University of Southern Denmark

Faculty of Engineering

Bachelor Thesis

Utilizing Commercial & Industrial Excess Heat for District Heating in Denmark

Business & Socioeconomic Assessment of Taxation

Author

Michael Thoisen Fog
Bsc. Energy Technology
Department of
The Maersk Mc-Kinney Moller Institute

Supervisor

Abid Rabbani
Department of
Chemical Engineering, Biotechnology and Environmental Technology

Ulrik Møller
Department of
Business Management and Economics

Number of characters: 62,314

1st of June 2018

Abstract

This thesis explores different aspects of utilizing excess heat for district heating. The purpose of this study is to create and develop a model that calculates the utilization potential and assess the legislation concerning utilization of excess heat by the use of cost of heat seen from the business and society's perspective. The cost of heat is carried out for utilization of excess heat and different production units.

The model is built in Microsoft Excel by the use of statistical data and studies provided by the Danish Energy Agency. A total external utilization potential of 43.03 PJ is calculated, where the actual utilization of excess heat is estimated to around 25 to 30 PJ. The results from the model are implemented in three energy flow diagrams for year 2016, 2035 and 2050, which are carried out in the software eSankey. The energy flow diagrams show that utilization of excess heat will play an important role in the future energy system, both for internal and external utilization.

The assessment of the legislation is carried out by comparing the levelized and society's cost of heat, which are completed by the use of Microsoft Excel. The comparison shows that direct utilization of excess heat is competitive with other production units, but not when utilizing a heat pump. The assessment results in a proposed legislation based on increased reimbursement of electricity tax, progressive taxation and a decreased taxation with an increase in the COP of the heat pump.

Preface

This report was written for a 15 ECTS bachelor thesis at the department of Maersk Mc-Kinney Moller Institute, University of Southern Denmark between February and June 2018. The main supervisor of the study was Abid Rabbani, assistant professor at the department of Chemical Engineering, Biotechnology and Environmental Technology. Furthermore, the thesis was co-supervised by Ulrik Møller, external lecture from Energinet at the department of Business Management and Economics.

A great thanks to Anders Bavnhøj Hansen from Energinet for providing the data required to create a comprehensive analysis of the future role of excess heat.

Table of contents

List of figures

List of tables

1. Introduction

Excess heat has become an important topic in the planning of the future district heating system with more and more data centres being built in Denmark. The data centres are capable of supplying heat as a baseload in a district heating system and thereby replace heat production from heating and cogeneration plants. The current utilization of excess heat for district heating are 3.45 PJ and have almost stayed the same for decades [1]. This development within utilization of excess heat could indicate that the legislation within this area do not create incentives for companies to utilize excess heat for district heating. Currently, excess heat is imposed with an excess heat tax to prevent companies from wasting energy instead of utilizing energy. But why should excess heat from a process with the highest available efficiency be imposed with excess heat tax?

> *Excess heat, in terms of energy, is the heat that cannot be utilized further for production processes when a company has done everything possible to energy-efficient its processes.*
>
> \- Technical definition of excess heat.

> *Excess heat, in terms of energy, is the heat that can be utilized from a production process. It is an unconditional prerequisite for the application of the special rules that the utilization of excess heat does not result in increased fuel consumption.*
>
> \- The Danish Tax Authorities definition of excess heat [2].

These are two definitions of excess heat, a technical definition and a definition from the Danish Tax Authorities. The main difference is that the technical definition takes efficiencies into consideration, where the Danish Tax Authorities is focusing on the amount of fuel used for the process. This can potentially result in a waste of energy as the same process with a low efficiency could be utilized before one with a high efficiency and thereby create an economic loss for the society. Furthermore, excess heat from a process with the highest available efficiency is imposed with the excess heat tax even though the technical definition defines this as excess heat.

This thesis analyses excess heat from a techno-economical and legislation point of view with the purpose of modelling the utilization potential and asses if the legislation creates the right incentives for utilization of excess heat for district heating. The modelling of the excess heat potential will be conducted for year 2016 and used for an understanding of its future role in an industry and commercial energy flow diagram for year 2035 and 2050. The assessment is examined through a definition of the current and future proposed changes in legislation with the purpose of comparing the levelized and society's cost of heat from utilization of excess heat and production units. The final assessment will take the future proposed changes in legislation and compare them with other changes that could create incentives for utilization of excess heat for district heating.

2. Legislation

The purpose of this section is to explain the legislation and taxes when utilizing excess heat from commercial and industrial processes. All data and information will be given in 2018 prices with the regulations of that year. Furthermore, the current tax of electricity used for heat and the proposed reimbursement will be presented.

2.1 Internal utilization of excess heat

Legislation concerning utilizing excess heat internally in a company is divided between process purpose, space heating and water heating. All excess heat from processes used for process purpose are exempt from excess heat tax and this also apply when there is a reimbursement of the energy tax on the fuels used for that process. The excess heat used for space and/or water heating is imposed with the excess heat tax. Though, this tax will only apply between the 1st of October and 31st of March. There are three methods of calculating this tax. The first is by measuring the amount of energy devoted, the second is through a square meter tax and the last one is only concerning ventilation of process heat. The square meter tax does not apply when excess heat is used for water heating [3]. The ventilation of process heat for space heating in a company is imposed with an excess heat tax applied on two times the electricity consumption for the ventilator that transfers fresh air to the heat exchanger [4]. The excess heat tax is paid through a reduced reimbursement of energy taxes given for that process where the excess heat is recovered from. An overview of the taxes is reported in Table 1.

Table 1 - Tax on excess heat utilized internally.

Process purpose [DKK/GJ]	Space heating [DKK/m^2/month]	Space heating [DKK/GJ]	Water Heating [DKK/GJ]
0	10	51	51

In cases where hot process air is utilized for space heating of that space where the process is occurring, the excess heat tax is dependent on the recovery system and whether it is liquified. Recovery by the use of a ventilation system that ventilates the hot air directly from the process and afterwards get liquified, is imposed with excess heat tax.

2.2 External utilization of excess heat

External utilization is imposed with external heat tax and can either be applied on the amount of energy leaving the company or on the compensation fee for delivering heat for the district heating. The taxes are reported in Table 2 [5].

Table 2 - Tax on excess heat utilized externally.

Energy leaving the company [DKK/GJ]	Percentage of the compensation fee [-]
51	33%

In 2010, the Danish Tax Council has decided in a case of delivery of excess heat from a company to another company, without a compensation fee, that no excess heat tax will be applied [6]. This principle case creates the opportunity for district heating companies to make the investment in the recovery system and for the companies to deliver the heat for free, without being impacted by a reduced reimbursement of the energy taxes.

There are cases where the excess heat tax is different. When utilizing excess heat from a cogeneration plant, the excess heat tax is dependent on its fuels. The taxes are reported in Table 3 [5] [7].

Table 3 - Tax on excess heat for cogeneration plants.

Gas, coal and oil [DKK/GJ]	Biogas [DKK/GJ]	Other fuels [DKK/GJ]
46.3	1.3	42.5

For industries within agriculture, gardening, mineralogical processes and refineries, the excess heat tax is 55.50 DKK/GJ. Heavy processes stated in the Carbon Dioxide Tax Law, Annex 4, are imposed with an excess heat tax of 7.50 DKK/GJ or 7.5% of the compensation fee [2]. In cases where fuels and/or electricity, imposed with no taxes, are partially used for process purpose and excess heat is recovered from that process, the excess heat tax is partially applied. In this case the excess heat tax is calculated by the proportion between energy input from fuels and/or electricity without taxes and the energy input from all the fuels and/or electricity [8].

2.3 Utilization of excess heat by the use of a heat pump

Electrical heat pumps can be used for both internal and external heating. The technology transfer energy from a heat source to a heat sink by increasing the temperature through a vapor compression refrigeration cycle. Heat pumps' efficiency is stated as Coefficient of Performance (COP), which is the increase of energy by the amount of electrical energy consumed. This energy increase will result in a high excess heat tax and the normal method of calculating the excess heat tax is not appropriate. Therefore, the excess heat tax is applied on the heat that is above 3 times the electrical consumption for the heat pump and is calculated by Equation 2.1 [3].

$$Heat_{imposed\ with\ tax} = Heat_{out} - (3 \cdot Electricity_{in}) \tag{2.1}$$

Electricity tax is also applied when utilizing a heat pump but with a reimbursement as the electricity is used for heat. The electricity tax and current reimbursement are reported in Table 4.

Table 4 - Tax on electricity and the reimbursement when used for heating.

Electricity Tax [DKK/MWh]	Reimbursement [DKK/MWh]
914	507

In November 2017, the government parties[1], Danish Social-Liberal Party and the Danish People's Party agreed on trying to increase the reimbursement [9]. Furthermore, the government proposed in April 2018, that they will try to increase the reimbursement further [10]. The proposed reimbursement is reported in Table 5 for the two agreements.

Table 5 - November 2017 and April 2018 agreement with fixed reimbursement from year 2021.

Reimbursement		
Years [-]	November 2017 Agreement [DKK/MWh]	April 2018 Agreement [DKK/MWh]
2018	657	657
2019	657	657
2020	707	707
2021	607	757

These agreements were made before the next broad energy agreement and will therefore be included for the assessment of the legislation in this thesis.

[1] Venstre, The Liberal Alliance and The Conservative People's Party

3. Utilization of excess heat for district heating

This section presents and analyse the current and potential utilization of excess heat for district heating from commercials and industries. The first part will present the current utilization by the use of statistical data and the latest survey. The second part will describe a model build with the purpose of analysing the utilization potential. Furthermore, the results and the model will be used for an energy flow diagram which presents a mapping of the commercials and industries energy consumption.

3.1 Current utilization of excess heat

The yearly utilization of excess heat from year 1994 to 2016 has increased with 0.610 PJ which is an increase of 21.5%. The utilization is presented in Figure 1.

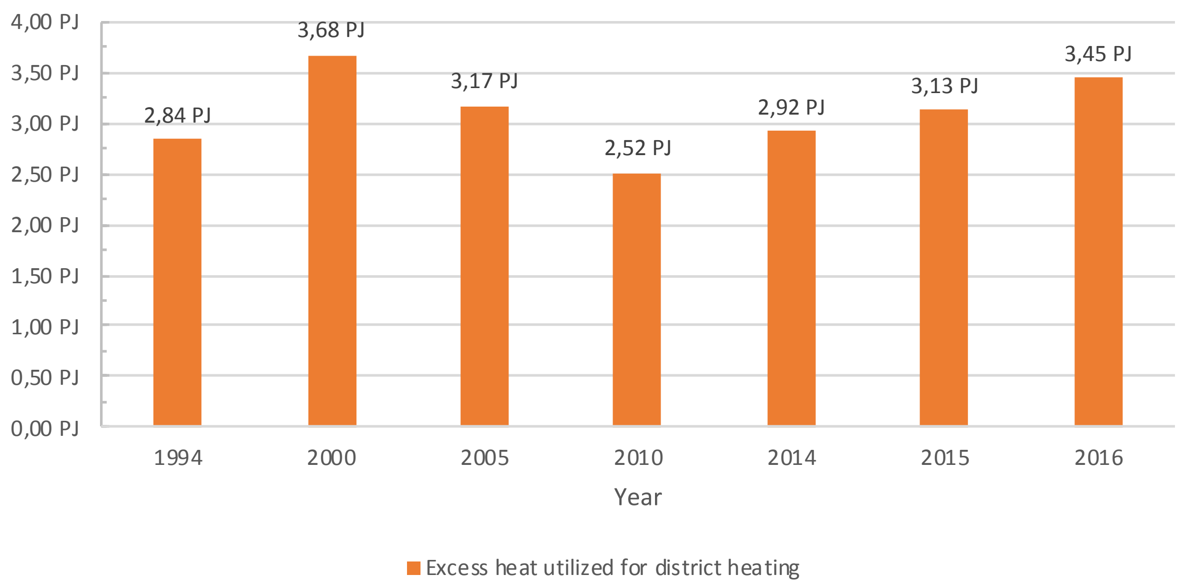


Figure 1 - Statistical utilization of excess heat for district heating (Decimal comma notation) [1].

In the figure it is seen that the delivery fluctuates, which could indicate that some companies have stopped while others have started the delivery, or the number of companies have stayed the same. By looking at the latest survey from 2015, it is stated that out of 41 companies; 15 delivered heat from refrigeration, 1 by the use of a heat pump, 2 which received cooling from the district heating network or a cooling supplier and the rest was delivered directly [11]. This survey shows that the utilization of excess heat is dependent on the recovery system as more heat is utilized directly and through refrigeration. The companies and the amount of delivered heat are seen in Appendix A.

3.2 Modelling the utilization potential of excess heat

This section describes the model used for analysing the utilization potential of excess heat through statistical data and studies provided by the Danish Energy Agency. The modelling was conducted in Microsoft Excel with the purpose of creating a model which can be modified and used for further analysis.

3.2.1 Sorting of data

The model uses both input from Statistics Denmark and different studies from the Danish Energy Agency. These studies do not include all sectors from the Danish Sector Code 2007 (DB07)[2] and therefore, the model is constrained only to include the sectors presented in these studies. The input from Statistics Denmark is the energy accounting in common units based on sector, time and energy type, from year 2016 and includes companies with more than 20 employees [12]. These sectors are seen in Appendix B. A matching between the sectors in Appendix B and the sectors included in the latest mapping of the energy consumption in companies from the Danish Energy Agency is conducted and an overview of the sectors, included in the model, are seen in Appendix C. Sectors not included;

- Extraction of raw materials (060000 & 090000)[3]
- Transportation (490010 to 530000)
- Construction (410009 to 430004)
- Health and social services (860010 to 880000)
- Public administration, defence and police (840010 to 850041)
- Energy supply (350010 to 350030)
- Water supply and renovation (360000 to 383900)

The energy accounting for the sectors are given for 8 categories with 46 subcategories describing which and how much of an energy type the sector is consuming. A sorting of the energy types into 7 categories is conducted based on its use. The 7 categories and energy types within those categories are reported in Table 6. Even though there are no consumption from geothermal heating, it is included for future use of the model.

[2] From sector A to S, 19 standard groups with a 6-digit number.
[3] Extraction of gravel and stone (080090) is included in the model

Table 6 - Energy types included in each category based on the energy accounting from statistics Denmark.

Categories	Energy Types	
Fuels (Process)	• LPG • Heating oil • Fuel oil • Waste oil • Petroleum coke • Orimulsion • Natural gas • Coal • Coke	• Waste • Straw • Wood chips • Wood pellets • Wood waste • Biogas • Biooil • Town gas
Fuels (Transport)	• LPG-transport • Engine gasoline • JP4 • Petroleum	• Flight gasoline • Jet petroleum • Diesel
Electricity	• Wind power • Water power	• Solar power • Electricity
District heating	• District heating	
Solar heating	• Solar heating	
Geothermal heating	• Geothermal heating	
Heat pumps	• Heat pumps	

3.2.2 Mapping of the energy consumption

The consumption is mapped based on the latest mapping of the energy consumption in companies from the Danish Energy Agency, from year 2015 [13]. However, refineries are not included in that mapping and the mapping from year 2008 are used for that sector [14]. Their mapping is based on processes and energy types, where processes contain conversion and net loss, process heating, transportation, space heating, heat pumps and electrical processes. An example from the mapping is seen in Appendix D. The categories and processes are reported in Table 7, these are the categories and processes referred to when writing about the model.

Table 7 - Categories and processes from the mapping of the energy consumption from Danish Energy Agency.

Categories	Processes
Conversion and net loss	• Conversion and net loss
Process heating	• Heating/Boiling • Drying • Evaporation • Distillation • Burning/Sintering • Melting/Casting • Other process heat <150 °C • Other process heat >150 °C
Transportation	• Heavy transport • Transport
Space heating	• Space heating
Heat pumps	• Heat pumps energy consumption
Services	• Lighting • Room cooling • Room ventilation • Fans • IT and other electronics • Other uses of electricity
Electrical processes	• Pumping • Refrigerator/Freezer (Excl. room cooling) • Compressed air • Hydraulics • Other electric motors

Conversion and net loss, process heating and space heating use fuels from the category; *Fuel (Process)*, reported in Table 6. A percentage division between these processes is calculated and multiplied with the total fuel consumption for each sector within that fuel category to yield the consumption for the processes. Even though the mapping states the actual consumption for specific fuel types, this method is used with the purpose of creating a model that takes changes in fuel types and consumption into account. The method is also used for transportation as the document divides transportation into transport and heavy transport. For electricity, district heating, solar heating and heat pumps, the percentage divisions between the processes are given in the mapping and used for the model. An example of this mapping, from the model, is presented in Figure 2.

100010 Slaughterhouses	Conversion and net loss	Heating/Boiling	Drying	Evaporation
- Fuels (Process)	0,19	0,54	0,68	0,12
- Fuels (Transport)				
- Electricity				
- District Heating				
- Solar heating				
- Heat pumps		0,10		

Figure 2 - Screenshot of the mapping from the model (Numbers in PJ with decimal comma notation).

3.2.3 Utilization from processes

A utilization rate is applied on the total energy consumption for each process with the purpose of knowing the amount of heat that can be utilized for further use. The total utilization rates and the processes with excess heat that can be utilized are provided by the Danish Energy Agency [15]. The utilization rates are reported in Table 8, where the processes not stated in the analysis from the Danish Energy Agency are set to zero.

Table 8 - Processes and their utilization rates used for the model.

Processes	Total Utilization Rate
Conversion and net loss	45%
Heating/Boiling	100%
Drying	100%
Evaporation	100%
Distillation	0%
Burning/Sintering	20%
Melting/Casting	0%
Other process heat <150 °C	50%
Other process heat >150 °C	75%
Heavy traffic	0%
Transport	0%
Space heating	0%
Heat pump energy consumption	0%
Lighting	0%
Room cooling	90%
Room ventilation	0%
Fans	0%
IT and other electronics	95%
Other uses of electricity	0%
Pumping	0%
Refrigerator/Freezer (Excl. room cooling)	45%
Compressed air	35%
Hydraulics	90%
Other electric motors	0%

Table 8 shows that utilization from fans and room ventilation are set to zero and is a result of being more feasible to reheat the ventilated air than to utilize for space heating or district heating. By implementing these utilization rates, the model results in a utilization potential of 64.28 PJ (32% of the total energy consumption).

3.2.4 Internal and external utilization potential

The utilization potential is divided into internal and external utilization potential by the use of a minimum requirement. A minimum requirement is estimated, by the use of the survey seen in Appendix A[4], to be 500 MWh per company, for services and electrical processes, and 1000 MWh per company, for process heat. This minimum requirement ensures that if the amount of excess heat is below, it is included in the internal utilization and if it is above, it is included in the external utilization. The model sorts it by dividing the consumption for each process with the total number of companies in each sector. The number of companies is provided by Statistics Denmark and contains companies with more than 20 employees [16]. The method limits the precision of the model, as the utilization is equally divided between the companies. Potentially, this could result in a utilization of zero from a sector even though one company has a large utilization potential. An implementation of this minimum requirement results in a utilization potential of 17.62 and 46.66 PJ for internal and external utilization respectively.

The excess heat is divided into temperature levels, where services and electrical processes are set to have a temperature of below 60 °C. For process heat, division factors provided by the Danish Energy Agency, are used for both internal and external utilization [17], seen in Appendix E. The division factors are stated for each sector and divide the process heat into temperature levels of; below 60 °C, between 60 and 100°C and above 100 °C. For sectors not stated in the analysis, an estimation is made based on a study of the related description for the sectors in the mapping of the energy consumption in companies from the Danish Energy Agency.

Section 2 describes the legislation when utilizing excess heat for both internal and external utilization and from this description it can be seen that it will be more feasible to utilize the excess heat for space heating than for external use. This also holds for the model by first utilizing the excess heat for space heating. The model ensures this by first utilizing low temperature excess heat from the internal utilization potential. If there are any demand for space heating after the utilization of the internal utilization potential, the external utilization potential

[4] Danish companies utilizing excess heat for district heating

is utilized in the same order. This is conducted for each sector and is added to the internal utilization potential.

3.2.5 Model results

The model calculates an external utilization potential of 43.03 PJ, which is 10 times larger than the current utilization of excess heat for district heating and 28% of the total district heating production in Denmark in year 2016. The external utilization potential also includes temperatures below 60 °C, which will be utilized through a heat pump and thereby increase the potential. The potential is divided between services, electrical processes and process heating, with the temperatures presented in Figure 3.

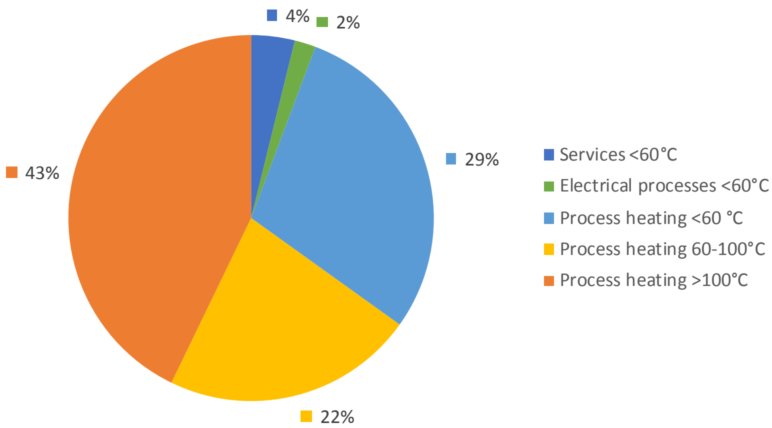


Figure 3 - Division of external utilization potential with temperatures and processes.

The figure shows that 43% (18.42 PJ) of the total external utilization potential has a temperature of above 100 °C and can therefore be directly utilized for district heating by implementing a heat exchanger. The heat below 60 °C make up 35% (15.01 PJ) of the total external utilization potential and by applying a heat pump this potential will increase. Figure 4 (Larger image: Appendix F) presents the sectors that have an external utilization potential and the temperatures of that potential.

	010000 Agriculture and gardening	030000 Fishing	080090 Extraction of gravel and stone	100010 Slaughterhouses	100020 Fishing industry	100030 Dairies	100040 Bakeries, bread factories, etc.	100050 Other food industry	110000 Beverage industry	160000 Wood industry
<60 °C	3,55 PJ	3,90 PJ	0,00 PJ	0,89 PJ	0,49 PJ	1,23 PJ	0,00 PJ	0,81 PJ	0,48 PJ	0,37 PJ
60-100 °C	2,46 PJ	0,00 PJ	0,38 PJ	0,68 PJ	0,62 PJ	1,08 PJ	0,10 PJ	1,22 PJ	0,46 PJ	0,77 PJ
>100 °C	0,00 PJ	0,00 PJ	1,63 PJ	0,34 PJ	0,31 PJ	0,93 PJ	0,58 PJ	1,05 PJ	0,39 PJ	0,17 PJ

	170000 Paper industry	190000 Oil refineries	200010 Mfr. of basic chemicals	200020 Mfr. of paint and soap, etc.	210000 Pharmaceutical Industry	230020 Concrete industry and brickworks	240000 Mfr. of metal	600000 Radio and television stations	610000 Telecommunications	630000 Information Services
<60 °C	0,14 PJ	0,15 PJ	0,36 PJ	0,27 PJ	0,42 PJ	0,29 PJ	0,00 PJ	0,03 PJ	1,54 PJ	0,09 PJ
60-100 °C	0,21 PJ	0,33 PJ	0,12 PJ	0,36 PJ	0,27 PJ	0,47 PJ	0,06 PJ	0,00 PJ	0,00 PJ	0,00 PJ
>100 °C	0,62 PJ	0,66 PJ	0,37 PJ	1,09 PJ	0,36 PJ	8,47 PJ	1,46 PJ	0,00 PJ	0,00 PJ	0,00 PJ

<60 °C 60-100 °C >100 °C

Figure 4 - Amount of excess heat and temperatures from the sectors.

In the figure it is seen that concrete industry and brickworks and manufacturing of metals have a large potential of utilizing excess heat at a high temperature. The model shows that the potential comes from heating/boiling, drying and sintering/burning processes and an implementation of a heat exchanger will make it usable for district heating. The sectors concerning agriculture and gardening, fishing and extraction of gravel and stone stands out with a large potential of excess heat. The problem with this excess heat is that most of these companies are located in places without a district heating network and with larger distances to their surrounding neighbours, which makes it hard and costly to utilize. The sectors concerning production of food have a large potential within the different temperature levels and are therefore capable of utilize both heat directly and through a heat pump. These sectors are always looking into process optimization, which means that the external utilization could potentially be lower than stated in the model. This also holds for the other sectors and therefore, the total utilization potential could be lower than stated. By considering the possible changes in the external utilization potential, an actual potential of around 25 to 30 PJ could be a reasonable estimation without taking heat pumps into consideration. However, the modelling of the energy flow diagram will use the total utilization potential.

3.3 Energy flow diagram year 2016

This section presents the results and data inputs from the model in the form of an energy flow diagram. The software eSankey are used and built on energy inputs, processes and outputs from these processes.

3.3.1 Modelling the energy flow diagram year 2016

The energy accounting[5] is used for the energy inputs by sorting them into 9 categories, where liquid fuels are both for process heat, space heating and transportation. The sorting is reported in Table 9.

Table 9 - Input energy categories and energy types from the energy accounting from statistics Denmark.

Energy Input Categories	Energy Types	
Electricity	• Electricity	
Gas	• Town gas	• Natural gas
Liquid fuels	• Heating oil • Petroleum coke • LPG • LPG-transport • Engine gasoline • JP4 • Petroleum	• Waste oil • Orimulsion • Fuel Oil • Flight gasoline • Jet petroleum • Diesel
Coal	• District heating	
Biofuels	• Straw • Wood pellets • Biooil	• Wood chips • Wood waste • Biogas
Waste	• Biodegradable waste	• Waste
District heating	• District heating	
Solar heating	• Solar heating	
Heat pump	• Heat from heat pump	

The method, mentioned in Section 3.2.2, creates an energy category, *Fuels (Process)*, which includes five energy input categories; Gas, liquid fuels, coal, biofuels and waste. The processes, which have these fuels as inputs, are process heat, space heating and conversion and net loss and a percentage division of these fuels are used. Before calculating the percentage division factor different assumptions are made. The first one is that conversion and net loss are multiplied with the specific fuel input divided by the total fuel input within that category. The second one is that space heating is multiplied with the percentage division factor, which means that the process heat is given by the remaining amount of energy. All the values are depending on each other and an optimization is conducted with the purpose of matching the fuel input, from the energy accounting, with the total energy consumed in the category, *Fuels (Process)*. Even though there are excess heat from the conversion and net loss, it will not be included in the energy

[5] Statistics Denmark, sector, time and energy types.

flow diagram as it is difficult to state the use of this excess heat. In the model it is added to the internal utilization potential.

Energy inputs from electricity, district heating, solar heating and heat pumps are gathered in that part of the model described in Section 3.2.2. The same goes for energy inputs for transportation.

Furthermore, the flow diagram includes the current utilization of excess heat, 3.45 PJ, presented in Section 3.1 by subtracting it from the external utilization potential. This is conducted by dividing the current utilization of excess heat between; electrical processes and process heat with 20% and 80% respectively, based on the survey in Appendix A.

3.3.2 Results - Energy flow diagram year 2016

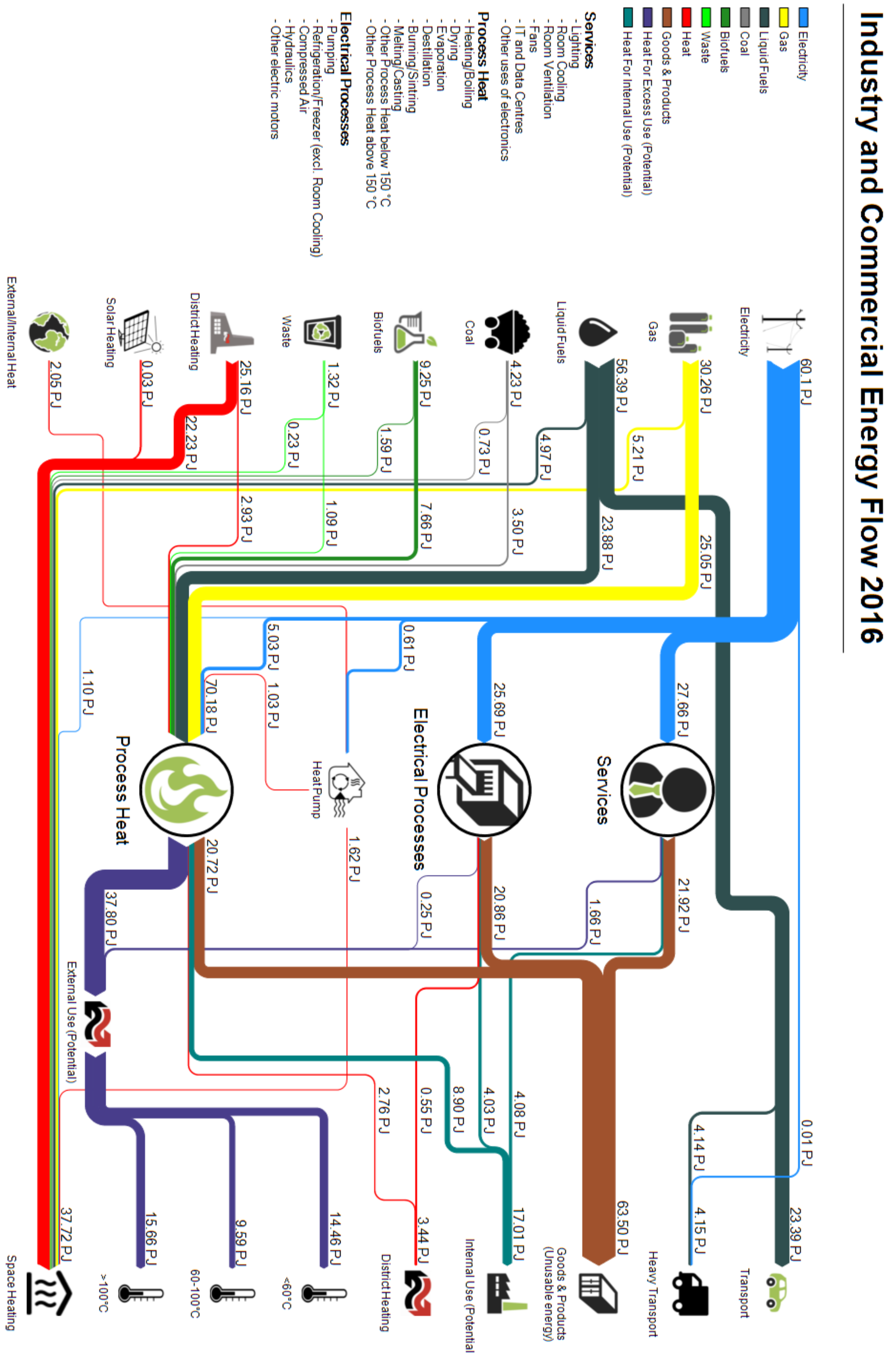


Figure 5 - Industry and commercial energy flow 2016.

The energy flow diagram for industry and commercial is seen in Figure 5, where the current utilization potential is shown as the process; *District Heating*, and the excess heat with a potential of being utilized for district heating as the process; *External Use (Potential).* The flow diagram shows that a large proportion of the fuel input for process heat comes from oil and natural gas, which in the future will be changed to other fuels and electricity. Therefore, a part of the internal and external utilization potential could be utilized in a heat pump for process heat. When building the model all excess heat that could be utilized for space heating was added to the internal excess heat potential and in the future energy flow diagrams, this excess heat will be utilized in a heat pump.

4. Energy flow diagram year 2035 and 2050

This section examines the future scenarios of utilizing excess heat from commercials and industries by the use of the model described in Section 3.2. It is built by including all excess heat with a potential of being utilized. The scenarios are built with the perspective that the energy consumption remain the same for all the scenarios and sectors, except for the service sector as the model includes an implementation of data centres. The future scenarios are based on the Global Climate Action (GCA) from the System Perspective 2035 [18]. GCA is future scenarios that keep Europe on track with the European Climate Goals. An excel document, provided by Energinet, is used and seen in Appendix G and describes the type and amount of energy sources used for process heating for GCA 2035 and 2050 [19]. For all excess heat with a temperature below 60 °C, a heat pump with an annual average COP of 4 is used.

4.1 Modelling the energy flow diagram year 2035

The energy inputs are calculated by the use of the given energy inputs and estimates based on the GCA 2035. For process heat the energy inputs are given in the excel document and used by multiplying the energy consumption for process heat in 2016 with that distribution. The excel document also states the COP of the electricity to heat conversion and it is assumed that with temperatures above 100 °C, an electric boiler is used with a COP of 1 and for temperatures below 100 °C a heat pump is used. The heat pump used for temperatures below 60 °C and between 60 and 100 °C is set to have an annual average COP of 3.25 and 2 respectively. The heat pumps are implemented by utilizing the internal and external excess heat from processes heat in the model.

Inputs for space heating are calculated by first utilizing the excess heat through a heat pump or directly by the same method as in Section 3.2.4. This method ensures that excess heat is preferred before other heat sources. From the GCA it is stated that space heating also will receive heat from biofuels, gas and district heating. The percentage distribution between these energy sources are set to; 5% for biofuels, 5% for gas and 90% for district heating.

Electricity is the only input for services and electrical processes. For services, data centres are included based on an analysis concerning big data centres from the Danish Energy Agency. The analysis expects that in year 2030, there will be around 6 big data centres with an average electric capacity of 150 MW [20]. In the model it is assumed that these data centres are fully equipped and running on full capacity in 8,760 hours per year. This is implemented in the model by adding the electricity consumption to the sector called; *630000 Information Services*.

The consumption for transportation is divided between transport and heavy transport as reported in Table 10, and is based on the consumption in the model for year 2016. For electricity a conversion rate of 20% is multiplied as electricity has a lower energy consumption per kilometre than liquid fuels [21]. This results in a reduced consumption of 9.69 PJ. The percentage division between electricity, gas and liquid fuels are estimated by the use of the Danish Energy Agency future energy scenarios [22].

Table 10 - Percentage division between fuels for transportation in year 2035.

Fuels	Transport	Heavy Transport
Electricity	$50\% \cdot 20\% = 10\%$	$10\% \cdot 20\% = 2\%$
Gas	25%	50%
Liquid Fuels	25%	40%

The energy flow diagram for year 2050 is presented in Figure 6.

4.2 Energy flow diagram year 2035

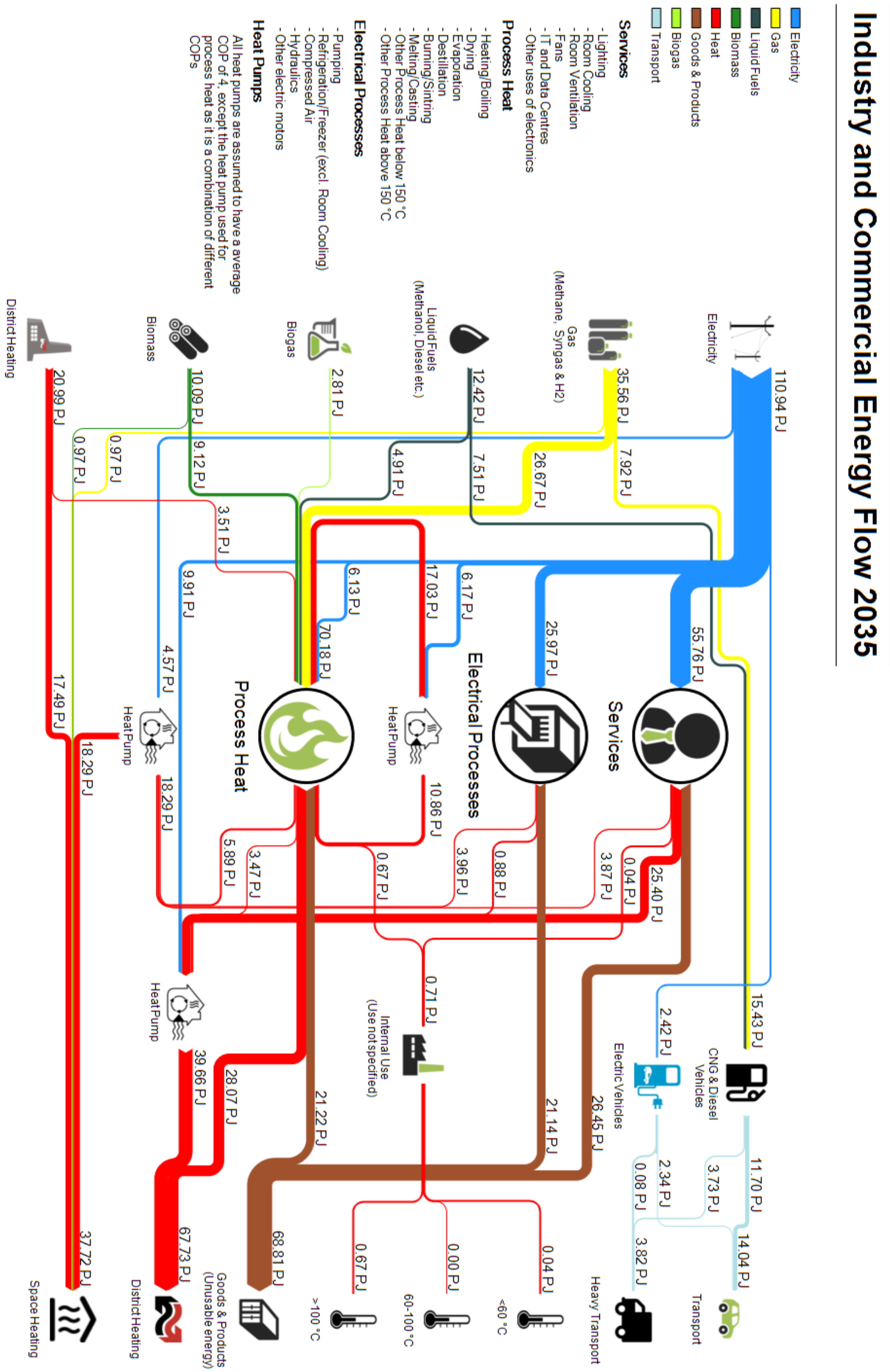


Figure 6 - Industry and commercial energy flow 2035.

4.3 Modelling the energy flow diagram year 2050

The method used, when modelling the energy flow diagram in year 2035, described in Section 4.1, are also applied for year 2050. The main difference is that the energy sources for process heat is updated to the GCA 2050, the distribution of the energy sources for space heating is changed, more data centres are included and the distribution of the energy consumption for transportation is changed. The distribution of energy sources for space heating are made so it first utilizes the excess heat from the processes through a heat pump and then from biofuels, gas and district heating. The distribution for the leftover space heating demand is set to; 2.5% for biofuels, 2.5% for gas and 95% for district heating. The analysis about big data centres expect that in year 2040, there will be 9 big data centres with an average electric capacity of 150 MW. This is implemented in the same way as in the energy flow diagram for year 2035. The consumption for the transportation sector is distributed as reported in Table 11, with the same conversion rate, of 20%, for electricity as in the energy flow diagram for year 2035.

Table 11 - Percentage division between fuels for transportation in year 2050.

Fuels	Transport	Heavy Transport
Electricity	$70\% \cdot 20\% = 14\%$	$50\% \cdot 20\% = 10\%$
Gas	25%	40%
Liquid Fuels	5%	10%

The energy flow diagram for year 2050 is presented in Figure 7.

4.4 Energy flow diagram year 2050

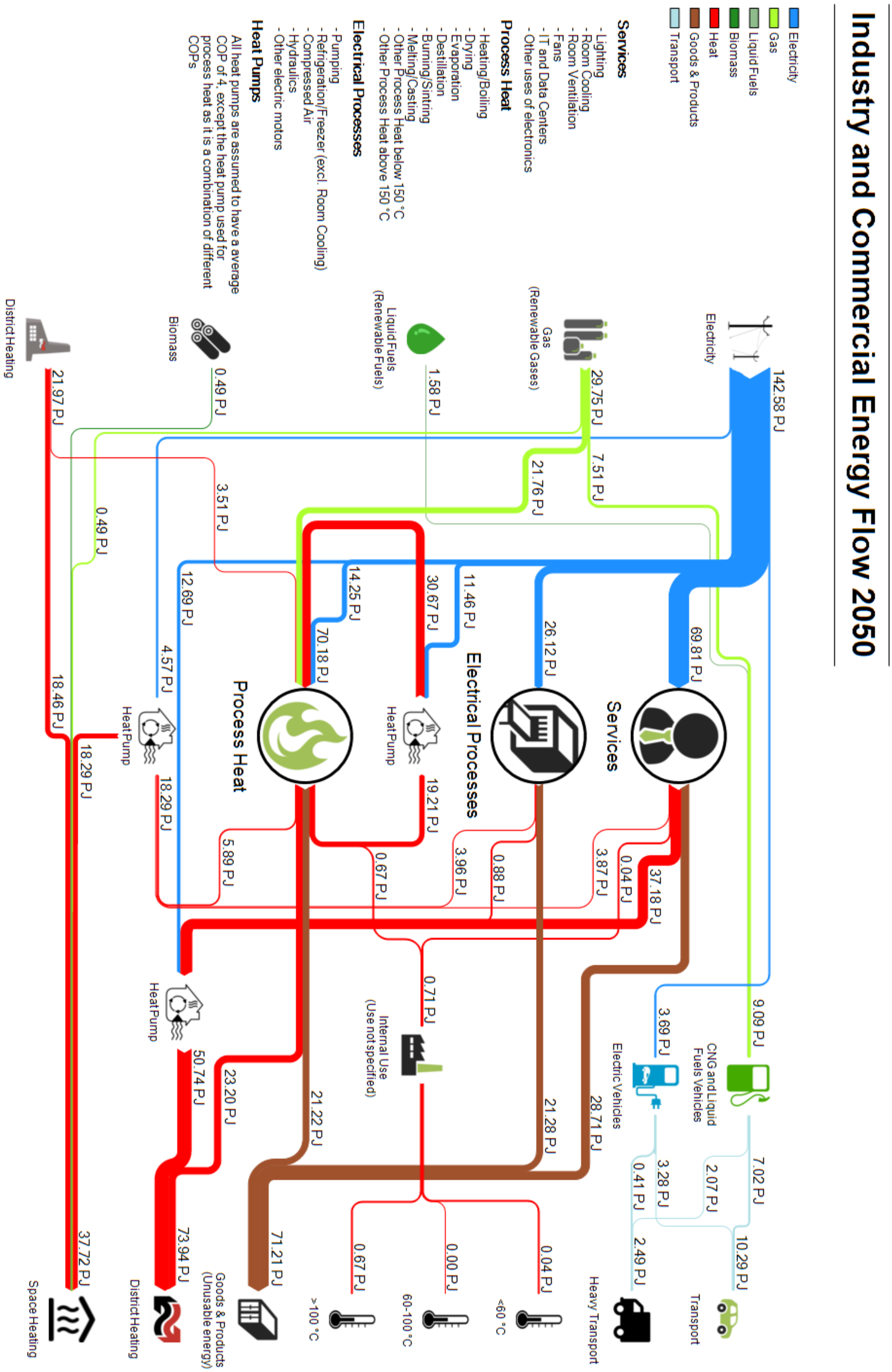
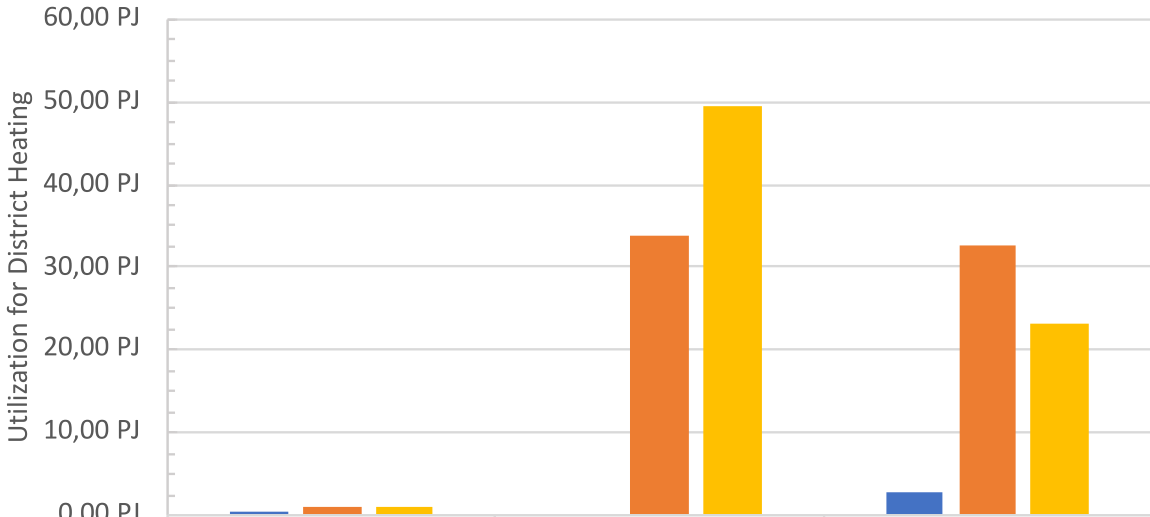


Figure 7 - Industry and commercial energy flow 2050.

4.5 Results

The mapping of the energy consumption, Figure 6 and Figure 7, for year 2035 and 2050 respectively shows that there will be an increase in the excess heat utilized for district heating. This increase is a result of implementation of more data centres in the services. The total amount of excess heat utilized for district heating from the different processes are presented in Figure 8.



	Electrical Processes	Services	Process heat
2016	0,55 PJ	0,00 PJ	2,76 PJ
2035	1,17 PJ	33,86 PJ	32,70 PJ
2050	1,17 PJ	49,58 PJ	23,20 PJ

Figure 8 - Amount of excess heat from processes utilized for district heating for year 2017, 2035 and 2050.

The figure shows that there will be a decrease in the excess heat utilized for district heating from year 2035 to 2050 for process heat, which is a result of an increase in the use of heat pumps for process heating.

The future scenarios show that there will be a large increase in the use of heat pumps for utilization of excess heat from commercial and industries, both for internal utilization and for district heating. Furthermore, it is seen that excess heat will have a large potential of being utilized for district heating. A comparison between utilization of excess heat and production of heat on different production units are conducted through cost of heat seen from business and society's perspective. This will address the competitive conditions between utilization of excess heat and production of heat.

5. Business- and socioeconomic analysis

This section compares the cost of heat from production and recovery units. The comparison is carried out through a calculation of the levelized cost of heat (LCOH) and society's cost of heat (SCOH). Furthermore, a LCOH comparison based on the proposed changes in the reimbursement of the electricity tax, mentioned in Section 2.3, is examined.

5.1 Methodology

The definition of cost of heat is the total cost of an investment over its lifetime divided by the heat production. The LCOH and SCOH are two methods of calculating the cost of heat. LCOH is the costs seen from a business perspective and SCOH is the costs seen from the society's perspective. Production and recovery units have different lifetimes and therefore, the investment costs are divided by the stated lifetime of the unit. For simplicity it is assumed that all production and recovery units will have a lifetime of 20 years[6] in LCOH and SCOH comparison. All costs are defined in DKK/MWh_{Heat} per year and this means that the total heat production over the 20-year period is defined as 20 MWh. The calculations take the risk and lost opportunities of making profit from other investments into account by calculating the present value with a real discount rate of 4%.

The calculation of LCOH, used in this comparison, is defined by Equation 5.1.

$$LCOH = \frac{\sum_{t=1}^{19} \frac{Costs_t - (Earnings_t + Reimbursement_t + Subsidies_t)}{(1+r)^t}}{\sum_{t=1}^{19} Heat\ Production_t} \tag{5.1}$$

Where, r is the real discount rate, t are the step length[7] and costs include costs associated with investment, O&M, fuels, taxes and tariffs.

The calculation of the SCOH, used in this comparison, is defined by Equation 5.2.

$$SCOH = \frac{\sum_{t=1}^{20} \frac{(Costs_t - Earnings_t) \cdot Net\ Tax\ Factor}{(1+r)^t}}{\sum_{t=1}^{20} Heat\ Production_t} \tag{5.2}$$

Here the costs include investment, O&M, fuels, tariffs and damage costs. The net tax factor, of 1.325, is multiplied with the costs and earnings as they could have

[6] From year 2018-2037

[7] Year 2018 is equal to 0 and 2037 is equal to 19

created a value for the society if otherwise used and therefore, the net tax factor is not multiplied with damage costs that are not tradeable (SO2, NOx and $PM_{2.5}$) [23]. The tax distortion loss is not included in these calculations as the investment can be funded by a private actor.

To ensure that all costs are defined as heat output, the stated annual average efficiencies and COP are used. Normally cogeneration plants estimate their fuel consumption for heat and power by the use of the V and E formula, but this was not applicable. Equation 5.3 calculates the total input capacity by dividing the output capacity of heat with the efficiency of the heat production, η_{Heat}.

$$Input\ Capacity_{Total} = \frac{1\ MW_{Heat}}{\eta_{Heat}} \tag{5.3}$$

Some cost and earnings are stated in power output capacity and therefore, Equation 5.4 is used for calculating the power capacity when the heat capacity is defined as 1 MW_{Heat}.

$$Output\ Capacity_{Electricity} = Input\ Capacity_{Total} \cdot \eta_{Electricity} \tag{5.4}$$

The tables with data inputs for the LCOH and SCOH are seen in Appendix H and Appendix I respectively.

5.2 Production and recovery units

The comparison includes the production and recovery units shown in Table 12. The production units are chosen by looking at the tendency within heat production and the recovery units are chosen to represent different methods of utilizing excess heat dependent on the temperatures.

Table 12 - Production and recovery units included in the comparison.

Type	Technology
Production Units	• Wood Chip Cogeneration Plant • Wood Chip Heating Plant • Straw Cogeneration Plant • Straw Heating Plant • Natural Gas Cogeneration Plant • Natural Gas Cogeneration Plant • Waste Incineration Cogeneration Plant • Electric Boiler • Solar Heating Plant with Seasonal Storage
Recovery Units	• Heat Exchanger • Heat Pump (T_{in} = 10 °C) • Heat Pump (T_{in} = 20 °C) • Heat Pump (T_{in} = 40 °C) • Heat Pump Data Centre

The three heat pumps with heat source temperatures of; 10 °C, 20 °C and 40 °C, are set to have an COP of 2.7, 3.9 and 6.8 respectively, by the use a ΔT of 5 °C. This is calculated by the Lorentz-COP, Equation 5.5, with an assumed mechanical and thermal loss of 60%.

$$COP_L = \frac{T_{lm,Sink}}{T_{lm,Sink} - T_{lm,Source}} \tag{5.5}$$

Where;

$$T_{lm} = \frac{t_{in} - t_{out}}{\ln\left(\frac{t_{in}}{t_{out}}\right)} \tag{5.6}$$

5.3 Data inputs

All prices are converted into 2018-prices in the unit of DKK/MWh_{Heat}, using the inflation rates provided by the Danish Energy Agency and a conversion rate of 7.45 DKK/€ to obtain DKK-prices [24]. Almost all production and recovery units are assumed to provide baseload in the district heating network and therefore 5,000 full load hours are used. The waste incineration cogeneration plant is set to 8,000 full load hours as they handle waste management. The temperatures of the district heating network are set to have a return and forward temperature of 40 °C and 75 °C respectively. Recovery units associated with heat exchangers and heat pumps in data centres are calculated based on real life cases.

5.3.1 CAPEX and OPEX

Capital expenditure (CAPEX) and operational expenditure (OPEX) for production units and heat pumps with different temperature inputs are provided by the technology catalogue from the Danish Energy Agency. The CAPEX and OPEX, including utilization from data centre and by a heat exchanger, are reported in Table 13. All numbers are without the added net tax factor.

Table 13 - CAPEX and OPEX used for the LCOH and SCOH.

Type and Technology	**CAPEX**	**OPEX**
Production units	[DKK/MWh]	[DKK/MWh]
Wood Chip Cogeneration Plant [25]	51.40	61.33
Wood Chip Heating Plant [25]	29.63	43.97
Straw Cogeneration Plant [25]	66.94	72.13
Straw Heating Plant [25]	39.37	65.60
Natural Gas Cogeneration Plant [25]	64.70	92.60
Natural Gas Heating Plant [25]	2.54	7.69
Waste Incineration Cogeneration Plant [25]	66.16	87.50
Electric Boiler [25]	3.70	3.70
Solar Heating Plant with Seasonal Storage [26]	378.17	5.32
Recovery units	[DKK/MWh]	[DKK/MWh]
Heat exchanger	8.37	0.17
Heat Pump (T_{in} = 10 °C, COP 2.7) [25]	29.63	12.24
Heat Pump (T_{in} = 20 °C, COP 3.9) [25]	29.63	12.24
Heat Pump (T_{in} = 40 °C, COP 6.8) [25]	29.63	12.24
Heat Pump - Data Centre	26.67	12.13

The CAPEX and OPEX for the utilization through a heat exchanger are based on the average of three different cases; furnace [17], flue gas [27] and drying process [28]. The OPEX for these utilization methods are set to 2% of the investment cost, as it was not specified. The cost of utilizing excess heat from a data centre is based on an analysis of implementation of excess heat from Apples data centre in the district heating network of Viborg [29]. This study analyses different scenarios based on different temperatures and capacities and therefore, the LCOH and SCOH are given as an average of six scenarios. It is assumed that the OPEX, for the heat pumps utilizing excess heat from the data centre, are the same as the one stated in the technology catalogue, with around 5,300 full load hours estimated by the use of the six scenarios.

5.3.2 Fuel costs

The fuel types used for the comparison are; wood chip, straw, natural gas, waste and electricity, and the costs related to these fuels are provided by the Danish Energy Agency [24]. The costs are given in yearly average and are dependent on whether it is used in a cogeneration plant or a heating plant. Waste is set to a cost of zero as the waste incineration cogeneration plant receive earnings for waste management. The fuel costs are presented in Figure 9.

2018-prices	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Cogeneration Plant																					
Wood Chip	DKK/MWh	185	186	188	190	191	193	195	196	198	199	201	202	204	205	205	206	207	208	209	210
Straw	DKK/MWh	158	160	161	162	164	165	167	168	169	171	172	173	174	175	176	177	177	178	179	180
Natural Gas	DKK/MWh	144	144	143	156	168	179	190	200	210	220	229	238	247	254	260	266	272	277	280	283
Waste	DKK/MWh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heating Plant																					
Electricity Price	DKK/MWh	188	195	221	232	243	254	264	275	286	297	308	318	329	340	351	362	373	383	394	405
Wood Chip	DKK/MWh	181	182	183	184	185	186	187	189	190	191	192	193	194	195	195	196	197	197	198	198
Straw	DKK/MWh	152	153	154	156	157	159	160	161	162	163	164	165	166	167	167	168	168	169	169	170
Natural Gas	DKK/MWh	150	149	149	161	173	184	195	205	215	225	235	244	252	259	265	271	277	283	285	288

Figure 9 - Screenshot of the fuel costs used for the comparison.

5.3.3 Taxes and tariffs

The comparison is based on the current and known future changes in taxes and tariffs. The known changes include; an abolishment of the PSO-tariff by year 2022[8] [30] and the expected changes in the price of CO_2-permits [24]. It is assumed that the taxes of CO_2 for gas and waste are given in CO_2-permits. Biomass is exempt for CO_2 and energy tax and are therefore set to zero.

Each year PricewaterhouseCoopers, PwC, publishes a handbook which reports the current taxes and reimbursements, and this is used for the taxes included in the LCOH comparison [31]. Conversions of the taxes are conducted as they often are given in the amount of fuel input or emission output. The conversion is based on the emissions, specified for the different production units, and the calorific value for the fuel inputs provided by the Danish Energy Agency [24]. The tax on excess heat is set to 33% of 195 DKK/MWh, which is the average fee that the companies receive in 2016 for delivery of excess heat for district heating [11]. An overview of the taxes is reported in Table 14.

[8] From year 2018-2022, 15.8, 9.5, 3.9, 0.2 and 0 respectively.

Table 14 - 2018 taxes used for the LCOH.

Taxes	Fuels/Energy Sources [DKK/MWh]					
	Wood Chip	Straw	Natural Gas	Waste	Electricity	Excess Heat
Energy Tax (Cogeneration Plant)			199.7			
Max Energy Tax (Heating Plant)			166.7			
CH4 Tax						
NOx Tax	1.8	1.8	0.73	1.9		
SO2 Tax (Cogeneration Plant)	0.1	2.1	0.02	0.3		
SO2 Tax (Heating Plant)	0.5	5.5	0.02			
CO2 Tax			Permits	Permits		
Waste Heat Tax				71.3		
Waste Surcharge Tax				95.4		
Electricity Tax					914.0	
Excess Heat Tax						66.8

Costs concerning transportation of gas and electricity are included in the comparison by the use of cost of tariffs. The tariffs are reported in Table 15.

Table 15 - Electricity and gas tariffs.

Gas Tariffs [DKK/MWh]		Electricity Tariffs [DKK/MWh]	
Emergency [33]	0.0051	System [32]	42.0
Volume [33]	0.0381	Transmission [32]	38.0
Distribution [35]	13.89	Distribution [34]	0.10
Energy Savings [35]	5.36		

The energy savings tariff and PSO-tariff are only included in the LCOH calculations as it is given as a subsidy for other investments.

5.3.4 Earnings, reimbursement and subsidies

The comparison includes earnings related to electricity sales and waste management. The earning from electricity sales is included in all cogeneration plants producing both heat and power. The earning from waste management is calculated by the use a projection of the price by statistical benchmarking and is presented in Figure 10 [36].

2018-prices	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Waste management	DKK/MWh	406	393	381	369	357	346	335	325	315	305	295	286	277	269	260	252	244	237	229	222

Figure 10 - Average development in earnings from waste management.

Cogeneration plants using biomass as fuel input receive a subsidy for the electricity production in the amount of 150 DKK/MWh, which is included in the LCOH for both the wood chip and straw cogeneration plant [37].

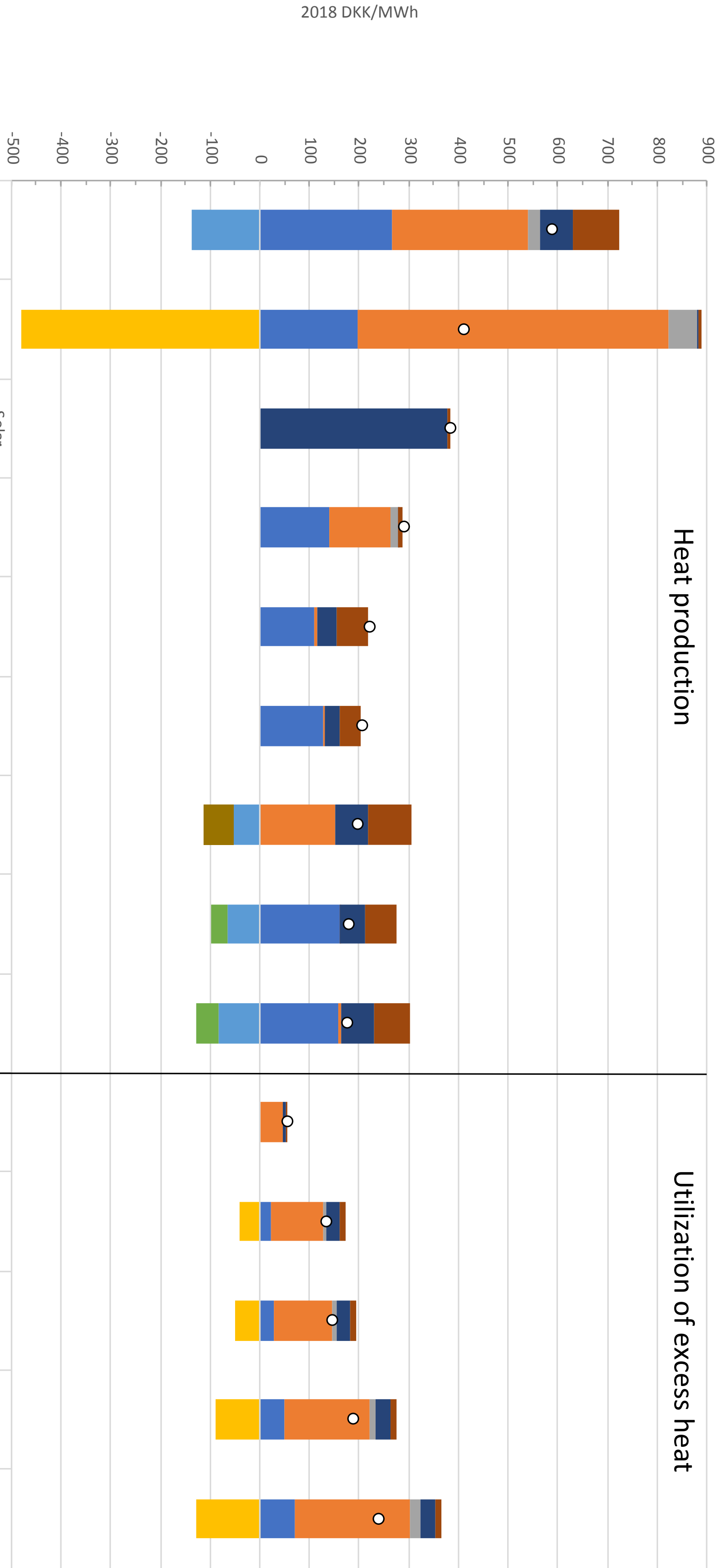
When using electricity for heat production, a reimbursement of the heat tax is obtained and defined by the production and recovery unit. For electric boilers, the reimbursement of 698 DKK/MWh is calculated by the difference between the electricity tax and the maximum electricity taxation for heating plants [38]. For heat pumps it is given by the difference between the electricity tax and the electricity to heat tax, which results in a reimbursement of 507 DKK/MWh [31].

5.3.5 Damage costs

Damage costs are the cost for the society when emitting by-products from burning of fuels. The damage costs are used for the SCOH comparison and are provided by the Danish Energy Agency. The damage costs of emitting SO_2, NO_x and $PM_{2.5}$ are from the SNAP 1 Sector, which includes emission from large cogeneration plants [24]. The damage costs of emitting CO_2, CH_4 and N_2O is given by the price of the CO_2-permits as they all contribute to the greenhouse effect. The CH_4 and N_2O have a larger contribution and are therefore multiplied with a factor of 25 and 298 respectively [24]. The damage costs are multiplied with the emissions to yield the specific damage cost for the different production units.

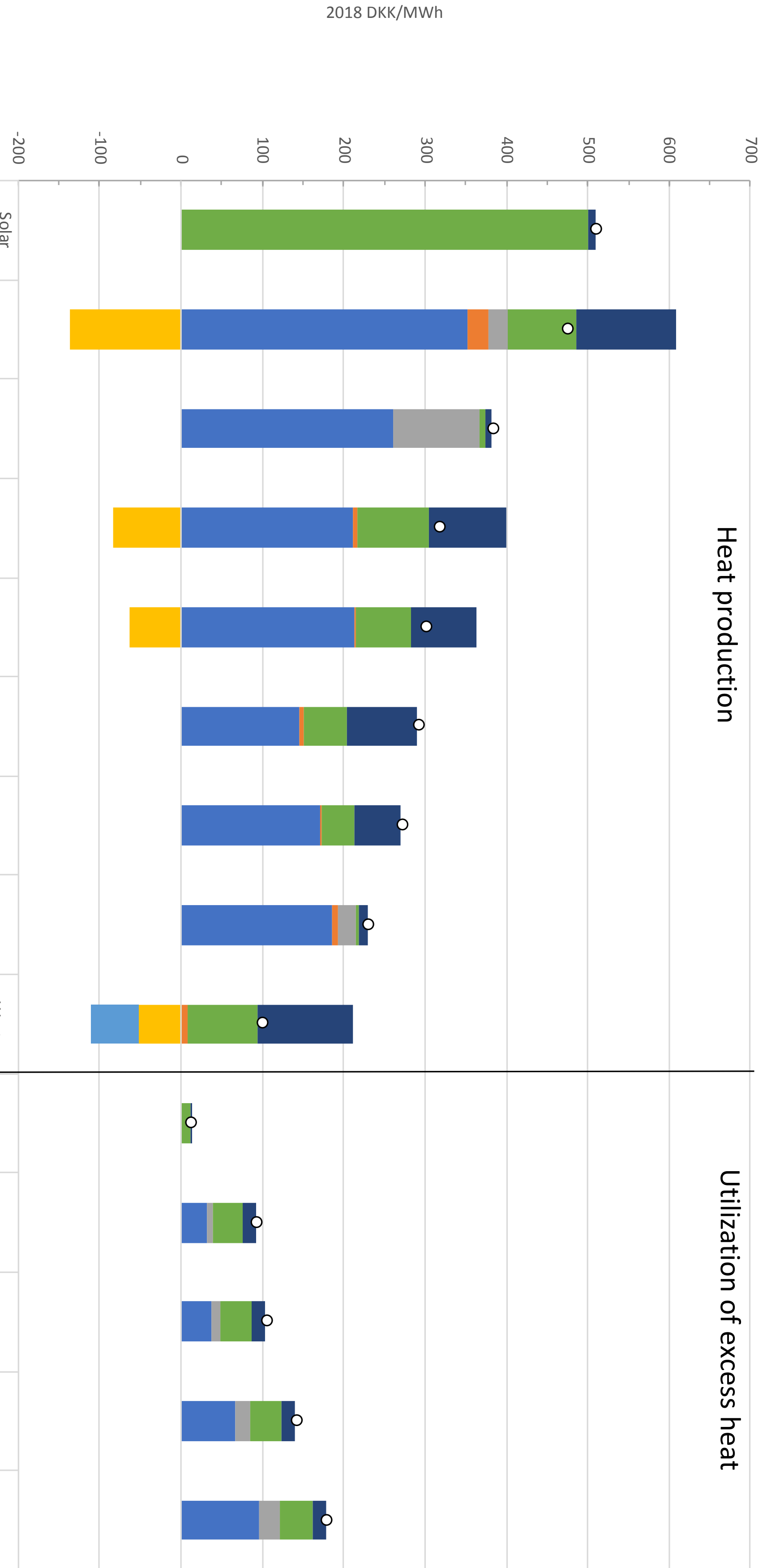
5.4 Results

The results from the comparison of the LCOH and SCOH are presented in Figure 11 and Figure 12 respectively as a breakdown of the CAPEX, OPEX etc. and states the cost of producing 1 MWh_{Heat}.



	Natural Gas Cogeneration Plant	Electric Boiler	Solar Heating Plant With Seasonal storage	Natural Gas Heating Plant	Straw Heating Plant	Wood Chip Heating Plant	Waste Incineration Cogeneration Plant	Wood Chip Cogeneration Plant	Straw Cogeneration Plant	Heat Exchanger	Heat Pump - Datacenter	Heat Pump COP 6.8 - Tin: 40°C	Heat Pump COP 3.9 - Tin: 20°C	Heat Pump COP 2.7 - Tin: 10°C
OPEX	93	4	5	8	66	44	88	61	72		12	12	12	12
CAPEX	65	4	378	3	39	30	66	51	67	8	27	30	30	30
Waste Management							-59							
Subsidies								-33	-44					
Electricity Sales	-136						-52	-64	-83					
Reimbursement		-479									-42	-51	-88	-128
Tariffs	25	56		13							7	8	14	21
Taxes	275	627		123	5	2	152	2	4	45	104	117	170	230
Fuel Price	266	197		141	110	129		160	159		24	29	50	72
LCOH	587	409	383	287	220	204	194	177	176	54	132	145	187	237

Figure 11 - LCOH for production and recovery units.



	Solar Heating Plant With Seasonal storage	Natural Gas Cogeneration Plant	Electric Boiler	Straw Cogeneration Plant	Wood Chip Cogeneration Plant	Straw Heating Plant	Wood Chip Heating Plant	Natural Gas Heating Plant	Waste Incineration Cogeneration Plant	Heat Exchanger	Heat Pump - Datacenter	Heat Pump COP 6.8 - Tin: 40°C	Heat Pump COP 3.9 - Tin: 20°C	Heat Pump COP 2.7 - Tin: 10°C
OPEX	8	123	7	96	81	87	58	10	116		16	16	16	16
CAPEX	501	86	7	89	68	52	39	3	88	11	35	39	39	39
Waste Management									-59					
Electricity Sales		-136		-83	-64				-52					
Tariffs		24	107					23			9	11	18	27
Damage Costs		25		5	2	6	3	6	7					
Fuel Price		352	260	211	213	145	170	187			31	38	66	96
SCOH	509	473	382	317	300	290	271	229	100	11	92	104	140	178

Figure 12 - SCOH for production and recovery units.

The breakdown of the LCOH and SCOH shows that utilization of excess heat by a heat pump is imposed with a high taxation. Furthermore, it is seen, from the society's perspective, that excess heat should be utilized first. A merit order of the LCOH and SCOH comparison, presented in Figure 13 and Figure 14 respectively, are created with the purpose of evaluating the main differences.

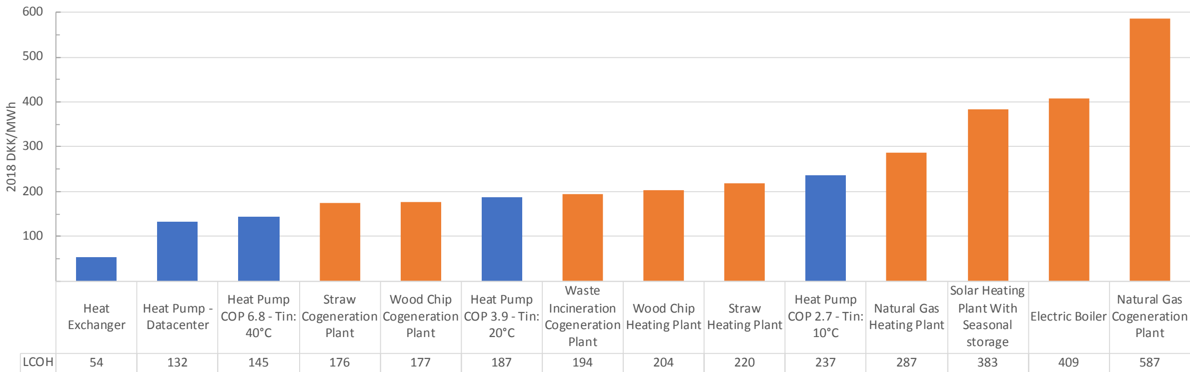


Figure 13 - LCOH in merit order (Blue columns: Utilization of excess heat).

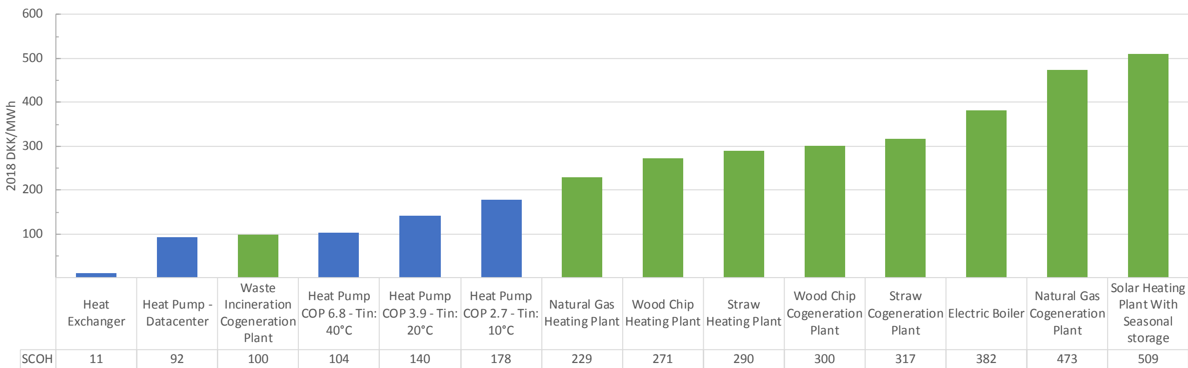


Figure 14 - SCOH in merit order (Blue columns: Utilization of excess heat).

The merit order reflects the type of production or recovery unit that should produce first. The main difference from the LCOH and SCOH is a shift to the left for the recovery units utilizing excess heat, as the taxes are removed. The waste incineration cogeneration plant is the only production unit with a lower SCOH than the heat pumps and is explained by the earnings from waste management. Direct utilization of excess heat through a heat exchanger and from a data centre has the lowest cost in the LCOH and SCOH comparison and are competitive with all the production units. The LCOH comparison shows that heat production from cogeneration plants fired with biomass is competitive with the utilization of excess heat with temperatures below 40 °C. With excess heat temperatures below 20 °C, the production of heat from heating and cogeneration plants fired with biomass and waste become more competitive. This is explained by the favourable legislation for biomass and earnings from waste management. Hence, the utilization of excess heat is competing with both waste and biomass and the current agreements made between the government and parties indicate that there will not be any changes in the legislation concerning production of heat from these two fuels. Instead there will be changes in the taxation of electricity used for heat, presented in Section 2.3, and for this reason are these proposed changes studied to see how it will affect the merit order of LCOH.

5.5 Proposed changes in reimbursement of electricity tax

The proposed changes explained in Section 2.3 are implemented in the LCOH comparison by changing the reimbursement of the electricity tax when used for heat. The reimbursement of the electric boiler remains the same as it is more favourable. The proposed changes are reported in Table 16 for the November 2017 and April 2018 agreement.

Table 16 - November 2017 and April 2018 agreement with fixed reimbursement from 2021.

Reimbursement		
Years [-]	November 2017 Agreement [DKK/MWh]	April 2018 Agreement [DKK/MWh]
2018	657	657
2019	657	657
2020	707	707
2021	607	757

The LCOH comparison for the agreement in November 2017 and April 2018 are presented in Figure 15 and Figure 16 respectively.

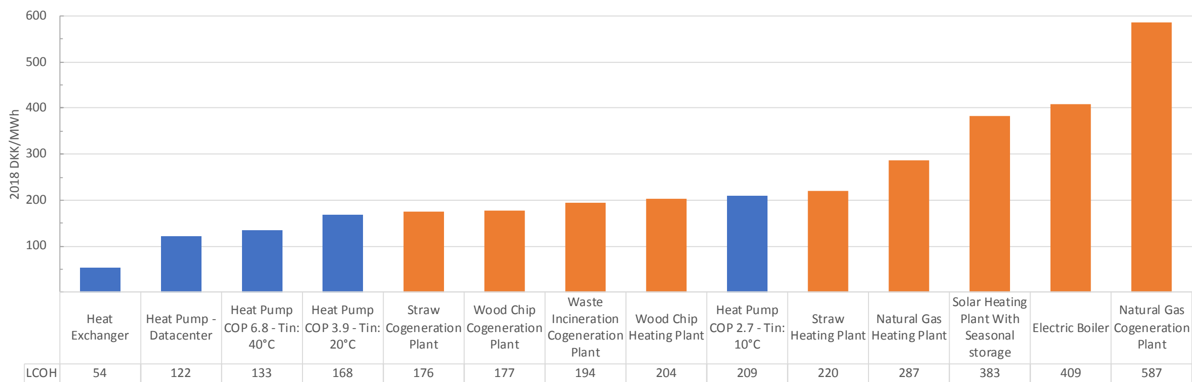


Figure 15 - LCOH in merit order with proposed changes from November 2017 (Blue columns: Utilization of excess heat).

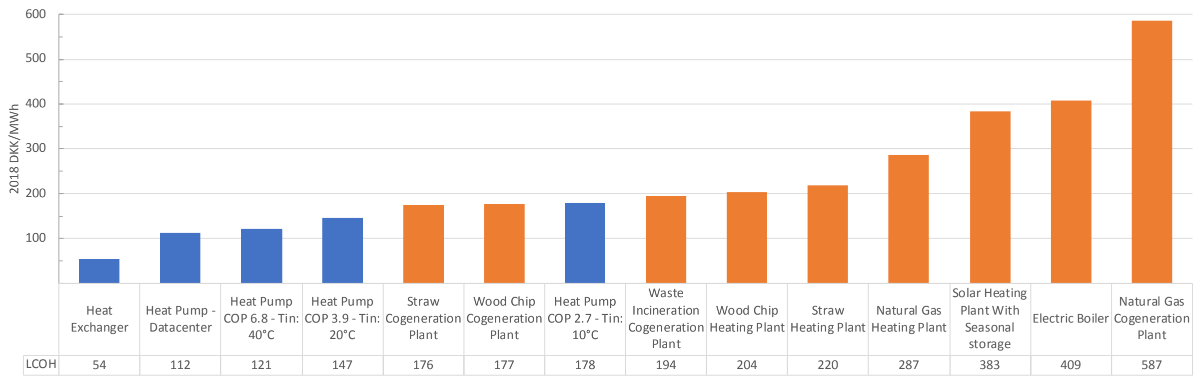


Figure 16 - LCOH in merit order with proposed changes from April 2018 (Blue columns: Utilization of excess heat).

The figures show that the proposed changes decrease the LCOH when utilizing excess heat by a heat pump. However, utilization of excess heat with temperatures below 10 °C are still not competitive with heat production from cogeneration plants based on biomass even though it is in the society's interest as presented in Figure 14. The incentive for utilization of excess heat is created based on lowering the tax on electricity, which only create incentives for heat pumps. Therefore, an assessment of the legislation based on the excess heat tax is conducted with the purpose of creating incentives for utilization of excess heat.

6. Assessment of the taxation and legislation

The energy flow diagram for year 2035 and 2050 showed that excess heat could potentially have an important role in the future district heating system, and also for internal utilization in companies. Therefore, this section assesses the current legislation based on the LCOH, SCOH and proposed changes in reimbursement with the purpose of creating incentives for utilization of excess heat.

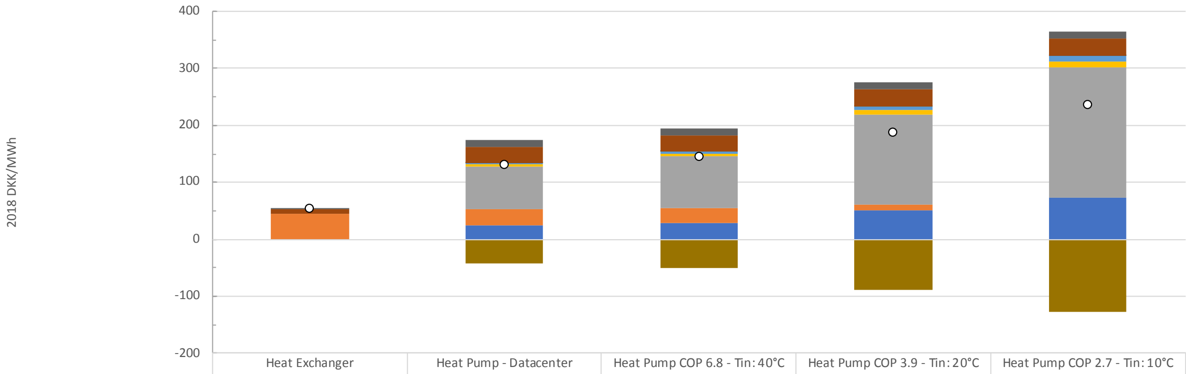
6.1 Assessment of the current taxation and legislation

The Danish Tax Authorities define excess heat by focusing on the fuels used for the process with excess heat and by applying excess heat tax on the total utilization of excess heat. This creates two problems that results in an economic loss for the society;

- A process with a low efficiency would have a higher utilization of excess heat than the same process with a high efficiency.
- A process with the highest technology standards will have to pay excess heat tax on the total utilization of excess heat and the utilization are thereby depending on the profitability.

The proposed changes in legislation from the government and parties indicates that efficiency and technology standards will not be included in the next broad energy agreement. Instead the proposed changes in legislation are focusing on taxation of electricity used for heat. Section 5.5 reported that these changes will create incentives for utilization of excess heat by a heat pump, but not directly through a heat exchanger.

Figure 17 presents the LCOH breakdown when utilizing excess heat based on the current legislation.



	Heat Exchanger	Heat Pump - Datacenter	Heat Pump COP 6.8 - Tin: 40°C	Heat Pump COP 3.9 - Tin: 20°C	Heat Pump COP 2.7 - Tin: 10°C
Reimbursement of Electricity Tax		-42	-51	-88	-128
OPEX		12	12	12	12
CAPEX	8	27	30	30	30
PSO Tariff					1
Distribution Tariff					
Transmission Tariff		3	4	7	10
System Tariff		3	4	7	11
Electricity Tax		76	91	159	230
Excess Heat Tax	45	29	25	10	
Fuel Price		24	29	50	72
LCOH	54	132	145	187	237

Figure 17 - LCOH for utilization of excess heat.

The figure shows that around 85% of the total LCOH are the excess heat tax when utilizing excess heat through a heat exchanger. This utilization could potentially replace other production units and thus benefit the society's economy. Additionally, the figure shows that a large proportion of the LCOH concerning heat pumps is related to taxation of electricity, and that the excess heat tax is increasing with an increase in the COP. This is a result of the applied excess heat tax on the output heat that is 3 times larger than the electricity consumption for the heat pump. A problem with this legislation is that an increase in the temperature of the excess heat will result in a higher excess heat tax as more heat will be produced.

As mentioned in Section 2, the excess heat tax is paid by a reduced reimbursement of energy taxes and therefore, processes consuming biomass are exempt with the excess heat tax. This increases the incentives for companies with a large amount of excess heat to convert into a production process consuming biomass. However, in the energy flow diagram for year 2035 and 2050, it is seen that only a small proportion of the fuels for the process heat will come from biomass.

6.2 Proposed taxation and legislation based on the assessment

This thesis proposes taxation and legislation based on the technical definition of excess heat, which is defined as the heat that cannot be utilized further, when a company has done everything achievable to energy-efficient its processes. Thus, the proposed legislation should refer to a standard within efficiencies and technologies. Different legislations are presented with the purpose of creating incentive for utilization of excess heat.

6.2.1 Proposed taxation

The European Commission publishes; "Best Available Technologies Reference Documents (BREF)", which is different documents containing information about the best available technologies based on technical and economic aspects [39]. One of the documents contains information about energy efficiency for different processes and could be used for defining the best available energy efficient processes. Therefore, the excess heat tax could be composed of a progressive taxation that will result in an increased taxation with a decreased efficiency of the process. An example of this is presented in Figure 18, with a BREF efficiency of 80% and a total excess heat tax of 66.8 DKK/MWh.

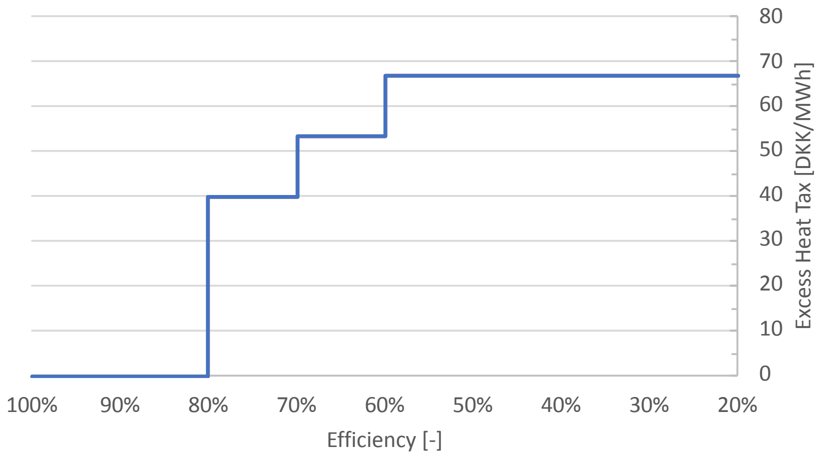


Figure 18 - Example of progressive taxation of excess heat. (Imposed with; 0%, 60%, 80% and 100%, of the total excess heat tax)

The progressive taxation creates incentives for companies to utilize excess heat from processes that have an efficiency above and close to the BREF efficiency. Processes with an efficiency below will obtain an exempt taxation on a part of the excess heat and still have an incentive to utilize the excess heat. It should be mentioned that this is an example of the progressive taxation and a higher taxation could be applied to ensure that only processes with a high efficiency have the economic benefit of utilizing the excess heat. The progressive taxation also creates incentives for companies with a high amount of excess heat to energy optimize their processes to reach a higher efficiency and thereby be rewarded through an earning from the delivery of excess heat. Equation 5.7 calculates the imposed excess heat taxation when 1 MWh_{Heat} is utilized from excess heat and is based on the example presented in Figure 18 with a process efficiency of 60%.

$$1\,MWh \cdot \left(\frac{20\% \cdot 0\,\frac{DKK}{MWh} + 10\% \cdot 40.08\,\frac{DKK}{MWh} + 10\% \cdot 53.44\,\frac{DKK}{MWh}}{40\%} \right) = 23.38\,DKK \tag{5.7}$$

Where 40% is the difference between the efficiency of the process and the theoretical efficiency of 100%. The calculation ensures that excess heat tax will only be applied on the amount of excess heat below the BREF efficiency. It should be mentioned that when excess heat is utilized from process, a measurement of the fuel input should be conducted to ensure that companies do not waste energy by increasing the amount of fuel input. Furthermore, this progressive taxation will only be applicable for direct utilization of excess heat.

When utilizing excess heat by a heat pump, the progressive taxation will result in an increased taxation. Therefore, the excess heat tax when utilizing a heat pump could be composed of a decreased taxation with an increased COP. This is based on the fact that excess heat with a high temperature creates more value for the society when utilized than excess heat with a low temperature. Currently, the excess heat tax is applied on the heat above 3 times the electricity input, which means that low temperature excess heat is exempt with excess heat tax. An example of the decreased taxation with an increased COP is presented in Figure 19 and is based on the same numbers as in the example from progressive taxation.

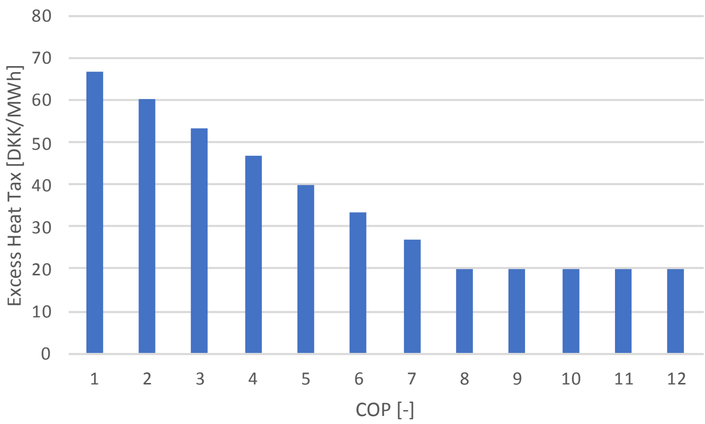


Figure 19 - Example of taxation of excess heat from a heat pump (Decreasing with 10% until a COP of 8).

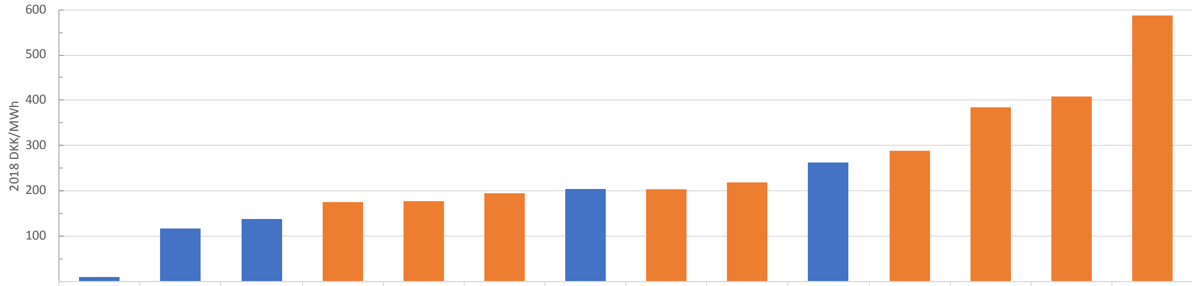
The figure shows that excess heat with a high temperature utilized in a heat pump will be imposed with a lower excess heat tax. The annual average COP of the heat pump dictates the excess heat tax that is applied on the amount of heat from the heat pump. To ensure that the heat from the heat pump is not imposed with a double taxation (Electricity and excess heat tax), the excess heat tax will only be applied on the excess heat.

To see how the LCOH is affected by the progressive and decreased heat pump taxation, it is applied in the LCOH comparison. The excess heat tax for the recovery units is reported in Table 17.

Table 17 - Excess heat tax with process above BREF for heat exchanger and a decreased heat pump taxation.

Recovery units	**Excess Heat Tax** [DKK/MWh]
Heat exchanger	0
Heat Pump (T_{in} = 10 °C, COP 2.7)	60.12
Heat Pump (T_{in} = 20 °C, COP 3.9)	53.44
Heat Pump (T_{in} = 40 °C, COP 6.8) [25]	33.40
Heat Pump - Data Centre	20.04

The LCOH comparison in merit order are presented in Figure 20.

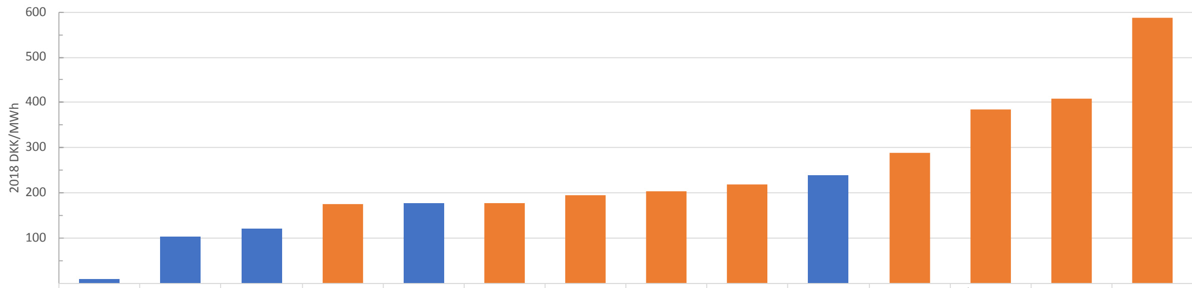


	Heat Exchanger	Heat Pump - Datacenter	Heat Pump COP 6.8 - Tin: 40°C	Straw Cogeneration Plant	Wood Chip Cogeneration Plant	Waste Incineration Cogeneration Plant	Heat Pump COP 3.9 - Tin: 20°C	Wood Chip Heating Plant	Straw Heating Plant	Heat Pump COP 2.7 - Tin: 10°C	Natural Gas Heating Plant	Solar Heating Plant With Seasonal storage	Electric Boiler	Natural Gas Cogeneration Plant
LCOH	9	115	139	176	177	194	204	204	220	263	287	383	409	587

Figure 20 - LCOH in merit order with this thesis proposed taxation (Blue columns: Utilization of excess heat).

The comparison shows that the progressive taxation will make utilization of excess heat from heat exchanger more competitive with other production units. It is also seen that heat pumps with a higher COP will have a reduced cost, which is a result of decreasing excess heat tax with increasing COP.

The decreased taxation on heat pumps should also be applied by the same method as the progressive taxation, by the BREF efficiency. This will increase the incentive to utilize excess heat from a process with an efficiency above and close to the BREF efficiency and should be calculated by the same method as equation 5.7. A LCOH comparison based on having processes with an efficiency above the BREF efficiency is presented in Figure 21.



	Heat Exchanger	Heat Pump - Datacenter	Heat Pump COP 6.8 - Tin: 40°C	Straw Cogeneration Plant	Heat Pump COP 3.9 - Tin: 20°C	Wood Chip Cogeneration Plant	Waste Incineration Cogeneration Plant	Wood Chip Heating Plant	Straw Heating Plant	Heat Pump COP 2.7 - Tin: 10°C	Natural Gas Heating Plant	Solar Heating Plant With Seasonal storage	Electric Boiler	Natural Gas Cogeneration Plant
LCOH	9	103	119	176	177	177	194	204	220	237	287	383	409	587

Figure 21 - LCOH in merit order with this thesis proposed taxation (Above the BREF efficiency) (Blue columns: Utilization of excess heat).

The figure shows that utilization of excess heat from a process with an efficiency above the BREF efficiency will make excess heat with a temperature above 20 °C competitive with production units. Currently the proposed changes in taxation from the government and parties indicates that an increase in the reimbursement of the electricity tax is going to be implemented in the next broad energy agreement. Therefore, the changes in reimbursement and this thesis proposed legislation are combined to examine the effect on the LCOH comparison.

6.2.2 Proposed legislation with reimbursement of electricity tax

The future energy flow diagrams for year 2035 and 2050 show that electrification will play an important role, which also match the proposed changes in taxation of electricity used for heat. Consequently, a study of this thesis proposed legislation and the proposed changes in the reimbursement of the electricity tax from November 2017 is implemented in the LCOH comparison. The comparison is based on processes having an efficiency above the BREF efficiency and is presented in Figure 22.

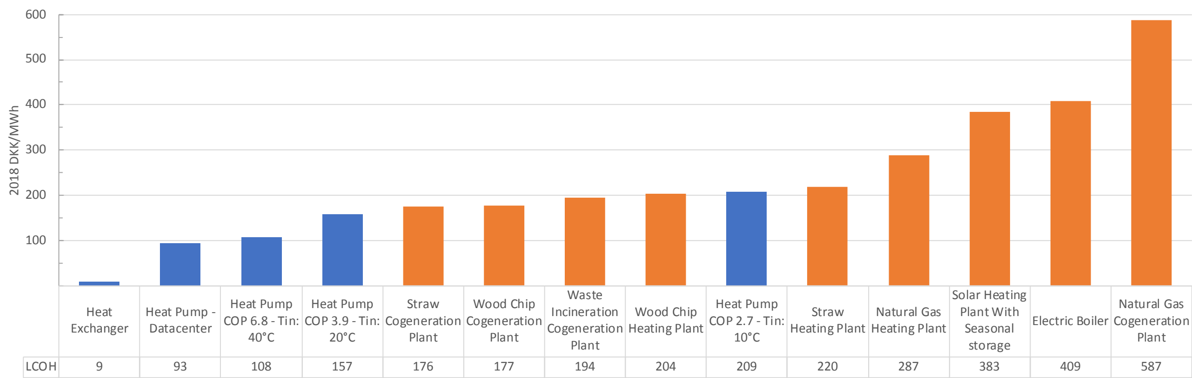


Figure 22 - LCOH in merit order with this thesis proposed taxation (Above the BREF efficiency) and changes in reimbursement from November 2017 (Blue columns: Utilization of excess heat).

In the figure it is seen that these changes in taxation will benefit utilization of excess heat both by applying a heat exchanger and a heat pump. Excess heat with temperatures above 20 °C are competitive with the production units, which also matches the SCOH presented in Figure 14.

To evaluate the impact of having processes with an efficiency close the BREF efficiency, the excess heat tax is imposed as reported in Table 18.

Table 18 - Excess heat tax with this thesis proposed taxation (Decreased with 60% from the taxation in Table 17 and full excess heat tax).

Recovery units	**Excess Heat Tax** [DKK/MWh]
Heat exchanger	26.72
Heat Pump (T_{in} = 10 °C, COP 2.7)	24.05
Heat Pump (T_{in} = 20 °C, COP 3.9)	21.38
Heat Pump (T_{in} = 40 °C, COP 6.8) [25]	13.36
Heat Pump - Data Centre	8.02

These numbers are based on a 60% decrease of the total excess heat tax for the heat exchanger and 60% decrease of the total excess heat tax for the heat pumps reported in Table 17. The LCOH comparison is presented in Figure 23.

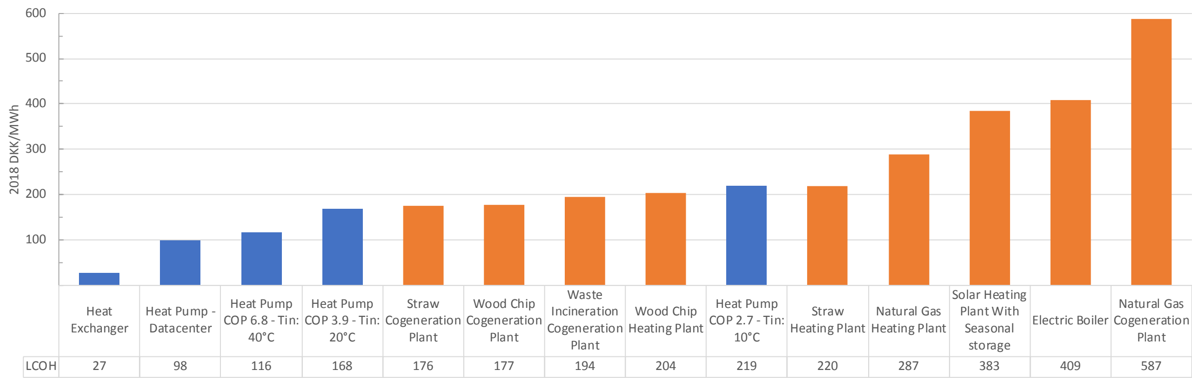


Figure 23 - LCOH in merit order with this thesis proposed taxation (Close to the BREF efficiency) and changes in reimbursement from November 2017 (Blue columns: Utilization of excess heat).

The figure shows that this legislation makes utilization of excess heat above and close to the BREF efficiency competitive with other production units. Furthermore, it increases the incentive for utilization of excess heat with temperatures above 20 °C compared to the current legislation.

This proposed legislation is based on an excess heat tax of 33% of the average fee for delivery of excess heat for district heating. By implementing the excess heat tax of 51 DKK/GJ, the LCOH will increase and the incentives for utilization of excess heat will decrease. However, this tax will only be applied in few cases as the fee for delivery of heat has to be above 556 DKK/MWh. This thesis proposed legislation was presented as 33% of the average fee for delivery of excess heat for district heating and should instead be defined as a percentage decrease from the 33%.

6.2.3 External investment from a district heating company

Another proposed change in the legislation could be an exempt excess heat tax if a district heating company makes the investment, operates the recovery unit and receives the heat for free. This is based on the SCOH comparison as excess heat that can be utilized for district heating will benefit the society as it replaces heat production from more costly production units. Currently, there is only principle cases, mentioned in Section 2.2, that lead when a company wants to deliver their excess heat for free. A legislation specifying these principle cases could incentive district heating companies to utilize the excess heat from companies. By applying this legislation, a standard within efficiencies should be referred to as it will exempt the excess heat tax and thereby increase the incentive to waste heat instead of utilizing excess heat. A standard could be the BREF efficiency, where this legislation only can be applied on processes with an efficiency above or within a specific range of the BREF efficiency.

7. Conclusion

Utilization of commercial and industrial excess heat for district heating in Denmark has been examined from a techno-economic point of view by the use of models, future energy scenarios, proposed changes in taxes and legislation and business- and socioeconomic cost of heat.

A model with the purpose of examining the potential of utilization of excess heat for external utilization was modelled. The model calculated a total external utilization potential of 43.03 PJ and a further study of the data lead to an actual utilization potential for district heating of around 25 to 30 PJ. With the current delivery of 3.45 PJ, from excess heat to district heating, the potential shows that excess heat could play an important role in the future district heating system.

The future energy scenarios were based on the GCA 2035 and 2050 with expected implementation of data centres in Denmark. The two energy scenarios were presented in the form of an energy flow diagram and built based on the results from the model, both internal and external utilization potential. From the energy flow diagrams, it is seen that a large proportion of district heating will come from data centres and process heat in the total amount of 67.73 and 73.94 PJ for year 2035 and 2050 respectively. Therefore, heat pumps will have an important role in the future energy scenarios, both for internal and external utilization from processes.

An assessment of the current legislation of excess heat was conducted based on a LCOH and SCOH for utilization of excess heat and production units. The SCOH comparison showed that utilization of excess heat should be preferred before production units, but the LCOH comparison showed that this was not the case. Therefore, an assessment of the legislation resulted in different proposals which could increase the incentives to utilize excess heat. This thesis proposes an increase in the reimbursement of electricity tax, when used for heat, progressive taxation and a decrease in the excess heat tax with an increase in the COP of the heat pump. This will increase the competitive condition for utilization of excess heat when utilized for district heating for both direct recovery and with a heat pump. Furthermore, it is proposed that a legislation should be created for excess heat delivered for free as this could increase the incentive even more.

8. Bibliography

[1] Energistatistik 2016. (2017). København K: Energistyrelsen, p.17. ISBN: 978-87-93180-31-4www. Available at: www.ens.dk.

[2] SKAT (2018). SKAT: E.A.4.6.10.6 Overskudsvarme der afsættes. [online] Available at: https://www.skat.dk/skat.aspx?oID=2062260&chk=214955 [Accessed: 14th of April 2018].

[3] SKAT (2018). SKAT: E.A.4.6.10.3 Beregning og betaling af overskudsvarmeafgift. [online] Available at: https://skat.dk/skat.aspx?oid=2062257 [Accessed: 16th of April 2018].

[4] SKAT (2018). SKAT: E.A.4.6.10.4 Udnyttelse af varm procesluft. [online] Available at: https://www.skat.dk/skat.aspx?oID=2062258&chk=214955 [Accessed: 16th of April 2018]. Website.

[5] SKAT (2018). SKAT: E.A.4.6.10.8 Satser ved nedsættelse. [online] Available at: https://skat.dk/skat.aspx?oID=2062262&chk=214955 [Accessed: 16th of April 2018].

[6] SKAT (2018). SKAT: Foræring af overskudsvarme uden afgiftsmæssige konsekvenser. [online] Available at: https://skat.dk/skat.aspx?oID=1918834&chk=214955 [Accessed: 16th of April 2018].

[7] SKAT (2018). SKAT: E.A.4.4.11.2.3 Godtgørelse af afgiften på biogas mv.. [online] Available at: https://www.skat.dk/skat.aspx?oId=2186134&chk=214955 [Accessed: 16th of April 2018].

[8] Skatteministeriet (2011). Gasafgiftsloven - Bekendtgørelse af lov om afgift af naturgas og bygas. §10, stk. 10. Published: 15th of April 2011. Available at: www.retsinformation.dk.

[9] Erhvervs- og Iværksætterinitiativer (2017). 12th of November 2017: Regeringen, Dansk Folkeparti og Radikale Venstre, p. 12. Available at: www.em.dk.

[10] Regeringen (2018). Energi - til et grønt Danmark. København K: Energi-, Forsyning- og Klimaministeriet. April 2018. p. 22-23. ISBN: 978-87-93635-51-7. Available at: www.ens.dk.

[11] Dansk fjernvarme (2016). Overskudsvarme - Kortlægning af udnyttet overskudsvarme i fjernvarmen. 20th of September 2016: Grøn Energi, John Tang, p. 4-5. Available at: www.danskfjernvarme.dk.

[12] ENE2HA: Energiregnskab i fælles enheder (detaljeret) efter anvendelse og energitype. Danmarks Statistik. Data 2016 Available at: www.statistikbanken.dk. [Accessed: 20th of February 2018].

[13] Energistyrelsen (2015). Kortlægning af energiforbrug i virksomheder. København K: Viegand Maagøe. 19th of January 2015. Available at: www.ens.dk.

[14] Energistyrelsen (2008). Kortlægning af eerhvervslivets energiforbrug. Dansk Energi Analyse and Viegand Maagøe. November 2008. p. 159-163. Available at: www.dea.dk.

[15] Energistyrelsen (2015). Kortlægning af energisparepotentialer i erhvervslivet. Kongens Lyngby: COWI. June 2015. p. 224. Available at: www.ens.dk.

[16] ERHV4: Arbejdssteder efter branche (DB07 127-GRP) og arbejdsstedsstørrelse. Danmarks Statistik. Data 2016. Available at: www.statistikbanken.dk. [Accessed: 14th of March 2018].

[17] Energistyrelsen (2013). Analyse af mulighederne for bedre udnyttelse af overskudsvarme fra industrien. København K: Viegand Maagøe. 28th of August 2013. p. 41 and 86. Available at: www.ens.dk.

[18] Energinet (2018). Systemperspektiv 2035 - Baggrundsrapport - Perspektiver for effektiv anvendelse af vedvarende energi i det danske energisystem på længere sigt. March 2018. p. 48-50. Available at: www.energinet.dk.

[19] Energinet (2018). Excel sheet - GCA - Procesvarme 2035/2050. Forretningsstøtte og -udvikling: Anders Bavnhøj Hansen. 12th of April 2018. Mail and Phone correspondence.

[20] Energistyrelsen (2018). Temaanalyse om store datacentre. Kongens Lyngby: COWI. February 2018. p. 12. Available at: www.ens.dk.

[21] Dansk Energi. Analyse nr. 18, Fremtidig vejtransport (2015). Part of: Kommercialisering af brintteknologier. 24th of June 2015. p. 23, Table 2. Available at: www.danskenergi.dk.

[22] Energistyrelsen (2014). Energiscenarier frem mod 2020, 2035 og 2050. p. 43-46. Available at: www.ens.dk.

[23] Finansministeriet (2017). Vejledning i samfundsøkonomiske konsekvensvurderinger. København K: August 2017. p. 35. ISBN: 978-87-93531-20-8. Available at: www.fm.dk.

[24] Energistyrelsen (2017). Samfundsøkonomiske beregningsforudsætninger for energipriser og emissioner. København K: 15th of August 2017. p. 8 (Table 1.c), 13 (Table 6), 20 (Table 9), 23 (Table 11) and 24 (Table 12). ISBN: 978-87-93180-29-1. Available at: www.ens.dk.

[25] Danish Energy Agency (Updated 2018). Technology Data for Energy Plants for Electricity and District heating generation. Copenhagen K: Danish Energy Agency and Energinet. August 2016. p. 63, 71, 82, 93, 173, 184, 189, 193 and 200. Available at: www.ens.dk.

[26] Danish Energy Agency (Updated 2018). Technology Data for Energy Plants - Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion. Danish Energy Agency and Energinet. May 2012. p. 96 and 111. Available at: www.ens.dk.

[27] Dansk Fjernvarme (2018). Handbook - 24 cases of urban waste heat recovery. Grøn Energi. 10th of January 2018. p. 18-19. Available at: www.danskfjernvarme.dk.

[28] E.ON Danmark A/S -Frederikssund Fjernvarme (2013). Levering af overskudsvarme fra Haldor Topsøe A/S til Frederiksund Fjernvarme.

COWI. May 2013. p. 11 and 20, Table 10.3. Available at: www.frederikssund.dk.

[29] Viborg Fjernvarme (2017). Analyse af balanceret fjernvarme. Aarhus C: Niras A/S. May 2017. p. 92-93, table 13.4.1 and 13.4.2. Available at: www.viborg-fjernvarme.dk.

[30] Energistyrelsen (2017). Notat om PSO-fremskrivning ifm. Basisfremskrivning 2017. København K: Energi-, Forsynings og Klimaministeriet. 22nd of June 2017. p. 11, Table 11. Available at: www.ens.dk.

[31] PricewaterhouseCoopers (2017). Afgiftsvejledning 2018 - Samlet overblik over afregning og godtgørelse af afgifter. Hellerup: December 2017. Available at: www.pwc.dk.

[32] Energinet (2018). Tariffer. [online]. Available at: https://energinet.dk/El/Tariffer [Accessed: 27th of March 2018].

[33] Energinet (2018). Betalinger for transport i gastransmissionsnettet. 1 Oc-tober 2017. Available at: www.energinet.dk.

[34] Dansk Energi (2018). Elforsyningens nettariffer & priser - Pr. 1 januar 2018. Frederiksberg C: March 2018. p. 9 (Table 2). ISSN 0909-0762. Available at: www.danskenergi.dk.

[35] HMN GasNet P/S (2018). Distributionstariffer for 2018 - Gasnet. [online]. Available at: https://gasnet.dk/priserogbetingelser/distributionstariffer/2018/. [Accessed: 27th of March 2018].

[36] Energistyrelsen (2016). Benchmarking af affaldssektoren 2016 (data fra 2015) Forbrænding. Dansk affaldsforening, DI and Dansk Energi. 29th of May 2017. p. 10 (Table 2). Available at: www.ens.dk.

[37] Energi- Forsynings- og Klimaministeriet (2018). Bekendtgørelse om lov om fremme af vedvarende energi. §45, stk. 2. Pubished: 9th of February 2018. Available at: www.retsinformation.dk.

[38] SKAT (2018). E.A.4.3.9.4 Eksempler på beregning af afgiftslempelse for forskellige varmeproduktionsanlæg. [Online] Available at: https://skat.dk/skat.aspx?oid=2061615. [Accessed: 27th of April 2018]

[39] European Commission (2018). Reference documents under the IPPC Directive and the IED. Available at: http://eippcb.jrc.ec.europa.eu/reference/. [Accessed: 17th of May 2018].

9. Appendices

Appendix A - Survey (Utilization of excess heat)

Selskabsnavn	Leveret mængde MWh
A/S DANSK SHELL, Fredericia	371025
ABC Glamsbjerg	82
ABC Holsted	50
Agri Nordold, Vejen	6009
ARDAGH GLASS HOLMEGAARD A/S	13353
Brugsen Skjern	45
C & D Foods Denmark	14
DAKA DENMARK A/S, Lunderskov	0
DAKA DENMARK A/S, Løsning	3447
DLG, Agersted	5500
DUPONT NUTRITION BIOSCIENCES ApS	13633
Ecocem, Aarhus	4495
FAXE KALK A/S	5301
FF SKAGEN A/S	16552
Grundfos, Bjerringbro	9471
Haldor Topsøe, Frederikssund	43000
Hals Metalsmelteri	2999
Hanstholms Fiskemelsfabrik A/S	11000
Jacobsen Bakery Hedensted	1000
Koppers Denmark ApS, Nyborg	24794
Krematoriet, Aarhus	1159
Kvickly Ebeltoft	95
Kvickly Odder	113
Kvickly Vejen	0
Logstor, Løgstør	1400
Nordalim, Aarhus	32323
Novrup krematorium	637
Naahaq Seafood A/S	100
R2 Agro Hedensted	2892
Rockwool Øster Doense (ved Arden)	8500
Scan Coat A/S	14
Skamol, Fur	3386
Skjern Papir	31843
Sukkerfabrik Nykøbing	14000
Super Brugsen Hedensted	341
Super Brugsen Løkken	220
Super Brugsen Ryomgaard	10
Super Brugsen Terndrup	0
Super Brugsen Ølgod	66
Aalborg krematorium	848
AALBORG PORTLAND A/S	331803

Figure 24 - Utilization of excess heat for district heating (Survey) [11].

Appendix B - All sectors from the energy accounting

Table 19 - All sectors from the energy statistics Denmark accounting (Reported in Danish) [12].

Hovedbrancher	Delbrancher
A Landbrug, skovbrug og fiskeri	
	01000 Landbrug og gartneri
	010000 Landbrug og gartneri
	02000 Skovbrug
	020000 Skovbrug
	03000 Fiskeri
	030000 Fiskeri
B Råstofindvinding	
	06090 Råstofindvinding
	060000 Indvinding af olie og gas
	080090 Indvinding af grus og sten
	090000 Service til råstofindvinding
C Industri	
CA Føde-, drikke- og tobaksvareindustri	
	10120 Føde-, drikke- og tobaksvareindustri
	100010 Slagterier
	100020 Fiskeindustri
	100030 Mejerier
	100040 Bagerier, brødfabrikker mv.
	100050 Anden fødevareindustri
	110000 Drikkevareindustri
	120000 Tobaksindustri
CB Tekstil- og læderindustri	
	13150 Tekstil- og læderindustri
	130000 Tekstilindustri
	140000 Beklædningsindustri
	150000 Læder- og fodtøjsindustri
CC Træ- og papirindustri, trykkerier	
	16000 Træindustri
	160000 Træindustri
	17000 Papirindustri
	170000 Papirindustri
	18000 Trykkerier mv.
	180000 Trykkerier mv.
CD Olieraffinaderier mv.	
	19000 Olieraffinaderier mv.
	190000 Olieraffinaderier mv.
CE Kemisk industri	
	20000 Kemisk industri
	200010 Fremst. af basiskemikalier
	200020 Fremst. af maling og sæbe mv.
CF Medicinalindustri	
	21000 Medicinalindustri
	210000 Medicinalindustri
CG Plast-, glas- og betonindustri	
	22000 Plast- og gummiindustri
	220000 Plast- og gummiindustri
	23000 Glas- og betonindustri
	230010 Glasindustri og keramisk industri
	230020 Betonindustri og teglværker
CH Metalindustri	
	24000 Fremst. af metal
	240000 Fremst. af metal
	25000 Metalvareindustri
	250000 Metalvareindustri
CI Elektronikindustri	
	26000 Elektronikindustri
	260010 Fremst. af computere og kommunikationsudstyr mv.
	260020 Fremst. af andet elektronisk udstyr

CJ Fremst. af elektrisk udstyr	
	27000 Fremst. af elektrisk udstyr
	270010 Fremst. af elektriske motorer mv.
	270020 Fremst. af ledninger og kabler
	270030 Fremst. af husholdningsapparater, lamper mv.
CK Maskinindustri	
	28000 Maskinindustri
	280010 Fremst. af motorer, vindmøller og pumper
	280020 Fremst. af andre maskiner
CL Transportmiddelindustri	
	29000 Fremst. af motorkøretøjer og dele hertil
	290000 Fremst. af motorkøretøjer og dele hertil
	30000 Fremst. af skibe og andre transportmidler
	300000 Fremst. af skibe og andre transportmidler
CM Møbel- og anden industri mv.	
	31320 Møbel- og anden industri
	310000 Møbelindustri
	320010 Fremst. af medicinske instrumenter mv.
	320020 Legetøj og anden fremstillingsvirksomhed
	33000 Reparation og installation af maskiner og udstyr
	330000 Reparation og installation af maskiner og udstyr
D_E Forsyningsvirksomhed	
D Energiforsyning	D Energiforsyning
	35000 Energiforsyning
	350010 Elforsyning
	350020 Gasforsyning
	350030 Varmeforsyning
E Vandforsyning og renovation	
	36000 Vandforsyning
	360000 Vandforsyning
	37390 Renovation, affaldsbehandling mv.
	370000 Kloak- og rensningsanlæg
	383900 Renovation, genbrug og forureningsbekæm-pelse
F Bygge og anlæg	
	41430 Bygge og anlæg
	410009 Nybyggeri
	420000 Anlægsvirksomhed
	430003 Professionel reparation og vedligeholdelse af bygninger
	430004 Gør-det-selv reparation og vedligeholdelse af boliger
G_I Handel og transport mv.	
G Handel	
	45000 Bilhandel og -værksteder mv.
	450010 Bilhandel
	450020 Bilværksteder mv.
	46000 Engroshandel
	460000 Engroshandel
	47000 Detailhandel
	470000 Detailhandel
H Transport	
	49000 Landtransport
	490010 Regional- og fjerntog
	490020 Lokaltog, bus og taxi mv.
	490030 Fragtvognmænd og rørtransport
	50000 Skibsfart
	500000 Skibsfart
	51000 Luftfart
	510000 Luftfart
	52000 Hjælpevirksomhed til transport
	520000 Hjælpevirksomhed til transport

	53000 Post og kurertjeneste
	530000 Post og kurertjeneste
I Hoteller og restauranter	
	55560 Hoteller og restauranter
	550000 Hoteller mv.
	560000 Restauranter
J Information og kommunikation	
JA Forlag, tv og radio	
	58000 Udgivervirksomhed
	580010 Forlag
	580020 Udgivelse af computerspil og anden software
	59600 Radio- og tv-stationer samt produktion af film, tv, mus
	590000 Produktion af film, tv og musik mv.
	600000 Radio- og tv-stationer
JB Telekommunikation	
	61000 Telekommunikation
	610000 Telekommunikation
JC It- og informationstjenester	
	62630 It- og informationstjenester
	620000 It-konsulenter mv.
	630000 Informationstjenester
K Finansiering og forsikring	
	64000 Finansiel virksomhed
	640010 Pengeinstitutter
	640020 Kreditforeninger mv.
	65000 Forsikring og pension
	650000 Forsikring og pension
	66000 Finansiel service
	660000 Finansiel service
LA Ejendomshandel og udlejning af erhvervsejendomme	
	68100 Ejendomsmæglere mv.
	680010 Ejendomsmæglere mv.
	68300 Udlejning af erhvervsejendomme
	680030 Udlejning af erhvervsejendomme
LB Boliger	
	68203 Boliger, husleje i lejeboliger
	680023 Boliger, husleje i lejeboliger
	68204 Boliger, ejerboliger mv.
	680024 Boliger, ejerboliger mv.
M_N Erhvervsservice	
M Videnservice	
MA Rådgivning mv.	
	69700 Advokater, revisorer og virksomhedskonsulen-ter
	690010 Advokatvirksomhed
	690020 Revision og bogføring
	700000 Virksomhedskonsulenter
	71000 Arkitekter og rådgivende ingeniører
	710000 Arkitekter og rådgivende ingeniører
MB Forskning og udvikling	
	72001 Forskning og udvikling, markedsmæssig
	720001 Forskning og udvikling, markedsmæssig
	72002 Forskning og udvikling, ikke-markedsmæssig
	720002 Forskning og udvikling, ikke-markedsmæssig
MC Reklame og øvrige erhvervsservice	
	73000 Reklame- og analysebureauer
	730000 Reklame- og analysebureauer
	74750 Dyrlæger og anden videnservice
	740000 Anden videnservice
	750000 Dyrlæger
N Rejsebureauer, rengøring og anden operationel service	
	77000 Udlejning og leasing af materiel

	770000 Udlejning og leasing af materiel
	78000 Arbejdsformidling og vikarbureauer
	780000 Arbejdsformidling og vikarbureauer
	79000 Rejsebureauer
	790000 Rejsebureauer
	80820 Rengøring og anden operationel service
	800000 Vagt og sikkerhedstjeneste
	810000 Ejendomsservice, rengøring og anlægsgartnere
	820000 Anden operationel service
O_Q Offentlig administration, undervisning og sundhed	
O Offentlig administration, forsvar og politi	
	84202 Offentlig administration mv.
	840010 Offentlig administration
	840022 Forsvar, politi og retsvæsen mv., ikke-markedsmæssig
	84101 Redningskorps mv., markedsmæssig
	840021 Redningskorps mv., markedsmæssig
P Undervisning	
	85202 Undervisning, ikke-markedsmæssig
	850010 Grundskoler
	850020 Gymnasier og erhvervsfaglige skoler
	850030 Videregående uddannelsesinstitutioner
	850042 Voksenundervisning mv., ikke-markeds-mæssig
	85101 Voksenundervisning mv., markedsmæssig
	850041 Voksenundervisning mv., markedsmæssig
Q Sundhed og socialvæsen	
QA Sundhedsvæsen	
	86000 Sundhedsvæsen
	860010 Hospitaler
	860020 Læger, tandlæger mv.
QB Sociale institutioner	
	87880 Sociale institutioner
	870000 Plejehjem mv.
	880000 Daginstitutioner og dagcentre mv.
R_S Kultur, fritid og anden service	
R Kultur og fritid	
	90920 Kunst, kultur og spil
	900000 Teater, musik og kunst
	910001 Biblioteker, museer mv., markedsmæssig
	910002 Biblioteker, museer mv., ikke-markedsmæssig
	920000 Lotteri og andet spil
	93000 Sport, forlystelsesparker og andre fritidsaktiviteter
	930011 Sport, markedsmæssig
	930012 Sport, ikke-markedsmæssig
	930020 Forlystelsesparker og andre fritidsaktiviteter
SA Andre serviceydelser	
	94000 Organisationer og foreninger
	940000 Organisationer og foreninger
	95000 Reparation af husholdningsudstyr
	950000 Reparation af husholdningsudstyr
	96000 Frisører, vaskerier og andre serviceydelser
	960000 Frisører, vaskerier og andre serviceydelser
SB Private husholdninger med ansat medhjælp	
	97000 Private husholdninger med ansat medhjælp
	970000 Private husholdninger med ansat medhjælp

Appendix C - Sectors included in the model

Table 20 - All sectors included in the model (Reported in Danish).

Hovedbrancher	Delbrancher
A Landbrug, skovbrug og fiskeri	
	010000 Landbrug og gartneri
	020000 Skovbrug
	030000 Fiskeri
B Råstofindvinding	
	080090 Indvinding af grus og sten
C Industri	
CA Føde-, drikke- og tobaksvareindustri	
	100010 Slagterier
	100020 Fiskeindustri
	100030 Mejerier
	100040 Bagerier, brødfabrikker mv.
	100050 Anden fødevareindustri
	110000 Drikkevareindustri
	120000 Tobaksindustri
CB Tekstil- og læderindustri	
	130000 Tekstilindustri
	140000 Beklædningsindustri
	150000 Læder- og fodtøjsindustri
CC Træ- og papirindustri, trykkerier	
	160000 Træindustri
	170000 Papirindustri
	180000 Trykkerier mv.
CD Olieraffinaderier mv.	
	190000 Olieraffinaderier mv.
CE Kemisk industri	
	200010 Fremst. af basiskemikalier
	200020 Fremst. af maling og sæbe mv.
CF Medicinalindustri	
	210000 Medicinalindustri
CG Plast-, glas- og betonindustri	
	220000 Plast- og gummiindustri
	230010 Glasindustri og keramisk industri
	230020 Betonindustri og teglværker
CH Metalindustri	
	240000 Fremst. af metal
	250000 Metalvareindustri
CI Elektronikindustri	
	260010 Fremst. af computere og kommunikationsudstyr mv.
	260020 Fremst. af andet elektronisk udstyr
CJ Fremst. af elektrisk udstyr	
	270010 Fremst. af elektriske motorer mv.
	270020 Fremst. af ledninger og kabler
	270030 Fremst. af husholdningsapparater, lamper mv.
CK Maskinindustri	
	280010 Fremst. af motorer, vindmøller og pumper
	280020 Fremst. af andre maskiner
CL Transportmiddelindustri	
	290000 Fremst. af motorkøretøjer og dele hertil
	300000 Fremst. af skibe og andre transportmidler
CM Møbel- og anden industri mv.	
	310000 Møbelindustri
	320010 Fremst. af medicinske instrumenter mv.
	320020 Legetøj og anden fremstillingsvirksomhed
	330000 Reparation og installation af maskiner og udstyr
G_I Handel og transport mv.	
G Handel	
	45000 Bilhandel og -værksteder mv.

	460000 Engroshandel
	470000 Detailhandel
I Hoteller og restauranter	
	550000 Hoteller mv.
	560000 Restauranter
J Information og kommunikation	
JA Forlag, tv og radio	
	580010 Forlag
	580020 Udgivelse af computerspil og anden software
	590000 Produktion af film, tv og musik mv.
	600000 Radio- og tv-stationer
JB Telekommunikation	
	610000 Telekommunikation
JC It- og informationstjenester	
	620000 It-konsulenter mv.
	630000 Informationstjenester
K Finansiering og forsikring	
	640010 Pengeinstitutter
	640020 Kreditforeninger mv.
	650000 Forsikring og pension
	660000 Finansiel service
LA Ejendomshandel og udlejning af erhvervsejendomme	
	680010 Ejendomsmæglere mv.
	680030 Udlejning af erhvervsejendomme
LB Boliger	
	680023 Boliger, husleje i lejeboliger
	680024 Boliger, ejerboliger mv.
M_N Erhvervsservice	
M Videnservice	
MA Rådgivning mv.	
	690010 Advokatvirksomhed
	690020 Revision og bogføring
	700000 Virksomhedskonsulenter
	710000 Arkitekter og rådgivende ingeniører
MB Forskning og udvikling	
	720001 Forskning og udvikling, markedsmæssig
	720002 Forskning og udvikling, ikke-markedsmæssig
MC Reklame og øvrige erhvervsservice	
	730000 Reklame- og analysebureauer
	740000 Anden videnservice
	750000 Dyrlæger
N Rejsebureauer, rengøring og anden operationel service	
	770000 Udlejning og leasing af materiel
	780000 Arbejdsformidling og vikarbureauer
	790000 Rejsebureauer
	800000 Vagt og sikkerhedstjeneste
	810000 Ejendomsservice, rengøring og anlægsgartnere
	820000 Anden operationel service
R_S Kultur, fritid og anden service	
R Kultur og fritid	
	900000 Teater, musik og kunst
	910001 Biblioteker, museer mv., markedsmæssig
	910002 Biblioteker, museer mv., ikke-markedsmæssig
	920000 Lotteri og andet spil
	930011 Sport, markedsmæssig
	930012 Sport, ikke-markedsmæssig
	930020 Forlystelsesparker og andre fritidsaktiviteter
SA Andre serviceydelser	
	940000 Organisationer og foreninger
	950000 Reparation af husholdningsudstyr
	960000 Frisører, vaskerier og andre serviceydelser

Appendix D - Mapping of the energy consumption

Slutanvendelse af energi fordelt på energiart år 2012. Branche 30 Fremstilling af asfalt og tagpap

Slutanvendelse	Enhed	LPG	Motorbenzin, farvet	Motorbenzin, benzin	Fyrings-gasolie	Diesel	Fuelolie	Petroleums-koks	Naturgas	Kul	Koks	Halm	Skovflis	Træpiller mm	Biogas	Bioolie	Affald	Brændsel i alt		El	Fjernvarme	Solvarme	Varmepumper	Totalt	
																		GJ	%	%	%	%	%	GJ	%
Konverterings- og nettab	%				1		1		1							1		13.604	1					13.604	1
Opvarmning/kogning	%				95		98		98							95		1.317.329	85	10				1.329.698	78
Tørring	%																	0	0					0	0
Inddampning	%																	0	0					0	0
Destillation	%																	0	0					0	0
Brænding/sintring	%																	0	0					0	0
Smeltning/støbning	%																	0	0					0	0
Anden procesvarme op til 150 °C	%																	0	0					0	0
Anden procesvarme over 150 °C	%																	0	0					0	0
Arbejdskørsel	%	100	100															45.380	3					45.380	3
Transport	%			100		100												142.102	9					142.102	8
Rumvarme	%				4		1		1							4		29.505	2	1	100		100	66.760	4
Varmepumpers energiforbrug	%																	0	0	3				4.229	0
Belysning	%																	0	0	4				4.948	0
Pumpning	%																	0	0	1				1.237	0
Rumkøling	%																	0	0					0	0
Køl/frys (ekskl. rumkøling)	%																	0	0					0	0
Rumventilation	%																	0	0	2				2.474	0
Blæsere	%																	0	0	10				12.369	1
Trykluft	%																	0	0	2				2.474	0
Hydraulik	%																	0	0	2				2.474	0
Øvrige elmotorer	%																	0	0	63				77.409	5
It og anden elektronik	%																	0	0	2				2.474	0
Anden elanvendelse	%																	0	0					0	0
Sum (energiartens procentdel af total)	%	100	100	100	100	100	100	0	100	0	0	0	0	0	0	100	0	1.547.919	100	100	100	0	100	1.707.632	100
Branchens forbrug til slutanvendelser	**GJ**	**45.371**	**9**	**2.882**	**393.646**	**139.220**	**50.533**	**-**	**888.876**	**-**	**-**	**-**	**-**	**-**	**-**	**27.383**	**-**	**1.547.919**	**100**	**123.694**	**19.103**	**-**	**16.916**	**1.707.632**	**100**
Varmeeksport fra overskudsvarme	GJ																							0	

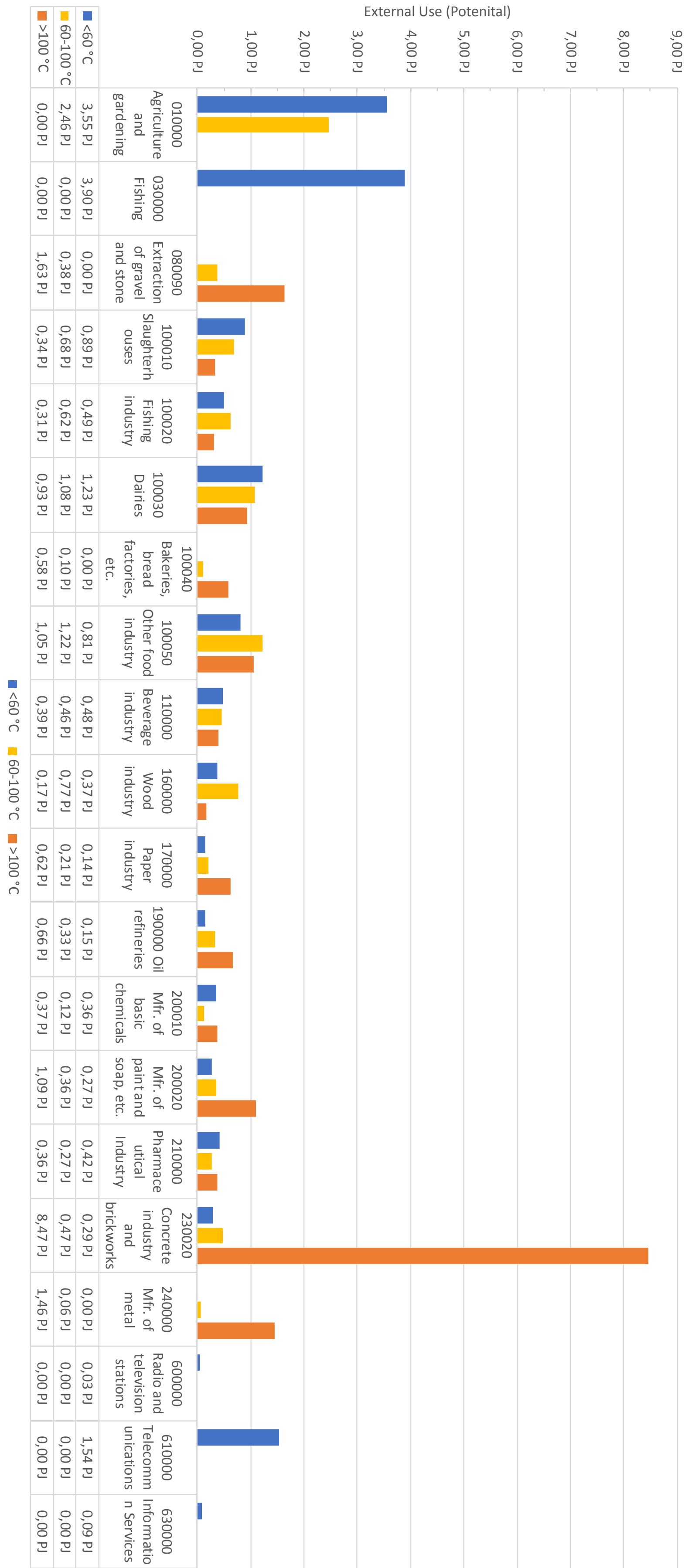
Figure 25 - Mapping of the energy consumption from the Danish Energy Agency [13].

Appendix E - Temperatures of process heat

Branche [-]	Energiforbrug [GJ]	Andel af proces <100 °C (%)	Andel af proces <60 °C (%)
Slagterier	4.246.412	80	40
Fiskeindustri	2.849.394	80	40
Mejerier	5.381.894	70	35
Bagerier, brødfabrikker mv.	2.993.845	40	20
Anden fødevareindustri	11.458.517	70	35
Drikkevareindustri	3.700.467	70	35
Tobaksindustri	258.795	90	45
Tekstil- og læderindustri	1.395.360	70	35
Træindustri	3.523.959	90	45
Papirindustri	4.772.583	40	20
Trykkerier mv.	1.329.277	80	40
Kemisk industri	7.605.411	40	20
Medicinalindustri	3.350.419	60	30
Plast- og gummiindustri	3.134.066	50	25
Glas- og betonindustri	17.065.416	10	5
Metalindustri	8.696.988	10	5
Elektronikindustri	1.112.978	80	40
Fremst. af elektrisk udstyr	973.886	80	40
Maskinindustri	6.114.198	50	25
Transportmiddelindustri	1.637.638	50	25
Møbel og anden industri mv.	4.020.641	70	35
Byggeri og anlæg	20.250.849	50	25
Handel og Service	72.625.538	50	25

Figure 26 - Temperatures of the process heat [17].

Appendix F - External utilization from sectors



	<60 °C	60-100 °C	>100 °C
010000 Agriculture and gardening	3,55 PJ	2,46 PJ	0,00 PJ
030000 Fishing	3,90 PJ	0,00 PJ	0,00 PJ
080090 Extraction of gravel and stone	0,00 PJ	0,38 PJ	1,63 PJ
100010 Slaughterhouses	0,89 PJ	0,68 PJ	0,34 PJ
100020 Fishing industry	0,49 PJ	0,62 PJ	0,31 PJ
100030 Daires	1,23 PJ	1,08 PJ	0,93 PJ
100040 Bakeries, bread factories, etc.	0,00 PJ	0,10 PJ	0,58 PJ
100050 Other food industry	0,81 PJ	1,22 PJ	1,05 PJ
110000 Beverage industry	0,48 PJ	0,46 PJ	0,39 PJ
160000 Wood industry	0,37 PJ	0,77 PJ	0,17 PJ
170000 Paper industry	0,14 PJ	0,21 PJ	0,62 PJ
190000 Oil refineries	0,15 PJ	0,33 PJ	0,66 PJ
200010 Mfr. of basic chemicals	0,36 PJ	0,12 PJ	0,37 PJ
200020 Mfr. of paint and soap, etc.	0,27 PJ	0,36 PJ	1,09 PJ
210000 Pharmaceutical Industry	0,42 PJ	0,27 PJ	0,36 PJ
230020 Concrete industry and brickworks	0,29 PJ	0,47 PJ	8,47 PJ
240000 Mfr. of metal	0,00 PJ	0,06 PJ	1,46 PJ
600000 Radio and television stations	0,03 PJ	0,00 PJ	0,00 PJ
610000 Telecommunications	1,54 PJ	0,00 PJ	0,00 PJ
630000 Information Services	0,09 PJ	0,00 PJ	0,00 PJ

Figure 27 - Amount of excess heat and temperatures from the sectors.

Appendix G - Process heat GCA 2035 and 2050

Cases Procesvarme 2035/2050				**TYNDP18 (GCA)**	**TYNDP18 (Sus)**	**TYNDP18 (GCA)**	**TYNDP18 (Sus)**
År				**2035**	**2035**	**2050**	**2050**
Procesvarme, nettobehov				TYNDP18 (GCA)	TYNDP18 (Sus)	TYNDP18 (GCA)	TYNDP18 (Sus)
År				2035	2035	2050	2050
Proces <50 gr.			GWh	**520**	**520**	**526**	**526**
	FV mv.		%	20%	20%	25%	25%
	EL		%	50%	14%	70%	70%
	Naturgas		%	15%	41%	0%	0%
	VEgas		%	0%	0%	5%	5%
	Olie		%	5%	5%	0%	0%
	Biomasse		%	10%	20%	0%	0%
	El vægtet COP		p.u.	3,5	3,5	3,5	3,5
Proces 50-75 gr.			GWh	**2412**	**2412**	**2340**	**2340**
	FV mv.		%	15%	15%	15%	15%
	EL		%	30%	11%	70%	70%
	Naturgas		%	35%	45%	0%	0%
	VEgas		%	5%	5%	15%	15%
	Olie		%	5%	5%	0%	0%
	Biomasse		%	10%	20%	0%	0%
	El vægtet COP		p.u.	3	3	3	3
Proces 75-100 gr.			GWh	**2430**	**2430**	**2496**	**2496**
	FV mv.		%	10%	10%	10%	10%
	EL		%	25%	9%	65%	65%
	Naturgas		%	40%	51%	0%	0%
	VEgas		%	5%	5%	25%	25%
	Olie		%	5%	5%	0%	0%
	Biomasse		%	15%	20%	0%	0%
	El vægtet COP		p.u.	2	2	2	2
Proces 100-150 gr.			GWh	**4198**	**4198**	**4393**	**4393**
	FV mv.		%	5%	5%	5%	5%
	EL		%	20%	7%	50%	50%
	Naturgas		%	40%	53%	0%	0%
	VEgas		%	5%	5%	45%	45%
	Olie		%	10%	10%	0%	0%
	Biomasse		%	20%	20%	0%	0%
	El vægtet COP		p.u.	1,2	1,2	1,2	1,2
Proces 150-200 gr.			GWh	**1111**	**1111**	**1162**	**1162**
	FV mv.		%	0%	0%	5%	5%
	EL		%	10%	4%	35%	35%
	Naturgas		%	50%	57%	0%	0%
	VEgas		%	10%	10%	60%	60%
	Olie		%	10%	10%	0%	0%
	Biomasse		%	20%	20%	0%	0%
	El vægtet COP		p.u.	1	1	1	1
Proces > 200 gr.			GWh	**4287**	**4287**	**4489**	**4489**
	FV mv.		%	0%	0%	0%	0%
	EL		%	10%	4%	30%	30%
	Naturgas		%	60%	67%	0%	0%
	VEgas		%	5%	5%	70%	70%
	Olie		%	10%	10%	0%	0%
	Biomasse		%	15%	15%	0%	0%
	El vægtet COP		p.u.	1	1	1	1

Figure 28 - Energy types for process heat GCA 2035 and 2050 [19].

Appendix H - LCOH data

Shows the costs, taxes, earnings, subsidies and reimbursement.

Electricity Efficiency	27,40%	Heat Efficiency	83,50%	Total Input [MWh]			1,20	Ouput Electricity [MWh]				0,33	Ouput Heat [MWh]			1							
Wood Chip Cogeneration Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Wood Chips	DKK/MWh	221,6	223,3	225,0	227,0	229,1	231,1	233,1	235,2	236,9	238,7	240,4	242,2	244,0	245,0	246,1	247,2	248,2	249,3	250,3	251,4	160,5
Taxes	Energy Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	1,5
	SO2 Tax	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	CO2 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OPEX	O&M (Fixed & Variable)	DKK/MWh	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	90,2	61,3
CAPEX	Investment	DKK/MWh	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	75,6	51,4
Earnings & Subsidies	Electricity Sales	DKK/MWh	-61,6	-64,0	-72,6	-76,1	-79,7	-83,2	-86,8	-90,3	-93,9	-97,4	-101,0	-104,5	-108,1	-111,6	-115,2	-118,7	-122,3	-125,8	-129,3	-132,9	-63,9
	Biomass Electricity Subsidies	DKK/MWh	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-49,2	-33,4
Heating Price	Heat Price	DKK/MWh	278,9	278,3	271,4	269,8	268,3	266,8	265,3	263,8	262,0	260,2	258,4	256,6	254,8	252,4	249,9	247,4	244,9	242,4	239,9	237,4	177,4

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Wood Chip Heating Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Wood Chips	DKK/MWh	180,7	181,7	182,7	183,9	185,1	186,3	187,4	188,6	189,7	190,8	191,9	193,0	194,1	194,8	195,4	196,0	196,6	197,3	197,9	198,5	128,7
Taxes	Max Energy Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,2
	SO2 Tax	DKK/MWh	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,3
	CO2 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OPEX	O&M (Fixed & Variable)	DKK/MWh	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	64,7	44,0
CAPEX	Investment	DKK/MWh	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	29,6
Heating Price	Heat Price	DKK/MWh	291,3	292,3	293,3	294,5	295,7	296,8	298,0	299,2	300,3	301,4	302,5	303,6	304,7	305,3	306,0	306,6	307,2	307,8	308,4	309,0	203,8

Electric Efficiency	29,40%	Heat Efficiency	68,80%	Total Input [MWh]			1,45	Ouput Electricity [MWh]				0,43	Ouput Heat [MWh]			1							
Straw Cogeneration Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Straw	DKK/MWh	221,0	222,7	224,4	226,4	228,5	230,5	232,5	234,6	236,0	237,4	238,8	240,2	241,5	242,3	243,1	243,9	244,7	245,4	246,2	246,9	159,4
Taxes	Energy Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	1,8
	SO2 Tax	DKK/MWh	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	2,0
	CO2 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OPEX	O&M (Fixed & Variable)	DKK/MWh	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	106,2	72,1
CAPEX	Investment	DKK/MWh	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	98,5	66,9
Earnings & Subsidies	Electricity Sales	DKK/MWh	-80,2	-83,3	-94,5	-99,1	-103,8	-108,4	-113,0	-117,6	-122,2	-126,9	-131,5	-136,1	-140,7	-145,3	-150,0	-154,6	-159,2	-163,8	-168,4	-173,1	-83,2
	Biomass Electricity Subsidies	DKK/MWh	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-64,1	-43,6
Heating Price	Heat Price	DKK/MWh	286,9	285,6	276,1	273,5	270,9	268,3	265,7	263,1	260,0	256,7	253,5	250,2	247,0	243,1	239,3	235,5	231,6	227,8	223,9	220,0	175,5

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Straw Heating Plant			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Straw	DKK/MWh	152,0	153,2	154,4	155,8	157,2	158,6	160,0	161,4	162,4	163,3	164,3	165,2	166,2	166,7	167,2	167,8	168,3	168,9	169,4	169,9	109,6
Taxes	Max Energy Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,2
	SO2 Tax	DKK/MWh	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	3,7
	CO2 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OPEX	O&M (Fixed & Variable)	DKK/MWh	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	96,5	65,6
CAPEX	Investment	DKK/MWh	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	57,9	39,4
Heating Price	Heat Price	DKK/MWh	313,8	315,0	316,2	317,5	318,9	320,3	321,7	323,1	324,1	325,1	326,0	327,0	327,9	328,5	329,0	329,5	330,1	330,6	331,1	331,6	219,6

Electricity Efficiency	37,00%	Heat Efficiency	53,00%	Total Input [MWh]			1,89	Ouput Electricity [MWh]				0,70	Ouput Heat [MWh]			1							
Natural Gas Cogeneration Plant			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Natural Gas	DKK/MWh	272,2	271,5	270,7	293,8	316,3	337,8	358,2	377,4	396,5	414,9	432,5	449,6	466,3	478,5	490,3	501,6	512,6	523,1	528,7	533,9	265,6
Taxes	Energy Tax	DKK/MWh	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	376,8	256,0
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	0,9
	SO2 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CO2 Tax	DKK/MWh	16,9	17,4	18,0	18,7	19,6	20,6	21,6	22,8	24,2	25,6	27,1	28,7	30,4	32,2	34,1	36,1	38,3	40,5	42,9	45,5	17,8
Tariffs	Gas Emergency Tariff	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Gas Volume Tariff	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,0
	Gas Distribution Tariff	DKK/MWh	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	26,2	17,8
	Energy Savings Tariff	DKK/MWh	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	10,1	6,9
OPEX	O&M (Fixed & Variable)	DKK/MWh	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	92,6
CAPEX	Investment	DKK/MWh	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	95,2	64,7
Earnings	Electricity Sales	DKK/MWh	-131,1	-136,1	-154,4	-162,0	-169,5	-177,1	-184,6	-192,2	-199,7	-207,3	-214,8	-222,3	-229,9	-237,4	-245,0	-252,5	-260,1	-267,6	-275,2	-282,7	-135,9
Heating Price	Heat Price	DKK/MWh	804,2	799,0	780,4	796,7	812,5	827,4	841,4	854,2	867,1	879,3	890,9	902,1	912,9	919,4	925,5	931,3	936,9	942,1	942,5	942,8	586,6

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Natural Gas Heating Plant			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Natural Gas	DKK/MWh	144,3	143,9	143,4	155,7	167,6	179,0	189,9	200,0	210,2	219,9	229,2	238,3	247,1	253,6	259,9	265,9	271,7	277,2	280,2	283,0	140,8
Taxes	Max Energy Tax	DKK/MWh	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	166,7	113,3
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,5
	SO2 Tax	DKK/MWh	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,01
	CO2 Tax	DKK/MWh	9,0	9,2	9,5	9,9	10,4	10,9	11,5	12,1	12,8	13,6	14,4	15,2	16,1	17,1	18,1	19,1	20,3	21,5	22,8	24,1	9,4
Tariffs	Gas Emergency Tariff	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Gas Volume Tariff	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Gas Distribution Tariff	DKK/MWh	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	13,9	9,4
	Energy Savings Tariff	DKK/MWh	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	3,6
OPEX	O&M (Fixed & Variable)	DKK/MWh	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	11,3	7,7
CAPEX	Investment	DKK/MWh	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	2,5
Heating Price	Heat Price	DKK/MWh	355,0	354,9	354,8	367,4	379,8	391,7	403,1	413,9	424,7	435,2	445,4	455,3	465,0	472,4	479,7	486,8	493,7	500,5	504,7	508,9	287,3

Electricity Efficiency	21,40%	Heat Efficiency	79,60%	Total Input [MWh]		1,26	Ouput Electricity [MWh]			0,27	Ouput Heat [MWh]		1									
Waste Incineration Cogeneration Plant			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Waste	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Taxes	Waste Heat Tax	DKK/MWh	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	89,5	60,8
	Surcharge Tax	DKK/MWh	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	119,8	81,4
	CH4 Tax	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx Tax	DKK/MWh	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	1,6
	SO2 Tax	DKK/MWh	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,3
	CO2 Tax	DKK/MWh	7,3	7,5	7,8	8,1	8,5	8,9	9,3	9,9	10,4	11,0	11,7	12,4	13,1	13,9	14,7	15,6	16,5	17,5	18,5	19,6	7,7
OPEX	O&M (Fixed & Variable)	DKK/MWh	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	128,8	87,5
CAPEX	Investment	DKK/MWh	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	97,4	66,2
Earnings	Electricity Sales	DKK/MWh	-50,5	-52,4	-59,5	-62,4	-65,3	-68,2	-71,1	-74,0	-76,9	-79,8	-82,7	-85,6	-88,5	-91,4	-94,3	-97,3	-100,2	-103,1	-106,0	-108,9	-52,3
	Waste Management	DKK/MWh	-111,3	-107,8	-104,4	-101,2	-98,0	-94,9	-92,0	-89,1	-86,3	-83,6	-81,0	-78,5	-76,0	-73,6	-71,3	-69,1	-67,0	-64,9	-62,8	-60,9	-59,2
Heating Price	Heat Price	DKK/MWh	283,9	285,6	282,2	282,9	283,5	284,1	284,6	285,1	285,5	285,9	286,3	286,6	286,9	287,1	287,4	287,5	287,7	287,9	288,0	288,2	194,0

Heat efficiency	99,00%	Total Input [MWh]			1,01	Ouput Heat [MWh]		1														
Electric Boiler			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Electricity	DKK/MWh	189,6	196,9	223,4	234,3	245,3	256,2	267,1	278,0	288,9	299,9	310,8	321,7	332,6	343,6	354,5	365,4	376,3	387,2	398,2	409,1	196,6
Taxes	Electricity Tax	DKK/MWh	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	923,2	627,4
Tariffs	System	DKK/MWh	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	42,4	28,8
	Transmission	DKK/MWh	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	38,4	26,1
	Distribution	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	PSO	DKK/MWh	16,3	9,8	4,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,4
OPEX	O&M (Fixed & Variable)	DKK/MWh	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	3,7
CAPEX	Investment	DKK/MWh	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	3,7
Reimbursement	Reimbursement of Electricity Tax	DKK/MWh	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-705,1	-479,1
Heating Price	Heat Price	DKK/MWh	515,9	516,7	537,4	544,5	555,2	566,2	577,1	588,0	598,9	609,9	620,8	631,7	642,6	653,5	664,5	675,4	686,3	697,2	708,1	719,1	408,7

Solar Heating Plant with Seasonal storage 1.5 m3 stroage per 1 m2 solar panel			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
OPEX - Solar Colector	O&M (Fixed & Variable)	DKK/MWh	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	3,2
OPEX - Seasonal Storage	O&M (Fixed & Variable)	DKK/MWh	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	2,1
CAPEX - Solar Heating	Investment	DKK/MWh	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	118,3	80,4
CAPEX - Seasonal Storage	Investment	DKK/MWh	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	438,3	297,8
Heating Price	Heat Price	DKK/MWh	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	564,4	383,5

Excess Heat - Furnance			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Taxes	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
OPEX	O&M (Fixed & Variable)	DKK/MWh	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
CAPEX	Investment	DKK/MWh	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	11,4	7,8
Heating Price	Heat Price	DKK/MWh	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	53,3

Excess Heat - Flue Gas			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Taxes	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
OPEX	O&M (Fixed & Variable)	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
CAPEX	Investment	DKK/MWh	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	2,6
Heating Price	Heat Price	DKK/MWh	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8	48,0

Excess Heat - Drying Process			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Taxes	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
OPEX	O&M (Fixed & Variable)	DKK/MWh	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,3
CAPEX	Investment	DKK/MWh	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	21,7	14,8
Heating Price	Heat Price	DKK/MWh	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	22,2	60,5

Heat Pump COP 2.7 - Tin: 10°C	Average COP		2,7	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		69,5	72,2	81,9	85,9	89,9	93,9	97,9	101,9	105,9	110,0	114,0	118,0	122,0	126,0	130,0	134,0	138,0	142,0	146,0	150,0	72,1
Taxes	Electricity Tax	DKK/MWh		338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	338,5	230,0
	Excess Heat Tax	DKK/MWh		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Tariffs	System	DKK/MWh		15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	10,6
	Transmission	DKK/MWh		14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	14,1	9,6
	Distribution	DKK/MWh		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh		6,0	3,6	1,5	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5
OPEX	O&M (Fixed & Variable)	DKK/MWh		18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	12,2
CAPEX	Investment	DKK/MWh		43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	29,6
Reimbursment	Electricity Tax	DKK/MWh		-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-187,8	-127,6
Heating Price	Heat Price	DKK/MWh		317,5	317,8	325,4	328,0	332,0	336,0	340,0	344,0	348,0	352,0	356,0	360,0	364,0	368,0	372,0	376,0	380,0	384,0	388,0	392,0	237,1

Heat Pump COP 3.9 - Tin: 20°C	Average COP		3,9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		48,1	50,0	56,7	59,5	62,3	65,0	67,8	70,6	73,3	76,1	78,9	81,7	84,4	87,2	90,0	92,8	95,5	98,3	101,1	103,8	49,9
Taxes	Electricity Tax	DKK/MWh		234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	234,4	159,3
	Excess Heat Tax	DKK/MWh		66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh		10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	7,3
	Transmission	DKK/MWh		9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	6,6
	Distribution	DKK/MWh		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh		4,1	2,5	1,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4
OPEX	O&M (Fixed & Variable)	DKK/MWh		18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	18,0	12,2
CAPEX	Investment	DKK/MWh		43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	43,6	29,6
Reimbursment	Electricity Tax	DKK/MWh		-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-130,0	-88,3
Heating Price	Heat Price	DKK/MWh		435,6	435,8	441,1	442,9	445,6	448,4	451,1	453,9	456,7	459,5	462,2	465,0	467,8	470,6	473,3	476,1	478,9	481,6	484,4	487,2	222,4

Heat Pump COP 6.8 - Tin: 40°C	Average COP		6,8	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		27,61	28,67	32,53	34,12	35,71	37,30	38,89	40,48	42,07	43,66	45,25	46,84	48,43	50,02	51,61	53,20	54,79	56,38	57,97	59,56	28,62
Taxes	Electricity Tax	DKK/MWh		134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	134,41	91,33
	Excess Heat Tax	DKK/MWh		66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	66,82	45,40
Tariffs	System	DKK/MWh		6,2	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	6,18	4,20
	Transmission	DKK/MWh		5,6	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	5,59	3,80
	Distribution	DKK/MWh		0,0	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
	PSO	DKK/MWh		2,37	1,42	0,58	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,21
OPEX	O&M (Fixed & Variable)	DKK/MWh		18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	18,02	12,24
CAPEX	Investment	DKK/MWh		43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	43,61	29,63
Reimbursment	Electricity Tax	DKK/MWh		-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-74,56	-50,66
Heating Price	Heat Price	DKK/MWh		304,62	304,73	307,75	308,78	310,34	311,93	313,52	315,11	316,70	318,29	319,88	321,47	323,07	324,66	326,25	327,84	329,43	331,02	332,61	334,20	164,79

Datacenter - Apple Viborg (55 MW - 80/40 °C)	COP	7,460092572	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	4805,927273	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	25,2	26,1	29,6	31,1	32,5	34,0	35,4	36,9	38,3	39,8	41,2	42,7	44,1	45,6	47,0	48,5	49,9	51,4	52,8	54,3	26,1
Taxes	Electricity Tax	DKK/MWh	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	83,3
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	3,8
	Transmission	DKK/MWh	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	3,5
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	2,2	1,3	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	12,3
CAPEX	Investment	DKK/MWh	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	47,7	32,4
Reimbursment	Electricity Tax	DKK/MWh	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-46,2
Heating Price	Heat Price	DKK/MWh	293,2	293,3	296,1	297,0	298,4	299,9	301,3	302,8	304,2	305,7	307,1	308,6	310,0	311,5	312,9	314,4	315,8	317,3	318,7	320,2	160,8

Datacenter - Apple Viborg (55 MW - 60/30 °C)	COP	8,280281331	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5308,563636	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	22,7	23,5	26,7	28,0	29,3	30,6	31,9	33,2	34,5	35,9	37,2	38,5	39,8	41,1	42,4	43,7	45,0	46,3	47,6	48,9	23,5
Taxes	Electricity Tax	DKK/MWh	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	75,0
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	3,4
	Transmission	DKK/MWh	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	3,1
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	1,9	1,2	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	12,1
CAPEX	Investment	DKK/MWh	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	38,0	25,8
Reimbursment	Electricity Tax	DKK/MWh	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-41,6
Heating Price	Heat Price	DKK/MWh	267,3	267,4	269,9	270,8	272,1	273,4	274,7	276,0	277,3	278,6	279,9	281,2	282,5	283,8	285,1	286,4	287,7	289,0	290,3	291,6	147,0

Datacenter - Apple Viborg (55 MW - 55/30 °C)	COP	9,100094206	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	4917,690909	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	20,6	21,4	24,3	25,5	26,7	27,9	29,1	30,2	31,4	32,6	33,8	35,0	36,2	37,4	38,6	39,8	40,9	42,1	43,3	44,5	21,4
Taxes	Electricity Tax	DKK/MWh	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	68,2
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	3,1
	Transmission	DKK/MWh	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	2,8
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	1,8	1,1	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	18,1	12,3
CAPEX	Investment	DKK/MWh	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	35,5	24,1
Reimbursment	Electricity Tax	DKK/MWh	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-37,9
Heating Price	Heat Price	DKK/MWh	252,0	252,1	254,4	255,1	256,3	257,5	258,7	259,9	261,1	262,2	263,4	264,6	265,8	267,0	268,2	269,4	270,6	271,7	272,9	274,1	139,7

Datacenter - Apple Viborg (45 MW - 80/40 °C)	COP	7,460089714	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5395,8	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	25,2	26,1	29,6	31,1	32,5	34,0	35,4	36,9	38,3	39,8	41,2	42,7	44,1	45,6	47,0	48,5	49,9	51,4	52,8	54,3	26,1
Taxes	Electricity Tax	DKK/MWh	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	122,5	83,3
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	3,8
	Transmission	DKK/MWh	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	3,5
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	2,2	1,3	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	17,8	12,1
CAPEX	Investment	DKK/MWh	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	44,7	30,4
Reimbursment	Electricity Tax	DKK/MWh	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-68,0	-46,2
Heating Price	Heat Price	DKK/MWh	289,9	290,0	292,7	293,7	295,1	296,5	298,0	299,4	300,9	302,3	303,8	305,2	306,7	308,1	309,6	311,0	312,5	313,9	315,4	316,8	158,5

Datacenter - Apple Viborg (45 MW - 60/30 °C)	COP	8,28000124	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5935,288889	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	22,7	23,5	26,7	28,0	29,3	30,6	31,9	33,2	34,5	35,9	37,2	38,5	39,8	41,1	42,4	43,7	45,0	46,3	47,6	48,9	23,5
Taxes	Electricity Tax	DKK/MWh	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	110,4	75,0
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	3,4
	Transmission	DKK/MWh	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	3,1
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	1,9	1,2	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	17,5	11,9
CAPEX	Investment	DKK/MWh	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	24,6
Reimbursment	Electricity Tax	DKK/MWh	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-61,2	-41,6
Heating Price	Heat Price	DKK/MWh	265,2	265,2	267,7	268,6	269,9	271,2	272,5	273,8	275,1	276,4	277,7	279,0	280,3	281,6	282,9	284,2	285,5	286,8	288,1	289,4	145,5

Datacenter - Apple Viborg (45 MW - 55/30 °C)	COP	9,10000731	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5532,4	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	20,6	21,4	24,3	25,5	26,7	27,9	29,1	30,2	31,4	32,6	33,8	35,0	36,2	37,4	38,6	39,8	40,9	42,1	43,3	44,5	21,4
Taxes	Electricity Tax	DKK/MWh	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	100,4	68,3
	Excess Heat Tax	DKK/MWh	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	66,8	45,4
Tariffs	System	DKK/MWh	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	3,1
	Transmission	DKK/MWh	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	2,8
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	PSO	DKK/MWh	1,8	1,1	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
OPEX	O&M (Fixed & Variable)	DKK/MWh	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	17,7	12,0
CAPEX	Investment	DKK/MWh	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	33,5	22,8
Reimbursment	Electricity Tax	DKK/MWh	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-55,7	-37,9
Heating Price	Heat Price	DKK/MWh	249,7	249,8	252,1	252,8	254,0	255,2	256,4	257,6	258,8	259,9	261,1	262,3	263,5	264,7	265,9	267,1	268,3	269,4	270,6	271,8	138,1

Appendix I - SCOH data

Shows the costs, earnings and damage costs.

Electricity Efficiency	27,40%	Heat Efficiency	83,50%	Total Input [MWh]			1,20	Ouput Electricity [MWh]				0,33	Ouput Heat [MWh]			1							
Wood Chip Cogeneration Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Wood Chips	DKK/MWh	293,6	295,9	298,2	300,8	303,5	306,2	308,9	311,6	313,9	316,3	318,6	320,9	323,3	324,7	326,1	327,5	328,9	330,3	331,7	333,1	212,6
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
	N2O	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,1
	SO2	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	NOx	DKK/MWh	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	1,7
	PM 2.5	DKK/MWh	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,3
O&M (Fixed & Variable)	O&M	DKK/MWh	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	119,6	81,3
Capital Cost	Investment	DKK/MWh	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	100,2	68,1
Earnings	Electricity Sales	DKK/MWh	-61,6	-64,0	-72,6	-76,1	-79,7	-83,2	-86,8	-90,3	-93,9	-97,4	-101,0	-104,5	-108,1	-111,6	-115,2	-118,7	-122,3	-125,8	-129,3	-132,9	-63,9
Heating Price	Heat Price	DKK/MWh	454,9	454,9	448,5	447,7	446,8	445,9	445,1	444,3	443,1	441,8	440,6	439,4	438,2	436,1	434,0	431,8	429,7	427,6	425,4	423,3	300,3

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Wood Chip Heating Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Wood Chips	DKK/MWh	239,4	240,8	242,1	243,7	245,2	246,8	248,3	249,9	251,4	252,8	254,3	255,8	257,2	258,0	258,9	259,7	260,5	261,4	262,2	263,0	170,5
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,1
	N2O	DKK/MWh	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,3
	SO2	DKK/MWh	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,3
	NOx	DKK/MWh	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	1,6
	PM 2.5	DKK/MWh	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,6
O&M (Fixed & Variable)	O&M	DKK/MWh	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	85,7	58,3
Capital Cost	Investment	DKK/MWh	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	39,3
Heating Price	Heat Price	DKK/MWh	386,8	388,2	389,5	391,1	392,7	394,2	395,8	397,4	398,9	400,4	401,9	403,3	404,8	405,7	406,6	407,4	408,3	409,2	410,0	410,9	270,7

Electric Efficiency	29,40%	Heat Efficiency	68,80%	Total Input [MWh]			1,45	Ouput Electricity [MWh]				0,43	Ouput Heat [MWh]			1							
Straw Cogeneration Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Straw	DKK/MWh	292,8	295,1	297,4	300,0	302,7	305,4	308,1	310,8	312,7	314,6	316,4	318,2	320,0	321,1	322,1	323,1	324,2	325,2	326,2	327,2	211,2
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	N2O	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,1
	SO2	DKK/MWh	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	1,8
	NOx	DKK/MWh	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	4,7	3,2
	PM 2.5	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
O&M (Fixed & Variable)	O&M	DKK/MWh	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	140,7	95,6
Capital Cost	Investment	DKK/MWh	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	130,5	88,7
Earnings	Electricity Sales	DKK/MWh	-80,2	-83,3	-94,5	-99,1	-103,8	-108,4	-113,0	-117,6	-122,2	-126,9	-131,5	-136,1	-140,7	-145,3	-150,0	-154,6	-159,2	-163,8	-168,4	-173,1	-83,2
Heating Price	Heat Price	DKK/MWh	491,3	490,5	481,6	479,6	477,7	475,7	473,8	471,9	469,2	466,4	463,7	460,9	458,1	454,5	450,9	447,4	443,8	440,2	436,6	433,0	317,4

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Straw Heating Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Straw	DKK/MWh	201,5	203,1	204,6	206,4	208,3	210,1	212,0	213,8	215,2	216,4	217,7	218,9	220,2	220,9	221,6	222,3	223,0	223,7	224,4	225,1	145,3
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,2
	N2O	DKK/MWh	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,3
	SO2	DKK/MWh	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	3,2
	NOx	DKK/MWh	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	1,6
	PM 2.5	DKK/MWh	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,7
O&M (Fixed & Variable)	O&M	DKK/MWh	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	127,9	86,9
Capital Cost	Investment	DKK/MWh	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	76,8	52,2
Heating Price	Heat Price	DKK/MWh	414,6	416,3	417,8	419,7	421,5	423,4	425,3	427,2	428,5	429,8	431,1	432,4	433,7	434,4	435,2	436,0	436,7	437,5	438,2	439,0	290,3

Electricity Efficiency	37,00%	Heat Efficiency	53,00%	Total Input [MWh]			1,89	Ouput Electricity [MWh]				0,70	Ouput Heat [MWh]			1							
Natural Gas Cogeneration Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Natural Gas	DKK/MWh	360,7	359,8	358,6	389,2	419,1	447,5	474,7	500,0	525,4	549,7	573,1	595,8	617,8	634,0	649,6	664,7	679,2	693,1	700,5	707,4	351,9
Damage Costs	CO2	DKK/MWh	22,4	23,1	23,9	24,8	26,0	27,2	28,7	30,3	32,0	33,9	35,9	38,0	40,3	42,7	45,2	47,9	50,7	53,7	56,9	60,3	23,6
	CH4	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	N2O	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,3	0,1
	SO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	NOx	DKK/MWh	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	1,6
	PM 2.5	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Tariffs	Emergency Tariff	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Volume Tariff	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	Distribution Tariff	DKK/MWh	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	23,6
O&M (Fixed & Variable)	O&M	DKK/MWh	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	180,6	122,7
Capital Cost	Investment	DKK/MWh	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	126,2	85,7
Earnings & Reimbursement	Electricity Sales	DKK/MWh	-131,1	-136,1	-154,4	-162,0	-169,5	-177,1	-184,6	-192,2	-199,7	-207,3	-214,8	-222,3	-229,9	-237,4	-245,0	-252,5	-260,1	-267,6	-275,2	-282,7	-135,9
Heating Price	Heat Price	DKK/MWh	596,1	590,8	572,2	596,2	619,7	641,8	662,8	682,2	701,8	720,5	738,3	755,6	772,4	783,4	794,0	804,2	814,0	823,4	826,5	829,3	473,5

Heat efficiency	100,00%	Total Input [MWh]	1	Ouput Heat [MWh]			1																
Natural Gas Heating Plant			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Natural Gas	DKK/MWh	191,2	190,7	190,1	206,3	222,1	237,2	251,6	265,0	278,5	291,3	303,7	315,8	327,4	336,0	344,3	352,3	360,0	367,3	371,3	374,9	186,5
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,2
	N2O	DKK/MWh	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,3
	SO2	DKK/MWh	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	4,8	3,2
	NOx	DKK/MWh	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	1,6
	PM 2.5	DKK/MWh	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,7
Tariffs	Gas Emergency Tariff	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Gas Volume Tariff	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
	Gas Distribution Tariff	DKK/MWh	18,4	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	34,7	22,8
O&M (Fixed & Variable)	O&M	DKK/MWh	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	10,2
Capital Cost	Investment	DKK/MWh	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,4
Heating Price	Heat Price	DKK/MWh	238,1	254,0	253,4	269,6	285,5	300,6	315,0	328,4	341,9	354,8	367,3	379,3	391,1	399,7	408,0	416,0	423,8	431,2	435,2	438,9	228,9

Electricity Efficiency	21,40%	Heat Efficiency	79,60%	Total Input [MWh]	1,26	Ouput Electricity [MWh]	0,27	Ouput Heat [MWh]	1

Waste Incineration Cogeneration Plant			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Waste	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Damage Costs	CO2	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	CH4	DKK/MWh	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,2
	N2O	DKK/MWh	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,7	0,7	0,8	0,8	0,3
	SO2	DKK/MWh	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	4,1
	NOx	DKK/MWh	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,0
	PM 2.5	DKK/MWh	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	0,9
O&M (Fixed & Variable)	O&M	DKK/MWh	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	170,6	115,9
Capital Cost	Investment	DKK/MWh	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	129,0	87,7
Earnings	Electricity Sales	DKK/MWh	-50,5	-52,4	-59,5	-62,4	-65,3	-68,2	-71,1	-74,0	-76,9	-79,8	-82,7	-85,6	-88,5	-91,4	-94,3	-97,3	-100,2	-103,1	-106,0	-108,9	-52,3
	Waste Management	DKK/MWh	-111,3	-107,8	-104,4	-101,2	-98,0	-94,9	-92,0	-89,1	-86,3	-83,6	-81,0	-78,5	-76,0	-73,6	-71,3	-69,1	-67,0	-64,9	-62,8	-60,9	-59,2
Heating Price	Heat Price	DKK/MWh	148,6	150,1	146,4	146,8	147,1	147,3	147,4	147,4	147,3	147,1	146,9	146,6	146,2	145,7	145,1	144,5	143,8	143,1	142,3	141,4	99,5

Heat efficiency	99,00%	Total Input [MWh]	1,01	Ouput Heat [MWh]	1

Electric Boiler			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
Fuel price	Electricity	DKK/MWh	251,3	260,9	296,0	310,5	325,0	339,4	353,9	368,4	382,9	397,3	411,8	426,3	440,7	455,2	469,7	484,2	498,6	513,1	527,6	542,0	260,5
Tariffs	System	DKK/MWh	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2	56,2
	Transmission	DKK/MWh	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9	50,9
	Distribution	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
O&M (Fixed & Variable)	O&M	DKK/MWh	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2
Capital Cost	Investment	DKK/MWh	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2
Heating Price	Heat Price	DKK/MWh	372,9	382,5	417,7	432,1	446,6	461,1	475,5	490,0	504,5	519,0	533,4	547,9	562,4	576,8	591,3	605,8	620,3	634,7	649,2	663,7	382,1

Solar Heating Plant with Seasonal storage 1.5 m3 stroage per 1 m2 solar panel			0 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	LCOH
O&M (Fixed & Variable) Solar Colector	O&M	DKK/MWh	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	4,3
O&M Seasonal Storage	O&M	DKK/MWh	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	3,7
Solar Heating	Investment	DKK/MWh	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	156,7	106,5
Seasonal Storage	Investment	DKK/MWh	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	580,7	394,6
Heating Price	Heat Price	DKK/MWh	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	749,1	509,0

Excess Heat - Furnance			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
O&M (Fixed & Variable)	O&M	DKK/MWh	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,3
Capital Cost	Investment	DKK/MWh	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	15,2	10,3
Heating Price	Heat Price	DKK/MWh	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	15,6	10,6

Excess Heat - Flue Gas			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
O&M (Fixed & Variable)	O&M	DKK/MWh	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Capital Cost	Investment	DKK/MWh	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,4
Heating Price	Heat Price	DKK/MWh	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	5,1	3,5

Excess Heat - Drying Process			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
O&M (Fixed & Variable)	O&M	DKK/MWh	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,5
Capital Cost	Investment	DKK/MWh	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	28,8	19,6
Heating Price	Heat Price	DKK/MWh	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	29,6	20,1

Heat Pump COP 2.7 - Tin: 10°C	Average COP		2,7	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		92,1	95,7	108,5	113,9	119,2	124,5	129,8	135,1	140,4	145,7	151,0	156,3	161,6	166,9	172,2	177,5	182,8	188,1	193,4	198,7	95,5
Tariffs	System	DKK/MWh		20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	14,0
	Transmission	DKK/MWh		18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	18,6	12,7
	Distribution	DKK/MWh		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh		23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	16,2
Capital Cost	Investment	DKK/MWh		57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	39,3
Heating Price	Heat Price	DKK/MWh		213,1	216,6	229,5	234,8	240,1	245,4	250,7	256,0	261,3	266,7	272,0	277,3	282,6	287,9	293,2	298,5	303,8	309,1	314,4	319,7	177,7

Heat Pump COP 3.9 - Tin: 20°C	Average COP		3,9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		63,8	66,2	75,1	78,8	82,5	86,2	89,8	93,5	97,2	100,9	104,5	108,2	111,9	115,6	119,2	122,9	126,6	130,2	133,9	137,6	66,1
Tariffs	System	DKK/MWh		14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	14,3	9,7
	Transmission	DKK/MWh		12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	8,8
	Distribution	DKK/MWh		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh		23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	16,2
Capital Cost	Investment	DKK/MWh		57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	57,8	39,3
Heating Price	Heat Price	DKK/MWh		172,7	175,1	184,0	187,7	191,4	195,0	198,7	202,4	206,1	209,7	213,4	217,1	220,7	224,4	228,1	231,8	235,4	239,1	242,8	246,5	140,1

Heat Pump COP 6.8 - Tin: 40°C	Average COP		6,8	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours		5000	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh		36,58	37,99	43,10	45,21	47,31	49,42	51,53	53,63	55,74	57,85	59,95	62,06	64,17	66,27	68,38	70,49	72,59	74,70	76,81	78,91	37,93
Tariffs	System	DKK/MWh		8,2	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	8,18	5,56
	Transmission	DKK/MWh		7,4	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	7,40	5,03
	Distribution	DKK/MWh		0,0	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,01
O&M (Fixed & Variable)	O&M	DKK/MWh		23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	23,87	16,22
Capital Cost	Investment	DKK/MWh		57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	57,79	39,27
Heating Price	Heat Price	DKK/MWh		133,85	135,25	140,36	142,47	144,58	146,68	148,79	150,90	153,00	155,11	157,22	159,32	161,43	163,54	165,64	167,75	169,86	171,96	174,07	176,18	104,02

Datacenter - Apple Viborg (55 MW - 80/40 °C)	COP	7,460092572	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	4805,927273	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	33,3	34,6	39,3	41,2	43,1	45,0	47,0	48,9	50,8	52,7	54,6	56,6	58,5	60,4	62,3	64,3	66,2	68,1	70,0	71,9	34,6
Tariffs	System	DKK/MWh	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	5,1
	Transmission	DKK/MWh	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,6
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	16,3
Capital Cost	Investment	DKK/MWh	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	63,2	42,9
Heating Price	Heat Price	DKK/MWh	134,8	136,0	140,7	142,6	144,5	146,5	148,4	150,3	152,2	154,2	156,1	158,0	159,9	161,8	163,8	165,7	167,6	169,5	171,4	173,4	103,5

Datacenter - Apple Viborg (55 MW - 60/30 °C)	COP	8,280281331	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5308,563636	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	30,0	31,2	35,4	37,1	38,9	40,6	42,3	44,0	45,8	47,5	49,2	51,0	52,7	54,4	56,2	57,9	59,6	61,3	63,1	64,8	31,1
Tariffs	System	DKK/MWh	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,6
	Transmission	DKK/MWh	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	4,1
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	16,1
Capital Cost	Investment	DKK/MWh	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	50,4	34,2
Heating Price	Heat Price	DKK/MWh	116,9	118,0	122,2	123,9	125,7	127,4	129,1	130,9	132,6	134,3	136,1	137,8	139,5	141,2	143,0	144,7	146,4	148,2	149,9	151,6	90,1

Datacenter - Apple Viborg (55 MW - 55/30 °C)	COP	9,100094206	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	4917,690909	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	27,3	28,4	32,2	33,8	35,4	36,9	38,5	40,1	41,7	43,2	44,8	46,4	47,9	49,5	51,1	52,7	54,2	55,8	57,4	59,0	28,3
Tariffs	System	DKK/MWh	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	4,2
	Transmission	DKK/MWh	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	3,8
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9	16,3
Capital Cost	Investment	DKK/MWh	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	32,0
Heating Price	Heat Price	DKK/MWh	110,0	111,0	114,8	116,4	118,0	119,6	121,1	122,7	124,3	125,9	127,4	129,0	130,6	132,2	133,7	135,3	136,9	138,5	140,0	141,6	84,5

Datacenter - Apple Viborg (45 MW - 80/40 °C)	COP	7,460089714	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5395,8	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	33,3	34,6	39,3	41,2	43,1	45,0	47,0	48,9	50,8	52,7	54,6	56,6	58,5	60,4	62,3	64,3	66,2	68,1	70,0	71,9	34,6
Tariffs	System	DKK/MWh	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	5,1
	Transmission	DKK/MWh	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,6
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	23,6	16,0
Capital Cost	Investment	DKK/MWh	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	59,2	40,2
Heating Price	Heat Price	DKK/MWh	130,3	131,6	136,3	138,2	140,1	142,0	144,0	145,9	147,8	149,7	151,6	153,6	155,5	157,4	159,3	161,3	163,2	165,1	167,0	168,9	100,5

Datacenter - Apple Viborg (45 MW - 60/30 °C)	COP	8,28000124	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5935,288889	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	30,0	31,2	35,4	37,1	38,9	40,6	42,3	44,0	45,8	47,5	49,2	51,0	52,7	54,4	56,2	57,9	59,6	61,3	63,1	64,8	31,1
Tariffs	System	DKK/MWh	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,6
	Transmission	DKK/MWh	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	4,1
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	23,2	15,8
Capital Cost	Investment	DKK/MWh	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	47,9	32,5
Heating Price	Heat Price	DKK/MWh	114,0	115,1	119,3	121,0	122,8	124,5	126,2	128,0	129,7	131,4	133,1	134,9	136,6	138,3	140,1	141,8	143,5	145,3	147,0	148,7	88,2

Datacenter - Apple Viborg (45 MW - 55/30 °C)	COP	9,10000731	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	LCOH
	Full Load Hours	5532,4	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Fuel price	Electricity	DKK/MWh	27,3	28,4	32,2	33,8	35,4	36,9	38,5	40,1	41,7	43,2	44,8	46,4	47,9	49,5	51,1	52,7	54,2	55,8	57,4	59,0	28,3
Tariffs	System	DKK/MWh	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	4,2
	Transmission	DKK/MWh	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	3,8
	Distribution	DKK/MWh	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
O&M (Fixed & Variable)	O&M	DKK/MWh	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	16,0
Capital Cost	Investment	DKK/MWh	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	44,4	30,2
Heating Price	Heat Price	DKK/MWh	106,9	108,0	111,8	113,4	114,9	116,5	118,1	119,7	121,2	122,8	124,4	126,0	127,5	129,1	130,7	132,2	133,8	135,4	137,0	138,5	82,4