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The twofold transition: Framing digital innovations and incumbents' value propositions for sustainability

Karolina Bähr | **Alexander Fliaster**

Department of Innovation Management, Faculty of Social Sciences, Economics and Business Administration, University of Bamberg, Bamberg, Germany

Correspondence
Karolina Bähr, Department of Innovation Management, Faculty of Social Sciences, Economics and Business Administration, University of Bamberg, Kärntenstraße 7, 96052 Bamberg, Germany.
Email: karolina.baehr@uni-bamberg.de

Abstract

Although digital technology offers many sustainable business model opportunities, they are not always exploited. We argue that the framing of technology is still rarely considered a cognitive antecedent of business models for sustainability, despite that it offers insightful explanations, connecting technology's sustainability potential to its business model implementations. We conduct a qualitative multicase study of virtual power plants, adopted by seven incumbent companies in the German energy sector, and explore how they frame innovative digital technology, as well as how it affects their value propositions and the energy transition. Our research reveals several value proposition differences between two company groups. The first generates a single-focused technological frame, concentrating on economic value. The second constructs a twofold digital and sustainable technological frame, resulting in additional socioenvironmental value components. Overall, companies that create a twofold frame operate as renewable energy enablers or system supporters and contribute to the energy transition.

KEYWORDS
business models for sustainability, digital innovation, energy, sustainability, technological frame, value proposition

1 | INTRODUCTION

Today's societies and organizations face the fundamental evaluative, ambiguous, uncertain and highly complex challenges of sustainability (Farla et al., 2012; Ferraro et al., 2015; Markard, 2017). Transitions towards sustainability imply enacting major changes in the established sociotechnical systems to prioritize more environmentally friendly production and consumption (Markard et al., 2012). These changes are nonlinear or disruptive and span longer periods (Loorbach et al., 2017). Sustainability transitions are highly dependent on context and policy and involve interactions between technology, institutions, and the social sphere (Hölscher et al., 2018; Markard, 2017). For companies, sustainability transition challenges refer to the need to move towards completely new and more sustainable value propositions and business models (Schaltegger, Hansen, & Lüdeke-Freund, 2016). Accordingly, scholars advocate for sustainable business models that permit the creation of ecological and social value, beyond purely economic benefits (Freudenreich et al., 2020; Lüdeke-Freund, 2020). Moreover, these business models must provide value not only to the company but also beyond its organizational borders, to its stakeholders and society as a whole (Hahn et al., 2014). Overall, sustainability aims to consider both today's and tomorrow's generational interests and to foster an acceptance that our environment's natural resources and ability to

List of abbreviations/acronyms: BM, business model; BMWi, Bundesministerium für Wirtschaft und Energie; Federal Ministry for Economic Affairs and Energy 2013–2021; ES, environmental sustainability; IT, information technology; MW, megawatt; VPPs, virtual power plants.

withstand pollution are limited (World Commission on Environment and Development, 1987).

Along with these sustainability transition challenges, companies are increasingly confronted with another fundamental issue, business digitalization. Several authors offer distinct definitions of digitization, digitalization, business digitalization, and digital transformation (Bharadwaj et al., 2013; Nambisan et al., 2017; Ritter & Pedersen, 2020). In this study, we define digitalization at the organizational level as the adoption of new digital technologies intended to enable new market offerings, business processes or business models (Brennen & Kreiss, 2016; Gregori & Holzmann, 2020; Nambisan et al., 2017). Past research provides substantial empirical evidence that companies deliberately deploy new digital technologies, such as social media, big data analytics or digital platforms, to achieve 'major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)' (Fitzgerald et al., 2013, p. 2). In simpler terms, scholars argue that business digitalization can increase a firm's internal efficiency and organizational growth by adding value to customers (Björkdahl, 2020).

While one main objective of business digitalization is to create economic value, sustainable business models enabled by digital technologies also aim for higher ecological and social value. Thus, while the challenges of digitalization and sustainability transitions are likely to be strategically relevant for the vast majority of industry sectors, they play a particularly decisive role for energy companies (Flaherty et al., 2019; Kolloch & Golker, 2016). Startups and established companies each make a unique contribution to the energy transition (Palmié et al., 2021; Schaltegger & Hansen, 2017). According to Palmié et al. (2021), incumbents excel at testing capital-intensive and complex business models, while startups, in particular, create business models that are characterized by a high ecological orientation, digital capabilities and a strong customer focus. In some industries, this business model innovation enables market players to initiate the sustainability transition, while in others, such as energy, the support of political and institutional players is essential (Schaltegger & Hansen, 2017). For instance, the German 'Energiewende' ('energy transition') policy explicitly strives to reduce greenhouse gas emissions, boost energy efficiency and enhance renewable energy (Umweltbundesamt, 2018), resulting in the energy sector's decarbonization. The changing regulation has also led to the German energy sector's decentralization (Lindberg et al., 2019), essentially transforming the competitive landscape and severely increasing competitive pressure on market players (Geels et al., 2016). This market pressure forces companies to put additional efforts into developing economically feasible solutions, such as more profitable value propositions, through digitalization (Kolloch & Golker, 2016). Furthermore, new German regulations, such as the Act on the Digitalization of the Energy Transition (BMWi, 2016), also promote energy companies' digitalization efforts. Consequently, more than three out of four energy companies in the German-speaking countries Austria, Germany and Switzerland are currently working on a digitalization strategy (Kearney, 2020), with 44% rating digitalization as their top priority (Basilio, 2020).

While research on business models for sustainability and business digitalization is burgeoning, these topics are largely disconnected in previous works, despite that companies are already facing these issues. Acknowledging this research gap, recent studies are increasingly addressing digital sustainability: the use of digital technologies for new business models that also enable social and environmental value creation (George et al., 2021; Gregori & Holzmann, 2020). These studies perceive business model innovation as a mediator between digital technologies and socioecological value creation and between sustainability innovations and business cases for sustainability (Lüdeke-Freund, 2020; Parida & Wincent, 2019). For example, *sonnen* uses software that can optimize charging and discharging processes to improve the life of batteries used to store renewable energy, and *LichtBlick* offers analyses of smart meter data to boost customers' energy efficiency (see for more information LichtBlick, 2022; sonnen Group, 2022). As such, the current study aims to contribute to this new and promising research area. From a theoretical perspective, we argue that companies' framing of underlying digital technologies is likely to affect how they support ongoing transitions to sustainability.

The energy transition builds on the belief that societies should replace fossil energy with renewable energy systems enabled, in particular, by technological innovations (Loorbach et al., 2017). An example of such technologies is virtual power plants (VPPs). VPPs virtually integrate several distributed power-generating, power-storing and power-consuming units to permit aggregation and remote control of individual units with different digital technologies (Nosratabadi et al., 2017; Othman et al., 2015). Aggregation and remote control of distributed units that use wind, solar energy or biogas help balance fluctuating power generation and grant access to more electricity markets due to minimum market entry constraints (Naval & Yusta, 2021; Nosratabadi et al., 2017; Othman et al., 2015). For example, Next Kraftwerke (n.d.) was a new entrant in 2009 and operated a VPP with more than 9500 MW and 13,000 units in 2021. In sum, VPPs unfold a huge potential to transform energy systems as they change established roles of industry incumbents (e.g., producer and consumer) by introducing new actors like citizens and their engagement in energy production.

Past research already indicates that similar organizations might interpret the same technology differently, depending on framing, which results in very different organizational actions (Edmondson, 2003; Spieth et al., 2021). Innovation studies use the framing construct at the meso level to explore vital organizational processes, such as administrative innovation implementation (Kennedy & Fiss, 2009), organizational responses to discontinuous innovations (Weber et al., 2019) and knowledge transfer interactions (van Burg et al., 2014). However, despite some notable exceptions (Hahn et al., 2014; Scrase & Ockwell, 2010), the application of cognitive frames in sustainability research, especially in sustainable business model research, is still limited and constitutes a promising avenue for research (De Giacomo & Bleischwitz, 2020; Lüdeke-Freund, 2020; Rovanto & Bask, 2021). De Giacomo and Bleischwitz (2020, p. 3362) propose in their literature review, 'to investigate the managerial cognitive dimension linked to BM [business model] for ES [environmental sustainability]', because cognition is still neglected in this literature. Additionally, Lüdeke-

Freund (2020, p. 678) concludes his 'list of barriers [to business models for sustainability innovation] is extensive but not yet conclusive. Further barriers might be added, such as cognitive effects'. To address this gap, we explore the following research questions:

- RQ1. How do incumbent companies in the German energy sector frame currently emerging digital VPP technologies?
- RQ2. Which role do digitalization and sustainability considerations play in their technological frames?
- RQ3. How do differences in incumbents' technological frames affect the design of sustainable value propositions and, as a consequence, the sustainability implications at the company and the broader societal level?

Our findings extend existing knowledge in several ways. First, we enrich the discussion on sustainable business model innovation by adding the technological frame as an important cognitive antecedent (Bocken et al., 2014). Thus, we answer the call to inform sustainability research with an established concept from organization studies (De Giacomo & Bleischwitz, 2020; Köhler et al., 2019; Lüdeke-Freund, 2020). Second, we add knowledge on the system perspective within business models for sustainability research by providing two explanations for how business models' value creation connects company- and system-level sustainability (Bidmon & Knab, 2018; Bocken et al., 2014; Sarasini & Linder, 2018; Schaltegger, Lüdeke-Freund, & Hansen, 2016). We elaborate on two crucial sustainable business model facets: considering many stakeholders and delivering a blended value (Gregori & Holzmann, 2020; Schaltegger et al., 2012). Lastly, we add insights on incumbents' role in the energy transition, as they are powerful actors whose support offers important opportunities for societal transitions to sustainability (Loorbach et al., 2010; Loorbach & Wijsman, 2013; Rovanto & Bask, 2021; Schaltegger, Lüdeke-Freund, & Hansen, 2016).

Primarily, we discuss technological framing and its relevance in sustainable business model research. Subsequently, we describe our data collection and analysis, followed by our empirical findings. In particular, we reveal that companies that create a twofold, digital and sustainable technology frame contribute to sustainability transitions beyond their organizational borders, operating as renewable energy enablers or system supporters. Finally, we highlight our managerial implications. For instance, we argue that influential incumbents should adopt potential sustainable technologies and that their communication strategy should encourage important sustainability-oriented stakeholders, such as green prosumers, to adopt digital technology to further promote society's sustainability transitions. The paper concludes with our limitations and suggestions for future research.

2 | SUSTAINABLE VALUE CREATION AND THE TECHNOLOGICAL FRAME CONSTRUCT

To create our theoretical framework, we respond to several sustainability scholars' recent calls for applying concepts from organizational studies to transition-related research questions (Köhler et al., 2019). One of the most influential theoretical constructs in management and organization theory is framing (Cornelissen & Werner, 2014). First applied to explore managerial cognition, and individuals' sense-making and decision making in organizations (Weick, 1995), framing has since expanded from the micro to the meso analysis level (Cornelissen & Werner, 2014; Maitlis & Christianson, 2014). Generally, framing helps us understand how organizations interpret information and how these interpretations guide organizational decisions and activities to adopt innovations and initiate organizational change (Edmondson, 2003; Kennedy & Fiss, 2009; van Burg et al., 2014; Weber et al., 2019).

Past research reveals that framing helps actors deal with high uncertainty situations, stemming from ambiguous or missing information (van Burg et al., 2014). Thus, framing is likely to be relevant in the process of adopting new digital technologies associated with both high technological and market uncertainty (Nambisan et al., 2017; Yoo et al., 2012). We believe that the framing of those technologies is also important in the context of sustainability transitions, in which 'the potential solutions and outcomes are not well-understood, societal preferences unclear and/or diverse, and political processes and techno-economic developments often unpredictable' (Markard, 2018, p. 628). In this context, technological framing should help organizations link novel digital technologies to broader societal discourses and design and articulate new visions concerning potentially sustainable innovations (Gish & Clausen, 2013). Hence, drawing on previous studies (Edmondson, 2003; Kennedy & Fiss, 2009), we argue that organizational actors' technological framing will guide their specific application patterns, such as new digital technologies' sustainability-oriented value propositions.

To address technological frames, we refer to Orlikowski and Gash (1994), who identify three broad domains: the nature of technology, technology strategy and technology in use. Several studies address these key domains (Olesen, 2014), providing empirical evidence that the domains 'are a useful starting point for examining key actors' interpretations of technology, and the nature and extent of differences among them' (Orlikowski & Gash, 1994, p. 204). The first domain, the nature of technology, involves the innovator's 'understanding of its capabilities and functionalities' (Orlikowski & Gash, 1994, p. 183), or features and uses (Davidson, 2002), and can be linked to the question, 'What is it?' (Saarikko et al., 2020). The second domain, technology strategy, captures innovators' 'views of why their organization acquired and implemented the technology' and denotes 'the motivation or vision behind the adoption decision and its potential value to the organization' (Orlikowski & Gash, 1994, p. 183). Additionally, it includes standards for judging the success of technology adoption and answers the question, 'Why should it be used?' (Davidson, 2002; Saarikko et al., 2020). Particularly, this domain gains significance when organizations begin to use these technologies and public discourses translate into specific organizational contexts (Linderoth & Pellegrino, 2005). Finally, the technology in use domain entails innovators' 'understanding of how the technology will be used on a day-to-day basis and the likely or actual conditions and consequences associated with such use' (Orlikowski & Gash, 1994, p. 183), referring to the question 'How is it used?' (Saarikko et al., 2020).

Previous studies reveal that technological frames are dynamic, as a contextual change can trigger organizations to reinterpret existing information and gain new insights (Davidson, 2002). Accordingly, the German energy sector is currently undergoing substantial changes, due to digitalization, deregulation, and decarbonization. This changing context may open up fresh opportunities to adapt and modify technological frames (Davidson, 2006), reflecting the growing awareness of sustainability issues. Hence, we expect energy companies to conduct business activities that use digital innovations to create economic value and solve ecological or social problems (Freudenreich et al., 2020; Lüdeke-Freund, 2020). These business activities can be embedded into novel business models that follow a 'rationale which positions sustainability as an integral part of the company's value proposition and value creation logic' (Schaltegger et al., 2012, p. 102).

Recent research also reveals that value creation and the resulting value propositions are central to business models in general and sustainable business models in particular (De Giacomo & Bleischwitz, 2020; Eyring et al., 2011; Geissdoerfer et al., 2018; Schaltegger, Hansen, & Lüdeke-Freund, 2016). To address sustainable value creation enabled by digital technologies, we refer to the business model paradigm (Amit & Zott, 2001), specifically to business models that combine value creation and capturing (Chesbrough, 2007). Despite the ongoing debate on business model concept definitions, the consensus on some central functions is growing (Zott et al., 2011). First, the business model describes value creation for all stakeholders, not just the focal firm's value capture logic. Second, it considers third-party activities, such as suppliers or customers. Third, it explains business logic at the system level and constitutes a new perspective for analysing organizations (Zott et al., 2011). Overall, business model innovation creates new business models through experimentation and exploration (Afuah, 2014; Chesbrough, 2010; Foss & Saebi, 2017).

We must also briefly address business cases of sustainability, as business model innovations may result in different business cases, depending on the corporate sustainability strategy (Schaltegger et al., 2012, 2019). Nonetheless, repetitive reproductions of single event-driven business cases can create business models for sustainability (Schaltegger et al., 2012). The literature discusses several different business cases in the context of sustainability (Schaltegger et al., 2012, 2019; Schaltegger & Burritt, 2018). For instance, Schaltegger et al. (2012) differentiate between regular business cases, business cases of sustainability and business cases for sustainability. According to the authors, business cases of sustainability create economic profit while companies consider social and environmental issues, whereas business cases for sustainability entail 'voluntary activity with the intention to contribute to the solution of societal or environmental problems', (p. 98) which must involve executive action and result in positive business effects. More recently, Schaltegger and Burritt (2018) introduce four business cases, depending on managers' ethical motivations for sustainability activities. Moreover, by integrating stakeholder theory, we can add other business cases, pertaining to stakeholder management and sustainability (Schaltegger et al., 2019). The commonality in all these concepts is that they differentiate between business cases' initial purpose, beneficiaries and sustainability roles (Schaltegger et al., 2012, 2019; Schaltegger & Burritt, 2018). Similarly, the technological frame addresses the purpose and benefits of technology adoption (Davidson, 2002; Orlikowski & Gash, 1994; Saarikko et al., 2020). These similarities constitute an excellent point of departure for the following ideas.

Recent studies argue that three essential features characterize corporate sustainable business models: (1) creating value beyond economic benefits, involving ecological and social value components; (2) systematically recognizing the interests of and creating monetary/non-monetary value for multiple stakeholders, not only for themselves, their customers and shareholders; and (3) addressing several stakeholders' individual demands, while contributing to societal welfare (e.g., communities) (Bocken et al., 2014; Evans et al., 2017; Freudenreich et al., 2020; Hahn et al., 2014; Lüdeke-Freund, 2020; Schaltegger, Hansen, & Lüdeke-Freund, 2016). However, others present a more nuanced view. For instance, the system perspective within sustainable business model research discusses how sustainable business model innovation can support sustainability transitions at the system level, such as the business environment, regulations or institutions (Bocken et al., 2014; Schaltegger & Wagner, 2011). Accordingly, Rovanto and Bask (2021) show that incumbents can support societal transitions through their influence on suppliers. Incumbents can also support industry sustainability if they replicate the sustainable business models of more sustainable entrants or commercialize their new technologies (Bidmon & Knab, 2018; Schaltegger, Lüdeke-Freund, & Hansen, 2016), as they have superior experience and infrastructures (Richter, 2013).

The relationship between business models and technology is especially intriguing in the context of sustainability, as the same technology might have different sustainability impacts depending on the chosen business model (Sarasini & Linder, 2018). Overall, scholars argue that new digital technologies can contribute to these key sustainable business model features by supporting the creation of blended value propositions that embed several stakeholders' social, ecological and financial values (Emerson, 2003; Gregori & Holzmann, 2020). Although prior studies demonstrate the importance of technological framing for digital technology adoption, research on sustainable business models has not yet employed this cognitive perspective (De Giacomo & Bleischwitz, 2020; Lüdeke-Freund, 2020). This cognitive perspective adds important insights as it helps to understand additional barriers to sustainability innovations and is essential to overcome these barriers. Thus, we empirically address this important gap by exploring how digital technological frames lead to more sustainable value propositions and contribute to sustainability transitions beyond organizational borders.

3 | DATA COLLECTION AND ANALYSIS

The multicase study methodology appears particularly useful for understanding complex phenomena, such as technological framing during sustainability transitions (Cunningham et al., 2017; Geels, 2002; Gregori & Holzmann, 2020; Yin, 2017). As it builds on constant case comparisons (Bansal et al., 2018), this methodology helps strengthen the reliability of emerging theoretical arguments.

Concerning data collection, we focused on incumbent companies, taking a cue from prior studies that identify incumbents' contributions to the promotion of renewable technologies as one of the central and underexplored themes in sustainability transitions, especially in the energy sector (Markard, 2017). Thus, we collected and analysed data on incumbents in the German energy sector that adopted VPP technology. Innovative digital service platforms (Midttun & Piccini, 2017), such as VPPs, allow for the integration of several renewable and decentralized power-generating units (Nosratabadi et al., 2017). The VPPs have recently attracted the attention of key actors, resulting in creative efforts to collaboratively explore new business models and address the challenges of weak profitability (Breuer & Lüdeke-Freund, 2017; Richter, 2013).

The VPPs contain several features that make them particularly suitable for our research objectives with regard to energy transition. For instance, they integrate especially renewable power-generating units, such as photovoltaics, wind turbines, hydro turbines and biogas. More advanced VPPs also embed power-generating unit and energy storage tool controllability, such as batteries, pumped storage or electric vehicles (Kasaei et al., 2017; Nosratabadi et al., 2017). As VPPs make decentralized, renewable power-generating units visible to system participants, they help avoid overcapacity and resource underutilization (Pudjianto et al., 2007).

Aggregation and controllability are particularly critical, due to renewable energy sources' high volatility: a VPP aggregator controls and manages the entire VPP system by load dispatching, selling and purchasing energy to and from the energy market, while also considering diverse data sources, such as weather, operating cost and forecast data (Nosratabadi et al., 2017). Furthermore, VPPs not only rely on the activities of different industry actors, such as energy producers, software and hardware developers and marketer service providers, but also transform key components of the ecosystem (e.g., the actors and their business relationships). Within the VPP ecosystem, many energy customers play a dual role, serving as both electricity consumers and producers (prosumers) (Dellermann et al., 2017). As those ecosystem changes will have profound consequences on different sectors, sustainability scholars have recently called for more research on platform technologies, including VPPs (Markard, 2018).

In this study, we identified the incumbent companies as the 10 biggest energy firms and 20 biggest municipal utilities in Germany. We conducted desk research and scanned publicly available information to determine which incumbents engage in VPP projects. As we could not obtain any information on VPP engagement for eight of the incumbents, we excluded them, as well as the incumbents that publicly reported using technologies developed by other incumbents that were already part of our case selection. Then, we contacted 78 middle managers and employees from 10 incumbents. From these, 53 did not respond, 12 answered our request, but were unwilling to participate, and one person agreed to have an informal exchange, but did not grant us permission to be cited. Thus, we were able to obtain 12 semi-structured formal interviews with respondents from seven incumbent companies (total interview duration 12.5 h, see Appendix A).

All informants were or are still directly involved in projects related to VPPs and can be considered knowledgeable agents (Gioia et al., 2013). This is particularly advantageous for our explorative study on technological framing and sustainability, because as previous research demonstrates, middle managers and employees offer valuable insights for analysing potentially radical changes (Jarzabkowski et al., 2019; Lassen et al., 2009). The interviews took place in person, via phone or video conference, following the interviewee's preferences, and all were recorded and transcribed with the interviewee's consent. The transcripts totalled 91,600 words on 234 pages.

We asked the interviewees to define VPPs, explain how their company uses them and describe what kind of value these VPPs have created for their company, customers and other constituencies. In this process, we followed the best practices for interview design (Rowley, 2012) and rigorous qualitative data collection and analysis in general (Gioia et al., 2013; Rheinhardt et al., 2017). For example, we returned to interviewees if new questions emerged during data analysis and flexibly adjusted our interview process to react to their answers. We also deployed additional sources to obtain information on the companies and their VPPs. Similar to other qualitative studies (Nag et al., 2007; Nag & Gioia, 2012), we collected and analysed publicly available corporate data (see Appendix B). Specifically, we studied 36 press releases and 47 annual reports covering VPPs, as well as archival data published in business magazines and newspapers (e.g., *Handelsblatt*), and energy industry journals (e.g., *Zeitschrift für Energiewirtschaft*). We used this additional information to develop a deeper understanding of the industry context and its current dynamics.

We took several additional steps to ensure that our data met Lincoln and Guba's (1985) seminal criteria for trustworthiness, which are particularly important for qualitative research designs. For instance, both authors were involved in the data analysis to ensure that the findings did not solely rely on a single analyst's interpretations. Following Gioia et al.'s (2013) recommendations, we also read the interview data several times and engaged in mutual discussions to achieve agreements. Moreover, we also gained outsider perspectives by discussing emerging insights with four other industry experts, who work in the energy sector, but are not directly involved in the studied VPP projects, and with several other sustainability and digitalization scholars during two international research conferences (Corley & Gioia, 2004).

We used MAXQDA® Plus 2020 to code the interview data, specifically applying inductive open coding to identify central topics from an informant's perspective and allow insights to emerge (Corley & Gioia, 2004). We searched for important issues to grasp what is occurring and highlighted the corresponding interview text passages, which resulted in informant-centric central concepts (Thornberg & Charmaz, 2014). We clustered similar concepts to form first-order categories and assembled them into second-order themes, based on theoretical considerations (Gioia et al., 2013; Nag et al., 2007; Nag & Gioia, 2012). In this second-order analysis, we considered whether the emerging theoretically distinctive themes can better explain the companies' different technological frames and value propositions (Gioia et al., 2013).

The data analysis consisted of several rounds. We went back and forth between the interview data and theoretical concepts, refining our framework based on accumulated evidence. Connecting emergent facets to previous technology framing literature, we concluded that several first-order categories could be optimally clustered into Orlikowski and Gash's (1994) three frame dimensions, while the other nine second-order themes emerged directly from the aggregation of informant-based first-order codes. In the final step, we further

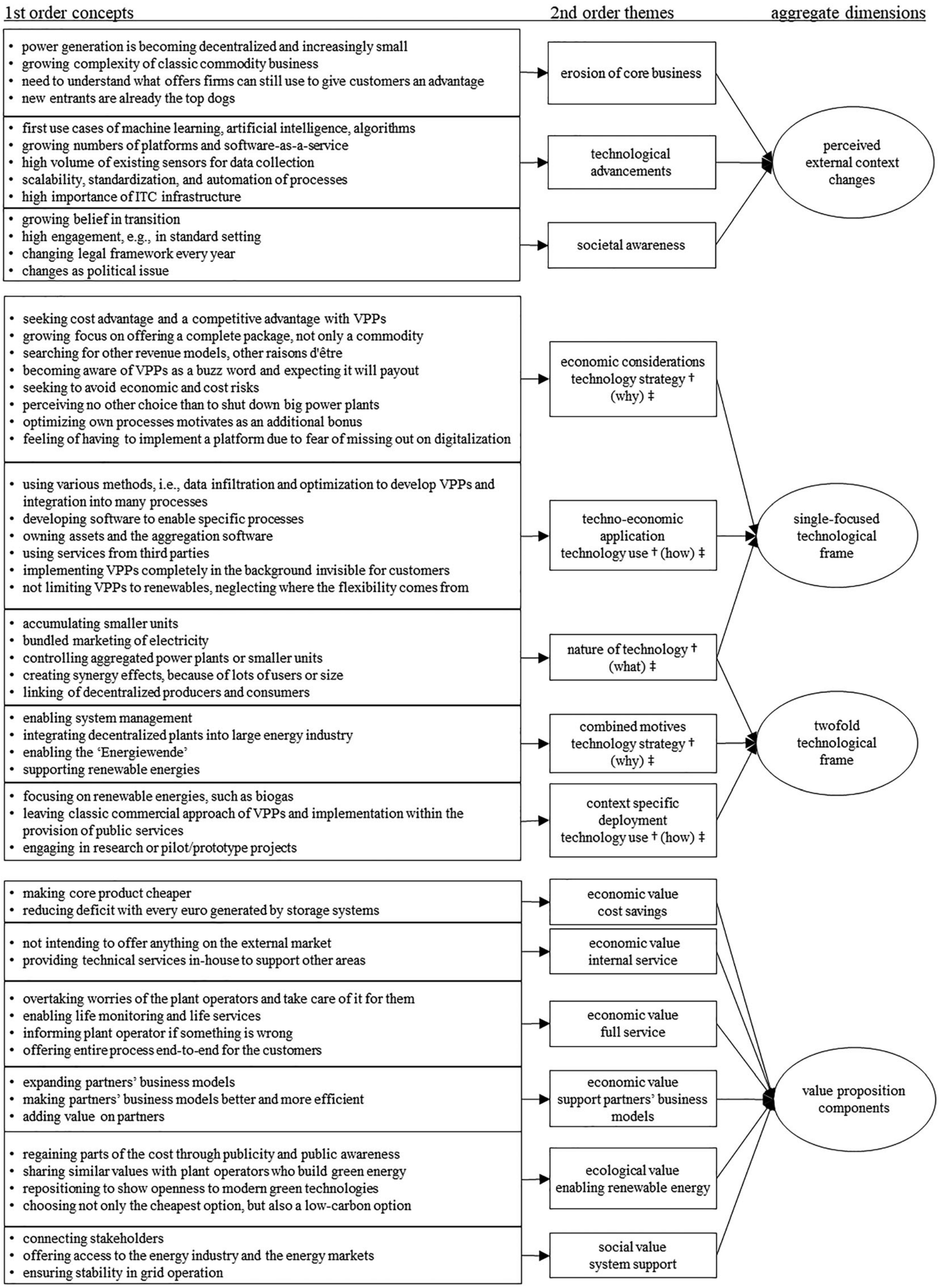

FIGURE 1 Data structure. †Emergent first-order categories are further clustered into nature of technology, technology strategy and technology use, referring to Orlikowski and Gash (1994) suggested concepts. ‡The questions 'what', 'how' and 'why' originate from Saarikko et al. (2020)

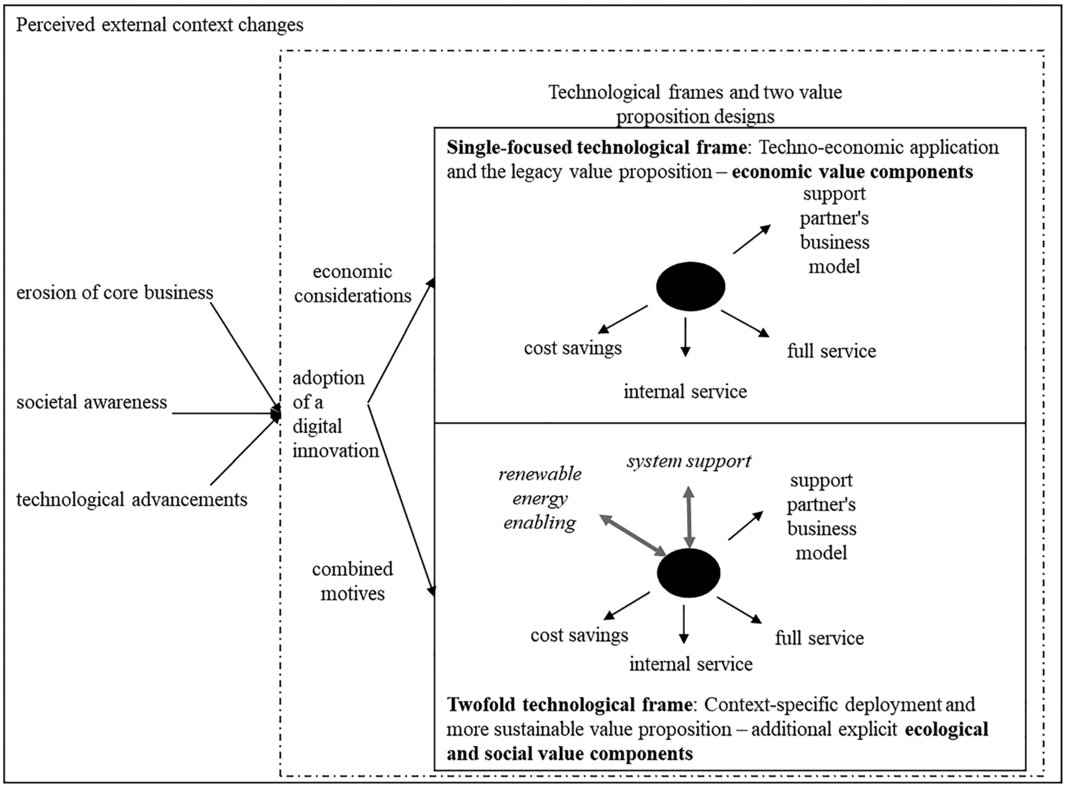

FIGURE 2 Resulting model of single-focused versus twofold technological frames: Incumbent companies value propositions

consolidated the second-order themes, eventually building four overarching dimensions shown on the right-hand side of Figure 1 (Corley & Gioia, 2004; Gioia et al., 2013). Our constant comparisons between codes, themes, dimensions and cases produced insights into the value propositions resulting from VPPs' technological framing in the face of the twofold energy transition. Figure 2 presents the resulting model.

4 | FINDINGS

Altogether, context is important for understanding technological frames and value proposition designs, as it shapes the environment in which they emerge (Thomas et al., 1993; Weick, 1995). Thus, our analysis allows us to conclude that the perception of contextual changes comprises three distinct themes: erosion of core business, technological advancements and the societal awareness. First, changes in the competitive landscape result in the erosion of the traditional core business, stemming from the decentralization of energy production. The business model of operating large power plants is disappearing (Interviewee 8), the ongoing commoditization of energy is perceived as a considerable challenge (Interviewee 7) and the emergence of new competitors is perturbing the industry (Interviewee 2). In fact, some customers quit and re-emerge as competitors (Interviewee 5). Overall, the new competitors demonstrate how to use VPPs to generate profits (Interviewee 11) and challenge established players to compete with lower prices (Interviewee 1).

Second, the technological advancements are growing in importance in the energy industry, with the emergence of artificial intelligence, cloud-based services and big data (Interviewee 2). These digital technologies enable the automation of processes (Interviewee 9), by integrating existing sensors for data collection (Interviewee 11). Similarly, Interviewee 6 explains that the management of minor decentralized power-generating units necessitates more digital technology implementation. Additionally, the existing digital infrastructure either enables or limits the opportunities stemming from small decentralized units (Interviewee 8).

Third, there seems to be a high societal awareness and acceptance of Germany's energy transition (Interviewee 4). Although the interviewees believe that the energy transition can work (e.g., Interviewee 4, Interviewee 8, Interviewee 11), many stress that the energy transition's design is dependent on regulation (e.g., Interviewees 1, 5 and 7). In other words, many actors, such as proactive customers (Interviewee 9) or standard-setting associations (Interviewee 4), support the energy transition, but the challenge lies in regulation, due to its imperfect (Interviewee 11) and fast-changing nature (Interviewee 3). In sum, the findings highlight how the energy companies perceive the energy transition and help us to contextualize their technological frames. Additionally, their perception supports our perspective that VPPs and the energy industry are a suitable case to study technological framing during sustainability transitions.

On the one hand, our data analysis reveals that all energy incumbents share a similar understanding of the first technological frame domain (the nature of technology) and stress the same fundamental issues: the virtual integration of small, decentralized power-generating units, the potential to include storage units and the active management of energy flows and market access. On the other hand, we find substantial differences between the incumbents regarding the two other domains (technology strategy and technology in use). Overall, the companies have two different patterns of framing VPP technology, leading to two different ways of designing value propositions and contributing to sustainability transitions.

4.1 | The single-focused technological frame: VPP's sole focus on business digitalization

The first group of incumbent companies primarily emphasizes the technological aspects of adopting VPPs, such as automation and modifying existing organizational IT systems, and focuses on the economic benefits of technology adoption, such as operational efficiency. Even when they strive to attract new customers, owing to increased digital capabilities, these companies adhere to their existing customer value propositions that were in place before using VPPs, which we refer to it as their 'legacy' value propositions (upper rectangle, Figure 2).

Economic considerations and strong market-pressure perceptions characterize the technology strategy domain of incumbents with a single-focused frame. For instance, Interviewee 1 explains: 'It is important to offer not only a commodity, but also a complete package, even though we are by far not the only one who can do this'. Similarly, Interviewee 8 declares: 'We need other revenue models, other raisons d'être, and of course, the topic of VPP came up as a buzz word'. Furthermore, perceived market pressures and sense of urgency lead to prioritizing economic goals. As Interviewee 4 states, VPPs make it possible 'to grant small units grid access and if necessary, to avoid economic risks. Balancing energy and avoiding cost risks, these are the objectives'. The ongoing commoditization trend drives incumbents to invest in innovative technologies to optimize their product/services portfolio (Interviewee 3) and target efficiency through digitalization, automation, and better process management (Interviewee 11). In this context, Interviewee 11 expresses digitalization's importance for competition in the energy industry: 'Everyone felt they had to have a platform, otherwise they would miss out on digitalization'.

Regarding the technology use domain, we find that synced technological and economic considerations also dominate the ways in which these companies adopt VPPs. For instance, Interviewee 8 explains: 'From the very beginning, we focused on small assets when we built our platform, both on the IT side and product side'. These techno-economic application facets outshine VPP sustainability. As Interviewee 1 notes: 'It's not just about renewables, it does not matter where the flexibility comes from'.

Our data analysis reveals that legacy value propositions, which focus solely on economic value, consist of four main components (see Figure 2). The first component, cost savings, centres on making the provided services more affordable for the customer and/or more profitable for the incumbent company. The VPP plays a limited and subordinate role, mainly supporting the legacy business model by adding flexibilities in the operations of heating or storage systems. The second component, internal service, means that the legacy business model's external customers obtain no economic benefits. Instead, the unit that operates a VPP creates economic advantages for other internal units of the same incumbent company. This internal service can be the first step in testing the value proposition that can then be scaled up. However, several incumbent companies do not currently plan to scale up their VPP operations, focusing solely on internal processes and services. The third component, full service, involves very intense customer service, as companies can use their existing knowledge and competencies in the energy business to organize end-to-end processes for their customers. The fourth component is to support partners' business models, entailing a strong external service orientation that is not limited to VPP processes. The services are bundled on digital platforms that enable partners to extend their business models by integrating third-party services.

In sum, the value proposition of incumbents with a single-focused technological frame is built around creating economic value for the focal company and its customers. For instance, Interviewee 3 summarizes: 'At the end of the day, for us, it was a purely monetary issue, so we had financial expectations. For customers, the plant operator […], their role in the VPP is profit maximization'. This sole focus on economic benefits also dominates the value propositions that companies with a single-focused technological frame offer to stakeholders other than customers. As Interviewee 8 notes: 'Yes, the added values can vary depending on the stakeholder. However, at the end of the day, it is usually about automation, reducing process costs, reducing complexity […], and expanding individual business models'.

4.2 | The twofold technological frame: VPPs as digital and sustainable technology

For the second group of energy incumbents, VPP adoption is a digital innovation that contributes to economic objectives and is an essential shift towards sustainability resulting in combined motives. For some, the shift towards renewable energy has been 'a very digital topic from the start' (Interviewee 2). Specifically, regarding the technology strategy, Interviewee 2 notes:

> The purpose is making the whole thing manageable, reasonably integrating decentralized plants into the large energy industry, and enabling Germany's *Energiewende*. It is a very ambitious goal to offensively expand renewable energies. Within my company, this goal is on every poster, in every office, and in every meeting room. The strategy is communicated very strongly here and to the outside world.

The twofold frame's technology use domain mainly addresses context-specific deployment decisions that are in sync with the technology strategy mentioned above. For example, Interviewee 2 explains that VPP activities occur outside the purely profit-oriented business field. The company sees them as a 'general public service', because granting citizens access to basic energy supplies is an important responsibility of municipal utilities. Other respondents mention the opportunity to 'balance small generation plants in the region' (Interviewee 6) and 'respond very individually to a plant's needs' by switching it off and on remotely, depending on its particular requirements (Interviewee 5).

Within this group, our analysis identifies two subcategories (lower rectangle, Figure 2). The first involves renewable energy enablers, who explicitly state that they aim to promote the energy transition at the societal level (Interviewee 2) and perceive themselves as pioneers in this process (Interviewee 5). Some of these incumbents declare contributing to a sustainability business model that acknowledges the natural environment as a salient stakeholder (Haigh & Griffiths, 2009; Stubbs & Cocklin, 2008). In addition, these companies feel connected to their customers, due to shared green values, and particularly appreciate lead users' contributions to the energy transition (e.g., prosumers) (Dellermann et al., 2017). As these incumbents recognize that their stakeholders have both economic and ecological concerns, they strive to extend their value propositions by blending economic and ecological values. For instance, Interviewee 6 observes: 'The generation plant itself is usually ecologically motivated. In the second step, there is the issue of integration into a VPP to generate additional revenues for this plant'. Interviewee 2 also explains: 'We are, of course, very close to the plant operators who produce green energy. This means that we work together and can also score very well with our green image'.

The second group involves system supporters, who particularly stress the importance of regional embeddedness and frame the VPP as a means to decentralize renewable power. In this 'new energy world' (Interviewee 9), the innovative digital infrastructure helps balance the fluctuating supply and demand of renewable energy by coordinating among a large number of small and diverse energy producers and consumers. System supporters also serve as enablers of further technological advancements in the area of e-mobility. As Interviewee 2 states, this is where 'we take over the control of the charging points in our VPP'. From a societal perspective, system supporters establish measures to sustain distribution and transmission grid stability by regulating plants and balancing energy production and consumption at the regional level. In other words, being a system supporter also implies that these incumbents target sustainable value creation for a multitude of stakeholders, including societal ones (e.g., communities) (Schaltegger et al., 2019).

Furthermore, our data indicate that the impact of these two additional value components is not just additive but also transformational (Stubbs & Cocklin, 2008). However, this may also change the roles of the four legacy components mentioned above. Not only are incumbents with the twofold frame likely to introduce sustainability or hybrid goals (Alberti & Varon Garrido, 2017), but they also install new sustainable decision-making criteria for business development, resulting in a conscious abandonment of market opportunities when the latter do not meet firms' self-imposed sustainability standards. In sum, our data analysis shows that creating these two additional value proposition components shifts the economic perspective of business digitalization towards a more sustainable value proposition for energy incumbents and their stakeholders, and contributes to sustainability transitions at the societal level. For instance, Interviewee 7 explains:

> In our grid region, we increasingly have to deal with challenging situations, with grid bottlenecks for example. As a result, feed-in management becomes too expensive for everyone from a societal perspective. Therefore, we consider the entire system to be advantageous if we can offer a means to regionally balance this. This is already inherent in a VPP to some extent.

Eventually, this broader perspective redefines value creation towards sustainability, because 'the lower economic benefit is compensated or outweighed by the second benefit of supporting the new energy world' (Interviewee 9).

5 | DISCUSSION

Our study reveals several differences between energy companies with single-focused and twofold technological frames that are related to their value definitions, the constituencies they consider relevant for the specific value they deliver and the technology frame domains that probably cause these differences.

5.1 | Incumbent companies' development of sustainable business models

Overall, the differences related to both value propositions and relevant constituencies highlight the particular ways incumbents in the energy industry strive to build sustainable business models (Freudenreich et al., 2020; Schaltegger, Hansen, & Lüdeke-Freund, 2016; Stubbs & Cocklin, 2008). Companies with a single-focused frame target economic value and as a result, implement VPPs as a typical business digitalization project (Fitzgerald et al., 2013; Ritter & Pedersen, 2020). Incumbents with a twofold frame strive to generate a blended value proposition (Emerson, 2003; Gregori & Holzmann, 2020), integrating economic, social and environmental components. They believe that customers or prosumers, such as farmers who own biogas plants, are not only interested in economic benefits, but also in the supply and demand of green energy.

Moreover, this shift towards more sustainable value propositions is associated with a broader definition of the constituencies energy companies target as value recipients (Schaltegger et al., 2019). Companies with a single-focused technology frame generate economic value, especially for themselves, their customers and customers' business partners. This can include banks that finance plant owners' investments in new technologies. On the contrary, as argued in previous studies, sustainable business models aim to deliver value to a broader set of stakeholders (Freudenreich et al., 2020; Lüdeke-

Freund, 2020). These findings elucidate two different sustainability facets: (1) companies consider stakeholders' interests more holistically, involving social and environmental concerns that exceed mere economic interests, and deliver a more sustainable, blended value (Evans et al., 2017; Hörisch et al., 2014; Lüdeke-Freund, 2020); and (2) incumbents consider a broader range of constituencies as value recipients, not only their primary stakeholders (e.g., owners and customers) (Hörisch et al., 2014). Therefore, we argue that combining these two dimensions supports the creation of sustainable business models and fosters their contribution to sustainability transitions.

Finally, sustainability scholars argue that a key constituency associated with sustainable business models is societal stakeholders particularly interested in social and environmental value (Freudenreich et al., 2020). Previous studies indicate that beyond considering individual stakeholders' interests, sustainable business models encompass the system's perspective, as companies and their stakeholders are a part of this system (Stubbs & Cocklin, 2008). For instance, Bidmon and Knab (2018) argue that business models mediate technological niche innovations and established regimes. Our findings provide insights into several pathways that sustainable business models can use to build around VPPs' potential sustainable technology. We argue that energy companies that integrate broader societal stakes within their value propositions, such as system supporters, contribute to system-level sustainability beyond their organizational boundaries by creating value propositions that support stable electric power supplies in entire regions. These companies collaborate with important stakeholders, such as prosumers (Stubbs & Cocklin, 2008). Hence, they also encourage the transformation of prosumers' attitudes towards sustainability. Accordingly, sustainability scholars theorize that to facilitate both firm-level and system-level sustainability, cultural changes, such as more sustainable customer attitudes, are necessary (Stubbs & Cocklin, 2008).

Our study also highlights industry incumbents' roles in sustainability transitions. Innovation research frequently portrays incumbents as resistors who frame innovation as a threat and try to delegitimize innovators (Christensen et al., 2015; Weber et al., 2019). Scholars also perceive incumbents' struggle as a critical issue for sustainability and believe they are slowing down the energy transition (Markard, 2018). However, sustainability researchers are increasingly questioning these portrayals (Köhler et al., 2019), with some claiming that incumbents can support sustainability transitions by using their influence on other industry actors and diffusing business models (Bidmon & Knab, 2018; Rovanto & Bask, 2021; Schaltegger, Hansen, & Lüdeke-Freund, 2016). Our work also contributes to this different perspective, because we reveal how the same technology can influence sustainability transitions in different ways, depending on technological frames and the resulting value propositions. For example, incumbent companies with a single-focused frame, with digital and economic orientations, contribute to technology diffusion, but their value propositions represent a business case of sustainability instead of a business case for sustainability (Schaltegger et al., 2012), due to their focus on customers' economic benefits. Specifically, we identify two incumbent company groups in the energy sector (renewable energy enablers and system supporters), who actively promote innovative digital technologies and foster sustainability transitions in several ways. In sum, our findings reveal three ways energy firms can build such models: (1) companies provide economic and blended values, (2) they provide value to many stakeholders and (3) they meet individual stakeholders' particular demands, while contributing to societal welfare.

5.2 | The relationship between technological frames, value creation and sustainability

We found that how companies frame emerging digital technologies, such as VPPs, shapes business digitalization strategies at the firm level and firms' contributions to sustainability transitions, beyond their organizational borders. Scholars are already integrating framing, cognition and sense-making to contemplate sustainability issues (Hahn et al., 2014; Weick, 1995). For instance, within the fields of global health and indoor air pollution, they highlight frames' powerful role in tackling sustainability impasses (Jerneck & Olsson, 2011). Our findings in the energy sector provide further empirical evidence supporting the notion that different frames generate 'different sets of key questions, understandings and actions' (Jerneck & Olsson, 2011, p. 263). We particularly show that energy companies' sustainability strategies, drawing on the twofold technology frame, include configurating new value propositions.

Moreover, we find that the technology frame's three domains probably play different roles in value propositions and sustainability (Davidson, 2002; Orlikowski & Gash, 1994). Concerning the nature of technology, all incumbent companies in our study share similar views on the functionalities of VPPs. However, crucial differences emerge in the technology strategy and technology use domains. Thus, we conclude that mere knowledge about the functionalities of technology and its sustainability potential is not enough to create value propositions that release this potential, as the primary driver of sustainability seems to lie in technology strategy. As the latter entails the vision behind technology adoption and performance indicators, it is probably closely linked to an organization's purpose (Davidson, 2002; Evans et al., 2017; Hörisch et al., 2014; Orlikowski & Gash, 1994).

Finally, previous studies on cognitive frames and adopting innovations frequently define framing as issue interpretations in categories, such as gain opportunities versus potential losses (Kennedy & Fiss, 2009; van Burg et al., 2014). However, our research indicates that framing innovative technologies is more complex. Sophisticated technological innovations, especially digital technologies, involve flexible affordances that make them potentially useful in different contexts and for different purposes, such as sustainability transitions (Yoo et al., 2012). Therefore, we argue that technological framing in today's organizations includes perceiving and interpreting the nature of technology and creating new value propositions and stakeholder relationships (technology strategy and use).

6 | CONCLUSIONS

In several industries, companies must address the challenges of sustainability transitions and digitalization, especially those within the energy sector, which plays a fundamental role in the economy and society (Flaherty et al., 2019; Kolloch & Golker, 2016). Although previous research disconnected digital innovations and sustainable business models, recent scholars are increasingly integrating them (George et al., 2021; Gregori & Holzmann, 2020; Parida & Wincent, 2019). In our qualitative multicase study, we explore how incumbent companies in the energy sector frame new digital technology, promote business digitalization and contribute to sustainability transitions beyond their organizational boundaries. Particularly, we find that different technology frames lead to different value propositions and contributions to sustainability transitions. While renewable energy enablers contribute by only operating with green electricity, system supporters sustain distribution and transmission grid stability by balancing energy production and consumption in their regional environment. Our findings extend existing knowledge in several ways. We introduce the technological frame as a crucial cognitive antecedent of sustainable business model innovation. We also add empirical knowledge to sustainability research by considering the system perspective within business models. Overall, our empirical insights contribute to a better understanding of incumbents' supportive role in sustainability transitions.

Additionally, these findings have managerial implications. First, as all companies in our sample are business organizations that must compete in the energy market, their value propositions must include economic values. Our empirical findings reveal several economic components in the value propositions, such as cost savings, that new digital technologies enable, while increasing efficiency and profitability. Figure 2's summary may guide managers in combining economic and non-economic value proposition components in several ways. The figure summarizes possible value proposition components and, therefore, helps managers to avoid missed opportunities for additional value creation. In other words, other energy companies can learn how pioneers adopt and deploy VPPs in an economically feasible way. Consequently, potentially sustainable VPP technology can be disseminated within the energy industry, contributing to sustainability transitions beyond organizational borders.

Second, our research shows that implementing VPP technology allows for more sustainable value creation. However, if this digital technology is primarily used for managing conventional energy, as several companies with single-focused frames do, it can reduce energy flows. Specifically in these cases, the positive ecological effect remains limited to minor carbon emission reductions. As companies with a twofold frame enrich their value propositions with system support and green energy, those that aim to employ digital technologies for blended value creation and promoting the energy transition should unequivocally focus on renewable energy and projects that involve green stakeholders (e.g., prosumers, such as biogas plant owners). The juxtaposition of both value proposition designs may help managers to become aware of their single-focused technological frame and motivate them to expand their framing.

Third, we encourage incumbents with a twofold frame to extensively communicate their contributions to sustainability transitions through several communication channels, as some already do in their public reports. Practically, active communication pertaining to new sustainable business models based on digital innovations can generate two positive effects: (1) publicly available information about a company's commitment to sustainable value creation can help attract like-minded sustainability-oriented stakeholders; and (2) as opinion leaders play a crucial role in innovation diffusion (Rogers, 2003), sustainability pioneers' effective communication can motivate other companies to develop twofold technology frames and eventually contribute to sustainability transitions.

Finally, our qualitative research methodology did provide valuable insights, but like all methods, it has its limitations that highlight attractive avenues for further research. First, our research considers only one industry with several idiosyncratic characteristics, such as high regulation, the importance of physical infrastructures, high commoditization and high change dynamics. These features might affect the technological frame and organizational responses, such as the configuration of value proposition components. Future research could show whether and how our insights can be transferred to other industrial settings.

Second, regarding the twofold transition, we argue that business digitalization and developing more sustainable business models can unfold at different speeds. Thus, longitudinal research is needed to investigate the dynamics of the interaction between these two change processes at the organizational level. Third, from a theoretical perspective, our explorative study focuses on technological frames' impact on innovation responses, such as creating new value propositions. As mentioned above, the notion that a specific framing supports a proactive implementation of technology corresponds well with previous research findings on the impact of technological frames on technology adoption (e.g., Jerneck & Olsson, 2011). From this perspective, the twofold framing paves the way for further progress in the energy transition because it enables incumbents contribute proactively to niche creation and development. We encourage scholars to explore the intra-organizational mechanisms that affect technology framing to build an effective bridge between managerial cognition, technological innovation (particularly digital) and sustainability. For example, we speculate that proactive incumbents might find it easier to create a twofold frame because of their general sustainability orientation (Schaltegger et al., 2012, 2019). Moreover, we suggest that a longitudinal research design may shed more light at the cause-effect relationships between a company's technology framings and its contribution to sustainability transitions.

Fourth, prior studies argue that congruent technological frames support digital technologies' successful implementation and stress that sustainable business models must consider multiple stakeholders (Freudenreich et al., 2020; Hörisch et al., 2014; Lin & Silva, 2005). As diverse stakeholders might have different demands and objectives, we assume that incongruences between their technological frames will emerge and hinder the successful adoption of sustainable digital technologies. Hence, further research should address the frames produced by multiple stakeholders and investigate how these frames emerge and how innovators can influence framing to promote adoption. We hope that our study spurs additional research on the intriguing issues of sustainable business models, digital innovations and technology framing.

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ORCID

Karolina Bähr https://orcid.org/0000-0002-3742-4566

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APPENDIX A: FORMAL SEMI-STRUCTURED INTERVIEWS

Interviewees positions/units	Interview duration (min)
Business and business model innovation	64
Business customer management VPP	59
Controlling renewable production	58
Head of close to market services	70
Head of commercial management	80
Head of decentralized commercialization	70
Key account management VPP	81
Product development and product management VPP	71
Product management for new businesses	39
Product management for new businesses	35
Senior innovation engineer	55
Smart and digital trading manager	57

APPENDIX B: SHORT CASE DESCRIPTIONS AND DATA SOURCES

Cases	Case descriptions	Data sources (covering VPP or the firm in general)
A	Case A primarily offers green energy and energy services. The VPP service focuses on the coordination of controllable energy users and producers, such as biogas plants.	• 1 interview • 1 informal interview • 6 press releases • 7 reports
B	Case B offers complex energy solutions on a supra-regional level. The VPP focuses on aggregations of controllable units, especially regarding the provision of flexibility and grid management.	• 1 interview • 1 press release • 3 reports
C	Case C offers smart energy or heat solutions, particularly by controlling combined heat and power plants.	• 1 interview
D	Case D offers the management of decentralized power-generating units, the establishment of regional markets and pooling services to gain market access.	• 2 interviews • 8 press releases • 17 reports
E	Case E concentrates on the provision of general public services and uses the VPP to integrate decentralized power producing and consuming units into the energy grid.	• 3 interviews • 5 reports
F	Case F has a digital platform around their VPP, offering four types of service building on this platform for a broad range of stakeholders.	• 3 interviews • 13 press releases • 11 reports
G	Case G uses software to offer VPP services, such as energy pooling and access to energy markets.	• 1 interview • 8 press releases • 4 reports