Case Studies in the Smart Grid Sector

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Learning Objectives

- Understand and analyze the case study,
- Understand the market situation and classify the resulting opportunities and risks,
- Apply the theoretical approaches and model from previous chapters on real-world cases,
- Identify value propositions,
- Describe a value architecture,
- Understand a revenue stream, and
- Answer business-related questions.

1 Introducing Case Studies

The changes at the technical, regulatory, and market levels discussed in the book enable the emergence of new business models. In particular, new opportunities arise from the use of advances in digitization for applications in the smart grid. In this

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C. Dinther et al. (eds.), *Smart Grid Economics and Management*,
Lecture Notes in Energy 51, https://doi.org/10.1007/978-3-030-84286-4_9

chapter, we would like to present and analyze examples of such new business models in two case studies. In recent years, a number of new companies have been established in the market. For example, in the B2B business, the German start-up Entelios and the American start-up EnerNOC successfully developed solutions in the area of demand response/demand-side management and were later acquired by the Italian energy company ENEL after a merger. With a growing share of renewable generation, especially forecasting of generation output of wind and PV plants is gaining importance. The German company Energy & Meteo Systems has specialized in this service. With Younicos, a German-American start-up has developed control software for electricity storage, targeting flexible management of electricity supply and demand in the distribution grid. Younicos was acquired in 2017 by Aggreko, a Scottish energy company. Discovergy is a company in the B2C market that offers smart metering services for end customers. These examples show just a sample of new areas where demand for new solutions has emerged. It also shows that new business developed in both sectors, B2B and B2C, and that successful businesses are sometimes overtaken by established players in the market. The transition of the energy system is progressing, and we will certainly see more start-ups and business models emerging. We cannot provide a complete overview within the scope of this book. Instead, we present Power Plus Communications (PPC) and GridX, two companies that can be used to elaborate on the challenges and opportunities of new business models.

2 Case Study on Power Plus Communications (PPC)

You are a market observer and tasked to evaluate the German company Power Plus Communications (PPC)[1] and its business prospects. PPC, which provides data communication systems for smart metering and smart grids, is a specialist for ICT-Solutions and market leader for certified smart meter gateways according to the German protection profile for privacy and security. Smart Meter Gateways are the central communication entity that is responsible for both, meter data communication as well as access to controllable devices of the household.

Today, with the increasing use of renewable energy sources and a greater need for energy grid flexibility, utility providers are looking to implement smart grid technologies and use data to improve the performance of the distribution grid. However, building a robust smart grid presents utility providers with a variety of challenges and creates a need for external solutions. One major requirement of a smart grid is collecting the necessary data in the field (e.g. meter data and sensors at substations) and transmitting it to the utility providers so that they can monitor the actual grid status, analyze it, forecast the grid capacity utilization, and take necessary actions to control the grid (e.g. switch on/off devices or generation). This is in direct contrast to how utility providers have historically operated: Previously, utility providers did

[1] Dudenstraße 6, 68167 Mannheim, Germany, https://www.ppc-ag.de.

not need, and therefore, did not install sensors or meters for real-time data collection. With the smart grid utility, providers can set up an infrastructure to measure on a real-time basis (at consumption or feed-in points) and to establish a bi-directional information flow to manage power supply and protect the grid from outages, overloads, overvoltages, etc. As a result, utility operators must implement intelligent metering systems and a robust communication infrastructure. Certainly, the communication infrastructure must be protected against cyber-attacks, since the electricity grid is a critical infrastructure. Building a communication infrastructure that supports utility operators' smart grid needs can be prohibitively expensive and difficult, however. This creates new responsibilities to comply with strict data privacy and security requirements laid down with the European General Directive on Data Protection (GDPR) and Germany's Federal Data Protection Law (BDSG) as well as with Metering Point Operating Law (MsbG) among other pieces of legislation that affect this highly regulated industry. Building a robust, cyber-secure smart grid, compliant with all these regulations, presents utility providers with a variety of challenges, and creates opportunities for third-party companies with the technical expertise utilities don't traditionally have. Technologies to implement bi-directional communication in a smart grid are broadband powerline (BPL) and mobile communication technology. BPL uses the already existing low- and medium-voltage power grid to transmit data. Because it utilizes already-existing infrastructure, this solution has several benefits:

1. This communication technology can be used to transmit data from any consumption point within an energy grid. Because all consumption points are by definition connected to the energy grid, they can all be connected with this technology. This is true even in less developed countries that may lack key infrastructure.
2. Using existing infrastructure cuts down on implementation and maintenance costs for utility providers.

Utility providers usually do not have much experience in turning their energy grids into a broadband communication network though and therefore seek out external suppliers and partners. Mobile technology is similarly already well developed and doesn't require utility providers to build an entirely new communication network, thus saving on investment costs (with higher operating cost due to subscription fees) and increasing flexibility. The European Union requires the member states to invest in intelligent metering infrastructure and to equip 80% of meter points with intelligent metering systems (IMS). As the EU does not set a standard for the IMS, it is up to the member states' regulation to set the standard. Germany has more than 40 million meter points in total as from about 2020 on regulation requires every customer with an energy consumption of more than 6,000 kWh to be equipped with an IMS. By 2032, at least 80% of the meters should be an IMS. In order to secure the energy system as a critical infrastructure against cyber-attacks and to meet data protection requirements, the regulation has laid down high-security requirements for an IMS, which includes two components: a smart meter and a smart meter gateway (SMG), a device responsible for securing meter data communication and access to controllable devices in the household. Consequently, every device in the IMS has to be certified by the Federal Office for Information Security according to a protection profile. The

process of certification is tough and takes a number of years: By end of 2018, PPC was the only company with a smart meter gateway ready for certification by the agency. But competitive regulations required that three SMGWs had to be available on the market. By the end of 2019, two further companies were able to successfully conclude the certification process. Besides meeting regulatory requirements, smart meter gateways should also be compatible with the hardware (meters, communication technologies) and software (administration systems) of many other companies in the market. Although all market requirements were met as requested by the regulator, IMS rollout starts on a moderately low level in 2020. As a German company, PPC not only primarily targets European DNOs and utilities but also has customers outside Europe. Its customers include all leading German utilities and network operators. Consequently, the company has a strong brand as a market leader in the segment. Located in Mannheim, PPC benefits from a central location with a direct connection to many European cities. PPC shareholders include the management, members of the supervisory board, and employees of PPC. In addition, a couple of family offices and the venture capital fund Climate Change Capital have shares in PPC. PPC offers two main categories of products and services to its customers. On the product side, PPC sells technologies that support data communication for smart metering and smart grids, including smart meter gateways. On the service side, PPC offers consulting and project management as well as training and workshops. PPC's products aim to offer utility providers cost-efficient, scalable, and flexible ways to implement their smart grids. The services that PPC provides are aimed at guiding customers through the complexities of smart grid communication and helping them successfully implement and use PPC's products.

PPC relies on its employees' knowledge and expertise in the BPL and mobile communication realm to create value for clients. The company is compact, with 80 employees working as project managers, network designers, technical developers, solution managers, software developers, and IT employees. These employees bring knowledge and expertise about BPL and mobile communication technology that utility providers lack but require for the implementation of their smart metering and smart grid projects. The company is *fablos*, that is, it does not have its own manufacturing facilities; its products are built by third-party manufacturers. The two founders, Ingo Schönberg and Eugen Mayer, PPC's two managing directors, have both led the company since its inception in 2001. PPC's ecosystem of partners includes not only resellers and suppliers but also research and development organizations, technical standards organizations, and regulatory authorities. The company is an active participant in many research and development projects, where they cooperate with research institutes and other organizations to develop new solutions to industry challenges. Outside of Germany, PPC works with resellers including Swistec (Switzerland), Mikronika (Poland), and CleverPower (Czech Republic).

Review Question

- Who are PPC's clients?
- What challenges do the clients face?
- How does PPC help in solving these challenges?
- Which other stakeholders profit from PPC's solutions?
- Is PPC's business model new in the energy sector?
- What role does the decarbonization of the energy sector play with respect to PPC's further prospects?
- Why is PPC's business model new in the energy sector? Which role does the decarbonization of the energy sector play with respect to PPC's further prospect?
- Which value proposition does PPC offer?
- What is PPC's value architecture with respect to resources, competences, internal/external activities, and processes?
- Of which components does the revenue stream consist?
- Has PPC established a value network?
- How do you overall evaluate PPC's business prospect?

3 Case Study on GridX

You're a member of the supervisory board of the German start-up company gridX[2] founded in 2016 by two alumni of RWTH Aachen. Today, you meet with the founders to discuss whether gridX should change its business model (BM). As an experienced tech professional, you are asked to give them advice on if and how they should act.

gridX developed a hardware device, the gridBox, and a dashboard, the gridX app. The gridBox enables the connection of all DERs, independent of the manufacturer. This includes not only various smart home devices but also devices such as heat pumps and battery storage. The main functionality of the gridBox is to connect these multiple hardware devices from different manufacturers to one device and manage all of them with one holistic service. This is necessary because different manufacturers, especially from China and the US, use different protocols that cannot communicate with each other. The gridBox functions as a gateway between the different hardware devices owned by the end-user and the gridX app. The dashboard analyzes and processes the internet of things (IoT) data provided by the gridBox, which can be used by the user to manage their devices. The app also proposes ways to minimize energy usage and can therefore be of economic value. Lastly, it can also warn the user in case of faulty equipment even before it stops working completely. The box is sold directly to end-users for a retail price of 499, which includes the physical hardware

[2] Oppenhoffallee 143, 52066 Aachen, Germany, https://de.gridx.ai/.

and the right to use the app. This price needs to cover the cost of manufacturing the box externally and also the development and maintenance of the app.

The customers (end-users) buy the product to have an easy and intuitive way to connect their smart home devices, yet some of them thought the price was too high. In two years, gridX was able to sell more than 1000 gridBoxes to end-users. The start-up has grown fast and has more than 25 employees now. The team around gridX consists of talents and experienced specialists from leading companies such as Google, McKinsey, and universities such as MIT, Harvard, and RWTH Aachen University. The company relies on its employees to engineer, program, and design solutions across the full stack of technologies. They were also able to secure a Series A investment, having collected several million Euros from well-known investors such as Innogy Ventures, Coparion, and VitoONE. They now propose a change from B2C to B2B business. The changing nature of the energy industry has created an imperative for utility providers to digitally transform themselves. The IoT has enabled the collection and utilization of data at all points across the energy value chain. With 1.7 million solar-energy systems and 70,000-plus EVs in Germany, the opportunity is ripe for new business models and product and management options. In order to fully take advantage of these IoT opportunities, utility providers need to implement IoT cloud infrastructure that enables digital business models along the entire value chain. For this reason, multiple utility providers have contacted gridX about their gridBox. Their first B2B customer is Viessmann, a leading international manufacturer of energy (heating) systems.

gridX has developed a platform which is built on a stack of technologies. At the uppermost level, gridX offers prefabricated solutions for the energy IoT sector. Companies who purchase gridX's platform service have access to a management dashboard, cloud hosting, and technical support for their customers. With this package of services, utility providers are able to easily and rapidly implement IoT solutions without the need to invest massive amounts of time or money into developing their own solutions or managing the technical side of their digital business models themselves. Going one level deeper in gridX's stack of technologies, these services are based on data stored gridX-Cloud, which receives and processes the large amounts of data from the fleet of remote IoT devices that the gridBox connects to. gridX's device management technology enables users to monitor the health of their devices and control their devices remotely, pushes alerts if something goes wrong, and pushes new software updates over the air. At its core, gridX's easily scalable platform is enabled by gridX's physical product: the gridBox communication gateway and its gridOS operating system.

The following Use Cases are possible: gridX Independent Homes solution is most closely tied with the original B2C gridBox offering: It's a white-label product for utility providers that enables flexible energy management and energy monitoring of private households. Households with solar panels and storage batteries can drastically reduce their energy costs and CO_2 footprint as gridX takes weather conditions into account and utilizes the storage capacity and the energy generation peaks. For utility providers, this solution supports grid resiliency and stability, opens the door to future revenue models, and enables up- and cross-selling business models based on data

collected by IoT devices. gridX's second solution enables smart charging for EVs. With this solution, which is available for both home and public charging, electric vehicle (EV) charging is made smart by considering the actual market price of energy and the source of energy generation. This information provides power distributors with more detailed information about significant power consumption patterns of their customers, which is useful for planning the required amount of energy correctly and thus minimizing the difference between demand and supply. Smart EV charging can also be connected with the Independent Homes solution so that households can further maximize self-consumption and save costs.

gridX's Microgrids solution allows for temporary independencies of the grid using decentralized energy units. It enables the monitoring, managing, and billing of customer energy flows to prepare forecasts for the management of the decentralized power plant fleets. It also enables peer-to-peer energy trading between consumers. The fourth gridX solution is called Smart Commercial, a holistic energy monitoring and management specifically targeting all companies in industry and commerce that generate their own electricity via a photovoltaic system or a combined heat and power (CHP). Among all four solutions, gridX is offering predictive maintenance. IoT measures energy consumption, temperature, noise, and other indicators to predict malfunctioning systems or machinery. It therefore enables agility and process flexibility, while keeping downtime costs to a minimum. All current gridX offerings are based on their Energy Management System (EMS) which offers many more possibilities and solutions customizable depending on customer needs and requirements. Focusing on B2B enables gridX to serve end-users it otherwise could not, take advantage of other energy firms' direct relationships with end-users, and create value for energy producers as well as energy consumers. The pricing model also differs for the two offerings: Although the gridBox was available to customers with a one-time purchase, the B2B platform service model is subscription-based. This B2B model also expands what gridX can sell to clients and how much revenue gridX can make.

Review Question

- What challenges can be solved by gridX products and services?
- What is gridX's value proposition?
- How does gridX transform their business model by offering B2B services? What effect does this transformation have on the value architecture?
- What do you advice gridX from a technical point of view? How could they benefit from rearranging their business model? Which role does interconnectivity play in this context?
- Who else could profit from gridX's value proposition?
- Who is part of gridX's value network and what kind of partners do you recommend to add?