UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

MASTER`S THESIS

THE ROLE OF DATA ANALYTICS IN CHANGING BUSINESS MODELS WITHIN THE ENERGY SECTOR

Ljubljana, September 2017 MAXIM VAN AERT

AUTHORSHIP STATEMENT

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

One of the biggest problems of the 21st century of humanity is climate change. According to the European Commission, 91% of the Europe population see climate change as a serious problem. (European Commission, 2015). The National Oceanic Atmospheric Administration (hereinafter : NOAA) pointed out that the 10 warmest years in a span of 134 year occurred since 2000 (NOAA, 2016). Numerous institutions have pointed out that humanity plays a vital role in this change. A lot of human inventions and advancements like certain firms, planes, cars increased our consumption on natural resources and that translated in the release of an extraordinary amount of greenhouse gases which ultimately results in a slow but steady temperature rise humanity is part of the cause of climate change, but can also be part of the solution.

At this time various policies, restrictions, guidelines and innovations have been called to life in order to reduce carbon emissions where the ultimate goal will be to restore the balance and have sustainable world. Innovations and optimizations enabled by technology within the automotive industry, within the manufacturing industry and especially the energy and utilities industry and initiatives as the Paris agreement are brought to life where an improved efficiency and a reduction in carbon emission are one main goals (Climate Group, 2008).

Society is called into action and innovations related to energy optimization are trending. Jeremy Rifkin's theory will gives it a bit more context. Jeremy Rifkin, An economic and social theorist argues that society is in the last stages an energy era, claims that a fundamental economic changes which are happening originates from the convergence from new types of communication and new form of energy supply and new forms transport and logistics. When significant innovations in these areas are taking places around the same time they create an infrastructure for a broad technology transformation platform.

Today humanity is at ending stage of the 2nd industrial revolution. The first industrial revolution was caused by the convergence of steam-power and typing machines. The second industrial revolution was caused by the convergence of the combustion engine and electric communication. Now the third industrial revolution the era where fossil fuels were our main source of energy is coming to an end. With Internet of Things and renewable energy we`re on the verge of stepping into the third industrial revolution where renewable and inexhaustible source of energy will be used. This third revolution is being caused by the co-occurrence by the internet revolution, a distributed communication revolution and renewable energy revolution, also in a distributed model where energy is found in the backyard (Rifkin, 2012).

The 3th industrial revolution is composed of the internet communication with energy distribution and transport system of autonomous electric vehicles. Communication, Transport and energy come together through Internet of Things. The focus of this work will be one of the 3 facets of this revolution; the transformation of energy industry with the focus on the role of data and analytics as a driver.

The reason data and analytics is playing a key-role with this transformation today is because the data presence and overall analytics capabilities of large energy companies is reaching level as well as their sense of urgency in regards of business intelligence being a key-differentiator in conducting their business. This is happening simultaneously to the required shift to green and ecological energy and revolution of different IoT-based technologies. This are the type of challenges that can be opportunities for certain companies.

The data that energy companies will gather can unlock vast amounts of business values if it can be trusted as accurate (Ruddy, 2006). While some companies are farther along than others, opportunities exist in every company, from monitoring information about physical assets, fields, commodities and counterparts to prescriptive systems. Today only a glimpse of its potential has been seen. This can be ingrained in every aspect and area of the world we see around us. Electrical vehicles, Smart houses, Smart meters and entire smart grid.

Another aspect of the data and analytics driven transformation is the maturity of advanced analytics and big data tools. The potential insights and analytics opportunities those tools offer wasn`t possible a couple of years ago. Tools and platforms like Hadoop, NoSQL can compute machine learning algorithms and process and store larger amounts as ever before. The tools are available from wide range of vendors and even larger community of open-source developers (Wegener & Velu, 2013).

The EU is committed to the third industrial revolution described by Rifkin through facilitation to this 4 pillar infrastructure (Rifkin, 2008)

- 20 percent renewable energy by 2020. This is mandate.
- Transform millions of existing buildings in little power plants, collecting energy from the sun on your roof, wind on the walls, etc...
- Store renewable energies.
- Communication evolution where everything comes together were we use the internet technology and the power and electricity grid will be turned in an inter-grid similarly like the internet.

Just like what can be seen in the internet where everyone can access and produce their own information, communication. The inter-grid would be a peer to peer network where billions

can produce energy through their buildings and if they produce more than the utilize they have the possibility to share it across the grid. Energy is created locally, in a decentralized topology. It`s shared peer to peer and it`s an fundamental revolution in the energy production which would take geopolitics and monopoly away.

This revolution translates into the transformation within the energy sector. The data which is being captured throughout organizations, value chain of energy and intelligent households. The use of technology in smart buildings and electronical cars is playing a role in enabling this transformation for industries and businesses. In optimizations of operations, new value propositions and marketing techniques, data analytics on these untapped data areas have the potential to enrich, evolve other insights. To a point where analytics has the potential to allow industries to operate like they never did before (Chen, Chiang, Lindner, Storey, & Robinson, 2012). That why we can speak about a data and analytics enabled transformation. Decision making has gone from a "gut-feeling" skill with calls for experience and specific industry knowledge to a knowledge-based decision process where analytics and data is in the center of the decision making process. Probably it the most discussed topic of the last years within the information technology. How we use numbers and data can also play a significant role in achieving more sustainable and renewable outcomes. The ability to observe micro and time specific data on a compressive scale and perform analysis on this data could help us address grand problems like climate change.

A sustainable and environment friendly industry is obviously not only driver of his data analytics enabled transformation. A modernized grid-system will result in other benefits like increased efficiency of the production and reliability. It will also provide consumers with information and automated tools which assist them in making informed decisions regarding their energy consumption. Since they`re (partly) self-sustaining entities who produce their own energy through their smart buildings will result more sustainable and responsible consumption of energy. Not only cause consumers want to live more ecological responsible but also because they immediately see the impact of their use/waste of energy.

A data driven approach is now ingrained in most modern businesses. Businesses are now looking for new solutions that allow to defend their position against digital disrupters. True digital transformation require them to make fundamental modernizations in customer experience, operations and processes throughout the organization. Big data and analytics has the ability to transform entire business models and industries. This is what is happening now within the energy industry.

The thesis will describe what a revolution in the energy sector could potentially imply by comparing emerged value propositions and business models, the use of data analytics and

machine learning techniques for customer segmentation and operational optimization and how this translate and their respective impact on the ecosystem, of the players which are leading the industry towards the future of energy market.

The thesis will try to answer the following research questions:

- How information is being generated across different parts of the value chain and used.
- How this information and technology is driving the transform of traditional processes to intelligent autonomous processes.
- Which “data-driven” business models are emerging within the energy sector
- How new types of value added services based are emerging and what is the value of the new kind of players.

The work will to give the reader a clear understanding of the energy sector and the road is heading down too. The main objective is to establish the role of information within the energy industry and energy business, Understand how this results in newly emerging business models, reshaped value propositions and an evolved ecosystem. A real life business model will be analyzed in order to concretize and understand the actual implications of the energy transformation and obtain and understanding of what`s being meant by data driven business model and the value of information.

1 DATA AND ANALYTICS ASSESSMENT IN ORGANIZATIONS AND THEIR NETWORK

This section will elaborate on the models and assessment techniques utilized in order to perform the comparative analysis. It covers the explanation on some concepts used in research questions in order to minimize the possibility of misinterpretations of the questions. Also different modeling techniques to describe business models and value propositions for describing the different cases. Lastly a small framework has been proposed in order to describe critical perspectives of a data-driven company and its effects.

The models used for comparing the different business models and value propositions will the business model canvas and value proposition canvas. This model gives the reader a quick and clear view of the company, it can be seen as a blueprint of the company and what is actually offers in order to identify the role of information throughout the organization. It can be considered. In the use cases below the entire model has been made

1.1 Business model Canvas and Value proposition canvas

A **business model** described the rationale flow of how an organization creates, delivers and captures value. The starting point of business model innovations should be a shared understanding of what a business model concept actually is. The business model canvas is a model of representation of the business model which is easy, facilitates description and discussion and intuitively understandable The business model canvas is a visual tool developed by Alexander Osterwalder which serves as a shared language when talking about business models (Osterwalder & Pigneur, 2010). It`s allows you to sketch out existing business model or business models you want to create. It`s a tool that helps u map, design and reinvent and test your business model. An organization business model can describe with 9 basic building blocks.

1. Customer Segments – Who are we creating value for?
2. Value Propositions – What value do we deliver to the customer?
3. Channels to reach customers – How do we reach our customer segments?
4. Customer Relationships – What type of relationships do our customer segments expect?
5. Revenue streams – What value are our customers willing to pay for?
6. Key resources – What Key resources do our value propositions require?
7. Key activities – What Key activities do our value propositions require?
8. Key Partners – Who are our key partners?
9. Cost structures – What are the important cost inherent in our business model?

Customer Segments are all the people or organization for which u create value. This includes simple users, paying customers. For each segments you have a specific value proposition. These are the bundles of services and/or products you offer. Channels describe to which touchpoint you interact with your customers in order to deliver value. Customer relations outline the type of relationships you establish with your customers. Revenue stream make clear how and to which pricing mechanism your business model is capturing value. Key resources show which assets are indispensable in your business model. Key activities show which things you really need to able to perform. Key partner's show who can help leverage your business model. Since you won`t have key resources yourself nor you will perform each key activity. Once you understand your entire business infrastructure you also will be able to understand your cost structure. This consist out of the cost or what it will take to create the goods and services described in the value proposition. Usually this forms out of three aspects. The cost of creating and delivering the value proposition, creating the revenue streams as well as the cost of long-term customer relationships.

The important feature is that all 9 building blocks captures entire business. The combination of great products and great business model and how the different buildings blocks are fitting together determines the success of a great business.

Osterwalder advises that for every building block you use post-it notes so groups of people can take it down, discuss and look at the impact when we remove/add posts it. The exercise works best in who can join.

The building blocks are all interconnected. If you remove one segment, key resources might become unnecessary as well. Difference levels of using the canvas. The checklist with the 9 buildings block is the first layer. But there is more, a step further would be understanding the connections between the 9 building blocks. They influence each other and compose the story by walking through all the building blocks.

A next level would be capture similar patterns across different business models. Look at Skype, Nespresso, Google and many others and identify patterns and similarities. Could I create a double-side market? Could I create freemium model? If you know the patterns you know the dynamics which go along with them.

The business model canvas is not a static document, it`s something that evolves, you test various business models, test hypothesis through this business model canvas and adapt and tinker and look at the impact. Failure is just hypothesis testing of the success of the business model.

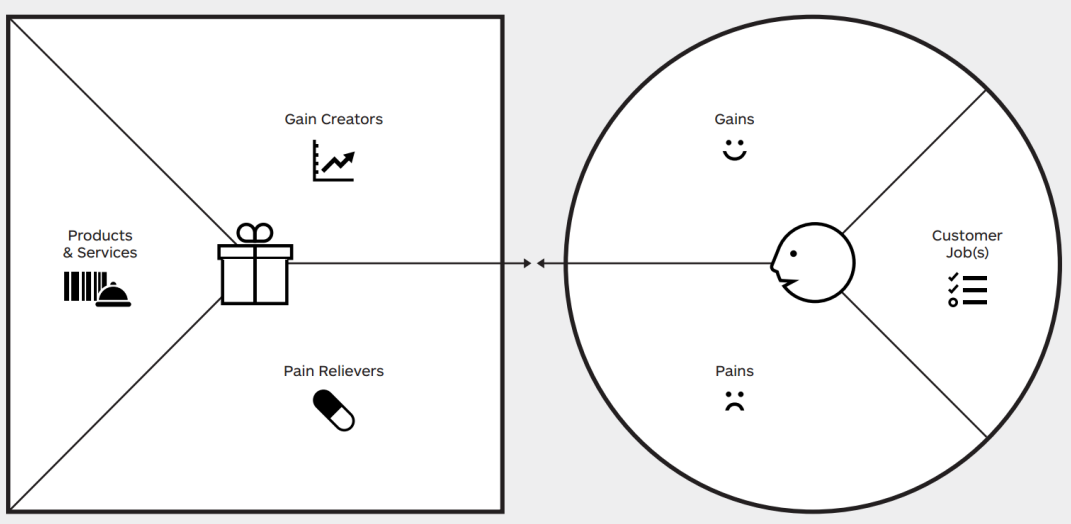
Another layer would be to zoom in 1 part of the business model where we look for instance to the value proposition as well as the customer segment, by looking and observing the customer we can identify the pains and the gains of the customers in regard of our value proposition. From there onwards we can map our value proposition (product, service, features) to these pain and gain of the customer to improve our offerings.

In order to evaluate the new value propositions, another model from Osterwalder will be used, the **value proposition canvas**. It`s can be seen to as a plugin to the business model canvas. The value proposition canvas zooms in on 2 elements of your business model: the value proposition (square) and the customer segments (circle) you will focus upon. With the value proposition canvas you will map out the fit between what u offer and what the customer want. The customer segment profile described the characteristics of your customers in detail. It consist out of 3 main elements: The jobs, tasks your customers are doing, the related pain to these jobs and third, the gains described the positive outcomes and benefits your customers love to have. These 3 elements of the profile described the customer's characteristics that you can observe in the market.

By looking to the value proposition map describing the features of your value proposition which you are design in regard of the pains, gains and jobs. The map is composed of product and service your proposition is building around, the pain relievers explain how your products/service address customer pains and third, gain creators, how your product/service create gains for the customers.

The point of the value proposition canvas is to achieve a “problem solution fit” when the features of your value proposition perfectly map the features of your customer segment profile. The market validate this maps and your value proposition gains traction within the market, a “product market fit”. Of course it important to remember that a great value proposition isn`t always sufficient to have a successful business. A successful business has a great business model where this proposition is a part of.

Figure 1. Value Proposition Canvas.



Source: A. Osterwalder, Y. Pigneur, G. Bernarda & A. Smith, *Value proposition design: How to create products and services customers want*, 2014, p290.

In order to fully understand the impact of an evolved business models it`s useful to also consider the network in which the business model exists. The **business ecosystem** in which the company will conduct their business and in which they will offer their products and services.

1.2 Business ecosystem

In biological term an ecosystem includes all the living and non-living things in a given area, these living and non-living things (sun, earth, animals, micro-organisms are all interacting with each other and they all have their own role to play. Taking away one element or adding another thing could have disastrous consequences.

In the context of business the word ecosystem is used to describe a network in which an organization operates, develops partnerships and how the different parties which are involved in delivering a certain products or service and how the different players interact and influence each other. Similar as in a natural ecosystem, companies also develop capabilities around new disruptive innovations. All these changes influence one another.

The term **business ecosystem** was first used by James F. Moore (Moore, 1993). He defines it as a structured community which is supported by organizations and individuals – the organisms of the business world. The community produces goods and/or services to customers (which are also part of the ecosystem). The ecosystem is constantly evolving and so are the members of it. Coevolving their capabilities, roles and directions.

Moore argues that every business ecosystems emerges in 4 distinct stages: Birth, Expansion, Leadership and Self-renewal or Death. Table 1 shows the different stages and their respective cooperative and competitive challenges. Identifying these stage in reality the evolutionary stages blur and overlap but across various companies in various industries from retail to healthcare the only constant factor was the process of co-evolution: Where companies interchange between competitive and cooperative strategies amongst each other.

Table 1. The evolutionary stages of a Business Ecosystem

	Cooperative Challenges	**Competitive Challenges**
Birth	Work with customers and suppliers to define the new value proposition around a seed innovation	Protect your ideas from others who might be working towards defining similar offers. Tie up critical lead customers, key suppliers and important channels
Expansion	Bring the new offer to a large market by working with suppliers and partners to scale up supply and to achieve maximum market coverage	Defeat alternative implementations of similar ideas. Ensure that your approach is the market standard in its class through dominating key market segments
Leadership	Provide a compelling vision for the future that encourages suppliers and customers to work together and to continue improving the complete offer	Maintain strong bargaining power in relation to other players in the ecosystem, including key customers and valued supplied
Self-renewal	Work with innovators to bring new ideas to the existing ecosystem	Maintain high barriers to entry to prevent innovators from building alternative ecosystems. Maintain high customer switching costs in order to buy time to incorporate new ideas into your own products and services

Source*:* Moore, J. F*, Predators and prey: a new ecology of competition.* 1993, p.77.

The first stage, Birth, focus lies on the value proposition and what the best form is of delivering it. It often pays off greatly having the right business partners. Aside from satisfying customers with offerings, a leader must rise to create a climate of rapid and ongoing improvement that draws the entire network to a grander future. The process of discovery with innovative ideas is harder to achieve with bigger corporate company, however established companies can replicate successful ideas and target broader markets, This implies that they`re entering the market at Stage 2, taking the preparatory work from others.

In the second stage, business ecosystem grow and conquer new horizons. Some new horizons might go easier as others, which might also be targeted by other ecosystems which have closely related offerings. For this stage 2 conditions should have to be present.

(1) A business value that speaks to a lot of customers. (2) A big potential for growth. Marketing and Sales are the main differentiators in this stage. Together with production and distribution new markets will be targeted.

In the third stage, power is derived from having something the ecosystem needs and being the only one which can obtain this. This happens through (with the help of patents or contracts) constant innovation and continuing to create value which is of importance for the ecosystem. For dominant players this is the make or break stage by shaping the direction of customers and suppliers.

The fourth stage of the business ecosystem occurs when mature business communities are threatened by newly emerging ecosystems and innovations. The sudden change of conditions which can be regulations, customer buying patterns or others impacts the balance within the ecosystem. How a company reacts on these changes determines their survivability in the disrupted ecosystem. Three general approaches can be identified how to stay afloat in the self-renewable stage. (1) Slow the growth of the new ecosystem. (2) Incorporate these new innovations in your own ecosystem. (3) Fundamentally restructure themselves try coping with a new reality.

Business leaders are required not only to evaluate their own position within the ecosystem but also their competitors. What partnership have they taken on? How is that different from our own? Do they depend on? What can pose a threat to the ecosystem as we know it? How can our value proposition become obsolete?

Moore tells us how business ecosystems / communities are social systems and that here the analogy with nature doesn`t stand anymore. The direction of a business ecosystem is determined by choices. Executives whose horizons are bounded by traditional industry perspectives will find themselves missing challenges and opportunities which would eventually result them to get blindsided by new competitions.

With the business model and value proposition canvas organization can be mapped to the different building blocks. Specific stages of the business ecosystems can be identified but there is no explicit notion of data and/or analytics within these models. One of research question was to see how information is being generated and used throughout the value chain. Another question was to see which data-driven business models are emerging. In the following part the work will cover what “data-driven” actually implies and how it can be evaluated.

1.3 Data-driven perspectives

Data-driven is an approach for business governance approach where decisions, processes and actions are backed up by verifiable data. In a data-driven business, the business processes are monitored, controlled, assessed and optimized through data which is being collected, analyzed and interpreted in a continuous and often automated manner.

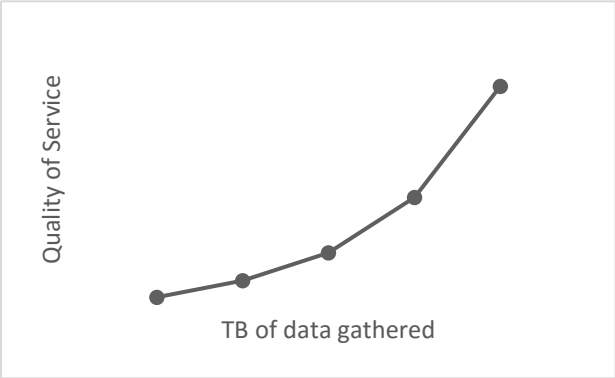
Data-driven marketing or data-driven decision management are quite common, but a company as a whole becoming data-driven isn`t that common, at least not in the understanding given above. being data-driven is not about seeing a few reports at the beginning of every day or week; it's about giving the business decision makers the power to explore data independently, even if they're working with big or disparate data sources. This usually happens through IT enabled dashboards where executives can filter and distill the information relevant to their purpose according to their needs. It`s about aligning technology, people and organizational resources (Weill & Ross, 2009)

Data-driven companies use data, small or big, structured (reports, databases, …) or unstructured (videos, music, images , …) to blend that data in an analytics engine and distill it down to actionable insights to solve business problems. Since data is the oxygen of a data-driven company, again the actions taken based on the insights are evaluated, which result in evaluating which action, insight and data sources yields the most benefits. (Mitzer, 2016)

Data-driven companies use different types of data. Structured data which are being generated in the form of reports, sheets, and databases. This structure data answers the question what is happening. The real opportunity however lies in unstructured data. This covers all the data which is being generated and doesn`t have a pre-defined data model. Videos, online reviews, emails, podcasts, collaboration software or social media feeds. The unstructured data answers why certain things are happening. Every day we create 2.5 million terabytes data where 90% of this data is unstructured. (Dobre & Xhafa, 2014)

Data-driven companies often identify themselves as service providers, for example Google`s search engine or Amazon online retail platform. They`re providing services and at the same time they`re collecting data. Other companies design loyalty programs in order to obtain their clients data. The success of a data-driven company stand and falls with the quality of their data. It`s important to mention that this only improved over time, over the amount of data being gathered.

Figure 2. QoS on TB gathered



Data-driven companies collect data from everywhere. An old way of thinking in BI was by asking what data was already available and how to integrate the data and map it to their metrics or help how metrics can be developed from this data. Data-driven companies do it the other way around. They have a business problems and then look at which data is required in order to get that the answer they need.

Being a data harvester is simply collecting every piece of data about your customers and people in any way you can order to gain insights about existing customers and relate that to future customers(Ryan, 2014).

Data-driven companies create an analytics culture. It can be broken into three categories.

- **Insight**: mining, clustering and using segmentation to understand customers, their networks and product insights.
- **Optimization** : Optimization of business processes, models and business functions
- **Innovation**: Discovery of new disruptive business models that provide pathways to evolution and growth.

Data-driven companies think long-term. They take action on their analytics and use the created insights to do optimize processes, innovate on their value propositions to tinker them to the needs of the customer or the needs of the companies. These needs are coming to the surface by putting context to the results of analytics. Data-driven companies consider mobile in order to exploit the full potential of their insights and innovations. Mobile is a medium to information which is practical, cheap and customer-friendly. Today mobile cannot be ignored.

In order to evaluate the data and analytics element of business models a technological transformative framework is proposed. The framework is a derivate from the framework

from a paper, Digital platforms as sources an organizational and strategic transformation (Resca, Za, & Spagnoletti, 2013). Their framework has organizational and architectural focus while my framework tries to put the emphasis on data and analytics. 3 different perspectives of this digital transformation are considered and evaluated. The three perspective are not coincidentally strongly related to the three categories from the analytics culture.

The first perspective is the obtained insights through data, similarly the first category of data analytics culture. Obviously one of the most important elements of having a data-centric business model is information and how this information is guiding your business and decision making process. The insights obtained from information are the lifeblood of a data-driven organization, hence the obtained insights from data is a vital portion of a data-driven organization.

The second perspective is innovations created through data. It considers innovations where data and the insights of the data are one of the main sources of this innovation. It can be seen as the insights of the first perspective applied to form actual products or services.

The third and last perspective which is considered is the business ecosystem. The ecosystem, as explained above explains the network in which the organization does business. An innovative business model can shake up the organization and the business ecosystem. Innovations and/or insights created through data and analytics can potentially alter the value chain. In this perspective the framework as shown in table 2 wants to encompass the impact of data and analytics on the ecosystem of the organization.

Table 2. Data and analytics assessment framework

Perspective	Key Concepts
Insights through data	Production data, Sensors, Customers information, Monitoring of systems, Maintenance systems
Innovation through data	Technological innovations Emerging value added services
Business Ecosystem	Partnerships Role in value chain Competitors

2 RESEARCH METHODOLOGY

In the first part of master thesis a theoretical background has been presented, using description method from a secondary collected data. This covers an outline of the context of the research topic, the research problem framed through the theory of Jeremy Rifkin. The first light has been shed on the data driven transformation and the purpose and the research questions of the thesis are presented. In the 2th section a framework has been established for assessing the role data and analytics. The section explains the concepts used in the research question purpose section to avoid misinterpretations. It also elaborates the different models which will be used for analysis of the use cases are elaborated as well as an explanation of self-developed framework with three evaluation perspectives based on other relevant scientific publications

In the 3th section, the part that follows on this, the energy sector will be briefly covered in order to shed some light on the sector and to establish basic understanding of the dynamics

of it. The different type of players will be discussed. The current market and the drivers of the change will be discussed. To summarize the Belgium energy market will be described by looking at the value chain, also here the role/maturity from data and analytics point of view will be evaluated in order to create a real-life baseline for our analysis.

In the last part before the qualitative analysis an accurate description will be given of the transformed sector. How the future energy industry looks like. How businesses evolve themselves within the changed landscape. The thesis will established the role of data and analytics after the transformation. How companies can use information and data to change and/or their value propositions and how this gives ground for new types of business models.

In the last part a practical look will be given through a comparative analysis between different emerged business models. The business models will be discussed through business model analysis techniques like business model canvas (Osterwalder & Pigneur, 2010) and other techniques elaborated in the 2nd section, the focus will lie on the role of data and analytics within those business models. The role of those organizations within the value chain will be analyzed, the transformation of the value propositions and the maturity of the respective organization on some key perspectives of the analytics culture.(Resca et al., 2013). In the discussion part which follows after the comparative analysis an evaluation and reflection will be done in respect of the established theoretical framework.

The thesis represent a qualitative study of data and analytics enriched transformation in the energy industry through use comparative analysis of the established baseline and the 4 presented use cases of Dong Energy, Solar City, Comverge and EcoFactor. These organizations are chosen because they all represent successful but at the same time very different approaches to the transformation. Our conclusion will consider all the established points and reflect on the current position of the industry. It summarizes the findings and make concrete recommendations towards organizations how to cope with the transformation achieve a fruitful position within the market. Possibilities for digital platforms will be described and how information is the core of those platforms.

3 THE ENERGY INDUSTRY AND ITS PLAYERS.

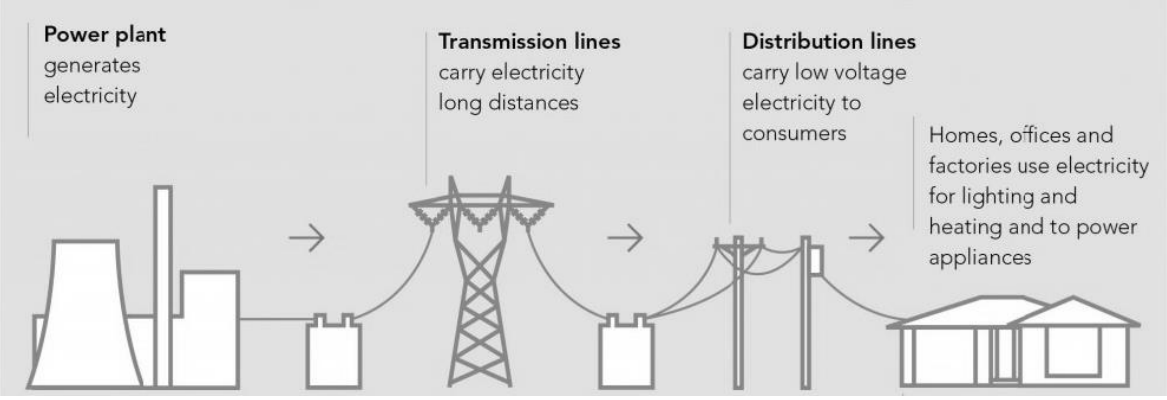
3.1 The players

For the past years, the energy sector wasn`t undergoing much change. A one-way flow of power and information, limited competition and a cost effective carbon-based generation towards consumers. The energy sector is consists out of some key players, mostly isolated from each other, which traditionally can be classified in the following segments. Generation, transmission, distribution and consumers. The key players discussed about form the traditional value chain within the energy market. Some players which are covered in the practical part 5 aren`t covered in here since they aren`t considered traditional.

Supplying energy to homes and businesses involve three key elements. Generating the electrical energy, transporting it and selling in the customer. Energy companies can conduct their business in 1 or more of these elements.

Energy generators are the first in the chain, they`re generating the power in either the traditional way, for example a nuclear power station or by using renewable energy sources. This generated power is being injected in high voltages into the national transmission network which transfer over the transmission network to smaller distribution networks or export it to other countries. It is also possible that this high voltage energy is directly delivered to end-users which would be bigger companies. Smaller power station can be connected directly to the distribution network, where power gets transferred in smaller voltages

Figure 3. Energy Value chain

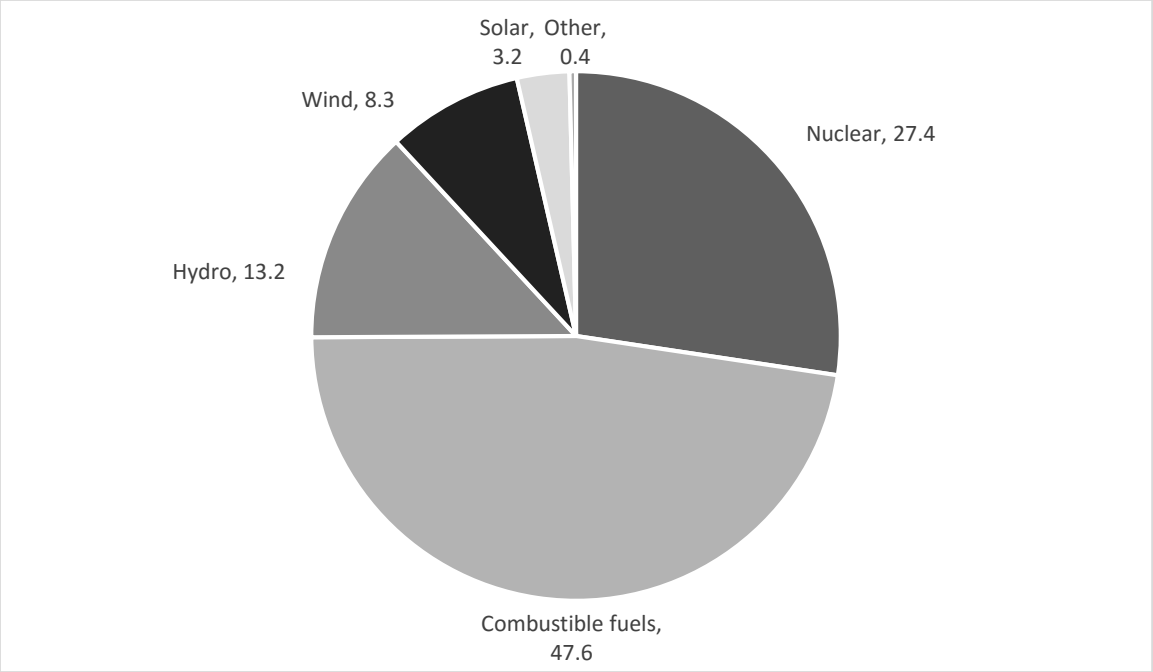


Source: Australian Energy Market Operator, *The energy supply chain*, 2017.

The process of generating electric energy from a variety of other sources of energy. This sources can be fossil fuels, nuclear flues and renewable resources. According to data

published by Eurostat in the end of 2016 (Eurostat, 2016a) the sources of electricity generation are as below.

Figure 4. Sources of energy generation



Source: Eurostat, *Electricity production, consumption and market overview*, 2016, nrg105a.

Combustible fuels covers coal, oil and gas. These resources are exhaustible, A today`s level of extraction BP`s estimated proved reserved of coal would be exhausted in 113 years, the last cubic meter of natural gas in 2069 and crude oil by 2067. (BP, 2015) Obviously these are just projections and should be taken with a grain of salt but that doesn`t take away the importance of moving away from these Fossil fuels to other resources of energy.

Nuclear fuels are the material used for nuclear fission or fusion, the 2 fundamental nuclear processes for energy production. Fission is the energetic splitting of atoms like Uranium or Plutonium into smaller atoms. All commercial nuclear power plants in operation use this reaction to generate heat which they turn into electricity. Fusion is the opposite. The combination of small atoms such as Helium or Hydrogen to produce heavier atoms and energy. Fusion reaction produce much less radioactive byproducts. However Fusion reaction haven`t been commercially developed yet, it enjoys serious interest worldwide due to its promise of nearly limitless, low-pollution energy.

Nuclear power can be considered sustainable since nuclear waste is recyclable. However economically it`s less sustainable since only 1% of the fuel that is mined and the rest is thrown away (as nuclear waste). Nuclear power can also considered Ecological since it only emits hot water, very little CO2 or other climate-changing gases come out of unclear power generation, around 50 times less than coal and 25 times less than natural gas plants.

Renewable energy is energy which is collected from resources which are inexhaustible on human timescale. Like sunlight, wind, tides and others. However indirectly sunlight is also the source of energy for wind and tidal energy. By using more renewable energy, the dependence on fossil fuels gets lower, energy production becomes more sustainable and renewable energy drives technological innovations as well.

Solar energy is probably the most known source of renewable energy. 10 years ago people were looking up when they saw solar panels on rooftops, today this is much more ingrained in society, which is obviously a good thing.

Solar panels absorb convert sun`s light into solar energy through the conversation of sunlight to electricity. Solar panels are made up out of smaller solar cells, made out of silicon, which is a semi-conductor. A silicon solar cell use 2 different layers of silicon. N-type silicon has extra electrons and a P-type silicon has extra places for electrons called holes.

Each silicon cells produces only 0.5 volt but you can string them together in modules call photovoltaic cell. 12 PV cells are enough to charge a cellphone, while more are needed power a house.

Also PV that are developed today aren`t capable to convert all the energy from the sunlight for now. The most efficient PV is able to absorb only ~45% of the energy which hits the panel while the panels people have on their roofs are only able to convert 15% of the sun`s energy. Today this efficiency is still being improved constantly, the price is going dropping and other types on thought-experiments like floating solar farms are existing. Solar energy is here to stay.

Wind energy, it is actually nothing new and we`ve been harnessing wind power for centuries, in sailboats, in wind-mills in agriculture and now for electrical power. A turbine should result in a decrease in CO2 2,365 ton a year. Wind turbines rotate at 15 to 20 rotations per minute generating electricity to the grid. A typical wind turbines spins 70-80% of the time which should be enough to power around 1200 homes which is the equivalent of 16000 solar panels. On top of that, onshore wind energy is the cheapest form of renewable energy.

But what role can data play for the generating energy? The energy players can optimize their operations through data and analytics practices. This can be within fossil or renewable sources, by deploying sophisticated technology that translate in descriptive and predictive analytics tools and real-time management tools that allow companies to make a wide range of forecasts. (IBM Corporation, 2012)

- Predictive analysis on the energy supply
- Predictive maintenance and risk of power failures on generation
- Descriptive monitoring tools like visualizations and dashboards to monitor performance indicators.

Transmission system operators are responsible for the movement of electrical energy from the place of generation to an electrical power substation. Transmission lines carry electricity at high voltage, between 30 000V to 380 000V over longer distances. This can go to national distribution networks or towards neighboring countries for export or directly to bigger energy consumers like big manufacturing companies etc.

The data and analytics could provide a number of insights regarding customer's behavior patterns in utilization of energy. It can assist identifying deviations of the normal usage patterns, provide further analysis on the cause of these deviations by cross validation this with weather patterns, pricing, external events. This all should translate for optimize the supply and demand balance between generation and energy consumers.

Distribution is the final stage in the delivery of electric power, it carries electricity over distribution lines hold moderate voltage power and carries it over smaller distances, feeding it directly to the consumers.

Similar applications for data analytics as for transmission can be identified here. Knowledge obtained from measurements improves understanding the customers. An example here could be the detection of energy theft. The distribution net is long and sparse, securing it can be costly but with help of data analytics and data algorithms energy theft can be one of the possible application of data put into action

Energy providers without energy generation capabilities have to buy their energy on the energy exchange. Energy for the current day as well as the day after can be bought and sold between energy players on a national level as the neighboring countries. It came to exist through the liberation of the energy market, which results in fair and competitive pricing.

Energy traders data analytics applications aren`t necessary related to energy but exchanges in general. Different predictive algorithms for models (i.e. neural networks) can assist in determining when to buy and when to sell.

Regulators are in Belgium and most of the countries the police of the energy market. They`re responsible for the below:

- They assure transparency of the energy and utilities companies.
- They advise government for energy governance
- Defending the interest of the customers

Consumers can be divided between large-scale end users, which can directly get their energy from the transmission operators and smaller consumers like household or small and medium sized companies. Consumers can be considered smart. The way energy is consumed has changed. They are savvier. And more involved with energy consumption. Using data analytics applications to get knowledge from their consumption and production (solar panels …) to be smarter consumers. With the help of these data analytics applications consumers will be more aware of the impact of energy saving endeavors like for instance increased isolation.

3.2 The market

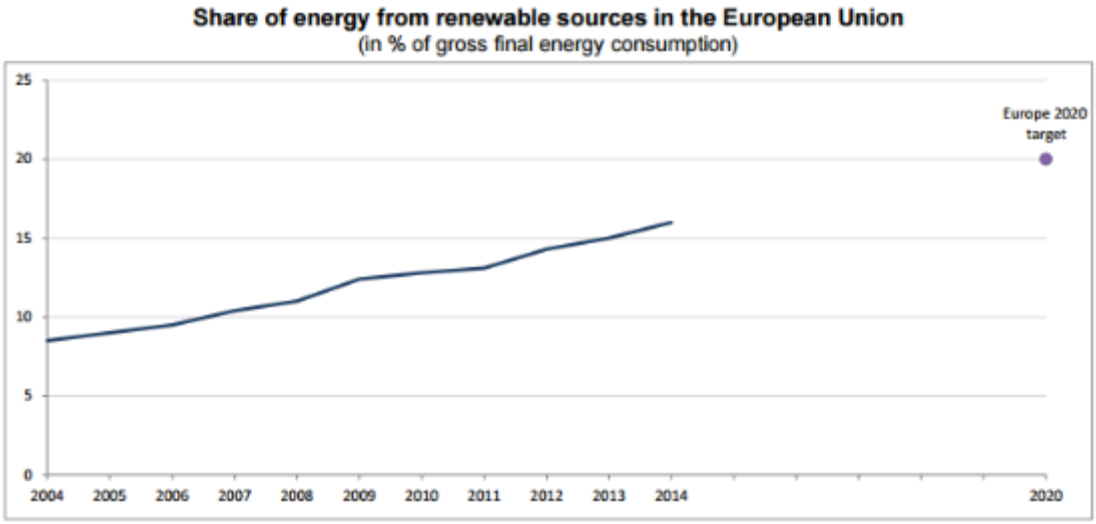
The European energy market is still fragmented. There are problems regarding transparency, choice and companies have grown beyond national border but their growth and development is still hampered by national rules, policies and practices (European Commission, 2010). This undermines true innovations and technological progress. Since policies developed on a national level haven inevitable an impact on other neighboring countries.

Energy is the market sector with the greatest economic impact on Europe. Fragmented market not only mean less security of supply, but also limit benefits with energy market competition. Energy related policies should be developed on a European level. It`s important to realize that the discussed data and analytics initiatives require an smooth integration and information exchange between the different players. The players that generation energy need to estimate the demand from the customers. Transmission players need to balance the 2 parties in order to enable a smooth and work towards optimizing that share of renewable energy resources.

In order for the EU to remain an attractive market for companies, the new European energy strategy must supported and integrated industrial approach. The share of energy from renewable sources as risen further to 16% in 2014, which is almost double that of 2004

where it was 8.5%. The target is in 2020 to have 20% from renewable sources in gross final consumption and 27+ % by 2030 (Eurostat, 2016b).

Figure 5. Share of renewable energy resources



Source: Eurostat, *Share of renewable energy in gross final energy consumption,* 2017, t2020_31.

However it`s a wrong to assume that Europe is leading regarding renewable energy. The EU could be much stronger and effective if this market would be unified across the member states. What is worrisome is that we still depend heavily on import of our energy resources. The EU is a strong geopolitical player in the energy markets and must keep the ability to act accordingly. (European Commission, 2010)

There is significant work needed on the energy use and demand side. The European strategy should encourage demand-driven policies. This implies that especially the transport and construction industry should assess their energy consumptions. By implementing energy-saving programs as well as diversifying more with renewable energy resources. This strategy should help in creating market conditions which stimulate distributed renewable energy and key technologies for energy storage and electronical vehicles as well as public transport.

On the supply side the priority should be even more on the renewable energies sources. This is also where the EU promises to provide a framework in which member states should be allowed to perform their respective targets but also ensure that the renewable energy resources and technologies are and stay economically competitive.

Electricity and gas markets are not working as a single market. It`s still divided in national markets with barriers for allowing fair competition. Energy players often have a monopoly

position in their respective countries. Improving competition in the energy markets will contribute in attracting investments and reducing the overall cost.

The commission is and has to encourage further development of renewable energy and make sure that developments are sustainable and consistently in line with technological progress. They need to play a role in harmonizing between the member states. Further efforts need to be made in order to upgrade energy infrastructure, particularly in the member states which are less developed. Europe is lacking the grid infrastructure which will enable renewables to develop and compete with the traditional energy sources. Smart meters and power grids are the keys for fully exploiting the potential for renewable energy and energy efficiency improvements. It`s up to the European commission to outline clear policies, shared standards on smart metering and smart grids to ensure interoperability across the network.

On 30 November 2016, the Commission proposed a new regulation, the governance of the Energy Union. The regulation mainly focused on three pillars (European Commission, 2016b).

1. Energy efficiency first
2. Being pioneer on the field of renewable energy
3. Let consumers profit from it in a fair way.

This pillars should be achieved through the importance of the collaboration between EU countries and the commission to ensure that energy and climate targets are achieved.

The roll of information technology in this endeavor cannot be underestimated. To integrate renewable energy in the grid a robust transmission and distribution grid is necessary. Europe network has to have good interconnection and significant investments have to be made in this regard.

Especially for the 3th pillar providing better information to the consumer about their energy usage as well as their energy costs are the first step. Propositions consist out intelligent meters and transparent costing. Aside from that platforms will be provided where consumers can compare, simulate and visualize all their consumptions and behavior patterns in regards of their personal energy usage.

To summarize, Europa`s energy markets have been opened and liberated to allow people to enjoy more competitive pricing as well as more sustainable energy. This potentials hasn`t been reached so far. Only now policies are outlined for a framework towards this unified European central network with good interconnections, renewable energy and a singular digital market.

3.3 Drivers of change

The transformation is been driven mainly but not exclusively by some key factors which are discussed in this section below. These factors have disruptive implications for energy companies, their strategies and their future role in the energy value chain.

3.3.1 Urbanization along with changing demographics as a driver

Each minute the population raised by 145, by 2025 it is estimated that we`ll have added another billion where the global population will be about 8 billion. Growing population and urbanization is shaping global economic growth, that growth creates a need for private and public infrastructure developments, modernization and expansion. The demand of energy and energy services has dramatically increases with this shift.
(PricewaterhouseCoopers, 2014)

Power companies can play a pivotal role in ensuring that future cities become 'urban smart'. In developing countries it takes a different form than in the west. The infrastructure isn`t existing but it provides the prospect of bypassing the grid and go straight to new local distributed technologies and market models. The pace of technological advances and cost reduction allows this. While in the developed cities, this will happen in parallel on top of already stretched infrastructure

3.3.2 Climate change as a driver.

Innovations within the energy sector are mainly driven by climate change. Why that is speak for itself. The industry accounts for more than 2/3 of the global greenhouse gasses. Fossil fuels are getting more scares and governments and international institutions are pushing and encouraging moving towards renewable resources by their policies. Countries are increasingly looking for an alternative for fossil fuels. Countries want to be energy independent from other imported energy (sources)

Fossil fuels have powered the first industrial revolution but now the stage is set for the era of modern renewable energy that is cost competitive, mainstream and sustainable. Consumers itself are as well a big factor within this driver, they`re making more conscious decisions regarding their consumption and are willing to spent more and take conscious actions towards a reduced carbon footprint

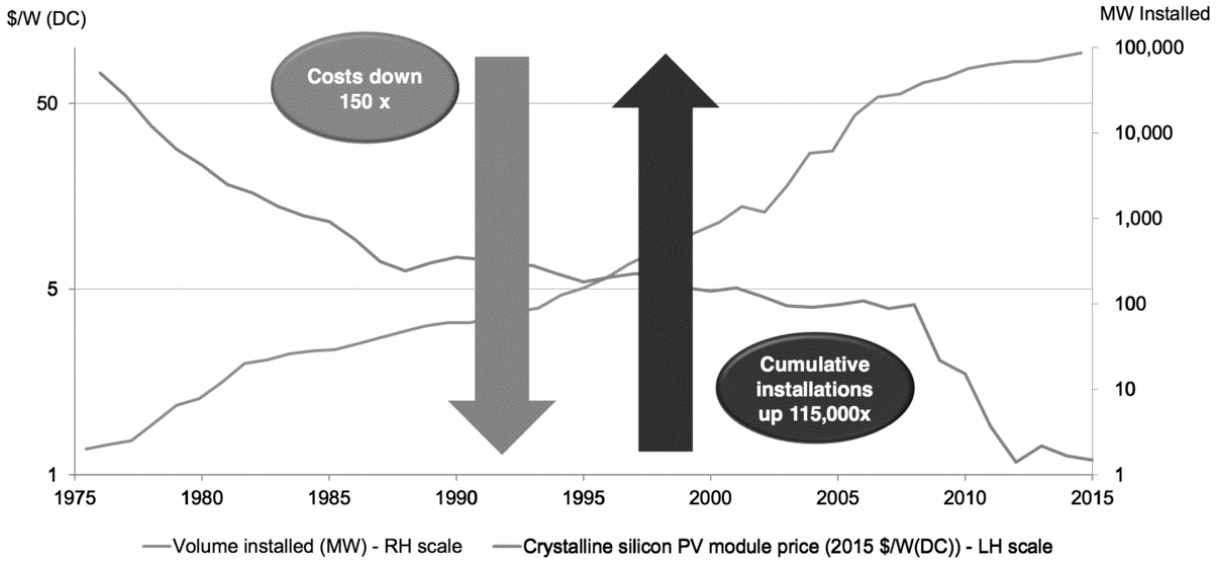
3.3.3 Technology as a driver

Technological innovation is the also one of the main driver of the evolution which is taking place in the energy industry. Technology becomes cheaper. In the past decade renewable energy sources like solar and wind struggled to compete with coal, oil and natural gas.

That picture has changed dramatically. Renewable energy is growing, becoming more efficient, even in suboptimal conditions such as low wind speed and low solar irradiation. Energy storage is improving fast along. Support by governments across the world have boosted this technological developments. While at the same time costs are decreasing.

However government has created the foundation for solar and wind to get a foot on the ground in the global power markets, Technology and economy is responsible for pricing falling down

Figure 6. Solar panel installation against price per PV



Source: BNEF, *Wind and Solar are crushing Fossil Fuels*, 2016.

For instance, solar panels which holds a photovoltaic (hereinafter: PV) models has experienced 150x price loss in comparison to 1975, at the same time the mouth of installation increased along

This results in increased competitiveness of solar panels as an energy source without subsidies. Also the cost of wind electricity cost has fallen by 18% (Breeze, 2014) making it the cheapest sources of new electricity. More than 100 countries now use wind power.

Also consumers are becoming more engaged, the access to information and personalized services is present in other industries like financial industries or telecommunications. This translates in evolved expectations from the customers. Power is not enough. Consumers want be informed about which energy sources, usage …

Technological developments spur more consumers in being an active participator of the electricity grid and interplay with electric power systems. Electrical Vehicles, Smart meters Home energy services and distributed energy generation allows the consumer to evolve and change one-way transaction towards something new. These technical innovations impact the power industry and drives it to its new era. This greater interactivity with consumers are the type of innovations that have drastic effects on the utility company traditional model. Hence the reason to re-assess the business model.

Technological innovation could also be an opportunity to become closer to the customer, to be an energy partner rather than energy provider

3.3.4 Policies as a driver

Policy makers play a vital role. They are responsible for creating a fruitful environment for making renewable energy a major part of their energy mix. By committing a long-term support. By putting non-financial support mechanisms in place they reduce uncertainty and make renewable energy an attractive and stable investment.

Rethinking energy means considering benefits of renewable energy as a whole, by taking a holistic approach opportunities for sustainable prosperity can be created.

The European Commission has put an agreement in place, the Lisbon Treaty, which includes the expectations from Europe in the energy area. Article 194 of the Lisbon treaty describes the expectations from Europe towards their member states. Those expectations are the following: (1) ensure the functioning of the energy market, (2) ensure security of energy supply in the European Union. (3) Promote energy efficiency and energy saving and development of new and renewable forms of energy. (4) Promote the interconnection of energy networks.

This basically concretizes self-evident attitudes towards energy expectations. However no measurable goals are being set here. In a communication from 2010 from the European Commission written by Jose Manual Barroso, the ex-President of the European Commission goals, strategies and guidelines are outlines for a smart and sustainable growth, including targets for energy (European Commission, 2010).

“Reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30%, if the conditions are right; increase the share of renewable energy sources in our final energy consumption to 20%; and a 20% increase in energy efficiency”

This target, along with other targets regarding sociological and sustainable growth are outlined by the European commission in order to encourage a strong union based on knowledge and innovation.

At the most recent Paris climate conference in December 2015, a 195 countries agreed to the first universal action for tackling climate change by limiting global warming to below 2°C Celsius. The Paris Climate Agreement is a global action plan where different governments upon the long-term goal of keeping the increase in average temperature below 2°C. Aside from that the participating countries also agreed to come together every 5 years to re-estimate more ambitious targets, report to each other and the public and to track progress towards the ultimate goal. Before and during the Paris conference countries submitted their respective national climate action plans which traces the way to achieve the ambitious targets set.

Energy policies is key for achieving the objective of smart, sustainable and inclusive growth in support of a strong post-industrial economy. The potential of policy instruments for a positive energy efficient and green economy should be fully exploited.

3.4 Road to a smarter industry

Shaped by the drivers discussed in the previous sections the road to a smarter industry lies ahead. The term smarter represents a scalable, integrated system that extends from businesses and homes through distribution, transmission and generation of energy. Within all these operations sensors and measuring devices are embedded. These digitalization of processes form the groundwork for an intelligent, automated network which has the ability to generate data to describe what happened in the business, what is likely to happen in the future and very mature stage, prescribe actions to take in order to rectify situations.

IBM identified three key factors for energy businesses to tackle in order to create a smarter energy systems that meet the challenges and opportunities facing the industry. (IBM, 2012)

1. Transform the electric and gas network
2. Optimized generation performance
3. Transform customer operations.

The first factor considered the transformation to a dynamic, automated network. This requires the involvement of various functional areas and players within the industry. The key enables to allow this transformation of the network are smart meters, work and asset management and communications, and obviously the integration of distributed (renewable) resources. Of all the mentioned elements, measurements and monitoring can be integrated from which data can be extracted which is required in order of achieving the demands of the transformed network. A responsive, transparent network where conditions can be continuously monitored.

The second factor, an optimized generation performance is partly enabled by the first factor. Processes can be monitored and standardized. Assets can be properly managed. The

integration of the different players allows an effective overall supply chain with automated performance reporting in real-time. This create an opportunity for effective maintenance by predictive analytics. Weather prediction and analytics can be added for optimized dispatching and optimization of renewable resources.

Customer operations falls back on effective customer relationship management with a single view of the customers through where they can be approached.an improved understanding of preferences and behavior helps effective customer programs and experiences. Customer segmentation can be done op customer data in order to further improve understanding of your customers and tailoring programs to their needs. Understanding the customer becomes even more relevant considering the significant changes of the energy customer and the economics of a self-generation and storage of the "prosumer". The customer becomes part of the change by being a more active participant in the self-generation market.

This and electric vehicles are pushing for a modernization of the grid. The current grid has critical shortcoming which doesn`t allow it the address the above requirements, where a smart-grid or intelligent grid is expect to be a better candidate for answering these points. A smart grid is a modernized electrical grid where digital information technology is integrated which results in an improved efficiency, reliability and safety.

In various areas this evolution is having an impact, hence companies are required to reassess their strategies with the focus on the below: (PricewaterhouseCoopers, 2014)

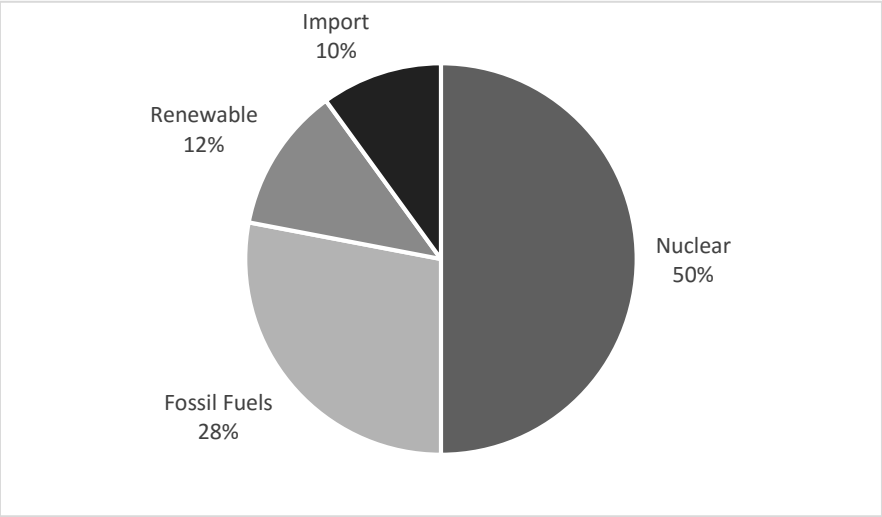
- Customer behavior
    - Aligning ambitions of the companies and customers for energy future and ensure relevant and cost-effective situation)
- Competition
    - Barriers for new entrée is lowering within new areas of value chain. Bigger players are being outflanked and outpaced as more nimble and specialized competitors
- Production service model
    - New transformative developments within renewable resources introduce and the chance to accelerate a move to alternative power systems. However this chance is one that consumers expect companies to consider. Over-reliance on centralized power generation introduces a risk.
- Distribution model
    - The modernized smart grid and local generation all create opportunity to engage customers. Data and analytics will be required to exploit this data opportunity. Data analytics for customer segmentation built upon enhanced by big data.

3.5 Belgium electricity market as point of reference

Belgium is losing points on the European innovation barometer. (European Commission, 2016a) Despite scoring high regarding knowledge and science levels the score on innovation isn`t on the same level. Roadmaps are being supported and created, projects and innovative endeavors are in some cases subsidized by the government but in general the Belgium energy market is, despite being liberated, still quite conservative and is in the progress of evolving to climate of energy. (Boogmans, 2014)

Electricity generators are generating the power in "traditional" ways with nuclear energy and in green way using renewable energy resources. Today the energy resources from Belgium are distributed as below. Nuclear energy account for half of the total energy resources and fossil fuels are accounting for nearly 30%. This fossil gases are almost all imported from outside Belgium.

Figure 7. Belgium Energy Resources



There are around 17 of energy suppliers in Belgium. They buy electricity or gas from the producers and sell them to the customers with a profit margin. There are suppliers that supply both gas and electricity, there are suppliers that only deliver gas (In Belgium DONG energy is one of those) and there are suppliers that only deliver electricity. The consumers have the freedom to choose their energy suppliers themselves, based on their experience, pricing and corporate responsibility every family. There are policies which let the customer changes energy supplier without any cost attached to it or irrespective to the duration of the contract.

In Belgium the company who`s solely responsible for the transmission part of the electricity value chain is Elia, making them the only transmission system operator. In Belgium electricity is produced and also exported, this also comes under the umbrella of Elia, responsible for delivering high voltage electricity to large companies, distribution nets as well as export to other countries.

The company who`s responsible for the transportation of gas is Fluxys, they take care of the transportation of gas to the producers to the distribution nets or, similarly as with electricity, directly to high usage organization.

The next part of the value chain is distribution. In Belgium this comes under the responsibility of the 3 regions in Belgium (Flanders, Walloon and Brussel-Capital). In Flanders 2 companies are currently active distribution system operators, being Infrax and Eandis. They`re responsible installation of electric or gas meters, yearly reading of consumption and possible payments of subsidies for energy saving and solar panels. In contrary to the energy suppliers which u can choose, you can`t choose you distribution system operator, this is determined by location (VREG, 2013)

The Belgium energy markets also has regulators which act as the all-seeing eye, this is required when some organizations have legal monopolies. These regulators are responsible for transparency and competitiveness in the energy market. Defending the interest of the customers and holding the energy market in line with the public interest and energy policies. Also here these regulators are on the level of the regions. The Flemish electricity and gas regulator is VREG.

The pricing mechanism for electricity and gas works as follow. The customer pays monthly bimonthly or each 3 months to the energy supplier. Usually this is a fixed amount based on the readings from past years. The customer has to provide the reading to the supplier or it could be that the supplier obtains the readings themselves. When changing supplier also the reading must be communicated and then the bill will come as well. With this energy bill you pay indirectly also the transmission, distribution and taxes on the provided energy.

Currently Flanders has, similarly to other developed countries, has a number of technological applications within the energy value chain. Within each players there is basic IT present to monitor and support business activities and processes. To make the statement that there is no information exchange between the players would be incorrect however there is still room for improvement regarding integration and optimization.

The Flemish region has constructed clusters of organization which try to position Flanders as a smart energy region. These are organizations from industry, research and government

which share the same ambition and assist Flemish companies in renewable energy sector as well as smart-grid who want to grow and strengthen their (international) position. The challenges posed to these types of companies require global top-down approach where information technology, business models form the base of the approach to capitalize the opportunities which are emerging.(Smartgridsflanders, 2016)

The vision of this cluster is that future energy system integrate different sources of energy and provide enough flexibility to maximize the portion of renewable in the energy mix. This can happen through energy efficiency project, innovative energy components, services and network which will be a part of the value chain.

The clusters has prioritized 5 innovation areas of critical scale and mass. (1) Energy in ports, (2) Micro-grids (3) Integration of energy on business sites, (4) Building innovation with integrated storages and lastly (5) energy platforms and apps. In all of these areas information technological plays vital role but our focus will lie on the platform and app where IT will have the most impact.

Energy cloud platforms are relying on uniform transparent and qualitative data which is made available by 3th parties. This allows apps and services to be developed. In the US similar things are happening where there is the Green button initiatives where the government publishes a standard format on energy readings where different apps can be built upon. (de Schepper, 2017) . This allows individuals and companies to build services where readings get enriched with other information from smart devices.

An example of is PlotWatt. It utilizes the data published by the green button initiative. The promising startup offers services that allow (small) businesses to analyze their energy usages by monitoring their usage. Plotwatt has developed smart algorithms that can address energy usage to household appliances. With this information, behavioral scientists try to understand and create personalized advice to reduce energy consumption.

The ambition of the cluster regarding this innovation areas is to have within 5 years the first multi-actor energy cloud solution which integrates energy products and has potential for international markets. Within 10 year the complete realization of connection energy platform as performant ecosystem where buildings, suppliers, transmission and industry interact. This through an integrated cloud solution that allows for data exchange, services offerings and the groundwork for new energy system.

4 A TRANSFORMED INDUSTRY

Based on the given information already it can be concluded that information technology is one is the biggest influential factor when industries and individuals are trying to constantly improving their efficiency and performance (Mithas, Lee, & Earley, 2013). Companies which are a part of the energy industry, should try to re-assess their position within the market and tap into the opportunities the transformation offers.

4.1 Business perspective

By questioning your business model, services and processes and consistently being able to answer to the volatile market only then you will stay relevant. Just like in other industries, for ex Healthcare, IT and more specifically data and analytics can help the company in playing a role in shaping their business and design and deploy solutions to assist in creating a relevant and sustainable position for your organization. Therefor data and analytics can be an important enabler in providing context for process optimizations and value propositions re-assessment in order to position yourself in the evolved industry

Organizations might require them to dive into new segments of the energy value chain and reevaluate where they`re currently spending time and resources on might not be where they spent time and resources in tomorrow. Companies can be forced to leave their most valuable sources of incomes and focus on the next big thing.

Data and information analytics and visualizations of it can be the facilitator in evolving an organization their business, where models and strategies are being shaped by the technology which is available and data which is being generated. Technology and information allows organization to conduct business in a new, improved way. This isn`t anything new, the last years technology is shaping business across multiple industries, as well as energy. But the key take away from this should be, not improving the old way of doing your business but re-inventing processes to come up a better way of doing it. If garbage is improved the result is improved garbage but it is still garbage.

On the other hand, Information can also serve value towards the customers. Where technology is a huge driver of change, it is also being engrained within every part of the production and delivery process of power to the households. Monitors and sensors are being added, measurements are being done and data is being generated.

This data, when put into context, provides value to the organization and consumers. Organization are able to analyses their processes, actions and bottlenecks in a quantitative manner. Organization can inform consumers about their energy consumption and this is where the true value comes from

Today consumers are intelligent, empowered and conscious entities of the value chain. In the past consumers were shielded from the entire energy processes and used power as for their preference. They didn't had a voice or gave feedback to upstream segments. That however evolved to where consumers wanted to control their usage, they want to have insight on where that energy is coming from and what was required to deliver it at their house. They will make conscious decisions in choosing their energy supplier and make trade-offs between price and product or service.

Organization can cope with this in various ways. They can target a segment which basically doesn`t care about how and where there energy is coming from. This however isn`t a very sustainable strategy. A better strategy would be to think along with the customer and to present themselves to the customer as partner rather than supplier. By answering the question the supplier asks, or didn`t ask energy provider evolve them self as a partner.

Today there are a lot of different startups that aim to make money by helping their clients to monitor their energy use and utility bills. These technologies and services for the different startups aren`t exactly the same, but the general idea is the same. Develop software that analyzes energy consumption and use that data to either recommend energy saving actions or automatically make adjustments to reduce energy usage.

4.2 The role of information within smart energy

Today organizations within the energy sector are getting bombarded with the term SMART, Smart energy, grids, house, logistics. But what does SMART actually mean? Smart energy is a catchall phrase for technologies and initiatives that attempt to manage the demand side of the energy equation Smart can be viewed as an intelligent way of operations through the integration of ICT. For example a smart building has integrated technology that allows the building to consume energy in a smart and energy efficient way. Making operations more intelligent can be referred to as a SMART-transformation. (Climate Group, 2008)

Information is present in every step to transform operations to SMART solution. These step are not to be confused with SMART-goals which is something important but totally unrelated.

(S) Standardize – How information (ex. On energy consumption) can be traced across different processes

(M) Monitor – Information (on consumption and emissions) across the value chain in real time.

(A) Accountability – tools can be developed in order to establish which part of the process accounts for which consumption.

(R) Rethink – This information should be used in order to rethink how we work in a digitalized and carbon-efficient industry.

(T) Transformation – of the industry and economy will occur when previous steps took place and low carbon alternatives have been developed and rolled out.

Information allows organization to act with direction, no gut-feeling involved but clear, argued decisions. It`s vital for an organization to obtain intelligence about their internal and external processes.

4.3 Emerging opportunity

As already indicated, the Flemish energy market is, despite being liberated quite traditional, no real disruption is taking place like in other countries as indicated in previous case studies (Elia, 2015). Yet the Flemish government has done quite some work to create an stimulating building ground for innovative projects like Flanders Smart energy where a cluster of concerned parties encourage and support initiatives of people and small businesses.

This made me realize that Flanders is waiting for disrupter that gets a permit to get things done without political decision making it impossible to accomplish something. The idea described could give more power back to the customer and be a potential starting point of a sharing energy economy.

So as mentioned, one of the priorities of the Flemish smart energy cluster would be to have an energy cloud platform where information related to energy consumption and pricing are presented. This could be presented through visualization and dashboards where the user is giving an overview how their consumption is translating into the energy bill. Which parties provide what and for which price. This on different levels of detail. The challenge would be to have an open-data culture between all the parties of the value chain, to let this data flawlessly integrate and realize the presentation of relevant information for all the parties, which is probably a critical success factor so that all the parties could benefit from such a system.

An idea could be that regulator would take ownership of such a platform. The regulator would be in the best position to create this open-data culture where data is shared with the regulator, where different interfaces and parameters would be shown based on which

player opens the application. Also mobile apps for consumers or employees could be developed in order to have a personalized interfaces based on your needs.

The data which would be considered would come from all the different facets of the production process. Is the consumer interested in understanding their energy usage in respect of resources? Does an employee needs to obtain some specific real time information to assist him with his task? Does the different energy producers want to compare market share? Basically the cloud application is the glue between all the concern parties of the energy chain, with the regulator as its owner.

5 PRACTICAL EVALUATION THROUGH CASE STUDIES

To make it all more concrete, in the part below four cases of innovators within the energy sector have been discussed. This is to understand how this transformation is happening. The cases discussed all take very different positions in how they feel fits them and the market best. All three cases have different strategies to cope with this disruption. It`s not really that one is better than the other. They`re very different companies. The cases are there to give the reader an understanding of how this transformation is unfolding in different way and how data and analytics helps them to get where they want to be.

5.1 SolarCity

SolarCity is an American provider of energy services, The company is America #1 solar energy provider. Their service consist out of the installation of solar system at houses, small businesses, schools and many more. It included a thorough analysis of the customer’s energy usage and identification of opportunities for improvements. Aside from that monitoring and repair services are also part of the scope of SolarCity. It`s the first company that integrate sales, financing and end to end installation and maintenance of solar panels. SolarCity performance monitoring system provide customers a real-time view of their net energy consumption and carbon footprint.

In June 2016 Elon Musk, who was already chairmen of the board of SolarCity acquired SolarCity with his other company, Tesla motors. This happens, without consequence, at an interesting period in our transformation of the energy industry. Tesla motors produces cars and batteries for households. Acquiring SolarCity would take Tesla motors to a whole new market. The fact that Tesla provides batteries allows it to link two biggest part of the entire industry. Supply and Demand. It`s the entire industry turn upside down.

Even though the battery might not be a huge success for the moment, allowing this smooth integration with solar panels really enables the true potential of an enabled and intelligent distribution system where during the day energy is being generated and batteries bring

charged and during the night batteries can provides saved energy. This to the house holds but also toward the grid

It`s not just that Tesla wants to be in 3 categories of products, it`s the integration of the 3 where an unlike experience can be provided, something that no one has done. Creating its own network of power storage, power consumers and power generation. Which would work synchronic where there is a big in demand falling back on the batteries. This would make the investment so interesting

Elon Musk released the second installment of Tesla Master Plan, where their automotive strategy is outlined. Yet the outline strategy goes far beyond just the traditional automotive industry, with the plan to integrate clean energy and smart-cities and cars.

Tesla wants to provide cars which aren`t depending on any other source of energy except clean energy. For now the electric cars that Tesla produces are not necessarily entirely fueled by clean energy since the charged electricity doesn`t necessarily come from renewable resources. The plan would be to integrate the selling of cars with possibly selling a package of solar panel installations through the branch of Solar City .

This would impact the traditional business model of the car industry but also the energy sector and pivot everything to an integrated approach where buildings, cars and prosumers will form the key parts of the value chain which will flow in 2 ways.

In the beginning of August, Elon Musk made news again when SolarCity announced to offer Solar roofs, where the solar panels would be integrated in the roof rather than a separate module on top of the roof.

This wasn`t actually the first time the solar roof was mentioned. Also in his second installment of Musk`s Master plan mentions of "*smoothly integrated and beautiful solar-roof with battery product*" was mentioned, where the emphasis was on the a decentralized power plants where consumers act like separate prosumers, a producer of energy as well as a consumer. Prosumers can share electricity peer to peer through micro grids. They can store energy during low load times in home batteries or electric car batteries.

The plans of Musk with SolarCity and Tesla Motors are laying the first fundaments of this transformed energy ecosystem. An ecosystem where power generation is decentralized through renewable energy plants are integrated the infrastructure as we know it.

With the deployment of distributed energy resources (hereinafter DERs), grid operation and planning is vital for continued market innovation. Today companies hold the majority of the grid data and only a fraction is available for the industry. Data sharing however is critical for the vision of grid modernization of SolarCity. It informs customer choice,

supports innovation and allows credible auditing and eventual foster a robust trans active energy market place. The solution can be that energy companies commit to data transparency and access to enable industry innovation (Solar City Grid Engineering, 2015)

SolarCity has different approaches in making the transfer towards solar panels and renewable energy as smooth and economically interesting as possible. The company offers three main choices to customers for the switch to solar panels (Xiaoyan, 2014).

1. Leasing of solar panels and hereby entering the Power Purchase Agreement (PPA)
    a. Initially SolarCity takes no money down for installation and leases you the panels over a 20-year period. The consumer never owns the panels, instead they rent them and utilize the energy they capture.
2. You buy the panels and own them.
    a. The consumer buys the solar panels from Solar city. They will take care of the installation. This choice has the highest upfront cost.
3. You buy panels and the payment happens over time.
    a. Similar as the section option where the consumer actually owns the panels however her the purchase happens in different cuts.

The leasing and PPA arrangement are what is the most interesting in SolarCity`s business. With this in mind, solar city is a company which is both a product as a service provider. Rather than just a simple installer of solar panels.

On the next page SolarCity `s business model is described based through the business model canvas from Osterwalder.

Table 3. Business model canvas SolarCity

<table>
<tr>
<td rowspan="2">Key Partners

• Suppliers of Solar panels resources
• Customers
• Third-parties for financing or joint-ventures
• Tesla Motors</td>
<td>Key Activities

• Sale, financing, engineering manufacturing, monitoring and maintenance of solar energy systems</td>
<td rowspan="2">Value Propositions

• Solar energy
• Solar energy systems
• GridLogic Platform
• Solar system components
• Energy storage products
• Electric Vehicle Charging stations
• Financing of solar panel installation through leasing or PPA agreements
• Maintenance and Monitoring of Installations
• Energy efficiency analysis and evaluation.</td>
<td>Relationships

• End to end service offerings personalized to the customer.
• Automated services which include defect detection
• Customer platforms where performance and energy usage data is provided.
• Online communities</td>
<td rowspan="2">Customer Segments

• Residential : individual homeowners
• Commercial: Companies and organization from different industries like manufacturing, retail, non-profit,
• Governmental or public: Universities, Military buildings, Governmental entities.</td>
</tr>
<tr>
<td>Key Resources

• Physical resources
• Solar panels, components
• Intellectual Resources
• Brand, Software
• Human resources
• Skilled employees
• Financial resources</td>
<td>Channels

• SolarWorks communication channel
• Door-to-door sales force
• Robust referral program
• Call center and virtual sales offices
• Partnerships organizations to sell their product</td>
</tr>
<tr>
<td colspan="3">Cost Structure

• Labor cost (Skilled employees with high wages , Training , …)
• Components cost (system components, raw materials, …)
• Additional costs (Warranties, performance guarantee expenses)</td>
<td colspan="3">Revenue Streams

• Leasing of solar panels
• Incentives from governments originated from leases
• Sales of Solar panels & components</td>
</tr>
</table>

With the Value Proposition Model, also from Osterwalder the paper will look closer to certain value propositions which originated from technological and data analysis innovations.

Table 4. Value proposition canvas SolarCity

<table>
<tr>
<td rowspan="2">Products and Services
Solar Energy (Panels)
GridLogic Control panel
PowerGuide
Energy Efficiency Assessment</td>
<td>Gain Creators
Energy regulator
Optimized renewable energy utilization
distribution energy generation (solar panels)
Creates visibility through platform of meter data
Multi-platform</td>
<td>Gains
Easy way to arrange temperature
Transparency on consumption
Reduction of carbon footprint
Energy efficiency
Reduction in energy bill</td>
<td rowspan="2">Customer Jobs
Ability to regulate home temperature
Transparency of energy usage
Recharge Car</td>
</tr>
<tr>
<td>Pain Relievers
Energy efficiency and energy balancing usage
Energy monitoring
Energy regulator
Improved reliability through decentralization of power generators</td>
<td>Pains
High electricity bill
Empty battery of car
Unpleasant temperature upon initial arrival
Power outages</td>
</tr>
</table>

From the value proposition model it can be clearly identified which features of the selected products and services (try to) answer on certain pains or needs of the customers. The selected products and services all use data for their analysis in order to create and obtain the offered added-value.

- The usage of solar panels translates in a reduction of carbon footprint as well as a reduction in the energy bill.
- Solar energy systems address the customers need for regulating their home temperature and transparency in the energy usage.
    - Sensors and Meters generate data which are being analyzed in order to offer information about the home temperature.
    - (Renewable) energy usage is being measured, tracked and visualized to end users which translate in increased visibility on their consumption.

- Through a decentralized / distributed energy generation on the roof of consumers' homes the reliability of the power grid improves drastically.
    - Consumers become self-sufficient, converting in prosumers
    - Excessive power can be stored into (car) batteries or sold back to the grid.

5.2 DONG energy

DONG energy came to stand upon the merger of six energy companies which worked through both upstream as downstream segments. This resulted in a true energy power house, which meets more than half of Denmark's energy needs**.** Denmark`s largest energy company is a transformed player that addresses multiple parts of the value chain with Northern Europe as their main market. DONG energy doesn`t just deliver energy to its customers, it does it in a clean and reliable manner. DONG vision include the goal of producing 85% of all their energy from renewable sources.

Recently DONG Energy went public and becomes immediately the largest initial public offering (IPO) so far on the market debut with 235 Danish krones per share. (Gronholt-Pedersen, Mikkelsen, & Skydsgaard, 2016) This is due to the amazing transformation from black to green energy where offshore wind farms are on of their main selling points.

By covering multiple parts of the value chain, DONG is able to achieve a lot of advantages in terms of strategy and scale, the production of energy provides prospects of growth and their downstream segments allows them to have steady cash-inflow.

The continuous evolution of the energy sector makes it uncertain where the most value will be made within the value chain, if this is in distribution and sales or upstream segments as generation of production of electricity. Being present across the entire value chain allows Dong to spread their activities and thus their exposure for risk. If significant changes are happening in one part of the value chain, other activities of dong minimize the overall impact of this.

The first part of the value chain covers the following all the different types of electricity generation. This part of the value chain is also under constant change due DONG`s total green transition.

The production of oil, natural gas in Denmark, Norway Greenland and Faroe Islands. Despite having their focus on renewable sources of energy, Jakob Boss, VP of Strategy mentions in the coming future we will still depend on oil and gas for our cars and manufacturing, for dong energy a point in their strategy is also to contribute in these areas through their own production of oil and gas.(CBS Case Competition, 2012)

However as mentioned, their focus lies on renewable energy. This is also where the most growth is expected. Which is why they also develop and operate windfarms and DONG energy is world leader in the design and operation of offshore windfarms, holding a global market share of 30%. DONG energy have constructed around 50% of all the offshore wind capacity worldwide. While onshore windfarms is the cheapest way of generating renewable energy, offshore windfarms offer other benefits like fewer concerned parties, higher average wind speeds and immense mouth of space

Since offshore wind energy isn`t exactly the most reliable energy source DONG energy also included biomass energy in their portfolio. In fact all their existing coal-fired power plants are being transformed to biomass power plants. This can help for facilitating the overall transfer to renewable sources of energy, since reliability is key-factor of a consumers energy requirements.

Sales and Distribution covers the downstream segments of the value chain where DONG supplies 1.2 million customers in Denmark, Sweden and the Netherlands with electricity and gas.(CBS Case Competition, 2012)

The demand part of the energy sector always poses the challenge of fluctuating demand. In order to ensure a stable and reliable source of power some level of flexibility needs to be obtained, this happens through a combination of solutions : the optimization of start-up and shut-down times and cost of the power plants, transmission over great geographical distances and Smart energy, building intelligent energy system to control consumption.

Radius, A partner of Dong is replacing all the conventional electricity meters with remote smart meters. These remote meters help that the grid is kept in pace with the green transformation. The pressure on the grid increases due to electrical vehicles and heat pumps. But with remote smart meters the customer is encourages to be flexible and use electricity in different periods of the day, leveling the load on the grid. The production behavior can be also steered with pricing mechanisms. (Dong Energy, 2017)

How does DONG use technology to drive their innovations and developments and how to offer new type of services? As any modern company, also for DONG information technology is the backbone of their system, But as part of their core business, Technology and data analysis plays a major role with the monitoring and maintenance off the wind farms. Operational analytics are being applied in order to get clear insights on their assets. Through data science practices and machine learning algorithms detecting and resolving any potential risks before a problem actually occurs allows DONG to maximize their reliability, profitability and efficiency.

Secondly DONG offers a “Power Hub” to their customers, a technology component of SMART grid, which allows DONG to optimally balance the needs of the users with those of DONG energy.

Balancing supply and demand are one of the biggest challenges with using renewable energy since renewable energy supply is not constant in nature. They`re various things being done to take care of this issue at the supply side but at the demand side there are SMART energy initiatives.

This can done through smart meters where the consumers, based on pricing models changes their consumption when there is excess demand and schedule their energy needs for certain things for non-peak hours, on the other hand there is POWER hub, a DONG`s Energy solution that helps with balances your consumption with the needs of DONG`s energy and energy generation in the most economical feasible way. And the best thing is that the end consumer wouldn’t notice a thing (in most cases).

These are all applications of data analytics without facing the customer. On the other side you also have customer facing applications where the focus is on giving customer insight in their behavior and energy usage.

The partnerships and acquisitions allows dong energy to provide additional value by combining existing products and services and offer a more customer-oriented value proposition .

Below the business model is again explained through the business model canvas

Table 5. Business model canvas Dong Energy

<table>
<tr>
<td rowspan="2">Key Partners

• Energy intensive businesses.
• governments and municipalities</td>
<td>Key activities

• Energy exploration and production – Offshore wind market, Bioenergy positions
• Energy trading
• Energy distribution to end users</td>
<td rowspan="2">Value Propositions

• Clean(er) sustainable energy supply
• Energy usage management though energy power hub
• Opportunities for climate partnerships.</td>
<td>Relationships

• Customer satisfaction program
• Partnerships with b2b customers</td>
<td rowspan="2">Customer Segments

• Individual households (private)
• Energy intensive Businesses with high potential.</td>
</tr>
<tr>
<td>Key resources

• Renewable energy resources
• Human resources (employees)</td>
<td>Channels

• Advertisement through media
• Value-oriented sales process tinkered to the partnership
• Dialogue on C-Level</td>
</tr>
<tr>
<td colspan="2">Cost Structure

• Cost for Initial investments of production plants
• Intensive and financial demanding sales cycle for partnerships</td>
<td colspan="3">Revenue Streams

• Revenue from value added services
• Revenue from Investors
• Continuous revenue from clients through partnerships & Loyalty</td>
</tr>
</table>

Also here the main value proposition of Dong Energy aren`t their technological solutions but in the below value proposition canvas the focus lied on the innovative data and analytics related solutions

Table 6. Value proposition canvas Dong Energy

<table>
<tr>
<td rowspan="2">Products and Services

• Clean(er) energy supply
• Power Hub Platform
-</td>
<td>Gain Creators

• Digital Intelligence to optimize renewable energy consumption
• Energy efficiency
• Sent excessive energy back to the grid
-</td>
<td>Gains

• Reduction of carbon footprint
• Energy efficiency
• Reduction in energy bill
• Transparency</td>
<td rowspan="2">Customer Jobs

• Arrange temperature of their house
• Charge Car
• Responsibility regarding Energy usage</td>
</tr>
<tr>
<td>Pain Relievers

• By balancing the demand and supply side this uptake of fossil fuels is minimized</td>
<td>Pains

• Usage of fossil energy sources to ensure stable energy supply
• Resistance to change usage patterns.</td>
</tr>
</table>

For the second case we also made a selection of the value propositions of DONG energy with the technology and data analytics aspect of their products and service offerings as focus. By looking at the (select) value proposition model of DONG energy. The following things can be extracted from the model.

- The power hub platform is one of the products that DONG energy offers.
- Power hub balances the energy needs of the customers with the energy supply from DONG
- Excessive energy will be sent back to the grid in order to reduce the electricity bill
- Smart meters and monitoring generate data and inform individuals on their consumption however no habits or efforts need to be made from the consumer's side.

Along with some flexibility power hub allows to optimize the usage of renewable energy, also during peak times with balancing supply and the different types of demand, the more devices and consumers are plugged into the power hub platform, the easier it becomes for power hub to do the balancing.

5.3 Comverge

Comverge is an example of a non-traditional player who built their business model around building a value proposition with main input from data and analytics. Comverge is industry-leader of demand response and energy management programs in both residential and industrial environments. Comverge provides the software hardware and services to implement personalized load control, dynamic pricing, and energy efficiency programs.

Demand response is the change of consumption to better match the match supply with demand. Price-based demand response programs set different prices for electricity depending on the time and available supply (Comverge, 2015b). Energy is more expensive during the peak hours. This, dynamic pricing is one of the 2 pillars of demand response actions. Another is Load control where the idea is to control the demand on of energy intensive devices. This can done by scheduling and has the ability to provide great edge when having volatile energy prices. Both pillars result in an effective usage of energy in respect of the supply.

They`ve developed a platform, IntelliSOURCE, a platform that uses this 2-way communication between the provider and their customers to deliver large scale demand response programs. This can happen through a device installed at the residence or between mobile devices. The IntelliSOURCE also provides advanced programs that use the 2-way communication data enriched with external data (demographic, weather, telemetry, market price …) to increase speed and accuracy of the demand response programs. The forecasting of load, integration of renewable energy resources. (Byers, 2016)

The IntelliSOURCE Enterprise provides additional capabilities for managing DERs and energy efficiency programs. On top of that a single operational dashboard to view all their small business, commercial and industrial demand-side initiatives. This addresses the challenges that energy players are facing. IntelliSOURCE Enterprise consist out integrated modules that forms one platform for management of demand response, energy efficiency programs and customer facing programs. Bring your own device programs and energy data analytics opportunities. The integrated nature of the platform strives for optimal performance of assets and achieving target outcomes.

The IntelliSOURCE platform can comes in different offerings that serves different types of utility customers and different needs. They offer an enterprise module for large industry players, express module for a pre-configured fast deployment. Defense for a security module on top of existing platform. Customer is a module, focused on mobile, for the on the go residential energy customer with a full set of tools to reduce household energy consumption. IntelliSOURCE-Analytics is a module that improves performance of demand side programs by providing insights in customers, forecasting and demand

response capacity. Optimization of thermostat operations and demand response dispatching for delivering customer comfort and maximum load drop.

Comverge hardware offerings are solutions like Smart meters and control switches. IntelliTEMP is a smart thermostat with WiFi that allows near real-time feedback and gives utilities a clearer view of the current available load. IntelliPEAK is a cost-effective switch that one of two way communication with your load control program. Also programmable relays can be configured to set control strategies. IntelliMARKET offers targeted and segmented marketing solutions for engaging customers to create multi-channel marketing.

IntelliMEASURE helps utilities achieve the full potential of their demand management programs. It tracks and measures the quantity and quality of reduction of load control events and receives insights in customer behavior, equipment functionality and others factors. Which result in a real-time decision making tool for load control operators

Comverge services enable energy players and utilities to deliver energy efficiency and customer engagement programs in the desired scale. Many other offering depending on the need of the customers of Comverge. But who are the customers of Comverge?

Comverge worked with a range almost private and public energy players as well as 5 million residential deployments. One of them is Pepco Holdings Inc, an electric utility delivering electricity to more than 815 000 customers in Maryland and district of Colombia. Since partnering together Comverge achieved significant successes. A 360 MW load reduction. Commercial and master meter programs and installation of almost 400 000 control devices. (Comverge, 2015a)

Most of the above mentioned offerings are on top of the intelliSOURCE platform. The core business and for which Comverge is widely known and that is their demand response offerings. However by partnerships with other companies as Apogee Interactive and Pro1 they benefit of the knowledge and expertise in their respective domains for further developments on their offerings.

Table 7. Business model canvas Comverge

<table>
<tr>
<td rowspan="2">Key Partners

• Utilities providers
• Electric providers
• Residential customers</td>
<td>Key activities

• Support utility companies in every aspect of an energy management program</td>
<td rowspan="2">Value Propositions

• IntelliSOURCE (DRMS)
• Smart thermostat (IntelliSOURCE)
• IntelliPEAK Control switches
• Marketing
• installation and support
• Measurement and verification</td>
<td>Relationships

• Dynamic working relationship
• 2 way investments</td>
<td rowspan="2">Customer Segments

• Residential businesses
• Commercial and industrial businesses</td>
</tr>
<tr>
<td>Key resources

• Data
• Knowledge workers</td>
<td>Channels

• Internet
• References
• Social Media</td>
</tr>
<tr>
<td colspan="2">Cost Structure

• Proof of concept or informative costs
• Employee costs (from training to salary to unforeseen expenses)</td>
<td colspan="3">Revenue Streams

• Service revenue for consulting / services
• Pay for performance model
• Traditional payment model</td>
</tr>
</table>

Table 8. Value proposition canvas Comverge

<table>
<tr>
<td rowspan="2">Products and Services

• IntelliSOURCE DRMS
• IntelliTEMP
• IntelliPEAK
• IntelliMEASURE
• IntelliMARKET
• IntelliSupport</td>
<td>Gain Creators

• Load control
• Dynamic Load pricing
• BYOD</td>
<td>Gains

• Environmental benefits of peaking benefits
• Hedges when prices spike
• Access and ability to control consumption remotely</td>
<td rowspan="2">Customer Jobs

• Handling supply and demand fluctuations
• Integration and optimized use of renewable resources
• Unexpected plant repairs</td>
</tr>
<tr>
<td>Pain Relievers

• Demand response systems
• IntelliPEAK DCU unit to control remotely
• IntelliMEASURE provides insight into customer behavior</td>
<td>Pains

• Increasing cost of energy. Difference between peak increases
• No visibility on consumption
• Need to have ability the control consumption remotely
• Supply variability</td>
</tr>
</table>

From the cases discussed this far, Comverge has the most notable data and analytic enabled offerings. Their value proposition is built around demand response solutions that are in essence data exchange put into action. When looking to the pains of the customers of Comverge, the most notable one is supply variability. Comverge built their value proposition around the difficulty to manage peak demands and maximize the integration of renewable energy sources. IntelliSOURCE is a platform that provides the foundation for demand response programs through load control and dynamic pricing. It establishes automated 2 way real-time communication between energy providers and their customers. This allows IntelliSOURCE to reduce demand on the grid when it`s needed, automatically act on price fluctuations as per consumers configuration.

Comverge also developed hardware solution that enable the 2 way communication, the IntelliTEMP smart thermostat enable two-way communication to allow the load reduction through unbiased control across the different customers.

The IntelliSOURCE platform already extended other different modules with focus simplifying and providing an elaborate end to end demand-side management programs. From customer engagement with IntelliMARKET to analytics with IntelliMEASURE. That`s another service built upon the IntelliSOURCE platform, the utility company tracks

and measures the quantity and quality of any reduction during load control events. The results are measurable and verifiable.

5.4 EcoFactor

EcoFactor is another example of a non-traditional player. Similarly as Comverge, EcoFactor also built their value proposition around a data and analytics offering. EcoFactor has developed a cloud based energy platform that runs proprietary algorithms to minimize energy usages. It is transforming how homes use energy by offering energy analytics as service. EcoFactor was able to save consumers about 100$ per year in Nevada (EcoFactor, 2015a). It does so by using data collection from a variety of data sources: connected thermostats, weather data, etc.) proactively and automatically minimize homeowner energy consumption.

All of this is a cloud solution where the Software-as-a-Service (Hereinafter: SaaS) solution is easy to launch, maintain and easy to integrate infrastructure which is already present

Automated Energy Efficiency Service is one of the services the platform gathers data from different household thermostats. The algorithms monitor the habits, routines and individual preferences from households and learns from it. This allows the platform to automatically adjust to the homeowner's lifestyle while maximizing savings without impacting the homeowner comfort. EcoFactor also offers a web-based and mobile-app which allows house temperature to be monitored and adjusted at all times. The EcoFactor app will also make suggestions in regards of energy management.

EcoFactor offerings also includes intelligent demand response systems. Similarly as Comverge. EcoFactor applies their analytics to cool each home before any DR event and minimizes any impact of DR programs for homeowners. This allows energy retailers for higher participation in their DR programs.

Another service that the EcoFactor energy platform offers is the performance monitoring. The sophisticated machine learning algorithms detect patterns and identify anomalies in heating or cooling systems and notify the customers. Real-time diagnostics and analysis detects different levels of wear early and provide comfort for the customer. According to EcoFactor in around 70% of the cases, users did not know issues existed which impacted their performance, which translated into average 14% efficiency gain from repairs (EcoFactor, 2015b).

Where Comverge is more focused to businesses, EcoFactor`s value proposition is more directed towards home owners. However not exclusively. EcoFactor also targets energy

retailers and utility companies. But also service providers like Cable Operators or energy auditors or regulators

Since it`s cloud based and allows for smooth interaction through application programming interface (Hereinafter: API). Utility companies can offer EcoFactor`s cloud-based energy management solution towards their clients in the form of a short-time-to market energy management solution. These synergies amongst different players allows for a full-range of service offerings which results in a better customer loyalty and tighter bound and most importantly an high revenue per user with all those new value-added energy services

EcoFactor energy analytics platform taps into the opportunity where customers are to busy with their daily routines to look at their thermostat. EcoFactor automates this so that customers can focused on the actual things which keep them busy while still being energy efficient and thus ecological.

As mentioned, EcoFactor has a web and mobile interface to manually control and monitor energy consumption and schedule. In the backend it works through big data analytics through technologies like Hadoop, Hive and Storm to offer a scalable SaaS solution

When looking at the business model we can see that EcoFactor is very similar as Comverge at a lot of different aspects. Their value offerings overlap as well as their customer segment.

Table 9. Business model canvas EcoFactor

<table>
<tr>
<td rowspan="2">Key Partners

• Utilities providers
• Electric providers
• Residential customers</td>
<td>Key activities

• Provide Support utility companies in every aspect of an energy management program</td>
<td rowspan="2">Value Propositions

• Energy analytics as a service
• Cloud based platform
• Optimized demand response
• Predictive monitoring tools</td>
<td>Relationships

• Form synergies with different players of energy value chain
•</td>
<td rowspan="2">Customer Segments

• Residential businesses
• Commercial and industrial businesses</td>
</tr>
<tr>
<td>Key resources

• Data
• Propriety algorithms
• Computational power</td>
<td>Channels

• Internet
• References
• Social Media
• Events</td>
</tr>
<tr>
<td colspan="2">Cost Structure

• Proof of concept or informative costs
• Employee costs (from training to salary to unforeseen expenses)</td>
<td colspan="3">Revenue Streams

• Service revenue for consulting / services
• Traditional payment model</td>
</tr>
</table>

Table 10. Value proposition canvas EcoFactor

<table>
<tr>
<td rowspan="2">Products and Services
Energy analytics as a service
Automated temperature control
Value added information</td>
<td>Gain Creators
Load control
Dynamic Load pricing
Api access
Cloud based
Web and mobile applications</td>
<td>Gains
Smooth integration with other parties
Energy benefits
Reduced energy bill
Informed
Access to control their temperature
For partners : Faster time to market</td>
<td rowspan="2">Customer Jobs
Controlling temperature at home
For partner utility companies offer value added services</td>
</tr>
<tr>
<td>Pain Relievers
Automation
Performance monitoring
Pre-cooling homes prior to DR-event</td>
<td>Pains
Busy schedule
House hold appliances breaking down
Unexpected, uncomfortable DR events</td>
</tr>
</table>

When comparing this value offerings with one from Comverge, it`s interesting to identify some of the differences and similarities between the two offerings. As indicted in the 3th case. Comverge offerings is built around the supply variability and anticipating on load control and demand response systems. The difference with EcoFactor is that they're more focused on the demand side of the value chain. Tapping into the customers behavior and habits and allows their algorithms to make an impact by suggestions through popups of their screen or automated energy control based on the behavior patterns of the households.

5.5 Putting it all together

When looking to the 4 discussed business models and value propositions from prominent energy disrupters a lot of things can be concluded. In the below framework a comparison will be made in order to establish a more visible and tangible idea on the data-centricity of the respective organization.

Table 11. Data analytics assessment framework: Solar city, Dong Energy, Comverge, EcoFactor

Perspective	Solar City	Dong Energy	Comverge	EcoFactor
Insights through data	Behavior patterns of energy consumption Power generation data of Solar panel offerings Preventive failure and defect detection of solar panels at end user	Preventive failure and defect detection of windfarms Forecasting Behavior patterns of energy consumption	Customer behavior Equipment functionality Energy demand and use Impact of action taken on load.	Customer behavior on energy Consumption and patterns recognition Home appliances monitoring
Innovation through data	Energy Management Systems (Power Guide) Energy efficiency analysis Storage for excessive energy (Demand Logic) Optimization of distributed energy resources. Dynamic control systems	Power hub – A product which balances supply and demand to maximize renewable energy usages Monitoring & Maintenance Systems	The entire intelliSOURCE demand response system is built around data and anticipating the insights given by the data. intelliMEASURE measures the impact and/or reduction during load control events.	EcoFactor energy platform Optimization algorithms Enhanced value added-service
Business Ecosystem	Traditional value chain applies less since it`s supporting a decentralized power generation and distributed energy grid	Partnerships with Energy intensive businesses. Energy generation, transmission operator and distributor	Partnerships for getting knowledge. New entrant in the business ecosystem of energy.	Partnerships with different players in value chain New entrant in the business ecosystem of energy.

By looking to the first perspective, Insights through data, a lot of similarities can be identified between the first two companies. Data is being gathered through sensors and metering systems through the different facets of the supply chain, mostly focused on the consumption and generation aspect of energy. With the generated data both companies try to establish preventive maintenance and failure detection patterns. This can be classified under operational analytics. The fact that the 2 big energy players are spending as much effort in this it not a question that the impact from failure can have dramatic consequences.

For Comverge and EcoFactor their entire value proposition turns around the insights of data. How that is steering the demand response actions, energy consumption and behavior. Comverge also developed some other value added services on top of that also based on insights created by their offerings. For Comverge and EcoFactor, different as Solar City or Dong, insights through analytics in ingrained in their business model and it`s their core business.

If we look to the context of those possible problems these efforts make sense. It is the supply of energy which we`re dealing with. Reliability is one of the key pillars of energy supply. A consumer might be willing to pay extra for using renewable energy sources but if these renewable energy resources / systems aren`t reliable the consumer will be less eager to switch to these type of solutions. Keeping in mind that financially these options might be a little less attractive, the significance of ensuring high reliability of these services are key for building trust in the brand and their solutions.

The 4 companies also gather behavioral data about the energy consumption of their clients. All the 4 companies do it for the same reason, understanding the customer. It is mentioned that energy supply and demand is a scale which should in balance. For DONG energy and Solar City this based on the purpose of delivering efficient and reliable energy. Both player also work the demand side but this isn`t their main focus. For Comverge and Especially EcoFactor, Their entire business model is built understanding the customer, working the downstream side of the chain and allowing consumers to consume in economical way.

For EcoFactor it makes sense to automate certain consumption behavior since customers aren`t occupied with their energy consumption throughout the day. It doesn`t fit in people busy schedule. There are already a lot of efforts done to ease the work for customers, but life always seem to intervene and disturb your schedule. EcoFactor is listening in the background and detect behavior and apply data science and provide information and/or automation for an improved emerged efficiency.

However it`s important to consider that not only by understanding the consumption patterns the above benefits will be achieved. Efforts in energy efficient behavior and flexibility is key in order to achieve the true potential of these smart solutions. The generated insights should be put into action.

When we take the supply side under the loop and look how we can use these behavior patterns, assuming that the consumer their behavior is what it is, other optimization can be done by ensuring and balancing the load to handle peak times as well as potentially reverting back to traditional energy sources. But since the main goal is not to do so, the most added value can be achieved by pursuing the consumer to spread their consumption and be flexible in things they can be flexible with. This can be done through pricing and through offerings in products and services, the second perspective of our framework.

Innovations through data covers how the insights are put into action by the respective companies in order to offer value to the customers and indirectly to themselves. Both companies have value propositions which seem to be quite similar at first glance but when going in more detail some vital differences come to surface. The 3 companies offer a type of a smart energy management system.

SolarCity offer include *PowerGuide.* An Intelligent real-time solar energy monitoring systems which allows the end-user to monitor their power generation performance and their consumption behavior through dashboards where key performance metrics are presented. This information is available with incredible detail. The system allows filtering by different time periods. It also include triggers to SolarCity when the systems detect unusual behavior. PowerGuide can be accessed on your computer but also on mobile devices through their MySolarApp.

DemandLogic is an intelligent energy storage system which takes care of the flexibility required from the end user to try and minimize energy usage during peak time. DemandLogic is a piece of technology build upon the assumption of having a storage possibility for energy. It allows the battery to be charged during high energy generation periods (When the sun is shining and solar panels are generating more energy than is being consumed). This excessive energy will be stored in batteries. When solar production decreases the battery is intelligently discharged to reduce peak demand charged. Also here the performance of the battery can be monitored real-time through mobile and desktop services.

And one of the key product offerings of SolarCity is the GridLogic Microgrid solution where different DERs can be managed. These DERs include battery storage, personal rooftop solar and ground-mounted solar, whatever applies to your specific case. The solution establishes a microgrid which can work completely independent from the public

energy grid. Intelligent algorithms optimize system performance in order to maximize savings for you and your community. This solution targets small communities, college campuses or military bases.

DONG Energy doesn`t have as elaborate product offerings as SolarCity. This is because their focus lies more on the generation of renewable power through wind which is obviously not as consumer friendly as Solar. This will be elaborated more in the section of their respective ecosystem in which they both conduct their business. Obviously innovations through data doesn`t necessarily need to be directed towards the consumers.

Dong`s key differentiator is their expertise in offshore windfarms. Here to use data to optimize those endeavors. A windmill is a huge investment where return will only be felt after a significant time period. This is why Dong energy has developed a monitoring and maintenance systems to detect and resolve any issues, even before they occur. Performance of those windmill is being monitored and forecasted for the future.

DONG energy also developed a smarter energy platform called Power hub, this platform uses data to intelligently balance the needs of the users with those of DONG. As mentioned before, renewable energy isn`t reliable and a balance between supply and demand is required. Power hub uses information from the consumption behavior of all their end users and data of energy production to intelligently balance this. Some flexibility from the end users is required in order to let power hub manage when certain devices are consuming energy. This is obviously within limits.

Power hub utilizes data from different sources, consumption, generation and pricing to optimize energy usage during attractive time periods when pricing and generation is opportune to ensure a reliable and financially attractive source of renewable energy.

Comverge offering is a rich and end to end demand response system intelliSOURCE. A platform that allows consumers to anticipate price changes and arrange consumers based on different pricing models. Or controlling the load based on the supply. DCU allows to turn energy intensive devices on and off based on the logic and algorithms in the platform.

EcoFactor offering is a pure data and analytics driven value proposition which is put on the cloud. Accessible through a rich set of APIs that allows from smooth integration and customizability. It energy analytics platform offers different services to the users and can be used in synergies with other utilities and traditional service offerings.

The last perspective considered in the framework is the ecosystem in which the four organization conduct their business. This is probably where there are most significant differences between the four. SolarCity and Dong can be directly compared with one

another regarding the ecosystem while Comverge and EcoFactor are different. Comverge and EcoFactor are smaller players that have energy optimizations through data, algorithms and technology. They cover the entire value chain in the sense that they can provide value for the entire value chain with their core business of providing insights.

SolarCity can be seen as a major disrupter of the four, replacing the traditional value chain with their own variant of this, where decentralized power generation forms one of the key pillar of their vision. With distributed energy generation transmission and distribution fall in the background since the energy will be generated more locally, the loads on the infrastructure will be not as high as with traditional energy sources and costs for grid infrastructure can be utilized elsewhere.

The business ecosystem of DONG energy is quite different than that from SolarCity. The supply chain remains quite traditional so to say, no real disruptive turn around. A notable observation is that DONG energy covers in some areas where they operate almost the entire value chain, up to the end users. In greater Copenhagen and north Zealand dong energy distributes electricity. In west Zealand and southern Denmark they also sell and distribute gas. But the actual focus of DONG energy lies in the development of the electricity grid of the future and long-term partnership agreements to produce smart, energy-efficient customer solutions.

DONG energy has entered into more than 100 Climate partnership agreements and developed a unique partnership model for this purpose. This ultimate goal of those partnerships is to assist organizations, municipalities and companies with decreasing their carbon footprint without impacting the stability and profitably of the respective organization. The partnership concept offers a more customer-oriented value proposition and personalized approach. It bundles the best of its offerings, which includes project management, financial solutions and energy savings. The climate partnership are targeting energy intensive organizations and having a large potential for differentiating through renewable profile. An example could be a large manufacturing plant which is transforming their supply chain, which could include subcontractors.

Comverge and EcoFactor are tapping into a new area of the energy value chain. The area of providing insights. It`s an area which is new and can be considered a new entrant within the energy ecosystem. The value offerings of new non-traditional however should be compared with other similar players and this is why it can be said that these players is in the “birth” or “expansion” stage of their business ecosystem, but playing a role in the already established ecosystem of energy.

Comverge and EcoFactor are great in their specific functional areas but are facing though competition from multiple ends. From small innovative companies to already established

players that see the value in the value offerings that Comverge offers. The established players have the benefit that have an establish customer bases and that they can ingrain the value proposition within the energy offerings. Something that consumers need.

On the other hand is Comverge , EcoFactor and other smaller players are more agile, they have the ability to jump faster within new segments, work together with bigger players and aren`t facing as much issues with change, processes and technological restrains. It`s however important to consider that entering the more established and traditional segments of the energy value chain have high-entry barriers like infrastructure, regulation.

6 DISCUSSION

The paper has evaluated 4 cases and analyzed them through some business model assessment techniques as well as the evaluated of 3 perspectives which are thought to be relevant for the purpose of the thesis.

The first point the paper wanted to investigate was how information is being generated across different parts of the value chain. Here it can be concluded that information is being generated across all across the whole value chain. The first perspective answer the question of the insights which are being generated through the information which is being generated. It`s important to note that sensors and meters are only generated data and that insights is a step further when put into context and have a meaning, only then information is being generated. Data generated from sensors and measurements devices is being enriched with from other sources like weather data. In the four cases examples would be that generated data is being utilized and put into context to understand the performance of the respective source of energy, understanding customer behavior with the ultimate goal of energy efficiency.

The second question the paper asked was how this information and technology is driving the transform of traditional processes into intelligent autonomous processes. The focus in our papier lies more how new business processes are emerging rather than the actual replacement or automation of processes. However in the example of Solar City, the proposed decentralized and DERs are replacing traditional generation, transmission and distribution processes. This transformation is facilitated by technologies and innovations in energy resources, the offered value is enriched by information and analysis. In the case of Dong energy, the traditional processes can be still observed and a real disruption isn`t as present as in the case of Solar City however those traditional processes are also enriched by information generation, additional value offerings have emerged and those new types of value offerings plug form a perfect synergy with the traditional value offering of (renewable) energy.

In the case of Comverge their business model is built around the ability to provide information in order to response and act in appropriate way in order to minimize energy bill, optimize energy efficiency and the usage of the renewable energy resources. These steps can also be automated by the system to autonomous processes. For instance that the rescheduling of energy intensive applications or tools happens automatically during low-peak times. It can be said that Comverge providing the information and automating the same for the consumer which doesn`t have to keep track of energy load times etc. the system will intelligently reschedule certain things based on the initial configuration and the parameters it`s have at that certain point in time.

For EcoFactor, it can be said that their value proposition and their core focus is the automation of energy consumption towards and intelligent autonomous process. Using data and analytics they take the burden away from the consumers and make proactive decisions in regards of energy consumption, Demand response optimization and performance monitoring on the household appliances. Automation for EcoFactor is a key-selling point much more than the other three cases.

The third point this paper was investigating what data-driven business models are emerging and what the value is of this new kind of players. Looking to the theoretical background the paper has established of data-centric models, it can be noted that the 3 perspectives we consider really lean close to the analytics culture the organizations create. Insights are being created, Optimization based on those insights and innovations based on those insights. For the discussed organizations this is the case. The cases take action on their analytics and they consider mobile in their offerings, all pillars of a Data-driven company. The case of Comverge and EcoFactor especially can be consider a data-driven business model. The value the company offers is created through the data recorded, put into context and offer these actionable insights to their clients. They are a new type of player that wasn't present in the traditional value chain and the value they offer is based on the overall value chain and the information exchange between the different players.

The last point to look how value added services are emerging and how this leads to new kind of players within the industry. In the first 2 cases this wasn`t as outspoken since the newly types of services aren`t their core business. The core business of Dong energy is renewable energy generation and not their power hub smart metering systems. Similarly solar city core revenue comes from their solar panels. However with solar city the leasing options of the solar panels leads to a new type of service, also with their disruptive vision they can also be considered as a new type of player. But real examples of this can be earlier mentioned applications, possibly based on the green button initiatives. Those are real small time businesses trying to position themselves in the energy industry by providing value from data and technology without being involved in the traditional supply chain. Comverge and EcoFactors offerings however consist solely out new kind of value added services and the integration between traditional players and consumers.

In the cases the ecosystem was also covered. Looking back on the established theory of business ecosystems it`s important to acknowledge the different stages the 3 organizations are.

It`s safe to say that the disruption that SolarCity is doing with their DERs put their business ecosystem in the birth stage. The challenges here are working with new customers and suppliers and developing their new type of value proposition. For protecting their ideas from other which working towards similar offerings Solar City shouldn`t worry too much.

With their partnership with Tesla motors and their position in the solar market in the US put them in a most favorable position for offering the value proposition their vision is holding. The focus of SolarCity is obviously to establish a market and a change of philosophy rather than protecting their revenue against competitors. This always has been the way that Elon Musk conducts his business, he opens and creates a market for a better world, never patents anything and support healthy competition.

Looking at the business of Dong energy and their (technological) innovations places them more in the self-renewable stage of the business ecosystem. It brings new ideas to the existing philosophy of the energy business, enriches the industry through innovations in renewable energy and new combinations but the market stays identical. The energy sector has automatically high barriers of entry since it`s intrinsic of the industry. Dong energy however takes a way a lot of new and sustainable alternative value propositions by offering something similar aside from their usual offerings.

Comverge and EcoFactor is a bit different. The value proposition is innovative, modern and logically one would consider them to be at the birth stage of the ecosystem. Working together to define new value propositions and protect your ideas from others. However it should be consider that their value propostions built upon the energy value chain. The value proposition of those players are working together with existing energy providers and customers. It offers value only in synergy with energy providers and their customers.

This is why Comverge, EcoFactor and the energy industry can be consider in the self-renewable stage. They`re innovator works together established players but wouldn`t ever be able to offer the same value as Dong energy. The entry barriers are too high and costly, but that isn`t the focus of those smaller companies either. The risk however is that the established players will incorporate similar offerings in their energy offerings to their clients. A client will find it an extra barrier to go to Comverge for the demand response system rather than straight to the energy provider. It`s more straight-forward to stick to 1 provider for all the services.

One strategy is to mitigate this risk by partnering up by creating a fruitful business relationship between the different parties by enriching their services offerings with the analytics platform and tapping into the customer base of that said partner. Its mutual beneficial and increases consumer’s loyalty as well as revenue.

One big limitation of the case work here is that all the information is gained through secondary data collection. It’s all public information, press releases and other white papers. This gives a view how the respective companies wanted to be perceived. There is no real “inside” view in the company to see what’s happening under the hood. A suggestion for further work would be to maybe retrieve additional information from sources inside the

company or partners who delivered information solutions to the respective company. Obviously this isn't trivial since most of these things are considered confidential.

Personally I do think that the comparison of these four cases gave a better idea how data and analytics can transform business in different ways. Which different types of business models and value propositions we can expect in the transformed energy industry.

CONCLUSION

The thesis has been looking to the energy industry. A background has been established with the theory of Jeremy Rifkin. He claims that the convergence new types of communication media and new types of energy supply and new form of logistics results fundamental economic changes which already happened in the past, industrial revolutions and now the post industrial revolution where internet revolution and distributed communication and renewable distributed energy revolution are forming the base for it.

Afterwards the work described the traditional energy value chain and it`s players in order to establish a point of reference to which the cases can be compared against. It consist out of four traditional segments. Generation, which includes out all the energy production, from fossil fuels, nuclear energy to renewable sources of energy like wind, tidal, biomass and sun. Transmission and Distribution which transport the energy to the consumers which can be big organizations and small individuals home owners.

A brief introduction has been given on the European energy market and it`s goals. How the share of renewable energy is rising but that forecasted target of 2020 is still feasible with significant efforts from the member states.

The work also sheds light on the drivers of the transformation which is happening in the market. How Climate change is just one of the factors and how this is putting pressure on other drivers of change. The paper covers urbanization as a factor of change, how growing cities are requiring an upgraded infrastructure and how underdeveloped cities are advised to go straight to a local distributed grid. Another drives was the technology which is improving every day. Innovations which were very expensive in the past are now in hand`s reach and how organizations, governments and countries should seize those opportunities to facilitate the long awaited transformation.

The focus of this paper is on the role of data within this transformation. In our theoretical framework the paper established a model in order to evaluate the most significant perspectives in a data and analytics culture. With this model along with business model analysis techniques three cases of energy players were evaluated. The specific results were presented in the Discussion section but the main findings were

- In order to make data culture data must be gathered from internal and external sources in various format
- Through data analysis techniques and putting this in the correct context, insights will emerge.
- These insights can be the value where products and services can be built around, the both cases had different implementations but the idea remained the same. Putting action to those insights.

- The ecosystem of the organizations will evolve along with the transformed business (model).

The cases both had different concrete implementations of their products and services. SolarCity was more of the disruptor and acted more towards a vision while DONG energy evolved existing products and services. This translated the both players being in a different stages of the business ecosystem. Comverge and EcoFactor were smaller modern innovators tapping into the new opportunities that the data enriched energy transformation offers.

For SolarCity it`s important to establish how this new ecosystem fits into the vision presented by Jeremy Rifkin where an entire new methodology and topology of energy resources is enabled by technology and data.

REFERENCES

1. BNEF. (2016). Wind and Solar are crushing Fossil Fuels. Retrieved March 28, 2016 from https://www.bloomberg.com/news/articles/2016-04-06/wind-and-solar-are-crushing-fossil-fuels
2. Boogmans, D. (2014). eindrapport VRWI toekomstverkenningen 2025: new energy demand.
3. BP, S. (2015). BP: World Reserves of Fossil Fuels. Retrieved from https://knoema.com/BPWES2014/bp-statistical-review-of-world-energy-2015-main-indicators
4. Breeze, P. (2014). Renewable energy technologies : Cost Analysis Series - WindPower. Power Generation Technologies, 1(5), 223–242.
5. Byers, T. (2016). Using Machine Learning to Improve Demand Response Forecasts.
6. CBS Case Competition. Moving energy forward 2012 (2012).
7. Chen, H., Chiang, R. H. L., Lindner, C. H., Storey, V. C., & Robinson, J. M. (2012). Business Intelligence and Analytics: From Big Data To Big Impact. Misq, 36 No. 4(Special Issue: Business Intelligence Research), 24.
8. Climate Group. (2008). SMART 2020 : Enabling the low carbon economy in the information age. Group, 30(2), 1–87.
9. Comverge. PHI to Reach More Than 370 , 000 Customers for Demand Response (2015).
10. Comverge. (2015b). Price-Based Demand Response.
11. de Schepper, K. (2017). How Focused Data Use Analysis Leads To Energy Efficiency. Retrieved June 25, 2017, from http://www.facilitiesnet.com/energyefficiency/article/How-Focused-Data-Use-Analysis-Leads-To-Energy-Efficiency--17245
12. Dobre, C., & Xhafa, F. (2014). Intelligent services for Big data science. Future Generation Computer Systems, 37, 267–281.
13. Dong Energy. (2017). Timing your energy use matters. Retrieved May 28, 2017, from http://www.dongenergy.com/en/sustainability/stories/timing-your-energy-use-matters
14. EcoFactor. (2015a). Automated Energy Efficiency Service. Retrieved from http://www.ecofactor.com/wp-content/uploads/2015/09/2015-09-EcoFactor-Datasheet-Energy-Efficiency.pdf
15. EcoFactor. (2015b). HVAC Performance Monitoring Service. Retrieved from http://www.ecofactor.com/wp-content/uploads/2015/09/2015-09-EcoFactor-Datasheet-HVAC-Performance-Monitoring.pdf
16. Elia. (2015). Federaal Ontwikkelingsplan van het transmissienet 2015-2025, (september). Retrieved from http://www.elia.be/nl/grid-data/grid-development/investeringsplannen/federal-development-plan-2015-2025
17. European Commission. (2010). Energy 2020. A strategy for competitive, sustainable and secure energy. Https://Ec.Europa.Eu/Energy/En/Topics/Energy-Strategy/2020-Energy-Strategy, 21.
18. European Commission. (2015). Eurobarometer Special Report: Climate Change 2015. Physiological Research (Vol. 64).
19. European Commission. (2016a). Innovation performance compared: How innovative is your country? Brussels.

20. European Commission. (2016b). MEDEDELING VAN DE COMMISSIE AAN HET EUROPEES PARLEMENT, DE RAAD, HET EUROPEES ECONOMISCH EN SOCIAAL COMITÉ, HET COMITÉ VAN DE REGIO'S EN DE EUROPESE INVESTERINGSBANK. Brussel,.
21. Eurostat. (2016a). Electricity production , consumption and market overview, 2008(July 2016), 1–8.
22. Eurostat. (2016b). Share of renewables in energy consumption in the EU rose further to 16 % in 2014 Nine Member States already achieved their 2020 targets, (February), 4–6.
23. Gronholt-Pedersen, J., Mikkelsen, O., & Skydsgaard, N. (2016). DONG Energy shares jump after biggest European IPO this year | Reuters. Retrieved May 6, 2017, from http://www.reuters.com/article/us-dongenergy-ipo-idUSKCN0YV0TP
24. IBM. (2012). Transforming the energy value chain.
25. IBM Corporation. (2012). Managing big data for smart grids and smart meters, 8.
26. Mithas, S., Lee, M., & Earley, S. (2013). Leveraging Big Data and Business Analytics. IEEE Computer Society, (December), 18–20. Retrieved from http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6674024
27. Mitzer, D. (2016). What is a data-driven company? | InfoWorld. Retrieved from http://www.infoworld.com/article/3074322/big-data/what-is-a-data-driven-company.html
28. Moore, J. F. (1993). Predators and prey: a new ecology of competition. Harvard Business Review, 71(3), 75–86. http://doi.org/Article
29. NOAA. (2016). State of the Climate: Global Analysis for Annual 2015. January 2016. Retrieved from http://www.ncdc.noaa.gov/sotc/global/201513.
30. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. A handbook for visionaries, game changers, and challengers (Vol. 30).
31. PricewaterhouseCoopers. (2014). The road ahead - Gaining momentum from energy transformation. Pwc. Retrieved from http://www.pwc.com/en_GX/gx/utilities/publications/assets/pwc-the-road-ahead.pdf
32. Resca, A., Za, S., & Spagnoletti, P. (2013). Digital platforms as sources for organizational and strategic transformation: A case study of the midblue project. Journal of Theoretical and Applied Electronic Commerce Research.
33. Rifkin, J. (2008). Leading the way to the third industrial revolution. European Energ Rev (Vol. 1). Retrieved from http://www.foet.org/ongoing/documents/Energy Vision Plan and Third Industrial Revolution for EU - footnoted.pdf
34. Rifkin, J. (2012). The Third Industrial Revolution-- How Lateral Power Is Transform-ing Energy, The Economy, and the World. World Future Review (World Future Society) (Vol. 4). St. Martin's Griffin (January 8, 2013).
35. Ryan, L. (2014). How to become a Data-Centric company. Retrieved May 29, 2017, from http://www.dbta.com/Editorial/Trends-and-Applications/How-to-Become-a-Data-Centric-Company-96164.aspx
36. Smartgridsflanders. (2016). Smart Energy Region : Een blauwdruk voor de Vlaamse speerpuntcluster energie. Brussel. Retrieved from http://link.springer.com/10.1007/978-3-642-21820-0
37. Solar City Grid Engineering. (2015). Integrated Distribution Planning: A holistic

approach to meeting grid needs and expanding customer choice by unlocking the benefits of distributed energy resources.
38. VREG. (2013). Wat u moet weten over energie en het veranderen van leverancie. Vlaamse Regulator van de Elektriciteits- en Gasmarkt. Retrieved from http://www.vreg.be/nl/opleidingsmateriaal-en-presentaties-0
39. Wegener, R., & Velu, S. (2013). The value of Big Data: How analytics differentiates winners. Bain Brief (Vol. 5). Retrieved from http://www.bain.com/Images/BAIN _BRIEF_The_value_of_Big_Data.pdf
40. Weill, P., & Ross, J. W. (2009). IT Savvy: What Top Executives Must Know to Go from Pain to Gain. Harvard business press. Retrieved from http://books.google.com/books?id=qn1zu_NSIUkC&pgis=1
41. Xiaoyan, H. (2014). Master ' s Thesis Comparative Analysis of Solar PV Business Models. Lappeenranta University of Technology. Retrieved from http://www.doria.fi/bitstream/handle/10024/98406/thesis-oneside.pdf?sequence=2