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Business model innovation in demand response firms: Beyond the niche-regime dichotomy

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ABSTRACT

Demand response (DR) is an innovation emerging at the intersection of the energy and information and communications technology sectors. This paper aims to investigate the drivers of—and differences in—business model innovation (BMI) behaviours of firms operating in these two interacting industries. Results from 22 semi-structured interviews with representatives of Finnish DR companies show that external drivers of BMI include regulation, competition, and the demise of the telecom industry following the fall of Nokia. Whereas technology start-ups and companies from adjacent industries are motivated by entrepreneurial opportunities, incumbent energy companies are driven by the threat of losing their existing customers and need to increase efficiency. The BMI behaviours observed do not fall neatly into the often-used dichotomous categories of niche/new entrant and regime/incumbent, as firms show behaviours from both extremes. To overcome this binary thinking, we propose a morphological box model that represents the extreme states of firm BMI while allowing for flexibility.

1. Introduction

In response to concerns over the perceived lack of agency in sustainability transitions research, the topic of actors' roles and strategies in socio-technical change has been gaining increasing attention (de Haan and Rotmans, 2018; Farla et al., 2012; Fischer and Newig, 2016; Ruggiero et al., 2021; Wittmayer et al., 2016). Actors can adopt different strategies at different levels of structuration—i.e. at regime or niche level—and can pursue single strategies or a constellation of strategies that change over time (Wittmayer et al., 2016). This can range from those advocating a particular niche, those not favouring a specific niche but making space for change at the regime level, and those actively opposing change (Kivimaa et al., 2019).

Firm strategies have generally tended to be conceptualised along two, rather simplified, lines: incumbents and front-runners. Incumbent actors may include firms that maintain the status quo through the power they possess for the purposes of resisting change (Geels, 2014b; Johnstone et al., 2017), thus contributing to the stability of regime structures (Geels, 2014b). In contrast, 'niche actors'—often considered to include entrepreneurs, start-ups, and spin-offs (Wittmayer et al., 2016)—are seen as front-runners, dedicated 'outsiders or fringe actors' in small networks who pioneer path-breaking innovations that challenge incumbent regime structures (Geels and Schot, 2007: 400). However, reality is much more complex; and we should not expect all incumbent firms in an industry to follow similar strategies. Furthermore, acknowledging that different niches and niche technologies interact with one

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another (Geels, 2018) and interact with multiple regimes (Konrad et al., 2008; Raven and Verbong, 2007), previously held niche-regime dichotomous conceptualisations of firms' strategies need to be developed through more fine-grained empirical cases (Berggren et al., 2015; Markard, 2018).

Recently, more nuanced understandings of the adaptive behaviour of firms in sustainability transitions have been highlighted. Firm strategies have been explored, for example, in terms of institutional strategies (Smink et al., 2015), technology strategies (Berggren et al., 2015), and strategic responses to economic, socio-political, and industry pressures (Geels, 2014b). Furthermore, in recent years, scholars have introduced the business model concept in an attempt to shed light on the "micro-dynamics within transitions" (Bidmon and Knab, 2018: 914). However, the behaviour behind firm business model innovation (BMI) processes (cf. Bohnsack et al., 2014) and the BMI strategies firms adopt has attracted much less attention. Moreover, very few studies have compared BMI between incumbent and new entrant firms (Foss and Saebi, 2017).

Business models describe how an organisation creates, delivers, and captures value (Osterwalder and Pigneur, 2010; Teece, 2010; Zott and Amit, 2010), whilst BMI specifically refers to either the re-configuration of some business model components or to an entirely new means of value creation and value capture (Massa et al., 2017; Sniukas, 2012). On one hand, BMI has been suggested to aid in accelerating socio-technical change by fostering the upscaling of niche innovations and the reconfiguration of regimes rules; on the other hand, it may hamper change processes by reinforcing regime structures (Bidmon and Knab, 2018). Insights into firm BMI strategies in sustainability transitions are still emerging, and nuanced understandings of firm BMI behaviours and strategies in the context of multi-niche and multi-regime interactions are largely missing.

This paper aims at developing an empirically-based understanding of firm BMI behaviour that moves beyond the niche/new entrant and regime/incumbent dichotomy. We fulfil this goal, by looking at the case of BMI in the context of the DR industry in Finland. We contribute to existing literature the understanding of the role of business models in socio-technical change by analysing the BMI behaviour of firms in an industrial sector that spans multiple socio-technical regimes. The DR industry serves as the basis for our empirical insights, as the implications of business models based on flexibility and servitisation in transitions are not yet well understood (Köhler et al., 2019). Demand response is a complementary innovation that can add reliability and flexibility to the energy system and accelerate the transition to renewable energy sources (Geels et al., 2017). In practice, DR may mean shifting consumption from one time slot to another (e.g. based on the availability of renewable generation or prices in the wholesale market) or reducing demand during peak times without shifting it due to network constraints, for example. Although DR does not directly compete with traditional energy technologies, it is an alternative to energy generation in energy system balancing (SEDC, 2017). Incumbent players such as energy retailers compete with new entrant DR companies in providing both aggregation and other load control services (Honkapuro et al., 2015).

Demand response services that optimise and control energy use are becoming more common due to the increasing convergence between information and communications technology (ICT), renewable energy technologies, and new business models, which are helping to popularise flexibility services in mainstream energy markets. Thus, DR is at the confluence of the energy and ICT regimes. Finland serves as an exemplary case, as it is a pioneer in automated DR services (Fingrid, 2018) and has one of the most developed legislative frameworks for DR in Europe (SEDC, 2017).

In summary, answering calls of transition scholars to better understand actors' roles and strategies in socio-technical transitions (e.g. Farla et al., 2012 and de Haan and Rotmans, 2018) and business model researchers to shed more light on the drivers of BMI and differences between new entrant and incumbent firms in BMI dynamics (Foss and Saebi, 2017), in this paper we address the following two research questions:

a) What are the drivers of BMI in the context of DR firms?
b) How do DR firms differ with respect to their BMI behaviour?

The remainder of this paper is structured as follows: Section 2 introduces our conceptual background, providing an overview of how firm strategies and business models have been addressed in sustainability transition literature and of BMI concepts from management literature, and presents our analytical framework. Section 3 provides an overview of the DR sector in Finland, while Section 4 describes our data and methods. Section 5 reports our findings, and Sections 6 and 7 outline our discussion and draw conclusions, respectively.

2. Conceptual background and analytical framework

2.1. Actor roles in sustainability transitions

Increasing emphasis has been placed on actors' roles and strategies in sustainability transitions (Wittmayer et al., 2016). Changes in socio-technical systems/sectors[1] are conceptualised in terms of interactions between a nested hierarchy of 'landscape' (exogenous context, e.g. natural disasters, global trends, and macro-economic and political developments); 'regime' (the deep structure of the

[1] Following Andersen and Markard (2020), we see sectors as socio-technical systems consisting of actors, institutions, and artifacts that generate a specific set of products or services.

currently accepted socio-technical system including its semi-coherent sets of ‘rules’); and ‘niche’ (protected spaces where radical innovation[2] and experimentation can emerge and replicate) (Geels, 2004). Although there are many ways to understand actors’ roles (Fischer and Newig, 2016; Wittmayer et al., 2016), a common conceptualisation, and one that helps demonstrate our case, is that of the niche-actor and regime-actor dichotomy.

Regime-actors, or incumbents, have been defined as “actors within a given technological regime that often have vested interests in maintaining the status quo rather than enabling transitions and will often act to strategically protect their privileged position” (Johnstone et al., 2017: 148). Indeed, incumbent firms have been portrayed as reluctant or resistant to “develop radical solutions,” and have a preference for incremental change[3] along existing innovation trajectories due to: i) lock-ins and sunk investments in existing technologies, skills, and people; ii) the disruption of existing competencies and risks associated with radical innovations; and iii) limited direct incentives to address societal problems because of collective good issues and free rider problems (Geels, 2014a).

However, recent literature has elucidated the plurality of roles that incumbent firms play in transition processes (e.g. de Haan and Rotmans, 2018); it is suggested that one-dimensional representations of incumbents offer a “limited understanding of the technological activities and strategies that incumbent firms may pursue” (Berggren et al., 2015: 1018). Furthermore, Späth et al. (2018: 4) note that although the term ‘incumbent actor’ is used “ubiquitously throughout the transition literature to signify the dominant actors within the existing regime, little effort is usually made to specify what kind of agency is to be expected from incumbents.” For instance, Berggren et al. (2015) show that incumbent firms experiment with radical niche innovations and at the same time continue to rely on traditional business models. The fact that companies can simultaneously foster radical and incremental innovation reflects what is known in management literature as ‘organisational ambidexterity’ (March, 1991)—the ability to compete in both new and mature technologies and markets through efficiency and incremental improvements on one hand, and flexibility and experimentation on the other (O’Reilly and Tushman, 2013). Furthermore, socio-technical transitions are complex, and involve many technologies (and their associated industries) in processes spanning multiple regimes (Konrad et al., 2008; Raven and Verbong, 2007) and sectors (Andersen and Markard, 2020). This is especially relevant when considering multi-regime and multi-sector interactions (heat, electricity, ICT) that are evident in the DR industry. As such, what may be an incumbent firm in one regime may not have the same power or resources or be bound by the same cognitive frames and institutional logics when entering a different sector (e.g. Erlinghagen and Markard, 2012).

In contrast to incumbents, niche-actors are framed as ‘front-runners’ that spur on entrepreneurial activities (Geels and Schot, 2007). Rather than fostering innovation within an existing framework, they seek to reconfigure incumbent regime structures by supporting innovation development and diffusion through entrepreneurial activities that include technological and non-technological experimentation, learning, expanding actor networks, and establishing collective expectations (Geels, 2005). Fischer and Newig (2016) suggest that niche-level actors play an instrumental role in the emergence of radical social and technological ideas, knowledge development and diffusion, articulation of visions, entrepreneurial activities, market formation, guidance of search activities, mobilization of resources, creation of legitimacy, and creation of starting points for systemic change.

As the literature on incumbency tells us that not all incumbents should be considered equal, the same should be said of front-runners. It is a diverse a category and can include entrepreneurs, start-ups, and spin-offs (Hörisch, 2015; Wittmayer et al., 2016); incumbent actors with the same (e.g. Berggren et al., 2015) or different (e.g. Raven, 2007) socio-technical regime; social entrepreneurs (Witkamp et al., 2011); public sector organisations; individuals representing public organisations; or elected officials (Pesch et al., 2017). These actors bring with them different values, competencies, capabilities and resources for BMI. Thus, to understand BMI in the context of sustainability transitions, we need concepts and analytical tools that help us move beyond the niche-incumbent dichotomy (cf. Schaltegger et al., 2016). In the sections below we argue that the business model concept and a morphological box of BMI behaviour fulfil this need.

2.2. Business model innovation in socio-technical transitions

Business models provide a “theory of the firm” to sustainability transitions research, and help to foster an understanding of the micro-foundations of socio-technical change (Sarasini and Linder, 2017). Scholars have described business models as “an activity system,” that is, a set of boundary-spanning activities allowing the focal firm to create and capture value via multiple networks of suppliers, partners, and customers (Zott and Amit, 2010). Various conceptualisations of business model elements can be found in existing literature. For instance, Teece (2010), Osterwalder (2004), and Tongur and Engwall (2014) suggest that business models consist of three key elements: i) a value proposition: the value a company offers to its stakeholders—the value embedded in the product; ii) value creation: how this value is created and delivered; and iii) value capture: how this value is monetised and distributed. In recent years, scholars have moved away from this relatively static perspective to a more dynamic view that acknowledges the dynamics of BMI and how business models evolve in terms of components, relationships, and structure (Andreini and Bettinelli, 2017).

The study of BMI in socio-technical transition literature has been gaining increasing attention (Bidmon and Knab, 2018; Bolton and Hannon, 2016; Sarasini and Linder, 2018; van Waes et al., 2018). Specific BMI strategies have been analysed in terms of Smith and Raven’s (2012) fit-and-conform and stretch-and-transform niche strategies. For instance, Huijben et al. (2016) analyse how solar PV system firms adopt different radical and incremental BMI strategies to deal with the regulatory regime. In the study of electric driving,

[2] Following Klarin (2019: 2), we understand radical innovation as “large-scale technological developments that create significant or revolutionary changes in their environments.”

[3] Following Klarin (2019: 2) we define incremental innovation as “continuous improvements or small-scale developments that do not create dramatic effects on their own, but that improve long-term productivity.”

Wesseling et al. (2020) highlight how firms follow strategies for niche products and services to either fit-and-conform or stretch-and-transform to different regime dimensions, including markets and users, user preferences, culture, industry, policy, and science and technology. However, Bolton and Hannon (2016)—investigating energy service companies—found that BMI itself is unlikely to be sufficient to enact system change.

These studies have provided valuable insights into the role of business models in socio-technical change and have examined general BMI strategies in terms of their intentions for restructuring regime dimensions. However, we still lack the knowledge and framework for conceptualising and analysing the aspects that lead firms to pursue specific BMI strategies and to exhibit certain behaviours. This is especially important considering the various roles firms can take on in terms of niche or regime level actions.

2.3. Firm business model innovation behaviour

While studies have shown BMI to be a crucial activity for organizational transformation and business renewal, very few studies have concentrated on understanding the drivers or antecedents of BMI (Foss and Saebi, 2017), which can be both internal and external. Internal drivers that influence BMI can be of "a strategic or a resource-based nature" (Andreini and Bettinelli, 2017: 40). External drivers can be linked to changes in the business environment of the firm, such as competition and regulation, or may be linked to the emergence of new business opportunities brought about by new ICT solutions, for example (Foss and Saebi, 2017). Studies have also identified threats to current business models as other drivers of BMI (Bucherer et al., 2012), for example price and customer pressure (Stampfl, 2014) and sustainability (Schaltegger et al., 2016).

There is limited research on the differences of strategies adopted by new-entrant and incumbent firms in BMI (Foss and Saebi, 2017). New entrant firms may have more flexibility than incumbent firms in terms of BMI, but the impact of BMI on performance may be less pronounced (Foss and Saebi, 2017). Still, new entrant firms like start-ups have certain characteristics such as flat hierarchies, simple organizational structures, and a risk-taking and questioning attitude that make them more agile in responding to external changes by introducing new business models (Stampfl, 2014). Literature has suggested that incumbent firms are generally less likely than new entrants to pursue sustainability-related opportunities (Hockerts and Wüstenhagen, 2010), though research has also shown that incumbents can be first movers in BMI and technological development (Bohnsack et al., 2014; and Berggren et al., 2015).

Few studies have analysed the difference in BMI behaviour between new entrant firms and incumbents. A review of the literature on BMI has identified a number of key 'typical' elements that characterize BMI strategies in incumbent and new entrant firms. However, as stated in Section 2.1, we would expect to see ambidexterity in the way incumbent firms operate.

i) *Radical or incremental nature of BMI*: the literature suggests that "incremental [BMI] involves continuous improvements of existing offerings without major changes in internal competences and external partner relationships, whereas radical [BMI] involves new types of offerings and the redesign of existing organisational characteristics and stakeholder networks (Pedersen et al., 2018: 269). Incumbents tend to pursue incremental innovation as BMI is constrained by path dependence and existing business model logics; they are therefore inclined to fit new technologies into existing business models. New entrants are not cognitively constrained by existing business models and are inclined to develop new business models for emerging technologies (Bohnsack et al., 2014; Chesbrough and Rosenbloom, 2002; Sosna et al., 2010; Stampfl, 2014).

ii) *Main source of value creation*: incumbents focus on efficiency as the main source of value creation, whilst new entrants focus on innovation and novelty as the main source of value (Bohnsack et al., 2014).

iii) *Resources for BMI*: incumbents have significant resources, especially large firms (Helfat and Lieberman, 2002), which allow for simultaneous BMI processes (Doz and Kosonen, 2010) and the cross-subsidization of new business models (Sosna et al., 2010). In contrast, new entrants are constrained by limited resources (Baker and Nelson, 2005) and only pursue a single business model at a time within a limited period for the purposes of experimentation (Sosna et al., 2010).

iv) *Bundling of products and services*: incumbents create complementarities and value by bundling old and new products and services, whereas new entrants create complementarities by bundling new products and services in unique ways (Bohnsack et al., 2014).

v) *Partnerships:* incumbents look to known partners to deliver value, whereas new entrants engage non-traditional partners (Amit and Zott, 2001).

vi) *Customer relationship*: incumbents use business models to serve existing customers, whereas new entrants use the business model to attract new customers (Bohnsack et al., 2014).

To complement the above parameters, we also add two elements from transition literature. Whilst the first looks at the expectations that BMI reveal related to the reconfiguration of certain sector/system elements, the second specifically addresses the ways in which firms seek to change or maintain regime rules.

vii) *expectations for sectoral reconfiguration*: transition studies have highlighted the performative function that socio-technical expectations have in terms of providing directionality to sectoral change (Geels, 2004; Geels and Schot, 2007). Business models articulate expectations in terms of the degree to which they seek to reproduce existing or reconfigure sectors (Lazarevic et al., 2019). These expectations can be related to different system elements, i.e., actor-networks, technologies and infrastructures, practices or institutions (van Waes et al., 2018; Wesseling et al., 2020). Niche-actor BMI can have ambitious expectations in terms of sectoral reconfiguration, with different business models focusing on different system elements (Lazarevic et al., 2019), whereas regime-actors tend to be locked-in to existing structures (Geels, 2014b).

viii) *attitudes to regime rule change*: regime rules, such as regulations and subsidies, not only provide regime structure but can form an integral part of business model value creation and capture strategies (see Lazarevic and Valve, 2020). Thus, actors may possess different attitudes and strategies to regime rule change as a part of their BMI behaviour. Niche-actors may seek to reconfigure regime rules to open new markets or disrupt existing ones that depart from existing institutional structures (Lazarevic et al., 2019). Alternatively, regime-actors may look to reproduce existing regime rules by adopting business models that align with incumbent institutions (Bidmon and Knab, 2018), or by utilizing existing regulatory and power structures to maintain competitive advantage.

2.4. Analytical framework

To move beyond the dichotomy of niche-regime actor and new entrant and incumbent firm, we built a framework based on the key elements i) - viii) presented in Section 2.3 by drawing on the morphological approach (Zwicky, 1948), often applied to scenario analysis and strategic planning in the energy sector (e.g. Pereverza et al., 2017; Salah et al., 2017). Specifically, the 'morphological box' is a space which consists of all possible configurations of a particular system. The box is constructed using previously identified parameters as its axes (or dimensions) and their extreme states. Thus, the box contains all possible combinations of the extreme states of each dimension. Table 1 illustrates the morphological box that includes dimensions of BMI for sustainability transitions, and their extreme states, which have been identified in management (new entrants vs. incumbents) and transition (front-runners vs. incumbents) literature. A morphological box is useful here because it allows us to accommodate firm behaviours that resist binary categorisation. We expect that firms will adopt a mix of different BMI behaviours depending on a combination of attributes, for example, their size (i.e. a start-up or large firm); level of structuration (i.e. regime or niche level actor); and new entrant to the industry or incumbent firm. The morphological box is therefore an analytical tool that may be used to overcome the typical "small" versus "big" (Schaltegger et al., 2016) or front-runner versus incumbent (Berggren et al., 2015; Markard, 2018) dichotomy.

3. Demand response in Finland

Traditionally, the short-term balance between demand and supply in the energy system has been maintained primarily by adjusting energy generation according to fluctuations in consumption (He et al., 2013). However, the increasing proportion of weather-dependent renewable generation is making this traditional approach to energy balancing less effective (Petersen et al., 2016). In contrast, developments in ICT and control technologies have made DR an increasingly feasible option (Khan et al., 2015; O'Connell et al., 2014). The EU's new electricity market directive 2019/944 defines DR as:

> the change of electricity load by final customers from their normal or current consumption patterns in response to market signals, including in response to time-variable electricity prices or incentive payments, or in response to the acceptance of the final customer's bid to sell demand reduction or increase at a price in an organised market… whether alone or through aggregation. (Directive, 2019/944)

While DR is often seen as a necessity in power systems relying on an increasing amount of intermittent generation (see e.g. Huuki et al., 2020; Taylor et al., 2016), it also leads to market disruption, that is, "the creation of a new market through the introduction of a new kind of product or service" (Klarin, 2019: 2), which changes the way value is created and delivered. This is because DR enables high shares of renewable energy in energy production, and it provides alternatives for flexible generation, such as natural gas, in the balancing markets. The benefits and challenges of DR in the electricity sector have been discussed widely by O'Connell et al. (2014) for example, and recently, the potential benefits of DR in the district heating sector have also gained increasing attention (Guelpa et al., 2019).

Finland is among the forerunner markets for DR in Europe (SEDC, 2017). All the marketplaces for balancing services operated by the Finnish electricity transmission system operator (TSO) Fingrid are open to DR resources (see Appendix A). Currently, independent

Table 1
Morphological box of business model innovation behaviours.

Parameter	Extreme states of BMI		
Nature of BMI	*Pursue radical and new business models due to the absence of lock-ins and path dependencies*	↔	*Pursue incremental business models, and fit new innovations into existing BMs due to path dependence and cognitive constraints*
Main source of value creation	*Focus on novelty as main source of value creation*	↔	*Focus on efficiency as main source of value creation*
Resources for BMI	*Have limited resources for BMI, innovating one BM at a time rapidly*	↔	*Have vast resources, can engage in innovating multiple BMs at the same time, but slowly*
Bundling of products and services	*Create complementarities by bundling new products and services in unique ways*	↔	*Create complementarities by bundling existing and new products and services*
Partnerships	*Non-traditional partners*	↔	*Existing/traditional partners*
Customer relationship	*Pulling customers from incumbents*	↔	*Meeting the expectations of existing customers*
Expectations for sectoral reconfiguration	*Possess specific expectations for the reconfiguration of actors, institutions, and artefacts through BMI*	↔	*Are constrained by the dominant logic of value creation, thereby reinforcing socio-technical system structures*
Attitudes to regime rule change	*Utilising regulatory change as a means of opening new and disrupting existing markets*	↔	*Resisting regulatory change, utilize existing regulatory and power structures to maintain competitive advantage*

aggregators (i.e. parties that do not supply electricity to the end users but whose flexibility they utilise) are eligible in the markets for frequency-controlled reserves, and arrangements related to their participation in other markets are currently being piloted (Fingrid, 2020a). Demand response has gained a significant role especially in the market for frequency containment reserves for disturbances (FCR-D). Since 2017, i.e. the first year when independent aggregators were allowed in this market, over 50 % of the contracted flexible capacity was DR capacity (Fingrid, 2019). Thus, DR has become a major competitor for electricity generation.

National legislation required distribution system operators to roll out smart meters by the end of 2013. As a result, the almost 100 % penetration of hourly registering smart meters allows for operators to offer time-variable electricity pricing to small end users as well. However, by the end of 2019, only about 11 % of Finnish retail customers had an electricity contract with prices bound to the hourly spot market prices (Energy Authority, 2020). Recently, market rules for DR have gone through many changes, and there have been significant variations in price.

4. Data and methods

Our empirical data consist of 22 qualitative interviews with representatives of DR companies and experts in Finland. To better understand the field and the role of DR in the energy transition, we conducted two preliminary interviews with two expert organisations, namely Fingrid (Finnish TSO) and the advocacy organisation for the Finnish energy industry (Finnish Energy), which provided a preliminary overview of the Finnish DR field.

As the research was focused on understanding the entire DR sector, our target was to interview as many DR firms as possible. The sample of participant companies was taken in two steps. First, we performed an internet search to identify companies that may provide DR services, using the search words 'demand response' (*kysyntäjousto*), 'flexibility' (*jousto*), and 'energy management' (*energianhallinta*). Via telephone calls and a desk study of company websites, this initial sample was then evaluated based on company service offerings and whether a company had plans to take part in DR markets. We decided to study those companies focused on providing DR services that were based on buildings' energy use as the source of DR.

In total, we identified 32 companies that were considered to be active in the field of DR linked to buildings. However, some were in the very early stages of business model development, and therefore declined to be interviewed, while others were not able to allocate time to the study. Eventually, the sample was limited to 22 companies that were either in an advanced stage of BMI or that had launched business models for DR services. The sample included all the main companies operating in the DR sector, offering a comprehensive view of the DR industry in Finland. To select the interviewees, we applied a snowball sampling method (Biernacki and Waldorf, 1981), in which the interviewees themselves indicated the most suitable informants.

The interviews were semi-structured and followed an interview guide combining questions about i) the company and its business models; ii) demand and customers; iii) energy markets and actors; iv) socio-technical system and policies; and v) conflicts and barriers. They took place in the autumn of 2018; 20 were conducted in Finnish and two in English. All the interviews were recorded and transcribed verbatim. In addition to the interview material, further data was collected from company websites.

Data analysis was an iterative process (Neale, 2016) conducted through NVivo 12. We applied thematic analysis (Gavin, 2008) in an abductive way, meaning that we moved back and forth between our theoretical framework and the data. This is in line with Dubois and Gadde (2002: 559) who stated that "in studies relying on abduction, the original framework is successively modified, partly as a result of unanticipated empirical findings". Therefore, in an abductive approach one enters the research process with pre-existing knowledge to then arrive at a more detailed and elaborated understanding.

In our case, the data analysis took place in two stages. In the first stage, we used a set of predetermined codes that were loosely derived from the literature on BMI and transition studies (see Appendix B). During this process, as new themes emerged from the data, they were added to the coding scheme. In the first phase of our analysis, we identified three groups of firms that were active in the DR

Table 2
External and Internal drivers of business model innovation.

Type of drivers	Drivers	Technology start-ups	Companies from adjacent industries	Incumbent energy companies
External	Demise of an industry (fall of Nokia)	X		
	Public support for R&D		X	
	Decreasing demand for heat			X
	Competition in energy markets			X
	Free data (e.g. climate and weather data)	X		
	Market changes		X	
Internal	Business opportunity	X	X	
	Being at the technological frontier ("new Nokia")	X		
	Capabilities (leveraging experience in adjacent industries)		X	
	Product/service innovation		X	X
	Value networks (collaboration with energy companies)		X	
	Efficiency (reduction in energy production costs)			X
	Increase customer loyalty			X
	Environmental values	X		

sector in Finland. As the general aim of our research was to contribute a better understanding of actors' roles and strategies in transitions through the lens of BMI, we used these three central categories to organize our analysis. At this stage, it became evident that the firms studied had followed different patterns of BMI.

In the second stage of the analysis, we went back to the theory to expand our coding scheme and determine the coding categories for firm BMI behaviour. These coding categories are the categories presented in Sections 2.3 and 2.4. The BMI behaviour that emerged from the data did not perfectly match the expected patterns of BMI behaviour found in the theory. To overcome this limitation and find a way to move beyond the dichotomous categories of niche/new entrant and regime/incumbent found in the coding process, we used the morphological box concept presented in Section 2.4 to categorize the BMI behaviours emerging from the data. A morphological box was useful because it allowed for flexibility in the coding process. In the next section, we present the results regarding the BMI behaviours found and illustrate the ways they diverge from the expected behaviour described by the literature.

5. Results

Analysis of the interviews revealed that there are three groups of companies operating in the DR sector in Finland. We labelled them: technology start-ups, companies from adjacent industries, and incumbent energy companies. Detailed information about the companies belonging to each of these three groups can be found in Appendix C. As expected, the BMI behaviours of these DR companies do not fall neatly into the dichotomous categories of niche/new entrant and regime/incumbent (the two extremes of the morphological box presented in Section 2.4). In other words, while firms' BMI behaviour tended to lean towards the expected behaviour of the actors typically categorized as niche/new entrant or regime/incumbent, there were still clear exceptions. Table 2 summarises the drivers of BMI whereas Table 3 shows the BMI behaviour of the three groups of companies identified.

5.1. Technology start-ups: "Gain customer base through collaboration"

5.1.1. Firm backgrounds and drivers of BMI

The first category of firms contained six technology start-ups, four of which were based on business models that can be said to have emerged from the "ashes" of Nokia, who worked on building automation solutions until around 2010. After Nokia's collapse, some of its former engineers established start-ups and became involved in DR. The remaining two companies were foreign and had only recently entered the Finnish market. All six companies shared similar features: they were all new (started after 2010), they were all either in the start-up or growth phase (in most cases, under five employees), and they were all in the smart energy domain. As the they grew, their business models evolved from being centred on software development to more customer-oriented services utilising ICT and sensor technologies. Apart from the fall of Nokia another external driver of BMI was the release of open data from the Finnish Meteorological Institute (a requirement of the EU's INSPIRE directive). Internally, BMI was driven by entrepreneurial factors, environmental values, and the desire to be on the technological frontier.

5.1.2. BMI behaviour

Not all of the technology start-ups had mature business models, as some were still in the DR software development phase. However, all had engaged in innovating new and radical business models, some of which bundled technologies and services in new ways—for

Table 3
Business model innovation behavior of firms.

BMI Behaviour	Technology start-ups	Companies from adjacent industries	Incumbent energy companies
Nature of BMI	Radical	Started as incremental, but some have developed to radical BMI	Incremental, except for one company
Main source of value creation	Novelty and environmental value	New services for their existing customers	Cost efficiency, new services for existing customers
Resources for BMI	Limited resources, but developing multiple BMs at the same time, using public R&D funding	Differing resources based on company size, notable public R&D funding for BMI. In most cases started by developing one BM, but moved to developing multiple BMs	It varies between the companies
Bundling of products and services	In new ways	Mainly adding DR to their existing services and technologies	Adding DR to existing products and services, except for one company
Partnerships	Traditional and non-traditional partners	With incumbent energy companies, acquiring start-ups	Non-traditional partnerships, acquiring start-ups
Customer relationship	Often shared with incumbents, decreasing the market share of incumbents	Mainly serving existing customer base, but also pulling customers from incumbents	Focused on keeping the existing customers
Expectations for sectoral reconfiguration	DR competing with energy production and allowing for more RES in energy markets, causing traditional energy BMs to be non-profitable	Changes in actor roles, non-energy companies will dominate energy markets	More limited reconfiguration expectations than the other two company groups, are not expecting major changes in actor roles in energy regime
Attitudes to regime change	Regulatory changes are important for their growth, limited policy power	Lobbying for regulatory changes, but also find the constantly changing regulatory framework challenging for BMI	Oppose regulatory changes, have notable policy power, active in lobbying

example by combining mobile phone applications, sensors, and optimisation software. One company referred to their business model as the “Airbnb of energy,” meaning that when their clients are not home, the company will control their energy use.

The start-ups had formed partnerships with traditional actors of the energy sector. Their business model relied on collaboration with incumbent energy actors, such as TSOs, distribution system operators, and energy retailers. In addition, they had built non-traditional partnerships with large companies outside of the energy field, such as building maintenance and construction companies. Their customer base was often shared with energy incumbents, since energy companies have an established customer link with the electricity and district heat users. Therefore, while start-ups are not directly pulling customers from the energy incumbents, they are still decreasing their market share.

The technology start-ups focused on creating value from novelty through radical business models and the innovative bundling of products and services. In addition, they emphasised environmental value creation by enabling their customers to reduce their carbon footprints, for example. Their main source of revenue was annual or monthly customer fees for energy services provided to building owners, as well as from selling their software to companies from adjacent markets and energy companies (see Sections 5.2.2 and 5.3.2). Since the Fingrid markets require minimum aggregation amounts of between 0.1 and 5 MW, it is still difficult for the start-ups to have enough load from their customers to participate in such markets.

The technology start-ups had limited resources for BMI (e.g. small personnel resources and personnel with mainly engineering backgrounds), and this hindered their innovation activities and growth, although some had received R&D funding which increased innovation possibilities. Regardless of limited resources, most start-ups were innovating multiple business models simultaneously.

In the current phase of business model development, the technology start-ups mostly preferred to collaborate with established energy companies because the DR market in Finland is still relatively small and they lack the customer base. However, these actors plan on gaining a wider customer base and independence from incumbents. One interviewee noted that start-ups are preparing for market disruption:

> We don’t want to shoot ourselves in the foot by going against the business of the energy companies. So, everyone is still waiting. Everyone is getting ready. Everyone knows it [disruption] is coming. Someone in the field will make the first step and then it starts. [Interviewee 3]

The technology start-ups expect DR to cause major sectoral reconfiguration, as it i) allows for energy demand to compete with energy production, and ii) allows for large-scale utilization of weather-dependent renewable energy production such as wind and solar. This reconfiguration has the potential to destabilise the traditional business models of incumbent energy actors by rendering them non-profitable.

The start-ups viewed regulation as a very important driver for their growth and hoped that changes in regulation would open larger-scale markets for them. While regulatory changes are expected in energy markets’ pricing mechanisms, start-ups are following different strategies; some are passively waiting for changes while others are actively lobbying despite feeling that their small size wielded insufficient political power. Moreover, they stated that some incumbent energy companies were trying to slow down DR development and had strong lobbying power that was threatening their business model. One interviewee explained incumbent energy companies’ opposition to DR as follows:

> There are always opponents to development, people who don’t believe in it [DR] and don’t think it’s necessary. We have also experienced this with Finnish energy companies. Energy companies that are still thinking in an old-fashioned way and are cold towards us. Their reaction is ‘no, there is no need [for DR]’. [Interviewee 1]

5.2. Companies from adjacent industries: “Create new offerings in new markets”

5.2.1. Firm backgrounds and drivers of BMI

The second category of firms included 10 companies that had added DR to their service and technology portfolio. These were small and medium-sized enterprises (SMEs) and large international corporations with core business areas in electronics, ICT, building automation, and building energy services. Many of them had experience in load control solutions. However, the reasons for load control had been related to the needs of individual clients, e.g. to maintain the indoor temperature of a building within a specific range or control certain industrial processes, rather than to energy system balancing. Therefore, the companies from adjacent sectors are new in the energy and DR sector, having their core activities in other industries. This makes them different from the start-ups who started operations in the smart energy and DR sector. The main competences of the companies from adjacent sectors lie in the development of hardware and software that enable the provision of DR services. Some of these companies have recently started to acquire start-ups to develop their DR related software and IT platforms. External factors motivating the diversification of these companies to the energy sector included market changes due to new energy pricing, such as hourly electricity pricing, capacity-based electricity networks, or district heat tariffs; and public support for R&D activities. The main internal driver for BMI was the possibility to pursue business opportunities by leveraging their capabilities in adjacent industries and value networks with energy companies.

5.2.2. BMI behaviour

All the companies from adjacent sectors entered DR markets through incremental BMIs, where their core business model and technology allowed for DR addition for their existing customers, who are often shared with energy companies. They created value for their customers by offering new services and environmental benefits, and by decreasing their energy costs. Four were taking part in the Fingrid markets directly or doing so indirectly through business partners. Two instead planned to join these markets in the near future to increase their business opportunities. In addition, three firms captured value by providing DR-enabling technology, mainly for incumbent energy companies.

Interviews revealed that energy companies tended to trust the firms in this category more than start-ups. This is because some energy companies have a long history of collaboration with many of the companies from adjacent sectors who provide other essential technologies and services to them. However, after initiating DR activities with incremental BMI, some of these companies identified business opportunities in linking buildings using vast amounts of energy (e.g. shopping centres or sport facilities) directly to the energy markets. Therefore, they started to develop business models for new customers without the involvement of the energy incumbents, which caused tension and conflict between them:

> The energy company dared to tell us that they don't know if they want to continue the collaboration with us because it is difficult for them [to accept] that we have customers without their involvement. [...] Then they wanted to negotiate and have lower prices. They said, if you give us a share of profits from your DR customers, we don't need to renegotiate our agreements. [Interviewee 6]

It is important to note that, for many companies from adjacent sectors, the DR part of their business was typically not yet generating profits at the time of the interviews. This is because these companies were using their resources to innovate their business models before expecting growth and increased revenue streams. Companies' use of resources varied according to their size. The largest companies from adjacent industries were able to use considerable human and monetary resources for BMI and were also gaining notable shares of the public DR innovation funding. They typically started innovating one DR business model, but later expanded to develop multiple business models.

Companies from adjacent industries expected sector reconfiguration as a result of DR. They could see that actors' roles in the markets will change, and that the largest energy companies of the future might not be the traditional energy entities, but rather companies from completely different fields. These companies had differing visions of their own future roles in the energy markets. Some saw their role in the future as a mere DR technology provider, whereas others saw themselves as major actors in the energy sector. Some of these companies viewed energy incumbents in the role of system integrators rather than producers and distributors in future energy markets.

Just like the start-ups, the companies from adjacent industries believed that regulation changes are needed for the DR market to scale up. They were lobbying for these changes, but at the same time the constantly changing regulatory framework caused difficulties for their BMI. One interviewee explained the effects of constantly changing regulation in the following way:

> Now there is uncertainty about the regulation. Payback times have to be really short because there is no guarantee that the market will still be there in future. [...] In the end, if Fingrid and regulation make this [DR] business possible, it [the business] will go to whoever provides it. [Interviewee 4]

5.3. Incumbent energy companies: "Increase resource efficiency and customer loyalty"

5.3.1. Firm backgrounds and drivers of BMI

The third category of firms consisted of six energy companies that recently developed new business models for DR services. The business models of these firms emerged as a response to external factors such as competition from new entrants and decreasing demand for heat. One interviewee explained the need for energy companies to adapt to the ongoing changes in the energy markets as follows:

> If we stick to our current ways of working and the current energy system, then it's likely that [in future] there will be surprises and we [may] have lost our competitiveness. So, we try to think about this every day. [Interviewee 9]

Apart from two cases, all of the energy companies were municipally owned. It is important to note that most of the Finnish energy companies are not active in DR. Therefore, the energy companies in this category consist of the front-runners. Different from the other two groups of companies who were motivated by business opportunities and desire to scale up the DR sector, the main internal driver of BMI for incumbent energy companies were cost efficiency and desire to increase customer loyalty. While the energy incumbents not developing DR services and technologies were not interviewed, some of the interviewees (representing both energy companies and other firm types) addressed their reluctance. The reasoning included municipal ownership leading to risk aversity (although many of the interviewed active energy companies were in fact municipally owned), small size leading to lack of resources, and also lack of interest in some employees working with energy retail companies who were already approaching retirement.

5.3.2. BMI behaviour

All the energy companies, except for one, offered DR services as an incremental addition to their standard energy services to their customers, who are primarily residential. One of the main motivations behind this was to keep their current customers by providing them with extra services and by creating value in the form of savings. In addition, energy companies created value from DR by decreasing their operational costs. In the case of heat production, companies used DR to reduce the peak loads and thus their production costs, while in the case of electricity supply, they used DR to minimise the difference[4] between electricity procurement (i.e. electricity produced independently or bought from the wholesale market) and demand (i.e. the electricity they or their customers use). Energy companies also utilised their customers' DR potential in the Fingrid markets.

Interestingly, one of the energy companies aligned more with the start-ups than others did. This company had sold its electricity

[4] The larger this difference is, the costlier it is for the energy companies, which are financially liable for the imbalances they cause.

sales business and acquired a start-up; at the time of the interview, it was fully focused on developing novel renewable energy and smart energy services, including DR. The company's BMI was radically based on new smart solar services, which were leading it towards new partnerships and customers.

The energy companies had a solid customer base and marketing channels, but they lacked the know-how to aggregate dispersed loads. To overcome this limitation, they formed partnerships with non-traditional energy sector actors; that is, with the start-ups and large ICT entities from the group of firms from adjacent industries. These companies provided the energy companies with the programming skills, software, and hardware needed to operate their DR services. Thus, the start-ups had access to the energy companies' customer bases, and stand to gain a greater market share in future.

Initially, the energy companies were not active in DR technology development, but more recently, they had begun software development. Thus, while the energy companies started with DR service and then shifted to technological development, the start-ups started with technological development and then moved into DR service development. One energy company interviewee described this shift in the following way:

> Before, we handled the customer process and outsourced the technical solutions. Now, we are responsible for a growing share of the technical part, and we produce the core technical functionalities in house. Thus, our role [in DR] is changing. [Interviewee 7]

The resources that the energy companies used for BMI varied notably. In some energy companies, DR was a small unit with limited resources, and they tried to influence company management to get more personnel and funding for BMI. However, in other energy companies, the DR departments had vast BMI resources. A general trend in the energy companies was to grow their DR resources, especially personnel, and thus they were actively recruiting ICT experts.

The energy companies felt that DR was reconfiguring the energy sector, and they wanted to be a part of this change. However, they saw the future of the DR sector differently from the other two company groups. First, most noted that the role of DR in Finland is and will be limited, whereas the other company groups had the opposite future vision for DR. Second, energy companies saw themselves as the main providers of DR services in the future, while other companies would only have a limited role as technology suppliers. To fulfil their strategy, the energy companies had established their own start-ups and acquired or were considering acquiring companies from the start-up group to be ready to assume a dominant position in the market. One interviewee from an energy company emphasised that not all the energy companies were trying to resist change; rather, some had decided to embrace it:

> It does not make sense to fight the change. Energy consumption is decreasing. Either you are part of it or against it. Yes, it is probable that we will sell less energy in the future; all changes around us are pushing in that direction. So, it is a strategic decision to be part of the change. I know that some energy companies are against it because they will sell less energy. [Interviewee 7]

Current DR market regulation favours the energy companies in some respects, and this caused the companies in this group to object to regulatory changes for the most part. For example, they can access all electricity marketplaces, so they can capture more profits from DR than start-ups and companies from adjacent markets. Furthermore, energy company respondents stated that the energy market regulations were "built for them," and felt that other companies could threaten their position in the market, for example:

> Market actors have traditionally had clear roles, but DR is a new technology, so there are third parties [new entrants] distorting the market. This creates disturbance among those for which the regulation was initially created. [Interviewee 10]

In contrast to start-ups and firms from adjacent industries, the energy companies had strong lobbying power and were active in various policy arenas.

6. Discussion

6.1. Understanding business model innovation beyond archetypal dichotomies

The first goal of this paper was to contribute to calls for a richer understanding of the drivers of BMI (see Foss and Saebi, 2017), especially in the context of sustainability transitions. Our results show that besides market changes, competition and the emergence of new business opportunities linked to ICT development and the availability of free weather data, a key external driver of BMI was the fall of Nokia. In fact, several former Nokia's employees established stat-ups and continued to work on building automation services after they were laid off. This is an interesting finding that highlights how the decline of an industry can contribute to BMI and spur the rise of a new sector. Participation in value networks and collaboration with energy companies were two internal drivers of BMI in companies from adjacent industries. This second finding underscores the role of market diversification strategies in triggering BMI. Diversification is an important strategy for firms because it promotes growth, risk reduction, efficiency, and better performance. However, in the management literature diversification through business models is an insufficiently researched aspect of corporate strategy that deserves more scholarly attention (Aversa and Haefliger, 2015).

The second goal of this paper was to investigate how new entrant and incumbent firms differ with respect to their BMI behaviour. Traditionally, transition scholars have characterised regime-actors or incumbents as actors mainly defending the status quo rather than enabling transitions (Johnstone et al., 2017). As Köhler et al. (2019) have highlighted, this assumption is gradually being replaced by a more dynamic view of the role of incumbents in transitions. To facilitate a better understanding of firm BMI behaviour, we developed a morphological box of BMI behaviour—extreme states from the management and transition literature—to overcome the problems of categorising firms in terms of the niche vs. regime (Berggren et al., 2015; Markard, 2018) or new entrant vs. incumbent (Hockerts and

Wüstenhagen, 2010).

Our results both confirm and contradict some of the preconceived notions of start-up BMI behaviour. For instance, although the technology start-ups analysed pursue radical business models, are sustainability pioneers, and have limited resources for BMI (confirming insights from the literature identified in Section 2.3), they were able to develop multiple business models at the same time and have formed partnerships with the traditional energy market actors, contradicting the new entrant versus incumbent understanding of firm BMI behaviour as identified in Bohnsack et al. (2014). Similarly, even though the literature suggests that incumbent BMI tends to lead to the formation of partnerships with known partners to deliver value (e.g. Amit and Zott, 2001; Bohnsack et al., 2014), we found that incumbents are actively collaborating with technology start-ups. Moreover, as the DR market matures, technology start-ups and incumbent energy companies are moving from a position of symbiotic co-existence to one of competition, shifting their behaviour towards more conventional niche-actor and incumbent roles compared to their starting points. This contradicts previous knowledge that niche-actor disruption with time would turn to cooperation and value creation with incumbents (see Ansari et al., 2016).

This paper illustrates the diversity of BMI behaviour in technology start-ups, companies from adjacent industries, and incumbent energy companies. By including firm expectations for system reconfiguration and attitudes toward regime change in our analytical framework of firm BMI behaviour, we were able to provide a more nuanced understanding of BMI behaviour. Our results suggest that firm expectations for sectoral reconfiguration and attitudes to regime change play a significant role in the BMI strategies that firms pursue when navigating future uncertainty in the DR sector. Technology start-ups framed the energy system reconfiguration in a very technology-specific way: the future dominance of renewable energy and DR. This stems from the engineering and technology-centred background of these companies; they focus on technology development and push for regulatory change which benefits their novel technologies. These expectations are generally shared by the companies from adjacent industries, although they have a more nuanced vision of future actor roles. Companies from adjacent industries see themselves as having a dominant role in future energy markets. This is visible in how they acquire start-ups and have started to compete with the incumbents in terms of customer interface. Furthermore, companies from adjacent industries actively seek regulatory change that would allow them to scale-up their business and enable predictability for their BMI.

The greatest variation was found in energy sector incumbents. The majority of the few energy companies involved in DR expected the role of DR in system reconfiguration to be relatively low; pursuing an ambidextrous BMI strategy as a response to future uncertainty in the sector whilst favouring the status quo in terms of regime rules. The category also showed that energy incumbents can take on the role of a front-runner in strategic niche development, confirming the findings of Berggren et al. (2015). For example, one incumbent energy company has been pursuing radical BMI comparable to that of technology start-ups (e.g. selling their traditional energy services to embrace a new focus on renewable energy and digital DR technologies). This calls for a more fine-grained understanding of how BMI parameters such as source of value creation, resources for BMI (e.g. size, type of ownership), partnerships, and customer relationships coupled with expectations for system reconfiguration and transition phase (i.e. from pre-development to stabilisation) influence their choices to discontinue innovation trajectories or reorient toward radical BMI.

6.2. Business model innovation and multi-sector interaction

Our findings also build upon the scant literature on the role that actors in adjacent industries can play in advancing sustainability transition (cf. Erlinghagen and Markard, 2012; Andersen and Markard, 2020). However, different from what has been previously outlined (Erlinghagen and Markard, 2012), we show that not all firms from adjacent industries have a plan to disrupt the incumbents from the focus sector. In the Finnish DR sector, some firms from adjacent industries have had long-standing collaboration with energy companies offering DR services in business areas other than DR. Nevertheless, our findings lend support to the idea that BMI building on alliances between powerful new entrants from adjacent industries and large energy users (Erlinghagen, 2014) could have significant effects on sectoral reconfigurations. In our study, this possibility was illustrated by the case of a multinational firm from an adjacent industry who started to provide DR-enabling technology to one of the large energy users of an incumbent energy company. Confirming the observations of Andersen and Markard (2020), our study illustrates that transition scholars need to better explore the role of firms from adjacent industries who provide technologies that, on one hand, advance energy system transition but on the other, hinder change processes. This calls in general for more attention to multi-sector interactions and their potential to produce knock on effects on sector incumbents. As for the dynamics of BMI in the context of multi-sector interaction, our findings seem to indicate that firms may follow unconventional patterns of BMI behaviour and, thus, adopt more hybrid BMI strategies. Future research should aim at better understanding how different types of sector interactions (or sector convergences) affect processes of BMI.

Our analysis also shows that incumbent firms from various sectors are involved in technology value chain development. This suggests an important role for 'diversifying entrants' that move from adjacent industries into the focal sector (Helfat and Lieberman, 2002). Many of the companies from adjacent industries have both large BMI resources as well as ICT and service development knowhow; when coupled with changing regime rules, this can open up space for more competition. Furthermore, when ICT incumbents enter smart grid technology or incumbents from the oil sector enter renewable energy technologies, these actors can potentially bring enormous resources that can make significant differences for further development (cf. Erlinghagen and Markard, 2012; Hockerts and Wüstenhagen, 2010). However, this multi-technology and -sector perspective on transitions increases the complexity of policy coordination and policymaking, also requiring a more nuanced understanding of the actors enacting BMI at the niche and regime levels.

6.3. Limitations

Although this study represents one of the first attempts towards establishing a better understanding of the differences in BMI between incumbents and new entrants in socio-technical transitions, it has limitations. In this paper, we consider only the energy companies and the companies from adjacent industries that are active in DR. Therefore, the views of other firms in these two categories are not included. As a result, while the paper sheds light on the factors that drive BMI in front-runner firms, we know little about why other companies are not participating in DR. In future studies, these limitations can be addressed by including the views of both front-runner and laggard firms for a more comprehensive view of the determinants of BMI.

7. Conclusions

The plurality of actor roles in sustainability transitions has been previously discussed, but—to our best knowledge—so far this notion has not been analysed empirically at the sector level. Our study aimed at filling this gap by enriching the description of actors' roles in transition studies with BMI behaviour. We formulated an analytical framework that addresses extreme actor BMI behaviours while allowing for flexibility between archetypes. Empirically, our analysis was based on 22 qualitative interviews with representatives of DR companies and experts in Finland. The results show that the external drivers of BMI in the DR industry in Finland include, apart from technological trends, regulation and competition, also the demise of the telecom industry following the fall of Nokia. At the firm level, the drivers of BMI differed considerably among the studied companies. Whereas technology start-ups and companies from adjacent industries are motivated by entrepreneurial opportunities, incumbent energy companies are mainly driven by the threat of losing their existing customers and the need to increase efficiency.

The BMI behaviours of the DR companies studied do not fall neatly into the dichotomous categories of niche/new entrant and regime/incumbent, as firms exhibit more hybrid behaviours from both extremes. The niche and regime categorisations represent different levels of structuration and stability. Unfortunately, analytical practice has tended to lump actors into these categories, tacitly associating actors' BMI behaviour and strategies according to these levels. Treating actors as homogenous categories limits our ability to understand the complexities of firm strategies. Whist the niche-regime dichotomy can be beneficial as a parsimonious heuristic, there is also the need for more a nuanced mobilisation in analytical practice that recognises the complexities of real-world interactions. This is even more salient when dealing with cases that straddle multiple sectors. To move beyond the dichotomous understanding of BMI behaviour, a morphological box of the extremes or archetypical states of firm BMI was presented. This tool was particularly useful as it allowed us to accommodate firm behaviours that escape a binary categorisation and open space for the contingencies of BMI. The results also demonstrate that multi-sector interaction may influence BMI as firms that have entered the DR sector from other industries do not have the same cognitive constraints of incumbent actors, and have expectations that non-energy companies will dominate the future energy markets. The study, however, shows that multi-sector interaction does not merely happen through the interaction of existing sectors, but can occur also through a declining industry that contributes to the rise of a new one. Future research needs to better address the role of firms from other industries in both accelerating and delaying sustainability transitions via BMI.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Reserve marketplaces and DR participation in Finland (Fingrid, 2020b, 2020c)

	Fast frequency reserve (FFR)	Frequency containment reserve for disturbances (FCR-D)	Frequency containment reserve for normal operation (FCR-N)	Automatic frequency restoration reserve (aFRR)	Manual frequency restoration reserve (mFRR)
Activated	In big frequency deviations, in low inertia situations	In big frequency deviations	Used all the time	Used in certain hours	Activated if necessary
Activation speed	In a second	In seconds	In a couple of minutes	In five minutes	In fifteen minutes
DR participation in Finland (9/2020)	No estimate, market introduced in 2020	400 MW	10 MW	0 MW	200 – 500 MW
Fingrid's obligation in 2020[a]	about 0–60 MW	about 290 MW	120 MW	60–80 MW (certain morning and evening hours only)	880–1100 MW

[a]Obligations for maintaining reserves have been agreed between the Nordic TSOs.

Appendix B. First stage coding scheme

The coding of the data was carried out in two stages. The table below shows the coding scheme used in the first stage of coding. Coding followed an abductive approach, i.e. some of the codes were deductively determined from theory before data collection whereas others (bold text) emerged directly from the data.

0 Basic company information	
0.1 DR service type	This node is used to specify on which type of DR service a particular BM element relates to. Covers explanations of how a specific type of DR service functions. Additionally, comparisons about the different business opportunities of the different DR solutions (e.g. why DR for district heating is more interesting than aggregating). 0.1.1 Spot optimization 0.1.2 Aggregating 0.1.3 District heating 0.1.4 Non-DR = optimizing electricity use at micro grid level, i.e. optimizing real estate's internal energy use.
0.2 Company history	This node covers all discussions that relates to company's history, e.g. previous practices, past finance, personal growth stories etc.
0.3 Company position in the industry	0.3.1 Incumbent company in the energy sector 0.3.2 Start-up company 0.3.3 Companies from another industry that may or may not be related to the energy sector
1 Business model elements	
1.1 Value proposition	The value embedded in the DR product. This node covers the benefits the service provides for the customer, energy company, society or environment, or the company itself. BM/ service likely covers other qualities besides pure DR.
1.2 Customer relationship	1.2.1 Customer segment (the customers the company tries to serve) 1.2.2 Market place (node covers how the DR is turned into money, i.e. which markets or to which actors the loads are sold: TSO markets/Fingrid, Nordpool, for another aggregator or energy company, or if used for balance settlement) 1.2.3 Other (customer channels and relationships. Discussion on how customers are contacted, who contacts the customers or end-users (also if sales are outsourced to partners). Discussion on how the customers/users affect the service and how the company communicates with the customers, before or after the sales)
1.3 Revenue model	How DR brings profit for the company (partly overlapping with value proposition). This node covers the costs and incomes of running the business, and their distribution across business model stakeholders. Additionally, possible financial support by the public sector, or other financiers.
1.4 Architecture	1.4.1 Key resources (financial, physical and human resources) 1.4.2 Key networks (informal cooperation with organizations) 1.4.3 Key partnerships 1.4.3.1 Energy company (business and R&D cooperation with energy companies) 1.4.3.2 Other partnerships (business and R&D cooperation with other actors, e.g. sub-contractors, Fingrid, other DR companies etc.) 1.4.4 Key activities (node covers the most important activities needed to provide value proposition, the practices the company specializes in. The node covers also R&D.)
2 BMI behavior	Covers the emerging patterns of BMI behavior that firms seem to follow since they become involved with DR. behavior refers to the way how the firm changes elements of its business model and acts towards other firms in the DR industry.
3 Business model critical factors	
These nodes cover the barriers and drivers that the business experience in Finland, for the node category "7 Exports and imports" has its own nodes for international barriers and drivers.	
3.1 Barriers	3.2.1 Starting the BM (internal or external barriers or hindering factors the company experiences when starting the BM) 3.2.1.1 Internal barriers (barriers or hindering factors the company experiences when launching the BM, that arise within the company, e.g. problems with R&D, tensions within company, lack of finance, unclearness about the BM, trouble in the supply chain.) 3.2.1.2 External barriers (barriers or hindering factors the company experiences when launching the BM, that arise from the selection environment, e.g. lacks in infrastructure, regulation, no demand for DR.) 3.2.2 Scaling up the BM (internal or external barriers or hindering factors the company experiences as scaling up the BM, i.e. factors that prevent the growth of BM, as it is already in the markets.) 3.2.2.1 Internal barriers 3.2.2.2 External barriers
3.2 Drivers	3.2.1 Internal drivers = internal motivations to develop the BM for, e.g. environmental values, strategic moves of diversification or networking. 3.2.2 External drivers = external drivers to develop the BM for DR, e.g. new opportunities occurring from market or political changes, or more straight forward incentives like suggestions to cooperate.
3.3 Competition and cooperation	Discussion on competitors, who they are, what they do and how they affect the company, is there cooperation etc.
4 Policy	Covers policies, legislation or other regulation and market rules
4.1 Current policy	Discussion on current policies, regulation or market rules, also discussion about research organizations objectives.
4.2 Policy recommendations	Hopes and statements for future policy or changes in market regulation. Also, discussion on lobbying or getting organized.
5 Impacts of BM on socio-technical regime	Covers all discussion on how various novelties, including megatrends/landscape changes affect the regime pressuring traditional actors to react to development, e.g. wanting to provide DR services, company fusions, falling out of business. Meaning besides BMs and new companies, all change pressures towards regime are coded in this node.
6 Innovation	All discussion on past and future R&D and realizations.
7 Conflicts	Conflicts and tensions that DR or the novel BMs for DR create in the energy markets, e.g. conflicts of interests, fear of losing market status, between traditional market actors or traditional and new-comer actors etc.
8 Scale of BM	8.1 Concept stage = discussion on why BM is under development, not launched yet or doesn't provide any income yet

(*continued on next page*)

(*continued*)

	8.2 Realized stage = discussion that points out that the BM is already put-in-practice and providing some income, though it is not necessarily profitable.
9 Market formation	Information on how the DR market is forming
10 Future visions	Future DR visions of the company

Appendix C. Details of the demand response companies studied

Company	Company category	Energy market activities	Core DR businesses	Customers (energy end users)
A	Technology start-ups	DH DR	Building an automation service package that includes DR	Owners of large buildings
B	Technology start-ups	Electricity: aggregation	Building an automation service package that includes DR, product sales, taking part in Fingrid markets	Owners of large buildings
C	Technology start-ups	DH DR, electricity: spot–price optimisation, planning sub-aggregation	Building an automation service package that includes DR, planning to take part in Fingrid markets	Households
D	Technology start-ups	Electricity: spot–price optimisation, planning aggregation	Building an automation service package that includes DR, planning to take part in Fingrid markets	Households
E	Technology start-ups	Electricity: spot–price optimisation, planning (sub-) aggregation	DR service package for energy end users, planning to take part in Fingrid markets	Households
F	Technology start-ups	Electricity: spot–price optimisation, aggregation and storage	DR service package for energy end users and renewable energy producers, taking part in Fingrid markets	Owners of large buildings
G	Companies from adjacent industries	DH DR	Building an automation service package that includes DR	Households and public buildings
H	Companies from adjacent industries	Electricity: spot–price optimisation and aggregation	Building an automation service package that includes DR, product sales, taking part in Fingrid markets	Large and semi-large building owners, piloting with households
I	Companies from adjacent industries	DH DR	Building an automation service package that includes DR	Households
J	Companies from adjacent industries	Electricity: spot–price optimisation and aggregation	Building an automation service package that includes DR, product sales, taking part in Fingrid markets	Households and owners of large buildings
K	Companies from adjacent industries	Electricity: enabling aggregation	Product sales, enabling large customers to take part in Fingrid markets directly	Owners of large buildings
L	Companies from adjacent industries	Electricity: spot-price optimisation and aggregation	Demand response service packages for energy end users and energy companies, taking part in Fingrid markets	Owners of large buildings
M	Companies from adjacent industries	Electricity: spot–price optimisation and aggregation	Taking part in Fingrid markets, DR service package for energy companies and building an automation service package for energy end users that includes DR	Households
N	Companies from adjacent industries	Electricity: spot–price optimisation, planning (sub-) aggregation	Building an automation service package that includes DR, planning to take part in Fingrid markets	Owners of large buildings
O	Companies from adjacent industries	DH DR	Building an automation service package that includes DR	Owners of large buildings
P	Companies from adjacent industries	Electricity	Product sales, business to business DR services	–
Q	Incumbent energy companies	DH DR in development phase, electricity: spot–price optimisation, aggregation	Electricity tariff with DR incentives (DR enabling technology via a partner), taking part in Fingrid markets	Electricity: Households (own energy customers), large buildings
R	Incumbent energy companies	Electricity: spot–price optimisation, aggregation	Electricity tariff with DR incentives (DR enabling technology via a partner), taking part in Fingrid markets	Households (own energy customers), large buildings
S	Incumbent energy companies	Electricity: spot–price optimisation, aggregation	Management of customer's multiple resources (loads, generation, storages)	Households and large buildings (NOTE: no own electricity customers)
T	Incumbent energy companies	Electricity: spot–price optimisation, aggregation	DR service package for electricity end users, taking part in Fingrid markets	Households (own energy customers) and large buildings
U	Incumbent energy companies	DH DR	DR as a part of heating service (main focus on cost savings)	Own DH customers (main focus on large buildings)
V	Incumbent energy companies	DH DR	Building an automation service package that includes DR (improved living conditions and cost savings)	Own large DH customers (large buildings)

Large buildings, e.g. rental housing, housing corporations, schools, supermarkets, shopping malls, hospitals, industrial buildings.
DH = district heating.
DR = demand response.

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