Is Peer-to-Peer Electricity Trading Driving a Second Wave of Disruption for Incumbent German Utilities?

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Abstract

Title: Is peer-to-peer electricity trading driving a second wave of disruption for incumbent German utilities?

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The German energy market is facing an ongoing paradigm shift. As a result, incumbent utilities have experienced a first wave of disruption in the form of proliferation of renewable energy. Increasing decentralisation and digitalisation of the electricity sector is now giving rise to new and innovative business models like peer-to-peer (P2P) electricity trading. This allows consumers with distributed energy resources (DERs) to directly trade and share electricity with each other, eliminating the need for intermediary actors and placing the traditional incumbent business model under pressure. This paper analyses whether the P2P business model could potentially drive a second wave of disruption. To underpin this analysis, eleven expert interviews are conducted, and the results critically analysed. The findings indicated that P2P trading is unlikely to be powerful enough to drive a second wave of disruption and continues to be a niche product with limited scalability, at least for now. Implementational hurdles like restrictive regulation and conventional infrastructure are holding back its full market potential. German utilities, slow to adapt their business models away from traditional generation, should be concerned about such a platform-based business models, but equally not fear imminent disruption.

Keywords: Peer-to-Peer Electricity Trading, Distributed Energy Resources, Decentralisation, Energy Market, Incumbent Utility, Prosumer, Platform Business Model, Disruption

Resumo

Título: O comércio de eletricidade entre pares (peer-to-peer) está a provocar uma segunda vaga de perturbações para os serviços públicos alemães?

Autor: August Graf von Westphalen

O mercado alemão da energia está a enfrentar uma mudança contínua de paradigma. Como resultado, as empresas concessionárias já existentes sofreram uma primeira vaga de perturbações sob a forma de proliferação de energias renováveis. A crescente descentralização e digitalização do sector da eletricidade está agora a dar origem a novos e inovadores modelos de negócio como o comércio de eletricidade peer-to-peer (P2P). Isto permite aos consumidores com recursos energéticos distribuídos (DER) negociar e partilhar diretamente eletricidade entre si, eliminando a necessidade de actores intermediários e colocando sob pressão o modelo de negócio tradicional dos operadores históricos. Este documento analisa se o modelo de negócio P2P poderia potencialmente conduzir a uma segunda onda de perturbação. Para sustentar esta análise, são realizadas onze entrevistas a peritos, e os resultados são analisados criticamente. Os resultados indicam que é pouco provável que o comércio P2P seja suficientemente poderoso para conduzir uma segunda onda de perturbação, que continua a ser um produto de nicho com uma escalabilidade limitada, pelo menos por agora. Obstáculos de implementação como a regulamentação restritiva e as infraestruturas convencionais estão a travar todo o seu potencial de mercado. Os serviços públicos alemães, lentos a adaptar os seus modelos de negócio longe da geração tradicional, devem preocupar-se com tais modelos de negócio baseados em plataformas, mas também não devem recear uma perturbação iminente.

Palavras-chave: Comércio de Eletricidade entre Pares, Recursos Energéticos Distribuídos, Descentralização, Mercado Energético, Utilidade Pública Incumbente, Prosumer, Modelo de Negócio da Plataforma, Perturbação

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List of Abbreviations

B2B	Business-to-Business
DAGs	Directed Acyclic Graphs
DERs	Distributed Energy Resources
DLTs	Distributed Ledger Technologies
DLCIs	Disruptive Low-Carbon Innovations
DSO	Distribution System Operator
EEG	Erneuerbare-Energien-Gesetz (Renewable Energy Sources Act)
EMS	Energy Management System
ESC	Energy Sharing Coordinator
EV	Electric Vehicle
FiT	Feed-in-Tariff
GTM	Grounded Theory Methodology
ICT	Information and Communication Technologies
IT	Information Technology
kWh	Kilowatt-hour
PPA	Power Purchase Agreement
PV	Solar Photovoltaic
P2P	Peer-to-Peer
RBV	Resource-Based View of the Firm
RES	Renewable Energy Sources
TSO	Transmission System Operator
VRIN	Valuable, Rare, Inimitable & Non-substitutable (Resource-Based View)

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1. Introduction

The global paradigm shift towards a low-carbon economy is influencing how energy is produced, delivered, and consumed. Ever-increasing energy prices and a drive towards sustainability and energy security have led to an unprecedented energy revolution. This development has arguably already caused a first wave of disruption for incumbent utilities in Germany. It started with the proliferation of DERs, small- or medium-sized energy resources directly connected to the distribution network (EC, 2015). The growing decentralisation of energy and penetration of renewable energy sources (RES) has been increasing pressure on grid infrastructure and causing a move away from previously centralised generation, transmission, and distribution structures. Primarily driven by new market actors, including farmers, individual households, and energy cooperatives, this development began to take over incumbent market share. The large volume of renewable energy entering the market created a merit order effect, lowering prices at electricity exchanges and forcing traditional generation capacities out of the market, disrupting the existing incumbent business models.

Today, a second wave of disruption is evident. Even though incumbent utilities have adjusted their business models to adapt to the initial disruption, they now face new challenges. DERs are transforming the energy system from a traditional hierarchical structure to a more decentralised model (Tushar et al., 2021). Consumers increasingly are changing from passive actors in the market to more active participants with electricity generation and trading capabilities. The growing importance of information and the rapid digitalisation of the electricity sector give rise to new business models. This creates opportunities for localised electricity distribution and trading models, such as P2P electricity trading. It can be described as a platform business model using an online marketplace where consumers and private electricity producers exchange energy without an intermediary (Soto et al., 2021). This puts the dominant production, supply, and distribution paradigm under pressure. Utilities are potentially facing a "[…] progressive reduction of their traditional and remunerative profits based on their role in the intermediation" (Antonioli Mantegazzini, 2020) and must now fear a potential second wave of disruption.

Even though first trials of P2P trading schemes have begun in a few countries, the academic literature mainly focuses on the business model and its technologies. Difficulties of implementing a local customer-to-customer electricity market model in specific country markets and effects on energy incumbents have not been covered in detail. This paper examines the disruption effect of P2P electricity trading on German utility incumbents and whether this will trigger a second wave of incumbent disruption. It further examines the feasibility of such a business model in a European market environment, in this case, Germany. Even though multiple resources are integral to the energy business, this paper will only focus on electricity. Therefore, from the literature review onwards, the term energy will solely refer to electric energy.

We begin by providing an overview of management theory that forms the basis for exploring this topic and its relation to disruption, innovation, and strategy. This is followed by an examination of the German energy landscape, including an overview of local electricity industry and market developments and the general climate policies and goals. In addition, the literature review covers the theoretical basis of the P2P business model. This is followed by an outline of the research methodology used and then an analysis that lays out the results of the research conducted. The findings are critically reviewed and evaluated, placing them in the context of the existing literature. The conclusion ties together the arguments from previous sections. Limitations of this paper and future research opportunities are also discussed.

2. Literature Review

2.1 Management & Strategy Literature

Energy transitions and their associated industry disruptions are extensively discussed in management literature. To further analyse the position of incumbent companies in this evolving market environment, several important theoretical concepts need to be visited.

2.1.1 Disruptive Innovation

Innovation is a crucial driving force in any industry and involves products, processes, technologies, or organisational factors that can evolve (Cooper, 1998). If done right, business model innovation can help companies become more resilient during times of change, and innovation processes developed can contribute to growth (Christensen et al., 2016). But while innovation can be beneficial, it can also cause severe disruption. For this paper, disruption is characterised as "[…] a process whereby a smaller company with fewer resources can successfully challenge established incumbent businesses" (Christensen et al., 2015). So-called "disruptive innovation" is a process that displaces the dominance of incumbent companies.

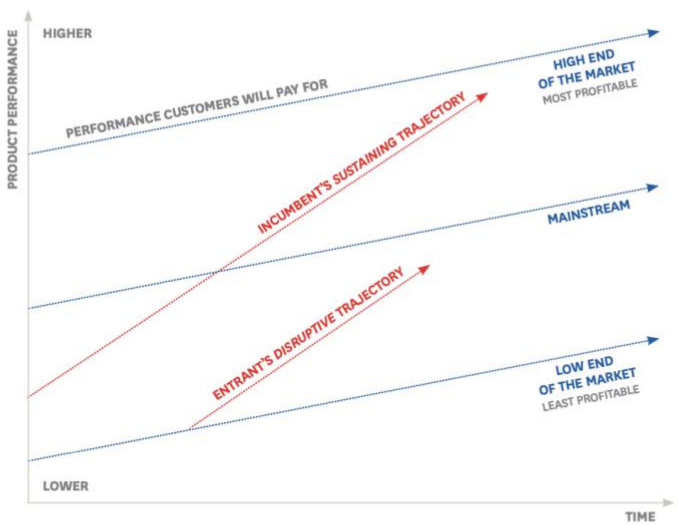

Figure 1. *The "Disruptive Innovation" model*
Source: Adapted from Christensen et al. (2015)

A focus on meeting the needs of a large and profitable customer cohort causes management to ignore undervalued and underserved market segments. They overshoot the needs of these niche and often low-end customers, leaving an opening for new market entrants (see Figure 1). Disruptive entrants deliver value for this neglected niche market or an all-new market by providing more functional products at a lower price. At the same time, incumbents tend to be oblivious as they chase higher profitability segments. Eventually, new entrants move upmarket on a disruptive trajectory, delivering products to incumbents' mainstream customers at a cost and performance advantage, challenging incumbent dominance and causing disruption (Christensen et al., 2015).

While disruptive innovation theory contributes to understanding industry transitions, it is narrowly focused on single products rather than a system that includes interacting innovations that create disruption across multiple dimensions (Geels, 2017). Taking this interplay of dimensions into account within a low-carbon transition setting, so-called "Disruptive Low-Carbon Innovations" (DLCIs) have been proposed as a theoretical construct. These offer a better way to consider the more efficient and lower-carbon alternatives that are challenging the traditional, incumbent form of energy generation, distribution, and use (Wilson, 2018). DLCIs differ from what has been previously defined as disruptive innovation because unlike the notion of disruption proposed by Christensen et al. (2015), they don't necessarily improve functionality or offer novel attributes but instead provide the same basic service for end-users. Similarly, disruption does not need to originate in lower, undervalued market segments but can come from above. It does so via superior products with more capabilities and functionality than existing offerings in mainstream markets (Wilson, 2018). They also can be more expensive, initially only appealing to a high-end existing market niche. However, cost and performance improvements rapidly catch up with the incumbent offering, thereby outcompeting and disrupting them. A platform business model like P2P electricity trading could be described as a DLCI. It initially requires a high-end market, which includes smart homes, to gain a foothold before moving down to mainstream market segments. It is here where it creates value by offering end users more autonomy, independence, and an active market role (Wilson, 2018).

2.1.2 Platform Business Models

The advent of internet technologies and internet-enabled devices has facilitated the development of new organisational business models based on platforms rather than on more traditional marketplaces. Corporate design has shifted from purely selling products to facilitating the economic exchange between two or more user groups (Zhao et al., 2020). Such platform models mediate user interactions instead of controlling a linear series of activities along the value chain. Platforms do not necessarily own or manufacture products but rely on resources provided and managed by actors on other sides of the market (Adner & Kapoor, 2010; Boudreau & Jeppesen, 2015; Thomas et al., 2014). In other words, platform-based business models "seek to leverage the assets of third parties" and, at the same time, "extend the value of economic activity to customers in ways that […] benefit them" (Shaughnessy, 2016). The P2P business model uses a trading platform and mechanism that relies on existing distribution infrastructure and generation capabilities without producing electricity. By allowing consumers and producers to easily exchange excess electricity for monetary compensation, an efficiency is created. It also provides value to consumers who have more straightforward and cheaper access to renewable electricity. For platform business models, technology is not the source of disruptive innovation but rather the organisational form that promotes new ways to organise wealth-creating activities (Shaughnessy, 2016). Compared to the situation of intermediaries existing outside the digital economy, platform business models introduce new transaction mechanisms at a much faster rate and lower costs (Zhao et al., 2020). Further disruption is caused by complementary effects, bringing about changes in the "[…] relative value of incumbents' offering in the ecosystem" (Meyer et al., 2021). However, leveraging third-party assets within a platform has particular requirements: trust levels between transaction parties must be carefully managed, a seamless transaction engine has to be created, and an implicit guarantee of profitability should be provided (Shaughnessy, 2016).

2.1.3 Strategy in the Face of Disruption

Strategy plays an important role, and precise strategic positioning generating competitive differentiation is key to achieving sustainable Competitive Advantage (Porter, 1996). An industry facing disruption forces incumbent companies to adjust their business models and strategic outlooks to keep up with the changing market environment. However, each sector has its own dynamics and competitive forces that define the nature and degree of competition in an industry which strategy must address to make the firm less vulnerable to attack (Porter, 1989).

Organisational Ambidexterity

In the face of successful disruptive moves by new players that change the status quo, established firms like the incumbent utilities are often forced to respond to preserve market share (Alpkan & Gemici, 2016). The response to disruptive innovation varies from industry to industry. Still, it can be summarised in five ways: concentrating on the traditional business, ignoring the disruptive innovation, disrupting the disruptor, scaling up only the disruption and lastly, scaling up the disruption while trying to keep traditional businesses going (Charitou & Markides, 2003). The last concept indicates that incumbent firms respond to disruptive innovation using ambidextrous solutions. By demonstrating organisational ambidexterity, exploring new opportunities, and exploiting established capabilities, incumbent firms engaged in disruptive innovation can thrive (Wood et al., 2013). Leveraging their capital reserves and project experience, the incumbent utilities have a chance at regaining market share or at least staying on top of emerging competitors. Nevertheless, managers and organisations must implement both incremental and radical innovation simultaneously to avoid the success trap, which is followed by failure, if they are to remain successful in the long term (Tushman & O'Reilly, 1996). However, a company operating in the same market with two different strategies might not be feasible. A clear strategic positioning requires trade-offs not to be stuck in the indifferent middle (Porter, 1996).

The Innovator's Dilemma

Still, incumbent players don't necessarily feel the need to quickly respond to a new threat when facing disruption. They tend to favour *sustaining innovation*, improving the performance of established products and services along the performance dimensions that mainstream customers have historically valued (Christensen, 2016; Denning, 2016). Thus, incumbents avoid implementing disruptive innovation as these take time to introduce and initially deliver lower returns compared to more promising outcomes gained from sustaining innovation (Christensen & Overdorf, 2000). In the case of German utilities, the low initial returns of RES has kept them focused on traditional generation sources, only incrementally improving their efficiency. This can lead to the so-called "Innovator's Dilemma", where a successful firm only focuses on satisfying the needs of its large customer base (Christensen, 2016). These firms become vulnerable to new market entrants (Christensen et al., 2015), resulting in the *creative destruction* envisaged by Schumpeter (1942) as the essential engine of competitive capitalism. Only incumbents who control a large portion of an industry's value chain have the strategic ability to introduce radical innovations. These integrated companies have the potential to master the various interdependencies associated with compatibility, interoperability, and legacy issues (Christensen et al., 2004).

2.1.4 The Resource-Based View and Dynamic Capabilities

Analysing competitive advantage has shifted from examining firms from the product side to the resource side, with the proliferation of the "resource-based view of the firm" (RBV) (Wernerfelt, 1984; Barney, 1991). This theory links firm performance and the internal characteristics driving that performance. A company is said to have a competitive advantage when "[…] it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors […]". In contrast, a *sustained* competitive advantage is only achieved when "[…] these other firms are also unable to duplicate the benefits of this strategy" (Barney, 1991). The theory assumes that firms within an industry are heterogeneous in the resources they control and that these resources are imperfectly mobile across firms, defining resources as "[…] tangible and intangible assets which are tied semi permanently to the firm" (Wernerfelt, 1984).

To maintain a competitive advantage, companies must utilise their tangible and intangible resources. To create sustainable value, these should be valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). Resources become valuable when they help a company introduce new strategies that improve efficiency and effectiveness. Similarly, resources only provide a competitive advantage when they are rare. If also possessed and exploited by many competitors, the value-creating advantage disappears. Valuable and rare resources allow firms to become strategic innovators because they can conceive and implement strategies that others cannot. However, a *sustained* competitive advantage is only achieved when these resources are also difficult to imitate, making it harder for competitors to duplicate a successful strategy. Lastly, the resource should be non-substitutable, meaning that there should not be strategically equivalent resources that other market actors can use. If these requirements cannot be met, no firm can expect to obtain a sustained competitive advantage (Barney, 1991).

Dynamic Capabilities

The RBV fails to capture how VRIN resources work in light of changing market conditions. To design, refine, implement, and transform a business model, a company must rely on higher-order (dynamic) capabilities. Based on the initial theoretical concept by Teece et al. (1997), the theory of dynamic capabilities has increasingly been conceptualised as an "[…] aggregate multidimensional construct". Barreto (2010) describes a firm's dynamic capability as the "[…] potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base". The dynamic capabilities framework re-engineers the RBV from applying only to static environments to work for the changing and complex markets faced by businesses today (Shuen et al., 2014). Dynamic capabilities further allow companies to "upgrade" their ordinary capabilities in rapidly changing markets "[…] to systematically solve problems". This potential can vary, indicating that firms can have differing levels of dynamic capability (Barreto, 2010). Strong dynamic capabilities will enable companies to quickly build, renew, and combine resources to address new market threats and opportunities, serving as a foundation for sustained competitive advantage. Nonetheless, they also require an organisation that "[…] has been designed and primed to be innovative and flexible" (Teece, 2018). However, while firms with superior dynamic capabilities are more likely to have a competitive advantage, these capabilities alone are not sources of long-term competitive advantage. The advantage lies in how effective managers use these capabilities to create superior resource configurations. Therefore, dynamic capabilities are a necessary but not sufficient condition for a sustained competitive advantage (Eisenhardt & Martin, 2000).

While the German electricity sector is not necessarily characterised by high-tech firms operating in an overly dynamic market, incumbents are facing an industry shift. Like upstream oil and gas companies, they need organisational and managerial innovations to take advantage of opportunities, to face incoming challenges and achieve competitive advantage. The incumbents need also be able to implement new technologies, manage resource deficiencies and new business environments, all while facing the "centralised-decentralised polarity" in a national context (Shuen et al., 2014).

2.2 The German Energy Landscape

2.2.1 The Electricity Market

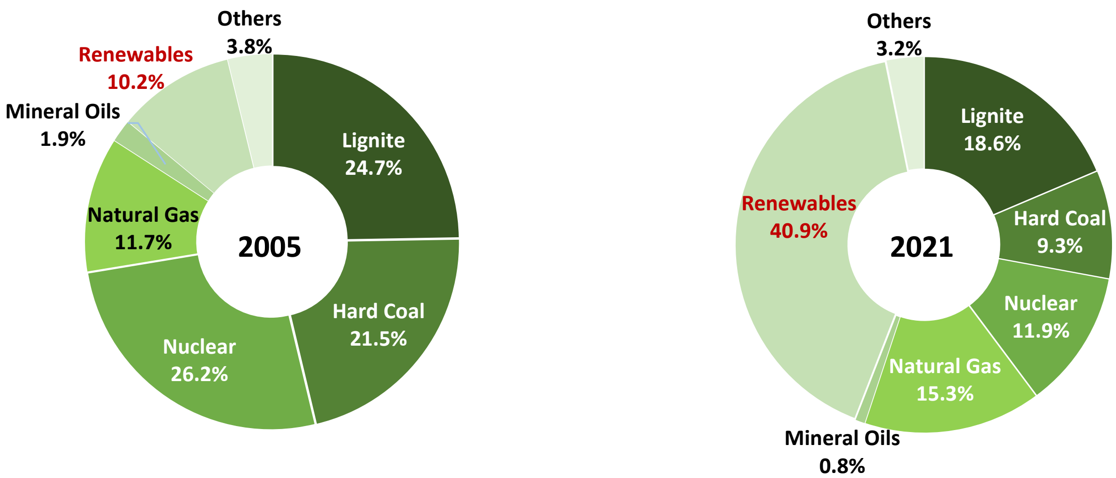

Figure 2. *Comparison of gross electricity generation in Germany by energy source 2000 & 2021 (in % of total)*
Source: Own illustration based on AG Energiebilanzen & bdew (2021)

Germany and its energy sector serve as an international showcase for national commitment of a large industrial economy to a low-carbon future. The country has set ambitious climate targets, including becoming greenhouse gas neutral by 2045 and RES increasing to 60% of final energy consumption by 2050. The energy sector is of central importance for achieving these goals, and the government plans to reduce sector emissions by 65% to 2030 compared to 1990 (BMUD, 2021). Nuclear capacity is supposed to be phased out by the end of 2022, with coal generation expected to stop by 2030. As shown in Figure 2, renewable energies contributed to 40.9% of gross German power production in 2021, compared to 10% in 2005. Similarly, the share of traditional energy sources like lignite and hard coal decreased from 46% in 2005 to 27.9% in 2021, indicating a downward trend for traditional generation types. Although these are promising numbers, studies show that Germany is unlikely to reach its energy targets by 2030 (EWI, 2021).

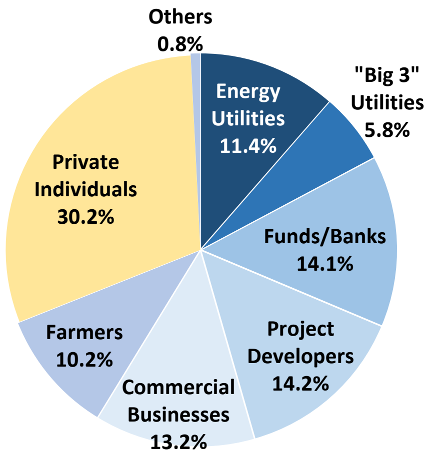

Figure 3. *Ownership structure of renewable energies in Germany 2019 (% share of total)*
Source: Own illustration based on AEE (2020)

The ownership structure of renewable energies in Germany is characterised by private individuals, which, if farmers are included, account for over 40% of installed capacity (see Figure 3). However, this must be compared to a share of over 50% ten years ago. The "Big 3" utilities, namely Vattenfall, EnBW and RWE, only control 5.8% of renewable capacity. Financial investors are also becoming more involved in renewable energy generation, especially regarding on and offshore wind energy. However, the energy transition should not be left to large investors alone. Private household generation capacity must be encouraged, and new capacity is needed in all sectors and size categories to achieve climate targets (AEE, 2020).

On the residential side, German consumers pay among the highest electricity prices in the world. In 2021, prices reached a new record level, at 32.2 cents per kilowatt-hour (kWh) (see Figure 4), a 234% increase over the past 21 years. However, only 25% of this amount accounted for electricity acquisitions and sales in 2021. Surcharges, fees, and taxes made up 51% of the price, and network charges the other 24% (bdew, 2021). Even though surcharges and fees are expected to be reduced in 2022, consumers still pay too much for electricity. This further illustrates the need

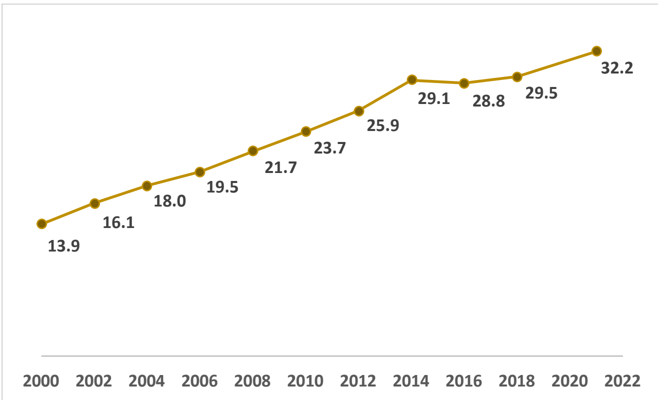

Figure 4. *Average household electricity price development in Germany 2000-2021 (in ct/kWh)*
Source: Own illustration based on bdew (2021)

for additional governmental support for decentralised energy resources and for alternative business models that allow consumers to take active control of their electricity cost structure.

2.2.2 The Electricity Players

The German energy industry is known for regularly undergoing significant structural and strategic changes, including the liberalisation of the sector in 1998. This resulted in a wave of mergers that led to the formation of oligopolistic and monopolistic dominant entities – among which were Germany's four biggest utility companies: E.ON, RWE, EnBW, and Vattenfall, referred to collectively as Germany's "Big 4" (Wagner et al., 2020). Their businesses were based on a traditional generation, and distribution portfolio using fossil fuels including coal (mainly lignite), gas, and nuclear energy. Up until 2004, these four incumbents accounted for 82% of the electricity production capacity in Germany and generated about 90% of the electricity in the country (Kungl, 2015). Apart from national incumbents, there are also medium-sized utilities working in regional monopolies on a municipal level. These so-called "Stadtwerke" (municipal utilities) are operating along the whole local energy value chain. They oversee energy production, distribution (in their role as Distribution System Operators [DSOs]), retail, and services to the customers, but also other "critical" infrastructure networks of the city (Mühlemeier, 2019). The national transmission network is operated and balanced by four Transmission System Operators (TSOs), separate from the generation business and directly overseen by the government due to their monopolistic nature and system relevance.

With the introduction of the Renewable Energy Sources Act (EEG) in 2000, the government paved the way for the large-scale integration of RES, which would fundamentally change the supply structure of the electricity sector. It obliged grid operators to prioritise renewable energy systems and supported them through advantageous fixed feed-in tariffs (FiT). This triggered a decentralisation of generation and kick-started the so-called *German Energiewende* (energy transition), causing new players to enter which also changed the role of consumers in the market (Brunekreeft et al., 2016). Considering the FiT returns as too small to warrant an engagement in this niche segment of the electricity market (Kungl, 2015), incumbent energy providers found themselves rapidly falling behind, with their market share of electricity generation declining towards 50% in 2020 (Wagner et al., 2020; Bundesnetzagentur & Bundeskartellamt, 2021). The energy sector's generation portfolio, power supply infrastructure, and market design changed, allowing new companies, novel business models, and innovative technologies to enter the market (Loßner et al., 2017). The number of non-incumbent players grew significantly, led by important disruptive actors called "prosumers".

Prosumers both consume and generate electricity (Zhu et al., 2020), trading and sharing it directly with each other. Thus, consumers who used to be passive participants in the electricity market increasingly become actively involved in energy production and distribution. Consequently, the current electricity supply is changing quickly from a "[…] top-down, single firm game into a decentralised, bottom-up, multiple-player system" (Brunekreeft et al., 2016), giving rise to local community and energy-sharing models. In the aftermath of the energy industry's first wave of disruptive processes, incumbents have begun to restructure business models to regain some market power, with E.ON and RWE pursuing a strategic reorganisation in 2018. Today, with the phasing-out of governmental FiT schemes, prosumers are left in a "post-subsidy" period for their green surplus electricity, limiting its income options (Herbes & Ramme, 2014). This increases interest in business models that offer new value propositions, like P2P electricity trading. However, recent regulatory change from FiTs towards market-based auctions as a procurement mechanism for renewable electricity is reviving the potential for incumbent action (Baker et al., 2021).

2.3 Peer-to-Peer Electricity Trading

The increasing number of DERs and storage devices connected to distribution networks at a residential level, combined with public incentives to promote further development, has changed the electricity market. A movement towards "smartness" in the energy system, with information and communication technologies (ICT) at the centre, also increases efficiencies and reduces costs of integrated renewables through Smart Grids and Smart Markets (Brunekreeft et al., 2016). This requires new market approaches to set prices and decentralise the market while also changing governance of electrical infrastructure (Goldthau, 2014).

2.3.1 The Trading Model

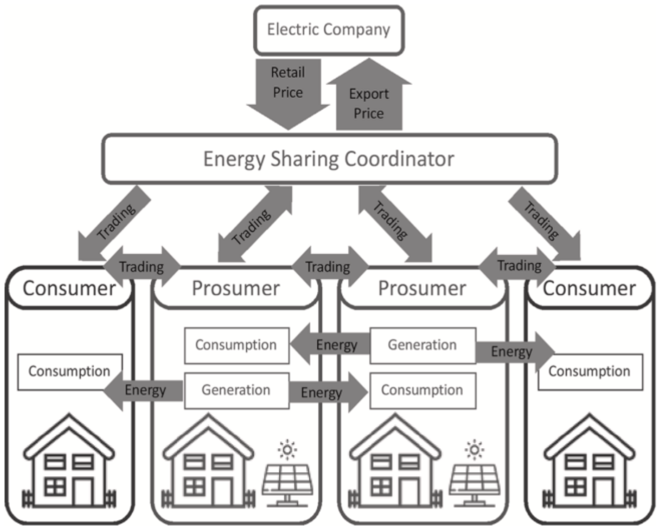

Figure 5. Peer-to-Peer electricity trading model
Source : E.A. Soto et al. (2021); adapted from Zhou et al. (2018)

Smart energy systems promote new business models like P2P electricity trading, which can be described as direct energy trading between peers, where electricity generated by DERs is traded among local energy prosumers and consumers (Zhang et al., 2018). Conventional energy trading is mainly unidirectional, with electricity transmitted from large-scale generators to consumers over long distances (Zhang et al., 2018). P2P electricity trading instead allows for a multidirectional movement of electricity within a geographical area, providing a more decentralised and open electrical network. This also allows electricity generated by DERs to be utilised locally to a greater extent. As shown in Figure 5, the P2P model consists of four main actors: consumers, prosumers, an energy sharing coordinator (ESC) and, at some level, the electric (utility) company. Prosumers can exchange energy and money with other consumers or prosumers. The entire negotiation process is managed and supported by a trading platform, enabled by ICT-based online services, that acts as the energy sharing coordinator. They form a local low voltage microgrid where trading is done without the traditional utility intermediary and prices are set more transparently, rather than relying on offers from large utilities. Electricity surpluses can be sold to the electricity company at the export price or additional demand imported at the retail price (Soto et al., 2021).

In most countries, the feed-in tariff/export price for selling electricity back to the power grid is lower than the price for buying from the grid. This creates economic incentives for customers to trade with each other first before trading separately with the electricity company (Zhou et al., 2018). Since the P2P trading price is set between the export- and retail price, customers can achieve a win-win situation, as buyers save costs while sellers increase profits (Liu et al., 2019). Apart from financial benefits, there is greater energy democratisation and market transparency. P2P markets have flexibility that enables consumers to choose which counterparties to trade with based on their own objectives, e.g., minimum costs, maximum profits, minimum pollution, and most reliable energy supply (Zhang et al., 2018).

2.3.2 Key Enabling Factors

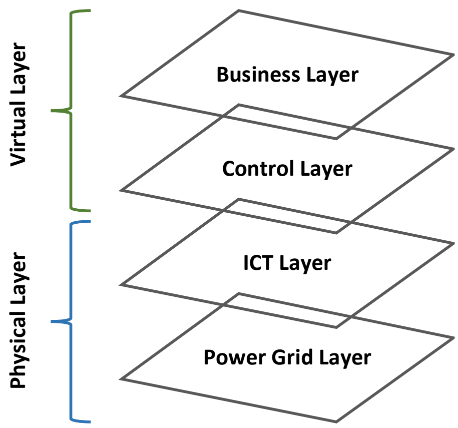

Figure 6. *Layer system architecture of P2P trading;* Source: Own illustration based on Zhang et al. (2018)

The P2P electricity trading market involves a complex mix of enabling factors that make the operation of such a system possible. These factors can be divided into a physical and a virtual layer (Mengelkamp et al., 2018; see Figure 6), facilitated by prosumers and supervised by a regulatory element. The physical layer includes the power grid- and ICT infrastructure and devices, whereas the virtual layer includes the energy management systems (control layer) and the market design (business layer).

Physical layer: Grid infrastructure

To enable P2P trading, electricity must travel freely between different prosumers and consumers. Therefore, it requires a functional and well-maintained grid infrastructure. This can be the public distribution grid provided by large transmission companies and utilities or private smaller, localised microgrids. In the case of the public distribution grid, the network acts like a pool. Electricity providers and prosumers inject power, and consumers, who cannot determine where the electricity physically comes from, subtract power from that pool (Zhou et al., 2020). This leads to the argument that P2P energy trading via the public distribution grid constitutes virtual energy trading rather than a physical energy exchange (Zhou et al., 2020). It also means that the P2P platform coordinator must interact directly with system operators and the electricity market to balance consumption and distribution patterns (IRENA, 2020), while extra grid connection, transmission, and distribution costs are passed on to the consumer.

Microgrids, small scale power grids operating at a low voltage level formed by local generations and storage devices (Lidula & Rajapakse, 2011), can also enable P2P electricity trading. They can either be operated in a connected grid or are self-sufficient, providing an alternative to the ageing and vulnerable centralised energy infrastructure that must reckon with increasingly fluctuating power supply and demand. Consumers and prosumers can be independent of the main grid, enjoying higher resilience and stability, and not fearing transmission losses due to the shorter distance the electricity must travel. However, this independence critically depends on energy storage devices to ensure power balance and cope with load fluctuations (Lidula & Rajapakse, 2011).

Physical layer: ICT infrastructure and devices

ICT technologies facilitate information exchange between P2P trading parties. A large amount of bilateral communication is needed across the negotiation, delivery, and settlement stages of P2P energy trading (Zhou et al., 2020), demanding robust communication infrastructure. System performance demands latency, throughput, reliability, and security (Jogunola et al., 2017) and trading needs to use up-to-date prices, production, and demand numbers. An enabler of this is smart electricity meters that provide production-consumption control, live power consumption, and distribution data for billing, allowing consumers and prosumers to participate in the smart shared grid infrastructure (Sigl et al., 2018). Similarly, as mentioned above, energy storage devices like at-home batteries or electric vehicles are an essential part of the P2P trading model. When prosumer generation is high and production levels cannot fully be exploited due to low demand, excess energy might have to be curtailed or fed back into the main grid. This will reduce profitability of prosumers' generation capacity and might lead to them investing only in lower capacity (Lüth et al., 2018). Thus, energy storage devices can significantly leverage the efficient energy flows within a community to reduce costs, decarbonise the grid, and enable effective demand responses. However, the upfront costs of storage devices can be substantial (Tushar et al., 2016).

Virtual layer: Energy management systems

In addition to its physical layer components, P2P trading also requires a virtual energy management system (EMS) responsible for market operation and pricing mechanisms. Data from prosumers and consumers needs to constantly be collected and analysed to check reliability and balance of the power system (IRENA, 2020). The decentralised nature of P2P energy trading has eliminated the need for a centralised third-party intermediary to validate and secure transactions, reducing transaction costs and time (IRENA, 2019). Researchers point to decentralised distributed ledger technologies (DLTs) to verify transactions, especially

Blockchain, Directed Acyclic Graphs (DAGs) and Holochain. DLTs include ledgers, smart contracts, and consensus protocols (Zia et al., 2020) to record critical information, define consumer preferences and validate transactions. Having a transparent, distributed, and secure transaction log that allows even the smallest energy transactions to be entirely and continuously traced (Mengelkamp et al., 2018) is desirable for P2P trading, which involves low-value transactions between small-scale customers with DERs (Zhou et al., 2020). However, issues persist related to scalability and cost, as well as user anonymity, privacy, and governance (Andoni et al., 2019), slowing down more extensive adoption. Nonetheless, centralised software platforms have also been designed. These are initially easier to implement and are more widely applicable to the market.

Virtual layer: Market design

Possible market designs for P2P energy trading can be based on the level of centralisation and split into three categories: centralised (coordinated), decentralised, and distributed (community). In a centralised market, an energy sharing coordinator communicates between consumers and prosumers and provides P2P sharing services, assuring a power and payment balance (Long et al., 2018; Liu et al., 2017). There is no central coordinator in a decentralised market, and peers directly negotiate to buy and sell electric energy (Sousa et al., 2019). Prosumers are in complete control of their decision-making process, and their privacy is well protected (Tushar et al., 2020). A distributed or community market lies between a centralised and decentralised market. The coordinator indirectly influences peers by sending price signals rather than directly controlling the export and import of energy (Zhou et al., 2018).

Regulatory element

Regulatory oversight is needed to ensure that potential benefits of a P2P trading model can be fully exploited along with a level playing field for platform-based businesses relative to traditional utilities and retailers (IRENA, 2020). The current regulatory landscape in most countries is still based on the conventional power system paradigm, which is vertical and unidirectional and thus not fit for a modern electricity system with high DER penetration and local electricity trading. Radical policy change is only slowly happening because the interests of many stakeholders across the whole electricity supply chain are involved (Zhou et al., 2020). Questions also persist regarding the regulatory definition of prosumers (as a consumer or supplier), the regulatory obligations required by these prosumers, and how to combine complex digital markets with equally complex electricity markets (de Almeida et al., 2021). Therefore, adequate regulation is key for shaping how P2P markets fit into the current energy policy. Key questions are what market designs are allowed, how taxes and fees are distributed, what protections exist for customers and how P2P trading is positioned relative to traditional electricity markets (Tushar et al., 2018). As a first building block for regulatory implementation, the European Commission in 2018 defined a legal framework (Directive 2018/2001) that promotes active consumer and prosumer participation, self-consumption, and energy communities (EC, 2018).

2.3.3 Market Effects

Decentralised electricity generation and distribution, enabled by business models like P2P electricity trading, has various effects on the energy market landscape. Traditional utilities and the main power grid are influenced in multiple ways. The rise in DERs and resulting increase in prosumers is slowly undermining the utility companies' business model of centralised generation (Zapata Riveros et al., 2019). Incumbent generators could face a "utility death spiral" (Laws et al., 2017) due to rising fixed costs of necessary modernising measures and maintenance of ageing transmission and distribution infrastructure, environmental regulations, and increasing prices of fossil fuels (Sioshansi, 2014). This is a positive feedback loop in which increasing retail prices reduces demand and customers switch to DERs or improve efficiency, causing a decline in electricity demand. This leads to a further rise in retail electricity prices, reducing demand until the utility becomes an unsustainable business. Although this "utility death spiral" is not entirely plausible, ballooning retail prices and growing seasonal variations in supply and demand are increasing grid defection likelihood (Laws et al., 2017). However, decentralisation of energy systems can also benefit utility companies. Since they have a historical advantage in terms of greater capital reserves and project experience, new business opportunities can emerge for them (Zapata Riveros et al., 2019). It is also expected that the conventional wholesale-retail market system and P2P energy trading will co-exist for some time, acting as the "residual balancer" for P2P trading by dealing with energy imbalances in the system when they arise (Zhou et al., 2020). P2P electricity trading also benefits the grid as it enables better management of decentralised generators by always matching local electricity demand and supply. Higher local consumption of variable renewable energy reduces the need for investment in generation capacity and transmission infrastructure (IRENA, 2020). By facilitating a better local power balance, P2P trading combined with DERs could also mitigate uncertainties for the upstream power grid, enabling a more extensive penetration of renewable energy sources in the grid (Zhang et al., 2018).

3. Methodology

3.1 Research Questions

RQ1: Are German energy incumbents disrupted by the P2P trading model given an increasingly challenging energy market?
RQ2: Can P2P electricity trading become an established business model in the future German energy market?

3.2 Research Design

The methodology comprises a combination of both primary and secondary data sources. The literature review in Chapter 2 was a secondary data source, studying theoretical aspects of the topic to enhance subject knowledge. This served as a basis for framing further primary data collection which took the form of qualitative semi-structured interviews with industry and energy incumbent experts. These were used to gain insight into the current state of the German energy market and its readiness to embrace the P2P business model. This interview-based qualitative approach provides a proactive approach given the complexity of the topic structure and the uncertainty of the surveyed market.

3.3 Data Collection

3.3.1 Secondary Data Collection

The literature review provided critical insights on relevant management theory and the theoretical basis of the topic, including the German energy market, the business model and information on enabling factors of an unproven business model. To gather secondary data, we used mainly Grade-A papers from Applied and Renewable Energy Sciences. Additionally, management papers, studies and briefs from major energy institutions and official government figures were utilised to supplement the analysis. The knowledge collected was fundamental for designing the primary data collection method and preparing the semi-structured interview questions.

3.3.2 Primary Data Collection

Expert Interviews
As mentioned above, the limited literature on implementation of the P2P business model in European markets and its effect on the existing incumbent utilities led to the decision to use

semi-structured interviews as a source of primary data. Interviewees were encouraged to elaborate their personal perspective within the interview framework and to share more relevant information (Kumar, 2019). To gain a variety of insights, a diverse array of experts in energy consulting, incumbent energy generation and supply, electricity storage and P2P business models were interviewed. Experts were chosen based on their professional experience in their respective fields and contacted through personal connections, company websites or LinkedIn. All eleven interviews were conducted via phone call or Zoom and Microsoft Teams and lasted between 30-60 minutes. Depending on the expert, the interview was held either in English or German, with slight variations in questions (see Appendix 3). All German interviews were translated into English. Interview partners were made aware that the interview would be recorded and promised complete anonymity and confidential use of their responses. Interviewee assessments were then used to analyse further the research questions asked. A complete overview of interview partners is provided in Table 1 below.

INTERVIEW ID	ROLE/POSITION	COMPANY TYPE	EXPERT JUSTIFICATION
M01	Company CEO	Renewable Energy Investments	20+ years of experience in the renewable energy space
M02	Company CEO	Lithium Battery Production	20+ years of experience in the energy and technology space
M03	Senior Consultant	Large Consulting Firm	Energy Industry Expert
M04	Market Development Director	Energy Storage Solutions and Virtual P2P Trading	Peer-to-Peer Trading Expert
M05	Partner (Energy Consulting)	Large Consulting Firm	Energy Industry Expert
M06	Equity Analyst	Sustainable Energy Investments	European Energy Market & Industry Expert
M07	Company CEO	Utility Research and Advisory Firm	20+ years of experience in the energy and utility space
M08	Head of Business Development	Asset Management in DERs	Energy Industry Expert
M09	Senior Renewables Originator	Utility Incumbent	Incumbent Expert
M10	Former Managing Director	P2P Trading Start-Up	Peer-to-Peer Trading Expert
M11	Head of Research and Development	Utility Incumbent	Incumbent Expert

Table 1. *List of Interview Partners*

3.4 Research Approach

Grounded Theory Methodology

This research utilised a simplified version of Grounded Theory Methodology (GTM) based on Philipp Mayring's system for qualitative content analysis. This allows the researcher to develop theories that explain certain phenomena by evaluating texts in a structured form (Cho & Lee, 2014). To handle large data sets with different data types, Mayring proposes a standardised seven-step approach to qualitative content analysis (see Figure 7). Categorizing qualitative data entails choosing between inductive or deductive frameworks. In this paper, inductive categorisation was applied, implying that categories originated autonomously and directly from the interview material and were not formulated in advance. This avoids biased representation (Mayring, 2015). In line with Maying's fourth step, the coding categories were revisited after 30% of the coding process and revised into larger units. This allows for a more efficient summary of the main findings in the final step. Due to the time constraints, a formative and summative check of reliability via another researcher was not conducted for this data. Instead, the data has been coded twice at different points in time to simulate a similar effect.

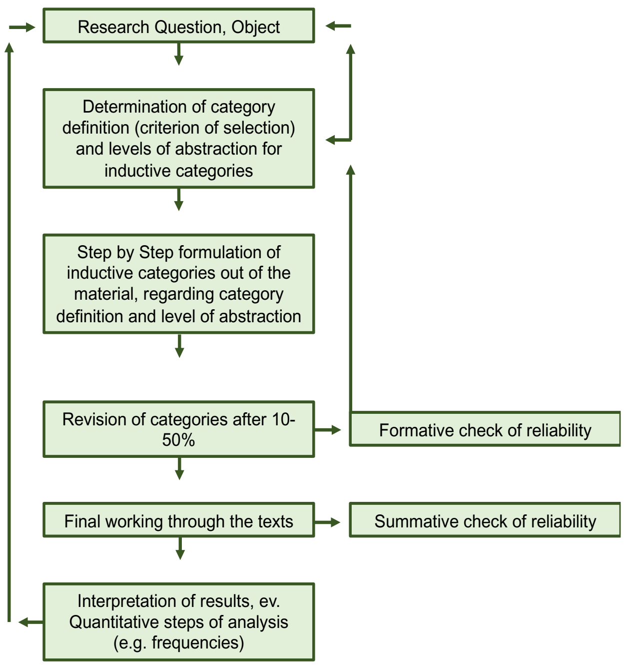

Figure 7. *7 Step Model of Inductive Category Development*
Source: Adapted from Mayring (2000)

Quantitised Content Analysis

To extract more meaning from qualitative interview data and facilitate pattern recognition, a selected amount of qualitative data was quantitised. This is defined as the "[…] process of assigning numerical [nominal or ordinal] values to data conceived as not numerical" that can be seen to "[…] enhance the value of qualitative data" (Sandelowski et al., 2009). For this research paper, the interview data was dichotomised, where the presence or absence of a thematic code was given a binary code of either 1 or 0 (see Appendix 1), so-called "coding for existence" (Babbie & Mouton, 2001). While this could lead to a loss of critical information, undercutting the rationale for qualitative research to capture nuance and subtlety of particulars

(Sandelowski et al., 2009; Cabrera & Reiner, 2016), this method was nonetheless chosen as the right approach. An analysis of the original qualitative data was also conducted to mitigate some of these criticisms and ensure that no insights were missed. Additionally, some interview questions were characterised on a Likert scale, allowing for a fundamental quantitative analysis of the topic.

4. Analysis & Findings

The coding categories for the transcribed interviews were created in MAXQDA 2022, a computer-assisted qualitative data and text analysis program. The goal was to identify specific themes in the data text obtained from the interviews. Once the complete inductive category development framework was applied, seven overarching categories became apparent. They are the result of summarising the main category findings and were deemed most important for answering the research questions posed in this paper. Figure 8 indicates the total percentage frequency of each category code in the data set.

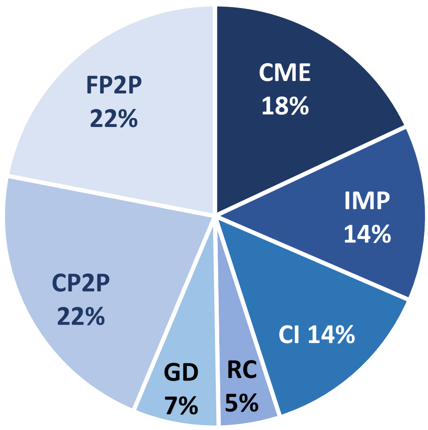

Figure 8. *% Frequency of category codes*

4.1 Changing Market Environment (CME)

Market Developments

The German electricity industry continues to undergo structural transformation. The market is no longer characterised by large incumbent utilities, as it was over the past decades, but by new and decentralised players in the renewables space ([Interview] M02, M08, M09 & M10). The growing decentralisation of electricity generation increases market complexity and, accordingly, electricity prices and volatility of electricity supply, jeopardising security of supply (M05 & M06). At the same time, there is a push towards electrification of the entire industrial value chain (e.g., using green hydrogen), together with significant market entry of new market participants (e.g., electric vehicles & heat pumps), all of which are driving electricity demand (M01, M04, M07 & M09). Large CO_2 emitters, especially the manufacturing industry, must reduce dependency on fossil fuels, leading to considerable increase in demand for electricity (M01 & M11). With volatile renewable energy supply, large utilities will always be needed to provide substantial, dependable electricity on demand, primarily to support critical existing infrastructure (M08 & M11). However, to make use of efficiency gains, an organic consolidation of the market players is likely (M06 & M10).

New Direction

The current developments are causing the sector to move in a new direction. The market is evolving towards an electrified society characterised by decentralised generation, enabled by digitalisation, and driven by trends like E-Mobility (M02). Renewable energies are increasingly competitive in cost and efficiency (M03 & M08). When experts were asked what role DER will play going forward on a scale from 1 (no role) to 3 (major role), the mean indication was 2.88, with a standard deviation of 0.35. This indicated an alignment of views across all experts on the importance of this phenomenon. Increasing competitiveness of renewables is coupled with an emergence of platform ecosystems within the electricity sector, causing disruption of the entire electricity value chain (M05). These ecosystems introduce highly scalable platform business models that entirely change the service offering from a user's point of view (not a product point of view) and therefore wholly disrupting the traditional energy industry (M02). The entire energy business model is evolving into offering Energy-as-a-Service, selling an entire bundle package with the energy. This includes energy storage, analytics, or maintenance, instead of just plain electricity (M07). To push this new service offering further, new electricity business models and supply contracts are needed which must take prosumers into account (M06).

4.2 Incumbent Market Players (IMP)

An Incumbent Market

While the market might be less dominated by incumbent utilities, they still play a central role. Municipal utilities are of particular importance, with their strong regional presence and local branding allowing them to develop new products and drive energy transitions further (M09 & M10). The energy sector consistently is very political. Large German utility incumbents have always had significant influence, with their interests prioritised in critical legislative decisions, including delaying a shutdown of fossil generation capacities (M01). These utilities can rely on an inherent competitive advantage due to their size and market presence. They have the technological, infrastructural, and regulatory capabilities in place to develop new business models while at the same time having the lowest marginal costs and access to very cheap capital (M06, M07, M08 & M09). Similarly, utilities also have a large existing customer base producing vast amounts of data, allowing them to respond to changes in customer preferences and expand their product portfolio (M04, M06 & M09). However, the incumbent's oligopolistic position at the top of the market has made them inert and inefficient, as there was no need to reduce costs for many years (M01 & M06). They never had to be customer-oriented or customer-centric organisations, and infrastructure, which used to be their unique selling point, is no longer a competitive advantage (M07 & M08). Compared to new players, they lack proper capabilities needed for customer-focused business models (M05). From the outset, incumbents have had difficulties considering digitisation, instead relying on legacy Information Technology (IT) systems and failing to react to new market trends (M03, M05 & M10). Interestingly, both utility incumbent experts (M09 & M11) did not see their companies as having any disadvantages compared to new players but rather viewed size as an advantage.

Strategic Outlook

Playing catch up with market developments and cutting their losses, incumbent German players are now adapting strategic positioning. Their established business model is limited, framed by thinking only from the product to the customer and not considering the platform economics in-between (M02). As a result, they are increasingly moving beyond pure commoditized sales towards Business-to-Business (B2B) Solutions, e.g., by supporting decarbonisation of large energy consumers or providing EV charging infrastructure (M03 & M05). Larger incumbents are also starting to reposition themselves in the generation space, with strong focus on investments in renewables (M01, M06 & M11) and reducing CO_2 emissions by selling off fossil capacity (M09). They are resituating themselves within the market, e.g., E.ON moving away from generation and focussing on end-customers and network operations, RWE concentrating on supplying industrial customers, and EnBW focussing on higher-margin residential customers (M01, M03 & M11). Incumbents will most likely speed up reorganisation by corporate venturing and acquiring new companies entering the energy space (M08).

4.3 Challenges for Incumbents (CI)

Energy Transition

Energy transition and decisions associated with it, including a predetermined path toward CO_2 neutrality, are challenges for German energy incumbents. From a generation perspective, it is difficult managing the shutdown of large, asset-intensive fossil capacities, like nuclear, coal and lignite (M01, M02, M04 & M10). Hand in hand with taking assets offline, HR matters must be handled in a socially acceptable manner, with thousands likely to lose their jobs or with a need to be retrained (M01 & M05). Incumbents now face the challenge of not becoming stuck in an increasingly risky regulatory model and letting go of established businesses that have low margins and are unsustainable (M05 & M07). Increasing CO_2 prices make traditional generation ever more expensive and inefficient (M01 & M06), bolstering the imperative to expand investment in renewables. This is further amplified by growing market decentralisation and the rise of prosumers. However, on a scale of 1 (no threat) to 3 (significant threat), a mean of 2.20 indicated that experts expect decentralisation to be a minor challenge compared to others. A standard deviation of 0.92 indicates the variance pertaining to this assessment, with P2P experts seeing prosumers as a greater danger, incumbent experts apprehending no or little danger, and other industry experts falling somewhere in-between. To combat this development, incumbents are forced to focus on large-scale projects, where they have to fight slow approval processes (M06) and frequent local and regulatory resistance (M01 & M11).

Competition

The paradigm shift towards a more decentralised electricity landscape also opens the market to a flood of new competitors. These can be prominent players from other industries such as multinational oil companies like Royal Dutch Shell plc, transitioning away from hydrocarbons towards renewables by moving into electricity generation, which is a vertical in the same industry space (M04, M08 & M10). Mobility providers, e.g., car manufacturers, are using their EV offering to provide end-to-end electricity services to customers (M05 & M10). Agile, modern start-ups will also increasingly enter the market with fully digitalised products, including a modern customer front end that is hard for incumbents to replicate (M04). In this context, it is interesting that both incumbent experts failed to mention the challenge of new competition whereas industry experts did not.

New Direction

Trends towards digitalization in the energy sector pose existential challenges for German incumbents. The rise of platforms and smart energy providers allows consumers to compare prices and educate themselves, making switching providers easier (M03). The customer base of utilities is being eroded as high-value customers leave their contracts for more tailored offerings, leaving only the stickier lower value customers (M10). This means the battle for customers will intensify, making adaptation of business models essential (M03, M06 & M08). Incumbents must develop new contracts and products that reflect customer demands, both in terms of hardware and software (M04, M06 & M10). This is hampered by problems which have plagued traditional utilities: digitalising processes and thinking about product digitalisation from the beginning of product development (M01 & M05). To remain competitive, German utilities must reduce transaction costs and bring down disproportionately high costs of servicing customers (M02, M03 & M10).

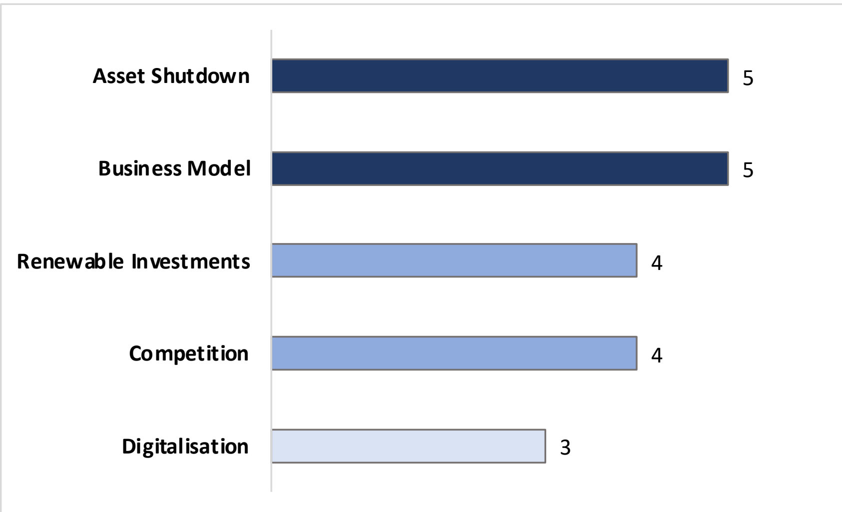

Figure 9. *Top 5 German utility incumbent challenges (mentions by no. of experts)*

As mentioned by the interview partners, the top challenges for incumbent utilities were ‘Asset Shutdown’ and ‘Business Models’, cited by 45% of experts. ‘Renewable Investments’, ‘Competition’, and ‘Digitalisation’ made up the remainder of the top 5. ‘Renewable Investments’ was the only challenge also mentioned by an incumbent expert. The data was further analysed by binarising the challenges, with 1 indicating a mentioned challenge and 0 otherwise, distributed across expert groups (industry, incumbent, P2P; see Appendix 1). A phi-coefficient of 0.67 between 'Asset Shutdown' and 'Digitalisation' indicated strong positive correlation between the two variables. 'Business Model' and 'Digitalisation' were strongly negatively correlated, with a phi-coefficient of -0.55. A simple correspondence analysis revealed that challenges 'Competition', 'Asset Shutdown' and 'Business Model' were more likely to be associated with industry and P2P experts, 'Digitalisation' with industry experts, and that 'Renewable Investments' had a similar likelihood across all experts (see Appendix 2).

4.4 The Role of Consumers (RC)

The changing role of the consumer in the market must also be highlighted. A new type of consumer is emerging – more decentralised and independent (M04 & M08). He is going to be increasingly at the core of transactions, having more interaction points (e.g., solar, EV, storage), as well as "skin in the game" (M07). Consumer preferences are changing, with electricity and climate change being demand choices, combined with a stronger desire to have control over one's own electricity (M04). There is also a somewhat greater inclination towards regionality, even in the energy sector (M03). However, consumer lethargy and inertia still are impediments for breaking up the market. Consumers not financially affected are comfort-bound and may stay with their primary utility provider (M03). A critical mass of consumers does not care about where their electricity comes from and are unwilling to invest time or effort into assessing their energy bills, so more education is needed (M04 & M10). P2P trading experts especially emphasised the role of consumers, whereas incumbent experts didn't highlight the importance of consumers for their businesses in the future. This might be explained by incumbents struggling to be more customer-oriented, as discussed in 4.2.

4.5 A German Disadvantage (GD)

While Germany used to be a pioneer in the energy transition, this has changed in recent years, mainly due to political and structural reasons (M06). There has always been a strong interplay of politics and business, especially for large utilities. This has meant that market progress has been slow, favouring incumbents (M01, M02 & M04). When it comes to emission reductions, Germany made the mistake of rushing to shut down nuclear power plants. This makes it more challenging to replace coal power plants as there are no large-scale alternatives (M06). Additionally, the country "[…] has a fondness for complexity" (M10). This includes a complexity of approach to many problems that other countries have solved in more straightforward ways, i.e., connecting small renewables or managing charging points. This makes new business models more challenging (M10). An example is the complex metering concept, where the roll-out of smart meters has been one of the slowest in Europe (M04, M06, M10 & M11). The majority of interview partners (55%) directly or indirectly stated that Germany is losing out to other countries when it comes to energy transitions. Other European countries have clear advantages when it comes to optimising the energy market. The Netherlands, for example, has already switched to a market structure where small operators have been consolidated and costs brought down through digitalisation and regulation (M06). The UK has introduced a model where new energy actors could borrow an existing incumbents' market licences, allowing them to move to market much quicker (Interview M10).

4.6 Challenges for P2P Trading (CP2P)

Infrastructure & Technology

P2P electricity trading faces several implementation challenges, including numerous technical issues. A significant challenge is grid infrastructure. Building the extensive renewable energy resources needed for a trading model requires expanding and upgrading the German grid to handle increased regional generation (M01, M04, M05 & M11). P2P trading might rely on a Microgrid, but this needs management to balance electricity levels, a separate connection to the main grid, storage provisions etc., which are expensive and not yet widely implemented (M03, M08, M10 & M11). Similarly, P2P trading heavily relies on technological solutions like smart meters. As discussed earlier, their roll-out has been slow in Germany, even though regulations are in place (M01, M03, M05, M10 & M11). These initiatives are supposed to be completed by 2032, which is not fast enough to enable P2P trading (M03). Critical IT infrastructure is also underdeveloped (M11). Digitalisation of grid infrastructure and the broader sector is years behind, stymying digital business models (M04, M06 & M10). Building an end-to-end digital product is nearly impossible in Germany, where some critical market actors still rely on fax machines (M10).

Regulation

Regulation of the sector was taken to be one of the biggest obstacles to large-scale P2P trading implementation. This starts with the regulatory classification of a P2P actor in the market. Once you begin trading electricity in Germany, many interrelated laws and requirements need to be satisfied (M08 & M09). The regulatory burden on electricity players regarding data protection is extensive and exaggerated (M11). Selling electricity to a third party or via the public grid essentially makes a prosumer an energy supply company with all the attendant rights and obligations. These include reporting requirements etc., which need to be handled (M09). Therefore, the regulatory framework must be adapted to the regular energy market (M05). German regulations also get in the way when it comes to developing decentralised renewables for P2P deployment, with approvals needing to occur at multiple levels making the system just too complicated (M01).

Others

Further, to have a sustainable and well-developed and liquid market that can challenge incumbents, a critical mass is needed on a platform, which currently cannot be achieved by a few thousand tech-savvy early adopters (M07 & M10). This problem is further exacerbated by a clear divide between the city and the countryside. Since trends favour urbanisation, most people in Germany live in rented apartments in cities where it is difficult for tenants or owners to install decentralised generation capabilities on a large enough scale (M03, M04 & M08). P2P trading might therefore remain a regional niche product (M03). Furthermore, marketing and building a new retail brand is costly, with incumbents like EnBW spending up to one billion euros to create new brands (M10). Start-ups on their own may lack funding or a capital base to challenge incumbents and withstand market risks (M06 & M10).

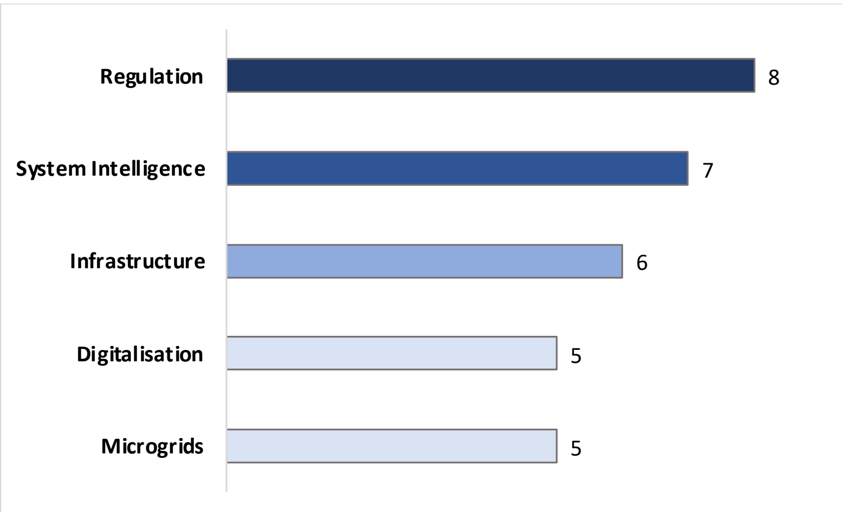

Figure 10. *Top 5 P2P challenges in Germany (mentions by no. of experts)*

The most frequently mentioned challenge slowing down the implementation of P2P trading is 'Regulation' with 73% of the experts viewing it as a key obstacle to successful P2P integration.

‘System Intelligence’, which includes smart meters and system digitalisation, was mentioned by 64% of experts. ‘Infrastructure’, including both grid and IT, was significant for 55% of experts, while ‘Digitalisation’ and ‘Microgrids’ were mentioned by 45%. This data was also dichotomised and statistically analysed (see Appendix 1). The two most significant phi-coefficients showed a strong positive relationship between ‘Regulation’ and ‘Microgrids’ (0.56) and a weaker positive relationship between ‘Infrastructure’ and ‘Microgrids’ (0.47). The correspondence analysis revealed that ‘Regulation’, ‘Infrastructure’ and ‘Microgrids’ were more likely to be associated with industry and incumbent experts, while ‘Digitalisation’ was clearly associated with P2P experts. ‘System Intelligence’ did not appear to have any clear association with a particular type of expert (see Appendix 2).

4.7 A P2P Future (FP2P)

Market Impact

The P2P business model potentially offers several benefits to German market actors. Consumers are expected to profit from lower costs linked to various factors. The P2P business model allows new players to enter the market, increasing the competitive environment and the market offering, which should drive down prices (M08, M09 & M10). The P2P market is expected to regulate and balance distribution grids on a regional level, which means investments in grid expansion and maintenance would not be needed on such a large scale (M03 & M05). Therefore, grid concessions can be avoided or significantly reduced, which should be passed on to all market actors (M03 & M10). Consumers also indirectly benefit through much greater system efficiency. Data-driven models provide greater real-time control over supply and demand, which should bring down the cost to serve (M10). This means the electricity market will become more simplified and transparent, benefitting actors both up and downstream (M08, M09 & M10). The P2P model also provides added value to small electricity producers, allowing them to finance assets and sell products in a networked energy community (M10). When the experts were asked whether they would categorise the P2P trading business model as evolutionary (1) or disruptive (2), the mean categorisation was 1.33 with a standard deviation of 0.5. The majority of experts categorised it only as evolutionary (73%; see Figure 11),

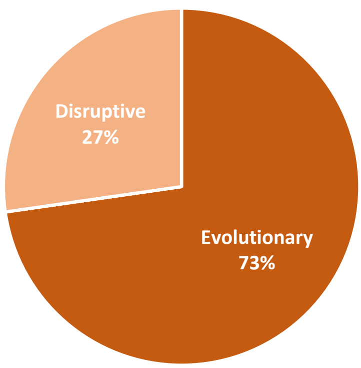

Figure 11. *% representation of P2P expert assessment*

seeing it as a natural progression of a digitalised electricity market, but nonetheless an innovative solution on the customer side. The data was further analysed using Fisher's exact test. All combinations of expert groups showed a nonsignificant statistical relationship (lowest p-value: $p=0.49$), suggesting no association between expert group and business model classification. This might of course change with a larger sample size which would also become closer to statistical significance.

Effect on Incumbents

P2P trading might only change the role of incumbent utilities in the market. They may potentially adapt and move toward becoming technical infrastructure providers, specialising in anything related to critical components or involving intensive labour that cannot be covered by smaller providers (M05 & M06). They could also pull out of the energy business altogether and focus exclusively on network operations, including connecting and operating grids (M11). However, there will always be the need for a residual power supplier, providing reserve capacities and predictable, consistent baseloads needed to meet the demand not covered by renewables (M03, M04, M05 & M07). P2P trading could also prove to be a profitable new business opportunity for incumbents (M09). Traditional German utilities can enable P2P trading by becoming the platform operator, providing technology solutions, and acting as digital intermediaries for their large customer base (M03, M04 & M06). On the other hand, P2P trading and additional generation capacities entering the market might render traditional utilities redundant. Large industrial companies will be directly supplied using Power Purchase Agreements (PPAs), and private households will trade electricity among themselves (M05). However, when asked whether platform electricity trading models (such as P2P trading) have reached a stage where they can challenge incumbents, the experts indicated a mean of 1.80 (1= not at all; 2 = on their way; 3 = yes definitely). The standard deviation was 0.79, showing disagreement between interviewees when assessing the threat of platform developments.

Requirements

Several requirements must be fulfilled to enable P2P trading. For one, it relies heavily on political involvement. Therefore, the government must introduce regulatory frameworks that govern decentralised energy, platform trading, and flexibility (M03, M06 & M07). Existing regulations must be simplified, creating openness, and shortening approval processes (M01 & M09). At the same time, there must be sufficient political incentives in play that support regionality, energy communities and energy start-ups, increasing confidence in alternatives to traditional energy consumption (M01, M02, M03 & M04). From a product point of view, the whole P2P trading process must attain a high degree of simplicity, automation, and general ease-of-use, so consumers do not need to expend more effort than before (M01, M03, M06 & M10). An end-to-end digital product, enabled by technologies like Blockchain, could be a complete service solution (M05 & M10). To make this possible, a whole smart system, including intelligent grids and smart homes, is required (M01, M05 & M10). When asking experts if they imagined P2P electricity trading as a business model for future electricity trading, 36% saw it as an established future trading mechanism, and only 18% did not envisage it happening. The remaining 46% were uncertain about the future of P2P.

5. Discussion

Structural transformation of the energy market, combined with its rapid digitalisation, is giving rise to new, innovative business models. Platform models, like local P2P electricity trading, eliminate the need for a traditional intermediary actor. Incumbent utilities in Germany, having already encountered a first wave of disruption in the form of a rise in DERs, are facing a new threat. For that reason, this paper set out to answer whether the rise of the local P2P business model could drive a second wave of disruption for German utilities. It asks if and how the incumbents are disrupted by P2P trading in the context of an increasingly challenging market environment and whether the business model is ready to become an established trading mechanism in the future German energy market.

Our findings indicate that while P2P trading is an innovative business model that can revolutionise the electricity sector, it is unlikely to be powerful enough to drive a second wave of disruption for the German utility incumbents. Although it has numerous benefits for both consumers/prosumers and the potential to help Germany accelerate the transition away from fossil generation, it still is a niche product with limited potential to scale, at least for now. On top of that, implementation hurdles like restrictive regulations and old infrastructure are holding back its full market potential. Germany's incumbent utilities, which are facing their own challenges in adapting their business models away from traditional generation and towards renewables and customised service solutions, should be concerned about such a platform business model but equally should not fear imminent disruption.

Disruption of Incumbents

In accord with the literature, the results show that the German energy incumbents have faced and continue to face numerous challenges. The experts' assessment indicates that the large utilities are still preoccupied with replacing their fossil generation assets and substituting them with renewable capacity. Recovering from the first wave a decade ago regarding renewable disruption, incumbents now are vulnerable to new competitors and business models challenging their market positioning. They are confronted by an increasingly digitalised energy sector that requires re-evaluating and re-focusing business models towards putting consumers and their service demands front and centre. Redressing the wrong strategic decisions made over a decade ago about renewables delays a proper response to these new challenges. Porter (1996) indicated that a company in the same market operating with two different strategies might not be feasible. Instead, the incumbents should aim for a clear strategic positioning to establish a competitive edge over new market participants.

Our findings further indicate that German energy incumbents struggle to maintain their oligopolistic competitive advantage. Referring to the "Resource Based View" (Barney, 1991), it becomes evident that incumbents' resources no longer meet VRIN criteria. The decentralisation of electricity generation and the rise of prosumers show that even small end-consumers have the power to "compete" with these larger companies in the generation space. However, the results don't fully support that all these requirements must be met to maintain a competitive advantage. Instead, they imply that the sheer size and market presence of incumbents, and the resulting access to cheap capital and a dependent market, are sufficient to maintain a competitive edge. Still, considering the paradigm shift in the energy market, incumbents need to make stronger efforts to optimize their position in the space. Building on the "Dynamic Capabilities" framework (Teece et al., 1997; Barreto, 2010), it becomes apparent that German utilities have problems reconfiguring internal competencies towards actively sensing opportunities, instead of just reacting to market trends and addressing new threats when they arise. Even though both the literature and experts highlight incumbent size and capital advantage, firms struggle to deploy requisite dynamic capabilities to re-orient their business model and upgrade capabilities to focus on providing a digitalised, customer-centric experience.

While these points might indicate that the German incumbents are not in as strong a position as they used to be, the data shows they still have a significant hold on the market and are responding to new trends. With regard to P2P electricity trading, deciding whether this business model is indeed disruptive is not straightforward since findings seem to suggest that this is the case but with certain caveats. In line with Christensen's (2015) definition of disruption and accounting for the definition of DLCIs, the P2P business model could be defined as disruptive. Its position as a new, low-carbon business model that focuses on an underserved market niche, albeit initially in a relatively high-end market, clearly vindicates this claim. However, analysis reveals it remains a niche product yet to migrate from that niche to commence a disruptive trajectory. While this might be explained by local P2P trading still being a new and unproven business model, it also shows a lack of capacity to challenge established incumbent businesses *successfully* as it stands today. Experts all concurred that P2P has not yet reached a stage to challenge incumbents. Additionally, the results differ from previous literature (Wilson, 2018), indicating that P2P electricity trading might not be a disruptive but rather an evolutionary development for the energy sector. A time factor partly drives this assessment. With the business model seemingly still requiring time to break into the mainstream market, utility incumbents can respond and adapt, embracing P2P trading as a new business opportunity. As a result, P2P electricity trading could more likely be defined as innovative and revolutionary.

In contrast to most P2P research, our analysis further suggests that incumbents do in fact continue to play an essential role for the future, making their complete displacement unlikely. This is also in line with Shaughnessy's (2016) definition of platform business models, which seek to leverage third party assets, in this case incumbent distribution infrastructure. Nonetheless, there are new and existing effects P2P trading will have on incumbents. The threat of new competitors entering the market, especially multinational oil, and mobility industrials with financially backed digital offerings, is likely to increase the pressure on utilities. While their role as a residual energy supplier and market balancer has been discussed in previous literature, a move into solely providing technical infrastructure for consumers or pulling out of the energy system altogether to focus exclusively on network operations, has not been mentioned. This suggests that further market transformation is still a likely consequence of this platform business model.

Established Trading Mechanism

The second part of the research question analyses whether the P2P business model is ready to become an established trading mechanism in Germany. This is important to discuss since a business model that is not feasible will not be a catalyst of a wave of disruption for incumbent companies. The evidence suggests that P2P electricity trading still faces numerous hurdles before reaching a relevant size and power in order to scale. While Germany is seen as a global leader in renewable generation, the findings indicate it is at a disadvantage compared to other European countries with regard to introducing digital business models for the energy sector. Although there is a push toward renewables and strict climate targets, a complex, bureaucracy, and slow approach toward energy problems reduces transformation potential. In line with previous research, the regulatory framework and regulatory classification of prosumers looks to be one of the largest challenges, especially for Germany. Similarly, infrastructure requirements have not been met, with ageing grid infrastructure and a delayed roll-out of essential technical solutions, especially smart meters, severely hindering efficient implementation of digital business models. To make up for these shortcomings, the government should overhaul existing regulatory frameworks to simplify application processes, enable new technologies, and make the energy sector more transparent.

Furthermore, there is the often-overlooked role of consumers who play an important part in making the P2P business model work. Although the demand for regionality and green electricity continues to grow, most consumers still seem comfort-bound and unwilling to change the status quo. This could mainly be explained by electricity being a low-interest product, which would only be overcome by increasing electricity prices to incentivise switching to alternative modes of electricity acquisition with cost advantages. The results also reveal a clear divide between the city and the countryside when it comes to making P2P electricity trading possible. A decreasing share of renewable ownership by private individuals reduces the potential of a P2P business model and makes it more likely that incumbent utilities take this on as an additional service, rather than there being free-standing P2P trading. Thus, local P2P trading is struggling to become a viable large-scale market option for now, with it likely remaining a niche business for the near future.

6. Conclusion

This study deals with a significant paradigm shift in the German electricity market, informed by management theory in the form of secondary data and primary research from industry experts. The incumbent utilities, only slowly responding to this shift, have suffered the first wave of disruption at the hands of new market entrants pushing into the renewable energies space. Now, with an ongoing rise in prosumers and the increasing digitalisation of the energy sector, P2P electricity trading has emerged as a promising business model to support further decentralisation of electricity markets. Germany's utility incumbents face a potential second wave of disruption putting their traditional business model under pressure. This research aimed to identify whether local P2P electricity trading could drive this potential second wave of disruption. The results are based on a qualitative and fundamental quantitative analysis of multiple expert opinions, which provide insights into current market developments. It can be concluded that the P2P business model is unlikely to disrupt incumbent utilities in Germany. Our results indicate that while it is an innovative business model with significant potential to transform the market, it is still a niche product that is unlikely to scale to successfully challenge incumbents.

The findings demonstrate the potential of this platform-based business model for the German energy market. It is clear that there is demand and need for an innovative way to trade excess electricity in the market. In line with previous research, both consumers and the electricity grid can benefit from this development, with a more balanced and transparent electricity market. This would allow new competitors, including oil multinationals, to enter a once dominated market, putting pressure on incumbent utilities who face challenges to keep up with market developments. They also need strategic repositioning towards consumer side models to take advantage of changing consumer demands, potentially entering the P2P trading space as a viable business opportunity. Nonetheless, the findings justify a right and need to exist for these incumbents in the market. This, however, makes it challenging for the P2P business model to disrupt these companies. On top of Germany's complex market design, the implementation of P2P trading is impeded by regulatory frameworks that need to be updated, old infrastructure, and slow integration of system intelligence. Taking this and the role of incumbents into account, it is unlikely that P2P electricity trading is on a disruptive trajectory that can power a second wave of disruption. However, incumbents will undoubtedly feel the consequences as it gains traction.

Limitations and Scope for Future Research

This research has several limitations. The P2P business model is still unproven, existing mainly at an experimental level. This makes it difficult to gain historical insights from past market implementations. It also meant that some of the experts did not know the business model and responded based on assumptions of the concept. Additionally, the results are limited by the small sample size. Only $n=11$ experts were interviewed for this paper, making meaningful statistical analysis difficult and not necessarily generalisable. This also resulted in an unbalanced dataset, with most interview partners being industry experts without special knowledge of the subject. The number of P2P and incumbent experts was limited, mainly due to a lack of availability. Topic experts are also likely to be biased towards their own views and interests, thereby not providing a synoptic picture of the market situation.

These limitations notwithstanding, this dissertation provides insight into German energy incumbents and implementational challenges of a new and digital business model in the German energy market. Opportunities for further work on the topic can also be identified. While this paper only touches on the role of consumers and mainly focuses on the incumbent utilities, it would be interesting to directly gain understanding of how consumers see such a business model and whether it meets their needs. Further, this paper laid the foundation for an in-depth scenario analysis that could focus on potential disruptive scenarios with P2P trading. Additionally, the significant challenges for both incumbents and P2P trading shown here warrant further deeper analyses to build a more complete understanding of the effect size.

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8. Appendices

Appendix 1: Quantitised Data Tables

Incumbent Challenges:

	AS	RI	BM	Co	Di
1	1	1	0	0	1
2	1	0	0	0	1
3	0	0	0	0	0
4	1	0	1	1	0
5	1	0	0	1	1
6	0	1	1	0	0
7	0	0	1	0	0
8	0	0	1	1	0
9	0	0	0	0	0
10	1	1	1	1	0
11	0	1	0	0	0

P2P Challenges:

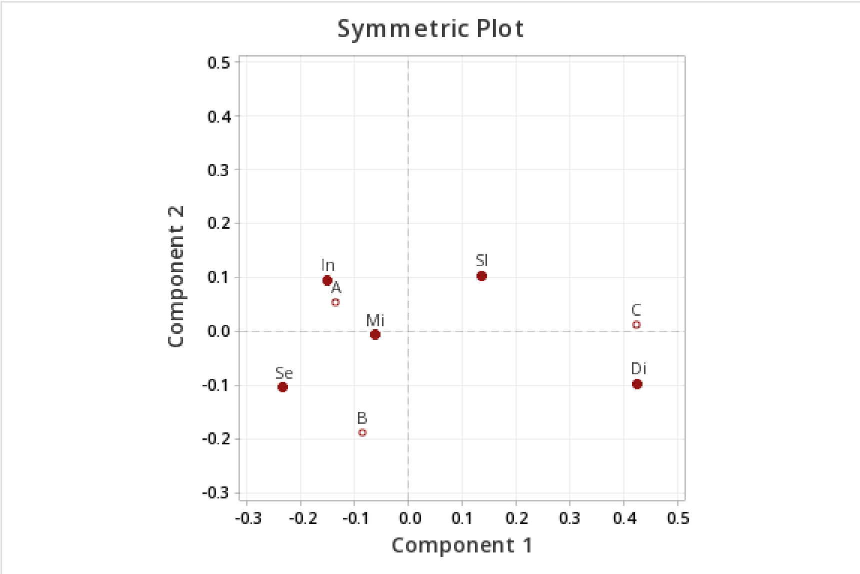
	Se	SI	In	Di	Mi
1	1	1	1	0	1
2	0	0	1	1	0
3	1	1	0	0	1
4	1	1	1	1	1
5	1	1	1	0	0
6	1	1	0	1	0
7	0	0	0	0	0
8	1	0	1	0	1
9	1	0	0	0	0
10	0	1	0	1	0
11	1	1	1	1	1

Where: (also applicable for Appendix 2)

Expert Groups	**A**	Industry Experts
	B	Incumbent Experts
	C	P2P Expert
Incumbent Challenges	**AS**	Asset Shutdown
	RI	Renewable Investments
	BM	Business Model
	Co	Competition
	Di	Digitalisation
P2P Challenges	**Se**	Regulation
	SI	System Intelligence
	In	Infrastructure
	Di	Digitalisation
	Mi	Microgrids

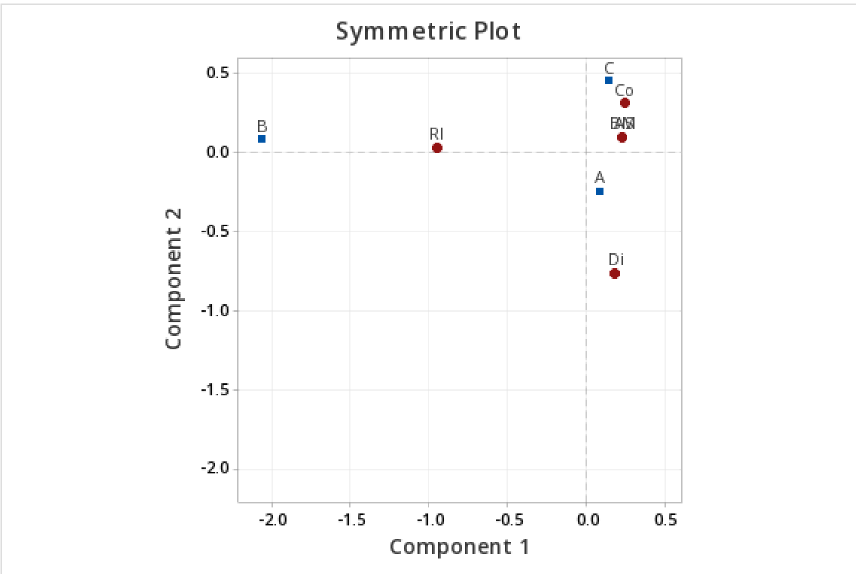
Appendix 2: Correspondence Symmetric Plots

Incumbent Challenges:



** Calculated using Minitab*

P2P Challenges:



** Calculated using Minitab*

Appendix 3: Interview Questions

Version A: Industry & P2P Experts	Version B: Incumbent Experts
1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?	**1.)** Which sector is your company active in and what role does it play in the German electricity market?
2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?	**2.)** Who would you say are the incumbent utilities in Germany? Do their strategies differ?
3.) What do you think are the (biggest) future challenges for these energy companies?	**3.)** What do you think are the (biggest) future challenges faced by your industry? How does your company try to cope with them?
4.) What do you think the German energy landscape will look like in 5-10 years?	**4.)** What do you think the German energy landscape will look like in 5-10 years?
5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?	**5.)** How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?
6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?	**6.)** Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?
7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?	**7.)** Are you familiar with the P2P electricity trading model? If yes, how would you describe it?
8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?	**8.)** Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge a company like yours? If not, when (if at all) do you think they will reach this stage?
9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?	**9.)** Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?
10.) What will be the role of traditional utilities in this model?	**10.)** What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?	**11.)** What will be the role of a more traditional company like yours in this model?
12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?	**12.)** In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?
-	**13.)** Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

Appendix 4: Summary of Interviews

Interview M01: Version A
Company CEO / Renewable Energy Investments

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Not in detail
- Decentralised energy producer and consumer directly trade energy without going through intermediaries

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- In the past, 4 oligopolistic entities: E.ON, RWE, EnBW & Vattenfall
- They are generators, grid operators and distributors, in direct contact with customers
- Due to the market unbundling, there now is a new market structure, with a competitive composition and a heterogeneous landscape
- Large number of distributors and new generation market players in renewable energies

3.) What do you think are the (biggest) future challenges for these energy companies?

- Shutdown of fossil capacity
- A socially responsible transformation process
- Process digitalisation & renewable investments

4.) What do you think the German energy landscape will look like in 5-10 years?

- We will see a rapid decommissioning of CO2-intensive capacities (coal & nuclear)
- We will need large investments in renewables and grid infrastructure
- The large players will still be there, they have access to cheap capital for renewable projects and the market is large enough to support all players

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Decentralised energy resources play a major role, especially offshore wind, but also private generation capacities on roofs and commercial buildings
- Solar power is the ideal choice for decentralisation

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- Theoretically yes, although still some distance away with some major requirements still not present
- However, the increasing electricity demand is only partially residential and cannot be covered by P2P trading alone, so there won't necessarily be an incumbent displacement

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Not yet, as there are nearly no providers in the market
- Requirements like a microgrid and a smart meter are not yet here on a large enough scale to make it possible

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Disruptive
- However, it should be a true shared community, using a local microgrid

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- No impact in the short term, due to technical constraints
- If it works, an intelligent P2P system can help stabilise the grid using demand management

10.) What will be the role of traditional utilities in this model?

- Not directly answered

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Technical challenges (including Smart Meters)
- The infrastructure, both from a grid and IT perspective
- A complicated approval process in Germany
- A strong interweaving of politics and business in Germany, slowing down progress

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Yes, because the demand will be there
- However, it is going to be a niche product for a long time

Interview M02: Version A
Company CEO / Lithium Battery Production

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Basic knowledge
- Direct trade between private producers and consumers via the grid infrastructure

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- E.ON, RWE and EnBW
- The incumbents feel that P2P trading is an unfair system, stealing market share

3.) What do you think are the (biggest) future challenges for these energy companies?

- Shutdown of fossil capacity
- Platform ecosystems
- Process eigitalisation
- Their own limited business model

4.) What do you think the German energy landscape will look like in 5-10 years?

- Electricity prices will go through the roof and nuclear energy will become important again
- The market will no longer be characterised by incumbent utilities, but by decentralised digitalisation products and services

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Will play a role, however there are problems
- e.g., wind only blowing in the north, but needed in south and local resistance to projects

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- No clear answer

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Can't accurately say if they have reached this stage yet
- However, by reducing transaction costs and offering a high degree of integration, platform-based business models can become market challengers

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Depends on how you look at it
- From the supplier side, its mostly evolutionary, but from a function optimisation and customer perspective, it can be disruptive

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Not answered

10.) What will be the role of traditional utilities in this model?

- Not answered

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Lack of entrepreneurial thinking, both from a business and a political perspective
- A lack of innovation culture in Germany, meaning the country has fallen behind when it comes to driving the energy transition
- There must be more political involvement to improve conditions for new energy business models

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Absolutely, it will be one of the core future business models

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Interview M03: Version A
Senior Consultant / Large Consulting Firm

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Heard of it
- The idea is to get rid of the intermediary and allow direct trade between suppliers and consumers

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- The Big 4: E.ON, Vattenfall, EnbW & RWE
- The municipal utilities are also important, especially the largest 8 which have large market shares
- E.ON and RWE have begun to clearly position themselves in the market with their deal

3.) What do you think are the (biggest) future challenges for these energy companies?

- Changing the energy provider is becoming easier, making it harder to retain customers
- The management of DERs and handling the trading with these generation capacities will not be easy
- Transaction costs must be reduced

4.) What do you think the German energy landscape will look like in 5-10 years?

- There won't be a large shift in market shares, the incumbents will remain dominant
- Smaller providers will have difficulties to compete with incumbents
- Regulations need to be adapted for new market models that can cope with the additional electricity demand from e.g., electric vehicles and increase flexibility

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- PV will take on the most important role, especially in the prosumer segment, as regulatory hurdles are lowest, and costs of generation are competitive
- P2P models will only become interesting once EEG FiTs are significantly reduced

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- No, most people live in rental apartments and don't have the opportunity to put solar panels on their roof
- New generation capacities introduced by private households will not be enough to trouble the incumbent utilities

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- That depends on the regulatory framework and the maturity of the technology behind it
- I believe in the next 5-10 years it will only be a niche product

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- I would say it does not have the market power to be disruptive, but is evolutionary

- Disruptive would mean it generates market share very quickly and quickly brings about some kind of market consolidation, which is not likely to happen right now

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- It might create autarch and decentralised markets with regional pricing mechanisms
- It will positively influence grid infrastructure, as the market would regulate distribution grids on a regional basis, reducing investment costs in grid infrastructure

10.) What will be the role of traditional utilities in this model?

- They can enable these local transactions by providing the platform infrastructure
- They can adapt to the role of residual electricity provider
- They can adopt their business model towards providing solutions, e.g., charging infrastructure

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Regulation is a big aspect; incentives must be introduced
- It needs to be more financially attractive for prosumers
- From a technology aspect: smart meters and storage capacities are needed
- It needs to be easy to use for customers

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- That depends on the capacity; if it is only possible in rural areas, it might just remain a niche product
- It must be financially worthwhile, and the right requirements need to be in place to make it happen

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Interview M04: Version A
Market Development Director / Energy Storage Solutions and Virtual P2P Trading

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Good understanding
- The end consumer can sell his excess electricity directly to e.g., his local neighbour or via a marketplace to an anonymous buyer

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- The biggest are Vattenfall and RWE
- E.ON, Vattenfall and RWE have all already tried to enter the Solar/Storage space in order to capture new and existing customers

3.) What do you think are the (biggest) future challenges for these energy companies?

- Developing new products adapted to the changing needs of customers
- Competition by new, non-traditional electricity providers
- Shutdown of fossil capacity

4.) What do you think the German energy landscape will look like in 5-10 years?

- The incumbents will still play a big role; have the ability to offer cheap electricity, especially in cities, where renewables are harder to implement
- The market entry of new users, like electric vehicles, will drive up demand and might lead to overloaded grids

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- They are becoming more important, as consumers increasingly want to be more independent and responsible for their own electricity
- However, that also depends on whether people live in cities or in the countryside

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- Yes, it will definitely lead to a loss of customer base for the incumbents in the long run
- All customers able to implement DER's will do so at some point

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Not yet, since regulation still has to catch up with this type of business model, even though some basic prerequisites are already in place
- Consumers are not yet concerned enough about their electricity supply
- However, these models are already causing the incumbents to rethink their structure

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Maybe a mix of both, but right now it is disruptive
- The market and the long-established structures must be rethought considering this business development

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Electricity prices and general electricity costs will be lower for consumers and businesses

10.) What will be the role of traditional utilities in this model?

- They can provide the platform for consumers to trade the electricity
- The incumbents will also be needed as residual electricity provider and maybe grid operators

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Regulation
- Digitalisation
- The expansion of the electricity grid
- Making sure electricity is always available in the system

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- I don't think so, unless it can be fully automatised
- For a start, I see virtual P2P trading as a possibility to pull people in the right direction
- There still is an urgent need for education on the advantages of this type of electricity generation and trading

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Interview M05: Version A
Partner (Energy Consulting) / Large Consulting Firm

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Familiar; one non-classical market participant trades excess energy with another non-classical market participant requiring energy
- Talking about digital solutions like blockchain enabling a trade

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- The large ones: E.ON, RWE, EnBW; but also smaller municipal utilities
- In the same generation & trading market, you also have new market players like Vonovia, Germany's largest housing company

3.) What do you think are the (biggest) future challenges for these energy companies?

- Transformation of the people business, as the industry is transforming in a direction that needs completely different skills from its employees
- Conventional generation asset shutdown
- Letting go of established, but low margin business models

4.) What do you think the German energy landscape will look like in 5-10 years?

- Whole value chain will be disrupted with a merging of the value creation stages (no more specialised incumbents)
- A much more diverse market landscape with disruption of market participants and on a technology level
- Hydrogen will play a big role

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Not answered

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- 100% yes; the value creation stages will merge, disrupting the market

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Models are ready-to-go, but customer base and customer readiness are not large enough yet
- However, soon, platform-based models will drive everything to do with climate change and decarbonisation

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- I would call it evolutionary; it's not a "Big Bang", changing the market over night

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- It will have similar effects to PPAs: there is no more need for the traditional provider role
- Increasingly decentralised energy generation will make the grid more volatile; might be fixed by intelligent grids and flexible pricing models enabled by e.g., P2P trading

10.) What will be the role of traditional utilities in this model?

- Role of "enabler" for private households, installing all necessary hardware
- They will always be needed to stabilise the grid provide reserve capacities

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- The energy market regulation, which must be adapted compared to the more traditional electricity market
- Intelligent consumers are needed, which require the correct technological capacity (e.g., Smart Meters, Smart Home)
- There needs to be supply security in a microgrid

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Yes, but not as part of a traditional utility

Interview M06: Version A
Equity Analyst / Sustainable Energy Investments

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Not familiar with the trading model

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- When it comes to generation: RWE, Vattenfall, Uniper & EPH
- On the traditional utility side, E.ON is important + the different municipal utilities

3.) What do you think are the (biggest) future challenges for these energy companies?

- Expansion of/investment in renewable energies, which is complicated in Germany
- Developing new contracts and products aimed at a more electrified society
- Adapting business models to reduce costs (downstream energy retail is inefficient)

4.) What do you think the German and European energy landscape will look like in 5-10 years?

- Reduction of subsidies will result in market consolidation, with small owners selling to larger operators -> leading to higher system efficiency
- A large reduction in fossil capacity not quickly enough balanced by renewable energies, causing electricity prices to remain high
- The European energy market needs to be more harmonised

5.) How do you see the role of decentralised energy resources in the German and European energy transition? Which technology options will be most relevant in the future?

- With regards to decentralised energy, solar power will play most important role

- The resulting increase in prosumers will lead to new electricity markets and contracts

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- Not really, for 2 reasons: firstly, you will always need a connection to the main grid and therefore be serviced by a utility, and secondly, it just provides new market opportunity for these incumbents (who can already build on a large customer base)
- However, the effect will be larger for utilities still in the fossil generation space

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Not really, since I haven't heard of any platform in Germany or Europe yet
- I don't think they will ever reach the stage, as electricity trading is something physical that is too complex and system-relevant to be managed by unregulated platform
- The costs to build such a platform are more likely to be incurred by a large utility

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- More likely as evolutionary
- It is a technological improvement of the current system

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Not directly answered

10.) What will be the role of traditional utilities in this model?

- Not directly answered

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany? Are other European countries better positioned for such a development?

- Regulation is the main challenge
- Acquiring funding might also be difficult for P2P start-ups, as it is a competitive market that can quickly change
- In comparison to other countries (especially southern European), Germany is behind when it comes to the roll-out of essential smart meters
- Development of new business models is also slowed down by many local energy monopolies

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- I think yes, definitely on a local basis (e.g., a city)
- However, it still is a technological challenge, and the digitalisation of grids has not yet advanced far enough

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Interview M07: Version A
Company CEO / Utility Research and Advisory Firm

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Yes, familiar
- Inevitable, but still nascent market opportunity with consumers at the core of transactions

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- Not answered

3.) What do you think are the (biggest) future challenges for established energy companies?

- A growing amount of risk for a decreasing return off the regulated model
- Climate change and old infrastructure (grids not configured for renewables)
- Changing business model away from a commodity business towards either pure generation or transmission and distribution

4.) What do you think the energy landscape will look like in 5-10 years?

- A trend towards energy-as-a-service, with third parties entering the market
- Primary relationship in contracts is going to change away from utilities to these third parties
- Large incumbents which have cheap access to capital markets will remain competitive

5.) How do you see the role of decentralised energy resources (DERs)? Which technology options will be most relevant in the future?

- DERs are going to be very important and a growing part of the portfolio
- We must not get stuck on a particular technology (but energy storage will be huge)

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- It's not just decentralisation, but that prosumers are much more efficient too

- Energy is increasingly becoming a more visible, integral part of a larger asset: consumers homes; it is therefore tied to freedom and mobility
- Consumers have more interaction points with energy, driving them away from traditional model

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Not yet, they must reach critical number of people on the platform first
- However, there is a lot of pent-up demand, so market will catch up in 5-10 years

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Evolutionary, it goes hand in hand with market developments

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Not answered

10.) What will be the role of traditional utilities in this model?

- They will continue to operate grids
- They will be needed to provide baseloads of predictable and consistent energy
- Incumbents have infrastructure and regulatory structures in place to remain competitive

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model?

- To have a well-developed liquid market, you need a critical number of customers
- The market is still unregulated, so regulation needs to be implemented/adapted
- Cybersecurity is a big aspect, as a lot of customer data is involved
- Blockchain and Microgrids are needed as enablers

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Yes

Interview M08: Version A

Head of Business Development / Asset Management Firm (Decentralised Energies)

1.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Yes, I am familiar with the P2P trading model
- Private-to-private electricity trade, directly with a neighbour or virtually

2.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- You have the large utilities: E.ON, Vattenfall, RWE & EnBW
- Behind them are thousands of small electricity generators (municipal utilities, farmers, prosumers)
- The incumbents are increasingly moving into the decentralised generation space

3.) What do you think are the (biggest) future challenges for these energy companies?

- Increasing decentralisation of customers results in reduced access to customers and a reduction of customer base
- Infrastructure, a once unique selling point, is no longer the competitive advantage
- Incumbents must adapt their business model to remain relevant

4.) What do you think the German energy landscape will look like in 5-10 years?

- An increasing decentralisation of energy, with solar at the focus, to generate as close to the consumer as possible and reduce grid congestion
- A big impact of E-Mobility in terms of demand but also storage capacity

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Play an important role, especially Solar, Biogas and Hydro, but there will always be the need for centralised energy resources
- Incumbents won't lose reason for existence, but the market will change away from what it is right now

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- Yes, revenues will be less, and it will be more expensive for utilities to keep everything on hand
- But it also provides a chance for incumbents to adapt their business model and use their size and knowhow advantage

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Not yet, private generation capacities are still too small
- It also depends on the regulatory framework and economic viability of the whole business model
- With rising energy prices, these models are becoming increasingly more interesting

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Innovative and evolutionary, but not disruptive; it is using existing technology and business models
- Nonetheless, it could be disruptive on the end-customer side, changing the way to earn money with electricity

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- You would have multiple different electricity markets with a lot more competition, possibly reducing prices for consumers
- There will be a market re-grouping, with incumbents being challenged

10.) What will be the role of traditional utilities in this model?

- They will lose their current role; pure customer support (without generation) can also be managed by much smaller companies
- However, size, knowhow and generation facilities give a competitive advantage
- Technical infrastructure, provision of special components and training will always need to be covered by large utilities

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Infrastructure (especially the grid) when it comes to real P2P, not virtual trading
- A lot must happen when it comes to regulation and adapting the market
- Microgrids prove to be a problem: who runs them, who pays for them etc.

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Not in the next 5 years; it will be a hybrid model, an additional service offered, but not a standalone solution
- You are always in competition with large utilities that have a cost advantage
- It needs to be more financially rewarding than the EEG levy at the minimum

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Interview M09: Version B

Senior Renewables Originator / Utility Incumbent

1.) Which sector is your company active in and what role does it play in the German electricity market?

- The company is active in electricity generation and trading in all sectors in Germany (B2B & B2C)
- Focus is on expansion of renewables (especially offshore wind) fossil free generation future within the next generation

2.) Who would you say are the incumbent utilities in Germany? Do their strategies differ?

- No longer the 'Big 4', but also municipal utilities in their regions
- In the renewables space, also a lot of small and unknown actors
- The incumbent strategy has changed towards expansion of renewables

3.) What do you think are the (biggest) future challenges faced by your industry? How does your company try to cope with them?

- Climate change and CO_2 neutrality (meeting climate targets)
- We are trying to achieve that by selling out coal generation capacities and focussing on renewables; our customers want that as well

4.) What do you think the German energy landscape will look like in 5-10 years?

- In 10 years, most of the generation capacity (around 85%) will be renewables, with gas power plants as a flexible backup
- The heating sector will lag behind the electricity sector development

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Play an important role, with strong market move towards decentralisation
- PV is definitely the technology driving this development

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- In the B2C space, it will definitely change the business model
- Demand will also rise due to e.g., e-mobility
- That's why prosumer can't really replace large utilities; they complement, not compensate

7.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Yes, direct B2B or B2C energy trading without any intermediaries

8.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge a company like yours? If not, when (if at all) do you think they will reach this stage?

- I am sceptical; it depends a bit on the target group: in the B2C sector, it doesn't really exist
- In the B2B sector, it is still very limited and a tiny segment of the market

9.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- It is an innovation, but not disruptive at the moment
- Disruption should happen quickly and make a business model obsolete; it doesn't do that currently

10.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Increased simplification, speed, and transparency of the trading process
- A decrease in electricity prices due to the increased competition
- New customers can be approached in this way

11.) What will be the role of a more traditional company like yours in this model?

- It can be an additional business opportunity, a new service offering
- I see this as an additional possibility, not a danger to us

12.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- The regulatory requirements placed on electricity generation and trading and the regulatory definition and treatment of prosumers as an electricity supplier
- Costs that occur when contracts are not met, and the grid is not balanced
- I don't see problems on the technological or infrastructural side

13.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- It depends on the target group; it would probably be easiest for largest industrial consumers, not for small private consumers
- I cannot see it as a relevant option for them in the short-term

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Interview M10: Version A
Former Managing Director / P2P Trading Start-Up

1.) Who would you say are the incumbent utilities in Germany? Why would you classify them this way?

- Not answered

2.) What do you think are the (biggest) future challenges for the incumbent energy companies in Germany?

- From a generational perspective, the phase out of fossil capacities and replacing that baseload generation
- Managing the increasing decentralisation of electricity generation
- At a retail level, managing their cost to serve and integrating new technologies and products into their portfolio
- The biggest challenge is new, financially capable competitors coming into the market

3.) What do you think the German energy landscape will look like in 5-10 years?

- TSOs and DSOs will broadly have same role, it needs to be regulated business with an added role to support data exchange
- Municipal utilities will become even more important with rise of energy communities
- At a utility level: build out of renewable energy & storage assets, but also potential acquisition by large oil companies like Shell, which are transitioning business model
- Mobility providers (car manufacturers) and oil companies will also enter retail space

4.) How do you see the role of decentralised energy resources in the German and European energy transition? Which technology options will be most relevant in the future?

- Not directly answered

5.) How would you describe the peer-to-peer (P2P) electricity trading model?

- An overlap between peer-to-peer and community; the idea of locally produced community energy delivered by P2P trading
- Trading needs to happen at more granular level than in grid

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- They do, but consumers need to be convinced first (they are mostly indifferent)
- Incumbents must therefore act fast enough to develop these new products before companies with a lower cost base sweep in

7.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge the incumbents? If not, when (if at all) do you think they will reach this stage?

- Yes, because you are beginning to see them, and they are now viable

8.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- Evolutionary, which also reflects how the grid has changed
- Power is decentralising which creates the need for a new model, which is an evolution

9.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- Creates opportunities for incumbents and municipal utilities, allowing them to develop new products and reinforce branding
- New players will enter market, with service providers building the platforms
- New way to finance renewable assets
- System benefits from greater control, efficiency and transparency

10.) What will be the role of traditional utilities in this model?

- Probably either generation or distribution; however, they run the risk of becoming supplier of last resort, which they should avoid
- Incumbents must create new legacy brands to respond to increased competition

11.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- Resistance of incumbents, both on the grid and distribution side
- There is a digitalisation challenge, as Germany has fondness for complexity, slow digitalisation of necessary infrastructure
- Germany is not ready from a technology standpoint (slow smart meter roll out)
- Not yet enough customers to have the economies of scale

12.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- Absolutely, as part of a service someone is providing for me
- It will definitely happen within an energy community
- However, you will always need an intermediary as a platform provider, providing the technology and the solution (including the responsibility for them)

Interview M11: Version B
Head of Research and Development / Utility Incumbent

1.) Which sector is your company active in and what role does it play in the German electricity market?

- The company has evolved from a traditional energy supplier into an infrastructure operator
- Our business are renewable energies and grid operations
- Still own a nuclear power plant which will be shut down

2.) Who would you say are the incumbent utilities in Germany? Do their strategies differ?

- Not answered

3.) What do you think are the (biggest) future challenges faced by your industry? How does your company try to cope with them?

- The grid must be greatly expanded, even though political acceptance is not always there
- Expansion of renewables must be accelerated to meet climate targets
- This all has to be done in a context of not losing one's customers
- The company is well positioned with a renewable energy focus

4.) What do you think the German energy landscape will look like in 5-10 years?

- We will see a complete nuclear exit and a potential rise in gas generation capacity
- Only a slow growth in renewables capacity
- Size will no longer play as big a role as in the past, since distribution and generation are likely to be no longer connected

5.) How do you see the role of decentralised energy resources in the German energy transition? Which technology options will be most relevant in the future?

- Not answered

6.) Do you think that the decentralisation of energy systems and the increase in "prosumers" pose a threat to the established business model of large energy utilities?

- No; the energy market is complex, requires know-how and has barriers to entry
- Decentralised energy is only cheaper because of tax advantages, but will lose out in real competition
- Prosumers will not be competitive compared to larger distributors

7.) Are you familiar with the P2P electricity trading model? If yes, how would you describe it?

- Yes, you trade electricity as consumers, aiming for a cheaper price

8.) Would you say that platform-based electricity trading models (such as P2P trading) have reached a stage where they can challenge a company like yours? If not, when (if at all) do you think they will reach this stage?

- I think large companies can be challenged
- However, it depends on political motivations, since it is definitely not economic efficiency reasons
- I see no advantage in small size

9.) Would you consider the P2P business model a disruptive or an evolutionary innovation for the energy sector? Why?

- With respect to today, it is evolutionary
- P2P trading will drive local monopolies again, which were supposed to disappear after the electricity market liberalisation

10.) What impact do you think this business model will have on the German energy sector and what opportunities will it create for the market?

- The private consumer electricity market is only a quarter of the German market, so it will always remain a niche product
- Therefore, no great impact

11.) What will be the role of a more traditional company like yours in this model?

- Utilities will probably pull out of the energy business altogether and focus extensively on network operation
- There is already no great money to be made in the energy business today, with its tiny margins

12.) In your opinion, what are the biggest challenges associated with the development of the P2P business model in Germany?

- The complete digitalisation of the product
- Roll-out of smart meters, where Germany is years behind
- There are regulatory disadvantages, especially when it comes to ensuring system security
- Data protection regulation is a great hurdle

13.) Can you imagine peer-to-peer trading as an established business model for electricity trading in the future?

- On a local level, it will remain an option for specialists
- In the long run, you won’t be able to offer cheaper rates than a large utility
- But it depends on whether it gets a political backing or not