

## APPLICATION FOR DISTRICT ENERGY AWARD

Excess heat to district heating

### 1. SUMMARY

Hamlet Protein A/S and Fjernvarme Horsens A/S have joined forces and made a sustainable project on turning excess heat into district heating by using heat pumps to maximize the resource and lower the environmental impact.

The project involves installation of wet scrubbers to collect water and reduce particles from the production process and turn the excess heat in the collected water into district heating by using the heat pumps – the largest heat pump project in Denmark right now.

Hamlet Protein A/S is a production company located in the southern part of the city Horsens. The production process emits a large amount of exhaust air, which contains particles and water vapor. The exhaust air from the production is going through an RTO, Regenerative thermal oxidizer, where particles in the air is (are) burned away to minimize odor and the environmental impact from the production plan.

Hamlet Protein A/S had a project to minimize water usage from the local waterworks and was keen to collect the water in the exhaust air by installing a wet scrubber after the RTO. The collected water (condensate) from the exhaust air can then be reused in the production after being cooled and cleaned.

Fjernvarme Horsens A/S offered to install heat pumps to cool the condensate with the purpose of making district heating.

Fjernvarme Horsens A/S supplied 8,500 households in 2015 and supplying 13,000 households to day with district heating and they are expanding the district heating supply area because of a decision to phase out natural gas and introduce district heating in the area around Hamlet Protein A/S and the outskirts of Horsens. This means that Fjernvarme Horsens A/S, who is producing and distributing around 340,000 MWh a year in 2017, is expected to produce and distribute around 574,000 MWh in 2022 when the conversion from natural gas to district heating has been completed which equals to 20,000 households.

The companies joined forces to convert 8 MW excess heat from the wet scrubbers into district heating, which results in 80,000 MWh a year equal to the energy usage of around 3,200 households. By converting excess heat to district heating the companies will utilize the resources optimally, so that the environment, the companies and the ordinary Dane benefit from it.

The results of the project are cheap district heating to the consumers and a positive environmental impact because of the saved fuel to produce district heating and the lower water usage at Hamlet Protein A/S, along with a reduced environmental impact.

The total project is expected to run by November 2019.

**Fjernvarme**  
Horsens

HAMLET  PROTEIN

## **2. THE OVERALL BUSINESS CASE**

As a business case, this collaboration between a utility company and a private company is a perfect example of utilizing resources optimally, so that the environment, the company and the ordinary Dane benefit from it. Hopefully this project can inspire other and similar projects in the future.

Environmentally, there are several benefits. The new plant collects large volumes of water from the purified process air. This water can be reused in production, which means that the company will need significantly less water from the waterworks. The excess heat that is not used today will at the same time benefit the district heating consumers, and much less energy will have to be used at Fjernvarme Horsens A/S to produce district heat.

By using excess heat, the companies complete the perfect circle where each company's health and growth goes hand in hand with optimization of resources, minimal environment impact and energy savings.

Hamlet Protein A/S and Fjernvarme Horsens A/S have created an energy efficient and sustainable solution by joining forces to optimize their outcome of the project.

## **3. BACKGROUND INFORMATION**

### **3.1 Conversion from natural gas to district heating**

In 2015, the city council in Horsens decided to agree on a conversion from natural gas to district heating in the greater area of Horsens.

Houses in the greater area of Horsens are being heated by independent natural gas stoves or by district heating.

By expanding the district heating supply area and the conversion from natural gas to district heating the CO<sub>2</sub>-emission is estimated to drop by 85 % based on the energy used as heating in one standard house.

Fjernvarme Horsens A/S is the district heating supplier in Horsens and has been given the task to expand the district heating supply area.

### **3.2 Energy and environmental optimizations at Hamlet Protein A/S**

Hamlet Protein A/S is a modern production company that produces proteins for animal feed.

As part of the production process Hamlet Protein A/S is using a great amount of water which is evaporated during the process, thus, the process air contains a large amount of vapor. Hamlet Protein A/S wanted to collect and reuse the water from the process air.

Hamlet Protein A/S and Fjernvarme Horsens A/S initiated a project of installing wet scrubbers after the RTO, Regenerative thermal oxidizer, where the process air is being cleaned. The wet scrubbers collect water from the process air and any particles that are left after the RTO.

The condensate from the wet scrubbers (attains) a temperature around 45-48 °C and needs to be cleaned before being reused in the production.

### **3.3 Turning excess heat into district heating**

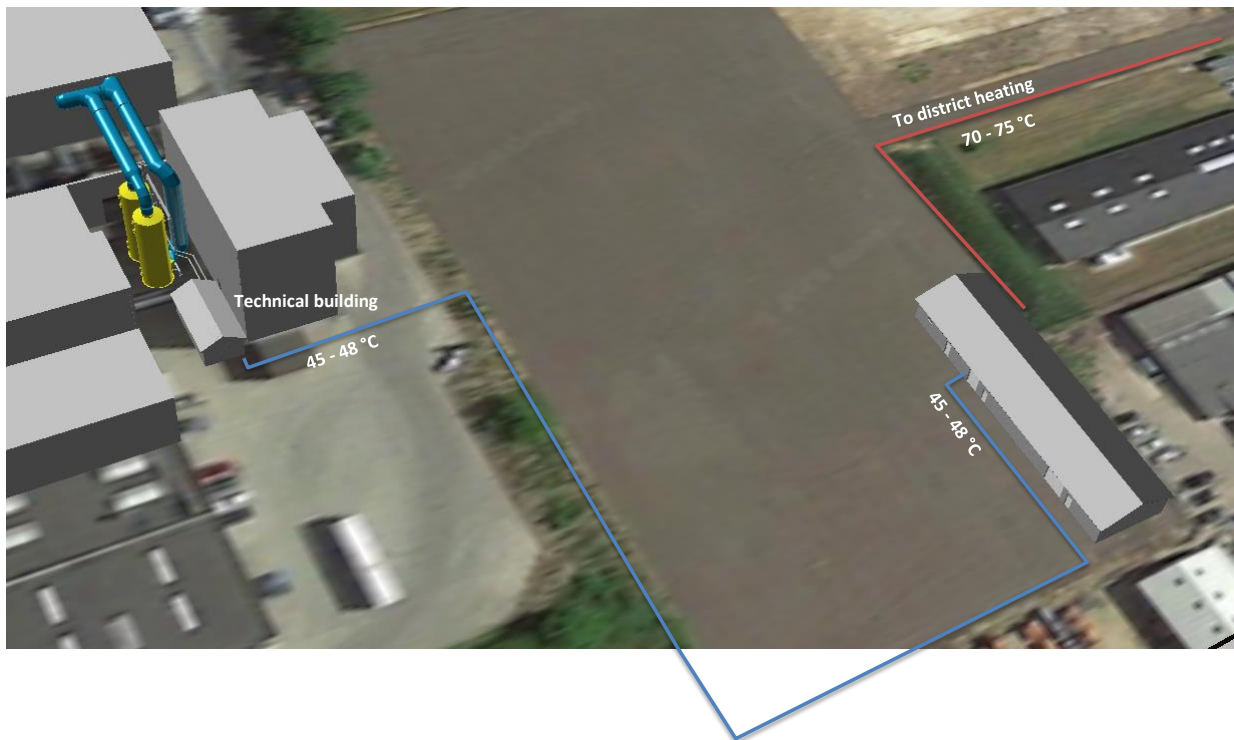
The condensate from the wet scrubbers withholds a lot of energy because of the temperature around 45-48 °C and it needs to be cooled before being reused in the production.

The energy from the condensate is being transferred to heat pumps where the temperature is increased to around 70-75 °C. The hot water from the heat pumps is lead to two 3,000 M<sup>3</sup> accumulation tanks before being distributed as district heating.

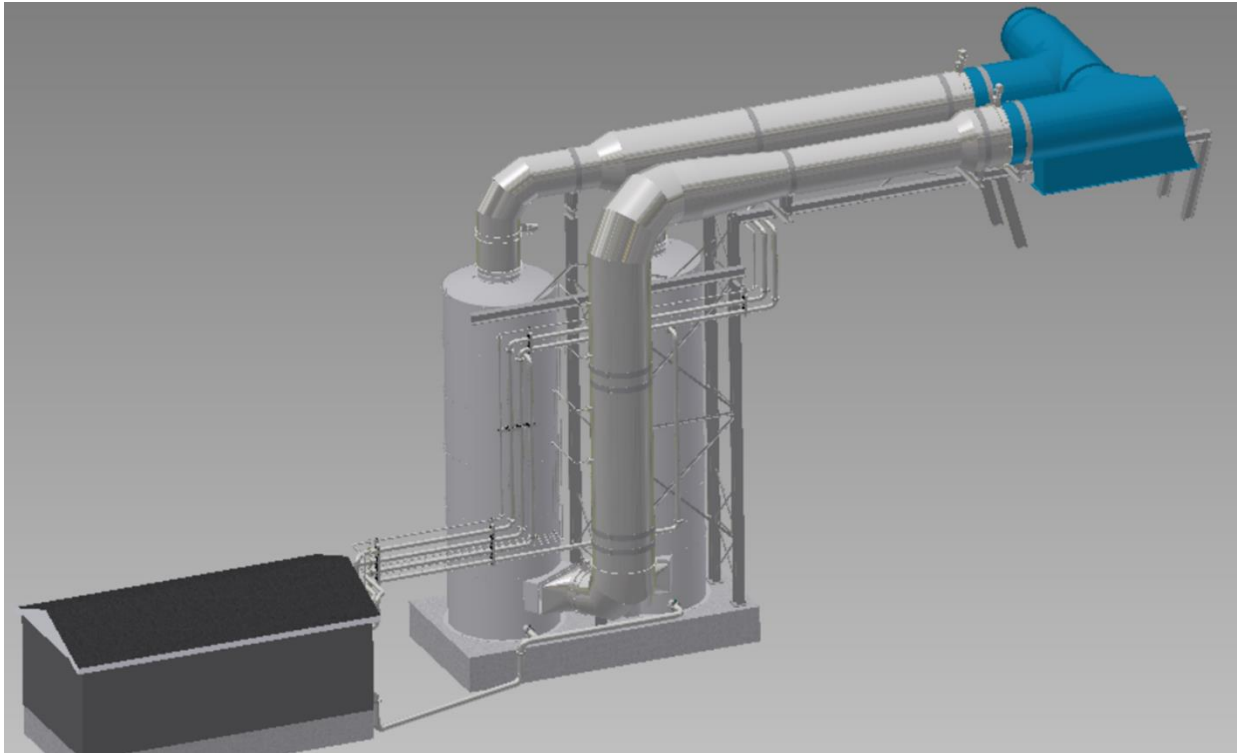
The purpose of the accumulation tanks is equal the fluctuations at the consumers.



Picture 1: Overall View. Credit: Fjernvarme Horsens A/S



Picture 2: Technical overview. Credit: Horsens Fjernvarme A/S



Picture 3: Wet Scrubbers. Credit: Horsens Fjernvarme A/S

## 4. Facts on the project

### 4.1 Environmental benefits

The expected energy usage from the wet scrubbers is around 8 MW and the heat pumps are adding another 2 MW, so the total expected energy production is around 10 MW which equals around 80,000 MWh on a yearly basis. This is the district heating consumed in around 3,200 standard households.

The COP of the heat pumps is estimated to be around 6.5.

Fjernvarme Horsens A/S is saving around 60,000 MWh energy each year, hence to the excess heat. This results in a decrease in usage of natural gas and wood chips which should have been used as fuel without this project.

The savings on fuel results in the following estimated reductions over a 20-year period

<i>Sum over 20 years</i>	<i>Units</i>	<i>Reductions</i>	<i>Percentage</i>
<i>CO2</i>	Ton	40,178	4%
<i>SO2</i>	Ton	18	6%
<i>NOx</i>	Ton	258	7%
<i>PM2.5 (particles)</i>	Kg	0,53	13%
<i>Garbage – fuel</i>	Ton	90,000	5%
<i>Wood Chips - fuel</i>	Ton	201,000	14%
<i>Natural gas - fuel</i>	1,000 m3	12,500	15%
<i>Electricity – heat pumps etc.</i>	MWh	-146,000	N/A

### 4.2 Impact on the community

The investment in the project is estimated to be 28 Mill. DKK after a subsidy scheme on energy savings.

The technical lifespan for the project is estimated to be around 20 years.

Over the lifespan, the economic gain for the community is calculated to 50.3 Mill. DKK based on a calculation model from the Danish energy authorities. This model incorporates all aspects of the project such as the environmental impact, fuel saving, investment etc.

### 4.3 Replicability

Many production companies have a lot of excess heat from their production processes and by converting the excess heat into district heating the community gains cheap district heating that has a positive environmental impact because it reduces the usage of fuel.

In Denmark around 40 % of the electricity is from renewable sources such as wind turbines etc. and the share of renewable energy is increasing over the next years.

In Denmark around 40 companies are supplying excess heat to district heating whereas two companies are supplying around 77 % of the total amount.

This project shows that by using excess heat as a source to create district heating there is a large environmental benefit and cost savings at the consumers.

The project is the largest heat pump project in Denmark when it comes to utilizing excess heat and produce district heating. By implementing heat pumps more excess heat sources can be used to create district heating in the future.