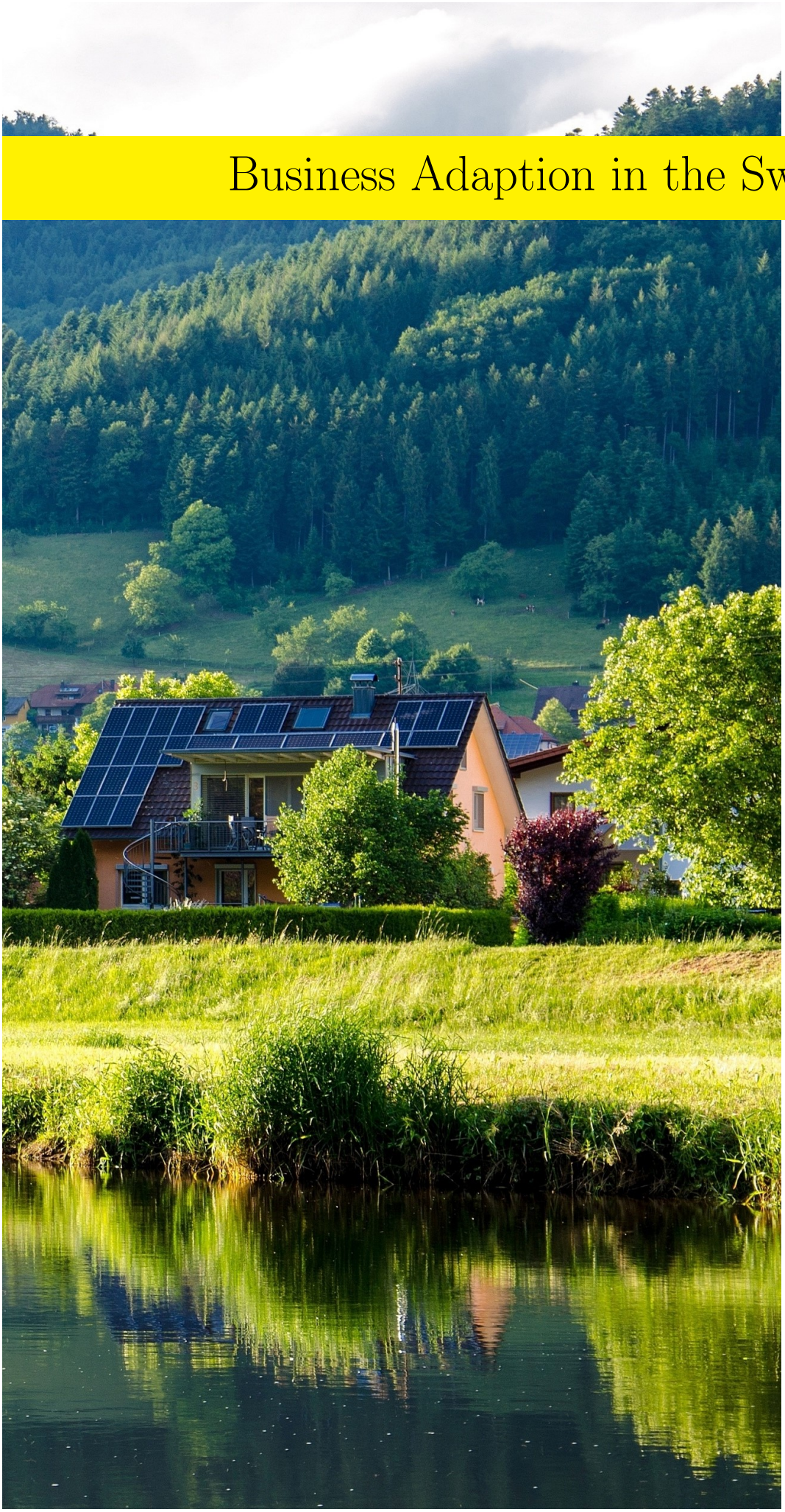
Business Adaption in the Swiss Energy Sector



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Business Adaption in the Swiss Energy Sector

The Problem

The Swiss energy sector is changing due to new regulations and emerging renewable energy technologies. The industry is experiencing a shift from centralized, large-scale power production to decentralized power production in the form of prosumer photovoltaics. Existing infrastructure and business models are not properly equipped to handle these changes and must adapt in order to survive.

The Goal

The goal of this paper is to provide a framework for business adaption in the Swiss energy sector with a focus on consumer perspectives.

Objectives and Methods

Our first objective was to analyze the Swiss energy sector. We accomplished this through background research and utility interviews. Understanding the Swiss energy industry provided us with a fundamental basis of how the sector operates, the existing regulations that surround it, and interactions between stakeholders. Background research from scientific journals, case studies, and regulatory legislation provided valuable and historical information about the energy sector. The primary literature consisted of information pertaining to energy experiments, niche-regime ecosystems, perspectives of utilities, perspectives of consumers, and the Swiss energy transition. We interviewed six companies within the industry and each interview included standardized and company specific questions. Conducting interviews with utility companies gave an in depth perspective of the energy sector and the immediate challenges they are currently facing.

Our second objective was to determine consumer perspectives. We accomplished this through the use of surveys in order to gauge consumer interests on the energy sector and their interests in producing their own energy. This is essential because utilities are now interested in understanding consumer needs due to the possibility of a liberalized market. With the impending challenge of decentralization, the role of consumers has expanded into that of prosumers and has created an additional interaction between the three main stakeholders. Consumers are also major influencers of regulation in Switzerland, which directly affects the direction of the Swiss energy sector.

Our third objective was to evaluate how utilities adapt to changes in the industry. We accomplished this through interviews with utilities in order to further guide our understanding of companies' business models and their motivations to adapt. We acquired information regarding ongoing projects, experimentation, and initiatives in order to determine the success and effectiveness of certain business strategies. The strategies and adaptations that utilities are integrating into their business models are allowing us to analyze responses to Switzerland's changing landscape.

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Key Findings

Our background research, interviews, and surveys have led to five key findings. First, **we found the business plan of simply selling electricity is no longer sustainable.** In the past, utilities have been able to directly produce, distribute, and sell to consumers. Now with the addition of prosumers, the relationship between utility and consumer has changed. All of our interviews agreed that solely selling electricity is no longer sustainable and Swiss utilities are currently in different stages of transitioning out of that business model.

As an expansion of the first finding **we found utilities need to expand their products and services in order to survive.** All interviewed utility companies expressed a need to explore additional markets not only to help raise profits, but also to diversify. As one company said, "It is always better to stand on more than two legs." The new markets include services such as grid projects, telecommunications, efficiency consulting, e-mobility, and PV solutions.

Along with expanding services, **we found utilities are showing increased interest in understanding consumers and their needs.** Currently, Swiss utilities lack a full understanding of their customers. Consumer needs have never been a priority due to the partially monopolized market. Decentralization and overcapacity of the grid are causing a shift in the market in which consumers are affecting the direction of the energy sector. In order to prepare for market shifts, utilities are focusing resources to understand consumer needs, create customer-oriented services, and eventually implement those into their business models.

Switzerland's government is a major influencer in the energy market and **we found complicated regulations make it difficult for companies to operate.** The Swiss energy sector is heavily regulated by the Federal Electricity Commission, restricting utilities from freely experimenting. The political cycle changes approximately every five years and the approval process extends beyond this time frame. The approval process includes substantial paperwork, which further deters utilities from investing in new technologies when regulations would require major design changes even before the project is completed. The fear of drastic policy changes inhibits utilities from new investments and developments.

After distributing consumer surveys, **we found consumers value low costs and green energy.** In our survey, we asked consumers what the most important factor is when they consume electricity. The two most important factors were price and renewability. Although this poses a challenge for utilities to deliver both factors to consumers, utilities now have a better understanding of what customers value.

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Recommendations

Based on our background research, interviews, survey results, and findings, we formulated a list of recommendations for the Smart Grid Plus team at ZHAW and Swiss utilities. These recommendations focus on the importance of the consumer in the changing energy sector and on the need for additional collaboration between academics and utilities. First, **we recommend utilities research consumer needs and wants.** The role of consumers is becoming more influential in the energy sector, but there is a lack of research on consumers. Therefore, utilities should allocate resources to conduct their own research on consumer needs and wants in order to design customer-oriented services.

After understanding consumer needs, **we recommend that utilities develop strategies for implementing new technologies and integrate customer-oriented services into their existing business models.** In order for utilities to smoothly transition with the changing Swiss energy sector, it is essential for them to innovate and adapt their current business models instead of creating new ones. The results from our interviews showed that developing departments dedicated to exploring niche technologies and allocating resources to create strategies is crucial.

Additionally, **we recommend that utilities increase customer outreach in the forms of marketing and education.** As utilities plan to add customer-oriented service to their business models, customer outreach is essential for those services to be successful. This will establish a line of communication with consumers that provide many benefits to utilities. Customers may be more responsive to utilities' services and support new projects and initiatives.

A rising challenge in the energy sector involves congestion in the grid during peak production hours and **we recommend the development of peak shaving regulations.** Peak shaving is a strategy for limiting injection into the grid during hours of peak production by restricting the maximum potential of prosumer installations. With current regulations, utilities are required to accept 100% of prosumer power production and the generated power is automatically accepted into the grid. Utilities must expand grid capacity in order to support the extra load from prosumer contributions. Peak shaving of prosumer power production could potentially mitigate the burden of grid expansions.

Finally, **we recommend that ZHAW conducts additional research into negative and positive effects of departmental company structures in the Swiss energy sector.** Many utility companies are comprised of multiple independent departments that do not collaborate effectively. This leads to gaps in communications and can result in the repetition of work and the loss of valuable time and money. Although our interviews revealed both positive and negative effects of the departmental company structure, it is unclear whether compartmentalization is beneficial or detrimental overall.

Abstract

This paper proposes a framework for business adaption in the rapidly changing energy landscape of Switzerland. By using a multi-level perspective, this study separately addresses the incumbent regime, exogeneous landscape, and niche innovations of the Swiss energy sector. A synthesis of existing research and original qualitative research, in the form of surveys and interviews, provides a novel perspective on the socio-technical transitions occurring in the Swiss energy sector. The major findings of our qualitative research include that utilities must expand their services in order to survive in the market because business plans that rely solely on selling electricity are no longer sustainable. In addition, utilities are showing increasing interest in consumers and must consider their needs if and when the market becomes liberalized. This paper was produced in collaboration with the Zurich University of Applied Sciences.

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Glossary

Business model	A strategy for success to deliver value to customers and make a profit from the services provided.
Decentralization	The shift of energy generation from large scale companies to small scale households.
Regime	Established utility companies
Niche technology/innovations	Renewable energy sources, other sources of energy outside the standard.
Secondary markets	Additional services and values that utilities can provide their customers such as storage, installation, telecommunications, etc.
Experiments	An experimental business strategy that is often not a defined business model. It is used to try out small-scale evaluations on the experimental models.
Prosumer	A consumer that is involved in generating their own energy and contributes to the grid (consumer + producer).

Chapter 1: Introduction

A global emphasis on renewable and secure energy has prompted developments in the energy sectors of many nations. The introduction of prosumer technologies such as photovoltaic cells has opened new markets for companies to expand into while simultaneously destabilizing existing electricity markets. Recent events such as the 2011 Fukushima Nuclear Disaster and the 2012 blackout in India have motivated countries to rethink their energy infrastructure. These changes have widespread effects on global and local energy economics. The Swiss Energy Sector has experienced these changes intensely and it serves as an excellent case study in energy transitions and business adaption.

In Switzerland, new technological developments and changes in the energy landscape are propelling a paradigm shift from centralized power production in the form of hydroelectric and nuclear towards decentralized power production in the form of prosumer photovoltaics. As power production becomes increasingly stochastic, existing infrastructure experiences an undue stress that it was not designed to handle. Many existing business models in the energy sector are not prepared for the changes in the industry and utilities must adapt quickly in order to survive. If utilities ignore the changes and fail to adapt to the increased prosumer production they will be phased out of the market.

Universities, companies, and government organizations frequently perform research relating to the energy sector because of its importance to society. Existing research focuses on the impact of new government policies and how changes in the European market impact the Swiss industry, but it tends to neglect the importance of consumers and the development of new business models. A team of researchers led by Dr. Juliana Zapata at the Zurich University of Applied Sciences (ZHAW) is currently working to develop new business models for electric utilities. In collaboration with the team at ZHAW, the goal of this research is to develop recommendations pertaining to how utilities may adapt to changes in the Swiss Energy Sector and to present consumer perspectives. In order to achieve this goal, this paper addresses three objectives:

Objective 1: Analyze the Swiss energy sector

Objective 2: Determine consumer perspectives

Objective 3: Evaluate how utilities adapt to changes in the industry

This project will contribute to a better understanding of the complex nature of the Swiss energy industry. Through analysis of developments in the current sector, we will provide utilities with a series of recommendations that will help them survive in the rapidly changing energy market. This paper addresses differences in utility and consumer perspectives, presents a self-assessment for utilities to analyze their survivability in the market, and provides recommendations for additional research.

Chapter 2: Background

This chapter identifies the key stakeholders of the energy market and describes their complex interactions with each other. Background research on key legislation, grid infrastructure, the Swiss energy market, and existing business models were conducted in order to analyze the Swiss energy sector. In addition, background research on business perspectives of niche technologies and the emergence of photovoltaic power production was conducted in order to narrow the scope of our project. Finally, we provided insight into other energy markets with a series of international case studies.

2.1 Primary Stakeholders

In the Swiss energy market, the three main stakeholders are the government, businesses, and consumers. The interactions between stakeholders determine the direction of the energy sector. Government regulations are developed by the Swiss Federal Council. Businesses in the sector range from energy utilities to software firms. Consumer stakeholders include both large companies and small households. These stakeholders are interconnected and are forced to react to the changing landscape of the Swiss energy sector.

Switzerland's government is a democratic federal republic and a direct democracy, where Swiss citizens hold direct political authority and influence (Switzerland's political system, 2016). The federal government currently does not allow all Swiss citizens to choose their utility company (Power hub Switzerland). The government's influence on the energy sector cannot be overlooked because both utilities and consumers must follow legislation. For example, after the 2011 Fukushima tragedy, the Federal Council created an energy strategy to initially phase out nuclear energy and utilities were forced to begin developing alternative strategies to meet demand (The Federal Council, 2016a). The government can influence the direction of the Swiss energy sector through the implementation of new policies.

Utility companies serve as the intermediary between consumers and the government by meeting the needs of consumers, while also obeying and influencing regulatory legislation. Utilities influence regulations through the use of trade organization. Trade organizations work alongside legislators to develop new regulations. Businesses are becoming reliant on consumer needs to shape their business models. In the past, consumer needs have not been the priority of utilities because the monopolized market of solely selling electricity was sufficient. Utilities must adapt to the changing landscape while still preserving the relationship with consumers and the government.

Consumers provide capital as well as economic incentive for utilities, which motivates utilities to change, adapt, and grow their business models. Additionally, consumers directly impact the federal government because of Switzerland's direct democracy. Consumers recently demonstrated their influence on the energy market by voting for a referendum to phase out nuclear power. The majority of Swiss citizens supported the bill and gradual changes will become implemented starting January of 2018 (Swiss vote for gradual nuclear phase-out, 2017). The role of prosumers is growing; this adds an additional layer of interactions with utilities. The concerns, needs, and wants of consumers have become a significant influence on the changing landscape.

2.2 Energy Strategy 2050

In May of 2017, 58.2% of Swiss voters approved the Energy Strategy 2050 (The Federal Chancellery, 2017). This referendum was created due to low energy prices and rapidly developing renewable technologies that are impacting the market (The Federal Council, 2017).

The policy rollout will be initiated in phases, with the first focusing on increasing energy efficiency, reducing consumption, and increasing the use of renewable energy technologies. In addition, there is a ban on the construction of new nuclear power plants. Current nuclear power plants can stay in operation as long as they do not pose a threat to the environment and are cleared through the Federal Nuclear Safety Inspectorate (Swiss Federal Office of Energy, 2016a).

Changes to the electricity power grid are needed in order to implement new power supplies. Long legal processes that prolong the upgrades to the grid often impact these changes. As a result, the referendum plans to accelerate the legal process by reaching decisions more quickly. The Strategy for Electrical Power Networks outlines how this process will operate (Swiss Federal Office of Energy, 2016d).

The construction industry accounts for 40% of Switzerland's CO_2 emissions and energy consumption (Swiss Federal Office of Energy, 2016b). Tax deductions are already provided to construction projects that focus on increasing energy efficiency. In addition, this energy strategy will make it possible to deduct demolition costs over the next two tax periods. CO_2 emissions for new passenger-motorized vehicles are also a focus for increasing energy efficiency.

The feed-in remuneration system was already in place before this referendum was passed. Due to high production costs of renewable energy technologies and low energy prices, the Federal Council established a feed-in tariff of 1.5 centimes per kilowatt-hour since 2009. The new Energy Strategy 2050 increases the amount to 2.3 centimes per kilowatt-hour with the hope of promoting the construction of new renewable energy technologies (Swiss Federal Office of Energy, 2016c). This subsidy program will be adjusted with how the market is performing, but will be limited to five years for new renewable energy plants.

2.3 Grid Infrastructure

Swiss grid infrastructure consists of a transmission grid that is managed by the company SwissGrid and a distribution grid that is managed and owned by individual utility companies. The transmission grid handles the transportation of electricity over long distances and between Switzerland and surrounding nations (Pattupara, 2016, p. 7-8). The distribution grid handles the distance between the transmission grid and end consumers.

Switzerland is a key component of the electricity network in Europe. The Swiss transmission network connects production heavy countries in Northern Europe, such as Germany, with countries such as Italy that need to import electricity to meet demand (Page, 2012). For these reasons security of the Swiss grid is important to all of Europe. A blackout in Switzerland could trigger widespread blackouts throughout Europe.

Since the transmission grid is connected to the distribution grid, security of the distribution grid is equally important; blackouts travel upstream. In order to prevent blackouts during abnormal peaks in production every area of the grid is built with a level of redundancy. The Swiss distribution grid is built to handle double the average load. This means that there are actually two sets of copper wires and at any given only one set is being used. If there is an abnormal peak that would cause a blackout the second set is implemented. Unfortunately, for a majority of the year 50% of the actual load capacity is left empty waiting for an emergency (Swiss Federal Office of Energy, 2017). The distribution grid must have a high enough capacity to handle all the electricity that is being produced and injected into it. This means that if more electricity is being injected the grid must be expanded. An increase in prosumer activity is necessitating expansions in some areas of Switzerland (Schmidt, Mejia, & Burger, 2012). Grid expansion generally takes the form of adding thicker copper wires or battery systems to handle the increased production. Batteries and thicker copper wires are often costly updates that utilities

and consumers do not want to pay for. In the case of necessary grid expansion there are existing regulations that make it clear who must pay for the expansion and generally the costs fall on utilities.

2.4 Swiss Energy Market

The Swiss electricity market is divided into several sections by regulation and common practice The first primary divide is created by a separation of the two aspects of all electricity markets: power production and power distribution. The second divide comes from market regulations specific to Switzerland that liberalize the market for customers that consume more than 100 MWh per year.

In 2016, power production in Switzerland was composed of 59% hydroelectric, 32.8% nuclear, 5% conventional thermal, and 3.2% miscellaneous renewables (Swiss Federal Office of Energy, 2017). Power producers in Switzerland trade their electricity in a European Electricity Market that operates similarly to any stock or commodity market. In some quarters, Switzerland is able to produce more than it consumes creating a net export of electricity; in other quarters the country must import more electricity than it exports. These quarterly differences generally correlate with seasonal fluctuations in hydro-production. During the winter season, the net production of hydroelectric power diminishes whilst the electricity demand reaches a peak. This seasonal relationship means that there is often a dependence on imported electricity from neighboring countries (Pattupara, 2016, p. 7-8). Swiss utility companies trade approximately two-thirds of all electricity they produce and then import to meet demand and distribute to customers (Swiss Federal Office of Energy, 2017). Due to the fact that much of the power delivered to consumers is imported and not received directly from Swiss production, the distribution of electricity to customers is almost completely separate from power production. Although many utilities do both, there are generally entirely different departments handling the two sections (Osorio & van Ackere, 2016).

ElCom, the Federal Electricity Commission, regulates the entire Swiss Electricity Sector and is responsible for monitoring utility compliance with all legislation. Regulation is a key factor in the structure of the electricity sector. One major regulation pertains to liberalization in the market. In Switzerland the market is semi-liberalized, consumers that require more than 100 Megawatt hours per year have the ability to choose which utility they are serviced by; All consumers under that threshold must use the utility that holds the contract for their region (Page, 2012; Osorio & van Ackere, 2016).

In the liberalized market, companies must compete for customers. Competition drives innovation, as every company needs to offer the best product in order to keep and gain customers. In the monopolized market there are no market incentives to innovate or offer the best products and services. Most residential consumers and businesses are in the monopolized electricity market of Switzerland. (Banfi, Filippini, & Luchsinger, 2002).

The Swiss Electricity Sector is changing quickly and some of the divisions that have characterized the industry may disappear. Complete market liberalization has frequently been discussed on the national stage. In 2002, Swiss voters rejected market liberalization and it was not until 2009 when the market became partially liberalized to its current state. The Swiss government originally intended to fully liberalize the market by 2015 (Page, 2012). It is impossible to know when the market may reach full liberalization but many key players anticipate Switzerland following other European countries in the full liberalization of the electricity market (Page, 2012).

2.5 Existing Business Models

2.5.1 Defining a Business Model

An understanding of business models and their current applications in the market is essential in order to create a rubric for grading survivability of utilities in the energy market. A business model is a plan for success on delivering value to customers and making a profit from the services provided to the customer (Richter, 2013, p. 1227). It can be broken down into four main pillars: core strategies and value proposition, innovation and flexibility, customer interface, and revenue models.[1]

Core strategies and value proposition encompasses the current services offered to customers that provide a revenue stream. This pillar includes, but is not limited to, energy production, energy sales, and additional services such as telecommunications or consulting. The second pillar, innovation and flexibility, includes investments in innovative new technologies or secondary markets that are not implemented in the current business model nor providing a revenue stream. Flexibility is the willingness and ability to transition to new core strategies, such as the ability to implement a new technology for profit. Customer interface is the third pillar and it is any interaction with the customer. This pillar includes community involvement, customer service, understanding customer needs, and education programs. Education programs can be related to knowledge and awareness of sustainability, green energy, reducing consumption, and price indexes. The final pillar is the revenue model and it is how the businesses are making a profit. This pillar is the cost-to-profit model and includes all revenue streams from offered services (Richter, 2013; Schmidt, Mejia, & Burger, 2012).

2.5.2 Current Business Models

Recent studies have shown that renewable energy gains in market share threaten the current business models of utilities (Richter, 2013, p. 1226-1227). As a result, utilities must find a way to implement renewable energy technologies into their business models. Currently, there are two general business models that take different approaches to renewable energy technologies. The first is utility-side renewable energy business models and this model focuses on large-scale energy production (Richter, 2013, p. 1228). The core strategies and value proposition includes generating large amounts of energy, feeding it into the grid, and distributing it to consumers (Richter, 2013, p. 1228). These power plants are similar to centralized non-renewable power generations, such as nuclear or coal. There is little focus on innovation and flexibility, and the revenue model and customer interface are similar to centralized power production models.

The second is a customer-side renewable energy business model and it is comprised of local small-scale generations. Contracting is often used interchangeably with this business model (Richter, 2013, p. 1229), and it is seen as the direction that the market is moving towards in the future. The core strategies and value proposition includes small-scale renewable energy generation for private customers and small businesses. These strategies are focused on decentralized power production and the mutual benefits between prosumers and utilities. Innovation and flexibility is necessary for this business model and it is accomplished by investments in various small-scale renewable technologies. The revenue model is based on direct use of the consumer and contracting services.

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[1] Three pillars are adapted from two sources: Richter, 2013 and Schmidt, Mejia, & Burger, 2012. Core strategies and value proposition are taken from both sources. Customer interface is taken from Richter. Innovation and flexibility was created independently.

Table 1[2]

Pillars	Utility-side Renewable Energy Business Model	Customer-side Renewable Energy Business Model
Core Strategies and Value Proposition	Centralized energy production fed into the grid	Small-scale solutions and energy related services
Innovation and Flexibility	Investments in large-scale energy production, limited flexibility	Investments in various small-scale renewable energy production, high flexibility
Customer Interface	Customer pays per unit	Customer is involved in energy production Prosumers share benefits with utilities
Revenue Model	Revenues through feed-in of electricity	Revenue from direct use, feed-in to grid and from services

Utility-side business models usually have steady returns and are profitable. However, the profits are not as lucrative as they have been in the past. Customer-side business models are not seen to be profitable for utilities and this issue is why many do not implement this model (Richter, 2013, p. 1234). The profitability challenge arises from the high cost of implementing small-scale renewable projects with low returns. As the technology becomes more advanced and the costs are reduced, this business model may be more attractive to utilities in the future.

2.5.3 Business Model Innovation

Business model innovation is the development of new ways to bring value to the customer and generate profits (Richter, 2013, p. 1228). This concept presents an interesting idea on how utilities can begin to adapt their current business models to new technologies. Utilities can conduct experiments in which they develop new technologies and implement them in a controlled environment. These experiments often do not get implemented into current business models, but if the experiment is successful the utility can develop a strategy to implement the new technologies in the market. Experimentation and innovation is essential in the case of the two generic models stated above because each represents opposing theories of how utilities should run their businesses. Business model innovation allows for trying new technologies and processes that take ideas from both business models to create new ones. This innovation will be essential for utilities to survive in the changing energy market.

2.6 New Innovations in the Swiss Energy Market

Businesses have historically viewed new innovations in the market as a threat and have shown resistance to adapting to new technologies (Steen & Weaver, 2017). In order to promote the development of new technology, the government provides incentives for utility companies to develop and implement renewable energy technologies. The shift from centralized power

[2] Adapted from Richter, 2013 and paraphrased from Schmidt, S., Mejia, G., & Burger, P, 2012. Revenue model, customer interface, and the two business model types are adapted from Richter. Some portions of innovation and flexibility were taken from Schmidt, S., Mejia, G., & Burger, P, 2012.

production to decentralized power generation is persuading businesses to implement niche technologies and to invest in secondary markets.

Utilities are focused on achieving a profitable business model. However, the current business strategy to sell electricity directly to customers is no longer resulting in lucrative returns as seen in years past. New renewable technologies instigated utilities to change, however, it was often met with resistance. Utilities were especially wary of transitioning towards renewables because of the potential loss of market shares, and consequently, profit (Richter, 2013).

Although Switzerland's energy landscape largely consists of renewable energy sources, primarily hydroelectric power, the relationship between customer and utility company has transformed, adding to the complexity of the energy sector. Now, utility companies must acknowledge the shift and consider exploring niche technologies and secondary markets, while considering prosumer activity in order to survive in the market. Even though Swiss citizens cannot currently choose their utility company, the semi-monopolized market has the potential to become liberalized. In this case, it is imperative that companies now prioritize the needs and wants of the consumer. Utilities must face the challenge of innovating their current business models. The survival of a utility company is reliant on its ability to adapt to the ever changing landscape of the Swiss energy sector.

2.7 Emergence of Photovoltaic Power Generation

In recent years, photovoltaics have experienced major growth at both the consumer and utility level (Bundesamt für Energie, 2017). With widespread availability of photovoltaic solutions in households, consumers are becoming prosumers by producing their own electricity. Other technologies, such as hydroelectric and wind turbines, are difficult to implement at the consumer level in Switzerland, and thus, photovoltaics are the primary technology for prosumer power production.

Prior to 2010, consumption of self-produced power in Switzerland remained relatively stable under 5000 GWh. However, since 2010, consumption of power that was generated by prosumers has been consistently increasing. Prosumer power generation has increased from 4694 GWh in 2011 to 6530 GWh in 2016 with an average yearly increase of 358 GWh (Bundesamt für Energie, 2017). The same trend occurs for thermal applications of solar collectors, increasing from 154.3 GWh of energy in 2000 to 680.7 GWh of energy in 2016 (Kaufmann, 2017). Despite the similar trend, the adoption of thermal applications is not as rapid as electricity production.

The increasing popularity of photovoltaic solutions does not solely apply to consumers and prosumers. Utility companies are showing increased interest in adopting photovoltaic power production as well. In 2000, solar power produced by utilities accounted for 11.2 GWh, and has consistently increased to 1333.4 GWh as of 2016.

The emergence of photovoltaics in the Swiss energy market can be described in part as a result of regulation changes and government incentives. Switzerland's 2050 Energy Act greatly encourages adoption of solar technologies. With the decision to phase-out nuclear power production, other sources of power production will need to fill the gap following June 2020 to meet or exceed Switzerland's power consumption. To help meet this goal, the plan expects photovoltaic power to reach an approximate capacity of 9.5 GW by 2050 (Grätz, 2012).

2.8 Case Studies

The energy industry is one of the world's largest industries and it receives an enormous amount of research attention due to its complex and dynamic nature. As a result of this high level of attention, there are many valuable research models to reference in the development of

additional research. Our team used multiple prior research projects as case-studies for the development of our project.

2.8.1 Understanding Stakeholder Relationships

One of the most challenging aspects of energy sector research is analysis of causal relationships between stakeholders. In 2009, a study by members of the Industrial Engineering Department at Istanbul Technical University entitled "Scenario Analysis Using Bayesian Networks: A Case Study in Energy Sector" addressed various methods of analyzing complex connections in the energy industry. The researchers began by surveying industry, political, and academic experts on the connections between different energy factors such as renewable energy investment, GDP per capita, and primary energy consumption. These results were then used to create a comparison matrix and a causal map. The researchers analyzed the causal map to create a Bayesian network. By applying Bayes' rule, the researchers were able to create probabilistic predictions on the future of different factors in the energy sector based on potential changes in other factors. The methodology that the ITU researchers followed creates a clear map and analysis of a complex industry. Our team will use this study as a basis base for assessing the Swiss Energy Sector. The study shows key factors that our study will need to address. (Cinar & Kayakutlu, 2010).

2.8.2 Potential Business Models

In the energy sector there are competing strategies for adjustment to changing market conditions and technological developments. In order to understand different current and potential business models, it is important to understand possible approaches to the changes. A 2011 article entitled "SuperGrid or SmartGrid: Competing Strategies for Large-Scale Integration of Intermittent Renewables?" authored by two energy researchers addresses different approaches to changes in the energy industry in Europe and in the United States. The article assesses in particular the possibility for the coexistence of various business models. The comparative nature of the article makes it useful as a reference for our research because we our project examines a variety of business model options for utilities. This article addresses certain limitations that businesses may experience due to federal regulations that limit their business model options. The importance of factoring in all aspects of such a complex market in the assessment of various business models is crucial to fully understanding the motivations and limitations an individual business may experience (Blarke, 2013).

2.8.3 Socio-Technical Transitions

Human history is characterized by a series of sociotechnical transitions; from large scale revolutions such as the invention of the internet to small inventions like the ipod, these are technological developments that change the way humans live. The transitions occurring in the Swiss energy sector can be understood using a multi-perspective of socio-technical transitions as introduced by Frank Geels in 2004.

Geels addresses socio-technical transitions from three perspectives: technological developments, landscape transitions and regime responses. The technological developments in Switzerland include the development of renewable energy technologies. Landscape transitions are changes in consumer opinions and legislative policies. The existing regime in the industry, utility companies, must react to these developments and transitions. The Geels approach forms the basis of our methodology and objectives.

Chapter 3: Methodology

This project aims to develop a series of recommendations for utilities on how to adapt to changes in the Swiss Energy Section, with a specific focus on consumers. This chapter addresses three primary objectives for accomplishing our goal:

Objective 1: Analyze the Swiss energy sector

Objective 2: Determine consumer perspectives

Objective 3: Evaluate how utilities adapt to changes in the industry

In this chapter the reader will find descriptions of the research methods used to answer key questions in support of the primary objectives. A timeline for our project is presented in Appendix B.

3.1 Analyze the Swiss Energy Sector

In order to analyze the Swiss energy sector, we first had to understand how the sector operates. Specific energy sector operations include, but are not limited to, business models, existing regulations, stakeholder interactions, and infrastructure.

By conducting background research, including a review of existing literature and case study analyses, our team obtained basic knowledge on the operations of the energy sector in Switzerland. The primary literature consisted of information pertaining to energy experiments, niche-regime ecosystems, perspectives of utilities, perspectives of consumers, and the Swiss energy transition. Case study research focussed on studies pertaining to the future of the sector, mainly those studies that address niche technological and social developments.

The research related to the operation of the energy sector has limited value due to differences in theory and practice. Although we were able to learn a majority of the theory behind the operation of the sector, there was a distinct need to learn about how the theory worked in practice.

We conducted interviews with various electric utilities throughout the Switzerland in order to learn about the common operations of the Swiss energy sector. These utilities ranged in size and composition, some were major state owned utilities and others were small private enterprises. The only common feature of all interviewees was that they work in the electricity sector. It is important to note that no single interviewee is an expert on all aspects of the industry. The primary value of this method in reference to the operations of the sector comes from the congregate of all interviews. We conducted nine interviews with six utilities.

Our team utilized information from both the interviewees and background research to form our understanding of the Swiss energy sector. The use of both methods allowed our team to understand social, technical, and regulatory aspects of the industry.

3.2 Determine Consumer Perspectives and Influencers

As the Swiss energy landscape evolves, it is necessary to understand the complex interactions between consumers and utilities. This will determine the perspectives of consumers and the impact they have on the energy market. In order to properly analyze this information, we need to gather consumer opinions on various aspects of the energy market.

Consumer views on renewable energy and data on their willingness to pay more for these technologies may prove useful to utilities. As prosumers become more prevalent in the energy market, it is necessary to gauge consumer interest in producing their own energy. This will allow us to accomplish our objective to present the perspective of consumers and their influence on the energy market. Additionally, consumer opinions on a liberalized market can potentially add another dimension to stakeholder interactions.

Our team conducted surveys on Swiss citizens in the city of Zurich, Switzerland. The sample population was decided using convenience sampling. The questions asked on the survey were related to knowledge of the Swiss electricity market, renewable energy production, liberalization, and prosumer activities. The English version of the survey document can be found in Appendix C. The surveys were translated to German in order to match the dominant language of the region and increase the likelihood of responses and this version can be found in Appendix D.

3.3 Evaluate How Utilities Adapt to Changes in the Industry

The energy market is shifting from large scale power generation to small scale production and utility companies must adapt to this shift in order to survive in the market. In addition, selling electricity as the basis for utility business models is no longer viable in the current market. In order to evaluate how utility companies plan to react to the impending challenges, we conducted background research and interviews.

Background research provides fundamental and historical information about the energy sector that will be beneficial to compare to the changes that are currently underway. We spent the first week familiarizing ourselves on the operations of the Swiss energy sector by reading scientific journals, case studies, and regulatory legislation. Background research allowed us to be well informed to present a multilevel perspective, influences, and challenges of the shifting energy landscape.

We interviewed six companies within the industry about the current challenges they are facing, if their current business models are working, and if they have infrastructure in place to adapt. These interview questions can be found in Appendix E. Conducting interviews with utility companies gave an inside perspective of what immediate challenges they are currently facing. Each interview consisted of standardized questions pertaining to market challenges, diversification, social impact, and company specific questions. The company specific questions were created by conducting additional background research. The insights from the interview process allowed our team to develop practical guidelines for utility market survivability and to understand the varying approaches that companies are taking.

Chapter 4: Findings

We used background research, interviews, and surveys in order to analyze the shift in the Swiss energy sector Key conclusions were drawn from qualitative and quantitative data from utility interviews and consumer surveys. We found:

1. The business plan of simply selling electricity is no longer sustainable.
2. Utilities need to expand their products and services in order to survive.
3. Utilities are showing increased interest in understanding consumers and their needs.
4. Complicated regulations make it difficult for companies to operate.
5. Consumers value low costs and green energy.

4.1 The business plan of simply selling electricity is no longer sustainable.

In the past, utilities have followed the conventional method of producing, distributing, and selling energy. The direct relationship between utilities and consumers has now changed due to an increase of prosumer activity caused by decentralization. Interviews with utilities revealed that they must now innovate their current business models in order to adapt to this shift and to survive in the market.

After a series of interviews with six utility companies, there was an overwhelming consensus that the business model of solely selling electricity is no longer sustainable. Although there was a consensus on this statement, Swiss utilities are currently in different stages of the transition period. The Head of Innovation at Company A explicitly stated that their business model is simply not working and the company is losing profits due to low electricity prices and high production costs. Company A recognizes this market shift and is currently experimenting with potential strategies in hopes to implement them into their business model.

Company D managed to increase their total annual operating revenue even with the decreasing prices of electricity because they were able to innovate their old business model by expanding their services industry. This utility is one step ahead in transitioning and has already begun to initiate new and sustainable practices. Company B, in comparison, has built the foundation of their utility on more than just selling electricity. Their business model was designed in consideration of the future and potential shifts in the energy market. This utility gained 8% in net sales due to the changes in the market. It plans to be a full service provider to further innovate and shape their business model to the shifting market. Expanding offered services provides alternative revenue streams to help cover the losses in profit from producing and selling electricity.

4.2 Utilities need to expand their products and services in order to survive.

All of the utility companies that were interviewed expressed a need to explore additional markets. Company A said that while these additional markets help raise profits, they alone do not compensate for the losses from electricity distribution. All interviewed utilities are looking to explore new markets in order to address market changes. Many of the additional markets require only a reallocation of resources or collaboration between departments. In most cases, the newly entered markets addressed consumer and prosumer desires that showed potential for growth in the coming years. The majority of these new markets are related to grid projects, e-mobility, and photovoltaic solutions.

Many utilities expanded into grid-based projects such as grid redundancy and telecommunications. Grid redundancy is a technology that improves the reliability of grid connection. Both Company A and Company B have described their involvement in the telecommunications business as successful. However, Company A discussed how they are

limited to installing fiber optic cables due to government regulations. Company A also emphasized that many other utility companies are resorting to telecommunications because of failing business models.

In addition to telecommunications, business are exploring grid redundancy and associated technologies. Companies A, C, and D have expressed their growing interest in offering redundancy services along with traditional electricity distribution. In the case of Company C, they have ongoing research on how to best provide this service based on their client's need. One form offers full redundancy and greater reliability, but limits the efficiency at 50% and is significantly more expensive. The second form, known as "n-1", allows for a similar redundancy service with slightly less reliability, but has a greater efficiency ratio and cheaper costs.

All interviewed utilities have mentioned an involvement in e-mobility solutions. These solutions included developments and research in charging stations, storage, and integrations with the grid. Company A has put an emphasis on e-mobility research and development as a successful option for expanding their markets. While Company C has a strong interest in this sector, they recognize that there are pros and cons to implementing these types of services. E-mobility can cause issues for grid congestion during peak hours. However, it can also encourage the deployment of storage solutions for residential buildings to alleviate grid congestion. It is important for utilities to evaluate the risk and reward of developing a new market.

Photovoltaic solutions for residential and commercial buildings are a primary focus for expansion for all interviewed companies. Some companies are conflicted with this market because the availability of photovoltaic solutions can signify reduced electricity sales from a consumer in the future. Yet, it is an investment in an opposing industry that provides security for the companies that offer these services. For Companies B, C, D, and E, these solutions are offered as complete packages, including installation and maintenance. This is because the majority of consumers do not want to devote much time towards PV solutions when their end goal is simply to save money or become more environmentally friendly. Some companies, such as Company C, use partnerships to provide these services. The majority of utilities bundle the purchasing and maintenance processes for the consumer.

Secondary markets are providing utilities with additional revenue streams that make them more sustainable in the market. In order to add new services that interest consumers, there is a need to understand what it is that they want. By addressing their needs, it provides an additional layer of security for utilities and their business models.

4.3 Utilities are showing increased interest in understanding consumers and their needs.

Swiss Utilities lack a full understanding of their customers. This is primarily due to the lack of consumer influence in a partially monopolized market. In the past twenty years, electricity markets throughout Europe transitioned to liberalization. The Swiss government has made multiple efforts to liberalize the market, but voters have continually rejected the concept. However, the Swiss government partially liberalized the market in 2012 allowing all consumers with consumption over 100,000 MWh to choose their utility provider. Many interviewed utilities discussed the possibility of approaching full liberalization and expressed a need to better understand consumers.

There is little research conducted on consumers in Switzerland because of the way the market currently operates. Swiss citizens do not have the option of choosing a utility company and as a result utilities are guaranteed profits from selling energy. Therefore, consumer needs

were never a priority. Decentralization and overcapacity of the grid are causing a shift in the market where consumers play a larger role in the direction of the market.

All interviewed utilities would like more research conducted on consumers to prepare for market shifts. As a result, many companies are focusing resources to address this issue. Company B discussed the need to interact directly with the customer in the form of telephone calls or door-to-door solicitation. However, they acknowledged that this may turn customers away from the company in the future and therefore have not attempted to reach out with these methods. Company B also claimed that it is important for a utility to be a chameleon and adapt to the changing market trends, but also adapt to consumers as well. These revelations show an increased interest in the perspectives of consumers that utilities previously ignored because of the monopolized market.

Company D is concerned with the potential shift towards liberalization. Their current clientele do not have any other option which is beneficial to the company due to the guaranteed profits. Should the market shift, it would add more competition into the market and the utility could be at risk to lose a portion of its customer base. Providing customer satisfaction and directly interacting with consumers is necessary in order to be proactive before a major market shift such as liberalization occurs. It would help limit the risk associated with future changes in the energy sector.

All utilities interviewed discussed the desire to add additional customer-oriented services. These services cannot be implemented unless there is an understanding of what the consumer needs. Company A stated that understanding the client and what they want is key, but they do not currently have a rapport with their customers. Similarly, most interviewed utilities expressed the same communication gap between their customers. Consumer perspectives are becoming increasingly important in the market and utilities are taking notice of this trend.

Some utilities have already added customer-oriented services such as telecommunications or information technology services to their business models. Many of these additional services have proved successful and are benefiting to the success of the company. Many interviewed utilities are trying to develop niche technologies or secondary markets without direct interaction with their customers or implementing them into their business models. This strategy poses a danger because of how quickly the market shifts. A new technological development or customer-initiated shift in the market could render a particular direction of the company invalid. For example, Company C is one of the largest producers of nuclear and hydropower energy in Switzerland and they are currently researching e-mobility solutions because that is the direction they see the market going in the next five to ten years. Charging stations and other in-home technologies are potential solutions if e-mobility takes off. Company A is aware of the risks of e-mobility and that is why they are interested in providing a variety of customer-oriented services. This example highlights the importance of creating a dialogue with consumers in order to shape the direction of the company and the need for research on consumer perspectives in the energy market. Analyzing consumer perspectives will help utilities predict outcomes of major votes on regulations. In addition, utilities will have the opportunity to predict large changes in the market such as a move towards liberalization.

4.4 Complicated regulations make it difficult for companies to operate.

The Swiss Energy Sector is heavily regulated by the organization ElCom, the Federal Electricity Commission. Representatives from 5 of the 7 interviewed utilities expressed that their companies find the regulations difficult to navigate. The political cycle is generally around 5 years, and the approval process often extends beyond this time frame. Company B said the approval process for new electrical generation facilities is generally much longer than 5 years,

often stretching to 15 years. The interviewees discussed how the process includes substantial paperwork to gain the approval of organizations such as the World Wildlife Fund and also includes several votes by local citizens. The time disparity between the political and approval cycles means it is difficult to justify investing in new facilities when regulations could require major design changes before the project is even finished.

Trade groups provide practical knowledge to legislators in order to make regulations that work well for the industry. The collaboration between trade groups, legislators, and academics works to create specific policies such as the Renewable Energy Road Map. Company D said that although this collaboration helps, it is limited in scope and should be expanded in order to increase the effectiveness of regulations on the industry. The same company discussed a concept of PV prosumer peak shaving where the amount of energy a consumer can produce during peak functionality of their solar panels is restricted in order to decrease the possible burden on the grid. According to the interviewee this method could significantly reduce the need for grid expansion with only a 3% loss in annual production. However, the company is unable to limit prosumer activity and introduce such caps due to regulations.

In Switzerland, many utility companies are owned either fully or in part by local governments. Company E, a local municipality, discussed the difficulty of remaining profitable while also serving the best interest of the public. The interviewee said that the public wants the company to provide cheap reliable utilities which would not create profit and would limit the growth of the company. Since the public has the ultimate control over the company and the regulations that control it, Company E and other similar companies must find a way to balance the two factors. An interviewee from Company D talked about the acquisition process. Company D often acquires smaller companies in the industry in order to grow. However, the company receives criticism for doing so; some citizens and businesses claim it is unfair for a government-owned company to acquire other companies. Although they are not currently limited by any regulations, the interviewee from Company D acknowledged that they must be wary of these criticisms because they could motivate the creation of new regulations. Utilities must constantly attempt to predict how regulations will change in order to invest properly. The fear of drastic policy changes often inhibits development.

4.5 Consumers value price and renewable energy production.

Surveys revealed that renewable energy production and low costs are the main concerns of consumers. Many interviewed utilities claimed that their customers solely cared about price. Company D stated that the biggest factor for consumers is low prices first, followed by reliability, and lastly environmentally friendly sources. Similarly, Company C stated that consumers do not care about where their electricity comes from as long as it is cheap. However, Company B recognized that customers want both cheap and green electricity. All utilities acknowledged that most customers only care about price, and that places little stress on utilities. Now that there is the potential for a liberalized market in the future, utilities want to understand what consumers value most.

After conducting a survey with a convenience sample size of twenty-nine Swiss citizens, we were able to identify customer values in regards to electricity consumption. When respondents were asked about what they are most concerned with when consuming electricity, the top two responses were price and renewable energy production. This proved that utilities were correct on customer concerns about price, but many failed to acknowledge the fact that customers also want their electricity from renewable energy technologies. In fact, 86.4 percent of respondents were interested in knowing how their electricity is produced. This statistic can be viewed by utilities as an opportunity to begin educating their customers about the company. The

full results of our survey can be found in Appendix I and a summary of significant results as well as a discussion of limitations can be found in Appendix H.

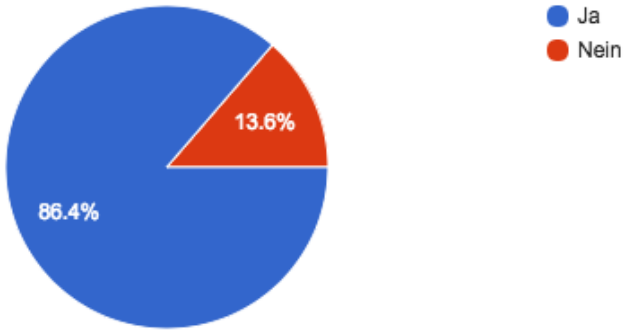

Figure 1. Consumer interest in knowing how their electricity is produced. This graph shows the outcome of consumer responses to survey question 4.

The responses from the surveys raised an additional challenge for utilities. It is difficult for utilities to provide cheap and renewable energy because these are currently conflicting ideas. Renewable energy technologies have high production costs and many utilities are not receiving returns from selling energy that cover those costs. However, the technology is developing at a rapid pace and it is unclear whether the production costs will lower in the future. In addition, consumers may impact regulation due to their growing concern for renewable energy production. Regulation may provide utilities with benefits that will help cover the high production costs.

Chapter 5: Recommendations

Based on our interviews, survey results, background research, and findings we have created recommendations for the Smart Grid Plus team and Swiss electric utilities. These recommendations focus on the importance of the consumer in the changing sector and on the need for additional collaboration between academics and utilities. We recommend:

1. Utilities should research consumer needs and wants.
2. Utilities should develop strategies for implementing new technologies and integrate customer-oriented services into their existing business models.
3. Utilities should increase customer outreach in the forms of marketing and education.
4. Trade groups should develop peak shaving regulations.
5. The team at ZHAW should conduct research into negative and positive effects of departmental company structures in the Swiss Energy Sector.

1. We recommend utilities research consumer needs and wants.

As decentralization becomes more prevalent, consumer roles will have a larger impact in the energy sector. There is a lack of research on consumers in the Swiss energy market and as a result all interviewed utilities discussed the importance of understanding customers. Therefore, utilities should allocate resources to conduct their own research on consumer needs and wants.

Current research related to consumers is often completed in the form of surveys. The concern with this method is that it needs to be done frequently because of how quickly the market changes. Surveying is a viable option for understanding consumer needs and wants, but it needs to be done more frequently. In addition, the method of administering the surveys contributes to response rates. We found that surveys need to be succinct and facilitated by individuals who speak the language of the region. Providing incentives for contributing to research projects may also help increase participation from consumers. These incentives can be in the form of a small free gift to show appreciation for their contribution.

Dedicating a research team to analyze consumer needs and wants will help utilities design customer-oriented services. If developing a research team is not an option for utilities, we recommend creating a partnership with a local university that has the time and resources to perform large research projects.

2. We recommend that utilities develop strategies for implementing new technologies and integrate customer-oriented services into their existing business models.

Through interviews with utilities, we learned that new technologies and customer oriented services must be integrated with existing business models. In order to smoothly transition with the changing Swiss energy sector, it is essential for utilities to innovate and adapt their current business models instead of creating new ones. We found that niche technologies, secondary markets, and additional services were successfully integrated into business models. We concluded in *Finding 2* that there is evidence that integrating these will lead to sustainability in the Swiss energy market.

The integration of new technologies in a utility's business model is essential to its survival. The popularity of niche technologies is rising and future regulations, along with consumer influence, may make it impossible to continue the use of nonrenewable energy. The recent referendum to phase out new nuclear power plants is an example of this. In order to incorporate these new technologies, our results from interviews showed that developing departments dedicated to exploring niche technologies and allocating resources to create

strategies is essential. Once proper resources are available, we recommend that utilities begin experimentation and create realistic milestone goals for the future.

Various customer-oriented services can be incorporated to adapt to the shifting landscape of the Swiss energy market. Services include photovoltaic solutions, e-mobility, batteries, and telecommunications. These services have proved to be successful with all utilities that have already implemented them. Utilities are considering consumer needs with the addition of these services. This will certainly be a distinguishing characteristic for the survivability of utilities if the Swiss energy market becomes liberalized. Another key addition would be to create full package services that are designed for simplicity. These services allow utilities to create partnerships and further diversify for the convenience and accessibility of end customers.

3. We recommend that utilities increase customer outreach in the forms of marketing and education.

As utilities plan to add customer-oriented services to their business models, customer outreach is essential for those services to be successful. All utilities discussed the potential for the Swiss market to become liberalized. This possible change causes utilities to address new challenges that were not present in a monopolized market. Company A discussed the need to develop a marketing department that previously did not exist because there was little need to interact with customers. Now that the market is changing, connecting with customers is essential in order to survive in the market.

Customer outreach establishes a line of communication with consumers that provide many benefits to the utilities. Marketing creates name recognition with customers that may make them more receptive to future company projects. In addition, it allows utilities to shape the dialogue that they want with customers and educate them on the positive initiatives and programs they are doing. Educating consumers about a variety of topics, such as energy consumption and the dangers of climate change, will be key for utilities and an opportunity to continue community outreach. As a result, customers may be more responsive to peak shaving services and renewable energy production projects.

One interviewed utility has had success with customer outreach. Company B implemented educational programs in a local school in their community in order to reach out to future generations. It established name recognition with students and taught students about energy consumption. This company highlights an important aspect about the feasibility of this approach: start local. Customer outreach in a local community can be beneficial for many reasons, specifically low budget and name recognition. Another example of an educational program in a local school is sponsoring a science fair. It reflects a positive image on the company with relatively low costs. In addition, when those students become homeowners later in life, they may be more likely to choose that company. Customer outreach in the form of marketing and education can take on many forms, but the positive aspects they have on the company contribute to survivability in the marketplace.

4. We recommend the development of peak shaving regulations.

The growth of prosumer energy production poses challenges for the grid and utility companies due to the added congestion during peak production. With current regulations, utilities are required to accept 100% of prosumer power production. The utility companies must expand grid capacity to comply with regulations where the grid is incapable of supporting such a capacity. However, peak shaving of prosumer power production could mitigate the burden of costly grid expansions.

Utilities should work with each other in trade groups to develop peak shaving regulation concepts and then collaborate with legislators to draft the regulations and propose them to the public. Utilities should then lobby voters and promote the concept of peak shaving regulations to communities. Utilities can use improved customer relations or marketing to positively influence public opinion about peak shaving regulations. Swiss citizens would then be able to voice their support for the development of peak shaving regulations and eventually vote for the regulations.

If these regulations are implemented, utilities can avoid unnecessary future expenses related to prosumer power production. As predicted by Company D, this change would allow them to limit the production of PV solutions to 70% of the capacity. This would avoid expensive grid expansions, whilst only decreasing the overall production from PV solutions by 3%. Thus, by following *Recommendation 4*, utility companies will be better able to handle decentralization due to prosumers.

5. We recommend the team at ZHAW conducts additional research into negative and positive effects of departmental company structures in the Swiss Energy Sector.

Many of the largest utility companies in Switzerland are comprised of multiple independent departments. As expressed in interviews with Companies A, C, and D, these departments do not often collaborate. The representative from Company D spoke about how he and his colleagues have developed programs to bring employees from multiple departments together to collaborate. He claimed that on occasion multiple departments have worked on the same project separately, essentially causing the company to pay for the development of the same thing twice. Increased costs from the repetition of work is a negative effect of compartmentalization at a large company. Despite an emphasis on the importance of collaboration, the representative at Company C said that there are some positive effects of the compartmentalization, such as the development of particular expertise within a focused field. The interviewee said that separated departments tend to branch off further into secondary markets than when collaborating.

Our interviews revealed positive and negative effects of the prevalent departmental company structure; however, it was not clear whether compartmentalization was beneficial or detrimental overall. There is a need for additional research into how such a divided structure affects the development of utilities. With many changes occurring in the industry, Swiss utilities would benefit from knowledge of these effects.

We recommend a comparison study comprised of interviews and an in depth analysis of company development and growth. The research should aim to answer the questions:

- Do compartmentalized companies grow faster than merged companies?
- What pros/cons do employees see with the two scenarios?
- Is there a clear difference?

A better understanding of the varying company structures will help utilities maximize their efficiency and react quickly to the changes occurring in the sector.

Chapter 6: Conclusion

By analyzing the current changes in the Swiss energy sector, we found that the current business models of utilities are no longer sustainable and consumer influence is growing in the market. In light of our findings, we have provided utilities with recommendations to help contribute to their survivability in the market. We based these recommendations on background research, consumer surveys, and expert interviews. Furthermore, we have included in this paper a self-assessment rubric for Swiss electric utilities to rate their overall survivability. The rubric scores each utility based on the four pillars of a business model: core strategies, innovation and flexibility, customer interface, and revenue model. The rubric provides a list of criteria that each utility should strive for in order to limit potential risk in the market.

The energy sector in Switzerland is changing rapidly. Research teams, utilities, and government agencies must be aware of the paradigm shift in order to react. Our research has provided an analysis of the changes occurring in the Swiss energy sector focussing on current adaptive business models and consumer influences. Additional research on peak shaving regulations and consumer needs will need to be done in order to further help utilities be sustainable in the marketplace. Electricity production and distribution are evolving as prosumer activities are placing additional pressures on the grid. These new technologies will continue to develop in the future and utilities must prepare for the changes to come.

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Appendix A

Project Timeline - Table showing the timeline of the project

Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
Week 1						
23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug
Background Research		Interview Prep				
Week 2						
30-Aug	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep	5-Sep
Interviews						
Week 3						
6-Sep	7-Sep	8-Sep	9-Sep	10-Sep	11-Sep	12-Sep
Interviews		Interview Analysis				
Week 4						
13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep
Survey Prep					Conduct Surveys	
Week 5						
20-Sep	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep
Conduct Surveys		Survey Analysis				
Week 6						
27-Sep	28-Sep	29-Sep	30-Sep	1-Oct	2-Oct	3-Oct
Final Analysis and Research						
Week 7						
4-Oct	5-Oct	6-Oct	7-Oct	8-Oct	9-Oct	10-Oct
Final Paper Productions						

Appendix B

A comparison of Utility-Side and Customer-Side Business Models

Table 1[3]

Pillars	Utility-side Renewable Energy Business Model	Customer-side Renewable Energy Business Model
Core Strategies and Value Proposition	Centralized energy production fed into the grid	Small-scale solutions and energy related services
Innovation and Flexibility	Investments in large-scale energy production, limited flexibility	Investments in various small-scale renewable energy production, high flexibility
Customer Interface	Customer pays per unit	Customer is involved in energy production Prosumers share benefits with utilities
Revenue Model	Revenues through feed-in of electricity	Revenue from direct use, feed-in to grid and from services

[3] Adapted from Richter, 2013 and paraphrased from Schmidt, S., Mejia, G., & Burger, P, 2012. Revenue model, customer interface, and the two business model types are adapted from Richter. Some portions of innovation and flexibility were taken from Schmidt, S., Mejia, G., & Burger, P, 2012.

Appendix C

The survey questions are directed towards Switzerland citizens and will consider demographic information in order to evaluate correlations of socioeconomic status or environmental concerns with age, gender, or household incomes. Personal information will not be shared and responses will be anonymous to protect privacy of participants.

Energy Survey[4]

1. What is your gender? ☐ Male ☐ Female ☐ Other ☐ ☐ ☐ ☐
2. What is your age? 18-24 25-34 35-44 45+
3. Annual Income? ☐ Under 50,000 ☐ 50,000-100,000 ☐ Above 100,000

---

1. Do you know the top energy sources in Switzerland? Please choose two.
   a. Hydropower b. Photovoltaic c. Nuclear
   d. Oil e. Coal

2. Decide whether the following statements are true or false. Please circle.

   In Switzerland, no new nuclear power plants can be built.
   a. True b. False

   In the spring of 2017, 60% of Swiss citizens rejected the new Energy Act.
   a. True b. False

3. Do you know how the electricity you consume is produced? (For example, hydropower)
   a. Yes, _____ b. No

4. If no, are you interested in knowing where your energy comes from?
   a. Yes b. No

5. If you had the option, would you like the ability to choose your utility company?
   a. Yes b. No c. I do not care

6. What would be the main reason you would choose your utility if you had the option?
   a. Cost
   b. Renewable energy production
   c. Customer service
   d. Other services that are offered, such as telecommunications

7. What utility company provides your power currently? Please fill in the blank.
   _____ OR I do not know

8. What are you most concerned with when consuming energy?
   a. Cost b. Renewable (Solar, Wind, Hydropower, etc.) c. Reliability d. Locally generated

9. From the list of energy sources, which options do you find environmentally friendly? Please circle.
   a. Oil b. Coal c. Hydropower d. Nuclear
   e. Solar f. Wind

10. If you had the option, would you consume electricity from only renewable energy sources?
    a. Yes b. No

11. Do you currently generate your own electricity?

---

[4] University of St. Gallen & Raiffeisen, 2017. Used as reference while creating survey.

a. Yes b. No, not interested c. No, not feasible d. No, but considering

12. What technologies are you interested in installing? Circle all that apply.
    a. Photovoltaic b. Electricity Storage c. Heat pump d. Other _____

13. Which of these technologies do you currently have installed?
    a. Photovoltaic b. Electricity storage c. Heat pump
    d. Thermal solar e. Other_____

14. Are you interested in investing in a community solar project?
    a. Yes b. No

Appendix D

Energieumfrage

Diese Umfrage wird von amerikanischen Austauschstudierenden der Universität WPI im Rahmen eines Forschungsprojektes der ZHAW durchgeführt. Die Fragen zu Energiethemen sind an Bewohner in der Schweiz gerichtet. Alle Informationen werden vertraulich behandelt

1. Ihr Geschlecht? ☐ männlich ☐ weiblich ☐ sonstiges
2. Ihr Alter? ☐ 18-24 ☐ 25-34 35- ☐ 44 45+ ☐
3. Jahreseinkommen netto (Ihres gesamten Haushalts)?
   ☐ unter 50,000 ☐ 50,000-100,000 ☐ über 100,000

---

1. Wissen Sie, wie in der Schweiz hauptsächlich Strom produziert wird? Wählen Sie zwei der folgenden Möglichkeiten aus:
   a. Wasserkraft b. Photovoltaik c. Kernkraft d. Ölkraft e. Kohlekraft

2. Entscheiden Sie, ob folgende Aussagen richtig oder falsch sind. Bitte kreuzen Sie an.

   In der Schweiz dürfen keine neuen Kernkraftwerke gebaut werden.
   a. Richtig b. Falsch

   Knapp 60% der Schweizer Bevölkerung hat das neue Energiegesetz im Frühjahr 2017 abgelehnt.
   a. Richtig b. Falsch

3. Wissen Sie, wie Ihr Strom produziert wird? (z.B. Wasserkraft)

   a. Ja, _____ b. Nein

4. Wenn nicht, interessieren Sie sich dafür?
   a. Ja b. Nein

5. Möchten Sie Ihren Energieversorger selber wählen können?
   a. Ja b. Nein c. egal

6. Wenn ja, was wäre ausschlaggebend bei der Wahl?
   a. Preis
   b. erneuerbare Stromproduktion
   c. Guter Kundenservice
   d. Angebot von zusätzlichen Dienstleistungen, z.B. Telekommunikation

   e. anderer Grund: _____

7. Wie heißt Ihr Energieversorger?

   _____ ODER Ich weiss nicht.

8. Welche der folgenden Energiequellen sind Ihrer Meinung nach umweltfreundlich? Bitte kreisen Sie ein.
   a. Öl b. Kohle c. Wasserkraft d. Nuklear (Kernkraft)

   e. Solar f. Wind

9. Wenn möglich, würden Sie Strom aus ausschliesslich erneuerbaren Quellen kaufen?
   a. Ja b. Nein

10. Erzeugen Sie selbst Strom?
   a. Ja b. Nein, interessiert mich nicht c. Nein, nicht möglich d. Vielleicht in Zukunft

11. Welche der folgenden Technologien hätten Sie gern zu Hause? Mehrere Antworten möglich.
   a. Photovoltaik (Strom) b. Solarthermie (Warmwasser) c. Stromspeicher (Batterie)

   d. Wärmepumpe e. sonstige _____

12. Welche der folgenden Technologien haben Sie schon?
   a. Photovoltaik b. Stromspeicher (Batterie) c. Solarthermie (Warmwasser)

   d. Wärmepumpe e. sonstige _____

13. Interessieren Sie sich für ein gemeinschaftliches Solarprojekt (Beteiligung an einer gemeinschaftlichen Solaranlage)?
   a. Ja b. Nein

Appendix E

Interview format and questions

Introductions

Personal Background Questions

1. How did you come to work for Company XYZ?
    a. If interviewee introduces past work -> What did you do there?
2. What is your role within the company?
3. Assume you were directed to hire a young assistant for your current work. What background, education, and/or capabilities would you expect and look for?

Company Background Questions

Ask a series of specific questions depending on the utility company being interviewed.

Diversification (motivations/constraints)

1. To your knowledge is your company exploring any new niche technology or secondary markets?
    a. Can you elaborate on the motivation for exploring xyz?
    b. What is your strategy for exploring this?
    c. How do you gain knowledge about the technologies?
2. Are there any constraints affecting the direction of the company?
3. Has your company noticed any trends in the energy market?
4. What are your views on decentralization?

Social Impact Questions

1. How does Company XYZ interact with the public?
2. Why do you think customers come to you?
3. What stands out to you as an important characteristic for an energy company?

Appendix F

Utility Survivability Self Assessment Rubric

Survivability Rubric

Business Model Pillars	Resistant 1	Responsive 2	Sustainable 3	Total
Core Strategies	- Energy generation from one source (i.e. nuclear) - Non-renewable source - Lack of diversification - Only offers energy production services	- Mixture of non-renewable and renewable energy production - Some additional services offered (i.e. telecommunications) - Limited diversification	- Primarily renewable energy production from multiple sources - Abundant additional services offered - Focus on diversification	
Innovation & Flexibility	- No resources allocated to developing new technologies - Against new technology trends in the market - Lack of experimentation	- Limited resources dedicated to new technologies - Lack of strategic plans for implementing new technologies - Some experimentation	- Resources dedicated to new technologies and secondary markets - Strategic plans for implementation of niche technologies - Heavy experimentation	
Customer Interface	- Limited interactions with customers - Unaware of consumer needs - Limited to no customer-oriented services (i.e. consulting)	- Some interactions with customers - Actively attempting to understand consumer needs - Some customer-oriented services	- Customer focused - Understand needs of the consumer - Community outreach - Customer service programs	
Revenue Model	- Negative trends in profit year-to-year - Profit only from selling energy	- Stagnant/no noticeable trend in profit year-to-year - Profit from some services - Limited ability to turn new technologies to profitable services	- Positive trend in profit year-to-year - Profit from multiple services - Ability to implement new technologies to gain profit	

Instructions:

Once finished with the rubric, please add up the scores in the four categories to find the total score and read the current state of your utility. The scores correspond to the adaptiveness and survivability of the utility in the changing landscape of the Swiss energy sector. Below find the definitions of the business model pillars used for creating the rubric.

Core strategies	Innovation & Flexibility	Customer Interface	Revenue Model
-Current services offered to customers that provide a revenue stream -Includes, but is not limited to, energy production, energy sales, and additional services such as telecommunications or consulting.	-Investments in new technologies or secondary markets that are not implemented in the current business model nor providing a revenue stream. -Willingness and ability to transition to new core strategies	-Community involvement, customer service, educational programs -Understanding customer needs -Education programs can be related to knowledge and awareness of sustainability, green energy, reducing consumption, and price indexes	- Net profits gained from offered services -Strategies to implement new technologies to profit -Revenue streams

Score Sheet

4-6	7-9	10-12
Resistant This utility has not yet adapted or considered the changes in the market. The survivability of the current business model is at risk.	*Responsive* This utility is aware of the changing landscape and is in the process of adapting their business model.	*Sustainable* This utility has accepted the changing landscape and is integrating niche technologies and secondary markets. It is currently having positive year-to-year profits and has the ability to implement new services to its business model.
In order to survive, it is recommended for this utility to look at the grade 2 category to begin implementing changes and to innovate their current business model.	In order to continue innovating, it is recommended for this utility to look at the grade 3 category to further explore niche technologies and secondary markets.	In order to continue to be sustainable, it is recommended for this utility to continue to adapt to the changing energy landscape. Maintain the criteria listed in the grade 3 category and improve on any categories that are below this grade.

Appendix G

Web Application for the Survivability Rubric

The Web Application available at pvd-ch.github.io is an interactive version of the survivability rubric proposed in this paper. Upon opening the web application, a message with the title of our project greets the user. At the top of the window, there are several links to different aspects of the webpage. On the home page, there are two buttons for interested users: "Take the Self-assessment" and "Learn More About our Project."

When the user goes to take the self-assessment, they are given detailed instructions about how to navigate our rubric and its purpose. The user is also shown the four pillars of business models in order to give background about the foundations of the rubric. After the user has read through this information, he can then click the "Take the Self-assessment" button to continue with the self-assessment.

On the self-assessment page, the user can see our rubric, with pillars of business models on the y-axis and the levels of agreement on the x-axis. For each pillar, he can select the description or level that best fits his utility company. When the user is satisfied with his responses, he can click the "Evaluate" button above the table to continue.

The evaluation page then gives the user the corresponding results for his rubric responses. The user's utility can fall under three categories: resistant, responsive, or sustainable. The other two results that did not fit the user's descriptions are dimmed. If the user believe that he had made a mistake, he can select the back button above the table to return to the self-assessment page. Otherwise, the user can continue to click the "Learn More About our Project" button.

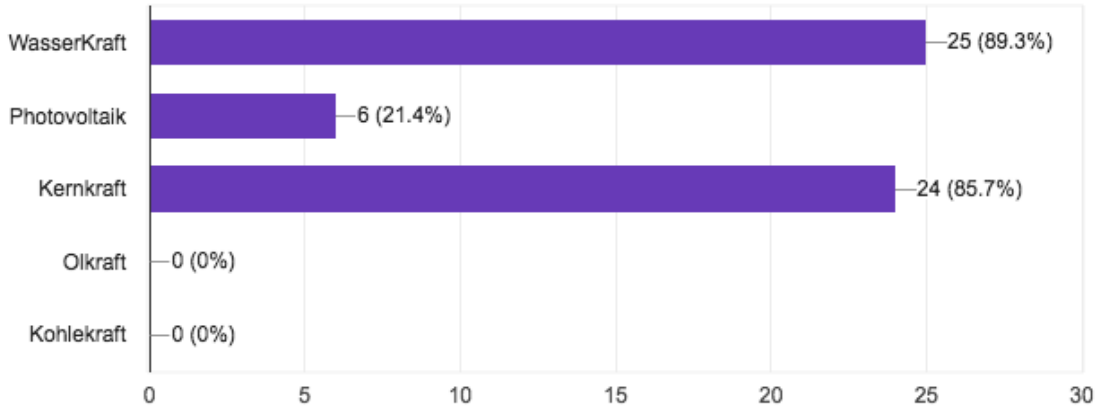
The final page, "Our Project", gives the user a brief overview of our project and the methods used in order to create this web application. This page discusses the problem, our goal, the objectives and methods used, our findings, and our recommendations. The page provides information for a better understanding of the current and future states of the Swiss electricity market.

In the future the website could be adopted and hosted by a university, utility, or consulting company that would keep it updated and accurate. The source code for the site is available at https://github.com/pvd-ch/pvd-ch.github.io. As the industry continues to change, a team such as the Power Alliance and researchers at ZHAW should update the text portions of the rubric to meet current standards. As a further implementation of the site we would advise the team at ZHAW to look into a more permanent hosting location and host organization with the know how to update and advance the site. The site could be updated to include data collection so researchers would see the input of utilities using the rubric.

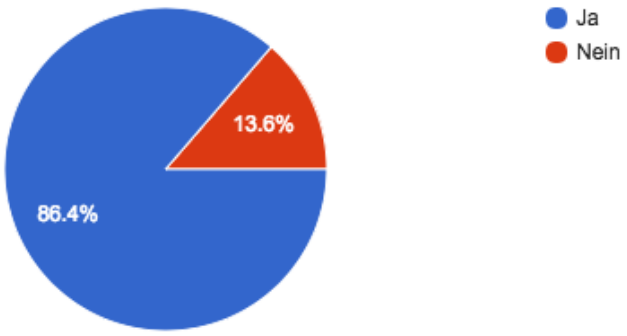
Appendix H

Significant Survey Findings

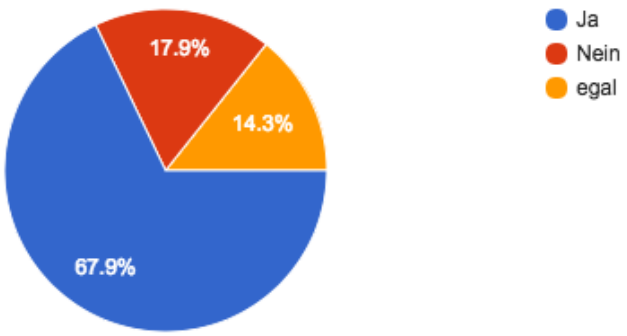
The following are the statistically significant findings from our survey results. The significance of these results is limited by the low number of survey responses. The surveys were conducted primarily in the city of Zurich using convenience sampling. The population in Zurich may disproportionately be renters instead of homeowners and therefore survey results may not accurately be extrapolated to address the whole of Switzerland. All limitations of the survey will be discussed in the final report and results will be elaborated upon. This survey, although significantly limited, proves the importance of surveying consumers as the findings contradict several utility assumptions.



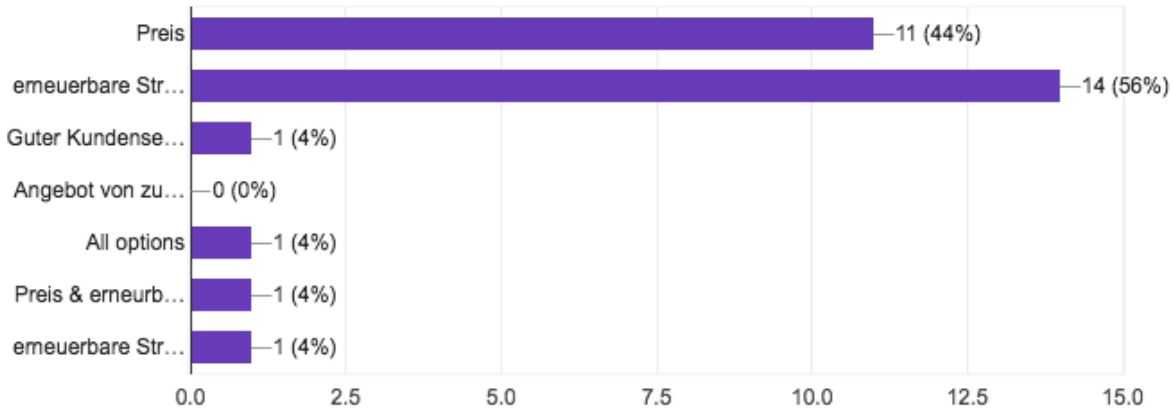
Surveyed individuals are generally aware of the most used production techniques.



Surveyed individuals would be interested in knowing where their electricity comes from.



Surveyed individuals would prefer to choose their utility.



The two most important factors for consumers are price and renewability.

Future Survey Recommendations

1. German speaking surveyers may be more succesful
2. Surveying a broader area would be beneficial to better match Swiss demographics
3. Additional demographic data would aid in data analysis

Appendix I

Survey Results

Gender	Age	Income	Question 1	2 [A]	2 [B]
Male	25-34	> 100,000	WasserKraft, Kernkraft	Richtig	
Female	35-44	> 100,000	WasserKraft, Kernkraft	Richtig	Falsch
Female	45+	> 100,000	WasserKraft, Kernkraft	Richtig	Falsch
Female	45+	50,000-100,000	WasserKraft, Kernkraft	Richtig	Falsch
Male	18-24	> 100,000	Kernkraft	Falsch	Falsch
Female	45+	< 50,000	WasserKraft, Kernkraft	Richtig	
Male	25-34	< 50,000	WasserKraft, Kernkraft	Richtig	
Female	45+	< 50,000	WasserKraft, Photovoltaik, Kernkraft	Richtig	
Female	45+	< 50,000	WasserKraft, Photovoltaik	Falsch	Richtig
Male	35-44	50,000-100,000	WasserKraft, Photovoltaik	Richtig	Falsch
Male	45+	> 100,000	WasserKraft, Kernkraft	Richtig	Falsch
Male	25-34	50,000-100,000	WasserKraft, Kernkraft	Richtig	
Male	18-24	< 50,000	WasserKraft, Kernkraft	Richtig	Richtig
Male	45+	< 50,000	Kernkraft	Richtig	
Female	25-34	< 50,000	WasserKraft, Kernkraft	Falsch	Richtig
Female	25-34	50,000-100,000	WasserKraft, Photovoltaik	Falsch	Richtig
Male	45+	50,000-100,000	WasserKraft, Kernkraft	Richtig	
Female	45+	< 50,000	WasserKraft, Kernkraft	Richtig	
Female	25-34	50,000-100,000	WasserKraft, Photovoltaik	Falsch	Richtig
Male	45+	50,000-100,000	WasserKraft, Kernkraft	Richtig	
Female	25-34	50,000-100,000	WasserKraft	Richtig	
Male	35-44	50,000-100,000	WasserKraft, Kernkraft	Richtig	Falsch
Female	25-34	< 50,000	Photovoltaik, Kernkraft	Richtig	Falsch
Female	25-34	50,000-100,000	WasserKraft, Kernkraft	Richtig	Falsch
Male	18-24	< 50,000	WasserKraft, Kernkraft	Richtig	Falsch
Female	25-34	50,000-100,000	WasserKraft, Kernkraft	Richtig	Falsch
Male	35-44	> 100,000	WasserKraft, Kernkraft	Richtig	Falsch
Female	25-34	50,000-100,000	WasserKraft, Photovoltaik, Kernkraft	Falsch	Richtig
Female	45+	> 100,000	WasserKraft, Kernkraft	Richtig	
Male	45+	< 50,000	WasserKraft, Kernkraft	Richtig	Falsch
Male	35-44	> 100,000	WasserKraft, Kernkraft	Falsch	Falsch

3	4	5	6
Kernkraft		Ja	Preis
Kernkarft		Ja	erneuerbare Stromproduktion
Nein	Ja	Ja	erneuerbare Stromproduktion
Nein	Ja	egal	erneuerbare Stromproduktion
Nein	Ja	Nein	All options
Wasserkraft	Ja	Nein	erneuerbare Stromproduktion
Nein	Ja	Ja	Preis & erneurbare Stromproduktion
		Ja	erneuerbare Stromproduktion
Nein	Nein	egal	
Wind	Nein	Ja	erneuerbare Stromproduktion und Guter Kundenservice
	Ja	Ja	erneuerbare Stromproduktion
Kernkraft & Wasser		Ja	Preis
50%		Nein	
Gas	Ja	Ja	Preis
Mullverbrewung (BS)?	Ja	Ja	erneuerbare Stromproduktion
Nein	Ja	Ja	Preis
Ja	Ja	egal	Preis
Nein		Nein	
Nein	Ja	Ja	Preis, erneuerbare Stromproduktion
Ja	Ja	egal	Preis, erneuerbare Stromproduktion
Nein	Ja	Ja	Preis
Nein	Ja	Ja	Preis, erneuerbare Stromproduktion
Atom	Ja	Ja	erneuerbare Stromproduktion
Solarstrom	Ja	Ja	Preis
Nein	Ja	egal	erneuerbare Stromproduktion
Nein	Ja	Ja	Preis, Guter Kundenservice
wasserkraft	Ja	Ja	Preis
Nein	Ja	Ja	erneuerbare Stromproduktion
Nein	Nein	Nein	Preis
Nein	Ja	Ja	erneuerbare Stromproduktion
100 % nature mode?	Ja	egal	erneuerbare Stromproduktion

7	8	9	10
BKW	Wasserkraft, Solar, Wind	Ja	
Elektra	Solar, Wind	Ja	Ja
Ich weiss nicht	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
EWZ	Solar, Wind	Ja	Nein, nicht moglich
Ich weiss nicht	Ol, Wind	Ja	Ja
EWZ	Solar, Wind	Ja	
Bern Wasser Energie	Wasserkraft, Nuklear, Solar, Wind	Ja	Nein, nicht moglich
Gocgeu	Wasserkraft, Solar, Wind	Ja	Nein, interessiert mich nicht
EWZ	Nuklear	Ja	Vielleicht in Zukunft
Glattwerke/ Glattnet	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
EWZ	Wasserkraft, Solar, Wind	Ja	
	Wasserkraft, Solar, Wind	Ja	Vielleicht in Zukunft
EAW	Wasserkraft, Wind	Ja	Vielleicht in Zukunft
RWE	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
IWB	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
Ich weiss nicht	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
Dowoze Bathawshe?	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
Ich weiss nicht	Wasserkraft, Wind	Nein	Nein, nicht moglich
Ich weiss nicht	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
Dowosei Bathoeshe???	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
EWZ	Wasserkraft, Solar, Wind	Ja	Vielleicht in Zukunft
Ich weiss nicht	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
Cemeindi	Solar	Ja	Nein, nicht moglich
EBC? EBL?	Solar, Wind	Ja	Ja
EWZ	Wasserkraft, Solar, Wind	Ja	
EWZ	Wasserkraft, Solar, Wind	Ja	Nein, nicht moglich
EWZ	Wasserkraft	Ja	Nein, interessiert mich nicht
Ich weiss nicht	Solar, Wind	Ja	Vielleicht in Zukunft
Ich weiss nicht	Wasserkraft, Wind	Ja	Nein, nicht moglich
EWZ	Solar	Ja	Nein, nicht moglich
Rii Seez Power	Wasserkraft, Solar, Wind	Ja	Ja

11	12	13
		Ja
Stromspeicher	Solarthermie	Nein
Photovoltaik, Warmepumpe		Nein
Warmepumpe		Nein
Warmepumpe	Stromspeicher, Warmepumpe	Nein
Photovoltaik, Solarthermie, Stromspeicher, Warmepumpe	Photovoltaik, Solarthermie	Ja
Photovoltaik	Pellet Stove	Ja
Photovoltaik, Solarthermie, Warmepumpe		
Photovoltaik, Stromspeicher		Ja
Solarthermie		Nein
Photovoltaik		Ja
Photovoltaik, Solarthermie, Stromspeicher, Warmepumpe		Ja
Photovoltaik, Solarthermie		Ja
Photovoltaik, Solarthermie, Warmepumpe	keine	Nein
Solarthermie		Nein
	wind	Nein
Photovoltaik, Solarthermie, Warmepumpe	keine	Nein
Solarthermie		Nein
Photovoltaik, Warmepumpe		Ja
Photovoltaik, Warmepumpe		Nein
Photovoltaik		Ja
Photovoltaik	Solarthermie	Ja
		Nein
Photovoltaik, Stromspeicher		Ja
		Nein
Photovoltaik, Solarthermie, Warmepumpe		Ja
		Nein
Photovoltaik, Warmepumpe		Nein
Photovoltaik, Stromspeicher, Warmepumpe	Photovoltaik, Fernwarme	Ja