Evaluating information interfaces on the current and future electricity market from a DSO’s perspective – A case study on Vattenfall

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Abstract

In the recent years, there has been an intense on going debate regarding a new market model that would significantly transform the information interfaces and the processes on the electricity market. The model in question is called a supplier centric model, which means that the supplier is the customer’s primary contact point. This report examines how a Distribution System Operator (DSO) would be affected by the implementation of the supplier centric model due to the restructuring of information interfaces. The research was conducted as a case study on Vattenfall, but interviews with external actors and a literature review were also conducted in order to get an unbiased view of the market changes. The findings of the research demonstrated that grid related processes and customers to the regional grid require superior technical expertise, which makes these processes disadvantageous to manage in a supplier centric manner. In addition, the report concluded that the implementation of a supplier centric model would increase the credit risk, but the overall economic impact will be neutral long term.
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# Content

Acknowledgements ........................................................................................................ 3

Introduction .................................................................................................................. 9

1 Background .................................................................................................................. 9

2 Purpose ......................................................................................................................... 9

3 Research Questions ...................................................................................................... 10

4 Delimitations ................................................................................................................ 10

5 Deliverables .................................................................................................................. 11

Market Changes and Characteristics of the Swedish Electricity Market .................. 12

6 Swedish Electricity Market ......................................................................................... 12

6.1 Actors on the Swedish Electricity Market ................................................................. 13

6.2 Regulatory and Advisory Actors ............................................................................. 14

7 Nordic Retail Market for Electricity ......................................................................... 14

8 Supplier Centric Model .............................................................................................. 15

9 Smart Grid ................................................................................................................... 16

10 Smart Meters ............................................................................................................. 16

11 Third Party Access .................................................................................................... 16

Methodology .................................................................................................................. 17

12 Research Process ........................................................................................................ 17

12.1 Introductory Phase .................................................................................................. 17

12.2 Current Processes ................................................................................................... 18

12.3 Supplier Centric Model ......................................................................................... 18

12.4 Analysis ................................................................................................................... 19

12.5 Conclusion ............................................................................................................... 20

13 Methods for Data Collection ..................................................................................... 21

13.1 Methods for Interviews ......................................................................................... 21

13.2 Method for Literature Review ............................................................................... 22

14 Methods for Scenario Design ..................................................................................... 23

14.1 Scenario Design Theory ......................................................................................... 23

14.2 Predictive Scenarios in the Supplier Centric Model ................................................. 23

14.3 Explorative Scenario Design in the Business Process Investigation ...................... 24

15 Limitations of the Research ....................................................................................... 24
## Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Illustration of the Swedish electricity market (Svenska Kraftnät, 2013)</td>
<td>12</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Illustration of the research process</td>
<td>17</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Illustration of the framework for analysis</td>
<td>19</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Illustration of influencing actors in the implementation of a supplier centric model</td>
<td>25</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Illustration of Ideological context of contract models in the electricity market</td>
<td>31</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Sub Contractor Model</td>
<td>31</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Power of Attorney Contract Model</td>
<td>32</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Illustration of the current &quot;point-to-point&quot; information exchange model</td>
<td>37</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Illustration of centralized datahub</td>
<td>39</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Illustration of &quot;point-to-point&quot; information exchange model with a name service</td>
<td>40</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Illustration of information exchange model with a service hub</td>
<td>41</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Illustration of current moving out process</td>
<td>46</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Illustration of current moving in process</td>
<td>47</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Illustration of the future moving process (in and out)</td>
<td>49</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Illustration of the current re- and disconnection process</td>
<td>50</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Illustration of the future re-and disconnection process</td>
<td>52</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Illustration of the current billing process</td>
<td>54</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Illustration of Engros Billing with a centralized hub in a subcontractor model</td>
<td>57</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Illustration of Pass-Through-Billing with a centralized hub in a subcontractor model</td>
<td>58</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Illustration of Pass-Through-Billing with a centralized hub in a power of attorney contract model</td>
<td>59</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Illustration of Pass-Through-Billing with a “point-to-point” information exchange in a subcontractor model</td>
<td>60</td>
</tr>
<tr>
<td>Figure 22</td>
<td>Illustration of Pass-Through-Billing with a “point-to-point” information exchange in power of attorney model</td>
<td>61</td>
</tr>
<tr>
<td>Figure 23</td>
<td>Illustration of current single error process</td>
<td>63</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Illustration of current significant power failure process</td>
<td>66</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Illustration of a future single error process</td>
<td>69</td>
</tr>
<tr>
<td>Figure 26</td>
<td>Illustration of a future significant power failure process</td>
<td>71</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Illustration of the current power quality process</td>
<td>76</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Illustration of a future power quality process</td>
<td>79</td>
</tr>
<tr>
<td>Figure 29</td>
<td>Illustration of the current local grid connection process</td>
<td>81</td>
</tr>
<tr>
<td>Figure 30</td>
<td>Illustration of a future local grid connection process</td>
<td>84</td>
</tr>
<tr>
<td>Figure 31</td>
<td>Economical impact of the supplier centric model</td>
<td>94</td>
</tr>
</tbody>
</table>
Introduction

1 Background
Since the Nordic electricity markets were deregulated in 1990’s, the target has been set to unite the Nordic countries in one integrated electricity market. In 2005 the Energy Minsters set the first clear objectives for a development towards a common Nordic end-user market and commissioned the organization for the Nordic Energy Regulators to coordinate the project. The project aims to simplify for the customer and “establishment across the borders for the suppliers on the market” to improve competitiveness on the electricity market. (Swedish Energy Markets Inspectorate, 2013a).

In order to establish a harmonization of the Nordic electricity markets, it is necessary that all countries first implement a supplier centric model. The main characteristic of a supplier centric market model is that the supplier is the customer’s primary contact point. Furthermore, a supplier centric model entails mandatory combined billing resulting in one invoice from the supplier and the distribution system operator (DSO) instead of two separate invoices as in the current structure.

Consequently, an implementation of the supplier centric model will result in significant changes in the information interfaces for the market actors. These market changes will have a large impact on the daily operations of both DSOs and suppliers. In order to adapt to the new prerequisites on the market, the market actors must understand how a supplier centric model will affect its organization and modify their processes accordingly. However, little investigation has been done on how the operations could be carried out in practice and what problems that needs to be managed as a result of the changes. Furthermore, there are still many important aspects of the supplier centric model’s implementation in Sweden that are unclear, which further complicates the process of preparing for the supplier centric model.

2 Purpose
The purpose of this master thesis report is to examine how the DSO will be affected by the implementation of the supplier centric model due to the restructuring of information interfaces.

Furthermore, the purpose of this report is to provide Vattenfall Eldistribution with guidance on how a DSO should act in order to adapt efficiently to a supplier centric market model.
3 Research Questions

In order to fulfil the purpose of the study, the master thesis will answer the following research questions (RQs):

- How will the supplier centric model be implemented? (RQ1)
- How will a DSO’s information interfaces transform if managed in a supplier centric manner? (RQ2)  
  i. How are the processes designed currently?
  ii. How would the processes be designed in a supplier centric model, and what are the obstacles of structuring processes in such a manner?
- How will a DSO be affected by the implementation of a supplier centric model? (RQ3)

In addition, this report will answer one more research question for the purpose of providing Vattenfall with some company specific guidelines.

- What measures need to be taken in order to operate efficiently in the future market? (RQ4)  
  i. What actions need to be taken in preparation for a supplier centric model?
  ii. What opportunities of improvements exist in the current processes?

4 Delimitations

In this section of the report, the report will discuss the delimitations of the master thesis.

First and foremost, one of the main delimitations of this report is that it only examines how a supplier centric model could be implemented in the future, regardless of whether it is likely that Sweden’s electricity market becomes supplier centric or not. While it would have been interesting to examine the probability of such an implementation, this master thesis report will not cover this matter due to time constraints.

Secondly, this report will focus on the prerequisites on the Swedish market. In order to identify best practice, the report will include a very brief discussion on other systems in the Nordic region. Practices in other countries might be studied for inspirational purposes, but will not be described in the report other than for benchmarking purposes. Other than this, the authors will not perform any analysis on external markets.

Third, the report will only analyze the implications of certain concepts from the DSO’s perspective. The concept will be explained from a comprehensive view; however, the applied analysis will only focus on factors with direct impact on the DSO and its operations.

Fourth, the report will only examine the information interfaces and the flow of information. As a result, the technological system requirements and implications will not be covered in the master thesis work. In other words, no physical flows will be examined. Furthermore, the report will not
examine any social complications or consequences. The report will cover some economic aspects, but it is not the focus of this research.

Fifth, the research of current and future process design and impacts on the DSO will be based on a case study on Vattenfall.

Finally, due to the legal requirement to unbundle, i.e. to separate “vertically integrated energy companies, resulting in separation of the various stages of energy supply chain (generation, distribution, transmission and supply)”(The Council of European Energy Regulators, 2013), the DSO, this report will not at all examine the implications for Vattenfall outside of Eldistribution.

5 Deliverables

In total, this master thesis resulted in four deliverables. During the course of the work, the master thesis project delivered a thesis proposal and a midterm paper. At the end of the master thesis, the authors handed in the final master thesis report and a summary of the most important findings in a powerpoint format.
Market Changes and Characteristics of the Swedish Electricity Market

This section of the report aims to provide a background of the Swedish electricity market, and some crucial market changing concepts such as Nordic retail market for electricity, Supplier Centric Model, Smart Grid, Third Party Access and to present important actors that have large impacts on the electricity market’s development. Readers who are well acquainted with these concepts may proceed directly to the methodology chapter.

6 Swedish Electricity Market

On the Swedish electricity market, it is important to understand that there is both a physical flow, and a commercial flow of electricity, which both impact the market. The physical flow (positioned right and down in the figure below) implies the electricity that is transported from the productions sites through the different levels of the grid to the end-users. The commercial flow of electricity (positioned top and left in the figure) implies the trade where the producers sell the electricity, directly or through a power exchange, to an electricity retailer, which finally sells it to the end user. This chapter of the report will cover important actors on the market that affect either of these flows, regulatory actors and the characteristics of smart grids and smart meters.

![Figure 1, Illustration of the Swedish electricity market (Svenska Kraftnät, 2013)](image-url)
6.1 Actors on the Swedish Electricity Market

This section of the report will explain briefly the different actors on the market.

The Transmission System Operator (TSO), in Sweden represented by “Svenska Kraftnät”, is a public utility, responsible for operating and managing the national grid as well as the overseas links (for 400 kV and 220 kV). The TSO possesses the overall responsibility for the power plants working together so that the state of balance between production and consumption of electricity is maintained throughout the country. On the open electricity market the TSO co-ordinates the economic and physical balance of electricity. In Sweden, the regional grid owners and producers pay grid fees to Svenska Kraftnät in order to be connected to the national grid.

The grid is operated by the Distribution System Operators (DSOs). The distribution system in Sweden consists of two types of grid with different voltage levels; regional electricity grids (40-130 kV) and local electricity grids (<40 kV). The regional grids are mainly owned by Vattenfall, E.ON and Fortum, while the local grids are also partially owned by smaller companies with local association. The DSO is responsible for distribution of electricity, including operation and power quality but also construction of new grids and connections to other grids. Furthermore, the DSO is responsible for measurements of the distributed electricity and to report the measured data to the end-user, suppliers and Svenska Kraftnät for settlement, billing and physical power trade. Distribution is a natural monopoly business, meaning that each end-user is only connected to one grid and consequently can’t choose their grid company. Furthermore, the DSOs are strictly regulated and supervised by the Swedish Energy Market Inspectorate. The Swedish Energy Market Inspectorate ensures that DSOs fulfil their obligations in accordance with the Electricity Act and that the DSO transmits electricity of good quality. If a DSO doesn’t meet its obligations the Swedish Energy Market Inspectorate can carry out inspections. Furthermore, the DSO business is highly regulated technically and financially. For instance, if a DSO doesn’t meet its requirements regarding good power quality, the DSO’s regulated revenue cap will be lowered and its profit will be affected (The Swedish Energy Market Inspectorate, 2014a).

The electricity retailer, also called supplier, has a supplier agreement with the consumer and can buy electricity from producers or from the Nordic power exchange, Nord Pool Spot. In the current market model the market for trading is restricted to Sweden.

The end users include everything from industries and private households to commercial buildings that are connected to and consume electricity from the grid. In the current market model the consumer must have an agreement with an electricity retailer to be able to buy electricity, as well as an agreement with the grid owner in order to transmit electricity on the grid. The consumer pays a grid fee for connection and transmission.

An electricity producer generates power, feeds electricity into the grid and finally sells it directly to consumers, electricity retailers or wholesale electricity markets (Nord Pool Spot Etc.) (Svenska Kraftnät, 2013).
6.2 Regulatory and Advisory Actors

Regulations have a large impact on businesses in the energy industry, and it is thus necessary to understand what regulatory actors, as well as which advisory actors, that should be monitored closely.

6.2.1 Regulatory Actors

The most important regulatory actor is The Swedish Energy Markets Inspectorate. Another actor that has a large impact on the Swedish energy industry is the European union. These actors and their responsibilities will be presented briefly in the following paragraphs.

The Swedish Energy Markets Inspectorate, in Swedish “Energimarknadsinspektionen”, makes sure that all enterprises follow the regulations on the market, but they also investigate new frameworks for the electricity market and deliver propositions for future improvements. (Swedish Energy Markets Inspectorate, 2013b)

The European Union is another important regulatory actor. Sweden, as a member of the EU, is committed to complying with EU legislation, i.e. the treaties and the legal instruments based on the treaties. Legal instruments in the form of directives are incorporated in the Swedish law. The Energy Efficiency Directive (2012/27/EU) and a number of other directives will have impacts on the energy industry in Sweden. The Energy Efficiency Directive is a framework of measures for the promotion of energy efficiency, where the access to customer metering data which should enable energy efficiency solutions, is one important aspect. (European Commission, 2014). Since the DSO today is responsible for the collection and storage of customer data, this directive is expected to have great impacts on a DSO.

6.2.2 Advisory Actors

In Sweden, the most important advisory actors are NordREG and Swedish Energy.

The far most important advisory actor is NordREG, short for “Nordic Energy Regulators” since it is an organization that connects the Nordic energy regulators in the Nordic region. Their mission is to “actively promote legal and institutional framework and conditions necessary for developing the Nordic and European electricity markets”(NordREG, 2012a). The cooperation applies to both knowledge sharing functions, analysis and development of reports and statements. In Sweden, NordREG is represented by The Swedish Energy Markets Inspectorate.

Swedish Energy, (Svensk Energi) is a trade association with the mission to represent their members’ interests in different context. Furthermore, Swedish Energy is involved in NordREG’s project towards a Nordic end user market through representation in work groups and the project steering committee. (Svensk Energi, 2012).

7 Nordic Retail Market for Electricity

The concept of a Nordic retail market is based around the proposition that customers should be able to buy electricity from any of the Nordic energy suppliers. To enable a common end-user market, there is a need for standardized processes and equality in regulations amongst the
participant actors in the region. Opening up the electricity market will increase the competitiveness on the market as operations across borders are facilitated. As a result of the standardized processes, the increased competition amongst suppliers and supplier's possibility to benefit from economies of scale, the efficiency on the market will be improved. In addition, the standardized regulation will facilitate automation for grid owners (DSOs and TSOs) and suppliers’ willingness to invest in e.g. renewable energy sources increase as regulatory risk is reduced. (NordREG, 2011). Consequently, the introduction of a Nordic retail market is believed to bring many benefits for the different actors on the market.

The first step towards a common Nordic end-user market was actually taken in the 1990’s when Norway, Sweden and finally Finland and Denmark deregulated their electricity markets. However, it was not until August 2005 the Nordic Council Energy Ministers set the first objectives of a common market and commissioned the Nordic Energy Regulators, NordREG, to coordinate the harmonization process. In 2012, NordREG decided that the market should be ready for partial and gradual implementation in 2015 and each of the Nordic countries should by then have introduced a supplier centric market model. Due to the fact that Finland’s government has not yet agreed to all the conditions proposed by NordREG, the introduction of a Nordic retail market is expected to be delayed until 2020. (Riksdag & Departement, 2013).

8 Supplier Centric Model

The supplier centric model is the name of a proposition of a new structure on the electricity market. The key features of the supplier centric model are that the supplier should be the customer’s primary contact point. In order to achieve this, combined billing will be implemented. In a supplier centric model, the customer will thus receive one invoice for both the electricity and the grid service as opposed to the current framework where two separate invoices are sent out; one from the grid owner and one from the supplier of electricity. Furthermore, the Swedish Energy Markets Inspectorate has suggested that the supplier of electricity should handle additional services such as moving processes. The goal is to decrease customer confusion regarding the responsibilities of grid owner and supplier, by establishing the supplier of electricity as the primary contact. However, in the first implementation step, the grid owner will continue to handle customer management in strictly grid related matters such as outage management, power of quality, new connection matters etc. (Swedish Energy Markets Inspectorate, 2013a).

The supplier centric model is expected to bring advantages of which the facilitation for the customer is one of the main benefits. Not only does the customer have one primary contact, but the unfavourable passive contract will also successively disappear as customers are forced to choose their own supplier when moving.

Furthermore, it is expected that a supplier centric model will be more efficient since customer service, IT-systems and competencies will essentially only be needed at the supplier. It also encourages development of new products and services, facilitates unbundling and clarifies division of responsibility between the grid owner and supplier of electricity. (Vattenfall, 2012).
As discussed in section 7, the supplier centric model is one of the cornerstones for full implementation of a Nordic end user market for electricity. In order to secure successful implementation of a supplier centric model, consideration must be taken with regards to credit risk and efficiency in operations. There are several suggestions for how such a model should be arranged to successfully meet these criteria. This matter will be examined in more detail in section 19.

9 Smart Grid

A transition to a sustainable energy system is crucial in order to tackle the challenge of climate change. This requires a fundamental transformation of both supply and demand side on the electricity market. Today’s grids need to be modernized in order to handle the future energy system and incorporate increased generation from renewable resources and distributed production. Furthermore, the grid must be adapted to enable active consumers, which are important to handle the balance between consumption and production. A modernized grid that handles the future conditions and operates in an efficient way is commonly referred to as a smart grid. In order to fulfil the requirements for smart grid smart meters with two-way communicating infrastructure is required. In the next section the roll out of smart meters in Sweden is discussed (Smart Region, 2012).

10 Smart Meters

Sweden was one of the first countries in Europe for a major rollout of smart meters. The roll out was conducted in two steps and was in both cases a result of legal demands. From July 2006 hourly metering for customers with a fuse description larger than 63 A (commercial and industrial Customers) is required and from July 2009 monthly metering for smaller customers with a fuse description less than 63 A is required. The policy objectives for the introduction of smart metering was to create incentives for energy efficiency and energy reduction, by providing consumers with a more comprehensive and accurate energy bill and enabling new contractual agreements. Despite only monthly reading is required for smaller customers, several DSOs have implemented smart metering technology that can handle hourly metering and provide this information to all of their customers (Smart Region, 2012). Furthermore the majority of the smart meters today are capable of two-way communication (NordREG, 2012b).

11 Third Party Access

At the same time as the supplier centric model’s implementation is discussed in Sweden, there are driving forces from EU-level and through the Energy Efficiency Directive that third parties should be granted access to the data collected by the DSO. According to the Swedish Energy Markets Inspectorate the purpose of third party access is to “open up the market for innovative new actors that might use the metering data to provide valuable services to customers”. Any access to data has to be authorized by the customer in order to ensure customer integrity. There are essentially three different ways data can be accessed; directly from the meter, from the DSO's local storage or from a centralized storage hub. (Swedish Energy Markets Inspectorate, 2011). Third party access will be discussed further when presenting different models of future information exchange models in section 21.
Methodology

This chapter covers the methodology and describes the research process, the embodied methods and the limitations of the research.

12 Research Process

The research process of this report was divided into five areas of research that corresponds to the five chapters discussed in the following sections; Introduction, Current processes, Supplier Centric Model, Analysis and Conclusion. The figure below illustrates the research process with the mentioned chapters.

The phases that are presented in the table will be described briefly in the following sections.

12.1 Introductory Phase

In the introductory phase of the project, the students conducted a literature review, defined research questions and delimitations.

Firstly, in order to establish common ground for the project, a summary of key concepts was written and supervisors from Vattenfall verified that the students’ basic understanding of project concepts and elements were correct.

Secondly, the authors of this report conducted a basic literature review in order to understand the problem and define the research questions, in close contact with supervisors at both KTH and Vattenfall. This phase was iterative; the literature review continuously provided the students with increased knowledge and the research questions were redefined accordingly. The adaption of the research questions further suggested new areas to explore in the literature review.
Finally, the discussions resulted in a thesis proposal with details on the definition of the problem and delimitations. The delimitations in particular was formulated in a very straight-forward manner of the type “this will not be included” in an effort to provoke supervisors to react if intended research areas was excluded. Supervisors from both KTH and Vattenfall reviewed the thesis proposal, and finally problem definition and delimitations was updated according to their notes when consensus was reached.

12.2 Current Processes
When the research questions had been defined and the authors of this report had established a basic understanding of the subject, the process of examining the current processes began. This research aimed to describe, understand and map the most important processes for a DSO in the current setting. The research was thus descriptive, defined as

"to describe phenomena as they exist; identify and obtain information on characteristics of the problem/issue”
(Collis & Hussey, 2009)

During the research phase of the current processes, the students understanding increased through a mixture of internal interviews, discussed in section 13.1.1 and a more thorough literature review. This research resulted in answering the RQ2(i);

- How would the processes be designed in a supplier centric model, and what are the obstacles of structuring processes in such a manner?

In order to answer RQ(ii.), a more thorough investigation of the supplier centric model was required, which will be discussed in the following section.

12.3 Supplier Centric Model
During this research phase of the project, the aim was to understand how the supplier centric model would be designed and implemented in Sweden. Initially, the authors of this report believed that this investigation of the supplier centric model would cover an already existing concept, and that the research would be descriptive. However, during the course of the project, it was discovered that there was an intense on going debate on the subject, and that few if any decisions had been made regarding the Swedish implementation. This research was thus exploratory, defined as

"used to gain an initial understanding where there is little or no existing knowledge”
(Collis and Hussey, 2009)

With these new insights, the research questions was redefined which resulted in the addition of RQ1:

- How will the supplier centric model be implemented?
In order to answer RQ1, the authors conducted external interviews, discussed in section 13.1.1.2. This investigation also benefited from information retrieved during the internal interviews, which was conducted during the research of the current processes discussed in section 13.1.1.1.

12.4 Analysis

During the analysis phase of this project, the report created a framework for analyzing future processes and impacts on the DSO. The process consisted of three parts; examine the future process and impacts related to supplier centric model and the transformation of future processes. This is illustrated in the figure below.

![Figure 3, Illustration of the framework for analysis](image)

The following section will explain the framework and the method for analysis.

12.4.1 Future Processes

The method for analyzing the future processes was designed to answer RQ2(ii.):

- How would the processes be designed in a supplier centric model, and what are the obstacles of structuring processes in such a manner?

In order to analyze the future processes, it was necessary to first examine the conditions on the future market. The explorative study of the supplier centric model discussed in section 16, provided the prerequisites of the future market, which was then applied to the current processes in Vattenfall’s organization in order to obtain the design of the future processes.

During the construction and analysis of future processes, the business processes were divided into two groups based on the outcome of the research of the supplier centric model.

The first group governed processes that will be included in the implementation of the Supplier Centric Model. Consequently, there are fewer uncertainties related to the future process design, and these processes could thus be analyzed by applying the supplier centric model directly on the current processes. For these processes, the analysis was further aided by some previous research and process design suggestions.
The second group included processes such as outage management and connections that are governed by high uncertainties since the suggestions for managing such processes in a supplier centric model have been highly criticized. For these processes, the report examined the process design in the scenario of supplier centric implementation and conducted a critical analysis regarding whether managing these processes in a supplier centric manner would be advantageous. In addition, the report examined potential obstacles to such an implementation.

12.4.2 Impacts of the Supplier Centric Model and Future Processes
The method for analyzing the impacts was designed to answer RQ3:

- How will a DSO be affected by the implementation of a supplier centric model?

The method for analyzing impacts was divided into two groups of impacts; impacts of the transformation of future processes and impacts of the supplier centric model.

Firstly, impacts due to changes in the DSO’s interfaces were evaluated. The analysis was carried out by identifying critical parts in the current business and how these would be affected by the transformation. In addition, the report examined what risks a DSO would be subject to in the new market model.

Secondly, the report assessed impacts of the changing market conditions as a result of a potential implementation of a supplier centric model.

12.5 Conclusion
Finally, the concluding phase of this master thesis project covered recommendations to Vattenfall, discussion and conclusion.

The recommendations to Vattenfall aimed to answer RQ4:

- What measures need to be taken in order to operate efficient in the future market?
  i. What actions need to be taken in preparation for a supplier centric model?
  ii. What opportunities of improvements exist in the current processes?

In order to answer these questions, the report assessed the different impacts as discovered during the analysis phase of this master thesis project. Disadvantageous affects were examined more thoroughly in order to establish recommendations that could offset the negative impacts on the DSO.

Finally, the report discussed the generalizability of the research and gave suggestions for future research. Afterwards, a conclusion was shaped based on the key findings of this report.

1 As understood by the authors of this report
13 Methods for Data Collection

This section of the report will examine the methods for data collection. Firstly, the report will examine the methods for interviews. Secondly, the methods for conducting the literature review will be assessed.

13.1 Methods for Interviews

In this section of the report, the method for selecting interviewees and the method for conducting interviews will be discussed.

13.1.1 Selection of Interviewees

The selection of interviews differs greatly between internal and external actors; therefore these will be discussed in separate sections below. In addition, a group interview was conducted during a seminar with numerous market actors.

13.1.1.1 Internal Actors

The method for selecting interviewees internally began with a list of subjects with expertise in different areas within Vattenfall that were suggested by the supervisor. These people composed the group of initial interviewees that the students met during the first weeks at Vattenfall. In order to efficiently identify potential interviewees, this initial group was asked to recommend new interviewees that had expertise in the areas where they themselves could not answer the questions posed during the interview.

13.1.1.2 External Actors

The method for selecting external interviewees consisted of two parts.

Firstly, potential subjects were identified in the problem definition phase when literature was reviewed through the making of a list of regulatory actors e.g.:

• The Swedish Energy Markets Inspectorate (Energimarknadsinspektionen, Ei)
• NordREG, Nordic Energy Regulators

Secondly, potential subjects were identified during the internal interview rounds, as interviewees were asked to recommend new potential interview subjects with expertise in e.g. Supplier Centric Model.

13.1.1.3 Seminars

Since there was an on going investigation of the future information exchange model when this research was conducted, it was necessary to get continuously gather information to ensure that the analysis was based on the latest updates. For this purpose, the students participated in a hearing where the consulting firm Sweco presented the finding that constitutes one part of the Swedish Energy Markets Inspectorate’s investigation of the future information exchange model. Many key actors on the electricity market participated in the hearing and the students retrieved important information and insights to the on going debate.
13.1.2 Interview Strategy
In general, the interview strategy of this master thesis consisted of three main components; a semi structured interview set up, unbiased questions and triangulation of results. These components will be explained briefly and justified in the sections below.

First of all, the chosen set up for interviews was semi structured, meaning that some themes and standardized questions are predetermined “but the interviewer may omit or add to some of these questions or areas, depending on the situation and the flow of the conversation” (Bradford University, 2007). This structure was chosen due to the fact that it allows for comparison of the results from different sources but still opens up to explore new topics (Collis & Hussey, 2009).

Secondly, the predetermined questions were phrased in an unbiased way in order to prevent interviewers perception from affecting the response. When interviewees were asked to define their information interfaces they were handed a blank paper and with the aid of questions designed to help their memory they were asked to draw the actors that they provided information to or received information from.

Finally, the interviews were constructed in a way that triangulation was accomplished. ”Triangulation is a method used by qualitative researchers to check and establish validity in their studies by analyzing a research question from multiple perspectives”. In the interview strategy, this master thesis mainly focused on triangulation of data, meaning “using different sources of information in order to increase the validity of a study”. (Guion et al., 2011)). In practice, the interviewees were given a graphic representation map of a process or the system as a whole, and were asked to validate or falsify the elements in the map and their relation to other elements. In addition, the interviewees were asked to add elements or relations that were missing. The authors of this master thesis report came up with this approach in order to reduce misunderstandings and ensure that no relations were forgotten in the process.

13.2 Method for Literature Review
This section of the report will discuss the methods for identifying and obtaining information for the literature review. Relevant information was retrieved in three ways.

Firstly, the authors of this report identified information online with the use of search engines such as Google and KTHB Primo. Keywords were “supplier centric model” and the Swedish equivalents “elhandlarcentrisk modell” and “leverantörcentrerad modell”, in combination with words such as electricity or grid in order to eliminate irrelevant results.

Secondly, as key actors such as NordREG and the Swedish Energy Markets Inspectorate were identified, the report proceeded to examine the documents available on their websites that might not have been discovered by the search engines.

Finally, during the interviews, the students also asked interviewees for additional information on the subject. This resulted in discovering additional reports that had not been identified in the search engine process.
14 Methods for Scenario Design
In order to perform an analysis of different scenarios, it was first necessary to decide what type of scenarios that would be evaluated in the study. This chapter will commence with examining theories on scenario design. Thereafter, the report will discuss the choice of scenario design for the analysis of the supplier centric model and the business processes.

14.1 Scenario Design Theory
The scenario design was constructed with the use of Börjeson’s (2006) mapping of scenario techniques. Börjeson et al (2006) has divided scenario design into three families; predictive, explorative and normative.

The first one aims to answer the question “What will happen?”, thus trying to predict the near future and typically investigate it in a quantitative manner. The second one aims to answer the question “What can happen?”, by exploring “situations or developments that are regarded as possible to happen, usually from a variety of perspectives”, typically in a qualitative manner. The third alternative is normative and aims to answer the question “How can a specific target be reached?” which is focused on investigating scenarios that will lead towards a predefined set of goals. (Börjeson, 2006).

This report will not examine the normative scenario design family further, since the analysis of the supplier centric model and the business processes both aim to understand uncertain future scenarios as opposed to a predefined set of goals, and therefore are mainly predictive and explorative. However, it is worth noticing that few scenarios are strictly predictive, explorative and normative but rather carry characteristics of several scenario design families. The predictive and explorative scenarios, however, will be examined briefly in the following sections.

14.1.1 Predictive Scenarios
Predictive scenarios are further subcategorized into two groups: Forecasts and What-if scenarios. The first responds to the question “What will happen, on the condition that the likely development unfolds?”. The latter on the other hand, aims to answer the question “What will happen, on the condition of some specified events?”. (Börjeson, 2006).

14.1.2 Explorative Scenarios
Explorative scenarios are divided into two categories; external scenarios and strategic scenarios. The first category of scenarios involves studies where the internal actors have little impact on the development of the scenarios e.g. when a new policy is implemented. The latter involves scenarios that are caused by internal decisions, and where the outcome of the study is an analysis of the internal implications of e.g. the introduction of a new policy. (Börjeson, 2006).

14.2 Predictive Scenarios in the Supplier Centric Model
When examining the different scenario designs, the study of the supplier centric model was best suited for a predictive scenario design study, since the research aimed to understand how a DSO would be affected by the market changes. According to Börjeson (2006), predictive scenarios “are primarily drawn up to make it possible to plan and adapt to situations that are expected to
occurs”, which corresponded perfectly to the aim of the scenario study of the supplier centric model. Furthermore, the chosen scenario design for the supplier centric model was defined as a Forecast since it will examine the market changes on the condition that a supplier centric model will be implemented in the future.

14.3 Explorative Scenario Design in the Business Process Investigation
When investigating the business processes, the chosen scenario design was explorative due to the fact that there is limited knowledge about the outcome of the future while the understanding of the present situation is well developed. In addition, the qualitative nature of the study is well suited for an explorative study. The business process analysis will be focused on explorative external scenarios, due to the fact that the potential implementation of a supplier centric is not an internal decision, but is highly dependent on the outcome of the regulatory investigations resulting from the implementation of a supplier centric model.

15 Limitations of the Research
The main limitation of this research results from the fact that the study focuses on one case (one DSO), which has unique conditions. Consequently, the conclusion might not be applicable for all DSOs. In order to get a wider perspective and to increase the generalizability of the research, the students performed external interviews as well as participated in a seminar where representatives from different DSOs expressed their opinions regarding important areas in the research.

Furthermore the research was limited to a time period of 20 weeks, carried out by two full time master students. Due to the time constraints, only a limited number of subjects within the different expertise could be interviewed, hence results might lack in generalizability internally. In order to increase the generalizability and decrease biased results, the students identified interviewees that had opposing views in different matters.
Supplier Centric Model

This chapter of the report is explorative and aims to answer research question one (RQ1);

- How will the supplier centric model be implemented?

In order to answer this question, the report will firstly examine which actors that have the decision-making power that can affect the outcome of the supplier centric model. Afterwards, the report will build on this knowledge and try to predict the outcome of the supplier centric model by examining numerous scenarios for identified key areas. Finally, the report will conduct a benchmark of three Nordic countries in order to understand the drivers for choosing different ways of implementing the supplier centric model.

16 Actors with Decision-Making Power

When it comes to the implementation of the supplier centric model, very few final decisions have been made. As such, there are numerous scenarios for how the model could be implemented in the future. In order to get a better understanding of the future scenario, it is crucial to understand what actors that influence the decision making process the most, and what other driving forces that have a large impact on the final decision. This section of the report will describe the decision making process and the actors with key impact on the final outcome.

The figure below illustrates the decision-making process with key influential actors:

Figure 4, Illustration of influencing actors in the implementation of a supplier centric model
The Nordic Council Energy Ministers are the initiators to a Nordic End User Market and commissioned the Nordic Energy Regulators, NordREG, to coordinate the harmonization process. However, NordREG is no supranational body (like EU) that can issue binding decisions and provide legislation through directives. Hence, NordREG can only promote legal frameworks and suggest how this can be implemented in the Nordic Countries. The Swedish Government is therefore to decide how recommendations should be managed in Sweden and have assigned The Swedish Energy Market Inspectorate to further evaluate and provide proposals for how recommendations issues by NordREG should be implemented in Sweden. Finally, the proposal by The Swedish Energy Market constitutes the foundation of the Swedish Governments final decision.

In addition, various stakeholders, such as industry organizations and consumer authorities have contributed with their expertise in the investigations that have been conducted by NordREG and the Swedish Energy Market Inspectorate.

In the subsequent sections NordREG’s and the Swedish Energy Market Inspectorate’s work are described in more detail. Thereafter, the report will discuss the current project status.

16.1 NordREG Coordination of Supplier Centric Model

The process towards a supplier centric model started in August 2005 when the Nordic Council Energy Ministers set the objectives for a development towards a common Nordic end-user market. At the same time they commissioned NordREG, the organization for the Nordic Energy Regulators, to coordinate the project. In the beginning of the project NordREG envisaged that the markets could be harmonized by 2010 (NordREG, 2006). However this was a very optimistic target and it was not until 2009 that NordREG had developed the first framework for how the market could be designed (“Market Design Report 3/2009”). In 2010 they published a new implementation plan, which suggested that the implementation should start in the beginning of 2014 and they also suggested that a Nordic end-user market should be based on a supplier centric model (NordREG, 2010). During 2011 NordREG focused on analyzing how a supplier centric model would affect the customer and what rights and obligations the DSO and supplier should have towards the customer in the new model.

In 2012 a new target market model was determined, and NordREG suggested that a supplier centric model should be implemented step by step, by redesigning key processes so that the supplier becomes the customers single contact point. The key processes identified by NordREG were: supplier switching (already supplier centric), moving process and combined billing. Furthermore, NordREG set up a new time frame and suggested that prioritized key processes should become supplier centric by 2015. (NordREG, 2012c). During the years of 2012 and 2013 NordREG issued recommendations of how the business processes should be designed and introduced in the Nordic Countries. However, many decisions related to this implementation were suggested to be made on national level, but with regards to the Nordic harmonization.
16.2 Swedish Energy Markets Inspectorate – Swedish Implementation

After NordREG had issued a recommendation of how the business processes should be designed the next phase was the implementation phase in each country. In Sweden, the government commissioned the Swedish Energy Markets Inspectorate to investigate this matter and propose a legal framework for the Swedish implementation. Their proposal was presented in the report “Enklare för Kunden-förslag som ökar försäkringarna för en nordisk slutkundsmarknad” and the recommendations were forwarded to the government in the summer of 2013 (Swedish Energy Market Inspectorate, 2013). However, respondents to the proposal argued that the investigation was insufficient and that analyzing impacts of a possible implementation is crucial (Svensk Energi 2013 & Vattenfall 2013). Furthermore the Swedish Better Regulation Council, i.e., the independent government-appointed committee of inquiry, rejected the proposal on the grounds that there was no basis for assessing administrative costs and the lack of consequence analysis (Regelrådet, 2013).

16.3 Current Project Status (May 2014)

The report “Enklare för Kunden” has been out for consultation since the summer of 2013, and the government is still (in May, 2014) evaluating how it should proceed in this matter, and it still uncertain when a proposition can be expected. (Hallgren, 2014).

One determining factor, that is still uncertain, is the how the information exchange should work in a supplier centric model. In the beginning of 2014 the government therefore commissioned the Swedish Energy Market Inspectorate to investigate this matter and to propose an appropriate information exchange model to the government by June 2014. The future information exchange model will be discussed further in section 21.

Consequently, when this report is written there are many aspects of the Swedish implementation of a supplier centric model that is unclear. However, it is evident that the success of the implementation is highly dependent on the support of stakeholders (NordREG, 2012b). One could therefore argue that stakeholders’ opinions will have a large impact on the decision making process regarding the supplier centric model’s implementation in Sweden. As a result, it will be difficult to reach a final decision before most actors in the industry have a somewhat consistent view of how the implementation should be done.

17 Processes Included in the Supplier Centric Model

As discussed in section 16 it is suggested that the supplier centric model will be introduced step by step, by redesigning business processes so that the supplier is the customer’s single contact point.

The changes will commence with transferring the moving process to the supplier. This will be followed by the implementation of mandatory combined billing. Thus, in the beginning of the implementation process, the supplier will handle new customer related processes. However, the DSO will still be responsible for the customer contact in strictly grid related issues, such as outage management, quality of supply and new connections.
In the scenario that the implementation of the first two processes is successful, the supplier might be given the task to manage more grid related processes as well. However, many of the most influential actors of the supplier centric model, such as NordREG and the Swedish Energy Markets Inspectorate have suggested that grid related issues should be excluded from the model. For instance, the Swedish Energy Markets Inspectorate stated that “the DSO will continue to independently manage customer contact during connections, outage management, quality of supply, compensation for damage and outage” (Swedish Energy Markets Inspectorate, 2013a). In addition, Gaia conducted an investigation on this matter and also recommended that grid related issues should be handled by the supplier centric model. However, the report also pointed out that the supplier could be the customers “first point of contact and then be guided to the proper service channel by the supplier”. Similarly, NordREG discuss the possibilities for a supplier to handle grid related issues on behalf of the customers as an additional and optional service (NordREG, 2013a).

In summary, it is certain that the moving process and mandatory combined billing will be implemented in a supplier centric model, and it can not be excluded that customer contact in some grid related issues, such as outage management and power quality, will be supplier centric in the future. (Loodin, 2014 & Callenberg, 2014).

18 Customers in the Supplier Centric Model
One aspect of the supplier centric model that is still uncertain is whether all customers will be handled in a supplier centric manner. Initially, it seemed that the Swedish Energy Markets Inspectorate suggested that all customers, including e.g. producers, would be handled in the same way. This would be highly problematic and inefficient, since producers and DSO’s for the local grid does not have suppliers. According to Marielle Liikanen from the Swedish Energy Markets Inspectorate, however, the supplier centric model is only intended to include customers that have a supplier. Still, there are on going discussions on whether large customers, such as large industries and customers connected to the regional grid should be included in the supplier centric model. This section of the report aims to highlight the different aspects of including or excluding such actors in the model.

18.1 Include all Customers
This section of the report will cover the advantages of including all types of customers in the supplier centric model. There are mainly two arguments in favour of this solution, and these will be discussed more thoroughly below.

First of all, some actors believe that the processes will be simplified by including all types of customers, which will result in higher efficiencies. E.ON. is one of the companies that support said suggestion since “It will result in uniform practices, which simplifies the processes and reduces costs” (Anders Berghman, E.ON., 2014). In addition, Oberoende elhandlare believes that “It is only when a process can be removed entirely that we will realize the entire potential of improving the efficiency”(Oberoende Elhandlare, 2013b).
Secondly, it seems that there have been difficulties in deciding where a potential line should be drawn between actors that should be included and excluded in the model. As a matter of fact, it seems that the absence of suggestions for where the line should be drawn is one of the main reasons why the Swedish Energy Markets Inspectorate suggested that all actors should be included (Marielle Liikanen, 2014). However, while the Swedish Energy Markets Inspectorate could not choose one over the other, there are mainly three suggestions for where the line should be drawn; exclude customers to the regional grid, exclude customers with a fuse larger than e.g. 63 A or exclude customers with an effect higher than a certain limit. (Marielle Liikanen, 2014) (Lennart Engström, 2014).

18.2 Exclude Large Industries

This section of the report will cover the arguments for excluding large industrial clients in the supplier centric model. There are mainly two problematic aspects with including large industries; the inferior expertise of the supplier and the obstacles to removing the billing system.

First of all, it might be difficult to include large industries in the supplier centric model due to their expertise and demand for information. Large industrial clients have very high costs for electricity and grid transmission, and as such, it is an important aspect of their profitability that this cost is reduced. As a result, they require more detailed information about their consumption, in order to correctly evaluate their costs for electricity. A standardized format for billing can provide large customers with actual metering values regardless of which actor that is responsible for the communication, however, it cannot be expected of the supplier to possess the expertise that is required in order to manage industrial clients. In addition, this requires an immense amount of information transfer between the DSO and the supplier, which might still not aid a customer service representative with limited expertise to answer the questions a well-informed industrial client could pose. Consequently, it seems that including large industrial clients in the supplier centric model would complicate and decrease the efficiency of the process for both suppliers and customers, not to mention the quality of the service to industrial clients.

Secondly, one argument in favour of including all customers, which would not apply to customers to the regional grid, is that the billing and customer management system at the DSO side could be eliminated completely. In the case of Vattenfall Eldistribution, the customers to the regional grid are managed in a separate system from the local grid. As discussed in the introduction to section 18, it has already been decided that producers and DSO’s of the local grid will not be included in the supplier centric model, and since such clients are managed in the system, it will not be possible to eliminate the system entirely. As a result, the intended gains of this model will not be possible to be realized. In addition, in the case of Vattenfall Eldistribution, there are only in the order of magnitude of 200 customers, as such it does not constitute the masses of customers. Consequently, it seems that it the drawbacks by far outweigh the advantages, and it is recommended that customers to the regional grid should be exempted from the supplier centric model.
19 Contract Models
The supplier centric model will significantly change the responsibilities of the DSO and the supplier and their obligations towards each other. This requires a new model for contractual agreements. This section of the report will firstly inform the reader about the two ideologies of contract models. Secondly, it will assess the Subcontractor model and the Power of Attorney model that have been suggested as alternatives for the contractual agreements between the DSO and the supplier in the supplier centric model.

19.1 Ideological Context of Contract Models
When this report examined contract models, it found that there were to ideologies related to contractual agreements. These are the “Dual contact point model” and the “Single contact point model” and this report will commence by explaining these concepts. Afterwards, the report will discuss the ideological context of the two suggested models.

The dual contact point model entails that the customers have separate agreements with the DSO and the supplier respectively. The grid contract governs the relationship between the customer and the DSO, while the power trading agreement governs the relationship between the customer and the electricity supplier. Thus, from the customers’ point of view, these actors provide two separate services. Sweden currently has a dual contact point model, and is thus close to the ideological extreme end of the theoretical scale of contractual agreements.

The opposite extreme end is the single contact point model. In a single contact point model the customer’s only contact is the supplier regarding all matters, and it is common in numerous other industries such as telecom and railway infrastructure.

The two contract models that have been suggested are both “Supplier Centric”, in other words, they both entail a slightly more supplier focused customer contact. In an ideological context, these models neither belong to the dual contact point or the single contact point ideology, but are a combination of the two. The subcontractor model is closer to a single contact point model, whereas the power of attorney model is closer to the dual contact point model (Sjöberg, 2014).

The figure below describes the relationship between the models and the ideologies.
Which contract model that is chosen in the implementation of a supplier centric model will have a large impact on the design of business processes and the DSO’s role and responsibilities. These aspects will be discussed for the subcontractor model and the power of attorney in the following sections.

19.2 Subcontractor Model
In a subcontractor model the customer signs a contract with the supplier, governing both energy supply and grid services. Consequently, the customer will only receive one invoice, and has no obligations or contractual agreements with the DSO. This means that the supplier is also responsible for debt collection in the scenario that the customer fails to pay the bill.

In order to manage the responsibilities between the DSO and the supplier, a separate contract is signed related to the obligations of the parties towards each other. The DSO charges the supplier for the grid services on a monthly basis as if the service was provided to the supplier and not the customer. The figure below illustrates the contractual agreements, payments and the invoicing between these three actors in the subcontractor model.
19.3 Power of Attorney Model

In a power of attorney model, the customer signs a contractual agreement with both the DSO and the supplier. Each customer will thus have two agreements with two different actors. However, the supplier will manage the invoicing procedure, and the customer will only receive one bill for the two services.

However, despite the fact that the customer only receives one invoice, the different services and their charges will be presented in two separate sections on the invoice, which allows for the customer to identify how much he/she pays for each service. The supplier thus has the responsibility of forwarding the grid fees from the customer, to the DSO. In addition, the supplier is responsible for the customer service regarding the invoice and payment terms.

Legally, however, the bill can be seen as two separate invoices and if the customer doesn’t pay, the DSO and the supplier are responsible for their own debt collections.

The figure below illustrates the contractual agreements, payments and the invoicing between these three actors in the power of attorney model.

![Figure 7, Power of Attorney Contract Model](image-url)
## 19.4 Comparison of the Two Models (Gaia, 2013)

<table>
<thead>
<tr>
<th></th>
<th>Sub Contractor Model</th>
<th>Power of Attorney Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Principle</strong></td>
<td>• Supplier bills customers and buys grid services as a commodity from the DSO.</td>
<td>• Supplier bills customers on the behalf of the DSO. Combined billing, but legally the invoice is two separate invoices.</td>
</tr>
<tr>
<td><strong>Contract Principle</strong></td>
<td>• One contract for both energy delivery and grid use between supplier and customer.</td>
<td>• Both supplier and DSO have a legal contract with customer for energy delivery and grid use respectively.</td>
</tr>
<tr>
<td></td>
<td>• A contract between DSO and customer regarding the grid connection is still required.</td>
<td>• Standard agreements terms between DSO and supplier to regulate their relationship.</td>
</tr>
<tr>
<td><strong>Debt Collection</strong></td>
<td>• Conducted by the supplier</td>
<td>• Conducted separately by the supplier and DSO</td>
</tr>
<tr>
<td><strong>Producing Billing Information</strong></td>
<td>DSO (or hub) produces the billing information for the DSO-services <em>per customer</em>.</td>
<td>DSO (or hub) produces the billing information for the DSO-service <em>per customer</em>.</td>
</tr>
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<td></td>
<td>DSO (or hub) produces the aggregated DSO billing information for billing the supplier.</td>
<td>DSO retail billing information, which includes detailed information on tariff, energy, and other payments is made available to the supplier.</td>
</tr>
<tr>
<td></td>
<td>DSO retail billing information, which includes detailed information on tariff, energy, and other payments is made available to the supplier.</td>
<td>Supplier produces retail billing information for of energy services.</td>
</tr>
<tr>
<td></td>
<td>Supplier produces retail billing information for energy services.</td>
<td>Supplier combines the grid and energy billing information and produces an invoice which includes both grid and energy charges but remains two separate invoices legally.</td>
</tr>
<tr>
<td></td>
<td>Supplier combines the grid and energy billing information and produces an invoice, which includes both grid and energy charges.</td>
<td></td>
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</tbody>
</table>
19.5 The Contract Model Debate
The two suggest models have been commented by numerous market actors. This section of the report will present the arguments of key stakeholders in the recent debate.

Firstly, this matter was investigated by Gaia consulting as an assignment for NordREG. Their conclusion was that the subcontractor model is superior to the power of attorney model from a legal perspective when combined billing is mandatory, and that the subcontractor model should thus be used in the implementation of a supplier centric model (Gaia, 2013).

Secondly, the Swedish Energy Market Inspectorate suggested a hybrid solution in their proposal “Enklare för kunden”, where the model is based on a power of attorney model with the modification that the DSO do not have any rights to require payments from the customer and conduct debt collection (Sjöberg, 2014, Vattenfall 2013 & Stawström, 2014).

Third, the responses to “Enklare för kunden” showed that the market actors seem to agree that the subcontractor model is preferred over the power of attorney model. None of the actors actively supported the power of attorney, while several respondents (Vattenfall, E:ON, Juridiska Fakultetskansliet, Svensk Energi, Sveriges Advokat Förbund, Bixia, Oberoende Elhandlare, 2013) explicitly stated that they supported subcontractor model. The advantages of a subcontractor model are that it has clearer division of responsibilities between the DSO and the supplier, but also that it is more straightforward and easier for the customer to understand. Furthermore, the power of attorney model has been accused of being complex regarding payment tracking, correction- and debt collection processes, when both the supplier and DSO are legally responsible for their own bill. As a result, this model is expected to be highly inefficient and costly (Gaia, 2013).

In addition, a few stakeholders (E:ON, Bixia, Oberoende Elhandlare, (2013)) further suggested that the extremer alternative of a single point contact model, where the customer’s only contact is the supplier, would be advantageous in the future. Their main argument is that such a solution would be significantly more customer friendly than a solution where the supplier would forward the customer to the DSO. In addition, they argue that many customers will ask the supplier regarding all matters in any case since they do not understand the division of responsibilities.

Even though the sub-contractor model seems to be the best solution for a Supplier Centric Model, NordREG has not issued a definite recommendation, but has decided that each country should choose the most advantageous solution depending on the prerequisites in the region. (NordREG, 2013a).

20 Credit Risk in a Supplier Centric Model
The introduction of a supplier centric model will result in an increased credit risk for the DSOs. In this part of the report this matter will be discussed in more detail. Firstly, the reader will be informed of why the credit risk will increase in a supplier centric model. Thereafter, tools for managing the increased risks, together with stakeholders’ opinions regarding this matter, is presented.
20.1 Increased Credit Risk in the Supplier Centric Model

In the current market model the DSO’s claims are distributed between many end-customers. Furthermore, the DSO has the right to shut off the power to a customer that fails to pay its debt. In a combined billing structure, however, the credit risk will change since the customer is not in debt to the DSO and the customer, but the customer is in debt to the supplier, and the supplier is in debt to the DOS. Consequently, the credit risk of a DSO is moved from all end-customer, to a counterparty risk towards the suppliers. As a result, the DSO will be subject to a higher credit risk, since DSO’s claims will be distributed amongst a few suppliers as opposed to hundreds of thousands of end-customers. In the scenario that a supplier becomes insolvent, there will be significant financial impact on the DSO. As a result, the DSO will therefore be highly dependent on the collection abilities and financial stability of the suppliers. In addition, if the supplier’s debt collection is inefficient, the payments to the DSO might be delayed, hence the DSO’s cash flow will be reduced and it will induce liquidity costs for the DSO (Vaasa Ett, 2013).

20.2 Tools for Managing the DSO’s Increased Credit Risk

There are different tools for managing the increased credit risk and for protecting the DSO from insolvent and unserious suppliers. One option is to demand financial securities from the suppliers. Another alternative is to introduce a supplier licensing system. Finally, a regulation that withdraws the supplier's right to deliver electricity can protect the DSO from forfeiting revenues when a supplier defaults in payment. These three aspects will be discussed in the subsequent sections.

20.2.1 Financial Security from the Supplier

There are mainly two alternatives for financial securities that aim to protect the DSO. Firstly, it has been suggested that suppliers should be required to obtain credit insurance for its claims. Secondly, mandatory collateral requirements are commonly used for financial security on the electricity markets. For example, the Nord Pool requires all members to post a collateral in a common pot as a guarantee that they can pay for the contracts they have entered into (Nord Pool Spot, 2014). Collateral requirements can for example be provided by cash deposits or bank guarantees. Furthermore, requirements could be set up for all suppliers equally or based on the credit worthiness of the supplier (Gaia, 2013).

There are different opinions among stakeholders regarding the question of financial security. Svensk Energi (2013) argues that a mandatory financial security is necessary. They argue that combined billing in combination with a limited opportunity from the DSO to require financial securities would create a possibility for unserious suppliers to establish on the market with the purpose to discontinue their activities without paying their receivables to the DSO. The Swedish Energy Market Inspectorate (2013) argues that a mandatory financial security would have a negative affect on the market competitiveness, which would induce extra costs and potentially create barriers to entry on the market. However, they advocate that a DSO could require a reasonable safety when they have reason to believe that a supplier will not meet their obligation towards the DSO. Furthermore, Oberoende Elhandlare (2013) is against any kind of financial security that will induce extra cost and increase the costs for electricity. Instead they advocate a Supplier Licensing System.
20.2.2 Supplier Licensing System
A licensing system can be introduced to protect the DSO from insolvent and unserious suppliers, and involves specific requirements that a supplier has to meet when entering the market. The initial requirement could be of both technical and financial character. One advantage of a licensing system is that it would constitute an initial filter that prevents unserious suppliers from entering the market. However in order to work efficiently, the supplier must be monitored continuously to verify that it meet the requirements. In addition, in the scenario that a supplier does not meet the requirements the supplier could be forced to leave the market (Swedish Energy Market Inspectorate, 2013).

20.2.3 Regulations of Terminating a Supplier's Right to Deliver Electricity
In the current model, the DSO has the right to shut off the power to a facility in the case of defaults in payment. Hence, most customers pay their receivables. In a model where the supplier is in debt to the DSO, the situation is different. Instead, if a supplier doesn’t pay its debt to the DSO the suppliers right to delivery electricity will be terminated and the customers will be transferred to other suppliers. However, to limit the time the DSO has to wait for payments it is crucial that there are well-functioning regulations that govern this procedure.

The practical implementation of such a regulation must be investigated thoroughly, and currently, many factors are still uncertain. One aspect that has been discussed intensively is which actor that should be able to withdraw a supplier’s right to deliver electricity.

The Swedish Energy Markets Inspectorates suggest that the DSOs should have the right to withdraw the supplier’s license to deliver electricity if the supplier fails to pay its receivables (Swedish Energy Markets Inspectorate, 2013). However, EON, Svensk Energi, Fastighetsägarna, Bixia and Oberoende Elhandlare (2013) argue that an authority must make such a decision, and the Swedish Energy Market Inspectorate has been suggested for the task. There are mainly two arguments for this:

Firstly, the actors argue that a DSO cannot make such a decision, since it can be part of an organization with competitive supply activities. Consequently, one market actor could shut out another market actor, which could harm the competition on the market.

Secondly, Svensk Energi argues that small DSOs might not be able to make such decisions, since it could induce a costly dispute between the DSO and the supplier. However, it is important to notice that an authority process could be a long dispute and could result in a long time of forfeited payments for the DSO (Sjöberg, 2014). In order to mitigate the risk for the DSO, Svensk Energi have suggested a common financial pot, from which the DSO can retrieve the forfeited payments during the authority process.

20.3 Conclusion of the Credit Risk Discussion
There are many aspects regarding the increased credit risk that has to be solved before introducing a supplier centric model with combined billing. Financial requirements, where suppliers have to pay significant amounts will lead to higher barriers to entry. However, if no financial security is required and a supplier become insolvent this will have a great impact on the
Section 32.2 examines the credit risk that Vattenfall Eldistribution will be exposed to in the scenario of a supplier centric model.

**21 Information Exchange Models**

The current information exchange system between the electricity market actors is not prepared for a supplier centric model and the future requirements on the market. In section 21.1 the current information exchange model is presented. In section 21.2 the report discusses why it is necessary that the information system is transformed. In section 21.3 different options of shared information systems are presented and discussed.

### 21.1 Current Information Exchange Model

The current information exchange model on the Swedish electricity market is based on a “point-to-point”-communication. The DSOs are responsible for the collection of metering data and for the distribution of the metering data to other actors on the market. Metering data has to be reported to balance responsible parties and the system responsible party (Svenska Kraftnät). In addition, the metering values are reported to the customer’s supplier for billing. In order to make the metering activity more efficient many DSOs have chosen to outsource this activity. Two of the biggest companies are Tieto and Reijlers that manages 75% of all metering points in Sweden. Furthermore, the original data regarding a customer and the customer’s metering point is stored in each DSO’s system. The DSO is therefore the authoritarian source for information that is needed in order to execute the electricity markets business processes. The “point-to-point”-information system is illustrated in the figure below.

![Figure 8, Illustration of the current "point-to-point" information exchange model](image)
21.2 Requirements of a new Information Exchange Model

The current information exchange model is not adapted for a supplier centric model, since information that suppliers need, such as the customer’s metering point-ID, is stored in the DSOs’ systems. Furthermore, the flow of information exchange is not quick and flexible enough. Other reasons for redesigning the current information model are; an increased demand for energy services and requirements for third party access. Hence, a flexible and secure solution for accessing customer data is one important factor when designing the future information exchanged model (Swedish Energy Market Inspectorates, 2014). This aspect will be discussed further in the section below.

21.2.1 Access to Customer Metering Data

In parallel to the discussions of a supplier centric model, the Swedish market actors work to develop a smart grid system, where accessibility to customer metering data is one of the key features. Customer data is important for enabling actors to develop and offer innovative energy service solutions, which is also a tool to achieve energy savings (NordREG, 2013b). Furthermore, customer data is required for enabling demand response, i.e., changes in customers’ normal consumption patterns in response to changes in the electricity price. A change in electricity consumers’ patterns should in the long term conspire to avoid capacity peaks, which would even out the consumption and reduce the volatility of such. As a result, the fossil fuel based energy production could be decreased (Swedish Energy Market Inspectorate, 2014b). Creating a well-functioning information exchange model for data and information is therefore crucial for enabling energy service solutions and to meet requirements from Energy Efficiency Directive, EU-regulations and reach the climate goals (NordREG, 2013b).

21.3 New Information Exchange Models

The Swedish Energy Market Inspectorate is commissioned to investigate and propose a future model for information exchange. In the model proposition it should be defined what data that should be communicated between operators, where data should be stored and how the data can be made available to different market actors. The proposal will also discuss the appropriate distribution of responsibilities between the electricity market participants and to what extent the model should be regulated. The proposal should be handed to the government on the 13th June 2014, hence, when this report is written it is therefore not decided how the model will be designed (Swedish Energy Market Inspectorate, 2014).

At the moment, the Swedish Energy Market Inspectorate is evaluating the option of developing the current “point-to-point”-information exchange model and the option of introducing a centralized data hub with centralized data storage. For the investigation they commissioned the consulting company Sweco to perform a cost-benefit analysis of the two models.

However the big market players (Vattenfall, Fortum and E:ON) is advocating a service hub, which is based on decentralized storage but with centralized functionality. The three solutions are presented in the subsequent sections.
21.3.1 A Centralized Data Hub

A central data hub is an information exchange model where all data that are exchanged between the actors are stored in a central database.

In the figure above an overview of the information flow and functions of the hub is presented. As illustrated in the figure the hub is the central point for the information exchange between the electricity market actors. The responsibilities for the data in the hub are distributed between the market actors. The DSO is responsible for defining all metering points with metering point-ID and other Basic Data regarding the metering point and to deliver metering values that are required for billing and balance settlements etc. The supplier is responsible of registering and updating data regarding the customer and Structure Data related to the supply of electricity.

One important aspect of centralized data hub is that original data regarding the metering point and the customer is stored in the hub instead of in each DSO’s system as in the case today. The hub is therefore the authoritarian source of information instead of the DSO.

The data hub enables two interfaces for accessing the stored information: A Web Service-interface and an Actor’s Portal. The Web Service Interface could be used by the actors’ local systems to retrieve information from the hub and to request services such as calculations and to present metering data for customers. The Actor’s Portal Interface enables an alternative for actors to handle tasks directly in the hub in case of disruptions in the actors’ local system. Furthermore, this interface enables new actors to establish themselves on the market without the need to establish systems of their own in advance. This interface could also allow for direct access to customer data for customers and third parties with customer’s approval without the need to
contact the supplier. Furthermore, business processes that requires information from the DSO’s system can be automated with the use of the functions in the data hub (Sweco, 2014).

21.3.2 Developing the Current “Point-to-Point” Information Exchange Model

Instead of introducing a central hub, the current model can be developed to enable the information exchange a supplier centric model requires and support the changes of the current business processes. An overview of the proposed development of the current information exchange model is presented in the figure below.

![Diagram of point-to-point information exchange model with a name service](image)

Figure 10, Illustration of “point-to-point” information exchange model with a name service

In the “point-to-point” model, the original data regarding the metering points, and who is supplier and balance responsible for each metering point is still stored in each DSO’s database.

To meet the minimum requirements for a supplier centric model where combined billing is mandatory, the current system (EDIEL) has to be complemented with new messages, which exchanges information regarding the combined billing. Furthermore, the system has to be adjusted so that suppliers can initiate and manage the new moving process where the supplier is the single contact point. To ensure flexible business processes such as moving it is preferable that a supplier can identify the customer’s metering point-ID. One solution could be a name service, similar to the Norwegian NUBIX, where a supplier can find a customer’s metering point-ID.

21.3.3 Service Hub- Decentralized Storage System with Centralized Functionality

A number of actors express that a central database solution is old-fashioned and that there is a general evolution towards more decentralized solutions. Experts argue that pushing information to a centralized server in advance would increase the loads and the vulnerability of the system. They therefore argue that the future exchange model should be based on a “pull” model rather than a “push” model, in order to decrease information flow and reduce the risk of overloading the system.
Vattenfall, E:ON and Fortum are advocating a service hub based on decentralized storage but with a centralized functionality (Callenberg, 2014 & Sweco, 2014). This model is illustrated in the figure below.

The model implies that the original data is stored in each DSO’s system (as in the current setting) but suppliers can request data and other information from a DSO through a central access server. The requested data is thereafter sent with the current information exchange protocol. The Service Hub can also constitute an interface for third party access. (Sweco, 2014).

However, Sweco (2014) argue that a decentralized solution with the same functionality as a central data hub is relatively untested and therefore a bigger risk.

21.3.4 Comparison and Discussion of Information Exchange Models
In this part of the report the models are discussed and compared to each other. The discussion is divided in the aspects: Market Condition, Flexibility, Neutrality, Access to metering data and Cost Benefits.

21.3.4.1 Market Conditions
One could argue that a centralized data hub solution, similar to the Danish and Norwegian hubs would be the natural choice, since this would simplify an integration of the Nordic electricity markets. However, it is important to notice that in Denmark, there was no functioning system for storage and exchange of data, and automatic reading had not been introduced previously. Investing in a centralized data hub solution was thus a natural choice to establish a pain free information sharing system. In contrast, Sweden has a well-functioning system and many experts argue that the current system with decentralized storage can be developed to handle the increased information exchange that a supplier centric model will induce (Callenberg 2014, Öhnell, 2014).
21.3.4.2 Flexibility due to Market Changes
There are different views of how flexible the different models are for changes and to meet future requirements on the market. Experts argue that a centralized data hub is less flexible for changes and that there is a risk for long lead-times when changes in the system are required. It might also limit a DSO that wants to offer additional information that is not required by the regulation and/or the data hub is not originally designed for, e.g. hourly/quarter values and quality of electricity data. This is possible in the case of decentralized systems (Callenberg, 2014).

However, a central hub offers flexibility due to the temporal decoupling between the actors connected to the hub. Hence, separate communication interfaces can be implemented for the DSOs and the suppliers. As a result, new communication requirements for the DSOs do not necessarily have to imply a change for the suppliers (Sweco, 2014). However a centralized hub is still not flexible for a single DSO that wants to offer additional services.

21.3.4.3 Access to Metering Data
One of Sweco’s main arguments for recommending a centralized data hub is that it would simplify the access of customer metering data for both suppliers and energy service providers/third party actors, since data is collected in one place and actors do not need to contact each DSO. It is also argued that a central data hub would improve the competition and neutrality on the market, since all actors will be handled in the same manner (Sweco, 2014). However, one could argue that a service hub could enable for competitiveness and neutrality equally well since the actors can request data from a centralized hub, and regulations could force the DSO to provide requested data within a timely manner.

21.3.4.4 Costs in Information Exchange Models
The initial costs for both a centralized data hub and a service hub is higher then a simple development of the current “point-to-point” model. However, in the long run the most cost-effective solution is the model which best simplifies the actors’ work on the electricity market. Hence, a well functioning model is a key factor for reducing costs for the actors and, in the end, the customers.

22 Benchmark of the Nordic countries
In this section of the report, a summary of the countries’ progress towards a Nordic retail market will be presented for Denmark, Norway and Finland.

22.1 Denmark
In Denmark a new market model called “wholesale market model” will be applied from 1st of October 2014. The new model implies that the customer has one single contact point; the supplier. The supplier will be the only market participator that has a contract with the customer and it will purchase the DSO’s services at the wholesale market. In Denmark it is likely that the DSO will be responsible for the task to measure e.g. the consumption of electricity. The model implies that each DSO will be in contact with a large amount of suppliers and in order to simplify the information exchange, Denmark has decided to implement a centralized data hub. The Danish TSO, Energinet.dk will be responsible for the operation of the hub. All active suppliers
on the Danish electricity market have to be connected to the hub and it doesn’t imply any direct costs for the supplier. The hub is financed by Energinet.dk and by revenues from the national grid tariffs. In the new model, the liability of taxation will be moved from the DSO to the supplier. In order to handle the new credit risk a special foundation functioning as insurance will be established. All suppliers acting on the Danish electivity markets will be obliged to be connected to this insurance.

22.2 Norway
In Norway the customers on the current market have two contracts, one with the DSO and one with the supplier. The work towards a common Nordic electrical market in Norway is focused on redesigning the business processes so that the customer will only have to be in contact with the supplier in the processes. One example of a process that will be taken over by the supplier is the supplier switching process. There are discussions on including the combined billing process, however, no formal decision has yet been made. Another question that has been a hot topic for quite some time for the Norwegian TSO is the management of information. It has been decided that smart meters should be rolled out no later than 2019, and that a hub-solution will be needed in order to utilize the new information from the smart meters. The Norwegian TSO, Statnett are responsible for developing the hub and the Danish hub-solution will be used for benchmarking purposes when designing the Norwegian solution. The hub should be in operation no later than 1st of October 2016.

22.3 Finland
In Finland, the current market model is based on two contracts with the customer, one with the DSO and one with the supplier. Finland’s government has not yet agreed to all the conditions proposed by NordREG. However the Finnish TSO, Fingrid are responsible for the information exchange at the Finnish electricity market and is currently evaluating benefits of a hub information model (Swedish Energy Market Inspectorate, 2013).

23 Summary of the Supplier Centric Model
In summary, this chapter of the report has examined and answered RQ1:

- How will the supplier centric model be implemented?

In total, this report concludes that it cannot be determined with certainty that the supplier centric model will be implemented in a certain manner in Sweden. The majority of the key aspects are subject to intense discussions and it is far from guaranteed that the supplier centric model will be implemented in the first place.

In the scenario that the supplier model is implemented, this report has concluded that the moving and billing process will be supplier centric. Furthermore, it is likely that the subcontractor model will govern the contractual agreements. In addition, it is improbable but not impossible that customers to the regional grid and grid related processes will be excluded from the supplier centric model.
Finally, this report has concluded that the questions that are subject to the greatest uncertainties, and the most intense ongoing discussions, are the matters of credit risk and shared information model. These are critical for the implementation of the supplier centric model, and there is a risk that the entire concept will be discarded if consensus cannot be reached in these matters.
Business Processes

In the previous chapter, the reader gained an understanding of how the supplier centric model could be implemented in Sweden. This chapter will examine the business processes in a DSO’s organization in order to answer research question two;

- How will a DSO’s information interfaces transform if managed in a supplier centric manner? (RQ2)
  
  iii. How are the processes designed currently?
  iv. How would the processes be designed in a supplier centric model, and what are the obstacles of structuring processes in such a manner?

In order to answer these questions, the report will firstly examine the current processes in Vattenfall Eldistribution’s organization. While the processes in this chapter are based on a case study on Vattenfall, it is expected that many of the DSO’s have processes that are structured similarly due to the strict regulations related to the monopoly activities.

Secondly, the report will examine the future processes in a DSO’s organization. The discussion differs from two categories of processes. The first category covers the moving process, the reconnection and disconnection process, and the billing process that constitute the introductory processes in an implementation of the supplier centric model. Consequently, these will be discussed on the basis of the conclusion of the supplier centric model presented in section “Supplier Centric Model”. The second category covers processes that will not certainly be included in the model, such as outage management and connections, covered in sections 27–30. These processes will be discussed from a critical perspective that assesses the obstacles to and advantages of making these processes supplier centric.

Disclaimer: The process charts and information that is presented in the following chapters aims to provide an overview of mainly the information interfaces with external actors. As such, it also focuses on an average scenario and does not take deviations into account. Consequently, the processes are highly simplified, and internal communication are much more complicated than illustrated in this report. In particular, information is commonly sent back and forth between different departments in the organization before a task is finalized. However, for the purpose of providing an overview of the external communication interfaces, the information in the following chapters should be valid.
24 Moving Process
In this section of the report, the current moving process and how the moving processes will be designed in a supplier centric model is discussed. The processes and the information that is presented below is a result of interviews with and verification by Christina Loodin (2014).

24.1 Current Moving Process
In the current moving process, the DSO is the main contact point and has the main responsibility for managing the process. The customer needs to sign a grid agreement with the DSO before he/she signs a supply agreement. Furthermore, the DSO possesses all required information about the customer’s metering point that is needed to continue the moving process. The DSO is also responsible for the metering, sending the metering values to the supplier, and to physically reconnect and disconnect the customer’s metering point. The current moving process can be divided into two separate business processes: moving out from a consumption place and moving in to a consumption place. The Electricity Act governs the moving process and the industry has defined a standardized procedure for the information exchange (Ediel-messages). The following chapters will describe both the moving in and moving out processes.

24.1.1 Current Moving Out Process:
The chart below illustrates an overview of the current moving out process. The tasks included in this process will be described in more detail in the following sections.

24.1.1.1 Customer contacts current DSO and informs about the move out
The moving out process starts when the customer informs the DSO about the move by calling customer service, using My Pages or filling out a form and sending it by mail, email or fax. The customer should provide the DSO with name, personal identification number, move out address, and date of move out. Preferably, the customer should also provide apartment number, metering point-ID and area-ID, in order for the moving out process to run smoothly. The DSO receives the information and registers the move in the system. Furthermore, the DSO sends a
confirmation with the date of moving to the old supplier (EDIEL-message). The customer’s supply agreement is automatically terminated when the supplier receives the information of the move out from the DSO. The DSO also sends a confirmation to the customer about the date that has been registered as the moving out day.

24.1.1.2 Send metering values and special specification
At the registered move out day the DSO reads the customer metering values and in the end of that month, the DSO sends the customers metering values to the supplier. Finally, both the DSO and the supplier send a final specification to the customer. If no new customer is registered on the metering point the DSO could disconnect the unit. In practice, when and if a DSO disconnect a metering point differs greatly between the DSOs in Sweden. Dis- and Reconnection will be discussed further in section 25.

In a case where the customer doesn’t inform the DSO about the move out, the contract and delivery of electricity continues until a new customer informs the DSO about a move in at the address.

24.1.2 Current Moving In Process
The process chart below illustrates the current moving in process. The different process tasks will be described in more detail in the following sections.

![Diagram of current moving in process](image)

Figure 13, Illustration of current moving in process

24.1.2.1 Customer contacts the new DSO with information about the move in
The customer contacts the new DSO through the customer service or homepage and informs about the move in. The customer service registers the move in and updates the customer information in the systems. If the customer has contacted the customer service by phone, the customer service’s representative also informs the customer that he/she needs a supply agreement. Depending on whether the customer contacts a supplier and a supply agreement is established or not, the procedure continues as follows:
24.1.2.2 If supplier agreement is not signed
If the DSO hasn’t received a confirmation (Ediel-message) from a supplier that the customer has signed a supply agreement at the move in date, the DSO provides the customer with an assigned supplier, with a passive contract. After the move in the DSO is obliged to inform the customer which supplier company that is responsible for delivering electricity at the metering point and the date of the start of delivery. Furthermore the DSO sends a confirmation to the assigned supplier and metering values for billing information. Furthermore, the unit is reconnected if necessary.

24.1.2.3 If a supply agreement is signed
If the customer has signed an agreement with a new supplier (or potentially “resigned” the agreement with the customer’s old supplier) the supplier sends information about the move in to the DSO (Ediel-message). The DSO validates the customer information, e.g. verifies that the same person has signed the grid agreement and the supply agreement, that the address is accurate etc. When validated, the DSO updates the supplier information connected to the customer’s metering point in the system. Furthermore the DSO sends a confirmation to the supplier along with metering values for billing. As in the case for an assigned supplier, the DSO is obliged to inform the customer which supplier that is responsible for delivering electricity to the customer’s metering point and the date of the start of delivery. Finally, the DSO reconnects the unit if necessary.

24.2 Moving Process in a Supplier Centric Model
The moving process is proposed to be the first step towards a supplier centric model. In the Swedish Energy Market Inspectorate’s recommendation of the new moving process, the customer only needs to contact the chosen supplier when moving from one consumption place to another. As discussed, this will force the electricity customer to take action and choose supplier when moving and, as a result, passive contracts will decrease. The recommendation for how the moving process should be structured is described below (Swedish Energy Market Inspectorate, 2013a):

1. The customer contacts the chosen supplier and informs about the new and old address.
2. The supplier contacts the current and new DSO
3. The current DSO receives the message and takes appropriate measures to end the grid contract.
4. The new DSO arranges a new grid contract that will be sent to the consumer’s new address or, if preferred by the supplier, it is sent to the supplier, who confirms the customer.

To enable the new moving process, a change in the information exchange model is needed, since the DSO possess all information necessary to execute the process. The chart below presents an overview of how the new process can be designed based on the recommendations from the Swedish Energy Market Inspectorate.
24.2.1 Customer Contacts the Chosen Supplier

The customer contacts the new supplier (customer service) and informs about the moving. In order to handle both the move out and move in process, the supplier must first identify what DSO/DSO’s the move concern. The more critical step is the identification of the metering point-ID. The information search should preferably be done in real-time, as a result, it is important to be able to call the customer. The current information exchange model between suppliers and DSO is not fast enough and a new shared information system is required. (Alternatives on this system are discussed in section 21. When the metering point-ID (for both old and new metering point) have been identified, the supplier can send a move-order to the concerned DSOs, which is possible with the current bilateral information exchange system. The order could also go through a centralized hub (which is illustrated in the chart).

24.2.2 Establish a Grid Agreement

It is unclear when a grid agreement is established in the future. However, if the customer doesn’t need to be in contact with the DSO, this should be done automatically when the supply agreement is established and the DSO receives the move-order.

In this case, the supplier must also be able to provide the customer with the concerned DSO’s grid tariffs. Another option is to implement a standardized grid tariff, which would greatly simplify the suppliers’ processes. The grid agreement could be terminated automatically when the DSO receives a confirmation about the move out.

24.2.3 DSO’s Realize the Move and Send Confirmation of Grid Agreement

The DSO receives the moving-order from the supplier, re-/disconnects the metering point, sends metering values to the concerned suppliers. Furthermore, a confirmation of the new grid contract will be sent to the new customer, or it could be sent to the supplier who in turn confirms the customer.
25 Reconnection and Disconnection

Disconnection means discontinuation of the transmission of electricity to a consumer’s unit and reconnection means to connect a unit that has already been connected to the DSO’s grid. The DSO is responsible to execute the physical reconnection and disconnection for their points of delivery if needed. The processes and the information that is presented below is a result of interviews with Christina Loodin (2014).

25.1 Current Reconnection and Disconnection Processes

As described in the process chart above, a disconnection and reconnection can be initiated by three actors; DSOs, suppliers and customers.

![Diagram of reconnection and disconnection process]

Figure 15, Illustration of the current re- and disconnection process

25.1.1 Reconnection and Disconnection Initiated by the DSO

A DSO can disconnect a consumer’s unit when a customer defaults in payments or breaches other fundamental parts of the contract. The DSO reconnects the facility when the customer has satisfied all their obligations under contract and compensation is paid for the grid undertaking’s costs for disconnection and reconnection. Furthermore the DSO should disconnect a unit that has no consumer of electricity. This means that disconnection and reconnection are initiated when customers are moving in and moving out from a consumption place. However, not all DSOs are disconnecting their units due to a move out, but instead the units are kept connected.

25.1.2 Reconnection and Disconnection Initiated by the Supplier

A supplier can initiate a disconnection when a customer defaults in payment or due to another fundamental breach of contract. The supplier should then address the DSO that performs the disconnection. The request is carried out manually by contacting the customer service by phone, mail or email. Furthermore, the supplier should verify that the customer has acted to repeal the breach of contract i.e. paid the bill, and thereafter the supplier should contact the DSO that performs the reconnection.
25.1.3 Reconnection and Disconnection Initiated by a Customer

The customer can require a temporary disconnection in case of reconstruction, or a permanent disconnection in preparation for a decommission of the unit. Furthermore, as mentioned above a move in can initiate a reconnection if the unit was disconnected before the move in. The customer contacts the DSO’s customer service for reconnection or disconnection of a unit. Vattenfall performs the reconnection free of charge the same day when the customer’s notification of reconnection is received on weekdays before 13.00 (E:ON and Fortum requires a notification the day before). When a notification is handed in after 13.00 and the customer wants the unit to be connected the same day, or in the case that the customer wants a unit to be reconnected on weekends, the customer has to pay for the so called emergency reconnection. Often emergency reconnections are performed due to a late notification about a move in from the customer.

25.1.4 Customer Service Process

The DSO Customer Service is responsible for receiving the requirements and determining whether the metering point should be re-/disconnected or not. Afterwards the DSO adjusts the customer’s metering point information in the system and creates a re-/disconnection order accordingly. Often the disconnection/reconnection order is created automatically according to the customer’s metering point status in the system (SAP). For example, as soon as a metering point according to the system does not have a consumer a disconnection order is created. Furthermore the Customer Service informs the customer that he/she will be billed in the case of emergency reconnection.

25.1.5 The Physical Re-and Disconnection Process

When a re-/disconnection is ordered the physical process is conducted. As can be seen in the process chart, there are two different procedures of the re-/disconnection. The procedure depends on what type of meters the unit has, i.e. automatically remote controlled meters or meters that have to be managed manually. Most of Vattenfall’s customers have meters that are possible to disconnect and reconnect automatically. In this case, as soon as an order of re-/disconnection is created, a system is performing the automatically disconnection within a short time (approximately 30-45 minutes). Thereafter, the file is reported back to the SAP-system and necessary updates for the metering point are logged automatically. For meters that are not remote controlled or in the case of the automatically re-/disconnection for some reason fails, an administrator creates an order for manual field service executed by a contractor. The contractor performs the re-/disconnection manually and reports back to customer service. The customer service thereafter logs necessary updates regarding the metering point in the system.

25.1.6 Invoicing Customer in the Case of Emergency Reconnection

As mentioned above, the customer will be invoiced in the case of emergency reconnection. Today the DSO bills the customer for the reconnection.
25.2 Reconnection and Disconnection Processes in a Supplier Centric Model

In a supplier centric model, the re-and disconnection process will be modified. This is due to the fact that the supplier is the customer’s primary contact when moving out and moving in from a consumption place and that the contractual arrangement between the DSO and the customer is changed. Furthermore, a possible introduction of a centralized information exchange system can influence the process design. The chart below illustrates an overview of the process in a supplier centric model.

25.2.1 Initiating the Re- and Disconnection

In a supplier centric model, where the customer does not have any contractual grid use agreement with the DSO and the customer is only in debt to the supplier, it is only the supplier that can initiate a disconnection if to customer defaults in payment. Furthermore, the supplier is the customer’s main contact when moving in and out from a consumption place, and consequently the supplier is the responsible party for initiating a re-/disconnection due to moving.

25.2.2 Customer Service Process

In the situation where re- and disconnection is initiated due to moving and defaults in payment it is the supplier that is responsible for the customer service process and creating a moving order. This could be carried out with the current information system with bilateral messages or, in a scenario where a central hub is introduced; a supplier can create a file in the hub.

25.2.3 The Physical Re-and Disconnection Process

The DSO is still responsible for the physical re-and disconnection process and to update the metering points information after the re-or disconnection.

25.2.4 Invoicing in Case of Emergency Reconnection

In the case of emergency reconnection, the DSO will most likely invoice the supplier for the work. The supplier will then invoice the customer.
25.3 Discussion and Impacts on the DSO
As mentioned in current re-/disconnection section the different DSOs have different routines regarding re-/disconnection of a metering point. Some DSOs do not re-/disconnect at all even though a metering point has no new consumer registered. Furthermore the DSOs are managing emergency reconnections differently. An introduction of a supplier centric model will most likely result in standardization regarding emergency reconnections (due to late notification of move etc.) and the payments for such services. Today the charge differs greatly between the different DSOs on the market.
26 Billing Process

In this section of the report, the current and future billing processes will be presented and discussed in more detail.

26.1 Current Billing Process

The process and the information that is presented below is a result of interviews with and verification by Theresa Albertson (2014).

Today, customers have separate agreements with the DSO and the supplier. Based on these agreements the DSO invoices the customer for grid service cost and supplier invoices the customer for the energy supply costs. However, some customers today are receiving a combined bill for supply and grid services. Combined billing occurs mainly within cooperation that is both electricity suppliers and DSOs (Vattenfall, E:ON and Fortum etc.). The chart below describes the current billing process when combined billing is not applied. If the supplier and DSO are within the same cooperation, as in Vattenfall’s case, only one billing stream occurs. This will be discussed further in section 26.1.5.

26.1.1 Collecting and Validating Metering Data

As demonstrated in the figure above the customer’s DSO is responsible for collecting and validating the customer’s metering data and forwarding the customer’s consumption values to the supplier. Vattenfall has outsourced their metering activity to a contractor.

26.1.2 Producing Bill for Supply Services

The supplier calculates the costs for supply service based on the customer’s consumption and supply tariffs (including VAT, energy taxes and fees for green certificates). In practice this is done
in a debiting system where the values are automatically controlled, and in case of deviation such as very high values, the data is analyzed and administrated manually. The values are thereafter forwarded to an invoice document where other costs, such as possible interest costs are added to the bill. Finally, the invoice is sent as an electronic-bill for customers that have chosen this service, or a data-file with the invoice is send to a contractor who prints the invoice and sends the invoice by mail to the customer.

26.1.3 Producing Bill for Grid Services
The DSO calculates the costs for grid services based on the customer’s consumption and grid tariffs (including VAT, electricity safety fee, emergency fee and supervision fee). This done in accordance to the supply invoicing procedure described above.

26.1.4 Debt Collection
The DSO and the supplier are each responsible for their claim, monitoring due to date, sending reminders and collecting debts.

26.1.5 Combined Billing Today at Vattenfall
Vattenfall cooperates with both supply and grid operations and uses the same IT-system for invoicing grid and supply customers. Vattenfall’s IT-system manages combined billing and in this case, both costs for supply and grid services are calculated in the debiting document. Monitoring due to date, sending reminders and debt collection is handled by Vattenfall’s (Sale and Eldistribution) joint customer service, according to a special procedure, where the risk is split between Vattenfall Eldistribution and Vattenfall Sales.

26.2 Billing Process in a Supplier Centric Model
As discussed earlier, combined billing is one of the key features in a Supplier Centric Model. However, there are many alternatives for how the new combined billing regime will be designed, and a decision has not yet been made regarding this matter.

Firstly, combined billing can in practice be realized according to two basic principles; Engros-Billing and Pass-Through-Billing:

- In Engros-billing the DSO provides the supplier with grid tariff information per metering point and the supplier calculates the costs for both grid and supply service based on tariffs and the customers metering data.
- In Pass-Through-Billing the DSO calculates the costs for the grid service and forwards the information to the supplier, who combines the costs for grid and supply services and produces one invoice. (Sweco, 2014)

Secondly, combined billing can from a legal perspective be introduced in two different manners, i.e., Power of Attorney Model or Sub Contractor Model (Swedish Energy Market Inspectorate 2013 & Gaia, 2013):

- In a Power of Attorney model, the bill can legally be seen as two separate invoices and if the customer doesn’t pay, the DSO and the supplier are each responsible for their own debt collections
In a Sub Contractor Model the customer is only in debt to the supplier, hence the supplier is alone responsible for the debt collection.

Third, the choice of the future information exchange model i.e., a centralized data hub or a development of the current “point-to-point” information system, will have big impacts on how the billing in practice will be applied. (Sweco, 2014).

Hence there are eight different theoretical models for how the business process can be designed which is illustrated in the following tables:

**With a centralized data hub:**

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Billing 1</th>
<th>Billing 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcontractor model</td>
<td>Model 1</td>
<td>Model 3</td>
</tr>
<tr>
<td>Power of Attorney Model</td>
<td>Model 2</td>
<td>Model 4</td>
</tr>
</tbody>
</table>

**With current “point-to-point” information exchange system:**

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Billing 1</th>
<th>Billing 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcontractor model</td>
<td>Model 5</td>
<td>Model 7</td>
</tr>
<tr>
<td>Power of Attorney Model</td>
<td>Model 6</td>
<td>Model 8</td>
</tr>
</tbody>
</table>

In practice all eight combinations above are not likely to be applied. Each model will be discussed below.

**Model 1:** Given that a hub is introduced in Sweden, this billing model is very likely to be applied. Furthermore this is the model that is used in Denmark.

**Model 2:** This model would imply that a supplier is responsible for the calculation of an invoice that the DSO is legally responsible for. One could therefore argue that for legal reasons this model is less likely to be applied.

**Model 3:** With the precondition that a centralized hub is introduced in Sweden, this billing model is likely to be applied.

**Model 4:** With the precondition that a hub is introduced in Sweden, this billing model is likely to be applied.

**Model 5:** According to Sweco (2014) Engros –Billing is hard to realize if a centralized hub is not introduced. This model is therefore less likely to be applied.

**Model 6:** As in the case for Model 2, this model would imply that a supplier is responsible for the calculation of an invoice that the DSO is legally responsible for. Furthermore as in the case for model 5 it could be hard to realize Engros billing if no centralized hub is introduced. It could therefore be argued that this model is less likely to be applied.

**Model 7:** If no centralized data hub is introduced this model is likely to be applied.

**Model 8:** If no centralized data hub is introduced this model is likely to be applied.

In the next sections the models (Model 1, Model 3, Model 4, Model 7 & Model 8) that are likely to be applied will be presented.
26.2.1 Model 1 – Engros Billing With a Centralized Hub in a Subcontractor Contract Model

26.2.1.1 Collecting Metering Data
The DSO is still responsible for collecting and validating data for each of their metering points. This activity can be outsourced, which is the case in today’s model. The quality assured data for the DSO’s metering point is sent to and stored in the data hub. (This procedure is the same for all models where a data hub is applied).

26.2.1.2 Producing Combined Bill to Customer
The data hub sends forward the metering data for each metering point to the concerned supplier. Furthermore, the DSO provides the data hub with grid tariff information for each metering point. The supplier thereafter calculates the supply and grid service cost for each customer based on the consumption, supply- and grid tariffs.

26.2.1.3 Invoice and Debt Collection
Supplier combines the grid and service costs in one invoice and sends the invoice to the customer. In a subcontractor model, the supplier is responsible for the debt collection, in the case that the customer doesn’t pay its bill.

26.2.1.4 Producing DSO Bill to Supplier
Based on the grid costs for each metering point the data hub calculates the aggregated invoice data for DSO services to the concerned suppliers. Based on the data the DSO produces an invoice and sends this to each supplier i.e. each supplier that are responsible for the supply in the DSO’s grid area receives one invoice with the aggregated grid service costs for all customers in this area.
26.2.2 Model 3 – Pass Through Billing with a Centralized Hub in a Subcontractor Contract Model

![Diagram](image)

**Figure 19, Illustration of Pass-Through-Billing with a centralized hub in a subcontractor model**

26.2.2.1 Collecting Metering Data
The DSO is still responsible for collecting and validating data for each of their metering point. This activity can as in the case today be outsourced. The quality assured data for the DSO’s metering point is sent and stored in the data hub. (This procedure is the same for all models where a data hub is applied).

26.2.2.2 Producing Combined Bill to Customer
The data hub forwards the metering data for each metering point to the concerned supplier. The supplier thereafter calculates the supply service cost for each customer based on the consumption and supply tariffs.

The DSO calculates grid service costs for each metering point based on the grid tariffs and sends the information to the data hub. The data hub forwards the information to the concerned supplier.

26.2.2.3 Invoice and Debt Collection
Supplier combines the grid and service costs in one invoice and sends the invoice to the customer. In a subcontractor model the supplier is responsible for the debt collection, in the case that the customer doesn’t pay its bill.

26.2.2.4 Producing DSO Bill to Supplier
Based on the grid costs for each metering point the data hub calculates the aggregated invoice data for DSO services to the concerned suppliers. Based on the data the DSO produces an invoice and sends this to each supplier i.e. each supplier that are responsible for the supply in the DSO’s grid area receives one invoice with the aggregated grid service costs for all customers in this area.

26.2.3 Model 4 – Pass Through Billing With a Centralized Hub in a Power of Attorney Contract Model

![Diagram of Pass-Through-Billing with a centralized hub in a power of attorney contract model](image)

26.2.3.1 Collecting Metering Data
The DSO is still responsible for collecting and validating data for each of their metering points. This activity can be outsourced. The quality assured data for the DSO’s metering point is sent to and stored in the data hub.

26.2.3.2 Producing Combined Bill to Customer
The hub forwards the metering data for each metering point to the concerned supplier. The supplier thereafter calculates the supply service cost for each customer based on the consumption and supply tariffs.

The DSO calculates grid service costs for each metering point based on the grid tariffs and sends the information to the data hub. The data hub forwards the information to the concerned supplier.

26.2.3.3 Invoice and Debt Collection
In a Power of Attorney model the supplier produces an invoice that includes both supply and DSO services, but legally it remains as two separate invoices (similar to how combined billing is produced in the current model). Furthermore both supplier and DSO are legally responsible for the debt collection. The DSO gets paid when the supplier has received payments from the customer.
26.2.4 Model 7 – Pass Through Billing with a “Point-to-Point”-Information Exchange in a Sub Contractor Model

26.2.4.1 Collecting Metering Data
The DSO is still responsible for collecting and validating data for each of their metering points. This activity can be outsourced, as is the case in today’s model. The quality assured data for the DSO’s metering points are stored in each DSO’s data system.

26.2.4.2 Producing Combined Bill to Customer
The DSO forwards the metering data for each metering point to the concerned supplier. The supplier thereafter calculates the supply service cost for each customer based on the consumption and supply tariffs.

The DSO calculates grid service costs for each metering point based on the grid tariffs and sends the information to the supplier.

26.2.4.3 Invoice and Debt Collection
Supplier combines the grid and service costs in one invoice and sends the invoice to the customer. In a subcontractor model, the supplier is responsible for the debt collection, in the case that the customer doesn’t pay its bill.

26.2.4.4 Producing DSO Bill to Supplier
The DSO calculates the aggregated invoice data for DSO services to the concerned suppliers based on the grid costs for each metering point. Based on the data the DSO produces an invoice.
and sends this to each supplier i.e. each supplier that are responsible for the supply in the DSO’s grid area receives one invoice with the aggregated grid service costs for all customers.

26.2.5 Model 8 – Pass Through Billing with a “Point-to-Point”-Information Exchange in a Power of Attorney Contract Model

26.2.5.1 Collecting Metering Data
The DSO is still responsible for collecting and validating data for each of their metering points. This activity can be outsourced, as is the case in today’s model. The quality assured data for the DSO’s metering point is stored in each DSO’s data system.

26.2.5.2 Producing Combined Bill to Customer
The DSO forwards the metering data for each metering point to the concerned supplier. The supplier thereafter calculates the supply service cost for each customer based on the consumption and supply tariffs.

The DSO calculates grid service costs for each metering point based on the grid tariffs and sends the information to the supplier.

26.2.5.3 Invoice and Debt Collection
In a Power of Attorney model the supplier produces an invoice that includes both supply and DSO services, but legally it remains as two separate invoices (similar to how combined billing is produced in the current model). Furthermore, both supplier and DSO are legally responsible for the debt collection. The DSO gets paid when the supplier has received payments from the customer.
26.3 Discussion and Impacts of Combined Billing

An implementation of combined billing will have big impacts on the DSO. Firstly, new IT-systems have to be introduced. Even though Vattenfall today has an IT-System for combined billing today, it is important to point out that there is no easy way to integrate combined billing from other DSOs and suppliers outside the Vattenfall group, without doing major changes in the current system. This is the case for all discussed models above. Secondly, depending on how combined billing is introduced i.e., if the customer only is in debt to the supplier and the supplier is alone responsible for collecting debts, the credit risk for the DSO will change. This aspect is discussed in more detail in section 32.2. Third, in order to introduce combined billing in an efficient manner, grid tariffs will probably have to be standardized and new standard agreements between the supplier and DSO have to be put in place.
27 Outage Management

Outages commonly occur due to bad weather that damage the grid when e.g. trees fall on the power line or the lightning hit the wire or technical appliances. In some scenarios, it is caused on construction sites when an excavator accidentally cuts the power cable. Outages can also be caused by technical problems e.g. when a fuse blows. In exceptional cases of grid overload, outages will occur when the Swedish TSO order the DSO to switch off the electricity in an area to avoid permanent damage on the grid (Krisinformation.se, 2013). Unfortunately, outages sometimes occur due to sabotage and copper thefts (DN, 2010).

An outage triggers the outage management process in a DSO’s organization. This chapter of the report will examine the current process, the future process and opportunities of improvement related to outage management.

27.1 Current Outage Management Process

This section of the report will examine the current situation regarding outage management processes in Vattenfall’s organization. The processes and the information that is presented below is a result of interviews with and verification by Niklas Arkemar (2014), Pär Höglund (2014) and Per-Olof Olofsson (2014).

In the case of outage management, the processes differ greatly when it comes to single errors and significant power failures. These two scenarios will therefore be discussed separately in the following sections.

27.1.1 Current Single Error Process

The process chart below illustrates the current single error process. The tasks embodied in this process will be described further in the following sections.

![Figure 23, Illustration of current single error process]
In the event of single errors, the process starts when a customer contacts customer service and informs the customer service representative about a power failure.

### 27.1.1.1 Customer Service Processes

The customer service receives the information, and proceeds to perform with three simultaneous tasks.

Firstly, the customer service representative poses control questions to the customer. These are designed to ensure that the problem is actually a result of an error on the power line, and not in the customer's own system e.g. due to the fact that a fuse has blown. When the customer service representative suspects that the problem is not related to the power grid, he/she will recommend the customer to hire an electrician for verification that the problem is external, before investigating the matter further.

Secondly, in parallel with the control questions, the customer service representative enters customer information and responses to the control questions in the system.

Thirdly, during the process, the customer service representative informs the customer that he/she will be billed for the customer visit in the event that the power failure is derived from an internal problem at the customer facility. The control questions discussed above are also designed with the aim to eliminate such a scenario.

### 27.1.1.2 Grid Operations Centre’s Processes

When the customer service representative has posed the control questions, the information is forwarded to the grid operations centre. The administrators at the grid operations centre perform three parallel tasks that will be discussed in more detail below.

Firstly, the grid operations administrators analyze the information in the system. The work is usually based on comparing similarities and differences between power failure reports from customers in the same area to narrow down the potential location of the error. On this basis, the grid operations administrators try to identify which customers in the area that have outages, however, this information will not be entirely correct since the administrators can only view outages on zip-code level automatically in the system. In the scenario that the information in the system is insufficient, or if it is unclear whether the customer has received information about potential billing or not, the grid operations representative is required to contact the customer again to receive supplementary information. However, the control questions posed by the customer service are redesigned continuously to minimize the occurrence of insufficient information.

Secondly, the administrator creates a customer file with the information about the customer, the complaint and the potential location of the problem.

Third, the administrator hires a contractor.
27.1.3 The Contractor Processes
The contractor receives information from the grid operations centre, and visits the customer or the defined problem area. During the customer visit the contractor performs three tasks.

Firstly, the contractor should identify the problem. During this process, the contractor performs both observations, particularly for airborne wires, and measurements between different switching points in the area to identify the problem.

Secondly, when the problem is identified, the contractor fixes the problem.

Third, during the entire process the contractor sends progress reports to the DSO. In more detail, these reports contain information about:

- When the contractor starts driving to the area, and estimated time until arrival.
- When the contractor arrives at the location.
- When the problem has been identified, and estimated time to solve the problem.
- When the work is finished.

The grid operations log the information in the system continuously in order to ensure that the customer service can provide information to the customer in the case that he/she calls to receive an update on the progress. In the scenario that there are numerous outages in an area, the customers will be provided with the same automatic information notifications as discussed in section 27.1.1.2 during a significant power failure. However, since the grid operations administrators cannot identify exactly which customers that are without power, this information is often inaccurate. As a result, customers that are not without electricity occasionally receive information that there is an outage in their facility.

27.1.4 Closing Processes
After the power failure issue has been resolved, two things happen.

Firstly, the grid operations centre writes a power failure report that explains why the issue occurred.

Secondly, there are two scenarios regarding the payments. If the power failure was caused by a grid-related problem, the customer is automatically compensated if the power failure lasted for longer than 6 hours after the customer reported the problem to the customer service. If the power failure was caused by an issue in the customer’s own facility, the customer is instead billed for the contractor’s visit.

27.1.2 Current Significant Power Failure Process
In the case of a significant power failure, the process starts when a circuit breaker trips which cause the system to take several measures automatically. The reason for the circuit breaker to trip is normally caused by either short-circuiting or due to a detected residual current. The latter could
e.g. be caused by a tree that has fallen which has connected the wire to the ground. In some extreme cases, the circuit breaker has tripped when the capacity limit was breached.

The process chart below presents an overview of the current significant power failure process, which will be described in more detail in the following sections.

**27.1.2.1 System Processes**
The process starts with three automatic and parallel tasks carried out by the system.

Firstly, the system sends out an alarm about a power failure.

Secondly, the system automatically sends out information to customer service and to customers that has requested this information service. The information is provided through numerous channels:
- SMS and e-mail to affected customers.
- Information on the mobile application and the webpage
- OJE-message to “Sveriges Radio”, if more than 50 customers are affected by the power failure.

Third, the system automatically creates a file with the power failure information that can be seen through the remote system.

**27.1.2.2 Grid Operations Centre’s Processes**
The system actions are followed by two processes carried out by the grid operations centre, namely to handle the information in the file created by the system and then hire a contractor.
In the process of identifying the problem, the work is carried out by both grid operations centre and contractor, in contrast to the scenario of a single power failure. The work is led and organized by the clutch manager. The clutch manager is responsible for the safety of the operations and holds the power grid map.

In the process, the clutch manager gives orders to the contractor to drive to a certain grid station, switch on or off a certain circuit that is not remote controlled. In the same way, the clutch manager gives order to the grid operations centre to switch on or off circuits that are remote controlled. In this process, the clutch manager can identify if there is an error in between to grid stations, and by repeating the process the location of the error is narrowed down.

When the error is identified, the contractor solves the problem.

27.1.2.3 Reporting Processes
During the entire process, from the time that a file is created until the problem is solved, administrators at the grid operations centre the information is logged according to internal updates and updates from the contractors. As already mentioned in section 27.1.1.3 the information in the log contains information about:

- When the contractor starts driving to the area, and estimated time until arrival.
- When the contractor arrives at the location
- When the problem has been identified, and estimated time to solve the problem
- What the problem was (only visible to customer service)
- When the work is finished.

This information is then forwarded automatically by the system through the different information channels as listed in 27.1.2.1 to reach the customer, customer service and occasionally “Sveriges Radio”.

27.1.2.4 Closing Processes
After the problem has been solved and the file has been closed, the system automatically pays out compensation to affected customers that suffered from power failures for longer than 6 hours. Finally, the grid operations centre writes a power failure report.

27.1.3 Opportunities of Improvement Related to Outage Management:
During the conversations with experts at Vattenfall, it became clear that there were mainly two interesting opportunities of improvement related to outage management. These will be discussed in the sections below.

27.1.3.1 Automated Submission of Customer Information to Contractors
One opportunity of improvement that was identified during the interview process was the opportunity to automate the submission of customer information to contractors. Currently, some contractors have access to customer files in the grid operations database, however, a significant part of the information is still transferred to the contractor through communication by phone. Experts that were interviewed on this matter believed that enabling direct access to the grid
operations centre’s customer files would save a significant amount of time on both grid operations and contractor end of communication.

27.1.3.2 Digital Contractor Log and Report System with GPS-Tracker

Another potential opportunity that was identified during the interview process was the opportunity to digitize some of the communication between the contractor and the grid operations centre. Currently, the greatest part of the report system relies on communication by phone. In addition, the information must later be logged into the system manually. This communication could be simplified with the use of an application connected to the system database, where the contractor could view the customer files and enter valid information to the log. Some functions, e.g. the log of the contractor’s arrival to location could be logged automatically with the use of a GPS tracker system. When applicable, this type of digital function could eliminate the grid operations centre’s communication tasks related to contractor reports and logs to a great extent, and largely simplify the reporting process at the contractor end of communication.

1.1.1.1 Automated Outage Information From Smart Meters

Finally, one interesting opportunity is to connect smart meters to an automated notification system. The smart meters could provide information about when a facility has an outage, and when the power is turned back on. This would be advantageous for both customers and the DSO.

Firstly, the DSO would benefit from automated information since the troubleshooting process would be highly simplified. This is due to the fact that the DSO would have real time data of which customers that suffer from outages, and as a result, it will be easier to locate the error. In addition, this process improvement could eliminate manual treatment related to customer notifications. Consequently, the DSO could save both time and cost with an automated outage notification system.

Secondly, the customer would benefit from automated information from smart meters since he/she would get accurate information with only a few minutes time lag. As a result, the customer can take necessary actions to avoid that personal property is damaged. In addition, since the automated notification system simplifies the troubleshooting process, it is expected that an outage will be fixed in a shorter amount of time than without such a system.

27.2 Future Outage Management Process

As discussed in section 17 it is not certain whether the outage management will be managed in a supplier centric manner in the future. This section of the report will examine how the outage management process could be transformed in the scenario that the outage management process would be supplier centric. This section of the report will also cover a critical discussion of obstacles to and advantages of including outage management in the supplier centric model.

27.2.1 Future Single Error Process

In the future scenario, where the supplier is the customer’s main contact point, the single error process could be modified as illustrated in the process chart below.
As can be seen above, some changes have been made in comparison with the current single error process. These changes will be discussed in the sections below.

27.2.1.1 **Customer Service Function will be Managed by the Supplier**

One important modification in the outage management single error process is that the supplier will manage the customer service processes. This means that the customer will contact customer service at the supplier, which will receive information about the power failure. As a result, the supplier will be responsible for posing control questions and enter customer information in the system.

One worrying aspect of making the customer service task supplier centric is that the DSO would not get direct access to the customer’s outage information. During the initial contact with the customer, the DSO receives information that is crucial for the outage management such as information that simplifies the troubleshooting process. More importantly, the DSO does not get alerted to the occurrence of an outage automatically, but are dependent on the customer’s communication. As a result, the initial customer contact is critical for the outage management process, and it might be seen as alarming that the supplier should be responsible for this task while it is the DSO that are governed by legal requirements for the quality of the outage management process that is largely dependent on the initial customer contact. In addition, the suppliers’ customer services would have to be open 24/7 all year long, in order to provide the DSO with the information required for the outage management.

Another issue in this matter is whether suppliers have the competence and the capacity to handle this kind of customer service process. For organizations with supply and grid activities, the changes will be of a smaller magnitude due to the fact that the competence is already in the
company. For smaller suppliers without grid activities, however, this is a completely new area. As a result, there might be a risk that the quality of information that reaches the DSO’s grid operations centre might be decreased in this setting.

27.2.1.2 Inform Customer About Billing
One task that could potentially be governed by the supplier is the task to inform the customer that he/she will be required to pay for the contractor in the scenario that the problem is related to the customer’s facility.

One could argue that it would be convenient if the customer service would be responsible for providing that information during the process of entering customer information and posing control questions. On the other hand, in the event that the customer is not informed, and refuses to pay the bill, the DSO is the one that has hired the contractor and consequently will carry the cost. It might be seen as alarming that if the supplier does not fulfill its responsibilities, the DSO would pay the price, and as such, this matter must be regulated in the scenario that the outage management process will be supplier centric.

27.2.1.3 Bill Customer for Visit
The task to bill the customer was covered in section 27.1.1.4., and will therefore not be repeated here.

27.2.1.4 Pay Compensation to Customer
In the scenario where the outage management process will be supplier centric, it is unclear which actor that should be responsible for paying compensation to the customers. There are mainly two alternatives on the subject.

One scenario is that the DSO is responsible for the cost and would make a separate payment due to the fact the supplier has nothing to do with the quality of the outage management. However, exemptions to the combined billing structure might be confusing for the customer.

In the second scenario, the supplier is responsible for making a payment to the customer, possibly through deducting a corresponding amount from the subsequent invoice. However, there are numerous alternatives for the underlying payment structure. In the subcontractor model, the DSO could have a contract-based obligation to the supplier that regulates the compensation, and the supplier would have a separate compensation structure for the customers. As a result, the supplier could use well-calculated but, according to the customer, generous compensation packages in an effort to get a competitive advantage. In the agent model, the DSO still has a contract with the customer, and the supplier would only forward the compensation directly to the customer, or alternatively the amount would be deducted off the invoice from DSO to supplier, and the supplier in its turn would deduct the same amount from the customer invoice.

27.2.1.5 Shared Information System
All together, the changes demonstrated in the process chart will raise the demand for a shared information system that will connect the supplier and the DSO. There are several suggestions for
the design of a shared information system, which are discussed in more detail in section 21.3. In the outage management process, the shared system would give the grid operations centre access to the customer files and information. In addition, the customer service at the supplier would get access to the contractor and grid operations log in order to answer customer questions correctly.

27.2.2 Future Significant Power Failure Process

In the future scenario, the significant power failure process will likely be modified as illustrated in the process chart below.

As can be seen above, some changes have been made in comparison to the current significant power failure process. These changes will be discussed in the sections below.

27.2.2.1 Automatic Information to Customers and Customer Service

One process that is likely to change in the future is the automatic information service to customers and customer service at the DSO side that is provided by the internal DSO alarm system in combination with a log and report system. In the future, the information must either be spread in the same matter as today or the supplier must get access to the data through some kind of shared information system, and then forward the information to the customers.

In the first scenario, the DSO would thus send out the same automatic error message, however, if the supplier centric model is constructed in a way that the supplier should be the customer’s only contact, the DSO would be required to send out messages on behalf of the supplier which could be seen as confusing. In a scenario where the DSO is still allowed to have some contact
with the customer, the message could come directly from the DSO, however, in that case one could argue that the point of a supplier centric model might be lost.

In the second scenario, the supplier must get access to the data quickly in order to both ensure high quality continuous information to the customer, and provide customer service with information in order to maintain the quality of the same. In order for this to work, the supplier must get access to the information in the DSO system through some kind of shared information system.

Regarding the tasks for a shared information system and to pay compensation to customer, there is little difference between the single error scenario and the significant power failure scenario. Since these processes were discussed in detail in section 27.2.1.5 and 27.2.1.4, respectively, this discussion will not be repeated here.
28 Planned Outages

A planned outage occurs when the DSO decides to shut off the electricity in order to mend or strengthen the grid. Unlike many of the other processes discussed in this report, the planned outage process is not initiated by the customer, but by the contractor or by the DSO itself. In the first case, it is common that the contractor identifies potential problems with the grid, e.g. a rotten wooden post, trees on the cable, damaged insulation, and notifies the DSO. In the second scenario, the DSO has decided to invest in the grid in order to improve security of supply or increase the capacity of the grid. During the course of this process, the DSO is only in contact with the customer during three activities; scheduling the planned outage, notifying the customers of a planned outage and informing the customers that call customer service. Since the rest of the process will not be affected by the supplier centric model, and due to time constraints for this project, this report will only discuss these three customer related activities. The information that is presented in this chapter is a result of interviews with Per Erkmar (2014) and Jonas Sandbäck (2014) and validation by Niklas Arkemar (2014).

28.1 Current Planned Outages Process

In the current situation, the DSO is responsible for the task of scheduling the outage, notifying the customers and informing customers through the customer service. These three activities will be described more thoroughly below.

Firstly, the DSO will to some extent take customers opinions in mind when scheduling the outage. However, since the grid operations center can only handle one outage in each electrical area at a time, the scheduling is somewhat limited by the availability at the grid operations center. Naturally, the DSO cannot take every individual into account when planning the outage, but since the goal is to minimize the inconvenience for concerned parties, the DSO will conduct some inquiries. In general, the DSO will contact the largest stakeholders such as schools and larger clients e.g. industrial facilities that cannot function without electricity. Often, the DSO examines the possibility to schedule large outages at night to minimize inconvenience.

Secondly, the DSO will notify the customers. Today, the majority of the notification is handled with mail and concerned parties must be informed at least five days before the outage, which can last for no longer than five hours. Individuals that have requested email and/or sms notification will also receive information on such channels. In addition, the scheduled time for the planned outage together with some basic information will be presented on the webpage.

Finally, the DSO is responsible for the task of informing the customers regarding the planned outage. In order to be able to update the customer, the contractor logs information in the DSO system regarding the progress of the project. This information can later be retrieved by the customer service representative when the customer requests information from the customer service. In the system, the customer service representative can access four pieces of information; the scheduled time for the planned outage, what the contractor will do during the outage and why, the time for switching off the electricity and the time when it was turned back on. In order for the information to be easily understood by both the customer and the customer service representative, the information is rephrased in a more casual way with less technical content.
28.2 Future Planned Outages Process
This section of the report will examine the future customer related activities of the planned outage process (scheduling, notifying and informing the customer) in the scenario that these activities will be included in the supplier centric model. These three processes will be discussed below.

Firstly, regarding the scheduling of the planned outage, it seems unlikely that this task would be conducted by the supplier. One could argue that the process of retrieving information and understanding how to prioritize different actors need for electricity, would be more efficiently and correctly handled by the actor with the most technical insight in the issue. At the same time, one could argue that one intermediary contact would not bring any obvious benefits, but would rather slow down the process. For these reasons, it seems more logical that this customer contact should be managed by the DSO.

Secondly, since the discussion regarding notifying and informing the customer is similar, these issues will be discussed together. For both processes, it seems that the customer contact could be handled equally efficiently by both actors. One the one hand, if the supplier centric model will be implemented, it is likely that the supplier will develop an information and communication system that could easily handle these kinds of notification and information tasks, provided that the supplier could easily access the information from the DSO through a shared information system. On the other hand, one could argue that the DSO should handle this with their current notification and information system in the future. However, since the DSO notifications is mainly carried out by mail and the current system does not allow any updates or changes, it might be seen as more efficient to incorporate this notification function in the system developed by the supplier. Regarding the task to inform the customer however, the system is more up to date and could easily be used for future applications. In summary, there are few obstacles to including notifications for planned outages in the supplier centric model.

28.3 Opportunities of Improvement Related to Planned Outages
When the process for planned outages was examined, the authors of this report identified mainly two opportunities of improvement: digitized notifications and continuous updates with standardized notification system. These aspects will be discussed more thoroughly in the following sections.

28.3.1 Digitized Notifications
This section of the report will discuss the opportunity of digitalizing the notifications to customers. Today, all customers receive information by mail despite the fact that numerous customers have signed up for other information services such as the phone application and the e-mail- and sms notification system. In general, Vattenfall should strive to digitize notifications, however, there are still some consumers such as senior citizens that do not master digital information channels. Consequently, Vattenfall should commence a transition towards digitized information but must naturally maintain the alternative of receiving information by mail for customers that prefer such information channels. However, for customers that have requested digitized notifications, one type of notification would suffice, and it could be seen as inefficient
to send an additional notification by mail. Furthermore, reducing the amount of notifications sent by mail would reduce costs for e.g. postage. In total, Vattenfall could reduce costs without infringing upon customer satisfaction by digitalizing notifications.

28.3.2 Continuous Updates With Standardized Notification System
Another potential opportunity of improvement is to provide continuous updates with a standardized notification system. This discussion will be divided into the two improvement areas; continuous updates and standardization.

Firstly, Vattenfall could improve the quality of customer notification by continuously updating the customer. Currently, consumers only receive information based on what is known prior to the planned outage regardless of which information channel that is used. However, the customer can get additional information by calling customer service that has access to information listed in section 27.1.2.3. This customer service load could partly be reduced by continuously updating customers digitally, and costs would be reduced accordingly. Since this kind of information is entered in the customer service system automatically, it should not be impossible to transfer this information to other digital information channels in the same way as during unplanned outages. There is already one actor on the market that provides this type of service; at Göteborgs Energi’s webpage, the customer can see when power was switched off and turned back on (Göteborgs, Energi, 2014).

Secondly, Vattenfall could facilitate continuous updates by implementing standardized messages for planned outages. During unplanned outages, the contractor informs the DSO about the progress of the work with information at standardized tollgates. The same kind of information could be transferred to the customer with the use of standardized messages e.g. when the power is switched off or turned back on. By standardizing such messages, the customer will receive more information without additional efforts, and all the while reducing customer service workload.

In total, the opportunity to provide continuous updates with a standardized notification system will increase the customer satisfaction and reduce customer service load and costs accordingly.
29 Power Quality

The Power quality process manages issues related to the quality of supply. An average customer commonly notices these problems through e.g. flickering light or electrical appliances that warns of low voltage.

This section of the report will examine the power quality process in Vattenfall’s organization. The processes and the information that is presented below is a result of interviews with and verification by Anne Jerresand Pekula (2014).

29.1 Current Power Quality Process

The current power quality process is illustrated by the process chart below. The activities described in the chart will be explained in the following sections.

![Current Power Quality Process Chart](Image)

**Figure 27, Illustration of the current power quality process**

29.1.1 Customer Service Processes

The process to start investigation of power quality begins when a customer contacts the customer service. The customer service receives the information about the customer’s problem and then performs three key tasks simultaneously.

Firstly, the customer service representative poses control questions to the customers. These are designed to categorize the error in order for the customer to be routed to the right department, but also create a basic understanding of the problem.

Secondly, the customer information is entered in the system to provide a background for the administrators that will try to solve the problem.
Thirdly, the customer service department creates a customer file that will then be forwarded to an administrator at the right department.

### 29.1.2 Power Quality Group’s Processes – Understanding the Problem

When customer service has categorized a customer request as an issue within power quality, the problem is managed by the Power quality group (PQ). In the initial process of understanding the problem they perform four tasks, where the first two are performed in the same time frame.

Firstly, the PQ administrator analyzes basic information about the problem. This information is derived from the customer’s own observations and from data about the customer’s facility that is stored in the DSO systems. This task aims to give the administrator a hunch of what the problem might be, and decide what questions to ask the customer in order to narrow down the problem.

Secondly, the PQ administrator contacts the customer and conducts a second round of questions designed to narrow down the location of the issue.

Thirdly, the analysis and the second point customer contact is commonly enough to choose a correcting measure in order to solve the problem with deficient power quality.

Fourth, in a scenario where the cause of the problem cannot be identified with the first and second steps, there is a need for the PQ administrator to order more thorough measurements. This measurement is conducted in two ways; Either the PQ administrator hire an entrepreneur to conduct a customer visit, perform measurements and deliver the numbers to the PQ, or the customer is sent a measuring device which is then sent back to the PQ. Following the measuring task, the PQ administrator will proceed to define the correcting measure.

### 29.1.3 Power Quality Group’s Processes – Correcting Measures

Following the problem definition phase, the PQ administrator can choose to solve the problem in one out of the three ways. The different alternatives will be described in more detail below.

Firstly, the PQ administrator can order for the grid to be reinforced. This measure is chosen when the system data demonstrates that the grid in a certain area is weak or deficient. In practice, the file is then transferred to the optimization department at Vattenfall, which will determine the most efficient way to reinforce the grid. This process is followed by the task to contact the customer, which mainly includes informing the customer about what measures that are being taken to solve the problem and when the problem has been fixed.

Secondly, the PQ administrator can hire a contractor to fix the problem. This is often the case when data suggests that there might be a minor fault on the grid side, e.g. a device is loose. This process will be discussed in more detail in section 5.4.1.4. This process is also followed by the task to contact the customer, and is carried out as described in the paragraph above.

Finally, the investigation might conclude in the result that there is an error at the customer side of supply. In this case, the PQ administrator contacts the customer and suggests that he/she hires
an electrician to look over e.g. the wiring, if some device is loose, if two devices are interfering with each other.

29.1.4 Contractor’s Processes – Solve the Problem
If the PQ administrator decides to hire a contractor (through public procurement), the contractor receives information about the customer automatically through a shared system interface. The contractor then proceeds to perform three tasks.

Firstly, the contractor identifies the problem, by narrowing down the problem step by step.

Secondly, when the problem has been identified, the contractor carries on to solve the problem.

Finally, the contractor reports observations and correcting measures to the DSO. The DSO will then log the information in the system.

29.1.5 Closing Processes
Finally, before the investigation of power quality is completed, there are some scenarios where customers will receive compensation for the problems that insufficient power quality has caused. This process is carried out in two steps.

Firstly, in the scenario where customer property has been damaged due to inferior power quality, the customer need to file a damage complaint in order to be eligible for compensation.

Secondly, the complaints centre will handle both damage complaints and other compensation packages. The complaints centre administrators will manage the complaints and then decide whether a customer can be compensated for damaged property or not. In the case where it takes the DSO longer than 6 months to reinforce the grid to elevate the power quality, the DSO also offers compensation packages to affected customers, which normally consists of withdrawing the fixed grid free of approximately 300 SEK.

29.2 Future Power Quality Process
In the scenario that the power quality process will be included in the supplier centric model, it will likely be modified as illustrated in the process chart below. This chapter of the report aims to examine potential issues related to including the power quality process in the supplier centric model. Such issues will be discussed in the following sections.
29.2.1 Customer Service Functions will be Managed by the Supplier

One important modification is that the supplier will provide the customer service. This change is similar to the future single error outage management process that was discussed thoroughly in section 27.2.1.1 and will therefore not be examined more closely here.

29.2.2 Contact Customer (1)

Another modification that would be required in order for the process to become supplier centric is that the supplier would handle the process of contacting the customer for additional information. When examining this process, this report concluded that it is highly inefficient to make this task supplier centric for mainly two reasons.

Firstly, the supplier does not possess the expertise that is required in order to conduct such an important part of the troubleshooting process. In addition, the information could get impaired when administrators with less technological insight shall gather information from the customer and forward it to the DSO.

Secondly, the supplier contact would not bring any benefits, but would merely act as a time consuming intermediary contact.

29.2.3 Inform Customer – no Grid Error and Contact Customer (2)

If the power quality process becomes supplier centric, it will be the task of the supplier to inform the customer of the outcome of the research; the issue was caused by the customer’s facility, the grid was deficient and will be reinforced, or a contractor has fixed the problem. In the first case, the task also includes advising the customer and suggesting connections that need to be examined.
by an electrician. As a result, the same argument applies to these tasks as the process discussed in section 29.2.2 and it would be highly inefficient and unnecessary to make these tasks supplier centric.

The necessity of a shared information system and the challenges regarding compensation payments are very similar in the process of outage management. These issues were discussed thoroughly in section 27.2 will therefore not be presented here.
30 Connection Process

This section of the report will examine the connection process in Vattenfall’s organization. In the case of connection, the processes differ greatly when it comes to connections to the local grid or the regional grid. These two scenarios will therefore be discussed separately in the following sections.

30.1 Local Grid Connection Process

The process of establishing connections to local grid could be initiated for mainly two purposes, either to get electricity to a facility or to increase the capacity of an existing connection. The first scenario is common when new houses or neighbourhoods are being built or e.g. when individuals decide to electrify their country houses. The latter is common for small industries that are expanding their activities.

This chapter of the report will examine the local grid connection process. The processes and the information that is presented below is a result of interviews with Jenny Tyrefors (2014).

30.1.1 Current Local Grid Connection Process

This section of the report will examine the current local grid connection processes in Vattenfall’s organization. The process is illustrated by the figure below, which will be explained in further detail in the subsequent sections.

30.1.2 Initial Processes:

The process is initiated by the customer (1) or the customer’s electrician (2).

1) In the scenario where the customer contacts the DSO, the contact could either be carried out by phone or digitally. By phone, the customer contacts the customer service and the customer service representative creates a customer file regarding connection. Digitally,
the customer fill out and send a tender enquiry regarding connections that can be found at Vattenfall’s webpage. This triggers a system to send an email to a representative at the Tender Technique group (TT), which creates a customer file.

2) In the scenario where the customer’s electrician initiates the process, he/she will send a preliminary application to the DSO. This document includes technical information about the fuse on the facility and the electrical prerequisites. This document could be filed either by sending a physical document or by filling out an online form on Vattenfall’s website. In the first scenario, the customer file will be created manually by a TT representative, similar to the customer contact process. In the second scenario, a customer file and information will be entered in the system automatically.

In both scenarios, the enquiry and preliminary application is followed by the creation of a tender which is then signed by both the TT representative and the customer. The connection fee which is listed in the tender is based on the distance to the grid and the capacity of the connection (the size of the fuse).

30.1.2.1 Tender Technique Group Processes
When the tender has been signed, three tasks are performed simultaneously.

Firstly, the TT representative sends out a connection authorization to the electrician. This document includes information about e.g. “the underground cable route, how it should be laid and which type of cable protection conduit should be used” (Vattenfall, 2013b) and aims to reduce the misunderstandings that could lead to unnecessary work and expenses for the customer.

Secondly, the TT representative sends out a confirmation to the customer by mail. This document confirms that the order has been received. In addition, the customer receives information such as the metering point-ID, the customer identification number and the grid area ID, which are necessary in order to choose a supplier for the facility. Furthermore, the customer is informed that unless he/she requests another supplier for electricity, the supplier will be Vattenfall.

Third, Vattenfall Service plans and suggests a new grid structure that includes the new connection.

Finally, a TT representative hires a contractor for the connection.

30.1.2.2 Construction Processes:
When a contractor has been hired to connect a customer to the grid, a serious of tasks are performed in parallel to a continuous task to log information in the system.

Firstly, the contractor prepares and plans the grid connection. Unlike the planning carried out by Vattenfall Service, this preparation focuses on the physical implementation. In addition, the contractor applies for permits from the landowner and occasionally from the municipality regarding permits to build a power station.
Secondly, the contractor starts building the new connection from the grid and all the way to the site limit.

Third, the electrician sends a notification of completion to the DSO. The electrician is responsible for the connection on the site, and the notification of completion guarantees the DSO that the work has been finished on the site.

Fourth, when the contractor has received the notification of completion, he/she will connect the new site to the grid.

During these four processes, the contractor reports continuously to the DSO. In practice, the contractor enters information in an internal system with a shared interface to the DSO system. As a result, the information is transferred and stored in the DSO system automatically when new information is entered in the system by the contractor. The information that is entered in the system is standardized and the contractor is supposed to report when certain tollgates have been reached such as e.g. when the grid preparation phase has been finished and when the facility has been connected.

30.1.2.3 Customer Information Processes
When the contractor has sent a report to the DSO, the information is logged automatically in the system. In the case that the customer wants information, he/she can contact the customer service. The customer service representative can access the customer file in the system, and inform the customer about the progress of the grid connection project. However, while the customer service has access to this information, it is not certain that all or any of the customer service representatives actually uses this information due to lack of knowledge.

30.1.2.4 Closing Processes
Finally, when the facility has been connected, three tasks are performed.

Firstly, the DSO invoices the customer for the grid connection service as agreed in the tender.

Secondly, the customer is registered in the system. This means that the customer’s metering point-ID is listed in the system, and the DSO starts charging the customer for the grid transmission.

Third, the contractor documents the connection. In practice, this means that the contractor will illustrate the modification of the grid design by include the new connection in the map. When the contractor has documented the connection, the DSO proceeds to execute documentation. This means that the DSO validates the alterations by the contractor and finally update the grid map according to the changes.

30.1.3 Future Local Grid Connection Process
This section of the report will examine the future local grid connection processes in Vattenfall’s organization. As illustrated in the table below, numerous processes will change in the scenario
that the supplier centric model will be applied to the local grid connection process. These processes will be discussed below.

30.1.3.1 Create Customer File
In the future, it is unclear which actor should be responsible for creating a customer file. Since the preliminary application is a technical document, it would make sense that this document is sent directly to the DSO. In the scenario that the supplier should handle this information, it would be both inefficient and increase the risk of incorrect information regarding the connection. Regarding the customer contact, however, one could argue that the process could be handled equally well by either the DSO or the supplier due to its basic administrative nature.

Consequently, this particular task could be handled in a supplier centric manner (by the supplier). This conclusion is only valid under the prerequisites that the DSO and supplier have a shared information system that facilitates the transfer of information.

In total, however, the task of creating a customer file would not be simplified in a supplier centric model, due to the fact that the preliminary application will be handled more efficiently and correctly at the DSO and that the task would thus have to exist in both organization.

30.1.3.2 Send Confirmation
The task of sending a confirmation to the customer is also fairly basic and should be possible to transfer to the supplier organization with the use of a shared information system. This type of solution would increase the coherency for the customer in the scenario of a supplier centric model, however, it might be seen as inefficient that the supplier should handle a process where their involvement does not bring any other additional value to the task.
30.1.3.3 Invoice Customer
In the future, it is unclear if the task of invoicing the customer should be handled by the DSO or the supplier. The discussion of how to invoice a customer for a technical service was covered in the process for outage management in section 27.2.1.3 “Bill customer for visit”, and will not be repeated here.

30.1.3.4 Inform Customer
The task of informing the customer could be handled by the DSO or the supplier. The discussion around what solution is most efficient is similar for other technical processes such as the power quality function. This discussion was covered in section 29.2.2 and will therefore not be repeated here.

30.1.4 Opportunities of Improvement Related to the Local Grid Connection Process
This section of the report will discuss some of the opportunities of improvements that were identified during the examination of the local grid connection process. Firstly, the possibility of digitalizing the tender process will be discussed. Secondly, the report will examine the alternative to provide automatic online updates.

30.1.4.1 Digitization of the Tender Process
One opportunity of improvement that was identified during the course of examining the connections process was to digitize the task of creating a tender. As mentioned earlier, the customer could request a tender by filling out a form on Vattenfall’s webpage. Afterwards, a TT representative must create a tender manually by moving information from the form to a standardized tender format. Since the majority of all requests for residential customers are subject to a standardized connection fee, it should be possible to digitize, and automate this tender process.

The new process could be designed as follows. Firstly, the customer could fill out a form on Vattenfall’s webpage, including information on the desired capacity of connection and characteristics of the facility. Based on the information entered in the form, the connection fee can be calculated automatically. The customer can then sign the tender directly online. Secondly, a TT representative verifies that the customer qualifies for the standardized grid fee and that all information is correct. Third, a TT representative signs the tender and sends a confirmation, digitally, to the customer.

Today, each tender requires approximately 30 minutes of manual labour that could be replaced by digital management. In total, approximately 20 people work in the Tender Technique group, and it is estimated that 75 % of their time, thus 15 employees full time, is spent on the process of creating a tender. Consequently, there is a large potential to reduce workload and cost by digitalizing the tender process.

30.1.4.2 Automatic Online Updates
Another opportunity of improvement that has been identified during the course of the investigation is the possibility to provide automatic online updates.
Currently, the customer can only retrieve information about the progress of the connection by calling the customer service function. In the future however, it would be much more efficient if the customer could view the progress directly online by logging into “My pages” at Vattenfall’s website. In order for this to work, it is necessary that the function of translating the information to everyday language, and forwarding information from Vattenfall’s reporting system to “My pages”, is automated. By digitalizing and automating customer updates, the customer service will benefit from reduced workload, which could reduce cost. In addition, customer satisfaction will increase with continuous updates.

### 30.2 Regional Grid Connection Process

The process of establishing connections to regional grid could be initiated for both new connections and for existing connections that need to increase the capacity or reliability of the transmission to their facility. The first is common for e.g. new wind power stations and the latter is common for producers or local grid owners. Particularly in the northern part of Sweden, new connections have been established between the local and the regional grid in an effort to reduce outages.

The following chapters of the report will examine the regional grid connection process briefly. First of all, the differences compared to the local grid connection process will be discussed, and secondly, the report will discuss why the topic has been excluded from more thorough investigation. The information that is presented below is a result of interviews with and verification by Johan Wachtmeister (2014).

#### 30.2.1 Main Differences Compared to the Local Grid Connection Process

When comparing the regional grid connection process to the local grid connection process, there are namely four differences; the required application for grid expansion, the frequency of new connections, the contractual agreements and the cost for connections.

Firstly, in order to construct a new connection on the regional grid, the DSO is required to apply for distribution line concession, which is authorization to expand the grid, from the Swedish Energy Markets Inspectorate. On the local grid however, the DSO has authorization to expand the grid within a particular distribution area, and must thus not re-apply for each new connection. As a result, the regional grid connection process is a significantly more complex and lengthy process.

Secondly, the frequency of new connections to the regional grid is significantly lower than on the local grid. The reason for this is that there are very few industries or producers that require such large capacities that they need to be connected directly to the regional grid. In addition, it is very rare that new industries of such size emerge, or that current industries decide to move their establishment elsewhere. In fact, the most common reason to expand the grid is that a current client requests an increase in capacity for an existing connection.

Third, the contractual agreements between the customer and the DSO differ greatly on the regional grid compared to the local grid. As mentioned in section 30.1.1 for connections to the
local grid the customer signs a contract in the beginning of the process. For connections to the regional grid, however, three contracts are signed during the course of the connection process.

Before the DSO starts planning the connection, the client is required to sign a first initial contract. This contract includes information on the intended capacity of the new connection and the undertaking of the DSO. In addition, it includes financial agreements e.g. about how much the client should pay the DSO for the planning in the event that the client decides to cancel the connection order. This type of contract thus helps to prevent the DSO from spending time and money on unserious requests. The second contract is signed when the DSO has finished preparing and planning the grid connection, and is signed instead of a tender. This document includes final information about the capacity of the connection, how the connection should be built, the grid fee for electricity transmission when the connection is up and running and the total cost for building the connection. Finally, a third contract is signed when construction has been finished and before the transmission of electricity begins. This contract governs the responsibilities for maintenance and the proprietary relationship of grid related technical appliances.

Finally, the cost for connections differs between the local grid and the regional grid. For connections to the local grid, the customer pays a fixed cost for the connection that is decided on the basis of distance to grid and capacity of the connection. For connections to the regional grid, the cost differs depending on the customer. Producers will be informed about the approximate costs of the new connection, but they are required to pay for the actual cost of connecting or upgrading the facility. Large industrial clients and local grid owners, however, will normally pay for the connection with regular payments for grid transmission. In order for the DSO to determine if this is a profitable investment, the DSO performs a break-even analysis. If it turns out that the grid fees can not cover the costs of the connection over its lifetime, the client will be required to pay a fixed initial fee for the connection, which is specified in the tender-like contract that is signed before construction begin.

30.2.2 Reasons for Excluding the Regional Grid Connection Process from Further Research

The regional grid connection process has been excluded from further research due to the rarity of the process and the low probability that it will be included in the supplier centric model. These aspects will be discussed briefly below.

Firstly, as discussed in section 30.2.1 above, requests regarding regional grid connection are very uncommon in comparison to the requests regarding local grid connection. For the regional grid, the amount of connections has been in the order of magnitude of ten connections per year, whereas the local grid receives thousands of requests each year. Consequently, due to the low frequency of connections to the regional grid and the time constraints of this project, the process has not been prioritized for further research.

Secondly, it is unlikely that this kind of process will be governed in a supplier centric model for two reasons. One reason is that connections in general are expected to be exempted from the
supplier centric model since there is such a close contact between the client and the DSO, and since this communication is of quite technical nature. The second reason is that it is unlikely that customers to the regional grid are expected to be excluded from the supplier centric model, since these type of clients demand more technical information which require more knowledge than one could expect a supplier to provide.

Consequently, due to the low probability that this research will be of relevance in a supplier centric model and due to the time constraints of this project, the process has not been prioritized for further research.

31 Summary of Business Processes
This section of the report has investigated and answered RQ2:
- How will a DSO’s information interfaces transform if managed in a supplier centric manner?
  - v. How are the processes designed currently?
  - vi. How would the processes be designed in a supplier centric model, and what are the obstacles of structuring processes in such a manner?

In total, this report has delivered process charts covering the current and future information interfaces for key processes in a DSO’s organization. In addition, this report has demonstrated that the processes will change due to both the supplier centric model and due to opportunities to digitize and automate processes.

This report concludes that it would be disadvantageous to include grid related processes in the supplier centric model, and that the main obstacles for such an implementation is lack of knowledge at supplier-side, risk for duplication of work and split incentives regarding responsibility and consequence.
Impact

In the previous chapters, the reader have gained an understanding of how the supplier centric model will be implemented in Sweden and how the business processes will be adapted in a supplier centric market model.

This chapter of the report aims to answer research question three;

- How will a DSO be affected by the implementation of a supplier centric model?

In order to answer this question, the report will firstly conduct an analysis of key identified risks related to a supplier centric market model. Secondly, the report will discuss the economic impact of the implementation of a supplier centric model in Sweden.

32 Risk Analysis

This chapter of the report will examine risks related to the implementation of a supplier centric model. Firstly, the risks related to the DSO’s diminishing customer contact in grid related questions, as a consequence of a supplier centric model, is evaluated. Secondly, the new counterparty risk towards the suppliers, due to combined billing is discussed.

32.1 Risks Related to Diminishing Customer Contact

In order to understand and discuss potential implications and the risks related to the diminishing customer contact in grid related questions, it is first important to emphasize some important aspects regarding the customer’s situation on the electricity market today;

Since the Automatic Meter Reading (AMR) was introduced in Sweden and the customer’s bill commenced to be based on actual consumption, the complaints regarding the invoice have decreased radically. Furthermore, according to Vattenfall’s Customer Ombudsman (Clemensson, 2014), the customers have during the lasts years increased their understanding of the electricity market's supply side. However, customers still have very little understanding of the grid side of their electricity connection. As a result, on the market today, almost all questions regarding the customers’ electricity usages are related to the grid use and the grid connection. Furthermore, most complaint cases are grid related. The DSOs in general, and not the least Vattenfall Eldistribution, are therefor today extremely customer-focused organizations and have customer services with very high competence in technically related questions. Furthermore, during the last years Vattenfall Eldistribution has made major efforts to develop well-functioning customer service processes and to establish an efficient complaint division (Clemensson, 2014).

In the subsequent sections, the report will discuss potential obstacles and risks related to loosing the initial customer contact in Single Outage Management, Power Quality Questions and grid related complaint cases.
32.1.1 Single Power Outage
In the event of a single power outage, the initial customer contact is crucial for the DSO, since it is the single most common way for the DSO to find out that there is a problem on the grid. As discussed in section 27.1.1.1, in these cases the customer calls the customer service and the customer representative poses control question that are designed to understand if it is actually a problem on the power line or just a problem in the customer’s system.

Vattenfall Eldistribution has during a long period of time developed and continuously improved these control question so that the customer representative can identify the problem in a very efficient manner, since it is of paramount importance that the problem on the DSO’s power line is solved as quickly as possible. If this kind of issue would go through different suppliers there is a risk that information is delayed and/or gets lost in the process. Consequently, the DSO might not be able to solve the problem as quickly as today, which could further increase the costs for outage compensation.

32.1.1.2 Power Quality Management
Power Quality is not as time critical as in a case of a power outages, however, there is still a risk that the DSO’s effectiveness will be decreased in the management of such issues if the supplier is responsible for the initial customer contact and should forward this information to the DSO that handles the issue. As described in section 29.1.1, when a customer today contacts the DSO’s customer service regarding power quality, the customer service poses control questions in order to categorize the error and route the customer to the right apartment. Even though these questions are standardized and could theoretically be posed by a supplier’s customer service, the lack of technical insight compared to a trained DSO customer service representative, induce a risk that the problem might not be accurately categorized. Furthermore, if the suppliers would be responsible for the first contact with the customer, the questions either have to be adapted to how each DSO handles this kind of questions, or more likely, standardized questions have to be developed. The standardization might imply that Vattenfall’s internal processes have to be adjusted in a disadvantageous way.

32.1.1.3 Complaint Cases
Even though Vattenfall Eldistribution today has a well-established complaint division and developed processes for how complaint cases should be managed, complaint cases today are time-consuming, and in practice does not always work efficiently. In a scenario where the customer should contact its supplier in grid related complaint cases and the DSO is responsible to resolve the problem, there is a big risk that this will be even more complicated. Different suppliers might not work uniformly regarding complaint issues and the DSO could therefore have troubles prioritizing and solving customer complaint cases in an efficient manner.

(Clemensson, 2014). In addition, different DSO’s might require different kinds of information for the management of complaints, which will complicate the supplier’s task. However, it seems impossible that all suppliers should understand the DSO’s processes well enough to manage these kinds of complaint cases. As a result, there is a risk that this will decrease the DSO's efficiency in handling complaint cases.
32.2 Credit Risk

When combined billing is applied in a regime where the customer is only in debt to the supplier and the supplier is in debt to the DSO, the credit risk will change. For a DSO the credit risk is moved from all end-customer, to a counterparty risk towards the suppliers. This would result in a higher credit risk for the DSO, since the DSO’s claims will be distributed between a small amount of suppliers instead of hundreds of thousands of end-customers (Gaia, 2013). This part of the report aims to examine the risk by calculating Vattenfall Eldistribution’s outstanding debts in a scenario that a supplier defaults in payment.

A supplier usually has customers from a wide spread geographical area, which means that non-payable debts from a single supplier due to bankruptcy, is distributed among many DSOs. However, Vattenfall Eldistribution is a big player on the Swedish market, with approximately 17 % customer share, and is therefore exposed to a higher risk. The following example illustrates Vattenfall Eldistribution outstanding debts after 1-3 months of defaults in payment from suppliers with 100 000 and 50 000 customers respectively. In the example, it is assumed that an average monthly bill for grid services is 290 SEK/month and customer (this value is an approximately average calculated from statics provided by the Swedish Energy Market Inspectorate (2014c):

<table>
<thead>
<tr>
<th>Supplier with 100 000 customers</th>
<th>Supplier with 50 000 customers</th>
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<tbody>
<tr>
<td></td>
<td>Vattenfall Eldistribution.</td>
</tr>
<tr>
<td>Customers: 17 000</td>
<td>Vattenfall Eldistribution</td>
</tr>
<tr>
<td>Customers: 8 500</td>
<td></td>
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<tr>
<td>1 Month</td>
<td>5 MSEK</td>
</tr>
<tr>
<td>2 Months</td>
<td>10 MSEK</td>
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<tr>
<td>3 Months</td>
<td>15 MSEK</td>
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<tr>
<td></td>
<td>2.5 MSEK</td>
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<tr>
<td></td>
<td>5 MSEK</td>
</tr>
<tr>
<td></td>
<td>7.5 MSEK</td>
</tr>
</tbody>
</table>

In the worse case scenario Vattenfall Eldistribution would have outstanding debts that amounts to 15 MSEK. Naturally, this would be an inconvenient loss for Vattenfall Eldistribution, however, since it has a turnover of almost 10 billion SEK, this would have a very marginal affect on its liquidity. Consequently, the total credit risk that Vattenfall Eldistribution is subject to in the scenario that a supplier centric model is implemented is not expected to be critical.

33 Economic Assessment

This chapter of the report will examine the economic aspects related to implementing the supplier centric model. First of all, In order to analyze the economic impact of the Supplier Centric Model, it is important to understand the regulations that form the basis of the DSO’s economy, and this chapter will therefore begin with an introduction of the most important economic regulations that applies to the DSO. This will be followed by an assessment of the economic impact of the supplier centric model in different areas and for the overall profitability. The information presented in this chapter is a result of interviews with Bert Ytterström (2014), Per-Olof Nilsson (2014) and Thorstein Watne (2014).
33.1 Economic Regulations

The most important economic regulation is currently the revenue cap, which regulates the DSO’s total revenues. This section of the report will briefly describe the design of the revenue cap, its impact on profitability and potential future changes to the model.

33.1.1 Model for Calculating the Revenue Cap

First of all, the revenue cap includes all types of revenue sources and does not affect the division of the revenues between different types of customers. As such, the DSO is responsible for distributing the revenues between the different clients and types of revenues as long as it avoids discrimination between similar customers.

The revenue cap is based on four factors; the grid investments, the unavoidable costs, the avoidable costs and a quality factor. These four factors will be described more thoroughly below. The grid investment factor is based on the investment cost per unit length and the length of the grid for each cable type and the cost of capital interest used for calculating the equivalent annual cost. As such, the calculation does not take into account the actual value of the grid through depreciation of assets, but rather examine the cost of capital for the investments. As a result, a DSO that does not change the grid will receive the same amount from this factor each year. This factor has the largest impact on the revenue cap and is responsible for an order of magnitude of 50% of the revenues that the DSO will receive.

The unavoidable costs are costs for e.g. upstream grid transmission. This means that the DSO on the local grid has to pay the regional grid DSO for the transmission of electricity to the local grid. Another cost that is included in the unavoidable costs is the cost for grid losses that occurs during the transmission of electricity. This means that the amount that is fed to the grid is higher than the amount of electricity that leaves the grid. The DSO has the responsibility to buy the electricity that is lost during the transmission, e.g. the difference between the input and the output. The unavoidable costs will be directly translated to revenues, and are responsible for approximately 25% of the revenues.

The avoidable costs are costs related to the DSO’s activities, such as customer service functions and maintenance. In today’s model, this revenue factor is based on average historical costs for the period 3-6 years before a revenue cap has come into effect. The regulation also takes inflation and expected productivity improvements into account.

The quality factor is related to the amount and length of outages that a certain actor is responsible for. If an actor manages to decrease its outages, it will receive a small revenue cap bonus for improving its quality. On the contrary, DSO’s with inferior results will have their revenue cap reduced. This factor is insignificant compared to the size of the other three; however, it pays an important role in encouraging quality investments as this factor improves the profitability of replacing poor cables for superior ones.

33.1.2 The Revenue Cap’s Impact on Profitability

In total, the current model has the impact that it neutralizes the effect of increased or decreased costs. Thus, if a DSO reduces their costs for e.g. customer service, its revenues will be reduced...
accordingly. Overall, this means that if the regulation is well designed, and costs are correctly evaluated, the DSO’s margin will be constant over time. However, due to the fact that the avoidable costs are evaluated based on historic data, the revenue cap lags behind. Thus, in the scenario that DSO costs increase due to large investment costs, it will be another 3-6 years before the revenue cap is increased accordingly. In addition, the time lag allows for efficient DSOs to increase their margin, provided their efficiency exceed the productivity factor which regulates the avoidable costs. However, since the difficulty of reducing costs will increase as the most efficient changes are made first, it is likely that the DSO’s margin will decrease over time unless the model for calculating the revenue cap is revised.

33.1.3 Changes in the Revenue Cap Model

Many actors in the energy industry support the idea that the avoidable costs should be calculated according to a joint standard based on equivalent annual costs e.g. based on amount of customers. However, the current proposal suggests quite the opposite i.e. calculating the grid investment factor and the avoidable costs based on actual costs instead of calculating the equivalent annual costs for both factors. One could argue that this kind of revenue model would create misleading incentives, since this type of model encourages DSOs to replace well-functioning cables for the sole purpose of increasing the revenue cap. On the other hand a revenue model with joint standards for the revenue cap would motivate DSOs to use the resources on their hands in the most efficient way. Large and medium sized DSOs would benefit from this type of arrangement, since their efficiency is commonly higher.

33.2 Economic Impact of the Supplier Centric Model

This section of the report will discuss the economic impact of the supplier centric model. In general, this report has identified three areas that will affect Vattenfall’s profitability and that is directly related to the implementation of a supplier centric model: the customer service function, the information management and the debt collection.

In total, the supplier centric model will have a positive impact on the DSO’s economy short term, which is illustrated in the figure below. The arrows in the figure point upwards to demonstrate a positive effect on the profitability and downwards to demonstrate a negative effect on the profitability. However, while the overall impact short term is positive, all three areas have only a marginal effect on profitability.
Long term, the effect is expected to be neutral due to the design of the regulated revenue cap. Since the revenue cap is expected to decrease over time (Gaia, 2013), the DSO will have to continuously evaluate and improve its efficiency of operations in order to maintain its margin. The assessment of the customer service function, the information management and the debt collection as illustrated above will be presented more thoroughly from an economic point of view in the sections below.

### 33.2.1 The Customer Service Function

In the scenario that the supplier centric model is implemented, the DSO’s customer service function will be reduced due to the fact that the supplier will be in charge for the moving process and billing the customer. As a result, the DSO’s costs will be reduced and its margin will increase due to the time lag discussed in section 33.1.1 regarding the model for calculating revenue cap. Thus, this change will have a momentarily positive impact on the DSO’s revenues. The billing and moving process accounts for more than half of the DSO’s costs for customer service, and will thus significantly reduce the costs for customer service. However, due to the fact that the customer service function accounts for a small part of the avoidable and total costs of Vattenfall Eldistribution, it will have an insignificant result on the overall profitability.

### 33.2.2 Information Management

Regardless of which solution that is chosen for the management of information, it is inevitable that the market actors will have to carry some additional costs for the restructuring of internal systems and a joint cost for the external shared information system. On the upside, it is also expected that a shared system will increase efficiency in a way that costs for daily operations could be reduced. One potential solution for information management is the data hub described in section 21.3.1. For the purpose of understanding roughly the economic impact of information management, this report will examine said data hub solution. The extension of the bilateral model will not be investigated since it is improbable to be implemented due to its inefficiency and
expensiveness (Sweco, 2014). Other available alternatives will not be examined due to limited availability of investigations regarding the economic impact besides the data hub solution and the bilateral expansion suggestion. However, the service hub suggested by Vattenfall, E.ON, and Fortum is expected to be equally viable or potentially slightly more profitable.

Disclaimer: As mentioned earlier, numerous deficiencies have been identified in Sweco’s report and calculations. However, for the purpose of understanding something about the order of magnitude of the costs and savings, this report will examine the results presented by Sweco. In order to understand the economic implications and the validity of Sweco’s calculations in different settings, this report has examined the initial costs and yearly savings for the best-case and worst-case scenarios.

33.2.2.1 Initial Costs
First of all, a data hub is expected to generate initial costs in the shape of restructuring internal systems and constructing the information system connecting all actors. According to Sweco, the company specific initial costs would be in the order of magnitude of 15-18 SEK per point of delivery. For a large DSO such as Vattenfall, the costs are expected to be in the low range of said spectrum since they can benefit from economies of scale. In the case of Vattenfall with almost 860 000 delivery points in 2012, the company specific initial costs would be just under 13 MSEK. In a more pessimistic scenario, the costs amounts to 15 MSEK.

In addition, the hub is expected to cost in the range of 270-340 million SEK in total for constructing the hub, which could be distributed among the actors on the market in two ways. For both scenarios, this report will examine a distribution proportional to revenues.

In the first scenario, the costs would be distributed among both grid owners (DSO’s and TSO) and suppliers according to total revenues. It is assumed that suppliers and grid owners receive 70% and 30% of the income respectively (Lars Garpetun, 2014). Vattenfall has 21% of the grid owner market (calculations based on annual reports from 2012)(The Swedish Energy Markets Inspectorate, 2012). Thus, in this scenario the costs range from 17-22 MSEK.

In the second scenario, the costs would be distributed among the grid owners only, according to total revenues. Again, Vattenfall has 21% of the grid owner market. Consequently, the costs ranges from 57-72 MSEK.

In summary, the total cost for Vattenfall should be in the order of magnitude of tens of millions SEK, however, IT projects are commonly more expensive then initially expected (Ny Teknik, 2006). According to the figures Sweco presented, the costs for a data hub will only marginally effect Vattenfall’s profitability. Furthermore, it is likely that the investment cost that comes with the data hub will be taken into account in the revenue cap in either of two ways. In the first scenario, the investment cost for the data hub will be included as cost of capital in the grid investment factor. In the second scenario, the data hub costs will be included in the avoidable costs factor. Regardless of which, the costs for the data hub will generate an increase in the revenue cap which allows for the DSO to increase its tariffs marginally, and thereby forwarding.
the cost to its customers. However, due to the time lag, the DSO will have to carry the initial cost until the revenue cap is adjusted. As a result, the data hub investment will have a slightly negative impact on Vattenfall’s profitability.

33.2.2.2 Yearly Savings
Second of all, the yearly costs are expected to decrease as a result of more efficient operations. According to Sweco, the grid costs per point of delivery currently amounts to 155 SEK per year in avoidable costs. In the future, taking into account both data hub implementation and the supplier centric model (e.g. supplier assuming the billing and moving processes), Sweco has estimated that the avoidable grid costs would be reduced to 93 and 118 SEK per point of delivery per year in the most optimistic scenario and most pessimistic scenario respectively. For these scenarios, Vattenfall would save approximately 32 to 53 million SEK per year.

However, numerous concerns have been raised regarding the assumptions in the cost benefit analysis conducted by Sweco, particularly related to the yearly savings. One major concern was the assumption that DSO’s would benefit from reduced costs for supplier switching, despite the fact that this process has already been transferred to the supplier (Leif Wiberg, Fortum Elistribution, 2014). In addition, the assumption that the transferal of the moving process to the supplier would result in a 100 % reduction in costs was deemed unrealistic, since the DSO must still manage deviations and reconnections. Finally, several actors pointed out that it was very surprising that the costs for settlement calculations would be reduced, since this cost is rather expected to increase. These aspects need to be examined more thoroughly, however, it is still expected that the gain will be in the same order of magnitude.

33.2.2.3 Summary
The best-case and worst-case scenarios are summarized in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Best-case scenario</th>
<th>Worst-case scenario</th>
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<tbody>
<tr>
<td>Total initial costs</td>
<td>17 + 13 = 30 MSEK</td>
<td>72+15=87 MSEK</td>
</tr>
<tr>
<td>Yearly savings</td>
<td>53 MSEK</td>
<td>32 MSEK</td>
</tr>
</tbody>
</table>

The table above illustrates the initial and yearly savings in the best-case and worst-case scenario. Worth noticing is that the payback time is shorter than 3 years even in the worst-case scenario. Since the initial costs could increase with 84 % before payback is longer than 5 years in the worst case scenario, it seems reasonable to assume that the payback time will not be longer than 5 years, and that the investment will be profitable long term.

In total, the investment in information management will increase the DSO’s profitability short term due to the time lag of the revenue cap, which is thus expected to decrease in order to balance out the savings long term.
33.2.3 Debt Collection

In the future supplier centric model, the DSO will no longer be in charge for debt collection. This will have an impact on the DSO’s economy due to the fact that the debt collection fees category represents a revenue with very high margin. However, since the revenue cap is designed to include all sources of revenue regardless of type, the DSO can easily compensate for the loss of debt collection fees by e.g. increasing its grid tariffs. As such, the margin of the grid tariffs would increase. In addition, debt collection fees represent an insignificant part of the DSO’s total revenues, and will thus have a very marginal effect on the profitability. In total, this means that the effect of losing the debt collection responsibility will have either marginally negative or neutral effect depending on how long time it takes before the DSO adjust their grid tariffs accordingly.

34 Summary of Impacts

This section of the report has investigated and answered research question three (RQ3):

- How will a DSO be affected by the implementation of a supplier centric model?

This report has concluded that the supplier centric model will affect the DSO in mainly three ways.

Firstly, the diminishing customer contact could increase the risk for insufficient and inaccurate information could create inefficiencies for the DSO, in the scenario that grid related issues will be supplier centric.

Secondly, this report has concluded that the credit risk will increase in the supplier centric model, but that the impact will be marginal for such a large player as Vattenfall.

Finally, the report has concluded that the total economic impact short term will be positive since savings in customer service and information management will offset the loss of debt collection fees. Long term this report has concluded that the economic impact will be neutral.
Recommendations

In the previous chapters, the reader have gained an understanding of how the supplier centric model will be implemented in Sweden, how the business processes will be transformed and how these changes will impact the DSO.

This section of the report aims to answer research question four (RQ4);

- What measures need to be taken in order to operate efficiently in the future market?
  iii. What actions need to be taken in preparation for a supplier centric model?
  iv. What opportunities of improvements exist in the current processes?

In order to answer these questions, the report will discuss key findings of the analysis and interviews conducted in the previous chapters. Firstly, the report will discuss the need to evaluate consumer promises. Secondly, the report recommends Vattenfall Eldistribution to impact the choice of information management system. Third, Vattenfall Eldistribution should evaluate the most efficient processes for optimization. Fourth, Vattenfall Eldistribution is recommended to digitize and automate their processes in order to improve efficiency in the organization.

35 Evaluate Need for Customer Promises

One interesting debate that the authors of this report encountered during the interviews was whether or not Vattenfall Eldistribution benefits from offering better financial compensation in consumer promises than what is legally required, and whether these benefits would be reduced in the event that a supplier centric model is implemented in the future.

This chapter of the report aims to highlight the advantages and disadvantages related to consumer promises with financial compensation and how these will change in a supplier centric model. In order to understand the difference between the legal requirements and Vattenfall’s additional compensation packages, this chapter will also include a brief discussion of current regulations related to Vattenfall’s consumer promises. Regulations and consumer promises are different depending on the type of customer. Due to time constraints of this master thesis project, this report has chosen to focus on residential customers. However, many of the conclusions presented in this chapter will be applicable for business customers as well.

35.1 Regulations

The regulations related to outage management are one of the key drivers for investments in the power grid. Some of Vattenfall’s consumer promises, discussed in section 35.2 are based on two regulations related to outages that are presented below.

The first one is the legislation stating that an outage should be fixed within 24 hours. Normally, this legislation is breached in the aftermath of a storm, when it is hard for maintenance to reach all the affected customers within time. According to Jan-Åke Rosenqvist, this is partly due to the
fact that it is difficult to locate the problem, since the outage could be a result of problems in different areas of the grid. The legislation further states that compensation of at least 900 SEK should be given to affected customers when power outage lasts for longer than 12 hours.

The second important legislation is commonly referred to as 3-11. These numbers represent the classification that 3 unplanned outages per customer and per year represents a good connection, 4-11 outages represents a bad connection and above 11 outages is illegal. This law came into effect no later than 1st of October 2013, and is thus a very recent addition to the previous legislation of the power grid. (Swedish Energy Markets Inspectorate, 2013c).

### 35.2 Current Consumer Promises

In addition to the legislation, Vattenfall has instituted consumer promises with financial compensation, which exceeds what is legally required. There are mainly three consumer promises where Vattenfall offers financial compensation.

Firstly, Vattenfall has implemented consumer promises related to outages. For residential customers, Vattenfall offers compensation of 300 SEK when power outage lasts for longer than 6 hours, thus for outages lasting half the time of what is legally required. In addition, these customers can apply for compensation when an outage has resulted in damages on electrical appliances in the household. This compensation is also better than what is required by law. (Vattenfall, n.d.)

Secondly, Vattenfall offers compensation to consumers when the quality of supply is inferior. In the scenario when a solution to the problem of deficient quality of supply is not solved within 6 months the customer is exempted from the fixed monthly fee for the power transmission until the problem has been resolved. (Vattenfall, n.d.)

Finally, Vattenfall offers compensation to customers if a new connection is not established on time. From the time that the customer signs the tender, Vattenfall guarantees that a connection to the site limit is constructed within 10 workdays. In the scenario that it takes longer than 10 days to establish the connection, and on the condition that the customers have provided necessary information, Vattenfall offers a 10 % discount on the connection fee. (Vattenfall, n.d.)

### 35.3 Arguments Regarding Customer Compensation

This section of the report aims to understand the purpose and advantages as well as the disadvantages of consumer promises with financial compensation. In addition, the report will discuss how these factors will be affected by the implementation of a supplier centric model.

#### 35.3.1 Advantages of Customer Compensation

This section of the report will cover two economic motives for offering customers financial compensation when consumer promises are reneged.

The main reason for having consumer promises is that it improves efficiency in the organization. By offering financial compensation to customers, inefficient work will lead to increased costs for Eldistribution and the margin will be reduced. As a result, it creates incentives for the
organization to work more efficiently. In addition, it ensures that Vattenfall Eldistribution remains at the forefront of the grid development, and will therefore be prepared for e.g. implementation of new regulations that could imply additional costs for the organization. For instance, as technology advances it is likely that the time limits for outages will be stricter, and actors with less efficient outage management will suffer from increased costs. The incentive to increase efficiency will not be effected by the implementation of a supplier centric model.

Another reason for compensating the customers is that the general patience increase if individuals are compensated for grid related issues. As a result, the number of complaints and calls to customer contact decrease, which saves time and cost for the customer service function. In a supplier centric model, one could argue that the value of reducing customer impatience could decrease, since many of customer service activities will be transferred to supplier. If it is valid to assume that financial compensation for outages creates a general good will that would increase customer patience for all services, the value of customer compensation would be cut in half since more than 50 % of customer service costs will be transferred to the supplier. On the other hand, one could argue that the value of financial compensation would remain the same since compensation is only paid out for processes that the DSO will likely be responsible for in the future such as connections, outage management and quality of supply. However, due to the fact that the Vattenfall Eldistribution and Sales have the same brand name, and the fact that the DSO will decrease in customer contact in the supplier centric model, it is expected that the majority of the benefits of the good will will be obtained by the sales department.

35.3.2 Disadvantages of Customer Compensation
This section of the report will discuss two counterarguments for consumer promises with financial compensation.

First of all, compensation is commonly offered in order to prevent that dissatisfied customers switch companies that provide a certain service. However, since grid operation is a natural monopoly activity, the customer cannot replace a DSO with another one regardless of satisfaction or dissatisfaction. As such, one could argue that the gains of customer compensation are insignificant from this point of view. This aspect will not be affected by the implementation of a supplier centric model.

Secondly, financial compensation evidently implies an extra cost for the organization. In order for this to make financial sense, the gains in terms of e.g. efficiency must countervail the extra cost. While it is a valid argument that monetary means are efficient for increasing motivation and productivity, it might not be necessary to spend these resources externally. Instead of making external payments, Vattenfall could examine the potential of incentives that result in internal benefits if efficiency is improved by e.g. rewarding efficient departments. This aspect will not be affected by the implementation of the supplier centric model.

35.4 Conclusion
In conclusion, this report recommends Vattenfall Eldistribution to re-evaluate the need for consumer promises with financial compensation by comparing the quantified efficiency gains compared to the cost. Furthermore, it is recommended that other incentives for increasing
productivity in the organization is investigated and compared to the alternative of customer compensation. Finally, it seems that the advantages of consumer promises will decrease in the scenario that the supplier centric model is implemented, since goodwill will decrease as the DSO loses customer contact. In such a scenario it seems unjustified that Vattenfall Eldistribution should carry the costs while Vattenfall Sales seem to be the main beneficiary of consumer promises.

36 Impact the Choice of Information Management System

In the following weeks the Swedish Energy Markets Inspectorate will finalize their recommendations to the government regarding the implementation of a supplier centric model, including the choice of information management system. Sweco was given the task of comparing two alternatives; data hub and extension of the current bilateral model, despite the fact that many actors on the market (including Vattenfall) suggested another solution - a service hub with decentralized storage. Ultimately, Sweco’s investigation recommended the implementation of a data hub. This recommendation will be one of the cornerstones for the Swedish Energy Markets Inspectorate’s decision regarding information management, and one can therefore not exclude the possibility that a data hub will be implemented in the future. Thus, since Vattenfall believes that a service hub will be a far more efficient alternative, it is important to try and impact the decision making process.

This report recommends Vattenfall to evaluate the most efficient way to impact the choice of information management systems. In addition, this section of the report will suggest three potential ways of doing so; assist the investigation, demand further research and cooperate with other stakeholders.

36.1 Assist the Investigation

First of all, Vattenfall might benefit from assisting the ongoing investigation with their expertise. The investigation conducted by Sweco contained many errors and the knowledge commonly decreases in the chain of decision-making. In practice, the Swedish Energy Markets Inspectorate possess less expertise than the DSOs, and then deliver the information to the government that are even less familiar with the processes. As such, it is extremely important that the basis for decision-making provided by the Swedish Energy Markets Inspectorate to the government is correct and has been properly investigated. One of the main arguments for excluding a service hub in Sweco’s investigation was that there were few previous studies on the subject (Sweco, 2014). As a result, the recommendation to the government could be entirely different if there were studies on the subject. Vattenfall must have conducted some kind of internal investigation in order to conclude in promoting the service hub, and this information could further aid the Swedish Energy Markets Inspectorate in making an informed decision. In addition, Vattenfall could benefit from conducting and publishing calculations of its own in order to create awareness of the advantages of implementing a service hub as opposed to a data hub.

36.2 Demand Further Research

Second of all, it is crucial that Vattenfall demands further research on the subject before any decisions are being made. Many of the studies regarding the supplier centric model have been
given remarkably little time compared to its impact on the electricity industry. As a result, DSO’s and suppliers have been concerned about the quality of the investigations. In general, the analysis has not been sufficiently anchored with the experts in the field and, occasionally, calculations have contained inaccuracies and unrealistic assumptions. It is unacceptable that such hasty investigations should form the basis of a decision related to a significant market change. Consequently, it is crucial that Vattenfall creates awareness of the deficiencies of the investigations, and demands that this matter is investigated further.

36.3 Cooperate with other Stakeholders

Finally, Vattenfall is not the only actor that supports the implementation of a service hub as opposed to a data hub, and should examine the opportunity to cooperate with other actors in order to have a larger impact on the decision making process. E.ON. and Fortum, for example, are other large actors on the market that supports the implementation of a service hub but also have concerns of the quality of the investigations. Together, these actors will have a larger impact on the decision making process than any one actor would have on its own. As a result, Vattenfall could benefit from cooperating with other stakeholders in order to enhance its impact on the decision making process.

37 Prioritize Processes for Optimization

An implementation of a supplier centric model will have big impacts on Vattenfall Eldistribution’s role and obligations on the electricity market. However, many aspects of the DSO’s role in a supplier centric model are not yet set, much because a future information exchange model have not yet been defined.

In addition, due to the increased demand on energy services and possible implementations of new legislations that should enable such services, Vattenfall Eldistribution’s role as neutral market facilitators will most likely be enhanced. For example, NordREG (2012b) suggests that all DSOs should have an open communication standard interface in order to simplify the access to customer’s metering data.

It is crucial for Vattenfall to be aware of their role on the changing market when making important strategic decisions, such as decisions regarding investments in optimization of processes. For example there is no need to optimize a process or investing in an area that in the future will be a supplier process/area.

The authors of this report therefore recommend Vattenfall to:

- Increase the external monitoring before making any big strategic decisions.
- Prioritize investments in processes and areas that for certain will be useful for Vattenfall Eldistribution’s operations in the future.
38 Optimization of Processes

This section of the report will discuss some measures that can be taken in order to optimize the processes discussed in this report. Mainly, the authors of this report recommend Vattenfall Eldistribution to increase digitization and automation of processes. These two aspects will be discussed more thoroughly below.

38.1 Digitization

One opportunity of improvement that was identified during the course of this master thesis project, was to increase digitization. This recommendation was applicable on four different tasks that will be described more thoroughly below.

Firstly, the contractor should be able to receive customer information digitally during the process of outage management. Currently, this information is carried out by phone which could be seen as inefficient and time consuming from both DSO and contractor perspective.

Secondly, all contractors should be able to report its progress digitally instead of by phone. This could be accomplished with the use of a phone application with predetermined buttons for all tollgates.

Third, customer notifications in the planned outage process could be digitized for customers that have already subscribed for digital information services such as the phone application and e-mail notifications.

Fourth, Vattenfall could offer the opportunity to send out customer confirmation digitally instead of by mail in the connections process.

38.2 Automation

Another opportunity of improvement that was identified during interviews was to automate processes. This report recommends eliminating manual workload for mainly four tasks that will be described briefly below.

Firstly, when the contractor has access to the digitized reporting system suggested in section 38.1, it should be fairly easy to automate the process of entering the information in the log and report system. Currently, the outage management communications is carried out by phone, and administrators at the grid operations centre enter the information in the system. This task could be eliminated if the digitized application could also enter the information in the log and report system automatically.

Secondly, it might be possible to automate some of the contractor logs in the outage management process with the use of a GPS tracker. For instance, one of the current status reports contains the information that the contractor has arrived at the location, and such information could thus be logged automatically in the system with a GPS function.
Third, customer notifications could be sent out automatically when a file is updated in the planned outage process. Currently, Vattenfall does not provide continuous updates to its customers despite the fact that this information is accessible in the customer service system. As such, it should be possible to provide customers with additional information by automatically updating the customer files and sending out notifications e.g. when the power is shut off.

Fourth, Vattenfall could automate the process of creating a tender when the customer uses the website to send a tender enquiry for connections. Due to the standardized grid tariffs and tender formats, the customer should be able to sign a tender directly online. As a result, manual labor would be reduced to verifying the request, signing the tender and notifying the customer. Consequently, the quality would be improved and costs would be reduced.

Finally, the smart meters could be used to automate the process of notifying customers and the DSO that the power is out. As a result, the quality of customer notifications would be improved, but more importantly the troubleshooting in the outage management process would become more efficient as the task of identifying the source of the outage would be simplified. Consequently, costs for troubleshooting would decrease.

39 Summary of Recommendations

This section of the report has investigated and answered research question four (RQ4):

- What measures need to be taken in order to operate efficient in the future market?
  v. What actions need to be taken in preparation for a supplier centric model?
  vi. What opportunities of improvements exist in the current processes?

This report has concluded that Vattenfall Eldistribution should impact the choice of information management system due to the criticalness of the decision and deficient basis for decision-making. In addition, Vattenfall Eldistribution should evaluate the alternative to remove consumer promises that will become less advantageous in the event of a supplier centric model. Finally, this report has concluded that there is a large potential to improve efficiency of processes through digitization and automation, particularly through the use of smart metering technologies.
Conclusion

The purpose of this master thesis project was to examine how the DSO would be affected by the implementation of the supplier centric model due to the restructuring of information interfaces, and to provide Vattenfall Eldistribution with guidance on how a DSO should act in order to adapt efficiently to a supplier centric market model. In order to fulfil the purpose of the study, four research questions (RQs) were constructed. In order to answer RQ1, the report conducted an explorative study on the Supplier Centric Model. A descriptive study of business processes was also conducted in order to answer RQ2. Finally, RQ3 and RQ4 were answered through an analysis of the impacts and recommendations of findings of RQ1 and RQ2.

The findings of this report are fourfold. Firstly, the report concluded that the implementation of a supplier centric model in Sweden is governed with uncertainties, particularly related to critical issues such as the credit risk management and shared information management. The report also concluded that the contractual agreements are likely to be of subcontractor model and that it is unlikely that regional grid customers and grid related processes will be supplier centric.

Secondly, the report delivered process charts covering the current and future information interfaces for key processes in a DSO’s organization. In addition, the report concluded that it would be disadvantageous to include grid related processes in the supplier centric model due to lack of knowledge, risk for duplication of work and split incentives.

Third, the report discovered that the DSO would be subject to a larger credit risk, but that the impact would be marginal for such a large player as Vattenfall. In addition, the report concluded that economic impact would be neutral long term and positive short term due to savings related to customer service and information management.

Fourth, the report concluded that Vattenfall should impact the choice of information management system, re-evaluate consumer promises and improve processes through digitization and automation.

In summary, this report has delivered a prediction of the implementation of the supplier centric model, mapped the current and future business processes, examined the impacts on the DSO and delivered recommendations that could aid Vattenfall Eldistribution to adapt to the supplier centric market model.
Discussion

In this part of the report the limitation of the result and identified future research topics will be discussed.

40 Generalizability of the Result
The main limitation of this research results from the fact that the study focuses on one case (one DSO), which has unique conditions. Consequently, the conclusion might lack in generalizability.

However, distribution is a monopoly business and the DSOs are strictly regulated, hence the DSOs’ activities and conditions on the market are in many aspects similar. One could therefore argue that most of the results are applicable on all DSOs.

However, the results are generalizable to a higher extent for large DSOs such as E.ON and Fortum, than for small DSO. This is due to the fact that business processes in companies that are in the same sizes are more comparable to each other, then for companies of different sizes.

Furthermore, the economical impacts of an implementation of a supplier centric model will most likely be different for a small DSO. Since a small DSO doesn’t benefit from economies of scale, the economical impacts might be negative.

41 Future Research
The future research topics identified by this study can be divided into those that would examine the limitations of this study and those that would examine topics identified as interesting by this study.

The main limitation of this study is the lack of generalizability of the result on small DSOs. One important future research is therefore to study the impacts of a supplier centric model on smaller DSOs.

Another crucial area for future research is to further investigate models for information exchange in a supplier centric market model. As discussed in the report, little examination has been done on the solution the big actors advocates i.e., the service hub solution. It is therefor crucial to investigate a service hub and examine how such solution could be designed in the Swedish electricity market. Another area of future research is to benchmark with Finland’s model for information exchange. All investigations that have been conducted in this matter so far have been focused on benchmarks of Denmark and Norway. The Swedish Electricity market is more similar to the Finnish market in respect to how far Sweden has come with e.g. smart metering. A proposed future research topic is therefore to investigate how Sweden can learn from solutions and models used in Finland, in order to create a model that is suited to the prerequisites on the Swedish electricity market.
Finally, one interesting area of research is to study how the decisions-making process towards a supplier centric model has been managed. There are good reasons to believe that this hasn’t been managed in a satisfactory manner:

- The Swedish Energy Market Inspectorate hasn’t investigated the information exchange solution that most of the market actors prefer.
- Many aspects in the Swedish Energy Market Inspectorate’s proposal of how a supplier centric model should legally be implemented in Sweden are still unsolved.
- Both investigations on a future information exchange model and the proposal of legal implementation of a supplier centric model, was conducted in a very limited time frame. As a result, both investigations were of inferior quality.

It would therefore be highly relevant to examine the decision-making process in order to prevent that similar mistakes are made in the future.
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