THE REQUIREMENTS AND COMPLIANCE OF THE FINNISH ACT ON ENERGY EFFICIENCY IN A LARGE ENTERPRISE: A CASE STUDY FROM THE HEALTHCARE INDUSTRY

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ABSTRACT

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Abstract
Energy management is becoming increasingly important for organizations due to legislative, environmental, and economic causes. The Act on Energy Efficiency came into force in Finland on 1st January 2015. One of the law's obligations requires large enterprises to enhance and report their energy efficiency performance with an energy audit every four years. However, a large company can be exempted from the energy audit obligation in three ways under the Finnish law. The aim of this study is to discover the best solution for the target organization to meet the obligations posed by The Act on Energy Efficiency. The options considered in this study are: 1) performing energy audit as the law requires, 2) implementing and certifying EES+ energy management system with the ISO 14001 environmental management system in place, and 3) implementing a non-certified EES+ with the voluntary energy efficiency agreement.

Previous research has widely studied environmental and quality management systems, but energy management systems are a more recent phenomenon where little research is conducted. Moreover, research on integrating environmental and energy management systems appears to be non-existent which indicates a clear research gap in the field.

This research was conducted as a qualitative case study. Data mainly consists of the law's and EES+ system's requirements, and the target company's internal material. The analysis was conducted utilizing content analysis method, but also comparative analysis was applied when comparing the option requirements and measures needed.

The results of this study clearly indicate that the most suitable option for the target organization is to implement the uncertified EES+ system with the voluntary energy efficiency agreement. However, as the target organization has already the ISO 14001 environmental management system in place, it would seem more reasonable to integrate the EES+ into the existing ISO 14001 instead of having two separate management systems.

Keywords
Energy efficiency, energy management, the Act on Energy Efficiency

Location
Jyväskylä University School of Business and Economics

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1 INTRODUCTION

1.1 Background

The energy production generates significant environmental impacts, hence the most environmental friendly energy is the one not consumed. In the European Union, buildings consume 40 percent of all energy, and generate 36 percent of the CO_2 emissions. By improving energy efficiency of buildings, the overall energy consumption in the European Union could be reduced by 5 percent. (European commission, 2015a.) In order to address the impacts of energy production on the environment and the climate change, the European Union enacted a vast legislation package on the climate- and energy policies, the so called 20/20/20-package. The package set three key objectives for the European Union nations: to reduce greenhouse gas emissions 20 percent from 1990 levels, to increase the share of renewable energy sources to 20 percent in energy consumption, and to improve energy efficiency by 20 percent by the year 2020. (European commission, 2014.) Furthermore, the forthcoming 2030 climate & energy framework of the European Union proposes for instance even 27 percent improvement in energy efficiency, and 40 percent reduction in greenhouse gas emission (European commission, 2015b). Hence, the importance of energy management significantly increases in organizations due to both legislative and environmental causes.

Deriving from the 20/20/20 package, the Energy Efficiency Directive was enacted and it came into force on 4th December 2014 (Energy Efficiency Directive, 2012). Consequently, implementation in the Finnish legislation, the Act on Energy Efficiency came into force on 1st January 2015 (Energiatehokkuuslaki, 2014). One of the law's obligations requires large enterprises to enhance and report their energy efficiency every four years with an energy audit. The first energy audit must be reported until 5th December 2015. A company is counted among large enterprises when it has more than 250 employees, or when its annual turnover is more than 50 million and/or annual balance sheet total exceeds 43 million euros. (Motiva Oy, 2015b.)

However, a company can be exempted from the energy audit obligation in three ways under the Finnish law. In the first option the company has a certified ISO 50001 energy management system in place. The second option is, the company follows a certified ISO 14001 environmental management system and a certified energy efficiency system EES+. (Motiva, 2014.) In the third option the company is seen to fulfill the obligation if it is involved in a voluntary energy efficiency agreement, and it has put into action the EES+ system. In this case there is no need for EES+ to be certified. (Motiva, 2015c.)

The target company operating in the healthcare industry already has a certified ISO 14001 system in place. In addition, the company has expended plenty of effort in energy saving measures and investments. Therefore all the options the law offers to fulfilling the energy audit obligation are available for the target company. In order to fulfill the energy audit obligation, the enterprise has a need for a comparison between the different options to explore which option suits them best. Nevertheless, the extremely tight time limit might restrict the implementation of the most desired choice; therefore all aspects of the case must be covered.

1.2 Research objectives

This study aims at finding the best solution for the case company to meet the obligations The Act on Energy Efficiency poses for large enterprises. The options considered in this study are: 1) performing energy audit as the law requires, 2) implementing and certifying EES+ energy management system with the ISO 14001 environmental management system in place, and 3) implementing EES+ energy efficiency system (non-certified) with the voluntary energy efficiency agreement. The fourth option that would fulfill the requirements, implementing and certifying the ISO 50001 energy management system, is left out of the comparison. Since the deadline is so strict and this option has the widest scope, it would not be a reasonable choice when beginning this study in late spring 2015. Consequently, it was decided by the target company's EHS Manager that the ISO 50001 system would be left out of the comparison as it became obvious right in the beginning that it would be the most expensive option to maintain. This knowledge was based on the auditing company's offer. Moreover, as the scope of a master's thesis should be well limited, the exclusion supported this aspect as well.

As the company already continuously takes measures in order to improve its energy efficiency, some requirements presented by the different options might be already covered. Therefore it is essential to know *what more* should be done in each option. Moreover, whichever option is chosen, it does not have an impact on the energy efficiency measures taken per se (as they are in a high level already), so the possible cost savings derived from them do not alter either. Hence, these investment costs and cost savings are not taken into account in the comparison.

Thus, the main research task is to compare which one of the choices (energy audits according to the law, certified EES+ with ISO 14001, or non-certified EES+ with energy efficiency agreement) is the most suitable for a complex and large enterprise operating in healthcare industry, taking into consideration as well the measures and resources needed.

The research questions considered are:

1) What similarities and differences requirements in each option include?
2) What measures should be taken in each option, and how much would they demand in terms of resources? In this case resources refer to hours converted to euros, and to other possible monetary costs that may occur (e.g. the use of external contractors, certificate and audit costs).

1.3 Motivation for the research

As the Energy Efficiency Directive has only recently been implemented in national legislation, it is a very recent phenomenon among large enterprises. In addition, the energy audit deadline on 5th December 2015 pressures companies to start improving their energy efficiency and to find optional ways to meet the legal obligation. There is not one best solution that would fit each company, and the current state of energy management varies considerably among enterprises. Therefore it is essential to perform a case analysis so that the best solution specifically for the target company could be determined.

Academically, there is plenty of research available on implementing management systems. Probably the most well-known management systems, the ISO 9001 quality management system and the ISO 14001 environmental management system are widely studied and their implementation including benefits and pitfalls are largely recognized. However, energy management system implementation seems to be a more recent phenomenon that has not been studied before. Moreover, research on integrating environmental and energy management systems appears to be non-existent which indicates a clear research gap in the field. Furthermore, the concepts on the topic, such as energy management is quite debated and there does not seem to be one common understanding on what it retains (e.g. Böttcher & Müller, 2014; Bunse et al., 2011). Therefore, the research topic is as well academically a recent phenomenon where more research is needed.

My personal interest in the topic stems from the curiosity towards different environmental management systems and in particular, their practical implementation and benefits for the organizations. In addition, when having a course of international environmental law, I became interested in the Energy Efficiency Directive and its application in different nations. When these two interests were combined, the research topic suits well to my personal interests.

1.4 Structure of the study

This study consists of two main parts: the theoretical framework, and the empirical framework. This first chapter, Introduction, included the background of the study, research objectives and research questions, motivation for the research, and presenting the structure.

The second chapter elaborates the theoretical framework, presenting main concepts and previous research related to the topic. The main concepts presented are energy efficiency, energy management including examples of systems, energy audit and focused energy review. Moreover, the previous research starts with introducing management system implementation in general. Then, the knowledge of energy management system case studies and tools are presented, as well as the Plan-Do-Check-Act –process. Lastly, the chapter ends with integrated management systems.

The third chapter begins the empirical part of this study assessing the research methods and data. The chapter includes the qualitative case study, data presentation, and data analysis method.

The fourth chapter presents the results of the study. It is divided into two parts, first the requirements, and second the measures and resources needed. The two parts follow the structure of the Plan-Do-Check-Act –process.

The fifth and final chapter is dedicated to conclusions and discussion that derive from the results. Additionally, the limitations and trustworthiness of the study are elaborated, and future research topics presented.

2 THEORETICAL FRAMEWORK

2.1 Energy efficiency

The concept of energy efficiency seems to be difficult to define as there not one unambiguously accepted definition (Ang, 2006; Patterson 1996). Additionally, Ang (2006) points out that practitioners of different fields may have different conceptualizations. Bunse et al. (2011) and Patterson (1996) present a general definition of energy efficiency as the ratio between useful output of a process and the energy input into a process.

$$Energy\ efficiency = \frac{useful\ output\ of\ a\ process}{energy\ input\ of\ a\ process}$$

Put in other words "getting the most out of every energy unit you buy" (Herring, 2006, cited by Bunse et al., 2011), or using less energy to produce the same amount of services or other useful output (Patterson, 1996). Patterson (1996) further elaborates the complexity of this generic definition, as the issue becomes, how to precisely define the useful output and energy input.

According to Ang (2006) Energy efficiency is often measured in thermodynamic, physical-based, or monetary-based indicators. Each indicator-group tends to serve a certain purpose and suitable indicator may vary for example whether it is concerned with environment or economic productivity (Ang, 2006). Patterson (1996) divides energy efficiency indicators similarly to thermodynamic, physical-thermodynamic, economic-thermodynamic, and to economic indicators. Purely thermodynamic indicators derive from the science of thermodynamics that is science of energy and energy processes. Both input and output can be indisputably measured (for example as joules or kelvins) for a given process resulting in ratio of either heat content or work potential. However, these indicators do not recognize the quality of the energy, therefore if inputs or outputs are of different quality they are no longer comparable. In physical-thermodynamic indicators the output is measured in physical units in order to

reflect better the end use service. For example for freight transport output could be measured in tonne kilometers and energy input in joules. This indicator is comparable also over time, as a tonne kilometer or a tonne of a product stays the same. The same does not apply economic-thermodynamic indicators, if for example the monetary value of the tonne of a product is used, as the value can change over time. These kind of economic-thermodynamic indicators are hybrid indicators, and differing from the physical-thermodynamic indicators where the output is measured in physical units, here it is measured as its market value ($). The most common economic-thermodynamic indicator is Energy/GDP ratio that is used to describe for example a nation's energy efficiency. The last group, purely economic indicators, measures both the input and the output in economic value ($). For example the previous example of energy/GDP ratio would now be the economic value of that energy compared to the GDP. However, this method is criticized of describing rather economic efficiency instead of energy efficiency. The most widely accepted purely economic indicator would be national energy input ($)/national output ($ GDP). (Patterson, 1996.)

Consequently, the Energy Efficiency Directive (2012) in article 2, and the Finnish Act on Energy Efficiency (2014) define energy efficiency as "the ratio of output of performance, service, goods or energy, to input of energy" which is quite the same as the definition, Patterson (1996) and Bunse et al. (2011) followed. Moreover, energy efficiency improvement is seen as an increase in energy efficiency as a result of technological, behavioral or economic performance, or for example by using energy recovery in the process (Energy Efficiency directive, 2012; Bunse et al., 2011).

In this study, the definition proposed by the Energy Efficiency Directive (2012) will be utilized, as it is the grounds of the Finnish Act on Energy Efficiency whose obligations are the focus of this thesis.

2.2 Energy management

There does not seem to be a universally accepted definition for energy management in academic literature (e.g. Böttcher & Müller, 2014; Antunes, Carreira & Mira da Silva, 2014; Bunse et al., 2011). One quite general understanding considers energy management as measurement, monitoring, control, and improvement activities for energy and carbon performance to support the achievement of a company's overall goals (Bunse et al., 2011; O'Callaghan & Probert, 1977 as cited by Böttcher & Müller, 2014). On the other hand, Bunse et al. (2011) emphasize the energy utilization aspect, and highlight that energy efficiency performance should be taken into consideration along other performance areas, such as cost, flexibility, and quality.

Furthermore, Bunse et al. (2011) point out that even if energy efficiency improvements are performed in the manufacturing sector, economically beneficial energy efficiency potential is still not fully utilized. This phenomenon is

called as *the energy efficiency gap*. Several barriers to implementing energy efficiency measures have been identified, for instance decisions that are based on payback periods instead of interest rate calculations, limited capital, low priority (given by the management), and a low status of energy management. (Bunse et al., 2011.) Consequently, Böttcher & Müller (2014) emphasize that thorough integration of energy management into the overall strategy, organizational structure, and daily operations is essential in order to systematically improve the energy and carbon efficiency.

There are tools available for effective energy management, and probably the best known is the ISO 50001 energy management standard. It provides organizations of all types and sizes a framework that enables them to build the systems and processes needed to improve energy performance. This includes the energy efficiency, use, and consumption. Systematic energy management performed along the standard should lead to reductions of greenhouse gas emissions and energy costs. (SFS-EN ISO 50001, 2011, p.9.)

2.2.1 EES+ Energy Efficiency System

EES+ system is a Finnish energy efficiency system drawn up in cooperation with Motiva Oy, certification companies, the Finnish Energy authority, and the Finnish Ministry of Employment and the Economy. It is a tool to continuously improve the energy efficiency of an organization. (Motiva, 2015c.) In practice, EES+ is a Finnish version of ISO 50001 that was created to respond to the requirements of the Energy Efficiency Directive (EED that was further implemented in Finland as the Act on Energy Efficiency). ISO 50001 was seen to fulfill the requirements of the energy audits as regulated in the EED but the correspondences were fragmented in different sections of the standard. Therefore all the sections in ISO 50001 that were regarded as corresponding to the EED requirements on energy audits were picked to the EES+ system and rearranged. Consequently, the irrelevant sections with regard to energy audit requirements were left out. EES was the predecessor of the EES+, as the EES was originally developed as a tool to help companies to fulfill their requirements of the voluntary energy efficiency agreements. However, its scope was not wide enough to the needs the EED formed, so EES+ was developed. (Hyytiä, 2015.)

It is possible to integrate the EES+ system to an existing ISO 14001 standard, or to other management systems in place. It is as well possible to implement the EES+ system on its own, applying it to the needs of the enterprise. EES+ is meant to help the organization to manage their energy efficiency, offering a tool to implement continuous improvements in order to save energy and costs. (Motiva, 2015b.)

Energy efficiency system EES+ can be described as a five-stage process. First is the energy policy that is organization's expression of will to commit to certain energy efficiency targets. Second, the organization should chart its energy consumption, set the targets, and agree on the measures and procedures in order to achieve the objectives and targets according to the energy policy. Third stage is the implementation and operation that includes implementing the en-

ergy efficiency improvement measures, organization, training and communicating the personnel. Fourth stage is the surveillance and corrective actions that consist of target-oriented consumption monitoring, benchmarking and energy efficiency self-assessments. The fifth and last stage is management review that assesses the functionality of the system and the fulfilment of the targets, and sets new targets. (Motiva, 2015c.) Below is an energy management system model that EES+ utilizes in addition to ISO 50001. The picture illustrates the different stages and continual improvement cycle (plan, do, check, act).

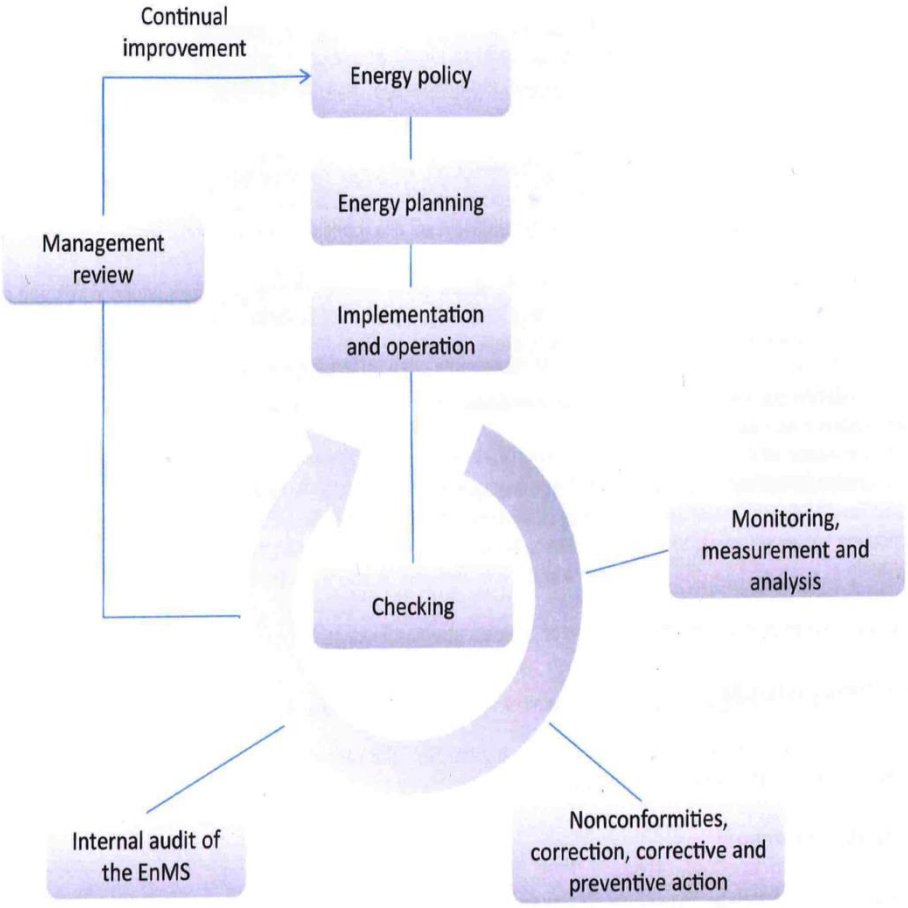

Figure 1 Energy management system model (SFS-EN ISO 50001, 2011, p.11)

2.3 Energy audit and focused energy review

Energy audits have become more popular as the awareness of human impact on global warming and the climate change has increased. It is estimated that 20 percent of energy consumption is wasted due to inefficient energy management. Good energy management can bring financial benefits among others in reduced fuel or energy bills and in reduced operation and maintenance costs (fewer hours of operation). (Al-Shemmeri, 2011, p. 24).

According to the Energy Efficiency Directive (2012) energy audit means:

> A systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile - -, identifying and quantifying cost-effective energy savings opportunities, and reporting the findings.

The Finnish Act on Energy Efficiency (2014) uses exactly the same definition of energy audit as the EED. However, the Act on Energy Efficiency (2014) differentiates additionally another type of energy audit that is called in this study as the *focused energy review*. Focused energy reviews are demanded of single targets, such as a building or a process. Focused energy reviews are needed to form a more comprehensive picture of the company's overall level of energy, and in order to discover energy saving potential in a trustworthy manner (Energiatehokkuuslaki, 2014).

Furthermore, the energy management standards have yet differing definitions. The energy efficiency system EES+ calls the energy audit as an energy review. In addition, focused energy review activities are included in the requirements but they are regarded as a part of energy planning. (Motiva, 2015a.) On the contrary, the ISO 50001 energy management system (SFS-EN ISO 50001, 2011) defines energy review as the "determination of the organization's energy performance based on data and other information, leading to identification of opportunities for improvement". This reminds more the definition of the focused energy review proposed by the Act on energy efficiency than energy audit as the systematic, comprehensive procedure.

Consequently, it can be seen that energy audit and focused energy review activities are included in each option available to fulfill the requirements of the Act on Energy Efficiency, only the terminology used is different. There does not seem to be universal or commonly accepted definitions for energy audits. Hence, it is important to have clear explanations on what aspect is meant. In this study, the concept *energy audit* is used to refer to the systematic and comprehensive procedure proposed by the EED and the Act on energy efficiency. Moreover, the *focused energy review* is utilized when referring to the concept proposed by the Act on energy efficiency, that is, the review having more limited scope and conducted to single targets.

2.4 Management system implementation

As there is no results available on implementing energy management systems, this chapter focuses on implementing environmental management systems as the research on them is abundant. There are plenty of researches conducted on the motivation of companies to implement an environmental management system (EMS). The most often named reason to go for an EMS is the will to improve the company's environmental performance (Morrow, 2002; Santos et al., 2015). Morrow (2002) conclude that the multinational and large corporations in the United States were motivated to adopt EMS for the desire to integrate envi-

ronmental, health, and safety management with total quality management systems (TQM), or their parent companies required them to improve the environmental performance. Also the desires to go beyond regulatory compliance or to cut costs were mentioned as motivators. Environmental management systems ISO 14001 and EMAS were seen as indicators of environmental responsibility and their certification as a way to improve competitive advantage. On the other hand, the German companies seemed to have a little differing motivation, as they strived for and EMS to not only to improve environmental performance but also to motivate employees, improve company image, and upgrade environmental documentation. (Morrow, 2015.) Santos et al. (2015) discovered quite contrary information among Portuguese small- and medium sized enterprises (SMEs). They had already certified quality management systems and had implemented an EMS too, but were reluctant to get certification due to lack of investment, and as it was considered merely as a form of marketing instead of offering real benefits on environmental protection. Interestingly, the SMEs that could overcome the monetary challenges and received certification, gained benefits in prevention of environmental risks, and improved both environmental protection and image. (Santos et al, 2015.)

Despite the differing motivations for implementing an environmental management system, the obtained benefits were quite similar. Increased regulatory compliance (Morrow, 2015; Zutshi & Sohal, 2004; Schylander & Martinuzzi, 2007), improved image or reputation (Morrow, 2015; Santos et al., 2015; Zutshi & Sohal, 2004), and reduction or prevention of environmental risks (Santos et al., 2015; Zutshi & Sohal, 2004) were often mentioned as perceived benefits of an environmental management system. In addition, better organization and documentation of environmental management activities (Morrow, 2002), improved employee motivation (Morrow, 2002), improved performance (Melnyk et al., 2003), improved internal processes (Zutshi & Sohal, 2004), and improved environmental awareness in the company (Schylander & Martinuzzi, 2007) were stated as obtained benefits. Furthermore, the studies show a clear indication that a certified environmental management system brings more significant impacts, such as stakeholder benefits and improved overall performance (not only environmental), than merely implementing a system would (Melnyk et al., 2013; Zutshi & Sohal, 2004; Santos et al., 2014).

The researchers are quite unanimous about the main challenge or barrier of implementing an EMS. The implementation and certification costs, including the use of external consultants, are often identified as the main barrier (Santos et al., 2015; Zutshi, 2004). Zutshi (2004) found out that for Australasian SMEs the resources required maintaining and auditing systems outweighed the benefits obtained from the certification. On the other hand, the SMEs that certified the system, obtained benefits, such as improving corporate image and internal processes, and compliance with regulatory requirements (Zutshi, 2014). In addition to the monetary aspect, the identified challenges have been for example the difficulties to change the company culture and motivate personnel, coordination between EMS and organization's strategy (Schylander & Martinuzzi, 2007),

barriers related to updating or changing systems, and training (Santos et al, 2015; Zutshi 2004), and EMS synchronization in value chains(Schylander & Martinuzzi, 2007).

2.4.1 Energy management system -cases

Even if the energy management systems -related research lacks the basic research assessing the goals, benefits, and challenges of the implementation, there are case examples available in successful energy management system or –program implementation. These cases present some motivations and outcomes that were achieved, in addition to common elements that are seen important. The cases found are from energy intensive industries, the cement and aluminum metals industries. It is important to notice that the cases are only examples, thus the results cannot be generalized to apply all sorts of industries. Nevertheless, the cases offer at least some experiences on implementation of an energy management program.

Coppinger (2010) presents a case of a cement company that initially wanted to tackle high CO_2 emissions of the industry by implementing Energy Star program. The goals in the company were to reduce energy use and costs, and to improve environmental performance as well as relations with the local communities. Along the energy management program, the company implemented improvement projects, such as reducing compressed air system's energy consumption, enhancing operational processes, updating energy intensive equipment, installing wind turbines and solar panels. Since the introduction of the program in 2003, the company has saved over $12 million and significantly reduced emissions. As a result, the company has established energy efficiency as a core value, improved their relationships with locals, and initiated partnerships with suppliers and customers to improve energy footprints of its products and operations (e.g. sharing best practices, training, identifying energy saving opportunities). In addition, the company has won several energy awards such as Energy star partner of the year, and sustained excellence award five years in a row. (Coppinger, 2010.)

Another case example comes from Colombia, where a governmental research project developed the SGIE technology for energy management. It consists of statistical and monitoring tools, as well as energy efficiency performance indicators, all conformable with the ISO 50001 standard. This technology was piloted to a cement plant. The application of the system had very similar results as the previous case presented. The electricity consumption in the plant was reduced by 4,6 percent that equivalents 5,2 kWh/cement ton, solely by innovations on the plant processes without investing on new equipment. This reflects the environmental performance as at the same time CO_2 emissions reduced by 3,3 kg per produced cement ton. At the operational level a culture of energy efficient management and continuous improvement was established resulting in enhanced productivity and competitiveness. In addition, energy management indicators were developed, that enables analyzing the energy efficiency. (González, Castrillón & Quispe, 2012.)

Both cases highlight the importance of top management commitment. Not only do they grant the necessary resources, but impact on the credibility of the program implementation for example by attending to related meetings. Another aspect that is emphasized is the phrase 'You cannot manage what you don't measure' that refers to the initial steps on measuring energy consumption in order to explore the baseline and develop improvement measures. Furthermore, both cases followed a framework, or system that guides the implementation. (Coppinger, 2010; González et al., 2012.)

Dusi & Schultz (2012) assessed the common traits in a successful energy management system. They found out that even if energy management programs were differently structured, they would be successful programs if containing certain elements. The highest level *managerial commitment* and *energy tracking* (understanding where energy is consumed) were identified as important elements similarly to the previous case studies. Analyzing deeper these two points, the writers discovered that in addition to managerial commitment, *the organization* of the energy management was important, for example in the form of an energy management team. Moreover, when analyzing energy consumption data, *benchmarking* was seen significant. Benchmarking refers here to looking for guidance from and sharing energy consumption data across the industry in order to discover the consumption level compared to other similar facilities, as well as to discover what others made differently in order to perform better. In addition to these, *audits* were identified as a key component. Their scope may vary but usually they allow energy management teams to assess their programs, and to establish action plans to achieve goals. *The goals and action plans* was another common element in successful systems. Usually goals are applied to the whole organization and then refined in audits. In action plans the issues are listed that have to be attained to achieve the goal. *Production reporting and maintenance records* may reveal important data when analyzing systems and pondering more efficient solutions. For example detecting and correcting flaws in systems or in equipment can remove production bottlenecks. One of the most important elements identified was *communication.* When successful programs are audited, the evidence of results should be evident around the plant, which requires keeping the employees informed. For example bulletin boards, newsletters and email can be utilized, as well as recognizing employees who have made a special effort in achieving a goal. The authors describe a program containing the presented elements as having a *system approach.* It limits the program risks and ensures that the resources are used effectively to achieve corporate energy efficiency goals. (Dusi & Schultz, 2012.)

Similarly, Peterson & Belt (2009) address the key elements of an energy management program utilizing aluminum metals industry as an example. They approach the subject from a more process-based viewpoint. The writers point out five broader elements that include similar issues as Dusi & Schultz (2012) collected. The first element is *define*, which includes identifying and defining significant processes with regard to energy consumption and then prioritizing the focus. Additionally, energy efficiency indicators should be chosen. The next

step is to *measure*, which refers to actually metering the energy consumption of those prioritized processes and equipment. However, the level of detail should be decided according to the scope and size of the organization, for example are all sources of energy included in the metering. This element is correspondent to Dusi & Shultz's tracking-element. The following element is *analyzing* that means benchmarking against similar processes. This is another corresponding element to the previous research. Peterson & Belt (2009) however present different benchmarking opportunities. For instance industry benchmarks can be utilized but it might be challenging to obtain the necessary information due to business-sensitive information. Historical benchmarks, comparing the process against itself at an earlier time, are useful if the process is upgraded over time and the records are available. The next stage is to *improve* the processes based on the measurements. Different methods can be applied, for example simply choosing the improvement projects based on cost savings and selecting the one with the biggest impact, or for capital projects to select the one with the greatest return on investment (ROI). The last element is to *control*: to document and transfer the knowledge. It includes three separate functions: ensuring that the improvements made are long-lasting and self-correcting if degraded over time, documenting the savings based on verifiable measurements, and communicating the results, the last one being corresponding to the previous study. (Peterson & Belt, 2009.)

All studies presented include similar, but also differing elements on what to be included in a successful energy program. The preceding presented a similar process approach that is utilized by the ISO 50001 and EES+ energy management systems, as presented in chapter 2.2. On the other hand, also the key elements by Dusi & Schultz (2012) are included in the systems' requirements. It can be seen there is not one commonly accepted standpoint but the mutual importance of the addressed elements may vary according to the organization and the scope of the system.

2.4.2 Energy management system tools

Even if the academic world has not seized the implementation or integration of energy management systems, there are yet some tools developed for improvement of energy performance. These tools can be regarded as energy management measures. Chiu et al. (2012) present a tool for organizations to developing sustainable energy management. Even if the ISO 50001 energy management system structure is similar to other ISO standards, it contains unique energy management demands and technical definitions, such as demands regarding energy performance indicators (EnPIs). ISO 50001 requirements include energy technology items that often require the help of external consultants to measure and monitor different detection devices. The researchers explored this issue by developing an integration-energy-practice model, trying to enhance the EnPIs of the ISO 50001 in business operations that would satisfy both the ISO 50001 requirements and third-party certifications. As a result of a case study, the

achievement rates for annual EnPIs improved, indicating the enhancement of the energy efficiency. The model

> integrates internal and external technical resources to establish energy technology think tanks, for promoting successful technology and experiences for various sectors, thereby allowing enterprises to integrate energy management and increase energy efficiency. (Chiu et al., 2012).

Gopalakrishnan et al. (2014) developed a method called the ISO 50001 Analyzer to facilitate the implementation of ISO 50001 energy management system. It is a software tool, where series of multiple choice questions have to be answered, supporting documents and records can be uploaded as applicable to each clause. The software goes through the entered data and analyzes whether the requirements of the management systems have been fulfilled. The software provides a step-by-step requirements process that helps to achieve an ISO 50001 compliant energy management system. The tool helped manufacturing facilities for example to determine the scope of work required, to develop timelines, and to allocate responsibilities among personnel in order to gain directed, incremental results. As a result of the study, the analyzer was able to provide adequate information on the gap analysis related to the ISO 50001 certification efforts, proving its functionality. (Gopalakrishnan et al., 2014.)

Antunes et al. (2014) state that there is a gap between theory and practical implementation of energy management that needs to be closed. The researchers aim to do that with an energy management maturity model that structures the essential energy management activities across five maturity levels. It is suggested that standards, such as ISO 50001 do not offer organization a model to assess their current situation against other organizations (excluding the final certification), or allow them to plan the energy management implementation along an improvement roadmap. The model is formed on the grounds of literature on energy management, such as energy management systems, energy guides and case studies. The maturity model is based on the Plan-Do-Check-Act -cycle, and consists of five stages. The first maturity level is Initial, assessing the starting stage of the organization. The second phase is Planning, starting the cycle by grouping activities that are considered as the first steps in energy management. The next level is Implementation, based on the Do-step, focusing on taking improvement measures. The Fourth stage is Monitoring, based on the Check-stage, and including tracking the impacts of the measures taken. The last level, based on the Act-step, is acting on the further improvements or corrections. After creating the model, the compatibility with ISO 50001 requirements was mapped. The model is regarded as complete, as every requirement in the model was found in the ISO 50001 requirements. However, there were four requirements in the ISO 50001 that could not be mapped to the model due to the insignificance in the literature. It is concluded that The Energy Management Maturity Model will lead in organizations to improved energy performance that signifies economic gains, image improvements, and compliance with regulations. It offers an incremental path for energy management that will assist in achieving compliance with the ISO 50001. (Antunes et al., 2014.)

2.4.3 Plan-Do-Check-Act

Management systems generally follow the principle of continual improvement presented as the Plan-Do-Check-Act –cycle (PDCA). The ISO 50001 and the EES+ make no exception and utilize the cycle as the grounds of the systems. Moreover, the requirements of the Act on Energy Efficiency can be situated in these different phases even if it is a formal law instead of a management system framework. It is required in the law that the energy audits, and the energy efficiency improvement measures included in it, are conducted at least every four years. This inevitably leads to continual improvement of energy efficiency, which is in the essence of the energy management systems as well.

The PDCA or PDSA (Plan-Do-Study-Act) cycle starts with the Plan-step. It includes for example identifying the goal or purpose, defining success metrics, and formulating a theory. The following Do-step involves implementing the components of the previous steps, such as manufacturing a product. In the case of energy management systems, the Do-step could be for instance implementing the energy efficiency improvement measures. The third step is Study, or Check, where the results are monitored and analyzed in order to identify progress or on the other hand, problems and improvement areas. The last step, Act, closes the cycle, summarizing the previous steps, too. The learning can be utilized to modifying the goal, changing the methods or even to reformulating the theory. After the last step, the cycle begins again leading to continual improvement. (The W. Edwards Deming Institute, 2015.)

Figure 2 PDSA Cycle (The W. Edwards Deming Institute, 2015)

2.5 Integrated management systems

Despite the interrelatedness of environmental- and energy management systems, the academic research has little explored the issues concerning the integration these two systems. However, there are researches available of integrat-

ed management systems in general and some results will be presented in the following chapter.

Wilkinson & Dale (2002) conducted a literature analysis on the models of management systems integration and revealed five key issues related to it. Firstly, they found two differing definitions used for the integration concept. The first approach is integration as alignment, mainly focusing on merging the documentation through similarities in the standards. The other approach is seen as implementing an integrated system, mainly through Total Quality Management (TQM) approach. Secondly, usually the standard writers have not favored integration into a single standard. Nevertheless, despite the lack of compatibility companies have merged their documentation in order to reduce costs. Thirdly, the scope of the systems is more important than thought, as differences may hinder the integration of the systems. Fourthly, even if TQM approach could bring more substantial benefits, the focus has been on alignment approach in the hope of cost reductions. Fifthly, the company culture could enable the improvement of performance, but it has not been addressed in the standards or the system concepts. Consequently, the writers suggest that differences in the scope of the standards enable the emergence of sub-cultures. Therefore, the development of one culture would be an important requirement of the IMS as it enables the improvement of performance at the same time. (Wilkinson & Dale, 2002.)

Differing from the two proposed integration aspects, Jørgensen et al. (2006) indicate in their study three different approaches in integrating management systems. They concentrated on integrating the following systems: quality management system ISO 9001, environmental management system ISO 14001, occupational health & safety management system OHSAS 18001, and social accountability standard SA 8000. The differentiated levels of integration identified are *corresponding, coordinated and coherent, and strategic and inherent* integration. *Corresponding* integration means increasing the compatibility between parallel systems for example with cross references or a common handbook. This integration method can bring benefits for example in saving time and resources, and securing alignment between the demands of different standards. In addition, it can reduce both confusion and duplication of tasks proposed by different standards. As an alternative in reaching the same benefits, the authors suggest building the systems on active employee participation. This in turn could make the system more fit to the organization, and to secure simultaneous implementation. *Coordination* in turn is based on an understanding of generic processes in the management cycle (the plan-do-check-act -cycle): policy, planning, implementation, checking and corrective action, and management reviews. This aspect possibly offers benefits in recognizing the responsibilities, examining synergies and trade-offs, aligning policy, objectives and targets. Coordination could offer solutions with regard to managing tasks and projects in different functional units and departments. As for integration as a *strategic and inherent* approach it is considered as the highest level of integration, requiring a throughout embeddedness in the organization. In this view, a culture of learn-

ing, shareholder participation and continuous improvement of performance should be realized. Thus, the focus should be in customer-based quality, product-oriented environmental management, and corporate social responsibility. This approach could offer solution to problems with regard to continuous improvement, such as improving competitive advantage and contributing to sustainable development. The challenges in creating this kind of institutionalized system include issues such as management commitment, employee motivation and participation, and overall changes. Even if the last integration aspect would represent the most thorough approach and would offer the most benefits, the authors nevertheless stress, that various organizational matters have a decisive influence on whether or not to integrate and on what level. These issues are for example the organization's structure, size, and regulatory demands. (Jørgensen et al., 2006.)

The target company operates on a business sector, the healthcare industry that is highly guided by rigorous regulatory demands on quality. Thus, it would not be reasonable to implement environmental management system in such a high detail as the quality management system is carried out. Therefore, the highest level of integration Jørgensen et al. (2006) propose would not be advisable either to perform. However, if EES+ is chosen to be implemented, it could be smoothly embedded to the ISO 14001 right from the start in order to achieve in integration at least the level of coordinated and coherent.

3 RESEARCH METHODS AND DATA

3.1 Qualitative case study

This study is realized as a qualitative case study. According to Hirsjärvi, Remes & Sajavaara (2010, p. 136), qualitative and quantitative studies are research approaches that are difficult to precisely differentiate. They do not exclude each other but can rather be complementary methods in a research. (Hirsjärvi, Remes & Sajavaara 2010, p. 136.) Eskola and Suoranta (2001, p. 13) further define qualitative research as non-numerical description of data and analysis. Following features are typical for a qualitative research: research data is in text form, the research proposal has a process character changing along the research process, and data sample is rather small and the aim is at analyzing it as deeply as possible. Compared to a quantitative research, qualitative approach does not have hypothesis, that is, presuppositions about the research subject or results. (Eskola & Suoranta, 2001, p. 13-20.) Qualitative research approach was a natural choice for this study, as the aim of the research is to find the best solution for the target company to meet the obligations posed by The Act on Energy Efficiency. Therefore the focus is on one specific phenomenon in one specific company. In addition, the research data is in text form and narrow enough to be analyzed deeply.

In a case study the research is focused on one or multiple cases, and the aim of the research is to define, analyze, and solve these cases. A case study is rather a research strategy and approach than just a data collection or analysis method. Typically in a case study the research phenomena share common time, place, or other criterion. (Eriksson & Koistinen, 2005, p. 4.) Yin (2009, 18) similarly defines a case study as a comprehensive research method, which can be more deeply assessed in a twofold manner. The first part assesses the scope of the case study, where a contemporary phenomenon is studied deeply in its real-life context, and where the boundaries between context and phenomenon are not clear (Yin, 2009, p. 18). In this study, the case is the compliance of a large enterprise in healthcare industry with the Act on energy efficiency. Following

the definition, it is a contemporary phenomenon as the Act was only enacted from the 1st January 2015 and this study is conducted during the year 2015. The case is indeed situated in a real-life context that is formed for example from the case's wider cultural environment, industry, operational environment or political situation (Eriksson & Koistinen, 2005, p. 7). There is not one universal solution that large enterprises could follow when they ponder on how to best meet the obligations of the Act. Each company is different; they have different kind of internal procedures and processes to manage energy efficiency, and for example the economic situation may vary considerably not only along the company, but also depending on the industry and therefore impact on the most suitable solution. In this case the context would be for instance the internal procedures that are already in place for energy management, and in a wider sense the industry's and Finland's unstable market situation where financial aspects are even more emphasized in the target company. Setting is part of the context, the concrete scene where the case takes place. It can be perceived as a stage where the case comes true. (Eriksson & Koistinen, 2005, p. 8.) In this case, the setting would be the target company and the actors in it. The outer setting would be the healthcare industry in Finland in addition to the industry in Europe as the law is based on the European Union directive on energy efficiency.

The second part of Yin's (2009, p.18) definition of case studies discusses the technical aspects of the research. Case study research assesses a technically distinctive situation where there are more variables of interest than data points. Case studies may utilize several sources of evidence and benefits from prior development of theoretical propositions that could guide data collection and analysis. (Yin, 2009, p. 18.) In this case, the data is gathered from multiple sources in order to investigate both research questions. The first question concentrates on the requirements, therefore the actual contents of the law and the EES+ standard are main data sources. The second research question investigates the resources needed to fill these requirements. The data sources utilized in this question are for example the organization's internal reporting system, reporting data from the ISO 14001, and a meeting where the hours needed were assessed. The data on one hand aims at explaining what has been done in the organization previously that would fill some of the obligations, and on the other hand assess how much fulfilling the rest of the obligations would cost.

Defining the case of this study more comprehensively, within the case it is researched, what requirements the different options would pose on the target company and how fulfilling these requirements would cost. Consequently, the options considered are: 1) performing energy audit as the law requires, 2) implementing and certifying EES+ energy management system with the ISO 14001 environmental management system in place, and 3) implementing non-certified EES+ energy efficiency system with the voluntary energy efficiency agreement. The target company is already a part of an energy efficiency agreement, thus it would be possible to implement EES+ system without certifying it. Practically, the differences between the options involving EES+ (certified or non-certified) are the supervising authority and costs. If the EES+ is certified with ISO 14001,

the enforcement authority is the certifying organization. If EES+ is utilized with the voluntary agreement, the Finnish energy authority supervises the implementation and may conduct random inspections. If the EES+ is certified, it produces evidently auditing and certification costs. The last exemption possibility the law offers, implementing and certifying ISO 50001 energy management system is left out of the comparison. This is due to the strict time limit the law poses: whichever option is chosen to be implemented, it has to be fully compliant by 5th December 2015. ISO 50001 is the choice with the widest scope, therefore in practice it would be the most difficult choice to implement due to the time limit. In addition, already the certification and auditing costs (based on an official offer) were significantly higher than those of the EES+, so this option was decided by the target company to be excluded from the comparison.

A comparative analysis method is used when similar cases or individuals are studied, but these cases nonetheless have differences. In a comparative analysis, these differences are assessed in order to explore the structure that produces the differences. The method is well suitable for exploratory research where the researcher aims at developing a more general invariance from the initial cases, for example to prove development or causality. Comparative method can be applied to the whole research structure or only to compare details alongside other methods. (Routio, 2007.) In this study, the cases compared are the different options that were presented earlier. Both research questions include comparison: first comparing the requirements, then comparing the resources needed.

3.2 Data

The data is formed firstly of the requirements of the EES+ system and of the Act on Energy Efficiency including the additional statutes. Secondly, in order to investigate the costs that each option would demand, additional data is reversely utilized to explain what has been done before. Multiple data sources are utilized for this means: for example organization's internal databases and reporting system, the material from Motiva's seminar "EES+ or the mandatory energy audits?", and the reporting data of the existing ISO 14001 standard. A more detailed list of data sources is presented in table 1. The data is mostly secondary data that is produced for other purposes than for this study. The only primary data utilized in this study is the assessment of hours required to fulfill the requirements of the options. This meeting included the EHS Manager and the Facility Manager of the company besides the researcher as is referred in the results as 'the meeting'.

The voluntary energy efficiency agreement reporting and the ISO 14001 reporting are completed regardless of the law, hence complying these obligations would not cause extra requirements or demand extra resources than what has been needed so far. Therefore these reporting materials aren't included in the comparison as such. Only part of the reporting material of the ISO 14001 is

utilized when assessing the second research question about the need of resources, as some energy efficiency related aspects are already included in the environmental management system. The following table presents the data utilized, divided in internal and external data.

Internal data	External data
ISO 14001 environmental handbook and appendices: Significant environmental aspects 2015 Environmental program 2013-2015 Management review 2015	The Act on Energy efficiency 1429/2014, and statutes 20/2015 (about energy audit) 41/2015 (about focused energy review reporting)
Other ISO 14001 material: EHS policy Internal audit checklist	Energy authority's compilation report template
The meeting where the hours needed were assessed on 11th August 2015 with the researcher, EHS Manager, and Facility manager	Energy efficiency system EES+ requirements and question list
EHS awareness -course material	EES+ or the mandatory energy audits? –seminar, organized by Motiva on 19th May 2015: Presentation by Helena Kunttu
Document management system	Enterprise energy auditor course information (Motiva's website)
Management of Change –checklist	Energy authority's email on interpretation of the law on 5th June 2015
Certification company's offer	
Focused energy review report from 2011	
Internal EHS-reporting system	

Table 1 Data sources

3.3 Data analysis

The aim of qualitative research analysis is to produce new information of the research phenomenon, and to create clear information on a fragmented material (Eskola & Suoranta, 2001, p. 137). That analysis method should be chosen that best brings up the answer to the research task or dilemma (Hirsjärvi et al., 2010, p. 224). However, the choice is not always easy to make, in particular in beforehand. The analysis can bring up issues that were not considered before defining

the research task. On the other hand, it is possible that not all research questions could be answered based on the data.

Tuomi & Sarajärvi (2002) present a basic qualitative research analysis description based on Timo Laine's structure. *The first step* is to make a strong decision on what is interesting in the data. *The second phase* is to first go through the material and mark the issues that are included in the interest, then to leave everything else out of the study, and to collect the marked items together separating them from the remaining data. *The third phase* is to classify, thematize or categorize the data. *The fourth and last phase* is to write conclusions. This analysis description also presents the pitfalls of qualitative analysis. It is noteworthy that usually in the analysis phase, several interesting issues are discovered and these might get in particular an aspiring researcher confused. It is better to choose a very narrow research phenomenon, and tell everything that the data suggests about it. The second phase is usually referred as transcription or coding. The third phase is often understood as the actual analysis despite the fact that it could not be conducted without the previous step, and on the other hand this phase alone without conclusions would not be meaningful. Classification is seen as the most straightforward way to organize data. In its simplest, the data is divided into categories and then counted how many times each category occurs in the data. Thematic analysis can be similar to categorizing, but the content of each theme is emphasized. In categorization the data is organized in certain groups. (Tuomi & Sarajärvi, 2002, p.93-95.)

3.3.1 Content analysis

Content analysis is a basic analysis method that can be utilized either as a single method or as a loose theoretical framework. Kyngäs and Vanhanen (1999, p.93 cited by Tuomi & Sarajärvi, 2002, p. 105) describe content analysis as a method that enables a systematic and objective analysis of documents. In this case a document can be for example a book, an article, a diary, a speech, a report, or almost anything written material. Content analysis aims at getting a description of the research phenomena in a condensed and general form. By using content analysis, the data can be organized for conclusions. This is often the reason why researches conducted with content analysis is criticized: the researcher has managed to describe the research with high detail but has not been able to draw conclusions but instead presents the organized data as results. (Tuomi & Sarajärvi, 2002, p. 93-105.)

It can be said that many different analysis methods are based on content analysis, if it is understood as a loose theoretical framework of analyzing written, heard, or seen material. Therefore, content analysis cannot be considered solely as a qualitative research method. Consequently, there are two different directions in the content analysis: *quantitative* and *qualitative*. Quantitative content analysis is basically quantification of the content, for example calculating how many times a certain issue or theme occurs in the data unit (for example an interview). Qualitative content analysis aims at finding meanings of the texts, for example what the above-mentioned issues or themes would retain. Tuomi

gives a describing example of utilizing both types of content analyses. The references of researches and master's theses were classified according to language and status (e.g. reviewed articles, published researches, textbooks). Then from each research, the amount of references from each data group was calculated. This gave the quantification but did not reveal how those references were utilized. For example, the reference list might look very impressive, but in the end, the theoretical understanding can rely heavily only on a few academically questionable sources. In the latter example, qualitative content analysis revealed essential information that quantitative content analysis could not have provided alone. (Tuomi & Sarajärvi, 2002, p. 93, 106-109.) It can be seen that qualitative content analysis is very similar to thematic analysis where data is similarly categorized into groups, themes. However, purely thematic analysis would not have provided answers to both research questions so content analysis method was chosen.

Furthermore, content analysis can be divided into inductive, theory-guided, and deductive reasoning. Inductive analysis is based on the research task. The inductive method rests on interpretation and reasoning, where the goal is to form a conceptualized impression based on grouping and abstracting the empirical findings. Theory-guided content analysis is similar to the inductive method, but the difference lies in the abstraction phase: abstraction is not solely based on the empirical data, but the data is linked to existing theoretical concepts. Therefore the concepts are not created from the data but found as already existent. On the other hand, deductive reasoning and the conceptualization is based on a former theoretical framework. In this case, the analysis is guided by a theme or concept map and everything outside it are left out of the analysis. This is suitable for example when an existing theory of concept system is tested in a new context. (Tuomi & Sarajärvi, 2002, p. 110-117.) In this study it is neither easy nor meaningful to clearly indicate, which method is followed, except that it is not deductive. The analysis method used has features from the inductive method as the analysis is strongly guided by the research task and questions. On the other hand, the requirements of the options compared could be regarded as already existing theory that guides the interpretation; therefore the analysis has features from the theory-guided content analysis as well.

The data analysis is conducted by following loosely the inductive analysis phases Miles & Huberman (1994, as cited by Tuomi & Sarajärvi 2002, p. 110) present: 1) simplifying the data, 2) grouping the data, 3) abstraction. First the data needed for the first research question was gone through carefully in order to form a clear picture of the requirements of the law and the EES+ system. In addition, from the Act on Energy Efficiency, only relevant parts were selected, cutting out chapters 4 and 5 that do not oblige the target company. The excluded chapters include obligations for companies selling or supplying electricity, district heat or cooling, or fuels. Then an excel sheet was compiled to map the requirements. In the excel table, the requirements were first roughly divided into similar categories. After this, the hours needed were estimated in the meeting. Finally, the requirements were in detail cut up to smaller categories that

were grouped to main categories along the Plan-Do-Check-Act -phases. After this, it was noticed that the division of hours did not completely match the smaller sections. Therefore the hours were divided to match the smaller sections and the changes were checked and approved by the EHS Manager. In the meeting where the hours needed were estimated, there were present the EHS and Facility managers of the target company who were well aware of both what had been done before for energy management and what kind of documents could be utilized as proofs. Therefore, only after the meeting the rest of the data was gathered mostly from internal documentation, and the second research question could be analyzed. Lastly, besides the hours converted to monetary costs, other costs were collected from applicable sources.

4 RESULTS

Presenting the results proceed in the order of the research questions. In the first part of the analysis the requirements of the Act on Energy Efficiency and the EES+ system are assessed. In the second part, the measures and resources needed are discussed. The sections' internal order proceeds along the Plan-Do-Check-Act –cycle and the smaller categories identified. In the first part of the results citations [EES+, Law] are presented from the requirements of the EES+ and the law in Finnish. The citations are not directly translated as the precise meaning would be very challenging to maintain. However, all the requirements are paraphrased in the analysis. An additional symbol [(…)] is utilized to indicate an extraction of text.

The analysis is structured based on the Deming cycle's four phases: Plan-Do-Check-Act. The EES+ system's undermining principle is continual improvement and it utilizes the PDCA-cycle as well. However, the requirements in the standard are not structured in a PDCA-process based order. Hence, the implementation of the option could be easier if the requirements were structured based on the order the actions should be performed. Furthermore, even if the text in the Act on energy efficiency is very formal, the requirements are similar then those of the EES+. As the law requires performing energy audit and the related focused energy reviews every four years, it should lead to continual improvement on energy efficiency. Thus, it can be argued that the law is as well based on the idea of continual improvement, and the requirements can be categorized under Plan, Do, Act, and Check -phases.

4.1 Requirements

In this chapter, the first research question "*What similarities and differences requirements in each option include?*" will be assessed. The options considered are the requirements of the EES+ and the Act on energy efficiency. The requirements of EES+ are the same regardless of whether the system is certified (com-

bined with ISO 14001) or not (combined with the energy efficiency agreement). Therefore, in this phase of the analysis the two options including EES+ system are discussed as one. The requirements of ISO 14001 or energy efficiency agreement are not discussed at all, since both of them have been utilized already several years and they are kept up-to-date regardless of the decision in energy efficiency law compliance.

4.1.1 Plan

EES+	Law
Energy planning Energy audit Objectives and targets	Energy audit
Energy policy	
Responsibilities	Responsibilities
Procedures	

Table 2 Requirements for the Plan-phase

4.1.1.1 Energy planning

Energy planning is a central part of the EES+ requirements. It includes energy audit activities, corresponding to the energy audit of the energy efficiency law. In addition to the energy audit, the energy planning activities include setting objectives and targets. The EES+ states that energy planning process should lead to energy efficiency improvement measures. Additionally, the energy planning should be documented and in line with the energy policy.

4.1.1.1.1 Energy audit

General requirements of the energy audit in the EES+ state that the organization shall implement, maintain, and develop energy audit activities that analyze the whole organization's energy consumption and the functions impacting on the energy efficiency, energy efficiency improvement possibilities, and energy savings. In addition, the energy audit should be updated periodically, as well as the decisions on significant changes of the facilities, appliances, processes or systems. Correspondingly, the law states that the energy audit is mandatory to large enterprises and it has to include focused energy reviews in order to form a clear picture of total energy efficiency of the company, and to be able to state the most significant improvement possibilities.

There are several subcategories of requirements in the energy audits: energy use analysis, focused energy reviews, metering, and energy efficiency improvement measures. First, the energy use analysis is assessed, which is demanded by both the standard and the law. According to the EES+, the organization should practice energy audit activities that analyze the whole organization's energy use and -consumption based on metered or other data. On the other hand, the law defines the analysis more specifically. The energy audit should be performed to the whole organization containing a review on all the

functions including buildings, industrial and commercial activities, and transportation, and their energy consumption profile. It can be noticed that the law does not directly imply on analyzing the energy consumption, instead only demands the energy consumption profile that in practice necessitates the analysis. In addition, the law specifically implies that all the functions have to be considered, including transportation. The EES+ requirement is vaguer in this as it only states the whole organization but does not specify what is included.

> Law: Yrityksen energiakatselmus tehdään koko konsernille tai yritykselle, ja se sisältää katsauksen yrityksen kaikista toiminnoista, mukaan lukien rakennukset, teollinen toiminta, kaupallinen toiminta ja liikenne, sekä niiden energiankulutuksen rakenteesta.

With regard to the focused energy reviews, the EES+ and law requirements differ in the scope significantly. The EES+ only demands to review those activities that may have an impact on the energy efficiency, and based on the energy use analysis to recognize the parts of the organization that have a significant impact on the energy use including facilities, appliances, systems, and processes. There are no specific requirements on the number of the focused energy reviews. As for the focused energy reviews of the law, detailed requirements are set on the contents and on the number of the reviews. The target has to be reviewed comprehensively and independently in order to form a clear picture of the energy consumption and its profile, energy costs, and total energy efficiency. Furthermore, the law has very detailed requirements on what and how many areas have to be reviewed. The focused energy reviews should be concentrated on areas that either have the highest energy consumption or where energy efficiency should be most improved. In addition, the focused energy reviews have to be conducted in minimum every four years and thus, the areas that have not been audited within four years have to be prioritized. The focused energy review has a slight moderation compared to the energy use analysis, as the transportation does not have to be reviewed.

> Law: Kohdekatselmuksia on tehtävä mahdollisuuksien mukaan yrityksen erilaisiin energiankäyttökohteisiin, keskittyen kuitenkin niihin kohteisiin, joissa energiankulutus on korkein, sekä niihin kohteisiin, joissa energiatehokkuudessa on eniten parannettavaa. Jos tietylle kohteelle on tehty kohdekatselmus neljän edeltävän vuoden aikana, tulee ensisijaisesti tehdä kohdekatselmuksia yrityksen muihin kohteisiin (...). Kohdekatselmusta ei tarvitse tehdä lentokoneille, laivoille, junille ja autoille.

While the EES+ does not include any requirements on how many focused energy reviews should be conducted, the law regulates this very precisely. At least one focused energy review should be included in the energy audit, unless there is not a single energy use area where it would be appropriate or economically justified. The focused energy reviews should cover at least 10 percent of the company's or concern's total energy use. All forms of energy are taken into account. If the company is renting the site's facilities, only the consumption that is paid based on metering is taken into account. The total energy consumption does not have to include transportation, which is an interesting point since the transportation had to be included in the energy use analysis. Nevertheless, when calculating the number of the focused energy reviews, the transportation's energy can be ignored in the 10 percent rule. The law enables also another

way of calculating the number of focused energy reviews. If the energy use locations are buildings or sites, the required amount of focused energy reviews can be calculated in a following manner:

> 1) if there are at the maximum 15 buildings or sites in the company or concern, at least one focused energy review must be included in the energy audit;
> 2) if the amount of buildings and sites is between 16 and 100, 10 percent of them have to be reviewed;
> 3) if the amount of buildings and sites is between 101 and 400, the amount of reviews is the square root of this number;
> 4) if the amount of buildings and sites is more than 401, 5 percent of them have to be reviewed; and
> 5) if the building's or site's own annual energy costs are less than 15 000 € or surface area is less than 500 m^2, it does not have to be taken into account when calculating the amount of required focused energy reviews.
> If the result of the calculation is a decimal, it should be rounded to the nearest integer.

Metering has been discussed in both options as part of the energy audit. The EES+ demands the organization to create an energy metering and monitoring plan that takes into account the size and special characteristics of the organization. It should contain an assessment of the metering need and its review in addition to a plan to calibrate and maintain the metering. The EES+ stresses that the metering way may vary considerably among enterprises from complex systems to simple operating measurements, and that the organization itself should determine the aim and method of metering.

> EES+: Mittaussuunnitelman tulee sisältää määrittelyt mittaustarpeesta ja sen katselmoinnista sekä suunnitelma mittausten kalibroimisesta ja huolloista. Kalibrointitietoja ja muita tapoja tarkkuuden ja toistettavuuden varmistamiseksi on ylläpidettävä.
>
> Huom. Mittaukset voivat vaihdella pienten organisaatioiden käyttömittauksista monimutkaisiin monitorointi- ja mittaussysteemeihin, jotka on liitetty ohjelmistosovelluksiin, jotka pystyvät yhdistämään dataa ja tuottamaan automaattisesti analyysejä. Organisaatio päättää itse mittausten tarkoituksesta ja mittausmenetelmistä.

In contrast, the law simply obliges companies to use reliable, up-to-date, and if possible metered and traceable operative information on energy consumption and energy use distribution. Moreover, it states that focused energy reviews must contain a sufficient amount of measurements but does not demand to complete a metering plan nor specifies what is a 'sufficient amount'.

Both the EES+ and the law oblige companies to identify energy efficiency improvement possibilities, and to perform calculations on these in order to prioritize them. Additionally, the EES+ asks the organization to maintain an energy efficiency improvement plan that should be updated yearly. With regard to the improvement possibilities themselves, the main difference between the options is that the EES+ enables the use of other potential energy sources such as renewable energy as an improvement measure. On the contrary, the law only considers the total energy consumption despite the energy source or quality. This interpretation derives from the Energy authority, it is not in the law as such. The law specifies that the improvement possibilities have to be individu-

alized in the focused energy review, and when calculating the savings, life cycle cost analysis must be prioritized when possible in order to take into account long-period savings.

> EES+: Energiakatselmusten toteuttamiseksi ja kehittämiseksi organisaation on: (...)
>
> c) tunnistettava, laskelmiin perustuen priorisoitava ja tallennettava mahdollisuudet energiatehokkuuden tason parantamiseksi
>
> Huom. Mahdollisuudet voivat liittyä myös potentiaalisiin energialähteisiin, uusiutuvan energian käyttöön tai muihin vaihtoehtoisiin energialähteisiin.
>
> Law: Kohdekatselmuksissa on yksilöitävä ehdotetut energiansäästötoimet sekä mahdollistettava yksityiskohtaisten ja todennettujen laskelmien tekeminen ehdotetuille toimille. Säästöjen laskemisen perusteena on mahdollisuuksien mukaan ensisijaisesti käytettävä elinkaarikustannusten analyysiä, jotta voidaan ottaa huomioon pitkän tähtäimen säästöt.
>
> Energy authority's interpretation on the law: Energialähteiden valintaan ei oteta laissa ollenkaan kantaa, eli kyseisiä toimia ei myöskään lasketa energiatehokkuutta parantaviksi toimenpiteiksi. Aurinkopaneeleiden tuottama energia tulee ottaa mukaan kokonaisenergiankäyttöä laskettaessa.

In addition, the minimum requirements of the focused energy review oblige that the focused energy review has to survey improvement possibilities that cost efficiently either improve the energy efficiency, or saves the energy costs of the review target. Moreover, the improvement possibilities should be clearly described, and reliable calculations must be made on the energy saving potential and profitability of the measure.

4.1.1.1.2 Objectives and targets

What is typical to all management systems, is setting the objectives and targets for the system. EES+ requires documented objectives and preferably measurable and scheduled targets and programs for energy efficiency. When setting the objectives and targets, the following issues have to be regarded: legal and other requirements, the most significant aspects of energy production and -use, the potential of the latest energy efficient technology, economic, business-related and other operational aspects, and the information from the previous years and the implemented improvement measures. In addition, it is important that the objectives and targets support the energy policy.

4.1.1.2 Energy policy

Yet another common feature for management systems is setting the policy. Consequently, the EES+ requires organizations to form and update an energy policy either as its own policy or as a part of an existing one. There are quite detailed requirements on the contents: it should determine the scope and limits of the energy management system, it should be suitable for the specific organization in terms of energy use and scope, it must include a commitment to continual improvement, the organization should commit to comply with legal and other requirements related to the energy production and -use, the organization should be aware of the policy, and the policy should set grounds for energy use monitoring and to define energy efficiency targets.

4.1.1.3 Responsibilities

Both the standard and the law include demands on commitment and dividing responsibilities. Nevertheless, the options take differing approach on organizing this. Primarily, the EES+ emphasizes the commitment of the top management who then give a mandate to a top management representative. He/she in turn is authorized to recruit energy management team, and is responsible to report to the top management and to ensure the functionality of the system. On the other hand, the law requires naming and qualifying one person, the enterprise energy auditor, who is responsible of the energy audit. He/she must pass a specific training and exam, in addition to having suitable education or work experience.

More specifically, the EES+ requirements demand the top management to show commitment to supporting the energy management system and continual improvement by:

a) Defining, creating, implementing and maintaining the energy policy
b) Naming the management's representative and accepting the formation of an energy management team
c) ensuring the necessary resources to form, implement, maintain, and improve the energy management system (including human resources, necessary skills, technology and economic resources)
d) Internally communicating the importance of energy management
e) Ensuring that objectives and targets have been set
f) Ensuring that results are metered and reported as scheduled
g) Conducting management reviews.

In regard to the top management representative, the top management has to name a representative(s) who has adequate skills and competence, and despite other responsibilities has the power and liability to ensure and manage several issues. The representative has to ensure that the energy management system is established, implemented and maintained, the principle of continual improvement is followed, and the energy management measures support the energy policy. He/she should identify person(s) to support him/her in measures concerning energy management, and define and communicate responsibilities and authorities to promote energy management. These points can be seen as referring to the establishment energy management team. In addition to these, the representative should report to the top management of energy efficiency and energy management system's performance, define criteria to ensure the efficiency of energy management and monitoring measures, and promote awareness of the energy policy and its objectives in all levels of the organization. Furthermore, there is a requirement in the EES+ standard concerning nonconformities, corrective and preventive actions. A person should be named, who has the power to investigate nonconformities and to start corrective and preventive actions. It would seem reasonable to combine this responsibility to the ones of the management's representative.

While the EES+ gives the opportunity to quite freely choose the management representative, the law lays down detailed obligations on the enterprise

energy auditor's competence. Surprisingly, the law does not state anywhere that an enterprise energy auditor has to exist in the organization, it only gives detailed requirements on the competence and registration. Consequently, only a person, who has a valid qualification and who has been registered in an enterprise energy auditor register can act as an auditor. The person should have a suitable education from the branch of technology, environment, or energy, or a compensating work experience in addition to a passed enterprise energy auditor training and exam. The company's own employee can act as the enterprise energy auditor as long as the mentioned conditions are fulfilled. The qualification and requalification is applied from and granted by the Energy authority, and it is valid seven years at a time. In case of requalification, the Energy authority either notes the maintenance of the professional skills, or requires a new accepted exam in order to grant the requalification. The Energy authority can withdraw the qualification if the person repeatedly neglects energy audit's minimum requirements or otherwise demonstrates to be invalid for the task. Furthermore, the Energy authority maintains an enterprise energy auditor -register, where the contact information, auditor number, and qualification period is recorded. Additional information of the performed energy audits can be recorded if so wished. An auditor has the right to get his/hers information from the register for free.

4.1.1.4 Procedures

The EES+ lays down requirements on documenting and creating procedures on numerous issues. These are collected under this section even if they concern other themes presented, since it seems more logic to have a clear list of issues that require establishing procedures, and because it would be useful to set the procedures before operating on the issue. First, the management representative should define the criterion and procedures to ensure the efficiency of the energy management activities and monitoring. Secondly, it is required that documents of external origin are to be identified and their management procedures have to be described in the operation procedures. Thirdly, the EES+ has a specific obligation for the company to create a procedure to identify and assess the compliance of the legal and other requirements (such as voluntary energy efficiency agreement) related to energy efficiency. These requirements have to be taken into consideration when the energy management system is implemented and maintained. Fourthly, the organization shall set a procedure to identify nonconformities in policy, objectives, agreed procedures, targets, and legal requirements. Fifthly, the organization should define and implement procedures to identify, search, and distribute records. Sixthly, the organization has to create a an internal auditing plan that includes the scope, criterion and procedures of the audit, the timeframe and responsible persons of the audits, the contents of the report, as well as the reporting method to the management and other parties.

4.1.2 Do

EES+	Law
Implementation	Implementation
Training, competence, and awareness	Training, competence
Communication	
Documentation and control of documents	Documentation
Other requirements	

Table 3 Requirements for the Do-phase

4.1.2.1 Implementation

The EES+ has little direct demands that would actually require doing or implementing issues. Similarly to other management systems, it mainly provides the framework, procedures, plans etc. that the organizations shall implement. Similarly in the EES+, there is neither a direct requirement to implement the energy efficiency measures. However, the EES+ states that the organization shall create, document and implement, and maintain and improve the energy management system as required in the standard. Furthermore, the organization should decide the methods on how it intends to fulfill the requirements in order to enable the continual improvement of energy efficiency. This clause can be interpreted as implementing the energy efficiency improvement measures, because without them it would seem unlikely that continual improvement would occur. Moreover, a clause in metering and monitoring demands to implement the metering plan.

As for the energy efficiency law, it does not either have requirements on implementing the energy efficiency measures. It only states that the focused energy reviews must be conducted in order to find improvement possibilities, and that a plan of improvement measures should be conducted, but it does not demand actually to implement those planned measures in any way.

4.1.2.2 Training, competence and awareness

The EES+ and the law have both requirements on training and competence of the ones involved in energy management. The EES+ requires that the organization must take care of the training and competence in particular of those people who may have significant impact on the organization's energy efficiency through their tasks or responsibilities. The training must include the energy management system's requirements on those parts that concern the person's work and influence, the energy policy and energy targets. In addition, the EES+ states that the management's representative's responsibility is to increase the awareness of the energy policy and -targets of the whole organization. Furthermore, the energy policy should be known by the personnel.

The requirements of the law on the competence and training mainly concern the enterprise energy auditor. As discussed earlier, the auditor must have

suitable decree or work experience. More specifically, the auditor must have in minimum bachelor's degree (or equivalent) from the branch of technology, environment, or energy. As compensative work experience at least three years' experience in energy-, production-, facility- or environmental expert tasks is accepted. The enterprise energy auditor training includes information on the energy audit legislation, energy audits, focused energy reviews, reporting, and the information that has to be reported to the Energy authority. With regard to the competence, the auditor can be requalified without retaking the exam if he/she has conducted an energy audit within the last four years and the audit was conducted when the person still had qualification.

4.1.2.3 Communication

The EES+ has several communication requirements dispersed throughout the standard. First, the top management's responsibility is to communicate the importance of the energy management in the organization. Secondly, the management's representative's responsibility is to communicate the responsibilities and authorities in order to promote efficient energy management. Thirdly, concerning the actual communication, the organization shall plan how energy issues are communicated and then implement the plan. It has to consist how, what, to whom, and when energy issues are communicated both internally and externally. Fourthly, regarding the nonconformities (in policy, objectives, procedures, targets and legal requirements), and the following corrective and preventive actions, the changes made have to be communicated in a defined manner.

4.1.2.4 Documentation and control of documents

There are plenty of documentation demands in the EES+ system and in the law. The EES+ asks for document different issues or procedures, but on the other hand the law asks for documenting the energy audit and the focused energy review. In the EES+ the documentation can be divided in two sections: the requirements on documentation and control of documents, and on records and control of records. In documentation, the EES+ demands first, to define and document the energy management system purview and boundaries. On the other hand, these were demanded already in the policy that could then act as the sufficient document. Second, the methods and criteria used in the energy audit have to be documented. Third, as presented in the previous chapter, the changes caused by nonconformities, have to be documented as well. Fourth, the objectives and targets defined, and the following programs for energy efficiency must be documented as well as the energy efficiency improvement plan that has to be updated yearly. Fifth, the actual documentation requirements demand to document the essential parts of the systems such as the policy, objectives and targets, scope, and their links to other documents such as the environmental management system. The requirements on control of documents have several specifications. The management procedures of documents and files have to be described in the organization's operation procedures (e.g. what, where, how, and how long information is collected and who is responsible). Additionally,

the documents of external origin have to be identified and the management procedures described. The essential documents have to be saved correctly and sufficiently, and in an easily findable form. The essential documents have to be reviewed periodically, updated if necessary, and approved.

In regard to the law, there are documenting requirements fragmentarily presented. These documentation demands concern the energy audit, the focused energy review, and the information that have to be reported to the Energy Authority. Nevertheless, all these required documents are also reports. Thus, they are discussed more in detail in Check-phase, chapter 4.1.3.4 Reporting as from the process point of view reporting is more checking than doing.

With regard to keeping records, the EES+ states that the result of metering and monitoring the essential features must be recorded. Second, records must be kept from the management reviews. Turning to the control of records, it is vaguely stated that the organization must create and maintain such records that prove the compliance with the energy efficiency system requirements, and that prove the achieved energy efficiency results. It is not explained further, what these records might be but on the other hand they seem to be linked in the aforementioned records from metering and monitoring. For example, when the system is monitored and energy consumption metered, and if the result is that the consumption has decreased, this would prove the achieved energy efficiency results. Furthermore, the compliance with the energy system requirements could be proved for instance with records from internal audits (that are assessed later in detail). Moreover, the organization shall define and implement a procedure to identify, retrieve, and deliver the information. The records must be and stay as readable, identifiable, and traceable.

In regard to the law and demands on records, there are some demands. First, concerning the energy use consumption and distribution, the data have to be recorded for historical analysis and performance monitoring. In addition, there is an interesting reverse clause with regard to the energy audit: there shall not be clauses prohibiting transferring the audit information from the company to third parties.

4.1.2.5 Other requirements

The EES+ includes some miscellaneous obligations that are classified under this chapter. First, the energy efficiency improvement possibilities and energy consumption have to be assessed when doing modifications in such facilities, appliances, processes or systems that can significantly impact on the energy efficiency. Primarily the savings calculations should be conducted using life cycle cost analysis. The results of this energy efficiency evaluation should be recorded, and utilized when applicable, in project specifications, planning, and procurement. Second, the procurement should inform suppliers that procurements are evaluated based on energy efficiency, if the energy service, appliance, or product can have a significant impact on energy usage. These requirements broaden the scope of energy management to future activities, so that energy efficiency would become more proactive instead of reactive. In addition, energy management is extended downstream the supply chain, since if the procure-

ments are evaluated partly based on the energy efficiency, it should evidently encourage manufacturers to develop more energy efficient appliances or services.

4.1.3 Check

EES+	Law
Consumption monitoring and analysis	
Management review	
Internal audit	
	Reporting

Table 4 Requirements for the Check-phase

4.1.3.1 Consumption monitoring and analysis

The EES+ has several requirements on how to check the energy management system functionality and performance. The organization has to ensure that the essential features for the energy efficiency level are monitored, measured and analyzed periodically. In minimum these essential features include the significant energy usages and other essential outcomes of the energy audit, other significant variables on energy use, energy efficiency indicators, and a comparison between expected and actual energy consumption. In addition, the when metering plan was established in chapter 4.1.1.1.4 Metering, it is here stated that the organization should periodically define and review its needs for metering. It has to be checked that when metering the central features, the appliances used produce accurate and repeatable data. In order to assure the accuracy and repeatability, the calibration information and other measures must be maintained. These measures should be documented as well.

4.1.3.2 Management review

The EES+ has specifications on conducting management reviews. Even if the law has requirements on enterprise energy auditor, it does not have demands on top management commitment or management reviews as the EES+ has. Consequently, according to the EES+ the management's representative's responsibility is to report to the top management about energy efficiency and energy management system's performance. Management review needs to be conducted at least yearly by the top management in order to ensure the suitability, adequacy and effectiveness of the energy efficiency system. The conclusions and the decided action plan should be clear in the results of the review. There are several requirements on what has to be reviewed:

a) An overview of previous management review's actions
b) Reviewing the results of internal audits
c) Reviewing compliance of legal and other requirements
d) Reviewing the energy policy
e) Reviewing the compliance of agreed procedures and decisions including ongoing action plans and programs

f) Reviewing the suitability of energy performance indicators and whether the metered results are in relation with the targets
g) Reviewing appropriateness of the energy efficiency system
h) Ensuring that necessary information is gathered for evaluating the energy efficiency system
i) Deciding the targets and measures for the next period.

4.1.3.3 Internal audit

Similarly to the management review, the EES+ requires to keep internal audits on a regular basis but in minimum yearly. If the system is integrated with other management systems, that system's internal audit should also include energy issues. The goal of internal audits is to assess the fulfillment of the continual improvement principle, and to produce information for the management about achievement of the objectives and targets. The audit should assess whether the energy efficiency system is appropriate to control energy issues, what updates are needed, and whether the system is implemented and maintained as agreed.

4.1.3.4 Reporting

In contrast to the EES+, the law does not demand direct procedures to check the functionality or compliance of the requirements. Instead, it has extensive reporting remands that can be regarded as checking the compliance as the reporting demands could not be fulfilled without performing the actions themselves. Therefore, compiling the reports at the same time ensures the compliance. Moreover, the law has reporting requirements concerning the energy audit, the focused energy review, and the information that has to be reported to the Energy authority. With regard to the energy audit, its reporting demands are left most open and the form of the report is not specified. The energy audit should contain the focused energy review's essential results and the most significant energy efficiency improvement measures. If possible, the audit should contain a plan and schedule for the future focused energy reviews that are going to be included in the next energy audit. An energy audit report has to be compiled after the energy audit. The reports have to be kept for 10 years and the company should have an energy audit report that is in maximum four years old.

In regard to the focused energy reviews, reports should be written of them as well. Also these reports have to be kept at least 10 years. Additionally, the company has to report from all the focused energy reviews the essential information to the register that the Energy authority maintains within three months of the completion of the report. The Energy authority has the right to have the actual focused energy review report upon request. The report has to be delivered within one month of the request, and it should not be older than four years.

Law: Yrityksen energiakatselmukseen sisällytettävästä kohdekatselmuksesta tulee tehdä kohdekatselmusraportti. Raportti tulee säilyttää vähintään 10 vuotta. Yrityksen on toimitettava kaikista yrityksen energiakatselmukseen sisällytettävistä kohdekatselmusraporteista keskeiset tiedot Energiaviraston ylläpitämään tai osoittamaan rekisteriin kolmen kuukauden kuluessa kunkin kohdekatselmusraportin valmistumisesta.

Law: Energiavirastolla on oikeus saada pakolliseen yrityksen energiakatselmukseen sisällytetyn kohdekatselmuksen raportti tarkastettavakseen. Raportti tulee toimittaa Energia-

virastolle kuukauden kuluessa Energiaviraston pyynnöstä, ja se ei saa olla neljää vuotta vanhempi.

In addition, there are direct demands on the contents of the focused energy review report divided in four sections. First section includes the basic information:

a) The name and business identity code of the obligated enterprise;
b) The target of the review and its specified name, address, and other possible location information;
c) Standard Industrial Classification (SIC);
d) enterprise energy auditor, auditor number, contact information, and employer;
e) the report completion date.
If the focused energy review is conducted to a company that is part of a concern, also that company's name and business identity code have to be included in the basic information.
If the target of the review is a building, the basic information should state the building type.

The second section includes the energy consumption and cost information:

a) The energy consumption, -cost information, and the type of energy of the target of the review;
b) In detail the distribution of the energy consumption in appliance groups or consumption areas;
c) Verbal description of energy costs, energy consumption and its distribution.
The consumption and cost information have to be presented from three full preceding calendar years as yearly consumptions and from the preceding 12 months as monthly consumptions if the information is available and it is appropriate.

The third section assesses describing the present state. The focused energy review has to describe on applicable sections the most significant energy consumptions and energy costs of partial loads or subsystems:

a) The need and use;
b) The energy efficiency of the system and appliance;
c) Control method, and its applicability and functionality;
d) setting method, and its applicability and functionality;
e) Operating parameters, and their applicability as set values and operating time;
f) Improvement possibilities of the energy economy.
The report should describe the energy consumption monitoring, the maintenance organization's operation related to energy economy, and the possible improvement measures.

The fourth section addresses the energy efficiency improvement measures. They have to be described so extensively and in detail that the company is able to make an implementation decision of the suggestions, decision of planning work aiming at implementation, or a decision of other required measures. The energy efficiency improvement suggestions have to include, where applicable, the following information:

a) A description of the measure;
b) The variable the change impacts on;

c) The variable value before, and after the suggested measure;
d) Energy consumption and the type of energy before and after the suggested measure of those energy types that are impacted;
e) Conservation estimate of energy types before and after the suggested measure;
f) An estimate of the measure's total investments including planning and implementation costs;
g) Profitability calculation of the measure;
h) Other possible impacts of the measure, such as impacts on the production rate, health impacts and maintenance costs.

Furthermore, the report has to describe that kind of improvement suggestions of which precise energy conservation or investment calculations cannot be presented.

Concerning the report that has to be delivered to the Energy authority's register (called as the compilation report), it has specified requirements on the contents and a specific form. The Energy auditor has provided a specific Excel-template for the report. The information included in the compilation report are the most essential information of the focused energy review. The relevant points for the target company are:

a) The company's basic information that had to be included in the focused energy review report;
b) The latest available information on energy consumption (MWh/a) and energy costs (€/a) classified by the type of the energy and by water (m3/a), as well as the examination year;
c) Description of the energy efficiency measures;
d) Estimated investment costs (€);
e) Information of the use technical aspects;
f) Estimated energy conservation (MWh/a) and cost savings (€/a) classified by the type of the energy and by water;
g) Profitability calculation as direct payback period (a) and information on possible life cycle cost analysis;
h) The state of implementation (implemented / approved / considered / discarded).

Other information demanded in the compilation report are not relevant for the target company as they concern for instance companies that produce or deliver district heat.

4.1.4 Act

EES+	Law
Nonconformities, corrective and preventive actions	Nonconformities, corrective and preventive actions

Table 5 Requirements for the Act-phase

4.1.4.1 Nonconformities, corrective and preventive actions

After implementing the system and checking its performance, the EES+ has set requirements on how to assess nonconformities and the following corrective and preventive actions. As presented in the Procedures-chapter 4.1.1.4, the company must set a procedure on how to identify the nonconformities (policy, objectives, procedures, targets and legal requirements). When nonconformities are discovered, the corrective actions have to be implemented and their performance monitored (by the responsible person that had to be appointed in the chapter 4.1.1.3). The corrective actions have to be in relation to the encountered problem, and they have to impact on the energy use. The changes made have to be documented and communicated.

With regard to the Act on energy efficiency, it does not have any direct requirements on nonconformities or corrective and preventive actions. However, if the report that is submitted to the Energy authorities is insufficient, or the authorities demand the energy audit of focused energy review reports, these could be seen as nonconformities that require actions. Consequently, the corrective actions could be either sending the necessary reports, or improving the report that was insufficient.

4.1.5 Deadlines

In addition to the requirements included in the Plan-Do-Check-Act –phases, there are requirements concerning the compliance deadlines of the options. These requirements did not seem to be part of the phases, thus they are assessed separately. The Act on Energy Efficiency directly states that a large enterprise has to perform an energy audit by 5th Dec 2015. Therefore, the optional compliance methods have to be performed by the 5th December as well. On other words, if the certified EES+ is utilized with the ISO 14001, the EES+ has to be certified by 5th December 2015. Similarly, if the noncertified is chosen with the voluntary energy efficiency agreement, the EES+ system has to be implemented in the organization by 5th December 2015.

Moreover, there are consequent time limits besides the first deadline. The law states that the energy audit must be performed every four years in minimum. However, the following deadlines related to the EES+ are no longer dependent on the energy audit cycles. As long as the company has a valid option in place, it is exempted from performing the energy audits. The time lines concerning the certified EES+ are different. According to Kunttu in Motiva's seminar, the certified EES+ system would need to be recertified by an external auditor every three years as the certification is valid only for three years at a time. In addition, compliance audits would have to be performed annually by an external auditor. In regard to the uncertified EES+ it does not have consequent time lines besides the initial compliance date as it has no audits. However, the company utilizing uncertified EES+ has to be prepared for Energy authority's random inspections that might occur any time.

4.2 Measures and resources needed

This part of the results assesses the measures and resources needed in order to fulfill the requirements of the law or the EES+ and consequently, seeks answers to the third research question:

1) What measures should be taken in each option, and how much would they demand in terms of resources? In this case resources refer to hours converted to euros, and to other possible monetary costs that may occur (e.g. the use of external contractors, certificate and audit costs).

Firstly, the measures and the hours needed are assessed, and secondly, other occurring costs. It is important to notice, that the hours are only estimates as the reality cannot be known before implementing the solution. In addition, the working hours are based on the principal that *only the extra work the requirement brings is assessed.* This is due to the fact that plenty of energy efficiency work is constantly performed in the organization regardless of the new requirements of the options. For example, when the law requires analyzing the energy use of the organization, the hours include only the time that is needed to gather and analyze information, not the time needed for metering as it has been done already to the extent that was necessary. Moreover, *the assessment of the hours of the EES+ includes both the certified and uncertified options* as the measures and the time needed are the same.

The estimation of the hours is primarily based on the meeting with the EHS Manager and the Facility Manager. In addition, the extensive internal reporting system, and ISO 14001 reporting material are widely utilized as they consist for example essential information on energy consumption and current reporting practices. The full list of data sources was presented in chapter 3.2 Data collection in Table 1.

Furthermore, not all the requirements presented in the previous section are assessed here as they may not cause direct measures or the measures are assessed in other topics. For instance, the law demands large enterprises to perform energy audits and it has to include a sufficient amount of focused energy reviews. This requirement does not pose direct measures as such, as the issues that ought to be included in the energy audit are regulated more in detail and in this analysis divided as separate measures, such as energy use analysis and focused energy review.

4.2.1 Plan

4.2.1.1 Energy planning

The EES+ required documenting the energy planning process, and as it hasn't been done before it was estimated in the meeting that the planning process and documentation would take 5 hours.

4.2.1.1.1 Energy audit

The energy audit as such does not require measures either in the EES+ or in the law. The issues required in the energy audit are separated in smaller sections below, and on the other hand some requirements do not necessitate measures, such as the energy audit must be performed in large enterprises.

The energy use analysis was required by both the EES+ and the law. Regarding the EES+ it was estimated in the meeting based on the internal reporting system that the energy use analysis requires approximately 10 hours. Consumption monitoring is currently made based on energy bills but a deeper analysis would require metering, and/or calculations based on appliance information. With regard to the law, the energy use analysis is basically differentiating the energy sources and different functions (such as buildings and transportation). This information is already available, so it was estimated that gathering and analyzing it would take four hours.

In regard to the focused energy review activities that were as a requirement both in the EES+ and the law, the hours differ considerably. In order to identify the most significant areas of energy use in the EES+, metering and systematic analysis are needed. In 2011, a comprehensive focused energy review was conducted to the whole facilities of the organization by an external consultant company. This review gave valuable information on for example the energy consumption differences between manufacturing and office areas, as well as on the most energy intensive systems. As the operations have not significantly changed after the 2011 review, it was estimated that not as extensive work is needed, and consequently, some of the information obtained from the review is still valid. So, all in all based on this previous review, and internal reporting information (energy consumption data), it was estimated in the meeting that focused energy review in EES+ would take 30 hours. With regard to the focused energy review of the law, it has so detailed requirements both on the contents and the performer (review has to be independently performed) that external consultant would be needed again. The external consultant company would perform the review (the costs are assessed later in chapter 4.2.5 Total costs), but it would additionally require internal workforce for example to gather and offer the necessary information for the consultants, and to escort the consultants when metering around the facilities. Therefore it was estimated in the meeting based on the previous review, that two working days, which is 16 hours, would be needed in this phase.

Concerning metering, the EES+ required a metering plan that is implemented. The facilities department does energy consumption monitoring already, and this process should be documented. It was estimated in the meeting that completing the metering plan takes two hours. As it was touched on in the previous paragraph, concerning the law, the metering is conducted by the consultants and included in the focused energy review. Therefore the law does not necessitate hours at this issue.

Energy efficiency improvement measures are planned and implemented constantly in the organization. The EES+ required the identification and priori-

tization based on calculations. These are already done in the facilities department, meaning no extra time is needed to find or implement them. Nevertheless, the process should be documented (for example who brings up the suggestions, makes the calculations and decisions). The information is based on the voluntary energy efficiency agreement reporting material, and the facility department's representation in the meeting. Therefore, it was estimated in the meeting that this issue would take two hours. With regard to the law, the improvement suggestions should be proposed and calculated by the consultant performing the focused energy review; therefore this assessing the measures would not require extra hours from the target organization. However, as the previous projects' information is needed as well, it was estimated in the meeting that it would take 2 hours of internal workforce to gather the data.

4.2.1.1.2 Objectives and targets

The objectives and targets was a requirement only in the EES+ standard. The current objectives and targets of the ISO 14001 system already include energy efficiency issues. However, the EES+ demands several issues to be considered when determining the objectives and targets, thus these should be checked and updated if necessary. For example the requirements of the voluntary energy efficiency agreement should be reflected in the objectives and the link made visible. It was estimated in the meeting based on the ISO 14001 reporting material that the check and update would demand 2 hours of work.

4.2.1.2 Energy policy

The organization has an energy policy, however it is outdated and does not include energy efficiency aspect at all. Based on the current environmental policy and the meeting, it was estimated that this would require one days' work that is 8 hours.

4.2.1.3 Responsibilities

Both the EES+ and the law had several, but differing requirements on energy management responsibilities. The EES+ demanded top management commitment and ensuring several issues in order to implement and maintain the system. Moreover, the criteria and means to ensure the effectiveness of energy management functions and monitoring had to be set by the top management. There is an existing environmental, health, and safety (EHS) management team in the organization that has scheduled meetings several times a year. This management team would act as supporting party to the system implementation, and the management review would be conducted in their meetings. It was estimated in the hours assessment meeting that ensuring the top management commitment and the issues included in it would require 4 hours of work. The estimation was based on the information from the EHS Manager. The 4 hours of work would include naming the top management representative, accepting the energy team establishment, and ensuring the required issues (such as necessary resources, goals, and objectives). In addition to the top management commitment, the EES+ had requirements on top management representative and the

energy team. As mentioned, the management reviews have been conducted already before so it is not a new requirement. In addition, an environmental team has been functioning earlier, so its scope should be broadened to include energy issues too. The requirements form only a few concrete measures that are still needed, such as naming the representative and team's responsibilities, and that the representative ensures for instance the implementation of the system. Thus, it was estimated in the meeting that this matter would require 2 hours. Furthermore, other responsibilities in the EES+ included for example naming the responsible person of the nonconformities, and corrective and preventive actions. As the EES+ would be integrated in the existing ISO 14001 system, its existing material is utilized. The environmental handbook of the ISO 14001 reporting material includes instruction on nonconformities and following actions, but some requirements of EES+ are not yet fulfilled. For example the person(s) who has the authority to solve nonconformities and initiate corrective actions has to be named. In the meeting it was assessed that updating the instruction in the environmental handbook to correspond the requirements would take 2 hours. Hence, altogether the responsibilities in the EES+ would require 8 hours.

In regard to the law, the responsibilities include only the enterprise energy auditor: naming him/her, training and exam, and certification from the Energy auditor. The training and exam would be organized by Motiva and it lasts 6 hours. The naming would take place in the EHS management team meeting, and the certificate application with necessary documents should be done as well. Hence, it was estimated in the meeting that in total these would require 8 hours.

4.2.1.4 Procedures

The EES+ has requirements on establishing procedures for numerous issues as presented in 4.1.1.4. Procedures. In the first part of the results, these procedures were assessed as their own section. However, in this second section most of the procedures are discussed along the matter concerned. For instance, regarding control of documents, the external documents have to be identified and procedures set in the organizational instructions. This requirement's hours are assessed along the other requirements concerning the control of documents so that hours could be assessed as a whole.

With regard to remaining procedures, fulfilling legal and other requirements of EES are well managed already in the organization. The organization yearly performs an internal environmental compliance audit to identify and update legal compliance. In addition, the company utilizes external service to obtain updates on changes in EHS legislation. Other requirements on energy efficiency in the target organization would include the voluntary energy efficiency agreement, and the company's internal energy efficiency goals. Both are already taken into consideration, therefore this section does not necessitate extra hours.

Concerning nonconformities, the organization should identify a procedure in order to recognize them. This procedure is already described in the ISO 14001 environmental handbook, hence this does not require extra hours.

In regard to internal audits, the organization was obliged to make an auditing plan. This has not been done before and it was estimated in the meeting that it would require 1 hour of work.

4.2.2 Do

4.2.2.1 Implementation

In regard to the EES+, the implementation included demands to for instance implement the energy management system as presented in the standard. This requirements is implementing basically all the discussed separate requirements. Hence, the implementation requirements in the EES+ do not form direct measures as they are assessed along other topics. The same applies to the measures of law, as the demand was to conduct focused energy reviews, and planning improvement measures (that were already assessed earlier).

4.2.2.2 Training, competence, and awareness

With regard to completing the EES+ requirements on training, competence and awareness the base exists already in the target organization. There is an EHS awareness course that all the employees must pass before starting working in the company, and after the first time it has to be revised annually. It can be completed independently in an e-learning environment. This course could be utilized in the energy efficiency and energy/environmental policy awareness of the employees. However, the energy aspect should be added in the training material. In addition, a more profound course should be tailored and given for those involved in energy efficiency functions, such as the facilities department and environmental/energy team members. Based on this information it was estimated in the meeting that updating the EHS-awareness -course material and compiling energy efficiency –course material would take 20 hours.

Regarding the law and its training requirements, the only demand was the enterprise energy auditor's qualification training that was assessed already previously in chapter 4.1.2.3 Responsibilities. Therefore no extra hours are allocated here.

4.2.2.3 Communication

In the EES+ there were demands regarding communication that have not yet been fulfilled. There is a cross-functional communication team in the organization that co-operates with the EHS-team as well. In addition, an internal EHS-newsletter has been sent about 10 times a year to the personnel by e-mail. This newsletter has already included energy-related communication for example during the national Energy Awareness week (annually week 41) and other periodical articles for example about facilities energy efficiency projects. Therefore the EES+'s requirement for top management's responsibility to communicate about energy management's importance could be easily fulfilled by giving this task to the communication team. Similarly the management's representative's responsibility of communicating the responsibilities and authorities of energy management could be given to the communication team. The team should

make a communication plan, more specifically add to the existing plan energy-related topics (such as the Energy Awareness week and energy management responsibilities) and define how, when, what, and to whom energy-issues are communicated both internally and externally. It was estimated in the meeting that updating the plan would require 2 hours.

4.2.2.4 Documentation and control of documents

The documentation requirements of the EES+ were collected as one list in order to form a clear picture of issues that have to be documented. In this assessment of resources, the hours needed are mostly included in the topic's demands. For example when the necessary hours were assessed previously for energy policy, it naturally included documenting the new policy. The same applies for updating the objectives and targets, and nonconformities etc. The only documentation requirement that is not included elsewhere, concerns the energy audit. The methods and criteria used in energy audits should be documented and the results of the audits recorded. The recording demand is rather self-explanatory as well, as the contents of the energy audit was previously discussed (e.g. energy use analysis, energy efficiency improvements) and the information has been documented already. Therefore the only issue necessitating hours is documenting the methods and criteria and it was estimated in the meeting that it would take one hour. Control of documents in EES+ included requirements on creating instructions on controlling documents (for example external documents, what and where is documented), and on reviewing documents. The company uses internal document management system, where documents are stored and controlled. The environmental management system documentation principles are described in the environmental handbook but they should be updated to comply with the EES+ requirements. Several points should be added in the principles, such as who is responsible of the documents, how long information is stored, and distribution of documents. Additionally, procedures for external documents should be determined. According to the environmental handbook the documentation is reviewed yearly in the management reviews, and this would be enough for the EES+ requirements on documentation reviews. Based on this information, it was estimated in the meeting that updating the control of documentation practices would take two hours.

As far as keeping records is concerned, the EES+ stated that monitoring and metering the central results must be recorded. This has been done by now already in the internal reporting system. Another demand concerned keeping records on management reviews, and the memorandums of the meetings have been recorded by now in the internal databases. Based on this, it was concluded in the meeting that no extra hours is needed for keeping records. With regard to control of records, it was demanded by the EES+ that the organization shall define and implement a procedure to identify, search, and distribute records. The records needed to proof the compliance of the energy management system and the achieved energy efficiency results. The document and record control procedures described in the environmental handbook are not sufficient to fulfill this requirement. In addition, the essential records needed as proofs should be iden-

tified and added to the list of environmental management system (ISO 14001) control of records. Therefore it was estimated in the meeting that the update would take two hours. Thus, documentation in total requires five hours.

In regard to the law, it had as well several documentation demands. Similarly to the EES+, the law demanded to record energy consumption and distribution data. As stated, the information has been already recorded in the internal EHS-reporting system so this does not require extra hours. Other documentation demands were reports that are assessed later in the Check-phase.

4.2.2.5 Other requirements

Other requirements in the Do-phase in the EES+ included planning activities that take into consideration energy efficiency improvement possibilities when designing new or renovating old spaces. The organization has a management of change –procedure in place, which basically is a checklist of issues that have to be checked when making changes in the facilities. In the checklist should be added a point addressing the change's impact on energy use and on energy efficiency. Another requirement was about informing suppliers of the importance of energy efficiency in procurements. This concerned mainly the facilities department and the issue has already been taken into consideration. However, the process should be documented. Based on the information presented, it was estimated in the meeting that one hour should be allocated in this section.

4.2.3 Check

4.2.3.1 Consumption monitoring and analysis

Consumption monitoring requirements in the EES+ requested monitoring energy audit results, central variables of energy use, energy efficiency indicator, and comparing expected and actual energy consumption. Energy efficiency indicators have been set already and they are presented and followed in ISO 14001 reporting materials. Also energy consumption is monitored monthly in the internal EHS-reporting system. If for example abnormal peaks occur, investigations are conducted to explore the reason. It was decided in the meeting that a more systematic and comprehensive monitoring plan would be realized and it was estimated that it would require two hours. The monitoring could be one potential task for the energy/environmental team.

4.2.3.2 Management review

Reporting to top management was required by the management representative, in addition to more detailed requirements of the contents of the management review. Along the ISO 14001, environmental reviews have been kept yearly and the reviews have included energy-related data. This information is based on the EHS Manager's information in the meeting, and the latest management review presentation from 2015. Nevertheless, not all the issues required by the EES+ have been gone through. Therefore, all the issues required by the EES+ on management reviews have to be added to the review agenda. It was estimated in the meeting that presenting energy related issues would require one hour of work.

4.2.3.3 Internal audit

The EES+ had detailed requirements on keeping internal audit in minimum yearly. Internal audits have been performed for ISO 14001, and a tool from the internal EHS-reporting system has been utilized. As the EES+ would be integrated to the ISO 14001, also energy issues should be assessed more in detail in the future. Along the EES+ system requirements, a set of evaluation questions was published by Motiva. This question list could be utilized in evaluation of the energy management system performance and therefore it should be added to the existing question list of ISO 14001. It was concluded in the meeting that merging the question lists would necessitate one hour.

4.2.3.4 Reporting

In regard to the energy efficiency law, it had several reporting requirements. First, a report of the energy audit should be conducted. A plan of future focused energy reviews was demanded to be attached to the energy audit. It was estimated in the meeting that compiling the report and the plan would require 12 hours. Second, a report from the focused energy reviews was demanded as well. Since the focused energy review would be conducted by an external contractor, the report would be the contractor's responsibility as well. Therefore no internal hours would be needed in this report. Third, a compilation report should be conducted. There is a ready Excel-template by the Energy Authority that has to be filled with energy audit information. It was estimated in the meeting that gathering the data and filling the table would require 10 hours. In all, reporting requirements of the law would demand 22 hours.

4.2.4 Act

4.2.4.1 Nonconformities, corrective and preventive actions

With regard to the EES+ requirements on nonconformities and the following corrective and preventive actions, a procedure has been set for assessing them already. This is included in the ISO 14001 environmental handbook. The person responsible for solving EES+ nonconformities was yet to be named, as it was discussed earlier along other responsibilities. Consequently, the hours were allocated there, thus no extra hours are needed here.

In regard to the law, the nonconformities were not defined in the Act. However, it was elaborated that if the Energy authority asked for detailed reports on the energy audit or focused energy review (that should be delivered only when asked), sending the reports could be seen as a corrective action. However, the hours needed for solving possible nonconformities were not elaborated on the EES+, as they or the resources needed cannot be known in beforehand. Thus, no resources are needed for this matter either.

4.2.5 Yearly update

In addition to the hours needed in the four phases, yearly updates are necessary for the EES+. The time frame for which the resources/hours needed are dis-

cussed is 4 years. This enables comparing the results between options, as the energy audit by the Act on energy efficiency should be performed only every 4 years. On the contrary, the certified EES+ should be recertified every 3 years in addition to the annual compliance audits. Therefore on the EES+ one full certification cycle of three years is considered, plus one extra year when only compliance audit is needed. Therefore it was estimated in the meeting that the hours needed to review the EES+ compliance is two hours per year. When that is multiplied with three years, it makes in total six hours. This time presents only the extra time needed to review the EES+ compliance, because it was discussed in the meeting that further updates are part of the everyday work since the EES+ would be part of the ISO 14001. For instance the environmental policy, and the objectives and targets have been updated and revised already along the ISO 14001, thus most updates would be done despite the existence of the EES+ system.

4.2.6 Total costs

In addition to the hours needed for the EES+ or for the energy efficiency law compliance, other resources are needed. In this section of the results, the total costs of the three options are assessed. Now the certified EES+ is separated from the uncertified one as the costs are not the same.

First, the costs of the certified EES+ are assessed. The hours needed to build and maintain the EES+ system explained in previous section, are in total 106 hours. The cost for one workday generally used in the target company is EUR 300, that makes an hourly cost for an eight-hour day EUR 37,50/h. Therefore the total cost of the workload is EUR 3 975. The principle of the EES+ certification cycle is that first, before having the certificate a certificate application must be done. It costs EUR 1 020 and covers the first year's certificate fee as well. The certificate fee for the three following years is EUR 1 080 each. After this, the certification audit takes place and as a result of this external audit, the actual EES+ certificate can be granted. The audits of the EES+ system costs EUR 1 550 per year. It does not matter whether it is the initial audit, or yearly compliance audit, the price is the same. There are three types of audits: the initial audit that is performed before receiving the actual certificate, the compliance audits that are performed in following two years, and then the third year's recertification audit. The EES+ system has to be recertified every three years as the certificate is temporary and granted only for three years at a time. In addition to these certification costs, the auditor charges EUR 20 office fee (per year), and travelling expenses. The travelling expenses are ignored in the calculation as an estimation of these was not received. All the price information is based on the auditing company's formal offer.

Second, the costs of the uncertified EES+ are estimated. The workload of building and maintaining the system is the same as in the certified EES+. Therefore the cost for this is EUR 3 975. In addition, it was mentioned earlier that the Energy Authority conducts random inspections for organizations utilizing uncertified EES+ as a compliance option for the Act on energy efficiency. There-

fore it was elaborated in the meeting that in case this random inspection would take place in the target company, it would require 20 hours input. This amount includes one day's work of two persons, and third person's half day as it was considered that the inspection would last for one workday. The persons needed would be the management's representative, energy/environment team's representative, and facilities department's representative for half a day would be needed. Therefore the extra 20 hours would cost EUR 750. Other costs for the uncertified EES+ would not occur as the audits or certificates would not be needed.

Third, the costs for the compliance of the Act on energy efficiency are assessed. The total hours assessed in the previous section were 52 that constitute EUR 1 950. In addition, the enterprise energy auditor training and exam costs EUR 500. The course is organized by Motiva, and the price is based on the course information available online. Furthermore, choosing this option necessitated utilizing external consultant company to conduct the focused energy review. The previous focused energy review conducted to the whole site cost about EUR 30 000. As the law does not require the whole site to be included in the review, it was estimated in the meeting that the most benefits could be received if the review would be conducted to one single building. Based on the previous review's cost, it was further estimated that if would cost approximately EUR 10 000.

5 CONCLUSIONS AND DISCUSSION

5.1 Conclusions

The aim of this study was to compare which one of the choices (energy audits according to the law, certified EES+ with ISO 14001, or non-certified EES+ with energy efficiency agreement) is the most suitable for a complex and large enterprise operating in healthcare industry, taking into consideration as well the measures and resources needed. The research questions following the research tasks were:

1) What similarities and differences requirements in each option include?
2) What measures should be taken in each option, and how much would they demand in terms of resources? In this case resources refer to hours converted to euros, and to other possible monetary costs that may occur (e.g. the use of external contractors, certificate and audit costs).

The research task and the research questions could be answered based on the data. In regard to the first research question about the options' requirements, common, and some separate themes could be found between the EES+ and the law. Table 6 presents all the themes found in the requirements divided in the Plan-Do-Check-Act –phases. Dashes indicate that the theme found in one set of requirements was not found in the other. Furthermore, even if the themes found may be common, the content of the requirements in that specific theme might be very different. The contents of the requirement groups were explained in detail in the results. Moreover, one main difference between the requirements of the EES+ and the law is the form of the requirements. The law usually gives direct statements on *what* and *how* should be done, whereas the EES+ gives demands on *what* should be done, but *how* is more often left open for the organization to decide. For instance, both demanded that focused energy reviews should be performed, but the law regulated precisely how many of them should be done and what it should consist of. In contrast, the EES+ demanded to review the most significant activities concerning the energy efficiency, and it

was left open for the organization to decide what and how many activities qualify as 'the most significant'.

PLAN	
EES+	**LAW**
Energy planning Energy audit Objectives & Targets	- Energy audit -
Energy policy	-
Responsibilities	Responsibilities
Procedures	-
DO	
EES+	**LAW**
Implementation	Implementation
Training, competence, and awareness	Training, competence, and awareness
Communication	-
Documentation and control of documents	Documentation
Other requirements	-
CHECK	
EES+	**LAW**
Consumption monitoring and analysis	-
Management review	-
Internal audit	-
-	Reporting
ACT	
EES+	**LAW**
Nonconformities, corrective and preventive actions	Nonconformities, corrective and preventive actions
Deadlines	Deadlines

Table 6 Requirement themes

With regard to the second research question, what measures should be taken and how much resources they would demand, an answer from the data could be found as well. The measures needed were assessed in detail in the results, and table 7 below presents the hours needed. Once again, the measures included in the presented hours may vary considerably as the requirements have varied as well.

Measures	EES+ certified (h)	EES+ uncertified (h)	Law (h)
Energy planning Energy audit	5 0	5 0	0 0

Energy use analysis	10	10	4
Focused energy review	30	30	16
Metering	2	2	0
Improvement measures	2	2	2
Objectives and targets	2	2	0
Energy policy	8	8	0
Responsibilities	8	8	8
Procedures	1	1	0
Implementation	0	0	0
Training, competence and awareness	20	20	0
Communication	2	2	0
Documentation and control of documents	5	5	0
Other requirements	1	1	0
Consumption monitoring and analysis	2	2	0
Management review	1	1	0
Internal audit	1	1	0
Reporting	0	0	22
Nonconformities, corrective and preventive actions	0	0	0
Yearly update	6	6	
TOTAL HOURS	**106**	**106**	**52**

Table 7 The hours needed

The second research question included other resources needed that refer to the other occurring costs. In table 8, all costs in the three options are presented. As it can be noticed, the prioritization based on the hours or based on the total costs differs considerably. If only the hours are taken in to consideration, the options including the EES+ system would be the least favorable options as the workload for EES+ would be 106 hours, and for the law only 52 hours. On the other hand, if other costs are noticed, the uncertified EES+ clearly becomes the most affordable as the total costs would remain under EUR 5 000, while for the certified EES+ the costs would be closer to EUR 15 000 and for the law nearly EUR 13 000. Therefore the final answer to the main research task, what would be the most suitable option for the target organization, would be to implement the uncertified EES+ with the voluntary energy efficiency agreement as it would be the most affordable.

EES+ certified	Costs (€)	EES+ uncertified	Costs (€)	Law	Costs (€)
Hours	3 975	Hours	3 975	Hours	1 950
Audits	6 200	Random inspection	750	Focused energy re-	10 000

				view	
Certificate fees	4260			Enterprise energy auditor	500
Office fees	80				
TOTAL	**14 515**	**TOTAL**	**4 725**	**TOTAL**	**12 450**

Table 8 Total costs of options

5.2 Discussion

The results of this study clearly indicate that the most suitable option for the target organization is to implement the uncertified EES+ system with the voluntary energy efficiency agreement. However, as the target organization has already the ISO 14001 environmental management system in place, it would seem more reasonable to integrate the two systems instead of having two separate management systems. In addition, the hours needed were estimated based on the assumption that only additional hours needed on top of the current energy management situation are assessed. Therefore implementing the EES+ would not mean building the system from scratch but rather adding necessary elements to the ISO 14001 as significant amount of the EES+ requirements are already fulfilled or nearly fulfilled in the current ISO 14001 system. Hence, in practice the most suitable option for the target organization would actually be a mix of two alternatives: the alternative including certified EES+ and ISO 14001, and the alternative including uncertified EES+ and the voluntary energy efficiency agreement. Thus, the lacking sections from the EES+ could be added to the ISO 14001 system, but only the ISO 14001 would be certified and audited. As a result, the combination would in practice be the uncertified EES+ with ISO 14001, but for the sake of legal compliance with the Act on Energy Efficiency, and for the surveillance of the Energy authority, also participation in the voluntary energy efficiency agreement is necessary.

As previously implied, there is not basic research available on energy management system implementation or integration of energy and environmental management systems. In addition, the law is so recently enacted that no previous research on it, or the Energy Efficiency Directive, either exist. However, this study could shed some light into integration of energy and environmental management systems. The results of the study suggest that the existence of a successful ISO 14001 environmental management system greatly eases the implementation of the EES+ system. In many elements of the EES+, the existing reporting material of the ISO 14001 could be utilized and not all documentation had to be developed from scratch. As the EES+ as a system is based on the ISO 50001 energy management system, it could be argued that ISO 14001 would simplify its implementation as well. However, more profound research should be conducted in order to include various type of organizations and levels of ISO

14001 implementation as this study included only one organization where the level of both environmental and energy management was already quite good.

It logically appears that the primary motivation for the target company to go for the EES+ system would be achieving regulatory compliance. It has also been one of the main motivators for companies to adopt an environmental management system (Morrow, 2015). Similarly, increasing regulatory compliance was often mentioned as the benefit of implementing an EMS (Morrow, 2015; Zutshi & Sohal, 2004; Schylander & Martinuzzi, 2007). Consequently, it could be argued that this would be the case also for the target company as implementing the EES+ would in itself achieve regulatory compliance with regard to the Act on Energy Efficiency. However, as previous research on EMS indicate that certifying EMS would bring more significant impacts than merely implementing the system would (Melnyk et al., 2013; Zutshi & Sohal, 2004; Santos et al., 2014), it would be worthwhile to explore whether the same applies energy management systems. Moreover, as the main barrier of implementing an EMS was identified the implementation and certification costs (Santos et al., 2015; Zutshi, 2004). It could be argued that the same barrier exists as well in the target organization concerning the energy management system, since the ISO 50001 was excluded from the options in an early stage due to the high costs.

In regard to the common traits found in successful energy management systems by Dusi & Schultz (2012), almost all of the traits could be found in the EES+ system too. Managerial commitment, organization of the energy management, energy tracking and benchmarking, audits, goals and action plans, production reporting and maintenance records, communication are all included in the EES+ demands. A program that contains the mentioned elements, was described to have a system approach (Dusi & Schultz, 2012), hence, it can be argued that the EES+ has the system approach as well. However, from the table 6 on page 57 it can be seen that the requirement themes of the law are significantly less substantial than those of the EES+. Several important elements are not included in the law, such as managerial commitment and communication. The law included responsibilities, but it was not demanded that the enterprise energy auditor would be in a managing position, or that a team or supporting group should be organized. Therefore organization of the energy management could stay rather superficial. It could be concluded that according to the model of a successful energy management system by Dusi & Schultz (2012), the energy management performance of the law would less successful, whereas the use of the EES+ would limit the program risks and ensure an efficient use of resources.

Concerning the level of integration, suggested by Jørgensen et al. (2006) the results of this study propose that integrating the ISO 14001 and EES+ systems could achieve at least the level of coordinated and coherent. The PDCA-cycle would be entirely understood, including integrated policy, planning, implementation, checking and corrective action, and management reviews, as was suggested in the results.

5.3 Limitations

The lack of previous research on the topic is one of the major limitations of this study, since it makes it more difficult to discuss the results in the academic context. However, this limitation could not have been impacted by the researcher and as a result of this study the research gap might be better understood. Similarly the research design as a case study, and examining only one case, may hinder the implications of the study in terms of generalizability as the state of energy management in organizations may vary considerably. Therefore, it cannot be concluded that the solution best fitting for the target company of this study would be the most suitable to other organizations as every case has their unique characteristics.

Furthermore, another evident limitation of this study is the exclusion of the ISO 50001 energy management system. Even if it would have not been an ideal solution to be implemented in terms of costs, academically it could have provided interesting knowledge when comparing the requirements of the options. For instance, the similarity with the EES+ system could have been discovered and scientifically proofed. In addition, the ISO 50001 could have brought up other non-monetary factors impacting the most suitable solution. As the ISO 50001 is an international standard, it could provide an international organization with improved image or reputation benefits, which has been one of the obtained benefits in certified environmental management systems (Morrow, 2015; Santos et al., 2015; Zutshi & Sohal, 2004). However, the EES+ and energy audits as the law required are only national solutions that would not have international recognition. Furthermore, another non-monetary factor could have been the supervising authority. As the target organization operates in a highly regulated business environment, any additional regulatory supervision and reporting is regarded as additional bureaucracy. Therefore, the options that would not be under supervision of the government could have been favored. Nevertheless, the difference in the costs was so substantial that in the end it is unlikely that this issue would have had a decisive impact.

5.4 Trustworthiness

Usually research methods are evaluated based on the concepts of validity and reliability. Validity refers to researching what was intended and reliability to the repeatability of the results. The concepts have nevertheless been criticized on the suitability to assess qualitative research as they have been originally developed for quantitative research. (Tuomi & Sarajärvi, 2009, p. 133.) However, Tuomi & Sarajärvi (2009,p. 135) stress the evaluation of the research as a whole, when the internal coherence of the study is emphasized. The research should contain certain elements but in addition, their internal relations are important (Tuomi & Sarajärvi, 2009).

In the center of this study is the phenomenon of energy management. It includes two aspects, the implementation of the Act on Energy Efficiency, and energy management system implementation. The main goal of the study was to gain understanding on which one of the options on fulfilling the legal obligations would best fit the target organization. Therefore, the results cannot be directly generalized to the healthcare industry as. However, the results may give some guidelines on what kind organizations could benefit from the EES+ systems as a means of legal compliance.

This study was conducted as a commission. The research task was given by the target organization but I as the researcher could freely choose the methods. The aim has been to examine the case as objectively as possibly, clearly stating the facts without further comments. However, it is always possible that my involvement in the target organization may have hindered the objectivity towards the target organization. For instance justifications in the second part of the results, the assessment of the measures and hours needed, may have been impacted by the everyday knowledge as practices become self-evident.

In regard to the research design and methodology used, it has been explained in detail in Chapter 3. Some issues in the methodology may have an impact on the trustworthiness of this study. First, the data collection regarding the assessment of the hours is evaluated. The meeting was held in a state of the process when the requirements were not yet grouped to PDCA-phases. Therefore, when the final version of the excel sheet was ready and requirements divided into smaller pieces into each category, some of the hours had to be divided again. The changes were accepted by the ESH Manager, but the estimation of the hours could have been more precise if it would have been conducted only after more detailed grouping of the requirements. In addition, some of the data was collected only when conducting analysis on the measures needed. As all the measures were not clear yet when the requirements were divided, supporting documentation on what had been done before had to be further collected later. Moreover, the assessment of the hours was mainly based on the knowledge the EHS Manager and the Facility Manager had on what had been done before. In the meeting, they proposed documents that would provide the evidence but not all these documents were in my knowledge beforehand.

Second, regarding the actual analysis of the hours needed it was difficult to estimate the hours needed as all measures or practices cannot be known beforehand. For example, if nonconformities would come up in an internal audit, it cannot be known how much time their corrective actions would demand. Therefore these kind of non-direct measures were left out of the comparison but it might impact on the division of the hours between the law and the EES+, as the EES+ would possibly necessitate more these kind of actions due to the variety of the requirements. Similarly, the estimation of the focused energy review's costs to EUR 10 000 may have an impact on the trustworthiness of the results. The previous focused energy review that was performed in the target organization for the whole facilities cost approximately EUR 30 000. The EUR 10 000 cost was estimated to include only one of the buildings instead of the entire site.

However, if only one particular system, or a process, such as compressed air would be reviewed, the costs would assumedly be much lower.

Third, as mentioned in the limitations, non-monetary aspects were left out of the comparison. If these would have been included, they may have had a slight impact on the results. As a consequence, if all these shortages would have been included in the comparison, most likely the hours needed for the EES+ would have increased. However, even if the amount and costs of the hours needed for the EES+ implementation would have doubled, or the costs of the focused energy review would have decreased in half, the uncertified EES+ still would have been clearly the most affordable option. Therefore, it could be argued that the impact of these issues after all has been quite minor.

5.5 Further research

As mentioned, it became clear right from the beginning of this study that implementing energy management systems lacks basic research. Similarly to existing literature in environmental management system implementation, the motives, benefits, and challenges of energy management system implementation should be discovered. Moreover, the subject of integrating environmental and energy management system is hardly studied at all, thus the amount of future research topics is rather unlimited. Consequent research could for instance provide beneficial practical insights on environmental and energy management systems potential synergy benefits, or overall what kind of organizations (size, industry, level of environmental and/or energy management et cetera) would benefit from an integrated system.

Furthermore, in regard to this study, longitudinal case studies of implementing the solution could be conducted. In other words, what benefits or gains integration of environmental and energy management systems could introduce. In addition, comparative research on the variables of implementing an energy management system solely, or with an environmental management system could be conducted. Moreover, the concepts around the subject, such as energy management and energy audits could benefit from more profound research on the definitions.

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