related nuclear phase-out (Figure 2).

To conclude, the whole field was in a process of change in which new logics emerged, conflicts grew, including relationship change, and the dominance of logics shifted back and forth several times – the dominance, for example, fluctuated from sustainability to safety, to cost-efficiency and back again (Figure 4). Since all these factors occurred simultaneously, we can characterize the situation as one of accelerating complexity. Moreover, amplifying processes were in play, as an additional logic immediately led to even more (potentially conflictual) relations among the logics. For example, for three logics, there were three potentially conflicting relationships, for five logics, there were 10 relationships but for seven logics, there were 21 relationships. This was the case in Period II, which had seven institutional logics and a total of 21 inter-logic relationships, 10 of which were conflictual.

This highly conflicting situation had important implications. From a field perspective, it led to the emergence of two clusters of logics that were in conflict with each other (Figure 5,

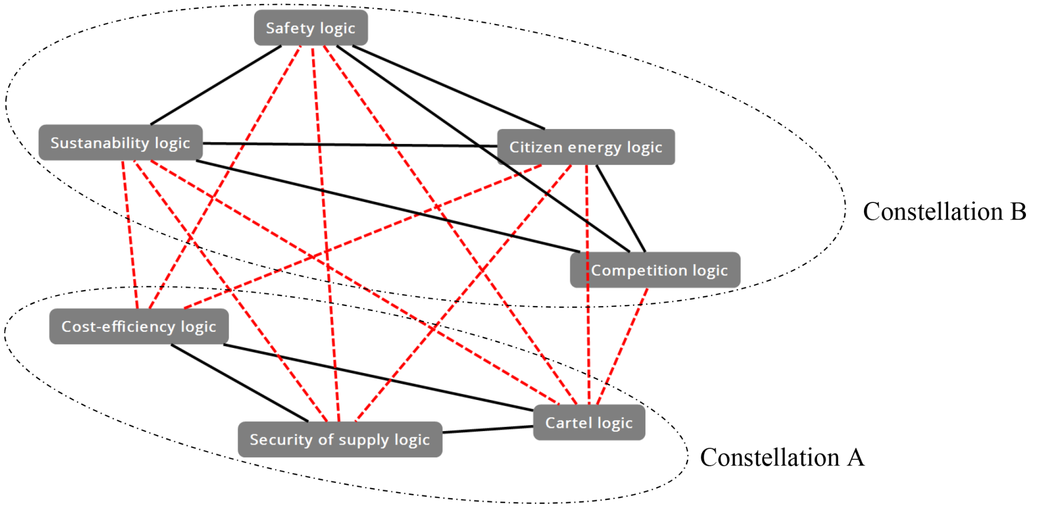

Figure 5. Two conflicting constellations, i.e., constellation complexity (dotted red lines between the logics indicate a conflicting character, black lines no conflicts; dotted ellipse show constellations) [Colour figure can be viewed at wileyonlinelibrary.com]

constellation A and B). In addition, the high complexity of the field threatened the business model of the former regional monopolists with their concentration on almost exclusively nuclear and fossil power; this conflicted with both dominant logics in that period, i.e., the sustainability and safety logics. As a response, the former monopoly companies – E.ON, RWE, EnBW and Vattenfall – engaged in major strategic turnarounds. E.ON and RWE both split up into two entities – one with a focus on the old fossil fuels and nuclear power plants and one concentrating on renewable energies; Vattenfall announced the sale of its lignite coal operations, and EnBW announced a major strategic refocus on renewable energy alone. Hence, the dominant companies of the energy field split their businesses and organizations into different parts. One part concentrated on the 'new' logics of the energy market related to renewables and a decentralized energy system. The other part followed the old way of the energy market; large power stations based on fossil and nuclear power that generated energy in a highly centralized system.

> On November 30th of last year, our board of directors approved our new corporate strategy proposal. This strategy is based on the assessment that two energy worlds have developed over the last years: A traditional one and a new one. (Johannes Teyssen, E.ON, Annual Report, 2014)

The notion that two energy worlds, with incompatible principles, had emerged, permeates the companies' announcements. This, they implied, rendered substantially different strategic responses inevitable. With the split, the companies separated their business so that each new individual company would follow one specific logic constellation in the field, either based on the old energy logics (cost-efficiency, security of supply and cartel) or the new ones (sustainability, safety, competition and citizen energy). The two logic constellations in the field were internally coherent, but there were clear lines of conflict between them, signifying constellation complexity (Figure 5).

Towards a Model of Growing Complexity and Field Transitioning

Based on the empirical results, we have developed a model for growing complexity (Figure 6). Here, we describe the model by presenting two different processes of growing complexity: increasing complexity and accelerating complexity. Both processes are characterized by different dynamics, which refer to the number of logics in a field, emerging conflicts between logics and shifts in the dominant logic.

Increasing complexity describes a change from institutional pluralism to institutional complexity, whereby at least one relationship between two individual logics becomes conflictual. In such cases, the number of logics and thus the number of relationships is often limited, i.e., there are two logics with one relationship or three logics with three relationships. Likewise, the shift in dominance is also rather linear (from one dominant logic to another) – if there is a shift at all. Examples of increasing complexity can be found both in Phase I in our study (the conflict between the competition and cartel logics) and in the literature, for example, the emergence and later replacement of the editorial logic by the conflicting market logic in the higher

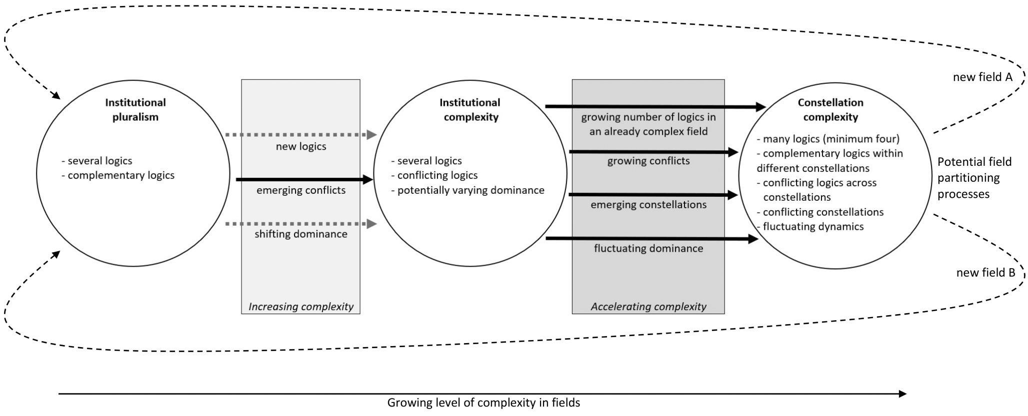

Figure 6. Growing complexity and field transitioning (dotted lines indicate optionality)

education publishing industry (Thornton and Ocasio, 1999). Thus, increasing complexity leads to gradual change processes.

In contrast, accelerating complexity is characterized by a higher intensity of dynamics, because the number of logics, the number of conflicts, and the dominance shifts grow simultaneously. In this context, accelerating complexity takes place in an environment in which complexity already prevails, i.e., new conflicts arise in addition to those that already exist. Furthermore, the number of relationships grows disproportionately, since each new logic leads to a higher number of potentially conflicting relationships. In a situation with three logics, there are only three relationships, with four logics there are six relationships, and with seven, there are even 21 potentially conflicting relationships.[1] Accelerating complexity is not only characterized by dominance shifts, but by alternations and fluctuations in dominance, which can change quickly and repeatedly in a short time. The consequences of accelerating complexity are thus a higher degree of complexity. In addition, the higher number of logics and conflicts may give rise to constellations of logics that internally have a complementary character but are in conflict with each other. We refer to such situations as constellation complexity.

In the simplest case, constellation complexity in a field is based on four logics. Two of these form a pair with a complementary relationship, but they are simultaneously in conflict with the other pair. However, much more complex situations are also conceivable, such as the seven logics of the energy field dealt with in this study. Hence, field complexity increases, with it being greatest in constellation complexity. However, constellation complexity may initiate field partitioning processes than can lead to a split of the field into two fields. The new fields would then each separately be characterized by a low complexity, i.e., institutional pluralism. This feedback loop finally points to the recursive nature of the field-level change processes we described. In more general terms, our model shows that the different velocities of complexity growth can have very different effects on fields.

DISCUSSION

Given our interest in the process of growing institutional complexity and its field-level consequences, we used a longitudinal research design to study the dynamics of institutional logics within the German energy field. We noted two types of growing institutional complexity, which we term increasing and accelerating complexity. We also described substantial field transition processes, which ultimately resulted in two opposing field-level logic constellations, a situation we term constellation complexity. We integrated these findings into a process model. In what follows, we discuss the resulting contributions to theory and then conclude by outlining the limitations and future research opportunities.

This article makes two theoretical contributions to the institutional complexity and field literature. First, we present a process model focusing on different types of growing complexity and its field level consequences. Hence, we respond to recent calls to understand institutional complexity more dynamic (Jancsary et al., 2017; Raynard, 2016; Schildt and Perkmann, 2017; Vermeulen et al., 2016). To do so, we distinguish between two processes of growing complexity, thereby conceptualizing different velocities of complexity growth. Increasing complexity describes the process of emerging conflicts between logics in a field (Dunn and Jones, 2010; Reay and Hinings, 2005; Thornton, 2002; Thornton and Ocasio, 1999). We speak of accelerating complexity when there are amplifying and parallel processes of more logics, more conflicts, emerging constellations and fluctuating dominance. The two processes of growing complexity differ in their nature and intensity (Figure 6). For instance, whereas scholars have observed linear changes in dominance or logic relationships akin to what we describe as increasing complexity – initiated, for example, by actors' strategic (framing) activities (Ansari et al., 2013; Meyer and Höllerer, 2010) – accelerating complexity is characterized by non-linear change processes, i.e., by fluctuating change that does not develop in one clear direction (Zietsma et al., 2017). The distinction between different types of institutional complexity helps to expand the institutional complexity concept in this respect. This is important, not least, to inspire empirical research and to address the old criticism that complexity research often deals with cases of relatively low complexity (Greenwood et al., 2011; Meyer and Höllerer, 2014; Schildt and Perkmann, 2017).

In particular, accelerating complexity is important because it is a novel concept that points to amplifying effects. As we have shown, in an already complex field, additional logics can lead to an exponential growth of conflicts among logics. Other studies have already noted that the number of logics in a field is a key determinant of the level of complexity (Greenwood et al., 2011). However, the concept of accelerating complexity adds to this view and shows that new logics lead to disproportionate rather than proportionate growth in complexity. This shows that, in an already complex field, the arrival of just one more logic can result in far greater complexity, with several new conflicts arising at the same time. This is an important finding, first, because it points to a processual perspective on institutional complexity that is concerned with the changing nature of complexity. While other authors have characterized different types of complexity (e.g., intra-institutional or volatile complexity; Meyer and Höllerer, 2014; Raynard, 2016), our study provides an approach that centres on different types of complexity dynamics. Second, our finding reveals that institutional complexity can change with varying intensity resulting in different field settings (Buchanan et al., 2022; Micelotta et al., 2017; Zietsma et al., 2017). This is critical because it helps scholars to better understand field transition in terms of the interplay between field-level logics (McPherson and Sauder, 2013), logic relationships (Besharov and Smith, 2014; Goodrick and Reay, 2011), and dominance dynamics (Dunn and Jones, 2010; Thornton and Ocasio, 1999). Thus, we believe our work will help advance future research on institutional complexity by identifying and conceptualizing an important source of variation. Furthermore, a focus in variations of growing complexity draws research attention to more extensive field transitions, which is still an underestimated research subject (Zietsma et al., 2017).

Our second theoretical contribution is the conceptualisation of what we term constellation complexity, that is a situation with at least two complementary logic constellations in a field, where these internally harmonic clusters of logics are in conflict with each other. Building on Goodrick and Reay's (2011) work on logic constellations, we argue that constellation complexity occurs whenever there is intra-constellation complementarity and across-constellation conflict in a field. By describing the concept of constellation complexity, we especially contribute to the literatures on logic constellations (Goodrick and Reay, 2011; Jancsary et al., 2017; Sadeh and Zilber, 2019), institutional complexity (Greenwood et al., 2011; Vermeulen et al., 2016) and field transitions (Buchanan et al., 2022; Faulconbridge and Muzio, 2021; Hinings and Logue, 2017; Micelotta et al., 2017; Zietsma et al., 2017).

In our model, we describe fields using three different settings of institutional logics: institutional pluralism, institutional complexity and constellation complexity. The three different settings suggest that a field can develop from one setting to another due to new logics, more conflicts and shifting dominance. The first two settings – institutional pluralism and complexity – are discussed in detail in the literature (Greenwood et al., 2011; Kraatz and Block, 2008). Vermeulen et al. (2016) have explained that institutional pluralism is a situation shaped by 'multiple, not necessarily incompatible' (p. 278) institutional logics. In contrast, a field characterized by institutional complexity is shaped by logics that are not only multiple but also conflicting (Greenwood et al., 2011). Both concepts differ from constellation complexity, which is a novel phenomenon focusing on conflicts between logic constellations. We thus add to the constellation literature (Goodrick and Reay, 2011; Jancsary et al., 2017; Sadeh and Zilber, 2019; Waldorff et al., 2013) by pointing to the significant role of the relationships between logic constellations in a field. While not discounting the possibility of a peaceful coexistence of different constellations, our study shows the key role of conflicts between logic constellations as a source of profound changes at the field level.

The concept of constellation complexity also represents a novel specification of institutional complexity (Greenwood et al., 2011). It shows that complexity can exist both between logics and between constellations of logics. Constellation complexity is thus a higher order form of complexity that extends the focus on conflicting logics (Lounsbury, 2007; McPherson and Sauder, 2013) by supplementing it with tension between constellations of logics. Hence, constellation complexity is an important characteristic of fields and helps to better describe their nature. As Zietsma et al. (2017, p. 402) have rightly noted: 'Fields vary in their degree of institutionalisation, their evolutionary stage, and their complexity'. Regarding this, we show that there are very different forms of complexity in fields.

Furthermore, the concept of constellation complexity allows us to advance the work around fundamental questions on field transitions, such as emerging field partitioning processes (Faulconbridge and Muzio, 2021) or the demise of a field (Zietsma et al., 2017). It shows that inherently complementary constellations or 'clusters' of logics can further extend the degree of segregation (Hinings and Logue, 2017; Raynard, 2016). The notion of conflicting constellations also strengthens the argument of recent field studies that segregation in a field may lead to field partitioning (Faulconbridge and Muzio, 2021). In our case, there is, on the one hand, the traditional energy logic constellation, associated with large scale centralized fossil power plants owned by the former monopolies, and, on the other hand, there is the new energy logic constellation, associated with often small and citizen-operated decentralized renewable energies like solar panels and wind power. The conflicting constellations and highly divergent practices developed in the process of growing complexity are a sign of a field drifting apart. A field can be pluralistic or complex, but that does not call the field itself into question. However, constellation complexity leads to the question of whether the field is still one distinct field or (in the process of separating into) two fields. Faulconbridge and Muzio (2021) have recently introduced the notion of processes of field partitioning when a 'formerly established field generates a distinct subfield with its own institutional infrastructure' (2021, p. 1053). Our research adds to this discussion by arguing that constellation complexity can be an important aspect in identifying field partitioning.

Additionally, our findings suggest that field partitioning does not necessarily proceed without contestation (Faulconbridge and Muzio, 2021) but could be initiated by massive conflicts due to accelerating complexity. While constellation complexity may not inevitably lead to a fully partitioned field, it is an important factor in the field partitioning process. In this respect, we contribute to the discussion on the division of fields (Buchanan et al., 2022; Faulconbridge and Muzio, 2021; Hinings and Logue, 2017; Zietsma et al., 2017), pointing in particular to the role of conflicting logic constellations.

In conclusion, our work shows that a focus on cross-logic conflicts, as often found in empirical research, needs to be complemented with an analysis of the cross-constellation conflict dynamics. In this respect, our article analytically and theoretically demonstrates how a field-level approach that considers the entirety of logics, including their relationships and dominance, allows for a more detailed – and a more complex – analysis of fields and their inherent institutional complexity. Hence, our insights speak to recent calls to further analyse the mutual relationship between institutional complexity and field transition processes (Zietsma et al., 2017), in order to better understand how fields evolve and 'are constituted as pluralistic domains of meaning' (Lounsbury et al., 2021, pp. 272–73).

LIMITATIONS AND FUTURE RESEARCH

Our mixed-methods approach has allowed us to look longitudinally at the growth in conflicts and institutional complexity in a controversial field, yet it also has its limitations. While we used communication data, which is a common approach when studying logics (Dunn and Jones, 2010; Goodrick and Reay, 2011; Loewenstein et al., 2012; Patriotta et al., 2011; Reay and Jones, 2016), this did not permit us to directly investigate the practices related to logics (Smets et al., 2015). We have sought to compensate for this limitation by including a wide range of documents and combining general field-level data with field-level actor reports. However, we are aware that this approach is especially suitable for use in contested fields that attract a certain level of public attention. For fields that attract little attention, it may be necessary to use other data sources like personal interviews, ethnographic data, internal reports or social media data. Such an approach would also allow researchers to take a closer look at the role of actors in complexity dynamics. For example, it would be worthwhile to explore what role actors play in the emergence of conflicting constellations – for instance, by promoting regulatory shifts. Methodologically, our mixed-methods approach also has drawbacks, because it does not put all its resources into one method but combines the advantages of several methods. For example, a greater emphasis on the qualitative analysis of the relationships between practices, symbols, and rules would allow researchers to study the intensity of conflicts and how they may increase or decrease over time. This would facilitate in deeper exploration of the relationships between logics and their dynamics, but it would also require a larger sample and possibly a focus on just one relationship.

Additionally, it would be instructive to expand the macro focus and discuss conclusions for societal change processes (Thornton and Ocasio, 2008). For this purpose, it would be necessary to relate field-level logics back to the ideal type logics introduced by Friedland and Alford (1991) and Thornton et al. (2012). Although this was not the aim of our study, our results allow us to present some initial ideas about this. Like other studies (e.g., Thornton and Ocasio, 1999), we show how the market logic initiated field-level change processes. However, an even more extensive impact on the field in terms of disruption and change came from the sustainability or environmental logic. Future studies can build on this and investigate fields that are simultaneously characterized by conflicts between, for example, the professional logic, market logic and sustainability logic. Thus, notwithstanding several limitations, our study shows the value of using a dynamic complexity perspective that accounts for a growing number of logics and cascades of conflicts to better understand field transition processes. This perspective opens further avenues for future research.

Specifically, we need more theoretical and empirical studies on constellation complexity, for instance, on the question of how the conflict between constellations may ultimately lead to field partitioning. Furthermore, our study raises new questions about the long-term impact of constellation complexity that would also be relevant to those interested in grand challenges and sustainability transitions (see e.g., Ferraro et al., 2015; George et al., 2016; Gümüsay et al., 2020), as the development of opposing logic constellations may be a barrier to the diffusion of specific institutional logics. Regarding the example of the sustainability logic, constellation complexity suggests that although one part of a field may be focused on sustainability issues, the other part may still be deeply embedded in traditional (and often rather unsustainable) practices. Additionally, due to organizational responses, such as demergers, the traditional businesses may have had to engage little with new logics. However, it remains to be seen whether this will lead to a greater retention of unsustainable practices in the long run, thereby slowing the transition process. A possible counterargument is that the emergence of a sustainability-oriented constellation may facilitate the emergence of more sustainable businesses because they can develop in a protected space. Other research has shown that, in unsustainable contexts, even sustainability-oriented organizations are often not able to work sustainably, because of long-established institutional constraints (e.g., Marti and Scherer, 2016). New field-level constellations may offer a social enclave or safe space and thus make it easier for novel organizations to emerge and develop – possibly transforming the entirety of an industry in the long run.

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NOTE

[1]Calculated with an adapted Gaussian total formula: number of logic relationships = $(n \times (n + 1))/2$; n = number of logics.

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