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Solar business model adoption by energy incumbents: the importance of strategic fit

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ABSTRACT

This paper answers recent calls to give more attention to the business strategies of incumbent actors regarding innovation and socio-technical transitions. We map the solar business model adoption of 30 Swedish electric utility incumbents and examine to what extent it can be explained by the strategic fit with the utilities' established business models, corporate strategies, and external environment. We find that all three dimensions need to be considered in order to explain adoption. Alignment with the established business model is mainly important concerning activities, resources, and partnerships, and utilities also re-configure solar models to increase this alignment (e.g. through outsourcing). However, it is not the main driver for adoption. Instead, incentives and pressures related to corporate strategies and external environment induce or block utilities from adopting solar models. By demonstrating the importance of strategic fit, these findings provide a more nuanced understanding of industry incumbent's strategies in relation to emerging technologies.

1. Introduction

The last few decades have seen an increasing literature on innovation and socio-technical transitions in important societal sectors such as energy and transport. The importance of considering the strategies and actions of different types of actors in such processes is generally acknowledged (cf. Farla et al., 2012; Rosenbloom et al., 2016; Verbong and Geels, 2007).

This applies not the least to incumbent companies, for which emerging technologies can be opportunities as well as threats (Galeano Galvan et al., 2020). Indeed, although much of the innovation and transitions literature expects incumbents to be concerned mainly with incremental and continuous innovation (Cherp et al., 2017; Geels, 2018; Winskel et al., 2014), recent literature has shown that established actors sometimes change strategic direction and reorient themselves to take an active part in developing more radical emerging innovations (Berggren et al., 2015; Cozzolino and Rothaermel, 2018; Geels et al., 2016). This has resulted in calls to give more attention to incumbent actors and their varying roles and strategies regarding new technologies (Ampe et al., 2021; Blanchet, 2015; Geels, 2018; Onufrey and Bergek, 2020; Turnheim and Sovacool, 2020; van Mossel et al., 2018). The overall aim of this paper is to contribute to this line of inquiry.

Previous literature distinguishes between institutional and techno-economic strategies (cf., e.g. Geels, 2014b; Smink et al., 2015; Turnheim and Sovacool, 2020) In brief, the former refers to strategies directed at the institutional environment, including efforts to create, maintain or disrupt political, cultural or normative institutions (Galeano Galvan et al., 2020), whereas the latter refers to

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strategies directed at the economic (or task) environment (e.g. technology and business strategies). So far, much research on the strategies of incumbents in large sectors such as energy and transport has focused on institutional strategies (Bakker, 2010; Geels and Verhees, 2011; Rosenbloom et al., 2016) or technology strategies (Budde et al., 2012; Magnusson and Berggren, 2011). In contrast, the focus of this paper is on business strategies. This is in line with suggestions by Geels (2018) to address the business dimensions of incumbent strategies in order to contribute to a more symmetric understanding of interactions between emerging innovations and established actors and structures (cf. also Penna and Geels, 2012).

The empirical focus of the paper is the electricity sector, where incumbent electric utilities are facing increasing competition from decentralized electricity generation by prosumers and other new entrants (Apajalahti et al., 2018) as well as various pressures to move their existing business in a more sustainable direction (Lempiälä et al., 2019). In response, they are increasingly engaging with 'new' renewables (Bergek et al., 2013; Johnstone and Kivimaa, 2018; Wassermann et al., 2015). Our specific focus is solar photovoltaics (PV), where a number of different business models have been identified in previous literature (Horváth and Szabó, 2018). This can be seen as business model innovation in the form of diversification (Geissdoerfer et al., 2018).

However, previous studies of energy incumbents' business strategies with regard to energy innovation rarely go beyond describing their investments in own generation capacity (cf., e.g., Kattirtzi et al., 2021; Kungl and Geels, 2018; Mori, 2021). This means that other possible business models within the "business model design space" (Huijben et al., 2016), are largely overlooked. Moreover, it is far from clear why incumbents prefer certain models over others. While it seems reasonable to assume that electric utilities would prefer solar models that can be integrated with their existing strategies (cf. Bidmon and Knab, 2018; Wainstein and Bumpus, 2016), no empirical study has so far been conducted to confirm (or reject) this assumption.

The purpose of this paper is, therefore, to identify and explore potential explanations for the business strategies of electric utility incumbents in relation to solar PV technology. More specifically, the paper maps the solar business models adopted by the 30 largest electric utilities in Sweden and analyses to what extent these models strategically fit, i.e. are aligned with the incumbents' existing business, corporate strategies, and external environment in order to answer two research questions:

RQ1: What characterises the solar business model adoption pattern of Swedish electric utility incumbents?
RQ2: To what extent can strategic fit explain the adoption pattern?

2. Analytical framework

2.1. Business models for solar PV

Our first research question concerns the adoption of different solar business models by established electric utilities. Most often, a business model describes how a specific organization creates, delivers and captures value (Osterwalder and Pigneur, 2010). This can be defined at the level of the entire organization or for individual business units, depending on the company's degree of diversification and the coherence between its different businesses. However, a business model can also describe a more generic setup for creating and capturing value from an emerging technology, which does not necessarily coincide with the borders of a particular firm (cf. Zott et al., 2011). This implies, on the one hand, that an entire "ecosystem" of different collaborating partners might be needed to realize a particular business model (Adner, 2017). On the other hand, the same basic business model can be adopted by several different firms engaged in the same technology, resulting in one or more dominant overall business model(s) at the industry level.

When a new technology emerges, companies need to develop appropriate business models in order to realize its potential value (Bidmon and Knab, 2018; Bolton and Hannon, 2016; Wainstein and Bumpus, 2016) and make the innovation competitive in mainstream markets (Bidmon and Knab, 2018; Huijben et al., 2016; Wainstein and Bumpus, 2016). However, there are normally large uncertainties with regard to what an appropriate business model is for a new technology. Before the emerging technology becomes institutionalized and develops its own dominant industry logic (Smith et al., 2005), actors – new entrants as well as incumbents – therefore tend to experiment with a range of different business models (Hess, 2016; Huijben et al., 2016; Huijben and Verbong, 2013).

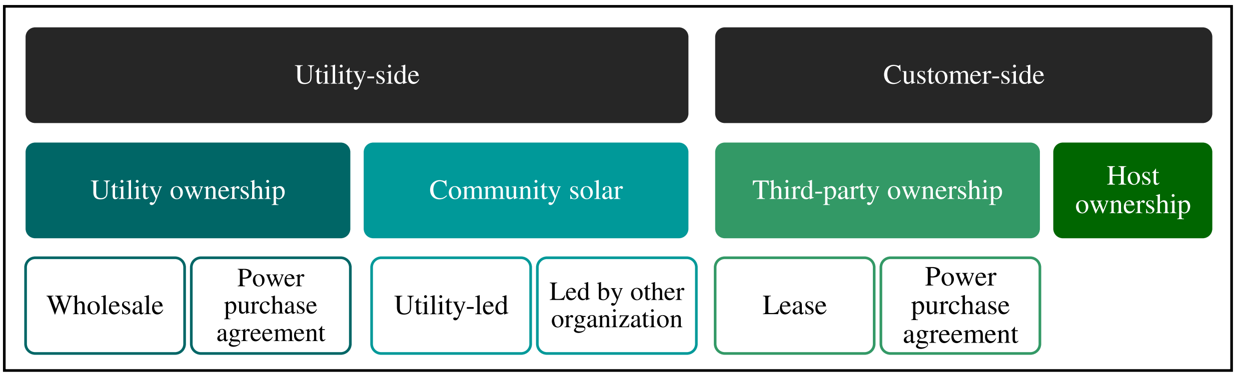

Fig. 1. PV business model archetypes (own illustration based on a review of previous literature).

This is also the case for solar PV, where earlier studies show that a number of different solar models have been explored by different types of actors (for a review, see Horváth and Szabó, 2018).

Based on such studies, a number of different 'archetypical' solar PV models have been identified and categorized based mainly on the physical location of the PV system and how the electricity is sold and used (e.g. Burger and Luke, 2017; Horváth and Szabó, 2018). Broadly, the literature distinguishes between utility-side models (in which the PV system is located on the utility side of the electricity meter, usually as a centralised 'solar park') and customer-side models (in which the PV system is located on the user side of the electricity meter, usually as a rooftop application) (Wainstein and Bumpus, 2016). These can be further divided into sub-categories (see Fig. 1).

On the utility side, two main solar model archetypes can be identfied. In the 'utility ownership' model, utilities own PV plants and sell the generated electricity to their customers either on the general electricity market ('wholesale') or under long-term contracts to a particular buyer ('power purchase agreement') (Burger and Luke, 2017). In the 'community solar' model, customers buy shares in solar parks, while the park is built and operated by either a utility or another organization like a cooperative or non-profit organization (Chan et al., 2017). This allows actors to invest in solar PV even if they cannot have a PV system installed on their premises (e.g. if they live in an apartment or have a shaded roof) (Burger and Luke, 2017; Horváth and Szabó, 2018; Huijben and Verbong, 2013).

The customer side can also be divided into two solar model archetypes. In 'host-ownership' models, the customer purchases and owns a PV system (Horváth and Szabó, 2018). This contrasts with 'third-party ownership' models, where the customer does not own the PV system even though it is located on their premises; instead, someone else (a 'third party') owns the system and takes care of the upfront costs, operation, maintenance etc., while the customer either leases the systems or purchases the generated electricity through a power purchase agreement (Drury et al., 2012; Overholm, 2015).

Electric utilities can, theoretically, be involved in all these models – through owning plants, building and operating community solar parks, acting as a third-party owner, or providing turnkey plants in a host ownership model – and so far, there is limited empirical evidence to suggest that incumbents prefer any one of them over the others. Roughly ten years ago, Schoettl and Lehmann-Ortega (2011) attempted to estimate the popularity of solar models for electric utilities. However, their study was conducted in an early phase of PV diffusion when little empirical evidence was available. After ten years of further development and use of different solar models, our study is based on empirical data on actual adoption.

2.2. *The importance of strategic fit*

Our second research question concerns the strategic fit of different solar models from the point of view of established electric utilities. The strategic management literature emphasizes the importance of different types of strategic fit (or alignment) for organizational decisions and performance. Such fit can be assessed from an internal or external point of view (Wadström, 2019). Internal fit refers to alignment between strategies and goals at different levels and functions within an organization. It includes both vertical alignment between strategies at different organizational levels (Kathuria et al., 2007) and horizontal alignment between different functional or business units within an organization (Wadström, 2019). External (or environmental) alignment highlights the importance of matching the company's strategies and resources to its environment (Kathuria et al., 2007; Venkatraman and Camillus, 1984).

2.2.1. *Horizontal alignment*

In this paper, horizontal alignment refers to the strategic fit between a new business versus one or more established businesses (e.g. host ownership versus electricity retailing). Niche innovations can, for example, be more or less aligned with existing business models in terms of value proposition (Bolton and Hannon, 2016), distribution channels (Geels, 2010), key resources and complementary assets (Smith et al., 2005; Verbong and Geels, 2007; Wüstenhagen and Boehnke, 2008), key partnerships (Apajalahti et al., 2018), and profit margins or return on investment (Geels, 2018; Huijben and Verbong, 2013; Kungl, 2015).

In general, it seems reasonable to assume that incumbents are more likely to pursue niche innovations that have a high degree of alignment with their established business model(s) (Bolton and Hannon, 2016; Rosenbloom and Meadowcroft, 2014; Wassermann et al., 2015). These are easier to recognize (Bidmon and Knab, 2018; Geels, 2018) and do not require any radical reconfiguration of existing value creation and capture processes and networks (Wainstein and Bumpus, 2016). Moreover, a high degree of horizontal alignment makes it possible to exploit synergies between different "sibling" businesses (Wadström, 2019). Some scholars have suggested that alignment in terms of value proposition, customer interface and downstream complementary assets is especially important for incumbents (Apajalahti et al., 2018; Bolton and Hannon, 2016; Hill and Rothaermel, 2003), but so far little empirical evidence has been presented to support this suggestion.

Regarding solar PV, it has been argued that it does not fit very well with the incumbent electric utility business model, which is focused on large-scale, centralized production and/or sales of electricity as a commodity (Huijben and Verbong, 2013; Rosenbloom and Meadowcroft, 2014). However, while this might explain the general reluctance or willingness of electric utility incumbents to engage with solar PV as such, it does not necessarily explain their choices of which specific solar models to adopt. Some have suggested that incumbents would be more likely to adopt utility-side models (Ruggiero and Lehkonen, 2017) since these are more similar to their traditional way of working (Funkhouser et al., 2015; Richter, 2013), while customer-side models might erode their current business (Bryant et al., 2018; Wainstein and Bumpus, 2016). For example, Schoettl and Lehmann-Ortega (2011) identify six generic solar models, resulting in recommendations for adoption based on their respective 'distance' to the established business model. They argue that utility-side models are more favorable given electric utilities' core competencies, but do not provide empirical evidence to support this recommendation.

2.2.2. Vertical alignment

In this context, vertical alignment refers to fit between, on the one hand, business unit strategies or individual business models (in this case different solar business models) and, on the other hand, the organization's overall strategy at the corporate level (Wadström, 2019). The latter includes corporate-level goals and objectives (Cornelius du Preez and Folinas, 2019) as well as the company's business scope and overall strategic orientation (Fainshmidt et al., 2019; Henderson and Venkatraman, 1999; Lin et al., 2019). Whereas business models are designed to create and capture value in a particular product market, corporate strategy is concerned with providing an overall sense of direction for business-level strategies to be designed and implemented in a consistent way (Kathuria et al., 2007). It also aims at coordinating and prioritizing between different businesses within the company (Bowman and Helfat, 2001) in order to manage and control shared resources and make sure that all businesses contribute to "the good" of the organization (Wadström, 2019).

Although previous literature does not present much evidence of this, it seems reasonable to assume that corporate-level goals and activities might influence which solar models incumbent electric utilities engage with. For example, previous studies suggest that some incumbents offer their customers the chance to invest in solar PV (through rooftop installation or community solar) mainly to retain and improve the relationships with their existing customer base (Funkhouser et al., 2015; Huijben and Verbong, 2013). This implies that differences between energy companies with regard to corporate goals and strategies might lead to differences in adoption patterns between incumbents.

2.2.3. Environmental alignment

Environmental alignment refers to the alignment between an organization's strategies, resources, structures and processes and its environment (Venkatraman and Camillus, 1984; Wadström, 2019). This includes both the task environment and the institutional environment (Scott, 1992). The task environment comprises external factors that are relevant for the activities firms perform to achieve their organizational goals (Scott, 1992). It includes actors such as, for example, a company's customers, suppliers, competitors, and regulatory groups (Carroll and Huo, 1986). The institutional environment includes regulatory, normative and cognitive rules (Scott, 1992) which can be general to the exogenous socio-political landscape or specific (and partly endogenous) to the industry a company belongs to (Geels, 2014a).

The task environment could be expected to be particularly important for companies' choices of business models for emerging technologies as it is more directly related to value creation and capture than the institutional environment (cf. Carroll and Huo, 1986). Regarding solar PV, previous studies have, for example, found that different types of adopters prefer different models, for example depending on their ability and willingness to pay a large upfront cost (Overholm, 2015; Strupeit and Palm, 2016) or their risk propensity (Karneyeva and Wüstenhagen, 2017), and that pre-existing industrial configurations can influence which models are developed and adopted (Strupeit and Palm, 2016). However, there is also some evidence that utilities that engage in community solar, third-party ownership or host ownership models are partly driven by a wish to gain political goodwill (Richter, 2013). In addition, technology-specific regulations and subsidies have been shown to influence which solar models are adopted in a country or region (Burger and Luke, 2017; Huijben et al., 2016; Karneyeva and Wüstenhagen, 2017; Overholm, 2015; Strupeit and Palm, 2016).

2.2.4. Framework for analysing strategic fit

To sum up, this paper is concerned with the importance of strategic fit between different solar models and the incumbents'

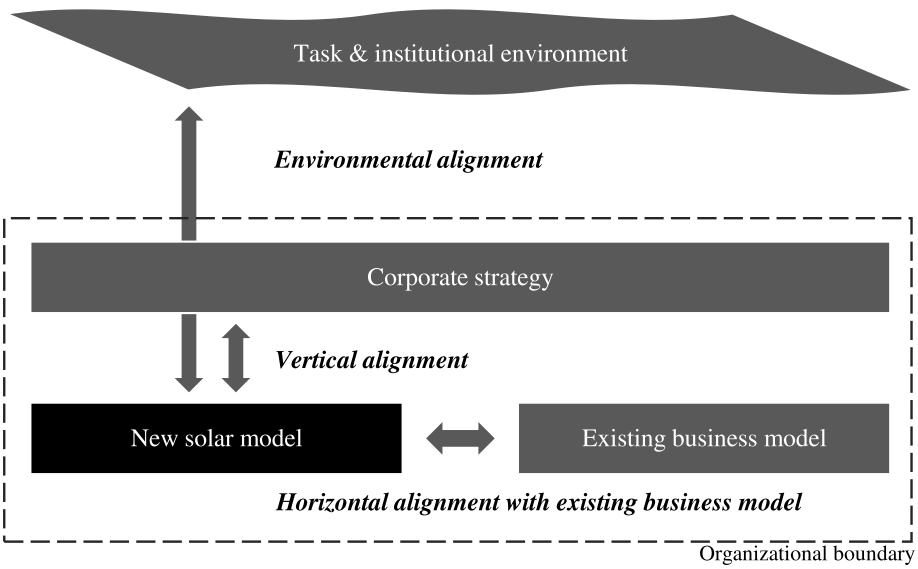

Fig. 2. Strategic fit dimensions considered in this paper (own illustration).

established business model, which can be broken down into horizontal, vertical, and environmental alignment (see Fig. 2). In our empirical analysis, we will assess the degree of fit between different solar models and (1) the established electric utility business model, (2) the corporate-level strategies of electric utilities, and (3) their external environment. The results of each of these analyses will be compared with the identified adoption pattern in order to determine the importance of horizontal, vertical, and environmental alignment – individually and together – for incumbents' adoption of different solar business models.

3. Methodology

3.1. The Swedish electricity sector and solar PV

Concerning business model design for solar PV, one size rarely fits all geographical contexts, solar business models rather need to be translated from one context to another (Ahlgren Ode and Lagerstedt Wadin, 2019). Although a certain business model archetype can often be found in several countries, the degree to which it succeeds, as well as details in its design, might differ between countries or regions depending on various local factors (e.g. Strupeit and Palm, 2016). This implies that study context variety is favourable to understanding business model adoption and, we would add, energy innovation and sustainability transitions in general. The Swedish case would be a relevant contribution to extending the empirical base.

Sweden differs in a central aspect from many other countries, as its electricity production is almost entirely fossil-free. It is based mainly on large-scale hydro and nuclear power, with smaller shares of biomass-based cogeneration plants and wind power. Thus, Swedish electric utilities are not necessarily subjected to the same landscape pressures and threats from sustainable niche innovations as incumbents in fossil fuel-based regimes (Geels, 2014b; Kattirtzi et al., 2021; Kungl and Geels, 2018; Lee and Hess, 2019; Winfield et al., 2018). Nevertheless, Swedish electric utilities are still facing destabilization of the established socio-technical regime of baseload generation (Johnstone and Kivimaa, 2018; Lee and Hess, 2019). Specifically, Swedish utilities face a decommissioning of all nuclear power plants by 2040 (Svenska Kraftnät, 2017). In contrast to the politically steered nuclear phase-out in Germany, Swedish nuclear plants are facing unfavourable economic conditions and approaching the end of their technical life.

Although Sweden is not among the top countries when it comes to installed solar PV capacity, the Swedish market for distributed PV is larger than the global average in per capita terms (Palm and Lantz, 2020) and is expected to grow sevenfold in the coming 20 years (Svenska Kraftnät, 2017). While this market has historically been dominated by specialized solar installation firms, electric utilities have been entering the market since around 2010 and this trend is increasing (Lindahl et al., 2020).

3.2. Selection of companies

So far, we have been referring to 'incumbents' and 'electric utilities' interchangeably. However, these two terms are neither exact synonyms, nor unambiguous. Indeed, the concept of 'industry incumbent' is defined and interpreted in different ways in different parts of the literature. Some authors associate incumbency with power and influence over markets and institutions (cf. Apajalahti et al., 2018; Galeano Galvan et al., 2020; Kungl, 2015). Other authors, especially in the innovation and strategic management literature, take a Schumpeterian perspective and define incumbents more generally as the established firms in a particular industry (cf. Buenstorf, 2016). With reference to the triple embeddedness framework by Geels (2014a), the first perspective equals incumbents with "core firms", while the latter also includes "firms in the middle" of an industry. In this paper, we adopt the latter perspective as it corresponds better with our management oriented analytical framework and also mirrors the diversity of actors on the Swedish market.

Several types of electricity companies have a long tradition of building and operating power plants and selling electricity in Sweden: the state-owned utility Vattenfall and, foreign-based utilities such as E.ON and Fortum (core firms) as well as privately owned energy companies and municipal energy companies (firms in the middle) (Bergek et al., 2013). Before the liberalization of the Swedish electricity market in 1996, these were integrated electric utilities that owned the electricity transmission and distribution grids, the local district heating systems, and most of the electricity generation capacity. As a result of the liberalization and the resulting 'un-bundling' of production and grid operation, there are now two main types of incumbent actors in this industry: grid operators and electricity retailers. Since electricity market regulations imply that it is infeasible for grid operators to adopt the solar business models discussed in section 2, we delimit our study to electricity retailers. Most electricity retailers belong to a company group that also includes production and/or grid operations (in a separate subsidiary) while some are pure trading companies. Independent electricity producers without any electricity retail business were not included in the study since they are new entrants rather than incumbents in the electricity industry.

The analysis is delimited to the 30 largest electricity retailers in terms of number of end-customers (see Table 1), since these can be seen as the most established ones. Two thirds of the selected retailers have inhouse electricity production assets, and the majority of them (14 out of 20) operate a small share of solar production in Sweden or abroad. It should be noted that selecting companies based on market share implies that the studied retailers might not be the most active ones in terms of solar. Moreover, the study is a snapshot taken within a limited time frame which aims at capturing the current experimentation and adoption of solar models by electricity retailers. However, since the technology is still developing and diffusing at a rapid pace, this adoption pattern will most likely not remain stable.

3.3. Data collection and analysis

To map the adoption pattern, secondary data was collected to gain an overview of the solar PV market in Sweden. These data were

Table 1
Retailers included in the empirical study.

Electricity retail company name	No. of customers	Ownership structure	Majority owner(s)	Electricity production (TWh) (whereof solar)[a]
Affärsverken Karlskrona	28 000	Municipal	Karlskrona municipality	(n.a.)
Bixia	210 000	Municipal	Linköping and six other Swedish municipalities	–
Borås Elhandel	63 000	State-owned	Vattenfall AB	–
E.ON Sverige	675 000	Private/ International	E.ON Nordic AB	1.1 (<1%)
Energi Försäljning Sverige	60 000	Municipal/ International	Multiple municipalities in Denmark	–
Eskilstuna Strängnäs Energi och Miljö	46 000	Municipal	Eskilstuna and Strängnäs municipalities	(n.a.)
Fortum	935 000	State-owned	The State of Finland	74.6 (<1%)
Fyrfasen Energi	40 000	Municipal/ International	Multiple municipalities in Finland	–
God El	90 000	Private	Non-profit foundation	–
Gotlands Energi	33 000	Municipal/ State-owned	Vattenfall AB and Gotland region (25%)	–
Gävle Energi	37 000	Municipal	Gävle municipality	0.1 (n.a.)
Göteborg Energi	275 000	Municipal	Göteborg municipality	4.2 (<1%)
Halmstad Energi och Miljö	30 000	Municipal	Halmstad municipality	(n.a.)
Jämtkraft	261 000	Municipal	Östersund, Åre and Krokom municipalities	1.1 (<1%)
Jönköping Energi	42 000	Municipal	Jönköping municipality	0.3 (n.a.)
Kalmar Energi	27 000	Private/ Municipal	Kalmar municipality and E.ON Sverige (50%)	0.1 (2%)
Karlstads Energi	41 000	Municipal	Karlstad municipality	0.1 (n.a.)
Kraftringen	129 000	Municipal	Lund and three other municipalities	0.2 (n.a.)
Luleå Energi	41 000	Municipal	Luleå municipality	(n.a.)
Mälarenergi	133 000	Municipal	Västerås municipality	0.5 (n.a.)
Mölndal Energi	101 000	Municipal	Mölndal municipality	0.1 (n.a.)
Nordic Green Energy	80 000	Municipal/ International	Troms region in Norway	–
Skellefteå Kraft	170 000	Municipal	Skellefteå municipality	4.9 (n.a.)
Stockholms Elbolag	28 000	Private	Swedish construction- and housing company	–
Storuman Energi	58 000	Municipal/ International	Multiple municipalities in Norway	–
Telge Energi	180 000	Municipal	Södertälje municipality	–
Umeå Energi	51 000	Municipal	Umeå municipality	<0.1 (<1%)
Varberg Energi/Viva	46 000	Municipal	Varberg municipality	0.1 (3%)
Vattenfall AB	927 000	State-owned	The State of Sweden	130.3 (<1%)
Öresundskraft	100 000	Municipal	Helsingborg municipality	0.2 (n.a.)

[a] The most recent available numbers 2018—2020. Explanations: (n.a.) = not available; – = no production).

found in market reports from public energy agencies and similar organizations. Data on the companies' solar offers and projects were collected from annual reports, project reports and company websites (May—September 2019). These secondary data were complemented by a pre-study consisting of short phone interviews and e-mail contacts with retailers, which served to identify cases for further interviews.

Conclusions about strategic fit were achieved in an iterative process. Existing literature and results from the pre-study generated ideas for an interview study, which in turn generated clues to be verified by secondary data. The findings presented in Section 4 stem from this iterative process. The interview study was carried out from November 2019 to June 2020. It consisted of nine semi-structured interviews, mainly with (solar) business developers, compiled in order to represent the diversity of retailers and therefore including different firm sizes and ownership types (see Table 2). These in-depth interviews were complemented by e-mail and phone conversations with in total 28 out of the 30 electricity retailers.[1]

As described by Kathuria et al. (2007), the literature on strategic fit does not define or operationalize 'alignment' very explicitly but rather uses various more tentative words such as 'coherence', 'consistency', 'coordination', 'agreement', and 'match' to describe a high degree of alignment. We therefore had to develop our own conceptual basis for assessment.

The assessment of horizontal alignment of the different solar business models was done in two steps. The first step was to specify the incumbent electricity retailer business model, as a baseline for the comparison from secondary sources and our own previous understanding of the specificities of the Swedish electricity market. The second step was to understand each solar model in detail and compare it with the established retailer model.

[1] Nordic Green Energy and Stockholms Elbolag have not responded to our communication attempts. These firms are blacklisted by Konsumentverket (the Swedish consumer protection agency).

Table 2
Interview sample.

Case title	No. of customers (thousands)	Ownership[6]	Position of interviewee	Duration (h:m)
Retailer A	100—500	Public	Business Unit Manager Products and Services	1:08
Retailer B	100—500	Public	Product specialist solar	1:11
Retailer C	100—500	Public	Business Development Solar	2:15
Retailer D	<100	Private	Business Development	0:50
Retailer E	<100	Public	Business Development Solar	1:13
Retailer F	100—500	Public	CEO	0:39
Retailer G	< 100	Public	Business Development	1:26
Retailer H	>500	Public	Product specialist solar	1:43
Retailer I	>500	Public	Vice President Business Development	1:10

[6] 'Public' summarizes municipal or state ownership, in order not to reveal the company identities.

To operationalize the business model concept, we used the "Business Model Canvas" (Osterwalder et al., 2005; Osterwalder and Pigneur, 2010) as it has established itself as one of the most commonly used frameworks, especially in the solar PV literature. It consists of four main dimensions, which can be divided into nine components: 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) (see Table 3 for a detailed explanation).

The degree of horizontal alignment was operationalized taking theories about incumbents' responses to technological discontinuities as a starting point. From this point of view, a case with no alignment would be one in which a new business model is disruptive (Christensen and Rosenbloom, 1995) and competence-destroying (Tushman and Anderson, 1986), i.e. reduces the value of the current value network, resources, partnerships etc. of established companies or even makes them entirely obsolete. A case with clear horizontal alignment would be one in which the new business model is sustaining (cf. Christensen and Rosenbloom, 1995), competence-enhancing (Tushman and Anderson, 1986) or symbiotic (Geels and Schot, 2007), i.e. reinforces the value of existing value networks and resources. In reality, we do not expect to see these two extremes but rather a combination of different degrees of alignment in different business model dimensions and components. We therefore developed our own operationalization of horizontal alignment that describes what a high degree could look like for each business model component (see Table 3).

Based on this operationalization, a detailed, component-by-component comparison was made for each solar model based on a deductive analysis of a combination of secondary and primary data (as described above). Missing or conflicting information was handled using interview data. The authors discussed the horizontal alignment of each business model component and dimension and made a qualitative assessment of the degree of alignment. Whenever the authors could not reach consensus, more data were collected in interviews or through email communications with selected retailers until the conflict was resolved. To simplify the presentation of the findings, the component-level results were synthesized into an assessment of the degree of horizontal alignment for each of the four overarching business model dimensions.

In a final step of the analysis, vertical and environmental alignment were assessed through an inductive approach. The interview data were scrutinized from the bottom up to identify factors described by the retailers as important for their choices of which business models to adopt. These factors were then categorized as corresponding to either vertical or environmental alignment, based on the theoretical descriptions of these concepts (as described in section 2). Within each of these two categories, we gathered similar types of influences into more general categories in a bottom-up, interpretative process. For example, we saw that several interviewees talked about how certain models enabled them to achieve some of their organizational goals, whereas other models created goal conflicts. We gathered these kinds of influences under the common label of 'organizational goals'. In Section 4, we summarize the strategic considerations we gathered under each label, with examples and illustrative quotes from different companies. When assessing the degree of alignment, we followed Henderson and Venkatraman (1999), Yamakawa et al. (2011), and Cornelius du Preez and Folinas (2019), among others. We focused our analysis on whether a specific solar business model was compatible with, or could even enable or contribute to, corporate level goals and strategies (vertical alignment) and whether it was compatible with, or could even help the company respond to, incentives and pressures in the company's task and institutional environment (environmental alignment)(see Table 4 for examples). This qualitative assessment was based in large parts on the interviewees' descriptions of potential synergies and conflicts between the solar business models and the other strategic dimensions.

4. Solar model adoption and strategic fit analysis

In this section, we present the specific characteristics of the five dominant solar models in the Swedish context and map the retailers' adoption of each model, which is summarized in Table 5.[2] The solar models are labelled corresponding to the value proposition they represent and introduced in the order of most to least adopted. We compare each solar model with the generic electricity retailer business model (see Table 6) as well as its vertical and environmental alignment. Based on this comparison, we then discuss to what extent the degree of strategic fit explains the overall adoption pattern of each solar model.

[2] Power Purchase Agreements (PPAs) are not included in this overview and the following analysis due to the lack of secondary data for the Swedish market during the main data collection period.

Table 3
Business model component descriptions and operationalization of horizontal alignment.

Main dimensions	Components	Description	Characteristics of a high degree of horizontal alignment
Value proposition		The company's bundle of goods and services, and this bundle's benefits for customers (e.g. newness, performance, customization, price, accessibility or convenience).	The new value proposition is compatible with or complements the existing value proposition, e.g. by providing a broader product portfolio or a means for differentiation or adaptation to specific customer needs or demands.
Customer interface	Customer segments	The different groups of people or organizations a company wants to serve (e.g. specific niches, closely related segments, or mass market).	The new business model either targets (sub-sets of) existing customer segments and utilizes existing channels and customer relationships or only implies customer interface additions that have little consequence for the established model.
	Channels	The means through which the company communicates with its customers to deliver a value proposition, including awareness, evaluation, purchase, delivery and post-purchase support.	
	Customer relationships	The kind of links a company wants to have to its different customer segments, including customer acquisition, exploitation and retainment.	
Infrastructure management	Key activities	The most important activities (e.g. production or problem-solving) required to create and deliver the value proposition, including selection of which to perform in-house.	The new model either builds on the same (type of) activities and utilizes existing resources and partnerships or only implies infrastructure management changes that have little consequence for the established model.
	Key resources	The most important physical, financial, intellectual and human assets required to create and deliver the value proposition.	
	Key partnerships	The network of suppliers and partners required to create and deliver the value proposition.	
Financial aspects	Cost structure	The fixed and variable costs that result from operating the business model, accounting for economies of scale, scope and experience.	The new model either results in a similar cost structure and generates revenues in the same way as before or implies financial aspect changes that have little consequence for the established model.
	Revenue streams	The way a company generates income from each customer segment, including pricing mechanisms.	

Sources: Descriptions of business model dimensions and components are based on (Dubosson-Torbay et al., 2002; Osterwalder et al., 2005; Osterwalder and Pigneur, 2010). The conceptualization of 'fit' for each dimension was developed by the authors specifically for this paper.

Table 4
Conceptualization of vertical and environmental alignment.

Strategic fit dimension	Characteristics of a high degree of alignment	Types of issues considered	Examples of high versus low alignment
Vertical alignment	The solar model is compatible with – or even enables – the company's corporate-level strategies.	Corporate goals and objectives; Strategic orientation (e.g. dominant business logic or competitive strategy);Business scope (e.g. product-market strategy).	A solar model that creates societal value (e.g. through more dispersed ownership) has a high degree of vertical alignment for a firm that pursues social goals but a low degree of alignment for a firm that pursues economic goals.
Environmental alignment	The solar model is compatible with – or even helps the company respond to –incentives and pressures in its task and institutional environment.	Task environment: market-related factors connected to suppliers/partners, competitors, or customers; Institutional environment: norms, regulations, and cognitive rules.	A solar model that helps a firm meet a specific (emerging) customer demand or is compatible with a particular regulation has a high degree of environmental alignment, whereas a model that creates a competitive disadvantage or challenges existing societal norms has a low degree of alignment.

Sources: Own conceptualization developed specifically for this paper.

4.1. PV turnkey sales

PV turnkey sales is the most widely adopted solar model among the studied retailers. Indeed, a majority of the retailers (21 of 30) sell PV turnkey systems to household customers and some of them have engaged with this model for almost a decade (Palm, 2016).

In principle, this model corresponds to the 'host-ownership' archetype described in previous literature. The value proposition offered by the retailers is a hassle-free investment which allows customers to own a PV system and produce their own electricity without much involvement. The 'turnkey' aspect includes key activities such as system configuration and installation, administrative, legal and investment support, and customer management (Aspeteg and Bergek, 2020; Aspeteg and Mignon, 2019). However, retailers partly avoid the complexity of this model by focusing on sales, while outsourcing many other activities to solar PV installation firms. In

Table 5
Solar models adopted by the retailers.

Electricity retailer	PV turnkey sales	Premium reimbursement	Solar electricity sales	Community solar intermediation	PV plant leasing
Affärsverken Karlskrona	X	-	-	X	-
Bixia	-	X	-	-	-
Borås Elhandel	X	X	-	-	-
E.ON Sverige	X	X	-	-	-
Energi Försäljning Sverige	-	-	-	-	-
Eskilstuna Strängnäs Energi och Miljö	X	-	X	-	-
Fortum	X	-	-	-	-
Fyrfasen Energi	X	X	-	-	-
God El	-	-	-	-	-
Gotlands Energi	X	-	-	-	-
Gävle Energi	X	X	-	-	-
Göteborg Energi	-	X	X	X	-
Halmstad Energi och Miljö	-	X	-	-	-
Jämtkraft	X	-	-	X	-
Jönköping Energi	X	X	-	-	-
Kalmar Energi	X	-	X	X	-
Karlstads Energi	-	X	-	-	-
Kraftringen	X	X	X	-	-
Luleå Energi	X	X	-	-	-
Mälarenergi	-	X	X	X	-
Mölndal Energi	X	-	X	-	-
Nordic Green Energy	X	-	X	-	-
Skellefteå Kraft	X	X	-	-	-
Stockholms Elbolag	-	-	-	-	-
Storuman Energi	-	X	-	-	-
Telge Energi	X	X	X	-	-
Umeå Energi	X	-	-	-	X
Varberg Energi/Viva	X	X	X	-	-
Vattenfall	X	X	X	-	-
Öresundskraft	X	-	-	X	-
Adoption rate	21	17	10	6	1

the customer interface dimension, retailers' sales representatives acquire and consult customers, configure plants, and manage contracts and invoices. In the infrastructure management dimension, they leave the installation of the plant to their new partners: the installation firms. With regard to financial aspects, a one-off project margin replaces monthly recurring revenues from electricity bills. Retailers differ in how they design the specifics of this business model, for instance which customer segments they offer turnkey systems to, whether the installation firm operates under the same brand as the retailer, and the exact division of labour between the collaborating firms.

The overall *horizontal alignment* of PV turnkey sales is poor. Its value proposition threatens retailers' established business model by increasing competition in electricity production and reducing customers' need to buy electricity. It, therefore, has a long-term disruptive potential. Moreover, the customer interface requires face-to-face interaction and the revenue stream is a one-off transaction. In the infrastructure dimension, retailers try to manage misalignment through outsourcing to solar installation firms (as mentioned above). While this reduces the need to acquire new resources (e.g. technical installation knowledge and personnel) and engage in new key activities (e.g. purchasing and warehousing), it requires them to develop new key partnerships and workflows.

In contrast, the PV turnkey sales model shows a high degree of *vertical alignment* for retailers who pursue an overall sustainability strategy focusing on renewable energies (Retailers A, B, G, F, H). In addition, this model allows municipally owned retailers to meet their owners' social goals (Retailers A, G, E):

"I think the solar business in itself it is in all our three goals. If we help people to make their own electricity, there is more place on the grid for heavy industrial locations … And it's very sustainable. And we are making profit of it. So it doesn't [have to] be any crash between them." (Retailer A)

"[O]ur main mission is to help our fellow people in the municipal area." (Retailer E)

At the same time, several retailers mention the misalignment between the turnkey model and the business logics of electricity retail and construction of large power plants (Retailers A, B, C, E, H and I), as PV turnkey sales requires much more intense customer interaction.

"Companies have found is that you can't just take the engineering approach in selling solar systems. The customers are interested in so much other things than just the hardware. And I think that was perhaps a little hurdle for us as well. Used to delivering things, installing things and then leave. And here we have other soft issues that was as... As important for the customer as the hardware itself. (Retailer E)

"We are the same electricity company that we always have been, so... […] we want to sell solar PV in the old way of working, but we can't. We need to find a new way of working." (Retailer H)

Table 6
Detailed solar business model description and horizontal alignment analysis.

Business model components	Established electricity retail business model	Solar model				
		PV turnkey sales	Premium reimbursement	Solar electricity sales	Community solar intermediation	PV plant leasing
Value proposition	Carefree and reliable (fossil free/renewable) electricity at reasonably low cost	Hassle-free ownership of solar PV system = disruptive potential to reduce electricity sales	Reimbursement for excess electricity at a premium price = counterintuitive but not complex or difficult	'Green' sub-set of value proposition = minor differentiation (and similar to existing sales of wind & hydro power)	Facilitating share-ownership = disruptive potential to reduce electricity sales, but retailer remains involved	Low up-front cost solar adoption with low hassle = disruptive potential to reduce electricity sales, but retailer remains involved
Customer segments	Retailers target all consumers connected to the grid.	Sub-segment (potential prosumers, i.e. customers who want to become electricity producers; access to capital)	Sub-segment (prosumers)	Sub-segment (customers with preference for solar electricity)	Sub-segment (potential prosumers who cannot (or do not want to) install solar on their own premises, or has limited access to capital)	Sub-segment (potential prosumers with lower risk propensity and/or limited access to capital)
Channels	Least direct contact possible (e.g. online electricity contracts); customer acquisition partly as default regional electricity suppliers.	Standard forms and phone calls + potential site visits later project phases: outsourcing of face-to-face customer contacts	Utilizes existing channels	Utilizes existing channels	Requires new, more local channels (e.g. walks through the solar park) = poor alignment for pure trading firms without regional anchoring	Standard forms and phone calls; later project phases: outsourcing of face-to-face customer contacts
Customer relationship	'Arm's-length' relationship with rather anonymous (mass) market	Retailer outsources large share of the customized aspects of each project	Prosumers need more support than average B2C-customers (e.g. administration of guarantees of origin)	Utilizes existing customer relationships and follows the same logic	The members of the cooperative (shareholders) become temporarily locked in to retailer as electricity consumers	Partial customization but standardized procedures (cf. channels)
Key activities	Trading, metering, and billing	Customer acquisition, sales, project management (+occasionally customer service). Other key activities (e.g. PV system procurement and installation) are outsourced	Payments to prosumers need to be deducted from electricity bills, which requires new, but simple routines.	Similar key activities	Project management and handling of the cooperative are not competence-destroying but more time-intensive; (smaller-scale) plant operation required	Project-based business (contracts + financing + insurance + taking-back plants after leasing period) = requires service-oriented mindset; (smaller-scale) plant operation required
Key resources	Expertise in engineering, system operation, and managing and collaborating in large projects	Project- and partnership-management skills applicable; more time-intensive because of new sales process	Prosumers need a more advanced electricity meter (which is provided by the grid operator in a standard procedure)	Guarantees of origin need to be handled on a smaller scale compared with other renewables	Existing project- and partnership-management knowledge applicable; new PV-specific knowledge is required; more time-intensive	Existing knowledge is not applicable; new intermediary, legal and PV-specific knowledge needed
Key partnerships		New partners: contracted PV installation firms	No additional partners required	No additional partners required	New partners: cooperative; engineering firms specialized on solar construction	Contracted PV installation firm (same as partner for PV turnkey sales)
Cost structure	Capital-intensive production determines the cost structure, directly (through own production) or indirectly (via the electricity spot market or PPAs).	Higher personnel cost, but no impact on traditional model	Higher cost per unit than for electricity from the spot market	Less capital-intensive	Smaller initial investment + the investment is later outsourced to the cooperative	Smaller-scale capital investments and higher personnel costs
Revenue streams	Monthly revenues from electricity sales supplemented by the sale of tradable guarantees of origin and green certificates.	One-off transaction (project margin / commission fee) instead of monthly revenues	No revenue stream for retailer	No difference in revenue streams	No difference in revenue streams	Monthly leasing fees for equipment (+ electricity sales)

Sources: Own analysis based in part on Hannon et al. (2013), Helms (2016), and Small and Frantzis (2010).

Despite this misalignment, all the beforementioned firms sell PV turnkey systems. One exception is a privately owned retailer for whom solar models do not fit into their lean portfolio.

Concerning the *environmental alignment*, several retailers see a growing demand for turnkey systems from their existing customers (A, E, F) and perceive that customers in general have developed from 'early adopters to 'early majority' (Retailer A, H) who expect PV turnkey sales as a hygiene factor (Retailer B). An exception is a privately owned retailer:

> *"It's about knowing your customer. In our case, almost all the customers live in apartments. So they can't buy their own PV system." (Retailer D)*

Moreover, as mentioned above (and confirmed by all the interviews), the crux of successful PV turnkey sales lies in finding suitable partners to outsource parts of the key activities to:

> *"If I compare with starting a district heating system or building a hydro power plant, that's much more difficult. Here it's more about finding a partner, discussing how should we do this together." (Retailer A)*

In Sweden, this is enabled by an already existing ecosystem of solar PV installers, which the retailers can exploit. However, the interviewees also mention sources of misalignment. Most notably, several of them argue that PV turnkey sales is largely unprofitable (Retailers B, C, E).[3]

> *"It's too little money in it. There hasn't been any incentive, economically speaking, earlier." (Retailer B)*

In addition, the turnkey market is subjected to complex building regulations (G, H) as well as uncertain economic policies (Retailers A, B, C, H):

> *"The only thing that is hard in this market is the ... changes in governmental economical support. […] Yesterday, for example, they closed down the support for farmers …. Bang, gone overnight, nobody heard about it. […] The biggest problem for us. The government gives support ... [but there is] not money enough. So when the money ... is gone, [it] makes a big mess of the market." (Retailer A)*

To sum up, the strategic fit analysis shows that the PV turnkey sales model on the one hand shows signs of misalignment in all three dimensions as it is characterized by a disruptive value proposition, complex customer interface, and nonrecurring payments (horizontal dimension), has an incompatible business logic (vertical dimension), and is perceived as unprofitable and restricted by complex and uncertain regulations (environmental dimension). On the other hand, PV turnkey sales can be made easier to adopt through outsourcing (horizontal dimension) in collaboration with existing installation firms (environmental dimension), is well aligned with general sustainability strategies and municipal owners' social and environmental goals (vertical dimension), and meets a (perceived) customer demand (environmental dimension). Considering the degree of adoption, the latter alignment characteristics clearly compensate for the negative ones.

4.2. Premium reimbursement

Premium reimbursement has not been identified as a solar model in previous literature but is rather common in the Swedish context. Reimbursement is a monetary compensation to prosumers for the excess solar electricity that they feed into the grid. Electricity retailers are mandated by law to receive electricity fed into the grid from micro-production units, such as solar PV plants. However, they are not required to offer any financial compensation for this electricity. Nevertheless, almost all of the studied retailers (29 of 30) offer reimbursement at spot market prices, and more than half of them (17 out of 30) offer a (time-limited) price premium.

It might seem counterintuitive to purchase electricity from micro-producers at a premium price unless this cost can be compensated for elsewhere. Roughly half of the retailers that have adopted this model (9 out of 17) consequently integrate premium reimbursement with other solar models. For example, some retailers sell the solar electricity at an even higher price to other customers through solar electricity sales, whereas others only offer premium reimbursement to customers who buy their turnkey systems through them. However, just as many retailers (8 out of 17) offer a stand-alone version of the premium reimbursement model, i.e. they do not link it to any other PV business model in their portfolio, which implies that it could be considered a unique value proposition directed at micro-producers.

Premium reimbursement aligns well with the established electricity retailer model in the *horizontal* dimension. The value proposition of this model is extra compensation for excess electricity, which complements the retailers' existing offers to micro-producers. It has no distinguishing characteristics in the customer interface or financial aspects, and blends smoothly with existing business operations since it can be implemented without additional key partners, activities, or resources.

However, the interviews reveal that horizontal alignment is not necessarily the most determining factor in this case. Instead, premium reimbursement is mainly a way to gain and retain customers in the longer term (mentioned in nearly all interviews), indicating a high degree of *vertical alignment*:

> *"It's mostly to get the electricity contract with the customer. If we should find the customers on 'Pricerunner' or 'Elskling' [i.e. online platforms for comparing prices] … we have to pay for that too. … So that's a good investment to get electricity contract customers. [Interviewer: Do you lose money with that?] Yes, of course." (Retailer A)*

Moreover, it aligns with the organizational goal of municipally owned electricity retailers to contribute to the diffusion of solar

[3] In contrast, Retailer F argues that selling PV turnkey systems can be a profitable business since prosumers are usually not too price-sensitive and also buy additional electricity.

energy in the society (Retailer C) and to create an environmental company image (Retailers C and F).

"[Interviewer:] But it's still a minus business as a whole? [Retailer C:] Yes, slightly. .... And then comes the next question: Why are we doing this? And one thing is that we like solar. So we want to stimulate more people [to] want to start with solar."

In this regard, Retailer B is an exceptional case, since it has been working with micro-producers for wind and solar for many years, before other retailers were interested in this business, and see premium reimbursement as part of their overall corporate strategy:

"We have a background in locally produced energy. And we have built up a network of many small producers … and in that way we can package locally produced electricity by buying guarantees of origin. And that, I guess, is our USP, that is what distinguishes us from the others." (Retailer B)

The *environmental alignment* of premium reimbursement has two facets: On the one hand, the model is a poor deal for all retailers (except Retailer F that has signed the most micro-producers of all retailers and couples this with solar electricity contracts and PV turnkey sales). On the other hand, nearly all interviewees expressed the need to catch up with their competitors in order to satisfy customer expectations:

"We've noticed pretty clearly that what other companies do in other businesses affects the expectations from the customers when they become our customer." (Retailer D)

To sum up, the wide adoption of premium reimbursement might seem counterintuitive at a first glance, considering that it is largely perceived as unprofitable (misalignment in environmental dimension). However, it is almost identical with the electricity retail business model in the horizontal dimension (and therefore simple to adopt), and is also aligned with the goal to retain customers (vertical dimension) and the need to match the competitors' offers in order to meet customer expectations (environmental dimension).

4.3. Solar electricity sales

One third of the retailers (10 out of 30) sell solar electricity contracts, which combines several archetypical solar models. The retailers source the electricity from utility-side and customer-side solar plants: four use solar electricity from their own solar parks, while others buy it from community solar parks, micro-producers, or the spot market.

The *horizontal alignment* is high for all business model dimensions except infrastructure management. Solar electricity sales provides a slightly differentiated value proposition and targets a narrower customer segment than the established retailer business model, i.e. those interested specifically in solar electricity for technical, environmental or economic reasons (cf. Palm, 2018). This resembles the dedicated wind and hydropower contracts that already exist in the Swedish market. In contrast, the infrastructure dimension differs substantially from the established model in that retailers must have dedicated processes to handle guarantees of origin in order to sell solar electricity bought directly from (micro-)producers rather than from the spot market. What distinguishes solar from other renewables in this respect is the larger number of micro-producers, which creates time-consuming paperwork. Combined with the lack of sophisticated software, which means that the matching of production and consumptionhas to be done manually, this is a surprisingly large hurdle: it was repeatedly mentioned in the interviews as a reason for not engaging with solar electricity sales and instead integrating the solar electricity from micro-producers into a general 'renewables mix':[4]

"The system that Energimyndigheten [i.e. The Swedish Energy Agency] has for GoOs and electricity certificates is not very compatible with other systems. So it's a lots of manual work ... It's very hard to keep track of it. They work quite a lot manually with Excel to … keep record of everything. But if we do a few agreements with larger [producers], it's easier …"

In terms of *vertical alignment*, most retailers did not have much to say, presumably because selling solar electricity contracts is similar to their existing business and market logics. However, Retailer D highlighted that it is not well aligned with its market strategy since they only sell renewable electricity that is certified with the Swedish environmental label 'Bra Miljöval' ('Good Environmental Choice') (which is not applied to most available solar electricity), while retailer F argued that the model suits its overall solar portfolio and is in line with its organizational goal to enable adoption for different customer groups.

The interviewees opinions were stronger in regard to *environmental alignment*, where there was an agreement that the solar electricity sales model is misaligned in several ways, especially with the task environment. Most notably, the model is not considered profitable (B, C) and there is a shortage of supply of certified Swedish solar electricity (C, D, H).

"But yeah, so you can understand the Math.… So they [i.e. the micro-producers] get 25 öre extra and we sell it for 2.50. So it's not a good business right now." (Retailer C).

"Even though our customers want to buy solar electricity, we can't offer it today, there's not enough volume. … It would probably only last for like 100 customers in a year or something. So, it's not worth it." (Retailer D)

"It's a fight about the guarantees of origin for the solar power. […] it's not much solar power out there in the market." (Retailer H)

Solar electricity is also still a niche market, which most customers are not interested in, as explained by Retailer E:

"No, we don't have that. I know it's sort of a small market by itself and some actors are niching into this … [but] we haven't seen that it's a big driver for the customers yet." (Retailer E)

[4] Retailer F stands out in this regard as it has developed a software for handling micro-producers and has even received acquisition offers because of this advanced system.

Nevertheless, several retailers see an emerging customer demand for buying solar electricity contracts (C, D, F, H), and this led C and H to adopt this solar model with guarantees of origin from other European markets.

To sum up, solar electricity sales is only adopted moderately although it has the strongest horizontal alignment of all solar models. However, the infrastructure dimension is a challenge because of complicated handling of guarantees of origin. Moreover, in the environmental dimension the model is perceived unprofitable and there is a shortage of supply. It should also be noted that all retailers already have other renewable energy contracts, which results in a lack of strategic differentiation on a vertical level. Retailers who do adopt solar electricity sales are mainly driven by a perceived customer demand (environmental dimension).

4.4. Community solar intermediation

Six out of 30 retailers engage with community solar parks. Only one retailer, Göteborg Energi, operates it as a traditional utility-led community solar park (cf. Funkhouser et al., 2015). The other five retailers have chosen to intermediate rather than own the plants: they develop the project and enrol citizens, local businesses and the municipality at an early stage but later detach the ownership into a cooperative, which owns the land and the production plant, sells shares, and pays dividends to its members (Magnusson and Palm, 2019).[5] The retailer continues to handle plant maintenance and solar electricity sales to the shareowners and also sell additional electricity to them when needed. Notably, this setup combines utility-side and customer-side logics as introduced in section 2.1.

Overall, the *horizontal alignment* of this model is moderate. The value proposition of community solar intermediation allows consumers to own a share of a plant to cover part of their electricity consumption. This competes with retailers' electricity sales. However, even though the cooperative owns the plant, the dependency on the retailer's technical expertise remains high. As the retailer stays involved – albeit in a different capacity – the long-term disruptive potential is smaller than for turnkey systems. In terms of customer interface, the model mainly requires additional human resources. During the initiation phase of a project, the retailer engages face-to-face with diverse potential customers, for which it requires access through local channels. In this phase, the key activities therefore consist mainly of customer management and project development, which are complementary to the retailers' established business (with small adaptations). However, pure retailing firms do not have experience in these areas and lack the manpower and corporate culture to make large capital investments. Most manual and time-consuming activities, such as shareholder coordination, are outsourced to the cooperative. This division of labour comes with another advantage from the retailers' perspective: low risk in terms of financial aspects, as the cooperative manages the investment through selling shares.

Regarding *vertical alignment*, the interviewees were of slightly diverging opinions. The publicly owned retailers for the most part describe it as very well aligned with their organizational goals (A, C, H, F). One of them even described how its owner, the municipality, lowered its profit requirements in order for the retailer to be able to realize a community solar park for its citizens (Retailer C). However, other retailers consider community solar to be misaligned with their overall corporate visions (Retailer B), investment strategies (Retailer I) and general ways of running business (Retailer E, which does not operate any other large-scale electricity production plants).

In terms of *environmental alignment*, Retailers A, C and G recognize a market demand from customers who have less purchasing power or do not own houses:

> *"We wanted to attract customers who weren't that wealthy … customers [who] are afraid for climate or are climate friendly but not all have a lot of money …" (Retailer C)*
>
> *"We have a lot of apartments here … and they are also very interested in solar cells. But they can't buy them. Or, they can buy them, but they can't put them anywhere. So we're thinking that they could like rent or buy, or whatever, some share of it." (Retailer G)*

However, other retailers identify several types of environmental misalignment as obstacles for adopting the community solar model: unavailability of land (A, F, H), poor profitability (A, I), and complicated, unfavourable and unstable regulations (B, C, E, F). Retailer H also mentions the lack of a suitable business models as a barrier, as the existing business model for wind community parks cannot be copy-pasted to solar.

> *"We have looked into that. It's legally a bit tricky from a tax perspective …. And then it [the park] becomes an economic association with all that this implies." (Retailer B)*

To sum up, community solar intermediation is horizontally misaligned in some dimensions (value proposition, customer interface, and some key activities), whereas other aspects align well with the established business model – at least for "integrated" retailers. It should here be noted that all retailers that have adopted this model are part of integrated, municipally owned energy companies that combine electricity production, grid operations, and retailing, and that have strong ties to their local communities. In these cases, strong vertical alignment with social and environmental sustainability goals seem to be able to compensate for horizontal misalignment as well as for poor environmental alignment in the form of complex, unfavourable, and unstable regulations, scarcity of land, and lack of profitability. In contrast, the community solar intermediation model is generally less appealing to 'pure' retailers.

[5] This cooperative model was in place before retailers started to be involved in the development of community solar parks and has also been used for wind power projects (cf. Mignon and Rüdinger, 2016).

4.5. PV plant leasing

Only one Swedish retailer, Umeå Energi, offers PV plant leasing. Leasing enables consumers to use solar panels with low up-front cost and low risk. In contrast to PV turnkey sales, leasing allows the retailer to retain ownership of the plant and remain in control over electricity production and sales.

The *horizontal alignment* of leasing is moderate. Its value proposition (as described above) complements existing business offers. Moreover, the financial aspects are characterized by monthly payments, which is in line with incumbent electricity sales. However, the complexity of the leasing model lies within the infrastructure dimension. As for PV turnkey sales, leasing requires complex intermediary activities and knowledge and the respective personnel, purchasing and warehousing, although this can be reduced substantially through outsourcing. Here, there are potential synergies between the two models in that existing partnerships from PV turnkey sales can be used for leasing. Compared with PV turnkey sales, however, key resources such as drawing up leasing contracts and arranging to take back PV equipment after the leasing period require novel partners and complex legal knowledge.

With regard to *vertical alignment*, leasing should be in line with the societal goals of some (municipally owned) retailers:

> *"Since we're owned by the municipality, we could think that we're going to do something [of] more benefit for the little person. … So it should be easier for ordinary customers. /…/ It will be quite hard to make a profit off of it. And it's a lot of work … But still, it could be a possibility if we really, really want it …" (Retailer C)*

However, several interviewees emphasize how difficult it is to implement leasing as it requires them to offer long-term financing solutions, which differs from the logic and mindset of selling electricity or even PV turnkey systems:

> *"For us, the question about if we should be a bank or not is the most important. And then, there we have decided to not offer this part." (Retailer A)*
>
> *"Well, it's more of a mindset than something practical. […] It's a different business model which hasn't been tested. Which we hadn't tested at least. And we used to install and leave and now we should live with subscribing customers. It's different... A totally different issue." (Retailer E)*

The overall *environmental alignment* is weak as it is difficult to find the right financing partners and define the legal terms: "*We're also looking into this leasing, or rental. I think we will start with it during the spring, hopefully, but … there's a lot of legal issues with these leasing … things." (Retailer G)*

In terms of customer demand, the interviewees are of different opinions; while some have identified a demand for leasing in their customer base (E, F), others have not (C, D). Retailers C and G see a general market trend for leasing services, which they argue could positively influence this model in the future:

> *"It's like this monthly payment instead. And we're seeing that more and more young people are buying solar cells. So I think we're moving in that direction…" (Retailer G)*

To sum up, PV plant leasing is the latest solar model on the Swedish market and has so far only been adopted by one retailer. However, a significant share of the interviewees has considered, or is considering, to adopt it (A, C, E, F, G, H) – mostly because of perceived customer demand (environmental dimension) or vertical alignment with social goals. So far, however, horizontal, vertical, and environmental misalignment are creating very strong barriers to adoption as the model requires close customer interaction and complex juridical knowledge (horizontal dimension), a new service-oriented mindset (vertical dimension), and legal standards and financial partners that are not yet in place (environmental dimension).

5. Discussion

At an overall level, this study largely confirms the initial assumption that incumbents are more likely to pursue niche innovations that have a high degree of strategic fit However, in comparison with previous literature, the findings described in Section 4 provide a more nuanced understanding of the importance and influence of horizontal, vertical, and environmental alignment for solar model adoption by electricity retailers. In the following, we will highlight the most important insights in this regard.

5.1. Horizontal alignment

The combined analysis of the overall adoption pattern and the horizontal alignment shows that solar business models that are compatible with or complement the established electricity retailer business model are not generally preferred over those that are more different. Most notably, solar electricity sales, which as a whole is quite similar to the established electricity retail business model, is uncommon, whereas the turnkey turnkey sales model, which is different from the established model in all business model dimensions, has been adopted by a majority of retailers. This seems to contradict previous literature, which has argued that incumbents are likely to engage with business models that are compatible with their established ways of doing business (and vice versa) (cf. Bolton and Hannon, 2016; Rosenbloom and Meadowcroft, 2014; Wassermann et al., 2015).

At closer scrutiny, however, our findings still suggest that horizontal alignment influences business model adoption. A key insight in this regard is that value proposition, customer interface, and downstream complementary assets, are not equally important as suggested in previous literature (e.g. Apajalahti et al., 2018; Bolton and Hannon, 2016; Hill and Rothaermel, 2003). Instead, the importance of horizontal alignment varies between business model dimensions. According to our study, the *infrastructure* dimension is the most important one for solar business model adoption. If a solar model has a low degree of fit in this dimension, retailers will either

(1) not adopt it at all, or they will (2) re-design it to improve its alignment with existing infrastructure. The first part of this argument is illustrated by the low adoption levels of solar electricity sales and PV plant leasing, which have complicated infrastructure dimensions that do not match the incumbent business model. The leasing example also supports the view that "competence-destroying" innovations (Tushman and Anderson, 1986) are difficult for incumbents to handle. The second part of the argument is best illustrated by PV turnkey sales, where retailers configure the common turnkey model to be more compatible with their established business operations by outsourcing the installation (which is the most complex and incompatible part of this model). This confirms Schoettl and Lehmann-Ortega's (2011) proposition that the installation aspect of PV turnkey sales is not compatible with retailers' core competencies, but at the same time shows that retailers have found ways to reduce this misalignment – an option that has not been explicitly considered previously.

Similarly, Swedish electricity retailers prefer community solar intermediation over traditional utility-led models, since outsourcing enables retailers to adopt the model with little additional requirements or consequence for the established infrastructure.

In contrast, alignment in the *value proposition* dimension does not seem critical for retailers to adopt a solar business model. Not only does the limited adoption of the solar electricity sales model indicate that a close fit in this dimension is insufficient for adoption to occur, but there is also a widespread adoption of solar models that have a poorer fit with – or even threaten – the existing value of the retailers' core business, such as PV turnkey sales. This is somewhat surprising, considering that this kind of "disruptive" (Christensen and Rosenbloom, 1995) solar innovation has been assumed to be particularly challenging for incumbent energy companies (cf. Bryant et al., 2018; Wainstein and Bumpus, 2016).

The results related to *customer interface* and *financial aspects* are inconclusive. Regarding customer interface, retailers on the one hand seem to prefer solar models that allow them to keep contact with mass-market customers to a minimum (e.g. reimbursement) over models that require face-to-face interaction (e.g. community solar intermediation). On the other hand, there is widespread adoption of the PV turnkey sales model even though it requires specialized sales representatives who have intense customer contact. Regarding the financial aspects, retailers adopt solar models regardless of whether they imply monthly payments (high alignment with existing revenue streams) or one-time transactions (low alignment). However, cost structure alignment seems to be of some importance considering that pure retailing firms are less likely to adopt solar models in which the cost structure requires capital-investments.

5.2. Vertical alignment

The findings show that three main aspects of vertical alignment matter for solar model adoption. First, the overall *organizational goals* of the retailers influence their choice of specific business models. This is especially apparent for municipal energy companies, which not only have to consider economic goals but also social and environmental ones (Wihlborg and Palm, 2008). Indeed, our study shows that municipal ownership can be a major driving force for both PV turnkey sales and community solar intermediation. This is in line with previous studies from Germany (cf., e.g. Richter, 2013) but contradicts some recent writings that suggest that municipally owned energy companies tend to be unable to reorient and reorganize their business models due to local vested interests (cf. Mori, 2021).

Second, several retailers describe how their choice of specific solar models is influenced by how well those models align with the overall corporate *business logic* in terms of what kind of company they consider themselves to be and what types of products they should supply. This is especially visible in relation to PV plant leasing (and to some extent also PV turnkey sales), which require a service mindset to establish regular interaction with customers. As emphasized in the industrial marketing literature, such a "service-dominant logic" tends to clash with the traditional logic in that it requires new perspectives on, for example, value (co-)creation (Lusch and Nambisan, 2015; Vargo and Lusch, 2004).

Third, the retailers consider how well new models fit their *overall market strategy* within retailing. With some individual firm exceptions, all solar models align well with establishing a sustainable brand supporting renewable energies. More importantly, however, the retailers use some solar business models – most notably premium reimbursement – to retain customers. While it has been acknowledged previously that customer retention can be a major driver for adopting solar business models in general (Funkhouser et al., 2015; Huijben and Verbong, 2013), our study shows that it can even be important enough to justify adopting inherently unprofitable business models.

5.3. Environmental alignment

Our study confirms that the retailers' choice of solar models is influenced by the models' alignment with both the task environment and the institutional environment and provides a more detailed understanding of the importance of profitability, competition, market demand, availability of suppliers and partners, and regulation in this regard.

Unsurprisingly, a perceived lack of *profitability* is one reason why retailers choose not to adopt some solar models, particularly community solar. However, most retailers also emphasize that they need to consider some solar models regardless of their lack of short-term profitability because of high *competition* in the industry. That is, retailers must offer the same models as their competitors in order to retain or increase their electricity retail market share and secure long-term overall profitability, which is especially prevalent with the premium reimbursement model. Solar model adoption, thus, seems to follow general industrial innovation patterns, where firms in an industry tend to imitate each other's technology adoption behaviours in order to reduce the risk of losing their competitive position in the industry (Lieberman and Asaba, 2006).

There is also a direct effect of *market demand* on the choice of solar models, in that an articulated or assumed demand from the retailers' established customer base can induce them to adopt a business model that is misaligned in other dimensions. This demand is to some extent affected by *economic policies* favouring small PV systems over larger ones and thus host-ownership over community solar. This confirms findings from previous studies that technology-specific subsidies influence solar model adoption (Huijben et al., 2016; Karneyeva and Wüstenhagen, 2017; Overholm, 2015).

The availability of *suppliers and partners* also influences the retailers' choice of solar models. On the one hand, limited availability of prosumers restricts the retailers' ability to engage in solar electricity sales and the lack of partners with legal knowledge limits the adoption of PV plant leasing. On the other hand, the Swedish retailers' choice of the PV turnkey sales model, where they outsource much of the key activities to external partners, has been facilitated by the already existing, well-developed Swedish ecosystem (or "industrial configuration" (cf. Strupeit and Palm, 2016) of solar installation firms (Bergek, 2020; Palm, 2015). This is in line with recent writings on business model innovation for sustainability, which suggest that ecosystems can provide important knowledge and complementary assets (Inigo et al., 2017).

Finally, retailers describe that their decision to not (yet) adopt some solar models is highly influenced by uncertainties related to *regulation*, including rules for community solar, guarantees of origin for micro-producers (in relation to solar electricity sales), and general conditions for leasing. An interesting finding in this regard is that these regulations, in contrast to the subsidies mentioned above, for the most part are not technology-specific but concern more general issues such as taxation and forms of ownership.

5.4. Strategic fit: the three dimensions combined

The analysis shows that solar PV is not generally misaligned with the established business of incumbent energy companies, as suggested in some previous literature (Hess, 2016; Huijben and Verbong, 2013; Rosenbloom and Meadowcroft, 2014). Instead, the degree of strategic fit varies between solar business models, as a result of differences in horizontal, vertical, and environmental alignment. In this section, we highlight some of the key insights on the relative importance of the three strategic fit dimensions and how they relate to each other.

One key observation in this regard is that we see little evidence that horizontal alignment drives solar model adoption, i.e. the retailers do not adopt particular solar models for the purpose of deliberately exploiting potential synergies between "sibling businesses" (cf. Wadström, 2019). Instead, a combination of vertical and environmental alignment is needed for retailers to consider adopting a particular solar model: it has to fit the retailers' organizational goals or marketing strategies and allow them to respond to external threats or opportunities. With regard to vertical alignment, the findings suggest that at least one of the identified aspects (organizational goals, corporate business logic, or overall market strategy) have to be in favour of a solar model for it to be adopted. For example, the PV turnkey sales model does not align with the retailers' main business logic – and even threatens their entire existence by turning customers into prosumers – but aligns well with the (social) organizational goals of municipal energy companies and most retailers' sustainability-oriented market strategies. With regard to environmental alignment, the retailers stress the necessity of meeting the demand for different types of solar products and services from their existing customers (most notably solar electricity sales and PV turnkey sales) and matching the solar offers of their immediate rivals (i.e. other retailers) in order to retain their customers as major reasons to adopt some models (for instance in premium reimbursement), which indicates quite traditional task-related incentives and pressures.

A second observation is that strong misalignment in one dimension can be enough for a solar model not to be widely adopted, even if there is alignment in other dimensions. This is the case for both solar electricity sales (which is restricted by the lack of solar electricity suppliers) and leasing (which would require an immense shift of business logic from selling electricity to becoming a service provider).

A third observation is that retailers to some degree can manage strategic fit. Horizontal alignment can be achieved through adaptation of new business models to make them (more) compatible with the established model, while increasing vertical alignment might require rather time-intense, non-material investments in shifting corporate identity. Environmental alignment is dependent on external, dynamic factors and is, therefore, more difficult to manage by a single actor. Nevertheless, actors can to some extent influence factors such as customer demand and policy through collective efforts (Geels, 2014a). Previous efforts to increase alignment illustrate the interdependency between dimensions. A good example of this is the turnkey sales model, where a perceived lack of infrastructure alignment has resulted in a model in which some key activities are outsourced. This is enabled by environmental alignment in terms of available partners (solar installation firms) to outsource to. Another example is community solar. In previous literature, this has been described as the first choice for electric utilities (Funkhouser et al., 2015; Richter, 2013; Ruggiero and Lehkonen, 2017), because of its strong (assumed) alignment with the established retailer business model. However, the adapted community solar intermediation model that exists in Sweden has primarily been designed to allow the retailers to pursue their social mission (vertical alignment), which has resulted in weaker horizontal alignment because intermediation requires closer customer interaction than the traditional utility-led community solar model. Such interdependencies might explain why Swedish electricity retailers – in contrast to suggestions in previous literature (cf., e.g., Ruggiero and Lehkonen, 2017; Schoettl and Lehmann-Ortega, 2011) – as a collective engage less with the 'utility-side' community solar model and more with the 'customer-side' PV turnkey sales model.

To sum up, these observations show that in order to explain solar business model adoption patterns, all the three strategic fit dimensions have to be considered together. Thus, in contrast to previous literature on solar PV, which has put forward horizontal alignment as the main explanation of incumbent actors' business model choices, our study highlights the importance of also considering vertical and environmental alignment and the interplay between these dimensions.

6. Conclusions and implications

The purpose of this paper was to further our understanding of the roles and strategies of incumbent actors with regard to emerging technologies. More specifically, the purpose was to identify and explore potential explanations for the business strategies of electric utility incumbents in relation to solar PV technology. In order to achieve this, we mapped the solar business models adopted by the 30 largest Swedish electric utilities and analysed to what extent these models were strategically aligned with the incumbents' established business model, corporate strategies, and external environment.

The first research question concerned the characteristics of the solar business model adoption pattern of the incumbents. The mapping shows some common features across the industry in this regard: (1) most of the studied utilities have adopted one or more solar models, (2) some models (PV turnkey sales and premium reimbursement) have been widely adopted, while others (PV plant leasing) have hardly been adopted at all, and (3) archetypes have been tailored the Swedish context.

The second research question concerned the importance of strategic fit for explaining the adoption pattern. Considering each of the dimensions individually, we find that (1) infrastructure (i.e. key resources, activities, and partnerships) has a higher influence on solar adoption than value proposition (horizontal alignment), (2) a solar business model must be aligned with the electric utility incumbents' overall organizational goals, main business logics, or market strategies (vertical alignment), and (3) competition, demand, policy, and availability of potential partners have a clear influence on utilities' choice of solar business models (environmental alignment). This can be further nuanced looking at the interplay between the three dimensions. In contrast to previous literature, we find that horizontal alignment is not the main driver for solar model adoption. Instead, a model needs to fit a utility's corporate strategy and allow it to respond to external threats or opportunities in order to be adopted. While strong misalignment in one of the three dimensions can hinder adoption, utilities have created ways to configure archetypical models to increase strategic fit, especially in the horizontal dimension. Moreover, empirical examples illustrate how re-configuration in one dimension can influence other dimensions. Overall, the findings highlight the relevance of the presented framework for analysing strategic fit.

These findings contribute to the literature on industry incumbents' strategies in relation to emerging technologies by demonstrating that incumbents can and do engage with potentially disruptive business models. While our analysis focused on overall adoption patterns and explanations, there is also some indication that electric utilities make different decisions with regard to the adoption and design of solar business models, depending on a combination of firm-internal strategic considerations and external pressures. This nuances the view of industry incumbents as a homogenous collective governed by a common industry logic (Bidmon and Knab, 2018; Geels, 2014a). Thereby, it confirms earlier observations that incumbents do not necessarily share the same interests, goals, or preferences (Cherp et al., 2017; Heiskanen et al., 2018; Markard et al., 2016; Mühlemeier, 2019; Rosenbloom, 2019) and takes this line of reasoning one step further by investigating the importance of different types of strategic fit for explaining business model choices.

Regarding further research, in-depth case studies of individual utilities could provide more detailed insights into the interplay between different strategic fit considerations and how they influence solar business model adoption and the configuration of specific models at the company level. Moreover, longitudinal industry-level studies of business model experimentation by incumbents (and other actors) could further our understanding of how the relative importance of strategic fit dimensions changes over time.

Finally, the study raises some questions about the role of incumbent actors for innovation diffusion. Most notably, it shows that Swedish electric utilities do not only contribute to solar PV diffusion through their own investments in PV systems, but also through exploring new roles as brokers in PV turnkey sales and community solar intermediation. Further research about these roles could contribute to the expanding literature on diffusion (or "user-side") and transition intermediaries (Barnes, 2019; Bergek, 2020; Glaa and Mignon, 2020; Kivimaa et al., 2020). The Swedish 'sales only' model for PV turnkey systems is especially interesting in this regard as it introduces a second-tier intermediary role in what appears to be an already quite well-functioning business model controlled by specialized solar installation firms. However, while incumbent actors can be of crucial importance for innovation development and diffusion (Bidmon and Knab, 2018; Geels, 2010; Heiskanen et al., 2018; Pinkse and den Buuse, 2012; Smith et al., 2010) some authors seem concerned that incumbents can 'dilute' the energy transition by moving emerging fields towards business models that are more in line with their current strategies (Apajalahti et al., 2018). Thus, future studies would be needed to investigate what influence the business model choices of electricity retailers will have, eventually, on the overall diffusion of solar PV in Sweden and elsewhere.

CRediT authorship contribution statement

Maria Altunay: Methodology, Investigation, Formal analysis, Writing – original draft. **Anna Bergek:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Supervision, Project administration, Funding acquisition. **Alvar Palm:** Investigation, Writing – original draft, Supervision.

Declaration of Competing Interest

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