The New Energy Paradigm

- An analysis of how a start-up is leveraging technological capabilities to gain a competitive advantage in the energy industry

Copenhagen Business School 2018
MSc. Business Administration and Information Systems
Master Thesis
Confidential

Date of submission: May 15, 2018
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Number of pages: 113 pages
Number of characters: 257.351

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WATTY

Abstract

The energy industry is currently experiencing challenges due to changing demands for new energy sources and new energy services, as a consequence of increased focus on sustainability and advanced technology. This poses opportunities for new entrants into the energy market, which for many years has remained unchanged. As many other established industries in society, the energy industry is challenged by technological forces, which introduce many changes in the industry. Hence, this thesis focuses on investigating how a start-up can utilize their capabilities to be competitive through the digitalization of the energy industry.

Within our increasingly digital world, Big Data and the Internet of Things are two known buzzwords which represents the way in which our world is becoming smarter and more connected. The case company, Watty, has applied these technologies to position itself within a branch in this industry; the energy management field. With a pragmatic research philosophy and an abductive research approach, we have examined the case company and the energy industry with in-depth interviews, exhaustive industry reports, internal Watty documents and observations. With the obtained data, we have uncovered how Watty has established first mover advantages and how the company can advance these further in order to establish a strong position within the energy management field. Throughout our thesis, we have used a conceptual framework adapted from the strategic framework originally presented by Suarez and Lanzolla (2007) and focused our attention on three enablers that contribute to first mover advantages; *firm-level enablers*, *isolating mechanisms* and *environmental-enablers*.

Throughout our research we have discovered that there is a smooth market – and technological development pace within the energy management field. Watty´s advanced technological capabilities has resulted in technological leadership and allow Watty to position themselves as information providers as the company provides entirely new and detailed energy insights. This position is an important aspect of the company´s long-term strategy towards new consumers and other companies. With highly advantageous capabilities, the company is qualified enough to partner up with other companies, and ultimately grow a strong and sustainable consumer base.

Acknowledgments

We would like to thank our supervisor, Ioanna Constantiou, for her professional guidance throughout the entire process. Ioanna has shown great interest in our thesis topic, which has truly been appreciated and has shared her impressive knowledge and has always been happy to discuss our ideas and reflections.

We would also like to thank Watty, and especially our contact person Gustav Gårdbro, whom has been very engaged throughout these past months. He has always been willing to help and provide valuable insights towards our research. Lastly, we would like to thank our family for their kind support.

We greatly appreciate the opportunity to spend the last five months studying a very relevant and attractive topic together as study partners throughout five years at Copenhagen Business School. Our research has truly enhanced our excitement for this topic and given us great insights towards the future of energy management.

Table of Content

List of Figures

List of Tables

Chapter 1

Introduction

In our digitized world with billions of Internet connected objects, people have an increasing need, and wish, to always stay connected. Actively using our fingertips to accomplish a wide range of tasks has changed almost all aspects of how we live together as human beings. However, the process of attaining this connectedness needs huge amounts of data to succeed. Data is becoming more and more available, as previously thought unattainable information is able to become datafied and used in our everyday lives. Nowadays, almost anything can be processed into readable data. We see it through fitness trackers that datafies your steps, heartbeat and sleep patterns into an easy and coherent visualization through various apps. Through the ability to transform a plethora of products or tasks, data can now be acquired from almost anywhere, and provide us with new and better insights about ourselves and our daily lives – the possibilities are endless.

Our entire world is becoming smarter, by being connected. The concept of a digital and smart world is annotated with many buzzwords. Two which are widely recognized, are the Internet of Things (IoT) and Big Data. *The Internet of Things* represents an idea that ordinary and everyday items are connected through various technologies. According to Uckelmann et al., "...the Internet of Things is a foundation for connecting things, sensors, actuators, and other smart technologies, thus enabling person-to-object and object-to-object communications" (Uckelmann, Harrison, & Michahelles, 2011: 1). The utilization of smart objects that can sense the slightest details, as well as interact with each other, only serve as building blocks for how connected, transparent and efficient our world will become in the future. *Big Data* represents the increasing amounts of data that is being generated. The connection and flow of data and information moves at high speeds, and it is continuously escalating.

1.1 Background

1.1.1 A connected world

According to the Cluster of European Projects on the Internet of Things, the IoT is expected to change our world by changing well established social processes, business, and provide many possibilities that we are not even aware of today (CERP-IoT, 2011:10). Society has discovered many of the benefits and the great potential that the connectivity IoT represents, both for individuals, but also companies in diverse sectors. This has increased the speed of corporate practices and operations, requiring businesses to pursue a much more agile approach than previously towards smart objects (Uckelmann et al., 2011). For most people, everyday lives have changed, and individuals are now able to control their entire household with just the use of a phone or change their daily routine based on previously unattainable data and information. An example of this connectivity can be seen in figure 1. Futurist and technologist Chuck Evanhoe describes how IoT will be an enabler for both consumers and businesses to obtain information. He also suggests the impact of IoT will be across the board for consumers, affecting them in multiple areas of their lives (Gasiorowski-Denis, 2016).

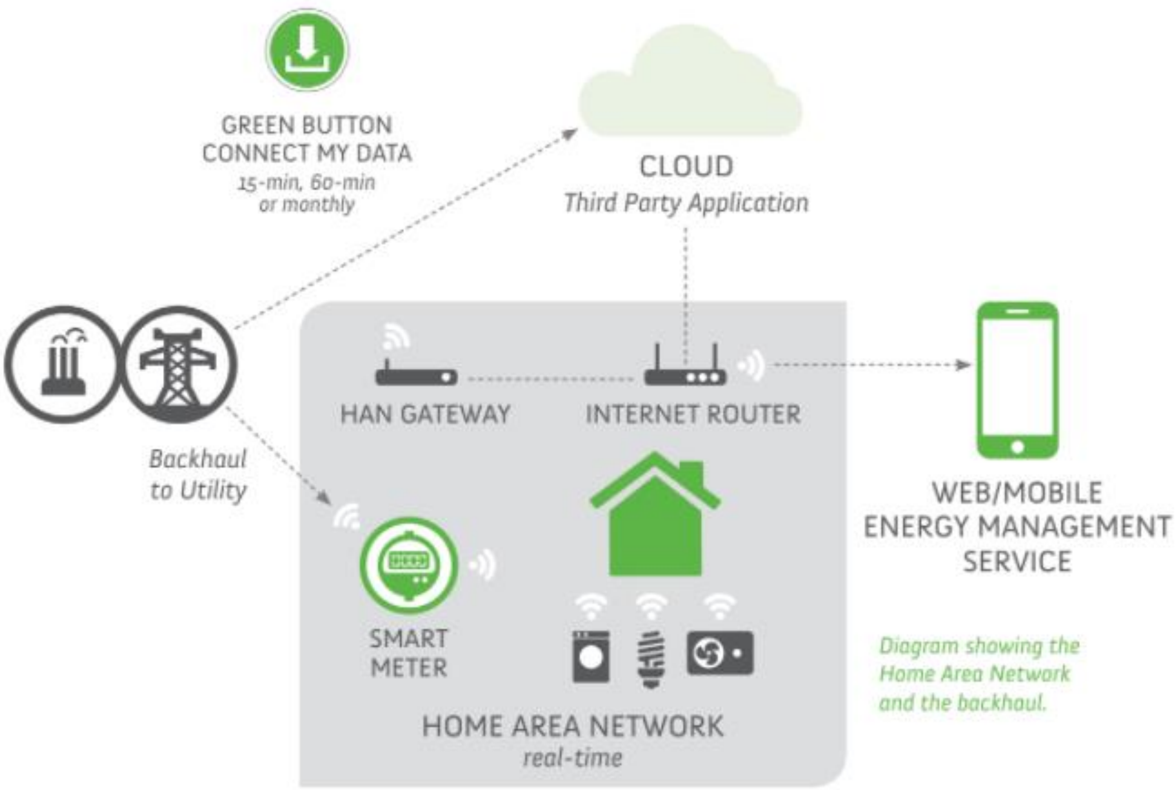


Figure 1 - Green IoT Landscape (Murray & Hawley, 2016)

Although the IoT advantages include improved efficiency, effectiveness and many new opportunities both for individuals and businesses, there are also challenges as disruption, governance, security, and privacy related to the Internet of Things. According to Höller et al., IoT is expected to rapidly disrupt several business sectors in the next 5-10 years (Höller et al., 2014: 4). For many companies, disruption entails considerable challenges, which for some have been too difficult to deal with. Also, new legislation is often necessary to address the challenges that the datafication age represents. In terms of privacy, it is often a question of how we can encourage the technological development, and at the same time care for our privacy needs. As our world becomes smarter, society's rules and regulations also need to be smart.

1.1.2 A sustainable and smarter world

As mentioned, digitalization enables companies to become even more connected to people through appliances in their homes and everyday items. This connectivity generates valuable insights into people's surroundings and behaviours, which in turn can be monetized by companies as seen with Google and Facebook (Business Insider - Nordic, 2017). Another of the more featured areas within the Internet of Things are Smart homes. In 2014, the well-known companies Danfoss, Grundfos, ROCKWOOL and VELUX GROUP established BetterHome to make it easy for homeowners to create energy efficient homes with a healthy indoors climate (VELUX Media Centre, 2014). The BetterHome project is the product of companies needing to innovate to stay competitive in a highly demanding market, with an ever-growing focus on sustainability. The demands from an increasingly environmentally conscious demographic begs the question; whether the market is demanding connectivity with an impact? Market data seems to agree. An article published by Deloitte Insights highlights the responsibility of a company and the potential of combining CSR and technology where they dub it Corporate Social Responsibility 2.0 (Deloitte Insights, 2016). They explain how millennials are biased towards companies with a lack of CSR practices or products, indicating that more than 50 percent would be less likely to either work or buy from a company without any CSR focus.

The increased demand for sustainability boosts many new start-ups gaining traction and, who have their core values focused on CSR (Forbes, 2014). The increased emergence of socially responsible companies can be attributed to the recognition of some established companies who have shown it is possible to succeed by focusing on sustainability. Companies such as Patagonian, an outdoor equipment manufacturer, is well known for its sustainable approach and boasted over 500 million USD in sales in 2014 and has over 1300 employees (Forbes, 2014). Consumers are asking for environmentally conscious solutions, and at the same time they expect easier and more aggregated solutions. Some start-ups, here amongst a Stockholm-based company named Watty, are rising to the challenge to establish sustainable solutions through greater connectivity and transparency (Figure 2). This start-up is aiming to create awareness of consumer’s energy usage through insights gained from massive amounts of data. Today, these insights, and more particularly, the ability to analyse data that is being collected from homes and devices, are now being recognized as a strategic and necessary asset for most companies (Bohé, Hong, Macdonald, & Paice, 2015).

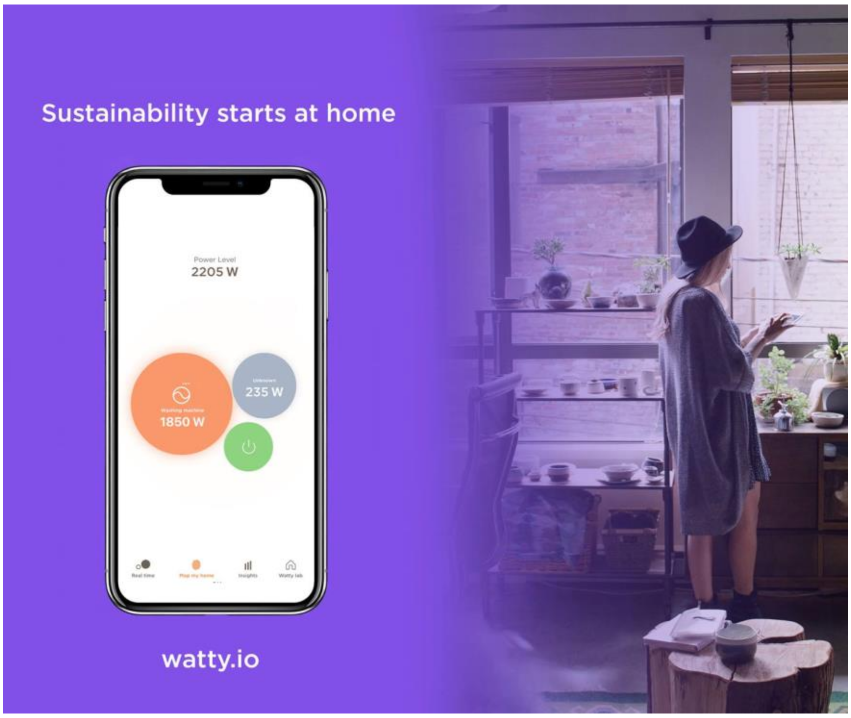


Figure 2 - Watty Sustainability Awareness

1.1.3 The Energy Industry

As mentioned, businesses in any industry need to pursue a much more agile approach than previously, in order to compete with new entrants in their markets. Companies operating in the energy sector is no exception. This industry, is estimated to change greatly throughout the next couple of years as is seen through a Gartner Consulting report predicting that the utilities industry will be greatly affected by transformational technologies such as IoT and Big Data amongst others, over the next 5-10 years (Sumic, Steenstrup, Geschickter, & Foust, 2017). There are four key forces currently shaping the energy markets around the world; connected everything, personalized energy, asymmetric competition, and shifting regulatory framework (Accenture, 2014). Although there are challenges with massive amounts of data available, the patterns revealed through machine-learning algorithms, means data and the accompanying data handling techniques are being perceived more and more as a valuable business resource. Furthermore, a growing number of utilities are applying smart meters to improve operational efficiency, reliability and customer service (SunGard, 2013). In fact, The European Commission aim to replace 80% of the current electricity meter, or more specifically approximately 200 million energy meters with smart meters by 2020 (European Commision, 2018). The smart meters that the utilities apply can provide millions of data points arriving in sub-hourly intervals (SunGard, 2013). There is no doubt that there is much potential and a fierce competition to stay on top of the continuous development within this industry.

Increased smart meter usage and data driven technologies provide unique insights into consumer energy usage, but the data is also considered useful for many other purposes. In terms of energy data, SunGard Energy (2013), argue that the combination of such data with other data sources as weather information, facility surveillance systems and even social media from customers, can provide extremely valuable insights (SunGard, 2013). These insights can provide a comprehensive perspective that can be used for many purposes, as for example predictive analysis with the help of machine-learning. Due to the increased focus on data in the energy industry, the competition landscape has changed, introducing new energy monitoring companies. These firms have seen the value of energy data and are often able to acquire huge amounts of data much quicker and more accurately than the traditional energy companies and can position themselves better across multiple industries (Accenture, 2014).

1.2 A Swedish Start-up

The Swedish start-up Watty is amongst the companies that has realized this change and entered the energy industry. Watty offer its customers an IoT device in order to collect data continuously, which is installed on customers' fuse box. The device collects energy signatures from the appliances people have in their homes and almost instantaneously converts these signatures to data points and runs them through multiple machine-learning algorithms. These results are then displayed on the Watty app as seen in figure 3. As the data appears in real-time, customers can accordingly understand, and keep track of, which appliances use energy at any time in their home instantaneously. The most distinct difference between utilities' smart meters and Watty's IoT device, is the speed, the magnitude of data collected, and the way in which this data is transformed into intuitive information for the consumers. Typically, a smart meter can measure one data point per every 15 minutes, whereas Watty has the potential to measure up to 750.000 data points per second, and still show the data in real-time. This is indicative of a more detailed and comprehensive approach towards data collection and enables Watty to present intuitive and personalized customer insights. Currently consumers cannot interact with the appliances through the app, but they are able to react and change their energy consumption behaviour based on the information provided.

Figure 3 - Watty Box and App

1.2.1 Company description

This thesis will conduct a case study of Watty with the purpose to draw conclusions based on a concrete case. Our aim is that these conclusions and findings can prove relevant for the case company and potentially other companies operating within the energy industry.

Watty AB was established in 2013 in Stockholm, Sweden by Hjalmar Nilsonne whom today is the CEO. The name "Watty" originates from the energy term "kilowatt", and Watty was then a catchy name for a company dealing with the kilowatt, the energy consumption, that people have in their household (CEO, Interview). Today, the start-up is seed-staged financed, with a total amount of 4 million euros primarily from two venture capital firms, but also the Swedish Energy Agency. Working with Cleantech Invest and EQT Ventures is according to the CEO a strategic move, as Watty "gets deep industry expertise from Cleantech Invest paired with a strong experience of scaling technology businesses globally from EQT Ventures" (Keane, 2016). The company has 16 employees, which represent a range of diversity both in relation to competencies but also culture, as the team collectively speaks Persian, Japanese, German, French, Russian, Mandarin, Italian and several Swedish dialects (Watty.io, 2018a)

The company's particular green vision, which will be described in the next paragraphs, has due to its popularity in society, generally acquired much attention. Up until now, the company has been featured in more than 54 media sources, here amongst BBC, Business Insider, and Tech.eu (Watty.io, 2018a). Disruptor Daily presented Watty as one of the 10 AI energy companies to know in 2017, and Wired magazine listed Watty among the 100 hottest start-ups in Europe in 2017 (Hillman, 2017; Temperton, 2017). Moreover, Watty was one of the finalists in the Swedish Mobile Gala within its IoT innovation category, and the company has out of all the Nordic Internet of Things companies, been acknowledged for its impressive technological innovation in the energy sector (Stojanovic, 2016). In addition, Watty has also won top data benchmarking within energy data three times, indicating a strong proficiency in their data collection abilities (Marketing Manager, Interview).

1.2.2 Purpose and target consumers

Watty was founded thanks to the CEO's hypothesis in 2013, that energy data is a vastly underused resource. With this assertion in mind, he collaborated with academics from the technical university in Stockholm, with a goal to make it possible for anyone to understand complex energy data (CEO, Interview). The CEO was primarily driven by the wish to contribute to a sustainable society, as “2016 has shown us that stopping catastrophic climate change is not something that can be left to our politicians” (Watty.io, 2018a).

The CEO claims that although society is aware that 20 percent of the world’s CO_2 pollution stems from buildings including households, nothing has changed regarding the households specifically. In addition, 30 percent of the energy that is used within buildings is used inefficiently (Figure 4). At first, he did not understand why everyone was so inefficient in doing something about it (CEO, Interview). After a while, it was apparent that the one thing that was really lacking, was the information. People are only provided with a highly uninformed energy bill, which is one of the reasons why addressing these issues, was developing so slowly (CEO, Interview). The wish to inform people about their energy consumption, fits well with initiatives from the EU Commission. The update of the Energy Performance of Buildings Directive December 2017 introduced new provisions “…to enhance smart technologies and technical building systems, including automation” (European Commission, 2018).

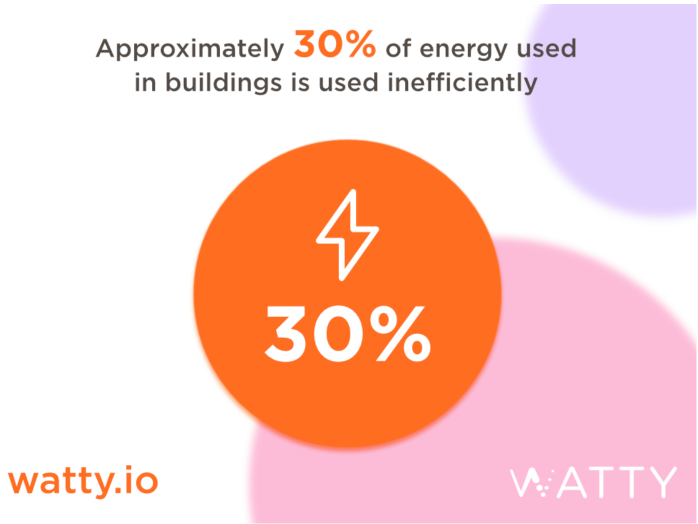


Figure 4 - Inefficient energy usage in buildings

For the first couple of years the company's core focus has been to empower homeowners through information, to become more aware of energy consumption in order to do three things; save energy, create awareness and save money. In an interview in 2014 with Swedish start-up Space, Nilsonne explained that "...we are building a product that finds the smartest way to save energy and money in each home, accurately and automatically" (Persson, 2014). Throughout the years, the core focus has changed slightly due to market research. Findings revealed that consumers most efficiently relate to topics like safety, real-time alerts, and energy management (Figure 5) (Marketing Manager, Interview). The company's slogan therefore comprises these three focus areas; "Watty will help you understand what is happening in your home. All the time. In real time" (Watty.io, 2018b).

Figure 5 - Watty's value drivers

Although Watty's mission still is to empower people to be better informed, the focus shifted from "saving money". The energy bill is rarely a concern amongst most citizens in Sweden, as energy expenses typically are fairly low. In short, "People don't care about the solution, because they don't care about the bill" (CEO, Interview). Instead, Watty's current target consumers are people living in Sweden who have one or more of the above-mentioned concerns or interests in their life; home safety, home insights, and home sustainability.

1.2.3 Product and service

1.2.3.1 Infrastructure (Software & Hardware)

Watty offers its customers both a product and a service, where an IoT device together with artificial intelligence-based algorithms collect energy data from the home and displays this data on the Watty mobile application. The energy data is collected from a range of appliances that people have in their home, like refrigerators and washing machines, and collects 10 data points per second (Machine-learning Engineer, Interview). The algorithm collects data via a non-intrusive load monitoring enabled by their IoT box and is able to directly analyse the electrical signature of the appliances in the home, and then publish it via the Watty app. Non-intrusive load monitoring allows Watty to identify specific electrical signatures with one device based on the total energy consumption, this is also called energy disaggregation (Beckel, Kleiminger, Cicchetti, Staake, & Santini, 2014).

In order to store and process this data, the company utilizes hosting services in several cloud spaces. With the help of various API's, the communication between the software components functions efficiently. With its 2GB memory ability and four processors, the device can be compared to a laptop (Software Engineer, Interview). Moreover, the algorithm that runs through the device, manages the comprehensive, complex and multi-component flow of data. As such, the data can be presented at any time, in real-time. According to one of the software engineers, "...we are basically doing all these steps by ourselves" and this is the core magic in the solution (Software Engineer, Interview). The complexity enables an intuitive solution that empowers customers to understand and keep track of which appliances use energy in their home, any time and in real-time. As Watty's employees state, this is a huge accomplishment in itself, as this all happens in less than a second (Machine-learning Engineer, Interview).

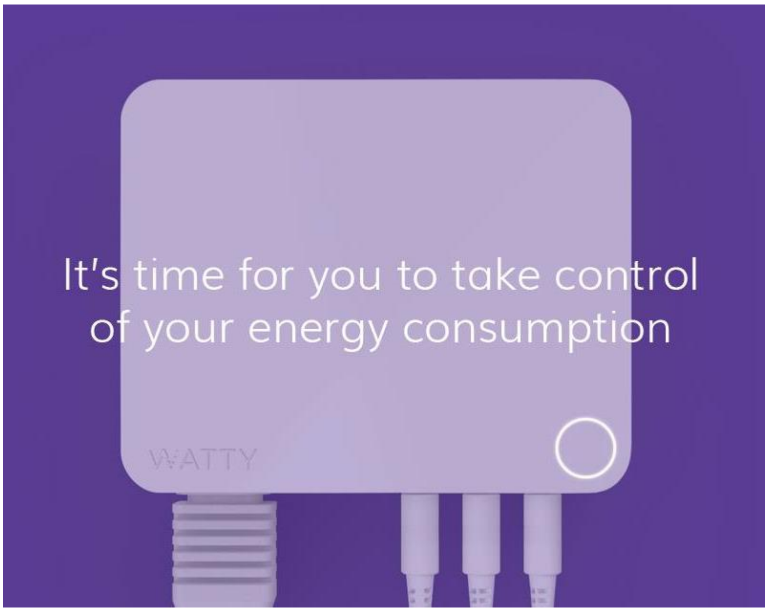


Figure 6 - Watty Box

For the Watty IoT box to be functional in the customer's home, a short installation process must be completed. Currently the IoT box can be installed by official Watty partners, whom are certified electricians. The electricians attach the Watty IoT box to the fuse box in the homes via four different connections. Three of the four connections are small electrical clamps, which are placed on the three current phases in the fuse box, which allows Watty to detect electrical signatures from appliances plugged in sockets. The last connection between the home's fuse box and the Watty IoT box is to measure the current voltage in the home (Machine-learning Engineer, Interview).

The current process is explained by a Watty employee as being very easy and quick. He mentions that almost everyone would be able to do it themselves, had it not been for safety regulations when dealing with installations to the fuse box. The current installation process and IoT box has improved greatly since Watty first started measuring electrical input. The current IoT box is their third version of a piece of hardware able to detect electrical signatures. The first two versions were similar to the traditional smart meters that the energy companies use, however with some alterations. In addition, during the initial data collection process, the company had to apply measuring equipment to all individual appliances in the homes. This approach was used for the initial 2-3 months of data collection, in order to obtain enough data for the training data they use. The company now uses the data that they acquire via the new box and approach, as new instances for their dataset help improve their machine-learning algorithms. Watty's employees have mentioned that the current installation process works well, as does the current version of the box. A detailed flowchart of the current process on how and where the data comes from and is processed can be seen in figure 7.

The flow chart represents a clear picture of how the collected data is processed through various software and API's. In the flow chart, the top box represented by a 'W' is to indicate the IoT box in the home. In addition, the area enclosed within the dotted line indicates the various software processes and actions needed to translate the collected electrical signatures to readable data points. These data points are pushed through to the app in a user-friendly interface, as seen in figure 3 in section 1.2. The app gives the users a clear picture on the total current energy usage of their home, and which appliances contribute to the current total energy usage. The current energy consumption is shown in the app, as "floating" spheres that through their size indicate how much energy each appliance is using. In general, the app allows the user to understand the data collected by the Watty IoT box, namely their energy consumption, in an easy way.

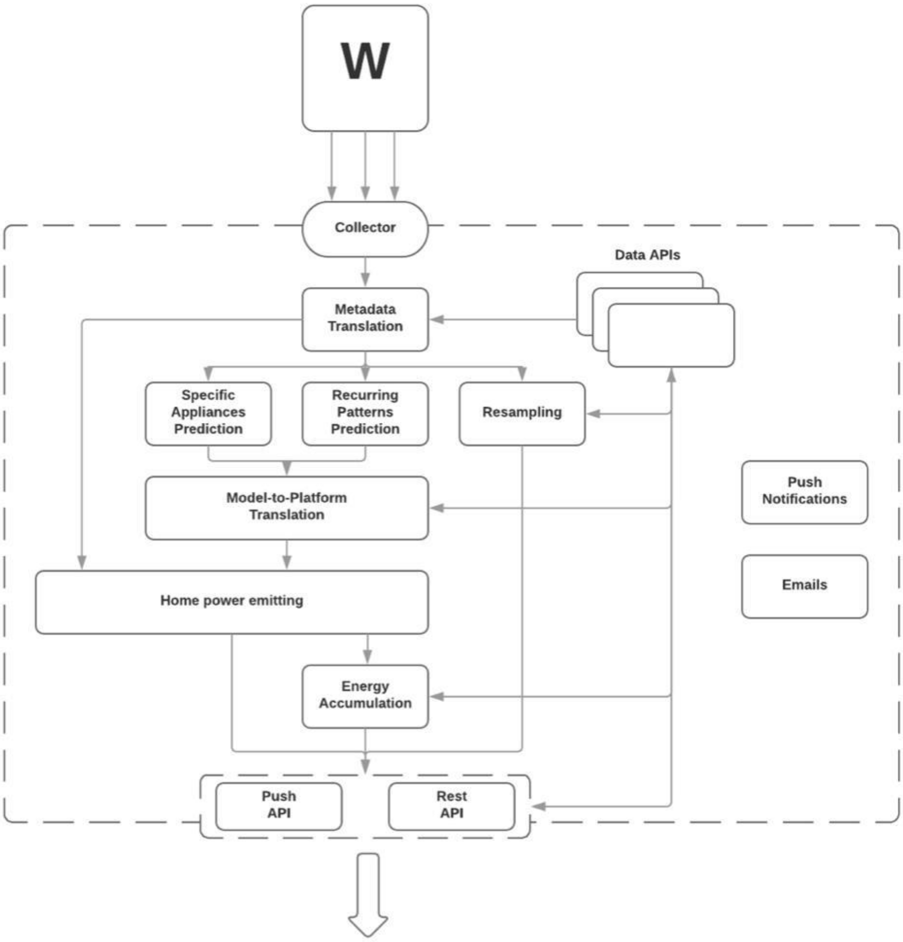


Figure 7 – Extended Watty Architecture

Watty is a company still undergoing a lot of changes, as their start-up nature and engagement with new technology allows them to remain adaptable towards their environment. We will later in our thesis go more into detail regarding their various technological skills and how this allows them to position them in the energy sector. Watty has up until now been leading the way within energy monitoring in Europe, however see competition on a global scale from their American counterparts. It is important for Watty to stay innovative and be able to adapt to any changes that the industry or customers require, however the CEO understands this and mentions, how the company can change from week-to week, and is prepared to do so (CEO, Interview).

1.3 Research aim and focus

With our completed bachelor's degree in information management from Copenhagen Business School and our soon to-be-completed master's degree in Business Administration and Information Systems also at CBS, we have an interest in how technological developments make our world smarter and how businesses can grow and position themselves in well established markets through the tech capabilities they hold. Throughout our bachelor and master's degree we have researched several relevant topics with the Maersk Group, and we wrote our bachelor thesis about the Danish taxi industry. As a result, we have some experience researching established industries, and developed an interest in further discoveries within such, supported by our competencies acquired from our studies.

In recent years, executives from large power utilities companies have claimed, that they expect a large transformation or critical changes to the energy industry (Flaherty, Jennings, & Schwieters, 2017). Change is expected based on trends and technological development impacting various areas of the energy industry. As presented through Gartner's hype cycle (Sumic, 2017), different technological advancements present the possibility of major change within any industry. These transformations are becoming more evident within the utilities and more specifically the energy industry, as the awareness of climate change has resulted in a larger focus on CSR and sustainability in society. These factors contribute to the possibility innovating a somewhat archaic and regulated energy industry.

The possibility of massive changes is impacting the market through new competition, consumer centric products and new policies. These global trends have the possibility to disrupt the current status quo of the energy industry and its value chain (Astarloa et al., 2017). However, the increasing use of transformational technologies and a larger demand from consumers are enabling new types of competition to enter the utilities market. Data collected from smart meters and the integration of IoT devices are empowering consumers to assume a new role within the energy industry.

The various digital technologies of predictive analytics, cloud computing and mobile electronics, enables firms to reach customers on an entirely new level and suggests new strengths and approaches to organizational capabilities and consumer benefits. Information and data-driven strategies have also become a more integral part of business and strategy. Business growth through tech and data capabilities has not only become an advantage, it has started to become a requirement for companies in many industries to even survive. However, the huge amounts of data are still seen as an unknown value source, as many companies lack the understanding and infrastructure to generate any value from the data.

We believe the combination of the technological developments, changes in the energy industry and how an environmentally conscious IoT start-up, with a powerful data collection tool can partake in the ongoing market changes, is a very relevant and attractive thesis topic. We expect to better understand how the competencies to analyse data, and leverage it as an asset, has become a necessity in the energy industry and how it can empower a start-up, such as Watty. Watty, which was founded on the ambition to create awareness of energy consumption and hopefully in turn make consumers more aware and reduce energy waste, is now able to do so much more due to their strong data capabilities.

The above-mentioned factors motivate us to take a further look at Watty´s main strategic capabilities, more specifically their technological capabilities and how these can provide competitive advantages, when operating within the energy industry. We hope these insights will help us better understand the industry landscape, and help answer the following research question:

How can a start-up utilize their technological capabilities to be competitive through the digitalization of the energy industry?

Our aim with this thesis is to 1) Find out if (and how so) the capabilities of a start-up can leverage competitive advantages, 2) what actions a start-up could focus on, in order to develop a sustainable long-term strategy based on industry conditions. In terms of our focus, our aim is to analyse the case company's technological capabilities towards that of the energy industry and discover the most appropriate internal and external environmental factors connected to the topic in question when determining their competitive strategy. We intend to use these insights to discuss a potential recommendation on how Watty can grasp the possibilities brought forward by new technologies and global trends.

1.4 Thesis structure

In the following section we will provide an overview of the thesis structure by briefly describing what each chapter will contribute with. This will provide the reader with a clear expectation of the thesis.

Chapter 1 – Introduction

In chapter 1 we provide the reader with an introduction to the thesis subject and our thesis company, the Swedish start-up Watty. We introduce the current trends within a more connected world, the increasing focus on sustainability, and the changing energy industry. Also, we explain how an IoT start-up like Watty has moved into a field embracing these three aspects of our society, as the company has the goal to make it possible for anyone to understand complex energy data. In this chapter we propose our research aim and purpose. We argue that the combination of the technological developments, changes in the energy industry and an IoT start-up with a powerful data collection tool, is a very relevant and attractive thesis topic.

Chapter 2 – Methodology

In this chapter we explain our methodological considerations towards our research and our accompanying thoughts during the research process. We describe our research philosophy as well as our research approach and research strategy in order to give the reader an understanding of our choices throughout the research. An overview of the data collection is provided, accompanied by our data analysis approach. We also give the reader insights into the research quality to explain its reliability and validity. Finally, various limitations and delimitations that have impacted our abilities throughout this research is discussed, in order to inform the reader about the challenges we met.

Chapter 3 – Theoretical Background

In chapter 3 we explain the main theoretical background for this research; Big Data and The Internet of Things (IoT). First, we assess researchers´ diverse perspectives on the variety, volumes, flow and speed, value, and trustworthiness of data. We also look into the connectivity, value drivers, and challenges that the IoT represents, as well as the current opinions on the development of the smart city industry. Finally, we explain how we wish to integrate the perspectives on Big Data and IoT into our particular research of an IoT start-up operating within the energy sector.

Chapter 4 – Strategic Frameworks

In this chapter we present the main theory and strategic framework by Suarez and Lanzolla (2007) regarding first mover advantages. Additionally, we also explain different attributing strategic concepts by various researchers (Douma & Schreuder, 2013; Ghasemkhani, Soule, & Westerman, 2014; Grant, 2016; Teece, 2007; Teece, Pisano, & Shuen, 1997) The concepts were used to support the proposed strategic framework. We have aimed at adapting the strategic framework originally presented by Suarez and Lanzolla (2007), towards a conceptual framework we can use against our findings and theoretical background. By explaining this framework in detail, we hope the reader comprehend the underpinnings of our analysis and discussion.

Chapter 5 – Findings

In chapter 5 we provide the reader with our insights and key findings from our data collection. We divide the chapter into three main sections; Environmental enablers, Firm-level enablers, and Isolating mechanisms in order to illuminate our findings in conjunction with the three influences of first mover advantages presented by Suarez and Lanzolla (2007). We present, amongst other things, how the energy management field is currently presenting as an emerging field in the energy industry but is also indicated to be one of the important aspects of the smart city industry. We wrap up chapter 5 with three tables which presents our key findings that we will focus on in our discussion.

Chapter 6 – Discussion

In this chapter we focus our attention on discussing the significance of our findings in light of the current research within the topic and appropriate strategic concepts. With this, we aim to propose new understandings or insights about the company´s position and present how it is leveraging its capabilities**.** We also divide this chapter into three main sections which illuminates the first mover advantage framework presented by Suarez and Lanzolla (2007). We also showcase the various aspects contributing towards the company´s first mover advantage in the energy management field, as adapted from Suarez and Lanzolla (2007). Finally, we explain the importance of our study, future opportunities for the company, as well as suggestions for further research.

Chapter 7 – Conclusion

Chapter seven concludes the thesis and focuses attention on answering what we presented as our research aim and focus in chapter 1. We briefly explain the ways in which we conducted our research, our most important discoveries, and what we propose for the further development of the case company.

Chapter 2

Methodology

The following sections will present our methodological considerations towards our research, and our accompanying thoughts during the research process. Initially, we will present how we looked closer at the ontological views and epistemological paradigms that were aligned towards our research**.** We will delve deeper into the different research philosophies and our considerations for each in the following section. Following the determinations of our research philosophies, we developed a subsequent research plan in order to best structure our approach towards our data. As part of our research plan, we outlined which approach we would use, choosing between *Induction*, *Deduction* or *Abduction*. The aforementioned research approaches were also influenced by our determined research strategy. Michael Crotty (1998) describes how the different areas of the research process are influenced by each other. He depicts the interdependencies through figure 8, where he states that each of the four elements inform on each other.

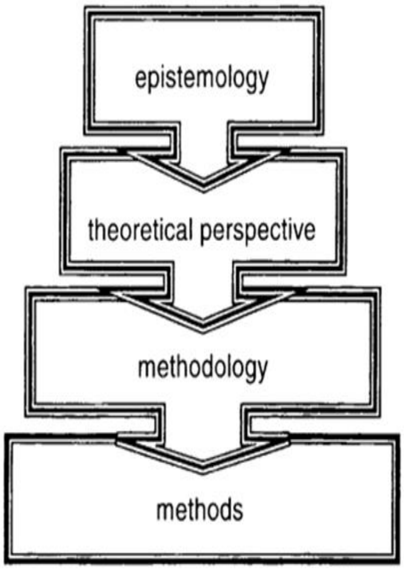


Figure 8 - Four elements of the research (Crotty, 1998)

Michael Crotty (1998) further explains that a need exists to justify the methodologies and methods used as a research process. He states, *"Setting forth our research process in terms of these four elements enables us to do this [justify], for it constitutes a penetrating analysis of the process and points up to the theoretical assumptions that underpin it and determine the status of its findings"* (Crotty, 1998: 6). During this methodology chapter, we aim to present how our research process was influenced, as seen in figure 8, and how we are able to justify this based on our research focus and question. Besides expanding on our research philosophies, we will present the various approaches which encompass the remaining three steps in the research process.

To conclude our methodology, we will present our thematic considerations that have been developed through an extensive coding and data analysis process, in which we loosely followed a four-step process for data analysis presented by Mariette Bengtsson (2016). During this section we also expand more on the different software used during our data analysis process and which considerations were made during coding.

2.1 Research Philosophies

A paramount first step in any research process, here amongst our thesis, is being able to determine and understand which research philosophy should be adopted. The different philosophies provide critical assumptions about *how we view the world, and how we know what we know* (Saunders et al., 2012). Michael Crotty (1998) presents, that ontological and epistemological views influence the theoretical perspective and in turn the methodology. We will also elaborate on our choice of choosing a subjective ontological approach and a pragmatic epistemological philosophy.

2.1.1 Ontology

Ontology deals with the nature of reality and raises questions on the assumptions that we as researchers have about *how* the world works (Saunders, Lewis, & Thornhill, 2016). Crotty (1998) argues that, we as people, have different views of what constitutes facts. He discusses that ontological philosophy is *how* we see the world and the facts in it. Readings surrounding ontology divide ontological philosophies into two different categories; *objectivism* and *subjectivism*.

When taking a subjective approach, it is argued that the truth exists within one's own mind and is influenced by perception and actions; "social phenomena are created from the perceptions and consequent actions of social actors" (Saunders et al., 2016: 132). Saunders et al. (2016) further explains how, with the subjectivist view, interaction between people is a continuous process and therefore the truth is also continually changing due to the different beliefs each individual might have. Based on the ontological concepts presented by Crotty (1998) and Saunders et al. (2016), we believe that our world view is aligned with the ontological philosophy of *subjectivism*. We see the facts presented during our research as subjective to whomever might be presenting them. In the context of the thesis and when we will be discussing the notion of being successful in the energy sector, we believe that this statement is subjective based on the perceptions and beliefs of each individual. We do however also recognize, that when dealing with IT systems, some truths are absolute and uniform, and therefore we also recognize the need for an objective perspective on occasion. Our main ontological philosophy will however still remain that of *subjectivism*.

2.1.2 Epistemology

The concept of epistemology deals with the "'the nature of knowledge, its possibility, scope and general basis' "(Hamlyn, 1995, in Crotty, 1998). As a theoretical perspective, epistemology deals with knowledge and what it entails to know; hence *how we know*, *what we know* (Crotty, 1998). Within the epistemological research philosophy there are multiple research approaches, which differ to certain degrees. Four main research approaches are highlighted and have been discussed amongst researchers to a substantial degree. They are; *positivism, realism, interpretivism* and *pragmatism*. These four research approaches can also be categorized within the two ontological philosophies; *objectivism* and *subjectivism*. Two of the epistemological philosophies, *positivism* and *realism* correlate with the objectivist view within ontology. The objectivist view within ontology focuses on an objective truth that is *true for all.* Whereas, *Interpretivism* and *pragmatism* correlate more with the subjectivist view. In the subjectivist view, multiple truths exist that need to be interpreted in order to uncover any latent meanings. We will present in the following sections, why we have chosen a pragmatic epistemological philosophy for our research.

As mentioned, a research philosophy within the epistemological view is the *pragmatism* approach, which also shares some relation to a subjective ontological view. *Pragmatism* provides a respite between the contrasting views of *positivism*, *realism* and *interpretivism*, as this philosophy, which focuses on the research question, provides an alternative (Saunders et al., 2016). It is argued, that *pragmatism* is a philosophy of meaning, in other words "[...] *pragmatism asserts that concepts are only relevant in as much as they are relevant for action"* (Keleman & Rumens, 2008: 40). Hence, researchers within a pragmatic view will choose a methodology that will provide the most value towards the research question. The pragmatic view enables researchers to get an encompassing view of their subject. However, this also means that researchers need to focus on their research questions, as observations outside their peripheral scope might impact their findings (Saunders et al., 2016). As we are most interested in understanding and answering our research questions, we therefore believed a pragmatic philosophy would best serve as our epistemological view towards our further research and choice of methodology.

2.2 Research approaches

Michael Crotty (1998) presents that the choice of a research philosophy can influence the choice of which research approach one should use going forward. Within the research domain, three research approaches exist; *deduction, induction* and *abduction.*

If a researcher starts with theory, develops a hypothesis and uses data in order to validate or discredit their initial theory, then they are using a deductive approach. Saunders et al. (2016) describes the logic behind the deductive research approach as follows, “In a deduction inference when the premises are true the conclusion must also be true” (Saunders et al., 2016: 144). In short, the deductive approach is used for theory falsification or validation. Within inductive research approach, the researcher will start by collecting data surrounding a subject and develop a theory based on which themes and patterns they have discovered (Saunders et al., 2016). The inductive approach allows researchers to explore multiple approaches, as they are not locked in on a research strategy as with a deductive approach, and they are able to let themselves be steered by the data, often obtained through qualitative research methods.

Saunders et al. (2016) claims that even though it seems as if there is a rigid division between deductive and inductive, there is a possibility to use both approaches, as is seen with an *abductive* research approach. Saunders et al. (2016) explain how an abductive approach moves back and forth between data and theory, utilizing both a deductive and inductive approach in either a sequential or simultaneous pattern. The abductive approach uses data in order to explore a subject and then identify themes and patterns to which they are identified in an existing framework, to then test this through subsequent data collection (Saunders et al., 2016: 144). The utilization of both deductive and inductive approaches allows an abductive research approach to be very pragmatic and is utilized commonly within business and management research. However, even though abduction is seen as a blend between two other approaches, there will most likely be one of the two approaches being more dominant based on the need and research focus.

For our thesis we wanted to be driven by the data in order best formulate an appropriate adaptation towards our theoretical considerations. Based on our inherent knowledge from our studies we had deductively made some considerations towards a strategic framework by Suarez and Lanzolla (2007). We used an inductive logic to allow a data driven approach towards discovering themes which could be adapted towards the strategic framework. Hence, we have utilized an abductive approach, as we had concepts in consideration when conducting our data collection, however we were still guided by the data to uncover how the discovered themes of IT and others could be used towards a well-established strategic framework and ultimately towards our research question. Based on our research question and the scope of our research, we believe that the abductive research approach was best suited for our thesis. The abductive research approach also aligns with Michael Crotty's idea of influence through four elements of research, as presented earlier in figure 8. The abductive research approach is a pragmatic approach and values the best way to process data, which is aligned with our applied pragmatic research philosophy where the data and the research questions are in the forefront.

2.3 Research Strategy

After we identified which research philosophy and research approach that we wanted to pursue, we determined how we more specifically could carry out our research. We knew that the way we chose to carry out our research, would play an important role in how we would be able to answer our research question, especially with a pragmatic epistemological view. In the following sections, we will present our overall research strategy. We will also go more into detail about the research strategies and methods we chose to utilize, as well as describe important aspects regarding such research methods.

2.3.1 Exploratory studies

As mentioned above, the way research questions are asked, will lead to a certain kind of research answers. More specifically, these questions will involve the researchers in either an exploratory, descriptive, or explanatory research (Saunders et al., 2016: 170). Our research can be categorized as exploratory as we want answers to "what", "how" and "why" questions. We have followed a funnel approach, as we started with a broad perspective and narrowed down our focus later, whilst still maintaining a flexibility to changes (Saunders et al., 2016: 173).

Particularly, we clarified our understanding about the energy industry and Watty through literature, industry reports, interviews, observations and internal documents. Due to our exploratory approach, we kept the interviews relatively open, which we will explain in more detail in a few paragraphs. Although we facilitated our broad understanding through interviews in the first phase of our research, we purposely scheduled some interviews later in the research process, in order to ensure insights that could provide an additional perspective. We were also aware that we would need to revisit data and have follow up interviews and be able to adapt to new findings. In short, we wanted to accelerate a research circle, where we constantly would challenge our insights, analysis, and findings.

2.3.2 Research Methods

There are two main research methods to choose from, *qualitative* and *quantitative*. Neither approach is more beneficial than the other, but the most suitable method depends on the objectives of the research (Saunders et al., 2016). As indicated above, we found a qualitative research method most applicable in regard to what our research question represents. We will very briefly explain the qualitative approach in the following paragraphs.

According to Flick (2014), the limitations found with quantitative methods, have commonly been used as a basis for developing reasons why qualitative research should be utilized instead. One of the most well-known reasons is that quantitative methods generate general statements. Qualitative research on the other hand, is more suitable to specific contexts, as the data collected often enables in-depth analysis of the topic being researched (Flick, 2014). The results from qualitative data collection are non-numerical, as the data collected is based on interpretations. We have utilized both interviews with Watty employees and expert interviews, as we wanted to understand Watty's main drivers and capabilities within the context of the energy industry and an IoT landscape. As researchers gather data through thorough conversations with various people, Saunders et al. (2016) argue that qualitative methods empower researchers to comprehend very complex situations.

Some researchers use both qualitative and quantitative research methods as a combination often provides a broader perspective. The overall goal with our research has been to provide some new insights based on our proficiencies and possibly suggest how Watty can ideally position itself in the energy industry. In order to do that, in-depth data and analysis is necessary. Therefore, we decided that a quantitative method would be insufficient, and it was subsequently disregarded.

Saunders et al. (2016) describe that qualitative research in particular, is associated with a variety of strategies and methods which all have a definite scope and set of procedures (Saunders et al., 2016: 163). We examined which strategy would best help us answer our research question. Given our chosen topic and close collaboration with a start-up, it was reasonable to the qualitative strategy of a case study. We believed that a case study approach would establish coherence in our paper and best serve our research, as attributed through our pragmatic research philosophy. We perceived case study as the most obvious choice of strategy, as we were looking closer at single company in the context of the energy industry. We will briefly present the case study approach, and then return to its research function in our data collection and data analysis paragraphs.

2.3.2.1. Case Study research

An essential aspect of our research has been to study the Swedish start-up Watty, which enabled us to look at a topic within a specific context. According to Andersen (2010), case studies are mostly used to analyse organisations and institutions, and the overall purpose is to draw conclusions from a concrete case and add these insights to existing research on the same topics. Andersen (2010) also argues that conclusions from case studies can boost existing research within the same research topic, and accordingly be inductive.

As previously mentioned in paragraph 2.3.1, we pursue an exploratory research approach, to draw answers to the “whats”, “hows” and “whys”. Applying a single case study research strategy in particular, is beneficial to follow as the strategy has a considerable ability to generate answers to these types of questions (Saunders et al., 2016: 179). When a case that is significant enough for the research question is found, the next step is to “...clarify what else belongs to the case and what methodological approaches its reconstruction requires” (Flick, 2014: 122). An example is to critically assess which types and how much data collection is needed to strengthen the analysis. Researchers using a case study strategy often use several sources of data (Saunders et al., 2016).

2.4 Data collection

In both qualitative and quantitative research methods, there are two types of data: primary data and secondary data. Equal to determining a suitable research strategy, the type of data that we chose also depends on the research question. It depends on what data is needed in order to support arguments and determine findings contributing to answering the research question. Interviews, observations, and surveys are typical primary data sources (Saunders et al., 2016). Data that has been collected in the past by others and for other reasons, is secondary data.

Both types of data are beneficial in its own sense. Primary data can be very valuable, as it provides entirely new insights that nobody has collected previously, but it also takes a lot of time to collect it. Secondary data on the other hand, is much less time consuming, but it is completely crucial to validate such sources, as they can disprove the entire research if they are found invalid (Saunders et al., 2016). We have utilized both primary and secondary data in our research, as we found both data types to be contributing to what we wanted to investigate in Watty and the energy industry and ensure validity through *triangulation*, which will be discussed in section 2.6.

2.4.1 Primary data

In order to gain a deep understanding of our topic, we decided early on that the best approach would be to conduct interviews as our primary data source. A research interview in general, is a conversation between individuals that has a certain structure and purpose. The information that is revealed throughout the interview contributes to the researcher's goal of answering the research question (Saunders et al., 2016). Interviews vary by the way in which the interview is structured and standardised. According to Andersen (2010), the degree of structure depends on the context and indicates to what extent the topics for the interview are established in advance. There are three interview categories that are mostly recognized: highly structured, semi-structured, and unstructured (Saunders et al., 2016). The latter is mostly utilized for early explorative studies where the researchers have no or very limited knowledge about the subject. Highly structured interviews are mostly used in qualitative research. Semi-structured interviews are a mix of these two and are often perceived as having a fine balance between structure and flexibility that highly contributes to especially qualitative research (Saunders et al., 2016).

2.4.1.1 Semi-structured interviews

We decided to conduct semi-structured interviews, as we believe this interview design would contribute mostly to our research. We utilized semi-structure interviews to help provide context towards our theoretical considerations. Flick (2014) explains that semi-structured interviews are widely used today primarily because it allows the interviewee to communicate viewpoints more openly compared to other interview designs. Hence, unanticipated information that otherwise wouldn't have been revealed, can add valuable insights to the research. In our research we found it applicable to utilize this type of primary data as it corresponds well with our abductive research approach. The open conversation allowed us to explore the "what", "how" and "why" questions as previously mentioned.

We prepared some questions and main themes prior to the interviews. Although this calls for a certain structure, we were open to any deviation in case the interviewee encouraged us to do so, as this potentially could be relevant to our research. Our prior knowledge from studies and secondary data collection prepared us to quickly adjust our questions if we moved away from the topic. Furthermore, our semi-structured interviews allowed us to keep our theoretical considerations in mind and allow us to follow-up quickly with any relevant questions if needed. We kept in mind that in order for the interview to be semi-structured we had to provide the interviewee with an adequate number of guidelines and information to keep on topic, but also allow for enough freedom so that the interviewee did not feel constricted (Saunders et al., 2016). Relevant information about the interviews and interviewees are illustrated in table 1.

Interviewee	Job position	Type of interview	Location	Date
Gustav Gårdbro	Business Development Manager, Watty	Semi-structured interview	Skype	18/01/2018
Hjalmar Nilsonne	CEO. Watty	Semi-structured interview	Stockholm, Sweden	02/02/2018
Arvid Mårtensson	Commercial Operations Officer, Watty	Semi-structured interview.	Stockholm, Sweden	02/02/2018
Oskar Lilja	Machine-learning Engineer, Watty	Semi-structured interview	Stockholm, Sweden	02/02/2018
Maral Kalajian	Marketing Manager, Watty	Semi-structured interview	Stockholm, Sweden	02/02/2018
Yayun Feng	Software Engineer, Watty	Semi-structured interview	Stockholm, Sweden	02/02/2018
Peter Suhr	Senior Managing Partner, Gartner	Semi-structured interview; Expert Interview	Copenhagen, Denmark	19/02/2018
Konstantin Hopf	Senior Analyst and PhD candidate, Information Systems and Energy Efficient Systems, University of Bamberg, Germany	Semi-structured interview; Expert Interview	Copenhagen, Denmark	22/03/2018
Gustav Gårdbro	Business Development Manager, Watty	Semi-structured interview	Skype (follow up interview)	23/04/2018

Table 1 - Interview Information

Table 1 shows that we have interviewed six different Watty employees with diverse competencies and roles in the company. All employees presented with in-depth knowledge of Watty, but also the industry and new technologies. Especially our main contact, the Business Development Manager showed an impressive knowledge base within both Watty and the energy industry due to his background as an engineer and having previously worked for one of Europe's leading energy companies, Vattenfall. His extensive knowledge provided valuable insights and helped ensure validity of our findings through follow-up interviews. We discuss our data validity later in section 2.6. In his book "An Introduction to Qualitative Research", Flick (2014) presents some of the various semi-structured interview forms that have appeared in research up until now. In the next paragraph we will describe the specific form of semi-structured interview that we conducted in our research, namely the *expert interview.*

2.4.1.2 The expert interviews

In total we conducted two expert interviews throughout our research. We characterized them as experts mainly because they all "...have technical process oriented and interpretive knowledge referring to their specific professional sphere of activity" (Flick, 2014: 166). An expert interview differentiates in the way the researchers perceive the interviewee when conducting the interview and collecting relevant data. According to Flick (2014), the interviewees are "[...] integrated into the study not as a single case but as representing a group" (Flick, 2014: 165).

There are several reasons why expert interviews are included in research. The main reason why we chose to conduct expert interviews was because we wanted insights from the energy industry and factors relating to the influential environmental dimensions. With these insights, we could supplement and contrast against the secondary data and insights gathered from the interviews with Watty employees, which we were convinced would contribute to answering our research question and align with our abductive approach. According to Bogner and Menz (2002), one type of expert interview, the systematizing expert interview, "...can be used to collect context information complementing insights coming from applying other methods (e.g., interviews with patients)" (Bogner & Menz, 2002 in Flick, 2014: 166).

Although expert interviews can provide great insights, there are limitations as with any other method. It is often utilized as a complementary instrument to other data. The reason for this is first of all because the knowledge can sometimes become too specific for the research purpose, and because experts often have limited time and this time pressure can limit the output (Flick, 2014). When we conducted the expert interviews, we ensured a knowledgeable foundation from our secondary data, so we could focus our attention on the most important aspects. We wanted the expert interviewees to maintain an objective view when discussing the industry in relation to our research. However, we were also aware that most of our experts have agendas based on their work, and we have therefore done multiple expert interviews to best validate their output. This is also why we only briefly introduced our topic and focus in the beginning of the conversation. Furthermore, in order to reduce the risk of generating any leading questions or bias, we didn't introduce Watty until later in the interview in order to get an objective opinion on their position and capabilities in the market.

2.4.1.3 Other sources

Furthermore, we received several internal documents in the form of power points about Watty´s perspectives on their current and future positioning, as well as data about the energy industry (Internal Watty document, USB Flash Drive). We found these documents to be very contributory as we could compare these to what we found in our own collection of secondary data. Also, we received other internal documentation such as screenshots of the IT infrastructure and API's (Figure 7; Appendix 6). As previously mentioned, one type of primary data sources is observations. According to Watson (2011), it is not possible to entirely understand what happens and how things work inside companies unless the researchers observe or participate (Watson 2011 in Saunders et al., 2016). When we went to Stockholm and spent a whole day at the Watty office we made several observations through informal conversations which supported our data collection from our semi-structured interviews (Delamont, 2007 in Saunders et al., 2016). We have documented these observations in a brief report (Field notes, Appendix 1). Overall, we observed an agile culture with a positive and ambitious approach towards the company and the changes it undergoes as a start-up.

2.4.2 Secondary data

According to Flick (2014), "Like other approaches in qualitative research, you can use documents and their analysis as a complementary strategy to other methods, like interviews or ethnography" (Flick, 2014: 255). In the beginning of our research process we collected an extensive amount of secondary data. We delved into various reports made by acknowledged companies, whom have done extensive research within the energy industry. Accenture, IBM, Oracle, Deloitte, KPMG, Capgemini Consulting, BCG, Gartner and McKinsey&Company, are a selection of the company reports used. Overall, these reports touched upon how the energy industry is changing. These were primarily used to establish an overview and understanding of the energy industry, which would strengthen our approach when we conducted the interviews. Due to the fact that someone in an organization had produced the report for some specific purpose and intention, "...documents are not just a simple representation of facts or reality" (Flick, 2014: 257).

While considering reliability, validity, representativeness, and meaning (Flick, 2014), we kept an open mind and focused on learning as much as possible about the industry and the diverse aspects within it. We also read press releases about Watty, and the 54 newspaper articles where Watty either has been mentioned or been the article topic. As a start-up working in a rapidly changing environment, it was interesting to discover different statements from especially the CEO throughout the years and compare it to what he revealed in the interview with us.

As previously mentioned, the primary data that we have collected was gathered for a particular reason; to help us answer our research question and provide context for the industry that Watty is positioned in. The considerable difference with primary and secondary data is that secondary data "...will have been collected for a specific purpose that differs from your research question(s) or objectives" (Densome, 2007, in Saunders et al., 2016: 319). It is also argued that some of the most common pitfalls when students use secondary data, is the lack of questioning (Wolf 2007, in Saunders et al., 2016). Being cautious and critical while assessing the data was therefore essential for our analysis and conclusions.

2.5 Data Analysis

Once we had collected a large portion of our data, we began our analysis in order to relate thematic concepts and important viewpoints towards the strategic framework by Suarez and Lanzolla (2007). In order to best structure our data analysis process, we utilized a proposed framework presented by Mariette Bengtsson (2016). She presents a four-step process when dealing with either a *Manifest analysis* or *Latent analysis* as part of the content analysis method. Even though we focused on a case study, we still believed that her approach towards breaking down the data and re-contextualizing it in order to present a thematic perspective was relevant towards our abductive approach.

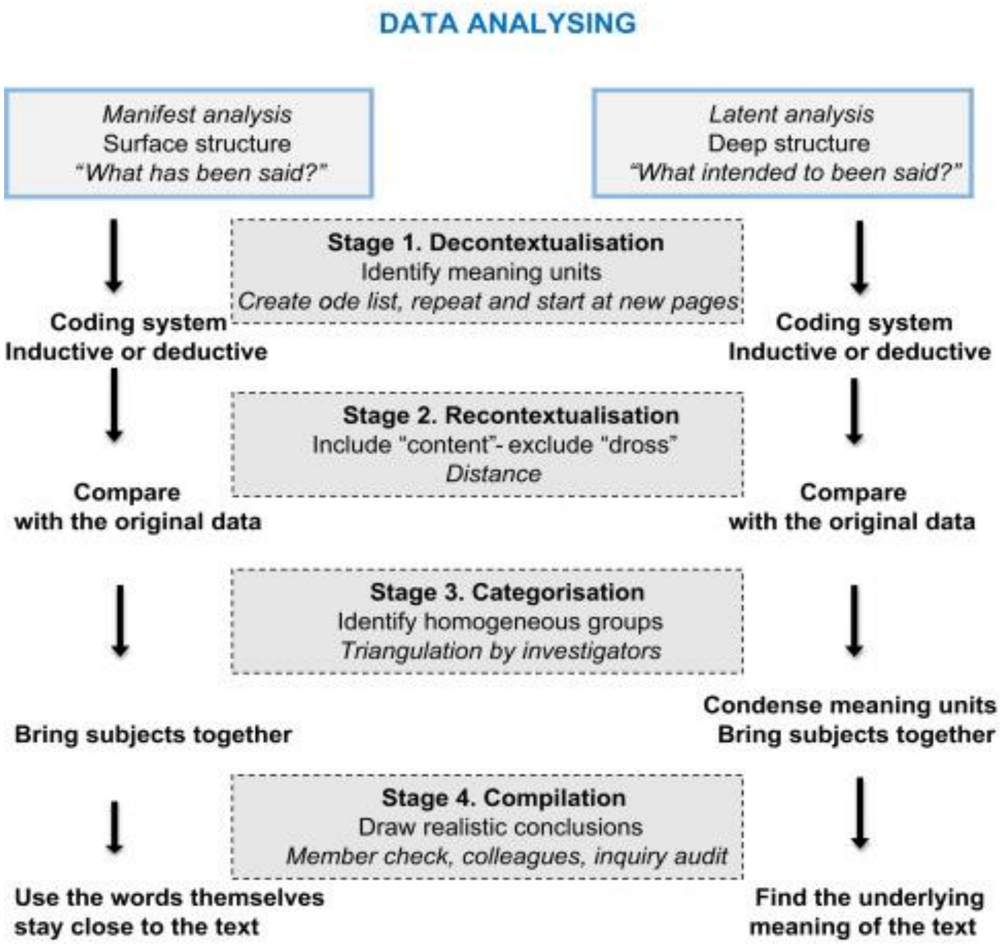


Figure 9 - Data Analysis Framework (Bengtsson, 2016)

Her framework, as seen in figure 9, was used as a guiding structure towards our data analysis process. During our data analysis process, we applied a thematic analysis approach to let the data drive us towards the strategic framework by Suarez and Lanzolla (2007) to better adapt the framework towards the context of new IT capabilities and energy industry. During these following sections, we will explain how we chose to analyse our collected data, and which considerations we made before and during the process, whilst loosely following the above-mentioned framework.

In order to best process our various data points, such as interviews and industry reports, we chose to use various software to help us structure, transcribe and code our qualitative data. The different software was chosen based on the assumption presented by Flick (2014) that, Qualitative Data Analysis (QDA) software can improve three aspects of the research process. The first two aspects are based on being able to improve the quality of qualitative research due to its consistency and to improve the research speed due to better organization of research through the QDA software. The last assumption that Flick mentions is that using QDA will enable better transparency of the research process through better consolidation (Flick, 2014). Our own choice for using varying software was, as Flick (2014) mentions, to help speed up the research process and hopefully also increase our qualitative research. In addition to using QDA software, we also utilized transcription software called Descript, to more efficiently transcribe our interviews, which was a necessity if we were to use the QDA software properly.

In the next sections, we will also present how we proceeded with coding our data based on our abductive approach as part of the de-contextualization process. Overall, the following paragraphs will present our data analysis process in more detail and the tools we used. Lastly, we will present our thematic output based on our coded data, which we re-contextualized and categorized for easier compilation. As per the framework seen in figure 9, we were able to present key findings from the collected data and apply these towards our adapted conceptual framework.

2.5.1 NVivo

As mentioned earlier, we choose to use a qualitative data analytic (QDA) software in order to better structure our data to better distinguish patterns and key concepts during the analysis process. For this task, we choose to use NVivo to help us improve our research process. NVivo is able to visualize and sort our data in ways that conventional software systems aren't able to. Furthermore, Nvivo enabled us to conduct a more comprehensive coding of our collected data and helped us discover any potential patterns with our data (Flick, 2014), giving us an opportunity to make various subcategories during our coding. Furthermore, NVivo also supports in-vivo coding which allowed us to use the transcribed text as code categories. We will explain more about our coding process later on. Due to its set-up, NVivo provides a clear overview of ones collected data and can easily generate an aggregated view of different code categories, as seen in appendix 2. This visualization enabled us to constantly have an overview and clear picture of our collected data.

2.5.2 Descript and Transcription

In order to fully utilize the capabilities of NVivo, we needed, as mentioned, to transcribe all of our interviews in Descript and import them as text files into the NVivo software. However, the process of transcribing interviews is noted to be very time consuming, where 1 hour of interview can approximately take a touch-typist between 6-10 hours to transcribe (Saunders et al., 2016). In order to reduce the time needed for transcription, we used a transcription software called Descript. The specific software uses speech recognition developed by Google Speech in order to automatically convert large media files into text (Descript.com, 2018). However, even with automatic transcription, we still needed to spend a substantial time cleaning each transcribed interview in order to showcase the nuances and different speakers during the interview. Furthermore, we also had to correct any words that the Google Speech software was not able to correctly translate. Even though we still spent a lot of time transcribing our interviews, we feel that the benefits of having our interviews as text and not only in audio outweighed the time spent.

During our transcription process we developed two different approaches when cleaning our transcribed interviews. Most of our interviews were transcribed in a way that eliminated many of the small speech annotations and overlaps when talking. This allowed us to best present a coherent view of the subject without any interruptions in the text. However, for two of our interviews, namely our interviews with the engineers, we chose to adhere to a stricter transcription protocol, as these interviews dealt with more detailed information. Therefore, we chose to transcribe these interviews in as much detail as possible, including annotations and cross talking.

2.5.3 Coding

The interpretation of data is the fundamental point for deciding which data that should be included in the analysis (Flick, 2014: Table 27). According to Flick, coding means developing relations between categories and properties (Flick, 2014: 435). In our coding process we kept the relational aspect as a main focus, as we believed these relations could better help us adapt our findings towards our conceptual framework and hence help us to discover the most interesting aspects in our research.

As mentioned above, one of the reasons why we utilized NVivo was because we wanted to be able to delve comprehensively into our collected data, and let our insights help us focus our attention on the purpose of our research and research question. There are several strategies for how to best utilize software in qualitative research. However, Flick explains that users of CAQDAS[1] programs "...should develop your own strategy against the background for the aims and research question as well as the sorts of data and resources in the project" (Flick, 2014: 368). The goal with our coding was mainly to de-contextualize and fully understand our data, through data-driven self-made categories and put these into an order that would best represent our findings towards our conceptual framework (Bengtsson, 2016).

[1] Computer Assisted Qualitative Data AnalysiS

Figure 10 - NVivo Word Cloud

After exporting the transcribed interviews from Descript, and importing it into NVivo, our first step was to conduct *in-vivo coding*. This is presented by Flick (2014) as using the data to create categories based on terms used in the interviews. We went through all our interviews and coded whenever we discovered relevance towards our research topic and conceptual framework. By using in-vivo coding we allowed ourselves to maintain a data-driven and abductive approach towards our data and keep our conceptual framework in mind. Afterwards, to ensure more specificity and coherence between our codes, we created our own code categories based on words and concepts that we discovered appeared frequently in our initial coding process. We visualized this through a word cloud generated in NVivo and chose the words we found to be most relevant as our category titles (Figure 10). This way, we advanced to a structured coding approach, as we believed this was more contributing to our coding process, as aligned with our pragmatic research philosophy. An example of codes can be seen in table 2.

Who	Quote	In-vivo code	Self-made codes
Business Development Manager	*And right now they [ref. potential partners as solar energy providers] don't have the **smartness** and the **necessary information** to make those decisions really. So, there we definitely is an interesting complement to the product.*	Smartness; necessary information	Technical Capabilities; Competitive Advantage; Future Aspirations
CEO	***IT has revolutionized** like every other industry in the past decade. Here we have a problem that we can solve with information technology. We don't have to invent the new battery or anything's just **getting the data** basically **connected** in the right way so that was basically really the starting point of the company.*	IT Revolutionizing; Data collection; Connectivity	Connectivity; Competitive Advantage
Marketing Manager	*You have this amazing powerful tool through the algorithm and its **data capabilities** that is pretty impressive for such a small company. And **providing some insights** for people that again, up until now have had no idea what's been going on in their homes. So we see that as pretty interesting, and how we able to work with them.*	Data capabilities; Insights;	Information Provider; Competitive Advantage; User needs
Senior Analyst and PhD candidate	*Um, my impression is rather that they [ref. energy companies] don't actually have no idea what to do with that data, even with smart meter data. It is so the data is still kept in that grid operation department and they **don't have actually ideas how to use that data** in further, um department.*	Lacking data knowledge;	Industry; Challenges
Software Engineer	*So, but from the like, **algorithm** wise, we can also **improve it with higher frequency** like, it when they have, when we have better cloud basically in the industry. We are **limited by the computing powers***	Algorithm; Improve at higher frequency; Limited by computing power	Technical Capabilities; Future Aspirations
Software Engineer	*That's, just like why Google is doing so good in translation because it gets lots of requests from other people. So, in this market we have **the best***	Best Data; Must-have skill	Competitive Advantage;

	***data** I would say. So, like that's, like **the number one requirement** by doing this kind of thing.*		Technical Capabilities
Machine-learning Engineer	*So, if we have discovered **re-occurring event** in your home and that we cannot classify by with our, with our like, **appliance-specific predictors**. We will say: "Okay, now we've seen that this happened four times in your home, do you know what it is? Can you label it?" And then you say: "Oh, it's my kettle." And the next time you start your kettle, It will show up in the **app**.*	Re-occurring data; Appliance-specific predictors; App	Technical Capabilities

Table 2 - Coding Examples

2.6 Research Quality

As part of any research, one must always consider if the research being done can endure scrutiny. Within the different epistemological views, their approach towards ensuring a high degree of research quality is divided. Typically, quantitative research papers will use a clear reliability and validity approach called Scientific canons of inquiry (Saunders et al., 2016). However, we believe that our pragmatic approach allows us to use the concepts of reliability and validity, in the form of triangulation, to best ensure a high research quality.

To ensure a high quality throughout our research, we have been aware of the common pitfalls when doing academic research. Saunders et al. (2016) present four areas where researchers need to be vigilant in order to not minimize the quality of one's research regarding reliability: participant error, participant bias, researcher error and researcher bias. They further claim that when doing any research, researchers must be vigilant in their methodology in order to avoid threatening the subsequent findings and minimizing any reliability (Saunders et al., 2016). In order to best mitigate the threats towards our reliability, we aimed to conduct our interviews in private and closed off areas and at appropriate times during the day. This was in order to minimize the potential participant error, which can be caused by affecting a participant’s behaviour due to time pressure, hunger or similar effects. By conducting our interviews in private areas, we aimed to reduce any participant bias that could occur, as our interviewees wouldn’t feel pressured to induce a false response in order to appease their colleagues.

In order to best mitigate the threat of researcher error and researcher bias, we were vigilant in planning and preparing for each interview we have conducted to best understand the subtleties we might have come across. However, we are aware that one of our interviews may be subject to some researcher error, as we were only given 15 minutes to prepare. Despite this, we believe that due to the interviews conducted earlier and our preparation towards these, we were able to still maintain a high reliability. Additionally, we aimed in all of our interviews to be as objective as possible when asking any questions and interpreting answers. As presented by Saunders et al. (2016), addressing these threats as best possible helps ensure that our research will not contain any “logic leaps and false assumptions” (Saunders et al., 2016: 203), and allow other researcher to replicate our work if needed.

Good quality research is not only achieved through high reliability, but with a strong validity as well. Yet, validity is usually measured when dealing with a quantitative research paper, typically within a positivist view. However, Saunders et al. (2016) present *triangulation as* another way of ensuring validity when dealing with a qualitative research paper. Triangulation enables researchers to confirm or validate their research by using multiple data sources and data collection. The purpose of using multiple data sources is to ensure a depth and complexity towards the research. It also helps ensure that researchers truly understand what it is the data is trying to tell them (Saunders et al., 2016). Even though we have mainly used interviews as a primary data source, we believe that our expert interviews and secondary data provide a sufficient validity towards our main interviews conducted within Watty. Furthermore, we also conducted follow-up interviews to ensure participant validation of our ongoing research.

2.7 Limitations

During our research process we were presented with various limitations that have impaired our ability to collect data, impacted the quality of the data or reduced the amount of data available. Due to the location of Watty’s office in Stockholm, Sweden and our location in Copenhagen, we were somewhat restricted in visiting Watty multiple times due to financial reasons. The cost of travel limited our visit to only one, where we therefore attempted to do as many interviews as possible. Hence, we also conducted interviews over Skype with our contact person, the Business Development Manager. Due to technological difficulties we do not have a recording of this interview, but extensive notes can be found in appendix 3. In fact, this also happened in our follow-up interview over Skype, with lacking signal and recording failure within the last 15 minutes of the interview. However, the content for the last minutes were mostly formalities.

Another limitation, which is most likely present in any private company, is the restriction to some data or people. The same goes for Watty. Even though we had been granted a lot of access, we were still restricted in some areas. As mentioned we only visited Watty once for interviews and had presented a list of interviews we wanted to conduct. However, we were restricted in speaking to some employees due to time and availability. This may have led to some loss of data, that we could have found useful. Our contact person within Watty did try to accommodate us as much as possible and provided us access to many internal documents in an effort to reduce any data loss that we missed out on from not interviewing certain people.

In addition, another limitation we found was a language barrier during our interviews. None of our interviewees had English as a first language and as such some of the interviews were affected by heavy accents. This provided difficulty in understanding and transcribing interviews. Furthermore, the limited language capabilities also generated some restrictions in the vocabulary during the interview, which again could have provided false meaning or a superficial explanation of a concept. This led us to be a bit more interpretive and vigilant when transcribing our interviews. However, all interviews were still performed with successful outcomes.

2.8 Delimitations

During our research process we needed to set some boundaries to various aspects of our research and data collection process. This is done in an effort to best scope our research. In order to scope down our research, we chose only to focus on Watty’s market position and the energy industry in Northern Europe. This decision was also made based on time and travel considerations during our research process.

Chapter 3

Theoretical Background

The purpose of presenting a theoretical background is to explore and understand a part of the literature within the field which relates to our research. As we were to investigate an IoT start-up company which collects great amounts of very specific data, we found it relevant to specifically look into the worlds of The Internet of Things and Big Data. Furthermore, we also wanted to create a substantial understanding of the mechanism that have an impact on the company of our case study. Our theoretical background will help us conceptualize the concepts of IoT and Big Data towards the strategic framework by Suarez and Lanzolla (2007), which will be described in more detail in chapter 4. In the coming paragraphs we will explain how we collected and reviewed the literature. Past and current perspectives from diverse literature on these phenomena contributed to our overall understanding and made us capable of assessing it and better comprehend its relation to our research.

3.1 Structuring the Literature Research

As the overall purpose of investigation literature within a specific field is to provide a foundation for how our research would contribute to this field, it was necessary for us to consider what elements we should be aware of throughout this process. We concluded that some of the concepts from a *systematic review* would be appropriate to follow in regard to our research question and aim, as we wanted to comprehend what currently is known in the field. With aspects from a *systematic review* we found inspiration to locate, analyse, synthesize and assess the literature in a structured way and ensure a proper data collection process throughout (Saunders et al., 2016).

We wanted to know how we could best be critical whilst reading and analysing the literature. Therefore, we kept in mind the five critical questions proposed by Wallace and Wray (2010), including “What is the writer saying that is relevant for what I want to find out?” (Wallace & Wray, 2010 in Saunders et al., 2016: 76). In order to identify which areas that would be appropriate for us to search, we constructed relevance trees. According to Sharp et al. (2002), such trees help to structure and guide the literature search process (Sharp et al., 2002 in Saunders et al., 2016). We started off with broad brainstorming from our research question, which resulted in a relevance tree. After this, we rearranged and redefined some of the terms and phrases that we had generated. This resulted in a second tree. We used a selected amount of these *terms* and *phrases* in our searches. Both relevance trees were generated in the online mind mapping software “MindMeister”, and these can be found in appendix 4. We also defined some parameters to our searches; language of publication (English), subject area (Business management, Energy etc.), document type (journals and books) and a wide range of keywords.

We utilized Elsevier´s Scopus, which is the largest abstract and citation database of peer-reviewed literature. Scopus made it easy to include other parameters and this enabled us to scope down the results. We decided that the Scopus results had our terms and phrases in either the title, abstract, or as keywords. When we explored the diverse abstracts, we also considered "related documents" that appeared in Scopus besides the respective abstract. Throughout the process of finding relevant literature, we also revisited literature we had covered in various courses throughout our graduate degree. The articles we included in our literature list fulfilled the same criteria as the new research.

3.1.1 Delimitations

Our literature review comprises of documents from between 1997 and 2018. As research in the era of Datafication, Internet of Things and Big Data develops rapidly, some of the perceptions may have the risk of being outdated. More particularly, the researchers could have switched arguments, and expressed new perceptions. As presented by numerous scholars, the evolution of information technology is rapid with many changes in the last 20 years. With this in mind, we wanted to explore the diverse perceptions that have flourished within this field over the past decade, as it would better promote and illustrate contradicting views.

Within our literature review on Big Data, we wanted to understand the phenomenon in broad terms, as we believed this would best facilitate our analysis and discussion. When assessing the literature on the topic, aspects of Big Data were almost always brought up to some degree. At the same time, we were intrigued by the 3V´s of Big Data, *volume*, *variety* and *velocity*, and the numerous suggestions of additional V´s, *value* and *veracity*. It was contributory to our awareness of the diverse aspects, but also the opportunities and challenges each of them represents. We found it best, based on our initial literature scoping to limit us to the 5 V's, as these aspects were often mentioned in relation to the business values, opportunities and challenges of Big Data. Other concepts have been developed in relation to Big Data, but we wanted to focus our attention on a broader aspect towards a business setting. Although the literature we found touched upon these aspects of Big Data, it should be mentioned that this was not necessarily the main focus of the research.

3.2 Big Data

The large amounts of data that our world comprises of, has been discussed for a long time. Seventy years ago, researchers first introduced data's expanding growth rate. Since then, researchers have investigated the development, challenges, opportunities and other perspectives on the great amounts of data and information. This is not surprising, as our world becomes more connected and every virtual activity creates digital traces. More specifically, researchers have delved into numerous topics about data, which has given rise to the well-known phenomenon "Big Data".

Michael Cox and David Ellsworth are recognized as the first people to introduce the *term* Big Data when discussing the storage problems of Big Data, and how it can be tackled by acquiring more resources (Cox & Ellsworth, 1997). Later on, in 2001, Dough Laney published a research defining three dimensions of Big Data: volume, variety, and velocity, which have been commonly accepted as the "3Vs" of Big Data. He argues that Big Data can be perceived as large *volumes* of broadly *varied* data that are created, stored, and analysed at high *velocity* (Laney, 2001). Numerous researchers have supplemented these original V's with more dimensions. For instance, *veracity* and *value* have now been added which has led to the acknowledged "5V's of Big Data (Bello-Orgaz, Jung, & Camacho, 2016; Koseleva & Ropaite, 2017). Xie et al. (2016) and other researchers argue that the first three dimensions (volume, velocity, variety) represent many challenges for data analysis in and of itself, whereas *veracity* and *value* provide the potential value that companies can utilize for better decision-making.

Due to the broad range of the phenomena, this review mainly examines researcher's perspectives about how data introduces new business opportunities and challenges, and its strategic position. We also examine the most accepted perspectives on Big Data up until now. Although there are several perspectives on how many "V´s" there are, we have decided to focus on the 5 V's mentioned earlier in the literature review. These are very briefly explained here; *variety* refers to the different types of data, *volume* concerns the vast amounts of data, *velocity* refers to the flow and speed in which data is generated, and *veracity* concerns data trustworthiness. Lastly, *value* applies to the data and how it contributes in some way, and therefore becomes valuable.

3.2.1 Variety of data

In his book "Data Driven: Profiting from Your Most Important Business Asset" Redman states that "More data, in greater *variety* and detail, means that there are more data to mine, more ways to informationalize, and more angles from which to view a problem" (Redman, 2008: 13). Redman also claims that the good decision makers in companies are the ones that are able to cultivate a wide variety of trusted sources (Redman, 2008). According to Xie et al., such abilities represent a type of "dynamic capability" that enables companies to quickly adapt (Xie et al., 2016). Redman argues that it increases insights into competitor's plans and innovative ideas, which have a great impact on important decisions that aim at driving the company forward (Redman, 2008). In fact, Xie et al. (2016) claim that it has now become a fundamental requirement to uncover and analyse potential advantageous data from several connected sources.

Alternatively, Perrons and Jensen (2015) argue that the aspiration for better decision-making has been around for a long time, so the real change is related to the mechanisms in which data is being managed and decisions made. Many companies and industries have seen the value of using new advanced analytical techniques to analyse the variety of data from diverse connected sources (Perrons & Jensen, 2015). In their study, Hopf et al. (2016) present how the utility industries are able to provide higher efficiency and subsequent decision-making through a combination of a variety of data sources and machine-learning algorithms, however still lack the ability to disaggregate the data in more detail. According to Davenport et al. (2012) it can be very challenging to deal with a variety of data. Davenport et al. (2012) further claim that it is particularly important to be aware of this when managing real-time data monitoring as it requires a more continuous and quick approach towards data handling than previously thought. In the energy industry for instance, this can be extra demanding as there is a high degree of *variety* in energy Big Data (Koseleva & Ropaite, 2017). According to Koseleva and Ropaite (2017), there is a mix between energy consumption data, smart energy management platforms and third-party aggregators. There is also e-mail or SMS notifications and customer interaction data. These combinations can create a considerable increase in the complexity of energy Big Data services (Koseleva & Ropaite, 2017).

When looking at the variety in data sources, Davenport (2014) also argues how this combination of various data can be deemed valuable for organizations as it can provide new potential insights towards a competitive advantage. Ghasemkhani et al. (2014) explain how the increased variety provide the potential for added value, however that increased difficulty in sorting has challenged companies in maintaining an advantage. The variety of data is further reiterated by Constantiou and Kallinikos (2015) who challenge the common beliefs surrounding Big Data as a homogenous source for change in strategy making. Instead, they agree with Anderson (2008) that Big Data is more heterogeneous, trivial and disorganized. Constantiou and Kallinikos (2015) point out the importance of structuring the different types of data. They explain how in most circumstances Big Data is comprised of large heterogeneous user data, collected directly from user input such as social media, or indirectly through connected sensors and smart meters, as seen in the energy industry (Zhou, Fu, & Yang, 2016).

Constantiou and Kallinikos (2015) further claim how a traditional view on Big Data with clean classification and a tendency towards aggregation and generalizability, becomes more difficult with larger heterogeneous data sets.

3.2.2 Volumes of data

Although Redman (2008) claims that the more variety in data, the better, he also points out that more data does not indicate more useful data. He also highlights the increasing demands required when using more resources to locate useful data. In short, the more data a company collects, the more resources are often required to manage that data. Chen et al. (2012) further argue that Big Data involves data sets that are so complex and large that they fundamentally require advanced data storage, management, analysis, and visualization tools. This has become an increasing demanding task for many companies to handle as our world becomes more connected and data can be found anywhere. For example, in the energy sector, the deployment of smart meters creates vast volumes of energy consumption data, especially with the new smart meters, which collect data every 15 minutes (Koseleva & Ropaite, 2017). Koseleva and Ropaite (2017) and Gandomi and Haider (2015) claim that such large amounts of data pose a great storage problem, but also challenges the analytical processes that the utilities need to apply in order to understand the data (Gandomi & Haider, 2015; Koseleva & Ropaite, 2017).

To tackle this, Chen et al (2012) argue that it is beneficial to focus resources on the data that is proved to be useful. Redman further states, “I find that it is often easier, although somewhat less effective, to determine which data are never used for anything and stop collecting them” (Redman, 2008: 13). Redman (2008) advocates for “sorting on the way in”, a term coined by Weinberger (2008) that indicates classifying data beforehand. Constantiou and Kallinikos (2015) argue toward the benefits of Weinberger’s (2008) other term, “sort on the way out”, which is classifying the data after it has been processed. As their names suggest, both terms present two different options towards sorting large amounts of data. However, both have benefits and drawbacks associated with them. Where the first approach is often quicker, there is typically a loss of specificity. Meanwhile, the other approach maybe more time consuming, it does enable a more diverse classification (Weinberger, 2008).

Redman´s (2008) statement about determining which data is useful seems practical in some cases, but Mazzei and Noble (2017) argue that companies need to re-examine their prior assumptions towards data as they don’t always know particularly *what* is useful. In this regard, Mazzei and Noble (2017) state that companies should not have a strategy dictating which data they should use, as it is often based on data that has proven valuable in the past. Such initiatives are aimed at creating a unique competitive advantage, as such insights have proven to be an absolute game changer for companies in the past. However, Lambrecht and Tucker (2016) argue that even though data is more available than ever before due to increased connectivity between devices, the large amounts data in itself are not necessarily valuable and can't provide new insights without the proper skills, organizational competencies and strategy in place. Perrons and Jensen (2015) state that it is demanding and requires a lot of resources, as new insights found through advanced analytical techniques, do not appear relevant at first glance. This further illustrates the major obstacles companies, including utility companies, are facing. Perrons and Jensen (2015) also support the arguments, that leading companies which utilize Big Data, do not only focus on known relationships. Instead they continuously focus on discovering new data relationships and patterns that have previously been *unknown* through large data sets.

3.2.3 Flow and speed of data

Research has not only highlighted the increasing amounts of data but also the increasing speed in which data is generated and in reference to this *"doubling time"* has been a key point of discussion. The *doubling time* refers to the data and information collected on a global scale being doubled every two years (Cai & Zhu, 2015). Cai and Zhu (2015) state how the information doubling time has become shorter since the end of the industrial age. Originally, the information collected on a global scale only doubled every 10 years. However, nowadays it doubles every two years. In 2011 the total accumulated information totalled 1.8 ZB. Cai and Zhu (2015) explain that due to this massive amount of data, it takes time for data to be processed in due time and maintain relevance in certain situations. Sagiroglu and Sinanc (2013) further argue that due to the time sensitiveness of some data, it is paramount to have the ability to process data in real-time or risk having information become outdated and useless. Gandomi and Haider (2015) further reiterate that due to the increased *velocity* of data streams, traditional systems aren't able to process it instantaneously, which is why Big Data systems are needed.

Data *velocity* does not only refer to the speed but also the *flow* in which data is generated (Sagiroglu & Sinanc, 2013). Koseleva and Ropaite (2017) and Bello-Orgaz et al. (2015) highlight the need to efficiently manage storage and analysis of data in both real-time and with traditional static datasets as both approaches need different types of data handling and analysis. This goes especially for situations where there is a constant real-time data flow. Bello-Orgaz et al. (2015) state that with the quick production of new data, in either real-time or near real-time, more complex algorithms are required in order to process it. Constantiou and Kallinikos (2015) state the importance of updating or even replacing systems to deal with the rapid influx and changes in data. The practice of engaging in real-time responses is typically associated with social media data (Bello-Orgaz et al., 2016; Constantiou & Kallinikos, 2015; Gandomi & Haider, 2015). Koseleva and Ropaite (2017) also present the increased challenges of fast moving data in the energy industry, as smart meter data enables companies to collect data from every sub-second to as mentioned previously, every 15 minutes. These various data speeds, ranging from real-time to 15-minute batches, pressure energy companies to consider data *velocity* when dealing with energy data analysis and processing (Koseleva & Ropaite, 2017; Zhou et al., 2016).

3.2.4 Value of data

Although the speed and flow of data represent many interesting aspects and opportunities, there are many ways to perceive what *value* is really generated from Big Data and how it benefits organizations (Ghoshal, Larson, Subramanyam, & Shaw, 2014). Koseleva and Ropaite (2017) also focus on the significance of data and claim that data management has grown in importance. This is mostly due to the fact that having the skills to *manage* data and being able to extract *value* out of great amounts of data, is increasingly essential to decision-making. Ghoshal et al. (2014) argue that *value* depends on the organizations strategic goals for adopting and using Big Data (Ghoshal et al., 2014). Big Data is generally being accepted as an input that boosts innovative products, services, and business opportunities (Günther, Mehrizi, Huysman, & Feldberg, 2017). More specifically, it is perceived as a source of increased efficiency, minimizing of errors, improving customer relationships and assists decision making.

Redman (2008) points out that the core capability of today's data exchange through advanced connectivity, the "speed of light", offers an advantage that "No other asset offers the potential to align the organization on common tasks or to be built on multiple products and services" (Redman, 2008: 26). Redman (2008) also argues that the most significant things with data as a company asset, is its uniqueness in regard to other company's data. In contrast, Braganza et al. (2017) argue that data can never be unique or rare, as in most cases multiple companies will have access to the exact same data. However, they further state that data can achieve its value and uniqueness through the skills and strategy of companies (Braganza et al., 2017; Lambrecht & Tucker, 2016). Mata et al. (1995) explain how the ability to exploit the various skills and competencies of a company provide the true value for IT technologies. Hence, when Perrons and Jensen (2015) further state that, "...in the age of Big Data, potential value is lurking within *all* digital information, no matter how inconsequential and disconnected it might seem at the time it is collected" (Perrons & Jensen, 2015; 119). It is understood that data needs to be minded and analysed correctly before it can show its hidden potential value. Mazzei and Noble (2017) present a three-tier framework that indicates strategies in achieving value from data. They claim that companies utilize data in various *tiers of value creation* to best leverage their data capabilities.

Within their framework, Tier 1 typically deals with the traditional use of data in solving value chain problems more efficiently, which is common for most companies (Mazzei & Noble, 2017). However, they also mention that for most companies, Tier 2 and Tier 3 are only attainable where data is in the forefront of business and dictates corporate strategy and not just used as a tool (Mazzei & Noble, 2017). A more detailed overview of the three tiers can be seen in table 3. Mazzei and Noble (2017), explain that in order to develop a successful and sustainable Big Data strategy, alignment is needed between the organization's existing digital capabilities and the competitive landscape they operate within. Their study shows how firms use this three-tier framework to leverage Big Data efficiently, and how nearly 80% of firms fail to fully integrate their data (Mazzei & Noble, 2017).

Tier 1	Data as tool	Managers are able to solve traditional value chain problems more efficiently and effectively; existing capabilities are improved through real-time, customized decision making for individual consumers.
Tier 2	Data as an industry	Spin-offs and new ventures are created to specialize in acquisition, storage, and analysis of data, construction of infrastructure, and development of software devoted to handling big data.
Tier 3	Data as a strategy	Visionary leaders develop companies dedicated to building data resources to allow them to develop radically innovative business models that wed traditional and modern strategic thought.

Table 3 - Three tiers of value creation from Big Data (Mazzei & Noble, 2017)

Redman (2008) also argues this point, claiming that the hype about the Information Age lies in the possibility of creating entirely new *value*. This puts a lot of pressure on companies that have not originally been able to utilize data efficiently, as there are numerous challenges in doing exactly that, with possibilities to generate even more value, as for example seen in the Internet of Things landscape. The hyped perceptions around Big Data, can according to Günther et al. (2017) lead organizations to believe that they can extract more *value* than they are able to do in practice. Xie et al. also states that "Although Big Data is viewed as a new form of capital, many firms are unable to excavate its value effectively" (Xie et al., 2016: 1037). It is therefore often debated that more data does not necessarily mean more useful data (Redman, 2008).

Perrons and Jensen (2015) claim that there are fundamental differences in how companies regard the function of data. They claim that leaders in Big Data perceive data as a "...valuable asset in and of itself", whereas oil and gas companies for instance, regard data as information that only explains the state of an asset (Perrons & Jensen, 2015: 119). Lycett (2013) and Braganza et al (2017) argue that the way to achieve most benefits from data is by understanding the analysis in itself: to understand how to capture, represent and deliver the data. Koseleva and Ropaite (2017) also state that energy Big Data in particular, is meaningless unless it is explored or minded thoroughly. Through these abilities of translating and analysis of data, value can be extracted and subsequently enhance business (Lycett, 2013). This is also pointed out by Davenport, who states "Some companies have built their very business on their ability to collect, analyse, and act on data. Every company can learn from what these firms do" (Davenport, 2006: 1). One example of these companies are the IoT specific companies, who leverage the connectivity that this field represents, as seen with Watty.

3.2.5 Trustworthiness of data

It is impressive how some companies can be entirely built on the ability to act on data as the digital information present in the era of Big Data, is noisier, messy, raw, unstructured and dynamic compared to previously, where data sets were significantly more static and structured (Ouellette, 2013). This is due to the increased connectedness between devices and technology infrastructures. Constantiou and Kallinikos (2015) reiterate this point and argue how data has now become more heterogeneous in nature. Its complexity is also increased, and this makes it more difficult to gain optimal value from. Normandeu (2013) claims that strategies focusing on how data is processed, stored, and mined are essential to avoid `dirty data´ that flow into the systems. Günther et al. (2017) present a possible solution on how a centralized capability structure could handle unstructured and convoluted data. However, they also highlight the potentials risk of using a centralized structure, as this may impede the insights and value generated for the various business units. They might feel disconnected due to limited communication and involvement (Günther et al., 2017; Sharma, Mithas, & Kankanhalli, 2014). Hence a proposed hybrid solution between a centralized and decentralized structure has been presented in some cases (Sharma et al., 2014).

Ouellette (2013) also states that there has been much focus on acquiring techniques to get structured data out of unstructured data, for example utilizing machine-learning algorithms. Redman also argues that the *new types* of data and information demand infrastructure technologies to detect, store, process, and transmit *new types* of data specifically when and where they are needed (Redman, 2008: 149). These initiatives do indeed illuminate the emerging need to deal with unstructured data, however Perrons and Jensen (2015) claim that the emerging phenomenon of Big Data presents much more tolerance towards data messiness and imprecision. Braganza et al. (2017) and Ghasemkhani et al. (2014) also claim that companies are in need of clear strategies and strong competencies to benefit from increased complexity in data sets. Within the IoT landscape, companies are forced to ensure clear strategies in how to deal with their data and its sources to ensure sustainable competitiveness.

3.3 The Internet of Things

The increasingly connected infrastructure of technologies produces large amounts of new data and challenges companies in how to best handle the increased complexity. The ability to exploit the real value of data is one of the fundamental aspects of the Internet of Things (IoT) puzzle. IoT has for the last couple of years become something almost everyone has heard about, with a multitude of definitions for the phenomenon constantly being offered. What IoT is today and what it will be in the future is still debated between academics as it is not commonly apparent. Although the phenomenon of IoT has become a buzzword today, it was coined first in 1998 by Kevin Ashton of Proctor & Gamble. It is perceived as a new paradigm that views all objects as connected, providing anyone with real-time data and global information access (Westerlund, Leminen, & Rajahonka, 2014: 5). Researchers have delved into the task of exploring the phenomenon and what it means for our society in countless dimensions. What many find important is IoT´s influence on the way we live our lives and is enabling a change of our status quo.

Connected devices can sense and relay great amounts of data from their surroundings, and these connections create new information’s and is also the foundation for the IoT. IoT is an aspect that details the connectivity achieved between the connectivity of daily life objects by using various sensors such as the RFID (Uckelmann et al., 2011). Thus, IoT seeks to join the physical and digital world by using sophisticated technology. The focus of the IoT is to ensure that the everyday devices are connected with each other regardless of the time or place to anyone and using any network, which signifies that it is the future of the internet (Magruk, 2015). By using data from the connectedness of IoT, various achievements have been made such as intelligent environments, smart homes and smart cities, which indicate the massive potential that IoT has.

3.3.1 Value drivers

Elgar Fleisch (2010) presents seven value applications for the IoT and explains them as such: “The first four drivers are dedicated to root causes based on machine-to-machine communication, whilst the latter three show root causes based on the integration of users” (Fleisch, 2010: 8). He developed these value drivers in an effort to understand the essence of IoT, and its value towards business and consumers (Fleisch, 2010). A more detailed definition of the seven value drivers in IoT can be seen in table 4.

No.	Value Driver	Business Value
1	Simplified Manual Proximity Trigger	Increases job satisfaction, empowers consumers by enabling consumer self-service and reduces labor costs
2	Automatic Proximity Trigger	Reduces labor costs, fraud related costs and process failure costs. Provides high granularity data for heightened efficiency.
3	Automatic Sensors Trigger	Enable local and prompt decision-making. Increase quality of processes and increase efficiency.
4	Automatic Product Security	Reduces the cost of process security and process failure due to fraud and increases consumer trust.
5	Simple and Direct User Feedback	Improves service effectiveness and efficiency through improving accuracy, flexibility and speed in processes.
6	Extensive User Feedback	New consumer contact and providing new services and advertising opportunities and service revenues.
7	Mind-changing Feedback	Enablement of new product features and new services and identification of trends.

Table 4 - Value Drivers in IoT (Fleisch, 2010)

In addition, Haller et al. (2009) draw on earlier work by Fleisch and identify two major paradigms from which business value be derived; business process composition and real-world visibility. Looking closer at a precursor of the seven IoT value drivers presented by Fleisch (2010), Haller et al. (2009) claim that “real-world visibility” enable sensors to better help companies understand what is happening through various technologies. With the introduction of IoT technologies such as RFID, automatic identification and data collection enables accurate and appropriately timed information towards various business functions (Uckelmann et al., 2011). Accurate and appropriately timed information can also provide an increased competitive advantage due to improved efficiency and process optimization and allow for more flexibility within a given system to better react towards dynamic changes (Karnouskos & Spiess, 2007).

The following research studies present how Fleisch’s (2010) value drivers can be identified in current and past research of IoT within the energy industry. Gottwalt et al. (2011) carried out a study where the principal aim of the simulation model analyses the *household behaviour* during various price periods. The objective was to come up with different residential load profiles on the historical data of energy usage. The researcher provided an algorithm, which was designed to provide the simulation of the residential load-shifting by time-of-use, utilizing the second value driver presented by Fleisch (2010). Furthermore, Conejo et al. (2010) carried out an additional study focusing on an optimization model whose critical function is to cut down energy usage to the least possible levels attributing towards several of the seven key value drivers presented by Fleisch (2010). The aim was to assess the minimum and maximum power load on an hourly basis.

Zipperer et al. (2013) also focuses on the probability of reducing the carbon footprint for the smart household. The argument is that the energy bills can be reduced mainly by increasing the energy efficiency in homes, for instance by using renewable energy. The study, therefore, focuses on the customer as the factor with the utilization of the seventh value driver (Fleisch, 2010) and also analyses the technology used to minimize energy use in the smart homes.

3.3.2 Smart cities and Data

Schaffers et al. (2011) argue that there has been comprehensive research on the aspect of using the connectivity enabled by the internet to design smart cities and smart homes. One of the aims for such a move has been the ability to leverage the seventh value driver; “Mind-changing Feedback” (Fleisch, 2010). New internet technologies such as networks powered by sensors, intelligent devices, RFID, the IoT and cloud networking to provide new services to the residents (Schaffers et al., 2011). The other aim has been assessing sustainability which is explored through the adoption of the green cities (Arshad, Zahoor, Shah, Wahid, & Yu, 2017). Therefore, there is a significant focus on an inclusive future where there is low energy usage, and there are fewer emissions of CO2 (Jensen, Gutierrez, & Pedersen, 2014). The main observation made by Jensen et al. (2014) is that the IoT is the main component of the current technologies that are being designed for the smart cities. Supporting this, Fleisch argues that the IoT is superior as it provides an active link between active sensors and RFID which enable a lot to be achieved regarding functionality, technology, and applications (Fleisch, 2010).

Gram-Hanssen and Darby (2018) explain that there is currently no specific definition of what a smart home is, but with the devices that seamlessly communicate with each other, the aim is to provide new services for people. Advanced energy management is one of these new services. Gram-Hanssen and Darby (2018) further state that one of the questions that is often mentioned in the literature on smart homes is to which extent smart homes can contribute to people's understanding and ability to manage energy consumption. This is also supported by Mayer and Guinard (2011), stating that IoT technologies can help users make better decisions about their energy consumption as they are provided with insightful data and information. However, it is essential to consider a user-centric approach when developing new solutions as it could affect adaptability (Uckelmann et al., 2011; Wilson, Hargreaves, & Hauxwell-Baldwin, 2015). This is also supported by Balta-Ozkan et al. (2013) who state that because one of the main purposes of smart home is to contribute to improved life quality, “[...] there is a need for a type of smart home system that is outwardly intuitive and easy to use” (Balta-Ozkan et al., 2013: 266). An important but challenging factor is to gain engagement from users in the development of smart solutions in the home. In this regard, *security* plays an essential role in the development and marketing of smart home technology (Gram-Hanssen & Darby, 2018). One example in regard to security mentioned by Darby and Pisica (2013) is how technology can detect active appliances while the householder are absent.

According to Holler et al. (2014), the internet features a wide array of data collected every second, but unfortunately the data is not always recorded and isn’t always converted to meaningful information either. The implication is that there needs to be better systems which can enhance the broad level of data quickly and turn it into more useful output. This challenge is also presented by Schaffers et al. (2011) who mention that in many cases, the current capabilities for developing smart homes and smart cities are challenged. The shortcomings listed in the study made by Marinov et al. (2017) present that the current data handling and storage capabilities cannot manage the IoT's requirement for its applications. The study asserts that the effectiveness of the IoT besides its connectivity, is the ability to capture data that has not been recorded in the past, act on it and increasingly extract value from it (Marinov et al., 2017).

According to Khajenasiri et al., (2017), the utilization of connected devices that simultaneously generate Big Data often increases the efficiency of various systems and monitor various functions in smart homes. Innovative and advanced technology is required to efficiently control the massive load of data generated from the numerous connected devices in smart cities, and in smart homes. This technology is typically unique from the usual software that is used to collect and manage the data (McKinsey, 2011). To accommodate the increased demands for smart homes and smart cities, more sophisticated algorithms and architectures are being designed each day to deal with increased complexity (Khajenasiri et al., 2017). Significant and complex data allows organizations to analyse various historical trends, make predictions and deduce potential behavioural patterns (Marinov et al., 2017). Merino (2016) also explains that because devices can forge connections with other objects, this creates an increased complexity and more demanding techniques. It is well known among Merino et al. (2016) and other researchers that the process of designing smarter ecosystems requires essential considerations to be addressed. The IoT integrates data obtained from digital, virtual and even real objects, and many applications have been built due to this development.

3.3.3 IoT Challenges

IoT is a revolutionary aspect of the IT industry, but it has some shortages. Issues of *security* and *privacy* present a significant problem for the implementation of IoT technologies (Gilman & Nordtvedt, 2014). The RFID tags, for instance, are said to follow people without their consent (Weber, 2010). Therefore, there is growing distrust among the people with regards to the extensive use of technology. In a study by Kranenburg et al. (2014), they state that successful user-centric services enabled through IoT are dependent on the participation and information sharing of people. It is therefore often paramount to ensure the willingness and participation of people in order to succeed as a company (Fan, Wang, Zhang, & Lin, 2014). Kranenburg et al. (2014) claim that the perception people have towards IoT, the perceived value and confidence that IoT enables for them, has a direct influence on their willingness to share personal data and information. The more people trust using the IoT, the greater their willingness to participate will be (Kranenburg et al., 2014). Hence, a strong presence of distrust in the IoT can impede on the effectiveness and success of a system.

Additionally, there is another challenge that should be addressed when dealing with IoT. Fan et al. (2014) state that due to the IoT being more than one device or application, *unified industry standards* are needed for communication and interface protocols to achieve a stable and lasting connectivity. However, they further believe that due to the large amount of companies setting different standards, that this has led to no top unified standard being set at all because of a divided market (Fan et al., 2014). The diversity in the market, allow vendors to freely choose which standard best suits their product, hence enabling a wide variety of products with various standards. Fan et al., (2014) argue that this can reduce the incorporation of data and interoperability between devices, as the IoT require devices to be connected and integrated with the internet. Due to the variety of applications and devices within an IoT systems, Fan et al. (2014) stress the importance of heterogeneity in standards to best ensure a successful IoT adoption.

Trends and forecasts point out to the IoT being the future internet network that will link objects and people all over the world (Sumic et al., 2017). Therefore, with advancement in the technology, we will be able to access multiple services and objects through applications (Khajenasiri et al., 2017). IoT is expected to revolutionize the way we do things including the way that we work, interact with others and even accessing entertainment (Uckelmann et al., 2011). The development of IoT will be fundamental in the development of smart cities, such as controlling energy consumption of buildings. Khajenasiri et al. (2017) evaluate an IoT architecture model which connects objects, individuals and the cloud. In this study, hardware immaturity was mentioned as one of the critical challenges in the study. Therefore, the critical lesson from this study and the rest, is that there are various shortcomings which should be eradicated before the best can be derived from the IoT. The other challenges that emerged include security, privacy and achieving a reliable and standardized IoT infrastructure (Fan et al., 2014). However, Fleisch (2010) provides an opportunity to identify several value drivers when dealing with IoT, which can be leveraged in current business situations.

3.4 Integration

Our literature has highlighted the debate regarding whether the strategic importance of data is derived from data itself or based on the skills and strategies attributed in dealing with data. The focus of our literature is in most cases on why established companies are struggling to some degree. Therefore, we find it contributing and very interesting to present in more detail, the abilities of an IoT start-up and how they handle Big Data in an effort to leverage this into new business opportunities. We will relate our findings towards the existing literature and present the significance of the various Big Data capabilities in relation to the energy industry. Additionally, our review of IoT has highlighted some of the main themes towards creating lasting business value for companies utilizing emerging technologies. Current literature on the IoT present interesting views on which value drivers can be detected when utilizing the connectivity that the IoT represents (Fleisch, 2010). The literature presents a strong value proposition towards utilizing the IoT and leveraging the interconnectivity as a competitive advantage. However, it also shows some of the limitations which exist due to privacy issues and a lack of standardization. We will later in chapter 6 provide substantial context in relation to the presented literature on how Watty can potentially leverage their IoT capabilities and connectivity, and potentially derive value.

We also found the perspectives on how the IoT boosts new business initiatives particularly relevant and interesting. Established companies represent a portion of the players utilizing the opportunities brought forward by the IoT. However, the fast-phasing start-up “evolution” could be argued to be the more powerful (Günther et al., 2017). The people behind start-ups innovate and twist existing technologies in directions that for some appear to be beyond the bounds of possibility. The literature sometimes mentions that start-ups are better able to accommodate the challenges of Big Data and IoT. However substantial research within the energy industry or other established utility industries seems lacking when dealing with the competitive advantage of using new technologies. With our literature review we have analysed a thorough selected amount of literature related to our topics. We better understand the possibilities of creating new business value in an established industry by endorsing Big Data and IoT. The literature presented indicates some clear advantages, but also challenges of these two phenomena. Our conceptual framework, which we will present in the following paragraphs, will utilize these concepts and present how these concepts work towards understanding the competitive position of Watty.

Chapter 4

Strategic Frameworks

The challenges of gaining competitive advantage have been a highly discussed concept with companies constantly seeking a way to obtain an advantage in their respective industries. As such, Big Data and IoT technologies are seen as pivotal in establishing advantages in various industries. Suarez and Lanzolla (2007) present a strategic framework describing how companies can capture *first mover advantages* (FMA), depending on how you leverage some of the advantages that exist in the firm and the environment. Their proposed framework can be seen in figure 11. Our aim is to adapt their strategic framework towards a conceptual one, which focuses on how new technologies, such as Big Data and IoT, can enable FMA for Watty. In the following paragraphs, we will explain in more detail the strategic framework by Suarez and Lanzolla (2007) and contributory strategic concepts.

Grant (2016) and Douma and Schreuder (2013) also highlight *first mover advantage* as a potential competitive advantage. Grant (2016) explains that FMA is “The competitive advantage that accrues to the firm which is first to occupy a new market or strategic niche, or to exploit a new technology” (Grant, 2016: 429). The notion behind competitive advantage is discussed as being more than just having an advantage that allows higher profits than one’s rivals, but instead also allows investing in market share or new technologies (Grant, 2016). Grant (2016) further explains how a competitive advantage is often doomed once achieved. He explains that competitive advantage is created through change and once a firm has a competitive advantage over the rest, a competition ensues to ‘destroy’ this advantage. The changes leading to a competitive advantage are influenced by either internal or external sources (Grant, 2016). Hence, our conceptual framework will highlight how the concepts of Big Data and IoT can influence the three enablers (Figure 11) originally presented by Suarez and Lanzolla (2007) and impact Watty’s strategic position. Furthermore, we will also apply our findings towards our conceptual framework, to indicate how Watty might be leveraging new technologies in the energy industry.

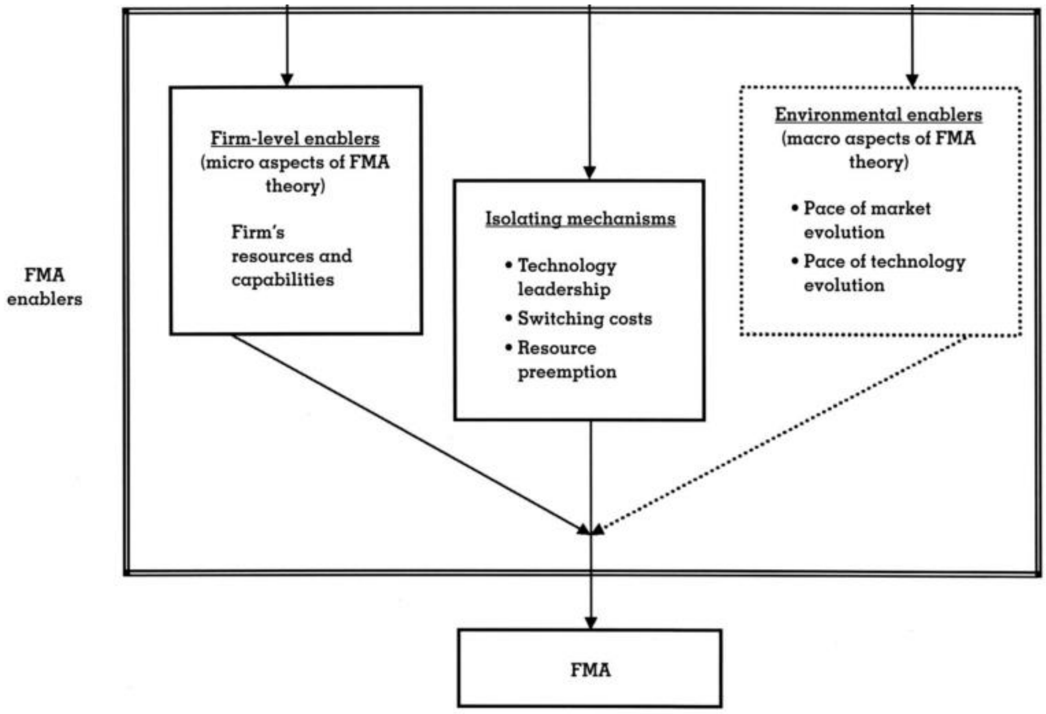


Figure 11 - First Mover Advantage Enablers (Suarez and Lanzolla, 2007)

4.1 Environmental enablers

In their proposed model of FMA - advancing existing FMA theory, Suarez and Lanzolla (2007) conclude that environmental dimensions either enforce limitations or establish advantages for a firm´s exploitation of FMA. They highlight two dimensions of a company's *environment*; the pace of technological change and the pace of market evolution. They introduce a matrix with four quadrants with each one illustrating a combination of these two environmental dimensions. They argue that these two environmental dimensions have the most influence on the effectiveness of the FMA *isolating mechanisms.* During chapter 5, we will apply our findings towards the two environmental dimensions in the energy industry and its evolutionary pace.

4.1.1 Pace of Market - and Technological Evolution

The first quadrant showcases a scenario where both environmental dimensions move at a smooth pace (Appendix 5). First movers will easier acquire a large share of the market and appear as market leaders, which makes it troublesome for late entrants to find space in the market. A smooth pace of technological growth is favourable for the first mover as well, as technological performances often can be difficult for later entrants to challenge when first established (Suarez & Lanzolla, 2007). Additionally, the first entrants could pay attention to what late entrants might offer and add potential changes to its existing product. In the first quadrant scenario, where the environment is predictable, first movers have the strongest conditions for benefitting from FMA (Suarez & Lanzolla, 2007).

The third quadrant on the other hand presents a situation where both the pace of technology evolution and the pace of market evolution are abrupt (Suarez & Lanzolla, 2007). The fast-changing technology, with an abrupt technology evolutionary pace, may hinder firms with first mover advantages, as their knowledge could quickly become obsolete. Furthermore, the quick development presents difficulties for first mover firms to catch up with products presented later on (Suarez & Lanzolla, 2007). Suarez and Lanzolla (2007) also look at the scenario when both environmental dimensions proceed abruptly, they often create a lot of uncertainty for firms and consumers. Uncertainty cultivates complex decision-making for both consumers and companies, including company's strategies in acquiring consumers and technological resources. During such uncertain times, it is widely agreed amongst researchers that companies are more likely to make inappropriate decisions (Porter, 1985; Wernerfelt & Karnani, 1987; Weick, 1993, in Suarez & Lanzolla, 2007). In addition, when dealing with an abrupt technology and market pace it may even be able to negate *switching costs*, which otherwise often suit first movers, as negative experiences may lead to the perception that later products are better (Suarez & Lanzolla, 2007).

The two other quadrants represent a combination of market- and technology evolutionary pace where they are not aligned. More precisely, one of these two quadrants illustrate a scenario where the pace of market evolution is abrupt and the pace of technology evolution smooth, with the other quadrant demonstrates the opposite (Appendix 5). The model proposes that in scenarios where the paces are not aligned, "...the net effect of environmental elements on isolating mechanisms will be weaker than in cases where both environmental elements are aligned" (Suarez & Lanzolla, 2007: 388). This is due to the fact that one environmental dimension may enable FMA isolating mechanisms whereas the other may tend to disable them, which might accommodate later entrants. These contrasting dimensions therefore provide minimal value to either first mover or late entrants (Suarez & Lanzolla, 2007).

Additionally, one of the first and most important circumstances mentioned by numerous studies, is the *optimal timing* in regard to FMA. Grant (2016) argues that the optimal timing relies upon a company's resources and capabilities and *when* these are aligned with opportunities in the market. Such conditions were explained by Abell in 1978 as *strategic windows* that are open for "...a limited period of time during which the "fit" between key market requirements and the particular competencies of a firm competing in the market is optimal" (Abell, 1978 in Kerin, Varadarajan, & Peterson, 1992: 40). Suarez and Lanzolla point out that with a certain level of firm resources and capabilities, "...the success of an entry timing strategy will be affected by the particular dimensions of market and technology evolution" (Suarez & Lanzolla, 2007). Another point made by Utterback and Abernathy is that the elements of a competitive advantage alter over time (Utterback & Abernathy, 1975 in Suarez & Lanzolla, 2007).

4.1.2 The Industry Life Cycle

The concept of the *industry life cycle* is based on the fact, that if products go through a life cycle, so do the industries that produce them and is used to better understand the current stage of a given industry. The industry life cycle encompasses four phases; emergence, growth, maturity, and decline (Figure 12), and it is primarily defined by the changes in an industry's growth rate over time (Grant, 2016: 207). As this research will be looking at the market pace and optimal timing in regard to the market development in the energy industry, it is relevant to briefly explain the stages within the industry life cycle. The first stage represents unknown product and few customers. The second stage, growth, represents increased market share through technological advancements and opportunities for acquiring a mass market. This growth will at some point hit the maturity stage where demand is ready for replacement. As this reaches a certain level and the industry is threatened by other products, the industry experiences a decline.

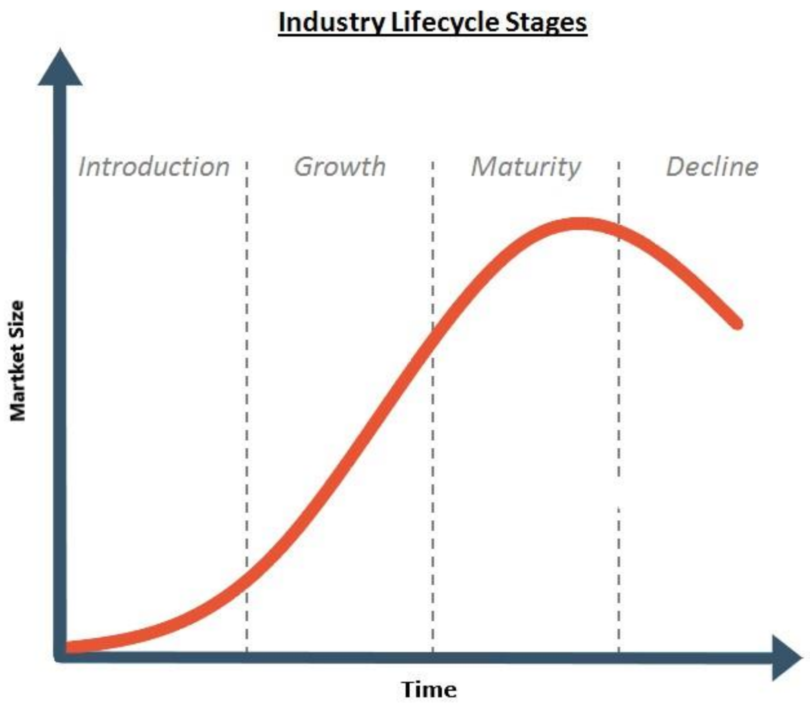


Figure 12 - Industry Life Cycle (Grant, 2016)

4.2 Firm-level enablers

4.2.1 Valuable resources

An essential aspect of first-mover advantages that is often mentioned, is a company's abilities to capture a *valuable resource*, that advantageously accommodates the *VRIN* attributes of *Valuable*, *Rare*, *Inimitable* and *Non-substitutable* (Douma & Schreuder, 2013). VRIN is an analysis tool, which represents four attributes that a company’s resources should possess in order to become a source of competitive advantage. The VRIN tool is typically used when defining the value of a resource in the competitive strategy. This is known as the resource-based view of the firm (RBV) which deals with the notion that a competitive advantage is always based on a resource that can either be owned or accessed (Grant, 2016). Additionally, obtaining a competitive advantage through first mover advantages (FMA) is often assessed “with reference to the competence and capabilities which new entrants have, relative to the competitors” (Teece et al., 1997: 529). Douma and Schreuder (2013) further explain that according to RBV, “a resource can be the basis of competitive advantage *only* if that resource has certain properties” (Douma & Schreuder, 2013: 213). These properties are indicated through the VRIN tool, which is comprised of the following four attributes; *Valuable, Rare, Inimitable, Non-substitutable*. In short, the four attributes represent the conditions that a resource needs to meet in order to represent the basis of competitive advantage.

The first attribute suggests that the resource needs to be valuable by enabling a firm to work more efficiently than its competitors or by providing added value to its customer (Douma & Schreuder, 2013). The second attribute pertains to a resource needing to be rare, making it very difficult or nearly impossible to acquire. Suarez and Lanzolla (2007) further explain that the rarity of a resource also depends on the pace of market evolution. The third attribute of the VRIN tool, is that it must be *imperfectly imitable*, making it very hard to replicate by others (Douma & Schreuder, 2013). Lastly, the resource must not be able to be replaced by other resources, hence making it non-substitutable. Douma and Schreuder (2013) point out that even though a resource conforms to the VRIN conditions, that advantage is temporary as changes in the business environment can alter the resources value. This is due to RBV and its subsequent VRIN tool being static, assuming that resources only exist and need to be chosen and doesn’t question how the resources could be developed or maintained (Douma & Schreuder, 2013).

Although there are several circumstances that can help companies achieve a first-mover advantage, Lieberman and Montgomery (1998) point out that the ultimate success depends on the combination of a company's competencies and position, its competitors, and environmental changes. Regarding a company's competencies and position, there are great differences between an entrepreneurial company, such as Watty and incumbent companies.

Grant (2016) describes an entrepreneurial company that has gained market adoption of its product and has been successful in establishing a *niche market* through exploratory processes. However, the company would most likely not have the required skills in place to move towards a *mass market*, where the company could exploit the benefits of economies of scale. Incumbent companies often struggle with the competencies required to combine *explorative activities* with its current skills in *exploitation* of existing products (Douma & Schreuder, 2013: 226). Therefore, there are examples of how established companies have exploited another firm´s invention and establishment of a niche market instead and from this, developed a mass market. In that sense, it is suggested by Markides and Geroski (2005) that if early movers enter the market and radically innovate, established firms should wait until a niche market is established, and then consolidate it into a mass market. More precisely, this means that the company would pursue the so-called *fast second* strategy (Markides and Geroski, 2005 in Douma & Schreuder, 2013) .

4.2.2 Dynamic Capabilities

Typically, when looking at resources within a company many researchers focus on the concepts of VRIN or RBV, which as mentioned have a static approach towards a company's resources. However, these concepts don't deal with changes in the environment (Grant, 2016). Dynamic capabilities are therefore often used in continuation of the RBV and VRIN in order to highlight the strengths of a company when dealing with change (Grant, 2016).

Professor David J.Teece first put forward the concept of dynamic capabilities. He explained that dynamic capabilities refer to how a firm can *sense*, *seize* and *transform* in order to meet new market conditions (Teece, 2007). Douma and Schreuder (2013) further define dynamic capabilities as "the capacity of an organization to purposefully create, extend, or modify its resource base" (Douma & Schreuder, 2013: 215). The concept of *sensing* deals with a firm's ability to detect changes in the competitive environment due to various factors, such as the environmental enablers presented by Suarez and Lanzolla (2007) or changes to the isolating mechanisms, to name a few. Alternatively, *seizing* deals with how firms are able to develop strategies and create the proper infrastructure to capture the opportunities or react to risks discovered through *sensing*. Lastly, *transform* is explained as the firm's ability to integrate and refine these strategies in order to address the new opportunities or risks, and in some cases bring about change in the business environment (Teece, 2018).

Typically, smaller companies such as Watty have stronger dynamic capabilities in an abrupt evolution setting, as they are often more agile in their business processes as opposed to large established companies and can therefor better adapt to rapid changes (Douma & Schreuder, 2013; Suarez & Lanzolla, 2007). Furthermore, the ability to employ dynamic capabilities in a firm can allow the firm to expand or change its resource-base if needed and potentially ensure a competitive advantage.

4.3 Isolating Mechanisms

Lieberman and Montgomery (1998) support that FMA reflects a company's obtained market share or economic profit (Lieberman & Montgomery, 1998 in Suarez & Lanzolla, 2007). Kerin et al. (1992) also claim that FMA can be achieved in numerous ways, either by introducing a new product, using a new process or entering a new market. Other mechanisms in which a company can gain first mover status is coined as FMA *isolating mechanisms* by Lieberman and Montgomery (1998). Their broadly accepted mechanisms highlight three categories in particular; technology leadership, pre-emption of scarce assets and switching costs/buyer choice under uncertainty.

The *technology leadership* category involves mechanisms as learning and experience effects based on consumers and R&D patenting. These mechanisms can help Watty achieve the market strength needed to establish leadership in the energy industry. If a product is patented, the technological attributes that accompany the product can become technical standards. When a standard has been set, "...displacing it becomes exceptionally difficult" due to learning effects and collective \`lock-in´ and the company will have a technological edge over competitors (Grant, 2016: 253). Customer or supplier \`lock-in´ refers to a situation where it would be inconvenient to switch to another provider of a product or service, and therefore a beneficial situation for a company. The second category presented by Lieberman and Montgomery (1998), *pre-emption of scarce assets,* represents cost advantages. It is argued that a company's ability to acquire scarce market resources, is relative to the pace at which an industry is maturing. Lastly, *switching costs* can arise from changed buyer habits, creating procedural switching costs, or from the presence of network effects. Over time, some early-mover companies have benefited from the *network effects,* which means that the company's product or service becomes more valuable proportionally with a greater increase in customers. More specifically, the value of the product or service to one individual customer, entirely depends on the number of other customers.

4.3.1 Information Quality

The Information Quality perspective has, according to Ghasemkhani et al. (2014) mainly been utilized in order to look at a company's operational competencies in relation to the design and management of systems and processes. These have the purpose of maintaining the quality of information, which Ghasemkhani et al. (2014) further highlight *is* a strategic concern for many companies. Madnick et al. (2009) argue that one important aspect regarding the quality of information is the struggle to *translate* collected information into relevant insights and provide a *standard* in how information should be perceived, creating procedural switching costs for consumers (Madnick et al., 2009 in Ghasemkhani et al., 2014). These insights are meant to help companies with better decision-making, business processes and create strategic advantages. Ghasemkhani et al. (2014) and Madnick et al. (2009) both claim that information's value depends on presenting the right information in the right format, to the right person at the right place and time. A certain "fit of use" for the user of the information is essential, and important attributes of the information are accuracy, timeliness, precision, reliability, currency, completeness and relevance (Wang & Strong 1996; Bailey & Pearson 1983; Ives et al. 1983; Lee et al. 2002; Strong et al. 1997; Wang et al. 1995 in Ghasemkhani et al. 2014). In short, the Information Quality perspective says that availability and usability is paramount to extract value of information. This increases the strength of the any potential switching costs that may occur.

4.4 Conceptual Framework

The proposed strategic framework by Suarez and Lanzolla (2007) offers a structure towards analysing the different enablers in order to achieve a first mover advantage and which concepts influence the three enablers. However, the framework is also presented in an abstract and generalized way, which makes it hard for any testing of the strategic framework towards our specific findings. Hence, we have chosen to adapt the framework towards a more specific setting in regards to *environmental-enablers* and present how Watty might be able to leverage *firm-level* capabilities and establish *isolating mechanisms,* so the company can ultimately achieve first mover advantages. Our initial adapted framework can be seen in figure 13 and we will present a findings specific framework later in chapter 6.

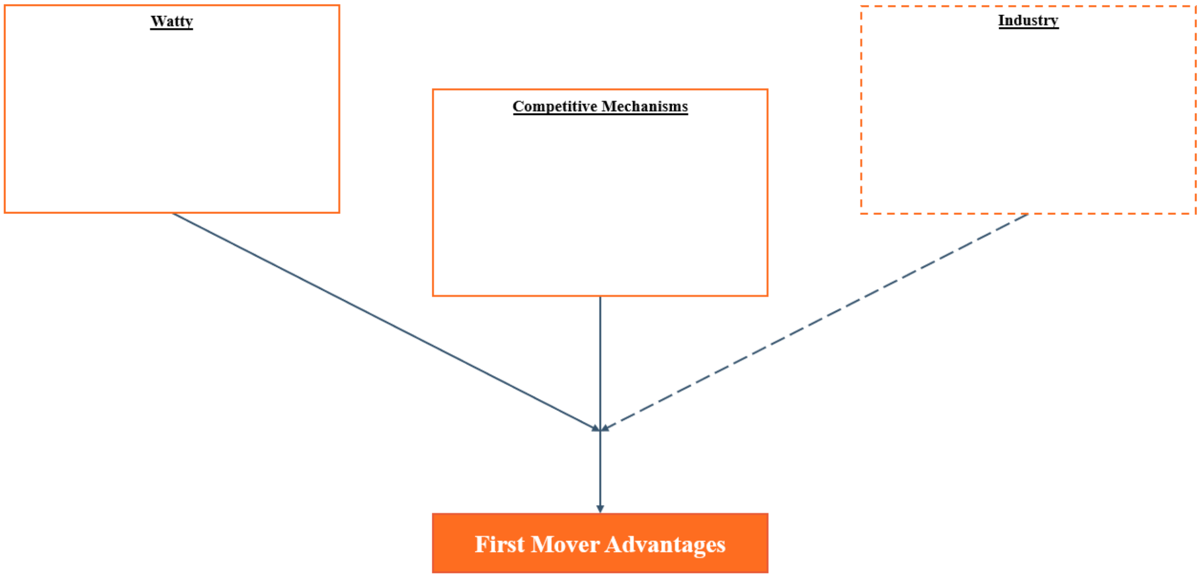


Figure 13 - Conceptual Framework

Chapter 5

Findings

As mentioned earlier, we have applied our findings towards our conceptual framework adapted from Suarez and Lanzolla (2007). We have divided our findings into the three different sections based on the enablers for gaining a *first mover advantage* presented by Suarez and Lanzolla, 2007. We have done this in order to best comprehend which influences impact the different enablers. In the first section we will present our findings in regard to the *environmental enablers* which can impact Watty and their potential FMA. This section is mostly based on extensive industry reports, but also interviews with industry experts and Watty employees. In the second and third section, we will present our findings towards Watty and their *firm-level enablers* and *isolating mechanisms*. These sections are mostly based on interviews with Watty employees, observations and internal documents.

5.1 Environmental enablers

5.1.1 Market evolution

The recent decade has been a challenging era for the energy sectors following an increased demand for alternative services through new technologies (Flaherty et al., 2017). A common challenge experienced in recent times includes the need to reverse the downtrend in revenue systems in the sector. Incumbent companies have been experiencing numerous challenges including stagnant growth in sales turnover (Accenture, 2014). The Senior Analyst and PhD candidate further reiterates this issue when discussing the increased churn of consumers towards the energy providers, stating that 10.3% of Swedish consumers churn from their energy companies, as liberalization and deregulation is challenging individual companies (Senior Analyst and PhD candidate, Interview; Hopf, Riechel, Sodenkamp, Staake, & Riechel, 2017). The most known challenges are a general focus in society on clean energy, and customer demand for new services as technological developments provide opportunities to pursue energy efficiency (Capgemini, 2018b). In the following paragraphs we will present findings on the trends that have been reported in the industry, illuminating concerns in the industrial developments in the world today.

5.1.1.1 New energy sources

Globally, clean energy production is becoming a significant threat to oil and gas companies diverting the attention of many users in a traditionally local market to the international arena in order to meet new standards of energy production (Biscardini, Morrision, Branson, & Maestro, 2017). As a result, many companies are outlining new strategies for energy consumption, with a large focus on renewable energy, creating a new baseline for energy production (Capgemini, 2018a). Electricity is a universal utility required for general development in all sectors of the community, and reports show an increase in usage of green energy amongst end-users, who are willing to pay premiums for renewable energy sources for their homes (Senior Analyst and PhD candidate, Interview; Accenture, 2014, 2015). Furthermore, more consumers are taking steps in becoming more self-sufficient in their energy consumption and are investing more in solar cells and batteries for their households (Business Development Manager, Interview; Frankel & Wagner, 2017; Rubel, Pieper, Zenneck, & Sunak, 2017). Although there is an interest for these products, it is important to distinguish between what people say they will do and what they actually do (Business Development Manager, Interview). The recent findings from industry reports prove that both emerging and incumbent companies focus on globalization and renewable energy as common courses to stabilizing the market system, in response to the demand gap created by the current trends in technology (Accenture, 2012, 2014, 2015; Flaherty et al., 2017; Frankel & Wagner, 2017; Rubel et al., 2017).

With more than 1.5 billion of the world population unable to access urban designed electricity supply, solar energy production is slowly making inroads in the universal market (International Energy Agency, 2017). Such trends suggest major threat concerns for companies on the development of various energy producers in the industry. Moreover, the focus on the reduction of pollution contents and emission of harmful gases is another trend in the modern production system as attributes towards the trend of private solar energy solutions becoming more popular (Business Development Manager, Interview; Rubel et a., 2017). Emerging technological tools, such as IoT sensors, help to monitor the levels of emissions released in the process of energy production services (Deloitte, 2017; International Energy Outlook, 2016; Sumic, 2017). Furthermore, IoT enabled devices help to enhance energy efficiency and challenge the traditional revenue systems used within the incumbent power production companies in the market (Accenture, 2014; Accenture 2015). Minimizing the release of greenhouse gases has therefore become a common pillar in global sustainable development goals.

5.1.1.2 New premium services

Our findings indicate that many energy companies are trying to provide a more holistic service range towards their consumers. The emergence of internet-based platforms creates influential channels that corporations can source for new business value as they venture into new service areas. This need is becoming more present due to the lack of a premium service in energy companies (Senior Analyst and PhD candidate, Interview). The Senior Analyst and PhD candidate explains that with the heightened focus on renewables, energy providers no longer sell renewable energy as a premium, but it has rather become the default in many companies, creating a vacuum in their business model for a premium service. The development of new services presents a guiding strategy on the use of substantial engagement practices as a tool to winning more consumers in the industry (Senior Analyst and PhD candidate, Interview). This puts many energy companies in an advantageous position allowing them to enter secondary markets and create new ecosystems as within the smart home and smart city industry (Business Development Manager, Interview). This is seen in figure 14, which shows that 61 percent of consumers would be willing to purchase home management services from their energy provider if offered. However, the role of information technology is pivotal in all cases, making the integration of technology central to the sustainability of their position within the emerging energy management industry. The early concepts of virtual reality and augmented reality further suggest a potential future for the various utility companies, positing a framework under which companies can lay the foundations for future success in the industry (Sumic, 2017).

Figure 14 - List of preferred providers for monitoring and controlling products (Accenture, 2014)

5.1.2 Technological evolution

Emerging technological tools does not only help to monitor the levels of emissions released in the process of energy production services, but entirely empower customers to shift their demand from the traditional electricity systems. This presents huge challenges amongst incumbent companies, and the need to bridge this demand gap for new services has become a focus point for many companies (Accenture 2014, Accenture 2015). Incumbent electricity companies are trying to incorporate new technologies to monitor and explore consumer behaviour systems in the industry (Senior Analyst and PhD candidate, Interview). Similarly, other sectors are also engaged in practices that allow them to adapt to the new set of technological advancements and needs within the energy industry. As an example, retailers such as Walmart and McDonalds have both engaged in the practices of managing their energy consumption. Walmart lowered their energy consumption rates by 20 percent within local branches, while McDonalds increased its' energy efficiency rate by similar measures (Flaherty et al., 2017). These findings indicate the use of technology has become a crucial aspect of the energy industry, encouraging many companies to adopt new ways of energy consumption and energy management in the industry. The consequence of this new trend also includes a reduction in general electricity demand in the world today as seen in figure 15 (Flaherty et al., 2017).

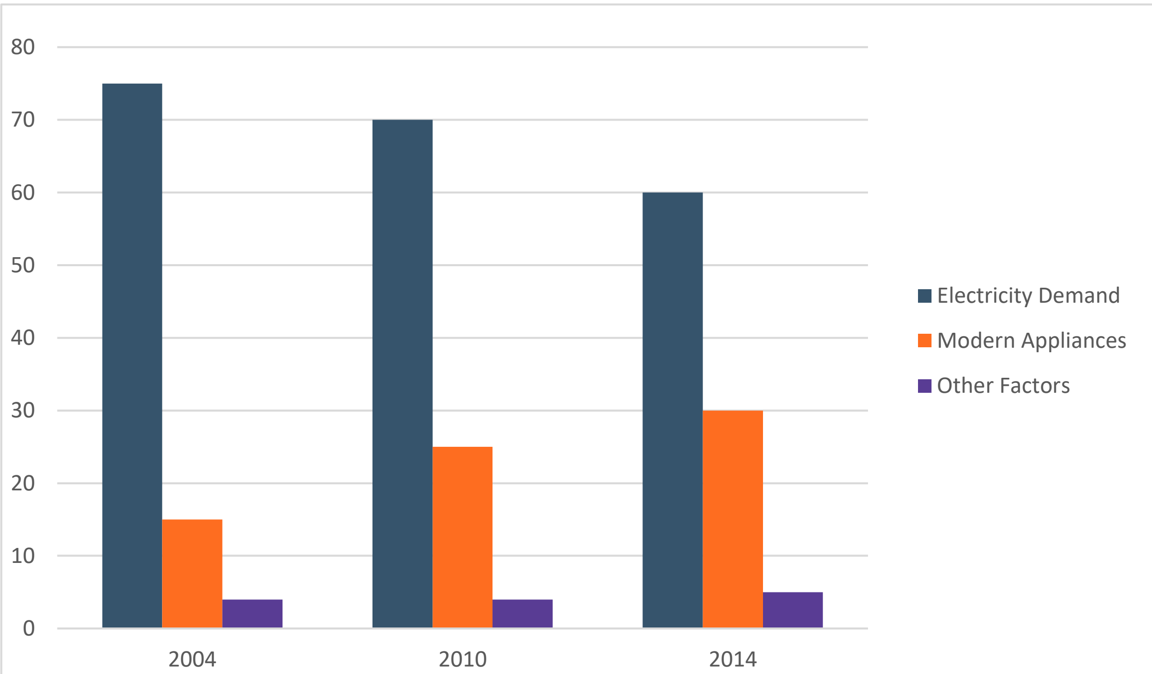


Figure 15 - Electricity demand levels among consumers (Flaherty et al., 2017)

5.1.2.1 Technological demands

There is now a shift towards solar energy production and integrated energy management systems as mechanisms to embrace sustainability and address the rising concerns surrounding the reduction of greenhouse gas emissions in the industry (Gustav Gårdbro, Interview; Capgemini, 2018a; Rubel et al., 2017). The Senior Managing Partner at Gartner states that there is an apparent issue related to the rising level of consumer demands and public engagements. The current generation is driven by technological mind dwelling on the use of energy, to produce various items. The rural societies are slowly expanding as community members turn to modern methods of production and business transaction (Senior Managing Partner at Gartner, Interview).

As such, the use of energy and other utility products has become a central aspect of existence among end users, and incumbent energy companies are heavily focused on how to meet these shifts in demand (Senior Analyst and PhD candidate, Interview). To accommodate these demands, an Accenture report has highlighted how companies who invest in the use of digital-driven techniques as their main channel in the market, can help attain a stronger market position in a changing industry. The report and figure 16 show how digital platforms like social media and mobile applications create interactive platforms in which the consumers can interact with the companies, airing their concerns or questions in a direct media. This provides a feedback mechanism, which is easy to access and comprehend for companies, and can contribute towards future developments needed in the energy industry (Accenture, 2014; Accenture, 2015). It’s apparent that the technologies that can enhance stronger connections with customers and energy companies are available, but our findings indicate that some companies are struggling to take advantage of these technologies.

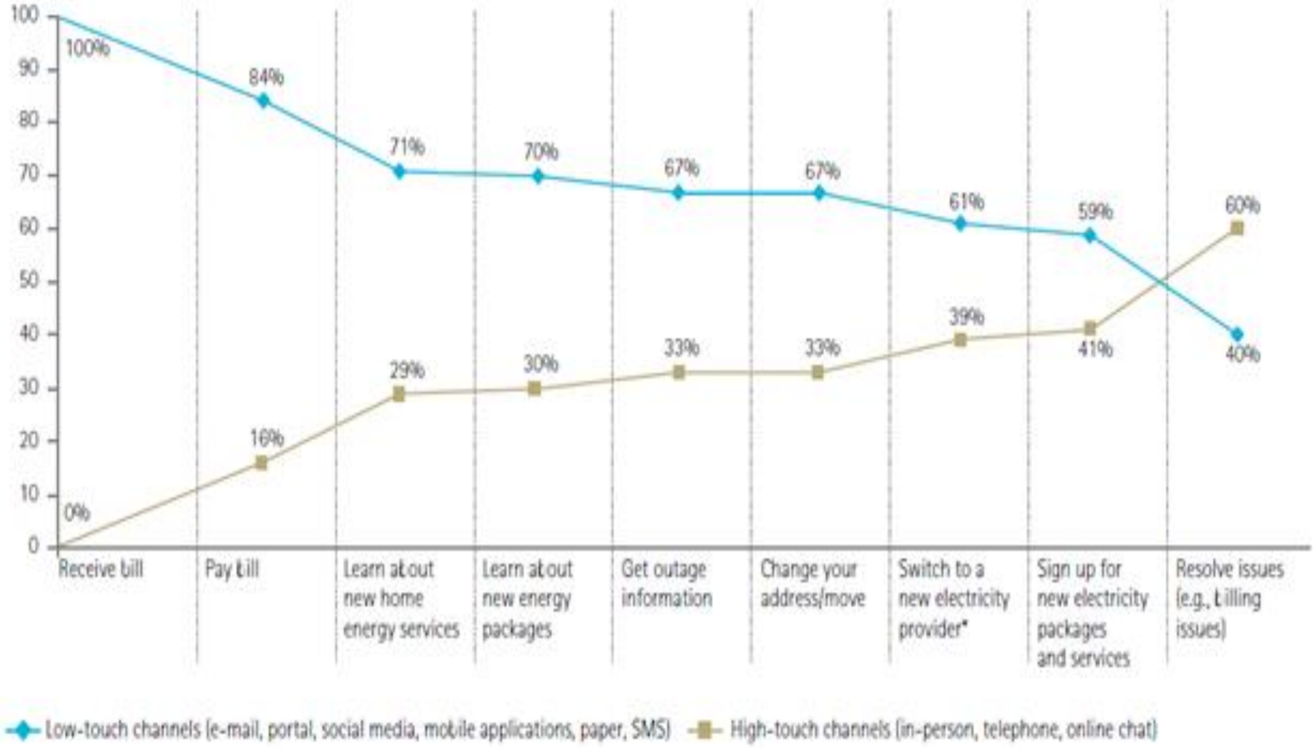


Figure 16 - Consumer prefer low-touch point channels (Accenture, 2014)

5.1.2.2 The energy management field

Many of these technological concerns present multiple advantages for new companies entering the energy industry as it allows them to venture into new energy services, and amongst these are energy management services. Start-ups and digitally focused companies enjoy the benefits of using technological services as their business model is often based on such capabilities. At the same time, they continually seek easy communication with consumers in the market, as is seen in figure 16 provided by Accenture (2014). New energy demands present a larger focus on energy consumption and renewable energy, allowing companies to not just be energy providers, but work with energy management. From various industry reports and interviews, our findings reveal a redefining of the traditional energy production industry into a field of energy management (Senior Managing Partner at Gartner, Interview; Senior Analyst and PhD candidate, Interview; Accenture, 2014, 2015; Capgemini, 2017). The change indicates an adoption and introduction of new technologies to allow consumers to be more involved with their own energy consumption. It also allows, as mentioned earlier, the entry of new companies who provide strong digital solutions. Our findings reveal the establishment of a field focused more on energy management, has been ushered in through technology and advanced monitoring through Big Data, as presented in the following sections.

5.1.2.3 Technological capabilities

Evidently, utility corporations are highly likely to benefit from the technological expansion just like other industries across the globe (Bertoncello et al., 2016; Bughin et al., 2016; Deichmann, Heineke, Reinbacher, & Wee, 2016). Many consumers have developed trust in their utility providers in creating technology-based systems to help them improve their energy management (Accenture, 2014). This suggests that utilizing information technology is one of the major capabilities and competitive advantages embedded in the development of companies in the energy sector (Accenture, 2015). Through the use of technology-bound information, companies can focus on a collaborative approach toward their end-users, as multiple reports reveal a shift in end-user’s mindset, going from a “me’ to a “we” (Accenture, 2015). This is mainly due to the introduction of new ecosystems through IoT and other technologies, providing new opportunities in the market for both user and companies who are digitally engaged, as they benefit from potential market gaps (Lee & Lee, 2016). These technologies provide added business value through multiple aspects as seen in figure 17.

Figure 17 - Digitally engaged energy consumers provide added business value (Accenture, 2015)

5.1.2.4 Big Data as an asset

The introduction of new ecosystems through IoT and other technologies that enables analytical practices has enhanced the performance of several companies in the energy industry as they can analyse their asset performance in the market. The concept of data collection illuminates a company's ability to demonstrate its' position in the market as it leverages this data when forecasting (Bughin et al., 2016; De la Pena, Fernandez, & Gonzalez, 2016; Deichmann et al., 2016). Consequently, the focus on Big Data enables access to new business ideas in the industry. The Senior Analyst and PhD candidate explains that energy companies need good data capabilities to help position themselves and offer new services and deal with the challenges this may represent. The Senior Managing Partner at Gartner also states "So you can see all of a sudden they have to reach out maybe to millions of customers, but they don't have any idea how to do that. They might be forced to do that" (Senior Managing Partner at Gartner, Interview).

Incorporating data as one of the most important company assets may include critical analysis of the market to generate new ideas, as well as business models to help the promotion of the actual energy production asset in the market. However, the Senior Managing Partner at Gartner and the Senior Analyst and PhD candidate debate the actual value of data presented by various reports. They both argue that the main issue with the utilization of data is the companies don't need high granular data as they are currently able to ensure proper predictions with their current input energy (Senior Managing Partner at Gartner, Interview; Senior Analyst and PhD candidate, Interview). Yet, the ability to leverage data still holds market value in the areas of marketing and promotion of goods and services in the industry (Murray & Hawley, 2016; Sumic, 2017).

With the introduction of IoT and other new technologies, Big Data is becoming a larger focus area for energy companies in the near future (Bohé et al., 2015). Big Data systems will help new companies and incumbent companies to better understand the industry and leverage data as an asset facilitating new opportunities – something that has had little scope up until now. As such, the focus on data as a mechanism for change may help to sustain the development of a company on numerous fronts. Findings indicate that the utilization of data in most any sector, has the ability to provide added value if handled correctly. An example is how companies like Tesla and WAYMO are tackling data, which is one of the major problems for the development of self-driving cars (Business Development Manager, Interview; O'Kane, 2018). As figure 18 shows, multiple aspects of data are enabling a new possible revenue stream for any who can leverage it.

Figure 18 - Forces converging to create conditions for data monetization (Bohé et al., 2015)

5.1.2.5 Smart meters

The ability to understand the value of data has become a larger focus since the introduction of smart meters. Smart meters are one of the technological innovations that incumbents have utilized in order to embrace emerging trends and respond to the use of technology as a major aspect of growth for the industry (Deloitte, 2015). Smart meters enable energy transfer and monitoring, and even though regulations only allow smart meters measuring energy every 15 minutes, this still produces nearly 16 terabytes of data, which can offer new insights about consumer´s consumption and operational efficiency for utility companies (Sumic, 2017; Verma, 2018). Smart meter appliances provide a comprehensive approach to the management of energy consumption systems. However, a Capgemini report shows that many incumbent energy companies have been ill-equipped to handle these large amounts of data resulting in partnerships with specialized digital providers (Verma, 2018).

Although our findings indicate that most energy companies don't really need detailed energy data, as they already have precise forecasting capabilities for energy consumption, the utilization of data to enable additional services as part of their retail offering is still underway (Senior Managing Partner at Gartner, Interview). However, when data collected within operations is to be used for retail purposes privacy issues arise. The Senior Analyst and PhD candidate further explains, "This can be the problem in Europe. There's this process of deregulation in the energy markets so they separate the grid operation from the energy retail [..] it can be that the company that does energy retail has no access to the smart meter data because of privacy regulations" (Senior Analyst and PhD candidate, Interview). The regulatory challenges and the introduction of the new European privacy bill can hinder efficient participation; however, it also forces the energy companies to shift strategic focus towards a more data driven approach in other segments of their business (Senior Analyst and PhD candidate, Interview; Verma, 2018).

In conclusion, the environmental enablers of market evolution and technological evolution have had significant impact on the progress of the energy sector, creating multiple issues but also opportunities within the industry. Currently, many companies use the modern contexts of technological development to explore and understand the market and consumers. It is clear that technology trends including customer customization, smart meters, Big Data, pollution reduction, as well as the emergence of solar energy systems, have had a significant influence on the progress of various companies around the world. As such, our findings suggest that new technologies will have a significant impact on the industry, as it transitions from an energy production industry towards a more data – and energy management focused industry, allowing for additional, innovative services and new entrants into the market.

5.2 Firm-level enablers

5.2.1 Resources and capabilities

Findings in section 5.1 explain that during the recent decade, there has been challenges within the energy sector due to increased demand for new services through new technologies (Flaherty et al., 2017). An increase in customer churn over recent years has contributed towards a change in energy demand (Senior Analyst and PhD candidate, Interview). Incumbent companies struggle to adapt, and although there are several valid reasons why, this allows new and agile companies, such as Watty, to leverage new capabilities that address modern user needs. In the following section, we will look into Watty´s resources and capabilities in order to reveal a broader understanding of how this company operates.

5.2.1.1 Architecture

Watty offers its customers both a product and a service, where an IoT device together with algorithms, collect energy data from the home and displays this data on the Watty mobile application. The ability to collect, structure and visualize data well is paramount for Watty, as this is the basis of the entire company. The architecture behind this process can be seen in figure 19 which shows the various steps from data collection to data visualization through the app and notifications pushed from the API. “We are measuring the total energy consumption in a household and from the total, we disaggregate this into different appliances” (Machine-learning Engineer, Interview). In that sense, identifying “...this part is the microwave, this part is fridge, this part is stove. And show that in real-time basically” (Machine-learning Engineer, Interview). The core reason why this is possible, is because every appliance in the home is on a different electrical pattern, and hence, different models have been developed to detect and predict the signature or “fingerprint” of the different appliance (Machine-learning Engineer, Interview).

A simpler architectural diagram can be seen in appendix 6, which shows that from the Watty box, data is collected and sent to their cloud providers. Watty hosts its services in multiple places. These services provide various cloud computing capabilities where the entire system can run. One of the main providers is Digital Ocean (Appendix 6), that provides economy-efficient computational power. Other data management tasks are supported by Amazon Web Services (AWS) and Google Cloud. For instance, AWS supports Watty’s e-mail services and SMS or push notifications (Software Engineer, Interview). Hence, Watty utilize several service providers to support its data capabilities. The process of collecting continuous data to their cloud services is done through load balancing, which distributes workloads across multiple devices to ensure better reliability. The load balancing distributes the data to Watty’s backend cluster in the cloud system, where the data goes through a Metadata Translation (Figure 19). The following four process steps each represent one of the key aspects of their data capabilities; Specific Appliances Prediction, Recurring Patterns Predictions, Resampling and Home Power Emitting (Figure 19).

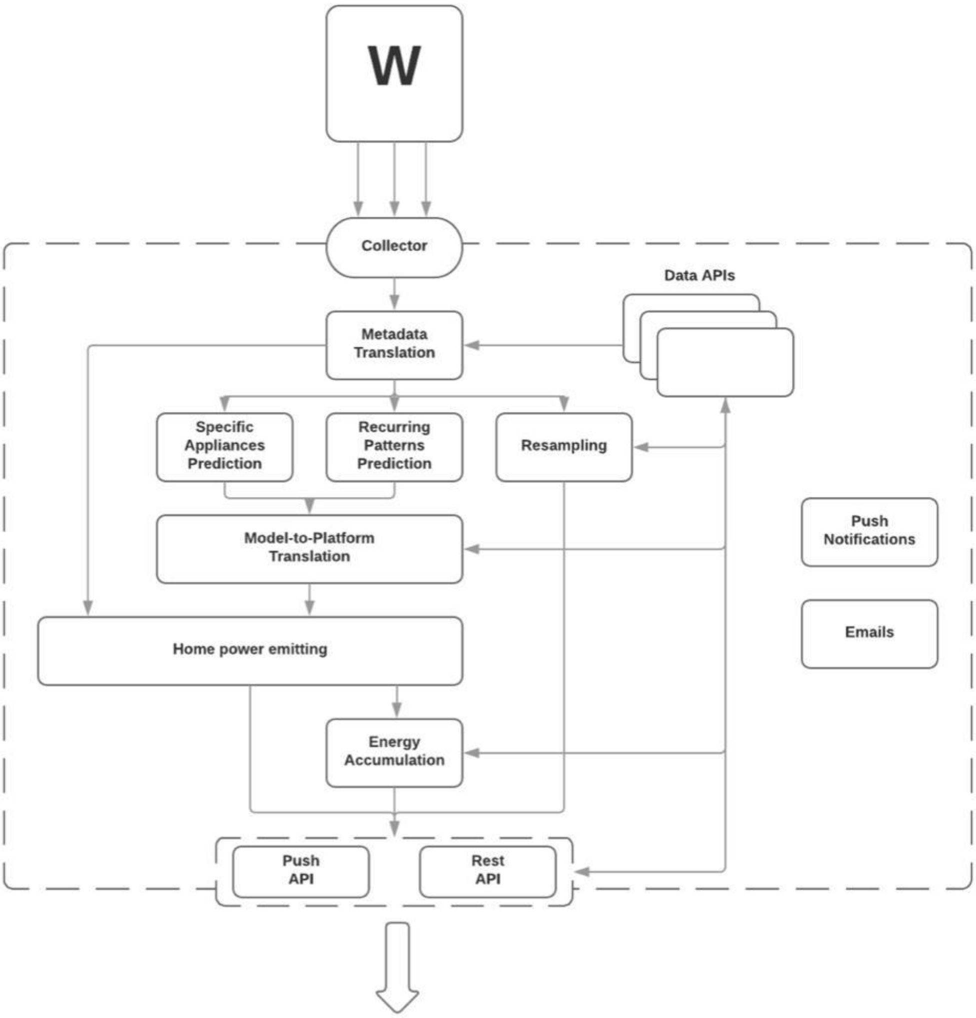


Figure 19 - Extended Watty Architecture

Most of the algorithms Watty has developed operate within the Specific Appliances Prediction and Recurring Patterns Prediction processes (Figure 19). These two processes are utilized to decipher *which* energy signature it is and relate it to a specific appliance if historic data is available. These processes are key for Watty, as this enables them to detect appliances, and use this data to run algorithms for *anomaly detection* or other purposes. However, the ability to detect appliances is only one part of their entire process. Whereas most of the detection happens through event-based data, their regular data stream helps provide a constant overview of the total current energy usage. More details surrounding both data streams are discussed later, in section 5.2.1.2. This process is done via the Home power emitting process (Figure 19). All of the processes work in concert to push the accumulated data from their API's to their application within seconds (Software Engineer, Interview). Our findings indicate an impressive feat of datafication, when looking at how the collected electrical signatures (Figure 20) are processed and visualized with a simplistic design as seen later in figure 21.

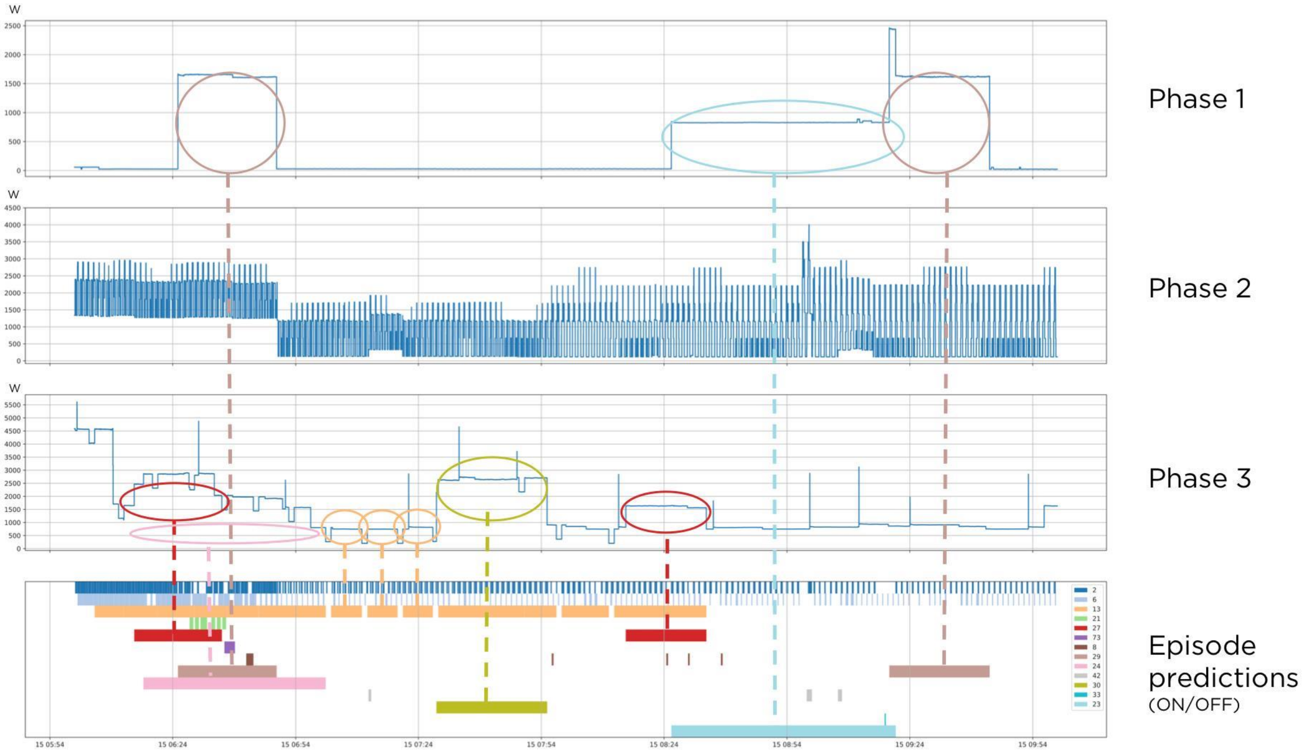


Figure 20 - Appliance Electrical Signatures

The Watty architecture illustrated in figure 19 shows key areas in which Watty have the capability to capture and leverage data towards an improved energy monitoring service. However, as mentioned earlier, the process of working with data also presents a challenge to ensure privacy for their consumers. The Commercial Operations Officer explains that the various API's they use, contains sensitive data from the backend. The push API (Figure 19) is a public API that pushes data from the backend to consumers through the mobile app or website. Furthermore, the Commercial Operations Officer states that Watty is able to grant access to these API's to partners or clients if needed. However, he also argues that this data can be very sensitive, so Watty remains very cautious about who should have access, especially after the introduction of the new European privacy legislation.

5.2.1.2 Regular – and event-based data

Watty's IoT box, enabled through algorithms, collects energy data from the home and displays this data on the Watty mobile application. Both *regular-data* and *event-based data* are sent from the IoT box to the cloud. Explained by the Machine-learning Engineer, regular data is sent every second with 10 hertz resolution, and particularly show how much energy an appliance is using. Although only 10 data points are sent each second, the technology has the capacity to send 750.000 data points every second (Machine-learning Engineer, Interview). However, collecting 750.000 data points each second, would be too detailed and they would not be able to differentiate between electrical signatures. As explained by the Software Engineer, it comes down to the frequency that they are sending. If the frequency is too high, they are not able to differentiate between appliances and would be questioning "Is this a LED light or is it a like a Mac charger?", which normally is something they easily can detect (Software Engineer, Interview). Furthermore, the heavy load of data would be too demanding for the Wi-Fi to transfer to the cloud. It has therefore been more feasible to limit it down to 10 data points per second. The findings explained above, prove that even though Watty has the capacity in terms of computing power to send 750.000 data points per second, they do not have the technical capability, algorithm-wise, to disaggregate appliances when data is too detailed. Watty is currently in the process of improving this, and we will have further details on this in later sections.

The Machine-learning Engineer further describes the *event-based data* and explains that when they stream the regular data and "...when something happens, we have a logic on the hardware that will extract if this was an *event* and then we'll send this event in higher resolution, 200 hertz" (Machine-learning Engineer, Interview). When the event data is recognized, Watty runs a neural network or another type of machine-learning classifier, which enables them to detect when an appliance turns on or off - or measure the total energy consumption of an appliance (Machine-learning Engineer, Interview). These results are sent to the app only 2-3 seconds from when it happens. Ideally, it would be beneficial if such results could be viewed by the user as fast as possible. According to the Software Engineer, they want the algorithm to be able to support only one second of real-time or event-based data. However, he further explains that it is mostly a matter of costs when it comes to how fast the algorithm can support real-time or event-based data. The Business Development Manager argues that there are surprisingly few who are able to build the backend system of streaming and processing data in real time, however he points out that it could be possible for anyone, but it is a matter of cost. In contrast, Watty is able to use their machine-learning capabilities and collected data as core assets to quickly gain insights into energy data and use it to draw very specific conclusions about energy consumption, instantaneously (Business Development Manager, Interview; Software Engineer, Interview; Machine-learning Engineer, Interview).

5.2.1.3 Algorithm development

Even though Watty has already been honoured with awards for their data capabilities, they are also aware that they need to keep developing their approach towards data and how it is being handled. Our findings present a clear trend inside the company to further develop and improve on their current algorithms. As mentioned earlier in 5.2.1.1, Watty's algorithms enable them to process and identify electronic signatures in the household and present it in real-time through the app. However, in order to better identify appliances in the future, especially appliances with resistive load signatures, such as kettles and other heating devices, Watty needs to further develop their algorithms (Machine-learning Engineer, Interview).

Due to the similar electrical patterns of resistor load appliances, another approach is needed to help disaggregate the data and identify the various appliances. The Machine-learning Engineer mentions that a more unsupervised approach for their algorithms when dealing with resistor load appliances, is needed. By developing their algorithms, Watty are able to provide additional services in energy management. However, Watty recognizes that they still won't be able to predict resistive load signatures with 100% accuracy using this method, but it will allow them to present the most likely appliances in use with an 80% certainty for the consumers. As of right now, they use only very simple characteristics of the appliances like the shape of the electrical signature, but according to the Business Development Manager they could also include other characteristics as signal prospecting and add that information to the models to help them better distinguish and detect appliance probability. This could potentially help the company realize new ways of exploiting the granular energy data and expand capabilities as *"anomaly detection*" which will be explained in section 5.3.2.3.

5.2.1.4 Hardware vs. Cloud

Advancing algorithm input to the models could help Watty to better distinguish and detect appliance probability and expand capabilities. However, the Machine-learning Engineer and the Software Engineer both highlight the limitations this might pose if better solutions for processing power are not found. Our findings from the interviews show that one aspect of this issue is the limitations to streaming more detailed data, as they are restricted by the Wi-fi connections used (Machine-learning Engineer, Interview). In addition, the Machine-learning Engineer also comments on Watty's 24/7 processing of data for more than 200 households, arguing; "... now we have two hundred customers or something and it's kind of computational inefficient to run everything on the cloud, you know. So, what would be great of course is if you could run your algorithms directly on hardware now, and then send stuff to the cloud" (Machine-learning Engineer, Interview). He also suggests that as soon as they have more customers, they would be able to utilize the Watty boxes as a distributional computational system to run the algorithms on.

The Business Development Manager also states that Watty is aware of the limitations with processing a larger amount of household with their cloud providers. Therefore, besides the potential in using the Watty boxes as a computational network in the prospect of growing their consumer base, they would also be able to use their Watty box to run their automatic detection algorithms locally. This will allow Watty to optimize their processing capabilities and only use the more advanced algorithms in the cloud (Business Development Manager, Interview). Our findings show that the utilization of the Watty box is becoming a larger focus area for the engineers and the company when looking at how to deal with a larger consumer base. As the Software Engineer explains, the processing power of many of their cloud providers is limited if one is not willing to pay up towards 250$ per household, and hence optimization of this process would be very beneficial (Software Engineer, Interview). However, it should be noted that Watty don’t see themselves as hardware manufacturers and will therefore not invest heavily in hardware development but recognize its importance and thus have still ensured a powerful, albeit simple device for the job (Business Development Manager, Interview; Software Engineer, Interview).

The Software Engineer elaborates on the problem of streaming data 24/7 and the need for constant computing which none of the cloud providers can provide. Hence, the engineers are aware of another solution being needed in the future, as potentially running the most common appliance algorithms locally and the rarer appliance algorithms in the cloud. The Software Engineer goes on to present the Watty boxes as powerful mini-laptops with customizability due to its Linux operating system. This customization can allow Watty to easily program the boxes to run additional process or re-arrange their computational power or memory to better mitigate some of the challenges with the cloud providers. In addition, the customizability of the Watty box also provides the opportunity to be developed into a device compatible with most IoT ecosystems, such as Google Home or Amazon Alexa. This trend is already seen with Watty’s US competitor called Sense, showcasing the next step in smart home integration and energy management with an Alexa skill enabled through an IFTTT protocol (Sense.com, 2018).

5.3 Isolating mechanisms

5.3.1 Technological leadership

Electricity is a necessity for any modern household and has remained unchanged for decades, providing incumbent companies with a stable and easy product to profit from. However, our findings reveal that the new way electricity is *managed*, pose great opportunities (CEO, Interview; Business

Development Manager, Interview). The smart meter appliances provide a comprehensive approach to the management of energy consumption systems (Biscardini et al., 2017). When utility companies implement smart meter appliances however, its usage is constrained by several factors as explained in section 5.1.2.5. However, Watty is not hampered by the same regulations due to not being an energy provider and as such, further discoveries within smart meter technology have been possible, and Watty has delved into this, by homing in on the electrical signature components. This provides them with a higher granular insight into energy data, which enables a new and more detailed energy monitoring compared to previous years (Senior Analyst and PhD candidate, Interview). Today, the energy companies cannot provide consumers with information about their consumption at any given moment. Instead of a weekly or monthly overview of energy consumption, consumers can get much more specific information about their consumption on an appliance level from Watty (Business Development Manager, Interview). In short, Watty provides an entire new information infrastructure towards energy consumption. It is therefore apparent that Watty is trying to leverage an opportunity and exploit the challenges impacting the energy industry.

As mentioned in 5.2.1.1, Watty disaggregate energy data to specific appliances and show that in real-time. Watty´s algorithms process highly complex flows of data as it consists of many different components. These components are the ones that Watty is able to leverage, and display in great detail as shown in a few paragraphs in figure 21. Information from these components therefore presents a solution that Watty is driving a form of innovation within energy monitoring, that has otherwise been non-existent or static for a few decades. According to the Business Development Manager, Watty´s data disaggregation capabilities is what makes the company able to take on the role as an information architecture of household energy data.

Sustaining these technical capabilities also allows for new business opportunities to arise, as explained by the Business Development Manager. He states that the ability to collect this substantial detailed data, can provide a new potential value proposition for Watty that goes beyond energy monitoring. Amongst these new opportunities, several ideas deal with the leveraging of data to either third parties or directly to energy companies as part of grid operations (Internal Watty document, USB Flash Drive). The various information that Watty generates is very reliable and often needed by other companies who operate within energy management services, and as of right now, Watty is among market leaders in retrieving this type of specific information (Business Development Manager, Interview). Thus, our findings indicate Watty positioning themselves as technological leaders in the energy management field. Additionally, Internal documents show that other energy monitoring companies similar to Watty are appearing, which indicates a larger focus on detailed energy monitoring within the industry. However, only a few of these companies share similarities towards

Watty, as most of them are working with non-intrusive load monitoring, mobile applications and smart home integration (Senior Analyst and PhD candidate, Interview).

However, even though multiple energy monitoring companies exist, our findings indicate that energy companies in the industry don't currently need or know what to do with highly detailed energy data, "I also share this opinion that the utility companies do not have the need for much more data. My impression is rather that they don't actually have no idea what to do with that data, even with smart meter data" (Senior Analyst and PhD candidate, Interview). Watty believes that the detailed data collection could support incumbent companies to embrace such opportunities (Business Developer Manager, Interview). These findings indicate that start-ups such as Watty can enable a new potential value proposition through technological leadership, that goes beyond energy monitoring. This is pinpointed by the Business Development Manager, who mentions that Watty provides an advanced informative infrastructure towards their consumers and potential partnering companies. A possible outcome could be that the advanced machine-learning Watty has, provide consumers not only with an understanding of their consumption at any given time, but also how this relates to the electricity price outcome.

5.3.1.1 Integration capabilities

As the industry changes, companies are forced to adapt to new trends to stay ahead of competition. Some examples are solar energy and battery storage, and peer-to-peer energy transfers through blockchain technologies (Business Development Manager, Interview). Similarly, previous industry changes have allowed Watty to exploit opportunities to leverage their technological capabilities and enter a market with previously high entry barriers and heavy regulation. Watty´s CEO explains that the heightened focus on renewable energy and energy management was why Watty was founded back in 2013 (CEO, Interview). Five years later, Watty is still a start-up, but with numerous awards for data handling and is now looking towards the future and the possibility of partnerships with other companies. Hence, Watty hopes to lead the way, when it comes to the collection, analysis and use of energy data in the energy management industry (Marketing Manager, Interview; Machine-learning Engineer, Interview; Business Development Manager, Interview).

In order for Watty to establish this position, it is paramount that Watty adhere to industry regulations as any other technological company. Consumers privacy concerns are one example which often can pose challenges. However, consumers also expect solutions to be so seamless as possible, and preferably integrated as it presents more ease of use. In order to better meet emerging user needs for custom solutions, Watty is utilizing API's compatible with other services if they need to be integrated or accessed by others, as this would be essential in the position as an information provider. Our findings show that privacy issues in data monitoring is a key challenge for any data-oriented company, and especially within the energy industry, where regulations, as mentioned, have limited energy providers in collecting smart meter data (Senior Analyst and PhD candidate, Interview). "Do they collect data? Yes it´s done for many years. Do they share it? No. Because of security concerns" (Senior Managing Partner at Gartner, Interview). Senior Analyst and PhD candidate explains, that this stems from end-users and governments fearing energy providers having access to data that can easily detect consumer behaviour unrelated to energy consumption. Watty has therefore been hesitant in opening these API's up for third parties, and as a result, is currently only allowing homeowners and Watty employees to access this information due to privacy issues (Software Engineer, Interview). However, if Watty is going to be positioned as a strong information provider within the energy management field, a viable solution is needed for both consumers and the company. The Software Engineer states that Watty is currently trying to find a suitable solution for all, by pushing data out to third parties instead of giving full access through the API's (Software Engineer, Interview).

5.3.1.1.2 Partnerships

As presented in section 5.1.1.2, the energy industry is developing new services to deal with environmental changes. Additionally, Watty has also recognized the need to focus on other companies who service the end-consumer. As mentioned earlier, Watty is looking at potentially partnering with other companies, as a possibility to grow their consumers base substantially. Some of these partnerships could include partnering with solar technology and battery companies for private homes. In the hunt for more energy self-sufficient homes, consumers are showing more interest in the prospect of generating their own solar energy and storing any surplus they don't need (Frankel & Wagner, 2017; Hasse et al., 2016; Rubel et al., 2017). However, to know how much energy is needed and when, a reliable and accurate data management tool is needed. The Business Development Manager explains how these companies have already calculated the cost for the installation of a type of smart meter, however this smart meter type is not optimal and very expensive (Business Development Manager, Interview). He explains that Watty could provide an alternative solution for these companies with no added cost, as they already have installation costs associated with their own products. Even though Watty believes that this type of partnership could provide a substantial increase in their consumer base, they do also remain realistic in their future planning. This is because the current trend for energy self-sufficiency in Sweden is relatively low and there is often a long way from words to action when a potential 9.000 Euro investment for a single household is needed (Business Development Manager, Interview)

5.3.2 Procedural switching costs

5.3.2.1 Granular insights

With the capability of providing very specific appliance data, Watty offers end-users an intuitive solution that empowers them to understand and keep track of, which appliances use energy in their home at any time in real-time (Figure 21). This, as Watty's employees state, is a huge accomplishment in itself because it happens within a few seconds (Machine-learning Engineer, Interview). According to the Business Development Manager, "The appliance level breakdown that we do, is unique" (Business Development Manager, Interview). The highly granular insights enable an entirely new way to visualize energy data through their app. As shown in internal documents and explained by the Business Development Manager, their app shows different facets, so the user can acknowledge and comprehend their energy consumption. An example, which was demonstrated during one of the interviews, was inserting a computer charger in a power outlet. Within seconds it showed up on the app, and the appliance was illustrated by a colourful bubble which "floats" around (Figure 21). This shows that through various software technologies and hardware, Watty has been able to transform and visualize energy data, which is often perceived as boring, into energy data that is intuitive and fun to interact with.

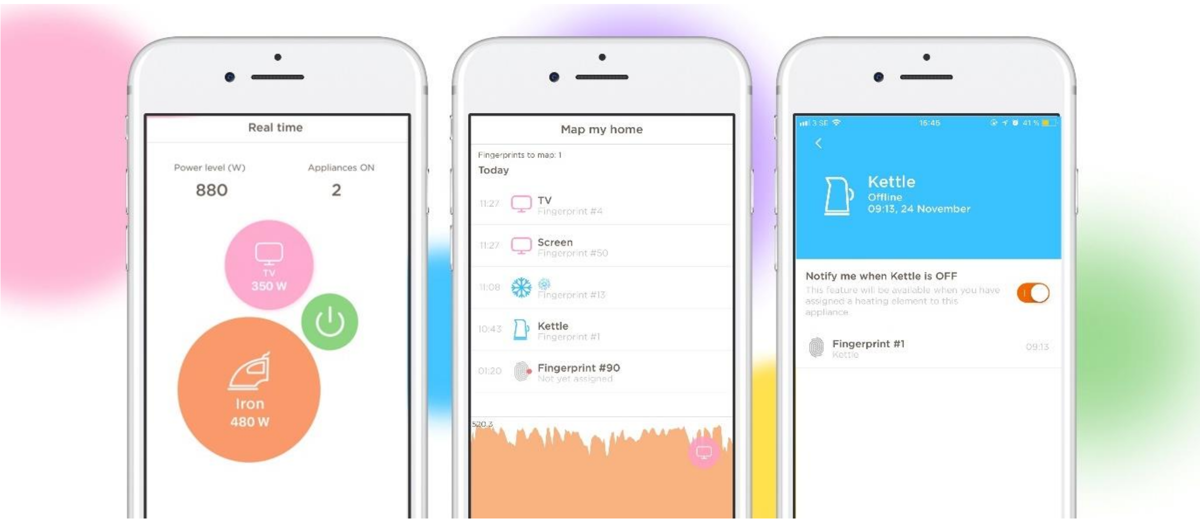


Figure 21 - Watty App

Empowering users to get a very clear picture of appliance level energy usage in their home through strong machine-learning algorithms, is as mentioned what makes Watty's solution unique. Several interviewees highlight that the app has the particular purpose of contributing to the understanding of what is consuming energy, and when (Marketing Manager, Interview; Business Development Manager, Interview). As explained by the Marketing Manager, it has to be extremely simple for people to utilize. According to her, it is all about "...simplifying into a level that my grandmother would understand it, it has to be very simple, extremely relevant to what they do every single day in their lives. Otherwise we will not be able to get through them" (Marketing Manager, Interview). As the Watty solution already enable an entirely new way to visualize energy data, it also introduces a new way in which people engage with energy data. Welcoming this new information and potentially act on it, is yet another thing people would need to relate to in their everyday lives. When first accepting the service Watty provides and establish a certain relationship with it, it would require an effort to change these ways to interact with energy data and switch to another provider.

There is also another factor that puts Watty in a favourable position towards other providers. Watty and the US competitor Sense both utilize non-intrusive load monitoring to obtain highly granular data readings from electricity to new insights and service towards their consumers. However, even though they are similar in design, they are quite different in how they develop their algorithms. The Business Development Manager from Watty mentions that Sense uses a pure crowdsourced approach in developing their algorithm. They have their customers manually label every appliance for the first few weeks, and only after this time is their algorithm able to automatically detect the different appliances. This can provide issues with reaching critical mass, as they are solely dependent on consumer input. Whereas, Watty has trained their algorithm on more than 500 households, which allows them to automatically detect the 5-7 most common appliances that most people have in their home. The algorithms that are not identifiable because they are less common, need manual input. In that case, it is the users themselves who assign the signatures or the "fingerprint" of their appliances. By providing automatic appliance detection for the most common appliances, the Business Development Manager believes that this will allow Watty to more easily incite consumers to provide manual input, as they can see the benefit right away. This reiterates the point that it would require an effort from consumers to switch to another provider. If consumers first utilize Watty, certain behaviour with the service will be established, which supposedly is more user-friendly compared to the US based competitor.

5.3.2.1.1 Granular developments

Although Watty easier can incite consumers to only provide manual input for some appliances and operate with a very user centric approach, the technology is to some degree limited because the amount of training data has not been enough to enable the models to accurately detect every appliance that people has in their homes. In addition to limited training data, many of the appliances have very similar energy signatures, which makes it difficult to distinguish between appliances. Therefore, the company will focus on developing the algorithms, so it can detect all types of appliances. As of right now, our findings have shown that the main appliances people have in their homes, which have often been assigned, are easier for the models to recognize and these can therefore be depicted more quickly with a higher accuracy. Our findings reveal that it is mostly tech-savvy people who utilize the service actively as of right now. To accommodate this obstacle of making sure that less tech-savvy users actually assign their appliances, Watty sends notifications if they have discovered a reoccurring usage of an appliance in the home that they cannot classify in any appliance category (Machine-learning Engineer, Interview). The Machine-learning Engineer states, “We will say: "Okay, now we've seen that this happened four times in your home, do you know what it is? Can you label it?" And then you say: "Oh, it's my kettle." And the next time you start your kettle, it will show up in the app” (Machine-learning Engineer, Interview). However, to make it even better Watty needs more people to actively add different appliances as it will help advance the algorithm. More user input for device registration through the app, will enable the algorithm to better recognize the signatures of all appliances, and eventually, users won’t need to do anything manually.

5.3.2.2 Anomaly detection

In addition to an intuitive solution, another aspect of the service that also favours procedural switching costs for Watty is the *anomaly detection* feature. *Anomaly detection* reveals when an appliance has been active for a longer period than usual, which is why *anomaly detection* is mainly used to fulfil consumers security needs. Today, Watty can do *anomaly detection* on three appliances; iron, hair straightener and curling iron. Oscar Lilja states “If you've labelled your iron or your hair straightener and we see that it's on for a longer than usual period of time, we will notify you” (Machine-learning Engineer, Interview). They are able to do this by looking at patterns in the data. These patterns can identify, for example, the average hair straightener usage time. Each time the user utilizes the hair straightener, the data will update and be added to the normal usage pattern (Machine-learning Engineer, Interview). Another example is if an end-user is ironing their shirts every morning with an average time of five minutes. If the user for some reason decides to iron ten shirts on a Sunday, which will require more usage time, Watty will notify the user as it goes beyond the average usage pattern that the algorithm has registered as seen in figure 22.

Figure 22 - Watty Anomaly Notification

5.3.2.2.1 Household specificity

Although anomaly detection brings appliance security to another level, Watty sometimes find it difficult to figure out how often they should notify people, as it easily can be either too much or too few notifications. Watty is using metadata to determine when people use specific appliances at specific times *compared* to others. In short, it does not make sense to use any fixed-timed algorithm, as there is a high variance in how much people utilize their appliances. In order to ensure proper and household specific anomaly detection, Watty uses algorithms that are adaptable towards the different usages within each home. This way, the algorithms can learn the average time spent using a specific appliance in a specific home, and then constantly adjust notifications based on the specific behaviour of the household (Business Development Manager, Interview).

5.3.2.3 Anomaly detection development

As mentioned previously, the Machine-learning Engineer explains how Watty is in the process of developing a disaggregation algorithm using a memory based neural network, to better detect various appliances and in turn advance their *anomaly detection* capabilities going forward; "We stream both historic, context data, and event-data into what we called a recurrent network. Which is the neural network that has a memory as well" (Machine-learning Engineer, Interview). Their ability to improve their current *anomaly detection*, strengthens Watty's position in a more user-centric industry that focuses on new services. The development of these algorithms is key to ensuring continuous development. Watty’s move towards new ways of utilizing the data indicates an actionable mindset that continuously challenges different ways in which their main asset is being exploited, as for example detecting anomalies in appliance usage. However, Watty employees have also acknowledged that if they wish to further improve their data, then they will need to overcome some of the restrictions in their current processing method. It currently depends on their Watty box and cloud computing providers to process that data. This solution works well with the current demands of their software and the granularity of data that they are collecting.

5.4 Key Findings

In this chapter we have presented our findings concerning the energy industry and the Swedish start-up found in our primary and secondary data. We divided the findings chapter in three main sections; 5.1 Environmental enablers, 5.2 Firm-level enablers and 5.3 Isolating Mechanisms. In section 5.1 we explained findings in relation to the emerging electricity demands, the energy management field, as well as the technological capabilities of energy companies including their approach towards data. In section 5.2 and 5.3 we presented Watty´s granular energy insights, technological capabilities, approach towards the future, and the future aspirations that the company holds. Based on our above findings we have collected some of the most important insights and highlighted these in table 5, table 6 and table 7. We will present these findings along with the rest in our discussion in chapter 6, where we will apply them towards our conceptual framework presented in chapter 4.

	Key Findings **Environmental enablers**
1	New electricity demands amongst consumers encourage new energy management needs.
2	New services within energy management are becoming the new premium service for energy providers.
3	Utilizing information technology and Big Data is one of the major capabilities and competitive advantages embedded in the development of companies in the energy sector.
4	Smart meters have become more prominent in the industry than most any other technological equipment in this era.
5	Many incumbent energy companies have been ill-equipped to handle large amounts of data resulting in partnerships with specialized digital providers.

Table 5 – Environmental enabler Findings

	Key Findings Firm-level enablers
1	Watty has been able to transform and visualize energy data, which is often perceived as boring, into energy data that is intuitive and fun to interact with.
2	Market leading machine-learning algorithms and quick data processing provides real-time energy insights for consumers.
3	The algorithms can learn the average time spent using a specific appliance in a specific home, and then constantly adjust notifications based on the specific behaviour of the household.
4	Watty´s key strength is their ability to measure energy consumption on an appliance level, as opposed to utility companies, who only measure the total energy consumption of households.
5	Watty's algorithm is improved through network effects – the more people who use it, the better it gets for the consumers.

Table 6 - Firm-level enabler Findings

	Key Findings Isolating Mechanisms
1	Watty provides an entire new information infrastructure towards energy consumption.
2	The company is driving a form of innovation within energy monitoring, that has otherwise been non-existent or static for a few decades.
3	The data disaggregation capabilities are what makes Watty able to take on the role as an information architecture of household energy data.
4	High granularity data allows Watty to automatic detect appliances, pushing innovation within energy management and *anomaly detection* providing new services for the consumers.
5	Watty technical capabilities allows them to position themselves as an important information provider within the energy management field.

Table 7 - Isolating Mechanism Findings

Chapter 6

Discussion

Based on our findings, review of current research within this topic, and our conceptual framework, we attempt to answer our research question through the following discussion. Revisiting our research aim and focus in section 1.3, we aim at answering the following question: *How can a start-up utilize their technological capabilities to be competitive through the digitalization of the energy industry?*

The purpose of our research has been to examine the energy industry and analyse how a start-up can position itself to gain competitive advantage through technological capabilities. We will focus our attention on discussing the significance of our findings in light of the current research within this topic and appropriate strategic concepts. With this, we aim to propose new understandings or insights about Watty's position and present how Watty is leveraging their capabilities. In the following sections we will present the main parts of the discussion towards our conceptual framework and how the environmental enablers support the isolating mechanisms together with Watty's resource-level enablers. Remaining sections will highlight the importance of our research, how this can encourage further research and finally, the possible implication of our research study.

The changes in the energy industry have enabled integration of new technologies, which can contribute to smarter ways of managing energy consumption. The integration of smart meters has fundamentally changed how energy companies have operated for decades. The most profound consequence of this implementation is the revolutionary insights about consumers that utilities can gain access to through the data collected. This relates to energy company´s new insights about consumers energy consumption, which Uckelmann et al. (2011) further claim is also becoming a larger focus for consumers themselves thus presenting a new demand paradigm for the energy industry. We believe that this paradigm shift has contributed towards the development of an energy management field within the industry which complement Watty. Based on our research question, and our findings, we hypothesize that Watty can leverage first mover advantages in order to gain a competitive advantage in the energy management field. We will throughout the discussion present our findings in correlation with our literature and strategic concepts in order to try and confirm our hypothesis.

6.1 From an established field to emerging industry

6.1.1 Shifting focus

Findings from this research prove that technological early adopters and environmentally conscious user influences have challenged established energy companies and encouraged a more progressive development towards energy management. Zipperer et al. (2013) presents how a larger focus on sustainability has given way to an increase in renewable energy consumption. This is supported by our findings which show that within many energy providers, renewable energy has become the new standard energy source instead of a premium service. Consumer receptiveness for new energy sources has ultimately given rise to new energy *services* as well, and our findings signify that basic energy management services are starting to become the new premium service within incumbent companies. With the introduction of a new premium service, the entry barriers within the energy industry have shifted and allowed for new entrants to sense opportunities in energy management.

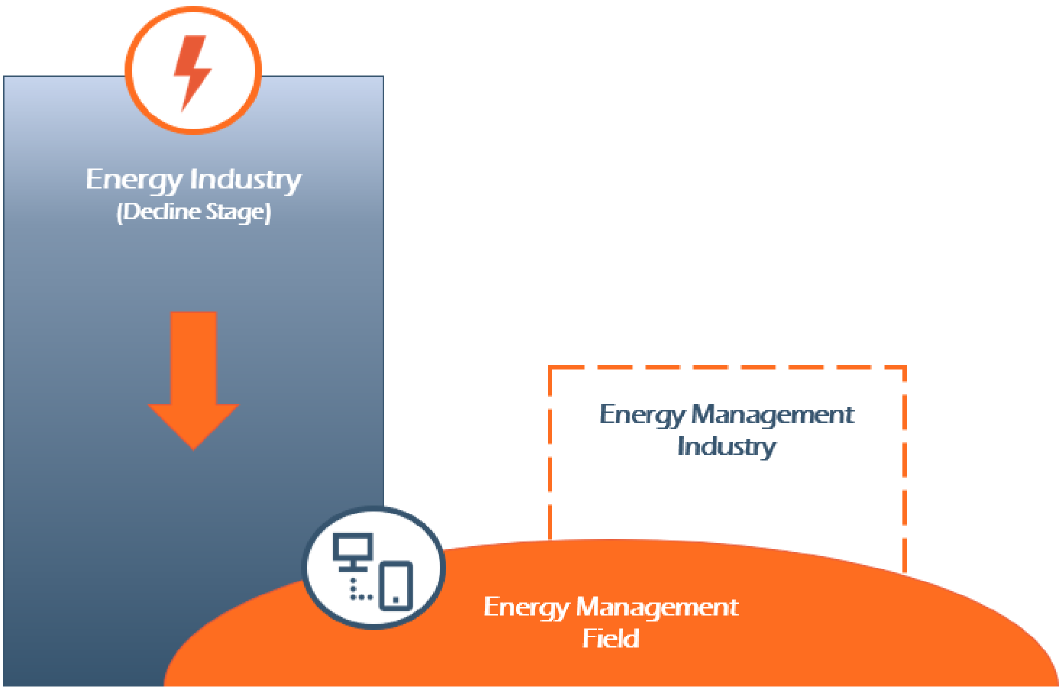


Figure 23 - Emergence of Energy Management Field

This shift reiterates the fact that the traditional energy industry is entering the decline stage in the industry life cycle as presented by Grant (2016). Simultaneously with the overall decline however, an aspect of this industry is emerging, which is what we have coined as the energy management field, which we believe could develop into its own industry. We have depicted this in figure 23. Two influential factors of this evolution are new technology opportunities and new accompanying consumer demands for sustainability, shifting focus towards the upcoming energy management field. The change towards this new emerging field, has made it possible for Watty to demonstrate its strengths in continuation of its basis of competitive advantage, and target the new market conditions towards energy management.

6.1.2 Energy management

The energy management field is currently presenting as an emerging field in the energy industry but is also indicated to be one of the important aspects of the smart city industry. We believe that due to the relational aspect of the energy management field and the smart city industry that further development of the smart city industry plays a crucial factor on the development of energy management. Also, the technologies that will flourish within the smart city industry play an important impact on energy management. Thus, we would argue that in the future, the smart city growth will lead the energy management from a field to an *emerging* industry (Figure 24). Therefore, the smart city industry development displays an important environmental effect on Watty´s positioning.

We argue that the technological developments within the energy management field are partially influenced by the evolution of the smart city industry. This industry presents high complexity as the industry needs to integrate many crucial factors and must consider many things when so many parts of society will be connected (Hashem et al., 2016). This highlights the need for proper management and detailed information about energy expenditure enabled by advanced technologies. It also reiterates the fact that energy management is an important aspect in the smart city industry. Therefore, the development of the smart city industry poses great opportunities for Watty to *sense* new changes. It is claimed that the future IoT architecture within the smart city environment will develop into an information ecosystem (Davenport et al., 2012). This ecosystem will span a network of numerous services sharing information and creating new insights for businesses (Davenport et al., 2012). A valid point would be that Watty could position itself as an information provider in the emerging energy field.

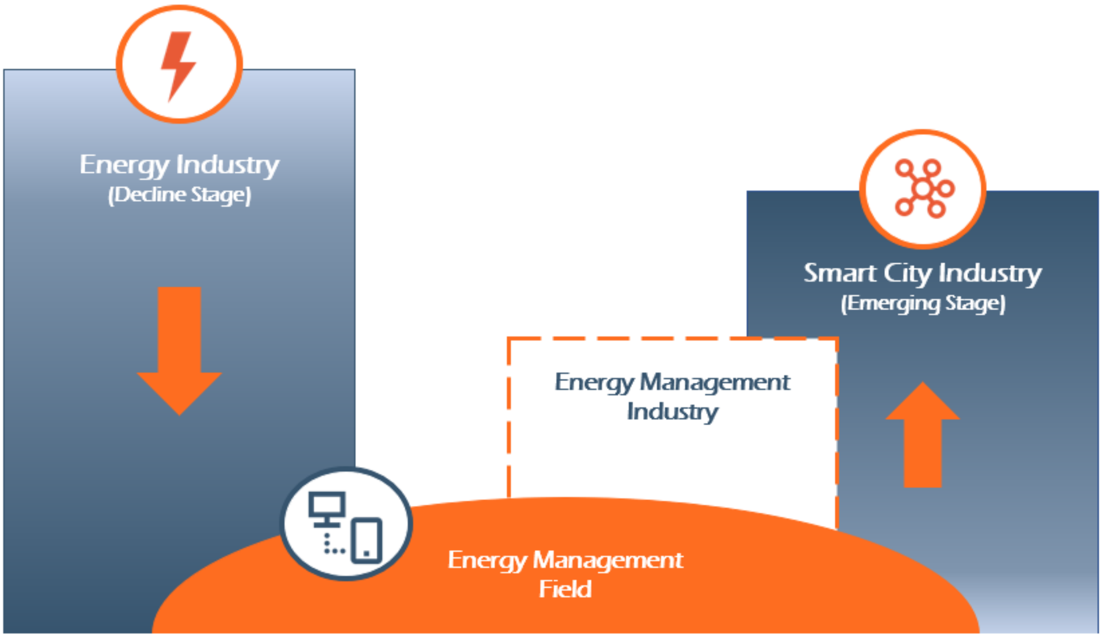


Figure 24 - Energy Managment Industry

The smart city industry is complex in its nature and dependent on generally all aspects of society, as all industries need to be more digitally connected and willing to participate in the integration process. To this end, Wilson et al. (2015) and Balta-Ozkan et al. (2013) also argue the importance of providing user-centric approaches to ensure proper engagement and adaptability. Due to its complexity and necessary engagement it is argued that the smart city industry operates within a steady but continuous development, indicating a slower evolutionary pace for this industry compared to other disruptive industries that appear today. Even though projections for the smart city are impressive in the coming years, the evolution is still undergoing incremental changes with technology and adoption (Reuters, 2018). Based on the assumption that the energy management field develops correspondingly with the smart city industry, we also perceive the *market evolution* within the energy management field as evolving at a *smooth pace*. Moreover, the connectivity that Watty's IoT service provides is also part of the current development of devices within the IoT landscape.

It is claimed that the IoT is the main component of the current technologies that are being designed for the smart city industry (Jensen et al., 2014; Reuters, 2018). However, our findings show that technologies are still being developed which are essential in order to strengthen IoT growth to a greater extent and to ensure a higher adoption rate amongst consumers. One example of the developing technologies are the current data handling and storage capabilities which struggle to manage the IoT´s requirements for its applications (Marinov et al., 2017). As there is a constant focus on developing new technologies that are crucial for the IoT landscape, and hence the smart city industry, we also consider the *pace of technological change* as evolving at a *smooth pace*. The smart city industry is undergoing incremental changes with technology and adoption, and due to the combination and alignment of technology and market growth for this industry, we argue that both the *market evolution* and *technological change* is evolving at a smooth pace. We further argue, that because the energy management field develops correspondingly with the smart city industry, this field also evolves at a smooth pace.

In earlier paragraphs, we have discussed how energy management is an important aspect of the smart city industry and possess IoT services that contribute to the technology landscape for the smart city industry. These points make it valid to discuss how the development of the growing energy management field into an individual industry, is dependent upon the *market evolution* and *technological change* within the smart city industry. As Watty is positioned in the energy management field, the aligned paces of smooth *market evolution* and *technological change* in the smart city industry can create favourable circumstances for Watty. Suarez and Lanzolla (2007) argue that when both environmental dimensions have a smooth evolutionary pace, it provides strong conditions for companies, such as Watty, to leverage *isolating mechanisms* and ensure early market share through FMA. This will also help ensure Watty's position when incumbents fully begin entering the energy management field. In the figure below (Figure 25), we have highlighted a few of the environmental enablers and adapted them towards our conceptual framework.

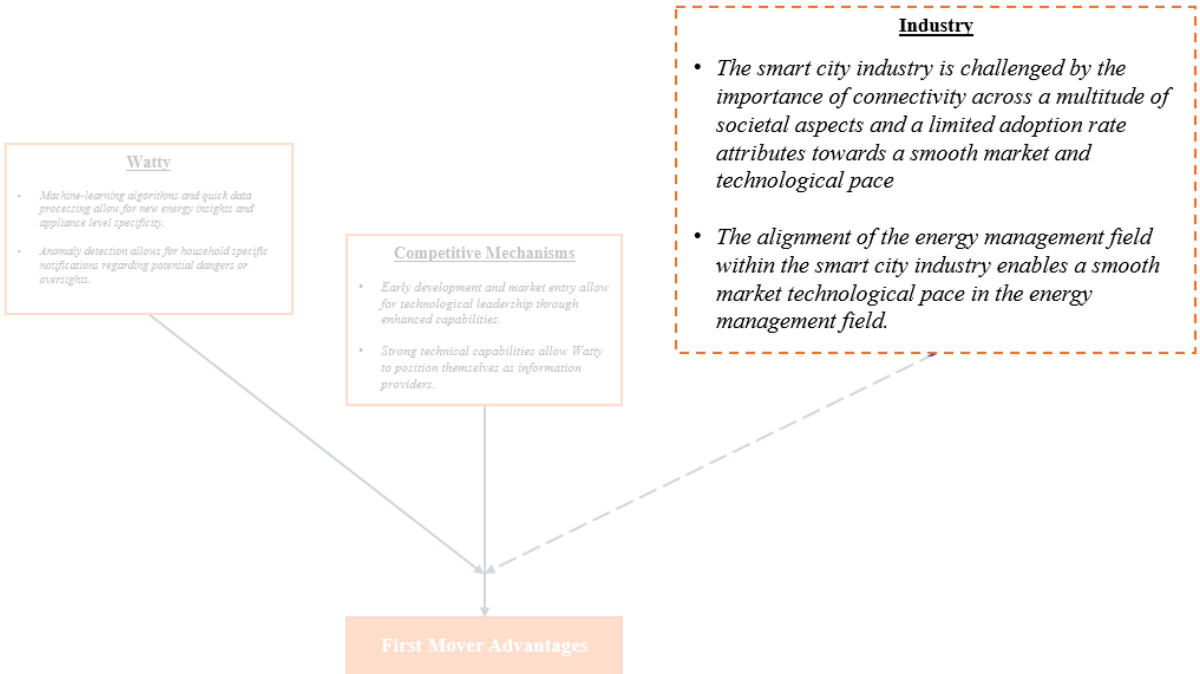


Figure 25 - Industry Enablers

6.2 Competitive mechanisms

6.2.1 Understanding energy

Shifts in consumer demands as mentioned in section 5.1.1, has been coined by Suarez and Lanzolla (2007) as one of the driver behind the *isolating mechanisms* in which a company can establish first mover advantages (FMA) when joining an industry. Our findings show that Watty has benefited from an increasing curiosity towards energy management amongst consumers. This interest towards energy management was already recognized by Uckelmann et al. in 2011, as consumers were becoming more interested in understanding their energy consumption, something they hadn't been exposed to in previous years. An example is stated by the CEO, where he mentions how energy information has remained unchanged until recently. This has mainly been due to the lack of technology such as smart meters, which prevented a more detailed understanding of the energy consumption beyond that of a yearly update (CEO, Interview).

Energy companies have responded to the increasing curiosity towards energy management, and therefore established initiatives to help customers to better understand energy consumption. However, there is a considerable distinction between how the utilities have addressed this curiosity compared to Watty. This distinction relates to how *often* data is collected and to which degree. Due to regulations protecting consumer privacy, energy companies can only collect energy data every 15 minutes, and only the *total* household consumption is collected. The recent implementation of smart meters and energy companies' progression with data capabilities, means they can now provide consumers with services enabling them to look at total consumption overviews on a weekly or monthly basis. This indicates an increased focus on data strategy within energy companies.

With the speed and granularity at which Watty collects data, the company is highly differentiated in its service compared to energy companies. The Watty box collects 100 hertz of data every second, in real-time, and not only on total consumption but on appliance level. Therefore, the more general consumption overview provided by energy companies has been transformed into a straightforward real-time service, which results in an entirely new way of perceiving energy consumption. Within the heavy field of energy, this is a bold challenge, as few people understand the difference between kwh and kw. Watty has been able to transform something as abstract as energy data, into something very concrete. The company has been able to translate information into meaningful insights and created a strategic advantage for themselves, which according to Madnick et al. (2009) often is a true struggle for companies.

Watty has started to meet some of the energy management demands, and at the same time accommodated some of the technological demands seen in society, such as connectivity and intuitiveness. The company's aim is to educate consumers through an intuitive solution and service, which goes beyond that provided by incumbent energy companies. It is stated, that if IoT technologies are going to serve its purpose of helping users to make better decisions about energy consumption, it is important to consider a user-centric approach, as the main purpose with smart city services is to make people's lives more seamless and not more complicated (Balta-Ozkan et al., 2013; Uckelmann et al., 2011; Wilson et al., 2015). Smart meters may have relieved consumers of manually reading their energy consumption off their fuse box, however, the smart meters only provide consumers with the most basic information about their total consumption. Hence, Watty's service will provide consumers with a new information standard – one they can't get with incumbent companies. In short, Watty is able to leverage and present the right information in the right format (usability), to the right person at the right place and time (availability) (Ghasemkhani et al., 2014). We believe that Watty is able to capture a *niche market* by acting as a new information sharing provider. This position also indicates a potential lock-in of customers, as it would be inconvenient for Watty customers to change to other providers. People are not used to being so informed about their energy consumption and providing consumers with entirely new information can potentially create an even stronger relationship with Watty. Therefore, Watty could also achieve the first mover advantage of establishing a loyal customer base and introduce procedural *switching costs* based on consumer preferences.

6.2.2 Sensing new opportunities

The way in which the company has detected the opportunities in the market exhibit what Teece (2007) would define as an ability to *sense* new changes, that can prove favourable to the company. In short, this has allowed Watty to *sense* a niche market for energy management services. Although Watty, as any other start-up, has changed focus along the way, Watty has proven the capability to purposefully adapt and develop strategies and proper infrastructure in order to embrace - *seize* - the *sensed* opportunity. Furthermore, the company has applied a comprehensive approach towards the integration of these strategies and been able to execute in implementing its service in households. The company has as mentioned addressed the opportunities by acting as an information provider in regard to energy consumption, which is very different compared to what the energy companies do. We can therefore claim that Watty also showcases an ability to challenge aspects of this field.

Through our findings and literature, we have also observed an approach towards data that has changed fundamentally. Previously, data that companies have collected was used as a tool to utilize in different business functions and processes. However, as our world moves at a faster pace than before, enabled by advanced technologies, companies are *sensing* the changing function that data is proving to have. Therefore, we argue that data is garnering larger focus in strategy formulation as it takes on a more active role as a key asset, instead of just a tool, as is described by the second tier in Mazzei and Nobles (2017) framework. We argue that, this asset would be something any company should engage in to a much higher degree than before, due to its consequential influences on various aspects of business. For some companies, data has already become the core asset that the entire company is built on. Hence, the company would not exist without its data collecting, storing, and analysing capabilities.

However, the literature highlights that for companies to develop a successful strategy, they must also be aware and realistic about their data capabilities and the competitive landscape around them. Our findings indicate that Watty is continuously exploring, or *sensing*, ways in which they can grow individually but also in partnership with other companies. Its strength as an information provider is something Watty has realized would be of great value for other companies, in order for the company to enhance its business model. Watty has in that regard acknowledged the potential of partnering with solar production and home battery solution companies to try and grow their consumer base. Watty recognizes that partnering with these companies will allow them to be exposed towards a more relevant and susceptible customer base, than if targeting single households our through incumbent energy companies. In their study Xie et al. (2016) mention the disillusionment of companies when looking at their own data capabilities often leads to unrealistic expectations and reduced value. However, the obtained findings indicate how Watty has been able to seize the sensed opportunities in the changing energy market, as well as applying a comprehensive approach when establishing itself as an information provider. Additionally, internal documents, interviews and our own observations strengthens our belief that the start-up showcase strong dynamic capabilities.

6.2.3 Appliance-level energy data

The basic information provided by energy companies could be a consequence of enhanced complexity through increased *connectivity*, which in turn demands more advanced techniques and thus pushes incumbent companies' data capabilities to the limit. It has been highlighted how data handling can be particularly demanding in the energy industry, as there is a high degree of *variety* in energy Big Data (Koseleva & Ropaite, 2017). It has therefore been paramount for Watty to have the right capabilities in place, in order to tackle great amounts of data input. Literature found throughout this research claims that large volumes of varied data can potentially provide more insights that can help solve business issues or detect new perspectives. This is aligned with our findings, where the most profound difference in how the incumbent energy companies and Watty leverage information to customers is, how Watty is able to handle the data by transforming highly detailed and appliance specific data in real-time, into true information and understandings about household energy usage.

The important point here is that providing basic energy data about total consumption does not necessarily provide any understanding and increased knowledge without the correct data processing capabilities and medium to deliver it through. This pinpoints the need to present data and information in the right format as mentioned by Ghasemkhani et al. (2014). Most solutions up until now have focused on the total household consumption and how to manage that, including utilities with the smart meter development. However, Watty has addressed this potential at another level, and looked in much greater detail at what contributes to the total consumption. Regarding Watty's data collection, Davenport et al. (2012) pointed out that it is important to be aware of the challenges related to the ability to deal with a *variety* of data when managing data in *real-time,* as it requires a more continuous and high-paced approach towards data handling. In the energy industry specifically, this can be extremely demanding as there is a high degree of *variety* in energy Big Data (Koseleva & Ropaite, 2017). Therefore, the traditional view on Big Data with clean classification and a tendency towards aggregation and generalizability, is challenged when larger heterogeneous data sets need to be managed (Constantiou & Kallinikos, 2015).

In this regard, one of our key findings shows how Watty's ability to process data through their machine-learning algorithms in real-time is beyond what the current incumbents in the energy industry are able to. Watty generates much more data, and in more detail per household as compared to energy companies. Although Watty does not have the same customer base as energy companies today, it is still interesting to consider whether Watty, with a larger customer base, would be able to store and analyse these amounts of data. As mentioned earlier, a company's success in any industry, and especially in industries like energy management and smart city, is entirely dependent on the abilities to store and analyse data. As we understand from our findings, Watty has unique capabilities in place to develop complex algorithms that are required in order to process the large volumes and varieties of data. In that sense, Watty has today, established somewhat of a *technological leadership* in data handling.

As discussed, this provides Watty with technological advantages towards the rest of the industry which in turn can provide potential lock-in effects towards their consumers. Suarez and Lanzolla (2007) and Grant (2016) argue that by establishing lock-in effects through isolating mechanisms, towards the consumers early on, it can help establish a basic market share in a new market. In addition, by establishing *technological leadership* through their machine-learning algorithms and continuously developing their capabilities, Watty supports the arguments presented by Khajenasiri et al. (2017), that there is a need for more advanced algorithms to deal with increased complexity in IoT landscapes and to ensure better adaptation.

6.2.3 Capturing early market share

Our findings show that IoT and Big Data technologies are driving the growth of energy management practices and present a multitude of new possibilities for consumers. However, the lack of common *standards* within IoT technologies, provide obstacles for establishing product leaders and slows the innovation process of technology for further development within energy management (Fan et al., 2014). With no clear product leader, some technologically based *switching costs* are negated for consumers when choosing which firm should provide their energy management services. Our findings and figure 7 in section 5.1.1.2 show, that 70% of consumers are most likely to choose a firm which specializes in connectivity and smart devices. However, 61% of consumers mentioned that they would also be willing to choose their energy provider if a new service was provided. These numbers could be disconcerting as it indicates a fairly strong relationship between utility companies and consumers in the industry. This may pose some difficulties for customer lock-in for Watty, even though as mentioned earlier, Watty may have established some procedural *switching cost* based on consumer preferences. However, if Watty is able to lock-in customers before the incumbents gain market share, they could have a great competitive advantage over established firms, as well as other entrants. The incumbent companies are however aware of the changes in the industry, and our findings further show that even though they can’t offer the same services as Watty yet, they are investing a lot of attention on engagement through digital platforms in order to ensure long-term customer satisfaction. Figure 17 in our findings section 5.1.2.3 shows how the growth in digital engagement has increased consumer satisfaction. In the figure below (Figure 26), we have highlighted a few of the isolating mechanisms and adapted them towards our conceptual framework.

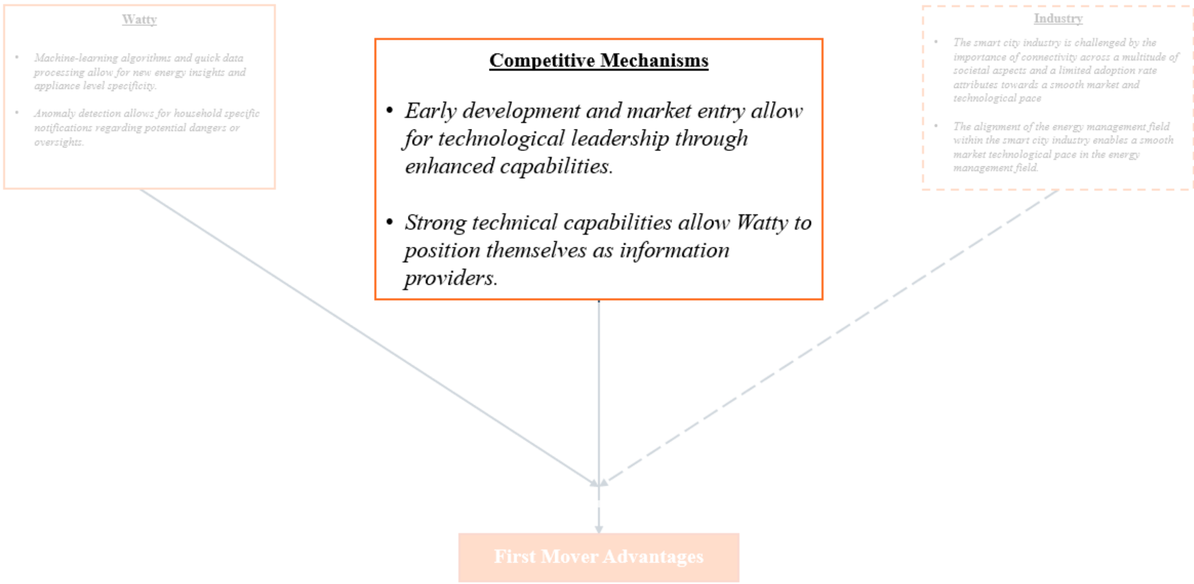


Figure 26 – Competitive Mechanisms

6.3 The basis of competitive advantage

As we have discussed, Watty has seized opportunities in the energy industry, as an increasing demand for sustainability has led to an emerging focus on managing energy and energy efficiency. We have argued how the company has capabilities in place to achieve a favourable position in this industry. The question, however, is more specifically how Watty may have had the ability to capture a valuable resource that highly contributes to first-mover advantages. It is argued that a competitive advantage is based on a valuable resource with certain properties, and what resources a company has, relative to its competitors. Furthermore, certain alignment of a company's needs and use of resources such as data, needs to be in place to ensure optimal value (Ghoshal et al., 2014). There are several beneficial environmental conditions that are favourable to Watty's development. Amongst these are the advances in technology, the changing circumstances in the energy industry which includes the growing branch of energy management, and finally the interest from customers due to sustainability. These factors provide one aspect of the entire formula to ensure a strong and sustainable competitive advantage for Watty. In short, Watty needs to have the abilities to execute on these external opportunities, which can be achieved through their own internal capabilities.

6.3.1 Value to consumers

It can be argued that the service Watty provides is not yet an actual managing energy tool. However, their current services contribute to an important educational movement of how people can *understand* energy consumption and potentially make changes to their behaviour which ultimately can lead to a more sustainable and insightful consumption in total. The ability to translate the often abstract notion of energy data to something understandable, indicates Watty's ability to leverage good information practices to ensure customer satisfaction. Findings from Watty reveal how consumers have reacted positively to energy management insights and indicates how the Watty solution can provide added value to the consumers (Marketing Manager, Interview). Additionally, Günther et al. (2017) argue that the use of Big Data often allows for new services and products that enhance customer relationships and bring added value. The key value of the solution is the specificity of the data, that enables increased security, more actionable insights about energy consumption to enhance energy efficiency, and peace of mind as mentioned in section 1.2.1. A key aspect of this is how this information is presented to the consumer. It is often mentioned how a user-centric approach is crucial to consider when developing new solutions as it could affect adaptability (Uckelmann et al., 2011; Wilson et al., 2015). Marketeer Marketing Manager also pointed out that if the product or service is less intuitive in its design and functionality, it may be rejected from consumers within seconds, which reiterates the point from Ghasemkhani et al., (2014) about displaying data and information in the right format. Watty has put great efforts into creating an educational experience for their consumers through advanced visualization, which has become a strength the company holds today, and will continue to focus on in the future.

The appliance specificity and intuitive visualization contributes to the value added for consumers and provides a new *standard* for how to look at household energy. It is fundamentally different from how the energy providers previously have provided consumers with information. The real-time flow and specific appliance data present a specific knowledge creation and experience effects that consumers have when they evaluate energy consumption and thus provides Watty the opportunity to further establish their *technological leadership* in how energy consumption should be viewed. As such, Watty needs to keep developing their technological acumen to be able to process data in real-time, as Sagiroglu and Sinanc (2013) argue that some data is subject to time sensitiveness and risks becoming outdated if not processed in time and hence can limit the value Watty delivers. However, Watty's continued development of processing real-time data and *technological leadership* contributes towards a possible FMA, as traditional systems are not able to process high velocity data and thus need specialized data systems (Gandomi & Haider, 2015; Suarez & Lanzolla, 2007).

In short, it is questionable if people, when becoming used to real-time data flow with high appliance specificity, would be interested in going back to less speedy and less informative solutions. One can therefore argue that Watty, with its great design advantages, has acquired a *niche area* within energy management. The educational process about managing energy, can therefore be argued to be one of the value adding contributions in Watty´s service.

6.3.2 A strategic window

Watty's development was, as mentioned earlier in section 1.2.1, based on the growing focus on sustainability and lack of change within the energy industry. Watty entered the energy industry just as market evolution began shifting towards energy management, and the pace of technology evolution also began showing trends within energy management, as is seen with the introduction of smart meters. The Business Development Manager further states that the energy management field is only just being explored commercially, hence also creating difficulties in establishing the actual market size of the energy management field. Consequently, the company has been able to leverage their capabilities at a specific time in the declining energy industry and encourage involvement in the energy management field. Thus, we argue that Watty has seized a *strategic window*, taking advantage of its capabilities within a specific time, which has empowered the company to become a leader in a currently *niche market* for detailed energy monitoring (Abell, 1978 in Kerin et al., 1992). These early stages of market and technology evolution have provided Watty with a *rare* advantage towards incumbents. Watty can already present functioning and reliable energy management solutions for their consumers, which we believe will allow them to establish a strong reputation amongst consumers and allow them to *lock-in* customers to their product and create a niche market unchallenged. Watty's early timing is a rare and important benefit in their attempt to secure a strong FMA, as incumbent companies have only recently begun developing similar capabilities. It can therefore be argued that the company in itself represents a valuable resource which makes it possible to establish itself as a strong information provider within the energy management field.

6.3.3 Watty´s skillset

Watty was founded in 2013 and has since its inception worked towards developing a strong disaggregation machine-learning algorithm. The way in which Watty is able to break down total consumption is new to the energy industry, providing Watty with a head-start and advantage. Due to Watty's long and intensive period with developing their algorithms, they have established a process to disaggregate and detect anomalies in data that is hard to replicate due to the time invested. Hence, developing a company's data capabilities early on can provide a strong position later, as the demand for data collection and processing will only become more challenging. In some cases, it is argued that if companies are unable to store and analyse data properly, it could be considered irrelevant to collect any data in the first place. In short, information can be worthless if it does not display availability and usability, (Ghasemkhani et al., 2014). It is also argued that through the skills and strategy of companies, data can achieve value and uniqueness (Braganza et al., 2017; Lambrecht & Tucker, 2016). If any of the incumbent companies were to do the same, it would require a large monetary investment (Business Development Manager, Interview).

The various literature examined highlights the importance of proper data capabilities and argues that without them, substantial value could be lost. That said, it also states that there is always some value to be extracted from data, even if it's just minor (Davenport, 2006; Lycett, 2013; Normandeau, 2013; Perrons & Jensen, 2015). The argument for whether a company should invest in data capabilities, is dependent on their corporate strategy and potential return on investment (ROI) as mentioned above. Our findings show that incumbent companies are still in the process of aligning their data strategy with their corporate strategy. As such, it is very unlikely for any of the incumbent companies to invest heavily in building data processing capabilities until this alignment of their data strategy and corporate strategy is completed.

In essence, it would be easier for the incumbents to acquire Watty as a company, than trying to replicate their algorithms and disaggregation process. As stated in our findings, Watty has shifted focus over the years, with updates over the last couple of months indicating a more focused approach towards Watty's next strategic steps and consumer growth. The specific knowledge that has been flourishing within the company since its establishment, is influenced by diverse competencies that have been essential for various aspects of the business. Often, the abilities to exploit various skills and competencies of a company, provides the true value of technologies (Mata et al., 1995). Their expertise within the energy industry, engineering skills and five years of development, are some of the key strengths that make Watty the IoT company it is today – a combination which is hard for other companies to replicate.

6.3.4 Unique machine-learning

Watty's disaggregation method; how the company is able to collect and process appliance-level energy data, has proved to be much more advanced than the incumbents' smart meter system. Although there are reasons for this, i.e. privacy regulations, it can be argued that it would be very difficult for the incumbents to substitute the service that Watty provides today despite having smart meters as a starting point. In particular, the incumbents are able to provide better efficiency through a variety of data sources and machine-learning algorithms, however they still lack the ability to disaggregate the data in more detail (Hopf et al., 2016).

Specific Appliances Prediction and Recurring Patterns are two processes that are essential for Watty to perform its disaggregation method. These specific processes assume key functions for Watty's machine learning algorithm. The Watty architecture (Figure 19) seen earlier in section 5.2.1.1 may present itself as a simple solution. However, when taking into consideration that Watty is also able to collect various electrical signatures, disaggregate them down to appliance level, automatically detect which appliance it is and visualize this on their app within a few seconds, it becomes that much more impressive. Compared to the incumbent companies' skills of presenting total consumption of energy, it is arguably much more complex to present appliance-level energy data, as Watty has to consider a high degree of variety in the collected data. In addition, it is argued that utilizing a disaggregation method is particularly demanding in the energy industry because of the variety in energy Big Data (Koseleva & Ropaite, 2017). Thus, the success is dependent on what kind of technology Watty has employed. It is with no doubt, that the time Watty has taken to develop strong machine learning skills, has been advantageous for the company. We argue, based on our findings and shared viewpoints from Ghosal et al. (2014) and Günther et al. (2017), that large amounts of varied data is valuable if you have the correct capabilities to handle it. Hence, Watty's data specific ways of collecting and processing data seem to solidify their technology advantage towards the incumbent companies.

The collected data is also used to run algorithms for *anomaly detection*. Watty's anomaly detection is among the elements the makes them difficult to substitute with other services. As mentioned in section 5.3.2.2, the algorithm is able to distinguish between behavioural pattern anomalies in one type of appliance within different types of homes. This is done by considering the average usage within each household, but also the consumer's individual usage patterns. One could argue that this shows the company's initiative to look into the data and try to detect new relationships and patterns – something that is considered a favourable approach when utilizing Big Data (Perrons & Jensen, 2015). A consequence has been an ability to advance from detecting appliances, to including more energy management focused features in the service. Through these detections, the algorithm can accordingly customize notification streams to the consumer. The reason why this is valuable for the consumer, is because there are sometimes great differences in how much a household is using an iron for example. A household with two people would have an entirely different average and usage pattern than a household of five people.

It is explained by Douma and Schreuder (2013) that the resource-based view and accompanying VRIN framework highlights the need for a resource to have certain properties if it is to create the basis of competitive advantage. In our research, we have not only looked at one resource which Watty possesses, but rather looked at the properties of the entire company that could contribute to competitive advantages. In the figure below (Figure 27), we have highlighted a few of the firm-level enablers and adapted them towards our conceptual framework.

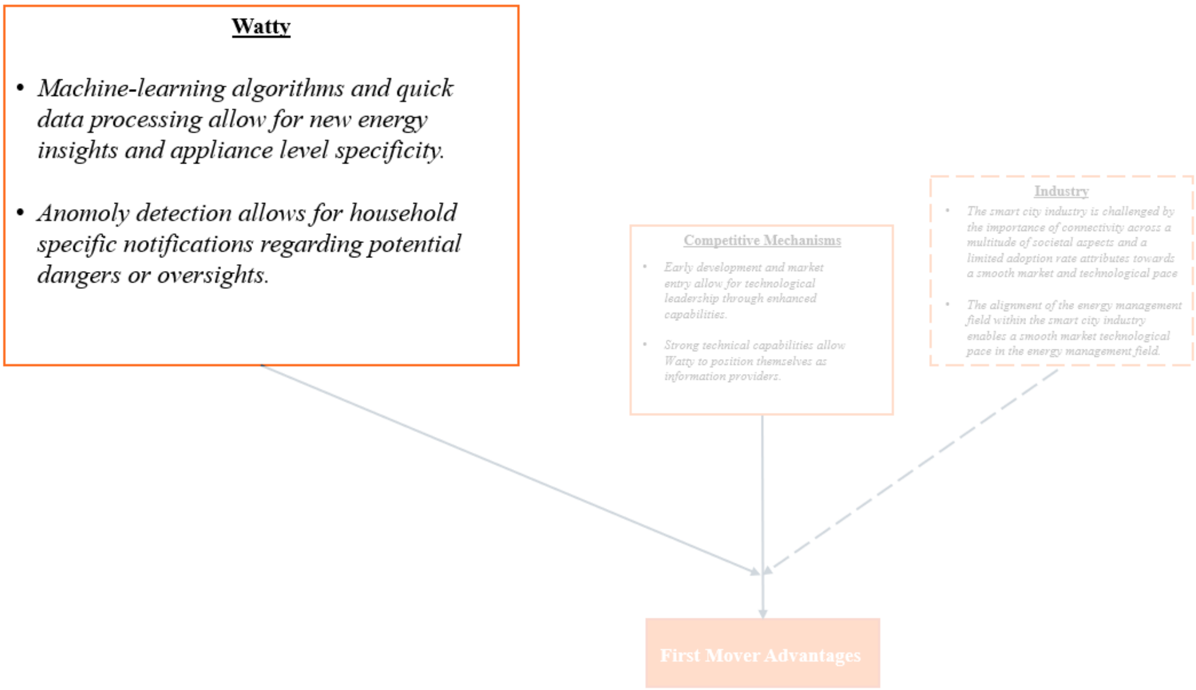


Figure 27 - Watty Enablers

6.4 First Mover Advantages

Watty has put great effort into becoming an educational, *value* adding information provider for their consumers – a key strength for the company today. We also argue that the firm has established a valid basis for achieving technological leadership. Furthermore, Watty has exploited its capabilities within an appropriate time-frame, a *strategic window*, which we would argue, has resulted in a rare advantage towards incumbents. Watty's ability to apply *inimitable skills* within the firm, has contributed and enhanced the true value of the technologies the company possesses. With these skills, we believe that Watty now has a strong head-start within the energy management field, which is difficult to replicate. Finally, Watty showcases *unique machine learning* algorithms which purposefully collect and process appliance-level data, distinguishing itself advantageously when compared to incumbents. We argue that these skills and capabilities are part of the firm-level enablers that support the *competitive mechanisms* contributing towards first mover advantages (Figure 27).

The competitive mechanisms along with both the Watty enablers and industry enablers, contribute towards Watty being able to leverage first mover advantages and ensure an important competitive advantage and subsequent market share. We have in figure 28, illustrated the various aspects contributing towards Watty's first mover advantage in the energy management field, as adapted from Suarez and Lanzolla (2007). The presented findings also support our hypothesis stated in the very beginning of the discussion section and helps answer our research question. Our remaining sections will deal with what contributions a FMA can provide for Watty, and some of the strategic and conceptual considerations we discovered during our research.

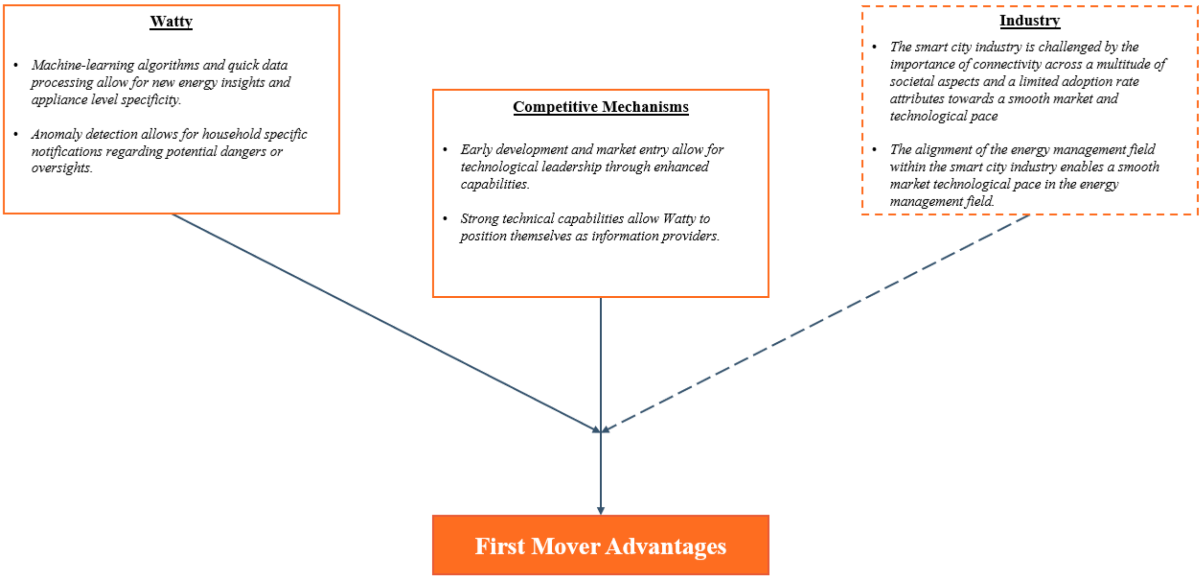


Figure 28 - Adapted Conceptual Framework

6.5 Considerations for strategy frameworks

For the purpose of our research paper we have adapted the strategic framework presented by Suarez and Lanzolla (2007) with attributing strategic concepts, towards our findings and literature collected. However, we have been aware that when discussing new technologies and concepts such as IoT and Big Data, traditional strategic concepts as those mentioned above are sometimes difficult to apply due to the technological evolutionary developments. We argue that when dealing with technologies based in ecosystems, it is hard to differentiate or single out one key component that is more critical than the rest. The basis of ecosystems is having multiple technologies and entities working together in concert to create value. Furthermore, based on Mazzei and Noble's (2017) 3-tier framework, the evolution of data as an asset, is no longer restricted to only being a tool that can be utilized and wielded for a specific purpose. Watty has established the required technological and data capabilities as part of their entire business, and thus do not perceive data as single resource, which they can leverage. Hence, we argue that when trying to determine a company's competitive advantage by determining a VRIN asset in firm-level enablers, the company itself should be considered the critical asset, as its capabilities and strategies needs to be in place to leverage data and new technologies into a competitive advantage over other firms (Braganza et al., 2017; Lambrecht & Tucker, 2016).

Lambrecht and Tucker (2016) claim that data alone does not uphold the VRIN requirements to ensure a competitive advantage and state, along with Braganza et al., (2017) and Mata et al., (1995), that competitive advantage is found within the managerial skills of IT. Based on this, we have chosen to apply the VRIN framework with the firm-level enablers towards Watty as whole, and examine their choices to develop and use their data capabilities, as what has provided the competitive advantage towards their competitors.

6.6. Importance of our study

Throughout our research, we have come to realize that only a handful of other companies have similar competencies as Watty. These companies also operate within the energy management field which we have argued is an emerging branch within the energy industry, and a field that is further encouraged by the smart city industry. Furthermore, they address the growing demand amongst consumers for energy management, as they focus on providing services within this field. We have chosen to examine Watty's resources and capabilities at the same time as we have considered the technology and market evolutionary pace. We believe that the company has the capability to benefit from first mover advantages. Based on our work within this research area, we have come to recognize that due to lack of start-ups operating within energy management and studies surrounding this, and the strategic considerations presented above, these areas in conjunction have not received a lot of prior attention together.

We believe that our research has contributed towards shedding light on the growing energy management field and which strategic considerations, start-ups can and should be aware of when entering an industry previously dominated by large incumbent companies. We further believe that we have contributed towards a better understanding of the value and need for strong technological and data capabilities and provided a better understanding in the difference of how Watty and the incumbent firms perceive and deal with data. In addition, we also believe that our research has helped contextualize the strategic framework by Suarez and Lanzolla (2007) for an atypical data industry.

We further believe that our research study can provide Watty with added insights on their own strategic position and which areas should be leveraged even further in order to grow and sustain their competitive advantage. We have in the following section presented the future opportunities for Watty, in order to maintain a longer-term competitive advantage and grow their consumer base.

6.6.1 Future Opportunities

Watty's current position in the energy management field is based on a niche consumer base of early adopters within IoT technologies and eco-friendliness. Currently, Watty is benefiting competitively from strong first mover advantages based on technological leadership amongst other things. However, due to Watty's current limited consumer base, the ability to fully capitalize on their achieved first mover advantages are also limited. Grant (2016), and Douma and Schreuder (2013) both discuss how large companies often wait until niche markets have been established, in order to then enter and grow it to mass market by adopting a *fast second* approach.

Therefore, Watty must be focused on achieving a larger consumer base as part of their next strategic steps. Based on our findings, we can already see that Watty is beginning to look at alternative ways in growing their consumer base, rather than just pushing their service directly to end-users. The company *senses* opportunities in the growing demand for private solar energy production and residential batteries. By partnering with these companies, the firm can grow at a much quicker rate, as its service becomes a complimentary product for consumers without extra installation costs. Watty will be able to target a consumer base where almost all are inclined towards self-sufficiency and home energy management. A small portion of our industry findings also present how further developments in energy management can potentially also include peer-to-peer energy trading through blockchain. However, this is only a part of the future opportunities for Watty. The concept behind this is trading any surplus that is attained through solar energy production and the amount that needs to be stored to serve the household. Hence, Watty could provide a powerful, yet user-friendly energy management service, acting as the 'brain' behind the systems and allowing for vital trading with other people.

Even though, we only have limited information regarding these new opportunities we recognize, as does Watty, the potential value in preparing for the next evolutionary steps, even if they might be 10 years away especially with a potential CAGR growth of 100%. Hence, Watty should keep developing their technological leadership and maintain their first mover advantage going forward as well. The ability to position themselves as leaders within the integration of solar energy and battery storage, and possible trading, will allow Watty to remain ahead of incumbent firms as the energy management field evolves.

We therefore recommend that Watty partners up with companies where it can function as a supplemental and support product, and more quickly grow their consumer base. From this position, Watty will be able to maintain a strong market position through a larger market share. Additionally, Watty will also experience positive network externalities through increased user input, which should improve the appliance detectability of their machine learning algorithm allowing for easier adaptation of laymen users. This partnering will also allow Watty to begin taking the initial steps towards becoming an integral part of the energy information architecture that will become more popular amid growth of the energy management field and smart city industry.

6.6.2 Further research

We believe Watty will grow to become an important information provider, both for its own consumers and also for other companies' developments. Optimally the latter can help expand Watty's customer base. To develop as an information provider, we believe that further research could benefit from bringing the information Watty provides more in focus. Hence, we argue that the Information-Based View of the Firm framework first presented by Ghasemkhani et al. (2014) provides a beneficial foundation for such an undertaking. In our research, we chose to draw on three of the four perspectives included in the Information-Based View of the Firm presented by Ghasemkhani et al. (2014), which is a framework that attempts to better distinguish the perspectives within information quality and IT management capabilities and relate this to competitive advantages and organizational performance (Ghasemkhani et al., 2014). By applying this framework towards future research, it would enable analysis of whether Watty transforms input into output of greater value.

Chapter 7

Conclusion

New technologies push forward innovation for consumers and companies alike. Over the past years, the introduction of IoT technologies and Big Data capabilities have fundamentally changed how the world is connected and how we view data. The ability to gain insights from almost every aspect of one's life, allows for an unparallel opportunity to understand more about our own behaviour and presents the opportunity to change tendencies that go beyond one's fitness habits, and which could have global impact. One of the big challenges of the world today is the need to reduce CO2 emissions on a global scale. Currently, 20% of all CO2 emission stem for household's energy consumption. In an attempt to impact consumers energy consumption, the Swedish start-up Watty has developed a service that allows their customers to constantly be aware of the energy consumption at home. Watty provides their customers with a constant insight of their total energy consumption disaggregated down to appliance level. Through advanced machine-learning algorithms it is able to collect, process and visualize the household data in real-time. Their current technological capabilities provide a clear advantage in energy management over the current incumbent companies in the energy industry.

In order to establish a thorough basis for our research we looked into two of the most recognized aspects of digitalization, namely the IoT and Big Data. Researchers have delved into both the challenges but also the favourable circumstances these technologies create for society. One thing that is certain from current research is that the possibilities that these technologies represent have become very attractive for many companies. Established industries are constantly experiencing disruptive forces as a consequence, and the energy industry is no exception. Hence, we found it very appealing to investigate an industry that has remained unchanged for several decades, with a company that has applied some of the most modern technologies to act on some of the disruptive forces in order to position itself within this market.

With a pragmatic research philosophy and an abductive research approach, we have examined Watty and the energy industry with in-depth interviews, exhaustive industry reports, internal Watty documents and observations. We adapted the framework by Suarez and Lanzolla (2007) and developed our own conceptual framework in order to illuminate the three aspects that enable first mover advantages. Thorough assessment of the collected data revealed that there are clear influences from the industry and Watty´s capabilities, which enable competitive mechanisms favorable for gaining first mover advantages. Due to the impact of technology and demands for new energy services in the energy industry, a field within the energy industry has emerged; the energy management field. This field is considered as an integral part of the smart city industry and due to this close relationship between the energy management field and the smart city industry, the smart city development also influences the energy management field. The energy management field presents as the primary market for Watty to operate within. Based on this, Watty´s unique technological capabilities have resulted in an intuitive and highly informative service for consumers within this market. The environmental influences, as seen with the aligned smart city industry, in combination with Watty´s capabilities have empowered the company to achieve a technological leadership and procedural switching costs. This has ultimately resulted in the appearance of first mover advantages for the company.

Throughout our thesis we have emphasized the importance of data and the required capabilities for companies. However, in an effort to determine the competitive advantages of data within Watty we discovered that data in itself cannot provide any competitive advantage in this context. We discovered that the specific capabilities of Watty and the time invested in developing them has attributed towards establishing a strong firm-level resource. Based on this discovery, we have proposed a consideration towards the VRIN framework, to not only focus on a single resource, but on the company as whole. Additionally, further research also proposes an evolution of strategic concepts and frameworks to better capture the impact of technological capabilities. In our own conceptual framework, we adapted this from Suarez and Lanzolla (2007), as we also recognized the need for a more specific framework towards our findings.

In conclusion, our thesis has provided us with a substantial insight into the changing energy industry. We have been able to uncover the different strategic enablers that will allow Watty to capture first mover advantages as the energy management filed continues to grow. Additionally, we have also seen the importance in having Watty enter into partnerships with other home energy services. By partnering with solar panel and home battery storage companies, Watty can position themselves as key information providers and potentially an information architecture allowing for trading any surplus energy a home might have. These partnerships will provide Watty with a substantial increase in their consumer base and allow them to continue their initial value proposition of educating consumers about their energy consumption, which ultimately may even impact the global challenge of sustainable energy practices.

Chapter 8

Bibliography

Accenture. (2012). Actionable Insights for the New Energy Consumer Contents.

Accenture. (2014). The New Energy Consumer: Architecting for the Future.

Accenture. (2015). THe New Energy Consumer: Unleashing Business Value in a Digital World Contents.

Andersen, I. (2010). *Den Skinbarlige Virkelighed* (5th editio). Samfunds Litteatur.

Anderson, C. (2008). The End of Theory: The Data Deluge Makes the Scientific Method Obsolete | WIRED. Retrieved April 3, 2018, from https://www.wired.com/2008/06/pb-theory/

Arshad, R., Zahoor, S., Shah, M. A., Wahid, A., & Yu, H. (2017). Green IoT: An Investigation on Energy Saving Practices for 2020 and Beyond. *IEEE Access*, *5*, 15667–15681. https://doi.org/10.1109/ACCESS.2017.2686092

Astarloa, B., Kaakeh, A., Lombardi, M., Scalise, J., Bocca, R., Guille, C., … Sims, D. (2017). The Future of Electricity - New Technologies Transforming the Grid Edge. *World Economic Forum*. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Electricity_2017.pdf

Balta-Ozkan, N., Davidson, R., Bicket, M., & Lorraine Whitmarsh. (2013). Social barriers to the adoption of smart homes. *Elsevier*. Retrieved from https://ac.els-cdn.com/S0301421513008471/1-s2.0-S0301421513008471-main.pdf?_tid=26108262-1541-40ca-9050-a4f40e787335&acdnat=1523621798_2e84a2131f1b20c5d889640f27b688ea

Beckel, C., Kleiminger, W., Cicchetti, R., Staake, T., & Santini, S. (2014). The ECO Data Set and the Performance of Non-Intrusive Load Monitoring Algorithms. *Proceedings of the 1st ACM Conference on Embedded Systems for Energy-Efficient Buildings*, 80–89. https://doi.org/10.1145/2674061.2674064

Bello-Orgaz, G., Jung, J. J., & Camacho, D. (2016). Social big data: Recent achievements and new challenges. *Information Fusion*, *28*(August), 45–59. https://doi.org/10.1016/j.inffus.2015.08.005

Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, *2*, 8–14. https://doi.org/10.1016/j.npls.2016.01.001

Bertoncello, M., Camplone, G., Gao, P., Kaas, H.-W., Mohr, D., Möller, T., & Wee, D. (2016). Monetizing car data. New service business opportunities to create new customer benefits. *McKinsey & Company*, (September).

Biscardini, G., Morrision, R., Branson, D., & Maestro, A. del. (2017). 2017 Oil and Gas Trends. Retrieved April 5, 2018, from https://www.strategyand.pwc.com/trend/2017-oil-and-gas-trends

Bohé, A., Hong, M., Macdonald, C., & Paice, N. (2015). Data Monetization in the Age of Big Data. *Accenture*, 1–12.

Braganza, A., Brooks, L., Nepelski, D., Ali, M., & Moro, R. (2017). Resource management in big data initiatives: Processes and dynamic capabilities. *Journal of Business Research*, *70*, 328–337. https://doi.org/10.1016/J.JBUSRES.2016.08.006

Bughin, J., Manyika, J., Woetzel, J., Mattern, F., Michael Chui, C., Lund, S., … Pinkus, G. (2016). Highlights in Collaboration With Mckinsey Analytics the Age of Analytics: Competing in a Data-Driven World. *McKinsey & Company*, (December).

Business Insider - Nordic. (2017). DCN report shows publisher revenue from Google, Facebook and Snapchat. Retrieved February 6, 2018, from http://nordic.businessinsider.com/dcn-report-shows-publisher-revenue-from-google-facebook-snapchat-2017-1?r=US&IR=T

Cai, L., & Zhu, Y. (2015). The Challenges of Data Quality and Data Quality Assessment in the Big Data Era. *Data Science Journal*, *14*(0), 2. https://doi.org/10.5334/dsj-2015-002

Capgemini. (2017). *Transformation of intelligent utilities with analytics, big data, and internet of things Transition to intelligent utilities*. Retrieved from https://www.capgemini.com/wp-content/uploads/2018/02/enabilling_intelligence.pdf

Capgemini. (2018a). 2018 Energy and Utilities Trends. Retrieved April 5, 2018, from https://www.capgemini.com/2018/02/top-energy-and-utilities-trends-2018-2-3/

Capgemini. (2018b). 2018 Energy and Utilities Trends Part 1. Retrieved April 5, 2018, from https://www.capgemini.com/2018/02/top-energy-and-utilities-trends-2018/

CERP-IoT. (2011). Internet of Things Strategic Research Roadmap. *Internet of Things Strategic Research Roadmap*, 9–52. https://doi.org/http://internet-of-things-research.eu/pdf/IoT_Cluster_Strategic_Research_Agenda_2011.pdf

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). BUSINESS INTELLIGENCE AND ANALYTICS: FROM BIG DATA TO BIG IMPACT: EBSCOhost. *MIS Quarterly*, *36*(4). Retrieved from http://web.b.ebscohost.com/ehost/detail/detail?vid=1&sid=89463539-05c9-4f08-9ae5-844c819b0eaf%40sessionmgr104&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=bth&AN=83466038

Conejo, A. J., Morales, J. M., & Baringo, L. (2010). Real-Time Demand Response Model. *IEEE TRANSACTIONS ON SMART GRID*, *1*(3). https://doi.org/10.1109/TSG.2010.2078843

Constantiou, I. D., & Kallinikos, J. (2015). New games, new rules: big data and the changing context of strategy. *Journal of Information Technology*, *30*(1), 44–57. https://doi.org/10.1057/jit.2014.17

Cox, M., & Ellsworth, D. (1997). Managing Big Data for Scientific Visualization. *ACM Siggraph*, *97*(January), 1–17. Retrieved from http://www.dcs.ed.ac.uk/teaching/cs4/www/visualisation/lectures/98-99/lect16ref.ps.gz

Crotty, M. (1998). The Foundations of Social Research, *1*, 5–9. https://doi.org/10.1016/S0074-6142(08)60345-9

Darby, S. J., & Pisica, I. (2013). Focus on electricity tariffs: experience and exploration of different charging schemes. Retrieved from https://ora.ox.ac.uk/objects/uuid:55a13d72-fc1f-4888-b418-a6527fe9eff6/download_file?file_format=pdf&safe_filename=8-318-13_Darby.pdf&type_of_work=Conference

Davenport, T. (2006). Competing on Analytics. *Harvard Business Review*. Retrieved from www.hbr.org

Davenport, T. (2014). *Big Data at Work: Dispelling the Myths, Uncovering the Opportunities* (1st ed.). Harvard Business Review Press. Retrieved from https://hbr.org/product/big-data-at-work-dispelling-the-myths-uncovering-the-opportunities/16574-HBK-ENG

Davenport, T. H., Barth, P., & Bean, R. (2012). How “Big Data” Is Different. *MITSloan Management Review*. Retrieved from https://sloanreview.mit.edu/article/how-big-data-is-different/

De la Pena, C., Fernandez, D. G., & Gonzalez, J. R. (2016). How analytics can improve asset management in electric-power networks | McKinsey & Company. Retrieved April 5, 2018, from https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/how-analytics-can-improve-asset-management-in-electric-power-networks

Deichmann, J., Heineke, K., Reinbacher, T., & Wee, D. (2016). Creating a successful Internet of Things data marketplace. *McKinsey & Company*, *14*(October), 1–8.

Deloitte. (2015). The power is on: How IoT technolgoy is driving energy innovation. *Deloitte University Press*.

Deloitte. (2017). Disrupting the utility: Tech Trends 2017 and the utility industry.

Deloitte Insights. (2016). Social impact of exponential technologies. Retrieved February 6, 2018, from https://www2.deloitte.com/insights/us/en/focus/tech-trends/2016/social-impact-of-exponential-technologies.html

Descript.com. (2018). Descript. Retrieved February 27, 2018, from https://www.descript.com/transcription/

Douma, S., & Schreuder, H. (2013). *Economic Approaches to Organizations* (5th ed.). Pearson.

European Commision. (2018). Smart grids and meters - European Commission. Retrieved April 26, 2018, from https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters

European Commission. (2018). Buildings - European Commission. Retrieved April 2, 2018, from https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

Fan, P. F., Wang, L. L., Zhang, S. Y., & Lin, T. T. (2014). The Research on the Internet of Things Industry Chain for Barriers and Solutions. *Applied Mechanics and Materials*, *441*, 1030–1035. https://doi.org/10.4028/www.scientific.net/AMM.441.1030

Flaherty, T., Jennings, S., & Schwieters, N. (2017). 2017 Power and Utilities: Managing a revenue downturn while meeting the demands of consumers. *PwC*.

Fleisch, E. (2010). What is the Internet of Things? - An Economic Perspective. Retrieved from www.autoidlabs.org

Flick, U. (2014). *An Introduction to Qualitative Research* (5th ed.). Sage Publications.

Forbes. (2014). 11 Companies Considered Best For The Environment. Retrieved February 6, 2018, from https://www.forbes.com/sites/susanadams/2014/04/22/11-companies-considered-best-for-the-environment/#3a99e06912ae

Frankel, D., & Wagner, A. (2017). Battery storage: The next disruptive technology in the power sector | McKinsey & Company. Retrieved April 27, 2018, from https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/battery-storage-the-next-disruptive-technology-in-the-power-sector

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, *35*(2), 137–144. https://doi.org/10.1016/J.IJINFOMGT.2014.10.007

Gasiorowski-Denis, E. (2016). How the Internet of Things will change our lives. Retrieved February 6, 2018, from https://www.iso.org/news/2016/09/Ref2112.html

Ghasemkhani, H., Soule, D., & Westerman, G. (2014). Competitive Advantage in a Digital World: Toward An Information-Based View of the Firm. *MIT Initiative on the Digital Economy*. Retrieved from http://ssrn.com/abstract=2698775

Ghoshal, A., Larson, E. C., Subramanyam, R., & Shaw, M. J. (2014). The Impact of Business Analytics Strategy on Social, Mobile, and Cloud Computing Adoption. Retrieved from https://pdfs.semanticscholar.org/9a4f/bc1b991375fe4c9a4384b5df37e170a14492.pdf

Gilman, H., & Nordtvedt, J.-E. (2014). Intelligent Energy: The Past, the Present, and the Future. *SPE*

Economics & Management, *6*(4), 185–190. https://doi.org/10.2118/167895-PA

Gottwalt, S., Ketter, W., Block, C., Collins, J., & Weinhardt, C. (2011). Demand side management—A simulation of household behavior under variable prices. *Energy Policy*, *39*(12), 8163–8174. https://doi.org/10.1016/j.enpol.2011.10.016

Gram-Hanssen, K., & Darby, S. J. (2018). "Home is where the smart is"? Evaluating smart home research and approaches against the concept of home. *Energy Research & Social Science*, *37*, 94–101. https://doi.org/10.1016/J.ERSS.2017.09.037

Grant, R. M. (2016). *Contemporary Strategy Analysis* (9th ed.). West Sussex, United Kingdom: John Wiley & Sons.

Günther, W. A., Mehrizi, M. H. R., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems*, *26*(3), 191–209. https://doi.org/10.1016/J.JSIS.2017.07.003

Haller, S., Karnouskos, S., & Schroth, C. (2009). The Internet of Things in an Enterprise Context. Retrieved from https://pdfs.semanticscholar.org/1c49/c74521b4c9eae7a352a3b223b4213294c681.pdf

Hashem, I. A. T., Chang, V., Anuar, N. B., Adewole, K., Yaqoob, I., Gani, A., … Chiroma, H. (2016). The role of big data in smart city. *International Journal of Information Management*, *36*(5), 748–758. https://doi.org/10.1016/j.ijinfomgt.2016.05.002

Hasse, F., von Perfall, A., Hillebrand, T., Smole, E., Lay, L., & Charlet, M. (2016). Blockchain – an opportunity for energy producers and consumers? *PwC Global Power & Utilities*, 1–45. Retrieved from www.pwc.com/utilities

Hillman, J. (2017). AI In Energy: 10 Companies to Know in 2017 - DisruptorDaily. Retrieved February 5, 2018, from https://www.disruptordaily.com/ai-energy-10-companies-using-ai-2017/

Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D. (2014). *From machine-to-machine to the internet of things : introduction to a new age of intelligence*. Elsevier.

Hopf, K., Riechel, S. J., Sodenkamp, M., Staake, T., & Riechel, S. (2017). Predictive Customer Data Analytics – The Value of Public Statistical Data and the Geographic Model Transferability. *ICIS 2017 Proceedings*. Retrieved from http://aisel.aisnet.org/icis2017

Hopf, K., Sodenkamp, M., & Kozlovskiy, I. (2016). Energy Data Analytics For Improved Residential Service Quality And Energy Efficienct. Retrieved from https://www.uni-bamberg.de/fileadmin/eesys/Publications/ECIS_yearly_classification_geodata_2016_04_05_final.pdf

International Energy Agency. (2017). *World Energy Outlook 2017*. International Energy Agency. Retrieved from http://www.iea.org/bookshop/750-World_Energy_Outlook_2017

International Energy Outlook. (2016). *Energy and Air Pollution*.

Jensen, M., Gutierrez, J., & Pedersen, J. (2014). Location Intelligence Application in Digital Data Activity Dimensioning in Smart Cities. *Procedia Computer Science*, *36*, 418–424. https://doi.org/10.1016/J.PROCS.2014.09.015

Karnouskos, S., & Spiess, P. (2007). TOWARDS ENTERPRISE APPLICATIONS USING WIRELESS SENSOR NETWORKS. Retrieved from https://pdfs.semanticscholar.org/9f31/328e9bd919280be2d245992f0e687d2a0dca.pdf

Keane, J. (2016). Smart energy startup Watty lands €3 million. Retrieved February 5, 2018, from http://tech.eu/brief/watty-e3-million/

Keleman, M., & Rumens, N. (2008). *An Introduction to Critical Management Research* (First). Sage

Publications.

Kerin, R. A., Varadarajan, P. R., & Peterson, R. A. (1992). First-mover advantage: A synthesis, conceptual framework, and research prop...: EBSCOhost. *Journal of Marketing*, *56*(4). Retrieved from http://web.a.ebscohost.com/ehost/detail/detail?vid=0&sid=d7a86407-0bd5-4978-9d57-9726f98aea7e%40sessionmgr4007&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#AN=9302070973&db=bth

Khajenasiri, I., Estebsari, A., Verhelst, M., & Gielen, G. (2017). A Review on Internet of Things Solutions for Intelligent Energy Control in Buildings for Smart City Applications. *Energy Procedia*, *111*, 770–779. https://doi.org/10.1016/J.EGYPRO.2017.03.239

Koseleva, N., & Ropaite, G. (2017). Big Data in building energy efficiency: Understanding of big data and main challenges. *Procedia Engineering*, (172), 544–549. Retrieved from https://ac.els-cdn.com/S1877705817305702/1-s2.0-S1877705817305702-main.pdf?_tid=99137c6d-b822-4311-8587-fde755eccee1&acdnat=1522938375_47f797f1516aa705e477a9d19b4d2624

Kranenburg, R. van, Stembert, N., Moreno, M. V., Skarmeta, A. F., López, C., Elicegui, I., & Sánchez, L. (2014). Co-creation as the Key to a Public, Thriving, Inclusive and Meaningful EU IoT (pp. 396–403). Springer, Cham. https://doi.org/10.1007/978-3-319-13102-3_65

Lambrecht, A., & Tucker, C. E. (2016). THE LIMITS OF BIG DATA’S COMPETITIVE EDGE. *MIT IDE Research Brief*, (2), 4. Retrieved from http://mitsloan.mit.edu/uploadedFilesV9/IDE/Content/BigDataAnjaLambrecht_CatherineTucker.pdf

Laney, D. (2001). 3D Data management: controlling data volume, velocity, and variety. Retrieved from https://blogs.gartner.com/doug-laney/files/2012/01/ad949-3D-Data-Management-Controlling-Data-Volume-Velocity-and-Variety.pdf

Lee, M., & Lee, S. (2016). *Evaluating Internal Terchnological Capabilities in Energy Companies*. https://doi.org/10.3390/en9030145

Lieberman, M. B., & Montgomery, D. B. (1998). FIRST-MOVER (DIS)ADVANTAGES: RETROSPECTIVE AND LINK WITH THE RESOURCE-BASED VIEW. *Strategic Management Journal Strat. Mgmt. J*, *19*, 1111–1125. Retrieved from http://www.anderson.ucla.edu/faculty/marvin.lieberman/publications/FMA2-SMH1998.pdf

Lycett, M. (2013). “Datafication”: making sense of (big) data in a complex world. *European Journal of Information Systems*, *22*(4), 381–386. https://doi.org/10.1057/ejis.2013.10

Madnick, S. E., Wang, R. Y., Lee, Y. W., & Zhu, H. (2009). Overview and Framework for Data and Information Quality Research. *Journal of Data and Information Quality*, *1*(1), 1–22. https://doi.org/10.1145/1515693.1516680

Magruk, A. (2015). The most important aspects of uncertainty in the Internet of Things field. *Procedia Engineering*, *122*, 220–227. https://doi.org/10.1016/j.proeng.2015.10.028

Marinov, M., Vitliemov, P., & Popova, E. (2017). Towards Big Data and Internet of Things as Key Aspects of Energy Efficiency, *6*(3), 427–435. https://doi.org/10.18421/TEM63-01

Mata, F. J., Fuerst, W. L., & Barney, J. B. (1995). Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis. *Source: MIS Quarterly*, *19*(4), 487–505. Retrieved from http://www.jstor.org/stable/249630

Mayer, S., & Guinard, D. (2011). An Extensible Discovery Service for Smart Things. Retrieved from https://www.vs.inf.ethz.ch/publ/papers/mayer-extensiblediscovery-2011.pdf

Mazzei, M. J., & Noble, D. (2017). Big data dreams: A framework for corporate strategy. *Business*

Horizons, *60*(3), 405–414. https://doi.org/10.1016/J.BUSHOR.2017.01.010

McKinsey. (2011). McKinsey Global Institute. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Business Functions/McKinsey Digital/Our Insights/Big data The next frontier for innovation/MGI_big_data_exec_summary.ashx

Merino, J., Caballero, I., Rivas, B., Serrano, M., & Piattini, M. (2016). A Data Quality in Use model for Big Data. *Future Generation Computer Systems*, *63*, 123–130. https://doi.org/10.1016/J.FUTURE.2015.11.024

Murray, M., & Hawley, J. (2016). Got Data? *Mission Data*, (January).

Normandeau, K. (2013). Big data volume, variety, velocity and veracity. Retrieved May 9, 2018, from https://insidebigdata.com/2013/09/12/beyond-volume-variety-velocity-issue-big-data-veracity/

O'Kane, S. (2018). Tesla vs. Waymo: who's winning the race for self-driving cars - The Verge. Retrieved May 9, 2018, from https://www.theverge.com/transportation/2018/4/19/17204044/tesla-waymo-self-driving-car-data-simulation

Ouellette, J. (2013, October). The Mathematical Shape of Things to Come. *Quantamagazine*. Retrieved from https://d2r55xnwy6nx47.cloudfront.net/uploads/2013/10/the-mathematical-shape-of-big-science-data-20131004.pdf

Perrons, R. K., & Jensen, J. W. (2015). Data as an asset: What the oil and gas sector can learn from other industries about "Big Data." *Energy Policy*, *81*, 117–121. https://doi.org/10.1016/j.enpol.2015.02.020

Persson, E. (2014). Want to save energy? Watty will tell you what to do - Swedish Startup Space. Retrieved February 5, 2018, from http://swedishstartupspace.com/2014/11/05/watty/

Redman, T. C. (2008). *Data driven : profiting from your most important business asset*. Harvard Business Press. Retrieved from https://www.goodreads.com/book/show/4073027-data-driven

Reuters. (2018). Global Smart cities Market Size and Trends – Industry Analysis by Key Developments, Players, CAGR Growth Projection to 2023. Retrieved May 1, 2018, from https://www.reuters.com/brandfeatures/venture-capital/article?id=30881

Rubel, H., Pieper, C., Zenneck, J., & Sunak, Y. (2017). How Batteries and Solar Power Are Disrupting Electricity Markets. *The Boston Consulting Group*, (January), 15.

Sagiroglu, S., & Sinanc, D. (2013). Big data: A review. *2013 International Conference on Collaboration Technologies and Systems (CTS)*, (May 2013), 42–47. https://doi.org/10.1109/CTS.2013.6567202

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (7th ed.). Edinburgh Gate: Pearson Education.

Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation (pp. 431–446). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-20898-0_31

Sense.com. (2018). Sense Integrations. Retrieved April 9, 2018, from https://sense.com/integrations.html

Sharma, R., Mithas, S., & Kankanhalli, A. (2014). Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organisations. *European Journal of Information Systems*, *23*(4), 433–441. https://doi.org/10.1057/ejis.2014.17

Stojanovic, P. (2016). 10 Nordic Internet of Things companies to know. Retrieved February 5, 2018, from https://www.hottopics.ht/8349/10-nordic-internet-of-things-companies/

Suarez, F. F., & Lanzolla, G. (2007). THE ROLE OF ENVIRONMENTAL DYNAMICS IN BUILDING A FIRST MOVER ADVANTAGE THEORY. *Academy of Management Review*, *33*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.9084&rep=rep1&type=pdf

Sumic, Z. (2017). Hype Cycle for Utility Industry IT , 2017. *Gartner*, (July).

Sumic, Z., Steenstrup, K., Geschickter, C., & Foust, N. (2017). Top 10 Trends Shaping the 2017 Utility Industry on the Road to Digital Business. *Gartner*, (April).

SunGard. (2013). Big Data — Challenges and Opportunities for the Energy Industry (White Paper). *SunGard*.

Teece, D. J. (2007). Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance. *Academy of Management Journal*, *51*(2), 315–334. https://doi.org/10.1002/smj

Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, *51*(1), 40–49. https://doi.org/10.1016/J.LRP.2017.06.007

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, *18*(7), 509–533. Retrieved from http://links.jstor.org/sici?sici=0143-2095%28199708%2918%3A7%3C509%3ADCASM%3E2.0.CO%3B2-%23

Temperton, J. (2017). The hottest Stockholm startups in 2017 | WIRED UK. Retrieved February 5, 2018, from http://www.wired.co.uk/article/best-startups-in-stockholm-2017

Uckelmann, D., Harrison, M., & Michahelles, F. (2011). An Architectural Approach Towards the Future Internet of Things. In *Architecting the Internet of Things* (pp. 1–24). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-19157-2_1

VELUX Media Centre. (2014). Four beacons of business will make energy modernisation easy for home owners. Retrieved January 22, 2018, from http://press.velux.com/four-beacons-of-business-will-make-energy-modernisation-easy-for-home-owners/

Verma, A. (2018). How to solve Utilities' Big Data problem? Retrieved April 10, 2018, from https://www.capgemini.com/2018/03/utilities-dont-have-a-big-data-problem-they-have-a-big-problem-with-data/

Watty.io. (2018a). About. Retrieved May 8, 2018, from https://watty.io/about

Watty.io. (2018b). Get Watty. Retrieved May 8, 2018, from https://watty.io/order

Weber, R. H. (2010). Internet of Things – New security and privacy challenges. *Computer Law & Security Review*, *26*(1), 23–30. https://doi.org/10.1016/J.CLSR.2009.11.008

Weinberger, D. (2008). *Everything is Miscellaneous: The power of the new digital disorder*. Holt Paperbacks.

Westerlund, M., Leminen, S., & Rajahonka, M. (2014). Business Models for the Internet of Things Environment. *Technology Innovation Management Review*, *15*(July), 1122–1129. https://doi.org/10.1016/S2212-5671(14)00566-8

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2015). Smart homes and their users: a systematic analysis and key challenges. *Personal and Ubiquitous Computing*, *19*(2), 463–476. https://doi.org/10.1007/s00779-014-0813-0

Xie, K., Wu, Y., Xiao, J., & Hu, Q. (2016). Value co-creation between firms and customers: The role of big data-based cooperative assets. *Information and Management*, *53*(8), 1034–1048. https://doi.org/10.1016/j.im.2016.06.003

Zhou, K., Fu, C., & Yang, S. (2016). Big data driven smart energy management: From big data to big insights. *Renewable and Sustainable Energy Reviews*, *56*(April 2016), 215–225. https://doi.org/10.1016/j.rser.2015.11.050

Zipperer, A., Aloise-Young, P. A., Suryanarayanan, S., Roche, R., Earle, L., Christensen, D., … Zimmerle, D. (2013). Electric Energy Management in the Smart Home: Perspectives on Enabling Technologies and Consumer Behavior. *Proceedings of the IEEE, 101*(11), 2397–2408. https://doi.org/10.1109/JPROC.2013.2270172

Chapter 9

Appendix

Appendix 1 - Field Notes

Field Notes

Location: Stockholm, Sweden

Date: 02/02/2018

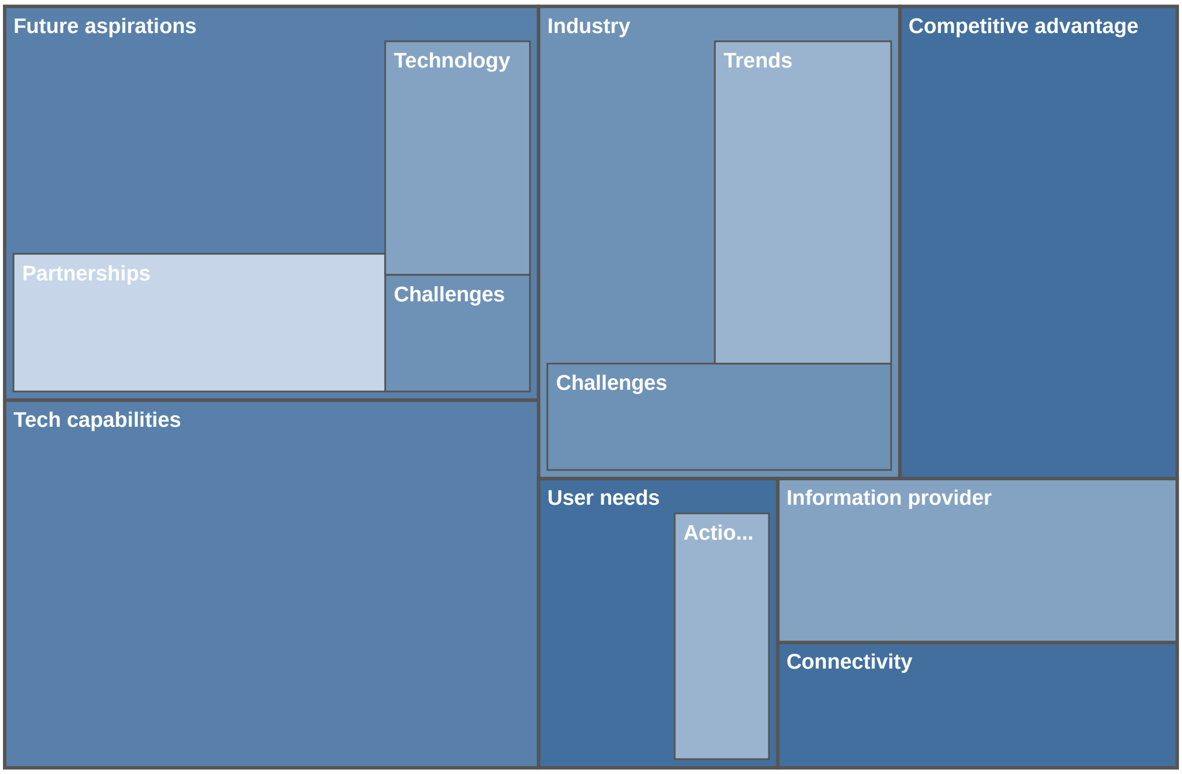
Time: 09:00 – 18:00

During our stay at the Watty office, we made several observations. The office was located in a building with other start-ups nearby and since the company is a start-up we perceived the office as fairly large with two floors that was connected and an open office space. The common areas had a large table, kitchen, a table tennis table and several meeting rooms. The Watty colours and logo were visible several places; on the walls, pillows, and bean bags. Through conversations and interviews we perceive the atmosphere at Watty as open and adaptive. The employees expressed great satisfaction with a start-up environment, at the environment seemed positive and inclusive.

Quote from CEO:

"When we recruit the first thing I look for in a candidate is pure curiosity. They can be very skilled, but if they're not very curious, they will not continuously learn about what they're doing and the skills you have today might be great, but next year, maybe we'll need something completely different, so I think one thing is you just need people on the team who have in them, the drive to learn and adapt all the time" (CEO, Interview).

Appendix 2 - Code Category Overview



Appendix 3 - Interview Notes

Interview notes

Location: Skype

Job position: Business Development Manager

Date: 18/01/2018

Company history

- Royal institute of technology - Energy data interpretation
- Understand how to bridge gap
    - People have no idea about how much energy they consume
    - Typical usage in a home - learn to recognize patterns - these usage data can refrigerator
- Hype, buzz around machine-learning, AI, a new method to do automize pattern recognition
    - Human ability to recognize patterns
- Incubator and university support in the start-up phase
- First idea of the company was to use smart meter data - data about household consumption is sent to grid companies, and in then in theory it would be available to consumers
    - Then we could retrieve data, and build models
    - Smart meters - we found out it was not so smart anyway
    - 1 data point every 10 seconds - 15 seconds
        - Cannot separate appliance data
        - Because it is limited by the input data
- Some companies use smart meter data and give back end-service to energy companies. Very basic breakdown. 30% for heating, etc. etc.
- But Watty think the more information you have, the better
    - Energy companies are very slow, traditional, IT systems are 20 years old - impossible to implement solutions like these to their backend
- Understand that you can use the energy data smart

    - Hardware on the smart meter - blink - a small diode blinks on top of the fuse box any time energy data is measured
    - 1 reading every 10 seconds in “real time”
    - Watty → 2000 times per second
    - Give weekly information about the overall energy your washing machine used
- When CTO joined - AI genius, engineering
- Angel investors, VC´s
- First build hardware - then create value - and eventually go to energy companies

The product

- Detect different appliances automatically; Fridge, freezer, microwave
- Recommendations - based on historical data
    - The heating element - resistive load that only generates heat
- One appliance can generate more than a fingerprint
- Three or four times of ironing - then the algorithm can recognize which appliance it is
- Fridge does not use energy all the time - few people know this
- Technical challenge is variation - some appliances have the same electrical signature which makes it hard to differentiate
- Only use the shape of the patterns
    - Future → Active, and reactive power, phase shifting
- Algorithm
    - The ML algorithm is quite generic
    - Put any type of data to this
        - Image recognition etc.
    - Randomize data - determine whether it is a hotdog or not
    - Not available for home appliances
        - Measurements on appliances
        - Very detailed metering
        - Put this into the algorithm
        - 500 homes
            - Unique set of training data
        - Crowdsource the data - people “fingerprint” appliances themselves - massively accelerate the position
        - Few broke down so too few to learn the algorithm
            - Stop use the washing machine - and then go back and figure out what happened

- Fridge
    - Time intervals
    - Can easily train algorithm that normal is 20 spikes. 20% below adapts - maybe fridge door is open? leaking? compressor is not working? Deviated behaviour from appliances
        - Need proof of concept from one appliance
- Hair strengthener
    - The time length gives info on when it is turned on

Value

- The balance between add value and being annoying for the consumers
- Hardware - sample power consumption, voltage from appliances, and then to the cloud, analytics, push that to the app → takes less than one second
    - Instantly
    - Hope that it will influence people's behavior
        - Climate change
        - Possible when they are using the appliance
- Maybe also district heating
    - Only direct heating - Heating elements
- Bring enough value
    - Save energy
    - Piece of mind
    - Integration to other things in the home
- Recommendations instead of app driven
- Testing on facebook ads - click rates
- Use it for - piece of mind - seeing which appliances that are on
- Track down energy usage
    - Energy savings recommendations
    - Tricky part is relevance in regards to energy usage, but easier to get in by “selling” piece of mind - create trust
    - Money savings aspects
    - People think it is too much work to do more right now to help the product

Short time focus

- 1. Improve models - mathematically improve detection of appliances
    - Customers so far - engineers, startups, tech people, energy interested

        - Want to automate everything
- 2. Add functionalities
    - No overview of energy consumption - energy consumption over time
        - Compare bill to “WATTY used”
        - People are charged differently - peak prices, variable prices, fixed prices, daily consumption

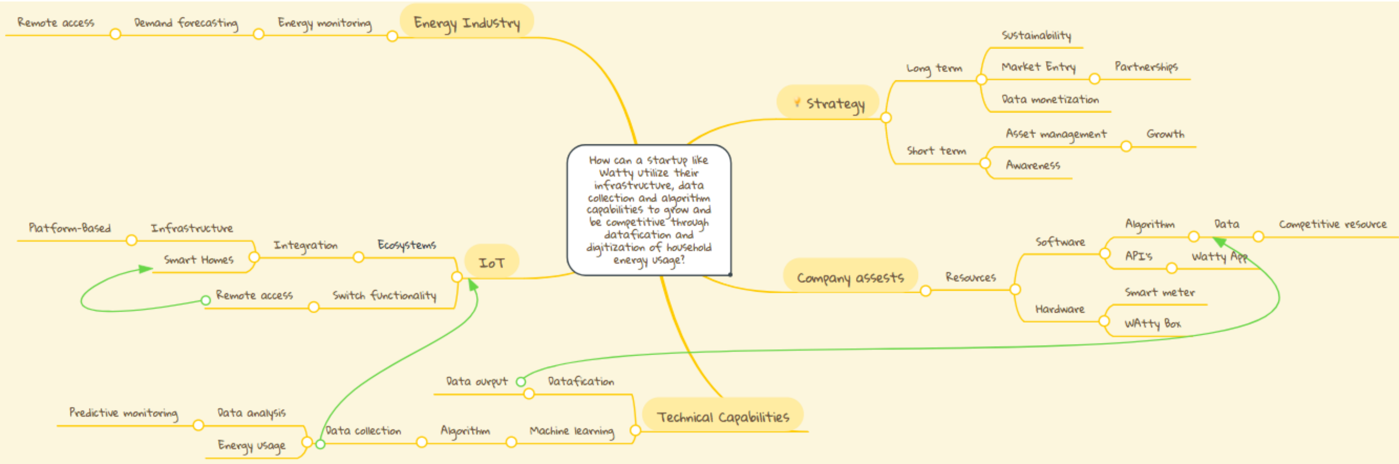
Long term focus

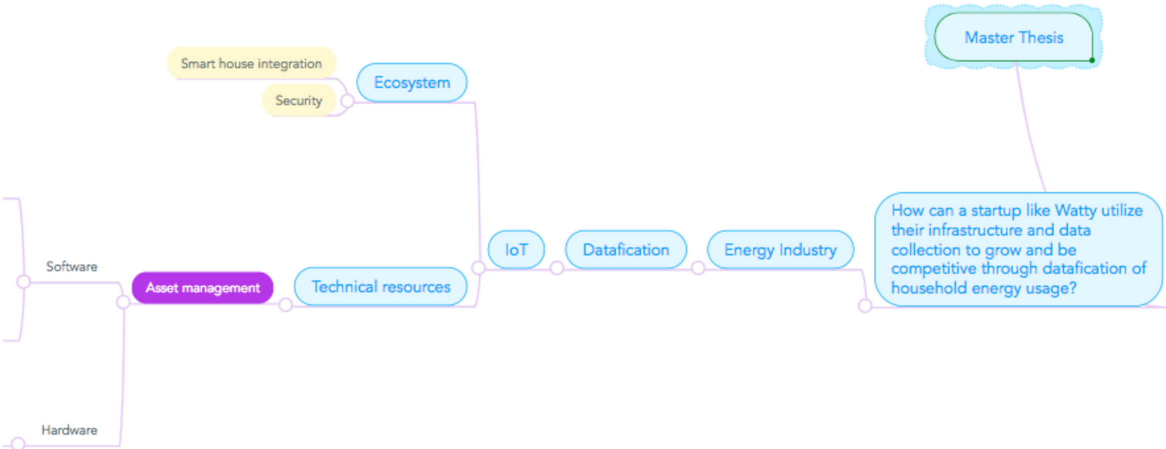
- Build services to other companies
- Predictable behavior
- Sustainable business model
    - Google - free
        - Add service that pays for the usage of it
    - At least as valuable data as google and facebook

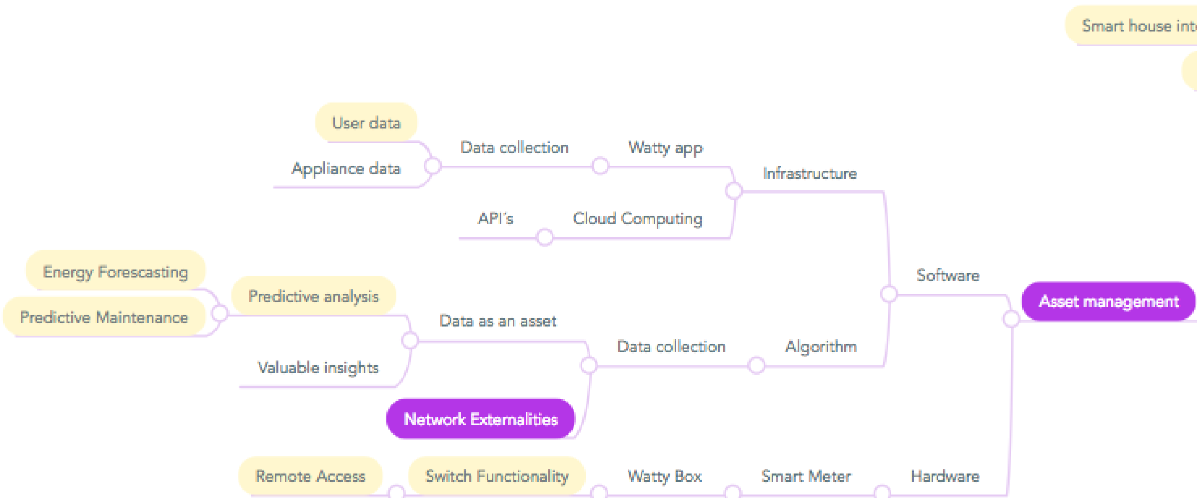
Relevance - marketplace

    - Install solar power
    - Recommendations relating to businesses
    - Kitchen fan without using stove = smoker?
    - The proposition do need to be linked to the context

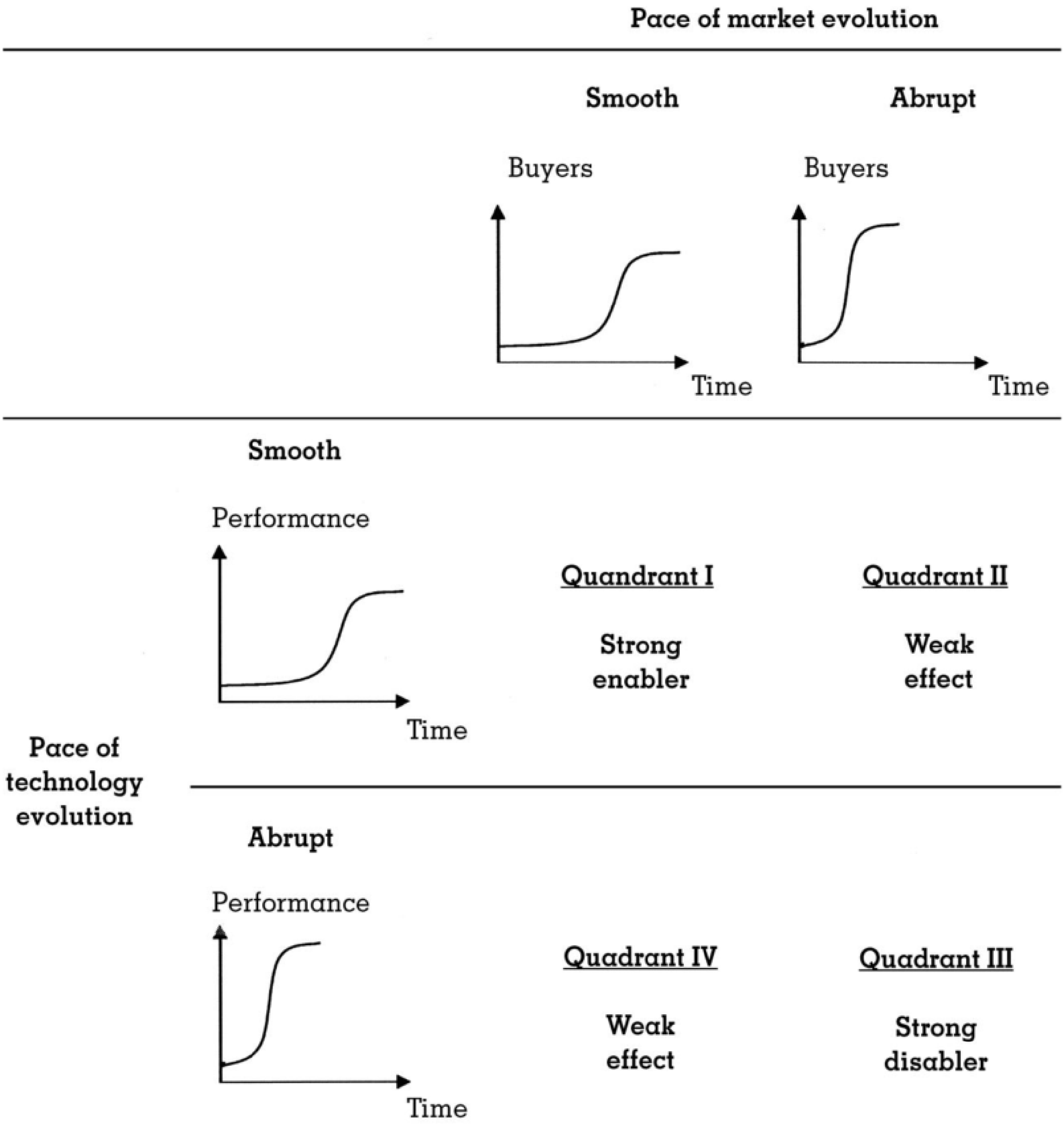
Appendix 4 - MindMeister Relevance Tree



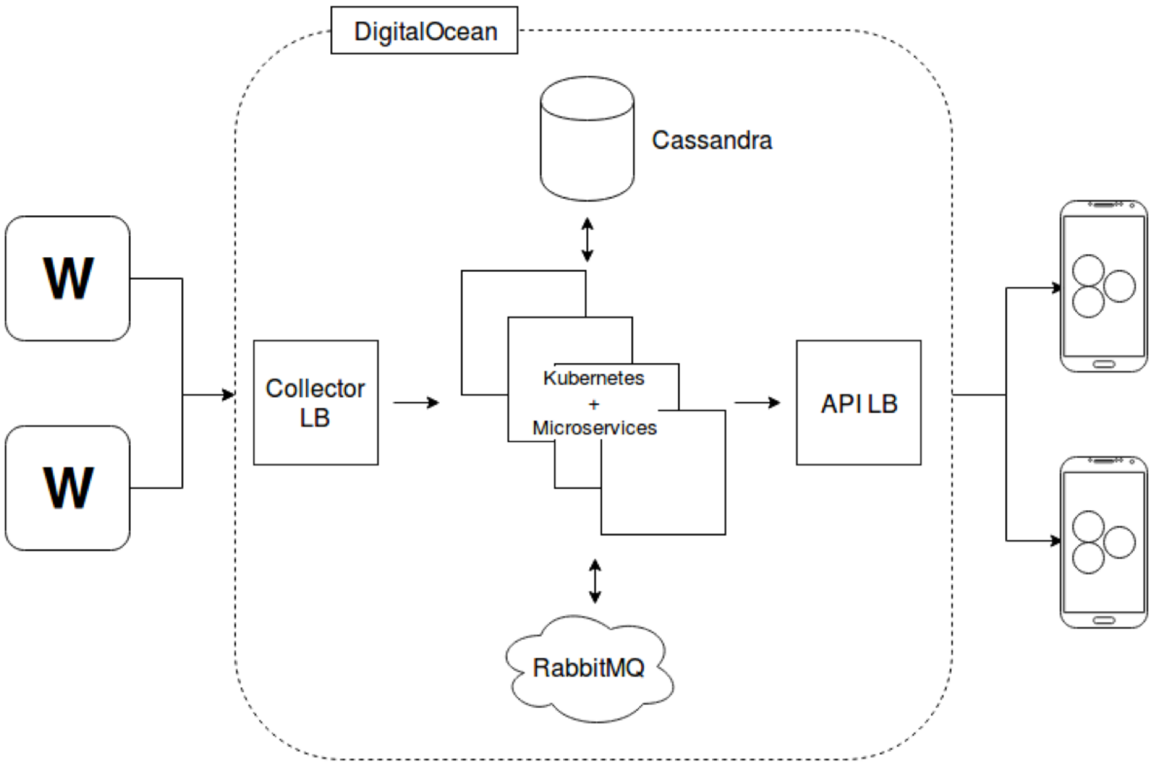




Appendix 5 - Environmental Dimension Quadrants



Appendix 6 - Simple Watty Architecture



Business Development Manager, Interview.

[00:00:00]
Gustav: Okay. Now it sounds better.
Patrick: Much better. How much did you hear what I was saying before?
Gustav: I heard you but I also heard myself, very much, when I was speaking so, it was something.... no.
Patrick: But yeah, so as mentioned we were just gonna do some more follow-up questions on some of these things that we felt that we needed a bit more answers to. A discussion on.... Just quickly do, will there be any time with just is it only going to be you today? Or you know if Oscar would have time later on it was just so I know how to structure some of the questions. Otherwise you might be getting a bit more technical questions as well.
[00:01:00] **Gustav:** So assume that he will not be joining this morning. So either I was try to answer the questions as good as good as I can, or we can book a separate call.
Patrick: Okay, cool.
Gustav: I might get him to join in, but he was very busy with some urgent stuff right now.
Patrick: Of course, of course. No, that's fine. Just so I know how to somewhat structure the questions.
Gustav: Yep.
Patrick: Cool. But yeah, so as mentioned we are looking at a bit more of the [unintelligible] perspectives for watching. So, I as I also mentioned we got some interesting findings, but based on some of the industry experts, based on the use of data actually within the industry industry. And from what I understood that you guys have been working on is like there's this potential for any with for energy companies, to use this data going forward especially because, what is unique about you guys, as we've discovered is like, the the specific like the [00:02:00] detailed way you guys measure the data and the way you can actually visualize it.
We were then actually exposed to that, a lot of the companies, energy providers, currently, they don't need actually more specific specific data. Basically because they don't know how to utilize this either. Can you hear me?
Gustav: Sorry. I'm....
Patrick: Can you hear me?
Gustav: Sorry. I'm listening to signal.
Patrick: Hello?
Gustav: Sometimes I hear you're very slowly and sometimes very quickly.
Patrick: Okay....
Gustav: I'm gonna try to disconnect the video and see if it's better.
Patrick: That's fine. We don't need the video. I'll disconnect mine as well. Am I still on video?
Gustav: Yeah.

Patrick: I have no idea how to [00:03:00] not show video. There we go. All right. Is this better? Do you hear me now? Or...
Gustav: Yeah, now I think it's better.
Patrick: Okay, but as I was saying that some of the findings that we found out from the energy is that there they actually their current need for more specific data beyond what they get from their own smart meters is actually not that High. Mostly also because they don't actually know how to use the data they're actually collecting currently.
We've found out that there's actually...and based on this also that there's also a big churn that's begun with energy providers. I don't know if you're actually aware of this, that actually people are beginning to leave energy providers based on on, because of other production facilities, like because they can produce energy by themselves or others, like options are available to them were you aware of this? Because apparently in Sweden, I think it's six or seven percent [00:04:00] over the past year has actually left energy providers, either becoming self-sufficient or something else.
Gustav: That number cannot be correct, actually.
Patrick: I think I can't remember exactly but I remember it was more than I expected. I didn't even know you could churn energy from energy providers. But I didn't even know that there was a tendency to actually leave. Was this something you guys were aware of or...?
Gustav: I mean, the installed capacity for solar, in which I think is the only viable option if you want to go off grid, that's like 0.06 percent of total energy consumption in Sweden. So, those other and like 95% of those are not self-sufficient. Sometimes you need a battery and some backup systems. I'm just thinking what their option could be, like these six percent. What are they doing?
Patrick: No. I would also say it was it was more on it's something we got from [00:05:00] another source. So, I'll probably try to follow up on it. I was just aware I was unaware of it completely when I was told. And I'm not completely sure about the six percent to be honest. I just feel like I remember it was that however, I just wanted to know if there's this was actually something you guys were aware of going into the industry or something like that? That there was actually a decline. Because I know Yalma started. He was like the basis of Ywatu was created, was to tackle some of the renewable, like these CO2 emissions and becoming more focused on people's own energy usage to try to help this. But did you see other other strategic opportunities? Do you know that when Watu was kind of started, did you see that there was because it was either decline or there was a shift in the energy industry?
Gustav: Yes, definitely like that. There is a shift in Industry that people are becoming increasingly, like producing their [00:06:00] own electricity. It's still extremely small numbers, but they are growing very quickly and you have some markets, for example, in Australia, where I think it's about 20-25 percent of each of the number of villas have produced like some electricity for themselves. And that's definitely a trend that's very much in line with what we are that we want to like sail in that tailwind so to speak.
Patrick: Yes, so, how would you say that, because I'm guessing this is then based on a

lot of the energy management and kind of thinking, that people because they're producing own energy and those are becoming more aware that they need some way how to understand what they're using, where it comes from, and maybe also try to manage it.
Do you see this is becoming a like a main focus now for the industry? Is it becoming a more like actually even its own industry to some degree [00:07:00] because this the services that are being provided towards Energy Management are becoming more and more or...?
Gustav: Yea, so I actually did a lot of work on this when I worked at [unintelligible] before and looking at how this, I mean you have this technology development for solar [unintelligible] battery storage. And they are going down like 15-20 percent per year and depending on how much [unintelligible] you have in a place, it it's becoming an economically viable option for like how you fulfill your need of electricity.
Patrick: Yeah.
Gustav: So that's like a fact and that's something you really can't stop because we have this very strong forces of technology development and economic scale that is kind of self-reinforcing. So the question then is how will they, the incumbent energy companies react to this. And so far, there are very few examples of big energy [00:08:00] companies, like the incumbants, finding a way to build a viable business on this trend. So it's kind of similar to what happened with digital cameras and Kodak, for example. Or main mainframe computer or and personal computers.
Patrick: Yeah.
Gustav: So they're like just waking up to this trend and in some markets, I mean the train has already passed and there is much more more market you can capture as big energy company. And for every kilowatt hour someone, like a residential customer produces for themselves, it's one less that they buy from their big energy provider. And then of course there is a very interesting difference in the cost structure of this new decentralized energy production assets and the old centralized, like fossil [00:09:00] fuel-based.
Patrick: Yeah.
Gustav: So then you ones are mainly money up front where you buy the assets and then the marginal cost of producing the next kilowatt-hour is basically zero. So if you are the old company owning these assets, if people start buying less energy you need to raise your prices to cover your fixed costs. And if you raise prices, the competitive situation competitive position for these new technologies gets even better.
They have this, like very negative, it's called like the death spiral or the energy industry.
Patrick: Yeah.
Gustav: If you really delve into it. But I mean this will come in different degree, in different markets, in different times, but it's definitely coming.
Patrick: But, so, I get that because of this, because people are becoming more self-sufficient also that it's becoming harder and harder, to some degree, for the energy companies, [00:10:00] but because we were discussing with one of the other people, that some of the services that energy energy companies provide is like they provide

this energy purely and then they have some billing options and then they like the typically have some sort of a premium product that is, has up until now, been been like renewable energy sources that you could as as a person or household serve or ensure that your energy sources that have come to the house are purely renewable. But you would pay a premium tarriff for that. However, after discussing especially in Germany and other places, they're actually this renewable energy is becoming more of a standard of actually energy production. So what's actually being delivered to households are more and more becoming are always becoming renewable energy sources. So, they're looking at what new type of premium service could be like attached or like how they could actually based revenue on this. And this is where we also think about the energy management industry. And what kind of what you were [00:11:00] doing already, is where the I we see maybe the actual industries are focusing towards.
Because on this, people wanting to be more aware of how they're using energy, but also with the future aspect of being able to control some sort of appliances during peak areas. So, you have remote access so an energy company could see that okay, you need to wash your clothes or something but during a peak period or the down period they would be able to turn this on for you whilst you were out of the house. Basing it more towards more of this. And this kind of were saying, how do you see the development? Like, how do you see yourself your own position is with what towards what the companies are doing right now?
Gustav: So yeah, first some further comments on the overall energy trend. I think you can compare it a bit to telecom companies. They used to sell you data per megabyte. So, the more they are used, no matter when you use it. The [00:12:00] more you paid.
Patrick: Yeah.
Gustav: That's kind of the business model that the energy company has been using. Like, you pay for kilowatt hours, the amount of energy you use. But for different reasons with like, how you dispatch renewable energy, what's becoming more and more valuable is when you use energy. So killowatts.
Patrick: Yeah.
Gustav: So the power needed at a certain time. And that's kind of comparable also to the coming industry where you have now like a fixed rate for a certain amount of data. And you pay premium if you want fast connection. So, I think the business model for the energy industry overall will move in that direction. And if you're really looking at like, what is the strategy department of these big energy companies saying about the future? Like the main thing is moving away from selling the commodity, like selling electricity.
So, they have kind of accepted that they will not be able to [00:13:00] make money out of selling kilowatt-hours. So they're looking to what are the energy related services that we can replace this revenue stream with? And how can we like create a competitive advantage without with some kind of product? So, I mean they are looking at electrical vehicle charging.
Some of them are moving into this landscape of this and write solar batteries. Someone are moving kind of vertically to selling like insurance and broad, like

internet connection. So, there are still a lot of trial and error for the big energy companies on how how they are going to move away from the killowatt hours, but kind of everyone agrees that the business model of the future will not be the one that has proven for the last hundred or so years. And for us that's a really good [00:14:00] development and we really embrace that. Cause we think we can be one part of like offering that energy related service as a premium.
So, for example, if it's a telco analogy again. So right now the sell you a bundle with their data and phone contract. And the subsidize something that's attractive to you for using that data, which right now is like the latest iPhone.
Patrick: Yeah.
Gustav: Well, what we hope to build with the incumbent energy companies is like, yeah buy our electricity contract that basically the same as everyone else's. And it's priced the same, so it's no different virtually. But you get these premium service or products that helps you use this boring product in a more efficient and [00:15:00] interesting way.
Patrick: Yeah, okay. I get that.
Gustav: And also when we are moving away from kilowatt hours to kilowatts. So, from how much energy you consume during a month to like more specifically the time during the day you consume the energy. There is no really good interface in explaining this to consumers today. So, let's say you instead of you have like a fixed tariff. So, no matter when you use the energy it costs you the same. From that going to that you can have like five times more expensive energy at five o'clock in the afternoon than 12 o'clock midday.
I mean, today there is no way for you as a consumer to know what the electricity price is of any given moment and what your consumption is that at any given moment. So, even if you would have these price incentives, [00:16:00] you don't have the information infrastructure to make people react to this price signal.
Patrick: Okay and that's actually what you or Watts is trying to provide more less.
Gustav: Yeah, exactly.
Patrick: Okay.
Gustav: So, that's the position that we can take to help these incumbents find a new way in this new emerging wave of the market. And the other way we... Oh sorry do you have a question?
Patrick: No no, no, keep on going. I'll come back to it.
Gustav: Okay. So that's one more thing we can do. Like, bet on helping these big incumbent companies finding their new position. Or, we can look at these emerging players like the solar installers, the battery manufacturers, the ones making complex, like virtual power plant management software. How can we be a piece of the puzzle of this new emerging landscape instead?
[00:17:00] And like over the last couple of months, I would say we're moving more and more towards that direction. So, the really interesting deals we have going on right now that could materialize in something like significant, is companies that already needs some kind of energy meter that is not this regulated smart meter that the energy companies use for building.

Patrick: Yeah.
Gustav: But you need like data with better quality, and better resolution, and more time. And they already have an alternative cost for the metering device, where we can like replace their existing meter. So, the marginal cost of switching to Watt is the basically zero. They already have an installation opportunity. So, they have an electrician on place installing, for example, a solar system. Then, the marginal cost of installing Watt is like [00:18:00] almost zero, it takes five to ten additional minutes compared to if you're selling what the other one often you need to send up an electrician like driving to [unintelligible] back.
Patrick: But do they already have, so the companies are talking, do they already have an existing meter or is that what they're trying to do now that they know that they need this and they're looking at how to best serve this possibility?
Gustav: Yea, so if we take solar installers as a specific example, or we can take two examples here. The first one is solar installers. So, they could potentially just sell you solar panels and just leave it there. But they do want to help the customer understand how much energy they use and for that they need some kind of energy meter.
And right now they're using like industrial-grade or same as or Schneider meters that are [00:19:00] like very high-priced and made a bit for different application that the residential one.
Patrick: Yeah.
Gustav: And there we also have like, if they are going to provide a lot of value to the customers, they should help them improve their amount of self consumption. So, right now you can either choose to to use your energy, or you can sell it to the grid, or if you have a battery you can store it. And this is a kind of interesting optimization problem where you can really save a lot of money for the customer. And right now they don't have the smartness and the necessary information to make those decisions really. So, there we definitely is an interesting complement to the product.
Patrick: Okay.
Gustav: And the other example, which is like very early stage could, like collapse or materialize into [00:20:00] something very significant on the energy market. And that's kind of peer-to-peer trading over blockchain. So, like my LinkedIn feed it's so spammed with energy people talking about blockchain right now.
I can't really believe it. And nobody has an idea what they're talking about. But I think there is some interesting fundamentals there in how can, let's say I have solar panels and you don't. You maybe live in an apartment. And I have, at sometimes a surplus, and you want to buy like low-priced green energy.
Patrick: Yeah.
Gustav: If someone can find a way that we could mutually set the price between us and have some kind of contract that doesn't require an intermed an [00:21:00] intermediary player like a big energy company or a bank, that could actually grow into something big when a lot of people is getting more like self- production.
Patrick: Yeah. Okay, I see that.
Gustav: To continue a bit on that. So, if we are going to do this there has to be a trade. That trading platform need to know how much energy you need, how much energy I

produce, and how much I can transfer to you. And that needs to happen in real time. And the existing infrastructure with the circles smartmeters can resolve the problem.
Patrick: Now. So, what I'm hearing is that especially this real-time application of Watt is pretty, I would say unique, and invaluable for future growth, at least within these areas because the [00:22:00] current situations are either very high price based on the on the industry grade, but the smartmeters are limited to the 15 minute intervals.
Gustav: Yeah, exactly.
Patrick: Okay.
Gustav: So, I think the first, like the deals that is gonna make the curve turn upwards to the right for Watt will be ones that already has some kind of cost for a meter today in their setup. So, for example a solar installer, a battery installer, a blockchain trading company.
Patrick: Yeah.
Gustav: That already needs this data and that can find a way to do this in a more reliable and cheaper way, through our just like our product asks the kilowatt readings, but that you also get the add on of having the desegregation.
Patrick: Yeah, but isn't... [00:23:00] Okay, so you're saying because the companies that do already know that we included the costs for this type of metering. I'm guessing that, I don't know if the solar panels on energy is part of that industry, but generally the the the the the growth of smart homes, and the interest of smart homes, and a general smart city, like integration, I'm guessing for all that they also need these smart meters based on because the demand for technology or for data is becoming more. So they can't rely on the 15 minute setups either. And because you're you're looking for more functionality and also remote access, I'm guessing have you thought about more like going, I know the this is still a very very early stages for that type of industry, but is that a way that Watt you also seeing Watt going into becoming like, because I'm guessing that anytime anything within the smart home you need to be developed or more integrated than the metering cost would also be included. So this would be a very good way also for Watt, I'm [00:24:00] guessing, to be able to grow pretty fast and exponentially going forward.
Gustav: Yeah, exactly. So, I mean that's also an additional use case that is more of an early adopter segment I would say. That people that want to have a smarter home and automize it in different ways, then the energy data we like the appliance level data we can provide with this relatively low cost solution. It could be like one part of the brain that makes the smart home things talk to each other.
Patrick: So, that's pretty cool actually. So, but you were talking earlier about how Watt could also help like incumbent companies continue on their path towards, well, yeah continue in their path. But I'm just that, aren't you afraid that by helping incumbants also develop this or like continue on that path that [00:25:00] this may be a bit of a niche market that you guys are creating for yourselves with being able to implement monitoring systems and preventing like this part of the brain behind energy management could be, kind of be overtaken by incumbant companies, if they are if they're able to actually develop similar functionalities and then create because I'm guessing at some point, there's going to be a growth that makes this into a mass

market because the self-sufficiency and the smart homes and smart cities will become such a big part of every day that it will be a necessity to have these types of metering, and optimal metering capabilities, and energy management capabilities.
Aren't you afraid that by maybe helping incumbents, you're kind of signing your own doom to some degree? That you're kind of like allowing them to come in and maybe establish some sort of a mass market later on? Or do you think that you will be able to get big [00:26:00] enough of a foothold yourselves to actually be able to grow and become more of a standard for for using metering in the future or any thoughts on that?
Gustav: Yeah good question. I mean today you have basically hundred percent of all households have relation with an energy company. And like that six percentage percent figure, I would be interesting to see where that comes from and which market it relates to, because, I mean people leaving their energy provider, I think, to my knowledge that much more rare than the numbers you're mentioning. I mean if I'm wrong I really need to be updated here, because that's something I must know.
Patrick: Yeah, I can definitely try to provide get the get in touch with our contact. See if he can give real numbers on...he [00:27:00] gave us he just mentioned some numbers during the interview for about Northern Europe, so, but I can try to get some more elaboration on that. But yeah, sorry carry on.
Gustav: Yeah. So the picture I have here is that there is an increasingly amount of people producing a portion of their own energy, but that do not go completely off grid and like discontinue their relation with energy company, which is quite a significant difference in terms of thinking about the future of this market.
Patrick: Yeah,
Gustav: But like also setting our, timeframe like strategic timeframe as a company in relation to this big industry trend. So like the time before the energy companies has lost a significant amount like 20% or more [00:28:00] of their customer base to them being like, self-sufficient for energy is well beyond, I mean that's at least five years into the future and then I'm being really really optimistic.
Patrick: Yeah.
Gustav: So we can't really bet on, like take that fact into consideration at this moment.
Patrick: Yeah, but but I'm thinking then that even though that it's people won't be self-sufficient. I'm guessing there's still the extra services that are provided through energy management, because I'm guessing, does what are you guys thinking only becoming like remaining within information, like creating this information architecture, providing these insights for companies and people? Or do you see yourselves like expanding on more remote functionalities like stepping more into an active role, I would say if that makes sense?
[00:29:00] **Gustav:** Okay.
Patrick: Yeah, we had some industry reports say that like 71% of people would actually be willing to use a specialized firm to have them control like energy like remote access, give them feedback and data on that point. Whereas only 60% would choose to use energy providers. So, in that sense, I'm guessing that Watt has been

specialized within this would have a good opportunity to actually grow that portion. Even before people become self-sufficient, but trying to expand on some of these services that people are beginning to look at.
In relation also with again smart homes and cities where I was we were quite surprised about how big up focused this is going forward. Even though the infrastructure may not necessarily be there, people are already like looking towards planning towards that.
Gustav: Yes, so one dimension, I think that's important here is the discrepancy between what people say and what people do.
Patrick: That's true.
Gustav: I [00:30:00] mean, if you ask people, like do want solar power? I mean 95 percent say yes, that sounds fine. And then you ask like, are you willing to invest, 9,000 Euros in this? To have this on your roof? They like take a step back, so to speak, which is like the investment you need today to fulfill your energy needs. And then you need a battery for 5,000 Euros and so on. But of course, it's a trend very much in line with what people we want in the future when the system and even more viable option economically. But but the back to the question like do we want to be, so if we go back to this optimization problem between if you have solar, you have a battery, and you have your consumption.
And you can either use, store, or sell the electricity in the grid. So, here we the battery manufacturers today are very much like they are trying to build as cheap as possible battery cells.
[00:31:00] **Patrick:** Yeah.
Gustav: And they're not very focused on the energy management system. An they are often not integrated with the solar installers. So here it could be a position, I mean we can either choose to be the date stream for the consumption to someone else that does the optimization like solving the optimization problem. Or we can move into actually being the player that has one of these data streams, but also integrate to actually being the brain of this battery. So, is that kind of the questionnaire posing here?
Patrick: Somewhat, because but because what I get from that is that your focus is very business-oriented. That the partnering that the product will watch it will be much more centered towards businesses and not directly to consumers as you are currently. Because, or am I getting that wrong? Because the way you if becoming the [00:32:00] info like the brains behind the information architecture of the infrastructure behind it. Is very specific towards how the energy like the battery and the solar panels and what might work together but the use for consumers I'm guessing, because last we've talked with with us he was talking about this anomaly detection and all this and optimization, but if that gets outsourced, I'm guessing that the consumer focus kind of gets removed a lot from the Watt. Or...
Gustav: Not really in this case, I would say. So, I think we need to both. So, if we take a battery case, that's really solving a problem for the consumer like how do they optimize because they will be the one owning these assets. They will own the solar panels and they will own the battery. And they will be the ones, so to speak, that make the decision whether to use so or store the electricity.

But the normal consumer isn't like an energy engineer [00:33:00] able to hack this together themselves. So, they need to have someone doing this for them through software.
Patrick: Okay. So what you're trying to.... Sorry if I'm interrupting, is that Watt will kind of be the platform that allows the consumers to trade their energy and kind of connects the two if they need to? Or...
Gustav: Yes, so we could move in that direction. Or we could be like a data stream into the ones that are doing this optimization, but someone will need someone will take that position definitely.
Patrick: Okay.
Gustav: And then it's a matter of like a question for us whether how specialized we want to be. If we want, cause then we have a trade-off between improving the desegregation and adding more use cases.
Patrick: Yeah.
Gustav: This is still a bit too early stage for us to having to make that decision. There was something else [00:34:00] you said... I thought about yeah, I have between like are we creating value for the consumer or for other companies? So, I don't think that's really an either/or. So, for example, if you take Google, they have like a two-sided platform that needs users on one side. And they need to have the best search engine for users to use it for free to find their information, and they need companies on the other side that are willing to pay for the value that Google creates for them to have this platform being improved continuously and being used and making money for like creating value for parts.
And if you remove if you focus too much on one of these you will lose on the other side. So, so that kind of two-sided business model is definitely something we see as [00:35:00] very instrumental to the successful Watt. Maybe not in the first and second stage of the company's lifetime, but definitely if you're gonna build like a multi-billion companies someday in the future. We need to have that kind of business model.
Patrick: So so, how do you see? Where do you see like, the Watt going in that direction? Do you see like becoming a the market leaders within kind of this information energy management and information like architecture kind of setup? Or will it be more as a support product? Maybe still a big one but a support product to one degree that will be bought up by a major company?
Gustav: I mean, I think those two are, at this moment, kind of equally probable scenarios. And it will be partly up to us and partly up to what happens on the [00:36:00] market. But I definitely think we are coming from an interesting place to position ourselves to taking this kind of role. So, I mean this optimization problem I'm coming back to for the solar and the battery.
Patrick: Yeah.
Gustav: Just like core of this development really of moving energy from being centralized within big companies to be decentralized among consumers.
Patrick: Yeah.
Gustav: That's really an easier problem to solve than the one we are solving right now

with desegregation.
Patrick: Yeah.
Gustav: But, if you don't have reliable data on each of these points like how much energy you produce? How much capacity do you have in the battery? How much energy are you consuming right now at this moment? And more importantly, what is [00:37:00] the the like normal consumption pattern for this unit? And what are the the forecasts for the market prices? There are a lot of variables that you need to take into consideration and having control over those variables, I would say is more important than right thing that the algorithm for the optimization itself.
Patrick: Okay.
Gustav: And there I think we're quite interesting interestingly positioned that we can have the the data for how much the solar produce. We have the best information on how you use energy right now. And we will probably but like by having the best right now, information we'll probably have the best predictions for how much energy this household is going to use at any given time. And then like knowing the capacity for the batteries really only the source of information will lack. [00:38:00] And that's not very difficult. That's a very simple software integration to the battery manufacturer.
Patrick: Okay.
Gustav: I feel like I'm like freewheeling a bit incoherently here, but...
Patrick: No, it's actually pretty well aligned to some of the findings that we actually looked at. Because so we're looking a lot of like what the industry has been saying. The evolution of the industry, especially within energy management. There's a and also because with the influence of renewable energy, how these two have gone together and then we've been looking at how you guys have been, based on what we knew, on how you guys have been working.
And then some of the strategic concepts and we're trying to figure out how and to which degree you're positioned with the strongest strategic like advantage going forward. So, is it first-movers? Is it like some other competitive advantage? We're trying to like position this or like at least flesh [00:39:00] this out so it presents in a in a feasible and, I would say coherent way. So there's some good points that you come with and one of the ones I know I'm...
Gustav: Sorry if I can interrupt you just with a quick thought on like how we would think of this conceptually. So, we are quite decided on that we are not going to build a pure B2C business selling this as just a smart home product like a security camera. We want to be something more.
Patrick: Okay.
Gustav: So we want thousand kind of distribution partnership with one type of company or several times but like center partnership is the way to take this product to the market. So, choosing let's say that everyone wants to do this with us, like the question for us is how much volume can we get through certain partnership. And there we have like the equation is, [00:40:00] how much like what's their customer base? And how big a share of that customer base can we reach? So, if we think of a big energy companies. They have a huge customer base, but the hit rates of reselling this

will probably be in the low single digit presents.
Patrick: Yeah.
Gustav: So, they might have a million customers, but we might reach two percent of those. And if we look at for example a solar installer or some were rolling out, a blockchain peer-to-peer trading platform, we're gonna probably, it will probably, in the coming years be a lower customer base, but we will reach upwards to a hundred percent of those customers, because we will be an integral part of their ecosystem.
Patrick: Okay. That sounds pretty good.
Gustav: Yeah, so we could reach if we want to reach 10,000 customers with a partner that equation or reaching those 10,000 can look very different.
Patrick: No, definitely. [00:41:00] Yeah.
Gustav: And the other thing is how much value can we create for that company with our data?
Patrick: Yeah.
Gustav: And there we have different use cases for for example the energy company that could be for example better targeting for the new marketing campaigns or improved forecasting in the trading. Or for a blockchain peer-to-peer platform. I mean, they can't really do this without a product like oars or hours product.
So, I mean there were quite high value for them openly from the beginning.
Patrick: Okay.
Gustav: And I mean, we don't we still don't know the answer to how do we reach a lot of customers that has a high value so we would try still trying to find that out.
Patrick: Yeah, because that's what I'm guessing a lot of this is of course [00:42:00] depending on like using some sort of a increasing some sort of the consumer base, but I would say the partnership seems like a pretty good way to go. But but the way then you're so I want to come back to...Let me just see. I just need to figure out with my questions. Some of the ways you were talking about a lot of this technology that you guys are doing and you've been you've are the best and the way that you're doing it. With the way you worked, it's is this, do you feel that you were kind of setting the stage for other people to follow? You kind of like innovating in the way that people are measuring the data? Are you afraid that some people might be able to replicate this going forward?
Because I'm guessing a lot of your like strengths are that you are able to provide a unique way to do some things that the solar panel companies or the the batteries or like the way that you do that type of issue isn't aren't able to do [00:43:00] themselves. But what stops them for actually doing this themselves to some degree besides of course a lot of money and investment.
Gustav: Yeah, so really good question, so I think if you want to do the same thing that we do basically, I mean if only want to build an energy meter that stream you kilowatt hour or kilowatt data, that's not a very difficult problem really. Although surprisingly like from the feedback we're getting from the market, surprisingly few actually managed to build this back and system streaming real-time data.
I mean, that's a problem you can just core a lot of money on to and hire good like backend software engineers and some hardware guys figuring out how to measure the

data. And I mean as I think I told you we don't really have much competitive [00:44:00] advantage in the hardware itself. It's all standard components designed and assembly by someone else.
So our competitive advantage is in the like solving the machine learning problem of making this data down to appliance level.
Patrick: Yeah.
Gustav: I'm trying to figure out how to explain this. The interesting thing with machine learning problems is that, there really is the first mover advantage. So, if you take autonomous cars, like self-driving vehicles.
Patrick: Yep.
Gustav: You really, which also is a machine learning problem with it, because it can't hard code instructions in onto a car like how it should perform in any given situation.
Patrick: No.
[00:45:00] **Gustav:** Therefore, you know, Tesla [unintelligible] all these companies have a lot of cars driving around collecting data. So, right now the highest-valued autonomous software company are the ones with the most data. And the more data you have, the better models you have, and the models you have the more you can have the the cars drive themselves and collect even more data. So you have these very self-reinforcing loop to having a first mover advantage. And this is very similar to this appliance level break down that we do. So, we have a competitor in the US called sense.
Patrick: Yeah, we noticed.
Gustav: Yeah. So we have we're doing basically the same thing. And you know, if you look at the bubble view, it looks I [00:46:00] don't know. I don't even know who copied whom.
Patrick: No. No, it looks very similar. We didn't notice that.
Gustav: Yeah. We have taken a bit different technical approaches. And we, I think we're just about to find out which one is the best.
Patrick: How so? How so?
Gustav: Yes, so they have take a completely crowdsourced approach approach. So they don't have any automatic models that they train themselves. So, they only when you saw that it takes two or three weeks before they start predicting somethings. And it's only based on what other people have labeled that kind of similar signatures to.
Patrick: Okay.
Gustav: So, and then we have taken is that we have collected these appliances data in over 500 households. So, we [00:47:00] have very high resolution training data with like the on the ground truth that we know that this is a microwave for example. And I think we have about a million hours of this very high resolution of minus level data that we can use to train models that predict which appliance you're using at the moment. Which I mean, I'm trying to think as I speak here... So the problem for them and for us is having a good enough product so people start using it so that they provide us with even more data to improve the models.
Patrick: Yeah.
Gustav: And if you're starting out with having to do 100% of the work for yourself,

like sounds does. You gonna have problem in getting the critical mass of feedback from users.
Patrick: Yeah.
Gustav: While, we have back on that [00:48:00] if we have five or seven automatic modes that's good enough for enough people to accept that this is a mature enough product so that we can roll this out to them and they start giving us feedback on the usage and like this data that we can use to make the [unintelligible] better.
Patrick: Okay.
Gustav: And if you compare this to like what would Eon, for example, if they decide that they want to do this themselves. So to solve this problem is it like a function of how talented of a machine loading team you have and how good data you have? And the at the moment have neither of those.
But they could, I guess, hire 50 good machine learning engineers, but they still wouldn't have, I mean, they have a lot of consumption data, but they have it in the completely wrong resolution, [00:49:00] that we already like we draw that kind of data that to the end of the road and realize that this is this will not be doable.
Patrick: No.
Gustav: So, they don't really have an advantage. They don't have a data advantage, which they could have before other problems. But for this specific problem, they don't really have an advantage.
Patrick: But I'm also guessing that to some degree because of your quick entrance into like this area that this is a major advantage just based on the time aspect that the amount that you're able to you've been able to, like get that much more data over a longer period of time.
Then if anybody goes into the market now, they'll always be a certain amount of distance behind you. I'm guessing, or....
Gustav: I mean if you have like a billion dollars, you could send out hundreds of people doing measurements [00:50:00] in thousands of homes in quite short time and build up a similar database.
Patrick: Okay, true.
Gustav: But if a big energy company would like trying to catch up with us, I think that would be much more expensive than acquiring us.
Patrick: Yeah, so that's actually pretty interesting that you guys have brought kind of had that advantage going for you, which is pretty cool.
Gustav: Yeah.
Patrick: I had a question that got away from me. I can see. Oh, yeah! So, you were talking about, like some of the demands, if you grow and all this with the partnerships between optimization and in any case we are how you go. How purely technical this is where might we might need Oscar or we thought maybe Oscar would be a good point. Purely technical, how are you able do will you be able to like keep up with this, because your your amount of data [00:51:00] collected and and like brought through is going to be very very huge.
Because I remember talking with both Yayun and Oscan and say there was there was some issues that some of the cloud providers won't able to process the data 24/7. And

they wanted to maybe use some of the Watt boxes as a complete computational network system to help kind of process all these things. How do you do you see any like technical challenges going forward with also the growth of you guys? And the and the way you're going to go with company and kind of services you're going to provide?
Gustav: So one challenge is definitely the scaling hardware. We're not really a hardware company and it's always a headache. I mean, you have quality control, you will have devices breaking down that needs to be replaced and so on.
Patrick: Yeah.
Gustav: But that kind of a known problem that every hardware company run into and there are ways of solving this. [00:52:00] Software wise, I mean if we would just if we would add 100,000 users today, we would have not very advantageous cloud costs.
Patrick: I know.
Gustav: So we definitely have work to do there on like optimizing how much data we send and process. But we have kind of proof of concept in continuously improving that. And at the moment we don't see like a theoretically that we're gonna run into that's going to stop the scaling. And we've also dimensioned our hardware way beyond what we using it for today. So, we have the possibility of moving a lot of the calculations down locally.
Patrick: Yeah.
Gustav: Which would put down the the [00:53:00] load on the the cloud. So, there were always be have a trade-off between increased hardware cost and increased cloud costs. But I think there are some interesting ideas about taking our automatic models, but once we have our fridge for easter, washing machine, tumble dryer, and so on. And doing those locally.
Patrick: Yeah.
Gustav: And if you want to do increased fingerprinting for your more unique appliances that will be processed in the cloud, for example.
Patrick: Okay, so that's one of the ways you could actually optimize on the way you process it and send it I'm guessing.
Gustav: Yeah.
Patrick: Okay. Yeah that also makes sense because I remember last time we were out you guys it was I I felt that was a bit of but again, you're you're you're still startup so you kind of like a lot of things happening, but there was some, I wouldn't say disagreement, but there was some differences in what to focus on when we were there I [00:54:00] felt like. So when we were talking with Yayun and Nosca they were like, oh, yeah, there's of course of opportunities with the Watt box. They're talking about this computational network that could be made and also discussing about producing more locally, but I think Yalpal stated pretty simply, the bug is not something that we really focused in that much on. So it's I'm guessing you've become a bit more aligned maybe on what's needed also technically going forward.
Gustav: I think the Yayun said that we made a decision kind of over-dimensioned from the beginning, to have the flexibility to do this thing software as in the future.
Patrick: Okay.

Gustav: So I think what mainly meant was that we don't need to make any design changes to the hardware to be able to do these optimizations.
Patrick: Okay. That's that's good to know.
Gustav: Yeah, and this is something we can do like remotely. We don't need to replace the box, or we don't need the user to do it and we can just push a button and then we add a [00:55:00] model locally for example.
Patrick: No, that's true. I'm just trying to see... So you're talking about, so the disaggregation I'm guessing based on what Sense is doing and going forward, so even though you're not going to be a pure B to C. I'm guessing you still want to evolve the disaggregation algorithms and software that's going towards that so becomes even better because last I was talking with Osca.
They said they were getting close but they were still a bit away from like doing proper anomaly detection through some neural networks that they were working on. Can you update us on I'm kind of like the process there. What's going on? Is that still as a big of a focus before because I'm guessing that being able to do that probably is also what gives you kind of the advantage like and keeps giving you this advantage going forward?
Gustav: Yeah, so we actually [00:56:00] implemented the first three anomaly detection models. So right now we have for your iron, your hair straightener, and hair curler. We have automatic anomaly detection models. So that they're appliances that you plug in manually. People tend to forget them. And if you forget them, they tend to risk start a fire.
Patrick: Yeah.
Gustav: So that's the reason we started with those of course. The difficult thing to solve here really is how do you give notifications to people, like not too much not too few. So if we have a hard-coded anomaly detection where iron say if you use if someone uses iron more than 15 minutes send a notification. If you're a big family that do a lot of laundry, you would go crazy [00:57:00] and uninstall Watt because you wouldn't get a notification every time you iron.
Patrick: Yeah.
Gustav: So, the reason we solved that is that these models are now adapted to the individual homes. So, during a couple of weeks they learn your usual behavior for these specific appliances. So, for for one home, it could be seven minutes until we send a notification and for one home 25 minutes, for example.
Patrick: Yeah.
Gustav: To only give you notifications when you really want them.
Patrick: And I'm guessing it becomes better and better the more you use, it gets used because I'm guessing that there might be outliers sometimes. So it might be more adapt, so yea, I'm guessing adaptive.
Gustav: Yeah, exactly.
Patrick: Okay. Well, that's pretty cool.
Gustav: So kind of like the proof of concept, but you still need to do the fingerprinting of these appliances yourself.
[00:58:00] **Patrick:** Yeah.

Gustav: So if you don't say that this secret comes from an iron, it will not work.
Patrick: Okay.
Gustav: I'm not really up to date what the next steps for anomaly detection is. I think now we have kind of proof of concept for that and we know how to do it. So, now let's more prioritization question against like launching more attic models. I think that's prioritized at the moment.
Patrick: Yeah, because I think the last time we also I spoke, one of the issues was trying to detect resistive load appliances because you just it's such a difficulty going into seeing around electrical signature because it's more like just a step change.
Gustav: Yeah.
Patrick: I know I think Oscar was talking about again using some sort of, I think it was an unsupervised algorithm to somehow figure that out. But, again, they were they were pretty stumped for, [00:59:00] because the problem is you wouldn't be able to go into more detailed and like signatures or at a lower frequency because then you would be able to see anyting apart.
But, I think where you're measuring currently you won't be able to you couldn't distinguish more or less between a kettle and what else uses resistive loads, which I can't remember currently off the top of my head. Do you know anything again about those or...
Gustav: Yes, so that's still is and will for some time remain a problem.
Patrick: Yeah.
Gustav: We will not have like an automatic predictor distinguish when distinguishing between your kettle and toaster for example, because the characteristics are too similar. So, the way we're looking at the right now is to have a way of, either using method method data, for example, which time of the day you using as compared to other people.
Patrick: Yeah.
Gustav: Or [01:00:00] have a very easy sewing is the user interface way back. We know 5 appliances that this, when 80% probability can you choose from this?
Patrick: Okay.
Gustav: We made a recommendation for you. And then again, I mean right now we only look at quite simple characteristics like the shape of the signatures. We had a stand up this morning where our CTO showed, like different signal processing spectrums for the frequency with some really promising results in, like using the information add that information to the models to be even better in distinguish between them and predicting the length of the episodes. So, like how long time the machine is on. [01:01:00] And there are like a handful of different charact....

CEO, Interview.

[00:00:00] **Patrick:** So just for a record if you could just state your name and your occupation and then yeah, you don't have to say how long you've been here because I'm pretty guessing that´s the entire time.
Hjalmar: Yeah, that's right. So my name is Hjalmar Nilsonne I am the CEO here at Watty. I was part of founding the company like four something years ago now.
Patrick: Yeah, great. Thank you.
Hjalmar: And today is February the second
Patrick: Yeah, that fine
Hjalmar: Second interigation.
Patrick: Thank you, awesome. Um yeah, so as Gustav mentioned if you could actually just kind of, to begin with, the thoughts behind Watty why did you found it?
Hjalmar: So we used to have this really cheesy tag line which was like "Watty connecting the world energy data", and I thought this was great and everyone else thought it was stupid, but I was really like a pretty good like integration of all the different thoughts we had so [00:01:00] basically like the reason we started the company was that we wanted to do something about the transformation of our Energy System from being basically fossil-fuel based, to being renewable and sustainable and that is something we have to do anyway, so you know I just I've always figured that's going to be the biggest challenge for Humanity over the next couple of decades so like what can be more fun than try to contribute to doing that.
And the problems on the energy Market are very particular in their characteristics. So there are not like almost any other industry and the biggest problem if you look at CO2 emissions, is not bill, or is not cars and trucks and all this stuff. So everything happening on the road basically is about ten percent of global CO2 emissions and buildings and households and the grid is about 20%. So like everyone is focusing on the cool stuff. We're like moving stuff around but actually the bigger [00:02:00] problem, the way bigger problem, is in buildings and households and that's an area where nothing has really happened.
It's like you know my dad was born in 1925. He would completely recognize our interactions with our energy usage today at home. Like an electric car would blow his mind. But like how I interact with my Energy company, and how that works within, its exactly like it was for him growing up, right, so nothing has really changed there.
And if you look into the data, so like okay, why are households and building managers, why are they so incredibly inefficient in how they manage their energy use? There's a lot of, because everyone is like it's not like we have found the secret that "oh twenty percent is actually like..." everyone knows this and the European Union has spent I dont know how many like decades trying to figure out how can we do something about this, right? It's a well-known fact. And you can see it. It's like. [00:03:00] When Russia invaded Ukraine the first action done by the EU was to set up a fund to do investments in households for installation. Why? Because the Reliance on Russian gas in households they knew was the biggest driver for their dependents like the the conflict there, so that was the first thing the EU did. They know the problem was to make sure they could

finance to make the homes more energy efficient, right. This is the deal, so why is it still happening. So it turns out there two factors and one factor is by far the biggest factor and that is that no one understands or cares at all about their energy consumption, so you get a bill you pay it, and that's the end of that.
And that's what my dad did and that's what I did right, so we had this problem where we kind of so okay people don't have access to good information. There are other companies like Gustav mentioned [00:04:00] who have developed really cool energy saving products. They have no way of finding the appropriate Customer because people don't care about their solution because they don't care about the energies to begin with and then we have the poor folks are trying to manage the whole system, and they're having a terrible time, and they have no way of interacting with any Appliance or with any homeowner or anything so everyone is like existing in their own little bubble and the thing that's really lacking is information.
So when we started to come over really think okay if we could only connect these different worlds into the same world then we could actually just using information so one of the biggest problems we have in the world. That feels like a pretty cool starting point. And then it's like oh its just information okay, like surprise surprise, like IT has revolutionized like every other industry in the past decade. Here we have a problem that we can solve with information technology. We don't have to invent the new battery or anything's just getting the data [00:05:00] basically connected in the right way so that was basically really the starting point of the company.
And then we looked a bit deeper, and we said okay what what is the first step to doing this? Well, and then we we started the company with two hypotheses, so we thought that on the one hand the metering data, so the meter is that are in every home already, that that data we could have access to easily. So we s said okat we can access to the data, and then we just need to interpret it for the End customer, and my background was doing this kind of like analysis of the data, so that, we just need to co-down some algorithms that do what we can do manually for the End customer, and then it's like okay infrastructure plus a little bit of software everyone in the world gets this amazing product. You know, cool easy, It´s super easy. Yeah, so we like yeah ok we're going to be in the market and I was kind of paranoid. I used to work with another thing that was very R&D [00:06:00] intensive, so I was really paranoid. I was like if this is going to be months or years of like with technical difficult stuff that no one has ever done before I'm out. It's like that's too difficult. I've tried it before and it just breaks your back trying to invent like make it work for the first time so we actually had a professor at KTH with two of his his PhD students. They did like a technical due diligence. That´s just to build the algorithm part. Is that easy to do? They said yes pretty easy to do lots of folks have done it before, we just Implement these five to six papers, and you're done. So we were like great, in six months we're going to have the algorithms down, we just need to talk to some energy companies, and you know four years later we launched our product. So it was one hell of a difficult journey. What happened was basically we learned that both of our assumptions were completely false. [00:07:00] So we couldn't get the data out of the smart meters basically at all for various reasons. And the algorithms to actually interpret the data for you, turned out to be super hard to do. So we had to completely rethink the whole assumption that the company was built on. We went in one direction, and it was the wrong direction. Then we went in another direction and now we have a pretty good direction. And now we're finally in the market with the product that can do all these

things that again is like the first step towards building that bigger vision of connecting all these different areas that needs to be connected.
So that's the five five minute version of the journey exactly.
Patrick: Uhm but yeah, that sounds pretty cool. So, what you are [00:08:00] saying is like going forward you want, Watty, you see Watty as a platform actually, just a meeting place for both, well the different areas that you spoke about earlier. The consumers, the energy companies, and the people that have a product that actually can help save the environment.
Hjalmar: That's sort of an ideal and state. I shouldn't say an but let's say like, you know if we can get that market position, that's definitely what we want.
Patrick: Yeah, you also mention that, and just if this becomes too technical please say so. You said that you didn't want to do anything R&D intensive, and of course, then you spent four years developing. And we've heard now from Oscar and people, that the algorithm is is good, but it's of course not perfect, and there is still lots of things that can be done. Do you think that's going to be the way forward as well to be able to [00:09:00] develop this Marketplace idea later on? That you need to grow that algorithm much more, or is it that do you think it's fine now. So if we say that you hit critical mass with the amount of consumer base that you have. So it's going to be that you have enough data that's viable to also commercialize towards suppliers or the energy Grid. I would say we've met the, you know, the phrase that I often use this sort of an acceptance level. I think we've reached the acceptance level for techies and early adopters. I don't think we've reached the acceptance level for an early majority, so I would say we now working to get to the acceptance level of the early majority. And I'm using here like fairly precise terminology from Crossing Picasa, which is the most well-known Book for sort of [00:10:00] describing how startups grow from basically appealing to different user groups over time.
Patrick: So I´ve aksed this question also to some of the other people cause as you mentioned the energy sector, so we just talked to Maral. She said that she sees Watty more in the smart home business and where as I would say of course, I would also say you definitely within the energy sector.
Hjalmar: True
Patrick: Um, you seem like more of an innovation concept going on within or like do you see Watty at is going to be more as a disruptive force also?
Hjalmar: I mean. First of all, like if you want, if you working with marketing its like smart home is so horribly a [00:11:00] lot more interesting and sexy than energy. Like only complete weirdos like Gustav and I get excited by stuff happening in energy like any normal person would just find that boring. Same as like energy is already like the best product ever. You flip the switch, it works every time, every time like in your entire life. You flip the switch and the lights went on. It's like it's a perfect product. That's why it's so boring, right, so Maral you know, she doesn't care one bit about Energy, she cares about smart home. And that's, the same goes like if you want to raise money. Yeah, I talked to an investor which I spoken to quite some time now, saying Hjalmar you have two problems and the first problem is clean tech and the second problem is Hardware. Like those words, which is very very bad. And I was like okay we have never use those words. But he was like yeah, but still you can feel it. And well, it [00:12:00] is something to do that. Investors don't want to put money behind it either. So it's really important to position your company in the way that sort of, yeah, doesn't, you don't land in this boring

part of the landscape, which is the energy, so I would say as hearts it's very much driven from the energy side, but in marketing and how like our customers didn´t really care about that.
Patrick: So do you still see that, because well actually I was also gonna mention that now you have three focus points? Do you still see those?
Hjalmar: What were the three focus points?
Patrick: So these words, was safety or peace of mind? the second was?
Sine: Actionable insights or sustainabliity? Or at least sustainable motivations for having the [00:13:00] product right, and the first one was safety. Safety yeah. So the example with the old people or your iron thing was safety, second example with your son coming home from football practice making some smoothie making sure that he's making that smoothie whatever. So yeah actionable insights. And the final to be more sustainable or green.
Patrick: Do you do see those three still as based on the vision that you started with?
Hjalmar: Sure, I mean you know, startups are really fluently yeah, but that's because you always start out with the wrong ideas. You know startups are really like, I think science. It's like you just, like the world is going to come out like the world is going to come out. It's like you can't. It is the way it is to some extent. So you, what you doing is you are [00:14:00] exploring how the world is much more than you are determining, shaping and deciding that this is how this company should be, right. So like we found out and this you know we had another product before where we made this mistake and what we found out was if you don't have a strong engagement with the end customer, there's no way to scale. And if you don't scale there's no way to really build a Data Business. So we started by focusing on distribution. Selling energy companies what they want. And we recognized that we'll never get to scale with them unless we focus on the End customer. So then we did basically rebuilt the product toward something that is attracted to the End customer. And again they care much more about like the safety of their home, than you know again this weird energy stuff. So you could always have the vision but well it's [00:15:00] how it comes out, so we just learned that that's how we have to do it. And the vision is still there, but we have to adapt it to sort of a reality place out.
Sine: So your way to success is adaption of the environment and the industry and how you, how your cabilities in-house are adapting to those
Hjalmar: Sure, and also technically I mean. Its like we figure out, oh actually we can´t with our own products. We actually we can't give safety alerts. Because the data quality wasn't good enough, so we you know, you just learn in all different parts of the business what you can do and what you can't do, and then you adapt, and we've made some pretty big kind of direction changes. Change direction completely would need very tough conversations. I mean, if you want to sit down with an engineer and explain to him that the thing you told them to build for the last three years is [00:16:00] useless. I mean that's that's not most people's idea of a fun day. And then you won't have that engineer leave that conversation really excited about doing something else you know. And we've done that actually several times.
So I think that's part of like building a startup culture where, yeah, we can pull those quick kind of things often. The reason most big companies fails is that they don't have the tough conversations. They don't change direction, and they just keep going until you know it's too late for them to adapt.
Sine: So how will you do that as a leader? Just make sure that your employees stay on

top of their game in terms of adapting. If that's what they do all the time, if that's how they can make this company grow together?
Hjalmar: Well the first thing is when we recruit, sorry to interupt, but first one thing is when we recruit the first thing I [00:17:00] look for in a candidate is pure curiosity. They can be very skilled, but if they're not very curious, they will not continuously learn about what they're doing and the skills you have today might be great, but next year, maybe we'll need something completely different, so I think one thing is you just need people on the team who have in them, the drive to learn and adapt all the time. I think that's definitely one point, then you need people who tell you that you're doing the wrong thing. Because you don't know that most of the time. I mean, you know, you make a plan you think it's grand. I mean every. This is what everyone does the 31st of December, right. They make a plan their head, like this is a great plan, I'm going to talk Spanish. I'm going to be, when summer comes I'm going to be in great shape you know so you you always think the plan is great. If you tell your New Year's resolution to someone else they instantly know that´s a stupid plan. I've known you for five years. You've never. [00:18:00] You know, looked good on the beach. You won't get good looking. So other people know that you're making all these stupid mistakes, so then you need to have people who tell you that you're making these stupid mistakes, and and that's another part of hiring and culture I guess.
Patrick: Do you see any technological developments for Watty going forward?I know that there been a lot of talk fried face on the algorithm, further, because just based on the capabilities Watty is able to detect, do you see any other changes?
Hjalmar: Things change every week literally. You know our product will change what we're doing and how we doing all the time. So hopefylly we are going to continue doing that. And I mean that quite literally like every week. It's like we're trying something quite different
Patrick: Do you see anything on the hardwood change. To be more interactive like have any switch. I know I think this was one of my first question I asked to Gustav. Like one thing [00:19:00] is you can see that you have actually oh, it's still on. I'm sure it's like is it something that you want to try to go for at some point like they can actually turn it off. I actually have no idea how that technology works now. Don't even know if it is possible, um maybe, that would be awesome.
Hjalmar: Maybe, but we. We don't spend a ton of time iterating on Hardware right now.
Patrick: No, but I'm also guessing there's some logistics because then you have to change everything you've already installed, right.
Sine: What kind of people do spend a lot of time talkin to externally? Like because you're interested in in a model where you can monetize your data, and gathering right? So I mean are you talking to companies. I mean sure we will try to do that and that's our aim, but are you doing that? Are you talkin to Industry people?
Hjalmar: Not that much, not on the data side, and this is because like. You know what? The great thing about being CEO is that you do whatever the worst job in the company [00:20:00] is at any given time, that's your job right, so like you're. The things that go wrong that are the worst, the most messed up, that's what you need to fix. So these kind of future things we need to spend a ton of time just understanding what's going on. Who's using data, in what way, how are they paying for it. But we don't really understand it now, and I spend very little time exploring that. We have made some efforts, but it's surprisingly difficult to find people who can give us good insights, don´t you think?

Gustav: Yeah, it's difficult to do it like a cup like one hour a week, you really need to dig deep down into it. Just because it's a good thesis I think. I know it's going to be super helpful if you can give us some, help us navigate them.
Patrick: Do you have any more questions? Because then I will turn this [00:21:00] and thank you very much.

Commercial Operations Officer, Interview.

[00:00:00] **Patrick:** Alright, so just to start off. If you could just state your name, what you do here, and how long you've been with the company, just so we have it on record.
Arvid: So, I am Arvid Mårtensson andArvid Mårtensson, and right here about two years ago with data collection.
Patrick: Awsome, well thank you. So as Gustav briefly mentioned, we are looking into how we can monetize the data that's hear, but because there's also an academic paper we also have to have a more academic focus to some degree. So more on a broader scope we're looking at how the tech capabilities of Watty and how it's applied into the industry, and how it can become successful. And this is then more specifically how can we monetize actual specific data, how do you collect the data so on so forth, so we actually have some output that we [00:01:00] can sell on.
And so just to begin with. You mentioned that you were part of the data collection to start. We just talked to Oskar and he said that you had like, you had 500 households that you've been monitoring on. Can you talk a bit about that process, and how that worked, and what you did there?
Arvid: The process of data collection in households has been work in progress basically, so it started a long time ago. And that is part of the whole company mission, to get as much data as possible used then for better decision-making. So the process has been, I don't really know how to answer that in an easy way but. So [00:02:00] we started basically with finding different solutions to measure data. Measure the power consumption of appliances. And worked our way through like the whole span of different products out there. And eventually we realized that we needed higher resolution than those products offered, in order to build better models. So we used blink data from Smart Meters. So that's the big thing that we kind of went out in the market with to begin with, and where we started to get some traction. And that turned out to be not good enough basically.
So it's a. Smart meters [00:03:00] have blinking diode showing how much power consumption you have. And that can be from I don't know like a 100 blinks per kilowatt-hour to 10,000 blinks per kilowatt-hour. So it´s different resolutions there as well. But now we're using induction meters as well as you see. But one thing that we needed to do was basically to find the appliance, fingerprints as we call them now, but basically how each appliance use power, right, in order to identify them in the whole. So to do that we used plug wise are they called, yeah, plug wise meters. I can't remember the resolution [00:04:00] of them now, but it's not very good. But it's good enough in order to get some kind of identification at least. And, so we went around in households and installed these plugs on as many appliances as possible basically, and push that data to our service in conjunction with measuring the total as well.
Patrick: Then all this data was just pushed to like a collective platform or?.
Arvid: Yeah, so we built our own platform, and that was before I joined the company, but that platform was built in-house, and every household is singled out. So every household has their own kind of cluster and then within that cluster all the meters in that [00:05:00] household are also identifiable. And then we used a lot of meta data as well,

so surveys, square meters, what kind of heating, how many people in the household, their ages, in some extent sex as well. And then appliance meta data as well. So in some cases like TVs and washing machines, and ovens. Like everything we could find we put down all their appliance not names but like serial numbers. Yeah something like that.

Patrick: So the reason for that type of labels [00:06:00] both on like each household, what was that used for like, because with how many people, I just doesn't see how. Is that kind of to understand the entire households energy consumption based on how many people live there, what their ages are for some later on or?

Arvid: Yeah, so it's just part of what you guys are doing now I guess. Like trying to figure out what can we do with this data, and how, I mean, or is there some kind of research interest in it, whatever. While we were there, why not. So and yeah, that's part of the reason I fell in love with the company, and started here to b egin with. I am super into like figuring out that kind of stuff. Like how people behave and relate to like their power consumption.

Patrick: So what has been the feedback from the people [00:07:00] that were part of the data collection. They were able to see some of the output, or were they just like?

Arvid: So in order to get people on board and to like get them to let us into their homes, and like play around with their TVs and you know. We've been digging in the darkest corners of peoples homes. And like finding stuff you know, a lot of. So in order to do that, we offered money basically. So we offered 999 kroners, which it's about a 100 euros or something like that. For a measurement period of about two to three months. To begin with they got a report after the measurement was done. So we came there with an [00:08:00] electrician installed everything and asked questions. Survey questions. And measured and came back, uninstalled everything and put it back together as it was before and did surveys again. And then they got a report of like their consumption. And this report varied, so it evolved. And by the time I started here we actually stopped using that kind of report, so instead we have this real-time web app. So they could go into the web and check out what's going on right now. Like, so your oven is showing this data, right now, yeah whatever. And obviously your total consumption.

And [00:09:00] eventually we kind of lost focus on the data collection as a whole. So we didn't have that good kind of visualization or good ways to show the customers how their consumption was. So eventually it turned out that we had to basically analyze it ourselves, and discuss with them and talk to them instead. And that turned out to be very, very effectful. So, basically most people loved like having somebody there to just like discuss how things work, and like. Especially I think. Maybe it's a [00:10:00] personal experience because I've worked with energy efficiency in big, like big buildings, churches and school and like office buildings and stuff like that.

So I have some kind of history in analyzing the data and seeing like what's going on. So I think that insight from people was interesting. And to find out that like okay, so maybe the gasket, do you call it that in English I dont know, the gasket, no, of the fridge, it´s like the seal. Yeah, it's kind of. So maybe the seal is broken like. [00:11:00] That's why your fridge is acting weird and is like on all the time. And like your floor heating is on during night even though you don´t go into the bathroom at night. And stuff like that. And that's all also very individual. Some people actually want it like that, so they can go up, like wake up and go to the toilet and have heated floors. So it's very, very individual and that's part of what I figured out, that it´s difficult to make this holistic.

Sine: Would you say that that´s your most important finding or what would you say is the most important things you got out of all the interviews? Were there some links or some things that were common between different households or?
[00:12:00] **Arvid:** Difficult to say since everything has been so incremental. But I think from the feedback I got, the most exciting times we're like either seeing everything on your app, like seeing that for the first time, like oh shit this is cool. This is technology gold and stuff of that, but maybe that doesn't do much in order to save the environment. So if that is the end goal then I think the most impactful thing has been talking to people. Yeah.
Patrick: Some of the data that you had, like when you did the surveys to begin with with the age, and sex, and how many people. Is that something you still do when they have to sign up through Watty?
Arvid: No.
Patrick: So all that data to begin with is just kind of like.
[00:13:00] **Arvid:** It's just for people who signed up for giving us data. So the product now, is the opposite of that basically. We want to keep their personal integrity like the privacy it's called in English.
Patrick: So you don't have, so not even the interests of like how many people are in the household. Not necessarily who they are, what the age is, but.
Arvid: No nothing. We only get, now we only get e-mail, house / flat or solar panels. So that's the three things.
Patrick: Okay, so that's all you need actually when you signed up?
Arvid: Yeah for now, no, until now. So now I think we actually, probably just need solar panels.
Patrick: Is their plans on like expanding some of that information for later on? Or do you know that? Or, as of currently you´re.
Arvid: That's above my. [00:14:00] Yeah, I think for me. I would love it, but yeah, that's me.
Patrick: So what´s kind of the feedback you've gotten that´s the main contributor to people why they like Watty? Is it just because it's the peace of mind, or just like it's nice to have because they can get some sort of detection or?
Arvid: Are you talking about the product or.
Patrick: Yeah, the product actually.
Arvid: Alright, because it's very different, like the data collection. Yeah. Like version, cause that was basically us getting some customers to us, and then paying them instead of the opposite. With the product. Let me think. So I think most of our customers today [00:15:00] are kind of high-tech, early adopters mostly. And those have been very interested in API´s, trying to like gather their own data from their power consumption, and figuring out stuff themselves, like I want to connect this to other things.
And the big stand off thing, what I've found. I don't have a statistic significance on this, but it's a very educated like gut feeling or something like that, it's the houses. So houses with their own heating solution cause that's what's, what costs money for household when it comes to energy consumption. Like compare a flat to the houses, it´s just ridiculous, right. [00:16:00] So of course there are some people who think that like ten kroners, like a Euro or less a month, is valuable for them, and that's maybe the reason they want to have this, but then, like the cost of having it, it's not worth it, right. So in data collection we had a lot of those kind of household where they had low income and

problems economically, so that's why actually they wanted to join us because we gave them some money. And then it was obviously these houses. So almost all the houses, the households that I´ve talked to are interested in cutting down like their energy costs, and like helping them environment more. So, maybe because they're kind of the group of people who [00:17:00] are more perceptive to that, I don´t know. But what we give them is definitely like cutting down your costs, so heating. That's the big thing.
Sine: When you look at your, the datasets that you have, because I guess you are the data-collector-person. So, do you have any categories? How do you specifically look at the data and find patterns or some valuable insights that you actually use for something. Could you just explain what you actually do, like your job.
Arvid: Yeah, so my job before like releasing the product and becoming customer success within data collection was basically just collecting data. Like figuring out what we need, and how to get it, and not to analyze it. So the analytical part has been on the model side. [00:18:00] So they haven't left it that much I think, actually. Unless, like, I was like outside of feeding it to models and training models on it. I don't know how much that has been used actually, so.
Sine: Because I mean now you've set some frames of okay this is what we need. This is how we get it. But I mean when you have such amounts of data, there should be some, or as you say they maybe haven't looked at it yet, but, you have a lot of data. You know that the links and patterns between them are valuable, you know that for sure. But do you know if they have a plan to do that or is it not just focusing on the main goal of collecting the relevant data from the appliances?
Arvid: Uhm, actually we haven´t done that for about half a year now, or more. So now [00:19:00] we've only focused on getting the product out there, and making sure people like it. So that's why I moved from data collection to customer success.
Patrick: So how would you say you can increase the product's popularity so to say. Because the basis of commercializing data for like any vendors or anything like that, is also that there's a success rate on the consumer side. And we're not going to be focusing that much because we're going to be basing the paper on the assumption that a certain amount of users have been reached, so that there's enough data that´s valuable enough to actually sell off or use some sort of a partnership with somebody else. But how would you say that Watty needs to like. What would you say you need to do as a company [00:20:00] to kind of get to there, or what is it that the consumers are asking for, is maybe a better question.
Arvid: So I don't think consumers are asking for data in that sense. They want to cut the costs. They want to help the environment, and some want to play around with it, like in order to connect it to their smart home or something like that or just because it's fun. Not because there is value for them in the data itself I think. So.
Patrick: Is it valuable that the company can come and maybe do some sort of a, either a direct post through the app or some secondary marketplace, but still through the app, where people can go and find better options for appliances if they have something that is either breaking down or like not working properly or they need to change something. [00:21:00] Because we've heard one of the examples that Gustav has, like that at some point hopefully they will be able to detect through a refrigerator that there's some abnormally now, a detection, right. They can see that the fridge is using much more power than it ued to, and maybe it´s cause the compressor is going out. So it will most likely, through the algorithm, be able to predict that this is going to break down within the

near future. One of the ideas in it is that your partnering with a vendor of some kind, that could do push automatically out to this person and say hey, we can see your fridges, and you're able to actually save this and this money if you purchase this fridge with us. Furthermore you can also save so and so much power based on your previous consumption. Is that something you've heard that there's any value in towards the consumers or? Is this maybe too intrusive based on just privacy?
Arvid: I [00:22:00] think in some markets it might be okay, so my guess is too intrusive, I think. But I think it's extremely difficult saying before it exists. And like from the experience I have now and the datasets we have I wouldn´t say we. I can't see, or identify that we actually can see if it's the compressor that's breaking down or if it's the fridge.
Patrick: No, we've been told that this is not possible yet, but this is kind of the idea that at some point hopefully.
Arvid: Yeah, I'm trying to figure out, so that's been part of what I´ve been thinking at least. I mean, it's not been my job, it's what I like to do anyways. Like trying to figure out [00:23:00] what parts of the household that have a big impact on like, if we could identify something. So fridge is kind of interesting because they evolve so much. Especially like comparing the fridges from the 70s to now is kind of crazy, like, I've been to households with fridges from the 70s and they are perfect, so like they work perfectly very perfectly. It's just like this is not a market for like identifying if the fridge is broken. And I think that when it comes to household appliances like that, people tend to upgrade them just because they can, and not because they need to.
If they can afford a product like ours. So that's the kind of conundrum, I think. So that like I [00:24:00] mean if we would push our product to everybody without them actually paying for it somehow, that's possible, then we're like talking about a much larger focus group, not focus group but like set of potential fridge buyers. Yeah, consumers.
I think a better thing would be like repair. Because I don't think it kind of goes hand in hand either with that company that wants to save the planet and like help the environment, to push people to buy new stuff. I don't know. That doesn´t speak very well to me, its like.
Patrick: Is that what you feel, that the like the main vision of the company is [00:25:00] like to save the planet?
Arvid: That´s why I started here, so maybe things change. I'm sure, but.
Patrick: We dont know, wer´e just. We haven´t talked with Hjalmar yet.
Arvid: I mean we don't know either. But it's the premise. Like that's how it started, and that's what's sold me for it, like this can actually help people reduce their energy consumption. And that is a big thing, it is going to help.
Sine: We have discussed you know, that people are aware of the environmental challenges that we have and more and more people are defenitely joining the wave of being sustainable, right. So it's a lot of focus on it, but do you think it's enough for people to pay for. Enough incentive?
Patrick: Is that a big enough a [00:26:00] competitive advantage to actually know.
Arvid: No
Sine: Because what we have thought could be a possibility is to actually you know, detect abnormalties right, and you said repair would maybe work better. Do you have any other ideas? If sustainability is not a strong incentive enough?
Arvid: Yeah, I think. Well, then definitely costs. For now at least. I mean maybe in the

coming 20 years at least costs are going to go up. But maybe then it is going to be free. I don't know.
Sine: Yeah, because they say that because of other energy sources, the energy bill will most likely decrease. Also because they are upgrading the network. We are more and [00:27:00] more people, we have population growth and as more and more people live in the same place they could potentially use that to bring more people on that network, or yeah.
Patrick: So what we're looking at is the actual industry, which is the energy industry, and we can see that the smart meters is like becoming a bigger and bigger thing also because the actual energy companies are implementing these as well. So at some point Watty will have, I don't know how much competition right now there is for Watty. Because as far as I can understand, it's pretty, you probably have one of the best detections, at least very precise compared to what energy companies are using, but at some point there's going to be some catch up. Do you think that the current version of Watty is competitive enough? and if not like [00:28:00] what needs to be done to stay ahead of it, because I like the ideal of being socially aware and like creating this to consumers, but it's also business, and I think at some point, for being enabled to keep on going, you also need to be somewhat commercially successful.
Arvid: You know, I think. Well the three things that people are asking for, is the guy is the first I think, like make the data available to the customer. And then it's cutting cost right now for houses. Because I mean they can say like thousands a kroners a month, and I think also for like restaurants and hotels and [00:29:00] other commercial properties, there is some kind of incentive in using Watty as an analytical tool, not just like you have this on all the time. So that's. also something I have discussed with different people, but.
Sine: So the inside is the key, right.
Arvid: Yeah, yeah. So like helping people understand this complex and abstract thing that energy is. Like how do they relate to it, and help them do it. So I think that's the big point we've kind of missed or not missed, but at least we haven't put efforts in it, because it takes a lot of capital. So I think [00:30:00] combining the different things that different players are doing now, like so we have some that are just taking the energy bill and saying like Okay, so you use this much, each month this is like 4000 hamburgers or someting like that. Like making them understand that like putting it into perspective. So like combining those things. So like this is what´s happening right now. This is reality, and real-time.
And also comparing how progress is made like, so what did it look like last year within the same kind of reference. So, that's also like a challenge. Okay, so if we're going to save money for a house [00:31:00] on heating or cooling because we are using cooling a lot instead. Like what did it look like this month, and what did it look like the same month last year for the same, and what where the temperature differences. Like all the other factors that can swing, like your heating needs. So that's a big challenge I think, like combining all these factors that can.
Patrick: So, it's a lot more on the analytical part actually being able to analyze the data that's currently.
Sine: Is that a potential. Cause I worked in Hafslund a norwegian energy company this summer. And what we really also investigated there was that we look at people's bills and you know, how impossible [00:32:00] actually it is to understand your consumption,

so I think it's a lot of potential. You can actually go from zero understanding to, like it hasn't even been a development I think. I think it's been just the same. For many, many years. So people today don´t understand so much more than people did many years ago. Well, actually people understood more then because they could see the, what is it called, the altometer. It was very visual, and in all homes. So people actually understood more then at least from our investigations. So yeah, I think you have a lot of potential.
Patrick: So how do you see like Watty´s placement because if you are able to use this historical data, this is based on like the algorithm and what needs to be developed. We just talked to Oscar and he said they are not there yet, so that's something they're working on, and we were also looking at a lot of, [00:33:00] like, how the tech capabilities for Watty is also going to be able to exist in the industry, the energy industry. So how would you, how do you think like Watty right now is performing. You mentioned that you've been working within Energy Efficiency within bigger like building. So you might have some understanding of what goes on in this. How would you say Watty´s position right now towards the energetic industry. Because sometimes you always see these stories with like smaller companies, like I'm not saying its new technology, but it´s technologies used in a different way. That's what I see. So is it like innovating, is it like it disrupting? Do you think it's going to change how the energy industry is going to be looking at data going forward?
Arvid: It's the only way to move forward. Like, it seems that it is so complex and that, that's the reason why it hasn't been done. Obviuosly you wanted to do this a long time ago saving [00:34:00] the grid, like making the grid better, would save the companies a lot of money, so obviously there is an incentive for it.
Patrick: But this right now, this is not capital heavy, but you're not investing in infrastructure, right, you're actually doing a simple solution and using the data from there to actually being able to provide. Because I'm guessing the data you get here is also valuable for the energy companies because when they have to do forecasting or energy trading they will be able to use that data to more efficiently distribute whatever, whenever, right.
Arvid: I think that that´s obviously like, so this is, you need this. Like all the energy grid owners need it basically, in all the households. And that's the conundorum as well, so that if only like a tenth of all the households have it, which is quite a lot, I mean for us at least, uhm I don´t think it would bring that much help for the company. So that's where smart [00:35:00] meters come in, right, so that's one of the possible potential ways to integrate into smart meters.
Sine: Because that´s where they are right now, right. They have only develped the smart meters, right?
Patrick: And smart meters are based on each household, or is that only for like a block, a city block.
Arvid: No, so you have both. Well, when we talk about smart meters yeah it is households, you are right, obviously, but then you also have all the like ways on the grid. So you have to see what this block is as well,
Sine: And that's where it becomes complex right, cause when a lot of people live in apartments is it very problematic to detect what each part of the block actually consume, cause they actually just use smart meters for the block and not a specific part because they have the same.
Arvid: Oh, not in Sweden actually, well actually in most countries now in europe you can

see it from each apartment. But [00:36:00] the problem is that smart meters are way behind, so they. I mean this is decided on a very high political level. That's the issue. So they have kind of based on faulty data, like the decisions on how to move forward. So like for UK for instance, so they decided to incorporate Smart Meters all over the UK before 2020 I think or was it 2015 first, something like that. And they pushed it like all the time because it turns out they're not like good enough.
And that's the [00:37:00] thing here in Sweden as well, so the new thing is that a smart meter has, maybe this is actually on EU level, I can´t remember. That the new smart meter has to have 15 minutes resolution instead of one hour, which was the last thing. So in the, I think it was the 2000 or the 90´s so we basically roled out smart meters for all the households in Sweden more or less, and they measured remotely, and that was the big thing, so they saved a lot of money, as people didn´t have to drive out and measure. So that was the big thing I think. So those smart meters have a resolution one hour.
But now, I mean we have like. 99.9% coverage of. the cell [00:38:00] networks with very high badwith so there is no problem in sending like a lot of data. But maybe that was the reason, so they wanted to send quite. That's just one string like every one hour its like, and I mean we can't do anything with that basically. So I think what the grid owners can do with that is maybe to regulate the grid on an hour base. And one other thing has been like smart appliances that you can control so the energy company controls like obviously not put your dishwasher on at this time, but you just put it on standby, and turn it on when the grid allows it to. But bringing this down to 15 minutes, I think that sure it´s good short, but it won't help anybody identify what is on and what [00:39:00] is off, and what it is doing right now. So that's like the one second data that we also have a large data base on. So that helps a bit with identifying some things. Likely on or likely off. But then we come down to the level like where we are measuring like now, which is twenty thousand times a second.
Patrick: Two thousand, right?
Arvid: Ah yeah sure, but we can measure on twenty thousand. We can nicely measure on twenty thousand, and a lot more even. Yeah, so that's just a question like how much to send I think, and how much we are needing right now.
Patrick: And so that's definitely a game-changer for the, and not just for Sweeden but for Europe especially with those regulations. How do you [00:40:00] like, do you see the energy sector needing to maybe having to adopt actually Watty as a baseline, or using as a smart meter instead for households, or do you think that there is going to be a possibility for them to do what you do currently themselves?
Arvid: So the issue with Watty is that it has to be connected at all times, to get this real-time obviously, so if there is a downtime in the network for some reason, but not the power grid, and you. So this is one of the things, that data has to be stored locally, and sent when there is a connection. This has to be like made sure that actually works. And that I mean that's an easy fix.
Patrick: Internal storage in the box?
Arvid: Yeah. But it kind of makes it not [00:41:00] reliable. So it wouldn't work as a stand-alone smart meter, because the smart meter has a lot more regulations it has to adhere to. It is a crazy amount of legislation you have to go through to build a new smart meter. And it have to fit into like every country in the world
Patrick: So there is actually some setbacks by Watty. So even though it's, I'd say the

way you're collecting the data, which is very innovative, will never actually be able to disrupt the industry because there's some regulations you just.
Arvid: What we could do is to merge with this smart meter company, or the smart meter company can release our product. So that´s I think, that´s one of the big things that we could do. It´s to license. So we can license the IP basically because the [00:42:00] hardware you see it´s simple.
Patrick: What about like data, the platforms that you're currently using like even on the cloud. Is that manageable to have any other company use? Or like get access to without having to have anything special type of platform?
Arvid: So now I think we are using AW.
Patrick: So it should be easy to be compatible with any other.
Arvid: I mean we have an API that any other company can use if we allow them to, so yeah. And that API can send out to all other things that we allow it to as well, so if it is like this appliance has been identified right now, that can be one of the things.
Patrick: So you can actually push that information out to any company that you would like to, if you needed to.
Arvid: But I guess you'll talk to an engineer today as well or?
Patrick: Yes, at some point we are talking to [00:43:00] Yayun. I think he knows a bit about the platform. Yeah software engineer, so.
Patrick: Yeah we are, I think starting to run out of time. Anyting we might not catch here, we might just schedule some sort of a follow-up. We will be the rest of the day, but we then might do something via Skype, if needed.
Arvid: So I have a lot of like data in my brain that is difficult to access without their rights setting I think. So there is probably a lot of stuff I should let you know and tell you but yeah. I think it's easier like when you have gotten [00:44:00] down to trying to write some stuff, and thought about it more, and more questions will pop up I think.
Sine: Maybe we also could send you something later when we know more specifically what they will write about, maybe a short draft or something with questions that you could answer via e-mail. If you have something, because it seems like you have a lot of insights.
Arvid: Yeah awsome, and that´s it, that´s the annoying thing with it that it is so much, so it is like difficult to grasp, or something like that. But for a specific setting or situation or specific problem to solve I think that's a lot you can find there.
Patrick: But yeah, I think that was it so far. Thank you so much.

Machine-learning Engineer, Interview.

[00:00:00] **Patrick:** Right um, so just for our records. Could you just please state your name and what you do here?
Oskar: sure so, my name is Oscar, Lilia, and I'm a machine learning engineer at Watty.
Patrick: And how long have you been part of the company?
Oskar: ohm, almost 1 and 1/2 year.
Patrick: And your focus is as i understand the algorithm that. Yeah,
Oskar: exactly what we do is basically non-intrusive load monitoring so what we try to do is basically.
We're measuring the total power consumption in a household and from the total power we decide to segregate this in two different appliances, so we want to be able to say when micro, like if if the user turns on a microwave and already, maybe there is a feature running or a stove or whatever we want to be able to.
To say okay, so this is total consumption or in in this total consumption this part is the [00:01:00] microwave this part is fridge this part is the stove and show that in real time. So that's my job to find the algorithms to be able to do this basically.
Patrick: So maybe in bit more detail. How does the algorithm go in and actually sort between these different, because I'm guessing each appliances and a different electrical pattern?
Oskar: Exactly so
Patrick: So is it one combined algorithm or they smaller ones that you're doing in
Oskar: For now like of course. It would be great if you could have one huge algorithm because you can then you could use like utilize the information shared information between them, but yeah, there is problem for that as well at the moment.
We have a lot of smaller smaller ones basically, so maybe we have one model, too. To detect and predict power for a microwave for example and one for fridge freezer and one for washing machine for example, So in theory actually need an algorithm for each appliance that you're actually detecting [00:02:00] it.
I would say there's some that are being able you that you can actually reuse I would say you Theory you could have only one, but that's difficult so yeah in practice. We have different models for different appliances, but of course things that are very similar. Like for example. I mean for example for now now we have one washing machine like it, and I think it will be a lot better if you could have that in combination with tumble dryer for example because then they accuse the often happened together and make using share information, so.
But it is it is it's always I mean it's always easier to to do the small departments here. And so we're trying to understand kind of like what even goes behind all the clothes work specialist more less, and I will not many technical details well, so my understanding is that okay? It's the electrical output of [00:03:00] these appliances its go and it measures so that's what I'm trying to understand so the algorithm is trance to somehow measuring that.
Electricity electric electronical output converting that into data, right is or could you maybe go into detail how the process I love it. I will try to explain will tell you if you go

something if if it's easier for you to show we can only know that we don't know that much about algorithms feel a little bit, but we know that they solve different tasks in order to complete a full task right something like that so I mean if you have something to show if that's easier for.
Understand that way sure I think. um if you can just walk through the process of how it actually goes from electrical output to data at some point yeah. Maybe it's it's a good idea to show you [00:04:00] something sure.
Should probably have prepared this no. No that's fine. We can cut this out of it really yeah worries. But yeah, it's as you think that I can just kind of reasoning behind is again. We want to understand as much possible about the entire product. I'm such a better understand also because again a lot of his faced on the take capabilities of a company.
We're hoping actually to some point. Leverages up against the industry that you're working within to see how that actually fits, and if that is an advantage or disadvantage to some degree so the more we know about the capabilities behind the company the better we can yeah. Yeah, I think IM. I think I have an idea what you want to okay.
No. That's good. We'll see I'm sorry like entrance is kind of slow, so.
[00:05:00] Worst case I might just show you pictures from me. We also talkin about with good stats earlier that we could maybe get some pictures or we can blur some of it if you want short, but I mean right to show our supervisors. Well, yeah. You mean pictures of. Like they thought or over either, or she's ashes.
She's very visually inclined to some degree so she would both like to see the product cycle like how it goes from Appliance. Through algorithm to from to the box, then to the cloud then back to the app. That's an even like seeing how the process because we're not going to be explaining anyting, but it's it's very nice for the reader as well that they have some indication of what they're actually when we're because otherwise they can become very.
Hard to [00:06:00] understand if you begin very conceptualize everything. We don't know who is our sensor so we could be an industry person it could be a more theoretical academic version so we need to put it as nicely as possible so hundred and twenty pages is a lot so when you have to read through that it should be nice to read and where yeah it is.
And I'm sure I can provide you some pictures and list of say that's okay. If there's anything that you think is confidential will just make the entire thing coverages and everybody sees it. Example you want maybe that's the best thing to do. I think it's fine like most of the stuff you could find in papers.
Yeah anyway, so I mean. We were thinking if there's something super unique that you have I don't know. Yeah sure [00:07:00] we can talk about stuff that unique, but I don't think you will put it in your paper. Don't like because then it's kind of technical so. so sorry I wanted to do it live like getting data, but it's I don't know what I don't know my entrance kind of very slow, so I have two pictures here, and it's kind of hard to see.
So before we look at this time has come now if it spark with twenty recording. So what we do right is?
So we have a hardware. I mean you know how to setup looks like right have a hardware. That's installed. in the house.
These roles poop and this Hardware [00:08:00] sense state that you are Cloud rights.
So we sending two types of data, so we're sending. regular data. and event-based.

the question is what clarifications regular data in event-based or what is written later. Yes. That's the next right so this terrific so and and that's okay, so maybe I'm first maybe now we're getting into the question that you asked for what this the big time so on through measuring 3 matching the voltage.
So we're playing this into a power outlet. Our hard work, and what and each power outlet in the house has a voltage now the most house are three phases. Some of them will be on one face and others will be a mother face and so we can measure the voltage directly from the power outlet should really [00:09:00] important thing because then the installation is a lot easier.
We only need to put clamps around like the three current like the three current faces, so we don't need to do the voltage. That's the dangerous Park measure the voltage directly from the outlet here. and them so. You have to have three faces and you have like a voltage. That's always the same curb, and then you'll have some sort of.
power.
power current curve that in response to this is. Completely dependent on which appliance seriously right so if you multiply these basically you'll get and take a Time average should get power when Powers will be consumed and what we pay for this game. So our algorithms as when the [00:10:00] hardware sampling this in like 7000 points per second or something and doing like a lot of preprocessing and then in the end.
We will send power in 10 Hodgson resolution so imagine like. How was medicine looking like this they put on the kettle? They put on a microwave. And so we're sending regular data every second 10 Mark solution. 10 points per second have reception SM. And then when something happens. Like a big we have a logic on the hardware that will extract this was an event and then we'll send this event and in high resolution.
127 pastes that's the event-based because the thing is like biggest [00:11:00] limitation we have like this has to go by fine. So like sending data. You mean, it's difficult like imagine sending for sending 10 large data. Every second. It's a lot of data stream 112 that will be even more. I mean maybe in the future you like to send even higher frequent data to see more interesting things in your signals right.
That's a big chunk. Okay, so that's that's what happens here, and the only questions. Just lose it right, and I mean you could think of I mean in the future what you would want to do. Maybe you would want to do like seeing their processing directly under the current and sending like feature components for example, and yeah, so how does it look?
[00:12:00] You are most interested in the amount of State base data right and so yeah, so it's the event basically the basic. That's used to be able to differentiate between things right but to be able to track power then you'd need regular inputs also right so you need a baseline yea, or not the Baseline with butter like you need to know what the power continuously, right?
And so I mean it's not enough if you get an event-based thing. That's s OK here is microwave now. It's own. I mean, then you need to track the power because we want to predict not only if its own rules want to predict how much it's consuming. Yeah, so. so this is. I just knew that I had a lot of different lots of this so that maybe this confusing but nobody well.
[00:13:00] This is the different electrical signatures from different appliances. Yes, because we did see a demo of the app and working when we had a Skype interview with. Go start. I think it was few weeks ago. So we saw how a fridge looks one way

when it turned on at his office and how ironing board looked and we actually see he. Either too, but he saw it in the app or we started the app. It's so we saw down at the bottom where the actual and it looked so the Indians not like that exactly so yeah, I think you did in the F, but so that's also an interesting story acting like. These kind of things on your chest reload monitoring the beginning was done like in 15 minutes or solution or one minute version, and it's so hard to see like the interesting thing occurs in that case right so this is for example.
This is how this one hundred hurts so this hundred points per second that we're [00:14:00] sampling. This is all my problems. So and actually don't don't look at all these other things. This is an export exporter analysis, but this is the real power basically looking out, so it has a very unique in this is like.
For different homes you see it's kind of similar even between hopes right I mean, there's a clear if you look at the bottom one always. Yeah, it has kind of like sedated spikes and then goes down and has a curved up and then. So it hasn't a very clear signature right and this is the event based data, so basically.
50 suffrage, thank you. What happens is Google stream the regular a time will stream and these events and when we get into vamped we will for example run the neural network or another type of classifier that art. That's trained on our training households basically. And they will [00:15:00] be able to say okay, this was a microwave start or for example as a difference this our fridge compressor looks like in real power Spectrum you see it's like.
it's very clear that it's something else right so even though because I did see on the microwave there are some like even though the. there were some discrepancies on how big like the different curves. I don't know if it's it's. But then the bill Network can actually classified based on how how big of a discrepancy there is like so so so so once we do also maybe the moment maybe that's one of the most important.
like.
components of how how it started.
Is we have we have a big crane medicine so so our training that set is [00:16:00] we've done this exactly like I said when we were gone to an house installer hardware and will live streamed or event-based, but we also have also like streamed a hundred parts all the time, so we have like full resolution like 24 hours a day basically four months and as well as.
Measured all the appliances in the vent individually, right. so that means we we have a training dataset where we have the. what we what we want to use in production basically like the total power consumption measured as well as like the ground truth right so we know when the fridge was on exactly we know when the microwave was on exactly.
I mean that's crucial for us to be able to train algorithms because when you train algorithm you you need to tell basically the algorithm, so this is how the data looks [00:17:00] when a microwave Zone. This is how the data looks when it's not all this how did it looks when a fridge is on and this is how it looks when it's not on.
I mean, that's the crucial part of training, and that's mean you need. Good annotated data to be able to that so we have like a fight like 500 households. I think with this kind of but this kind of measurements, and then we can then we can stream data. The same way as we do in production and we can have our algorithms so and when they when they get this microwave provide start time it should should predict all.

I mean the crucial part participate work. Is that there are enough features in the signature? Or in the data for the algorithms to learn to be able to generalize to like all microwaves right, so let's say you have a hundred microwaving and training data [00:18:00] it need to be similar enough, and they need to contain the same type of features.
That would be expected in the full distribution. So and that's a big problem for us because I mean there are a lot of appliances that looks like this that has a lot of things natcher, but there's also a lot of things that are kind of only resistive loads. You know like heating elements like a kettle for example.
I mean the only thing it does is its water, and how you achieve that it's basically by. I mean letting current run through our sister. And that's a like that's a very long linear low like response to that with yours. Look
like this. And then if you have a lot of those types of appliances in a house, you won't be able to differentiate the Miss very hard or you have to frenzy, but if they are. [00:19:00] I mean how much. Like the power while some hope that stuff is not. The same power all the time enough and that's something we really need to to prove on so to be able to do that we have.
a completely different system actually so. this is this is what we do when we. like. Out of the books algorithm, so we use Deploy on the hardware, and it's going to work in all homes. You know that's nice for the use of because. when you look at the draft your microwave Eternal with your microwave.
It's going to show up. That's great. You see your features for example your might your washing machine. Maybe at this kind of stuff. It's we're not able to do that the more so then we need to basically do unsupervised learning in in your [00:20:00] specific hole. And then you need to label your stuff because we can't I mean if you put on your cat though, and we have a neural network for example that tries to classify that this Kettle a it's it's it's impossible, but but if we take.
that you have put your put on something three times that looks like a step change or like a heating element for three times. That we know okay, this will read this happens in this home, so we can say this is something we can recognize, but you have to label it, but is it because you it was really 500 households enough does that create enough instances for each Appliance and your home to actually depict cease to question.
That's impossible to. Answer safely short like because that's the I'm I was just wondering why I stopped at 500 because wouldn't it be more means better with more data.
[00:21:00] Always and hopefully in the future of course you want to use your production data. Even extend your data. Sets I mean, that's that's the best way good idea that the more people label their own stuff the better your current data will also be and then we can use that exactly actually also have another question in regards to.
You said that the different appliances need have some of the same features right well. No not different places. No. No the same applying. Sorry so you have a cattle right, but what if you have the kettle or people have different kettles with from different labels for example, so they are some are cheaper than others, so they have maybe different kind of power consumption.
I don't know. Thank you, so so let's so. Let's do your sample, but with my questions that because kettles like I said, it's difficult to do yes. There are smaller, but yeah, that's also fine as long as you have that type types of microwave in your training data, so let's say you have three [00:22:00] different types of microwaves as long as you have enough.

Of each of the type yeah, that's fine, then the algorithm color like a multimodal description like that's fine, so it doesn't need to be the same. Type as long as you can read like this long as there are enough of each tag. Yeah. Yeah, exactly. What is that? Yeah, so what if you and you a new type of microbe comes to Market.
Yeah, yeah, then did you need to test that if I guess it's I mean I mean the. The hope is also that I mean most of these stuff. They used basically the same electrical components right here, and I mean that's what gives the signature, but of course if it comes like if it can if a micro accounts that's actually an album.
You know and works in a like an advent, then we won't be able to stick those microwave, so yeah. I'm also. I'm just thinking because so part of the idea [00:23:00] about all this is also. They want to create a Marketplace. I where we're talkin to where we're trying to connect users and and vendors to some degree depicting on like basically algorithm because what we've also discussed because I was at the algorithm is a book based on the electrical willpower its should be able to see discrepancies from previous from normal behavior so to say and that it should indicate something's wrong. Maybe or something yeah, I mean, that's that's definitely. I mean so you mean anomaly detection basically, but you need something. If the compressor on the fridge is okay and its Computing much more power. The algorithm is she will detect this and that should indicate if you've seen these anomalies before as you saying if you seen that once you would drink data.
You [00:24:00] saw a fridge breakdown it had say monogamy. You should be able to detect in theory exactly. This is a breakdown what we're trying to do some of the idea is also that this information could be useful for vendors to do some sort of a Marketplace. A concept a person that's having a fridge breaking down somebody that wants to sell afraid I mean exactly.
It is I mean it's difficult partly because you need the data. I mean you need to have faith like have stuff that you know this this is broken or whatever. Yeah, and the second thing is like the best thing to do to almost the best thing. We might in my view like the best thing you could have to be able to do animal detection is to have a great decision algorithm like if you have a algorithm.
That's really really good at detecting how a fridge looks [00:25:00] then you could quite easily do because anyting with outside the norm would be a deviation from that would be something wrong exactly. But I mean then you'd need to have a great desegregation algorithm in the first place, and I mean I mean we're working on it, but we're not from perfect as it is you know I mean, it's so you know you can do it better if you make it better yeah, so so I'm not sure are you interested in the algorithm?
Yes, yeah, so so basically so what we've been doing for a long time. So I said we have two tracks right so we have the supervised learning where we trained on with our training data, and IR event-based stream and artistry. So we have what you've done so far is basically.
like I said.
right so to begin our [00:26:00] Windows yet. Space streams, and then okay, so we get this. Thing that looks like a microwave. Or French start for example, and then we say okay. We have a classifier that says. If this microwave hey one yeah, it's microwave this this is Melissa fixtures on microwave two different classifiers, and then we have algorithms say okay now on microwave started.
And then we have lecture Mystics to track power you know. So we looked at the case.

What was the power dish when it started from? What was the difference between before and after and then we try to track the flour and then we had ristic stew? to see when it. when it went off basically and that's I mean it works pretty well for migraine Finch and. But it's like not robust [00:27:00] enough against noise in houses where a lot of things happens and stuff like that. So that's like. Yeah, so but now we have we have you algorithms that actually utilize both. Both regular stream and event-based and the event-based Agents of interest to them and they said then we stream both.
Story. I contacted by an event into because recurrent Network, which is the neural network that has a memory as well. You know so that we can in the hope is that the algorithm can can remember them? so. Here it's here like the washer machine start like those ocean is a very good example where it works very well because you have an altar that goes and then you have a heating cycle, and then like that the motor is going all the time so [00:28:00] if the algorithm can learn to classify this Market things, and if it has seen enough of those it will know now the washing machine is running, right?
Then it will be able to also track power in the same time so we can we can train the next to both know if something is on as well as predicting power continuously basically, which is like more of an end-to-end approach to actually training models instead of using and like classifiers to know if something is on and then the ristic Stu track power and when it's off basically yeah.
So that's like some of the evolution that's been happening at least in the algorithms Park, so. I'm make it if it's on the right level or it is if we actually understand a lot of returns, and we have a big day today virtually done classifiers and supervisor Atlanta by turning. Who's ever done neural networks, but [00:29:00] we've you know people that have done it, and we've seen it.
We've done clustering. Thank you very interesting to talk about this, so don't even talk about it. Yeah, so that's kind of where the algorithm is on its way to now at least on the supervised track, and I mean and also of course you want to mean we want to use even higher frequent data like have more features to these kind of end-to-end approaches and other and then like there's also something called different Power components. Which is maybe it's bit too technical in electrical. You can see like different different. different Power. different electrical components will have like if you have a capacitor / sister / inductor. They will have a different effect on how on the cut on the car and try so you will have [00:30:00] phase shifts, so.
Three phase shifts between like the voltage and current basically, that's also something. We could we could detect the news as features basically voltage and current, so you know what type of what what would be like yeah? And then you know our current here. How's it already? With Mike's yes kind of.
habit speak at the same point right or I mean sometime sometimes. while a phase shifts that loan would like.
maybe be lagging or leaving. with respect to [00:31:00] the. That's so then you'll have like you can imagine if you multiply this signals. You will have some parts that are. better positive in some parts there-. so we need but in this case you like everything kind of positive, so that's really like that, but what value does that bring so that's it brings?
I mean that this is another feature for differentiating different types of appliances of course okay for example. And so which we should use self more.
And so that's so higher high frequency data. or components. and of course like in the end to make everything like to make whole this whole system scalable. I mean because

now we have like two hundred customers something and it's kind of. Like it's kind of computational [00:32:00] computationally inefficient to run everything on the cloud.
You know. So what would be great of course is you if you could run your algorithms directly on hard right now and then send stuff to the cloud. That's more like you don't need to send everything and do the. End of the basically when we deploy Hardware, you know how in all homes I mean they're quite powerful like they have pretty strong processor so basically.
As soon as we roll out a lot of customers. We have distributed computational Lee computation computational system that we could use, but that's I mean, that's it's a lot of other challenges of course and what about the vice yeah equation like what if something breaks down are what if / turns off is that that's the problem?
That's the problem? We basically live today te yeah, okay? There is no memory storage right isn't that this? So I'm not so. Well in the Heart Like The Harbor logic [00:33:00] different fun part, but so we we are not actually storing that much. I think I think we're losing like that's also something. That's should be publisher have like a member.
I think might have some but I know if it's time for an hour definitely. Will it would be Gap about it because it's it's extreme amount of data. I'm thinking like you have it all In Crowd right now or and it hasn't storage system right? Yeah, we also that's like so we have it in the I mean we have a real-time platform right so everything like when you stream the data.
Everything happens real time for Ustream today te dosent like to the engineering side where they do some stuff then they. Let me through our models basically, and we have the predictions, and they will send it to that and that's like 2-3 seconds from when it happens, and we want to have a slow latency as possible for the user to me like it's half. I keep engaging. [00:34:00] Lots of course then we also have a lot of storage things on the side where we store historic our data for example yeah, because I'm thinking. As a right now you actually can see the past week or months energy usage per Appliance, and so what was you can't are you can now you can let Mom know, but I think that's what your mom Atif Ali with them when it would be feeling I'm spending this much power on on the TV or on the fridge absent as a group like really strong and sensitive these four people excuses.
Products or service because they want to know what are they actually using their money on and that would be an incentive for any person entire world even though like probably I mean the depends. I mean I agree. Is it is it ok so I totally agree, but it's also [00:35:00] like the pencil. That's depends totally on how much you actually pay for your. Electricity right I mean if you have a low power. With our bill like if you can say ten 10 trimmers whatever amount you. Will you won't cat right so so sure for some for painful Germans or something where that super expensive. It's going to be okay. I can save money, but otherwise like I think more of it as a monitoring system.
You know. You can know when like if you leave your house, and you're still whistle or whatever and and kind of like yeah, kind of like. Safety and peace of mind thing you know as well as kind of like a cool Gadget. You can see how many hours of TV. You should whatever. Saving and hopefully people will say them energy when they understand like in the ideal world of course you could say can you have a you have a fridge that has consumed this amount of energy the last month.
[00:36:00] If you bought our new fridge, that's like one-third. You'll save good save the money you paid for new fridge in a year. You know that's an easy sell for a company

right now. I'm definitely. There is some value for energy companies to be found because if this could be a plugin with energy companies using this without of their own, but I guess you've seen that up, so they usually they just kind of implement.
It's kind of buggy so this like over time you where you can see how much energy you consume not working very well alone seems so that I mean I'm you could have this for four specific appliances of course that would be great, but again that kind of. I mean you need to have like almost perfect power deterioration for it to make a lot of sense right now.
So it's and Shore I could as well come back to that algorithm. That's kind of yeah, that would be even [00:37:00] better always. it's because that's actually also kind of where I'm getting at the I'm not saying the future body is like a lot of dependencies are based on how good the algorithm can get. Edward let me because the algorithm seems to be the basis of a lot of the things depending on both for a value for the users, but also for any potential other consumers or vendors or however that might be I totally agree I mean.
I mean, but the interesting part is like I mean there are products on the market that basically sells just like an energy meter for like it's expensive. You know and you have that. You have that already, which one so you mean if you want an energy meter with. Like with additional features, I mean which which are cool even if they're not perfect.
I like I think there should be a segment that as well, but of course if you want to do it like [00:38:00] really basically conquer the market yeah, you need you need like. Perfect stuff I think so. So, but it's interesting. I think we're on our way at least though definitely Market. Have you seen them all of that yes Costa via Skype, but now you can see it light OK.
I just want to quit the phone work on something based on the different types of data to so I got everything so because we started the it strategy at all this specific question was those from our thesis supervisor is based on what type of. Data's there was you said there was like the different categories of daily reworking was isn't based the regular and then you you have done some sort of like.
would say. in a collection or no no like when there was any discrepancies from the data as you mean [00:39:00] like people like feeling holds or or we always like if we saw that there was something. I lost the word right now, so like if we saw that the fridge is spending more power than anything else and so it goes in automatically detects something out of the norm.
Okay, so I can remember we call it. We set the word. It's on the tape fair enough. I wouldn't normally. Thank you that normally. We were not doing any animal Decay you not so right now the characters like real time. Not all the regular and then vent based Frank. I mean, that's the data. Yeah. And but actually we just deployed we have deployed and new service for you can call the non-fiction, and that's so and that's so like I said we have our answer provides system as well where the user labeled But Eric are now so and then if you're labeled your your iron ore your hash trainer, [00:40:00] and we see that its own for a longer than usual pair of time.
We will notify it. To send you a notification so that's something I would that's close the closest thing to a normal that you have say great year in show in three using three different data categories for whatever algorithm Source unsupervised supervises now. We're using the same the same date, so we were only streaming this regular and the event-based so the event-based is also what we use for our unsupervised ok so

basically because that's just.
Events that happens in your home, so if we have discovered reoccurring events in your home and that we cannot classify by with our with our like Appliance Pacific predictors. We will say okay now. We've seen that this happened four times in your home, and you know what it is. Can you label it, and then you say all it's my Kettle [00:41:00] and next time you start you Capital.
It will show up in the app. I'm you see that you. Send a notification if the iron has been on for a longer time. How do you label normal like yeah? I mean is it an average or I mean you can you can iron one shirt, or you can iron attempt. Yeah, so we expected it. So yeah, it's a very good question, so we just talked with the guy yesterday who wrote it. My it's so we're trying to learn so we have like I think we have up. A value that I'm not sure how they choose the first tell if it's like 10 minutes or 20 minutes or something and then basically when you use it each time you use it will update. What's your normal usage pattern right so so we have some sort of I think it's like a coma filter that kind of tries to learn.
how [00:42:00] like how long your normal usage pattern is or something and. So of course when you've done it 10 times and you always maybe all you always iron your shirts in the morning you know and then if that takes five minutes, then it will think you're normal like Patton. It's so then if you start ironing 20 shirt like Sunday afternoon. Maybe we'll warn you you know, but maybe that's good. I don't know. I like ya then again. The more you do that the more will be dependent towards exactly sure. So of course you need to kind of set something that will be that improves with time. I was just unsure if it was um household Pacific or if it was like not the tire overall so there will be hold ok.
my thing. then we can just do. If it's quick final question, [00:43:00] but just on the personal work. You used like where do you see the algorithm or like watching going? and I mean. I would love like I think we have a really cool. Framework earlier newest model some if you can just extract more and better features from our data.
You know like high frequent data. Just find some killer features in the data that we can kind of.
Extend or Frameworks, but I think I think could be really I think we could take the lot in house, and then I mean it's all emitted. It's so difficult initially say how like what kind of? Accuracy or you'll achieve, its I mean there will always be houses where stuff won't work in basically and some house work [00:44:00] fantastic.
So it's yeah. I don't know if that's not all that's fine. We're just trying to get some now we were thinking of course the thing is with this product. Which is also the interesting part. The more you get people to use it the better it. Also gets is how we understand. I mean, that's true to some extent.
I mean I know there are other things that need to bleed, but exactly so for example like I said the things are supervised system. I mean it's not improving while usage right, but but the answer provides a in some sense yeah, so.
Okay, um I think we actually do have some questions for you, but do maybe we could take a follow-up. What's on time or sure are you are you nothing more? We're going to be leaving today and but we might be able to do something over Skype for ya course send you some specific questions via mail, or I don't know sure you confirming your eyes.
[00:45:00] So will the same person. ok so I also be here if you have just. grab me at

some point if you have different really informative and yeah very much. Thanks. Thank you.

Marketing Manager, Interview.

[00:00:00] **Patrick:** So just for the record before we begin could you please just state your name, your occupation so to say what you do here, and how long you've been with the company.
Maral: So my name is Maral Kalajian. I've been here. It's going to be one year in first of March so in one month to go, and I'm the head of marketing and communication. And I'm the first marketeer here in the company's history. After three years, they hired some marketeer.
Patrick: That was because they went to market like six months ago, right?
Maral: Yeah. It's very new yeah, it makes sense.
Patrick: So yeah, so you just heard what we are trying to focus on, uhm, so what we're going to discuss more with you, is of course the ability or the opportunities that might exist with other companies and a bit more at least on the commercialization, and not as much on the actual algorithm and data, cause I am guessing that is not your forte. [00:01:00] But yeah, if you of course have any insights please do cover them. It's a very informal interview approach, so yeah, we'll make up questions and go based on what you say, but if you could just kinda, to start off with, could you maybe put some words on how you see Watty because as you are the first martketeer your job is like to be able to sell this product to people out there. So by that you also kind of need to know what they're looking for to some degree.
Maral: Do you want me to go through like the history so what we have done since, like what they have been communicating before I joined and then what we have changed it to. Yeah, so basically if I said Watty to anyone before it was more like oh you save energy and save money. Best value we do as a company, because we have to always connect it to certain value for people to buy your product. And so when I joined it was [00:02:00] also my impression, that end of the product was not finished yet. It was still work in progress. And then we discovered that actually we don't really say to people how much money they are saving. And actually people in Sweden at least, they are not really interested because electricity is very cheap in Sweden, so they don't really care.
So we had to find a different value for them and to do that we came up with different scenarios on what actually people do and then we've noticed that a lot of people are interested in Watty for safety reasons. So, if you look at like the smart home category that are safety and also like energy management, and then real-time alerts. Those are the things that people actually look for before they want to buy a smartphone. So from five scenarios we came down to three, and then we tested that on social media to see like digitally which one is going to generate [00:03:00] most leads or people are gonna be more interested in.
So the three scenarios were safety, that's the number one reason why people buy Watty today. That is because 1 in 8, yeah I think that was the number, they leave their apartment thinking that they have something switched on, so then they run

back to see if it's real or not. That's me. Yeah we always get that when I ever pitch to someone. So the people who are paranoid. I read that there are even like psychological reasons people go to see psychologist about it. So this actually gives that piece of mind. Number two is in general what´s happening at home and getting inside like smart insights. Let's say we have a customer that has a son that has played football and that he plays three to four times a week when he is at work. So he has to come, I think it´s like 14:00 or 15:00, so he comes back alone home. And he has [00:04:00] to make a certain smoothie every time he´s back. So his father can actually check if he had this smootie or not.
Or we have the grandma example. I don't know if you have heard of it before? So a lot of people also want to check on loved ones. For example, elderly people, did she like put the coffee on time? Did she boil the water on time? So there are like this types of insights. Like it's a bit maybe creepy people watching that each other, but it's also a lot of like knowing what's happening inside your home when you're not there.
Patrick: I could imagine that´s nice for parents when you have like kids go to bed. No TV, and you're like TV. Yeah. Yeah.
Sine: I also read somewhere that especially our early generations grows of course, and more and more people live at home instead of elderly care homes. And this is mostly because we don't have enough space and sometimes people are actually healthy enough to stay at home, but they still need some care and some security and [00:05:00] that's what we're talkin about right, that can actually check if you wake up at that time, make some coffee or whatever.
Maral: Yeah, like it's a basic thing, like did you get the kettel on, or did you put the microwave on. So because we all have like daily routines, maybe it changes on the weekend, but it's still the same routines you follow most of the days, unless like you travel, maybe it would be at 4 am in the morning. So that's like the type of uhm actionable insights that we call it.
Maral: Then the third one is the energy. Like sustainability, and a lot of people do claim that they care about like the climate, but actually people don't really understand when you say to them cO2 emissions, and we're gonna die, and there is like no snow. They don't understand and that's why they don't care, because they don't understand. So those are the top three messages. And just the way I listed, those are the ones that we actually use. So we did fifteen different types of campaigns. When I said different types [00:06:00] it's like we took five, the three categories we did five different pictures and messages, just said it differently. But they all say the same, like it´s serving the same purpose. Like the three purposes. So we run them, and it was really good for us to learn. We run them for three weeks. It changed from the first week to the second week, but the first week was always the safety and what´s happening, the insights, and then the third one was energy. The second week it changed to safety and energy, and then what's happening at home. And then the last week was back, so safety, what's happening at home and energy. Yeah, yeah, we learned a lot from these campaigns.
Patrick: I could imagine. So, I´m trying to just remember what you said. So people, when they look at Watty they are looking at [00:07:00] also smart homes. Like that,

that's the idea.
Maral: That´s the category we fall into somehow.
Patrick: Yes, but you're also operating within, I'm guessing you're smart homes, but also within the energy sector. Because you're measuring energy appliances, so you're actually keeping on to a turf that's dominated mostly by energy companies. So now you're kind of a new type of player because you're not providing energy, but you just measuring it, so you're kind of in between.
Where do you see like Watty you going forward. Is it going to be more on the smart homes? It is going to be more integration? Because in Denmark for example, we have integration between actually Velux - who make the ceiling windows and the gas company actually called Danfoss, and they actually have a company, well they don't have a company together, but they actually work together to regulate how much air and CO2 and warmth, and how warm it has [00:08:00] to be in the room. Is that like, do you see Watty going that way? Is it that, do you know that, or is it more like
Maral: Are you asking my personal opinion, or is it more, like, the head of a marketeer. Like, because what I say, it could be just like a personal opinion. It could be yeah, what do you want?
Patrick: I will probably like as a Watty employee.
Maral: Watty employee, okay. So I think like this. So if you look at like smarthome websites today, they are, none of us actually know what we're doing, but we are doing it anyway. Because it's like yeah, like if you want to take products like the Alexa or what's the Google one, it's Google home. And all these things they're selling a lot, they have a lot of sales, but what people are using it for is like, I don't, I am an early adapter, yeah, a "hands-free" like that is what they [00:09:00] say like, that's the feature. And they are buying it because they trust these brands right, so everyone else is like somehow trying to make something. So for me, the way I see it as a Watty marketeer, is that we have to understand, we have to show people why they need it. Because you say energy, let's say, let's take it from the energy perspective. Up until today without Watty, I have never understood how I use energy inside my home. No one has ever told me what I do, and I don't have the tools to measure what I do. The only thing that I get is the bill that I have to pay every three months to my electricity company.
So energy hasn't been anything I have been interested in at all. I mean, it's a bill I pay and it's not too much, so whatever. In my home country. I come from Lebanon, energy, like paying electricity is so expensive so if I pitch the story like to someone from there, they're going to just want to know if the government is stealing from [00:10:00] them, because that's the, because it's too high so we always think that something is wrong in the system. So you see it's different. So I'm going to take it to the perspective in Sweden so yeah, so it's just the idea that I can actually see how I use energy, like let's say if I have a very cheap IKEA lamp when I put it on, the, my Watty, my like baseload go so high. And then if I change the lamp it goes low, so I learn a little bit how I do things with energy inside my home. So I think that's the, Watty raises a lot of awareness on how we do certain things inside our own homes. That's how I see it, but for us as a company to get to a lot of people and to scale we

need partners like energy companies because people are a bit spoiled.
They don't also want to pay themselves even if it's as cheap as 39 swedish kroners a month. So that's why it's more that, they had some [00:11:00] sort of an expectation, that this will come from, like, the people that they rent from, where they buy from, or the people that they buy energy from. So it's like it's everyone, but themselves. So it's that mentality that we have. So that's why I think that it's good for us now to have a community that we are learning how the product can develop. But to scale it to big numbers, we need to partner with like probably energy companies are the best ones.
Patrick: Yeah, because I'm thinking right now as we were discussing it with the energy. That's very informative for the consumer. And as you saying people are a bit lazy. Yeah, so wouldn't that also mean that if you could ease part of somebody's day, not necessarily related to energy, but in some other aspects, that would then, that would actually be a bonus through that, right. Because that's kind of what we're discussing at least with the marketplace idea that we've discussed Gustav. Is [00:12:00] that, because of the information that Watty is getting right now. They have an enormous amount of data on the person and maybe even some user behavior, but specifically one of the options that we've been discussing is this abnormality detection. Wow that was difficult. But based like on your fridge, if you can see suddenly that the app can see that this fridge is using more power, the algorithm detects if this is outside the norm and this is mostly like because the compressor or something is wrong, it is broken. This means that this will probably go down, and then the idea is that being able to push a new fridge to the consumer through the app or maybe a secondary platform of the app that is a marketplace idea where you actually, so you're not hassled either by it constantly pushed the messages but some degree.
Do you think that is something as, because I'm guessing you have some sort of a [00:13:00] maybe market research based on what people have.
Maral: No, but, no we don't have any market research, because it's like from day one I just do what we need to do. So I don't know, how familiar are you with a startup? It's like it changes almost every day. The focus. But I can help you from my background from Philips, maybe, because I worked there for 25 years. I worked across the department's on the consumer part. It was such a pain for Phillips when people had problems with their products.
I mean, and then, at the same time from a marketing perspective back then, we used to spend a lot of money advertising towards people to buy certain things without even knowing if they have fridge problems for instance. So if this re-marketing concept somehow can maybe go from the customer service and see who's fridge. If they had this type of data, [00:14:00] it could be prevented and even better customer experience if they can send an, I don't know, send a message to those people who are about to, like if they had the data from the Watty app let's say. And if they get the message from the customer this might attach to people who are going to have a problem, then maybe they can like do marketing towards those people, personalized, to tell them like "fridge". Not like, this is very very visionary, but yeah, I mean of course the data is there, but no one is using it so electronic companies like Philips

electronics are potentially great people, but you have to make those people see a bit outside their world, because they are like doing toothbrush with an IoT enabled app. I don't know. How it is going for them, but I don't know if people need it, or if I want to communicate with my fridge. Let's say, you know [00:15:00] like the series of Silicon Valley, have you seen that episode where the fridge communicates, and then he gets pissed off so he wants to crash it?

So it's like. I don't know like what, if it is smart home, smart features, smart ovens that we need, or we just need to know when let's say it's going to break or something is not working. I want to know what it is, instead of like going and paying someone else to.

Patrick: Because I am thinking right now as I understand it, that some of the. Uhm, if you're able to detect. I don't know if they actually are. We need to ask that question, but if Watty is able to detect what type of frigid it is based on like, that should also be valuable information if you're able to input like some sort of serial number or something or at least yes, this is Phillips, that will also be valuable information. I would guess for Phillips knowing about the product, because they can then see okay, we have a tendency that this product only actually has a product life cycle of eight years, we thought it was 10, or there's a commonality of problems that this is usually like, this keeps on breaking [00:16:00] down. So I'm guessing so there might be some sort, but yeah, of course this is dependent on how open the different companies are I'm guessing on.

Maral: Yes of course. I mean, I think that if, when I was like, now you were talking, I was thinking maybe the best part should be like this. You see when we have measure many households, and then we see like okay, if there's a kettel say, the Phillips kettel versus the Electronics kettel. Which one is actually generating more energy. So they can have like, we can suggest to people to buy it. Did you know that Electronics has cheaper. So this is also like game philosophy, competition game for them to see which one performs better as well. Because there was a study when I was working there, University study, and then it went out to the media. So there were researchers testing the hand blender. And then, so the cheapest one that Phillips had was one of the best performing ones generating less. There was [00:17:00] some sort of a chemical something, and one of the most expensive ones, they tested like the cheapest range, it was, I think it's like Braun was it, or I don't remember, so I'm not sure, I'm not sure which brand it was, but it was like almost a shock that the cheapest one in Phillips were much better performing than others, who claimed to be healthy, so they generated things. I think when you put like on hot food.

I don't remember, but there were some studies, and then the media picked it up, and then we had to like. It was good for us this time, but I mean Phillips as a company, really healthcare was number one. So I don't know about the others, and I'm going to be like maybe bias towards them because I worked there, and I didn't leave because I wasn't happy, but they really did care about like the health part, so I think that maybe the data that we gather is a lot about like the brands as well. So there's something there. Maybe to make them compete against each other. I don't know, like [00:18:00] you know, like "prisjakt" price hunt. Yeah something like that, maybe. So I

don't know, it's a new thing. You know this data is a new thing.
Patrick: Oh, yeah defenitely, you can even, like as you're saying, it could be be more as a rating system. Like saying, which appliances uses less power, well based on Watty, which blablabla rate said this one is best in power.
Maral: And then on the long run like the life of the appliance, you can also probably know that, so yeah, there are definitely a lot of potential in Watty I think.
Sine: But also Watty data combined with data from other Smart Home Solutions. I don't know what specifically that could be, but data put together could together show patterns between them, which could be valuable as well.
Maral: Yeah of course, but it's like, it's like you have all this information the flow of data, but I mean if, it's like if you don't make it into something [00:19:00] I would use as a consumer, as a person, it's not going to be valuable for me. So I think that, what we are missing, not we at Watty, but what we are missing in the industry is, its like, not think about us, but more think about. Not go maybe bananas on the technology, but more or less simplify it down to what´s in it for them, and how they will use it. Because you can create a lot of stuff, but people won't use it, then, what's the value in it?
Patrick: I just wanna clarify, when you say industy, what industry are you talking about.
Maral: I am talking about smart home, yeah, yeah. Because, I mean I don't know if we are actually in that one, but that's what we are associated with. So it's easier for you, to put us there.
Patrick: Yeah, we kind of see you both in smart home and energy yeah.
Maral: If I'm going to choose I would prefer smart home. Energy is boring for people unfortunately, but we make it exciting.
Patrick: You make people understand it. But I also see that´s actually where there's maybe [00:20:00] more growth opportunity than anywhere else. Because I would say that the applications for Watty, for Energy company seems very very valuable based on any forecasting, training, that they need to do later on. Just insights as well, because that's a very easy way to go.
Maral: And I mean look at the trouble we are into. Hjalmar, I don't know if you have spoke, you haven't yet?. So it's like, startet Watty cause he has the vision to tackle climate change. That's why we excist. But take a very big world problem and bring it down to a level that my mother and your mother is going to use, and has an impact on our own Vision. So that's why we have to come up with ways for people to be interested in it, and the end-user, that it has to be extremely simple solution for them for us to be able to get to our goal. I mean, if you ask him, I´ve asked him many times before I joined Watty and after I joined Watty. Why did you start this? That's what he started [00:21:00] Watty for. But people, yeah, it doesn't mean anything for people.
Patrick: But it is difficult, because the idea is very grand, but you also need some money to make that happen.
Maral: Yeah, of course.
Patrick: There need to be, there is a business behind any great idea.
Maral: Yeah, yeah, you have to have, of course it's otherwise just wishful thinking.

And the energy industry, I am not an expert in that. I have no background in energy, but it's like it's one of the like oldest, is it hasn't changed for the last hundred years I think.
Patrick: That´s what we actually thought was an interesting about Watty. Because we know that the energy industry is very old and our thesis supervisor really loves this. Because she also, she likes energy. And it is quite interesting to see how Watty is, and I asked Arvind this earlier, like based on Watty, is it innovating, or is it disrupting an energy industry, which is very old. Because they do have the smart meters right now with the blink technology, but yeah. Is it, is it enough, is it good enough, so that's what we also find is pretty interesting.
Maral: I [00:22:00] think we are like frenemies. Not like, we need each other or somehow.
Patrick: Yeah, no definitely, but it is because it's. Your not in any company, but you go in and do stuff that energy companies do, but you have this amazing powerful tool through the algorithm and its data capabilities that is pretty impressive for such a small company. And providing some insights for people that again, up until now have had no idea what's been going on in their homes. So we see that as pretty interesting, and how we able to work with them.
Maral: Yeah, and for me that's enough reason for me to get one. Seriously. Like it's just that I understand what I do inside my home, that the knowledge that I have, its for me it's a great, like let's say that you. I didn't know that you have like the fridge and the freezer always plugged in on electricity, but they don't get, they are not always on. Yeah, so it's like, when I say this to everyone, they dont get oh really, they get like, it's a new information. I mean, they didn't teach us these things in schools in fact.
[00:23:00] **Sine:** People love getting new information, I think especially when it's so personal as your home. So that would be a very, a selling point as well.
Patrick: But yeah now you've been here for a while, with Watty. What would you say is some of it´s strengths and weaknesses, maybe towards going forward. Because there's of course this, uhm, I would say. To have an impact on climate change, or be successful there has to be a growth on consumer base right now. And also be able to commercialized any data, we need a certain base. Like our thesis going to be based on the assumption that a certain critical mass has been achieved. What that is, we don't know, but that's where we're going to be writing about. We've talked to Gustav about that, but what do you see like are the strengths and weakness towards Watty going forward?
[00:24:00] **Sine:** Because he said that people are not willing to pay for certain services.
Maral: Yeah, they don't expected that they should be the ones to pay.
Sine: So what are the next steps exactly to buil that?
Maral: I think we need yeah, I think that my job as a marketeer here in a company like what it has to be more not like promotion but more education. So I have to, we have to educate people why they need to be interested in it and why they need a product like that. So it's more like educating people. It's like more education, and when I say education I mean like raise awareness about why, the why, and what's in

it for them, and not talk about disagregation, not talk about, I don't know, like data, not to use any of these technical words we startups love. So it's about simplifying into a level that my, I always like to say like my grandmother would understand it, it has to be very simple extremely relevant to what they do every single day in their lives. So [00:25:00] otherwise we will not be able to get through them.
And if you look at our communication today, it has, it´s various because if we totally remove energy from our communication, it's not going to be fair for our vision and what we stand for. So that's why we, it's a bit, like a challenge for us to choose what we are going to say. It's not Energy Management exactly, it's not just safety as well, so, we're like all these three points that we are, we are like that thing still, yeah. So that's what we are communicating right now. And I think that it's a good thing, and at the same time it's a bad thing. Because like the general perception of us is that we are an energy cleantech company. But at the same time that's also not 100% true because we are. Some people see us as energy, some people see us as AI. And some people see us as like, no one sees us as safet [00:26:00] yet our like smartphone. So I think the biggest challenge for us. I think that in this year that I've been here, we have done at least we have those three points. Before it was just about cut, and we really don't like when people write that about us, like, it's to save money. It's not, it´s not for that. It's for you to understand how you use energy. That's what I think it is. So so the biggest challenges is to make people understand why they should care. And then there are lots of ways to do it, like to sell them the problem, or make them aware of the problem more. And not from a perspective where its like a bear on the ice, because when we say climate change, unfortunately they always think about that, you know, a bear on the ice falling and the ice is melting. But if I'm sitting in my home in Stockholm, in the city, that doesn't affect me. Its not close to me, it's not happening to me. So the role for us is to raise awareness on how it does [00:27:00] affect them, I think.
Sine: And what is an example of that?
Maral: An example of that could be that like a lot of climate change is actually a lot of like diseases. Like health diseases, but I'm not an expert in that so I can´t say, but I mean it has a lot of things, and the one thing that I use a lot is the statistics that everyone wants to like not take the cars, and they just ride the bus, but the fact that buildings, and houses generate 20% versus transportation which generate 10% of the CO2 emissions. I think that when we talk about the energy waste they have, like not say that they don't know, like maybe give them advices if they have like enough water for the kettel. For one year, like I don't have to fill the entire kettel. If I [00:28:00] just fill in the cup that I'm going to drink, on one-year you already save a lot of energy. So these things are fun facts, and very interesting for people, because they will also like yeah, it's just a bad habit, they want to cut that down. So like try to train them to change their routines maybe. It's not anyone's fault, it's just that we are not aware of it.
Patrick: That's something that could come actually through like tips through the app. Cause I am figuring that the algorithm can figure that stuff out.
Maral: Yes, yes.

Sine: And also finding the balance between how much people want to compromise, because people like to live their lives comfortably, and we like to keep. Like some people take a long shower, some people doesn't know about effect. So what you say, is that you want it educate people in how they can do it smarter, and that small things like not filling the kettel entirely, would actually have an effect on the [00:29:00] consumption. And you know, it's very simple, but it's finding the balance between giving up too much. You know. Not all people want to wash their clothes during the night because of the peak hours. Not necessarily. Some people will, but yeah. It can´t be too much compromising.
Maral: Yeah, and one thing you have to know when you're doing like any type of marketing campaign or communication, is that you should not make people feel bad about what they're doing. They will hate you forever, like they don't. When we communicate it has to be like what you are doing is, okay, but you can do better. So when I go and say you are killing those bears, they're not gonna have a change. Like sometimes extreme shock could work if done properly, but people don't want to feel bad about themselves. And I'm not going to help climate change or Watty if I go and say these things to them. But I think like [00:30:00] if you give them small insights and tips that they can relate to, they would love it, and they will apply it. Of course it's not going to be like putting a little less water than more, it´s not a big change right, so yeah.
Patrick: But what about. So the thing about Watty is that the information that comes out of this based on the tips, and the value that also give it to the consumers, is also, it's also partially based on their own input, because they have to label fingerprints. It's only currently, there's only like, though, I think the washing machines maybe or the fridge, and the microphone. The five products that can automatically detect it through the algorithm. So I'm guessing right now as a marketeer, how do you push, like, you have this great product, but you also have to do some of the work yourself. Like that also has to be some sort of a limitation or hindrance, because you're saying like, how does or how is suitable to my to my grandmother? Would your grandmother go into the app and [00:31:00] say ok this fingerprint, so I went in and like. Or do you have to wait until the algorithm is so good that they don't have to do that.
Maral: No you can't. Our product is not perfect, and we cannot make it perfect and ship it after it's perfect, and then see what people. I think that it's good enough for people to know how to use it and use it. It's reliable and it's quite simple compared to a lot of other things that they have been doing. So what we communicate as a company is, like, if you look at our website or our social media channels, we don't say things that is not done. That the product doesn't do. But of course, you're not going to go and say like, the fingerprints and explain. But we have the Watty community, and we communicate with them, and teach them via newsletters, and also we're going to start like within notifications on the app as well.
Of course it's extremely challenging, because it's such a complicated thing [00:32:00] plus a new behavior for people to adopt and do, and also keep them coming and use it, engage them is not like. There are three different challenges of course in that sense, so

the engagement. But thankfully people are very engaged with our app like helping them use it and see the value in it as well. Yeah, it is error, no, I mean it's not impossible. It takes time. We have to learn to be also patient a little bit, and also we have to really be good listeners to the community, because they are the ones who are going to help us build with the product. I mean, sometimes we argue like which features we should push first, but I think that, like maybe we can just push things and then learn which one is best. Because people like, think that they know what they want, they also don't know, and it's like, [00:33:00] it's a learning curve for all of us. But there's definitely a need for a product like Watty at every home. I really believe in it.
Patrick: Its a crowd source built product.
Maral: Yeah. Yeah, it is, and of course the data, like the data that we capture. The energy companies probably have it, but they haven't captured it as we do. Like they haven't gathered as we do.
Patrick: Yeah and at least what we understand is that they have some data like you have, but they have no idea. Not as high quality or as often.
Maral: Yeah, probably you've heard that we got top three time, top energy data, a benchmark in the world. You're going to talk with the Hjalmar, right? Yeah, he will tell you that. Yeah, we're very proud of that. Yeah, yeah. Like one just a few months ago, and before that we've been I think two or three times I´m not really sure. Like top. When it comes out, the data that we have is a top top notch.
[00:34:00] **Sine:** Also when we read about the industry and read about other solutions as well, we really understand now what you do, and what you're doing is really really cool. Very valuable.
Maral: Yeah because like AI is a very hot topic right now, but if it is. But without the data it is nothing. So I think that's one of the top reasons that Watty is very special because we like, it's already smart enough for people to start using it, even if it's only five appliances. I mean, if you asked me five years ago I wouldn't even imagine that I could actually know when my kettel was switched on or switch off, and how much energy it uses, right. I mean, do you know, I don't know if anyone explained to you how the entire technology works, like the fingerprints.
Patrick: Yeah, yeah, we've had some introduction.
Maral: Yeah. So when I like, when I'm at events and talk about like the fingerprints that are unique, and people are so amazed. It's like almost like magic, especially when you put it on, and then it [00:35:00] pops up on your app.
Patrick: It is also very easy. It's been put down to a very low level. Like it's very layman terms, so everybody can understand it. It´s like nothing technology like you are saying, oh you have to code somehow, like identify your electrical signature. No, no you have a fingerprint, you just have to name it.
Maral: Yeah, exactly.
Patrick: It´s like you know what you've just turned on. Because I remember when I. Gustav showed it to us like on the live screen, and I was like one of those things that I was thinking about first of all would be doing a gamification, sort of like score, and because I was actually thinking about, I haven't told you that, but part of the

marketplace is like using points, the more you label, the better you label, the points go to some sort of marketplace activity.

Maral: Yeah, we have to reward. We have been discussing this, but now we want like the minimum. Our CTO love this product. Are you going to speak with him too, the CTO?

Patrick: No, I don't think we have an interview with him today.

Maral: Yeah, he is very busy.

Patrick: We have [00:36:00] Yayun later today. Engineering. Yeah software. We need some more of the technical talks. But yeah, but we definitely see because that's also a way to go, but it's pretty cool to see how you guys have like brought a pretty complex subject about electricity patterns, and like what you do to a very down-to-earth approach, I would say.

Maral: Yeah, that´s what I want to hear, as a communication person. And the funny thing is that's one of the energy companies that we spoke with, Hjalmar told me, like they said that you don't speak only to men in your communication you also speak to women, because we took a lot of examples on the hair straightener or the curler, so it was like people, when they talk about smart home, or like these advanced technology, they only talk about guys, and guys are the only ones who buy it. But actually women are now buying a lot, because of the hair thing. [00:37:00] Because no one has actually picked that up and raised that awareness. How many women actually forget, think that they have forgotten that and lef it on, so I think yeah, it's like, I think that we are really trying hard to simplify it down to everyday use of the product. If we only had more budget, it would be better.

Patrick: True, and that's where we hope at some point commerzialisation can help, right. Do you have anything else right know?

Sine: No, no it's really good and valuable insights.

Patrick: Yeah, yeah, so I think that was actually it, soI will just turn it off.

Senior Analyst and PhD candidate, Interview.

[00:00:00] **Patrick:** All right, we are a go. Um, so first of all if you could just state your name and what you do or your background?
Konstantin: Yeah I'm Konstantin. Um, I'm a PhD candidate at the University of Baumburg. I'm doing research in the field of energy data analytics. So basically a combination of business analytics and energy data and what we are going to do is to find patterns in the data and try to support the utility company with insights about their customers. That's basically what we are doing.
Patrick: Well. Thank you very much. So, um based on so Joanna has only quickly briefed us on what you do so my knowledge may be a bit lacking in regards to what you were, the full scope of your research is about but as I understand it as you also mentioned he looking a lot more so into the specifics about [00:01:00] data and within the energy industry. Is it only about the specific of once it's been collected or are you also looking at the different technologies that might be involved in data collection or is it just based on on the actual output?
Konstantin: Um, what I'm not doing is collecting the data, so we are working with data that is stored somewhere in the utility company. This can be um, another consumption data for billing purposes, this can be smart metadata, so 15 minute. Meter readings, um or daily data. It depends really on the utility company what they have and what they collect and we are looking on it, um from a data and analytics to expect of so more business intelligence data science perspective then technically.
Patrick: Okay.
Konstantin: So we are trying to move the smart meter data and so, uh time-series data we try to figure out what are the important characteristics of this time series [00:02:00] and to make any predictions or explanations, why this household consuming a lot of more energy then others?
Patrick: Okay. So what is this may be a big answer but what's the overall goal? What are you hoping to achieve with this? Show some sort of predictions based on forecasting of the energy usage for the utility companies that they can better, um allocate their energy they have within each sector or household?
Konstantin: So we are not doing energy for consumption forecasting.
Patrick: Okay.
Konstantin: There's a lot of research doing that. It's very technical and this is more, um operations operations things. Um, what we are looking into is and we have 2 goals: 1 goal is to identify pattern that you can use for energy efficiency, so targeted feedback to customers, um support energy efficiency campaigns automatic energy Consulting. There's a big ideas that we aim for to realize with data mining [00:03:00] and the other part is to support marketing basically, so energy retail. The question is always what is the value of smart meter data? So smart meter data has in fact a lot of a lot of benefits for grid operation because you can better allocate um renewable energy production and so on. Um, what is also very important thing for the side of the European countries is

fraud. So a lot of people stolen have stolen energy before and with Smart Meters, not anymore possible to steal the energy. So these are the grid operations, um questions regarding to it to smart meter data, but in Germany you have not you have a very good forecasting system.

You have no energy fraud. So what is the motivation for utility company to introduce Smart Meters? This is the reason to my impression why the Germany, Switzerland, and Austria are not introducing so much Smart Meters. They are asking what is the value of that? They [00:04:00] have about 16 Euro transmission costs for the data per year and customer and that's a lot.

Just for having a Smart Meter and then you need to install it. So about 150 Euro, um to install a Smart Meter is huge amount and you need to in any way realize that expenses. So the question is, what is the value of smart meter data and we are trying to have some solutions for that, for marketing for develop new product development, maybe or even energy efficiency.

Patrick: Okay, because um, it's somewhat similar to what we are actually I think to some degree looking at with Wathiq. I don't know how much you've been introduced to the company by Joanna or how much is talked about...

Konstantin: She just said that there was an app and it's quite amazing.

Patrick: Yeah. Well so uh, just to brief explanation about so it's a Swedish startup based in Stockholm. They [00:05:00] uh, they've been, well, they've existed for about three and half years three, three, and half years. Uh, but they haven't been operational for about more than just a bit more than six months now. What they do is that they um, they install a sensor unto the fuse box in each home, um which goes in and can uh detect each appliance signature in each own based on their energy signature and they're able to uh measure I think it's up towarsds 100,000 times per second if needed be, but I think that right now they're averaging about I think it's about 2,000 just based on because the the more detailed you become, the harder they have of recognizing each signature because it becomes too uh too detailed.

Um, but right now they're currently able to actually Identify some, uh electrical patterns or electronic signatures based on the different types of appliances. So [00:06:00] apparently, um, a fridge goes like it has a very steady kind of signature and that turns on maybe every 10 minutes. So it's automatically uh able to detect that they've of course, they said the first six months before they actually went live or four months or how long was I can exactly right now and they actually they went out and paid 400 uh households where they're allowed to put sensors on each of their plants in the entire home with computer and then they just measured everything. So that's their bases of the training data they have right now, but now that they're trying to expand. Now you just have to have a small box and they're able to with only four connections able to more or less and measure anything in your home, um that produces a certain amount of current.

Of course if it's only a phone charger, it doesn't produce enough. So it won't be able to take more less anything-- and then what they can do is that they show this real time via an app. Um, and you can see how much your total energy consumption is, how much each different appliance is and stuff like [00:07:00] that. Uh what they're working towards is then of course the way they are able to recognize this automatically is because they've had more data they've been trained and there's some appliances that are very unique in their signature as with a fridge, I think a washing machine as well a dryer. They have a but there are some appliances that are just more as a heating mechanism

like a toaster or stuff like that.
They just kind of peak and then go down. Yeah, um, they need more data to be able to identify that so in the beginning of the process that once you plug something in the app will show you then a fingerprint is what they've done and then you just have to call in yourself. So you have to name it at the beginning.
Konstantin: Yeah.
Patrick: The more you do this the more then after a few times will be able to automatically detect and what they hope of course is that they get a certain amount of people utilizing some sort of a network effect to just have uh the data so the more people that use in theory, it becomes more more valuable based on because just the algorithm behind it gets better and better.
[00:08:00] **Konstantin:** Yep, sure.
Patrick: Um, their idea as a company was because of the CO, he wanted to reduce energy waste and twenty percent of all energy, you might know this or twenty percent of CO2 comes from households, and he wanted to try to tackle that problem and as it's also business, they're also called so of course want to try to make some money and I think the focus is still of course want to focus on this energy efficiency and energy awareness, but now they're also looking at maybe what else is in play, especially with the data that they're actually able to collect that.
Um, and that's where my thesis partner and I come in. We are trying to evaluate their current position, um, both both on what their technical capabilities are currently, what they're using both on how to some degree they're collecting, what the mechanisms are behind basically on the algorithm, how that works and not in too much detail, but we're also looking at then so what their aim is with [00:09:00] the data how they work with it and then of course what the industry and what's viable within with what data they have now.
Konstantin: Yeah.
Patrick: Um, and we have looked at different options. They have some ideas as well. We also have some some concepts that we might be be looking at. Um, of course once he is a bit more, um, focused on the pure commercial side, but we are still looking at actually what's feasible. So yeah, that's basically it but they're doing a lot of what you're actually looking into but they have the same issue as with Germany.
So to say, the energy in Sweden is very cheap. They don't have any fraud, um so the aspect of like having, this they're not looking at going operationally either, um because I'm pure operational but they also know that people are not using this product without because they want to save money. Yeah, it's not because they [00:10:00] thinking okay, I can save this and this because the energy is so cheap anyway, that that's not incentive.
So they're looking at how does this data, that's what we're interested in, how what kind of value does their data have towards other concepts and this is more towards B2B Section.
Konstantin: Um, that's the Swedish. Um, I'm not sure but Sweden has a full rollout of smart meters has it.?
Patrick: Um, so the energy companies do have Smart Meters and I don't...
Konstantin: Now this means 15-minute meter readings?
Patrick: Yes. I'm not sure if it's through everything or it is only in like some of the major areas, but I know they have smart meter data, but,what he has, so what is actually their

measurement right now is a third phase um, it's or the third version. The first one was a classical more less smart meter, um with a kind of the diode system, that just blinked. [00:11:00] Then they upgraded that and then the but they still didn't feel it was precise enough the one better measurements and then they found this small box that they actually have um, which is very very Nifty.
Um, yeah and it is I would say much more it's much better to detect any sort of uh, signature explanations or anything just because it's based clients are not just per entire household.
Konstantin: Yep.
Patrick: Um, yeah, so. We've we've also discussed with some external partners. Uh, we had an interview with a Gartner um, where we were more interested in maybe on the different industry perceptions of how data is valuable. And what I would like to know is maybe based on what you know so far, what is your perception? Because he had uh, say maybe a [00:12:00] bit more worrisome if you're looking through them from what you signed when he said that the data that the energy companies have right now from the smart meters and a lot of that is very efficient and is that's what they have and they don't need anything more than that.
They don't need it to be more precise because but that's again that's also on a very operational point of view. Um, What is very adamant in the way that they are in the energy industry and that's how they want to think however, they also have some internal conflicts right now because they have a marketing manager who is very pushy on that. They're also within IOT Smart Homes, and so we're trying to figure out how does this also fit? If you could just Enlighten, this was a very long speech from my side, if you could just Enlighten bit on what your perceptions and what you have learned from like the basis of what is the value of energy actually with for the energy companies within energy sector? Is there like we right now we have a one point of view that says well of course data is always nice to have [00:13:00] but right now the energy companies at least, the more that point of that part of the energy industry isn't... They're fine with what they have currently.
Konstantin: Um, so I have two things, We should I should just say that that you have it in your mind. So there's a lot of research in non-intrusive load monitoring. That's the term you should go for when you are searching for research on that fine granular energy monitoring thing.
Patrick: Yeah.
Konstantin: There's a lot of research out there. Um, we know that stuff, but the problem is as you said it's a lot amount of data and you you can detect signal appliances and can do some nice visualization, but uh, so what? So what is what is the, it's just interesting but when it comes to energy feedback people are not changing their behavior just because they know that their fridge is consuming 20% of the energy. [00:14:00] So, um, the question is and this is also what wanted to add. Um, I...
So we have this non-intrusive load monitoring thing and the question is, why is this research that is old as I think the first paper was 1991 about nine trees of load monitoring. Um, the question is why is this not realized in practice? Um, the question is do people pay for that app? Or they pay for the box?
Patrick: Yeah. So, um, they pay a one-time fee for the installation of the Box because it needs to be installed through a certified electrician.
Konstantin: Yeah.

Patrick: Because there are attaching, it's actually pretty easy, but there is one connection that goes into some voltage I think detection and just based on that they have to have an electrician.
Konstantin: Do you know Fluke So? [00:15:00] This is a similar approach is also a device that you can plug on the main, um fuse and it also records that energy in very detailed way, but they do not disegregate this this load. So flux so there's a lot is a community. You can buy this box about 20 20 Euro, um, and you can self plug this on your main main electrical, um, fuse.
Patrick: Okay.
Konstantin: So this could be another direction where I can search for fluxes.
Patrick: Um, we've seen other an American company uh but they are also in a similar approach and what they do with "what he" but they're also a bit more focused on solar energy. So if you have solar panels, they've tried to incorporate that into there.
Konstantin: There's also in Germany there's a company called Discover G, Discover G and also doing kind of load [00:16:00] desegregation with very fine-grained data, but I also share this, uh, this opinion that the utility companies do not have the need for much more data.
Um, my impression is rather that they don't actually have no idea what to do with that data, even with smart meter data. It is so the data is still kept in that grid operation department and they don't have actually ideas how to use that data in further, um department. So what we are doing is to trying to unlock the value of this 15 minutes smart meter data to the whole company and this is the research we are doing with figuring out what feasible solutions how we can really support that but it's that's a difficult process.
Patrick: That's only two words the energy companies. You're not looking at any external factors like...
Konstantin: The problem is um, so why is [00:17:00] um, let's let's look on why the politicians decide the 15-minute as an interval for utilities comp-, utlities companies? Because when you go um into finer details, um, it becomes a privacy issue because the utility company can then know there are studies that showed when you have uh less than 15 minute meter reading intervals, you can see what TV program the household is watching right now.
Patrick: Yeah.
Konstantin: So they decided to make that 15 minutes as a minimum data granularity for transmission in the grid because it's a cost-benefit. As not at the privacy concerns are are handled and the information that is necessary for grid operation is it's okay.
So 15 minute is I think the important um granularity also for utility companies and they don't actually need much more [00:18:00] details. I think um, The question is what is the value proposition of this company? Do they go for energy efficiency or do they they go for? Um, I don't know.
Patrick: Yeah, so currently the um one of course, I would say awareness or in that way not as much efficiency, I think but it's more awareness that's kind of the idea.
Konstantin: But people don't pay for a banners.
Patrick: Well, no not that many right now. So back to your previous question. They pay 749 Swedish krona for the installation and then they pay I think it's 39 Swedish krona month as a subscription.
Konstantin: It's pretty much the business model of Discover G.

Patrick: Okay.
Konstantin: They pay about 60 Euro that are uh times eight about 400 Kroner per year for the subscription.
Patrick: Okay. Yeah, that's more or less similar action and what they're hoping of course is that they [00:19:00] can monetize on the data so it becomes more of a free I think um, uh a free service besides based except for the one time fee. Um, so that's that's kind of the idea. So we're looking at this as both like a short-term strategy but a long-term strategy. How does this monetization? Look and what's viable?
Konstantin: I think the selection effect is quite problematic. So um and in a survey for example, um, when you address people and ask them, please be part of our research and then you have a selection effect. So only the engaged people um answered the survey we have um a company where we are working together to spend energy. They are located in Switzerland and they do energy concerns consulting for energy utility companies and they offer also energy efficiency problems where people can [00:20:00] log in and analyze the energy consumption and we we've seen a selection effect.
So, um, they send letter out, letters out to come to the households to all households of a utility company and showed them so you're consuming that and your household neighbors your neighbors consume that and all the people that consume more than the neighborhood registered on the portal. So you have when you look on the energy distribution, the people that are using the portol will have a higher energy consumption, uh, significant higher energy consumption that others.
So what you what you attract with with the people with such a um service your attract the people that have kind of abnormal consumption.
Patrick: Yeah.
Konstantin: So the question is how much value is in the data when you only have customers that have a higher consumption than others so you can know that...
Patrick: They actually have a [00:21:00] need and yeah.
Konstantin: Yeah, but when you want to set the data, it is not representative.
Patrick: No.
Konstantin: This is a problem.
Patrick: That's true. Um, their value proposition is is actually based on three legs. So one is the awareness, the other is uh a sort of peace of mind because you're able to show via the app, um, what type of or how many when anything is turned on or anything. Granted they made some sort of a a research based on how many times a woman forgets to turn off her straightening iron.
Apparently that's quite a lot actually that's a that's a it's almost a third apparently of all women forget to turn this on or they there, you know, leave your home like oh crap did I turn this on this is actually so this is its kind of this piece of mind concept. They also trying to that's figuring and that's a lot of what people may be actually been using it for as well because able to track any appliance.
So if your oven on or your straightener is on [00:22:00] but also if your kids if you set them to bed and like saying no TV past nine o'clock and you can look on the app and like okay, it's 10 o'clock and TV is still on upstairs. What's going on? That's the second one and then of course there is still this, um again, the awareness part is more both for a person but it's also for I would say more on the environmental side this CSR thinking, um for people that actually are interested in maybe somehow reducing their their usage based on the environment and not as much as cost.

Um, but we've also kind of noticed that one of their is a the market itself is not that easy to expand because the people they have right now that are actually um, subscribe subscription or subscribers to this is based on um, people that they know of course within their personal social circles, but also early [00:23:00] adopters, so people that love like these techie finance thing or not finance but high-tech things.
And this is probably not the typical again behavior of a normal household and not the typical people. So there they are struggling also to try to expand this.
Konstantin: I think that's much more value in that um, in other fields not in the energy domain, um, when you think about monitoring, um, for example in Sweden, there are a lot of holiday houses.
So what is going on in this house? So it's there maybe a burglary or something like that? So maybe you can use that information to monitor the occupancy of a house some somebody there or not this uh, might look strange for the first pass, but if you really want to monitor or something, this could be a good application for it.
Patrick: Yeah, one of the things we've discussed some as Gardener as also actually security [00:24:00] is would be and maybe a good way to go, integration of Smart Homes, and yeah IOT. The thing is right now the the Box doesn't have any switch functionality. So you're not able to turn anyting on and off through the app so that could be a development. They have to go with the hardware to be able to maybe be able if you've actually seen crap, I forgot my hair straightener. I'm turning it off now.
Um, but that may be something else but that's also and that's also I think what we've seen is that internally also there within the organization. There is a marketing person that is more towards the IOT for the CO is a thing still pretty adamant within the energy because that's what they started and that's what their his main focus was to begin with. Um, but that's kind of their problem.
Konstantin: How large is that company? How many employees do you have?
Patrick: Um not very big only 16, 17 people,so...
Konstantin: That's quite a number.
Patrick: Okay, yeah well based other companies, um, but no, I think they're about 15, 16 when we were there [00:25:00] about a month and half ago, there were 16. I think.
Konstantin: Um, how many customers do they have? Do you know that?
Patrick: I think they have approximately 300 and maybe a bit more. Uh, he wasn't completely sure when we talked to him last. Some of the people have been and people that were part of the actual training study as well. And then of course it's based on these early adopters. I'm sorry.
So what they're also looking at there's then seeing how does this data, because they also know that and we're not supposed to go into the whole operational part, but they what they've been interested in is looking also towards commercial use based on like how to and this is where because it was I was quite interested in what you said that this 15-minute intervals because then you become, it becomes too precise able to detect like even TV shows and stuff like that.
But that's actually kind of [00:26:00] what they're looking for because they feel that that has a commercial application towards other companies because there is to some degree that they could actually see that if your fridge is not working if you can see that there's a longer time between when the compressors turns on or the actual signature has peaked or it's different that this might indicate some sort of error detection or like some error either the fridges open or something might be wrong with the compressor or something

like that and what they're hoping is that if they can detect that any like within any appliances going to break, um that you could get some sort of direct contact from a supplier about a new fridge, washing machine whatever.
They're looking at this more as a marketplace idea actually using their um their app as that of course and there's still some work to do but they believe that this must be possible. They have um, they see themselves as the opportunity to do [00:27:00] some what like Google or Facebook where they can actually just sell the data off to third-party people based on either with kickbacks based on if it's a product sale or just information because as I understand at least the viability of within the Energy company is is not that big. Which is pretty interesting because that means they might be in the wrong actually sector. Um, well at least they need to shift focus internally.
Konstantin: We also believe we had a contact with that Discover G, and we were really um hardly searching for some application to do with the data, so it's fine grained. You can do a lot of would, but what is the impact of that?
Patrick: Yeah.
Konstantin: So what we are we are not interested in for a research that we're not interested in in researching because of research we want to do some relevant things and uh, we didn't find um yet so maybe there is one the future, uh, they really want to [00:28:00] cooperate but, I have no idea what to do with that data because it's it's only the people pay for the service that they become a nice facilitation, but they they pay how good the visualization is. So when we can improve the visualization a bit, how do you measure how much improved this specification is right now?
Patrick: Yeah.
Konstantin: So when you do a better diagram, you can maybe do a survey and ask them if they more like the diagram now, but that's not the not another large impact.
Patrick: No.
Konstantin: You can also not commercialize it so that's a bit of the problem with that kind of data I have.
Patrick: Do you see that, um, because I was I've been reading a on a different sorts, um within some of these transformational technologies that are in play, and IOT has been mentioned like just basically big data from the beginning and do you see that within their energy company that there might be any like large changes within the [00:29:00] coming years five to ten years because now I know your research problem not done yet, but based on when you see they might not know how to use a smart data right now, but do you see that there will be an impact where that's it might actually be feasible or of course that's maybe what you're trying to figure out but you see any tendencies towards any transformational technology later on?
I know sometimes it's it's hard not to go up early because when you look at a company's... You look energy companies, you're looking at basically smart grids and stuff like that, but you see any larger impact because when we first heard about Whattey like the first Concepts without having too much information about like, oh my God, this is going to completely disrupt everything like where the energy companies not doing this. Why aren't they like buying watching like plugging this everywhere? Because I'll guess that more information is always almost always better and and so detail and stuff like that, but you see any impact on like this type of technology or any type of other information?
[00:30:00] **Konstantin:** I do think that this data analytics when they're really focus on how to create value out of this time series information, you can detect what we can do is

we can detect um single households to 92% accuracy. We can detect old heating systems. We can detect a lot of things we can detect purchase intention for a fiber to the home service. We can detect if people want to purchase a photovoltaic installation, not 100% correctness, but we can identify the most promising customers to be addressed. So this is a huge thing that you can do when this can transform the whole marketing of utility companies.

So at the moment utility companies have three products they have I'm not talking for all, but in general they have three products one standard product. Electricity is not sexy so you can you just need it. Yeah, this is the basic product. Then there's [00:31:00] a cheaper product where you have less service. So an electricity bill that is online, for example, so they say if the cost to mail you you that bill and then there's maybe a premium tariff.

It is mostly Echo tariff. So green electricity something like that, but, I think this structure is now changing. You have a lot of no more renewable energies so we some Switzerland partners are now, um changing their default product to green. So they have enough green electricity because of that also in Sweden, I think there's no problem with green electricity of the water and the water turbines that produce a lot of energy and also wind and sun and so on.

So utilities going to change the default product to Green then, what is the the premium product about? You cannot say if your product is the green product and we say we sell an echo tariff to a higher price.

[00:32:00] So they need to think about new products. And I think there are a lot of products. Let's think about um, locally produced energy. This is the current reset product. We are working on trying to to um, introduce a local produce energy so that as a photo and this building over there and you electricity comes from that.

So this is an added value so you spend money to the community around. You can think about electricity electric mobility. So maybe you have a flat rate tariff where you can charge your electric vehicle somewhere in the in the country and this is just the Tariff you have at home.

Um, maybe think about.... I think a lot of things with added value propositions that the utility can offer. Their combined tariff with infrastructure water, gas, electricity, telecommunication. Why not? I think there is a lot of things are going on and um the [00:33:00] data they have they can use it for targeting better segmentation and so on so maybe they can rid of, can get rid of their marketing department when the rhythm is doing this stuff.

I think there are changes. The question is rather do they realize it or do they stick in their old way of thinking and their seelos so the good operation and the then you have also regulatory problems. So maybe the and then we retail departments are not allowed to use the data from smart metering.

This can be the problem in Europe. I think. Um, so the there's this, um process of deregulation in the energy markets so they separate the grid operation from the energy retail and it can be that the two separate companies and it can be that the company that does energy retail has no access to the smart meter data because of privacy regulations.

[00:34:00] I think it has a chance to be disruptive but I have no clue how it works out.

Patrick: No, no, no, of course, but it's interesting to hear um your thoughts about that. Um, um, I just had a question that I lost and hopefully that'll come back to me at some

point. Um,
No, yes, um now we were we've also discussed that one of the options again, this should also be within heightened IOT functionality because what we see that the value of Whattsee and this box and the app itself is that the data of course has its own value, but um, I would say that integration within the IOT also creates added value based on because we're looking at why [00:35:00] should this be valuable also for companies, but if a company then an energy company would be able to based on the detection with through the app going because a lot of people they always, their peak periods within the energy consumption right people do in the morning and when they come back from work everybody has to drive.
But if an energy company is able to actually automatically detect low end like a low peak periods or low periods. They should be able to if you have like the clothes in the washer they should able they might be able to turn on the dryer or washer or something like so they're able to actually to monitor some of your energy consumption. This Also again needs some sort of functionality within the company.
The problem is right now or like within the IOT device, the problem is right now and we asked and what why the the whatsee box was not like being integrated more as like being integrated as part of the energy monitoring for energy utility companies. The issues right now is that they're also based on [00:36:00] a cloud system.
So all their data so their boxes actually more less like a mini computer is a small view and process for everything and it gets sent up to the cloud. the algorithm and everything goes through the different API's and it's shown on your app within less than a second, soextremely quickly. But of course, it's also dependent on uh, a working internet connection.
So that's actually one of the reasons why they're not able to uh, go together with any utility company being official because they just don't have the, the stability of having current on will always current.
Konstantin: I think the maybe customers won't like that. The utility company has more insights into their home. So I think it's also part of the value proposition of this company that they are not intermingled too much with the utility company.
Patrick: You don't [00:37:00] think of that you don't think that um,,,
Konstantin: Think abou,t the think about um, what about a cooperation with the insurance company. So insurance companies would be I think very interested in that data because when they can predict, um wrong usage of your uh furniture they can cancel the contract for whatever insurance.
Patrick: Yeah.
Konstantin: Or they make it higher at a higher price because they know you are not taking care of your belongings. So that would be an interesting thing but to customers really want to have the that connection between in detail energy monitoring and another count- company.
Patrick: But you don't think that because I'm we're looking at the the development of IOT smart homes and stuff like that people use these or are attributed to Smart Homes because of the ease and this connectiveness and the lack of them actually [00:38:00] having to do anything. I know in Denmark, um, there's a there's a partnership between. I think it's Den Fast which is the heating company and Be Looks who makes the skylight windows. They uh, they do Smart Homes together or they what they call Better Homes what they were able in concent to regulate the healing air, um freshness and different

stuff.
So the window will open and the heat will turn on and that's just and people enjoy that because that means the things are like it's done for them. And I'm pretty sure that they detect a lot at least dendiface based on the heating em, don't you believe that because we're all moving towards a more smart connected world,I this may be a bit out of scope but em that this idea of having because half of the people don't know about energy, like people don't care about it.
The Energy company hasn't like the bills are being sent out the same way. They have been from or less little past 80 years. They haven't [00:39:00] changed and people only do with energy companies in three different settings when they move into a new apartment when they move out of an apartment and when they have to once a year, uh, read their system more or less.
That's typically from my own I would say that's the basic idea.
Konstantin: Think about so in in Sweden, you have 10% customers churning their electricity company every year. There's a big problem in Sweden and in Norway it's worth percent in Germany 6%. China's a huge problem. A lot of things people don't know that.
Patrick: Why why do they churn because of pricing issues because of low service quality and so on the others churns that is exempt and always the highest in Europe. Churn Rates.
Konstantin: So but wouldn't that also then be able to that if if the issue its [00:40:00] service or even pricing for some degree wouldn't have more detailed data be able to help toward some of those issues?
Konstantin: Sure but utilities companies need to do that. So it's a part of what I'm saying, the value proposition energy is not sexy.
Patrick: No.
Konstantin: You can make it sexy with a lot of things, add ons, servicesm, making people feel that they are valued customers. So in this way...
Patrick: It's a more more personalized solution at least. Okay that's actually interesting. I didn't know about that curnder. That's good to know.
Konstantin: I have about 15 minutes now.
Patrick: That's fine. I'm running out of questions.
Konstantin: Okay? Okay, that's fine but you're more than welcome to contact me at a later point. I'm really interested in the work you are doing maybe there is some also interaction with the company where they say, um, they're interested in our work or something like that. We can also arrange it that I come sometimes Sweden [00:41:00] and we have a meeting.
Patrick: I definitely so we when we were up there last time we did because Joanna also expressed interest so and if like other people could work with on with them again, they seemed open to it.
So I definitely think that's possibility.
Konstantin: So we are searching also from for um larger research projects in Europe where we also need industry partners and your honor would be also interested in that so we can maybe think about um a research project where we really think about new business models for such kind of data-driven different business.
I think that would be beyond of the skull of your mass now, but it can I think there are enough also funding opportunities for research projects in that area. So the the politics

know that there's a lot of value in that data and they want to realize it and. I spend a lot of money to to help [00:42:00] utility companies to make better sense of the data.
So, um, there is money out there for research funds. If they are interested we can I think arranged some some European cooperation.
Patrick: And we will definitely let them know. But yeah, I don't think otherwise actually have that many other questions. And I've pretty much gone through my list. I didn't have that many.
Konstantin: Okay, but I can you can have a look on on the publication's of mine and also of colleagues of mine. There's one there's one PhD that might be interested, a PhD thesis that might be interesting for you from Felix Lawson. I can send it to you.
Patrick: Yeah that would be great.
Konstantin: Um, and he compared different kind of feedback, um kind of feedback in terms of.
Um, what works best for energy savings and he found out that the monetary incentive is one of the lowest incentive so it's much more important to do better than your neighbors [00:43:00] that you get a certificate of your the energy-saving champion and so on it's much more important from up psychological perspective than a discount on your bill.
Patrick: Oh interesting.
Konstantin: Yeah.
Patrick: Okay, that's pretty good.
Konstantin: And when this this um, social normative feedback, so you stick to your social environment and when others are better than you and that's a huge incentive to become better.
Patrick: That's pretty cool. I will definitely but know if you could send that down would be great.
Konstantin: Yeah I can do that.
Patrick: But yeah, otherwise, I don't think anything else just finish this off.

Senior Managing Partner, Gartner, Interview.

[00:00:00] **Patrick:** Thanks, right, if you can just state your name, and where you are working again.
Peter: Peter Suhr, Gartner Consulting.
Patrick: Thank you very much. Alright, so as mentioned IoT within, or technology within the energy sector. How is that? How can you position yourself as a company, but also what's, what current trends are maybe actually coming up and so on so forth just as a brief recon.
So, uhm, what we would like to maybe ask you is basically just a bit of an overall question is, how do you currently see the technological advancements in the energy industry and the impact that they have. Could you may be go into a bit of detail on the different trends that you're seeing right now, and what do you foresee maybe those impacts could be?
Peter: I remember I was actually supporting the merger of the 5-6 utility companies in [00:01:00] Denmark that became Dong energy and now Ørsted. And I was sitting there with one of the guys from Dong energy, and we actually, the technologies were already available at that point in time - actually smart metering were coming up. We got the idea that we would actually establish our own company just you know for the fun of it. Because we could see, we could sell, that if we could manage people's wash machines and other stuff we could just start it you know. We could sell the electricity for maybe half the price.
Because when you work with the big power generators like E2 just over there, when you go to Amager. I mean the peak consumption of electricity is around you know 19:00 - 20:30 every day and then again 16:00 to 17:30, if you have seen that. And you got to have the capacity at least. I mean you've got to produce the electricity at that point in time. So we said if we could delay those washing machines or whatever [00:02:00] people put on, or maybe also start up the oven at 2 o'clock and stuff like that, we could sell it much cheaper too, and we said Gentofte cause we lived there. So, but we also knew, I mean it will take time, so you could say already now 12-13 years ago that was, you could actually do it. You could say why didn't Dong energy do it? Why didn't Vattenfall and all those other guys. And I have actually, just a few years later, I spoke with the head of strategy and the CFO of one of the big European utility companies about exactly that. Managing, you know people's consumption of energy.
And he said, you know Peter? We can make so much more money today by trading the rights. You know, the right volumes of energy, more than we will make in one year, two years or three. So it wasn't on the radar. I mean, you [00:03:00] would kind of producing huge quantities of you know energy and distributing in through the network, and people could switch on and off, and you could maybe make out some special pricing agreements with especially the big companies. But for people like me, I mean it's almost like take-it-or-leave-it.
I think five-six years ago a young lady called me on the phone and said "Do you want cheaper electricity?" and I was like yeah why not. "Yeah because we can make you save you know 600 DKK". Now you see the deregulation of the industry starting to, that

somebody can actually pull up some energy they can fuel into their house. There's no energy management in it as such. But they start to see at least that it will hit us as private consumers. And I said well sounds really cool. How will you then after a year be able to [00:04:00] demonstrate for me that I save these money. And she was totally silent. And she actually used the source when I pushed a little, "Extra bladet", you know. Daily Mirror. It was so funny. Oh yeah, Extra bladet. That's why you're find the truth. I mean, so you see here, you know that was probably a little phony, and how to kind of deal with that. Then we saw, I mean an energy management system we've seen Microsoft starting talking about it. If they got all the devices in our home they might use it in a more advanced way. The big companies starting to replace meter. So why not have a two way communication thing in the metering. Now, you know, now slowly, maybe some components are getting in place in people's home.
Still for some reason, it's kind of like insurances have a little low interest. I mean, [00:05:00] there are certain people like me who turn down (the energy) and put curtains in the big living room. And we have maybe thirty percent less energy consumption. Which is great. We've got to sell it. But it, I don't know, it's these taxes are so much of it. So I, you know, what's in it. But it's still you know being a little old-fashioned. Why burn all that energy. I could of course installed something doing all that by itself. I know one of my American colleagues think it´s so funny that we run around and regulate the heating ourselves. Because he wouldn´t have done that for the last 30 years.
Patrick: So the aspect actually of Smart Homes, like the introduction of these being able to automatically regulate based on any kind of data that they're collecting.
Peter: Exactly.
Patrick: So just kind of to follow up [00:06:00] on this.
Peter: So, I mean one thing is the, and I will show you in a minute, it's something we call the hype cycle. So we say whenever a new technology, a new concept hits, you know, is introduced, there's a lot of hype, very often a lot of hype around it. And it goes through, you know, a lot of hype, and then you go through the disillusionment. People get disappointed, and then you know, it climbs up, and you'll see slowly something happening and more and more people will embrace the technologies or companies.
So, and that can take 10-15 years. So from the first time you see smart metering or smart energy management or whatever it takes a lot of time. Because there's some players who are not really interested in it. You don't know how the pricing should be, and you don't have the all, the small baby [00:07:00] grid technologies really, to kind of make it fly.
Sine: Do you think that will be a slower of a development in then energy industry as its so established and hard to get into. Like I know that cycle that you're talking about, and that's relevant for other industries of course. We've seen that several times. But would that be in the energy industry as well, or do you think that would be more time than 15 years? 10-15 years.
Peter: No, I think, I mean like this steam iron or whatever. It take some time. Some of it becomes obsolete. So some of the concepts will never fly. It might not be actually the big energy companies who manage this, because they are so consumed with nuclear power, safety and pulling up wind farms. And there's also another thing, and you will see that also with the disruptive forces in the pharma industry to take an example. They make drugs, they don´t [00:08:00] treat patients. They don't have any conversation or interactions with patients. That's the physician. So they develop drugs, but now the

new, I mean, I just spoke with a big Pharma company here earlier today. The legal people around it. I mean you will get into a situation where you will be forced by FDA in the US, to look for adverse reactions by looking at social medias. What? I mean normal you would call the doctor, and say it doesn't work, the product. I get sick or. They have to report it. But now you can actually data mine it. So you can see all of a sudden they have to reach out maybe to millions of customers, but they don't have any idea how to do that. They might be forced to do that.
They want to keep on with the drugs, and what they know, and it takes twelve years and billions. [00:09:00] It's like a casino game. They're good at it, but you know, having any interaction with us is not a good thing. And not for them I mean, but probably for us. It takes time, and the same for the big energy companies. So who's going to take care of you, you know, management. And then you could say I could use architect, what was it again, IoT, but also AI. So you could use AI, maybe you just set it up, and it does it by itself basically. That could be, kind of interactive. You set it up and plan it yourself. What kind of temperature will I have during the day. So the Energy company has nothing to do with it really, but then for them I guess, based on what´s on their agenda, and the CEO level it becomes well. That's a marketing gimmick.
Patrick: But what I'm thinking, because the thing is when setting up an AI, or IoT device in the homes. You're able to collect a ton of data and especially if you're more precise. The [00:10:00] more precise you are, the more trends or patterns you'll be able to detect in any household. As I currently understand it the current smart meters are typically for just one household based like once every second. They'll do a quick measure on what's being used in that household or even just for an area. So the aggregate, like it's just, it's very aggregate kind of collection of data based on energy usage that then the energy companies use to some sort, to somehow forecasts, and then if they need to do any energy trading.
So, but, what I'm trying to ask is, long point, is that, the more precise the data becomes, shouldn´t that have an increased value then for the energy companies, because the more precise and the more specific, they know that the trends and the actually usage of energy and energy in a certain household or for then a given area, that will be much better for them when they do forecasting or like within peak period.
Peter: Yeahm there might be some, but yeah, but then you should yeah, if you can, if you can impact the [00:11:00] usage pattern it makes sense, because they know very, very well what they have to produce in mega watt, minute by minute over eight o'clock in the morning. I mean, they don't need a billion. I mean, the big numbers just flowed up to what they can see, so that's fine. And then you might have, could they have a smarter distribution? The fine thing with electiricty is that you use it, or you don't use it. I mean, it's not like you store it then, or you lost it I mean, necessarily. So that should be somewhere where you, where you could actually impact the consumption of the energy which might have an, so I can, I mean. I either see that it's getting more wind later in the day or whatever, so I try to get a, you know, a much more interactive way of having big companies.
Like, take Norwegian Hydro, aluminium. They look into, with a [00:12:00] forecasting and prices minute-by-minute, it's so expensive to produce aluminium. A fixed door and so, on paper mills and are doing the same forecasting the price on energy, forcasting the prize of energy. You couldn't, and they have some, some packages they buy from the big energy companies, but that might be even smarter. You know, if I can move some

consumption in this area due to wind or whatever, or I have some maintenance on a turbine, you know, driven by coal or gas, I could maybe make a better prize for my, for the Enterprise I am working with.
Patrick: So you, I just want to kind of reiterate. So the basis is right now that there is of course a lot of value in the data that is collected from the homes, because it does help the energy. But as of right now they are actually doing quite well on their own.
Peter: Yeah, but I would say, I mean the question is would they [00:13:00] see any value in helping, like by the way companies using less electricity. I mean, that's, that was one thing with Dong, if you have the concession you also have to have big campaigns for people to turn off their light, which they were not interested in. So that would, because they knew something about it, they had all the households and send out letters "don´t use electricity". Kind of funny. No, don´t read our paper from newspapers, or don´t turn on the TV.
I mean, they´ve had that, to some extent you could say, could they then by having millions of customers that were optimized that, take a premium for that. But it has to be this AI again. I mean you cannot, it has to be fairly automated. And I think that is going to be some other players.
Patrick: Because this then kind of [00:14:00] brings us to our case company. Now I can try to introduce it. Because one of the things that our company is. It's a Swedish startup, it's called Watty. So, based on the actual name of the electricity, watt, the measurement, and then w a t t y. It´s enables to detect and show the energy usage of each appliance in your home in real time through an app. So their product is towards, is focused on the end user. So it's actually started based on an idea by the CEO, because he wants to reduce the CO2 emissions. Because twenty percent of all current CO2 emissions comes from households. And you wanted, like how can we tackle that problem.
Currently the prices in Sweden of energy are pretty low so people are not focused on saving money on energy. So from them right now, it's making people aware of their energy usage, if they're interested. Also, like, it's also a monitoring tool, [00:15:00] because what they're able to do is that you can automatically see if your oven is still on, or if you've forgotten to turn off your hair straighthener, or if the kids are still watching TV, but you said they should go to bed.
Furthermore, so what they do is actually then, they are able to measure each appliance, or the electricity output from each home, up to I think it's seven hundred thousand times per second, but they don't, because then they're not able to, there are too many granualities in the electrical signature. But based on each of the electrical appliance, they each have a unique signature. So they're using AI now to automatically detect each appliance and then show. The more people that use the app, the better the app becomes as it gets trained on everybodyelse's input.
Peter: But they can only see if it's being charged. They cannot see if it's being used. I was just thinking you might sell this to Apple, you know, when are they using your Apple phone, but you're not seeing that actually. Or they can see it themselves.
Patrick: You can see, you can see. So through the app you'll be able [00:16:00] to see now my fridge is on. So now the compressor turned on, you'll be able to see through the app that now, out of the total 380 watt you're using at your household, the app, the fridge is going to use, is using currently 170 of it.
Sine: And it's actually very specific. You can actually take in your charger and out again, and you can see it pop up on the app.

Patrick: Within seconds.
Peter: Then the big question is. I mean you can do a lot of cool things, you know, and then. So who cares?
Patrick: And that's the aspect. Because right now they're being able to. What they're working towards is also doing some sort of predictive analysis based on. If they can see that the compressor, or compressors that are usually on the fridge, are on some sort of a continuous cycle that is pretty predictable. So it will be on for about 10 minutes, and then it'll do that maybe every 20 minutes based on normal usage. But if it suddenly becomes, if it uses more power or if it goes on more often, there might be a problem with the fridge. And what they're trying to do is now then to detect abnomalies and then from there on present this to the user.
Peter: And [00:17:00] that's, and I would for them I would think kind of ecosystems. Because, you can have a lot of cool use-cases, but who's going to drive that. I mean, who would buy it and who would benefit from it becomes for many companies a little unclear. So you know Grundfos the pump maker. They make, there is 40,000 pumps in the sewers of London. Maybe twenty thousand pumps here. Do they collect data? Yes its done for many years. Do they share it? No. Because of security concerns, if somebody gets into the pump they could. They have pump in nuclear power plants. They have pumps everywhere. And then they start "OK we got to digitized this, we have all these data, somebody will buy them". Nobody will buy them. You know if you buy a Grundfos pump, it will work forever. You know, it's, engineering Jutland based. You know, you cannot sell it, it´s not going to work in a lifetime, and it does. Engineering around it, and [00:18:00] all that is fantastic.
So you start to work on this, ah somebody must be able to use in the milk production, tetra park. I´ve been into those machines, that´s Grundfos pumps. That´s Danfoss heat regulaters and stuff. That's just one case. Another case is the zoo, swimming pools, whatever you know. They are everywhere, in the oil industry. And you kind of end up by what's the use case here. So you have to think, and how can I, probably these guys, connect into Vattenfall and home security. Bosch, do you want to know more about the pattern that might be a compressor fault, for the breakdown of Bosh.
And Bosh themselves actually have just you know how its, you know you could say, Okay Bosch now have. They have sensors in it, so you can actually put it on the net. So you could say, [00:19:00] Bosh would say yeah, but we don't need that. We have those data. The problem is, that when you change then the router or something in you home, the Bosh machine is off. Who are you going to call. All kind of crazy things. Cause you just do it, you know. They would love this. They come and put it up, sets it up, the oven, and you change your router or whatever. Now the oven is not. Whose problem is that. I mean there is a lot. They might be able to, in a very you know easy way collect all these data. Do some analysis on it by saying to Bosh "instead of you collecting all that, well let us be part of that.
So they're actually. Their value proposition should be based on the data that they're collected should go to retailers, and based like that create some sort of a.
Could this have some kind of Interest, OK Bosh maybe, lets call Bosh or maybe put it out for them to be used. And you know.
Do you think the way that they are working now with the way. Just because, you did [00:20:00] mention that the energy companies are not necessarily interested in like the collection on how to collect. Because they are interested in producing the energy, like,

this is like what the farm is, this is what they do. So do you think it has any value? Do you think it has any sort of changes? Like, that this company will be able to push any changes through to the energy companies based in this industry, or is it just a miniscule impact it's going to have. Because, I would say the increase of data will again, this talkin about the hype train, big data has been a buzzword for I don't know how long now, and everybody was on, we have to do big data, we have to do big data. But is it then again just kind of a hype train that we're going on here. Or is it, or should the energy industry maybe push towards maybe, getting more accurate amount.
Sure, I mean if you go even further into it, and now it stopped, or at least the big electric cars. But you could have maybe also, which has been one of the things we have been looking at from Gartner, is that when people have their electric cars, [00:21:00] and they charge them during night, or you could set it up.
So outside peak hours.
Exactly. So we do it during the morning. But you might also take electricity from them. So you have a peek hour, and you understand there is 1500 electric cars plugged in, with full batteries. So now we take 20 percent. And we pay you well for it, so I can get, you know, cut down on a peek, now it becomes you know. You might have, you know so Statkraft if you know them with the water. It's so funny, you know. They make so much money. They have the oil, and now they also have water, well they´ve had for many years. Because when it's really windy in the North Sea, it's for free, the electricity. At least on the trade market. Totally free. So all the pumps is driving like hell pumping up water. It's like a huge battery. [00:22:00] And then they wait. For prizes to go up, and then they pump it up. So that's an Arbitrage model, and you can say that these can live well out of that.
So you could in that sense, you might do that if you had battery access. But it's again, you know, we are pretty far out probably how do you make that model. I have to know the guys in. But you were willing to give a certain amount of that electricity.
They're also limited by their own technology, because they have a box that's put on directly onto the fuse box, and then measures all electrical output from that. But currently it doesn't have a switch function. So you're not able to remotely activate or deactivate anything. It's only a monitoring tool. But they're using some pretty elaborate algorithms using AI machine learning, to then detect, predict and stuff like that. But [00:23:00] because we've heard a lot from the, of course they're very optimistic, but they're probably also a bit subjective. But we are of course trying to see how are they able to commercialize on this data. Is there actually a market for it as well, and is what they're doing actually
Because what they claim is that, yes the huge energy companies they have a lot of data. They collected it as well, but we have this even more specific data, and we're doing something about it, and maybe we can partner up with those huge companies, and then we can give our algorithm, our unique insight into the data some, something. And what it is, is not very clear right now. But they feel that what they do is very special for the big companies cause they are not doing anything about it, and why haven't they done for many many years. So that's kind of the question they are asking us to figure out. How they can do something about it.
Yeah, yeah, for sure. I mean it's just, and not [00:24:00] to be too pessimistic about it. But that's why I'm. So the big Energy company on the top. But then you might actually just on the. We have all these data. What should they use the data for. They produce

and distribute energy. They have different sources. Fortum in Finland, if you go into the reception, they got windmills and models and all kind of, it's all green. And if you look at page 272 in the in the yearly report, it's like 1.8. percent renewable energy. They got nuclear power plants. They got cold and gas. That's it. Oil.
But they want to have that image. So that could be a way to approach it. We want, you know, we go to them "you should have the EU prize for something". So you installed this for people to be much smarter in consuming energy. There might also be something to people, you know, you want it cold during [00:25:00] night in some rooms, and all that, we can set that up for you. We can start the cooking.
And you know sometimes people download a lot of apps. They never use and they might use it like Wii, do you remember Wii. We just got one out of the house yesterday. When did you see the last update of the Wii software? I mean it still works and it's actually sold and whatever on Blå avis. You knowavis. You know my wife is really good at getting of all that stuff on the Blå avis. You it up at getting rid of all that Blå avis. You know somebody picks it up for a couple of hundred kroners. That's fine. You know, but then. So the Wii stuff, big hype. So what. Now people could get at (muffled speak) and this might also for some of it be the same unless of course you have it so smart, like it simply works. Why not push the bottom. Yeah, it's fine, it´s fourteen degrees in the living room and just type it in. If they can do that, can they turn it up, turn down heating or can [00:26:00] they just.
Patrick: Right now it´s only within electricity so yeah, Danfoss would be within the heating in Denmark. But they're already doing that part of, they have the smart home concept with Velux, so they're able to like regulate from a distance or set to a certain, so that air humidity, fresh air, temperature.
Peter: They have to be part of that ecosystem. Because also Danfoss does not really understand. I know they didn't. Nest was that what they called it, the termostat that came. Google bought it. They bought, and then in Danfoss, it was so funny, because we worked with them, and they asked, why did Google buy this? Well, energy management could be one thing, which you basically sucks at Danfoss, because you don´t have a clue. I mean yeah.
Sine: Because they actually have different perspectives within the company as well. Like some people think that they should go into the smart home industry sector, whatever, [00:27:00] IoT. And I think, was it the CEO? He is much more into the energy industry. That's where we are. That's what we are going for.
Patrick: Because he has this, he wants to make this impact on like. Because he has, at heart he's still like, he wants to change the environment, change the world.
Sine: But you can do that through the smart home industry or like change the perspective in a way. Because yeah, you have energy data, but could you use that in another way than partnering up with the energy companies?
Peter: Yeah, I think you should be open to all that. And my point is here that Danfoss was like why. And this is also by the way the engineering approach was "it's a lousy product". Yeah, I mean if it works and works for five years and save me money, and then let´s put a camera in it. Why a camera? Well, you can actually see that there is somebody in your home. You know, and then now you know surveillance and all that, they have all of it. So I can see if they are actually watching TV or whatever those [00:28:00] kids are doing so. Or whatever pops up of that. But now you know, what does that give up new ideas? I mean, and stuff like that. So I think in the ecosystem would be

to chip in, in different places. I mean the energy utility industry might be interested, but it would be more that we help our clients. We agree and all of that, because at the end of the day they are looking at, like Dong, how to put on the next big wind farm for billions of dollars in the north of Scotland and stuff like that. I mean, that's what they are looking at. And not exactly understanding how I use energy, because then they just aggregate those data.
Patrick: I had another question but it just eluded me. So at the beginning we discussed like the current, what has been so far of [00:29:00] technologies and current technologies. What do you think are technologies that might become disruptive or very innovative within then the energy industry.
Peter: Do you know our hype cycle for the utility industry. I will send it afterwards and then you can read fifty pages of what's happening.
Patrick: Oh lovely
Sine: We want to do that.
Peter: Yes great.
Patrick: It needs to be constant, typically.
Peter: It's actually now awaiting. I've been in this industry for many years and a bit before then I was in IBM. And you know, fifty percent of all IT projects fail. It has always been fifty percent. So, and I thought well we might. Why don't we [00:30:00] go to a higher level of maturity? We do, and they just put more stuff on it. I mean, but just imagine any other company than the IT industry, having fifty percent of the clients not happy. For how long could you sell ice cream or meat in the butcher you know, if 50% of your clients everyday was unsatisfied. It's a fantastic industry.
So here you have it. Just you don't see the years on it. I think this is five to 10 years. This is more than 10 years so let´s say Block Chain is not augmented distributed energy [00:31:00] resource management that´s something about it. There are drones, virtual cars, mobile customer interaction. So let's have a look here. Enables utilities to look into information by customer´s using smartphones our communication or SMS. So now you see, what we see, that they talk about. An increased number of utilities are applying mobile. It might be nice for you to know too. And then, you'll get it, but I'm just showing you how it works.
Patrick: So I can see down on the slope of enlightenment, you're looking at meter data management and load forecasting. [00:32:00] So is this hype cycle based on where they are currently? Each of the different concepts? They can go through a different speed. So that's why they have different colors. You know meter data management. Doing that is, I mean, not rocket science. You can do that, that´s what it says. But still two to three years before, it kind of tips over and it's nothing we're talking about.
Patrick: But this is really cool.
Peter: Big Data, meter data analytics, it´s also five to 10 years. This does not mean though, that they "ah nobody will use us the next 5-10 years". It's just that it will take [00:33:00] time before really it get up to a certain volume.
Patrick: So do you think that actually. That the companies. Because there's actually a similar company in the US doing more or less the same, but they're also implementing solar energy as part of it, so you can see how much of your home energy usage is based on any solar panels you might have. They have also actually now implemented with Alexa, Amazon's Alexa, so like based on, again this more smart home architecture basis. What was I going to say now?

Sine: Maybe what we talked about earlier today. How Watty could do something like that. I mean what we talked about earlier today is also that there's a lot of regulation in EU, but if I mean, it's a Swedish start-up right, so they could have some advantages compared to the us-based company that actually do the same thing except that there including solar energy as well.
Patrick: Yeah, [00:34:00] well my my question was actually, that's also a good one, but it was actually, are they too ahead of the time actually? That was. Because if you're saying like some of these might have 5 or 10 years before they become actually something that's applicable.
Peter: But still. I mean that's fun thing. I mean somebody here who makes this, right, like these swedish guys, might make a fortune. I mean, also, if you're going up here, I mean, there is a lot of money investment in it, and you still have somebody bying it, but before you are on the platau of productivity, I mean it´s actually used by a big portion, yeah you know, of people and end-users will take some time, that's what it says. So there's somebody awarding on all of this. When we talk with say Dong energy and they say, hey Peter when are we going to do that mobile customer interaction, we have talked about that. Yeah, it will take some time before you have people kind of embracing it, and then we say that that's gonna die, [00:35:00] by the way, that concept will not survive as it is.
Sine: Could you explain what that is, the outage management?
Peter: It's if you have, I think that models Network double if a safe efficient field operational later out is restoring.
Patrick: Okay so like if the let's.
Peter: If it goes out in the area and you find out pretty quickly what's the problem. You got a SCADA systems is also. So that is basically over-looking at the network and its performance.
Patrick: What's the triangle?
Peter: Let´s see. By mobile its. That´s the. I mean more than 10 years I think. Let´s see here, we have another view on this, you would have the. This is what you would get. Why doesn´t it work. So here we got another view with the same. More than 10 [00:36:00] years, yeah.
So here you got. This is transformational has a high impact model and low impact. Energy efficiency gameification. Her you go another one. Why don´t you go to the college people, there will be a box of beers for those optimizing energy and stuff like that. But it wouldn't have a huge impact.
Patrick: No I think that concept is actually something that the US counterpart is doing, because you can earn points based on how much you save or because. But they're much more focused on actually saving money and saving energy, because the pricing in the US is much different than there [00:37:00] is in Sweden of course. So that's probably a thing.
Sine: You could reach some people that are willing to compromise your lifestyle, like okay, if you're a family you need those peak hours. I mean you need to make dinner at that point of time, but are you student you could maybe change some of your dayly rutines.
Patrick: So at 10 p.m instead of.
Sine: Exactly, and wash your clothes at one when you get home after party or something. I don't know. It's a lot of opportunity.

Patrick: But yeah, this is really great. Its a really good idea of trends coming up. But alo, because again as we mentioned earlier one of the aspects we also want to see, how is this company Watty. How are they positioned towards like the utilities IT and what's going on. So this can help us at least give a.
Peter: You could do some cool around what are you talking about, ways in the hype cycle. And when I talk about the ecosystem. I don't know it could be a case by the way. [00:38:00] So Santander the big Spanish global bank in the northern Europe. We don't think about Spain more than sunny beaches, but they cover Southern America and many other places Santander. And they have found out for these small loans, where you have to maybe, buy a washing machine or something like that. They don't do the credit evaluation anymore. They totally have a social startup doing that, which collect all the data. You know. So they send in, we have this for approval. Somebody else sends it back, and they do that globally because they don't want to build the systems for it. And, so you know because somebody already got it.
Patrick: But isn't that an aspect then, that you could think that the energy companies could utilize. Because I'm guessing like installing Smart Meters, generally having to update those. I don't know how, what the life expectancy is for like a smart meter, but being able, if there is a demand for increased information, they need to update [00:39:00] regularly. That also is a quite big infrastructure, a cost for them, to some degree. If Watty could go in and like say. Because you have a non-invasive. It's a box you put on your fuse box which is already installed, and that's it. Then that should be able to actually go in and piggyback, or like to some degree replace what they're already doing. Of course there's some things with ethics, reliability, but that could maybe also I don´t know, be an option.
I'm at least. I'm guessing. But no, this is a very very cool. But yeah, that actually also kind of answer my question, the upcoming trends.
Peter: Yeah, that's the upcoming yes, you can, yeah I am not really, I mean, I'm not into all of that. There is also some cool. [00:40:00] That´s the old hypr cycles, okay.
Sine: Now I know what we will do this week, reading, yes.
Peter: The road to industry, on the road to these business. Oooh, looks cool too.
Patrick: But so based on what you know from Watty´s, what we've told now of course you don't have an in-depth. But, just basically how they're operating right now. Do you think this is a viable business, your personal opinion?
Peter: I mean, only one out of 100 makes it. If I had to bet on it, would be a no. But then nobody would do anything.
Patrick: No, of course, but based on what they are doing do you think they have opportunity if they can like, do you think that there is an opportunity now, or are they too early? Are they like five years too early, or is it just like there is not, there is actually not that need that they need. Like for the data. Or at least [00:41:00] they need to do something more differently than they're doing now. Of course we are asking you some questions that are maybe.
Peter: The early starters never succeed. Facebook were not the first, Google were not the first. Amazon never. The first ones never make it. They are too early, they pave the way, they might be bought by somebody. We had a. Somebody I know sold a company to, what was it called, network company. Because they made these DVD machines before anybody else. Up in Hørsholm. Let me playin Hørsholm. I mean, entrepreneur. This is great DVD. Yeah, it´s a machine Peter. Yeah, but that could be a nerd to

operate, yeah but. And they did, it could communicate with the early internet. It was dead, I mean it was dead until somebody from the US. They pay them 600 million kroners because they wanted them to impact Cisco on getting into the home. Because they knew the home, [00:42:00] Cisco didn´t know the home. Did that work on up. They don't know in Cisco, they don't remember, they buy a company every day. I mean, that's how it works. Somebody made something. And, I mean there you could say maybe they could maybe.

Patrick: Because that aspect you mentioned, like it's only the nerds that would operate it. We were discussing with their, one of the operation managers who is actually in charge of like data collection and their end-users, and he also says they don't have that many right now. They're still only on within the first couple of years of their startup, but they are also saying that the only people that are using it actually right now, are people that they either know within their personal networks, or people that are into this, that like have an explicit interest and love like this kind of like being able to work with your own API´s. So the early adopters right. This is, these are the only people right now that are using it. Because you also, you want the system, because being able to easily identify anything right now. They can only identify a [00:43:00] certain portion of equipment in the home. So the rest you have to, what you will get its like called a fingerprint. You can automate, the app will detect an appliance going on, but it won't know which one necessarily, so you'll have to actively go in and say this is the hair straightener. And then the more you do that, the more often than after a few times it will be automatically able to detect those going forward. But I'm thinking like if you have a grandmother that wants to know like how she's spending energy, but she's not that tech-savvy, you're not asking a seventy-year-old lady to go in and.

Sine: It needs to be more automatically driven I think. And I also think that the data they are having right now. I think it would be more of a home security stuff. I think they should partner up with some of the security companies.

Patrick: Yeah, at least some home architecture system.

Peter: Top ten trends in the utility. IoT, consumerization. So we have [00:44:00] operating environment. Evolving innovation. Exploratory. IT consumerization.

Patrick: But these are lovely readings.

Peter: Block chain, yeah some of them might be. Solar.

Patrick: But just before we go on I just want to see if I have anything. Because I think we're almost. I don't think I have actually any more questions right now based on what´s been said. At least not for the part of the official interview.

Peter: But you could see the guys who started this credit, whatever evaluation that now Santanter hoops up with, will probably make a lot of money. [00:45:00] Did they know it when they started up. Did they start somewhere else, maybe they did. Well, they be in bad shape at some point of time because they actually looking at somebody not.

Sine: It has changed. I mean at the beginning they were more focused on cutting costs for people right, but then they realized oh the energy prices are not that high in Sweden. Not very viable.

Patrick: It´s a startup, and they needed to be adaptable.

Sine: It´s the whole piece of mind they are playing on right now.

Peter: And that's one I think you should really be, or not you know. Of course look at the energy, but my, it would probably not be among, it'll probably not be like Vattenfall. Vattenfall might also team up with Microsoft, before they even will be able to. Big

fingerprint. So it might be somewhere else. It might be that they be part of a project.
Sine: We just need to find this creative [00:46:00] way of looking at the data. Could we use it for something else because I think that if they do that that could be a key point like right now. It's hard for us to realize. Okay. What is the value in this data? What can they use it for.
Patrick: No but I think it's pretty interesting. It's pretty. We've now discussed like what they're able to do, but also based on the industry, and what's also being talked about in the industry and what's actually viable and the interest there. There are some alignments, but there are also definitely some misalignments so to say. But yeah, I don't have any further questions besides.
Sine: No, me netiher. Yes it´s without g. Yeah we can turn it off.

Software Engineer, Interview.

[00:00:00] **Patrick:** Yes. Um, so, just for the record to start off could just please state your name and your position here at Watty and how long you've been with the company?
Yayun Feng: Sure. So, my name is Yayun and I my, my work here is mainly software engineering and I work in the platform team for like 15 months. Basically, since our current real-time product started [specifically] [Inaudible], yeah.
Patrick: Okay, [time]. Yeah, awesome. Well, thank you. That's for just so we have some sort of a reference for the record. [Clears throat] So, uh, if you could just maybe to begin with just quickly go through what it is you're actually doing. Um, so you, uh, because you mentioned that you have this platform, can you tell us a bit more about this platform, and what is actually that's happening?
Yayun Feng: Yeah, so, uh, our platform is basically like cloud-based and the streaming data platform. Where we support all the [00:01:00] households where if you have a Watty box installed you're going to have all the capability to, passing through the data to our cloud platform, and then, uh, we support the algorithm running on-the-fly and there you have everything. Um, that's, we hope on all your appliances in the real-time; like, like, uh, our goal is one second real-time. Basically, so, you, something happened at your home, it opens up your [say something] like within short,
Sine: Mm-hmm, okay.
Yayun Feng: like, so your entire high-level goal basically. So, without any downtime which has been a super challenging thing in the society like, in the industry.
Sine: Mm-hmm.
Yayun Feng: Making sure something is running all the time basically
Sine: Yeah.
Yayun Feng: results your seeking data basically, it's our strategy. Uh, so [Inaudible] from our team and it's an engineering team. Yeah, basically.
Patrick: So, what type of platform is it? I think somebody mentioned it was AWS?
Yayun Feng: Uh, [00:02:00] so we are hosting our services like, in, um, actually, in multiple places. Uh, one of the cloud providers we are using is actually called Digital Ocean, which is also known as Space on the, uh, the States Start-up. So they provide like economy-efficiently cloud instances. Like, the difference compared with them and the rest, they are like just a matter of cost. And we also use AWS and Google Cloud for some of our usages. That's not like, entirely we rely on something, so basically, we're hosting in different places.
Patrick: Okay.
Sine: But they're Incorporated or?
Yayun Feng: Yeah.
Sine: Yeah, so,
Yayun Feng: Like we, for example, we use AWS for hosting our like, email services and,

Sine: Okay.
Yayun Feng: like, uh, more like, uh, initially like sending SMS or sending Push Notifications if you know like, uh, remind users. This kind of servicing,
Sine: Oh, okay.
Yayun Feng: messaging service from AWS and we hosted some [00:03:00] like, storage there as well. And also, our like cloud computing, computing units which, uh, called easy to in AWS. We are using an another one too, so, basically also providing like Cloud Instances where you can do, uh, cloud computing basically, like the run the entire system, yeah.
Patrick: Okay. Um, because one of the things worth, as Gustav mentioned, is we're looking at how to monetize the data and one of these approaches is we're looking at this kind of a marketplace idea. Providing, um, the data that's been gathered from the consumers to some type of supplier be it Phillips, Electrolux, Bosch, something like that or even like a power grid. So, we're looking at how compatible, also how do you, how it you might be able to maybe push this data through to the platforms is it compatible with other companies, or is it like a closed system only? So.
Yayun Feng: Yeah, we do have a many APIs at [00:04:00] the moment. They are mainly use by our client only and we actually had some partners before they require some access to our internal data so which we could actually easily support. So, the processing data we had their stored and mostly it's in the system where we had a different type of storage like, retention, rotation like a period compared like, depends on different kinds of data basically. Like, uh, for a different appliances. Let's say for microwave, so how many times its running in the last three days, this kind of thing. We have [Inaudible] that kind of data [Inaudible] all the time.
Sine: Mm-hmm.
Yayun Feng: But for our like, for your like real-time power graph. This kind of data we probably, uh, we mostly and also them, we don't store like for like the entire usage. We have them in a short period but we do have, uh, like, live graph going on. [00:05:00] So, yeah, basically if you want to access that's actually absolutely possible because we are.
Patrick: So, actually, do you have the entire historic data currently from when the Watty box was activated to now?
Yayun Feng: Uh, we, some of them.
Patrick: Yeah.
Yayun Feng: But not, because they are huge amounts of data.
Sine: Yeah.
Yayun Feng: And we don't, and they don't provide like, let's say if you want to see your yearly data,
Sine: Mm-hmm.
Yayun Feng: So, it's not worth to see every second, right?
Patrick: Totally.
Yayun Feng: So, like, um, we have a do have a lot higher frequencies,
Sine: Okay.
Yayun Feng: than seconds. So, from a year or from two years, we have aggregation

like, you have, uh, accumulated like, during these smalls you have this kind of,
Sine: Yeah, an average. Yeah.
Yayun Feng: Yeah, yeah. So like, if you looking into a day or two you can get very detailed like ten hours data. Like, you have the exactly what happening on the second.
Sine: Yeah.
Yayun Feng: Like even lower frequency, uh, like higher frequencies.
Patrick: But is this something that they can access already through the APIs?
Yayun Feng: Uh, yeah. But it's, uh, it's,
Patrick: It's limited.
Yayun Feng: Yeah. Its, I mean, [that's] a very sensitive thing. We have, uh, we have [00:06:00] very, uh, like a serious thinking about security for the users because that's very sensitive to open to all of the users. Yeah, basically, that's limited. Now is based on,
Patrick: What should be, um, do you think it's possible then to maybe to push some of this through the app so that's instead of showing them the entire graph, but just showing them some aggregate scores. So, if they're asking being able to access whatever data is in there, but so it's figured through the app. So, its showing what's my usage for the past month, year, date or is this actually there already?
Yayun Feng: Yeah, that's actually in progress already.
Patrick: Okay.
Yayun Feng: So, it's almost there. Just not out to the App yet. So, this kind of data, uh, we would consider it see, like, its private data, but is your data. So,
Patrick: Yeah.
Yayun Feng: you have access to your home as you can access to all,
Patrick: Yeah.
Yayun Feng: data you have basically.
Patrick: Yeah.
Yayun Feng: Not other people's.
Patrick: No, no, no. Yeah, yeah, yeah.
Yayun Feng: So, that's already in [00:07:00] the pipeline, so.
Patrick: Okay, good. Because I know we've been talking with [Inaudible] Oskar, who we'd talked with earlier as well. Being able to show even at some point maybe per appliance.
Yayun Feng: That's actually,
Patrick: Like, how much power you used on your fridge for the past month or?,
Yayun Feng: That's already, I mean, that's not the [Inaudible]. We have for ready having such data as long as our app is working. So, we actually have likes the homes total energy already aggregated and is already shown. Uh, and we are actually, would, it's just this week and next week we are working on per appliances. So, basically our algorithm identify your microwave from, for last like, 20 times. So, we can aggregate to how much energy is used. Like they are already, also available and these are data are not having the less time it How should I say this? There is actually a retention period. So, it's not always there because they don't require higher resolution storage.

So, basically,
Patrick: No, no, no.
Yayun Feng: They don't run on your, [00:08:00] macro is like, thousand times per day. So basically, we are able to store all the historic thing for this kind of data, so.
Patrick: Okay.
Yayun Feng: Now, we do have such thing already, so.
Patrick: That's pretty cool.
Sine: That's very good. Yeah.
Patrick: Um, I'm trying to look through some questions here. So, you, um, you talk about a bit or I'm guessing you're part of what's being like, the data that's being tracked and monitored and other stuff like that. Is there a better way to do it as the thing you're doing currently, or is there a way maybe to optimize this going forward or?
Yayun Feng: Yeah, they're like, I will say they're probably a hundred places you can improve. We are a startup company, what matters most is getting something out quickly. So, basically, what we are doing during last year is just want to show something is really working, and we have the capability to do things. So, we do like, [00:09:00] do the heavy algorithms in the cloud which is quite high from the cost-wise is quite heavy. So, 'cause we run lots of algorithms on the fly. So where, where we can iterate in doing some more improvements We might like, not like waste our computing powers basically. But now we don't, uh, we don't, we are not focusing on improving this site at the moment, but we are doing step-by-step thing. So, but from the like, algorithm wise, we can also improve it with higher frequency like, it when they have, when we have better cloud basically in the industry. We are limited by the computing powers
Patrick: Yeah.
Sine: Okay.
Yayun Feng: So, like so, um,
Sine: Because of the cost right?
Yayun Feng: Yeah, Yeah. So,
Sine: Have it on cloud because that's,
Yayun Feng: Yeah, yeah.
Sine: Because of these costly solutions.
Yayun Feng: Yeah, yeah. So, yeah. So, basically that's mainly about it.
Sine: Yeah.
Yayun Feng: And, um, so, we don't want [00:10:00] some delay. So you open your microwave, you start to use it, you won't see it. No, not like two minutes later, right? So, so that's like we are doing tradeoff like with current setup of the industry's cloud, how much computation we can do basically that's how,
Patrick: Not losing latency.
Yayun Feng: Yeah, that's like, a, uh, we are like, we can't afford like two seconds maybe is like it shows up, so it's like impressing. But if it shows up 26 Seconds later, no one's going to still say that. So, that's like, uh, yeah, that's kind of trade off we're doing. So, and also, lots of small places we, uh, so we are like, we're going to switch

focus to make some more efficient instead of more functional. So, our main focus last year obviously like, "Show this concept if this thing works." That's like a to top [00:11:00] one,

Commented [1]: I am not sure exactly what he say but maybe something for future aspirations

Sine: Yeah.
Yayun Feng: but, uh, we are, have already proof like this kind of thing works. So, we need to find the right like, position where we can get costs down, we have got to,
Sine: Okay.
Yayun Feng: everything like, like running sustainably.
Patrick: Yes.
Yayun Feng: Like, uh, not like, uh, losing money for everyday basically.
Patrick: No.
Sine: No.
Yayun Feng: That's how we want to target, to,
Sine: Mm-hmm.
Yayun Feng: Yeah.
Sine: So how, um, you've kind of touched upon it now; that you want a cloud service that's better than the industry is currently, but is that in how you [Crosstalk], of course.
speaker 3: Uh, we can't, can we sit in the room for you after the conference?
Patrick: Yeah, yeah. Sure.
Sine: Sure,
Speaker 4: We are ending everything maybe 10:30.
Speaker 5: If you need to grab something you could just come in now.
Sine: Yeah.
Patrick: Yeah, that's good, thanks. Um, so is that where you're seeing like, the future Watty going purely technical wise as well? Because we've talked with the Oskar based on like, where he sees, he see [00:12:00] the algorithm going. But is that where you also seeing that, yeah, this is because he's also mentioned that maybe some of the computing power should be, could be made part of the hardware, so you don't actually have to send it up. So, like actually has a more adequate, quicker also computing?
Yayun Feng: Yeah, that's the one like, part we are considering to improve and this, so the bigger part form our point of view, uh, I mean, I would say that platform site because our system as the moment's is different compared to whatever thing you see in the market because the box, they are running, they are sending data 24/7. So, basically, you have a constant load all the time.
Patrick: Yeah.
Yayun Feng: So, and which none of the cloud providers can provide you like, constant computing. So, basically, that's, uh, we are actually targeting like, streaming platform, where it might be wrap by, like wrapped by some open source project or it might wrote [00:13:00] entirely by ourselves because they have, we have enough, enough experiences already to understand the problem because like a different time, over the day, you have different like a, like lots,
Patrick: Yeah.

Yayun Feng: You're going back, you're going back after work, you have lots of things happening.
Sine: Mm-hmm.
Yayun Feng: We need small power. So, basically, the automatically scaling the platform basically.
Patrick: Yeah.
Yayun Feng: So everything, uh, like we want to move things to the place where it can run things faster and make the overall date instances. They are like, capable to handle what's they have now. So, these things, not yet,[e-market] it yet. Basically, we need to improve the site in order to making sure even when we have a lot more loads than [Inaudible], we can still handled it within, uh, you don't want to end up [where] you have 202 workers like, say, Linux note like it won't [Inaudible].
Patrick: Yeah.
[00:14:00] **Yayun Feng:** And then 20 of them are super busy and the other are, the 180 are not busy, so you'll lose your performance basically. And we want to make like good algorithm from our side as well to better distribute. Basically, that's what our like, I would say, main target at the moment, trying to.
Sine: Because you talk a little bit about, um, that this is [Inaudible] is or the algorithm is different than any other in the market right? Could you just talk a little bit more about what is unique about your algorithms,
Yayun Feng: Yeah.
Sine: technology you have? What is so great about it, and what motivates you to continue working on it?
Yayun Feng: Uh, so from the models prospective, I think it'll probably also talk with them. So, what we have done before is we have done many years in this industry to like focus on energy data in the in the household. So, where it matters most in the following years in an our [00:15:00] like date or whatever industry is actually our data.
Sine: Mm-hmm.
Yayun Feng: So, what you have unique is our data. So, we have a unique data sets where we have lots of like, to innovate, we can do things that [Inaudible]. Like, you can't like a let's say electronics. I don't know what they are doing now. Are they producing microwave? They don't know microwave, how memory works actually from the geek side. Probably now, they are doing something but they don't know all the other,
Sine: No.
Yayun Feng: like, products. Uh, we do say we have good enough model. We know likes 99% of the microwave, how it works. So, that's based on our [Inaudible]. Like, doing data collection for like three more years. So, do we go to every household to do this kind of thing? That's, just like why Google is doing so good in translation because it gets lots of requests from other people. So, in this market we have the best data I would say. So, like that's, like the number one requirement by doing this kind of thing. Basically, we have [00:16:00] this and also we may understand the program because we are running this kind of, I mean, if you look at the market like [Inaudible]

products they are most server heavy, moves so slowly to make their platform.
Sine: Mm-hmm.
Yayun Feng: They don't know how it works. But we do actually experiencing a lot by trying to tune a good platform, which could handle this kind of problem. So, I don't think there is any similar company, as we see in Sweden doing this, or Europe doing this kind of thing is pretty challenging actually. I mean, that motivates you everyday to like, I mean, as the engineer or as a like, an algorithm.
Sine: To stay on top.
Yayun Feng: Yeah.
Sine: Stay there.
Yayun Feng: Yeah, you just, you have problem to solve and you don't have answer. That's like something back. I would say amazing but it's
Patrick: Um, [00:17:00] [Crosstalk in whispers]. We've covered some of the things here. So, um, just so we get this clarified because I've heard a few different numbers based on how often is it that the data is collected like, you're measuring per second but you're measuring what? The 2000 per second,
Speaker 4: It's 1000.
Yayun Feng: Yeah, they're like a different like frequency compared to different kind of data basically.
Patrick: Yeah because Oskar told us what, you have to regulate data.
Yayun Feng: Yeah.
Patrick: You have event-based.
Yayun Feng: Yeah.
Patrick: And are those on different, so event-based is only triggered whenever something turns on, right?
Yayun Feng: Yeah.
Patrick: So then the regular is every is that 10 kilohertz or something? But I'm guessing the 10 kilohertz is, uh, the event-start. It's actually right.
Yayun Feng: The streaming data we have.
Patrick: Yeah.
Yayun Feng: Like, uh, the date we call it 24/7 like, all the [00:18:00] time.
Patrick: Yeah.
Yayun Feng: Where it's called streaming, um, that is 10 hertz like basically 10 times per second.
Patrick: Yeah.
Yayun Feng: It's sending all the time or over the day. and then, we have another kind of data where we show the graph with current usage, that at the moment is 4 hertz, like four times per second we're collecting, and the other the third type of data Oscar mentioned it, so we want to know something's happening like about the interesting part; that is actually, uh, we do collect 2,000 hertz at a certain amount of time, like, basically, if you want to predict microwave start. You only need two seconds or we actually collect 11. So, like during this period they're like we have from the hardware-wise, it has a possibility to collect them 700,000 hertz data.
Patrick: 700!

Yayun Feng: Yeah, 750,000 hertz. That's like 'cause the magic of the hardware. So, basically, it has an analog signal it has the [ability] [00:19:00] to handle that amount. So, what a limit us to Los Angeles, that higher resolution, it's because of computing power. That's what basically the, I mean, you'll see the amount of data.
Patrick: Yeah.
Yayun Feng: Then, you'll see this is only the second, it's only appliance and a home. So, you want to scale things up, you can't like what you are saying in the Autonomous driving industry. They actually have already the technology in place. It's just a matter of how powerful their computer need to be they can build a car with like two three million dollars. With lots of expensive chips inside they have possibility crack things. So we can't do this kind of like 700,000 physical data, so we actually down-sample to 2000 and we know when something is happening. At a moment I, because I am not working on this algorithm side, I know some of the appliances they are using like 100 hertz data. So. like 100 [00:20:00] points per second in order to identify if this is something happening. Yeah, I like, so if we have higher resolution, we going to know more basically. So, you going to know when your like, let's say, your phone charger is on, this kind of thing it requires more data. So, the limitation has a moment it's smaller in our side, engineering side basically or, I think most of the problem in the market for like a machine learning or data science they actually, engineering challenges is quite heavy. It's not like, you figure out the algorithm, you figured out everything. No, that's not the case actually. 'Cause you need to you can't, um, I mean, you can't run a home based on like $10,000 per month cost. Just to know "Okay, this is like, a Mac charger. Whatever, these kind of small things." So, yeah, that's how it is. That's why you hearing so many frequencies. So, basically, uh, after we're limited [00:21:00] by the like, hardware.
Sine: Mm-hmm.
Yayun Feng: We are having basically the, I mean, this is pretty clear actually, so. We have different frequency when it's to talk with different purpose, yeah.
Speaker 4: That's pretty cool.
Speaker 5: Yeah.
Patrick: Um, you talked to Gustav once, um, it was like, I think it was a few weeks ago. He was showing us the app, he also mention something about there's there's a certain limit on when you can actually detect an appliance is that correct? Do you know anything about that?
Yayun Feng: Uh, can I?
Patrick: Yeah. So, he said that because, um, the appliance need to use a certain amount of power or voltage, I'm not sure.
Yayun Feng: Yeah, yeah.
Patrick: Before the app or the sensors are able to detect this. You might be able to see that there's an increase in the base power, but it's not necessarily to come up as a fingerprint or anything because,
Sine: It's so small right?
Patrick: Yeah.
Sine: Yeah.

Patrick: The thing is you can, I, Gustav mentioned that you could [00:22:00] reduce the sensor like, the limit but then, the problem is you get too much noise in or something like that.
Yayun Feng: Yeah, yeah, yeah. So, that's actually exactly the same main thing mentioned before because of our compute power. Uh, so, let's say we send 100 hertz data, so like, 100 per second, so we can't differentiate. "This is an LED light or is it a like a Mac charger?"
Sine: Okay.
Yayun Feng: Because this requires higher resolution in order to understand things happening. So, like with our current frequency we have, we can only have like some big appliances, uh, it's like a round 25 to 70 watt. You can't use an LED light, basically. If you do have let's say like hair straightener, whatever, they are taking more like, power usage; so you can't easily differentiate them. So, basically, is all, no matter of frequency we are sending. So, we start, let's say [00:23:00] you want to say, if you open your LED light when you go home you say the power [Inaudible] use like, increased by 10 volt that can not going to be detected by, as an appliance at the moment. From the like, technology point of veiw, is possible. It's just like, uh, you can't make something, uh, Insecure lapsing where it can't scaled to other users.
Patrick: Mm-hmm.
Yayun Feng: So that's like why it limit us. So, basically, what we are building here, what's Gustav shows you is hopefully at every [Inaudible] basically, that's like what we want to do basically. You, we're not like, faking [Inaudible]. So. yeah. That's a [Inaudible]-wise we are still limited by the data we're sending.
Sine: Okay, just to make sure I misunderstood, you are limited by the computing power of the platform use, right? In the market,
Yayun Feng: Yeah.
Sine: Offered externally. You're
Yayun Feng: It's a matter of cost as well.
[00:24:00] **Sine:** Okay. It's a matter of cost, if you were able to pay for it, you could do this, right? Or you could,
Yayun Feng: Uh, base on current, uh, yeah, I would say yes. But we're limited by, as I mentioned, you can't run a home with $10,000 per month cost.
Sine: No.
Yayun Feng: Basically, you can't scale things up without any like, thinking of cost basically.
Sine: Mm-hmm.
Yayun Feng: So, I wouldn't say there are no like, powerful enough machine, it just like, let's say, the 32 core CPU cloud image, It costs probably $500 per month and you where you can only run maybe 2-3 units in order to have such great experiences.
Sine: Okay.
Yayun Feng: That's like a, uh,
Sine: So your hardware, the Watty box is, has the potential to stream 700,
Yayun Feng: Yeah. So, Watty box has,
Sine: its good enough that way, right? But it's just not, um, efficient like in the way

that,
Patrick: The power that it needs to process the data that it's sending is not able to [00:25:00] do that.
Yayun Feng: Yeah, yeah.
Sine: Only for a few hardware.
Yayun Feng: Yeah, yeah.
Sine: Okay,
Yayun Feng: So,
Sine: just to make sure,
Yayun Feng: Yeah, yeah. So, basically, we want to make the hardware, we put the [Inaudible] like we might want to move some computing data.
Sine: Yeah.
Yayun Feng: So, we actually reserve some CPUs or memory whatever. But everything we sent back to our platform they are limited by the like, the market like, the clouds. And so, I wouldn't [inaudible] in, okay the cost-wise mainly.
Sine: Yeah.
Yayun Feng: So, if you have infinite money,
Patrick: So you can,
Yayun Feng: just scale up like many instance. That's like, no problem. That'a usually not how you do things in the company.
Sine: Yeah.
Yayun Feng: It's only in the lab.
Sine: Yeah.
Yayun Feng: So, before,
Sine: Are there some other instances would make the frequency better at, yeah, It would?
Yayun Feng: So, basically, we know it's gonna work. If we have a better like computing power at the lower [00:26:00] price. [Inaudible] 'cause, we had already proved to be the 700 hertz, we know lots of appliance already and with higher frequency we know both [Inaudible] can work as well.
Patrick: Yeah.
Yayun Feng: That's like, yeah.
Patrick: Um, so you get the data as raw data from as electrical like, output, right? Or,
Yayun Feng: We actually do run an [electric] software in the box as well, where we sampled data. We transformed from the signal, analog signal to the real like, power reading data. Where it can be easily understand by the software, so we actually actually, runs through an application on the box.
Patrick: Okay.
Yayun Feng: That's used to collecting power usage from the home that we sent back to our clouds. So, both sides [00:27:00] is our own like software.
Sine: Mm-hmm.
Patrick: Okay.
Yayun Feng: It's not like a we buy an industry hardware, it's sending something clear. It's not automatic, you need to do your like, own business.

Patrick: Yeah. So, the power gets into the box and from there, there's an application,
Yayun Feng: Yeah, yeah.
Patrick: That it's able to,
Yayun Feng: Yeah, do a logic.
Patrick: Yeah. And then, it convert that to data that's,
Yayun Feng: Yeah.
Patrick: Where you run the algorithm and all go through the [Inaudible].
Yayun Feng: Yes. So, yeah. There're a bit more things happening, but yeah, that's mainly the is a magic. Yes.
Patrick: Okay.
Sine: So, you would say that your internal that, your software, um, which is applied to the platform, and the way they int

erconnect is the magic?
Patrick: Well, actually through the,
Sine: Through the box.
Patrick: It's actually the Watty box.
Sine: Yeah.
Patrick: So, the power, it comes into the Watty box as I understand it.
Sine: Yeah.
Patrick: And then, from there, there's an application in the box that transform that into [00:28:00] data that is able to go through, up to the platform and through the algorithm and all that stuff.
Sine: Mm-hmm.
Yayun Feng: No, they are actually quite complex, uh, from we're running box. Somewhere we, 'cause we have a lots of different electrical components in box, they are responsible for reading the fuse box data. And then, we do our application likewise translation to our cloud knowledge data we sent back to us.
Patrick: Yes.
Yayun Feng: That's how it [Inaudible]. But we are basically doing all the steps by ourselves. So, basically, all the stuff like, including reading powerless and doing the things and also running all those, yeah. That's all like, uh, our challenge still basically.
Patrick: Yeah, of course. Um,
Yayun Feng: I would say that's pretty unique as well. You say that the date you collect [00:29:00] is very unique. But this is also, that you are actually in charge of all the steps as you say.
Yayun Feng: Yeah. So, we actually we have some competitors, compared, uh, when it comes to the box.
Sine: Okay.
Yayun Feng: So I don't think like, we are doing different things. We are basically, doing the same things; collecting power data and
Sine: Okay.
Yayun Feng: sending back. Yeah, that's, uh, there're a couple of companies also doing this kind of box [Inaudible] to things. [States] company so, is, uh,

Patrick: Basically, this is more in the algorithm.
Yayun Feng: Yeah, yeah. So, basically building the hardware is a small industry nothing like, if you have enough sourcing power, enough experiences of building stable enough software like this kind of thing. Yeah, but [Inaudible] all of them is build by us but I think they are also some company doing that. And [00:30:00] they are, they actually just electrical meter, if you compare to the next current stuff. Is just we run at advance algorithms and meter. Your meter probably read power like, in a very low frequency.
Sine: Yeah,
Yayun Feng: it's just want to know how much money you need to pay. So,
Sine: Yeah.
Yayun Feng: like,
Sine: the smart meter.
Yayun Feng: Yeah, yeah. Now we are between very high frequency reading. And we want to know what's happening
Sine: Yeah.
Yayun Feng: that's the difference.
Sine: So, that's where you think you distinguish yourself, uh, compared to your competitors is that you have higher frequency, right?
Yayun Feng: Yeah, yeah.
Sine: Yes.
Yayun Feng: Yes.
Sine: So, and not only the great companies, but also other startups or whatever.
Yayun Feng: Yeah,
Sine: Has this kind of hardware.
Yayun Feng: Also the utilities companies or the meter companies are working in a very low frequency.
Sine: Yeah.
Yayun Feng: It's like highest, 1 second. As far as if we understand. So, you know nothing during, in this 1 second frequency. Basically, when it come to the power [00:31:00] usage it's actually just a [sharp] it goes down or what do, you will not, you will not get the inside what's happening in your home.
Sine: You will only get the peak.
Yayun Feng: Yeah, yeah. How much money you need to pay.
Sine: Yeah.
Yayun Feng: If you aggregate like that frequency, you would get cost.
Sine: Mm-hmm.
Yayun Feng: That's, "Okay, you need to pay this amount for your bill." But you'll never know fridge take that percentage or microwave take that percentage. That requires higher frequency, you know, basically, that's,
Sine: What about other players in the market? "Cause you're talking about the utilities, but
Yayun Feng: Yeah, yeah.
Sine: Other startups or medium-sized companies that are doing this?

Yayun Feng: Yeah, we have some of them, but I'm not so good at the point, I think Gustav knows a lot more than me. From what I understand there's United States companies, they are doing pretty good.
Sine: Okay.
Patrick: Yeah, they are, he mentioned at least two.
Sine: Yes. [Crosstalk]. So, not in Sweden?
Yayun Feng: Um, they are not in Sweden, but if you'll coming towards Sweden I think we are pretty experienced in this, we have been running this business for a while, so.
[00:32:00] **Patrick:** Yeah.
Yayun Feng: For four years. We are collecting data for three years,
Sine: Mm-hmm.
Yayun Feng: With this product.
Patrick: Um, I've asked this question to [Inaudible], I think almost everybody else. I, even to you today, um, but it's pretty interesting because it's pretty unique product that you're sitting with, especially with the algorithm; when you process the data. And your operating in an industry that is very, very old and very [regulated] and hasn't changed a lot. Um, we're seeing that there's an introduction of smart meters coming in and there's definitely some change coming for the Energy companies, but do you think what he's doing now is like, more innovating on the energy sector? Or is actually going to maybe create disruption based on how they need to look at data, and [Inaudible] and or even how they actually measure it, and treat the data, or what do you think?
Yayun Feng: I think that most of the utility companies they already know they can't earn money by just providing user electricity. I mean, especially in the country like Sweden, [00:33:00] people,
Patrick: It's very cheap.
Yayun Feng: people don't really care how much you pay, but what you would provide on top of your data is features.
Patrick: Yeah.
Yayun Feng: Like, why would you pay, let's say 200 Krona per month. I don't know how much for this kind of electricity grid is probably nothing, but while we actually don't required that much money. You know, uh, we [seek] something valuable for the user if you're [Inaudible] or what kind of erecting electric fences, they are running in a very like, wrong way, so we can [Inaudible] and you might have some probably this kind of [Inaudible]. So, for me personally, I was always worrying if I do some laundry, when if it going to through my bathroom, or this he's kind of thing. Basically, we can provide a feature on top of data.
Patrick: Yeah.
Yayun Feng: Which is not available yet on any of the utility companies. [00:34:00] So you are they are definitely moving to this direction because if you can see your own bills, they're actually trying to show you something like you actually pay this amount this month. They want, they want to show something to you as well.
Patrick: They want to be able to break down

Yayun Feng: Yeah, yeah.
Patrick: It is not able to
Yayun Feng: Yeah, yeah. So, basically, as far as we understand from the market that's the right way to go for the electricity. I mean, so, I used to work in the telecom industry for a like, long while. So, consider how Talia works now they actually providing the pipe where can transform data between like, people. They are not earning money by like this kind of data transferring. They are earned by Google or by Facebook this kind of internet players.
Patrick: Yeah.
Yayun Feng: So, basically, electricity companies, there are in the same way compared to the people who build highways. So, basically, they are providing the like, the public services.
Patrick: Yeah.
Yayun Feng: They don't want to be [00:35:00] in that position. Like, I don't think people want to be in that position. Just providing the pipe for all the host service. They want to build some like, value on top of it was a half, so they actually do some. We do lots of partnership with their companies. They do not self prototype or study. Just because they are slow moving company. they do things slow like, the big companies.
Patrick: Yeah.
Yayun Feng: So, they don't care like, they lose a million they don't care. So, they just put money. They want to do something, but that's how it's now. If some big players coming into the this industry, where they can provide very nice thing compared to what you have before so, it's exactly the same thing why Ericsson and Nokia got such bad situations at the moment.
Patrick: Yeah.
Yayun Feng: Because of Skyping because of the Google [Inaudible] or Face Time. So, you see how Face Time impact the people using like, mobile; how many time to do send an SMS or [00:36:00] making a phone call.This kind of thing actually is similar, so everybody want to work with data instead of providing a basic service.
Sine: Yeah.
Yayun Feng: So, I don't believe this is the right way to go. It might be too early because what we can build is to last in order to attract everyone.
Patrick: Right.
Yayun Feng: Like [Inaudible] it doesn't matter of time or technology [Inaudible].
Patrick: So, our, um, our thesis will be kind of based on the assumption that what he has some sort of critical mass.
Yayun Feng: Yeah.
Patrick: The user base so that any potential and marketplace, which is like as you said, this is a kind of like using the data, actually providing a service through the data. On top of what you're actually getting and we expect that there has to be some sort of critical mass before this makes sense. But then, it is also providing some sort of an aspect based on the information that we know from like a fridge that's breaking down.

Yayun Feng: Yeah.
Patrick: Then, that would [00:37:00] notify somebody in Phillips or whoever that has like or like, a multiple vendors, if depending on that's what we're trying to figure out. How this should this look like but then they are able to contact or direct Market, um, the consumer who has issue or something.
Yayun Feng: Yeah, yeah. I think there're, as long as you figure out how to use those kind of data, there are lots of features you can build on top of it.
Patrick: Yeah.
Yayun Feng: Actually, the fundamental part is how you, uh, having the possibility to get to the millions homes to have such kind of data then you can try to think how we build is a product or the concept or whatever. So, like I think there if you do not bring some [Inaudible] session there are lots of ideas can come off have such possibilities like, notifying you this kind of thing has almost broken or your fridge is a [Inaudible] 300 watts than others like, they're using ninety customer. I'm living in new built Apartments my [00:38:00] appliances are [Inaudible] paid like 54 per month for my electric bill. I do the same thing as others because my appliances used less power they don't they do exactly the same thing. Actually, lots of appliances, especially, the older ones they do use lots of energy. So like [Inaudible] sort,
Patrick: Yeah. [Inaudible].
Yayun Feng: So, I think it doesn't matter how we can like, do this kind of thing right to the people. So, now basically, we are doing early-stage to the, our customers they are, many of them are very tech orientated. They are very interested in how could this kind of thing happen? Something someone even like, interest "Okay, I want to know how this works." So, basically, so, if we can prove we can provide like for ordinary people. That's like the time where we care this kind of data I think, yeah. [00:39:00] That's just from my opinion, every industry having this kind of moving like [Inaudible] like digital industry like, you would, everyone want to understand. Like that's why a lot of companies trying to do data scientists sensing, and the machine learning, or, ok, [Inaudible] specialty. Actually they have no experience before with what should build software, which they should do, but they still want to trying to be more involved in the movement.
Patrick: Yeah.
Yayun Feng: Who knows, this might be the future or actually they believe this is the future, they just move slow. I think that's something comfortable and so, yeah.
Patrick: Because actually we've heard that, I think it was your marketing communication Maral?
Yayun Feng: Yeah, Maral.
Patrick: Yeah. Um, she mentioned that this like she sees this as part of a smart house,
Yayun Feng: Yeah.
Patrick: But this definitely like application for within like, this being an IoT [00:40:00] product, right? You're connecting different things, um, you mentioned it now, so IoT, very buzzword, It's very big. And It is of course something that's going to, how do you see maybe what if becoming bigger part of the IoT landscape?
Yayun Feng: We, so, we actually did a thing something to being an IoT hub from the

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Watty box like, we want to be easily integrated with whatever we have in the like, lets in the factory, in your like warehouse.
Patrick: Yeah.
Yayun Feng: So it is so, but that's there's nothing in place yet. So, we don't really understand how these goin to like work either.
Sine: Mm-hmm.
Yayun Feng: But at least what we have now as a base infrastructure, our box is actually running the Linux, where [Inaudible] just laptop. So, basically, it's a whatever we have the [00:41:00] possibility in the market, you can easily write [Inaudible] because it's not like a specially-made like industry hardware you only be able to type something, to do something it has all the possibilities with the latest technology. Basically, if you want to build some features there it's just a matter of a quick, so we write some feature or we just try this also. We actually do this can see all the time. So, we want to show we do able to work together with let's say solar or whatever different kind of thing. So, we can connect it. We can read it that doesn't [Inaudible] or you can prove it work. So, basically, um, so every company wants to build their own housewares in order to be in the central place of like a smart home or like industrial IoT, this kind of thing. I think we are more flexible than the bigger like, others, but [00:42:00] on the other hand, we don't we, don't know how to do that basically I can, none of us has such experiences basically so. I wouldn't obviously we have the coding technology trying out [Inaudible]. So, what we are lacking maybe is just a good integration ideas. So which we also trying to talk with the different companies actually. So when it comes to this kind of problems they want to solve it's actually very easy to do in our point view. So we have already done a lot in this like,
Patrick: Remake Yeah.
Yayun Feng: Yeah, yeah.
Patrick: At least is very good as you say have a common technology that could be applied to other smart home technology. So you have, your not narrowing down too much, you can apply to other and cooperate has hardships, whatever.
Yayun Feng: Yeah, that's actually exactly what we are [00:43:00] trying to do now. So, our box has like nothing limited. It's just a laptop. It has 4 core CPU it has a 2 gigabytes memory; basically if you install it at your home you have a laptop there. So, that's also why is cost something. So what matters is us, what kind of software can we build.
Patrick: Yeah,
Yayun Feng: Yeah, that's,
Patrick: I know, that makes sense, but it's pretty cool because I as I mentioned to begin with one of the areas that we're looking at is like that should take technical capabilities of Watty based on like, how the algorithm work, how they even the hardware at the box, and seeing that you're even though you're not focused on it, but you're able to provide an IoT solution for the people that actually want to do it. Is what we're interested in because we're we're looking also at how the current energy industry looks like, um, because you can see there's a bigger focus with smart grids and IoT enablement. But its [00:44:00] still its so old and its so slow. So, we're trying

to see how Watty positions themselves towards that company and also then, from there on, how is it then we can make this data commercially viable? Um, so that's pretty cool that you're saying this with the IoT because I definitely see some nerds, uh, I'm not that much of a nerd, but there's some people that will be able to do that and hook that up to Google home and say hey Google is my oven still on and then like, "Bill, no. Apparently." Because they can use Watty or something.
Yayun Feng: Yeah. that's, uh,
Patrick: Simplification.
Yayun Feng: You know that idea just mentioned is already in a product in United States. So it's just our competitor in that sense. They actually integrated with Alexia from Amazon.
Patrick: Oh.
Yayun Feng: So, they've already done it. So, like they can read data from Sense. So, which the company muscle heard that from other guys from here because they are very serious competitors. Fuzzy. I could, see I'm doing, I wouldn't say [00:45:00] exactly the same thing, pretty same thing in addressing it aspect trying to understand how the energy is used in the home, basically. Because they already did a project with Amazon. I don't know how good is it but it was, they actually want to provide the thing you just mentioned. So, it's actually pretty cool. I mean someone already sought trying to make it happen and they,
Sine: Mm-hmm.
Patrick: But I like said well they might be a big competitor, but we just heard that what it, what was it, for the third time in a row, when the quality of data on energy for the third time. So, that's always something. Um, but yeah, but it seems like you have some pretty strong capabilities at least within the company which is pretty nice, which makes our thesis that much better. And do you have any more questions Ashley?
Sine: No,
Patrick: Um.
Sine: This is very informative. Thank you so much.
Patrick: Yeah, I don't think I have anything else. Um, I don't know if it's possible because we talked with Gustav about this, but is [00:46:00] it impossible to like get any screenshots maybe of how the platform looks like or how? We don't need to actually see what's going on. It just because our thesis supervisor really likes the visualizations and like, as part of the appendix. We can put when we're referring to it. Is there any like or is it just a lot of code on a screen or?
Sine: We were just thinking maybe this since you said that you said that you work in or
Patrick: I don't actually see that how it comes up and then, we can like, here might be something that we can see that. "Okay. This is where data comes up into the screen, and then"
Yayun Feng: I see what you mean. I can't decide sorry. I need to ask. Like, 'Cause I don't know how this kind of thing is [Inaudible].
Patrick: Oh. We are, we can blur any information out it's just so that we have an idea

of how it looks like. The actually information on there is, but yeah, we can take this with Gustav.
Sine: Then we can get to your.
Patrick: Yeah. I mean, if that's not a problem. I will be happy to provide something.
Sine: Yeah.
Yayun Feng: Uh, There are [00:47:00] some like, very like, picture already. I mean, you got nothing from the picture is just a clever idea of how it works.
Patrick: Yeah, yeah.
Sine: Yeah.
Yayun Feng: I can't like, I'm not sure how all this works because I, I'm not working on this kind of area.
Patrick: No, no. Of course.
Yayun Feng: So, maybe we wait,
Sine: Yeah.
Yayun Feng: uh, Gustav.
Patrick: Yeah.

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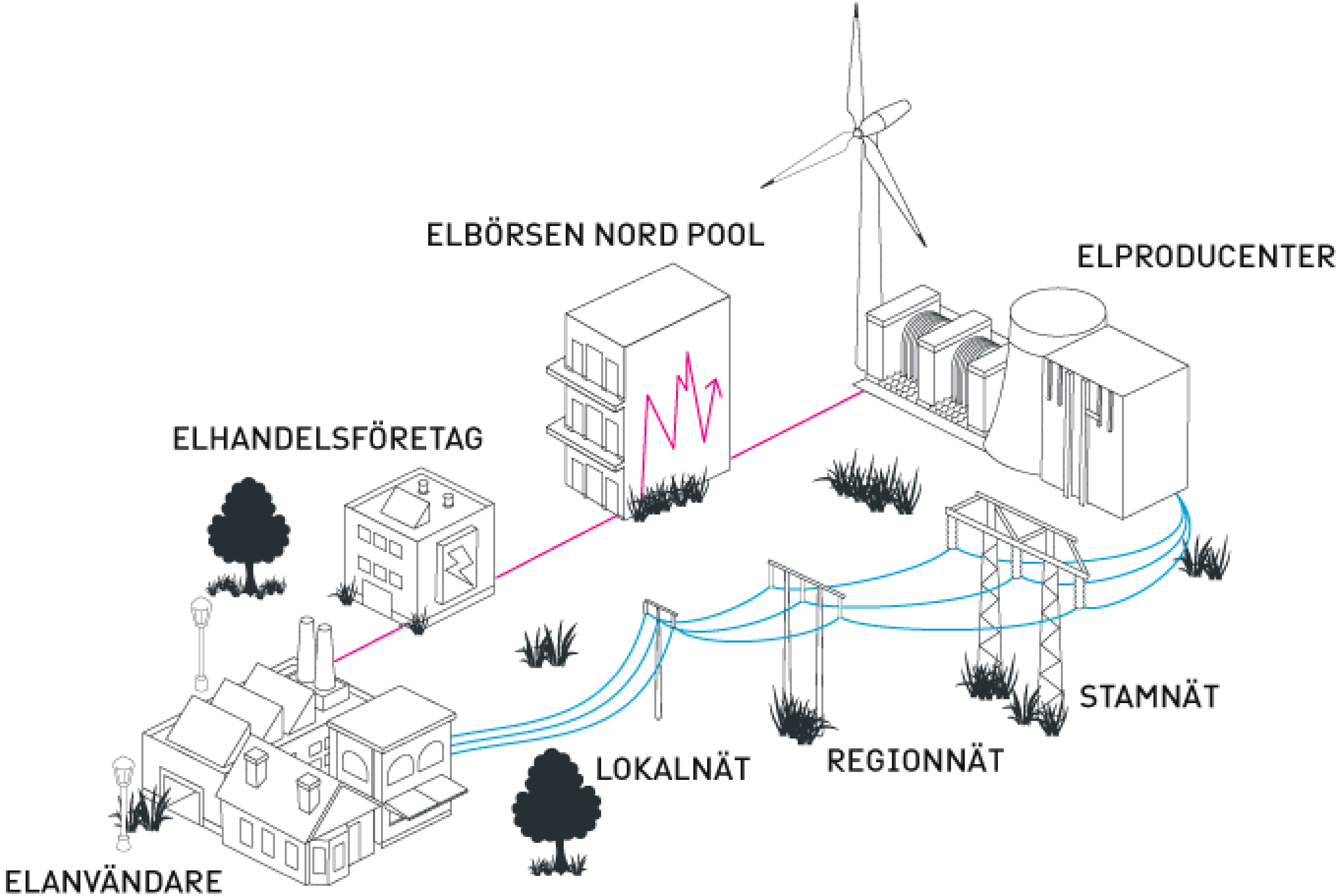
ENERGY INDUSTRY 101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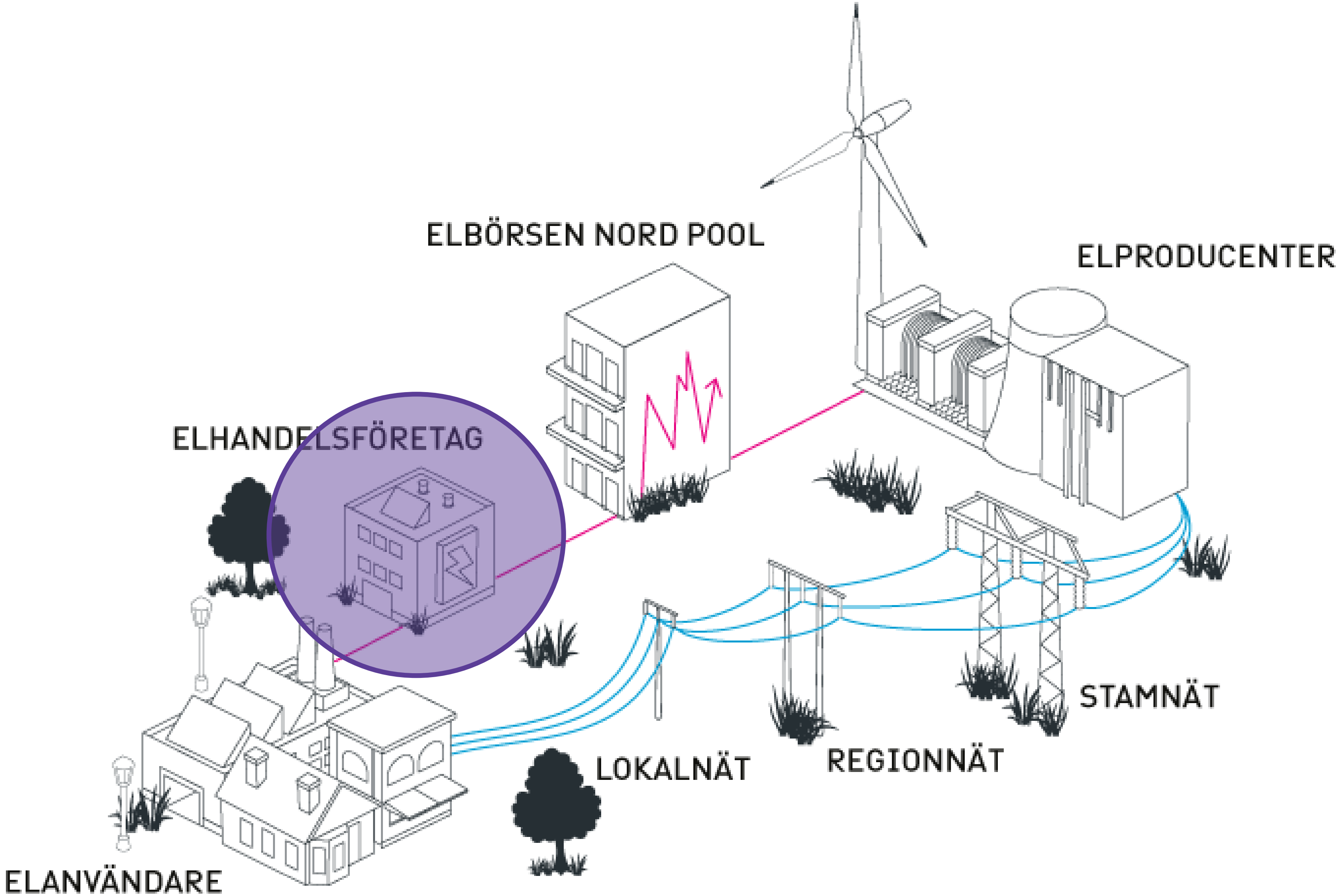
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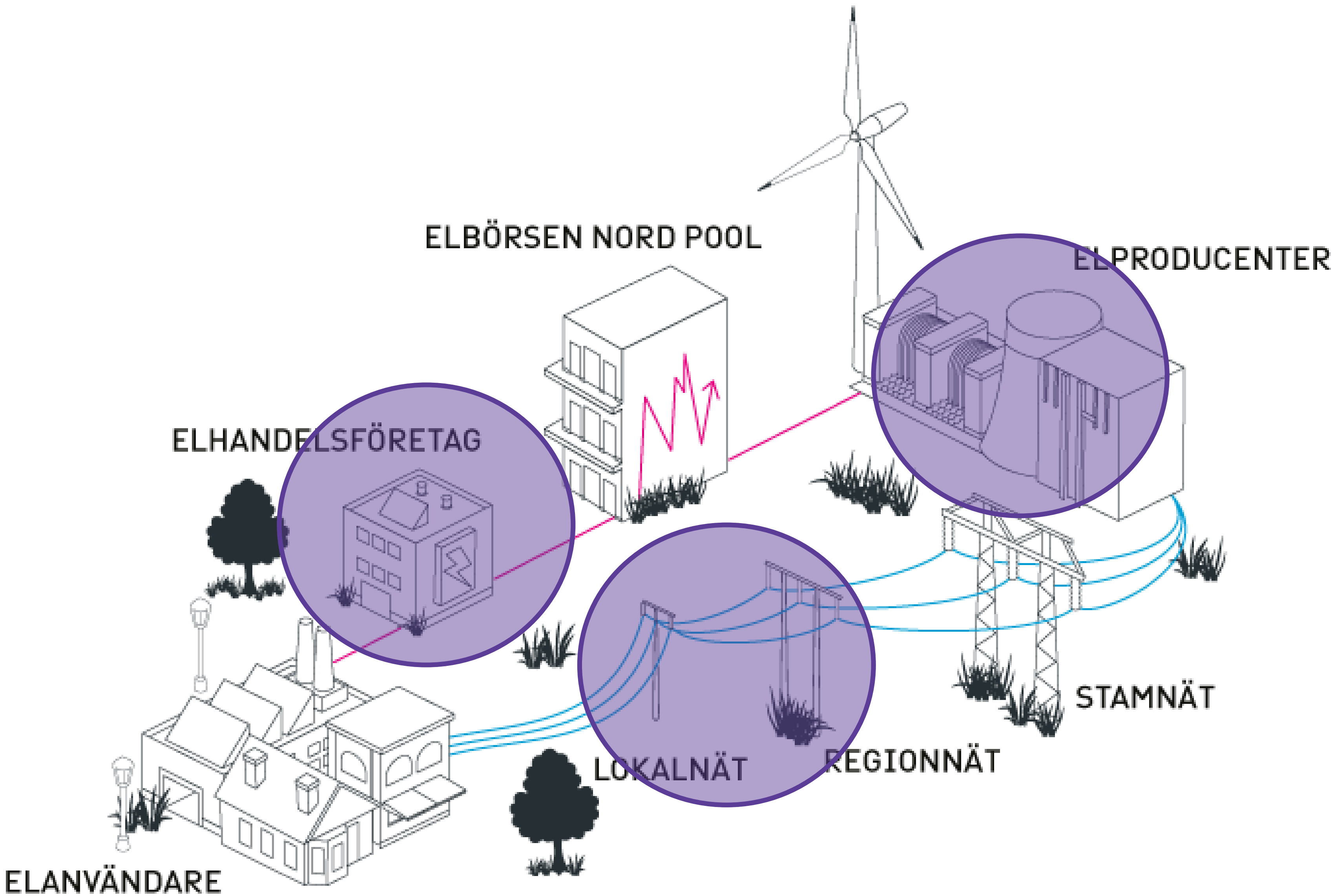

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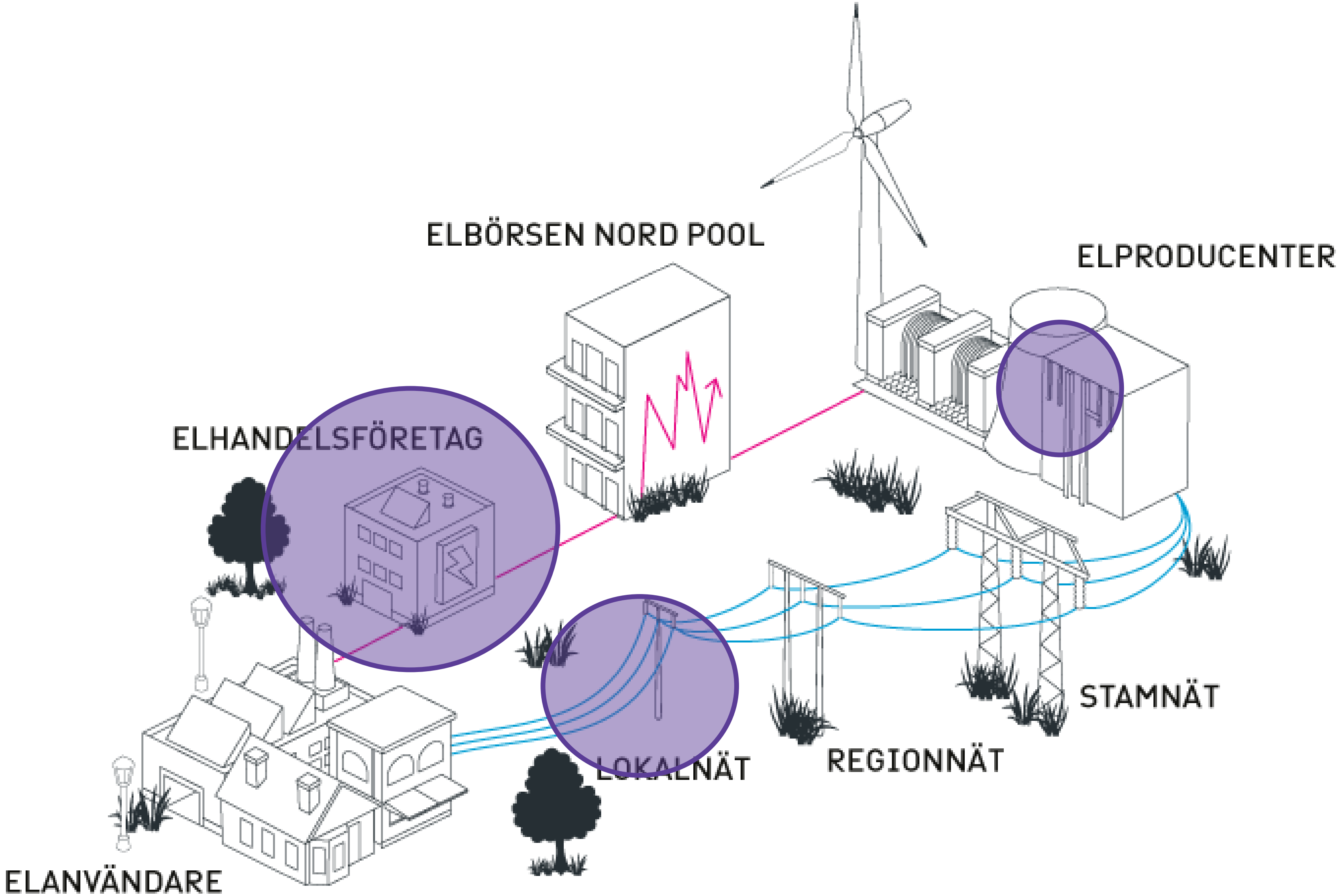
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STAMNÄT
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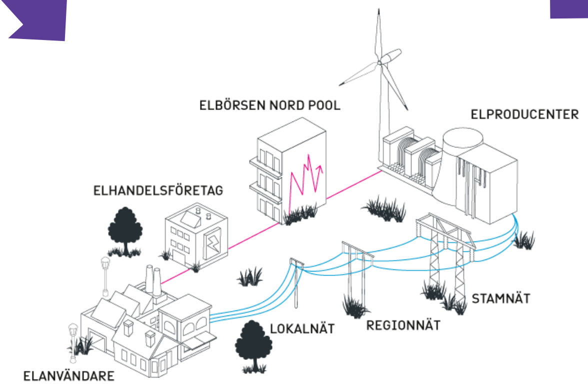
REGIONNÄT
ELANVÄNDARE

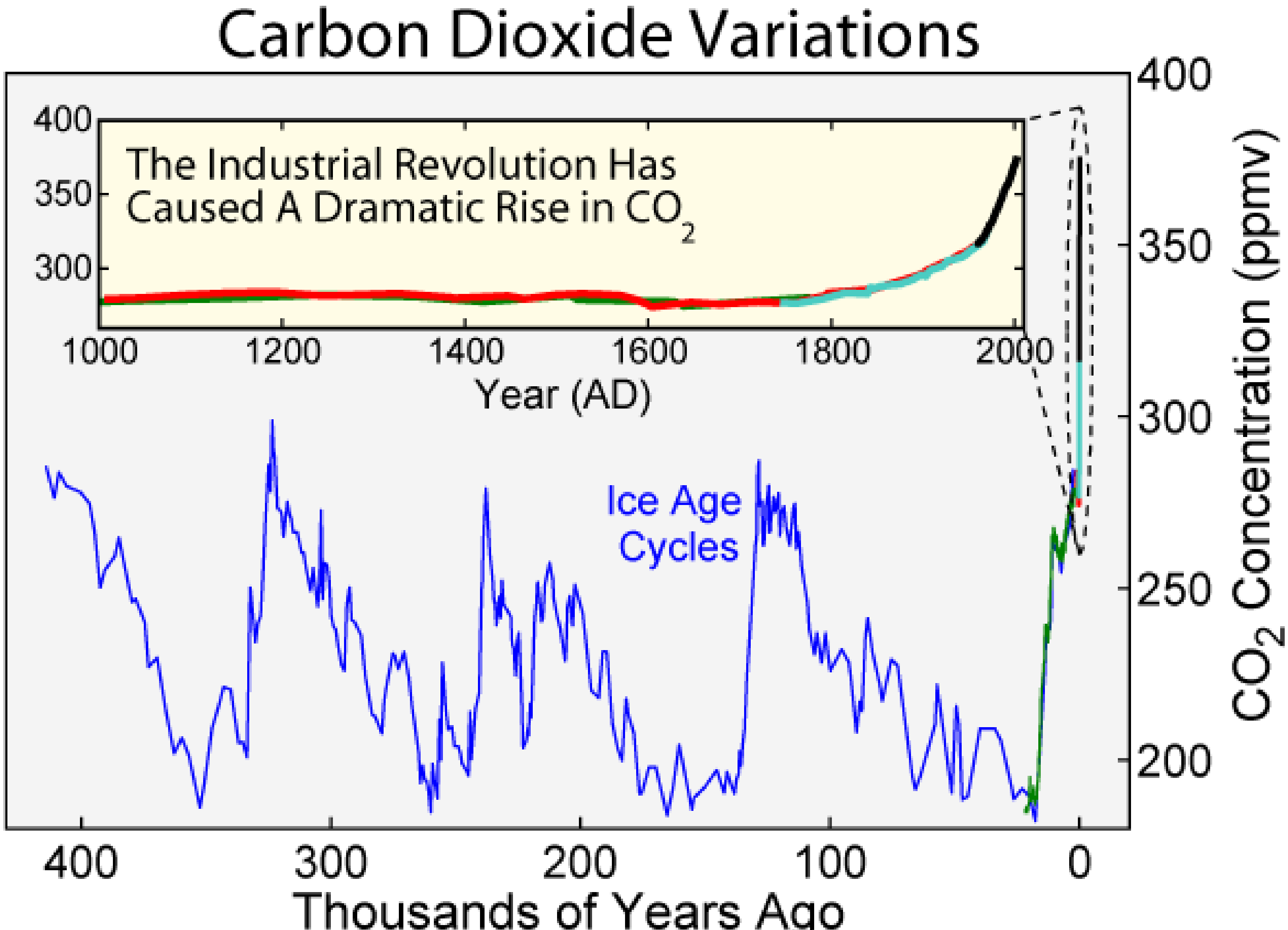
DECARBONIZATIO
N

DIGITIZATION



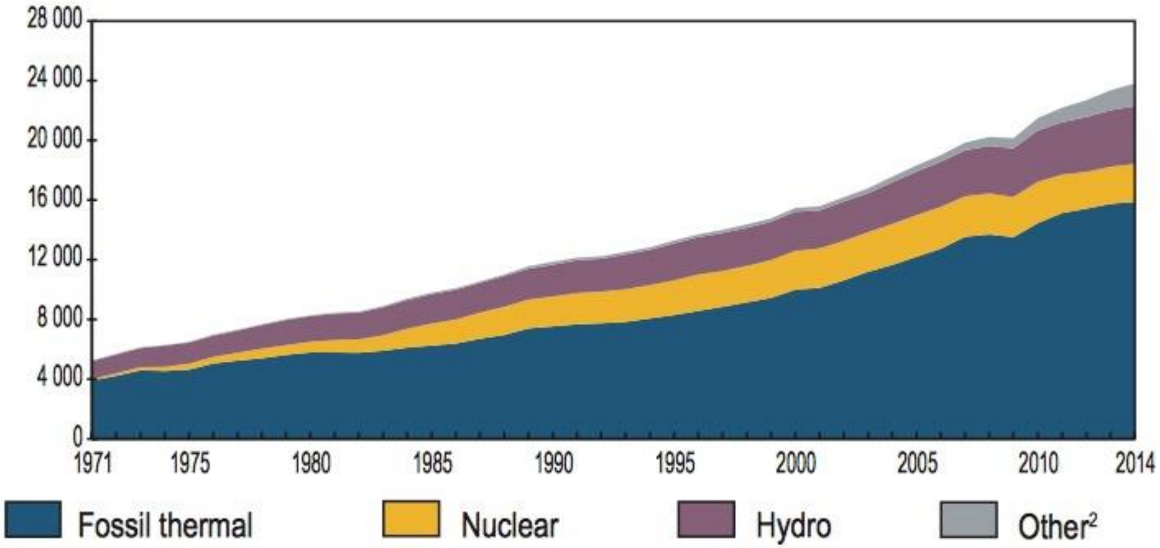
DECENTRALIZATI
ON

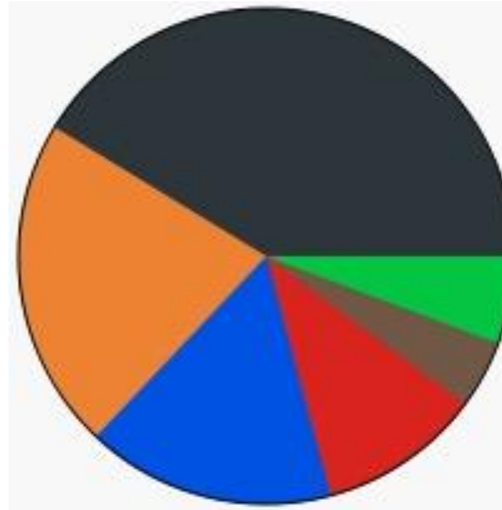
DECARBONIZATION



Carbon Dioxide Variations
The Industrial Revolution Has Caused A Dramatic Rise in CO_2
400
350
300
1000
1200
1400
1600
1800
2000
Year (AD)
Ice Age Cycles
400
350
300
250
200
CO_2 Concentration (ppmv)
400
300
200
100
0
Thousands of Years Ago

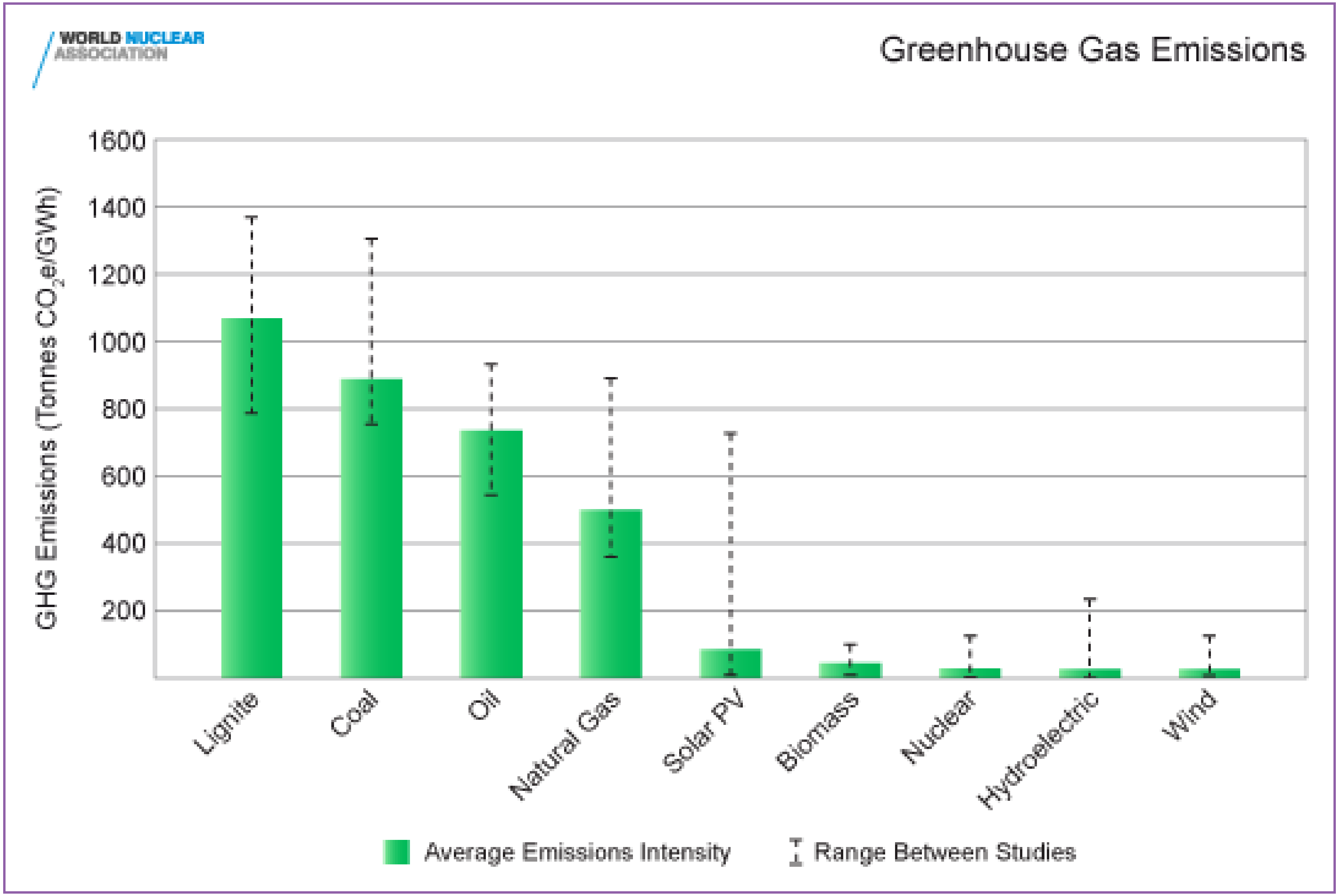
World electricity generation[1] from 1971 to 2014 by fuel (TWh)

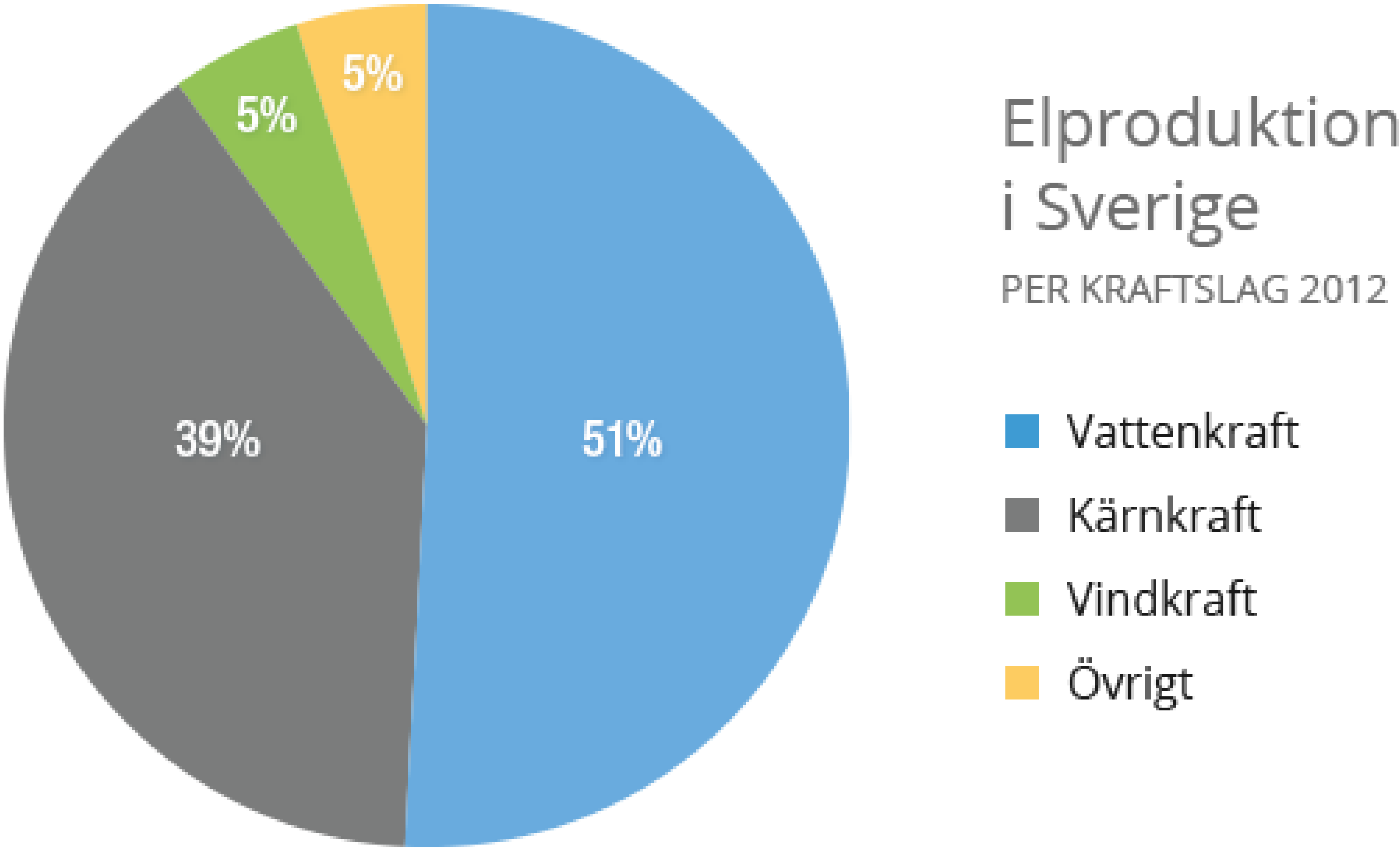


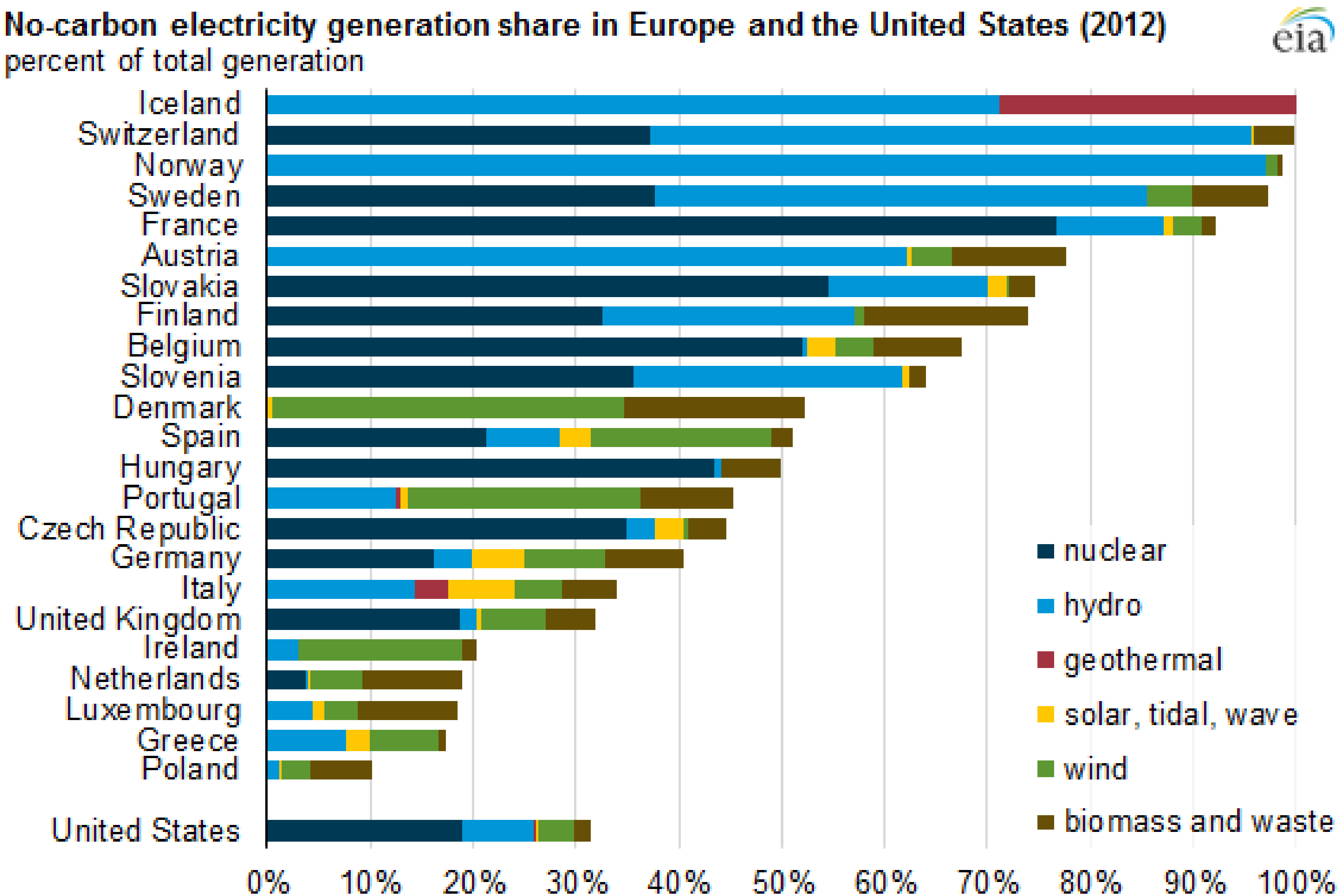


2013 World electricity generation (23 322 TWh) by source (IEA, 2015)[3]:24

- Coal/Peat (41.3%)
- Natural Gas (21.7%)
- Hydro (16.3%)
- Nuclear (10.6%)
- Oil (4.4%)
- Others (Renew.) (5.7%)

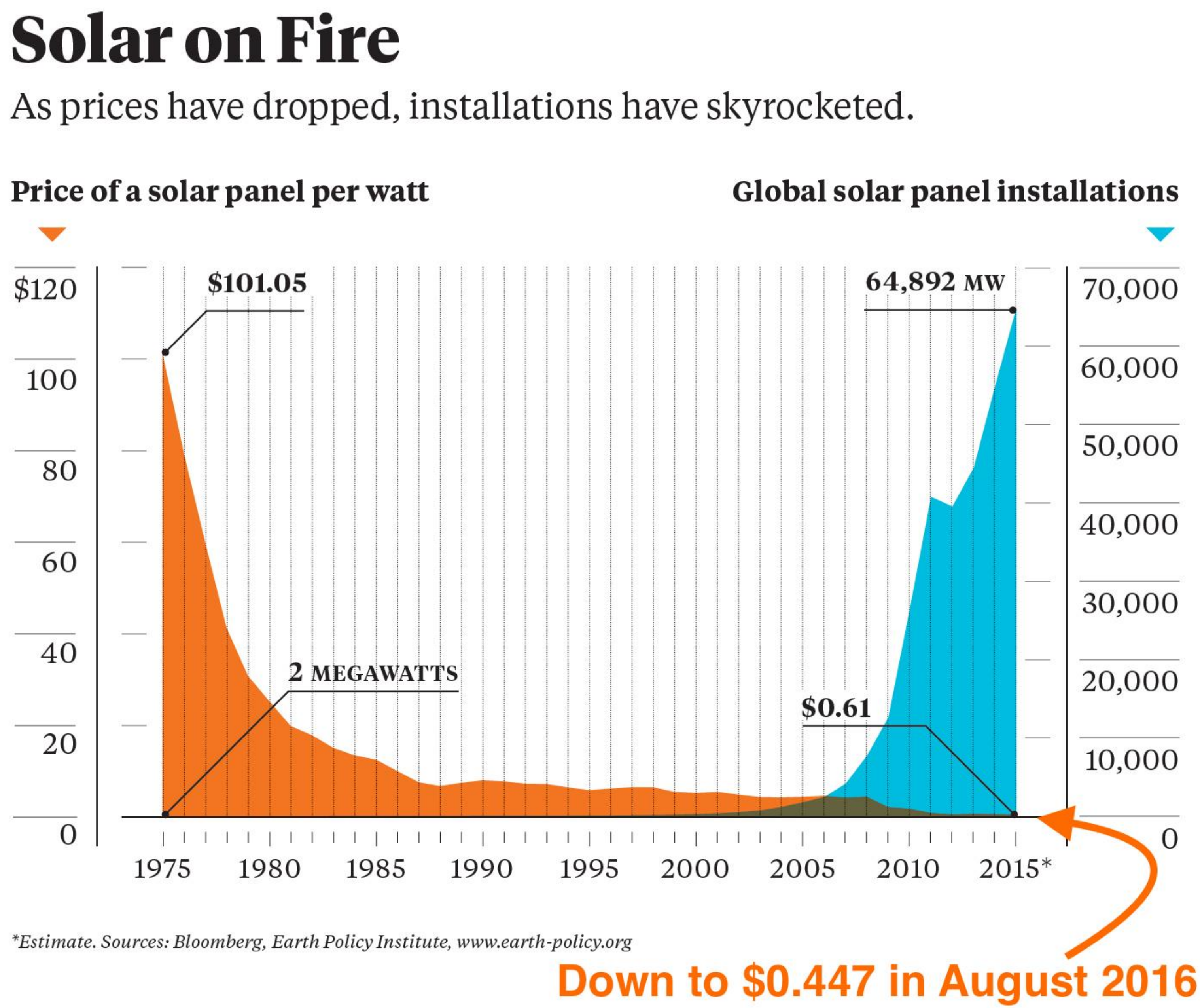

WORLD NUCLEAR ASSOCIATION
Greenhouse Gas Emissions
GHG Emissions (Tonnes CO_2e/GWh)
1600
1400
1200
1000
800
600
400
200
Lignite
Coal
Oil
Natural Gas
Solar PV
Biomass
Nuclear
Hydroelectric
Wind
Average Emissions Intensity
Range Between Studies


5%
5%
39%
51%
Elproduktion i Sverige
PER KRAFTSLAG 2012
Vattenkraft
Kärnkraft
Vindkraft
Övrigt


No-carbon electricity generation share in Europe and the United States (2012)
percent of total generation
eia
Iceland
Switzerland
Norway
Sweden
France
Austria
Slovakia
Finland
Belgium
Slovenia
Denmark
Spain
Hungary
Portugal
Czech Republic
Germany
Italy
United Kingdom
Ireland
Netherlands
Luxembourg
Greece
Poland
United States
nuclear
hydro
geothermal
solar, tidal, wave
wind
biomass and waste
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

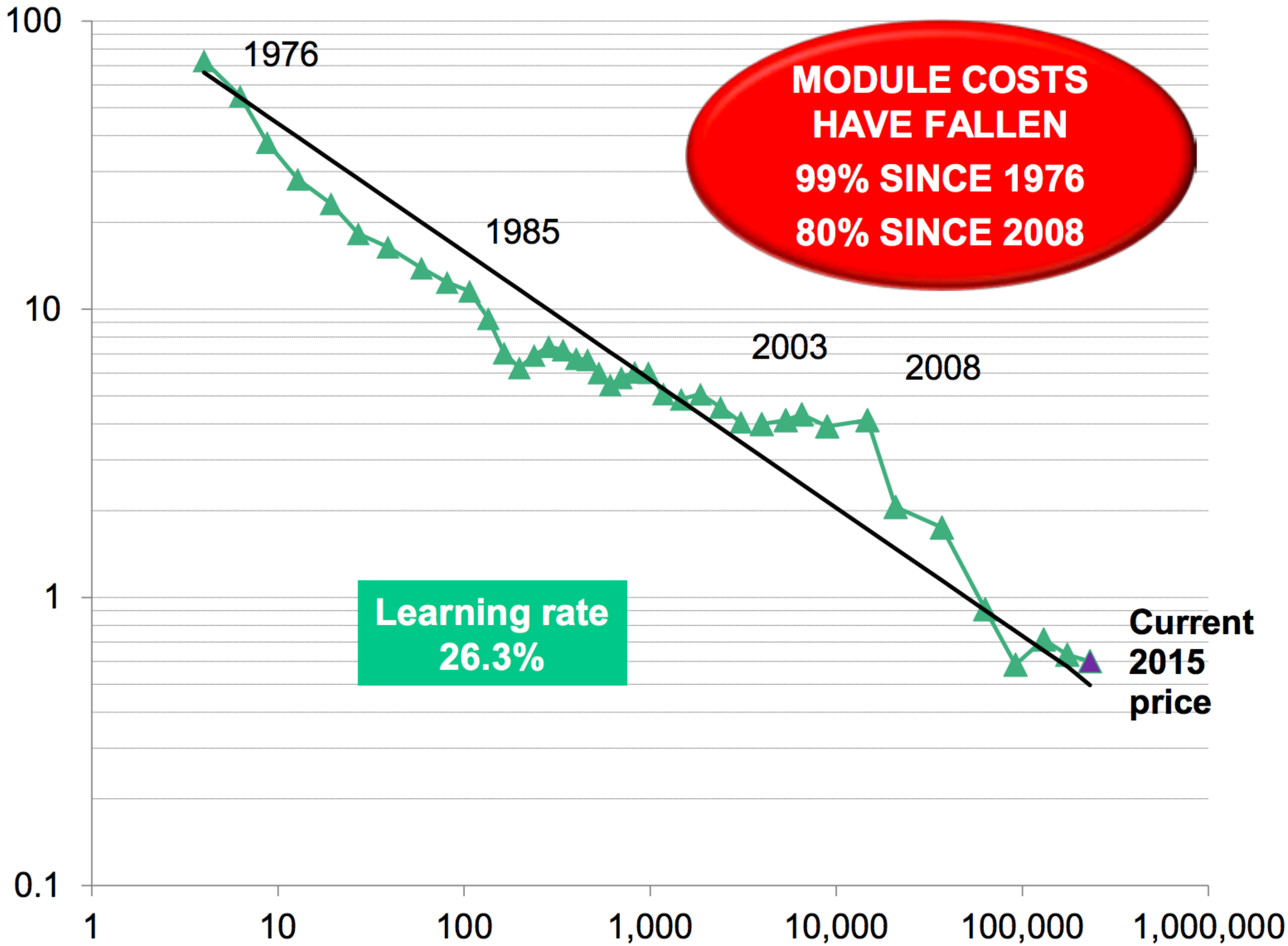
Total CO_2 emissions		People		Services per person		Energy per service		CO_2 per energy unit
CO_2	$=$	P	$\times$	S	$\times$	E	$\times$	C
↑		↑		↑		↑		↑
needs to be zero		going up		should go up		down some		key

DECENTRALIZATIO
N

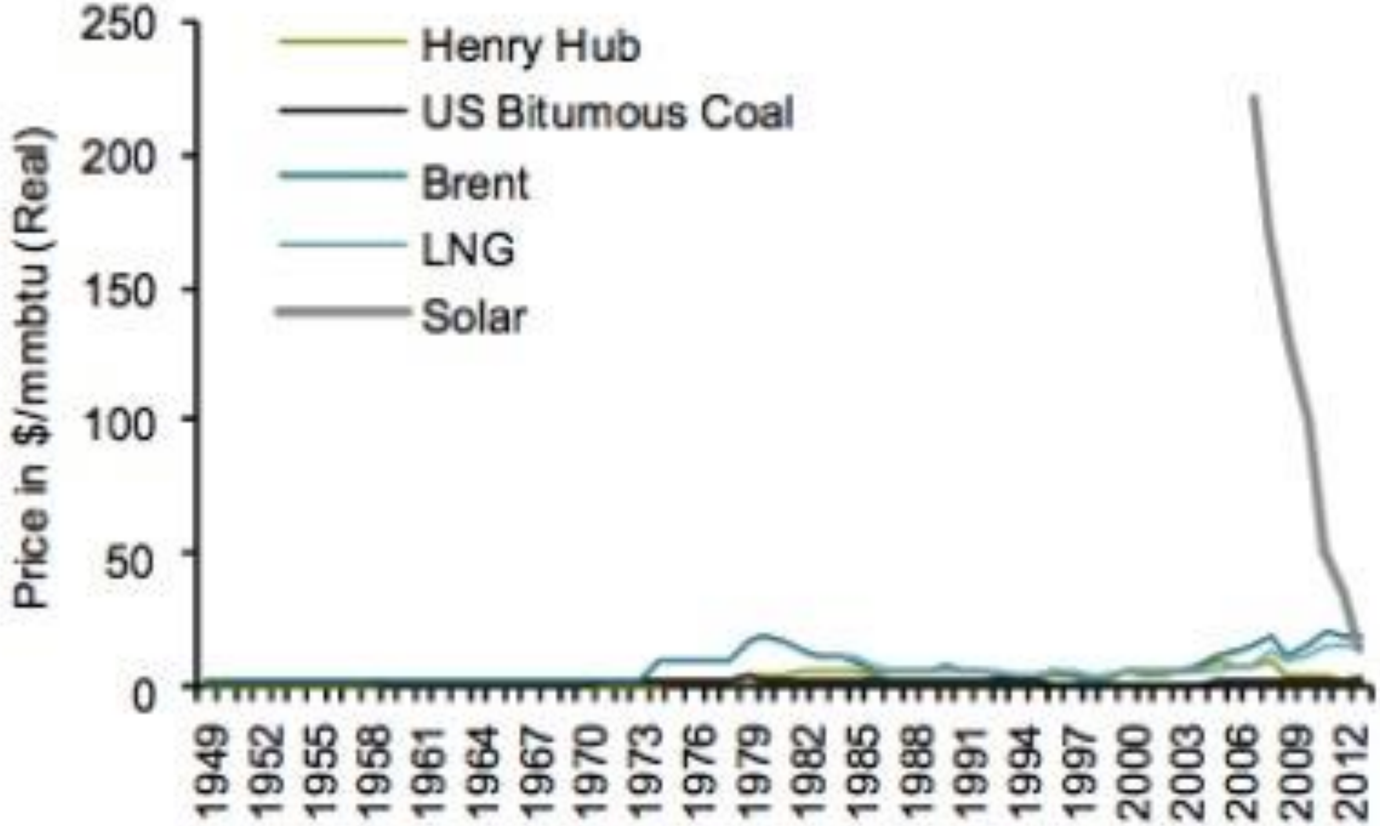

Solar on Fire
As prices have dropped, installations have skyrocketed.
Price of a solar panel per watt
Global solar panel installations
$120
100
80
60
40
20
0
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
$101.05
64,892 MW
2 MEGAWATTS
$0.61
1975
1980
1985
1990
1995
2000
2005
2010
2015*
*Estimate. Sources: Bloomberg, Earth Policy Institute, www.earth-policy.org
Down to $0.447 in August 2016

The Beautiful Math of Solar Power

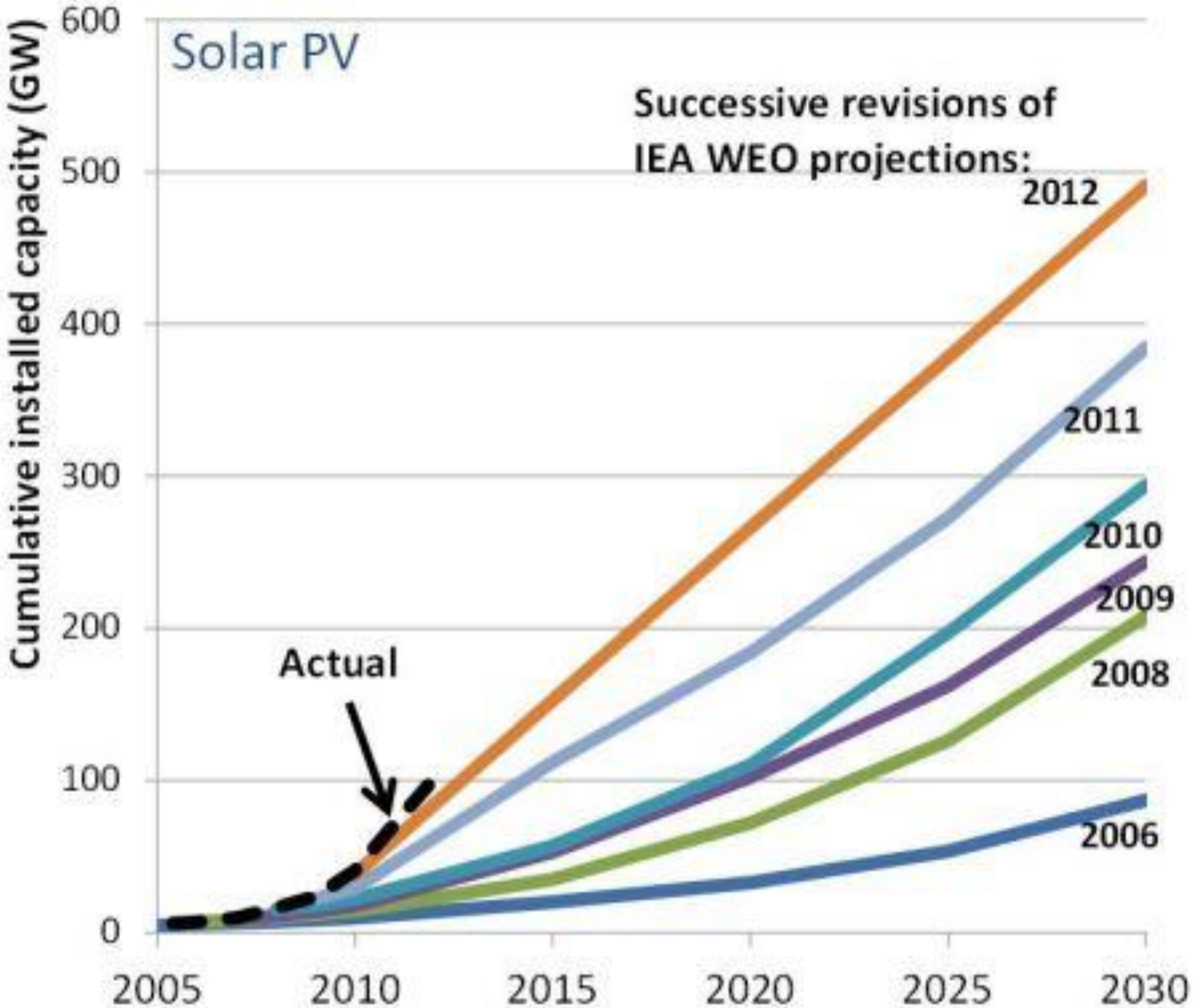
Every time the world's solar power doubles, the cost of panels falls 26%



Welcome to the Terrordome… $/MMBTU by Energy Type

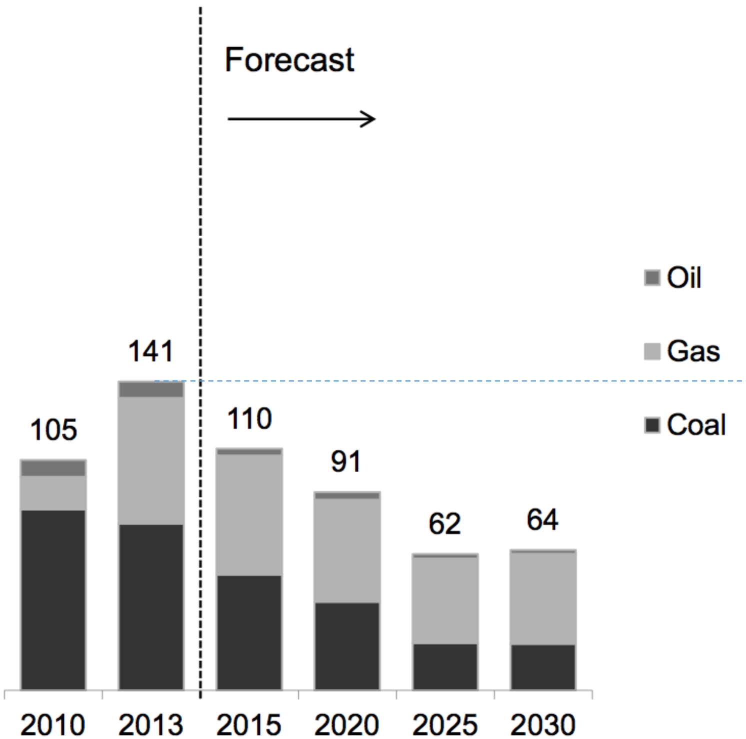


Source: EIA, CIA, World Bank, Bernstein analysis



Solar PV
Successive revisions of
IEA WEO projections:
2012
2011
2010
2009
2008
2006
Actual
Cumulative installed capacity (GW)
600
500
400
300
200
100
0
2005
2010
2015
2020
2025
2030

FOSSIL FUEL



CLEAN ENERGY

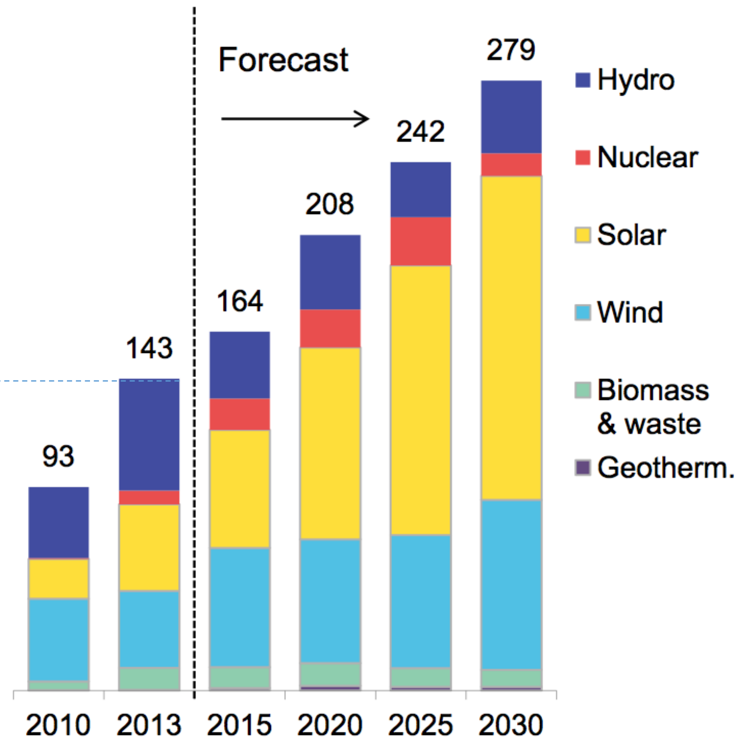
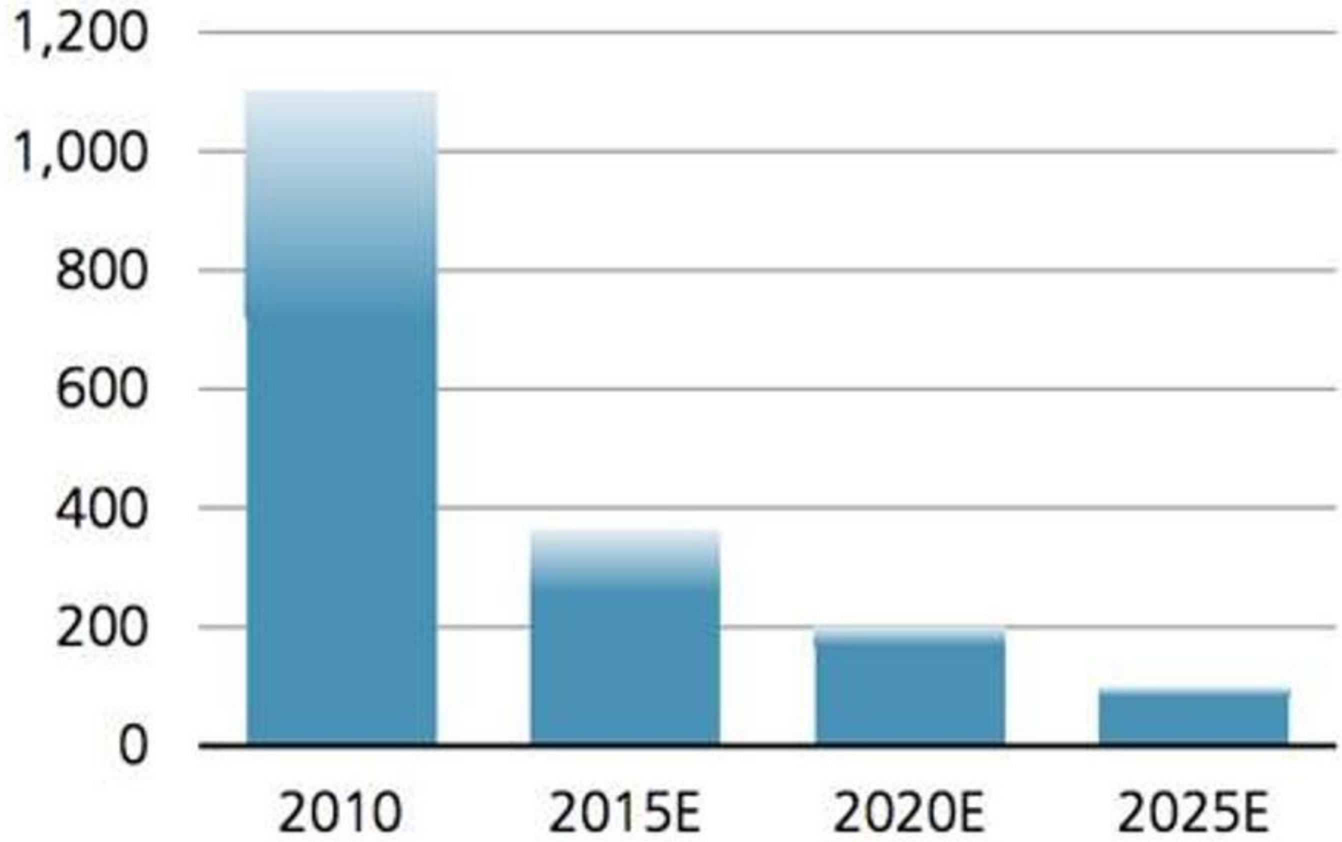


Figure 2: Lithium battery cost to decline >50% by 2020



Source: Tesla, Umicore, UBSe. Cost estimates are for the battery pack (€/kWh).

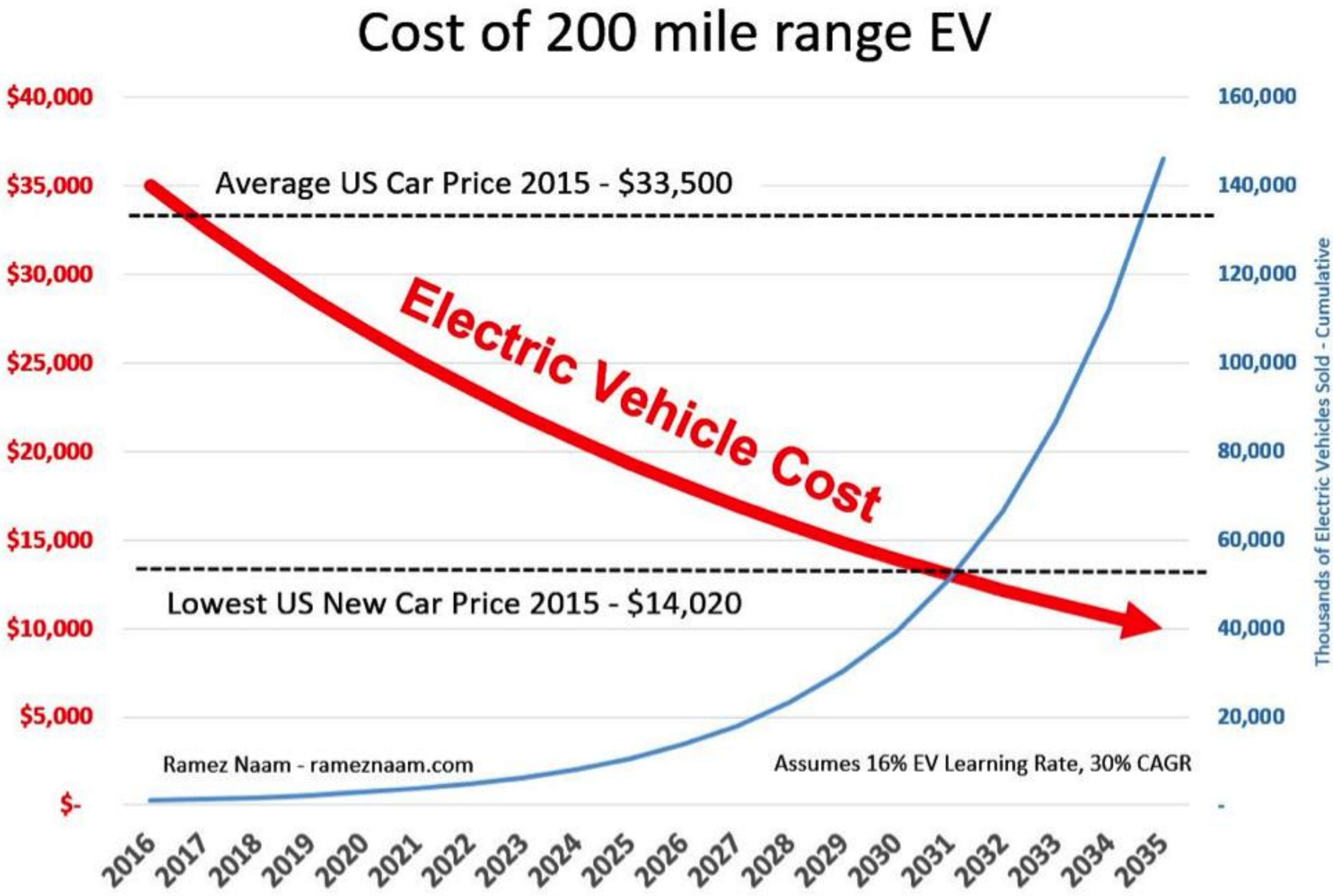

TESLA

Prices on electric cars will continue to drop until they're within reach of the average family.

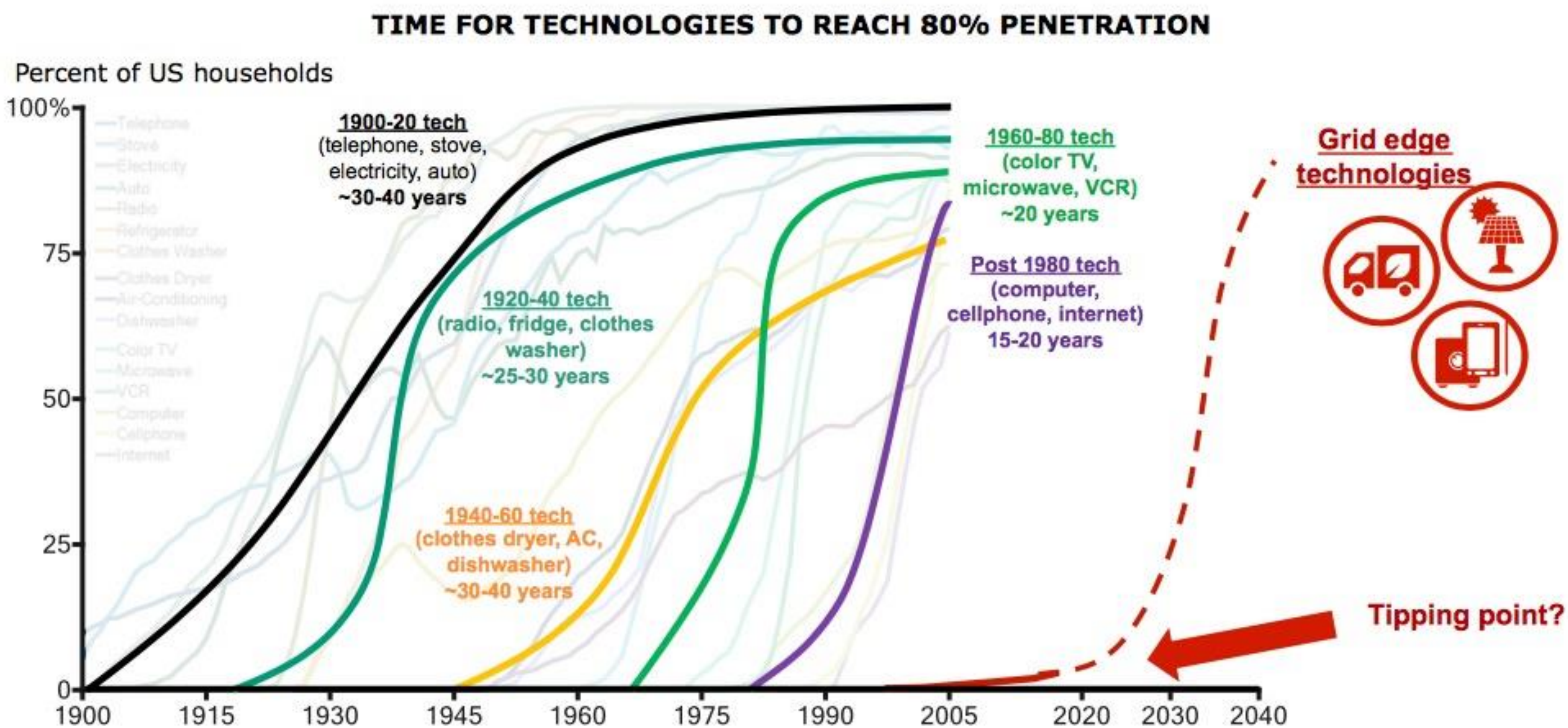
- The Washington Post

Prices on electric cars will continue to drop until they're within reach of the average family.

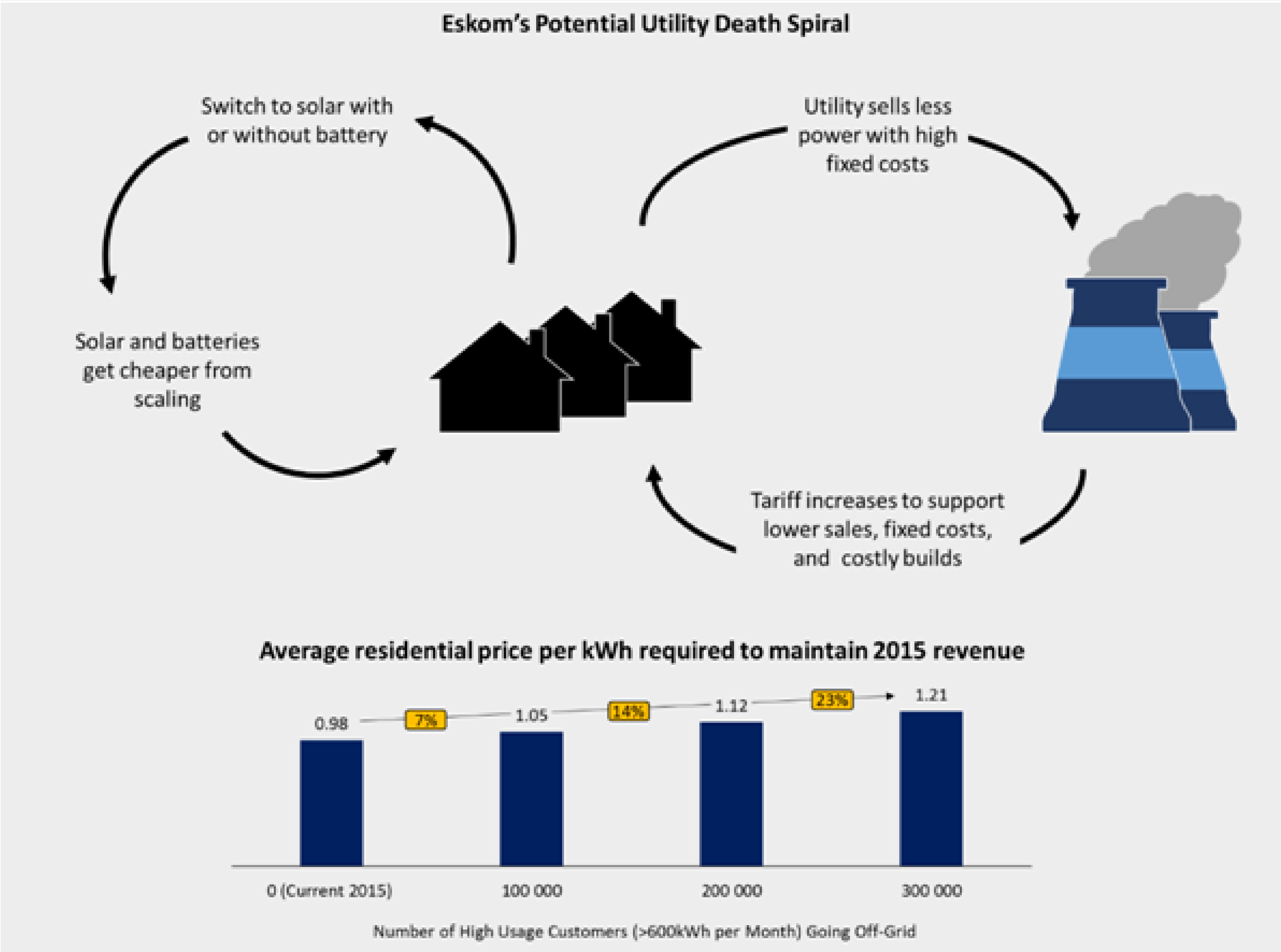
- The Washington Post, 1915

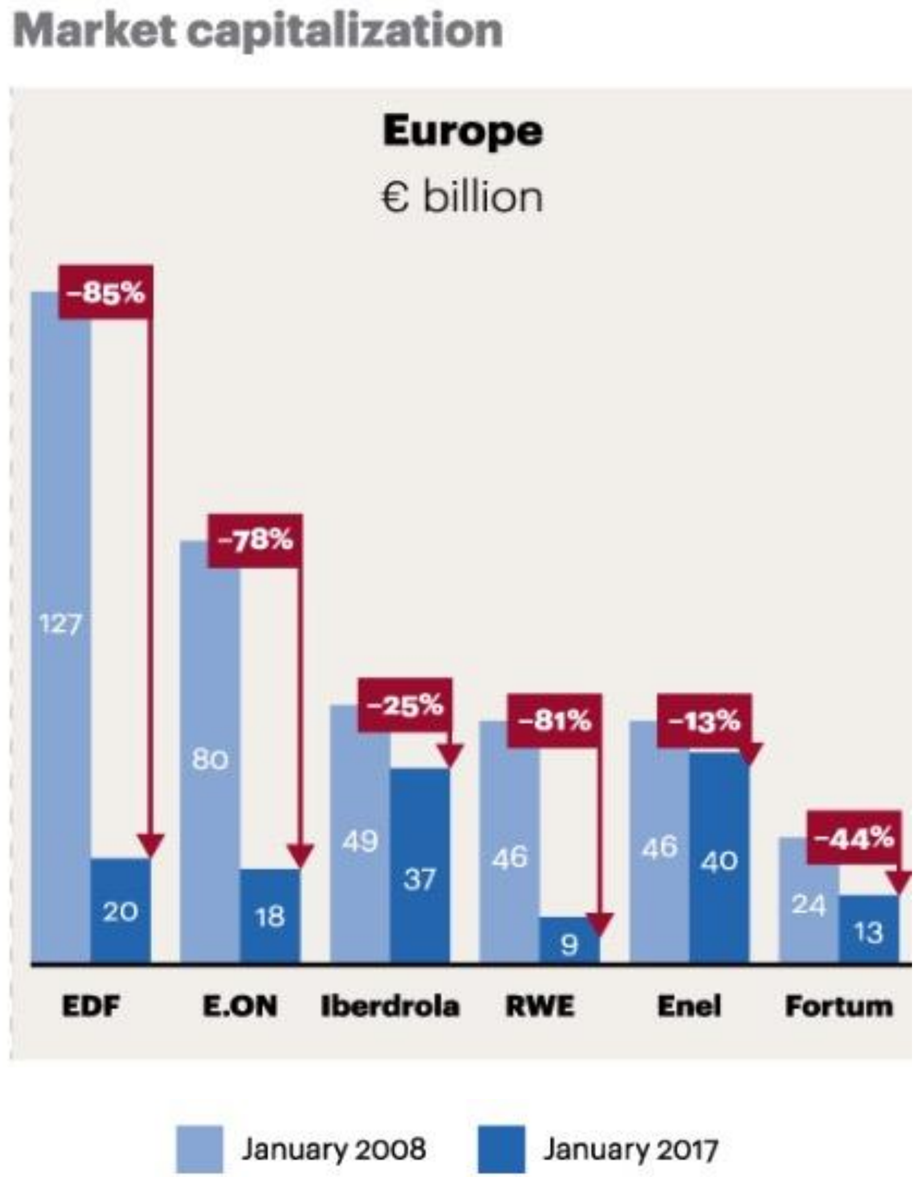


Cost of 200 mile range EV
$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$-
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Thousands of Electric Vehicles Sold - Cumulative
Average US Car Price 2015 - $33,500
Electric Vehicle Cost
Lowest US New Car Price 2015 - $14,020
Ramez Naam - rameznaam.com
Assumes 16% EV Learning Rate, 30% CAGR
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035


TIME FOR TECHNOLOGIES TO REACH 80% PENETRATION
Percent of US households
100%
75
50
25
0
1900
1915
1930
1945
1960
1975
1990
2005
2020
2030
2040
1900-20 tech
(telephone, stove, electricity, auto)
~30-40 years
1920-40 tech
(radio, fridge, clothes washer)
~25-30 years
1940-60 tech
(clothes dryer, AC, dishwasher)
~30-40 years
1960-80 tech
(color TV, microwave, VCR)
~20 years
Post 1980 tech
(computer, cellphone, internet)
15-20 years
Grid edge technologies
Tipping point?

IKEA
Home furnishings
IKEA
IKEA
Entrance


Eskom's Potential Utility Death Spiral
Switch to solar with or without battery
Utility sells less power with high fixed costs
Solar and batteries get cheaper from scaling
Tariff increases to support lower sales, fixed costs, and costly builds
Average residential price per kWh required to maintain 2015 revenue
0.98
7%
1.05
14%
1.12
23%
1.21
0 (Current 2015)
100 000
200 000
300 000
Number of High Usage Customers (>600kWh per Month) Going Off-Grid


Market capitalization
Europe
€ billion
-85%
-78%
-25%
-81%
-13%
-44%
127
20
80
18
49
37
46
9
46
40
24
13
EDF
E.ON
Iberdrola
RWE
Enel
Fortum
January 2008
January 2017

E.ON → Uniper: Gas, coal, and nuclear generation, energy trading, and parts of its international business.

E.ON → E.ON: Energy transition-focused businesses, including sales, grids, renewable energy, and customer solutions.

RWE → innogy: Sales, grids, and renewable energy

RWE → RWE: Coal, gas, nuclear plants and energy trading

"We face new challengers in terms of technology, energy supply and generation, energy management and, of course, access to customers. We are going head-to-head with like of Google, Amazon and Samsung".

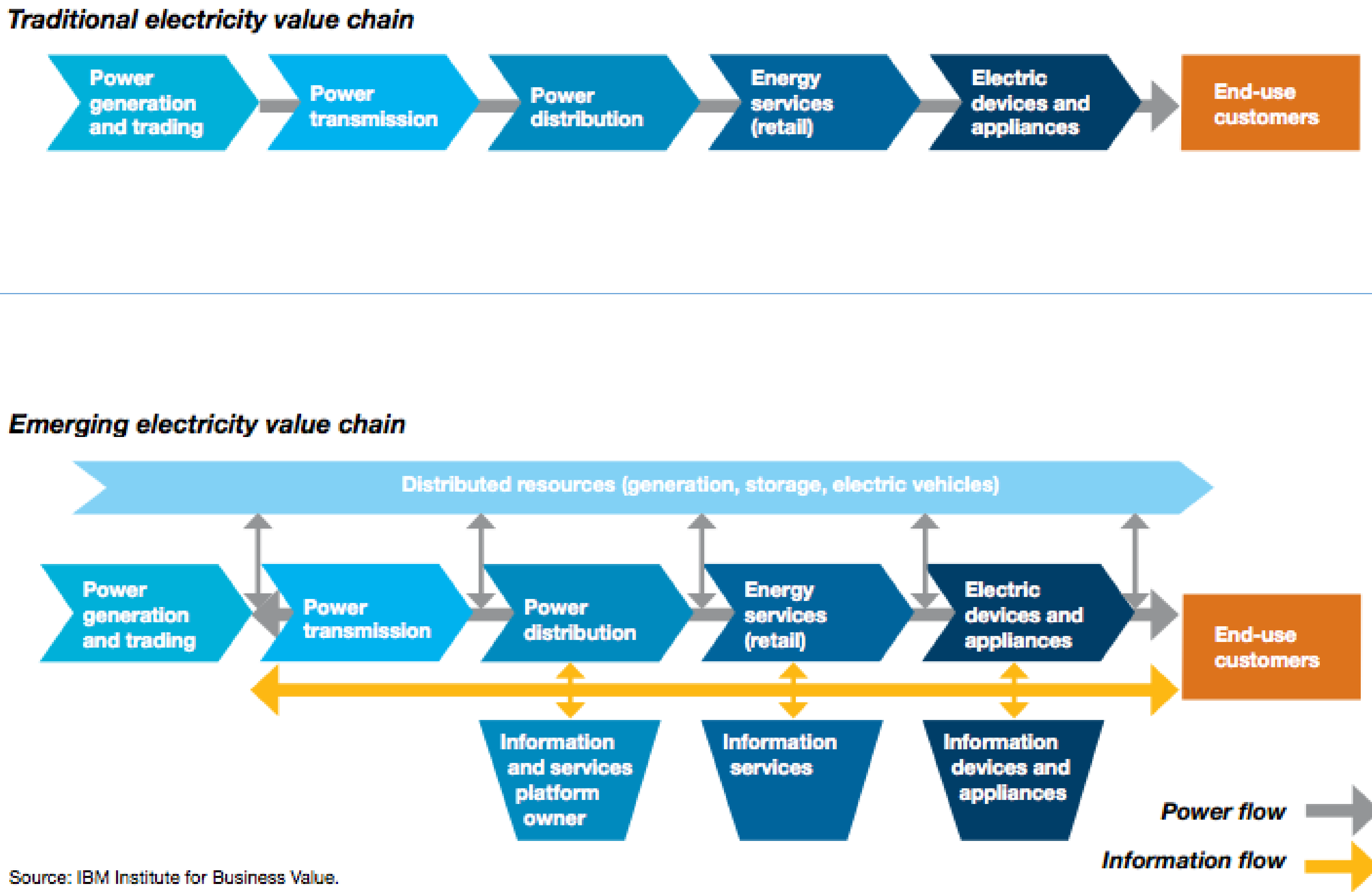
– Ian Conn, CEO Centrica

"The integrated model is dead"

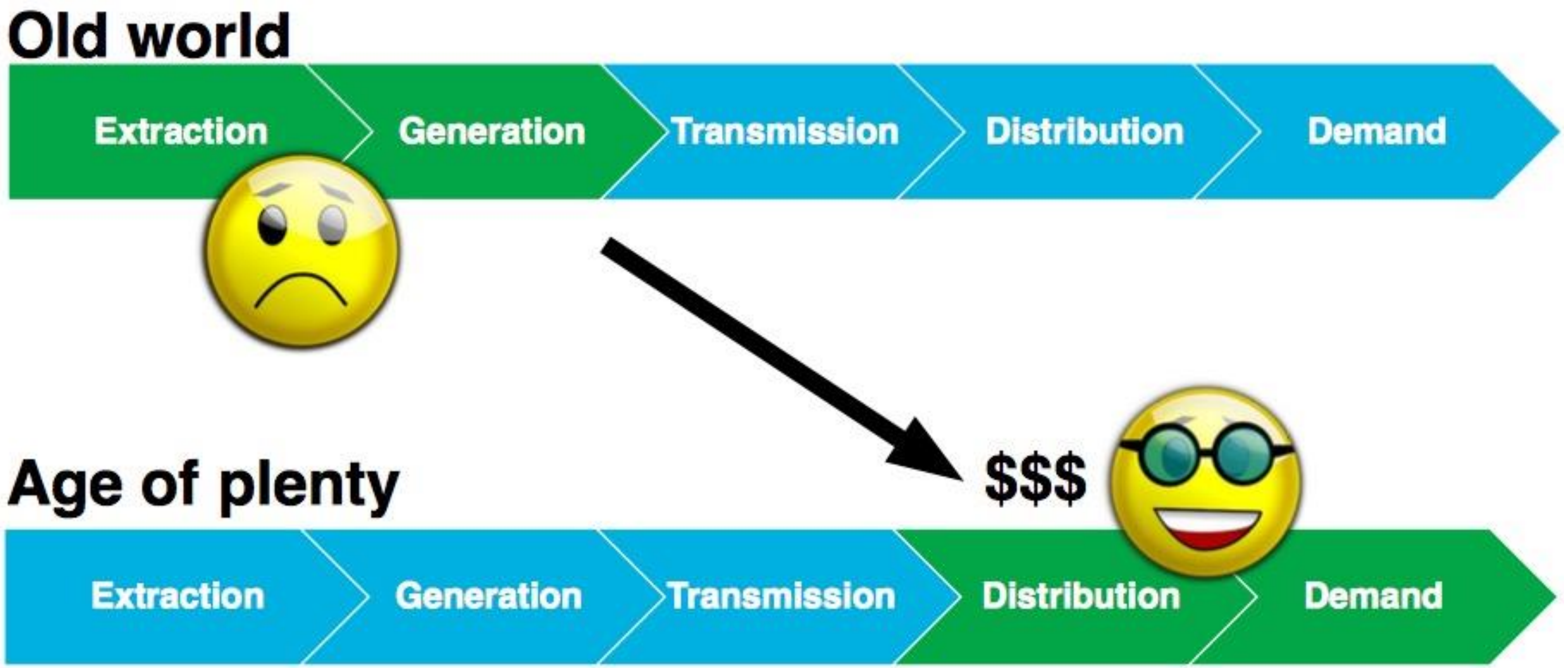
- Johannes Teyssen, CEO E.On

"The energy supply business is facing a life-or-death moment".

- Paul Massara, Chief Executive, Npower



Source: IBM Institute for Business Value.


Old world
Extraction
Generation
Transmission
Distribution
Demand
$$$
Age of plenty
Extraction
Generation
Transmission
Distribution
Demand

	Television consumer	Electricity consumer
Passive	• Passive receipt of content • Limited sources of content generation • Major media companies exclusively control content • Provider-customer relationship one-to-many, driven by demographics and geography	• Passive receipt of power • Limited sources of power generation • Incumbent utilities exclusively control power generators • Provider-customer relationship one-to-many, driven by demographics and geography
Active	• Consumer interest drives new and more targeted choices in content • More interest in and leverage of information on quality indicators for content (e.g., TV program rating systems) • Broader choice of providers drives more active role in provider selection • Consumer does not control content, but has stronger influence via choices • Introduction of time-shifting technologies enables more active selection and management of content at individual level	• Consumer interest drives new and more targeted choices in power supply • More interest in and leverage of information on quality indicators for content (e.g., green energy standards) • Broader choice of providers drives more active role in provider selection • Consumer does not control generation, but has stronger influence via choices • Introduction of residential time-of-use programs and green power options enables more active selection and management of generation deployment at individual level
Participatory	• Interactivity and involvement with content and service providers increases • Consumers active in producing content and influencing content distribution • Rapid creation of new content types as technology change causes explosion in capabilities • Dynamic, value-based pricing of content • Provider-customer relationship dynamic is increasingly customized to specific entertainment and information interests, with consumer analytics a key driver	• Interactivity and involvement with generation and service providers increases • Consumers active in generating power and influencing generation planning decisions • Rapid creation of new power supply options as technology change causes explosion in capabilities • Dynamic, value-based pricing of power (e.g., time-of-use) • Provider-customer relationship dynamic is increasingly customized to specific energy management goals, with consumer analytics a key driver


DIGITIZATION

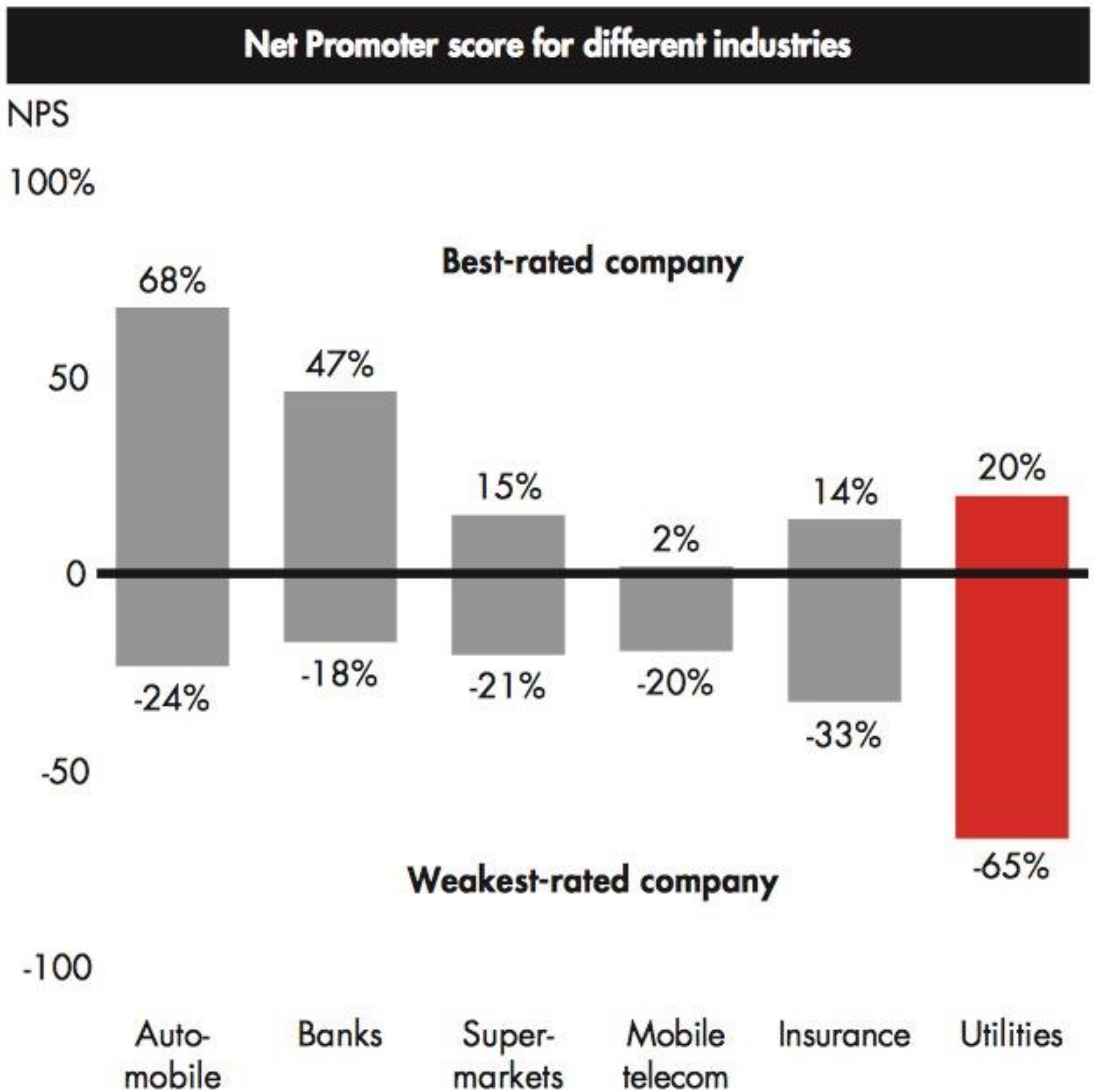

Net Promoter score for different industries
NPS
100%
50
0
-50
-100
Best-rated company
Weakest-rated company
68%
-24%
47%
-18%
15%
-21%
2%
-20%
14%
-33%
20%
-65%
Auto-mobile
Banks
Super-markets
Mobile telecom
Insurance
Utilities

Figure 24. Consumers typically have limited interaction with their electricity providers.

In the past 12 months, how much time did you spend in total interacting with a representative of your electricity provider (e.g., over the phone, e-mail, in a store, in your home, etc.)?

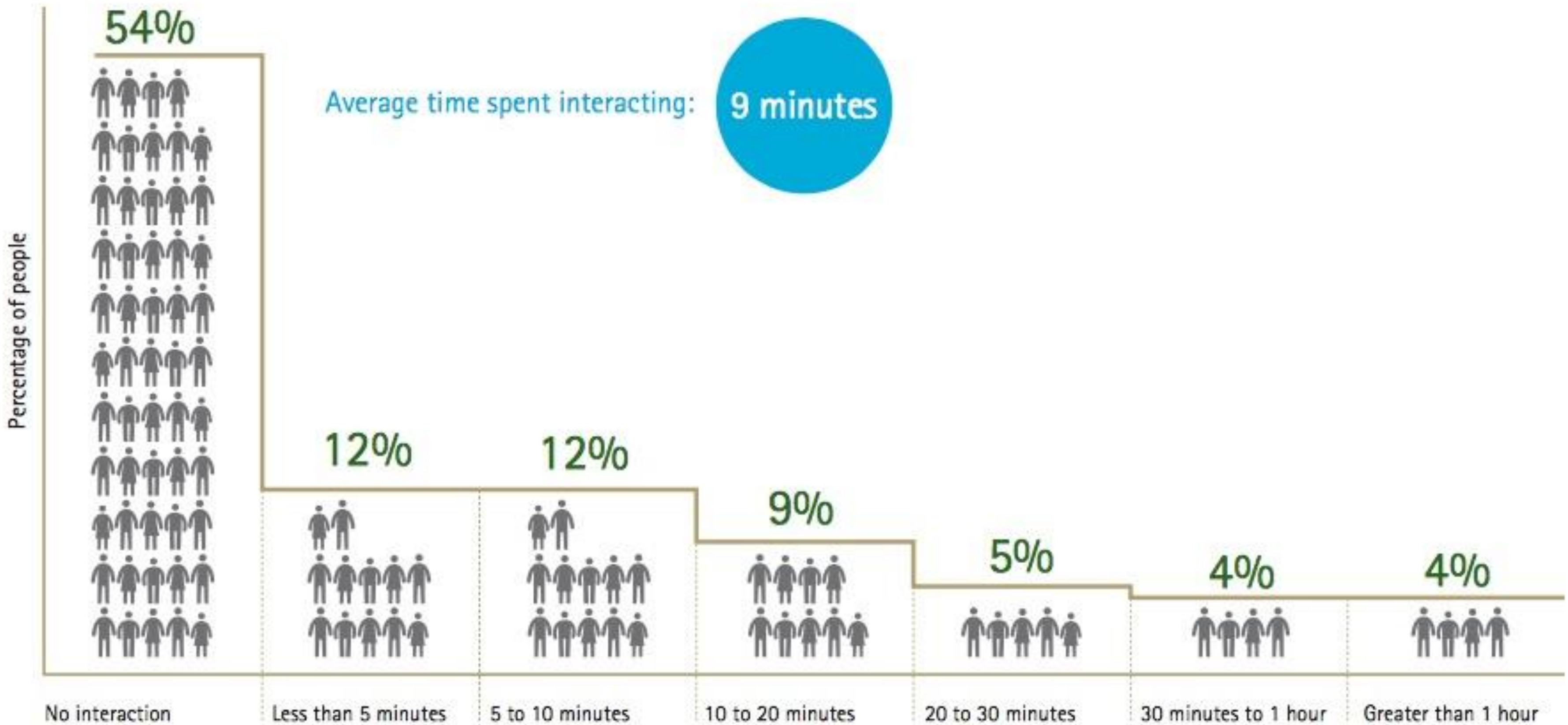
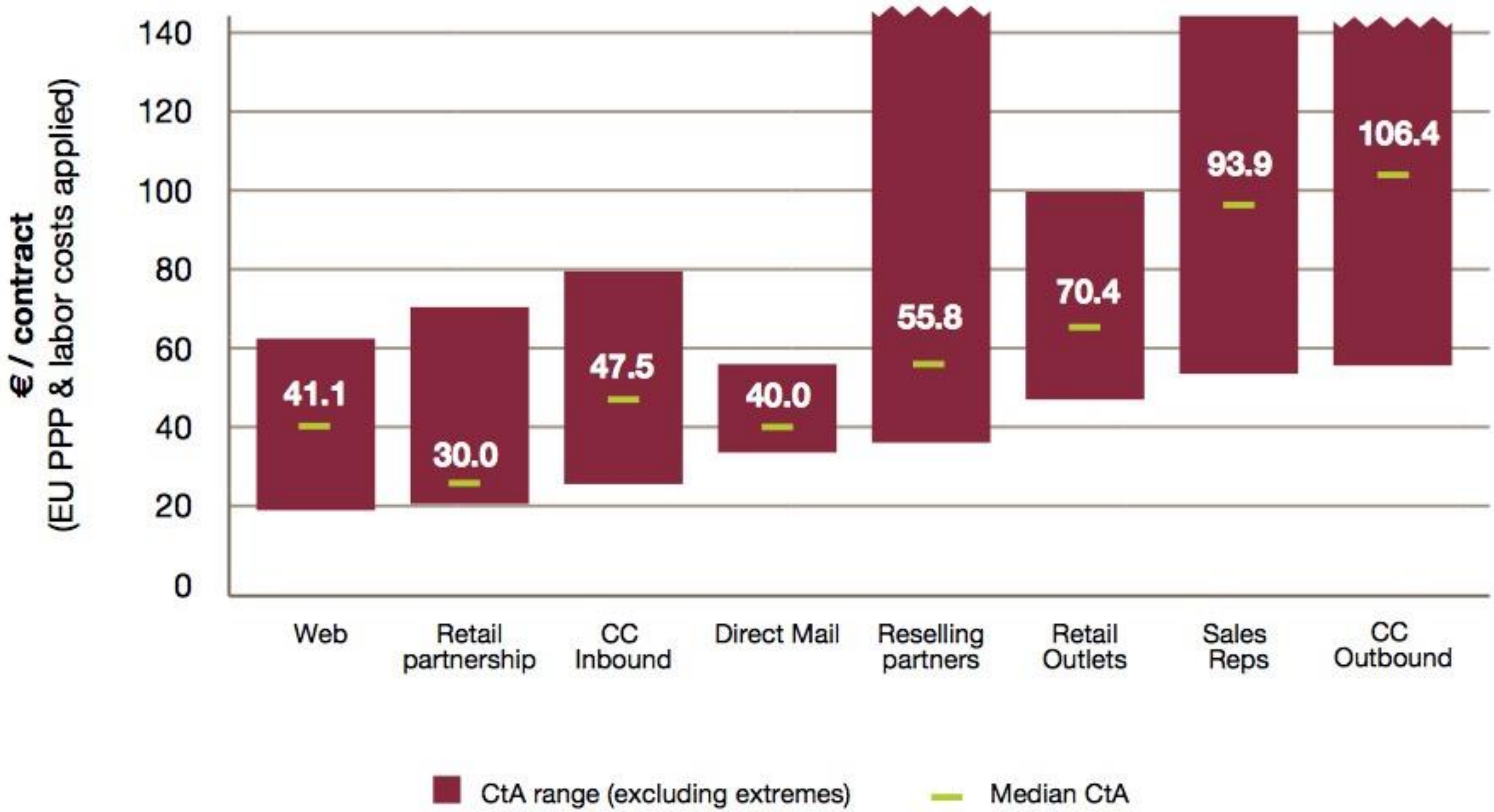


Figure 13: Cost to Acquire by channels



Source: Capgemini Consulting – European Multi-Client Retail Utilities B2C Benchmark

The characteristics of the new energy consumer

1. **Energy Perspective**—addressing a spectrum of consumer mindsets, from energy literate to agnostic
2. **Omnipresent**—supporting seamless virtual interaction anytime, anywhere
3. **Individualized**—personalizing the energy experience to address unique needs and preferences
4. **Social Centric**—creating a gathering place for ideas, conversations and collaboration
5. **Prosumer**—buying and selling energy via a variety of business partners
6. **Tech Savvy**—providing set-and-forget technologies that deliver financial savings, convenience and individual control
7. **Interconnected**—developing bundled solutions that combine energy with other products and services for the home, business and automobile
8. **Pay It Forward**—offering a range of prepaid energy solutions to meet a variety of lifestyle needs
9. **Energy Diverse**—adopting a range of nontraditional energy options, including distributed generation, net metering and microgrids

Figure 2. The digitally engaged energy consumer unleashes more business value for energy providers.

Base: All respondents.
Source: Accenture, New Energy Consumer research program, 2015 consumer survey.

TECHNOLOGY NEWS | Wed Jan 11, 2017 | 3:15pm EST

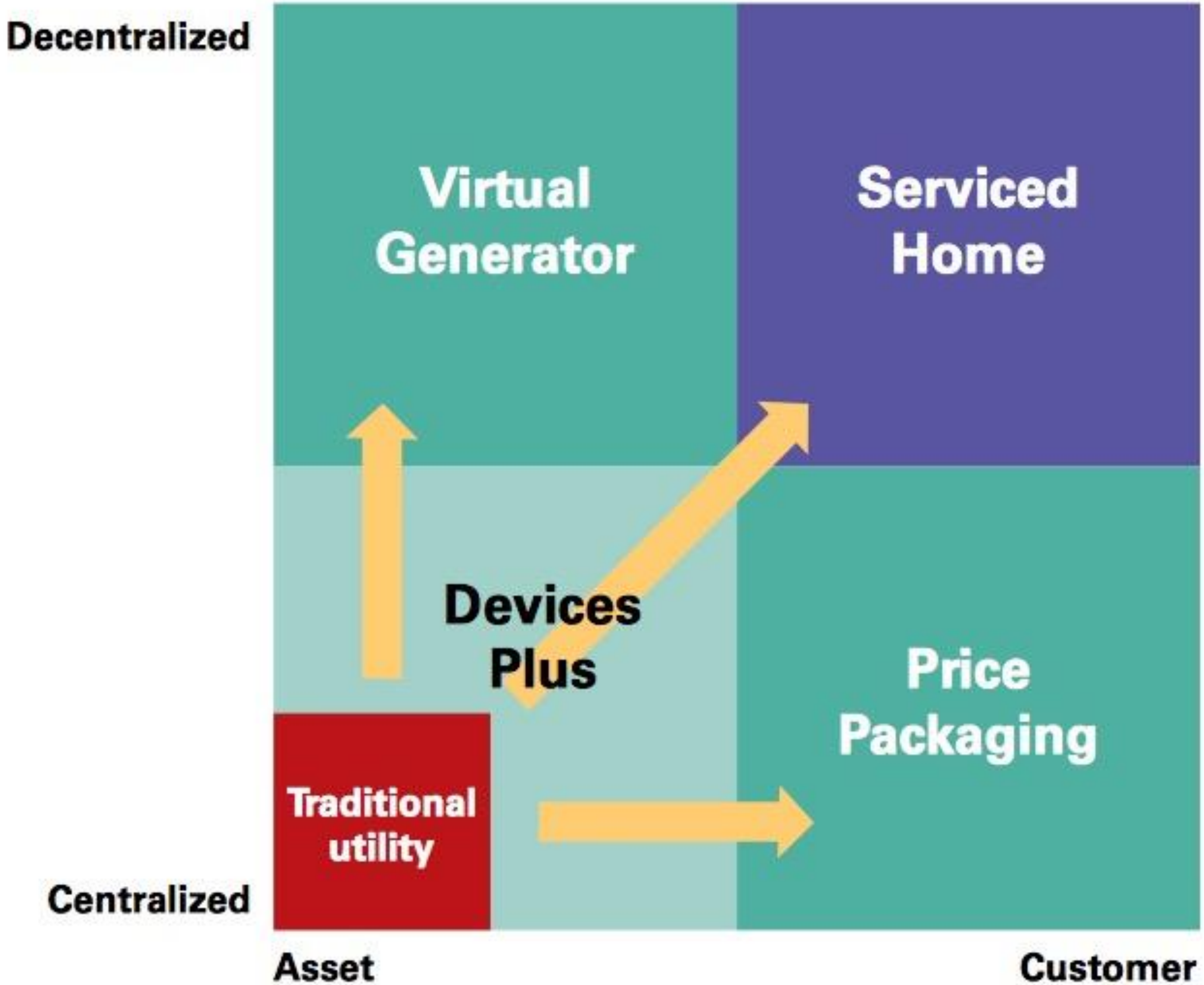
Third of global consumers open to Google, Amazon banking: survey

Attendees wait for the program to begin during the presentation of new Google hardware in San Francisco, California, U.S. October 4, 2016.
REUTERS/Beck Diefenbach

Roughly one in three banking and insurance customers globally would consider switching their accounts to Google (GOOGL.O), Amazon (AMZN.O) or Facebook (FB.O) if the Silicon Valley giants offered financial services, according to a new survey on Wednesday.

Table 1. Possible changes to the power sector structure.

	Now	Future
Cost structure	Mainly marginal	Mainly capital
Pricing	per KWh	?
Planning and operation	Flexible supply to match demand.	Demand response to match supply.
Control and dispatch	From center	Throughout system (cf Internet)
Role of demand-side	Passive	Interactive
Role of grids	Neutral conduit	Smart player


Decentralized
Virtual Generator
Serviced Home
Devices Plus
Price Packaging
Traditional utility
Centralized
Asset
Customer

Summary

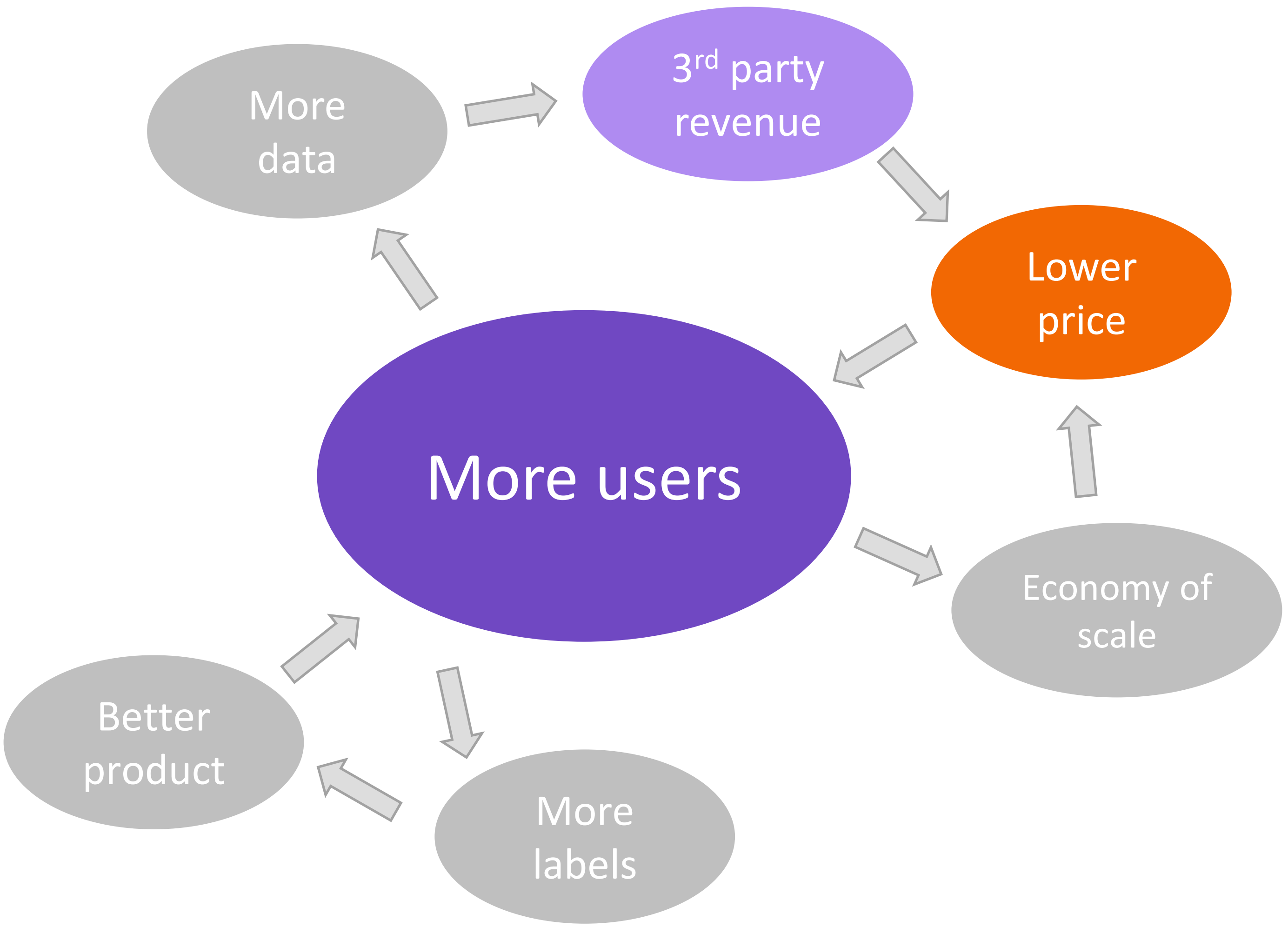
- The old asset focused and centralized business model of utilities has served them well for >100 years, but are causing unsustainable negative externalities in form of GHG emissions
- A combination of regulations and innovation is starting to make alternative technologies profitable
- These technologies are greener and more decentralized, allowing the customer to set higher demands and participate more in the generation, distribution and usage of energy
- Even in the companies where this insight in strong and part of the strategy, the organizations are still very much formed by asset focused and centralized line organizations
- If they not manage to adapt, other types of companies will win the battle of the customer and

Watty Data Case

The world's most valuable resource is no longer oil, but data

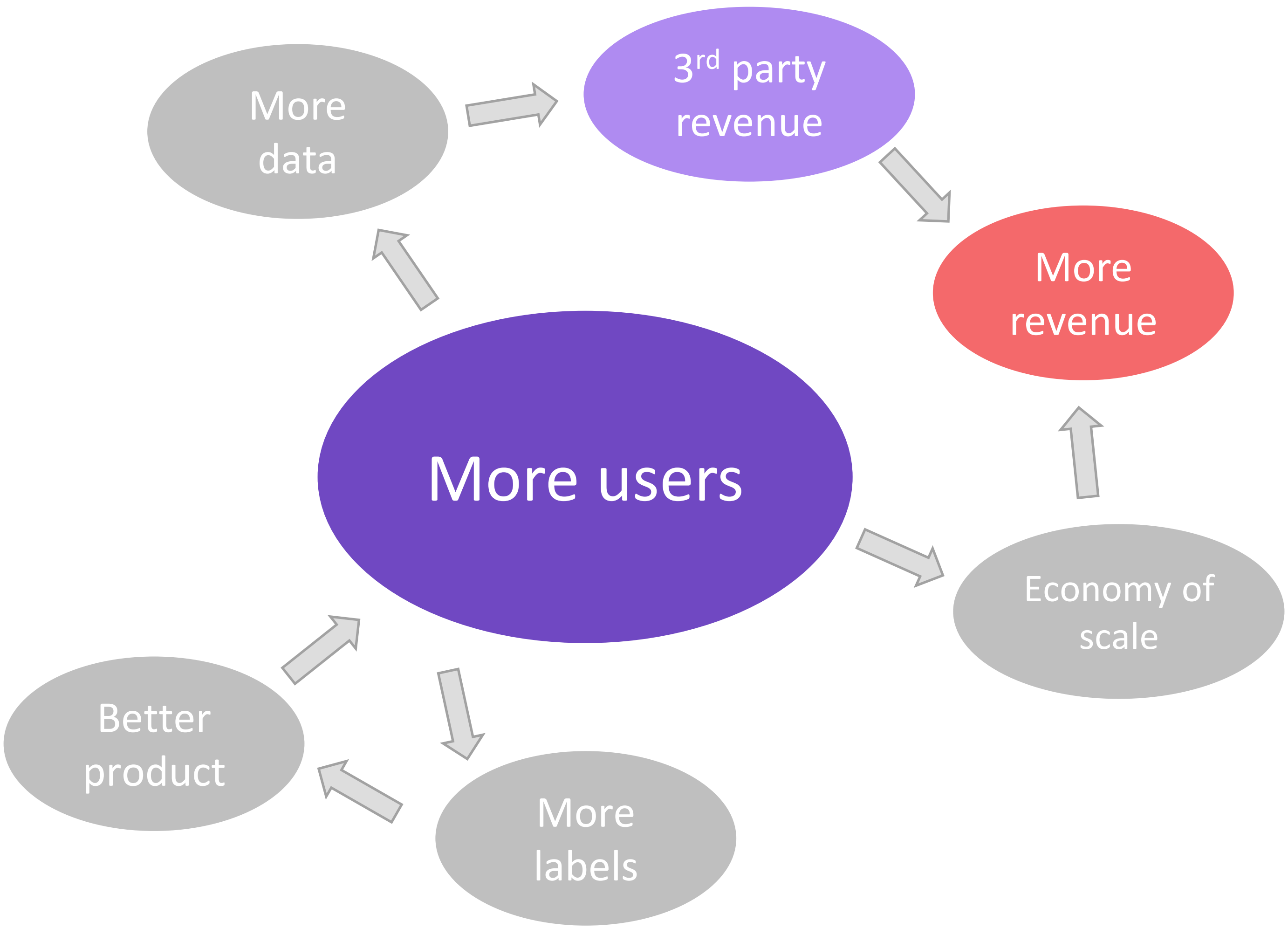
STEP 1 – Growing the network

3rd party data revenue can be instrumental to scale



STEP 2 – Profit

3rd party data revenue can provide significant profits



Process overview

How to identify and verify business models

Desktop research → Talk to people → Define BC short list → Verification on value

Desktop research

- Industry reports
- Research

Talk to people

- Industry people
- Consultants
- Industry organization

Define BC short list

- Brainstorm
- Long list
- Prioritize
- Short list

Verification on value

- Verification from potential buyer
- Prove in pilot project

Watty as a market place

PROBLEM

Reaching out to the right customer in the right time is getting increasingly difficult in the noise of other companies, and ad prices increase

SOLUTION

By understanding which appliances people have, how they use them and when they use them a company can send very specific offerings when people actually want them

EXAMPLES

- **Targeting very specific segments based on actual living situation and/or behavior**
    - Offer special electricity contracts to people with heat pump
    - Discount on hair products to people who use dryer & straightener >5 days/week
    - Extra intense marketing for TV channel subscription to people using the TV more than 14 hours/week
- **Send message in the exact moment a customer need a service**
    - *Behavior direct*: Being offered to buy detergent when turning on the washing machine
    - *Machine direct*: When an appliance (is about to) break down
    - *Behavior indir*ect: When a user does a specific behavior, for example turn on the TV at 8 P.M on a Friday but hasn't cooked yet, offer them food delivery service ads
    - *Machine indirect*: Find users that recently got an electric car and offer them charging boxes

Watty as a market place

Helping users find other products and services that fulfill their needs

Other ad platforms earn €0,3-4/click. Affiliate programs give 4-8% commission.

What makes us better

- Can identify and therefore offer more specific breakdowns of behavior
- Can reach customer in exact the right moment

What makes us worse

- Limited number of impressions we can display before being perceived as intrusive
- No recognition as an ad portal, higher cost of sales
- Limited in scope (can't sell ex. travel)

AdWords:

- Click Through Rate: 2% (non-brand terms)
  - 15-20% (brand terms)
- Cost Per Click: $1 – $2, with some keywords over $50

LinkedIn:

- Click Through Rate: 0.02%-.09%
- Cost Per Click: $2.00
- Cost Per 1000 impressions: $6.00

Twitter:

- Click Through Rate: 1-3%
- Cost Per Click (engagement): $0.50 – $4.00 (depending on targeting)
- Cost Per 1000 Impressions: $3.50
- Promoted / Sponsored Hashtag / Event: $200,000 per day

Facebook:

- Click Through Rate:
  - Display ads (right hand column ads): 0.04%
  - Newfeed Ad: 2.09%
- Cost Per Click:0.27
- Cost Per 1000 Impressions: $4.03

Average PPC Costs

Metric	2014	2013	2012	2011	2010
Cost per click (CPC)	$1.02	$0.92	$0.84	$1.04	$1.24
Click through rate (CTR)	0.9%	0.5%	0.5%	0.4%	0.7%
Average Ad Position	1.9	2.1	2.6	3.0	3.7
Cost per mille (CPM)	$8.81	$4.70	$4.03	$3.97	$8.55
Conversion rate	4.7%	8.8%	3.4%	5.3%	6.8%
Cost per conversion	$30.25	$10.44	$24.40	$19.74	$13.14
Invalid click rate	7.8%	8.3%	8.0%	10.9%	6.7%

TABLE 1 – Fixed Advertising Fee Rates for Specific Product Categories

Product Category	Fixed Advertising Fee Rates
Electronics Products	4.00%
Amazon MP3 Products	5.00%
Amazon Instant Video Products	5.00%
Game Downloads Products	10.00%
Gift Cards Redeemable on amazon.com	6.00%
Gift Cards Not Redeemable on amazon.com	4.00%
Grocery Products	4.00%
Video Game Console Products	1.00%
Headphones Products	6.00%
Industrial Products and Products available on Amazonsupply.com	8.00%
Products available on Myhabit.com	8.00%
Products available on AmazonLocal (local.amazon.com)	6.00%

Volume-Based Advertising Fee Rates for General Products

Number of Products Shipped/Downloaded in a Given Month**	Volume–Based Advertising Fee Rates for General Products
1–6	4.00%
7–30	6.00%
31–110	6.50%
111–320	7.00%
321–630	7.50%
631–1570	8.00%
1571–3130	8.25%
3131+	8.50%

This is the link that you will use on your actual money website to link to this product. When your website visitors click this link and they go to Amazon, they will be cookied by Amazon. This cookie lasts for 24 hours. This means that even if the visitor did not buy the product you were linking to, but decided to buy something else, you will still get paid money for the duration of the 24-hour cookie. The more people you get to click your affiliate link, the more people become “cookied” and the more sales you are likely to make.

Watty as a market place

Business model

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Intermediators for ad sales	Electricity retail companies	Contact users with an offer tailor made to their needs at a time when the are the most likely to buy it	Co-creation partnership	Electricity retail companies Seller and/or repairers of broken equipment Other product and/or service providers
	Key Resources Data Algorithms Engineering Sales		**Channels** Direct sales	

Cost Structure	Revenue Streams
Server Development Marketing & sales	Pay per click ROUGH estimate: €1-4$/click 1-2 click/user and year

Watty as a market place

Implementation roadmap

Core product → **POC** → **Product development** → **Scale**

Core product

- High % labeled
- High accuracy

POC

- Test notifications with links to landing page
- Data on CTR and conversion
- 2-3 use cases

Product development

- Segment users
- Optimize notifications
- Ad buying portal for partner

Scale

- Improve existing use cases
- Test and deploy new

Watty as a grid asset

PROBLEM

As more unpredictable renewable production enters the production and consumption patterns change due to EV's and PV's, the grid is not dimensioned to meet this change. Grid companies need to make large investment or find a way to alter behavior

SOLUTION

By knowing when a customer increase load and having an interface to communicate with them, we can create a more flexible demand that can be integrated to

EXAMPLES

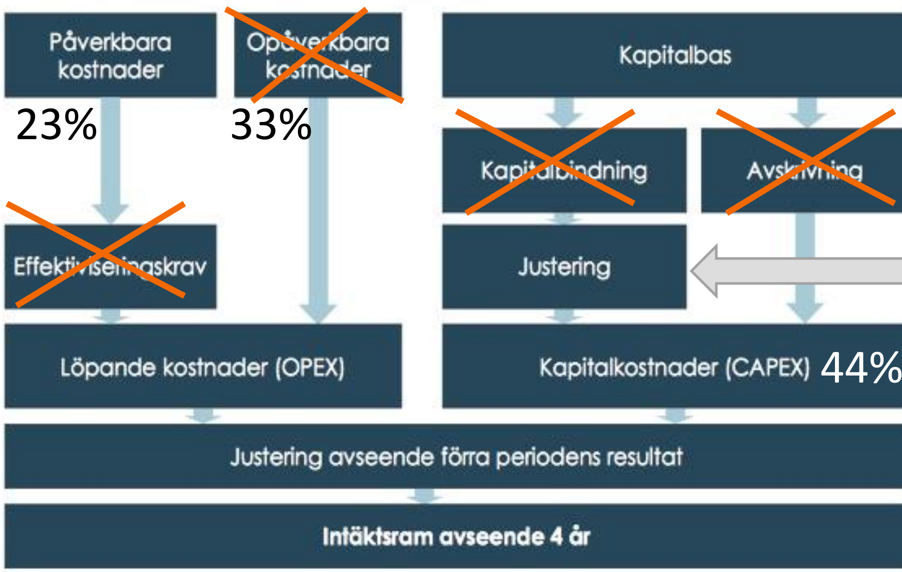
- **Direct use of real time data**
    - Make better decisions on the Elbas balance market for physical intraday trading
    - Better understand the dynamic between supply and demand with new decentralized energy sources
    - Create efficient automated demand response programs based on insights in the best possible measures
- **Indirect benefits from changed behavior of using Watty**
    - Even out load factors by changed behavior
    - Decrease grid losses and costs to adjacent grids by behavioral load shifting by Watty users

Box 1.1 Elnätsreglering i Sverige 2016–19

Elnätsföretagen för eldistribution på lokal nivå är lokala monopol, och deras affärsverksamhet regleras. För att motverka oskäliga priser regleras prissättningen genom en intäktsram. Elnätsföretagen ansöker om sin egen intäktsram för fyra år i taget, en så kallad tillsynsperiod. Den nuvarande perioden gäller 2016–2019.

Intäktsramen baseras på tre huvudkomponenter, kapitalkostnader (CAPEX) samt påverkbara och opåverkbara löpande kostnader (OPEX).

- Maintenance
- Measuring
- Calculations
- Reporting



- Fewer and shorter outages
- Low grid losses
- Even load factor
- Low cost to adjacent grid
- +/-5% adjustment

Tabell 22. Kostnadsbesparingar av efterfrågeflexibilitet från hushållskunder som medför att lokalnätet får en lastflytt på 10 % från höglasttimmar till låglasttimmar

	Årlig kostnadsbesparing (SEK per år och kund)
Nätförluster	19
Kostnader till överliggande nät	30
Nätinvesteringar	75

Källa: (Koliou, et al., 2015)

En minskning på 3–5 procent i efterfrågan under en timmes pristopp kan minska energi-kostnaderna med 20–50 procent.

Case in point: The US estimated potential value of smart grid analytics

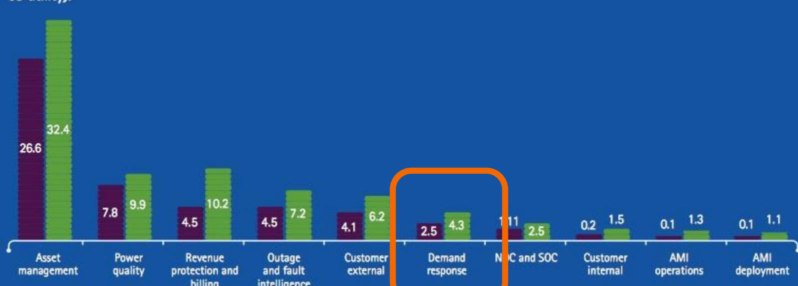
As previously stated, Accenture's analysis suggests that the potential value of smart grid analytics, at a conservative estimate, could approach $40 to $70 per electric meter per year, with estimated benefits generally split with 60 percent benefit to the consumer and 40 percent to the utility. Figure 4 illustrates potential annual savings from AMI analytics in various business areas, created for a representative US utility.

The bulk of the benefits to utilities, up to 85 percent, are derived from four main categories:

- Asset management
- Power quality
- Revenue protection and billing
- Outage and fault intelligence

Using data from Figure 4, the estimated share of annual savings per meter from AMI analytics, by business area, is shown as percentages in Figure 5.

Figure 4. Estimated average annual savings from AMI analytics, by business area, on a US dollar-per-meter basis (representative US utility).



Note: NOC: network operations center; SOC: smart operations center.
Source: Accenture analysis, 2013.

Conclusion

Consumers are dramatically reshaping the utility industry — and, as a result, the value of world-class customer engagement is becoming clearer than ever before. Based on our experience with over 95 utilities in nine countries, we've found that utilities can increase the return on their customer relationships by 20-55% and earn €15-€40 annually for every household they engage.

Key engagement goals	Programme goals	Annual benefit per household
Customer relationship	Reduced churn and increased acquisition	€3-€8
Digital engagement	Lower cost to serve	€7-€11
Marketing effectiveness	Increased cross-sell and up-sell	€1-€10
Demand response	Improved load management	€0.5-€3
Efficient behaviour	Energy efficiency*	€3-€8
Total expected benefits per household		**€15-€40**

FIGURE 10: ANNUAL COST SAVINGS AND INCREASED PROFIT FROM INTEGRATED CUSTOMER ENGAGEMENT SOLUTIONS

* Efficiency is a future value driver in most European markets but will become more relevant as the Energy Efficiency Directive policy frameworks are established.

Watty as a grid asset

Business model

Key Partners

Other suppliers of grid & flexibility services

Key Activities

Prove value

Key Resources

Customer interface
Real time data

Value Propositions

Decrease operating costs and make better decisions on grid operation by accessing real time disaggregated data

Customer Relationships

Development partnership

Channels

Direct sales
White papers

Customer Segments

Distribution System Operators

Transmission System Operators

Cost Structure

Server costs
Development costs

Revenue Streams

Estimate €0,5-7/user and year

Watty as a grid asset

Implementation roadmap

Core product → **POC** → **Product development** → **Scale**

Core product

- High % labeled
- High accuracy

POC

- Send notifications at high peak loads
- Data point on target vs. control group, change of behavior?

Product development

- Experiment with nudges
- Build incentives, revenue sharing
- Connect to balance market
- Follow up

Scale

-

Watty as a monitoring system

PROBLEM

As more unpredictable renewable production enters the production and consumption patterns change due to EV's and PV's, the grid is not dimensioned to meet this change. Grid companies need to make large investment or find a way to alter behavior

SOLUTION

By knowing when a customer increase load and having an interface to communicate with them, we can create a more flexible demand that can be integrated to

EXAMPLES

- **On household level**
  - Tell landlords which appliances that need t replaced first and which are already broken
  - Give insurance companies better data for controlling claims
  - Inform a service company that repair or has guarantees on an appliance that it's broken
- **On community level**
  - Provide traders at energy companies with faster and more detailed data on demand and forecasts for better decision making

Watty as a monitoring system

Business model

Key Partners

?

Key Activities

Develop interfaces
Segment users

Key Resources

Real time disaggregated data

Engineering

Value Propositions

Keep an eye on specific appliances in many homes to increase service level and process efficiency

Customer Relationships

Collaboration partnership

Channels

Direct sales
White papers

Customer Segments

Landlords

Insurance companies

Major appliance sellers with guarantees

Cost Structure

Server costs
Development costs
Sales costs

Revenue Streams

Service fee per user and month

No estimate right now

Watty as a monitoring system
Implementation roadmap

Core product → POC → Product development → Scale

Core product
- Anomaly detection
- High % labeled
- High accuracy

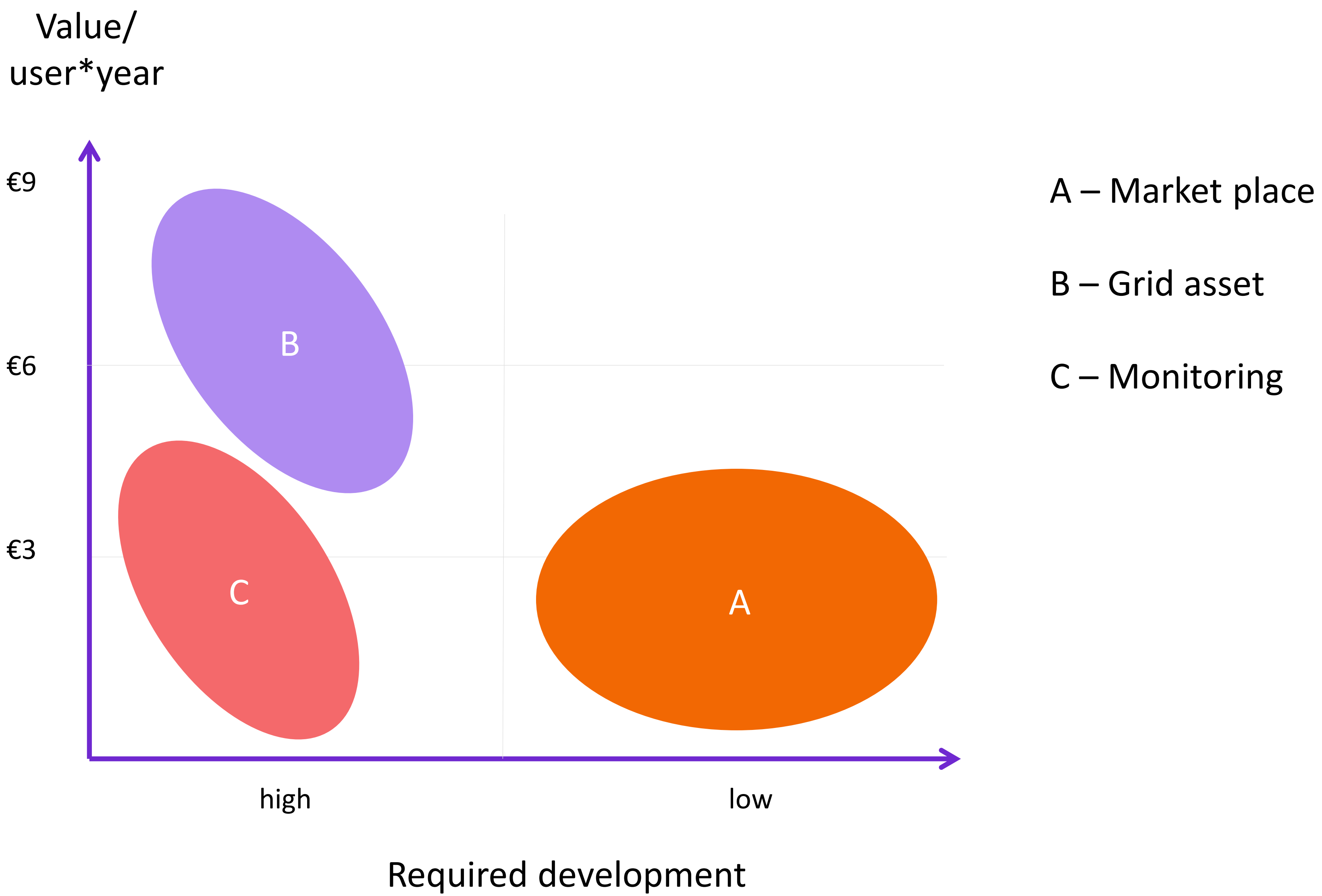
POC
- Small reference case

Product development
- Interface towards partner, customizable

Scale
-

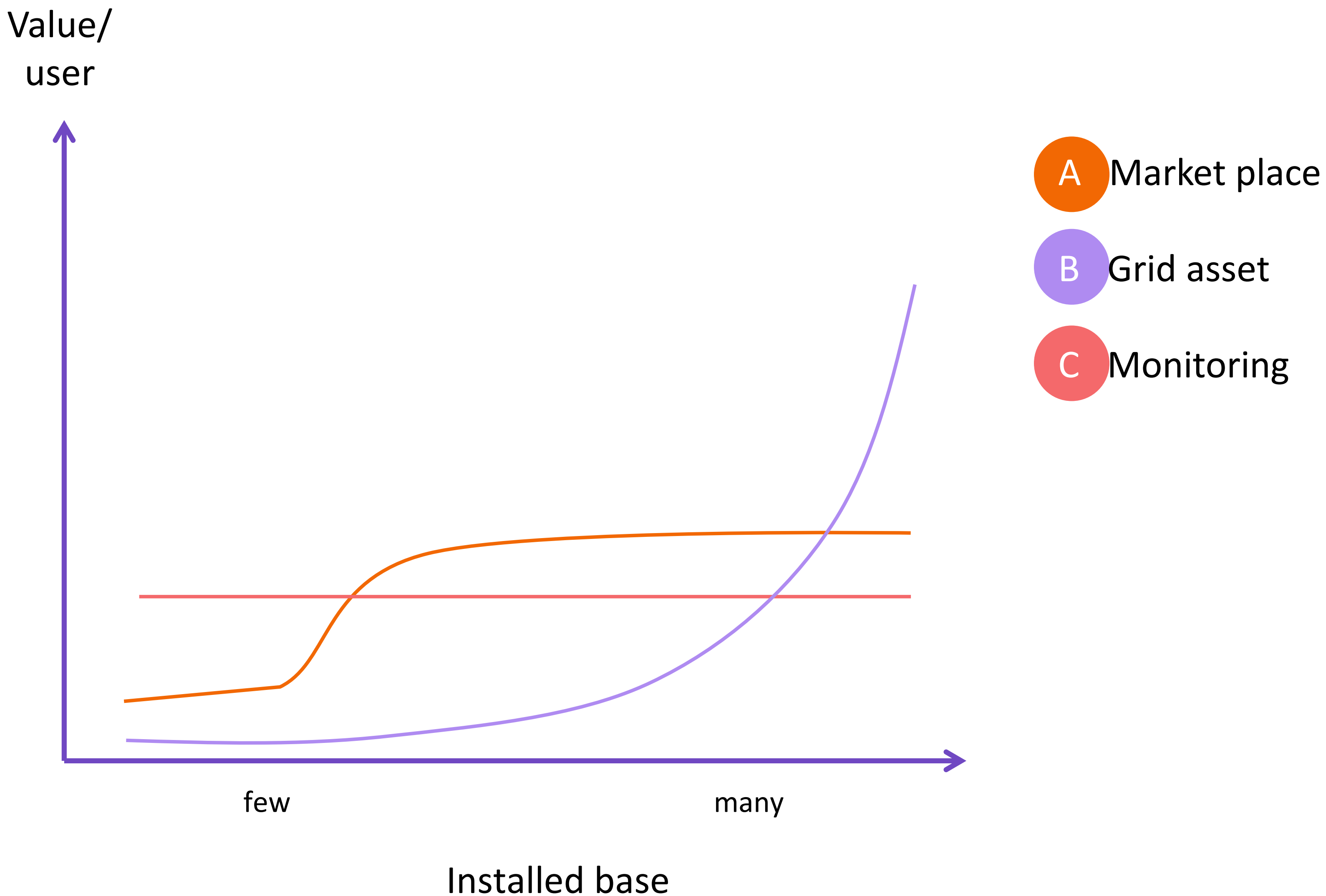
Preliminary findings

Three categories of use cases



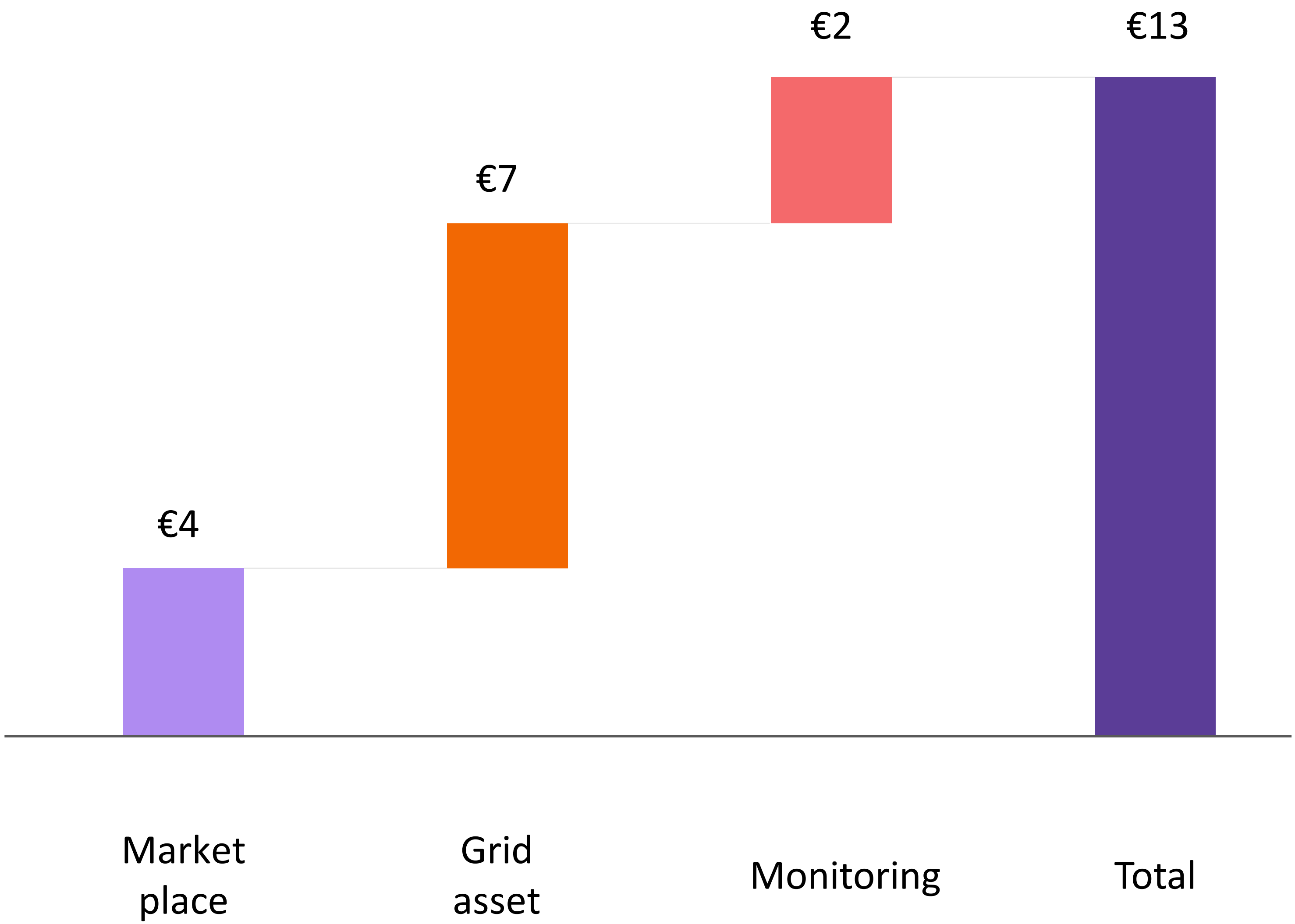
Preliminary findings

Three categories of use cases



Preliminary findings

A customer can generate up to €1/month in 3rd party revenue



Meeting list

Held
- Mattias Westerlund, Sweco
- Thomas Kollfeldt, Vattenfall
- Oscar Almén, P.A. Consulting Group
- Peter Takasc, Vattenfall
- P-O Nylén, Vattenfall R&D. No B2C aggregation cases, focus industry
- Niclas Snellman, Bambuser. Not much value
- Jens Marquart, Expektra. Lot of lower hanging fruit for flexibility
- Linda Thell, Svenska Kraftnät. Pilot project on FDR-C
- Peter Söderström, Vattenfall Eldistribution. Want stronger case, have no incentives with regulation model.
- Smart Grid hearing. No light in regulation tunnel, still CAPEX focus
- Carl, Eurostaff. Amazon case, 20-30% cut (iPhone).

Booked
- Fredrik Lundström, Energimynidgheten

Discussion (mail/phone)
- Maria Sandqvist, Swedish Smartgrid
- Johan Hagsten, Vattenfall trading

Wishlist
- Amazon
- Someone at Modity Energy Trading
- Someone at LOS Energy

Challenges

Privacy

- **How will customers react to advertising and monitoring?**
- **GDPR compliant?**

Competition

- Is data based business models compatible with partner strategy? Can we send Siemens ads for an “E.ON”-sold Watty box?
- Is there other data sources/alternative products that are “good enough” but already accessible?

Value capturing

- Can we prove that our grid benefit really comes from us?

Capabilities

- Are we sure enough that our data is good enough to use it as in for example insurance claims?
- We have not proven that Watty changes behavior in a way that create value for grid companies

Segment and target customers based on behavior	Tailor made electricity contracts	Identify EV owners without fast charger	Cross sell. Has appliance A, get offer B
Target customers based on appliance malfunctions	White goods suppliers	Repair companies	Rental house owners
Creating values by the changed behavior	Lower peak loads, for grid co's		
Group level insights on behavior	Research & universities	Energy trading	

CASE A - Segmentation

Who has the problem?	Electricity retail companies
What is the problem?	Energy retailers use very blunt segmentation tools and don’t understand specific customers needs. Switch rates are >15% in the Nordics. Average full cost to acquire a new customer is 80€ Average cost to serve a customer is 26,8€
How can Watty solve it?	By understanding customers’ energy use in more detail services can be tailored, increasing up-sales and retention of more satisfied customers
What’s the value of a solution?	- Reduction of churn and CAC up to 50%, lower cost for campaigns - 1-10€/customer, year
What’s the proof points?	- Spanish utility Endesa achieved these results with worse data - Opower has studied the impact of more granular segmentation

CASE B – Grid balancing

Who has the problem?	Electricity grid companies
What is the problem?	As more unpredictable renewable production enters the production and consumption patterns change due to EV's and PV's, the grid is not dimensioned to meet this change. Grid companies need to make large investment or find a way to alter behavior
How can Watty solve it?	By knowing when a customer increase load and having an interface to communicate with them, we can create a more flexible demand that can be integrated to
What's the value of a solution?	aaa
What's the proof points?	aaa

CASE C – Efficient trading

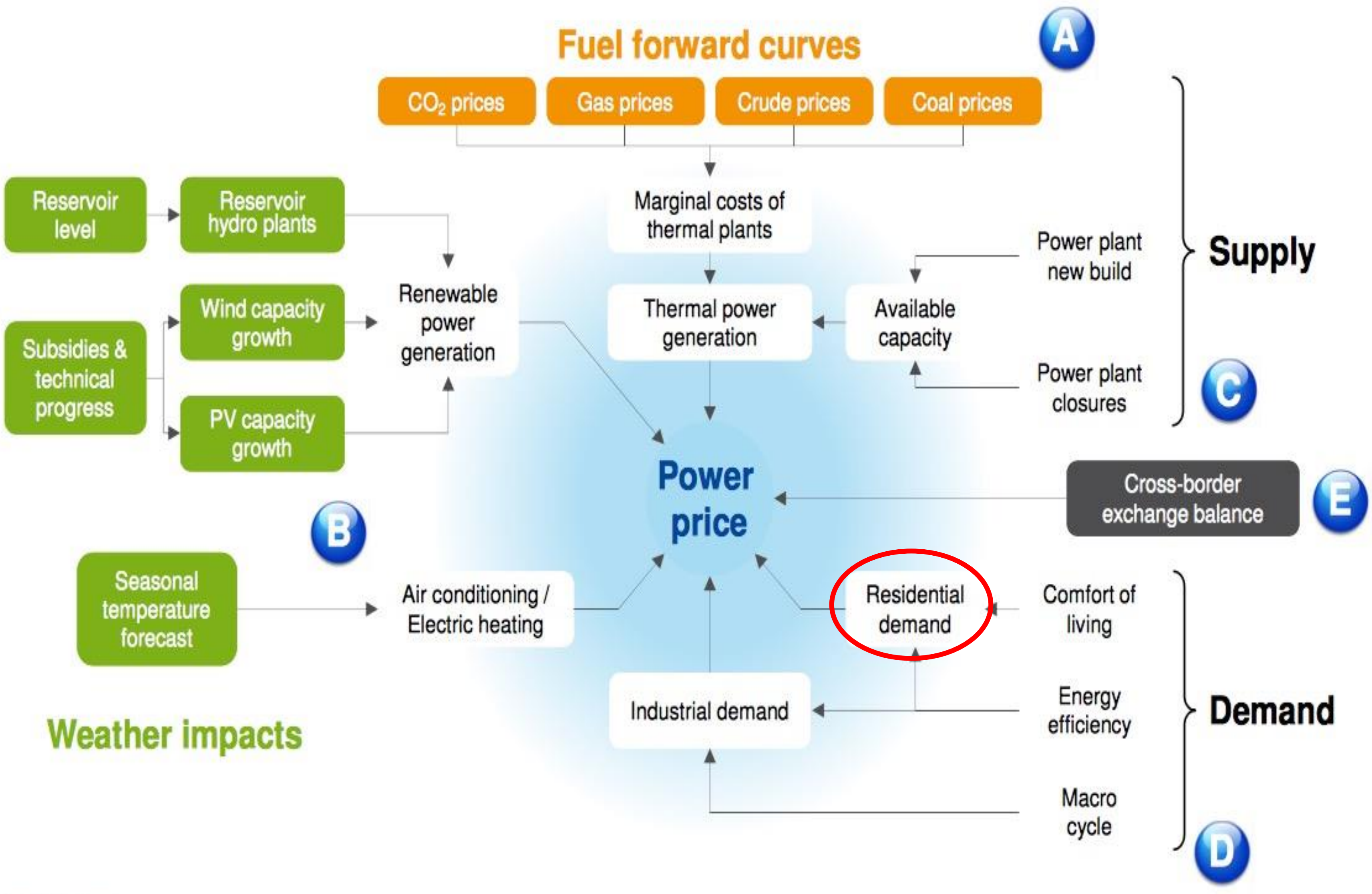
Who has the problem?	Energy companies, trading department
What is the problem?	Hypothesis: Energy trading is very complex, margins are low and utilities has difficulties attracting the best talents. The data for making decisions is still very old school and there is significant room for improvement
How can Watty solve it?	By creating an API with "real" real time information and more accurate forecasts based on better insights, traders get an overhand against competitors, mainly for intraday physical trading on the NordPool Spot market
What's the value of a solution?	To be investigated. Meeting booked with former Vattenfall trader to discsuss
What's the proof points?	None yet

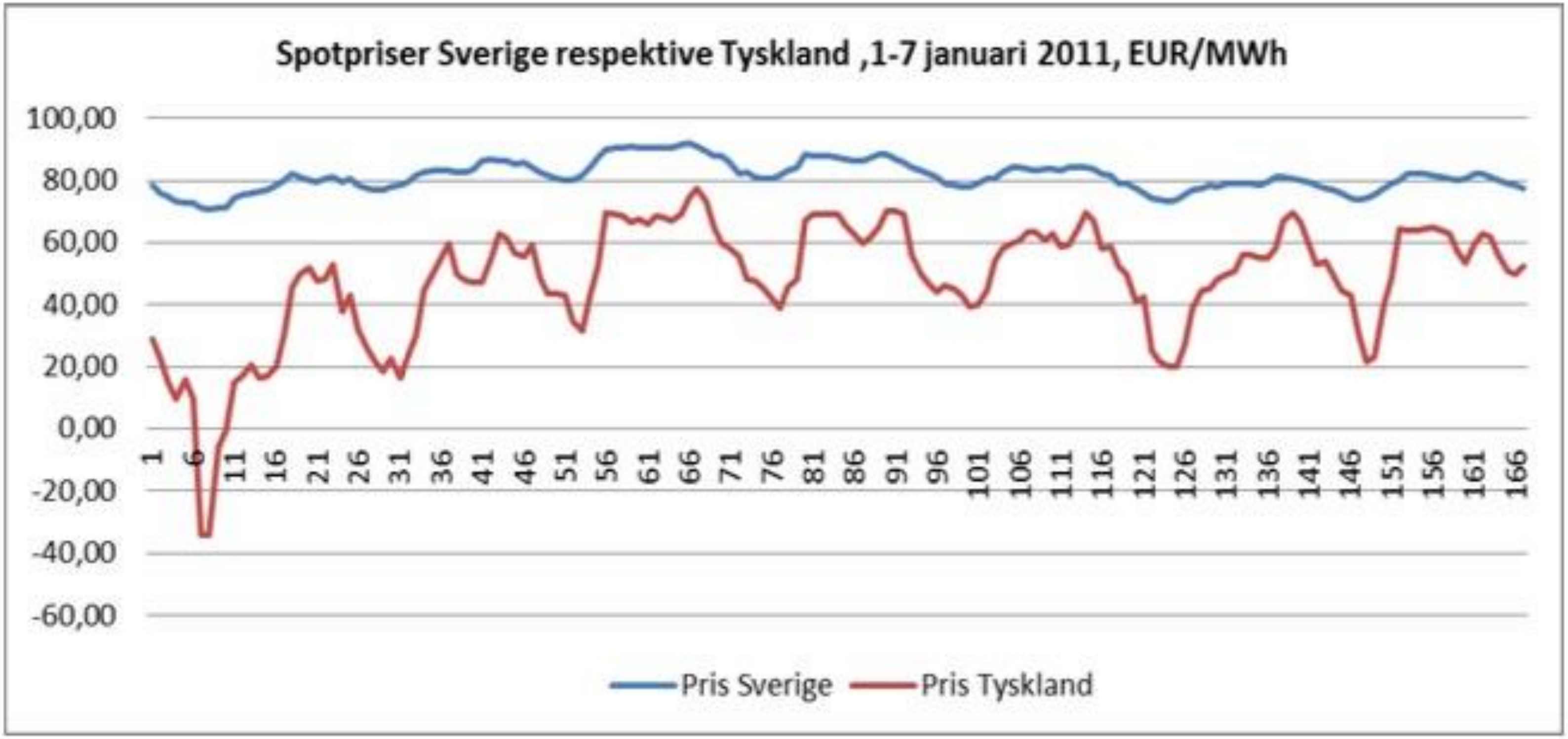
CASE D – Appliance

Who has the problem?	OEM's/retailer of home appliances & white goods
What is the problem?	aaa
How can Watty solve it?	aaa
What's the value of a solution?	- Unknown
What's the proof points?	- Unknown

CASE E –

Who has the problem?	aaa
What is the problem?	aaa
How can Watty solve it?	aaa
What's the value of a solution?	aaa
What's the proof points?	aaa

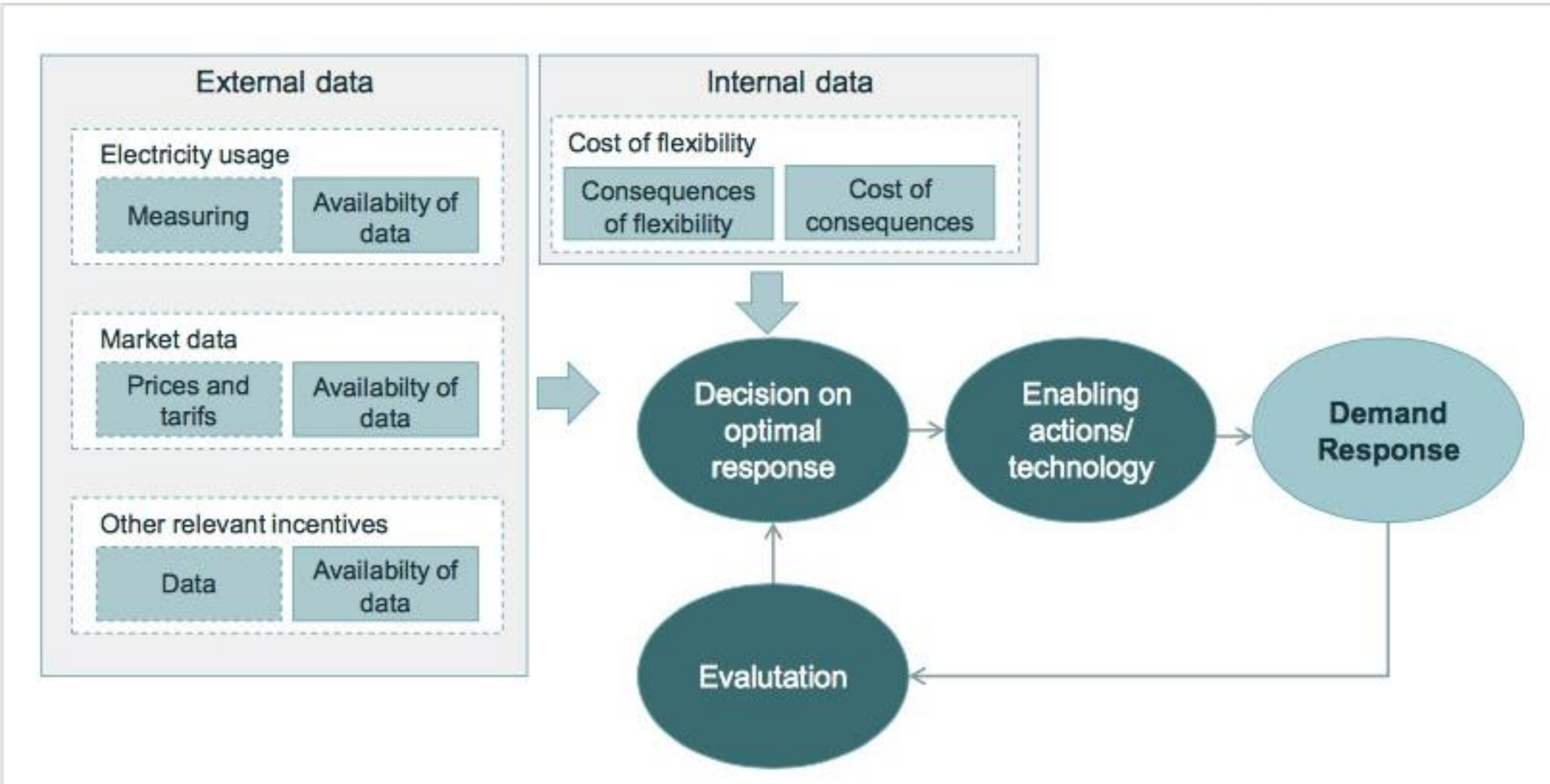

Fuel forward curves
A
CO_2 prices
Gas prices
Crude prices
Coal prices
Reservoir level
Reservoir hydro plants
Marginal costs of thermal plants
Power plant new build
Supply
Wind capacity growth
Renewable power generation
Thermal power generation
Available capacity
Subsidies & technical progress
PV capacity growth
Power plant closures
C
Power price
Cross-border exchange balance
E
B
Seasonal temperature forecast
Air conditioning / Electric heating
Residential demand
Comfort of living
Energy efficiency
Industrial demand
Demand
Weather impacts
Macro cycle
D



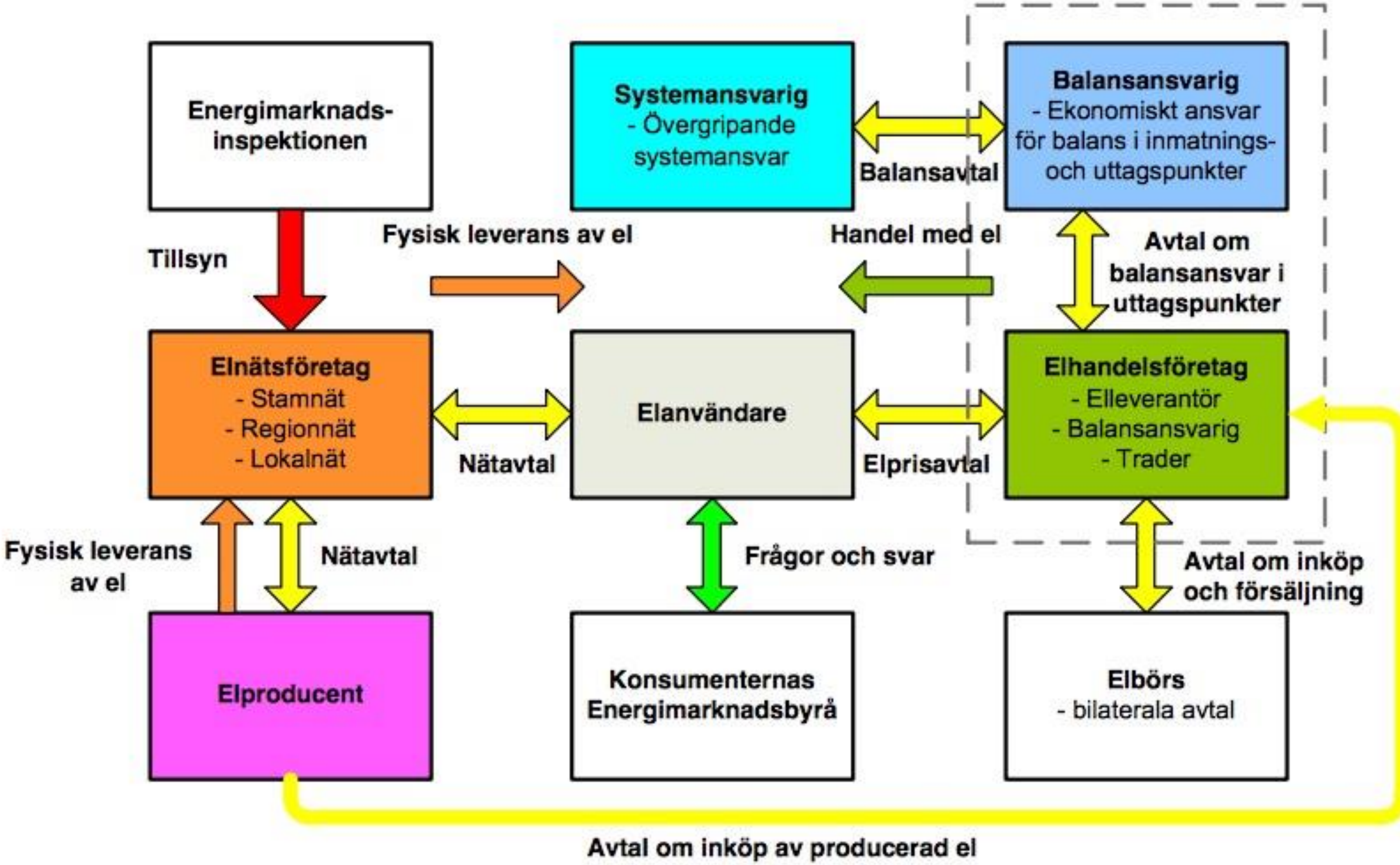
Figur 2: Spotpriser i Tyskland och Sverige 1- 7 januari 2011, EUR/MWh

DSO Case

Figure 15: Decision making process for a provider of demand response



Relationerna mellan aktörerna



talkostnader består av kostnader för avskrivningar och avkastning på kapital. stningen styrs av WACC-räntan, (*Weighted Average Capital Cost*). WACC-an beräknas på kapitalbasen, som består av bland annat kablar, transforma-r och olika byggnader.

et av kapitalbasen bestäms utifrån inrapporterade uppgifter om elnätsföreta-anläggningar, vilka värderas med hjälp av en normprislista, men det går att begära en prövning om att få ersättning för anskaffningsvärde om det ett mervärde i en dyrare variant, exempelvis smartare teknologi. Kostna-a beräknas på antingen 10 eller 40 års avskrivningstid. Intäktsramen justeras öretaget presterar bättre eller sämre, vilket mäts genom olika indikatorer. e och kortare avbrott, låga nätförluster, jämn belastning (lastfaktor) och låga nader för överliggande och angränsande nät leder till att intäktsramen juste-uppåt med upp till 5 procent. Tvärtom sänks intäktsramen med upp till 5 pro-om företagen presterar sämre.

rkbara löpande kostnader inkluderar drift och underhåll av nätet samt kund-nader såsom mätning, beräkning och rapportering. Dessa baseras på histo-kostnader, som varje år justeras ner enligt ett effektiviseringskrav. Detta då man förväntar sig att företagen ökar sin produktivitet. Effektiviseringskra-sätts enskilt för varje företag, och är under nuvarande tillsynsperiod mellan 1 1,82 procent per år.

verkbara löpande kostnader ersätts fullt ut och inkluderar kostnader för nät-ster, abonnemang till överliggande och angränsande nät och kostnader för dighetsavgifter.

tsramen överskrids med mer än 5 procent kan Energimarknadsinspektionen en straffavgift.

gen är fria att själva utforma sina nättariffer, under förutsättning att de inte der sin intäktsram och att tarifferna är objektiva och icke-diskriminerande ormas på ett sätt som är förenligt med ett effektivt utnyttjande av elnätet. r i tariffer får förekomma mellan olika kundkategorier och olika typer av tarif-ndas, givet att skillnader kan motiveras av kostnadsskillnader och att alla rbjuds samma alternativ.

marknadsinspektionen

- *Operational costs* are the sum of *non-controllable* and *controllable* costs.
  - *Non-controllable costs* relate to costs that are considered difficult for the DSO is for instance the cost to the feeding grid, the cost of purchasing energy losse However, with new techniques and solutions, some of those costs can to some which in turn has motivated new incentive schemes since 2016.
  - *Controllable costs* relate to other operational costs that the DSO can control include all expenses associated with the operation of the grid, than those controllable costs".
    - To simulate conditions on a non-monopoly market, Ei added an *effic* of which those cost shall decrease each year.
- *Capital costs* consists of *depreciation* and *return*.
  - The regulatory *asset base* is the sum of all present purchase values (PPV) according to Ei's directives. The asset base is input to calculation of *capital*
  - The underlying calculation of *depreciation* and *return* is described later in thi
    - The *return* is sometimes *adjusted* by incentive schemes: reliabili efficiency. These are described later in the paper
    - The adjustments are limited to ±5 % of the revenue cap.
- The sums of the operational and capital costs are *adjusted for last period's over- or un*
- The result of this gives the company's *revenue cap regarding a 4 year period*.

The share between different cost categories vary between DSOs and years. In average, the sha costs ~23 %, non-controllable costs ~33 % and capital costs ~44 %

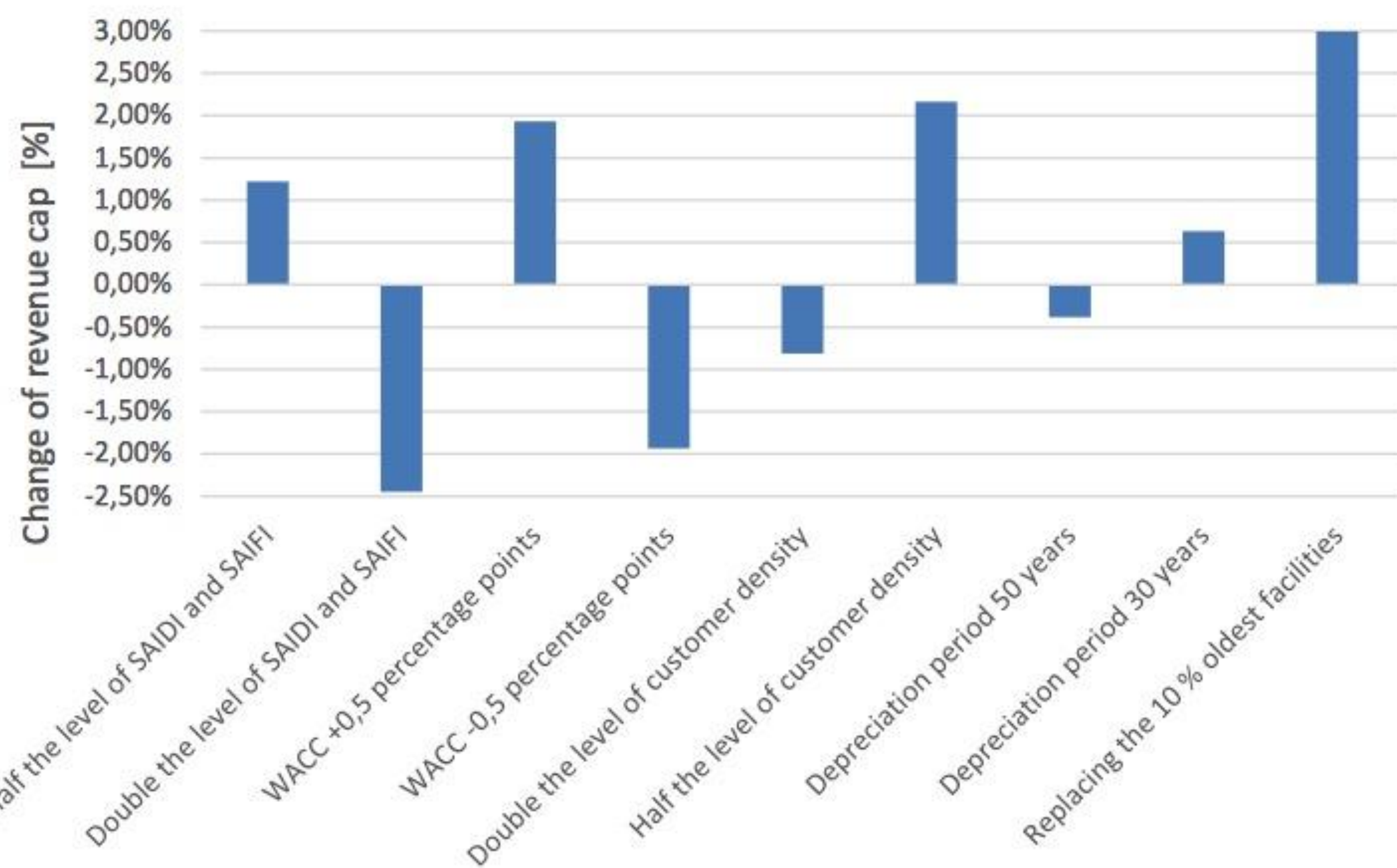


Figure 7 Examples of overall sensitivity analyses results regarding the current regulation

För att efterfrågeflexibilitet ska kunna vara en del av lösningen på kraftsystemets utmaningar behöver vi riva ner hindren:

1. Kundernas kännedom och intresse för efterfrågeflexibilitet är lågt.
2. Kunderna känner inte till sin egen potential för efterfrågeflexibilitet och det finns heller ingen teknik installerad hos hushållen som gör det enkelt för dem att erbjuda sin flexibilitet.
3. Idag finns ett begränsat utbud av smarta tjänster och avtal för kunder som vill vara flexibla. Det finns heller inget verktyg för att jämföra och utvärdera eventuella avtal och tjänster.
4. Slutligen finns det marknadsbarriärer och andra hinder för kunderna att sälja sin flexibilitet till marknaden eller till elnätsföretag.

NYTTOR FÖR EFTERFRÅGEFLEXIBILITET

FRAMTIDA UTMANINGAR	Cirka 100 procent av efterfrågeflexibiliteten utnyttjas ÅRLIG BESPARING	Cirka 50 procent av efterfrågeflexibiliteten utnyttjas ÅRLIG BESPARING
Frekvenshållning	370 miljoner kr	370 miljoner kr
Effektbristsituation	128 miljoner kr	128 miljoner kr
Ineffektiv resursanvändning	675 miljoner kr	381 miljoner kr
Lokala nätproblem	587 miljoner kr	294 miljoner kr

KOSTNADER FÖR EFTERFRÅGEFLEXIBILITET

ÅTGÄRD	ENGÅNGSKOSTNADER	ÅRLIG KOSTNAD
Investeringsstöd för styrutrustning av värmelaster		200,5 miljoner kr
Kundanpassad information om efterfrågeflexibilitet	20 miljoner kr	
Information om tariffer till kund		1 miljon kr
Timmätning och dygnsvis timavräkning för samtliga kunder		567 miljoner kr
Nättariffer på Elpriskollen	1,5 miljoner kr	0,5 miljoner kr
Total kostnad	21,5 miljoner kr	769 miljoner kr

Tabell 6. Faktorer som bestämmer marknadsvärdet av flexibilitet på olika marknadsplatser

Marknadsplats/marknadsaktör	**Faktorer som bestämmer marknadsvärdet av flexibilitet**
Dagen före-marknaden	Prisvolatilitet, dvs. prisskillnader mellan timmar. Även den absoluta prisnivån spelar roll för flexibilitetens värde.
Intradagsmarknaden	Prisskillnaden mellan intradag- och dagen före-marknaden, plus värdet av flexibilitetsresurser som inte aktiveras på dagen före-marknaden.
Balansmarknaden	Ersättning på reglerkraftmarknaden och marknaderna för automatiska reserver.
Elnätsföretag	Nättariffernas struktur samt ersättning för direkt laststyrning.
Effektreserven	Ersättning med en fast och en rörlig del för att reservera produktionskapacitet eller minskad förbrukning som kan aktiveras vid elbristsituationer.

Källa: Ei

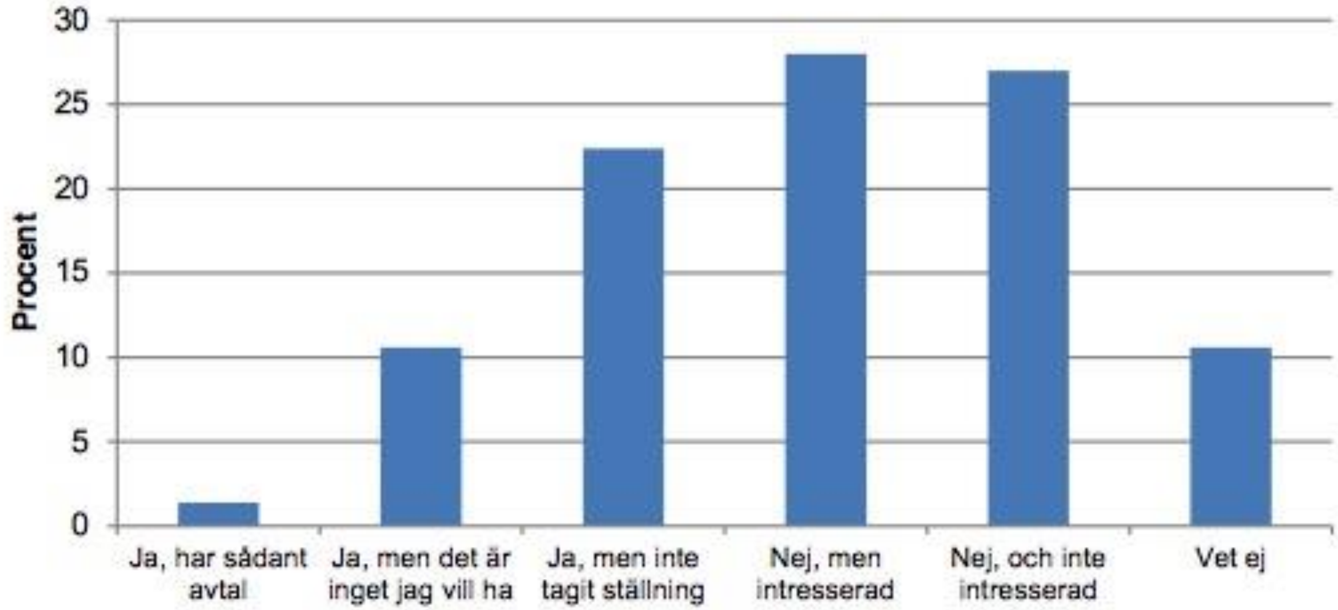
Kunderna kan bidra med sin flexibilitet och bli ersatt för denna genom *implicit* eller *explicit efterfrågeflexibilitet* (Smart Grid Task Force, 2015b).

Implicit efterfrågeflexibilitet, som även kallas för prisbaserad efterfrågeflexibilitet, innebär att kunden genom olika avtalsformer väljer tidsvarierande elhandelspriser och nättariffer. Kunderna kan med implicit efterfrågeflexibilitet påverka sin totala elkostnad genom att anpassa sin förbrukning efter variationer i slutkundspriset mellan timmar.

Explicit efterfrågeflexibilitet innebär att kunderna blir kompenserade för att använda mer eller mindre el under en given tidsperiod. Den energi som frigörs på detta sätt kan erbjudas olika marknadsplatser (exempelvis intradag- eller reglerkraftmarknaden) eller användas i andra syften (exempelvis lokal nätnytta). Explicit efterfrågeflexibilitet innebär en hårdare styrning av användaren, genom exempelvis laststyrning, jämfört med implicit efterfrågeflexibilitet eftersom återförsäljningen av den frigjorda kapaciteten måste kunna garanteras.

Innehavare av en flexibel resurs (förbrukning såväl som produktion) kan få intäktsströmmar från dagen före-marknaden, intradag- och balansmarknaden samt från effektreserven och sitt elnätsföretag. Flexibiliteten kan därmed sägas vara prissatt i elsystemet. I Tabell 6 redogörs för faktorer som bestämmer marknadsvärdet av efterfrågeflexibilitet.

Figur 4: Andelen hushåll med timprisavtal, och om de känner till att sådana avtal finns.



På en fråga om de ”skulle kunna tänka” sig att betala ett företag för en analys av hushållets energianvändning för att få personliga energispartips har 67 procent av respondenterna svarat "Nej". Detta resultat kan kopplas till en misstro mot att låta kommersiella intressen få tillgång till information om våra levnadsvanor. I Figur 8 presenteras deskriptiv statistik för frågan om vilka aktörer hushållen vill ge tillåtelse att analysera deras elanvändning. I figuren kan det klart och tydligt utläsas att folk bryr sig om *vem* som analyserar deras elanvändning och i vilket syfte detta görs. Värt att notera är att cirka 18 procent av respondenterna har svarat att de inte vill att någon ska analysera deras energianvändning.

Tabell 4: Hushållens efterfrågan på olika typer av information.

Information om den egna elanvändningen historiskt						
	Högutbildade	Övriga	Alla	Högutbildade	Övriga	Alla
Ja	343	265	608	69%	63%	66%
Nej	108	101	209	22%	24%	23%
Vet ej	48	53	101	10%	13%	11%
Totalt	499	419	918	100%	100%	100%
Information om andra hushålls elanvändning						
	Högutbildade	Övriga	Alla	Högutbildade	Övriga	Alla
Ja	227	161	388	45%	38%	42%
Nej	226	198	424	45%	47%	46%
Vet ej	46	60	106	9%	14%	12%
Totalt	499	419	918	100%	100%	100%
Information om elförbrukning på apparatnivå						
	Högutbildade	Övriga	Alla	Högutbildade	Övriga	Alla
Ja	312	236	548	63%	56%	60%
Nej	135	132	267	27%	32%	29%
Vet ej	52	51	103	10%	12%	11%
Totalt	499	419	918	100%	100%	100%

5.2 Elnätsföretags drivkrafter för efterfrågeflexibilitet

Elnätsföretag är ansvariga för drift och utbyggnad av sina nät. De ska även mäta mängden överförd el för varje nätkund. Inom alla dessa områden finns nyttor och möjligheter med ökad efterfrågeflexibilitet (CEER, 2014; CEPA, 2014; SOU, 2014).

En möjlighet med efterfrågeflexibilitet ur ett elnätsperspektiv är ett jämnare uttag med minskade effekttoppar. En direkt följd av minskade effekttoppar är minskade nätförluster, eftersom förlusterna är proportionerliga till lasten i kvadrat (CEPA, 2014). En ytterligare nytta med minskat effektuttag på näten är sänkta kostnader för överliggande och angränsande nät, eftersom dessa beror på abonnerad eller uttagen effekt i gränspunkterna. Genom efterfrågeflexibilitet kan elnätsföretagen också undvika eller minska risken för avbrott (Nylén, 2011; THEMA Consulting Group, 2014)[89]. Efterfrågeflexibilitet kan dessutom användas av elnätsföretag för att undvika eller skjuta upp investeringar i elnäten, vilka normalt är mångdubbelt högre än kostnaderna för flexibiliteten (SOU, 2014). För att efterfrågeflexibilitet ska

kunna vara ett alternativ till nätutbyggnad måste den dock vara förutsägbar och stabil under en tillräckligt lång tid. Nyttor för elnätsföretaget av efterfrågeflexibilitet från hushållskunder genom minskade investeringar, nätförluster och kostnader till överliggande nät har uppskattats till cirka 13,7 EUR per kund och år (Koliou, et al., 2015).

Tabell 32. Kostnader för timmätning och dygnsavräkning uppskattad för olika aktörer

Aktör	Kostnad kommunikation (ökad datamängd)	Kostnad insamlingssystem (servar, databaser etc.)	Arbetstid DoU, frågehantering och kundkostnader	Total kostnad per år (SEK)
Elnätsföretag	Investering 23 kr per mätare (2,3 kr per mätare och år) Rörlig merkostnad 0,54 kr per mätare och år Rörlig merkostnad för dygnsavräkning 30 kr per mätare och år[148]	Investering 50 kr per mätare (5 kr per mätare och år)	Rörlig merkostnad 84 kr per mätare och år	Cirka 524 miljoner per år (4,3 miljoner mätare x (2,3+0,54+30+5+84) kr per mätare och år)

Nyttan av efterfrågeflexibilitet – Typproblem 3: Ineffektiv resursanvändning

- Nyttan, eller effektivitetsvinsten, av att få med efterfrågeflexibilitet i prisbildningen på dagen före-marknaden uppskattas till 675 miljoner kronor per år om samtliga hushållskunder i småhus är flexibla i sin elanvändning för uppvärmning. Om enbart 50 procent av hushållen i småhus väljer att vara flexibla uppskattas nyttan till 381 miljoner kronor per år.

Nyttan av efterfrågeflexibilitet – Typproblem 4: Lokala nätproblem

- Nyttan av efterfrågeflexibilitet för lokala nätproblem uppstår i form av kostnadsbesparingar för minskade nätförluster, kostnader för överliggande nät och minskat investeringsbehov i elnätet. Denna nytta uppskattas till 587 miljoner kronor per år om hushållskunderna i samtliga lokalnät i Sverige lyckas minska elanvändningen under höglasttimmarna med 10 procent genom att flytta elanvändning till låglasttimmar. Den antagna nivån av efterfrågeflexibilitet hos hushållskunder förväntas kunna uppnås som ett resultat av en tidsdifferentierad tariff. Om enbart 50 procent av hushållen väljer att vara flexibla uppskattas nyttan till 294 miljoner kronor per år.

Sammanlagd nytta för kunden från elhandel och elnät

- Total besparingspotential för en småhusägare 2030 som flyttar elanvändningen för uppvärmningen till närliggande timmar är cirka 1 200 kronor per år. Kunden kommer att ha tjänat in sin styrutrustning på cirka 4 år.
- Total besparingspotential för en kund 2030 som flyttar elanvändning under dygnets samtliga timmar är cirka 2500 kronor per år.

Tabell 22. Kostnadsbesparingar av efterfrågeflexibilitet från hushållskunder som medför att lokalnätet får en lastflytt på 10 % från höglasttimmar till låglasttimmar

	Årlig kostnadsbesparing (SEK per år och kund)
Nätförluster	19
Kostnader till överliggande nät	30
Nätinvesteringar	75

Källa: (Koliou, et al., 2015)

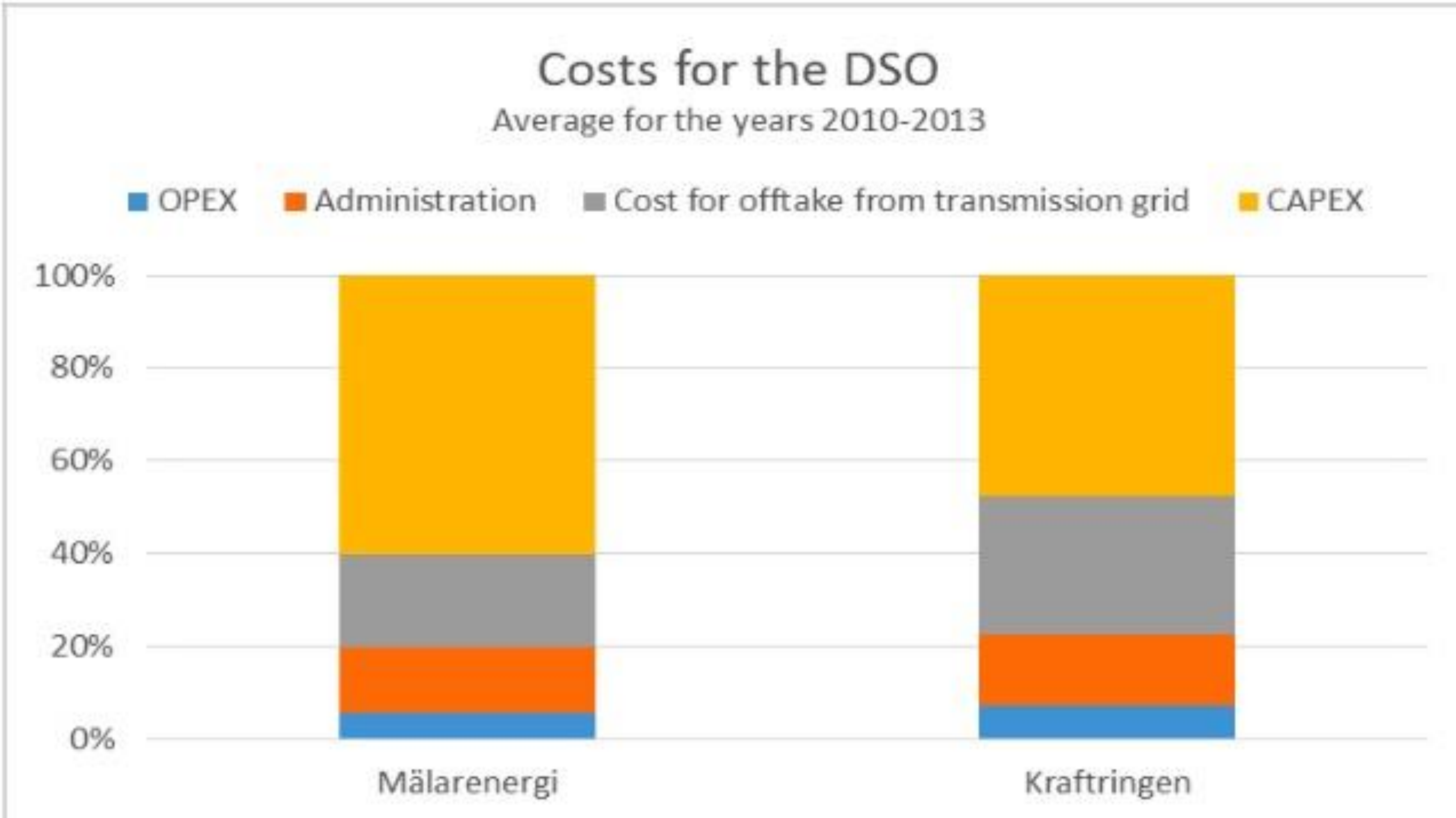
Tabell 32. Kostnader för timmätning och dygnsavräkning uppskattad för olika aktörer

Aktör	**Kostnad kommunikation (ökad datamängd)**	**Kostnad insamlingssystem (servar, databaser etc.)**	**Arbetstid DoU, frågehantering och kundkostnader**	**Total kostnad per år (SEK)**
Elnätsföretag	Investering 23 kr per mätare (2,3 kr per mätare och år) Rörlig merkostnad 0,54 kr per mätare och år Rörlig merkostnad för dygnsavräkning 30 kr per mätare och år[148]	Investering 50 kr per mätare (5 kr per mätare och år)	Rörlig merkostnad 84 kr per mätare och år	Cirka 524 miljoner per år (4,3 miljoner mätare x (2,3+0,54+30+5+84) kr per mätare och år)

Tabell 34. Uppskattade årliga nyttor av efterfrågeflexibilitet för varje typproblem (M SEK)

Typproblem eller framtida utmaningar	**Kunder som delar**	**Övre nyttoestimat** **100 procent av hushållskunderna i småhus är flexibla i sin elanvändning för uppvärmning** **Årlig besparing MSEK**	**Undre nyttoestimat** **50 procent av hushållskunderna i småhus är flexibla i sin elanvändning för uppvärmning** **Årlig besparing MSEK**
Frekvenshållning (automatisk reserv)	Hushållskunder	370	370
Effektbristsituation	Industrier och hushållskunder	128	128
Ineffektiv resursanvändning	Industrier och hushållskunder	675	381
Lokala nätproblem	Hushållskunder	587	294

Källa: Ei



Costs for the DSO
Average for the years 2010-2013
OPEX
Administration
Cost for offtake from transmission grid
CAPEX
100%
80%
60%
40%
20%
0%
Mälarenergi
Kraftringen

Vid avbrott på en eller flera faser som varar längre än 12 timmar är nätägaren skyldig att betala ut avbrottsersättning till kunden. För ett avbrott mellan 12 och 24 timmar ska en ersättning om 12,5 procent av kundens totala årliga nätavgift utbetalas. För ett avbrott längre än 24 timmar och för varje ny påbörjad 24-timmes period efter det ska en ersättning om 25 procent av kundens totala nätavgift betalas. Avbrottsersättningen får dock högst uppgå till 300 procent av kundens totala årliga nätavgift. (SFS 2013:884, kap 10) Ett avbrott på längre än 24 timmar innebär också att nätägaren begår lagbrott och måste betala vite samt lämna in en åtgärdsplan för att förbättra leveranssäkerheten till Energimarknadsinspektionen (Werther, 2014)

En nyckel till att kunna använda mätdata i driftverksamheten är mer information om lågspänningsnätet. Idag är mottagningsstationer, och hos vissa nätföretag även nätstationer, anslutna till olika driftövervakningssystem. Men på lägre nivå är det något av ”ett svart hål”. Driftpersonalen har i nuläget ganska dålig översikt över vad som händer på lågspänningsnätet. Det antas att allt fungerar tills en kund meddelar och rapporterar om avbrott. (Persson, 2013)

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Case in point: The US estimated potential value of smart grid analytics

As previously stated, Accenture's analysis suggests that the potential value of smart grid analytics, at a conservative estimate, could approach $40 to $70 per electric meter per year, with estimated benefits generally split with 60 percent benefit to the consumer and 40 percent to the utility. Figure 4 illustrates potential annual savings from AMI analytics in various business areas, created for a representative US utility.

The bulk of the benefits to utilities, up to 85 percent, are derived from four main categories:

- Asset management
- Power quality
- Revenue protection and billing
- Outage and fault intelligence

Using data from Figure 4, the estimated share of annual savings per meter from AMI analytics, by business area, is shown as percentages in Figure 5.

Figure 4. Estimated average annual savings from AMI analytics, by business area, on a US dollar-per-meter basis (representative US utility).

Note: NOC: network operations center; SOC: smart operations center.
Source: Accenture analysis, 2013.

Case in point: The US estimated potential value of smart grid analytics

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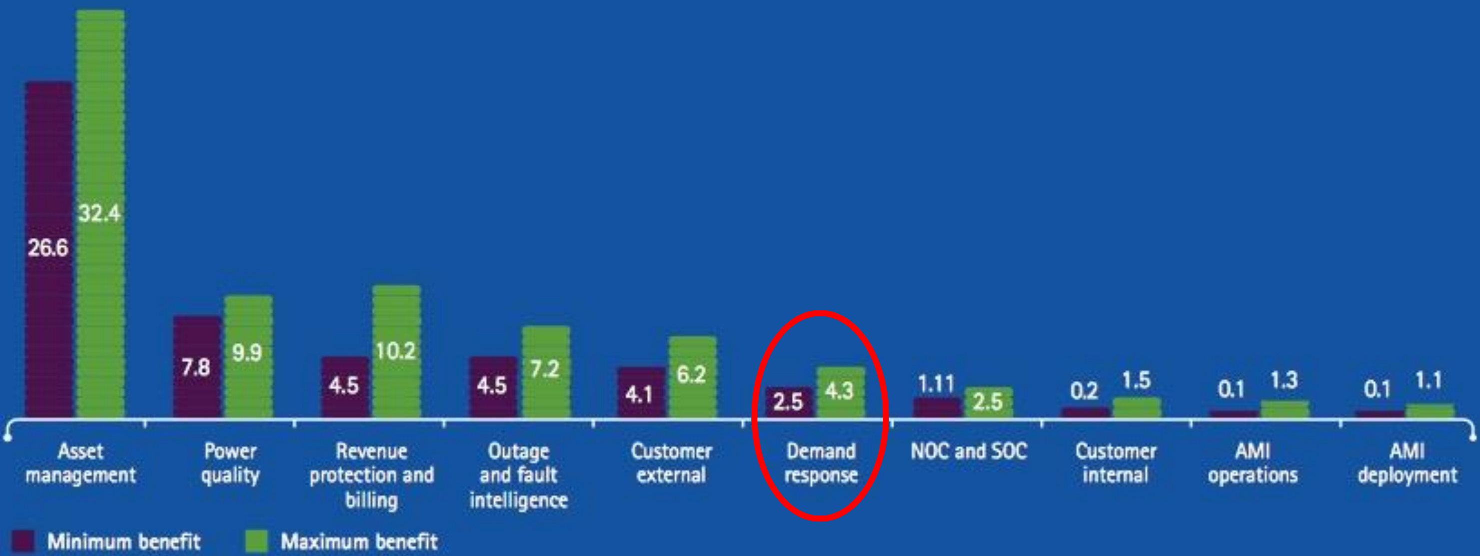
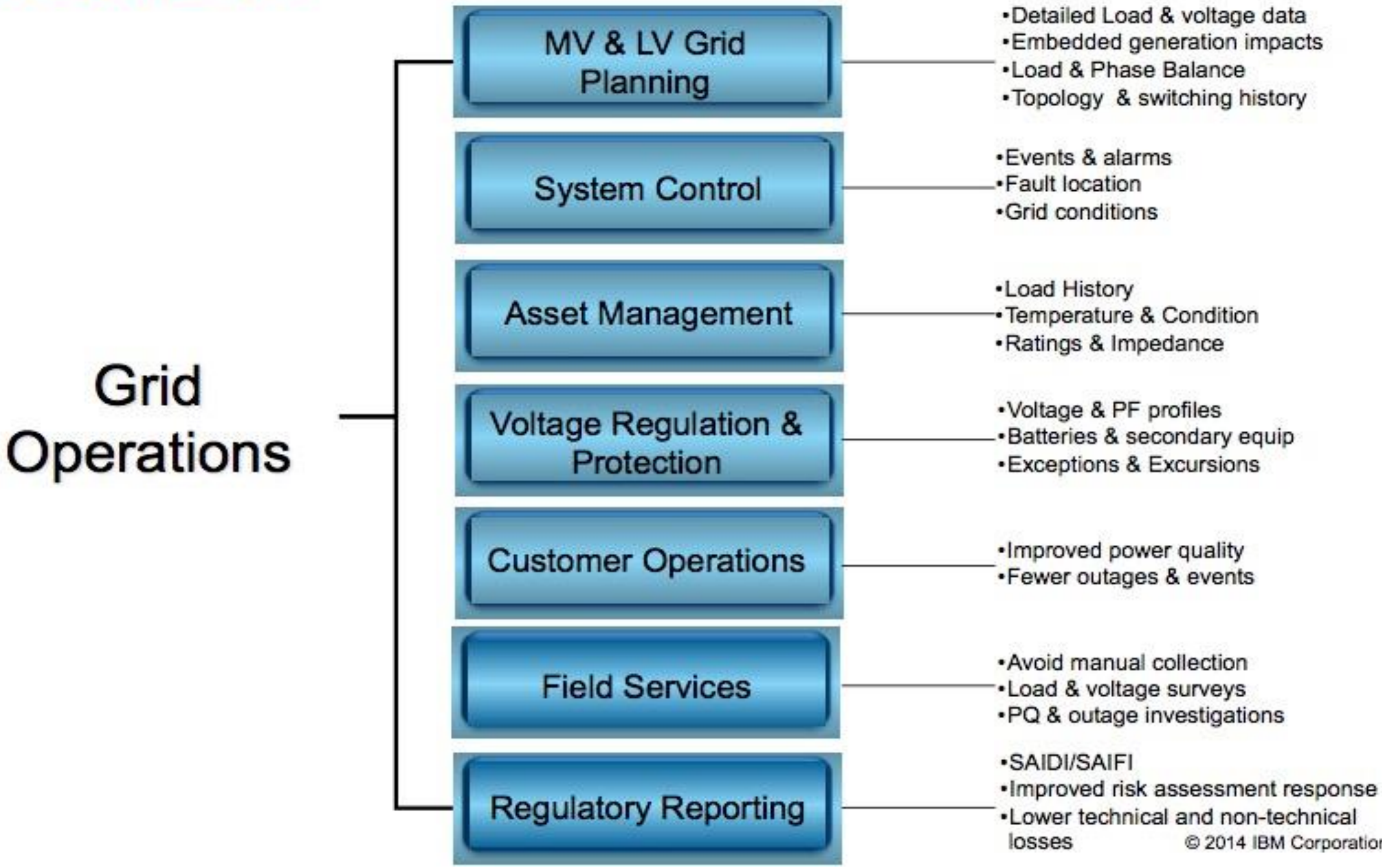


Note: NOC: network operations center; SOC: smart operations center.
Source: Accenture analysis, 2013.

IBM

Big data & analytics capabilities can drive real business value from **Grid Operations**



Retail Case

Findings

- Switch rates are >15% in the Nordics. Lower in southern Europe
- A customer in in contact with supplier 1,3 time/year
- Average full cost to acquire a new customer is 80€
- Average cost to serve a customer is 26,8€
- A Spanish retailer used big data analytics for better segmentation and reduced churn by 50% in 2 years. Acquisition cost was reduced by 50% and time to form a new campaign by 70%

Conclusion

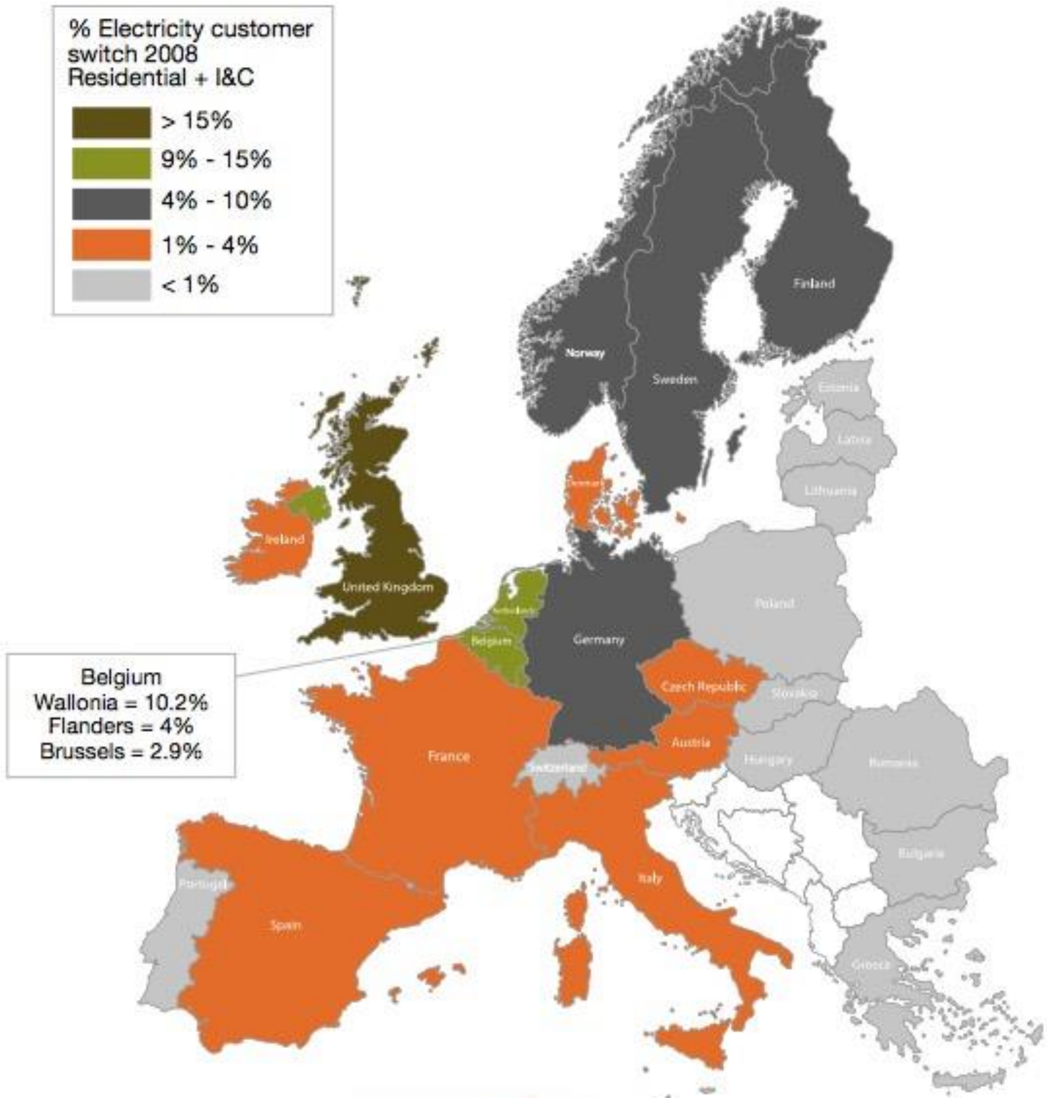
Consumers are dramatically reshaping the utility industry — and, as a result, the value of world-class customer engagement is becoming clearer than ever before. Based on our experience with over 95 utilities in nine countries, we've found that utilities can increase the return on their customer relationships by 20-55% and earn €15-€40 annually for every household they engage.

Key engagement goals	**Programme goals**	**Annual benefit per household**
Customer relationship	Reduced churn and increased acquisition	€3-€8
Digital engagement	Lower cost to serve	€7-€11
Marketing effectiveness	Increased cross-sell and up-sell	€1-€10
Demand response	Improved load management	€0.5-€3
Efficient behaviour	*Energy efficiency**	*€3-€8*
Total expected benefits per household		**€15-€40**

FIGURE 10: ANNUAL COST SAVINGS AND INCREASED PROFIT FROM INTEGRATED CUSTOMER ENGAGEMENT SOLUTIONS

* Efficiency is a future value driver in most European markets but will become more relevant as the Energy Efficiency Directive policy frameworks are established.

Figure 3: Switch Rates across Europe (2008)



Research provided courtesy of vaasa ett

Figure 8: Cost to Serve tree – average costs

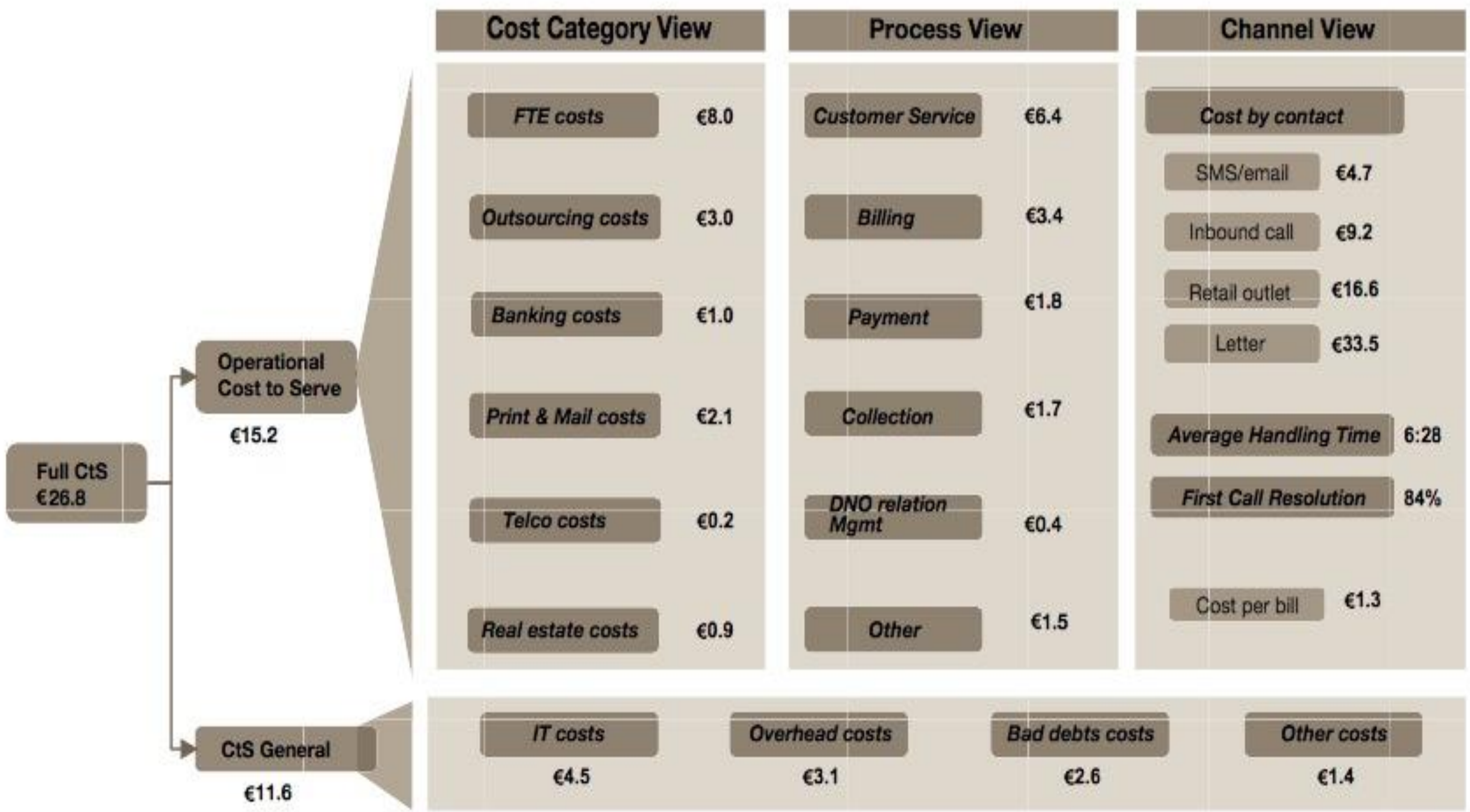
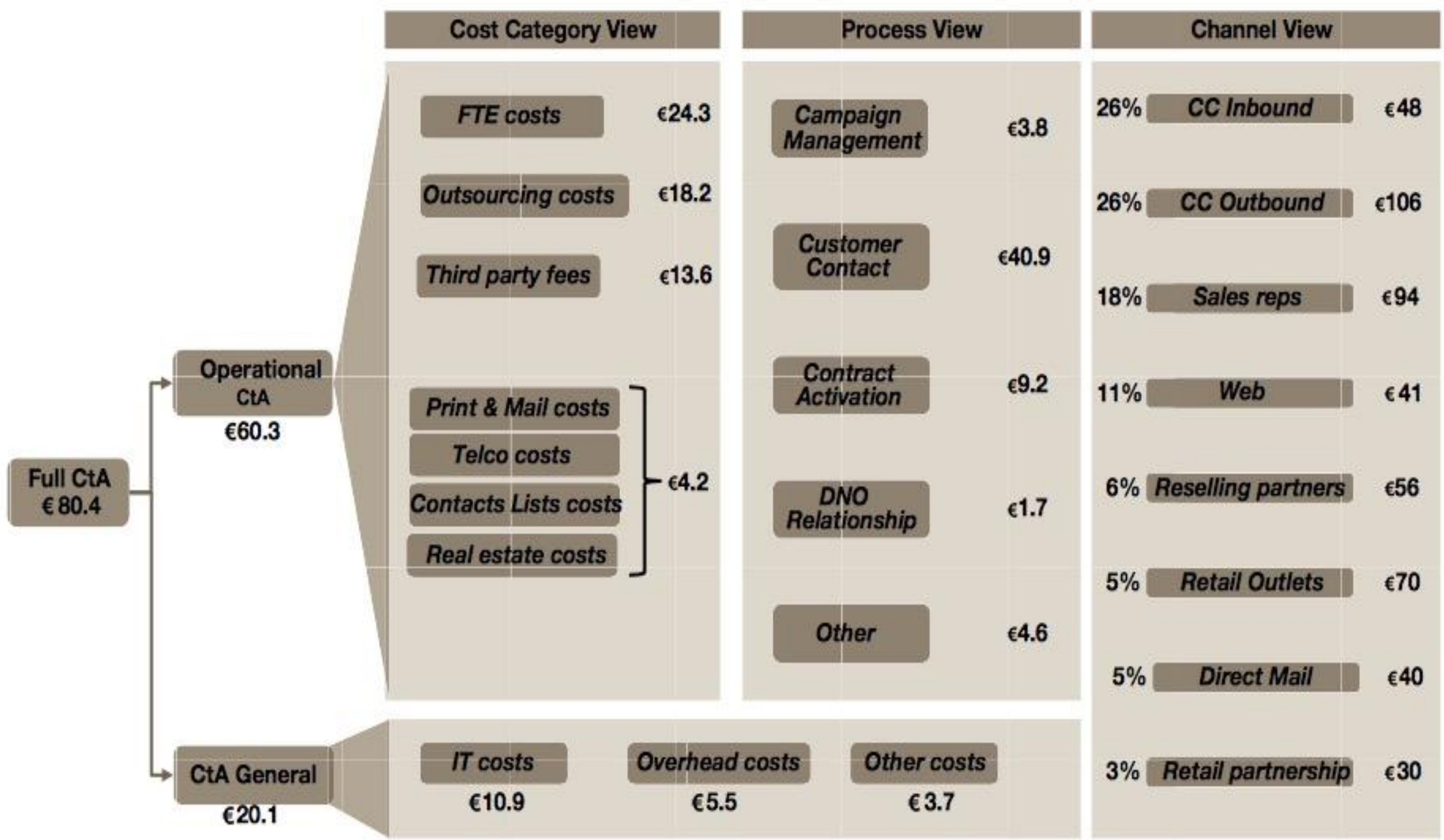


Figure 12: Cost to Acquire tree – average costs



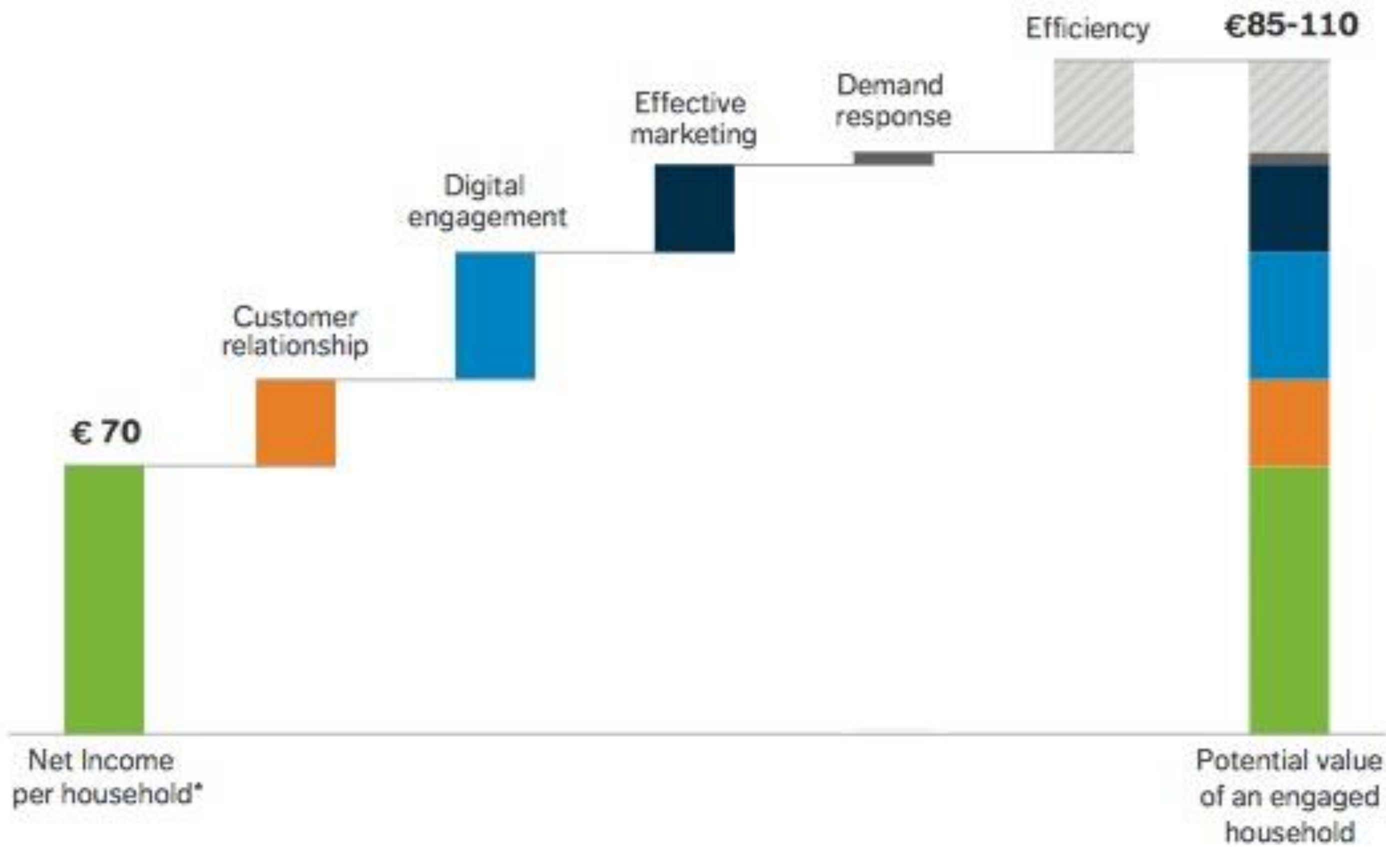


FIGURE 1: PROJECTED VALUE THAT A BETTER CUSTOMER RELATIONSHIP CAN DRIVE

Illustrative values based on typical European figures

Figure 2: Methodology – Drivers, Explanation and Observation

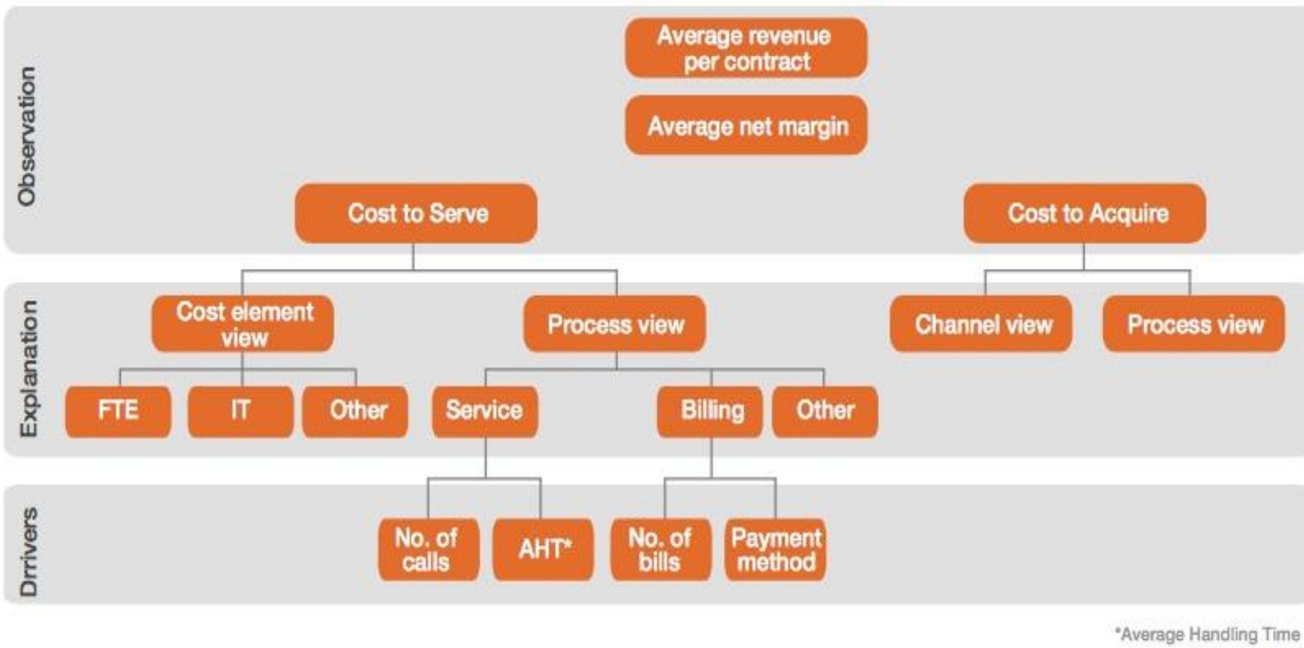


Figure 8: Number of contacts per contract per year

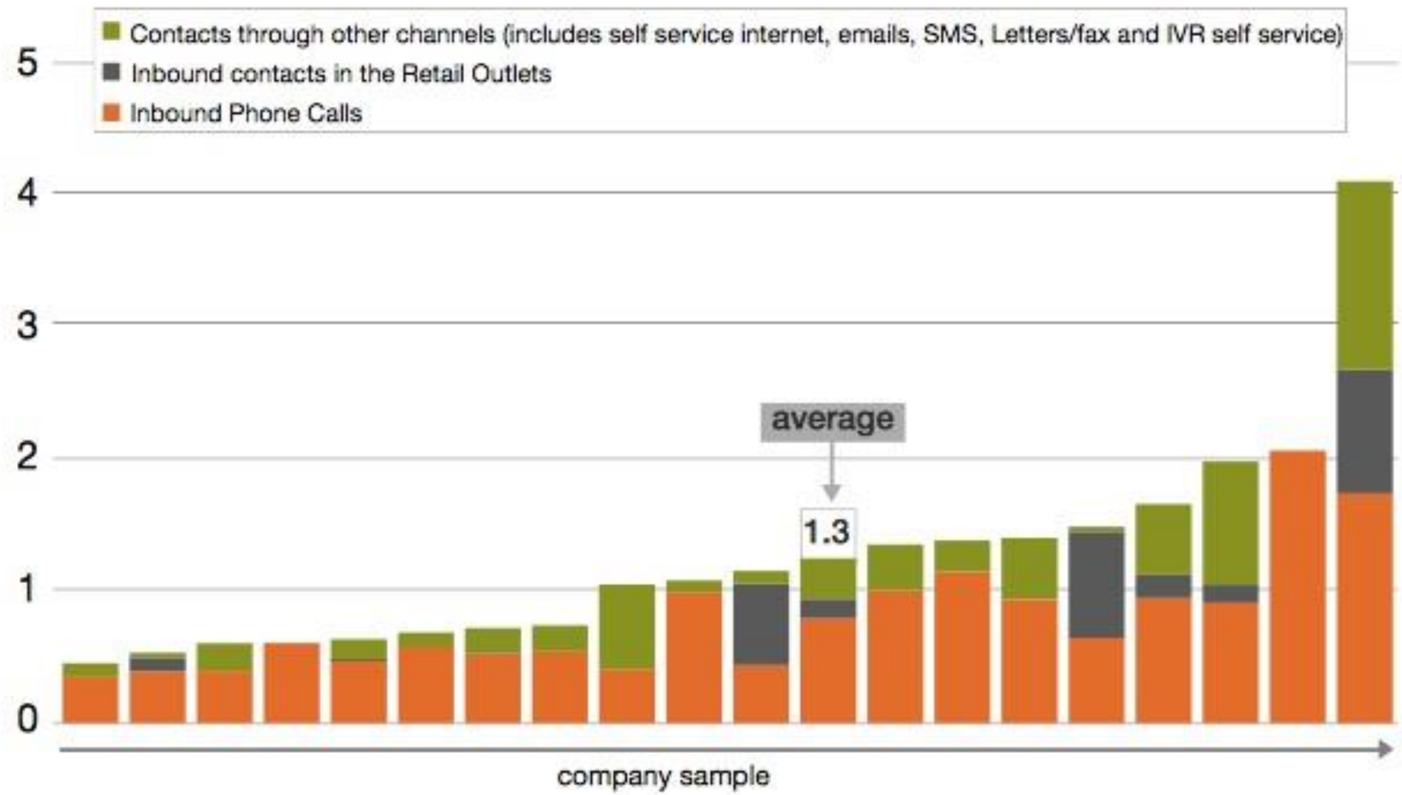


Figure 11: Full Cost to Acquire (corrected with ppp index)

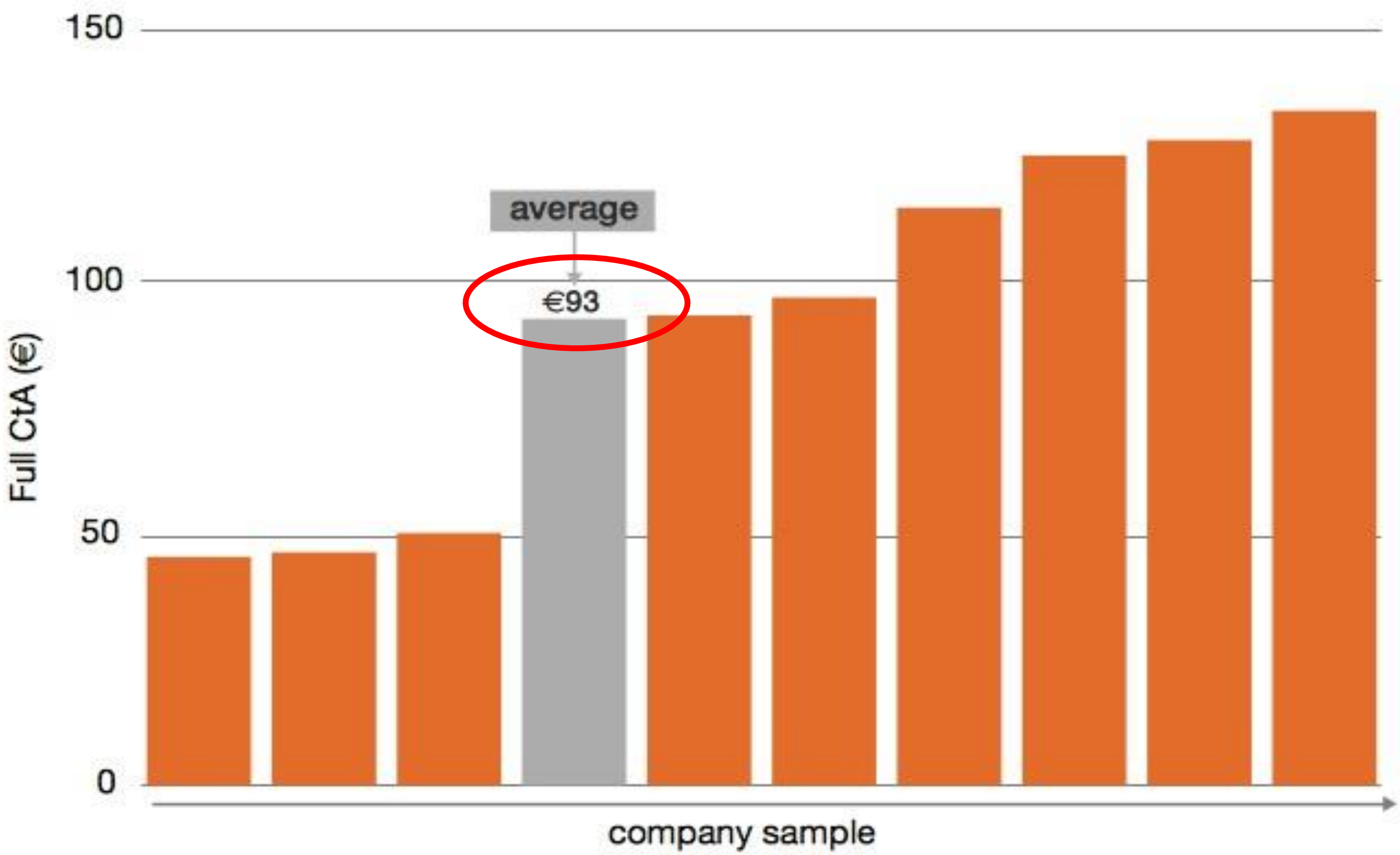


Exhibit 2 | Three High-Potential Opportunities for Retail Energy Providers

Tactic	Examples	Sources of value	Total EBIT impact (%)
Accelerate customer insight	Improve bundling, cross-selling, and up-selling	Increase product penetration and revenues	7–20
	Boost retention	Reduce acquisition spending and churn	
Streamline business processes	Reduce bad debt	Improve recovery rates	6–11
	Increase billing and monitoring accuracy	Lower complaint-handling costs and increase revenues	
	Improve management of customer complaints	Boost customer advocacy	
Establish a beachhead in the ecosystem	Create affinity deals through customer access	Generate advertising and commission revenues	7–22
	Sell insights gleaned from data	Create new sources of revenue growth	

Source: BCG analysis.
Note: EBIT = earnings before interest and taxes.

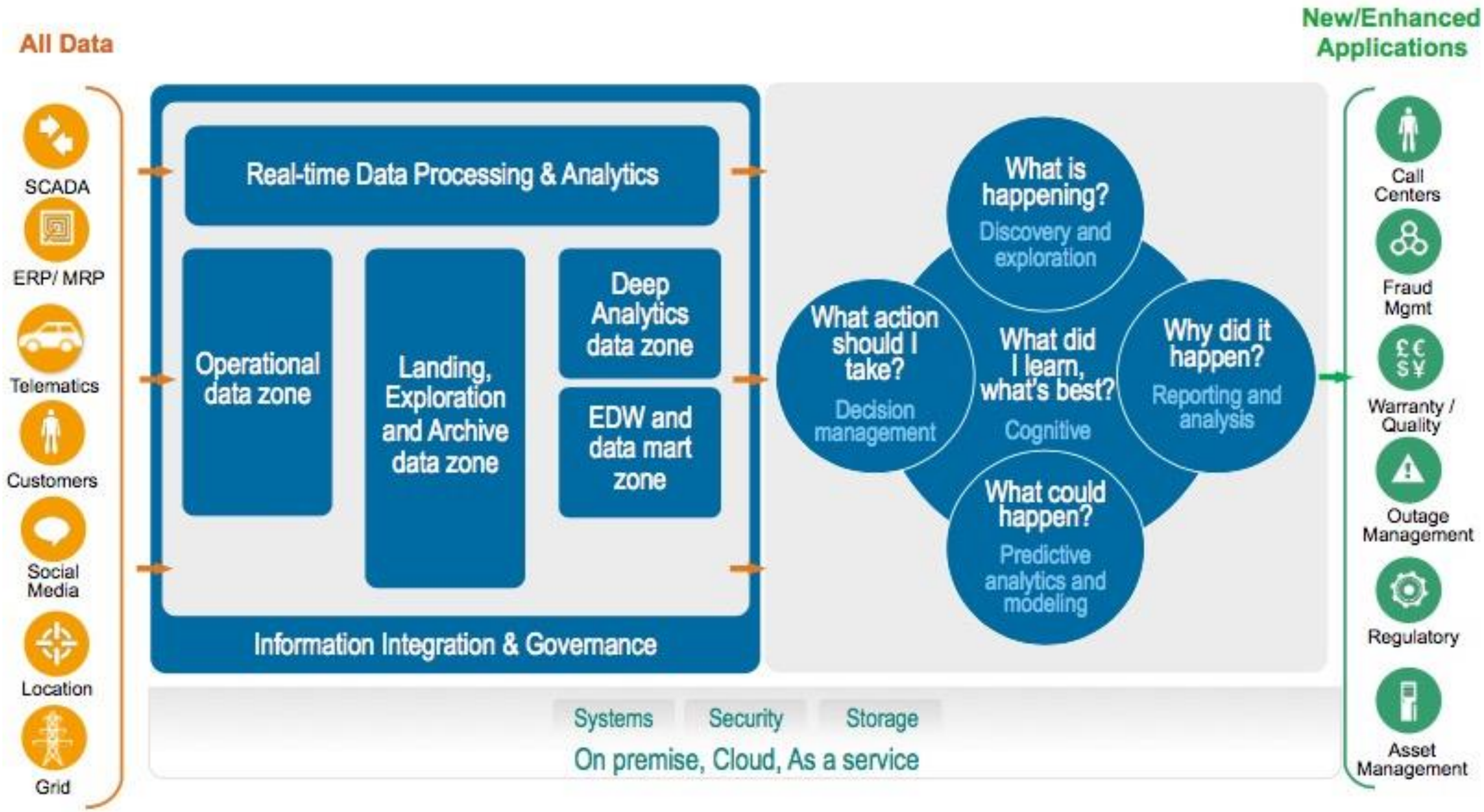
Endesa Uses Analytics to Reduce Churn By 50%

Endesa is a leading electricity dealer and second-largest gas vendor in Spain. The company wanted to acquire and retain customers in a deregulated and highly competitive energy market. Implementing an analytics solution helped the company to segment and better understand its customer base and streamline campaign management. This in turn helped build customer loyalty and acquire new customers. Endesa reduced churn by 50% in two years, reduced customer acquisition costs by 50%, and improved cross-selling. It also furnished Endesa with a 70% reduction in the time required to design new campaigns and generate a target customer list.

Source: SAS client case study

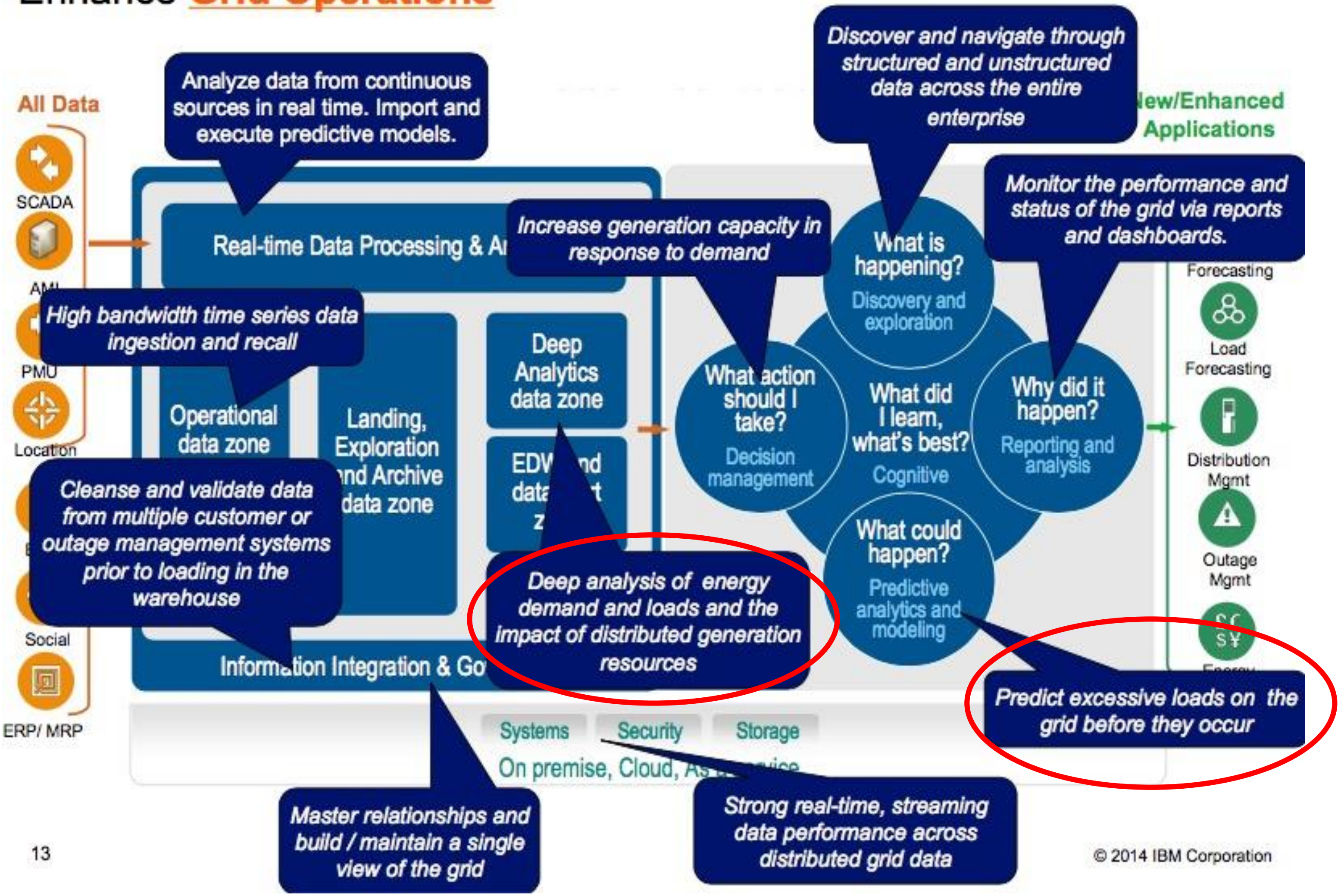
Demand Response Case

Big data & analytics capabilities are required to address these challenges and opportunities

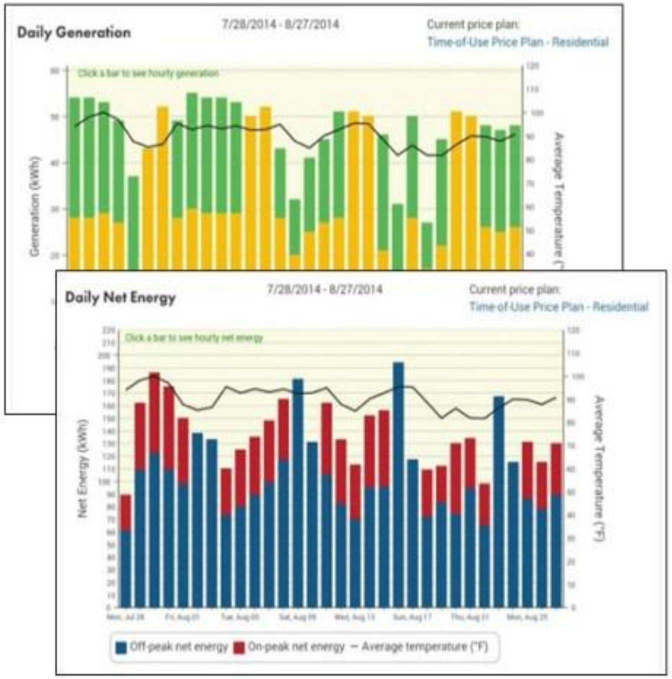


General findings

Enhance Grid Operations



The Big Data Utilities Opportunity



How can you couple customer energy usage behaviors with intelligent devices and smart grid to deliver evidence-based recommendations to home and business customers to:

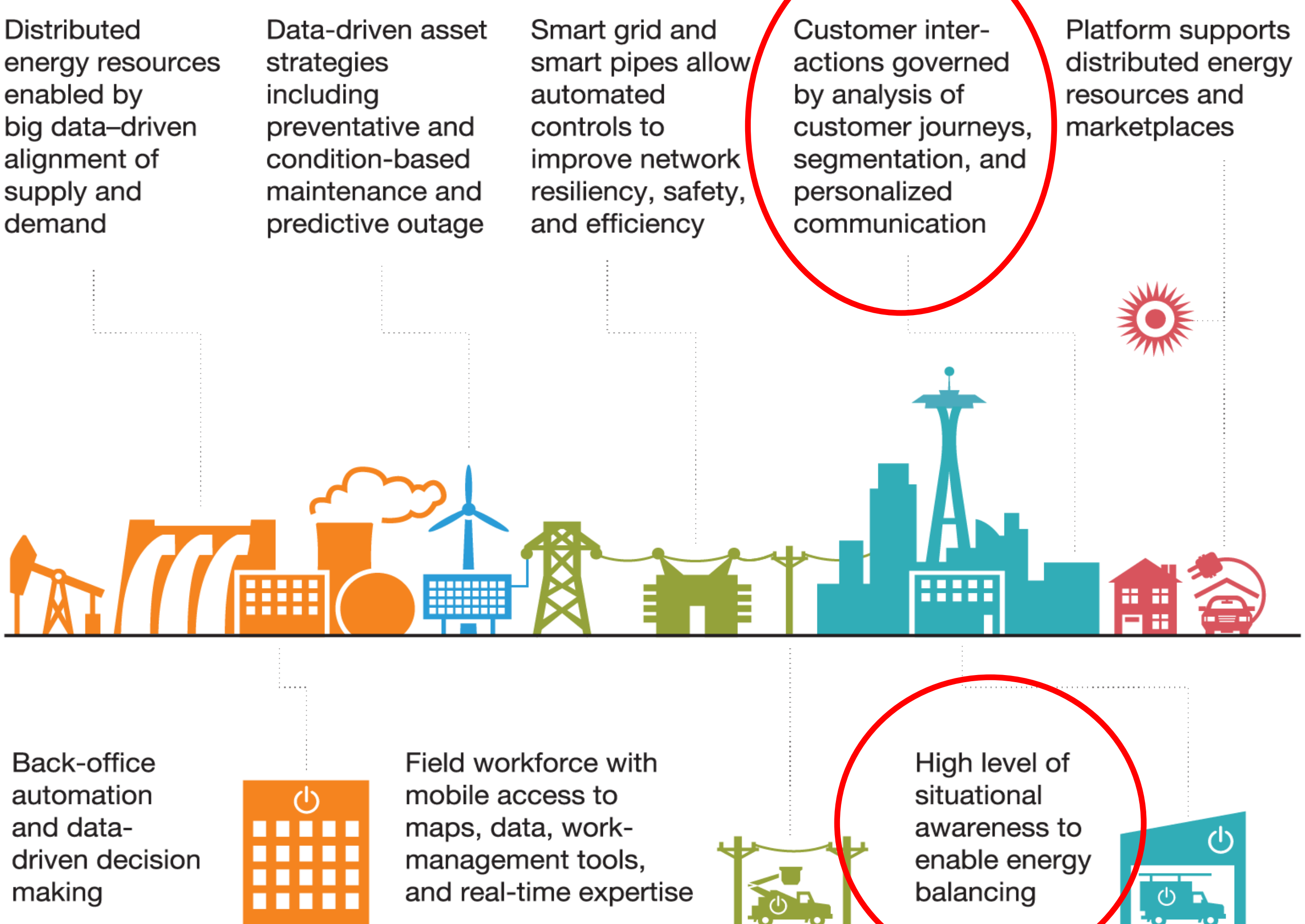
- Increase customer satisfaction
- Improve energy production and transmission reliability and efficiency
- Optimize maintenance and parts inventory
- More accurately forecast demand
- Accelerate conservation efforts
- Optimize home & business customers energy usage

Big Data Analytics for Utilities – Indicative Use Cases

Big Data and analytics can help utilities improve operational efficiency and customer experience. Operational benefits include revenue assurance, network and production management, demand forecast, asset management, and optimization of support functions. Similarly, analytics helps improve customer experience through customer relationship optimization, proactive marketing and custom offers and services.

Marketing and Customer Care			Operations				
Offer and services	Proactive marketing	Network and production management	Support function optimization	Asset management	Demand forecast	Customer relationship optimization	Revenue assurance
• Tariff optimization	• Customer base management	• Customer base management	• Supply chain	• Real-time asset performance monitoring	• Energy consumption forecasts	• Electricity load optimization	• Fraud detection
• Services: energy management tools, smart home	• Brand & communication (e-listening, web analytics, media campaign optimization)	• Brand & communication (e-listening, web analytics, media campaign optimization)		• Predictive maintenance	• Trading optimization	• Capacity planning (including renewable energy)	• Network loss prevention

The digital utility of the future captures opportunities all along the value chain.



McKinsey&Company

Figure 1: Analytics can perform tasks ranging from simple descriptions to more complex capabilities that predict outcomes or help determine which actions to take

Prescriptive

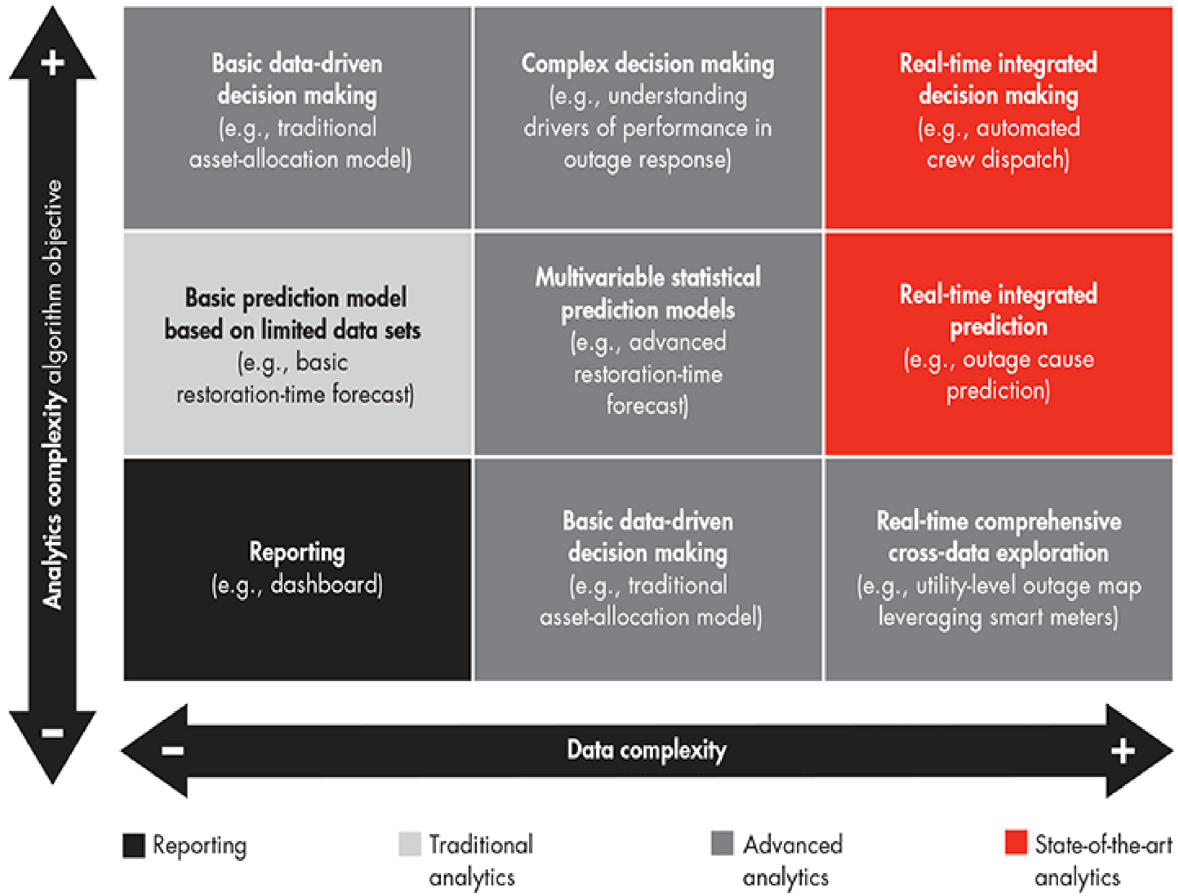
The most sophisticated analytics capabilities go beyond monitoring systems and equipment, and make recommendations for preventative or optimizing actions

Predictive

Midlevel analytics offer insight on risks to operations and the potential for outages or other types of failures

Descriptive

Basic analytics give a view of operational and financial performance, through dashboards or even real-time maps that use sensor and smart-meter data to show usage



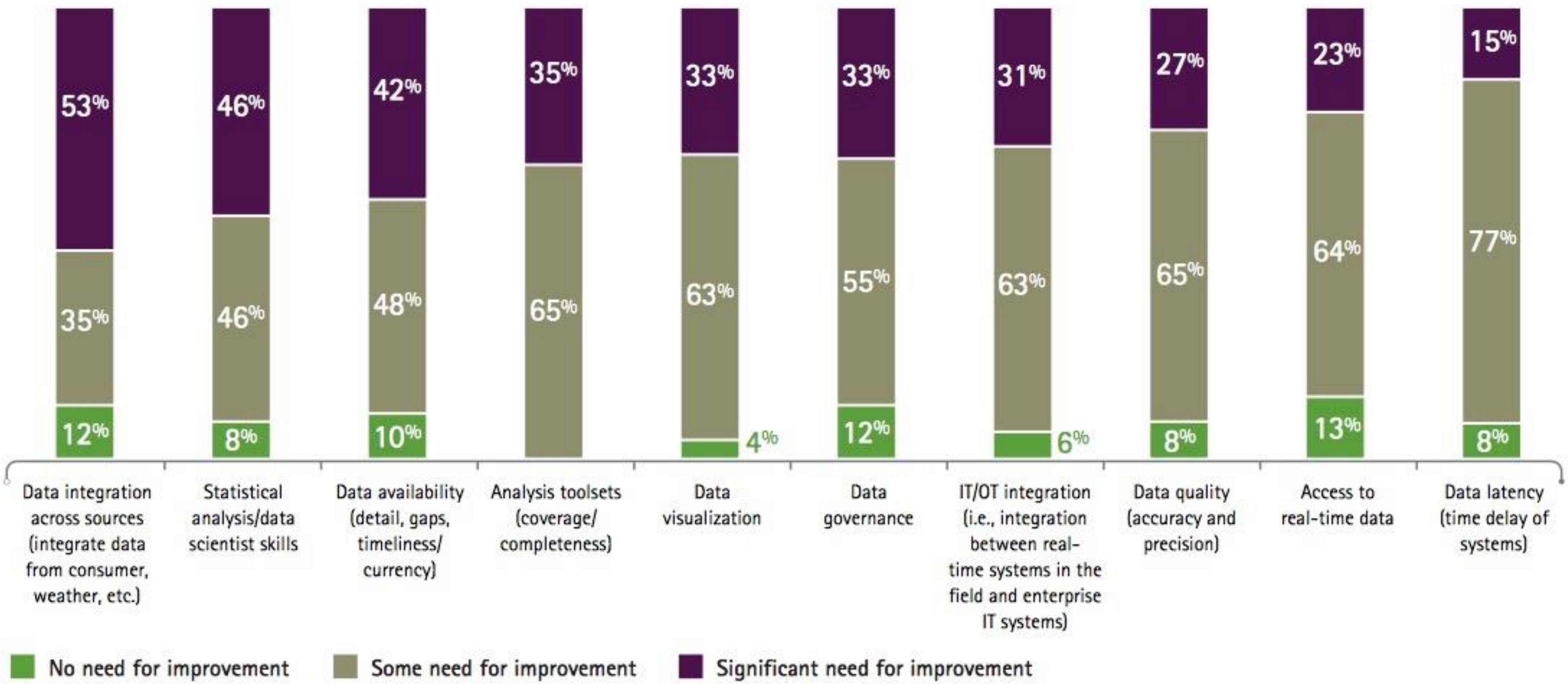
Source: Bain & Company

Table 2. 10 priority use cases that can drive significant value for utilities.

Opportunity Areas	Drivers
Revenue protection	Detecting unauthorized use and configuration errors and recovering lost revenue
Voltage optimization	Using asset-condition models to refine operational settings of assets to save on power costs
Demand-response effectiveness	Increasing participation in demand-response programs and improving savings achieved from load control
Load forecasting and planning	Improving long-term investment planning based on bottom-up demand and asset load and condition indexes
Outage detection and response	Reducing outage costs from enhanced response to outages (detection, isolation and restoration)
Outage prevention	Reducing equipment outages by focusing on assets with highest risk of failure
Investment planning	Revising priorities of asset investments based on analysis of asset risk and consumer impact
Maintenance strategies	Revising maintenance strategies, policies and programs based on condition and risk analytics
Energy efficiency	Identifying and helping consumers improve value from energy and energy efficiency
Energy services	Targeting consumers for services and pricing to help improve value from energy and with adoption of new uses (e.g., use of distributed generation, photovoltaics)

Figure 2. Maturity assessment of current analytics capabilities.

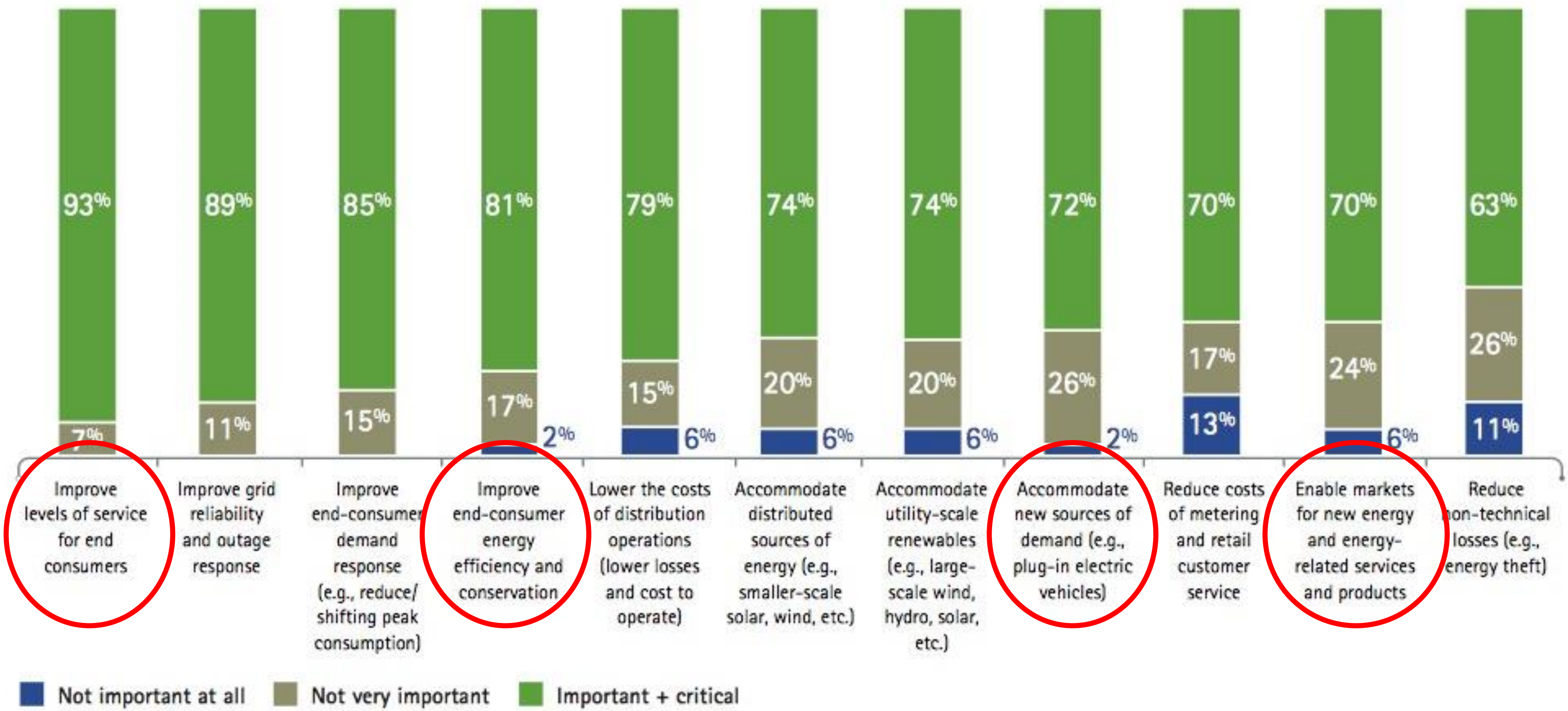
How would you assess the maturity of your current analytic capabilities in each of the following areas?



Base: All respondents, analytics section.
Source: Accenture's Digitally Enabled Grid program, 2013 executive survey.

Figure 15. Importance of value levers in the decision to deploy smart grid solutions.

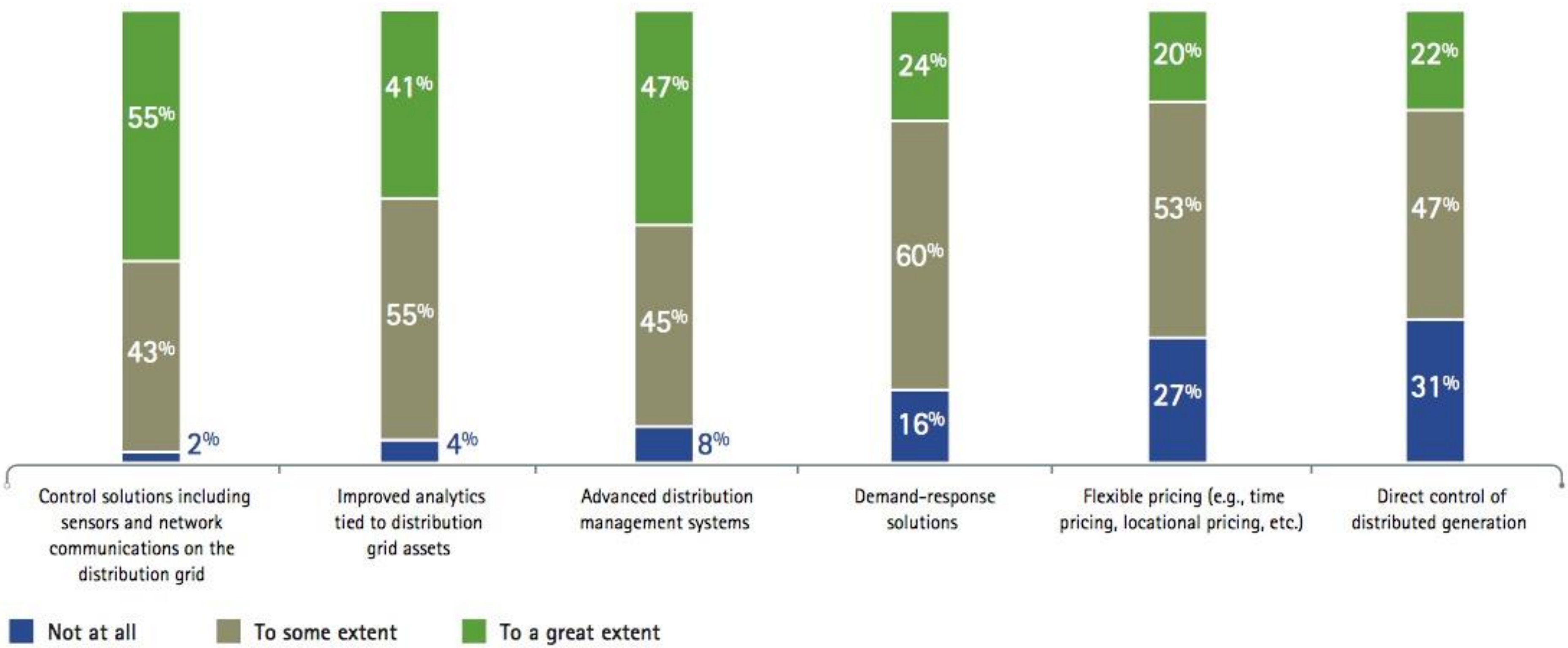
What is or would be the importance of the following value levers in the decision to deploy smart solutions in your company?



Base: All respondents.
Source: Accenture's Digitally Enabled Grid program, 2013 executive survey.

Figure 6. Capabilities to enable improved grid operations management.

To what extent would the following enable improved grid operations management?



Base: All respondents, grid operations section.
Source: Accenture's Digitally Enabled Grid program, 2013 executive survey.

Market analyst GTM Research predicts global utility company expenditure on data analytics will grow from US$700million in 2012 to US$3.8bn in 2020, with gas, electricity, and water suppliers in all regions of the world increasing their investment https://www.engerati.com/article/big-data-analytics-potential-utilities-profit

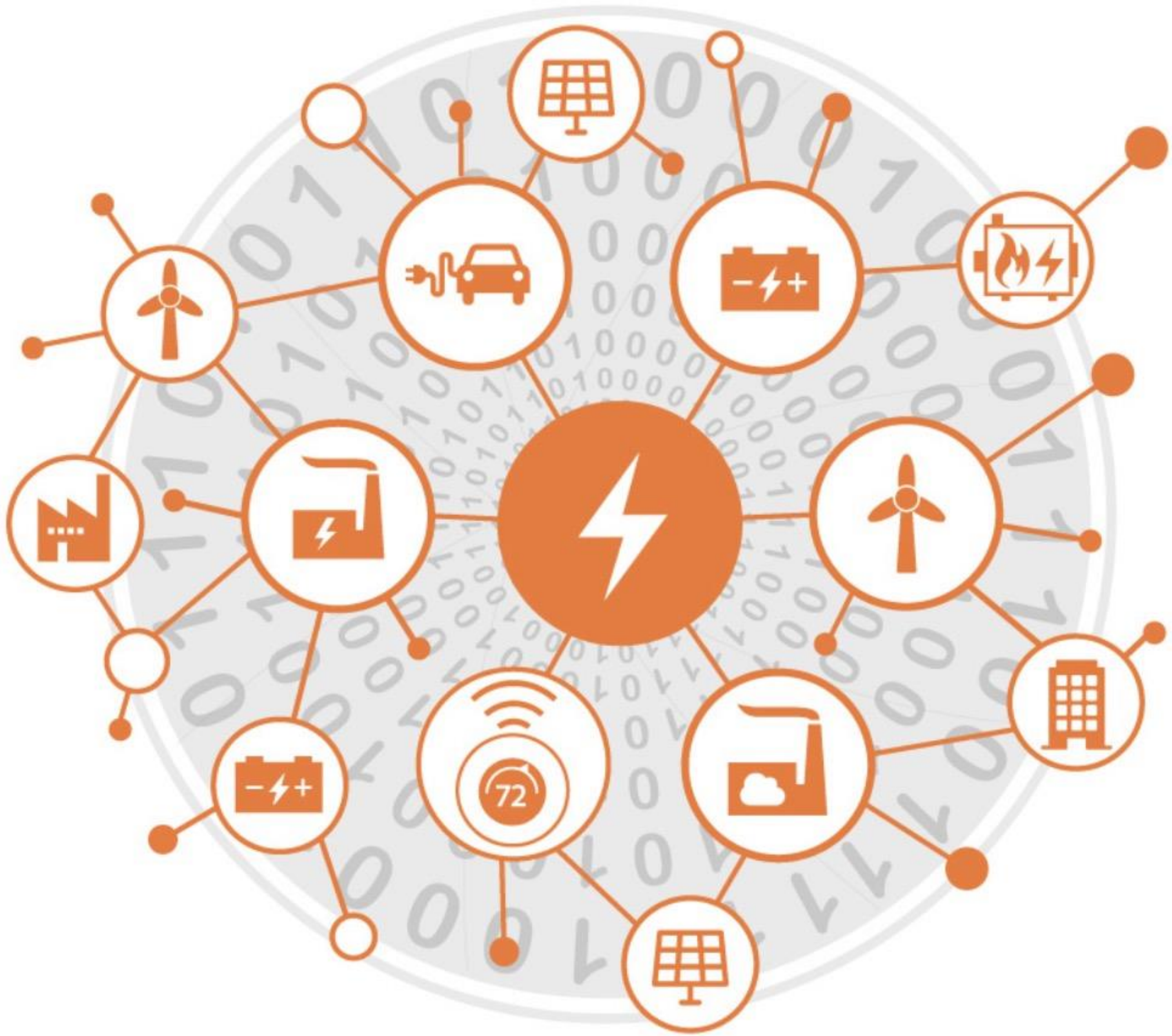


FIGURE 1-1: The new Energy Internet.

GENERATION PROBLEM

- **Generation dilemma:** Over-capacity shock eliminating spreads
- "Marginal cost-zero" economics: renewables flat supply, reducing producers' rent for good
- Fixed cost/capex cannot be earned back via today's EOM markets
- Value is moving upstream, i.e. goes to equipment manufacturers

DISTRIBUTION PROBLEM

- **Distribution dilemma:** Significant imbalance of generation and consumption locations
- Generation location choice not a function of distribution cost anymore as unbundling pared with subsidies are creating local supply imbalances
- Resulting local supply/demand imbalances need fixing using three levers:
  - Moving demand to new supply by price differentials
  - Invest in infrastructure to transport
  - Flexible demand/storage solutions

CONSUMER PROBLEM

- **Consumer dilemma:** More technology choices than customer needs, customer requires energy manager to find right solutions
- Utilities currently focus on solution side rather than customer needs
- Churn is less a consequence of price, but rather lack of individual services, e.g. advise on self supply, energy efficiency
- New segmentation needed into
  a) Commodity Buyers
  b) Power Users/Prosumers
- Granularity in business models increasing, often with start-up character with focus on agile, flexible, cost efficient products and services

S&T

1. Flexibilization of the generation portfolios
2. Expansion and marketing of renewable energies
3. Expansion of storage systems
4. Portfolio management for Third Parties
5. Marketing of distr. generation and storage via VPP
6. Offering of balancing energy and generation capacity
7. Marketing of storage capacities
8. Trading of distributed commodities (e.g. H_2)
9. Marketing of waste heat
10. Marketing of end customer flexibility (DSM)

T&D grids

1. Remote monitoring and control of grid facilities
2. Automation of load balancing
3. Load management via Smart Meter data
4. Integration and control of renewable energies
5. Grid-integrated building automation
6. Energy management of public infrastructure
7. Smart public lighting
8. Integrator for converging grids from power to traffic
9. Services for regional micro grid structures
10. Offering of network services for external networks

B2C

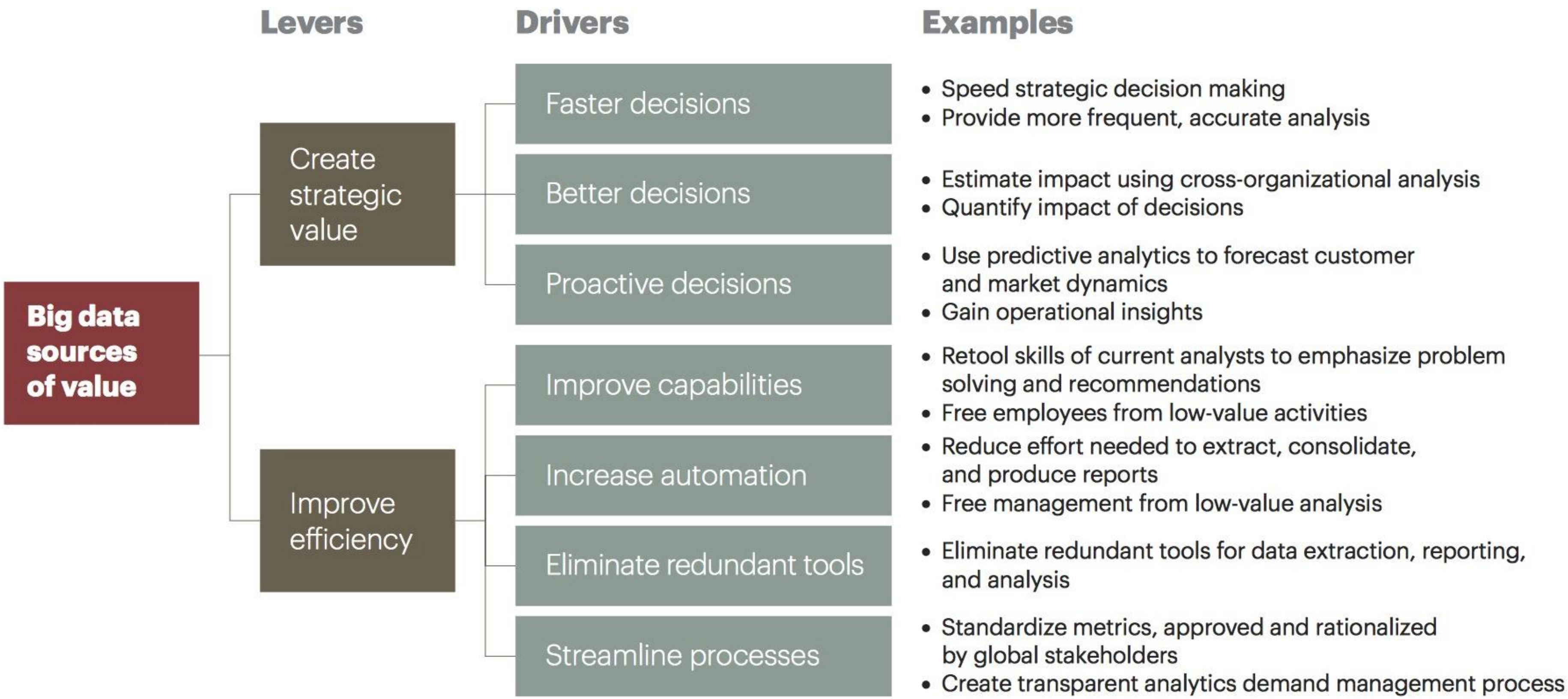
1. Distributed generation systems, e.g. PV, CHP, etc.
2. Distributed power, heat and cooling storage systems
3. Provision and operation of eMobility infrastructure
4. Energy consulting and energy efficiency measures
5. Energetic modernization of buildings
6. Installation, operation and maintenance services
7. Sale of product bundles (energy and TelCo)
8. Smart Home solutions
9. Smart Meter services
10. Connected security and care services

B2B

1. Sale of distributed generation and storage systems
2. Contracting
3. Electric vehicle fleet and fleet management
4. Trading platform for energy management
5. Customer-specific tariffs via real time forecasts
6. Partner for energy efficiency measures
7. Energy benchmarking across sites
8. Financing, insurance, residual current delivery
9. Analytic data services
10. Security systems for systemi-cally relevant infrastructure

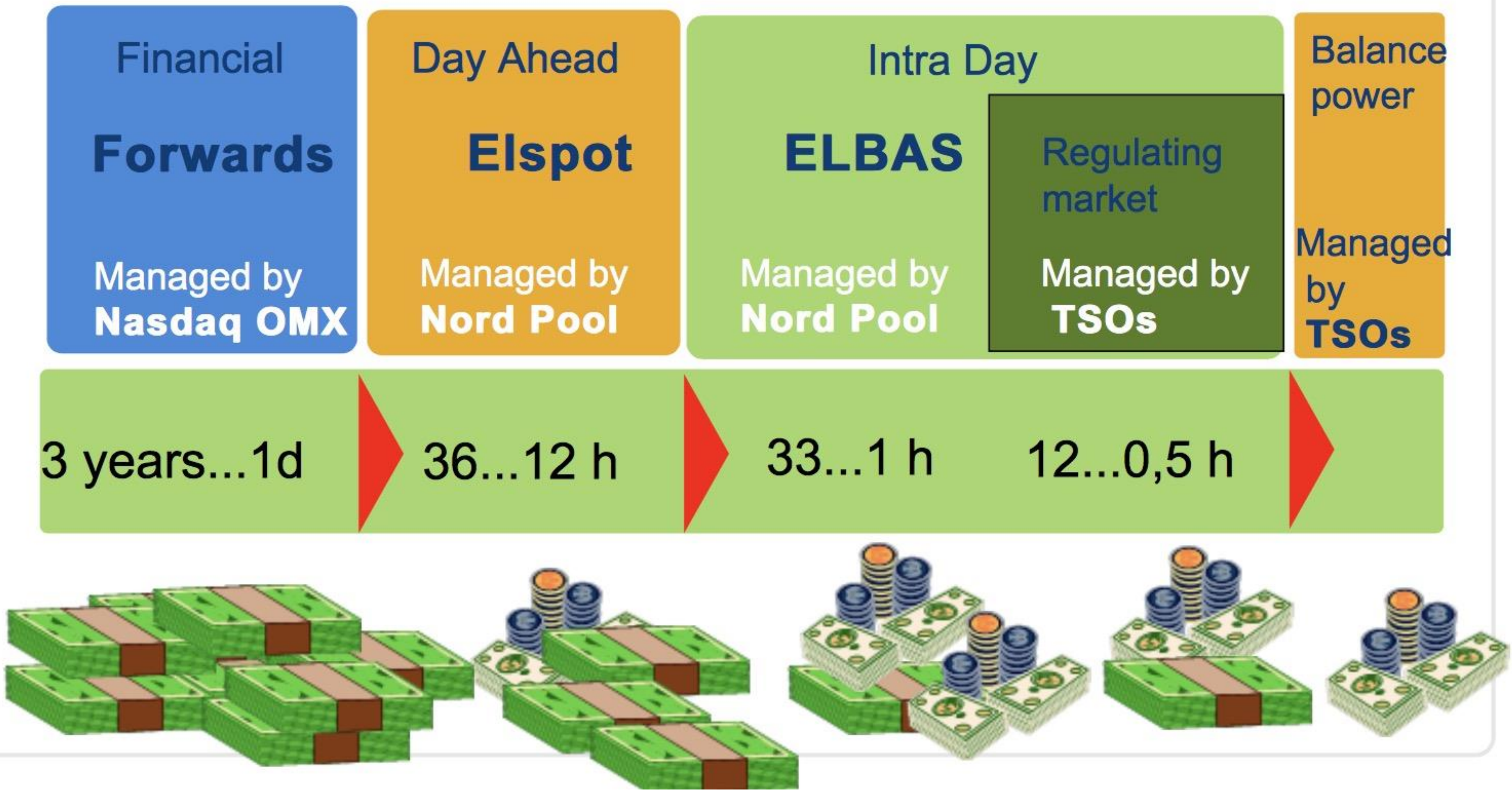
Figure 3

Harnessing big data can boost top- and bottom-line results



Source: A.T. Kearney analysis

Marketplaces in the Nordic power market, summary



Bokslut & nyckeltal	2016-12	2015-12	2014-12
Antal anställda	18	14	10
Omsättning (tkr)	9 363	7 154	4 020
Res. e. finansnetto (tkr)	-4 998	-1 271	-402
Årets resultat (tkr)	-4 998	-1 317	-165