Contents

1 | Introduction

In 1992, the Environmental Protection Agency and the Danish Energy Agency put forth a label for energy efficient consumer products known as the Energy Star label [3]. The purpose of the label is to mark products that use 20-30% less energy than required by federal standards [9], in an attempt to raise consumer awareness to reduce the amount of greenhouse gases emitted by power plants.

In recent years the practice of labeling energy-related products (ErP) has been developed further, particularly in the European Union. In 2010, the European Union put forth a new directive to expand upon the idea of the Energy Star program, by introducing a energy efficiency rating system [4], that serves to mark most white goods, light bulb packaging and cars with respective labels to inform the user of the specific product's energy efficiency. The rating labels range from A, being the most efficient products, to G, being the least efficient products. Since the introduction of the energy efficiency rating system, even more regulations have been put forth, in order to raise consumer awareness.

While these regulations ultimately serve a greater good in reducing greenhouse gases, they put a lot of pressure on manufacturers and resellers. This can be a good thing, as the increased pressure creates an incentive to produce energy efficient products. On the other hand, if there are no clear guidelines available for these parties, it can potentially be damaging for their businesses. For example, these new directives require resellers of heating systems to rate and label packaged solutions according to energy efficiency. Rating packaged solutions requires the resellers to do calculations that they are not capable of doing manually (see Appendix A), but if they do not rate the systems they could face economic penalties.

1.1 ECO-Design Directive

On the 26th September 2015 a new EU directive came into force which affects the energy industry, from suppliers to installers [8]. The new directive is called ECO-design, and it requires an Energy Efficiency Index (EEI) on all offers, with the purpose of standardizing the EU energy market, and helping customers choose more energy efficient offers. The types of offers that are affected by the ECO-design directive are called packaged solutions of which the contents are mentioned below.

1.2 Different kinds of packaged solutions

This section will describe the most common kinds of packaged solutions found on the Danish market.

- Combination of a boiler or heat pump with temperature regulation. Whether or not the temperature regulation functionality is integrated into the boiler or heat pump is irrelevant.
- Combination of a boiler or heat pump with solar heating and optional temperature regulation.

- Combination of a electric water heater with solar heating.
- Hybrid solutions with combinations of, but not limited to, an electric water heater with a supplementary gas boiler.

Any packaged solution must be given a correct EEI that is in compliance with the ECO-design directive requirements. During a brief phone conversation with a representative of the Secretariat of Eco-Design and EEI of Products we were informed that the calculations for the EEI's made by different distributor were all using the same calculations. We were also informed that the secretariat had given the plumbers some time to implement this new EEI system. They stated that they were about to increase the amount of checks conducted due to the plumbers having had almost a year to implement and use the new EEI's. We were told that the Danish Energy Agency had made a calculator for the EEI available on there website, but as of the twentieth of September it was not on the website and had not been for weeks according to the representative of the Secretariat.

1.3 Initial Problem Statement

Through this chapter, the subject has been chosen and described. The following chapters will expand on the following initial problem statement:

What are the implications of the new ECO-design directive, and how do companies in the industry handle the new requirements?

- How do they handle the task of calculating the combined energy marking for a system?
  - What existing technological solutions are available to aid with this task?
  - What are the potential financial repercussions of the new directive, if any?
- How has the work flow of the company changed?

1.4 Methods

In this section, the different methods the group has employed during the report are described.

1.4.1 Case Studies and Literature Research

All literature regarding the new ECO-design is chosen because it satisfies at least one of the following criteria:

- Author must be an entity, or directly connected to an entity, with some authority in the energy regulation industry.
- Source must be a peer-reviewed article.

The group has employed the search engines **aub.aau.dk** and **scholar.google.com** for the literature research.

The main source of information in **Problem Analysis I** is the case study of the local company Hjørring VVS, which has been affected by the ECO-design directive. Seeing that the directive is fairly new, this approach is largely preferable to searching for literature describing the problem in an industrial context. The case study can be found in chapter 2, and involves an interview with the executive director of the company.

1.4.2 Interview Method

During the case study in chapter 2, the group conducted an interview with the executive director of Hjørring VVS, a company in affected by the ECO-design directive. The interview was conducted as a semi-structured interview since the main focus of the interview was to see the problem from the perspective of someone who encounters it regularly. This required more nuanced answers and also created the opportunity for the interviewee to expand on the subject as well as add new perspectives that might not have been brought up in the preemptive research [2, p. 143]. The questions asked during the interview were prepared beforehand and were designed to start a conversation about the problem as well as gain some more information to conduct a PACT analysis and to gain knowledge on the problem domain and application domain for further development of a solution. An attempt was made to leave the questions as open as possible, but some questions that were either easy to answer or required a concrete answer were left as "yes" or "no" answers.

Part I

Problem Analysis

2 | Case Study

2.1 Initial Interview

To gain more knowledge of the problem at hand, an interview was conducted with Brian Nielsen, the executive director of the plumbing and heating company Hjørring Varme- og VVS ApS[1]. The interview method is described in section 1.4.2.

2.1.1 Results

The transcript of the interview conducted with Brian Nielsen can be found in appendix A. During the interview Brian described his perspective on the problem. He described how he has experienced problems calculating a proper EEI for his packaged solutions whenever he has to combine components from different manufacturers. This is, according to him, something that happens on a monthly basis. He also described how the new laws regarding the ECO-design directive is currently not being enforced, but that whenever the Danish Energy Agency starts enforcing the law and checking up on his and other firms they would have to pay fines for not properly labeling their solutions. The laws only require that calculations are made for packaged solutions from different manufacturers. When a company buys an entire packaged solution from one manufacturer the calculations will have to be made by the manufacturer. If Brian just needs to check how components will affect the EEI he can use one of the several ErP calculators the manufacturers have available. The problem with these calculators is that they can only make calculations on packaged solutions consisting of their own components.

Brian stated that this law does not only require him to calculate EEI's for solutions his company is installing, but also for any offers they send out to potential costumers. This means that even if a potential costumer receiving an offer chooses another company, Brian still has to calculate the EEI label as well as prepare any other required paperwork. Brian stated that his work as an executive director required a lot of paperwork.

Brian's company mainly orders from one manufacturer, but he also stated one of the reasons for this is the problem of having to calculate EEI for more than one manufacturer.

In conclusion, calculating the EEI for a solution consisting of components from different manufacturers is a problem for Brian. Solutions for the individual manufacturers already exist, but a solution for more than one manufacturer seems to be non-existent. As Brian stated, he does not have much time in his daily routine to spend on doing calculations for their different offers, so a solution to this problem would be well received by him and his staff.

3 | Existing Technologies

Currently most major suppliers offer services that label their products and packaged solutions with the correct EEI's. All these services have one thing in common; they only offer labeling on their own products, and do not provide services for cross supplier labeling. In this section, an analysis of the current services regarding EEI's will be made. We have chosen to primarily focus on three different labeling services from Bosch, Viessmann and the Danish Energy Agency.

3.1 Bosch

Bosch offers an online ErP-calculator[1]. When the user enters the site the interface consists of three main columns; 'Categories', 'My system' and 'My marking'. The Categories column provide a simple interface where components can be chosen from a drop down menu. This drop down menu is organized in the main component categories used by installers. The system represents the components with a name, picture, and the individual component EEI. It is also possible for the user to search for products instead of using the drop down menu. When a component is chosen it shows up in the 'My system' column, and a visual representation of the .PDF print-out shows up in the 'My marking' column with a live calculation of the EEI. Throughout the component selection process, an information display is shown in the screen center with components the user can add to complete the system. The Internet site does not provide a way for the user to save a packaged solution, and the user starts from scratch every time a new offer has to be made. The Bosch ErP calculator can be used by everyone and no special login is required.

3.2 Viessmann

Viessmann, like Bosch, also offers an online ErP-calculator[2], although Viessmann's solution requires a log in, only obtained by installers or partners of Viessmann. Viessmann's interface layout consists of a centralized search bar used to add components to the packaged solution. Below the search bar is a table of all components added. Viessmans's layout also include a button named "new label" and a drop-down menu, placed in the top right corner. The new label button creates a new .PDF label of the components added to the packaged solution. The drop-down menu is organized into three groups. The first group is for the users product catalog with functions to create new products and look up already created products. The second group gives the user the option to create new labels and look up former made labels. The third and last group is an option to open Viessmann's component catalog. Viessmann provides users with the ability to save both labels and packaged solutions, and users do not have to start from scratch each time they need to create a packaged solution.

[1] https://www.erp-calculator.com/bosch/dk/
[2] https://erplabel.viessmann.com/6600/da

3.3 Danish Energy Agency

The Danish Energy Agency do not offer an online ErP-calculator instead they distribute an Excel spreadsheet which contractors can download and use for their EEI calculations. Currently, this Excel spreadsheet is unavailable from the official agency site, and for this project we obtained this spreadsheet by email directly from the agency. Since the ErP-calculator in question is an Excel spreadsheet it is relatively simple both in layout and functionality. Users add information about products from their data sheets into the spreadsheet and run the calculator, this provides them with a printable EEI document. The spreadsheet can be lacking in usability since it does not provide basic features, like storing products, searching for products or clearly displaying the products currently in the packaged solution. The spreadsheet does, however, provide the functionality to save product solutions and labels by the saving each Excel document, but not in any clear or meaningful way.

3.3.1 Pros and Cons of Existing Technologies

Table 3.1: Table displaying the pros and cons of existing ErP calculators

Technology	Pros	Cons
Bosch	- Everyone has access - Simple layout - Help when adding components - Displays a dynamic EEI that updates as you add components	- No option to save packaged solution
Viessmann	- Simple layout - Ability to save packaged solutions - Ability to save labels	- No live energy marking calculation - Log in required
Danish Energy Agency	- Cross supplier EEI calculation - Ability to save packaged solutions - Ability to save labels - No log in	- No live energy marking calculation - Hard to obtain at the moment - Only Excel document - Lacking useability

The central issue concerning both Bosch's and Viessmann's implementation is that they can only be used for components from one supplier. This issue is solved by the ErP-calculator from the Danish Energy Agency, but their implementation is lacking in usability and functionality. While the ErP-calculator from Bosch and Viessmann solve the same problem, they have visually and functionally been implemented differently. Both Viessmann and Bosch support searches and selecting components from a list, however, Viessmann focuses more on searching by centralising the search bar and placing component selecting from the product catalog inside another menu. Bosch focuses more on the drop-down selection but chose to place the component selection search bar and drop-down menu close together, but the user starts in the drop-down menu and has to choose the search selection. The two implementations are also different in terms of the functionality they provide to the user. Viessmann gives the user the ability to save labels and packaged solutions which are useful when the installer has multiple instances of the same offer over a long period, or only a few components are different between offers. Bosch is more accessible to the general public by not requiring a login and providing help throughout the selection process. Bosch also gives live EEI calculation so it is easier for the user to follow along with the results. All three implementations of the ErP-calculator consist of useful layout traits and system functionalities which can provide inspiration for a more powerful ErP-calculator.

4 | Problem Definition

Throughout our problem analysis information has been obtained about the EU directive that requires EEI's on packaged solutions, and how this new directive create problems for contractors. In section 2.1.1 we concluded that EEI's on packaged solutions that use components from different suppliers, pose an issue for our case person Brian Nielsen's company Hjøring Varme- og VVS ApS. We mentioned in chapter 3 that suppliers already provide EEI's on packaged solutions, but only for their own product catalog and do not support cross supplier calculations. Brian Nielsen commented that he primarily chooses to use components from one supplier at a time out of convenience, and because he has no clear way of figuring out how to perform cross supplier EEI calculations on his own. This provides the foundation for the problem definition below.

How can we design and then develop an application that makes cross supplier EEI calculations possible and easily accessible to contractors in the major appliance industry?

Part II

Design, Implementation and Evaluation

5 | Design Requirements

5.1 PACT-analysis

People: The people who will use the system are mainly plumbers in the age of 30 to 60+ years old. Currently, Hjørring VVS prefers to put together packaged solutions with products from one single manufacturer so that they can use the manufacturers own proprietary ErP calculator. Because of this, the ErP calculation is usually done once a week or once a month. However, if an ErP calculator that works across products from different manufacturers is developed, Hjørring VVS can put together packaged solutions with whatever products they want, and the ErP calculator might be used more frequently. Hence the interface should be intuitive and minimalistic. This is achieved by designing the system to incorporate step-by-step logic, to guide the user throughout the process.

5.1.1 Persona: Brian Nielsen

- Age 25+
- Uses computer daily at work
- Professional plumber
- Supplementary education in Commerce Management
- Only uses his phone for communication
- In charge of finding solutions for clients, calculating the EEI, and provide clients with the full offer

Activities: The main activity is to generate EEI's for packaged solutions, which combine components from different vendors. This includes finding and comparing different components and their EEI's.

Context: The activity takes place indoors using a computer in the office. The users are usually under time pressure, as they have more important business to attend to. The system should not take much time from the user.The system should only be used by one person at a time, so there is no immediate need for interaction between users.

Technology: The system will be developed as a desktop application for use on a computer. Input will be done through a mouse and a keyboard and output from a monitor.

5.2 Stories

The following stories have been written with the goal of identifying design opportunities in mind. In later chapters, conceptual scenarios that attempt to solve the problems in the following scenarios will be presented. The following stories are based on the stories we were told during the interview with the executive director of Hjørring VVS.

Single sale with competition

Kenneth is an installer employed at Hjørring VVS and is heading back to the office after visiting a potential client. The client needs a packaged solution that Kenneth has put together for another client before, but the client did not want to replace the old boiler they had, which requires Kenneth to put together a system that consists of components from different suppliers. He is informed that the client is waiting on another offer from a competitor. When he arrives at the office, Kenneth finds the components the client needs and starts thinking about how to calculate the correct EEI. The different suppliers have proprietary calculators for this purpose, but only for their own products. Kenneth does not know how to calculate the energy mark, and therefore he will either have to mark the entire system according to the lowest label, or gamble on the change that an arbitrary label of his choice is 1. equal to or worse than the correct label and 2. better than his competitors label. The first option is likely to make him lose the sale to the competition and the second option carry the same complications, but also put him at risk of the company being fined by the government.

Acquiring component specifications

Jacob has received an order from a client that lists a single boiler from a specific supplier. Seeing that the system consists of only one component, Jacob knows that the EEI for the entire system is the EEI of the boiler which the supplier is required to provide him with. However, Jacob cannot find the product catalog on the supplier's website, and cannot send an official offer to the client before knowing the exact EEI and other specifications. Jacob types up an email requesting this information, and receives an answer the next day containing a product overview for the specific component he requested. Jacob now has to decipher a, to the untrained eye, incomprehensible list of product data to find the specifications that are relevant to him. This requires even more time before the client can receive a final offer.

Large sale without competition

Marcus, salesman for Hjørring VVS, is working on a large sale which includes a large amount of smaller systems (a boiler and container from Bosch and a solar heating panel from Sonnenkraft to a major local company. Marcus has sold all of these components before, and knows their specifications. However, he now faces the same issue as Kenneth, and cannot calculate the combined EEI for any of the several systems he is selling. The proprietary ErP calculators from Bosch and Sonnenkraft can not help him with the combined EEI. Marcus now has three options: Tell the client that the sale cannot go through unless all the components are from the same supplier, which may result in the client backing off completely. With a sale this big, this is far from optimal. Mark all the systems down, which may cause the client to back off because of poor energy label which implies

heavy and unnecessary power consumption. Go through with the sale by either guessing the EEI's or not label the system at all, which puts the company at risk of being fined for each system individually.

5.3 Conceptual Scenarios

The conceptual scenario described in this sections aims to describe some requirements for a computerized EEI application. After analyzing the three stories in section 5.2, the common elements have been identified and accumulated, resulting in the following conceptual scenario:

Installers with a basic understanding of computers will be able to enter component information into a program that then calculates the EEI for them, regardless of supplier. The program then saves the information for later use.

5.4 Concrete Scenarios

The purpose of this section is to actualize the conceptual scenario in different ways, handling as many of the common elements from the stories in section 5.2 as possible. Each concrete scenario is structured according to the PACT framework, describing the people (see 5.1.1), activities, context, and technologies used. Furthermore, each concrete scenario marks specific design choice opportunities with end notes (eg. [a], [b], and so on). These end notes are later referenced to clarify the specific design choice.

Concrete Scenario 1

Brian has a client who is interested in replacing his old heat pump system but do not want his old boiler replaced, the client's original system is from Viessmann. Brian opens his computer and runs the EEI program. He finds a previous packaged solution he made for another client in the database [a]. In this packaged solution he used Bosch components, and not Viessmann components. He chooses this solution and replaces the Bosch boiler component with the data from the client's old boiler [b] and the program calculates the energy marking for the packaged solution.

Notes for Scenario 1: [a] The user should be able to save systems and components he works with and find this information later when needed. [b] The user should be able to change the components that make up an older system from the database.

Concrete Scenario 2

Brian has received an order that lists only a single product, but the supplier has only sent a list of product data and no EEI's. This means that Brian has to open the application on his computer to calculate the EEI for that single product. He searches the database [a] to see if the product already exists, but no data. Brian therefore

decides to create the new product [b]. This is done by filling out a form for a new product with data from the received data paper [c]. After this is done, a calculation on the new product is made to receive the EEI.

Notes for Scenario 2: [a] The user should be able to search the database for components he has previously used when making packaged solutions. [b] The user should be able to add components to the database as needed. [c] When adding a component to the database, a form should be filled out to make sure all needed information is provided.

Concrete Scenario 3

Brian is making an offer for a major local company. He is selling a boiler and a container with a solar collector. He decides that the client needs a boiler and container from Bosch and a solar collector from Sonnenkraft. He opens his computer and runs the application. He searches the database for the the components, and finds the boiler and container he needs, as he has registered these components in the database before. He adds these components to the list of components for the packaged solution [a][b]. The solar collector is not yet in the database, so he can't add this component yet. He acquires the solar collector specifications and adds the solar collector component to the database by filling out the form provided by the program, providing the data from the component specifications. He then adds the solar collector to the list of components for the packaged solution. Finally, he creates the packaged solution[c], and the program calculates the correct EEI. The program generates an EEI form that he then prints out and sends to the customer [d].

Notes for Scenario 3: [a] The user should be able to see a list of components that make up the packaged solution he is trying to assemble. [b] The user should be able to add components from the database to the list of components for the packaged solution. [c] The user should be able to add a completely new packaged solution to the database and save it. [d] The program should be able to generate a document containing all the information required when describing an EEI.

5.5 Requirements based on scenarios

The scenarios described above show some of the different possibilities of use and problems users already face. These can be summed up into some specific requirements for a solution:

- The user should be able to add and save components and packaged solutions created in the system.
  - The user should be able to find saved components and use them again.
  - The user should be able to find saved packaged solution, modify them and use them again.
- It should be easy for the user to add new components to the system
- Creating a packaged solution should be simple and intuitive.
- The user should be able to calculate the EEI of a packaged solution as well as create a correctly formatted .PDF document with the information.

5.6 Summary

This chapter has been concerned with making overall design choices based on conceptual and concrete stories describing how and when a user encounters the problems the system should solve, and how a system would solve those problems. Furthermore, characteristics regarding the users have been uncovered, which have helped guiding the process of making design choices. All gathered information has resulted in a final set of design requirements.

6 | Problem Domain analysis

This chapter will cover the results of our analysis of the problem domain. The resulting model of the problem domain is based on information from the initial interview with Brian Nielsen, which was later used as a basis for a set of rich pictures describing the situation from our own point of view.

6.1 Class candidates

The initial list of class candidates can be found below. Section 6.3 will cover the list of classes that qualified the criteria and were added to the model of the problem domain.

- Profile
  The purpose of this class would be to keep track of the user, the components and packaged solution he had created, and allow access to the archive.
- Component
  This class would represent the single components that the contractor combines into packaged solutions.
- Packaged Solution
  This class would represent the final combination of components that would later require a correctly calculated EEI before an offer could be made for the client.
- EEI
  This class would represent the EEI itself, i.e. the resulting .PDF file formatted according to regulations.
- Archive
  This class would contain all previously created components and packaged solutions.
- Calculation
  This class would contain all needed formulas for calculating the correct EEI for any packaged solution.

6.2 Event candidates

- Profile created
  This event would occur when a profile is created.
- Component created This event would occur when a component has been added to the system archive by the user.

- Component updated This event would occur when the user updates the information in a component already in the archive.

- Component r

- Component removed This event would occur when a component has been removed from the system archive by the user.
  This event would occur when a component is registered by the user. The component would then be added to the archive.

- Packaging begun This event would occur when the user has decided to construct a packaged solution.

- Packaged solution built This event would occur when the packaged solution has been built with all needed components and is ready for EEI labeling.

- Packaged solution updated
  This event would occur when a packaged solution has been edited by the user.

- Component added to packaged solution
  This event would occur every time a component is added to a packaged solution.

- Component removed from packaged solution
  This event would occur every time a component is removed from a packaged solution.

- EEI calculated
  This event would occur when the EEI for any packaged solution is calculated.

- EEI formatted
  This event would occur when the calculated EEI has been formatted according the regulations regarding EEI labeling.

- EEI exported
  This event would occur when the final .PDF file has been created and exported to the user.

6.3 Qualifying classes

This section will cover the classes that were systematically selected from the list of candidates, as well as the reasoning for leaving out the classes not selected.

The **Profile** class was not selected from the list of candidates since it was not an inherent part of the problem domain, and may be better qualified for consideration when modeling the application domain.

The **Component** class was kept as a class in the problem domain as it models an important part of the problem domain, and satisfies all criteria for a class candidate [6, p. 61 - 63]. Furthermore this class will represent all specialized components, e.g. boilers, heat pumps, solar heaters, and so on.

The **Packaged solution** class was kept as a class in the problem domain as it, like the component class, represents a vital part of the problem domain. An immediate concern is whether or not this class satisfies the criteria that a class candidate should contain unique information, as it at first glance simply is a collection of component objects. However, this is not the case as not all combinations of components qualify as packaged solutions, and the criteria for creating packaged solutions would be contained in this class.

The **EEI** class was kept as a class in the problem domain as it represents another vital part of the problem domain described for us in the initial interview. However, a decision was made to combine the **EEI** class and **Calculation** class into the EEI class. This decision was made since the EEI itself would too simple of a class to include, as it simply contains information about the calculated EEI and nothing more. However, it is an essential part of the problem domain described to us, and so is the process of choosing the correct formulas for calculating the EEI. This is what the EEI class will represent.

The **Archive** class was initially not selected from the list of candidates, as it would contain nothing more but component and packaged solution objects. This made the class fail some of the criteria for critical class selection. However, the class was ultimately kept for representing the problem domain, seeing that it is a vital part of the system definition. Furthermore, during the initial interview, Brian Nielsen often reiterated how an archive of the components and packaged solutions he had previously used would be appreciated greatly by him and his staff. For the purpose of modeling the problem domain, and by extension developing the system, to the users best understanding, the Archive class has been kept.

6.4 Qualifying events

This section will cover the events that were kept from the list of candidates, and the reasoning behind removing the candidates that did not qualify the criteria.

Most of the event candidates were kept, as they hold relevance for modeling the problem domain with the classes. Naturally, **Profile created** was removed, seeing that the Profile class was also removed from the list of class candidates.

The three events **EEI calculated, EEI formatted** and **EEI exported** were reorganized into two new events, seeing that the EEI and Calculation classes were combined. The two new events are **Calculation chosen** and **Calculation added**, and occur when the correct EEI calculation formula has been chosen by the system, and when the EEI has been applied to the packaged solution, respectively.

6.5 Event table

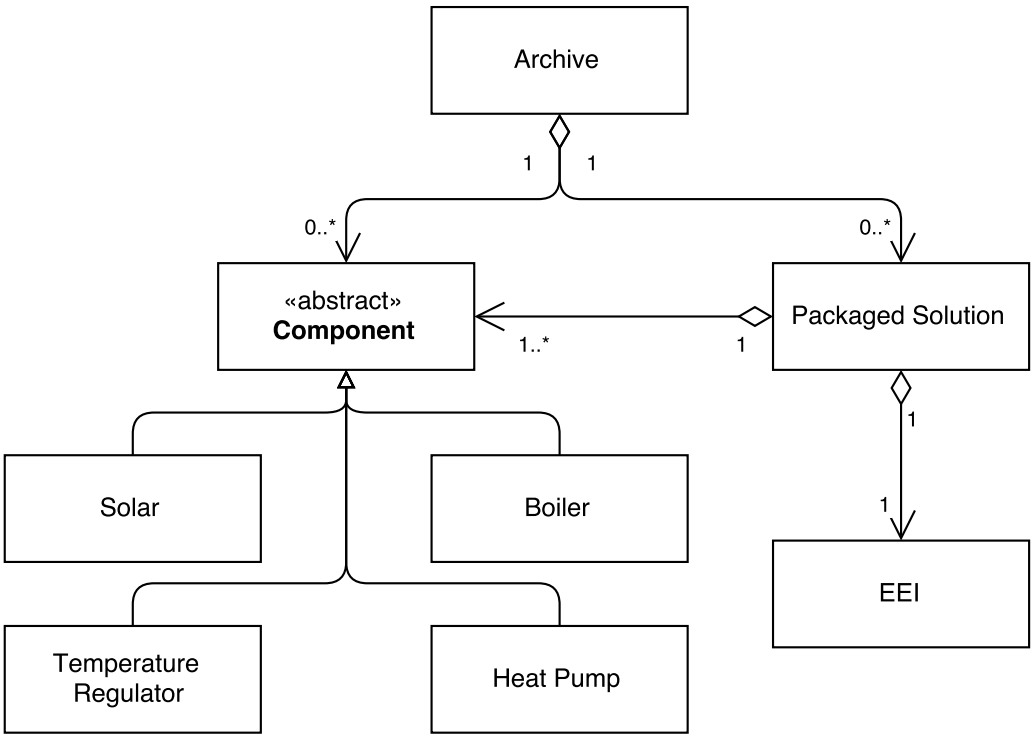
The final event table containing the selected classes and events from the problem domain analysis is presented below. A "+" sign indicates that the event will happen 0 or 1 times, and the "*" sign indicates that it can happen multiple times.

Classes / Events	Component	Packaged solution	EEI	Archive
Component created	+			*
Component updated	*			
Component removed	+			*
Packaging begun		+		
Packaged solution built		+		
Packaged solution finished		+		*
Component added to packaged solution	*	*		
Component removed from packaged solution	*	*		
Calculation chosen			*	
Calculation added		+	+	

6.6 Structure

Based on the selected classes and events and their respective relationships, the object and class structures have been modeled in figure 6.1 below. As the figure suggests, a packaged solution should aggregate several components and an EEI label. Both the packaged solution and the component is aggregated by the archive.

Figure 6.1: UML diagram modeling the structure of the classes and objects in the system.



6.7 Behavior

In this section, the behavioral patterns of all the classes, except the archive class, will be described using state-chart diagrams. The state-chart diagrams have been realized through several examples of event tracing for each

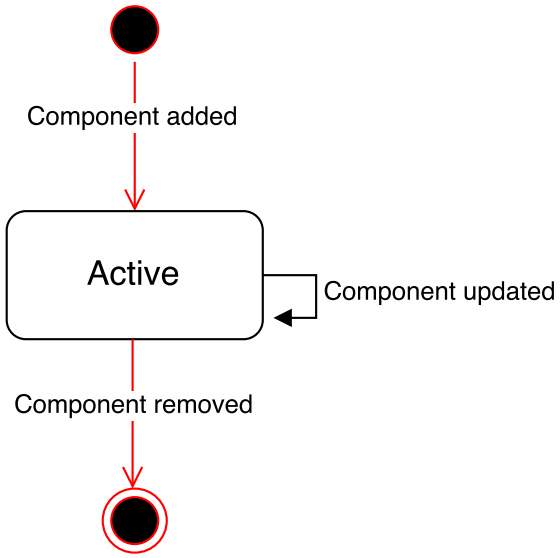
class.

The behavior of the archive class is not shown here because of the simplicity of the behavior (only one state, adds and removes components and packaged solutions).

6.7.1 Component

The state-chart diagram for the Component class is shown below in figure 6.2. The Component class can only be in one state, the "active" state, which is entered when the component is created in the system. During this time, it can be updated by user which will not change its state. The "active" state is cancelled when the component is deleted from the system.

Figure 6.2: State-chart diagram depicting the behavioral pattern of the Component class.

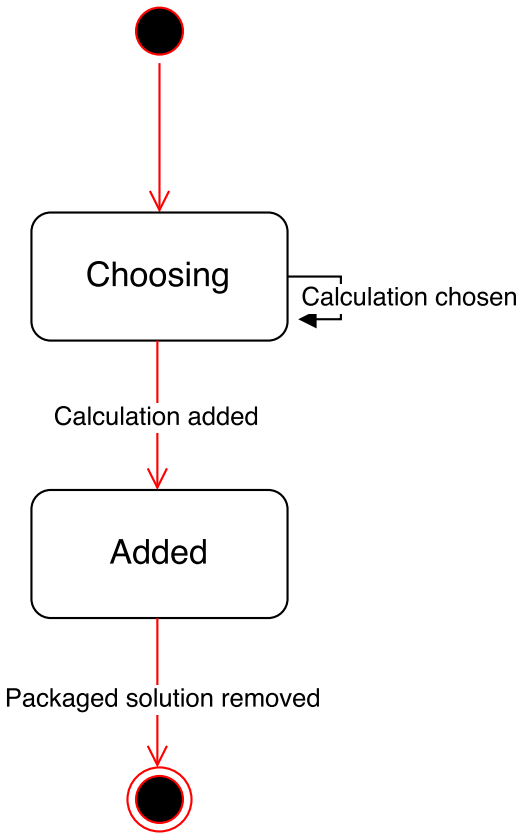


6.7.2 EEI

The state-chart diagram for the EEI class is shown below in figure 6.3. The EEI class has two states, "choosing" and "added". The "choosing" state is entered when the object comes into existence. During the time in this state, the class is continuously choosing which formula for calculating the EEI is the best one to use. Since the specific formula depends on the contents of the packaged solution, this class can choose a new formula each time a component is added to a packaged solution, given that the EEI object is in the "choosing" state.

When the packaged solution is no longer being updated, the EEI class has determined the final formula to use, and the EEI label can be added to the packaged solution, continuing to the "added" state. The only way to exit this state is by destroying the object that the EEI label is connected to, namely, the packaged solution.

Figure 6.3: State-chart diagram depicting the behavioral pattern of the EEI class.



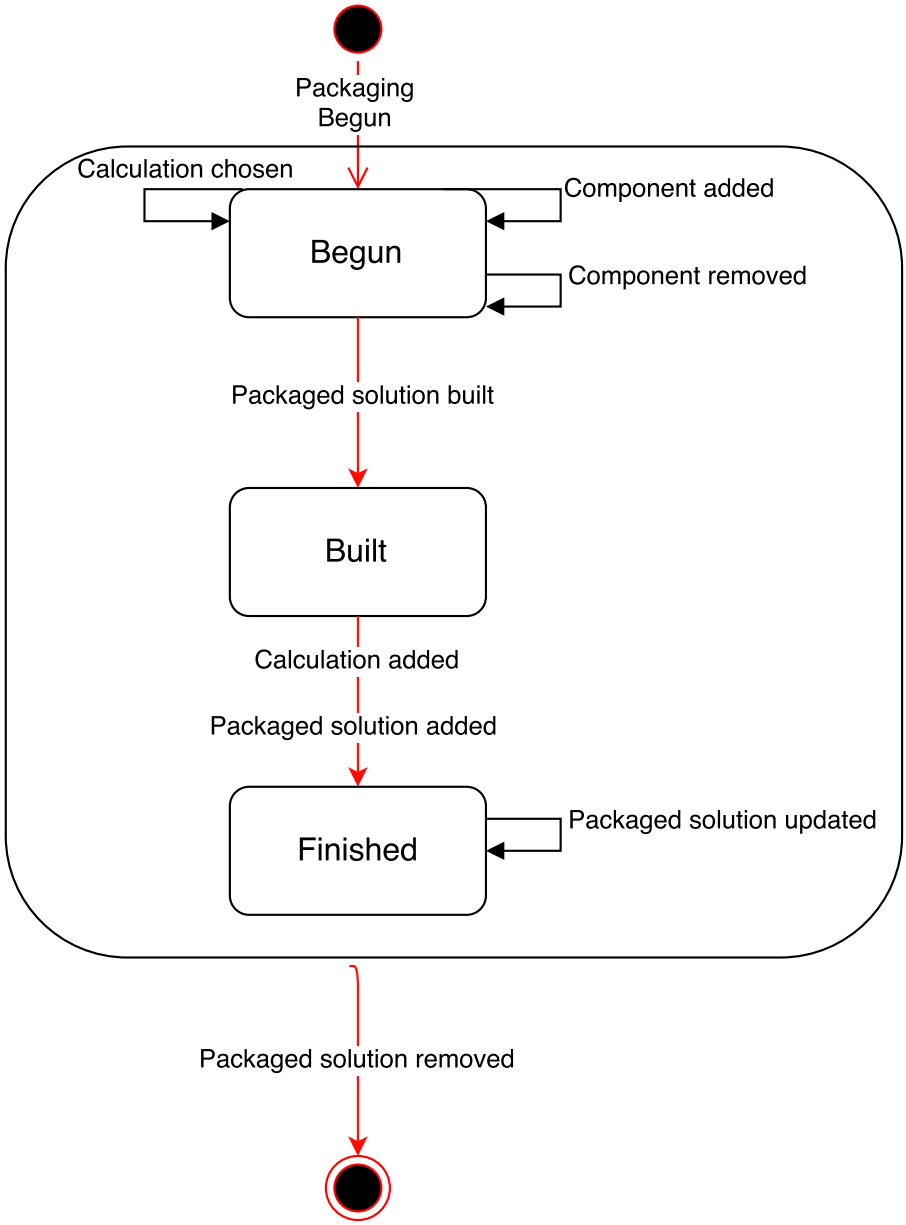
6.7.3 Packaged Solution

The state-chart diagram for the Packaged Solution class is shown below. The class has three states, "Begun", "Built, and "Finished". The "Begun" state is entered is soon as the packaged solution object has been created in the system. During this state, the packaged solution can have components added to or removed from it. Simultaneously, every time a component is added or removed, a new calculation will be chosen by the EEI class.

Once the user is satisfied with the build, the packaged solution passes onto the "built" state. This state signals that the packaged solution is ready for an EEI label, which is added as the packaged solution enters the "finished" state. Simultaneously, the packaged solution itself is also added to the archive in the system.

During the "finished" state, the packaged solution can be updated by the user, which will not change the state of the object. All three states can be exited by either going to the next state, or by removing the packaged solution from the system.

Figure 6.4: State-chart diagram depicting the behavioral pattern of the Packaged Solution class.



6.8 Summary

This chapter has been concerned with analyzing and modeling the problem domain of the system. The classes and events have been systematically selected from a set of candidates and put in relation to each other in an event table. The relations between the classes and objects are depicted in an UML structure diagram in figure 6.1. The individual behavior of the classes are described through state-chart diagrams in chapter 6.7. The following chapter will present an analysis of the application domain.

7 | Application Domain

7.1 Usage

In order for a system to be successful in a certain application domain, an underlying understanding of the users work process and their requirements for the system are needed. This understanding is obtained by describing actors and use cases for the system. This information is then later used in the application domain analysis when describing functions and the interface.

7.1.1 Actors

In this section will determine the actors of the system which are an abstraction over the system users or other programs that interact with this system. The actors gathered from this section will later be assigned to use cases which provide an understanding of how the users use this system. The actors in this section are determined from the interview with Brian Nielsen and his description of the work process.

Contractor:

Goal: A person who has the responsibility of creating and presenting offers to customers. In order to achieve this, the contractor needs a way to calculate the EEI label in accordance with the directive described in section 1.1.

Characteristics: The characteristics of the contractor is a varying age group with different levels of exposure to computer systems, low level of exposure to calculating the EEI label by hand, but with a deep knowledge of component models and packaged solutions.

Example: The contractor Hans-Peter has a responsibility to create an offer for a customer that want a boiler replaced in their current packaged solution at home. The customer uses products from Bosch but the contractor knows that a boiler from Viessmann will work in their current setup and it is more energy efficient compared to an equally priced Bosch boiler. Hans-Peter creates a packaged solution where he includes all the Bosch component from the customer's current solution and adds the Viessmann boiler, he then exports the EEI label as a .PDF and combines it with the other offer documents and presents it to the customer.

7.1.2 Use cases

In this section, a description of relevant use cases and the associated state chart diagrams will be made. With the purpose of determining how users interact with the system. The use cases are constructed based on the initial interview with Brian Nielsen and the analysis of scenarios in section 5.4.

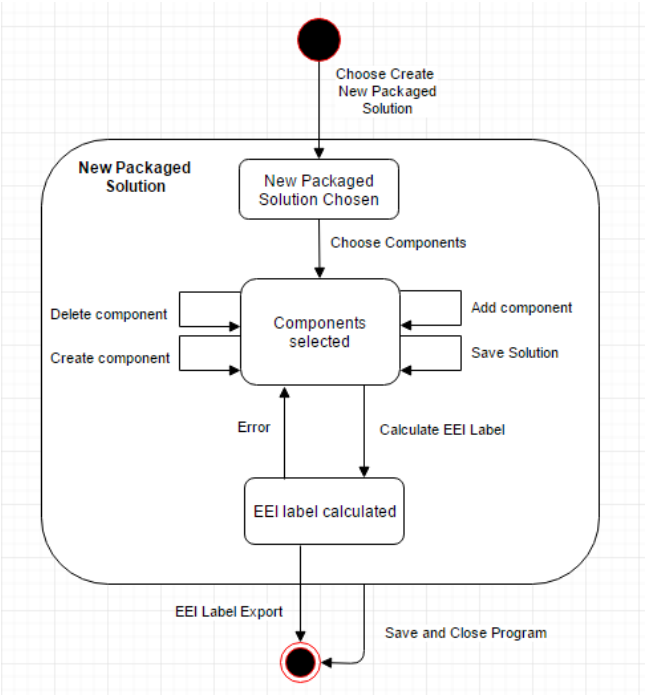
Create packaged solution

Use case: The create packaged solution is initiated by the contractor when a completely new offer has to be made. After choosing to create a packaged solution from a button in home screen, the contractor is greeted with a search bar, drop down menu for component selection. The contractor then chooses which component to add by searching. The component search will result in either finding the correct component or a polite message say the component does not exist in the database, at which point the contractor can choose to add a new component to the database, if this option is chosen a new window appears and the contractor can enter the product data into a form and save the component to the database. When all components have been chosen the contractor can save the packaged solution, calculate the EEI and export the final EEI label as a .PDF which completes the use case.

Objects: User and Components, Packaged solution, EEI label.

Functions: Add component, Create package solution, Search for components, Select/add to basket, Calculate EEI and Export EEI.

Figure 7.1: Statechart diagram of use case "Create packaged solution"



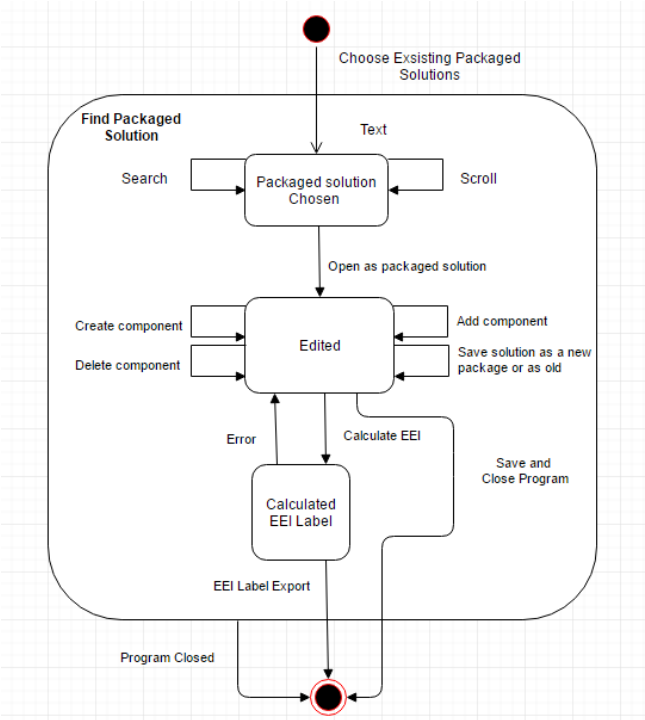
Find packaged solutions:

Use case: Finding packaged solutions is initiated by the contractor. A contractor wants access to previously made packaged solutions if two offers have to be essentially the same. When the contractor has access to the existing packaged solutions a list of previously created packaged solutions is displayed. At this point, the contractor can search for packages or scroll through them. When a packaged solution is found the contractor can press to view it in "calculation mode", at which point the product list shows in a table on the right-hand side of the screen where the contractor can remove components as needed and add components to the packaged solution by the same process as in "Create packaged solution" use case. When all components have been chosen the contractor can save the packaged solution, calculate the EEI and export the final EEI label as a .PDF which concludes the use case.

Objects: User and Components, Packaged solutions, EEI label.

Functions: Search for old solutions, Edit solution, Add components, search for components, Create package solution Search for components, Select/add to basket, Remove/delete from basket, Calculate EEI and Export EEI.

Figure 7.2: Statechart diagram of use case "Find packaged solution"



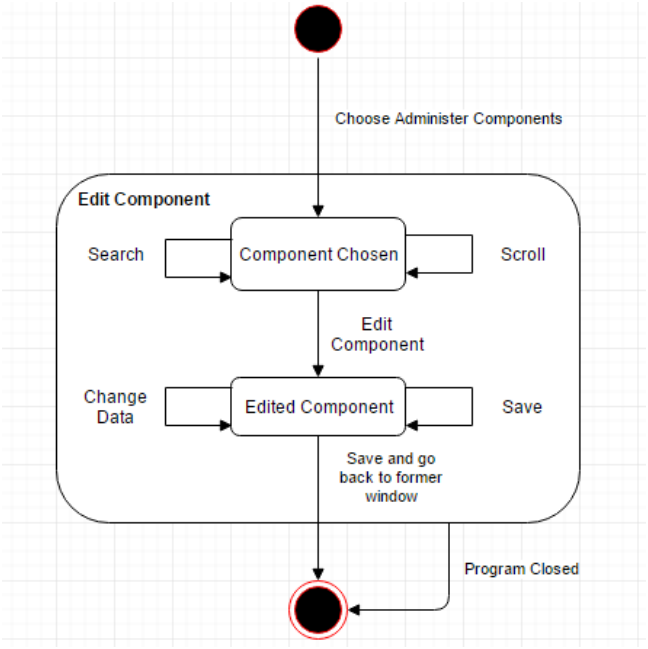
Add/Change component data:

Use case: Adding or changing components is initiated by the contractor when a need for more components arises or when some components have wrong values associated with them. The contractor can choose to administer components from the home menu or when creating/changing packaged solutions. When a new component is needed the contractor chooses the "Administer components" option which opens a new window displaying all components in the database, at this point the contractor can choose to add a completely new component or edit one currently listed, either option opens a new window where data can be entered. When the contractor has completed the changes the save button is pressed and the use case is completed.

Objects: User and Components.

Functions: Add component.

Figure 7.3: Statechart diagram of use case "Change component data"



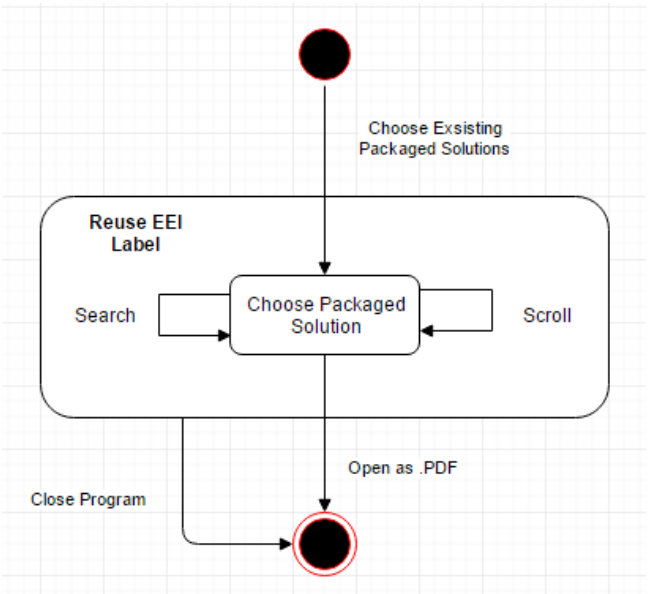
Reuse previously made EEI label:

Use case: This use case is initiated by the contractor when an offer is identical to a previously made offer. The contractor Chooses the same option as in the "Find packaged solution" use case, which opens a window displaying all existing packaged solutions. At this point, the contractor can search or scroll through the packaged solutions. When the contractor finds the packaged solution needed it can be directly opened as a .PDF file. At which point the use case is completed.

Objects: User and Components, Packed solution, EEI label.

Functions: Search for old solutions, Export EEI.

Figure 7.4: Statechart diagram of use case "Reuse previosly made EEI label"



7.2 Functions

This section will describe which functions the solution should contain. Furthermore it should describe the complexity of the functions and which type it is. The functions are chosen based on the use cases formulated in section 7.1.2

We have chosen to describe the system by the following functions shown in table **??**. For each of these functions we have determined how difficult they are to make, based on our knowledge and thoughts of how it should be made. After estimating the difficulty. We thought about which of the four following types of functions:

1. **Update**: A function type that is activated when events in the problem domain change the model data.
2. **Read**: A function type where data is gathered from the model and sent to the a calculation function or shown to the user.
3. **Calculation**: A function type where data from the model and actors are used for calculation.
4. **Signal**: A function type which delivers a signal to the user about changes to the model, or triggering of events.

Function	Complexity	Type
Add component	Easy	Update
Create package solution	Easy	Update
Search for components	Complex	Read
Search for old solutions	Complex	Read
Edit component	Easy	Update
Edit solution	Easy	Update
Select/add to basket	Easy	Update
Remove/delete from basket	Easy	Update
Delete component	Easy	Update
Delete old solution	Easy	Update
Calculate EEI	Medium	Calculation
Export EEI	Complex	Read

Table 7.1: Table with the different functions

In this section the functions required for the systems were explored. The functions were based on the use cases stated in section 7.1.2, which resulted in a above function table.

7.3 Interface

7.3.1 Interaction Design

The base of most GUI's is WIMP as both Windows and Mac is based of it. The W stands for Windows which means sharing a graphical display and resources on multiple applications at the same time. the second letter I stands for Icon which is used as a symbol to represent an application, folder, file or device. The third letter M is menu which is used as a list of commands or options which the user can choose from. The fourth and last letter P is Pointing devices which is the device the user uses, this is often a mouse, or a touchscreen. We have decided to use WIMP because it fits the system good. By visualizing the diffrent products with icons and names in menus.

7.3.2 Initial Prototype

As a way of developing ideas for the graphical user interface, we decided to work on a low-fidelity prototype. The benefit of this type of prototyping is that changes can easily be made along the way if the group evaluates that something has to be changed. With this form of prototyping, no ideas are off limits because they can easily be implemented into the prototype and quickly evaluated. This allows every member of the group to be involved in the design process.

When we began working on the prototype, we had limited knowledge about the system as we had not yet made a system definition or even created any conceptual scenarios. However, as we had conducted our initial interview at this point (see section 2.1), we had a few key points in mind including:

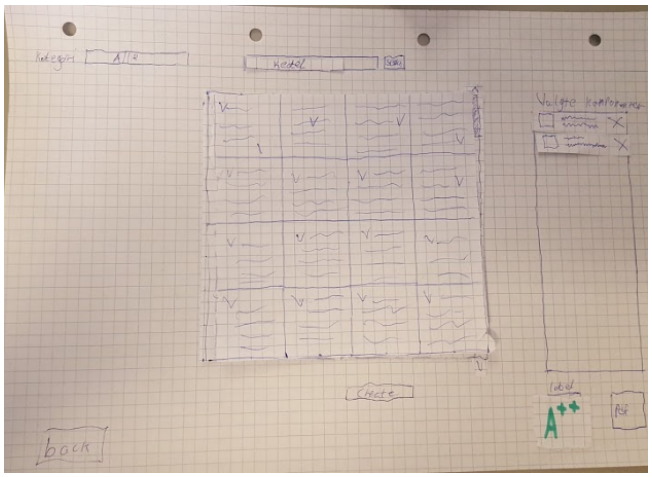
- The design should be simple to use, as the system is to be used infrequently (i.e. once every two weeks).
- The design needs to include the capability of adding new components to a local catalogue.
- When creating a packaged solution, the user should be able to add the components one by one and see a live calculation of the EEI.

Before we started working on the paper prototype, we did a mock-up of the design on a blackboard. At this point we agreed on three main components of the design:

- **Splash window:** The first window visible to the user should be a navigation window, from which the user can access the rest of the application.
- **Component window:** There should be a window in which the user is able to add single components to a local database. The window should change its dimension and fields depending on which type of component is being added.
- **Packaged solution window:** This window should serve two purposes. First of all, its main purpose is the ability to create a new packaged solutions, but it should also be possible to browse previously created packaged solutions. The window should have a search bar and a grid of elements (both single components and previously created packaged solutions), which is refreshed whenever the contents of the search bar is modified.

When we turned the blackboard prototype into a paper prototype, we did not make any major changes to the design. However, the paper prototype gave us a better understanding of the relations between the different windows and forced us to consider decisions regarding the functionality of the system. After making the paper prototype (see Figure 7.5) we had a member of the group interact with the system, where another group member was responsible for creating the system responses. We used this interaction to evaluate the changes we would need to make in our presentation prototype.

Figure 7.5: Picture of the paper prototype.



7.3.3 Design Choices

Several choices were made during the development of the presentation prototype. The color scheme of the prototype was kept neutral and mellow to be easy on the eyes as well as fit in with other systems Brian Nielsen makes use of on a daily basis such as the Viessmann ErP-calculator or Excel sheets used for accounting. The layout of the prototype will also be simple and only elements of importance will be highlighted. While the middle part of the screen will change based on what is currently being operated on, while the top and sides of the screen will not change to remind the user of what components they have already chosen as well as allow for the user to continue searching if the current operation does not output the wanted components.

For every object available for interaction on the prototype, it has been made as clear as possible how to interact with it and what the interaction results in. Navigation through the prototype will be helped by always informing the user of where they are in the system.

The sidebar for adding components to the packaged solution has to purpose of constantly showing the user what is currently in their packaged solution. The interface will also allow for easy removal of unwanted components in the packaged solution.

Some functions that exist in current solutions described in section 3 will not be present in the presentation prototype, such as the messages informing the user that a packaged solution is not compatible or helpful tips for finding new components. This is because the prototype has the purpose of evaluating the usability of the initial design. The messages and errors that require implementation of such logic will then be evaluated at a later iteration of the design.

The implementation of this design along with implementations of the design requirements stated in section 5.5,

will be evaluated with the main subject of the case study, Brian Nielsen.

7.3.4 Presentation Prototype

Based on the layout of the paper prototype a prototype for presentation was developed. The main goal of the presentation prototype is to research whether or not the layout and design is intuitive and understandable for the user. The presentation prototype was made with the intent of testing it on Brian Nielsen to gain input from him and change the system accordingly.

We developed the presentation prototype based on the experience gained from the work with the initial prototype and the design considerations made in section 7.3.3. From these two sections we obtained the following points to consider during the development of the prototype:

- The overall interface design and structure worked fine. (e.g Splash window, Component window and Packaged solution window).
- Some buttons in the initial prototype were not placed correctly when considering their name (e.g The create component button could be understood as "Create packaged solution" or as "Add a new component" to the achieve).
- Most of the interface ideas from the initial prototype can be used again for the presentation prototype. (e.g The simple design and the sidebar)

The process of developing the presentation prototype started in much the same fashion as the initial prototype, where we first did a mock-up design on the blackboard and discussed different possibilities for layout. From this mock-up we gathered the following points:

- Button elements should be placed closer to the interface elements they affect.
- Add advanced search.

From this point we started developing the presentation prototype as a Windows Presentation Foundation (WPF) with the intention that all except the interface code should be thrown away when starting to develop the high fidelity prototype. While developing the prototype we only made few deviations from the mock-up created on the black broad mostly in the form of extra buttons, and the main layout concepts were also mostly kept intact compared to the initial prototype. The prototype were then evaluated by Brian Nielsen, the details of which are described in the next section.

Picture of the Prototype

7.4 Presentation Prototype Testing

The presentation prototype is created to test out the initial layout and intended functionality of the system created based on the system definition decided on in **??**. The presentation will be tested during a second interview conducted on Brian Nielsen.

7.4.1 Goal of Interview

The main goal of the interview is to receive feedback on the presentation prototype described in **??**. The interview will be designed not only to recieve feedback on the design of the prototype, but also to resolve some of the issues encountered during the design process. The issues include knowing when a packaged solution contains components that are not compatible as well as the issue of whether or not Brian wants to input all information regarding a component into the system allowing him to look up components and their specifications inside the program or if he simply just wants to input the required information to calculate the EEI and use another source for looking up component specifications.

The interview will be conducted after giving Brian some time with the presentation prototype. During this test his interaction with the system will be monitored to gain further understanding of the current prototype and its shortcomings. The questions needing answers during the test and interview is therefore divided into two sections:

- Interview
  - What does he like about the prototype?
  - What does he not like about the prototype?
  - Does the current prototype represent all needed functionality?
  - How does Brian know when a packaged solution will work?
  - How would Brian prefer to use the program?
    - Just for calculations?
    - As a component register along with an EEI calculator?
- Observation
  - How does Brian interact with the system?
  - Is the current user interface intuitive?
  - What issues arise with the current design?

Interview Plan

Since Brian Nielsen already has helped during the initial phases of the project, he will already know the main functions of the program. Therefore the testing will start with just a simple introduction for Brian. The testing of the prototype will be conducted through a series of small assignments for Brian to complete. Shortly after the interview with Brian, an Instant Data Analysis(IDA) will be conducted to get the development started while the data from the testings are being processed. The setup for the test will include:

- One interviewer
- Two Observers
- One test monitor

The schedule for the interview will look like this:

- Quick introduction for Brian
- Prototype testing
- Post-test Interview
- IDA Analysis

7.5 High fidelity Prototype

Interface dialog patterns

Navigation diagrams

Interface elements

Prototype demonstration

7.6 Calculating the EEI for packaged solutions

The calculations used in this project are taken from the report written on behalf of the Danish Energy Agency by Acting Head of Department at Sweco A/S, reviewed by a senior consultant at the Danish Technological Institute [7]. When calculating the EEI for a packaged solution, there are several different variables to consider. The first part of this section will describe the different variables.

7.6.1 Annual fuel utilization efficiency

The annual fuel utilization efficiency (AFUE) is the main variable in calculating the EEI for packaged solutions. AFUE describes the ratio of useful energy output to energy input, expressed as a percentage, for combustion equipment like boilers and water heaters. For example, a 90% AFUE water heater supplied with 100 BTUs of natural gas will output 90 BTUs of useful energy, whereas a 110% AFUE water heater will output 110 BTUs. The EEI of a packaged solution is based on the AFUE of the packaged solution, we must therefore calculate the AFUE of the packaged solution.

7.7 Calculating the AFUE of a packaged solution

The equation for calculating the AFUE of a packaged solution is split into separate parts described briefly in this section.

7.7.1 Primary heating component

A packaged solution must have a primary heating component. To calculate the AFUE of the packaged solution, we must first determine the AFUE of the primary heating component paired with a temperature regulator, regardless of it being an internal or external component. Temperature regulators are put into classes like so:

```
Class 1 = 1%
Class 2 = 2%
Class 3 = 1,5%
Class 4 = 2%
Class 5 = 3%
Class 6 = 4%
Class 7 = 3,5%
Class 8 = 5%
```

Once the class of the temperature regulator in question is determined, we add the percentage denoted by the class, to the AFUE of the primary heating component in the packaged solution.

7.7.2 Effect of a secondary heating component

Calculating the effect of a secondary heating component, is dependent on the type of primary- and secondary heating component. If both the primary- and secondary heating component are boilers, the equation for calculating the effect of the secondary heating component is:

$$(AFUE_{primary} - AFUE_{secondary}) \times 0.1 \tag{7.1}$$

Whereas if the primary heating component is a heat pump and the secondary heating component is a boiler, or the primary heating component is a boiler and the secondary heating component is a heat pump, we need to find a variable 'II' to use in the equation:

$$(AFUE_{primary} - AFUE_{secondary}) \times II \tag{7.2}$$

The variable 'II' denotes the balance between the primary and secondary heating component. The value of 'II' is derived from one of two tables. Which table to use depends on which type of heating component is primary and secondary. If the primary heating component is a heat pump, the value of 'II' is derived from table 6 in [7, p. 6], whereas if the primary heating component is a boiler we derive the value from table 5 in [7, p. 10]. After determining which table to use, we need to calculate the difference in wattage between the primary and the secondary heating component, as it will be used as a key to finding the 'II' value in the table. The wattage of the primary heating component is denoted as P_{rated} and the wattage of the secondary heating component P_{sup}.

$$\frac{P_{rated}}{P_{rated} + P_{sup}} \tag{7.3}$$

Lastly we calculate the effect of the secondary heating component using equation 7.2. The result of equation 7.1 or 7.2 is then added to the AFUE of the primary heating component.

7.7.3 Effect of solar collector

To calculate the effect of a solar collector, two new variables are introduced 'III' and 'IV', both based on the primary heating components wattage 'P_{rated}' and are calculated as follows:

$$III = \frac{294}{11 \times P_{rated}} \tag{7.4}$$

$$IV = \frac{115}{11 \times P_{rated}} \tag{7.5}$$

Other values needed to calculate the effect of a solar collector include the size in square meters denoted '$Solar_s$', the size of the water container connected to the solar collector in cubic metres denoted '$Container_s$', the solar collectors effectiveness denoted '$Solar_e$' and the classification of the container denoted '$Container_c$'. Lastly a constant 'C' is needed for the calculation, 'C' is 0.9 when the primary heating component is a boiler, 0.45 when the primary heating component is a heat pump and 0.7 if using combined heat and power (CHP). All of the above is then used to calculate the effect of the solar collector, by plotting them into the equation:

$$(III \times Solar_s + IV \times Container_s) \times C \times \frac{Solar_e}{100} \times Container_c \tag{7.6}$$

The result is then added to the AFUE of the packaged solution. Note that, if a packaged solution has both a secondary heating component and a solar collector, the lowest value of the results found in equation 7.2 and 7.6 will be halved and subtracted from the final AFUE.

7.7.4 climate related factors

According to Regulation 813/2013[5, p.16] the AFUE in colder and warmer climates should also be stated for packaged solutions using a heat pump as a primary heating component. These values can be found on the specifications on the given heat pump[7, p.8]. For low temperature heat pumps it is not needed, but here it is needed to state the AFUE at lower temperature usage, here called LTU. The LTU is calculated as such:

$$LTU = calculatedAFUE + (50 \times II) \tag{7.7}$$

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List of Figures

Appendices

A | Interview with Brian Nielsen

Brian: Nu ved jeg ikke hvor meget I har været inde og kigge, men fra Energistyrelsen af, hvor de skriver om de her ErP-mærkninger. På siden skriver de lige nøjagtigt om de her problemer med energimærkning af systemer på tværs af diverse producenter.

Anders: Nå ja, jamen vi læste godt på energistyrelsens hjemmeside, at hvis der var dele fra flere producenter involveret i et system, var der problemer med at udregne energimærkningen for systemet. Men da vi så prøvede at finde udregningsformlen og vejledningen herfor, så fandtes hjemmesiden ikke, så vi prøvede at ringe til dem og det fik vi ikke meget ud af.

Brian: Nej lige nøjagtigt, men her beskriver de (bilag A), hvad pakkeløsninger er, som f.eks. er når flere teknologier kombineres i et system. Den mest gængse pakkeløsning på markedet er kombination af en kedel og varmepumpe med temperaturstyring, uanset om temperaturstyringen er integreret i kedlen/varmepumpen eller ej, eller kombinationen af en kedel og et solvarmeanlæg, evt. temperaturstyring. Det er der problemet opstår, du kan nok ringe til en af producenterne og bede om en energimærkning på deres del af anlægget, men du kan ikke ringe til en af dem og bede om energimærkningen på deres del plus en del fra en anden producent. Det ved de ikke, de har kun på deres eget. Så står jeg lige pludselig med to energimærkninger og ved ikke hvordan jeg skal kombinere de to.

Brian: Så ringede jeg til Sonnenkraft (en af producenterne) her i morges, for at få en energimærkning på et kompakt multi anlæg. Så fik jeg en mail, hvor der stod at hvis jeg trykkede på nedenstående link, så ville jeg få informationen på det pågældende anlæg. Dvs. det er ikke nogle informationer der ligger frit tilgængeligt, det kræver at jeg tager kontakt til producenten for at få diverse informationer, hvilket koster en del tid. Det er meget forskelligt fra producent til producent dog, nogen af dem har informationerne liggende frit tilgængeligt, mens andre kræver at man ringer ind hver gang. Det viser sig så at informationerne jeg fik sendt tilbage fra producenten ikke var et energimærke, da udregningerne for det pågældende anlæg ikke var lavet (informationerne fremgår af bilag B). Så er det jeg begynder at være i vildrede, fordi jeg ved ikke hvad jeg skal bruge alle de her informationer til, jeg kan ikke lave ErP beregninger – det sørger producenterne normalvis for, så hvad gør jeg nu? Man kan let komme i vildrede, når man ikke har en fast side man kan gå til for at få lavet sine udregninger.

Brian: Et andet eksempel, er når jeg har eksempelvis en kedel fra den ene producent og en varmtvandsbeholder fra en anden, og jeg så anskaffer mig energimærket for de to gennem de to producenter. Så sidder jeg eksempelvis med en kedel der er energimærket A og en varmtvandsbeholder der er energimærket B, hvordan finder jeg så ud af hvad energimærket er for de to? Loven dikterer at jeg godt må tage udgangspunkt i det laveste energimærke og bruge det for systemet, men hvad gør jeg så når en anden leverandør satser og sætter en højere energimærkning for de to systemer, for at få jobbet? Det er noget værre rod.

Brian: Yderligere ringede jeg til en af leverandørerne i dag for at få en snak om bl.a. opfølgning på udsendelse af de her beregninger. Idéen, som de fleste af os forstår det, er at der bliver lavet stikprøver på diverse firmaer for at finde ud af hvorvidt firmaerne overholder de konventioner som er fastsat af loven. Leverandøren svarede, at de havde brugt næsten fire år på at udvikle deres egen ErP beregner og de håbede derfor på at der snart ville blive fulgt op på tingene, så den tid de havde brugt på at udvikle deres ErP beregner ikke var spildt.

Anders: Først og fremmest, hvordan oplever du problemet med udregning af energimærket for de forskellige anlæg?

Brian: Jamen, problemet som ligger i det, er at jeg ikke laver energimærkningen for anlæg der spænder på tværs af producenterne, da jeg ikke har nogen form for erfaring eller tid til at udregne disse manuelt.

Anders: Så du står for skud, hvis der blev lavet kontrol?

Brian: Ja, og jeg frygter de implikationer som måtte følge. Så vidt jeg har forstået så er det en bøde på omtrent ti tusinde kroner per ikke udsendt energimærke. Jeg håber derfor på at der snart vil blive fundet en løsning, så jeg kan sende tilbud ud til kunderne med god samvittighed igen. Sagen er jo den, at jeg ikke blot vil blive stemplet hvis jeg har udført et stykke arbejde og glemt energimærket, jeg bliver stemplet for blot at have udsendt et tilbud uden energimærke. Så det kan sagtens være at jeg har udsendt 30 tilbud på systemer uden energimærker, men jeg har kun fået arbejde ved 10 af dem, så skal jeg stadigvæk bøde for de tilbud hvor jeg ikke har medsendt et energimærke.

Anders: Så, hvis jeg har forstået ret, er problemet at det kun er muligt at udregne energimærker for systemer der falder under en producent.

Brian: Lige nøjagtig.

Anders: Kan du forestille dig hvorfor de forskellige producenter ikke medtager produkter fra andre producenter i deres ErP beregner?

Brian: Jeg tror ikke det har nogen interesse for dem, da de selvfølgelig ønsker at leverandøren køber udelukkende fra dem.

Anders: Er der nogle funktionaliteter du godt kan lide ved de nuværende beregnere, og er der noget du tænker kunne gøres bedre?

Brian: Jeg ved sgu ikke lige, jeg synes systemerne fungerer rigtig godt for sig selv, men jeg tænker måske at der burde ligge noget fokus på forbrugerne. Man kunne jo forestille sig at nogle forbrugere godt kunne tænke sig at finde den mest energirigtige løsning, ved selv at kigge lidt på produktudvalget og sammensætte systemer. Det er svært at sælge systemer til brugerne der er energirigtige, fordi de ofte koster en smule mere, så vi sender altid tilbud ud på de billigste systemer og ikke altid de mest energirigtige.

Mikkel: Så du mener, at hvis brugerne selv kunne få lov at sammensætte potentielle systemer og læse op på fordelene ved et mere energirigtigt system, så ville de måske købe dem istedet? Altså, det er et slags kvalitetsmærke for forbrugerne?

Brian: Det er korrekt. Energimærket er helt klart et kvalitetsmærke, men forbrugerne er ikke nok inde i det, til at vide hvad der er godt og skidt.

Anders: Når I sidder og regner på energimærket til de forskellige systemer, hvem er det så i firmaet der påtager sig den opgave? Hvilken slags uddannelse har personen/personerne?

Brian: I vores firma er det mig der udfylder den opgave. Det gøres som et led i udformelsen af diverse tilbud til kunderne, og min uddannelse er en erhvervsøkonomi og installatør.

Mikkel: Men er det forstået korrekt, at du ikke laver udregningerne, du går bare ind og bruger leverandørenes ErP-beregnere? Du har ikke en dybere forståelse for beregningerne?

Brian: Det er korrekt. Jeg laver kun beregninger på de færdige anlæg, jeg laver ikke noget på tværs, da det er de eneste beregninger jeg kan få ud af leverandørenes ErP beregnere.

Anders: Men det er dig der har ansvaret?

Brian: Ja det er mig der har ansvaret.

Anders: Rent praktisk. Når et tilbud skal laves, hvad er det så du gør? Kan du gennemgå processen for os?

Brian: Jeg tager ud og besøger kunden, finder ud af hvad situationen er og hvad der mangler. Så tager jeg hjem og beregner en pris på det. Så går jeg for eksempel ind på Viessmanns hjemmeside og udregner et energimærke for systemet, såfremt alle komponenterne er Viessmann komponenter. Ved siden af det, så har jeg også lige energitilskuddet jeg skal ind og søge for kunden, og så har jeg lige en anmeldelse af kedlen jeg også skal skrive. Så skal jeg så ud og aflevere det her tilbud, og have underskrift på det hele - først og fremmest energitilskudet, som jeg skal tilbage og sende ind for at få det her energitilskud. Når så vi har udført arbejdet, så skal jeg skrive en faktura, og den skal kunden så betale. Så skal en kopi af fakturaen sendes med energitilskudet tilbage, så vi kan dokumentere at arbejdet er udført og betalt. Så som i kan høre, har vi vanvittigt meget papirarbejde bare i et salg.

Gruppen: Ja.

Brian: Det værste er næsten at de fleste af vores private kunder er ældre mennesker, og de skal lige guides igennem mails hver gang. Det tager en evighed.

Brian: Men der er faktisk meget papirarbejde i det. Nu har jeg lige haft en sag med noget energitilskud for eksempel, det var faktisk her i går, hvor jeg havde anmeldt montering af kedlen i forgårs, men det gjorde den så ikke fordi producenten ikke fik den sendt, så den kom først i går morges, og der skal ansøges om energitilskud inden kedlen bliver monteret ellers kan man ikke få det. Så ringede de inde fra naturgas at de blev nødt til at afvise ansøgningen, fordi vi havde monteret kedlen, men det havde vi jo så ikke, så blev jeg nødt til at skrive til dem at jeg under tro og love erklærede at vi ikke havde monteret kedlen endnu. Så der er rigtig meget bureaukrati indenfor vores felt.

Anders: Når du er ude ved en kunde, finder du så selv ud af hvilke produkter kunden skal have?

Brian: Ja, vi vælger selvfølgelig altid de produkter vi selv snakker godt om, men kunden har selvfølgelig også et ønske nogen gange, så det er vi også nødt til at føje os for. Lad os sige at en kunde har haft en Bosch kedel i mange år, som de har været glade for, jamen så er jeg nødt til at lave et tilbud på en Bosch kedel, og så bliver det et problem med at udregne energimærket fordi de andre komponenter er Viessmann. Vi kan jo også komme ud til en kunde som har en kedel og en utæt beholder, hvor vi så siger skal vi ikke skifte det hele, men de er ofte glade for systemet, så bliver vi nødt til at skifte den ene del og beregne energimærket for det samlede system igen alligevel.

Anders: Okay, så skal i energimærke det samlede system igen samlet? Altså finde informationer på de gamle dele og kombinere med de nye?

Brian: Ja, det er ofte en smule problematisk. Spørgsmålet er jo om jeg kan finde data på alle de gamle komponenter. Men nogle gange tænker jeg også, at det ville være fordelagtigt for kunderne at have adgang til en hjemmeside hvor de kan afprøve forskellige systemer for at finde en energirigtig løsning. De kunne f.eks. finde en kedel med energimærke A, og så kombinere med et solcelleanlæg så de får et system med energimærke A++, og tænke "så er det dét vi skal have". Så bliver kunderne også lidt mere obs. På det her, og det betyder selvfølgelig også mindre arbejde for os, med samme mulige indtægt.

Anders: Hvor ofte om måneden laver i et tilbud hvor i kombinere komponenter på tværs af producenter?

Brian: Jamen det er nok en gang hver anden uge.

Mikkel: Men sådan noget med at udskifte en enkelt del, og vurdere energimærket for det nye system, hvor ofte sker det?

Brian: Ejm, jo, på det sidste har vi faktisk gjort det en del. Men afhængigt af årstiden, er det nok en gang om måneden.

Anders: Når du sammensætter de her tilbud og regner energimærket, hvor sker det så? Er det på kontoret eller hos kunden?

Brian: Det er på kontoret udelukkende.

Anders: Og det er kun dig der gør det? Du arbejder ikke sammen med andre om det?

Brian: Nej det er kun mig.

Anders: Så jeg har lidt en fornemmelse af at I har travlt når I skal lave de her tilbud, med alt det papirarbejde der hører med?

Brian: Jamen det er jo det, vi har meget travlt i hverdagen. Jeg har kun så meget tid jeg kan bruge på kontoret, resten af tiden må jeg selv ud og snakke med kunder også. Så det plejer at være en time eller to af gangen når jeg lige har lidt tid til overs, at jeg svinger forbi kontoret og udarbejder et par tilbud. Så der kan i godt se at jeg ikke rigtig kan bruge to timer på at sidde og udregne energimærker for hvert enkelt system.

Anders: Nej det er klart.

Anders: Hvilken slags platforme anvender du til at udforme tilbuddene? Jeg tænker på iPhones, tablets, computere osv.?

Brian: Jeg bruger bare en computer, og ikke andet.

Anders L: Bare for at gøre det helt klart, er det en windows, mac eller anden slags computer?

Brian: Det er bare en computer der kører windows 10.

Anders: Er der nogle specielle programmer i bruger meget til at udforme tilbuddene og det andet papirarbejde?

Brian: Til tilbud der bruger vi Sigma, og det er egentlig det program jeg bruger mest tid i.

Anders: Grunden til at jeg spørger, er for at få en idé om hvilke layouts du er bekendt med, og hvad der virker.

Brian: Sigma er et program der er bygget op på Excel platformen, hvor man kan indtaste en masse informationer og så har den en række smarte funktioner der genererer forslag til mig.

Anders: Så, når du skal sammensætte tilbud, har du så mulighed for at finde specifikationer på alle de produkter du skal bruge?

Brian: Jeg burde have mulighed for at finde informationer på alle de produkter vi forhandler, det meste ligger frit tilgængeligt, men noget af det kræver at jeg ringer til producenterne for at få informationer. Det er meget forskelligt fra producent til producent.

Anders: Super. Så når i sammensætter systemer, er der nogle komponenter i arbejder mere med end andre?

Brian: Altså gaskedler og beholdere primært, men der er også ting som olie kedler og solfangere. Solceller arbejder vi ikke med længere.

Anders: Et slag på tasken, hvor mange forskellige leverandørere som Boschmann og Viessmann arbejder i med?

Brian: Der er nok omkring 10 leverandører, hvor vi selvfølgelig bruger nogen mere end andre.

Anders: Hvis i skal lave et tilbud, vægter i så at alle komponenterne kommer fra samme leverandør udelukkende fordi det er besværligt at udregne energimærket hvis komponenterne er bestilt på tværs af leverandørerne?

Brian: Ja det gør vi.

Anders: Når i sammensætter et tilbud til en kunde, går i så nogensinde tilbage i en database eller andet katalog og ser på lignende systemer for at gøre processen hurtigere?

Brian: Ja det gør jeg faktisk ret ofte, fordi tilbudedne ofte minder om hinanden afhængigt af kundens situation. Så tager jeg bare tilbud jeg har lavet før og genbruger dem ved at ændre adresser og tidspunkter. Det sparer mig en masse tid.

Anders L: Hvad med en standard installation? Det vil ofte ikke være på tværs af producenter går jeg ud fra?

Brian: Det er korrekt, i en standard installation, vil vi tage vores primære leverandør og bruge produkter fra deres katalog for at strømline processen.

Andreas: Har i så nogle standard komponenter i bruger i sådant et tilfælde?

Brian: Ja Viessmann har en række pakkeløsninger, så vi plejer bare at vælge en af dem. Det gør det hele meget nemmere.

Anders: Når nu sådan et energimærke skal laves, så har vi set at det endelige produkt er en PDF. De har alle sammen nogenlunde samme format. Ved du om det er en standard opsætning som man skal følge?

Brian: Jeg er ikke helt sikker, men det mener jeg at man skal. Udregninger osv. skal fremgå af PDF'en. Kunden får bare hele rapporten, så bliver vi ihvertfald ikke fanget på noget.

Anders L: Jeg har en undren. Du siger at du laver de her løsninger på tværs af leverandørerne, nogle få, men et par stykker intet mindre. Vil det sige at der findes en række systemer derude som ikke er energimærket?

Brian: Dem findes der mange af.

Anders L: Men er det ikke et problem ift. kunden, for at få noget energitilskud?

Brian: Nej det betyder ikke noget, de baserer mængden man får i energitilskud på antallet af kilo / timer sparet ved brug af anlægget ift. en fastsat standard.

Anders L: Men er det noget kunderne undrer sig over? Altså at der ikke kommer et energimærke med systemet?

Brian: Jeg tror ikke de tænker over det, vi har ihvertfald ikke hørt noget fra nogen endnu.

Anders: Når i sammensætter et system, er det så prisen eller energimærket der er den afgørende faktor?

Brian: Hovedsageligt prisen.