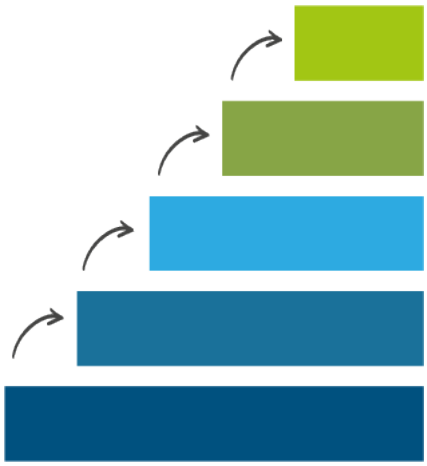
BALTIC INDUSTRIAL SYMBIOSIS

Generic case

SYMBIOSIS OPPORTUNITIES FOR SURPLUS HEAT



SYMBIOSIS CENTER DENMARK
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Interreg Baltic Sea Region

EUROPEAN UNION
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THE MAIN POINTS

The utilization of surplus heat in industrial symbiosis generates both economic and environmental benefits and has much potential in the future.

Surplus heat is equal to a waste of resources unless it can be utilized for another purpose. In this way, heat residuals can be turned into a resource that can create a better economy and reduce negative environmental impacts.

UTILIZATION

Surplus heat is accessible in many industries and many kinds of processes, and it can often be utilized. Either internally within the company, in collaboration with nearby companies or delivered to a local district heating network.

In Denmark, if a company can use surplus heat in its processes, the heat is free and can even displace other forms of fossil energy, which results in economic and environmental benefits.

If heat is used for central heating or sold, it can often provide an economic benefit to both the buyer and the seller. At the same time, the utilization can have a significant positive environmental effect, which can be attributed to those who supply the surplus heat and those who utilize it.

GREAT SAVINGS AND ENVIRONMENTAL BENEFITS

Surplus heat is often a cheaper alternative to general heating. In some cases, utilization of surplus heat can even result in optimization of other processes or savings on investments in other equipment for cooling or heating, which can strengthen the economy of a surplus heat project.

An industrial symbiosis that utilizes surplus heat can thus contribute to increasing resource efficiency, enhancing competitiveness, and reducing environmental impact.

SURPLUS HEAT

Surplus heat is an energy surplus from a process, e.g. compressed air or cooling systems, where heating is a necessary part or a result of a process.

Surplus heat occurs in many places — especially where motors and machines are used, including hydraulic systems, and where heating or cooling occurs.

The following provides inspiration for installations and processes, where companies can find surplus heat, and which would be worth to utilize:

- Engines / machines / process plants (water / oil cooling and possibly exhaust)
- Boiler plant
- Large hydraulic systems and compressed air systems
- Evaporation
- Drying
- Freezing
- Burning, melting, casting and sintering
- Manufacturing processes
  - Refining
  - Chemical processes
- Cooling
  - Cooling of perishable goods in supermarkets, cold stores and manufacturing companies (e.g. food companies)
  - Cooling of data centres and server rooms
  - Cooling of wastewater
  - Comfort cooling (a larger air conditioning system)

SYMBIOSIS EXAMPLE - PRE-ANALYSIS FOUND GREAT ENVIRONMENTAL AND ECONOMIC BENEFITS

Food ingredient company CP Kelco, chemical manufacturer Sun Chemicals, pharmaceutical company FeF Chemicals and flooring producer Junckers generate large amounts of heat from, among others cooling towers and processes. A pre-analysis funded by the Danish Business Authority's Green Industrial Symbiosis program has examined possibilities of utilization of this heat as district heating at project holder VEKS - Vestegnens Kraftvarmeselskab.

The partners explored the possibility of using surplus heat as district heating in the Greater Copenhagen district heating system. In this way, surplus heat from the companies can supply CO2-neutral district heating to the city of Copenhagen.

SYMBIOSIS EXAMPLE - FROM COOL HEAT TO HOT ECONOMY

Company Coldstar in Vejle stores food for the grocery sector and catering customers in a large chilled transit/distribution warehouse of more than 100,000 m2. Cooling of this warehouse emits a considerable amount of surplus heat which the company is planning to utilize in collaboration with Trefor Heat.

The heat from the cooling process is currently discharged directly to the surroundings. By installing a heat pump and a heat exchanger in the refrigeration system, Coldstar will be able to accumulate and utilize surplus heat as district heating through Trefor Heat’s district heating network.

UTILIZATION

Surplus heat can be utilized either as process heating in another (industrial) process, as central heating (comfort heating) or as district heating by selling it to nearby companies or a neighboring district heating network.

PROCESS HEAT

The most profitable surplus heat utilization often occurs within the companies themselves or in other companies' processes. The surplus heat utilization usually requires high and stable temperatures and stable production. Therefore, utilization is often combined with other heating sources to ensure the best possible security of supply. Process water preheating, drying processes and some forms of cleaning are examples where temperature and volume requirements can be more flexible.

CENTRAL HEATING

Utilization of surplus heat as central heating is often easier and can occur at lower temperatures.

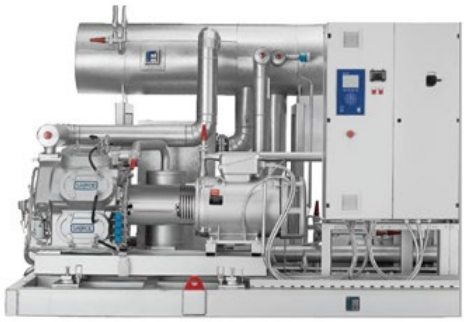
Ideal utilization occurs through low-temperature systems with large heating capacity, such as floor heating systems. In Denmark, surplus heat utilization as central heating requires tax calculation since this type of utilization is considered as " comfort" heat rather than "process".

DISTRICT HEATING

In the past in Denmark, most district heating companies required extremely stable temperatures and amounts of surplus heat, and they required quite burdensome and long-term agreements with heating supply companies.
It has been a barrier to surplus heat utilization in cooperation with district heating companies.

Today, district heating companies are better at dealing with fluctuating amounts of heat. The companies have, in some places, lowered the temperature requirement slightly, and since the utilized amounts of heat can be reported as a company's energy saving, subsidies can thus be obtained through energy companies' energy saving obligations. It has, therefore, become much easier to get agreements on supply of surplus heat to a district heating network on terms that are not too burdensome.

Today it is also possible to increase the temperature of the supplied heat by a heat pump. Nowadays, there are great opportunities in Denmark of obtaining subsidies through the energy saving scheme for heat pump projects, calculated as heat delivered minus electricity consumed. The subsidy (with current prices) can potentially cover up to 40 - 75% of the investment in such heat pump solutions, making the payback time short and the project economy very attractive.



ECONOMIC PROFIT

The possible economic profit from utilization of surplus heat depends on the amount of energy that can be utilized, the cost of establishing the necessary equipment for utilization, the price of the energy the surplus heat displaces, and taxes to be paid. These things also depend on specific conditions, for example, how high the temperature of the available surplus heat is, the distance to the recipient of the energy and for what purpose the surplus heat will be used.

If heat can be utilized profitably, a financial gain for a company that sells the energy will usually occur in a form of an income from the sale of surplus energy to another company.

The financial gain for the company that receives surplus heat comes from reduction in the cost of energy the company uses for heating.

If a selling company has large cooling requirements, utilization of cooling energy as surplus heat can mean reduced costs for cooling.

In other cases, utilization of surplus heat can lead to an economic gain, because the need for establishing reserve capacity or peak load capacity of heat is reduced or eliminated. And if surplus heat can be utilized, a recipient company can avoid expanding or converting its existing energy facility.

SYMBIOSIS EXAMPLE - ECONOMIC PROFIT IN COLDSTAR AND TREFOR'S SYMBIOSIS

Coldstar benefits economically by selling its surplus heat to Trefor Varme. The surplus heat was thus turned from a waste product into an asset.

Trefor Varme will have an opportunity to buy CO2-neutral district heating at a price that is lower than the plant's lowest production price, which will help reduce the cost of heating for the company's consumers.

SYMBIOSIS EXAMPLE - ECONOMIC PROFIT IN KØGE ENERGY SYMBIOSIS

The symbiosis project with four industrial companies in Køge showed that especially at CP KELCO there were great environmental and economic potentials in replacing the company's large cooling towers by heat pumps that could potentially deliver approx. 35,000 MWh surplus heat as 85 ° C district heating to VEKS. The project demonstrated that it was profitable to install heat pumps at CP KELCO, as the payback period was only approx. 3 years - with an extra income for CP KELCO of approx. EUR 268,000 per year.

Other project participants had less potential, due to low temperatures and individual operation units, and thus the economy was not so attractive.

ENVIRONMENTAL VALUE

Surplus heat is often an untapped energy resource that can be utilized with significant environmental benefits, as utilization displaces other forms of heating and thereby increases overall resource efficiency. Several analyses show a very high potential in utilization of surplus heat across industries. According to The Danish Energy Agency's 2009 report, the surplus heat potential that Danish companies can utilize profitably is in the order of 5,000 TJ per year, which corresponds to approx. 3% of the industry's total energy consumption.

By utilizing surplus heat, an enterprise or a district heating company can reduce existing fuel consumption, mitigating emission of CO2 and harmful particles to the atmosphere. Especially if the displaced fuel is of fossil origins, such as gas, oil or coal.

If flexible utilization of surplus heat can be established, e.g. by creating a stock capacity, the delivered heat can be controlled. It will be advantageous for the receiver's supply system and will lead to even larger reduction in total energy consumption.

In general, utilization of surplus heat leads to better resource utilization and energy efficiency, by using an energy resource that would otherwise be wasted, while reducing the use of other heating sources.

SYMBIOSIS EXAMPLE - ENVIRONMENTAL BENEFITS IN COLDSTAR AND TREFOR'S SYMBIOSIS

Surplus heat from large refrigeration systems can be minimized, but not completely avoided. A part of supplied drive energy will, together with a part of cooling energy be available for recycling. The utilization of the excess amount of energy will lead to an environmental benefit.

It is expected that the heat recovery will generate 5,980 MWh per year, which corresponds to more than 330 average family homes' annual heat consumption. It means that the amount of energy that would otherwise have to be supplied can be saved and scarce resources conserved. Since surplus heat displaces heat produced partly on fossil fuels, the project will simultaneously result in a reduction in CO2 emissions of more than 1,600 tons per year.

SYMBIOSIS EXAMPLE - ENVIRONMENTAL PROFIT IN KØGE ENERGY SYMBIOSIS

In addition to significant economic gains for CP KELCO, the project will generate great environmental benefits. By reducing the need for cooling in CP KELCO's cooling towers, energy consumption is reduced, reduction in greenhouse gas emissions amounts to up to 140 tons of CO2 per year and water savings for cooling is approx. 22,000 m3 pr.
The lower CO2 emissions from VEKS, by using excess heat as district heating instead of heat produced by other sources, is approx. 1,000-1,200 tons of CO2 per year.

BARRIERS

The most significant barrier to utilization of surplus heat in green industrial symbiosis can be unwillingness to investigate and pursue opportunities. Perhaps, it is a fear that the four primary barriers mentioned below make it difficult, expensive or risky to exploit the use of surplus heat.

The four primary barriers companies should consider are:

1. Security of supply to the recipient, including required temperature and accessibility
2. Simultaneity between production and consumption of surplus heat
3. Taxes
4. Investment needs / payback period

SECURITY OF SUPPLY

If a recipient of surplus heat becomes dependent on stable delivery, lack of delivery, including incorrect temperature or quantity, can lead to a problem for, or completely stop the recipient's production. Therefore, many companies choose to provide alternative supply options if the surplus heat is present in insufficient quantities. Either by preserving existing systems or by using alternative heat sources if the supply of surplus heat fails.

SIMULTANEITY

An essential parameter in connection with utilization of surplus heat is simultaneity between accessibility of surplus heat and time when the heat can be utilized.

For example, surplus heat from a compressed air system is available all year around, but it can only be used for central heating in winter. Another example is a production process where surplus heat is available in the morning but can be used only in the afternoon.

Therefore, to ensure a high yield of surplus heat projects, coordination between accessibility of surplus heat and the period when it can be utilized should be sought. It can be ensured through reorganization of production or establishment of stock capacity, which makes it possible to store the heat until it is needed.

Utilization of surplus heat in a district heating network is generally not so time dependent, because of high inertia and large heat requirements in district heating networks. On the other hand, seasonal fluctuations can be a challenge because of the difference in heat demand in a district heating network in summer and winter.

TAXES (IN DENMARK)

Taxes are perhaps the most substantial barrier, but investments in utilization of surplus heat can be paid back, as heat costs 0 euro per. kWh before utilization costs and taxes. Additionally, the environmental effect of utilization of surplus heat is independent of any taxes. The Danish Energy Agency assessed barriers and opportunities for utilization of surplus heat, after which it has become clear that taxes related to utilization of surplus heat, can compete with other energy taxes.

As mentioned above, taxes related to utilization of surplus heat are lower. Thus, the tax legislation is in favour of utilization of surplus heat, and potentially, the tax advantage is twice as high if heat can also be utilized out of the heating season (e.g. for hot water) since the surplus heat tax is not involved here.

INVESTMENT/PAYBACK PERIOD

In some surplus heat projects, the payback period is short, in others, it can be longer. Most often, companies would like to establish cooperation based on utilization of surplus heat if the payback period is less than 4-5 years.

This case for industrial symbiosis with symbiosis possibilities for surplus heat aims to inspire to utilize heat in better way by describing options and benefits of such symbiosis. Don't use the case as a design or decision basis.