THESIS FOR THE DEGREE OF LICENCIATE OF PHILOSOPHY

Narratives of energy incumbents

Unravelling perspectives on municipal electric utilities

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Abstract

The dominant narrative in sustainability transitions studies frames electric utilities as incumbents and "villains" who hinder the diffusion of niche innovations (Johnstone et al., 2017; Turnheim and Sovacool, 2020). This behavior is in line with the conception of incumbent actors as part of the dominant sociotechnical regime (Geels, 2002, 2006a), painting the picture of incumbents with a broad brush and limiting nuance. However, several authors have made attempts to illustrate heterogeneity among incumbents and that some can take on proactive roles in advancing niche innovation (Altunay et al., 2021; Ampe et al., 2021; Apajalahti et al., 2018; Berggren et al., 2015; Stalmokaitė and Hassler, 2020). The purpose of this licentiate thesis is to advance this inquiry by unravelling the narratives of electric utilities as incumbents in energy transitions.

Three narratives are explored through a synthesis of two qualitative case studies of Swedish electric utilities' engagement with solar photovoltaics. The thesis is organized along two core questions: *how* electric utilities engage with this emerging technology at the level of business models and collaborations, and *why* they choose to engage in certain ways, investigating internal and external drivers. The findings show that most electric utilities engage with solar photovoltaics through a variety of business models and collaborations, depending on a combination of firm-internal factors (i.e., organizational goals, business logics, and resources) and external factors (i.e., the task environment, the institutional environment, and the industry regime).

The study illustrates the need for extending dominant narratives, as it shows that electric utility incumbents can support niche innovations, display niche and regime characteristics simultaneously, and react heterogeneously to similar external pressures. As a result, this thesis contributes to pluralizing incumbencies within sustainability transitions.

Keywords: Solar PV, business model choice, innovation, interaction, business relationships, niche-regime interaction, dichotomy.

List of appended papers

Paper I:

Altunay, M., Bergek, A., Palm, A. (2021) Solar business model adoption by energy incumbents: the importance of strategic fit. *Environmental Innovation and Societal Transitions*, 40, 501-520.

Author contributions:

Paper I was written in shared authorship by Anna Bergek, Alvar Palm, and me. While Anna had the idea for the study, acquired the project funds and developed the introduction and theoretical framing, Alvar contributed with his expertise on the solar photovoltaics market in Sweden, and my core responsibility lay in the empirical work. For instance, I conducted the mapping of solar business models in Sweden, drafted the interview guides, conducted, and transcribed the interviews, and analyzed the different levels of strategic fit. As Alvar left Chalmers to continue his career at the municipality of Gothenburg, Anna and I went through the revision process in agreement with him.

Paper II:

Altunay, M., Bergek, A. (n.y.) Interaction between energy incumbents and solar entrants: Relationship status complicated. *Manuscript to be submitted to a scientific journal.*

Author contributions:

Paper II was written in shared authorship by Anna Bergek and me. We developed the idea for the study together during an early project phase, and Anna supervised me in leading the process for conceptualizing, collecting, and analyzing the data, and theoretically framing it. Moreover, Anna contributed with her expertise on niche-regime interaction from a transition's perspective throughout the paper.

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"Some energy companies, I will not name any specific ones, but they said 'no, no, that will never work. We're completely uninterested. Solar will never work in Sweden."
(Solar North, founding member)

1. Introduction

The quote above illustrates most Swedish energy companies' lack of interest in selling solar products and services around 2012. Hesitant and impeding behavior towards niche innovations is in line with the common understanding of incumbent actors in a socio-technical transition. Socio-technical transitions can be conceptualized as system innovations or reconfigurations (Geels and Schot, 2007; Kemp, 1994). The Multi-Level Perspective (MLP) (Geels, 2002) describes transitions in three levels: Regime, landscape and niche. The *regime* is a 'semi-coherent set of rules' constraining and enabling interaction between actors, while the *landscape* refers to external structures and trends. A window of opportunity at the landscape level is required to let radical *niche* innovations enter and disrupt the regime.

Resulting from this classification, incumbents can be expected to react hesitantly when facing change, which has induced many scholars to study their power and influence to shape the direction and speed of a transition (Geels, 2010; Heiskanen et al., 2018; Mori, 2021; Smith et al., 2010; Turnheim and Geels, 2019). To shed light on what exactly previous literature has found about them, let us investigate three dominant, interrelated narratives of incumbents in socio-technical transitions: (i) incumbents as opponents of transitions, (ii) incumbents as part of the regime (as opposed to the niche), and (iii) incumbents as a homogeneous collective of actors making similar strategic choices[1]:

(i) Incumbents as opponents of transitions

Most pathways based on the MLP assume that incumbents try to hinder niche innovations from entering the regime and changing regime rules (Geels, 2002; Geels et al., 2016; Geels and Schot, 2007). In the transitions' universe, niche actors are "challengers" (Lee and Hess, 2019) while incumbents are "villains" (Turnheim and Sovacool, 2020). A common mechanism incumbents use to protect the established routines and ways of doing business is exerting influence on their institutional environment (Geels, 2014a; Smink et al., 2015a; Wesseling et al., 2015) and using strategies of incumbency to 'mask' the real costs, 'capture'

[1] In this thesis, "narrative" should not be understood as a methodological tool, but as a word of everyday language, defined as "a particular way of explaining or understanding events" by Cambridge University Press. Thus, narratives are used as a lens for understanding incumbents through their actions in relation to sustainability transitions.

important political positions, forge ‘reinvention’ or ‘secure’ their interests by connecting to a topic of national security (Johnstone et al., 2017).

(ii) Incumbents are part of the regime as opposed the niche

As introduced in the MLP, a strict separation between the three layers of the framework exists, classifying incumbents are part of the regime and new entrants as part of the niche (Geels, 2006b; Geels et al., 2016; Schot and Geels, 2008). Being associated with the regime means that incumbents are subject to lock-in and path dependence, allowing only for incremental innovation (Geels, 2002). Types of self-sustaining or ‘lock-in’ factors include established routines, infrastructure and technology, patterns of production and consumption, institutions and public regulation as well as cultural values (Klitkou et al., 2015; Seto et al., 2016; Steen and Weaver, 2017). As new entrants try to disrupt the regime and incumbents try to stabilize it, any interaction between actors at the two levels is by default conflict driven (Hess, 2016; Pekkarinen and Melkas, 2019; Smink et al., 2015b). Different modes of conflict characterize the niche-regime interaction also in most transitions pathways (Geels et al., 2016; Geels and Schot, 2007). This narrative enforces narrative (i), depicting incumbents as opponents of transitions, as they only can belong to one level (the regime) and their default interaction with other levels is hindrance and conflict.

(iii) The collective of incumbents makes homogeneous strategic choices.

Initially, incumbents were introduced as part of the social groups which form sociotechnical regimes and are guided by a “semi-coherent set of rules” (Geels, 2002, p. 1260), later refined as “actors [who] are self-interested, act strategically, and try to calculate which actions will best achieve their goals” (Geels and Schot, 2007, p. 403). In spite of this early conceptualization as self-interested and strategic actors, their depiction in transition studies has mostly been much more limited, describing them as “monolithic and inherently coherent entities” (Turnheim and Sovacool, 2020) or “economically motivated unitary actors” (van Mossel et al., 2018). Concealing the variety of motives and strategies within the group and its ‘semi-coherent’ rules supports both narratives (i) and (ii) by putting the same label on all incumbents.

In sum, according to these narratives incumbents as regime actors can be expected to react homogeneously to disrupting niche innovations through different opposing mechanisms. While many examples confirm this dominant story, it does not correspond to our observations of the solar photovoltaics development in Sweden. In contrast, Swedish energy incumbents have engaged in numerous ways with solar photovoltaics, for instance by investing in solar parks, experimenting with novel leasing solutions, and facilitating the establishment of community energy associations. Recent attempts to nuance the energy incumbent narratives need to be considered in order to explain these observations. For instance, incumbents have been shown to play an active role in energy transitions by experimenting with renewable energies (Altunay et al., 2021; Heiskanen et al., 2018), mobilizing social legitimacy for emerging niche innovations (Smith et al., 2010), engaging at the niche level and the regime level simultaneously (Berggren et al., 2015; Galeano Galvan et al., 2020; Stalmokaitė and

Hassler, 2020), and responding heterogeneously to external pressures (Bergek et al., 2021; Näyhä, 2020; van Mossel et al., 2018; van Welie et al., 2018). The purpose of this licentiate thesis is to advance this line of inquiry and further unravel the narratives of electric utilities in sustainability transitions. It thereby follows recent calls to pluralize incumbency by Turnheim and Sovacool (2020) and Kungl (2022). The thesis' structure and contribution follow two guiding questions, which are depicted in Figure 1.

The first guiding question concerns *how* electric utilities engage with solar photovoltaics as an emerging technology. This question is investigated in terms of both action and interaction. First, business models and technologies have been identified as mechanisms through which incumbents can accelerate transitions (Apajalahti et al., 2018). Therefore, the business model concept is introduced in section 2.1.1, and an inventory of the Swedish electric utilities' business models presented in section 4.1.1. Second, interaction between incumbents and entrants is conceptualized from a perspective of business relationships (section 2.2.2) as it has been argued that the success of new entrants depends on collaboration with incumbents because of the influence and power they possess (Geels, 2010). Especially the role of neighboring regimes has been considered beneficial for niche innovations to flourish (Ampe et al., 2021; Turnheim and Geels, 2019). The respective results can be found in section 4.1.2.

Figure 1 Two guiding questions in this thesis[2]

The second guiding question concerns the drivers behind electric utilities' engagement, i.e. *why* they choose to engage with solar photovoltaics in certain ways and not others. I start by outlining the relevance of different external factors of the task and institutional environment in section 2.2.1, in line with Scott (1992), which then is complemented with firm-internal factors in section 2.2.2, as suggested by van Mossel et al. (2018). A collection of the factors influencing Swedish electric utilities can be found in chapter 4.2, followed by a discussion of the findings. The thesis is concluded with a nuancing of the presented narratives, their implication in relation to sustainability transitions research, and an outline of future research plans.

[2] Icons from NounProject.com (Internal by Gregor Cresnar and Diffusion by Ralf Schmitzer)

2. Analytical framework

This chapter starts by creating a shared understanding of which types of firms can be considered *incumbents* in the energy sector (2.1). As outlined in the two guiding questions, it then presents business model choice and niche-regime interaction as two complementary perspectives on *how* incumbents can engage with emerging technologies (2.2) and then presents factors *why* they do so, in terms of external and firm-internal drivers which incumbents can be subject to (2.3). The chapter concludes with an overview of the presented perspectives in Section 2.4.

2.1 Incumbents in the energy sector

To define incumbents, transitions scholars refer to the power and influence they can wield over markets and institutions (Galeano Galvan et al., 2020; Heiskanen et al., 2018; Kungl, 2015; Kungl and Geels, 2018), or the resources they possess to steer transitions in their desired direction, such as customer bases, knowledge, capital, or legitimacy (Bui et al., 2016; Kangas et al., 2021; Turnheim and Sovacool, 2020; Wadin et al., 2017). In this commonly applied understanding, energy incumbents equal *large* utilities (i.e. Apajalahti, 2018; Frei et al., 2018; Kattirtzi et al., 2021; Pereira et al., 2022; Wadin et al., 2017), which in the Swedish context are represented by Vattenfall, E.ON and Fortum. This perspective neglects other types of utilities and the role they can play in sustainability transitions.

In contrast, innovation and management scholars define incumbents more generally in terms of being established actors in an industry (Buenstorf, 2016). This understanding allows us to include municipal electric utilities in the definition of energy incumbents as they have played a central role in Europe in building and operating electricity production and grids for over a century (Högselius and Kaijser, 2010). Furthermore, the Triple Embeddedness Framework offers a combined perspective on firms-in-industries including 'core firms', holding power over other firms and influence regime rules in their interest, and 'firms in the middle' (between the core and the periphery), which have less power but more flexibility in responding to regime rules (Geels, 2014b). While municipal electric utilities are *firms in the middle* on a national level, they could be considered *core firms* in limited geographical scopes, as they possess power and influence on municipal or regional levels (cf. Mühlemeier, 2019).

2.2 Incumbent action and interaction

Facing the low-carbon transition, it has become an indisputable truth in the energy sector and respective literature that electric utilities have to transform their established business models (i.e. Frei et al., 2018; Geels et al., 2017; Nillesen et al., 2014; Richter, 2013a). The established electric utility business model is focused on centralized, large scale production, and requires capital-intense investments, project management skills and engineering expertise (Helms, 2016; Schoettl and Lehmann-Ortega, 2011). However, in relation to new technologies, it is far from clear which business models they consider favorable and how they

choose to implement them (Schoettl and Lehmann-Ortega, 2011). In order to advance these lines of inquiry, section 2.2.1 explores the business model choices of electric utilities regarding solar PV and section 2.2.2 interaction in business relationships.

2.2.1 Business model choices

Business models have been identified as drivers for transitions, as they can be tools for realizing the value of novel technologies, helping to commercializing them in mainstream markets and potentially entering the regime (Bidmon and Knab, 2018; Bolton and Foxon, 2015; Wainstein and Bumpus, 2016). A business model describes the business logic of an organization (Osterwalder et al., 2005), i.e. how it creates, delivers and captures value (Osterwalder and Pigneur, 2010). Business models conceptualized in the business model canvas consist of four dimensions, which can be further divided into nine components (Osterwalder and Pigneur, 2010): value proposition, customer interface (customer segments, channels, and customer relationships), infrastructure management (key resources, key activities, and key partnerships), and financial aspects (cost structure and revenue streams).[3]

It seems reasonable to assume that incumbents are more likely to engage with innovations which are more similar to their existing way of doing business and do not require radical configuration of existing value creation and capture processes and networks (Wainstein and Bumpus, 2016). Business model dimensions which have been found to play a central role in the acceptance of new business models are, for instance, value proposition (Bolton and Hannon, 2016), key resources and complementary assets (Smith et al., 2005), and key partnerships (Apajalahti et al., 2018). In general, solar PV is regarded as a misfit, as its small-scale, decentralized nature opposes the conventional business logic of large-scale, centralized production (Huijben and Verbong, 2013; Rosenbloom and Meadowcroft, 2014). However, it has also been shown that electric utility incumbents experiment with a wide range of solar PV business models (Horváth and Szabó, 2018; Huijben et al., 2016). In general, these can be classified into utility-side and customer-side business models, as shows in Figure 2:

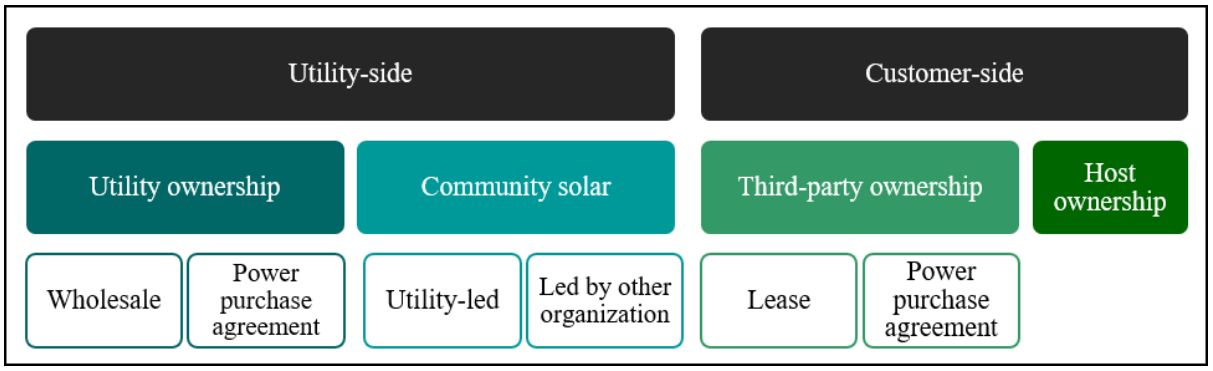

Figure 2 PV business models (own illustration based on a review of previous literature, see Paper 1 Figure 1).

The variety shown in Figure 2 indicates that *solar PV* is an umbrella term which can include a variety of technologies, scales, target users, and business models. Schoettl and Lehmann-Ortega (2011) identified six more granular solar PV business models based on their similarity

[3] A detailed description of the business model canvas and its components can be found in Paper I, Table 3.

to the utilities' established business model and argued that utilities would prefer utility-side business models such as centralized solar parks over pure installation business models (as part of host ownership), considering their core competencies.

Business models can also be used to describe a more generic model for creating and capturing value from an emerging technology (cf. Zott et al., 2011). In this understanding, several actors can play key roles as they form a network for realizing a business model (Bankvall et al., 2017; Palo and Tähtinen, 2011). In this respect, several authors have investigated the importance of alliances between electric utilities and niche actors in developing business models for emerging technologies such as solar PV (Pereira et al., 2022; Wadin et al., 2017; Yang et al., 2021).

2.2.2 Niche-regime interaction

As described in the introduction, the transitions literature assumes conflict-driven interaction between niche and regime actors (cf., i.e. Geels, 2006a; Hess, 2016; Pekkarinen and Melkas, 2019; Smink et al., 2015b). Only a few conceptual frameworks allow for more collaborative modes of interaction, such as the integration of add-ons and modular niche innovations in the reconfiguration pathway (Geels et al., 2016). However, collaborative patterns have been observed empirically, both for solar PV and other energy-related technologies (Apajalahti et al., 2018; Heiskanen et al., 2018; Kangas et al., 2021; Ruggiero et al., 2021). This illustrates the need for a conceptual lens allowing for a neutral perspective on collaboration.

The Industrial Marketing and Purchasing literature offers such an approach, studying business relationships between two actors and how these are influenced by their surrounding networks (Håkansson and Johanson, 1992; Håkansson and Snehota, 2017). Business relationships describe collaborations between two actors that aim at creating value together. Håkansson and Snehota (2017, 1995) suggest studying the substance of business relationship as activity ties, resource links and actor bonds (ARA) between two partner firms.

In the first layer, administrative, technical, and commercial activities are tied together and coordinated. The activity layer is commonly understood as the division of labor between two firms and therefore readily observable. Factors which have been discussed in relation to niches and regimes regarding their activity ties include shifting actor roles and changing interactions within networks (Bui et al., 2016; Elzen et al., 2012). The second layer concerns how resources are tied together, including tangible and intangible resources. A core assumption of the ARA framework is that interactions in successful business relationships increase the value of resource exchanges (Laage-Hellman et al., 2021; Sundquist and Melander, 2021). Incumbents typically hold a significant amount of resources (as described in section 2.1), which they can use to amplify the limited resources of niche actors (Kangas et al., 2021; Wadin et al., 2017). The third layer investigates how actors form bonds by aligning goals and agendas. This human aspect of the business relation is the most difficult to observe, as it often comprises abstract concepts such as trust and social capital (cf. Arvidsson and Melander, 2020; Finch et al., 2010; Hartmann and Herb, 2015; Holma, 2012). The interaction between niche and regime actors can be challenging on this layer, as they are likely to have

diverging visions, beliefs, cultures, or institutional logics (Ingram, 2015; Pekkarinen and Melkas, 2019; Smink et al., 2015a). The three layers, activity links, resource ties, and actor bonds, are interrelated and should be interpreted as a whole.

2.3 Factors influencing incumbent strategies

It is widely acknowledged in organization and management literature that firms act strategically as described in section 2.2.1. In transitions literature, however, the focus is often on institutional (external) pressures, rather than firm-internal realities. This corresponds with an understanding of incumbents in which they possess little autonomy, as they are governed by external pressures (van Mossel et al., 2018). Instead, we take on a perspective in which electric utilities' strategies are influenced by diverse factors from both sides, external factors such as regulation and stakeholders on the one hand, and firm-internal factors such as path dependency and resources on the other hand (Sump and Yi, 2021). This allows for a perspective where incumbents act proactively and drive transitions (van Mossel et al., 2018). In order to enhance the understanding of the variety of drivers, this chapter provides an overview of external (2.3.1) and firm-internal factors (2.3.2).

2.3.1 External factors

Firms can, to a certain degree, adapt their strategies and resources to their external environment (Kathuria et al., 2007; Venkatraman and Camillus, 1984; Wadström, 2019), for instance, to capture opportunities and incentives in the market (Wesseling et al., 2015). The bi-directional relationship between firms and their environment is also emphasized in transitions literature (Geels, 2014b).

External factors have been most popularly conceptualized as task and institutional environments (Scott, 2001, 1992). The *task environment* refers to factors influencing an organizations' operations, including customers, suppliers and competitors, and includes selection pressures such as competitiveness, efficiency, and financial performance. It is more closely related to the firms' organizational goals, including strategic aspects (such as market positions) and operational aspects (such as exchanges of resources) (Bergek et al., 2021; Geels, 2014b). The *institutional environment* refers to regulatory, normative, and cognitive rules, which determines firms' legitimacy and social fit within the larger society.

In addition, the Triple Embeddedness Framework conceptualizes a third dimension, the *industry regime*, which mediates a firms' interaction with the task and institutional environments they are embedded in (Geels, 2014b). The industry regime consists of firms in a particular industry and can be characterized by a collective mindset, regulation and laws, identity and norms, as well as technical knowledge (Geels, 2014b).

In transitions studies, a bias towards institutional influences on incumbents and their responses can be observed, often neglecting the task environment (Bergek et al., 2021). However, municipal electric utility incumbents as *hybrid firms* have to balance political (institutional) and market (task) spheres (Palm and Fallde, 2016), illustrating the relevance of

including both dimensions. In addition to external factors, internal motives and strategies determine electric utilities' response to landscape pressures (Mori, 2021; Steen and Weaver, 2017), as presented in the next section.

2.3.2 Firm-internal factors

At the firm-internal level, resources are matched with the external environment (Onufrey and Bergek, 2020). The importance of resources is highlighted by the fact that they play a key role both in the infrastructure dimension of business models (section 2.2.1) and in the ARA framework for analyzing business relationships (section 2.2.2). These two frameworks mirror two perspectives on resources: whether competitive advantage is created by resources possessed by a single firm (Barney, 1991), or by the combination and exchange of resources between two or more firms (Håkansson and Snehota, 1995; Laage-Hellman et al., 2021). In both cases, the main goal is gaining a competitive advantage to achieve a superior market position (Porter, 1985). The example of automotive incumbents' engagement with electric vehicles illustrates that the focus on competitive advantage characterizes *followers* rather than *first-movers* following sustainability goals (Bohnsack et al., 2020).

This implies the relevance of other firm-internal factors, such as corporate strategy and goals. Corporate strategy steers how value is created and distributed within an organization and is superordinate to business models and business-level strategies. It provides the organization with an overall sense of direction and consistency (Kathuria et al., 2007), ensures that all businesses contribute to "the good" of the organization (Wadström, 2019), and coordinates and prioritizes between different businesses (Bowman and Helfat, 2001). Such strategies cannot easily be adapted to the environment as they tend to be deeply rooted within the firm and subject to path dependency. This has not least been observed for energy utilities (cf. Apajalahti, 2018; Sump and Yi, 2021). In terms of organizational goals, private companies are expected to prioritize economic goals, while public actors can prioritize social or environmental goals. Being in-between those, municipal electric utilities have, for instance, chosen innovative business models in order to gain political goodwill (Funkhouser et al., 2015; Huijben and Verbong, 2013; Richter, 2012).

In sum, firm-internal factors are characterized by resources and corporate strategy, goals, and business-level strategy, which can be adapted to the environment to a limited extent. Together, these have a significant influence on a firms' engagement with novel technologies and partnerships.

2.4 Résumé

As described above, this thesis is structured along two guiding questions: *how* and *why* electric utility incumbents engage with solar PV as an emerging technology. Table 1 shows how the concepts and dimensions presented in chapter 2 relate to these two guiding questions. The *how* will be investigated in terms of (i) electric utilities' business model choices, for which electric utilities' adoption of solar models will be mapped and each model compared to the established electric utility business model and (ii) the interaction with niche

actors, for which business relationships with solar firms will be analyzed along the ARA layers. The findings from both analyses are shortened substantially in this licentiate thesis and can be found in more detail in the respective papers. Then, a discussion of the *why* can hopefully provide explanations for the observed actions and interactions in terms of external and firm-internal factors.

Table 1 Components of the suggested framework

Guiding question	**Concept**	**Dimensions**	**References**
How	Business model choices	'Fit' of novel solar model with established utility business model in these dimensions: value proposition, customer interface, infrastructure management, and financial aspects	(Osterwalder et al., 2005; Osterwalder and Pigneur, 2010)
	Niche-Regime interaction	Analysis of interaction between electric utilities and solar firms based on the ARA: Activity links, resource ties, actor bonds	(Håkansson and Johanson, 1992; Håkansson and Snehota, 1995)
Why	External factors	Institutional environment, task environment and industry regime	(Geels, 2014b; Scott, 2001, 1992)
	Firm-internal factors	Corporate strategy, organizational goals, business logic and resources	(Barney, 1991; Kathuria et al., 2007; Wadström, 2019)

3. Method

3.1 Project context

This licentiate thesis is the result of two and a half years of work conducted in the project "Electricity retailers and solar power diffusion: strategies and critical trade-offs", funded by the Swedish Energy Agency. The idea for it emerged during the preceding project "The roles of intermediaries in the transition to a sustainable energy system", which studied the role of solar and wind entrepreneur firms as brokers between users and technology in 2015-2019. At the end of the project period, it seemed like electric utilities were starting to sell solar PV turnkey systems in competition with solar firms, which sparked the idea for the current project, comparing the electric utilities' approach with that of the solar firms. The original outline included a mapping of the adoption pattern of electric utilities' engagement with solar PV and qualitative interviews for the comparison.

The mapping and pre-interviews were conducted as planned at the beginning of this project in 2019 and revealed that electric utilities were not competing with solar firms but had instead entered into partnerships with them. Thus, in addition to analyzing the electric utilities' perception of strategies and trade-offs regarding solar business models (Study I), the collaboration between those two actors evolved as a central aspect of this research (Study II).

3.2 Overall study design

The general methodological approach in this thesis is explorative and qualitative, based on a critical realist understanding of the world (cf. Danermark et al., 2019; Easton, 2010). In order to answer the *how* and *why* questions, the thesis includes an additional synthesis, elevating the findings from both studies and discussing them in relation to the presented narratives. As the different concepts introduced in the analytical framework require different methods of investigation, they will be described separately as part each respective study.

In Study I, theoretical lenses from strategic management and sustainability transitions were combined in order to illustrate strategies and trade-offs regarding solar business models: the organizational perspective (individual firms) with the industry perspective (collective of firms). This allowed us to develop a framework explaining energy incumbents' perceptions and choices based on semi-structured interviews.

Study II was a 'case study' (cf. Dubois and Araujo, 2005; Eisenhardt, 1989; Yin, 1984), including multiple cases and perspectives on the same phenomenon and rich empirical descriptions (Easton, 2010; Eisenhardt and Graebner, 2007). From the very beginning, Study II had a different nature than Study I, investigating the relationship between electric utilities and solar firms. Case studies are considered suitable for analyzing interaction between actors (Dubois and Araujo, 2005; Easton, 2010).

3.3 Study I

As defined in the project proposal, the objective of Study I was to understand incumbent electric utilities' strategies and trade-offs regarding solar energy. Therefore, we started by mapping the solar business model adoption of the 30 largest electric utilities in Sweden. Choosing the largest firms instead of the most active ones ensured that we could also identify reasons for *not* engaging with solar PV in general or specific solar business models.

For the purpose of this licentiate thesis, it should be noted that there were different types of energy incumbents in the Swedish market. Before the liberalization in 1996, the market was dominated by municipal, vertically integrated electric utilities, as well as a few large firms such as Vattenfall, Sydkraft (which was later acquired by E.ON), and Fortum. These firms had to "unbundle" or separate their production and retail business from grid operation – thus resulting in grid operators or production and retail firms who could all be considered incumbents. However, it was the firms' retail division who became the interface with customers and held the responsibility for new products and services such as solar PV. Therefore, in both studies, the actors in focus were *electricity retailers*. Based on the mapping of Study I, we identified retailers varying in ownership (public and private), size (number of employees), and engagement with solar business models. This resulted in nine semi-structured interviews with diverse types of retailers.

In order to map the solar business models of the 30 largest electricity retailers in Sweden, data was collected from the companies' websites and annual reports. As it was often not clearly communicated on the website whether the retailer offers PV turnkey sales in collaboration with an installer, e-mails and phone calls were used to clarify this. In this way, we communicated with 28 out of the 30 firms in the sample. Two retailers, Nordic Green Energy and Stockholms Elbolag, have not responded to our communication attempts. These firms also happen to be blacklisted by Konsumentverket (the Swedish consumer protection agency). Based on this mapping, retailers were chosen for in-depth interviews as described in the selection of cases (see Paper I, section 3.2). The interview guide included questions on the general motivation, drivers and barriers for adopting solar PV (in general and specific to each solar PV business model), and details about how each solar PV business model works (for more details, see Paper I). All interviews were transcribed and analyzed from three different perspectives as described below:

i. Assessment of the fit of the novel solar business models in comparison with the established utility business model. This resulted in the horizontal alignment analysis presented in Paper I.
ii. A case-by-case analysis of the individual firm cases, which brought to light aspects such as 'solar champions' as enablers for solar models, which did not fit the scope of Paper I, but are elaborated on in section 4.2.
iii. Identification of firm-internal and external factors and industry-regime factors influencing the individual firms in their decision to adopt solar business models. This was first presented at the IST conference in 2020 and later

resulted in the vertical and environmental alignment analysis presented in Paper I.

While (i) horizontal alignment was the centerpiece of Paper I, it was shortened in this thesis to an inventory of solar business models (4.1.1) and the influence of external and firm-internal factors on business model choice and is presented together with the results of (ii) and (iii). All findings were re-interpreted for the findings section of this kappa in order to allow for a synthesis with the findings from Study II.

3.4 Study II

With regard to ownership, we decided after the first study to focus on municipal retailers as we saw divergent motives and strategies from privately owned and state-owned utilities and wanted to investigate these further. While municipal electric utilities might not be the largest incumbent firms in the market, they have often operated electricity production and distribution for over a century. Municipal electric utilities have rarely been in focus of transition studies but constitute a "fundamental component for the understanding of the energy transition in federal energy governance systems" (Mühlemeier, 2019, p. 127). Thus, they can be considered 'core' firms on the municipal or regional level (Mühlemeier, 2019) that act as 'system builders' (Palm and Fallde, 2016) in Sweden and abroad (Busch and McCormick, 2014; Heiskanen et al., 2018; Palm, 2016).

With municipal retailers as a starting point (based on Study I), the population for Study II consisted of 42 retailers selling turnkey systems, as compared with more than 1000 solar firms. We identified several municipal retailers with different characteristics (firm size, geographic focus) and partly overlapping networks. Thus, we aimed at maximum *variation* of cases (Flyvbjerg, 2006). At the same time, we had learned about some solar firms who played a central role in the development of the Swedish solar market, which we thought should be included in the study as *critical* cases (ibid). This resulted in four triadic relationships which consisted of retailers, solar firms, and joint customers, while several actors had multiple relationship connections. These four cases together formed a multiple case study on relationships in turnkey triads. Instead of choosing similar cases for replication and generalizability (Dubois and Gadde, 2014), we aimed at identifying both commonalities and differences between them. By doing so, we hoped to contribute with a detailed understanding of relationships in the turnkey triad, providing a nuanced perspective on niche-regime interaction in transitions.

The data for Study II could not be derived from publicly available information. Therefore, the aim was to conduct in-depth interviews with several employees at each firm and mutual customers. In total, 17 semi-structured interviews have been conducted for the second study. They aimed at understanding how interaction in terms of activity links, resource ties and actor bonds form the business relationship as suggested by Håkansson and Snehota (1995). These interviews cover four triads, each consisting of an electricity retailer, a solar firm, and one or more end customers. The interview transcripts were scrutinized in several rounds:

i. Summary of each case study in terms of the development of the triad
ii. Deductive coding (with MAXQDA) using broad categories: activity links, resource ties and actor bonds, in order to generalize for cross-case comparison
iii. Inductive coding (with MAXQDA) to allow for variance between cases
iv. Abductive creation of themes and linking to theoretical concepts as discussed in Paper II.

After the third round (inductive coding), it became clear that the focus of Paper II should be the relationship between solar firms and electric utilities. Therefore, round iv. did not include the interviews conducted with customers, and the four triads were split into six dyadic relationships. Based on the same study and interview data, a third manuscript is planned which focuses on the value creation in these triadic turnkey relationships, including end-customers.

3.5 Reflection on methodological challenges

The first and most prevalent challenge I experience is *rigor* in qualitative studies. As a social scientist in a community of engineers, one has to learn how to legitimize methodological choices. For instance, adapting the interview questions throughout the course of the study seems like a logical thing to do when some simple questions were answered and new, more interesting questions emerged. As I am not striving towards generalizability, I appreciate the following understanding of rigor:

> *"case study has its own rigor, different to be sure, but no less strict than the rigor of quantitative methods. The advantage of the case study is that it can 'close in' on real-life situations and test views directly in relation to phenomena as they unfold in practice."* (Flyvbjerg, 2006, p. 235)

In essence, Flyvbjerg suggests that being close to the studied subject creates rigor, as the subject is human and will question wrong assumptions promptly, whereas variables can be operationalized and studied without ever being questioned. I further agree with Flyvbjerg that case study research can be applied both to generate and to test hypothesis, and I hope that its recognition in the scientific community will grow accordingly. Personally, I will always prefer qualitative or mixed-methods study designs, because I am genuinely interested in understanding *how* and *why* questions.

Closely related to the first challenge is the challenge of *defining boundaries*. In systems thinking, it is central to define boundaries of the phenomenon in question. One empirical example is to delineate the 'solar PV system' from the 'energy system' even though the former consists of multiple sub-systems (i.e. upstream and downstream) and actor perspectives. For instance, if solar firms possess technology competence and have created stable sales channels and policy for solar PV, have they become a regime by themselves? Defining such boundaries upfront seems hardly possible when doing exploratory work, especially in case studies, as indicated in this quote:

> *"The strength of the case method is that it allows these decisions to emerge in the course of the research process as the nature of the phenomenon and its context become clearer."* (Dubois and Araujo, 2005, p. 208)

A common approach to overcome this seems to be to define systems boundaries throughout the process and make them clear in hindsight for other researchers, rather than taking them as a starting point.

Another challenge is *non-linearity*. While the methodology described in most publications is presented as a linear and straight-forward process, I would rather characterize the reality as a messy, twisting rollercoaster and often difficult to explain. Just as with defining boundaries, there seems to be a gap between the reality of the research process and the written words in publications. For me, the following quote captures the essence of the process of going back and forth between theory and data:

> "*First, the analytic process of constant comparison and replication logic attempts to find a common pattern across the focal cases via persistent and creative iteration. (…) Yet categorization and abstraction are also part of the "art" that is hidden, creative, and hard to describe."* (Eisenhardt, 2021, p. 151)

Going through this process of identifying patterns and hypothesis is a time-consuming process, requiring an experienced mind. This poses a challenge for young scholars (such as myself), trying to navigate the maze of exploration, while many lack examples or guidance throughout the process. I am thankful for the guidance of my supervisor when I get lost in the depths of interview data.

4. Electric utilities' engagement with solar photovoltaics

Chapter 4 presents the findings of Studies I and II regarding electric utilities' engagement with solar PV and respective drivers, as outlined in section 2.4, and discussed them in comparison to prior literature.

4.1 Action and interaction

Concerning *action*, a high engagement of electric utilities with solar business models could be observed, as (i) almost all utilities pursue at least one solar business model and (ii) the engagement spreads over a variety of solar business models. However, the market is still in the middle of an experimentation period, where it remains unclear whether it will consolidate, and some solar business models emerge as dominant choices. One of the observed models is PV turnkey sales, which was studied in-depth regarding the collaboration of electric utilities with solar firms. The respective findings provide surprising insights regarding the *interaction* of regime actors with niche actors.

4.1.1 Inventory of solar business models

The mapping resulted in an overview of the adoption of solar business models of the 30 largest Swedish electric utilities, which can be seen in Table 3 in Paper I. Each of the studied solar models is shortly introduced in the following paragraphs, based on the descriptions in Paper I.[4]

PV turnkey sales was offered by 22 electric utilities. The value proposition of this business model is a hassle-free installation for the customer, including services such as system configuration and installation, and administrative, legal and investment support (Aspeteg and Bergek, 2020; Aspeteg and Mignon, 2019). Some electric utilities started to offer this model as early as 2011 (Lindahl, 2011), by entering into partnerships with solar (installation) firms. Thus, they outsourced a majority of the complex service aspects to their partners and are now mainly responsible for customer management. This collaborative model is further investigated in Section 4.1.2.

Solar electricity sales (in the form of dedicated solar contracts) only occurred at a third of the retailers. Four electric utilities sourced the electricity from their own solar parks, while the others purchased it from micro-producers, community solar parks, or the spot market. We found that solar electricity contracts do not offer enough diversification compared with existing renewable electricity contracts.

The *community solar intermediation* model was operated by six electric utilities, out of which five facilitated the development of local community solar associations by investing initial personnel and financial resources and handing the park over to the association later. An association managing its shareholders brings the advantage of lowering financial risk for the

[4] Power Purchase Agreements are not included in this overview, as the publicly available data at the time of the study was too limited.

retailers. This way of engaging with community solar parks could not be identified in the international literature and can, thus, be referred to as *the Swedish way.*

PV plant leasing was offered only by one electric utility at the time of the study (in 2019). While this model is similar to PV turnkey sales, it offers a low-risk investment where the customer pays a leasing fee for an extended period of time, in contrast to an upfront investment (as in PV turnkey sales). It is the rarest solar business model on the Swedish market, while being very popular in the US (Strupeit and Palm, 2016). A central barrier in Sweden was the lack of a legal framework for the implementation of PV plant leasing and little juridical knowledge at the (smaller) municipal electric utilities.

Lastly, *premium reimbursement* has not been identified as a solar business model before, but it is very common in Sweden, with 29 out of 30 active electric utilities. It refers to the electric utilities paying financial reimbursement for the solar electricity that prosumers feed-in to the grid. While electric utilities are required by law to physically accept this electricity, there is no obligation to provide a financial compensation for it.

In general, the mapping shows that electric utilities engage in both utility-side and customer-side solar models; surprisingly, despite PV turnkey sales being a customer-side model, it is the second-most adopted one. Comparing the five identified solar models' alignment with the established utility business model, we found that the fit of the value proposition was not decisive for adoption, while the infrastructure management dimension was central. Electric utilities could adopt a business model which required novel aspects in the infrastructure dimension such as partnerships, resources (i.e. legal knowledge) or activities (i.e. project planning and investments), but would stay away if it was incompatible or competence-destroying in any of these sub-dimensions. The electric utilities have, however, found ways to work around this incompatibility, namely by entering partnerships with solar firms in the case of PV turnkey sales. Nevertheless, adding electric utilities as an additional layer to an already functioning business model (with low margins) seemed rather surprising to us from the solar firms' perspective.

4.1.2 Collaboration with niche actors

As described in the previous section, the infrastructure management dimension of PV turnkey sales was difficult to handle for electric utilities, requiring novel activities and resources. Therefore, it was therefore not surprising that resource exchange was identified as the main driver for initiating the relationships studied in Paper II. Solar firms offered purchasing, installation, and service competence in return for the trusted brand and sales channels municipal electric utilities could provide. With this combination of resources, the firms propelled the demand market for solar in Sweden.

On the layer of activity links, they shared the responsibility for project operations. As the solar firms provided training to the utilities to build customer services, which allowed the utilities to take over more responsibility for project operations over time. The initial resource exchange and merged operations were enabled by a local connection, with the solar firms and their first electric utility partner originating from the same city. This facilitated the

development of bonds between upper management representatives and the alignment of goals. It also allowed for an informal form of operation with oral agreements in the beginning of these collaborations. However, at later stages, formal processes were introduced (i.e. sales managers and contracts). Mismatches of the goals and strategies became apparent when solar firms grew beyond regional boundaries and, consequently, conflicts emerged. Below, five themes are presented which resulted from analyzing the evolution of this niche-regime interaction.

The first theme, *synergetic resource exchange*, illustrates successful value creation when tying resources across firm boundaries. It also illustrates how incumbents can use their existing resources to propel niche technologies, as the utilities in the studied cases did not have a competitive or exploitative intention.

While the firms shared a common vision at the beginning of their collaboration, i.e. to establish a market for solar PV in Sweden, an underlying *incongruence of goals* became apparent. Namely, most solar firms had a private sector logic where their main goal was to achieve company growth, while the municipal electric utilities followed a public sector logic, striving to do good for their citizens. This became clear when some solar firms started bypassing their electric utility partners offering lower prices to customers.

This can partly be explained by two *shifts of power.* The first shift took place when utilities took over the contact with the customers in relation to turnkey project operations. This shift, however, was not unintended – it was planned by both parties and did not result in observable negative effects on their interaction. The second shift took place in the wider network. As solar firms performed successful projects, the word spread in the utilities' partner network, helping the solar firms to sign more contracts through a snowballing effect. Thus, over the years, the solar firms established their own brands, partner network, and sales channels, which decreased their dependence on the utilities. This resulted in different behaviors of solar firms which were not in line with the collaborative agreements. For instance, one solar firm behaved opportunistically where it competed directly for customers, knowing this could terminate their relationship with the electric utilities.

The electric utilities benefited in this situation from *local governance*, meaning that the requirement for formal governance mechanisms such as quality controls remained low, as they had a close relationship with their customers. The customers would get in contact with their utility in case they experienced problems with the solar firms, lowering the transaction cost for the utilities.

Finally, the quality of *social fabric* contributes to explaining the shift from collaboration to conflict in the observed relationships. Once the shared operations had been established and the activity links shifted from strategic to operational interaction, the firms failed to re-create the social capital that had been built up between the upper management representatives. The new individuals involved in the operations were not in the position to align goals or solve major conflicts, and several solar firms did not follow the collaborative agreements, leading to a breach of trust.

This is a short summary of the evolution of several business relationships which is described in more detail in Paper II. It is relevant to mention that one case deviated from these generalizations. In that case, the collaboration concerned two firms that had geographically more limited goals and reach, continued to build actor bonds between the same individuals over many years, and continued to create novel resource ties. This local case confirms many of the explanations which were derived from the other cases, such as the relevance of local connection as a resource.

4.2 Influences on action and interaction

Drawing on the findings, both external and firm-internal factors were significant in determining the electric utilities' choice of business models and interaction with niche actors. The next section illustrates how utility strategies are governed by the firms' perception of the external environment, i.e., in terms of competition, customer demand, and regulation, and its internal conditions, i.e., organizational goals, business logics, and resources.

4.2.1 External factors

Regarding the task environment, Paper I shows how a lack of short-term *profitability* made some solar business models unattractive; however, the strong *competition* in the industry forced retailers to adopt certain solar models anyhow. For instance, the premium reimbursement model was launched into the market by one electric utility, Bixia, which had been offering reimbursement deals to other kinds of micro-producers (e.g. hydro power and wind power) for some time, when most utilities did not. Years later, Vattenfall shocked the market by introducing a reimbursement of one crown (comparable to 10 Euro cents), which forced many other utilities to follow as they were afraid of losing customers. This pattern of following competitors (or trends) in the market can also be observed in the interaction between electric utilities and solar firms. While each relationship has unique aspects, the structure of selling PV turnkey systems in collaboration with solar firms is similar across all municipal electric utilities in Sweden.

Another common driver at the task environment was *customer demand*. In the examples of premium reimbursement, PV turnkey sales, and community solar intermediation, customer demand was a central driver for adoption (as shown in Paper I). In the case of PV turnkey sales, this demand was influenced by favorable *economic policies* (such as investment schemes) favoring small, residential systems over others. In addition, municipal electric utilities are close to their citizens and the identification of customer demand can be as informal as a conversation at the local soccer club. This closeness between utilities and their customers enabled *local governance* as described in Paper II. Furthermore, I found that many customers expressed a high level of trust towards their municipal utility, that they were loyal (buying a PV turnkey system from the utility even if the price was comparably higher), and often expected improvements in their municipality rather than economic rewards.

A factor which created another advantage for PV turnkey sales in the task environment was the *availability of partners and suppliers*. While utilities struggled to find partners and

expertise for PV plant leasing, a plethora of solar firms existed (or entered) with expertise in PV turnkey installation. Paper II describes in detail how solar firms invited electric utilities to enter collaborations for resource exchange, enabled by *local connections* between firms being located at the same city. In addition, the relevance of supplier contacts was illustrated when the solar firms' *competence* in negotiating with PV equipment manufacturers became a valuable resource. Moreover, the utilities' network with other utilities influenced the interaction between the two firms, as it helped solar firms in creating their own partner network, resulting in a *shift of power*.

In the institutional environment, unstable and missing *regulation* were pointed out in Paper I as hindering factors for engaging in certain solar business models, specifically PV plant leasing and community solar intermediation. While the regulatory framework for PV turnkey sales (and related micro-production) has been clarified over the past decade (cf. Lindahl et al., 2021), the legislation for the other solar models has remained rudimentary. Regarding its influence on the interaction between electric utilities and solar firms, it is difficult to tell whether their close collaboration has been a driving force for the legislation for PV turnkey sales, or vice versa.

4.2.2 Firm-internal factors

Regarding *existing business models*, the findings indicate that the infrastructure dimension is the most important one in determining the utilities' choice. If the infrastructure of the solar business model requires significant novel activities, partnerships, or resources, or is disruptive to the existing components, the utilities will either not adopt the solar business model or re-design it to increase the fit, for instance through outsourcing.

Furthermore, the utilities' organizational goals, business logic and overall market strategy determine their business model choices. The significance of *organizational goals* became apparent when comparing different ownership types. While utilities in private ownership target mainly efficiency and profit maximization, municipally owned electric utilities have to meet social and environmental goals next to economic ones. The alignment of organizational goals is also necessary for successful collaboration, as exemplified in the *incongruence of goals* in Paper II, where municipal electric utilities wanted to create a market for solar PV collaboratively, while some solar firms misused the same goal for self-serving company growth.

The *business logic* could be described as the firms' mindset and self-image, or its internal 'normative and cognitive' rules. It describes, in other words, what the sum of employees think a firm is supposed to be doing and what it can do, and often remains implicit.[5] The example of PV plant leasing shows how this was both an enabler and a hinder for the adoption of novel business models. While some utilities thought that they should not offer financial services similar to a bank, other (municipal) electric utilities entered the market for leasing early because they needed to enable access to solar energy to their citizens. This way of thinking is closely connected to their ownership, as municipally owned electric utilities are

[5] This interpretation is not made explicit in Paper I.

influenced by politicians on the board and expectations from their surrounding community to create more than financial value. The business logic is also influenced by more explicit, regulative, institutions which municipal electric utilities are constrained by (as discussed in 4.2.1). The municipal law ('kommunallag') sets boundaries for the types of competition municipal electric utilities may enter, forbidding them to sell products and services which are commercially available in the market. In the case of PV turnkey sales, there are diverging interpretations of this municipal law, influencing the interaction with partner firms. One utility has decided not to sell PV turnkey systems because a previously planned project turned into a public scandal. All other interviewed firms (and the majority of municipal electric utilities in Sweden) interpret this law as a grey zone and sell PV turnkey systems in collaboration with solar firms. This exception illustrates the path dependence this utility was subject to, and how it influenced the business logic of this individual firm compared with other firms in the same sector. The influence of institutions on business logic also shows the fluid boundaries between some firm-internal and external factors.

Lastly, electric utilities' overall *market strategy* results from their organizational goals and business logic and influences their preference for certain solar business models to match the utilities' sustainable brand, digitalization, or customer retention strategies. For instance, solar electricity sales is relatively easy to digitalize, making it an attractive solar business model for utilities focusing on digitalization in their market strategy.

In addition to the factors identified in the two papers, I want to put forward a few ideas which could not be included in the publications. First, the utilities' *degree of integration* seemed relevant for their business model choice, namely whether the firm belongs to a larger company group including production and grid operations or is a stand-alone electricity retailer. Integrated utilities operate in competitive and monopoly markets at the same time, which creates the challenge to align diverging goals and logics from different business units. However, this integration can also enable certain solar business models. For instance, if a utility's production capacity mainly consists of combined heat and power (in the winter months), it can be matched with decentralized production from PV turnkey plants (in the summer months). Unfortunately, we had too few stand-alone utilities in the sample to draw conclusions from that in Paper I.

Moreover, the *geographical scope* of an electric utility matters both for their business model choice and collaborations. Whether a firm operates on a local, national, or international level, influences its organizational strategy and goals. The first example are the three large incumbent utilities in Sweden, E.ON, Fortum, and Vattenfall. All three operate internationally and have production capacity outside of Sweden. This influences their choice of solar models in Sweden because the conditions for constructing a solar park might be much better on other international markets (i.e. India or Africa) than they are here (as described by one of them in an interview). In contrast to these large incumbents, the second example is Electric Utility D with a very local focus in Paper II. This firm's local strategy was a core enabler for a long-term symbiotic business relationship with its partner solar firm, which also had no international ambitions. In contrast, the other two solar firms had

international growth ambitions, which, I would argue, partly explains why they broke their engagements.

Solar champions were also identified as a firm-internal factor, i.e. individual employees at different hierarchy levels who acted as proponents of solar energy. They often faced unfavorable situations when first trying to introduce solar business models and had to advocate for and alter other organizational influences – such as goals, business logics, or strategies – to make solar business models a realistic choice for the firm. Some individuals working at municipal electric utilities even engaged in creating new policies favorable to prosumers owning shares in wind and solar parks.

The last theme I would like to discuss is the industry regime, which is both firm-internal and external, shared between the firms-in-industry. The fact that, for instance, a general trend to adopt solar models and a shared perception of regulation could be identified, confirms that a common identity exists in this industry regime. For instance, all interview partners expressed that the established utility business model must be transformed, which illustrates an implicit collective agreement. However, structural differences such as the degree of integration and geographical scope show that different sub-groups within the regime should be taken into consideration and that firm-internal factors can create divergence between the collective and the individual firm. Firms are subject to influences at all levels simultaneously, and the influences are constantly changing.

4.3 Discussion

As illustrated above, the findings indicate that a combination of firm-internal and external factors (*why*) influences electric utilities' choice of business models and interaction (*how*). This discussion puts them in a broader context in relation to previous literature.

A finding from Paper I is that solar business models which were more similar to the established utility business model were not generally preferred over those which were more different, in contrast to what has been suggested by prior literature (cf., i.e. Bolton and Hannon, 2016; Rosenbloom and Meadowcroft, 2014; Wassermann et al., 2015). Our findings indicate that the business model fit is rather dependent on individual business model dimensions. For instance, we found that alignment in the infrastructure dimension was more important than alignment in the value proposition for electric utilities. This is illustrated by the Solar electricity sales model, which is *not* common, even though its value proposition is similar to the established utility business model; and the PV turnkey sales model, which is widely adopted even though it has a disruptive value proposition and requires novel partners, resources and activities in the infrastructure dimension. However, the utilities have found a way to re-configure or 'translate' (Ahlgren Ode and Lagerstedt Wadin, 2019) this model by entering partnerships with solar firms. This availability of partners and direct customer demand (driven by economic policies) in the task environment enabled adoption. Moreover, utilities were driven by internal (politically steered) organizational goals.

Of the six different business relationships for PV turnkey sales studied in Paper II, only one collaboration proved successful as it remained on a local scale and none of the partners had international ambitions. This could confirm a claim of the solar firm – stating that PV turnkey sales is most successful on a local level, as it involves high customer engagement. This engagement and general relationship of electric utilities to customers enables municipal electric utilities to take on a special role in facilitating transitions (cf. Busch and McCormick, 2014; Gustafsson and Mignon, 2020; Mühlemeier, 2019; Palm and Fallde, 2016). The argument is further illustrated by the community solar intermediation model in Paper I, where municipal electric utilities acted as intermediaries between the technology and community solar associations. The different interactions electric utilities can engage in with partners and customers also indicate the importance of investigating the social fabric between actors for understanding transitions processes.

Even though the task environment was an enabling factor for PV turnkey sales, it was comparably hostile to electric utilities in general. The task environment they were operating in can be summarized as a *death spiral* (Castaneda et al., 2017; Felder and Athawale, 2014), in which customers were demanding solar turnkey systems, resulting in an increase in decentralized micro-production and, thus, decreasing electricity sales. At the same time, competition was pushing the utilities into unprofitable businesses, most notably the solar business model of premium reimbursement, which demonstrates a classic follower, or reactive, incumbent behavior (cf. Bohnsack et al., 2020; Dodgson et al., 2008).

The other solar business models were, however, more strongly connected to firm-internal goals in relation to solar technology. In this regard, the electric utilities took on several different, more active roles as *facilitators* in the community solar model, *proponents* of institutional change in PV plant leasing, and *partners* to solar firms in PV turnkey sales. In prior literature, such roles have commonly been associated with solar intermediaries (Aspeteg and Bergek, 2020; Bergek et al., 2013) or niche actors (Huijben and Verbong, 2013; Smith et al., 2014). However, municipal electric utilities could venture into early markets when risks were too high for commercial firms, as they did with the community solar and PV plant leasing models. Indeed, one utility acted as a true first mover, enabling premium reimbursement to micro-producers long before other firms did, which later enabled a novel solar business model.

This example also illustrates how resources held by one firm internally (cf. Barney, 1991) can provide the means to develop future business models. Resources were also a central driver for initiating the collaborations between solar firms and electric utilities, as described in Paper II. The resource exchange between electric utilities and solar firms confirms how resource ties across firms enable innovation (cf. Laage-Hellman et al., 2021). Both parties were driven by the idea to connect their resources and successfully created a shared vision, which has been identified as a central component for regime transformation (cf. Yang et al., 2021). We also observed that the value of resources changed over time and was dependent on the combination with other resources held by actors in the network (Finch et al., 2010; Sundquist and Melander, 2021), confirming that “no business is an island” (Håkansson and Snehota,

2006a, 2006b). On the contrary, firms and business relationships are embedded in networks, and a shift in the network positions can influence relationships directly, as the solar firms' advancement illustrates.

Regarding the institutional environment, common aspects such as social legitimacy and external regulatory, normative, and cognitive rules did not come out strongly in this study. This was not surprising, as trust in institutions and authorities, including municipal electric utilities, is generally high in Sweden and the social legitimacy for solar PV has been constantly favorable over the past decades (Holmberg and Persson, 2020). However, these external factors still influence the municipal electric utilities internal goals and business logic. The relationship between electric utility incumbents and their environment is bi-directional, shaping one another (cf. Geels, 2014b). Paper I illustrated that business logics can diverge between different types of utilities, which can be explained by differences between core firms and firms in the middle, forming one regime (cf. Geels, 2014b), but also different economic and social goals determined by ownership. In addition, this thesis describes tensions within firms, concerning municipal electric utilities, which is not surprising as they are hybrid firms, handling political and business goals (Gustafsson and Mignon, 2020; Mühlemeier, 2019). This thesis also investigated another layer of potential tensions between different business units, being governed by different institutional and task environments. This finding confirms the relevance of the task environment, in addition to the institutional environment, for engaging with emerging technologies (Bergek et al., 2021).

5. Conclusion and implications

The purpose of this licentiate thesis was to further unravel the narratives of electric utilities in sustainability transitions, which I do by highlighting some contrasting empirical observations based on the synthesis and discussion in chapter 4. The overview of *how electric utilities engage with solar photovoltaics* shows that they engage in diverse solar business models through multiple roles and through collaboration with solar firms; and *why they choose to engage with solar photovoltaics* illustrates the influence and variety of firm-internal and external factors such as business logics and competition. The respective findings allow for nuancing of each narrative through one or more counter narratives, contributing to transitions literature on incumbents and niche-regime interaction.

In contrast to the first narrative, the municipal electric utilities in this study did not act as 'villains' (Turnheim and Sovacool, 2020) but rather the opposite; their uptake of solar business models illustrates that incumbents can act as catalysts for niche innovations. One possible explanation why they did not try to influence their institutional environment in favor of their existing routines (cf. Geels, 2014a) or adopt other classical strategies of incumbency (cf. Johnstone et al., 2017) is the need to transform the established utility business model (cf. Helms, 2016) as it is subject to the death spiral in the task environment. Uncertainty regarding primary activities has earlier been identified as a driver for electric utilities to invest in niche technologies (Steen and Weaver, 2017).

However, not all utilities adopt all solar models; they can engage with certain models, while disregarding (or even opposing) others. Some electric utility incumbents show first mover behavior, following proactive strategies because of long dating goals and values similar to the hydropower incumbents in Steen and Weaver (2017), while other incumbents resemble followers who have reoriented their strategies over time (Apajalahti et al., 2018; Mori, 2021). While it was surprising that a majority of utilities adopted PV turnkey sales, a disruptive customer-side business model, this adoption was influenced by a mix of firm-internal and external factors such as organizational goals and customer demand. The findings further show engagement in solar business models through different roles, such as facilitator and partner, contributing to the diffusion of this emerging technology. Incumbents do this mainly by investing resources, i.e. project management knowledge in community solar facilitation, brand and sales channels in PV turnkey sales, and legal knowledge in PV plant leasing. This confirms recent observations that incumbents can be proactive and have a positive influence on renewal if they so wish (Apajalahti, 2018; Stalmokaitė and Hassler, 2020). This applies especially to municipal electric utilities, who have a unique closeness to their customers, which was shown in community solar intermediation and PV turnkey sales. This predestines them to take on a special role in transitions, where they can mediate between uncertainty and stability at a local level.

In addition, resulting from the first narrative of hindrance and opposition, incumbents are expected to be in conflict with niche actors as they meet (Geels et al., 2016; Hess, 2016; Pekkarinen and Melkas, 2019; Smink et al., 2015b). Instead, most of the investigated collaborations between electric utilities and solar firms *started* collaboratively with the

creation of a shared vision and symbiotic resource exchange, and only years later turned into conflict, while others kept the relationship alive. This illustrates the need for alternative transitions pathways (cf. Geels, 2006b; Geels et al., 2016).

The second narrative, assigning incumbents to the regime category as opposed to the niche, is contradicted by the niche-regime interaction shown in the case of PV turnkey systems, where electric utilities showed atypical behavior compared with how incumbents are normally described in the literature (Verbong et al., 2008). The electric utilities as municipal firms had various sustainability goals following a public sector logic, and, thus, were interested in keeping the collaboration with solar firms alive. Another observation contrasting the second narrative results from the combination of the inventory of solar business models and internal factors. It shows how typical incumbent actors pursued different goals in different parts of the firm and in different markets. Thus, they can show *regime*-behavior and *niche*-behavior simultaneously, which is in line with previous findings concerning incumbent firms' technology and innovation strategies (Berggren et al., 2015; Geels, 2018; Ruggiero et al., 2021).

The third narrative assumes that the collective of incumbents makes homogeneous strategic choices (Geels, 2011; van Welie et al., 2019). At an overarching level, some homogenous patterns of action could indeed be observed among municipal electric utilities. It could be seen, for instance, in a shared understanding among actors of the industry regime that the established utility business model must be transformed. At a more fine-grained level of analysis, however, they displayed heterogeneity in terms of the solar business models they adopt influenced by firm-internal factors, and how they perceive and respond to external factors, emphasizing the relevance of distinguishing between the individual firm and the collective of firms-in-industries (Kattirtzi et al., 2021). We find that their choices are not only driven by economic motives (van Mossel et al., 2018) but depend on the firm-unique combination of firm-internal conditions (i.e. roles, strategies, and resources) and interpretation of the external environment (i.e. laws) similar to findings by Mori (2021) and Sump and Yi (2021). The findings further demonstrate that the degree of integration and the geographical scope influence the actions and interactions of utilities, indicating regime heterogeneity (Bergek et al., 2021; Steen and Weaver, 2017; van Welie et al., 2019).

In sum, the nuanced narratives of incumbent actors allow us to see them as (i) supportive to niche innovations, (ii) displaying niche and regime characteristics simultaneously, and (iii) behaving heterogeneously. These modifications are not aimed at replacing the dominant narrative. Instead, they should be seen as an additional chapter in the book of transitions, which deliberately takes influences from the task environment as well as individual actor goals and motives into consideration. In order to achieve this, the methods toolkit for analyzing transitions needs to be extended to include micro-level studies of business strategies and interactions. This thesis introduced two frameworks from other literatures that can be used for this purpose, namely the *strategic fit* framework (Paper I) from management and strategy (Kathuria et al., 2007; Venkatraman and Camillus, 1984), and the *ARA*

framework (Paper II) from industrial marketing and purchasing (Håkansson and Johanson, 1992; Håkansson and Snehota, 1995).

In addition, this thesis illustrates the importance of drawing clear (methodological) boundaries. The level of identified actor homogeneity versus heterogeneity depends on the researchers' (conscious and subconscious) bias and intended outcomes, where a larger level of homogeneity can arguably be achieved by choosing more granular sample groups. For instance, municipal electric utilities can further be divided into the sub-groups of regional, large, and small utilities as in (Richter, 2013b), which can be expected to behave more homogeneously than the entire group of electric utilities.

Even though the implications for transitions research were in focus of this licentiate thesis, it also has some implications for policymakers and industry. In terms of national policy making, the identified heterogeneity in the energy regime poses a challenge for designing policies. However, the nuancing can help in drafting 'policy mixes' (Kern et al., 2019) which target different sub-groups of the regime, for instance in terms of energy innovation policy by the Swedish Energy Agency and Vinnova.

The heterogeneity poses less of a challenge to local and municipal policymakers and politicians, who might use the findings of this thesis as an inspiration on how to use municipal electric utilities as a political tool when facing an uncertain future. Even though it was my assumption that this would already be a common practice, not all municipalities seem to understand their electric utility as a valuable resource in their possession. The municipality of Helsingborg for example tried to sell its electric utility last year but was stopped by a citizen voting with over 90% wanting to keep the utility.

Addressing industry, the thesis illustrates the importance of creating a shared vision and aligning goals for successful business relationships, which, to a large extent, are based in the social fabric between individuals. Building such relationships takes time and cannot be achieved through efficiency. This is also true for business models which require local interaction and customer engagement, such as PV turnkey sales. The future will show which strategies turn out successful for customer retention.

6. Future research avenues

Through the application of different frameworks to transitions phenomena, this thesis illustrated the importance of complementing meso-level frameworks with micro-level studies, which will hopefully inspire more transitions researchers. Based on the results of the micro-level study of business strategies, we also suggest that future research on niche-regime interaction should have a stronger emphasis on actor behaviour based on their goals, values, and strategies and how this behaviour influences transitions in different phases. Future research could moreover contribute to an improved understanding of how the importance of influencing factors in the energy industry evolves over time through longitudinal studies.

In addition to the ideas for future research outlined in Paper I and II, this chapter will describe more personal avenues. In general, two broad paths correspond *widening*, i.e., applying the same research questions or frameworks to other empirical fields, or *deepening*, i.e., investigating new research questions in the same field. As illustrated throughout this thesis, I am interested in how and why questions, making the second option, deepening, more appealing to me.

My personal interest lies in understanding the role that municipal electric utilities can play in sustainability transitions, being hybrid firms. This thesis gave an insight into some of their actions, interactions and respective motives. While most interviews were conducted with interviewees at the electricity retail unit of the utilities – supposedly following a private sector logic – I observed elements of a public sector logic in many of their decisions. Such logics I would rather have expected at the monopolized parts of the utilities, such as local grid operations and combined heat and power plants. ADD GRAPHIC? This combination of and tension between logics opens up for several research avenues: (i) internal tensions, (ii) collaboration and mergers, and (iii) policy response.

First, (i) *internal tensions* could be observed in relation to different motives, strategies, and goals. Prioritization of goals and motives can diverge, for instance, between profit maximization and social goals such as providing customers with access to solar energy. These can occur both at different parts of the firm and between the management-level and the political steering. Even more so, if the level of analysis is elevated from the single electric utility to the municipality as a political actor steering a variety of firms. In Sweden, many municipalities own building and housing companies in addition to electric utilities, and sometimes fiber broadband networks, public transport, and venture capital firms. Interesting questions in this regard include: How these municipal firms contribute to the sustainability transition? How do they interact and create symbiosis (or tension)? To what extent (and through which mechanisms) do municipal and regional governments utilize them as vehicles to meet their sustainable development goals?

Second, the division of private and public sector logics allows for (ii) *collaboration and mergers* between municipal electric utilities across municipalities regions, as they do not compete on the same markets in a majority of their business operations. While conducting the mapping for Paper I, I have observed that two municipalities have merged their electric utilities, some had established a collaboration for technology innovation, and another group

had regular meetings with their ‘solar club’ to exchange knowledge and best practices. Moreover, electric utilities engage in a plethora of collaborations with other actors, i.e., with the aim of finding new ways of acquiring customers: Bixia signed an agreement with a supermarket chain and GodEl (a private - not municipal - electric utility) entered a partnership with Ellevio (Fortum’s former grid operator) to become their default electricity supplier. Thus, in addition to the micro-network investigated in Paper II, a promising avenue would be to study the evolution of the complete industrial network which electric utilities operate in.

Third, the two studies included in this licentiate thesis had a strong focus on business-level strategy, which opens up for further opportunities regarding the municipal electric utilities’ (iii) *policy response*. Is the heterogeneity observed between large energy incumbents and municipal energy incumbents mirrored in their policy responses? In which aspects do they overlap or differ? An archival analysis of policy documents, annual reports, and public debates could shed light on the motives underlying their policy responses.

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