Beyond Energy Action Strategies

BEAST

D.3.1.c – Business Plan of Waste Heat Ovako Boxholm

Title of the project: Waste Heat from Ovako Boxholm
Location: Boxholm Municipality

Energikontoret
ÖSTRA GÖTALAND

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1 Summary of the Project/Project at a Glance

Ovako, is a steel mill located in Boxholm Municipality. Boxholm municipality wants to start a project to utilize the waste heat from Ovako and thus be able to supply the municipality with cheaper energy.

The Boxholm Project is a unique in the way that the energy is planned to be stored by a new technique for minimizing energy losses. In this way the project offers the opportunity to concretely show waste heat combined with energy efficiency improvements.

The project is expected to provide reduced energy costs by utilizing a resource that would otherwise just go to waste. At present, the project is only calculated on the utilization of low-temperature water but plans are to ultimately also utilize high-temperature water from Ovako. The energy cost is estimated to be halved compared with the cost of district heating from biomass.

Boxholm Municipality has about 5 000 inhabitants and is located in Östergötland on the border of Småland in Sweden and outside the urban area it is a sparse built forest municipality. The largest part of the population lives within and in proximity to the Boxholm society. Boxholm began producing steel as early as the 18th century.

Boxholm has an aging population and in recent years several apartment buildings were converted to service apartments and residential care. Boxholm has over 500 registered companies, which range from small businesses to leading international companies, mainly in the steel and wood industries. The four largest companies, Ovako Bar, Accalon, Rörvik Timber and Boxholms Steel have over 500 employees.

Ovako Bar, Accalon, Rörvik Timber, Boxholms Steel and Boxholms dairy are included in Boxholms energy group with representatives from the municipality and the energy sector. The municipality's energy group is a network set up in 2006 with the aim of establishing contacts between politicians, officials, energy consultants, companies and energy utilities to exchange experiences on energy efficiency and get information about what is happening on the energy front. The idea to take advantage of waste heat has been around a long time in Boxholm and different solutions have been discussed in many rounds without coming to action.

During the period 2002-2007 there have been major changes in energy use in the residential and services sector, which is partly a result of the municipality's energy plan by 2002. The municipality has converted the majority of its properties from electricity and oil heating to district heating in urban areas and pellets and heat pumps in the smaller towns.

In the municipal public-owned properties, district heating covers 92% of the total heating and hot water needs today. Even among the privat houses there have been changes in the distribution of different heating systems since the last energy plan was written. The conversion to pellets or wood and rock-, soil- and heating pumps has almost entirely taken place during the 2000 century. For this group, the price trend for oil and electricity has been a strong driving force to convert and there have been a number of conversion supports for individuals.

The energy production in Boxholm consists of biomass plant combined with district heating, two smaller hydro plant and biomass for small-scale wood burning. Vattenfall AB owns the

grid in the municipality. The total production of renewable energy in the municipality was 81,6 GWh in 2010.

In 2010 the biomass district heating plant in Boxholm supplied 52,6 GWh of energy. Biomass in the form of bark and sawdust are used as the main fuel in the plant with E01 fuel oil (sulfur content <0.1%) as a reserve at peak load needs. The bark and saw dust comes from Rörvik Timber plant in Boxholm and consists of residues from the manufacture.

The total consumption of energy in Boxholm in all sectors was 460 GWh in 2004. Of these, 100 GWh were used in households, 58 GWh in service and 220 GWh in the industrial sector. The remaining portion, 82 GWh was used for transport. According to statistics, 2004 was a normal year in the region, which means that the figures are representative of a normal year.

Today 83% of the district heat goes to the industry, 13% to municipal buildings and 4% to consumers.

2 Details of the Proposed Project

Boxholm municipality wants to be an energy player by taking advantage of the waste heat from Ovako. The municipality wants to establish an energy store for the supply of heat and hot water in a residential area and also take over the district-heating network and supply the entire municipality with district heating from Ovako and thus replacing heat from biomass, which is used today.

Ovako has both high-grade and low-grade energy and need to be disposed of both. The goal and the terms of condition from Ovako´s part is that there must be a plan and a goal from the municipality to get provision for both. This is a long-term requirement and it does not play a major role which heat to start with, but both parts have to be disposed.

Boxholm Municipality is too small for the use of all energy. Only the low-grade energy of Ovako´s waste heat is estimated to 20 GWh. The total energy need of the household and service sectors in Boxholm is 160GWh.

The Municipality has suggested starting up with a pilot project where heat storage and low temperature waste heat is combined. The size of the storage is about 4.5 GWh and it will supply a group of service housing with heat and hot water.

A continued expansion of district heating in urban Boxholms could eliminate many small emission points and replace them with a larger discharge point with better purification. Boxholm energy plan states that investigation of heat recovery from the local industries is a priority for reaching the local energy efficiency goals

System for district heating is already in place in the central parts of Boxholm. An expansion of district heating is a goal in the energy plan but has virtually stood still for the past years, largely due to the fact that Vattenfall Heat AB (owner of district heat system) has tried to sell this business. An expansion of the district heating in urban areas and the local heating of the municipality's smaller communities can help to replace several small emission points with a single discharge point with purification capabilities. An expansion of the infrastructure in the municipality would also given more choice for individuals and businesses to replace e.g. oil and electric heating.

Outcome effects on the environment eliminator of low-temperature water:
Greenhouse effect (1000kg CO2 equivalents): Biofuel 60/Waste heat 18,
Acidification (mol H+) Biofuel 49500/Waste heat 2388,
Fertilization(kg O2 equivalents): Biofuel 10400/ Waste heat (308),

3 Internal aspects

Weaknesses

- Boxholm municipality needs co-financiering for daring to invest in the project.
- Fear of investing in a system today when maybe new research produces better solutions in a few years.

Strengths

- Optimal use of the stored energy by using technology of stearing different exergies into different zones.
- The waste heat from Ovako Bar is intermittent and completely dependent on the Ovako Bar production which has both a winter and summer break while heating requirements for the residential is continuous and applies regardless of winter or summer. In other words, the energy storage will make use from an intermittent flow of energy to be used continuously.
- The storage system can continue to operate according to plan B (sun or wind power) even if Ovako bar closes down in the future.

4 External environment

Opportunities

- At present a decisions is taken on a small portion of the low-grade waste heat, which will be utilized, in a high-tech storage for use as heating and hot water in a service housing area. Decision still remains on how all the waste heat will be utilized!
- The low temperature storage will be a pilot plant for a relatively new technology, putting Boxholm on the National map!
- Reduced energy cost for the house holds in the municipality of Boxholm. The feasibility study made by SEEC shows that the energy price can be lowered by at least 50% by using their efficient storage technology.

Threats

- Funding is needed for research on the storage of high-temperature waste heat in the same storage system for the low temperature waste heat.
- Uncertainty on how to solve the form for ownership of the system. The intention of Boxholm Municipality is to supply energy to a lower price than today. Their wish is to go ahead with the proposed project Energy storage system for low temperature waste heat (40 degrees) with SEEC's technology with drill holes in the ground/rock. Suggested size is about 4.5 GWh and will supply a group of service housing with heat and hot water.
  Ovako has both high-grade and low-grade energy and need to be disposed of both.

The goal and the terms of condition from Ovako´s part is that there must be a plan and a goal to get provision for both. This is a long-term requirement and it does not play a major role which heat to start with, but both parts have to be disposed. Boxholm Municipality is too small for the use of all energy. The low-grade energy of Ovako´s waste heat is estimated to 20 GWh. The total energy need of Boxholm is 11GWh.
EON owns the district-heating network in Boxholm and their network covers about 80 percent of the community. EON is currently purchasing energy from sawmill, Rörvik timber in Boxholm and also supplies heat to the sawmill. If the plant for energy storage is built, EON has stated that they are not interested in participating in the project. EON however are interested in the high-grade waste heat.

5 Market Potential

There is a large global potential for recovery of waste energy from industry today. Energy that today just goes to waste could be utilized and provide cheaper energy costs and environmental improvements. In Sweden, an annual average of about 5 TWh of district heating from residual heat was produced in in Sweden during the the 2000s , corresponding to approximately ten percent of the total production. According to the District Heating Commission and its consultant's reports there is a potential additional 3.5-5 TWh, which could be exploited in Sweden.

In 2007 approximately 4 TWh of waste heat were delivered to the district heating network in Sweden, from a total of 71 companies. The total district heating supply from the Swedish District Heating Association's members was 47 TWh. The largest heat suppliers were energy-intensive industries such as pulp and paper mills, chemical industry and steel industry. An estimate of possible waste heat potential in Sweden varies. Swedish District Heating Association has calculated a theoretical residual heat potential for the Swedish manufacturing to between 6.2 and 7.9 TWh. This would represent an increase by 50-100 per cent compared with the quantities delivered in the current situation (Cronholm, Grönkvist, Saxe 2009), corresponding to approximately ten percent of the total production.

The proposed project for a storage system i Boxholm could serve as a reference plant to influence other regions to follow as a good example. Boxholm do also have plans for further development of the system for the procurement of high temperature waste energy, which might be for generating electricity. The system also includes a plan B if Ovako would close down. It is to replace the waste heat with solar heating and heat pumps.

The supplier of the storage system is SEEC. Their technology is unique to minimize energy loss of energy storage in rock / soil. SEEC has developed a drill formation in combination with a unique control system which is simplest described like a thermos that provides minimal energy loss, high efficiency and good economics.

SEEC energy storage consists of a stratified layer of boreholes with ground tubes, recharged as for example by waste heat or solar collectors. The energy storage is combined with a power module / heat pumps for reaching the right temperature of heating and hot water. Generally, regardless regulated or unregulated the ground storage technologies aim is that an intermittent flow of waste heat is made accessible to be used for the delivery of a continuous heat demand.

Ovako Bar waste heat temperatures lies between 25 up to about 95 C and is to be used for heating and domestic hot water production for a nearby residential area. The waste heat from Ovako Bar is intermittent and completely dependent on the Ovako Bar production, which has both a winter and summer break, while heating requirements for the residential is continuous and applies regardless of winter or summer. In other words, the energy storage will make use from an intermittent flow of energy to be used continuously.

In an unregulated storage various waste heat exergies are mixed. The exergy in the warehouse will be an average of the different exergies and one loses the ability to continuously utilize the exergy of the best quality, which in this project is to meet the energy needs of homes / heating demand.

SEEC storage technology provides the ability to control the waste heat flows with different exergies to different portions (zones) of the storage which unregulated storages can not do thus enabling the waste heat to be stored and utilized in an optimal manner.

6 Risk analysis

There are many players involved in the project and so far they do not agree on the target, which makes it difficult to come to a decision regarding economical, technical and legal solutions. The council has come to a decision to invest in the project with energy storage and now it is up to the municipality to find solutions for all the remaining waste heat. This is a requirement on the municipality from Ovako. In the current situation there is no provision for all waste energy within Boxholm, which means that the municipality needs to either create new solutions inside the municipality or outside. Either way this demands for an expansion of the district-heating network.

The district-heating network is currently owned by EON and the heat distributed comes from the sawmill in the locality. It is a complicated issue for the municipality to take over the district Heating system and turn off the heat from the sawmill.

7 Financial Analysis

7.1 Cost

30 000 € co-financing project leading

20 000 €. Time for promoting and informing, organizing seminars and jam sessions,

Application on 150-300 000 € for research

7.2 Income

The municipality would be able to halve their energy costs and even sell energy to residents in the municipality.

7.3 Feasibility assessment

An estimate of the investment cost for energy storage is set to 25-26 million SEK (~2,5-2.6million €). The project will be profitable for the municipality since they will get access to nearly half as expensive energy from the captured waste heat. Depending on many factors such as e.g. ownership, it is currently difficult to have exact figures.

7.4 Sensitivity analysis

If Ovako would close down or other changes occurs that leads to that the waste heat is no longer available, there is a Plan B for the project with energy storage with the SEEC solution by using solar or wind power instead. But how to solve the heat supply to the entire Boxholm is still to consider.

7.5 Social benefits and Public support

- Energy storage for low temperature waste heat (40 degrees) with SEEC's technology with drill holes in the ground/rock. Suggested size is about 4.5 GWh and will supply a service housing with heat and hot water. Funding is needed for project leading and co-financing for the implementation.
- Development of energy storage of high-temperature waste heat. Funding to investigate a high-temperature storage system has been applied by SEEC to the Swedish Energy Agency and Jernkontoret.
- Building a connection to the TV's (Tekniska Verkens) district heating network in Mjölby. On the way to Mjölby there are large farms that are interested in supplying biogas to natural gas pipeline. Possibilities for cooperation would be interesting to look at.
- Join the rest of the municipal buildings to waste heat through EON's district heating network, which requires discussions with EON, TV and Rörviks timber.

8 Implementation roadmap

1. Find funding/financing for project leading. Funding from Swedish Energy Agency and Jernkontoret for implementation of low energy system is ongoing by SEEC.
2. Impartial investigation of various proposed alternatives by researchers from LIU.
3. Decision from Boxholm Municipality on how to handle all waste energy in short and long term.
4. Agreement Signing between Boxholm and Ovako.
5. Discussions with EON and Tekniska Verken (who owns most of the district heating system in the region)

9 Conclusion

The basic idea to take advantage of the waste heat is good. The aim of the municipality is to get access to cheaper energy, which would be beneficial for the municipality and all habitants.

Calculations carried out in a study conducted by the County Administrative Board in Östergötland and Örebro (Residual heat as resource potential for the recovery of residual heat) shows that it is always positive from an environmental standpoint to replace the district heating production with industrial waste heat if the district heating is produced in a hot water boiler and if the waste heat is considered "free "from an environmental perspective. A quarter of the potential waste heat in Östergötland and all the potential in Örebro County are within this category. This amount of heat is equivalent to the need of heating and hot water of 4,500 private homes.

It is worth noting that when it comes to replacing heat from cogeneration plants with waste heat the results depends to a large extent on how the system boundaries for electricity are set and the allocation principle used. It will not be an environment improvement if the power generation is replaced with a dirtier production of electricity.

The energy storage solution is probably also a good idea since it enables a continuous supply of energy regardless of interruptions. Moreover, the need to store energy and renewable energies in particular is large today and Boxholm could become a pilot municipality with a unique solution to show.

Although it is uncertain if it is a good idea that the municipality enters as an energy player. The municipality has difficulties to meet the requirement from Ovako, which is to find solutions for taking advantages of all the waste heat. Further on it seems hard to find an overall solution that does not lead to dissatisfaction among all or any of the actors involved within the municipality.