STALEMATE IN POLICY-PUSHED MARKETS: THE CASE OF LOCAL ENERGY FLEXIBILITY MARKETS

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ABSTRACT

The formation of policy-pushed markets has been underexamined in the transition literature, despite their importance for achieving sustainability policy objectives and their greater risk of failure. This study draws from service-dominant logic, i.e., a marketing-originated meta-theory of markets, to explain why one of these policy-pushed markets—local energy flexibility markets—may not develop. In particular, we show that when policy-pushed markets are proposed to actors, they assess their resourceness, anticipate the required interactions to integrate resources, and forecast potential value formation. Actors' limited resourceness and unwillingness or inability to interact explain why value processes do not unfold so that the market does not develop. We also demonstrate that when markets are tightly coupled, actors' agency to procure access to resources or coordinate value flows is limited, which prevents the market from self-adjustment. This paper shows that the application of service-dominant logic as a meta-theory for understanding market-making may complement the explanations provided by diffusion theories and transition studies.

Keywords: *sustainable markets; service-dominant logic; resource integration; electricity markets; energy industry*

1. INTRODUCTION

Understanding why markets for environmental innovations fail to expand is a fundamental question in transition studies (Boon et al., 2020; Köhler et al., 2019). Most research has examined markets resulting from entrepreneurial behaviour that start operating in niches (Ottosson et al., 2020). However, other markets are policy-driven (Quitzow et al., 2014), i.e., pushed by policy-makers onto regime actors. The main impulse for these markets is usually the achievement of socioenvironmental goals, such

as decarbonization (Di Silvestre et al., 2018), rather than an entrepreneurial assessment of value gaps (Cohen and Winn, 2007). For this, it is plausible to assume that policy-pushed markets have a larger failure potential as the structural tensions are greater (Johansson et al., 2020; Tóth et al., 2018).

The provision of distributed flexibility in electricity systems (flexibility markets hereafter) is an example of policy-pushed markets. These markets are necessary to uphold the decarbonization of the energy industry; for this, they have received great "policy push", especially in the European Union (e.g., Directive EU2019/944; Fjellså et al., 2021). Flexibility can be defined as the possibility of modifying generation and/or consumption patterns following external signals (Villar et al., 2018). Industrial consumers play a pivotal role in flexibility provision, given their higher energy intensity per consumer (Chau and Fernando, 2018). There are two flexibility services offered by industrial consumers: balancing and local congestion management.

Regarding balancing, to cope with the increasing intermittence of renewable energy sources and other generation/consumption mismatches, transmission system operators (TSOs) resort to balancing markets by procuring the reduction or increase in energy generation or consumption to ensure balance at any given time in exchange for compensation. In relation to local congestion management, distribution system operators (DSOs) are increasingly engaged in the active management of the distribution grid. Until now, distribution grids have been overdimensioned to cope with very high, but very rare, peaks in demand. DSOs could use the flexibility provided by industrial consumers to manage local congestions at those peak hours, which could defer or avoid costly grid reinforcements (Ruester et al., 2014). Although these markets may create, *inter alia*, economic and environmental value for incumbent actors, at the time of this research, flexibility markets for local congestion management remain underdeveloped (Minniti et al., 2018; SmartEn, 2021). Thus, they constitute an appropriate context to study, namely, why policy-pushed markets may not develop. More specifically, our guiding research question is as follows: what processual dynamics hinder flexibility market development?

This question has not been fully answered in past studies for two reasons. First, other work has explored the motives and barriers of a single actor, notably industrial customers (Angizeh et al., 2017; Jonkman et al., 2018; Heffron et al., 2020; Ma et al., 2018, 2020). Not only have some actors (e.g., TSOs and aggregators) gone underexamined (Bray and Woodman, 2019; Khajeh et al., 2020), but the interaction among actors in dyads or triads has been limitedly studied (CEER, 2016; Hadush and

Meeus, 2018; Lambert et al., 2018). This approach has occluded a full understanding of the complex network underpinning market formation. Second, past studies have listed the barriers perceived by incumbent actors, but an integrated and comprehensive explanation of the mediating mechanisms whereby these barriers jeopardize market development is missing (Khajeh et al., 2020; Roth et al., 2020).

Studying this market from service-dominant logic (S-DL) (Mele et al., 2018; Vargo and Lusch, 2004) could help overcome these gaps. S-DL is a meta-theory of markets developed in the marketing discipline that has seldom been applied in transition scholarship to explain the formation and development of sustainable markets. Specifically, three main tenets of S-DL may contribute to our understanding of policy-pushed market making: (1) value formation is cocreated by all market actors (Fryberg and Jüriado, 2009), (2) value is cocreated as a result of actors' resource integration (Vargo and Lusch, 2008), and (3) value processes are affected by existing institutional arrangements (Vargo and Lusch, 2016).

First, extant explanations for market underdevelopment often centre on final users and their assessment of potential value creation (Clausen and Fichter, 2019; Jonkman et al., 2018; Forouli et al., 2021; Vesa et al., 2020). However, market development depends on a wide range of stakeholders who jointly co-create value (Fichter and Clausen, 2021; Ottosson et al., 2020; Vargo and Lusch, 2004). Indeed, markets are integrated by manifold actors coupled through value creation processes (Akaka et al., 2012; Chandler and Vargo, 2011; Lusch et al., 2010). Thus, consistent with the scholarship on transitions (Köhler et al., 2019), a multiactor examination is fundamental to explain market development. However, scant studies have provided data from more than one actor (Chowdhury et al., 2016), especially in studies of flexibility markets (Forouli et al., 2021).

The second fundamental tenet of S-DL is that value is interactively formed (Plé, 2017; Vargo and Lusch, 2004), as actors integrate their resources to cocreate value (Mustak and Plé, 2020; Plé, 2016). The understanding that all actors are resource integrators contrasts with the traditional emphasis on suppliers' deployment of resources to create value (Kleinaltenkamp et al., 2012). Resource integration (RI hereafter) is a fundamental social process underpinning market development and, for this, the mediating mechanisms linking barriers and market development. Our proposed conceptualization centred on RI complements other processes—such as legitimacy construction or innovation acceptance (Köhler et al., 2019; Papachristos, 2018)—that are already used to explain market formation and development.

The third key insight of S-DL consists of institutional arrangements and their shaping of the RI process, either by constraining/expanding the resources of actors, facilitating/curtailing the integration of resources, or the realization of positive outcomes (Caridà et al., 2019; Mele et al., 2018; Plé, 2016). This third tenet ensures that both agency and structure and the reciprocal influence on one another are considered when explaining market formation and development (Akaka and Chandler, 2011; Chandler and Vargo, 2011; Geels, 2020).

We apply these three tenets to explain why flexibility markets are limitedly developed. First, as these markets require interactions between and among several actors (notably, industrial consumers, DSOs, TSOs and aggregators), their views should be examined simultaneously. Second, we maintain our analytical focus on RI as a central process for value creation and, consequently, for market development. Most research on S-DL has examined RI in markets already formed and has thus studied actors in their interactions (e.g., Cabiddu et al., 2019; Caridà et al., 2019; Plé and Demangeot, 2020). In contrast, this study centres on a policy-pushed market proposed to actors but not yet fully-fledged. For this, we examine actors' expectations about the RI process, namely, their forecast of their resourceness, the resource-integrating processes, and their expectations about ensuing value creation or destruction. Finally, although our primary aim is to understand actors' views, we also examine the institutional arrangements governing this market and how they can affect the RI process.

Our analysis is grounded in 31 in-depth interviews with all actors that could potentially participate in the market in four EU countries. To expand the generalizability of our findings, we also review past studies reporting actors' perceptions of flexibility markets in other countries (see Appendix 1 for a summary). We revisit their results and show that they are consistent with the conceptual framework presented here. We show that the limited resourceness of actors and the unwillingness and inability to interact with other actors curtail the resource integration process. Moreover, as actors anticipate net deficits from the interaction, they are reluctant to obtain the resources or overcome the resistance to interact. Institutional arrangements shape the RI processes by curtailing the willingness and ability of actors to reconfigure the RI process. As a result, the flexibility market is not developed, despite the push from policy-makers (Johansson et al., 2020).

The contribution of this study is twofold. First, the application of S-DL to better understand the dynamics leading to the limited formation of markets enriches our understanding of how energy and nonenergy markets may develop, which is a gap that

has been raised by past studies (Ekman et al., 2019; Sadjadi, 2020; Smyth et al., 2018). Moreover, we demonstrate that the application of S-DL not only helps explicate existing markets but also may provide the basis for a programmatic analysis to forecast the trajectory of newly formed markets, especially policy-pushed, sustainable markets. Second, we contribute to the literature on flexibility markets by providing an integrated and process-based explanation for their limited development. More specifically, we go beyond the descriptive lists of the barriers encountered by actors (e.g., Olsthoorn et al., 2015) to explicate the mediating process whereby these barriers hinder market development. In doing so, we also aim to provide actionable strategies for more effective policy-making that can sustain these sustainable markets.

2. RESOURCE INTEGRATION, VALUE FORMATION AND MARKET DEVELOPMENT

Resource integration (RI hereafter) is the fundamental process underlying value formation (Kleinaltenkamp et al., 2012; Vargo and Lusch, 2004). RI can be defined as "the incorporation of an actor's resources into the processes of other actors" (Gummesson and Mele, 2010: 192). RI is multidirectional and collective (Fryberg and Jüriado, 2009) since manifold actors mobilize and integrate resources "across and through networks" (Caridà et al., 2019: 67).

RI can be studied by focusing on three suborder processes: matching, resourcing and valuing (Caridà et al., 2019). *Matching* consists of the "fitting of available resources" (Caridà et al., 2019: 70). Actors may own these resources or simply have access to them (Edvardsson et al., 2011) from other networks (Greer et al., 2016). The resourceness of actors is a precondition for RI to occur: if actors lack resources—and cannot or do not want to obtain them—then RI integration cannot occur (Kleinaltenkamp et al., 2012). It should be borne in mind that matching is not cost-free; the use of resources has a cost for actors (Salonen and Jaakkola, 2015). At a minimum, opportunity costs are to be considered, especially when the matched resources are locked in a value process and cannot be used in other value processes (Smith, 2013).

Resources are anything that can potentially create value (Akaka and Chandler, 2011). The broad distinction between intangible or operant and tangible or operand resources established by Vargo and Lusch (2004) has been complemented by more fine-grained classifications (Plé, 2016). Following Peters et al. (2014) and Plé (2016), operand resources can be further distinguished into financial (monetary resources that allow acquiring other resources) and physical (tangible resources such as physical materials or

spaces). Similarly, operant resources can be broken down into human (individual competences or skills to act upon other resources), organizational (corporate operations and culture), informational (information about markets and competitors) and relational (networks of relationships actors can draw from).

Resourcing consists of actors' operations on available resources so that actors' basic resources are integrated and transformed into composite and interconnected resources to create specific benefits (Caridà et al., 2019). Actors' resources have *potential* value; this potential value is only realized when one actor's resources are integrated with those of other actors to coproduce a service (Caridà et al., 2019; Peters et al., 2014). Thus, resourcing involves creating a contextualized configuration of resources for service provision (Plé, 2016). Because resourcing is a cooperative activity, limited trust among actors may hinder resourcing (Kleinaltenkamp et al., 2012). Additionally, if there is a missing a procedure for resourcing that is understood and shared by actors, then the actors' ability to interact may be curtailed (Caridà et al., 2019).

Valuing entails the assessment of positive or negative outcomes created in the two previous subprocesses. As much research has shown, RI does not necessarily lead to value creation. If resources are not integrated or if they are misintegrated, actors may experience resource loss or diminish their ability to exploit resources (Cabiddu et al., 2019; Echeverri and Sklären, 2021; Laud et al., 2019; Plé, 2016; Plé and Chumpitaz-Caceres, 2010; Smith, 2013). Then, the value potential may not be realized; thus, it is said that value is either not formed or destroyed (Makkonen and Olkkonen, 2017). Although value destruction has been found to result from resource misintegration, it should be noted that the reverse does not always occur, as resource misintegration does not necessarily lead to value destruction (Plé and Chumpitaz-Caceres, 2010; Plé, 2016). Given that value is multidimensional, destruction of one form of value may be tolerated if compensated by other forms (Cabiddu et al., 2019; Plé, 2017). However, if an actor anticipates net deficits (negative valuing), it is likely that such actor will refuse to fit resources or to interact (Gebauer et al., 2013), and RI would not occur.

Thus, the three subprocesses of resource integration (matching, resourcing and valuing) should not be regarded as linear and orthogonal to one another; rather, they are interlinked. Actors' forecasted risks in resourcing and/or actors' expected negative valuing might affect their matching or fitting of available resources. Valuing does not occur at the end of an interaction. Rather, actors at any point reflect on the value being created (Kleinaltenkamp et al., 2012); actors anticipate potential value creation following

RI so that if the forecasted benefits are not evident, actors may not fit resources or interact (Blut et al., 2020; Heinonen et al., 2013; Kleinaltenkamp et al., 2012).

Although research has shown that value creation and destruction may temporally coexist (Echeverri and Skålén, 2021; Plé, 2017; Plé and Demangeot, 2020). Over time, incumbent actors may initiate changes to redress value destruction (Akaka et al., 2012; Plé, 2016). It is unlikely that actors maintain their commitment to matching and resourcing if they do not obtain net positive outcomes (Gebauer et al., 2013). This homeostatic view of markets was defended by Vargo and Lusch (2008)—and supported in several studies (Tóth et al., 2018)—when they asserted that markets self-adjust or change to ensure that value is realized for actors over time as a condition for their continued participation in value processes. Additionally, this view reflects the agentic view of actors that can affect, at least partially, how markets evolve (Chandler and Vargo, 2014).

However, self-adjustment is more difficult in tightly coupled service systems (Mustak and Plé, 2020) or markets guided by hard contracts that "explicitly formalize and specify the terms and conditions of the actors' association" p. 310), with clear specifications and clear power centres. In tightly coupled systems, actors tend to experience limited agency or limit other actors' agency (Mele et al. 2018; Mustak and Plé, 2020). These hard contracts are usually the result of existing institutional arrangements (Mele et al., 2018; Vargo and Lusch, 2016), notably regulation. If regulation limits actors' agency, the three subprocesses described above are hindered: if regulation does not enable actors to ensure their resourceness and/or to integrate resources with other actors, the negative outcomes may outperform the benefits. Not only may the agency of actors be curtailed; in tightly coupled systems, benefits may not be distributed equally among actors. Then, the so-perceived losing actors will be less likely to fit resources, as they anticipate net deficits from the interaction (Kleinaltenkamp et al., 2012; Tóth et al., 2018).

In sum, we argue that resource integration is the underlying process for value formation. When policy-pushed markets are proposed to actors, these actors assess their resourceness, anticipate the required interactions to integrate resources, and forecast the potential value formation by estimating the benefits and costs associated with matching and resourcing. If RI is negatively assessed, actors will not start interacting, value processes will not unfold, and the market may not be developed. When institutional

arrangements limit actors' agency to overcome resistance, the potential for market development is even lesser.

3. FLEXIBILITY MARKETS

This section describes how flexibility markets work. First, it explains the actors, activities and resources theoretically necessary for this market's work. Second, it succinctly explains the regulation shaping this market.

3.1. Actors, activities and resources

Flexibility markets are based on the ability of an end-user to purposely deviate from a planned/normal generation or consumption pattern (USEF, 2018) in response to economic or environmental signals (Albadi and El-Saadany, 2008; Abdollahi et al., 2012). This study examines explicit flexibility, whereby end-users receive specific economic and/or volume signals to modify their power consumption or generation, in addition to regular electricity prices and tariffs (e.g., $1/kWh for a reduction of consumption from 6 pm to 9 pm on a given day). Reactions to these flexibility signals can be activated manually or automatically. The choice of one or the other usually depends on the end-user preferences and the flexibility product conditions (e.g., fast response products generally require automation). The latter requires some sort of local controller that, for example, switches on/off certain appliances in response to flexibility signals subject to comfort or process-related constraints. However, especially in residential demand response, direct load control (DLC) has been tested internationally in the context of different implicit and explicit flexibility provision programs, with varying levels of acceptance (Darby and McKenna, 2012; Fell et al., 2015). Fell et al. (2015) show that explicit flexibility programs based on DLC (in which appliances are limited during certain hours of the day) are more popular among residential consumers than implicit time-of-use tariffs. Nonetheless, DLC—understood as demand-side resources being activated directly by the grid operator/utility—is not addressed in this paper since it does not fit within the unbundling rules established by the European regulation (except for legacy systems in some Eastern European countries).

Flexibility markets unfold in complex networks (Chandler and Vargo, 2014) where actors compose different dyads and triads where resources are integrated. Industrial consumers may offer their flexibility to system operators (DSOs and TSOs) directly or to aggregators who then bundle energy units from industrial consumers (and possibly other types of consumers and producers) and offer them to system operators. Moreover, different market designs for flexibility procurement may lead to additional dyads and

triads. For instance, flexibility providers (industrial consumers and/or aggregators) may operate in combined flexibility markets, in which both TSOs and DSOs are buyers simultaneously. Another possibility is that flexibility providers participate in different markets organized by TSOs and DSOs separately.

Additionally, different markets may exist for a single system operator. This could be the case for a TSO, for instance, that may organize a market to procure flexibility to solve network congestions and another market to balance generation and demand in real-time. Finally, a hierarchy of markets may be set in place. For example, a flexibility provider offers flexibility to the DSO local congestion management market first. The bids that the DSO does not use are then automatically forwarded to the TSO congestion management market (CEDEC et al., 2019; Gerard et al., 2018).

Flexibility markets are nested into existing electricity markets. The value processes underlying this market will thus be affected by other concurrent value processes in the electricity market. Some market actors (notably, industrial consumers, DSOs and TSOs) need to adopt new roles that coexist with the previous ones (CEER, 2015); thus, depending on the value process, actors, roles and resources are flexibly assembled (Ramaswamy and Ozcan, 2018). To illustrate, in flexibility markets, an industrial firm acts as an energy provider to system operators. However, the same company simultaneously acts as a consumer of energy, in other instances, by withdrawing electricity from the grid and paying producers and networks for its consumption. Flexibility markets demand that actors perform a different role (Plé, 2016). This role change demands new resources (e.g., industrial consumers may need energy generation resources such as photovoltaic panels) or that actors use their existing resources differently (e.g., use their industrial machinery and operations for energy production) (Angizeh and Parvania, 2019; Kuiken et al., 2018). Additionally, industrial consumers need new competences to perform this role, such as understanding the operations of flexibility markets or the ability to design interruptible industrial operations (Hamwi et al., 2021; Ma et al., 2018; Roth et al., 2020). Similarly, DSOs need to change their approach to grid management, moving from the "fit-and-forget" approach to active management of the grid (Hadush and Meeus, 2018; Ruester et al., 2014). This requires organizational changes, such as developing capabilities for market design and operation, as well as market platforms, communication and monitoring equipment (Giulietti et al., 2019; Laaksonen et al., 2021). The new role performed by TSOs in this market requires new uses of resources and new resources, such as a different relationship with DSOs

(CEDEC et al., 2019), including the sharing of the system's operation and responsibility with the DSOs (IRENA, 2019; Roos, 2017).

Not only do actors change their roles in value processes, but also other roles are also necessary for this market. Aggregators of industrial demand are a case in point (Blomgren et al., 2021). Such a role may be played by existing retailers or by new incoming actors, such as ESCOs (Lampropoulos et al., 2018). Aggregators, tapping onto ICT developments (i.e., cloud services, artificial intelligence or IoT), offer flexibility provision services (Siano, 2014) to both industrial consumers and system operators.

3.2. Institutional arrangements and regulation

Due to EU-level regulation, power systems and markets in Europe are harmonized vis-à-vis their guiding principles and structure. They are characterized by liberalized wholesale and retail markets (Pérez-Arriaga, 2014). Transmission and distribution companies (TSOs and DSOs, respectively) are natural monopolies and hence regulated activities that are required to fulfil unbundling requirements if they are part of a company group that also operates in a generation or retailing (CEER, 2014; Pérez-Arriaga, 2014). These unbundling requirements were progressively introduced in Europe, starting with the so-called First Package[1] in 1996 and reaching the most recent and current Clean Energy Package (CEP) in 2019. Article 35 of Directive (EU) 2019/944 defines that large DSOs should be at least legally unbundled from a vertically integrated undertaking. TSOs are subject to an even stricter requirement, as they must implement ownership unbundling (Article 40.2 of the Directive (EU) 2019/944). This regulation shapes flexibility markets, as the roles and activities of DSOs and TSOs are regulatorily defined. Simultaneously, the CEP calls for the introduction of several mechanisms aiming at "pushing" flexibility markets, such as the need for incentives for DSOs to use local flexibility in distribution networks (Article 32 of the Directive (EU) 2019/944); however, these mechanisms should be decided nationally.

Member states have some margin to *manoeuvre* for implementing or not implementing certain parts of these directives or for transposing them differently across countries (Mlecnik et al., 2020). For example, while Directive (EU) 2019/944 calls for incentives for DSOs to use flexibility, it also leaves member states to assess when

[1] The most relevant EU legislation on the power sector were published under "packages" of EU Directive and Regulations. These packages were published in the following order: First Package (1996), Second Package (2003), Third Package (2009) and the Clean Energy Package (2019).

flexibility use is beneficial (considering economic efficiency, distortions in other markets or network congestions), the decision on how to incentivize DSOs, and the definition of products, services and procurement mechanisms (Article 32 of the Directive (EU) 2019/944). This whole process of transposition and approval of secondary legislation and norms can last several years. This can lead to a large gap between the publication of EU legislation and national adoption or when the policy is only partially implemented, not providing the necessary institutional arrangement for the market to develop. The limited definition of the aggregators' role is a case in point (Bray and Woodman, 2019; Poplavskaya and de Vries, 2018).

Regulators and policy-makers have a key role in the resource integration process by providing fertile institutional arrangements, especially considering the heavily regulated nature of some actors and activities in electricity markets. Whereas flexibility markets are being pushed by EU policy-makers, existing regulation affects their development (1) because it constrains actors' agency, e.g., by limiting the activities of certain actors, such as DSOs or TSOs or the emergence of new roles such as aggregators; (2) because other regulation may act as a barrier for this market to unfold, e.g., DSOs require a change in the way their revenue is regulated to have appropriate incentives; or (3) because there are policy or regulatory gaps, especially concerning market design, actors' responsibilities, coordination mechanisms, and value capture and sharing among actors.

4. METHOD

In-depth personal interviews were held with representatives from key actors who should participate in flexibility services markets in four European countries, namely, Portugal, Slovenia, Spain, and Sweden. The rationale behind the selection of countries is twofold. First, for certain stakeholders, a multi-nation sample is necessary, as only one institution exists per stakeholder type (namely, the TSO or the regulator). Second, each of the four selected countries presents slight differences in their national regulation of energy markets.

An interview guide was used to establish a baseline, ensuring comparability among interviews. Nevertheless, a semistructured and conversational approach was followed, allowing for a deeper exploration of the interviewee's perceptions. Questions were adapted depending on the actor. We started with general questions such as "would you be willing to sell (buy) your flexibility to power companies (from industrial consumers)", followed by more specific questions (e.g., "Do your industrial processes

allow for a reduction in electricity consumption for a short time? What benefits and risks do you anticipate from participation in flexibility markets? What changes you deem necessary to hedge the risks associated with your participation in these markets?").

In total, 31 personal interviews, each of which lasted between 45 and 90 minutes, were carried out. After selecting the relevant institutions from each country, individual informants were identified and contacted with the help of local contacts in the four countries. Interviews were conducted both online and face-to-face. To ensure validity, interviews were conducted in teams, assigning each interviewer a different role (e.g., one interviewer´s role was to obtain new information; the other interviewer focused on comparing variables across companies) (Eisenhardt, 1989). To preserve anonymity, nationality was not disclosed if it could make the informant identifiable (Table 1).

Table 1. Description of informants

	Portugal	**Slovenia**	**Spain**	**Sweden**	**Total actor**
End users (industrial association, prosumers representatives, DER owner)	2	5	1	1	9
System operators (DSO/TSO)	1/1	1/1	2/1	2/1	10
Retailer and energy service providers (ESCOs, Aggregator, Retailers)	1	2	2	1	6
Regulators/policy-makers	1	1	2	2	6
Total country	6	10	8	7	31

All interviews were then transcribed and analysed using pattern-matching and explanation-building techniques (Yin, 2004). We read through each transcription and gave first-order labels to each of the barriers or problems described by informants. These labels were then classified and relabelled as resources using the typology presented in the conceptual framework. These resources were then systematically compared across countries and actors; however, we did not observe any relevant or systematic difference in the discourse of a given actor (e.g., DSOs) across countries, other than references to national or local specificities. Finally, we searched for the actors' rationale explaining why they were reluctant to obtain their missing resources or, if they had them, why they were reluctant to interact with other actors. To triangulate the findings, we compiled past studies on motives/barriers for flexibility markets (Appendix 1). We then re-interpreted

their results in light of our emerging themes. Our explanation of the dynamics hindering the development of flexibility markets is consistent with their results.

5. FINDINGS

The analysis of the interviews shows that two main factors explain the limited development of flexibility markets. First, actors anticipate barriers to matching, resourcing and valuing. These forecasted obstacles hinder the RI processes; actors cannot or do not want to interact, the potential value is not realized, and the market remains underdeveloped. Second, actors have limited potential to self-adjust. The anticipated barriers are, at least partially, difficult to overcome since existing institutional arrangements shape them. Consequently, market balancing mechanisms are not deployed (Tóth et al., 2018). These two factors are explained in turn.

5.1. Anticipated barriers to the subprocesses involved in resource integration

Actors' resourceness is the first condition for RI to unfold. However, matching is curtailed due to actors' lack of necessary resources for value formation (see a summary of missing resources in Table 2). For instance, industrial consumers report lacking physical resources such as interruptible machinery or organizational resources such as interruptible processes. For this, their current operational procedures are not fitted to provide flexibility to the grid. Small industrial firms also lack energy-management competences: they lack personnel with expertise in energy and are able to design operations that can be activated/deactivated following grid demands. These companies also have limited relational resources: their operations managers have not deployed a network of relations with energy-related companies they feel at ease to interact with. Industrial firms also report limited informational resources, notably concerning the financial impact of flexibility provision. As one informant stated, "It is not that they don't have interest; it is the uncertainty about the impact on the bottom-line. How much money is it going to cost, and how much money am I making with it [selling flexibility]? If profitability is good enough, they will be interested"

This quote shows the reciprocal linkages between matching and valuing. Because actors have limited organizational and informational resources, they are uncertain about the outcomes of flexibility provision. In turn, this uncertainty limits their willingness to invest in acquiring their missing resources. To illustrate, industrial consumers could outsource energy-management services to compensate for their lack of built-in capacity. However, they acknowledge their reluctance to share what they regard as sensitive information with ESCOs. As a condition to outsource, they demand some form of

evidence about future benefits, but to be shown these benefits, industrial consumers must first nurture relational resources with ESCOs, which seems to create a vicious cycle. As a member of an industrial consumers' association put it:

Table 2. Missing resources acknowledged by informants

	Physical	Human	Organizational	Informational	Relational
Industrial consumers	Smart or interruptible equipment (e.g., smart fridges or heat pumps) that can be (de)activated following market demands for flexibility. Storage systems or self-production systems. *Similar missing resources reported in France (Hamwi et al., 2021) and the Netherlands (Jonkman et al., 2018; Lampropoulos et al., 2018).*	Personnel with energy expertise that can plan interruptible industrial operations. *Similar missing resources reported in Austria, the Netherlands and Spain (Marino et al., 2011).*	Interruptible operational designs. Operations that can provide energy in the required blocks. *Similar missing resources reported in France (Hamwi et al., 2021), Denmark (Blomgren et al., 2021) and Europe (Marino et al., 2011).*	Research or studies demonstrating the positive outcomes (notably, economic) of providing flexibility to the grid. Methodology to measure and anticipate the return on the potential investments that consumers should do. *Similar missing resources reported in Germany (Roth et al., 2020) and US (Livingston et al., 2018).*	Trustworthy and cooperative relations with energy operators. *Similar missing resources reported in Denmark (Ma et al., 2018) and Germany (Roth et al., 2020).*
DSOs and TSOs	Platforms that can support the coordination of flexibility procurement and activation. Devices to ensure observability and controllability.	Personnel with skills and competences *Similar missing resources reported in Sweden, Spain and Turkey (Marino et al., 2011).*	Organizational capabilities to manage the flexibility service. Revenues tied to grid reinforcement. *Similar missing resources reported in*	Studies demonstrating the financial return of potential investments. *Similar missing resources reported in UK (Bray and Woodman, 2019), US (Livingston et al., 2018)*	Relational network between DSOs and TSOs. *Similar missing resources reported in Denmark (Roos, 2017), Europe (CEER, 2015; Hadush and Meeus, 2018).*

	Similar missing resources reported in Brazil (Bellido et al., 2018) and Europe (Giulietti et al., 2019).		*Europe (Giulietti et al., 2019; Shomali and Pinkse, 2016).*	*and Europe (Giulietti et al., 2019).*	
Aggregators	Lack of standardization of market interfaces across countries. *Similar missing resources reported in UK (Bray and Woodman, 2019) and the Netherlands (Jonkman et al., 2018).*			Information about industrial consumers' energy consumption and management. *Similar missing resources reported in UK and Belgium (Forouli et al., 2021), the Netherlands (Lampropoulos et al., 2018) and Denmark (Blomgren et al., 2021).*	Limited network of relations among industrial consumers. *Similar missing resources reported in Europe (Giulietti et al., 2019).*

> "They are very, very touchy concerning information. I mean... they, they are so touchy that they don't want to share that [referring to the disaggregated electricity consumption of the different industrial sites] with me. Even though they are in the same association. So, this is very... and some of them are extremely touchy. And, also, all the other data that we publish in the reports is always aggregated so that you cannot identify our associates."

Other industrial consumers have resources, but these are locked in other value processes. Unlocking these resources is costly, as companies would have to redesign their industrial operations to make them fit for flexibility provision. If energy costs are a small percentage of total operational costs, industrial consumers anticipate limited economic value, and for this, they are reluctant to fit resources. Finally, industrial consumers' resources may be misaligned or ill-fitted for integration. To illustrate, some consumers could provide flexibility services in blocks larger than what is required by TSOs or DSOs.

DSOs also report lacking expertise and capabilities in managing this service. As happens with industrial consumers, the anticipation of net deficits from the interaction limits their willingness to acquire these resources. Currently, DSOs' revenues largely depend on investments in conventional lines and transformers. Thus, using flexibility services may reduce their asset base and, therefore, their revenues. Consequently, DSOs keep investing in conventional network components. This creates path dependency for the future. Once these investments are in place, they may act as a further reason not to invest in flexibility service management so that future valuing is negatively assessed.

It is also important to note that moving from a "fit-and-forget approach" to flexibility markets may also affect the security of supply; concerns about the reliability of flexibility services compared to conventional grid reinforcements in the long term were raised by informants. If reinforcements are not made in the expectation that flexibility will be procured, but this is done for reasons outside the control of the DSO, then flexibility is not available, and security of supply can thus be compromised. As one DSO phrased it, "You cannot do this without taking a risk". Hence, again, limited informational resources about the market's working, specifically, about future earnings for flexibility provision and about the costs borne by this actor in case the security of supply is compromised, increases uncertainty about future positive outcomes and limits their willingness to fit resources.

Concerning the participation of industrial flexibility in balancing markets, TSOs identified two main types of missing resources: physical and operational. Regarding

physical resources, several TSO representatives stated that it is essential that TSOs have sufficient observability of the resources to verify that they are providing the service. As this quote shows, observability requires deploying measurement devices and communication systems complying with the technical requirements, with a very high time granularity.

> "I don't like the idea of activating that resource, and I don't see what the resource is doing. But I believe they actually are doing what I said, they have to do. But I don't see that. And I want to see it immediately. I mean, immediately. As immediately as in one minute."

Conventional smart metress are not able to provide this information, and there is a lack of an appropriate ICT infrastructure to manage flexibility provision at the network level. In countries where interruptible contracts exist at the moment, the procedures are totally manual (e.g., activations are requested via phone). Again, uncertain positive valuing explains the reluctance of actors, notable TSOs, to deploy this resource.

Another important physical resource mentioned by TSOs corresponds to the platform for flexibility procurement and coordination. Resource integration would require TSOs to adapt to the market platforms they currently manage. In addition to the costs involved, some TSOs expressed concerns about the fragmentation of the market, which is seen as a potential source of value destruction. In particular, the creation of manifold local markets will erode liquidity in upstream flexibility markets, as recognized by one of the informants:

> "You are adding even more market layers to the already existing day-ahead, intraday, mFRR, aFRR and RR[2]. So, what I think could be a challenge is that we split the liquidity."

Additionally, to perform their role in these value processes, TSOs would need to change their organizational procedures and extend this change to the network level. This is a very complex task, particularly because balancing services are critical for system stability. Thus, TSOs are generally reluctant to implement changes unless these new procedures provide greater value than existing procedures. Missing informational resources about the economic value of flexibility services reinforces their reluctance to fit this resource.

[2] mFRR, aFRR, and RR refer to the different types of balancing products, usually procured markets operated by the TSO.

The final market actor are aggregators. To perform their role, they require relational and informational resources (notably, energy-consumption information of industrial consumers). These informational resources are not public and can only be accessed by aggregators if industrial consumers share them. Since consumers, as we explained, are unconvinced to procure them, this resource is missing. They also lack a physical resource, namely, compatible market interfaces EUwise, to expand their customer base, which is necessary to increase valuing. However, the standardization of market interfaces across countries is an important missing resource for aggregating international demand. As one of the aggregator/suppliers recognized:

"The main barrier is that you have to start from scratch again in each European country because, on purpose, we have completely different regulations and legislations in each country, which is mainly for protecting the national market against big suppliers from other countries."

Informants also pointed to barriers limiting actors' interactions to operate on existing resources, thus curtailing the resourcing subprocess. Resourcing demands the "alignment of procedures, understanding and engagements" (Caridà et al., 2019: 70). Distrust among actors limits this alignment. In the interviews, industrial consumers' distrust about DSOs was especially noted. Industrial consumers believe that value formation is captured mostly by large utilities. As a result, they are unwilling to share information or to act on information they receive from other actors, as they believe that this information is biased to suit their corporate interests ("Then it is still the game for four of the rich companies. There is no money for small players") (Slovenia).

Beyond distrust, all informants acknowledge that coordinating mechanisms for resourcing are missing. Such coordinating mechanisms emerge "through knowledge, skills and institutional arrangements" (Caridà et al., 2019: 70). As mentioned above, knowledge and skills were two of the missing resources reported by actors, so this may partially explain the difficulties encountered in deploying such coordination mechanisms, only aggravated by existing regulation as discussed in Section 5.2.

In sum, matching is limited, either because they do not possess resources fitting the value process or because they depend on other actors' resources and are unwilling to fit them. Moreover, their uncertainty regarding future value creation, or worse their anticipated net deficits, explains why actors are reluctant to invest to procure these resources. Resourcing, or acting upon resources to coproduce the service, is also jeopardized because distrust among actors inhibits their willingness to interact and/or

because missing coordination mechanisms hinder their ability to interact. Here, again, uncertain or anticipated negative valuing restricts the willingness of actors to invest in creating such coordinating mechanisms.

5.2 Existing institutional arrangements limit self-adjustment

The analysis of interviews also showed the relevance of institutional arrangements for flexibility market's formation. Moreover, the interviews also showed the obstacles that regulators and policy-makers encounter to change these arrangements.

Informants acknowledge that existing regulatory dispositions, regulatory *lacuna* and regulators' limited responsibility in providing missing resources limit the three subprocesses described above. Next, we provide some illustrations of these three ways whereby regulation limits market self-adjustment. Regarding existing regulation, regulators recognise that the existing CAPEX bias, i.e., regulation encouraging investment over flexibility procurement. In current DSO revenue regulation is a key barrier and one of the priorities for regulators ("I think it the wording in the Clean Energy Package places a pressure on the member states to try to rethink CAPEX-based regimes"). Whereas they are aware of the problem, they generally expressed that it is unclear how regulation should be framed to overcome it. Another informant recognizes that regulation needs to be adapted, but there is no agreement as to which regulations need changing, where and how. Another regulator mentioned that explicit flexibility mechanisms need to be coordinated or consistent with implicit flexibility mechanisms embedded in network tariffs (e.g., critical peak tariffs) ("When designing explicit mechanisms, it is important to consider the effect on the implicit mechanisms, so one doesn't jeopardize the expected effects of the other."). However, there is no agreement yet on how these mechanisms should be set in place.

Concerning the provision of missing resources, regulators and policy-makers also note that industrial consumers are reluctant to enter the market ("unlocking end-user flexibility is probably the hardest change to materialize", said one informant). With their reluctance, the valuing potential for other actors is curtailed, and consequently, the RI process does not unfold. Regulators acknowledge that they should take up the role of resource providers, for instance, by facilitating information about the market or even subsidies for the required equipment. Additionally, to increase valuing consumers, they also envisage the need to reform electricity tariffs. However, these enabling mechanisms are not yet in place.

In addition to increasing the positive outcomes resulting from RI, regulators also recognise the need to reduce the costs. As mentioned in Section 5.1, DSOs expressed concerns about the effect of flexibility used on the security of supply and the costs that breaches of supply would be enforced on this actor. Regulators could reduce these costs by establishing margins of acceptable risks. As one DSO said, "Regulation itself has to be able to accept this risk and provide guidelines that will give the security that we are taking a risk that the regulator considers acceptable". Therefore, regulators are faced with the challenging decision of complying with European regulations by fostering flexibility markets but at the same time have to assess and decide on adaptations in the governance of power systems without putting at risk their reliability.

The interviews also showed that regulators and policy-makers find barriers to changing existing institutional arrangements to enable the development of flexibility markets. First, the necessary changes are not straightforward, considering the complex interrelations between enabling flexibility markets and other policies and regulatory aspects (e.g., electricity tariffs). Second, they face uncertainty with regard to the system's reliability after the changes. It is important to note that they are also incentivized in different ways. While they are required to adopt EU regulations and look for economic efficiencies, maintaining reliability remains a larger incentive, which explains why regulators act in a risk-averse way. Finally, governance and organizational aspects may also pose challenges. Some inefficiencies sometimes influence the former in the sharing of competences between policy-makers and regulators.

Moreover, regulators and policy-makers recognize having limited resources to implement the goals set up in the directives, notably in the clean energy package. This directive places new responsibilities on regulators, but they are not allocated enough resources to carry them out as desired. Others claimed they would like to have more competences (e.g., enable pilots/sandboxes or provide guidelines for regulated tariff design). In sum, regulators and policy-makers describe a scenario in which they face difficulties in promoting the necessary adjustments to foster flexibility markets.

6. DISCUSSION AND CONCLUSION

This study has examined the dynamics leading to limited development of policy-pushed markets, those driven by policy-makers and those imposed on regime actors as part of a socioenvironmental strategy. By drawing from S-DL, we argue that resource integration among actors is necessary to create value and, thus, to develop the market. If this microsocial process is blocked, policy-pushed markets remain underdeveloped. We

illustrate this process by focusing on flexibility markets, an example of an underdeveloped policy-pushed market in the EU.

In particular, RI is the result of three interconnected subprocesses: matching, resourcing and valuing. If any of these subprocesses is curtailed, RI does not occur. Matching is hindered by actors' limited resourceness and aggravated further by their unwillingness to fit the resources necessary in this value process. Additionally, resourcing is hindered because actors are unwilling or unable to interact to coproduce the service. Uncertain or anticipated negative valuing explains their reluctance to fit these necessary resources and/or to interact. Consistent with other studies (Marino et al., 2011; Paterakis et al. 2017), we show that institutional arrangements also block market expansion. Since institutional arrangements limit actors' agency to provide missing resources or create a governance system that ensures coordination and fair distribution of value, the market cannot self-adjust and remains underdeveloped.

The application of S-DL to understand the formation and expansion of sustainable markets enriches and complements past studies. Unveiled in this study, the notion of limited resourceness of actors underpins some of the meta-factors that have been shown to impede the diffusion of environmental innovations. The fact that users' perceived limited compatibility and perceived value as well as the producers' limited market push can be explained by the limited resourceness of actors (Clausen and Fichter, 2019). This suggests that S-DL and diffusion theory may be bridged to analyse the trajectories of markets better, since actors' resourceness is a necessary and prior condition for adoption and diffusion. A focus on resource integration can also provide useful insights for transition studies since it offers a programmatic analysis that can help forecast transition trajectories. Researchers are encouraged to first understand which resources actors should integrate and to assess whether actors may have access to them, together with their willingness and ability to integrate them. Moreover, unless it is clear how actors capture value, they may anticipate net deficits that further hinder the resource integration process.

The application of this analysis will show gaps in the RI subprocesses that need remedying for value to be created so that the market develops. If other value networks cannot provide these resources or actors are reluctant to fit these resources, the market is unlikely to develop. As the case studied showed, to increase actors' resourceness, it is fundamental to act upon other fields or value networks. To illustrate, to ensure industrial consumers' resourceness, actions must be taken in industrial equipment design to make it compatible with interruptibility, in the training of planners of operations, and even in

the markets that industrial consumers attend to. Thus, market formation is also dependent on the ability to mobilize resources in these other value networks and facilitate linkages among these fields. This provides further reasons for a *whole system view* to understanding the energy transition (Bauknecht et al., 2020).

This study also underlines the fundamental role of the institutional arrangements in which markets are embedded. Whereas other studies have foregrounded the role of governments as market shapers (Ottosson et al., 2020) and the influence of policy-making on diffusion (Fichter and Clausen, 2021), this study shows that public policies may curtail the resource integration process. If institutional arrangements do not enable actors' role appropriation and performance, resource integration will be curtailed. We have noted how both existing energy regulation/policies or regulatory lacuna limit matching (actors' resourceness), resourcing (interactions among actors) and valuing. This observation reflects another form of "policy incoherence" (Huttunen et al., 2014) that, in this case, hinders market development.

This study opens future research avenues. Future work could study actors who have participated in this market to examine how the anticipated barriers have been removed or navigated. Related to this, it would be necessary to study how actors capture value, what forms of expected value were obtained and whether they have compensated different forms of value (e.g., lesser economic value with more environmental value). Additionally, further work could examine how actors interpret institutional arrangements and their attempts to influence regulation and other institutional arrangements to enable the resource integration process.

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CRediT roles.
CV. Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Roles/Writing - original draft; Writing - review & editing.

LL. Data curation; Formal analysis; Investigation; Validation; Roles/Writing - original draft; Writing - review & editing
RC. Data curation; Formal analysis; Investigation; Supervision; Validation; Roles/Writing - original draft; Writing - review & editing
CE. Data curation; Formal analysis; Writing - original draft; Writing - review & editing

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