

Application for

# The First Global District Energy Climate Award

System Varberg District Heating Systems  
Location Varberg, Sweden  
Owner Varberg Energi AB  
Ownership Varberg Stadshus AB, the Varberg municipality holding company

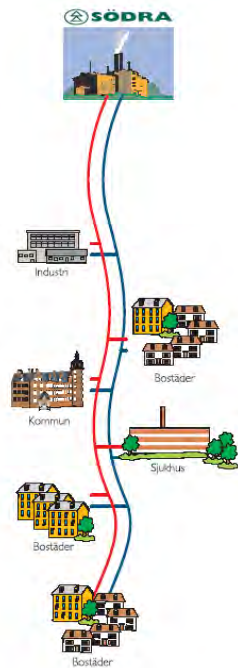
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## System Description

Varberg Energy operates five district heating systems, one major and four minor in the municipality of Varberg, having about 56000 inhabitants. The major system supplies heat in the town of Varberg (27000 inhabitants), while the four minor systems are located in the villages of Tvååker (2400 inh.), Träslövsläge (2500 inh.), Veddige (2100 inh.), and Bua (1800 inh.). The major system had 93% of all district heat deliveries in 2008.

Customers served are 67 public buildings, 53 commercial and industrial buildings, about 7000 flats in 260 multi-family houses and 780 single-family houses. During 2008, 467 TJ heat were delivered to the customers with total revenues of 79.5 million SEK. Hence, the annual average price of district heat became 170 SEK/GJ (17 €/GJ).

The market share for district heat in the town of Varberg is now about 45%. In 1999, the heat demands in Varberg were met by natural gas (39%), electricity (33%), heating oil (21%) and district heat (6%). A municipal decision was taken in 1999 to extend the supply of district heat in order to reduce consumer heating costs and for reducing the local emissions of carbon dioxide. Hence, Varberg started later with district heating than most other Swedish cities.



Picture 1. The Södra Cell Värö pulp plant, the main heat source for the major district heating system.

The major system are based on heat recycling of industrial waste heat from the Södra Cell pulp mill located in Värö, 18 km North of Varberg. One biomass steam boiler in Värö and one bio-oil boiler and five natural gas boilers fulfil the peak and reserve demands. During 2008, 469 TJ heat were supplied to the major system, thereof 375 TJ industrial waste heat, 58 TJ from biomass, and finally 77 TJ from natural gas. The industrial waste heat is the remaining process water from the pulp bleachery, originally mainly heated by internal biomass streams with a very small share from heating oil. The own use of natural gas was higher than expected during 2008, since the pulp mill used a longer period for maintenance than planned, giving less industrial waste heat. The four minor systems are supplied by heat from local biomass boilers with a total heat generation of 45 TJ.

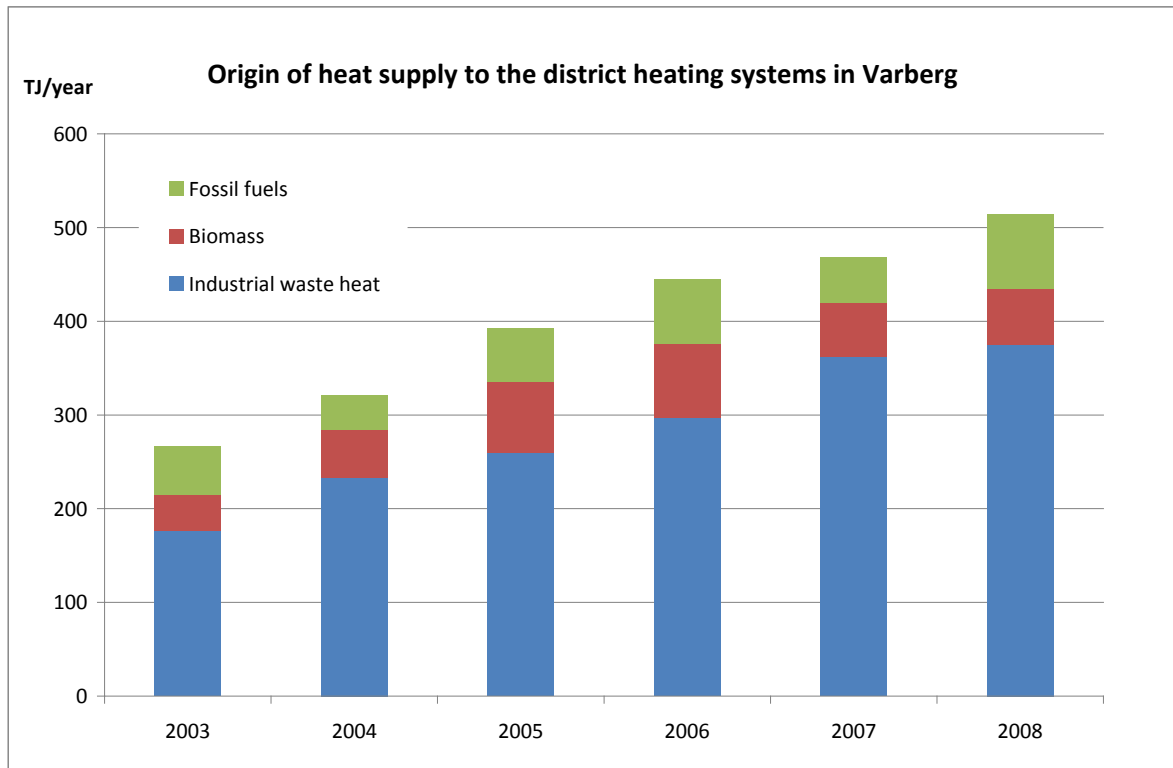


Figure 1. Composition of origin of heat supply



**Picture 2. The heat transmission pipeline between Värö and Varberg, when constructed in 2001. Picture taken Aug 6, 2001.**

The transmission pipeline from the pulp mill was constructed in 2001, see Picture 2. The first heat was delivered from Värö to Varberg on December 12, 2001. The Swedish government decided in March 2000 to support the transmission project with a 24 million SEK grant from the Swedish climate investment program (LIP). The main purpose with the grant was to reduce the financial project risk in order to receive the carbon dioxide emission reduction associated to the project.

The total trench length in the distribution networks is 113 km, thereof 106 km in the major system. The transmission line with double 350 mm pipes from the Värö pulp mill to the town of Varberg is 18 km long. Only prefabricated district heat pipes are used. The twin pipe solution is used for small dimensions. The total distribution heat losses constitute of 47 TJ, corresponding to 9% of the heat supplied to the systems. The indus-

trial waste heat has only a temperature of 80°C. In order to maximise the utilisation of the waste heat, the distribution temperatures are kept as low as possible. During 2008, average supply temperature was 82°C, while the average return temperature was 43°C.

During the period of 2001-2008, 302 million SEK (30 M€) have been invested in the district heating systems. The total investments by year and purpose are presented in Table 1. The total cost for the transmission line from the pulp mill became 106 million SEK (10,6 M€), after deduction of government grant for the transmission pipeline.

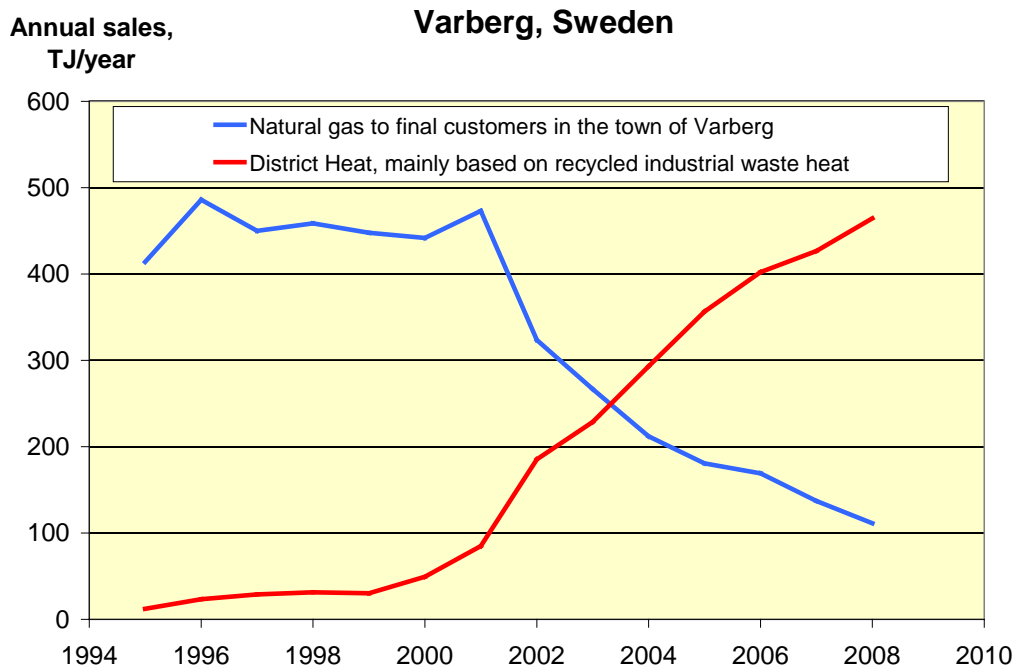
**Table 1. Investments in million SEK in the Varberg district heating systems, 2001-2008.**

Year	Heat generation	Heat transmission	Heat distribution	Substations	Heat meters	By year
2001	0,0	84,8	0,3	0,0	0,0	85,2
2002	0,0	17,9	9,3	2,8	0,3	30,3
2003	0,0	3,4	30,5	3,5	0,6	38,1
2004	6,4	0,0	27,9	1,0	0,5	35,8
2005	2,1	0,0	25,8	0,4	0,6	28,8
2006	1,8	0,0	9,0	0,1	0,5	11,4
2007	0,7	0,0	26,9	0,1	1,0	28,7
2008	14,2	0,0	28,6	0,0	1,3	44,1
2001-2008	25,2	106,2	158,3	7,9	4,7	302,4

## System benefits

The major benefit with the Varberg district heating systems is that the heat recycling from the pulp mill and the biomass used have substituted the use of natural gas, heating oil and electricity for heating buildings in Varberg. Since 2001, the local use of natural gas has decreased with 75%. This transition from natural gas to district heat is illustrated in Figure 2. This quick transition became possible, since Varberg Energy also is the local provider of natural gas in Varberg.

The consequences from this fuel substitution are primarily lower primary energy demand and lower local carbon dioxide emissions. Since Sweden lacks fossil fuel resources, the substitution also lower the energy import, supporting a higher security of energy supply.



**Figure 2. The development of natural gas and district heat sales in the municipality of Varberg 1995-2008.**

The lower primary energy demand comes from the recycling of the industrial waste heat. Since the pulp mill mainly use biomass and recycled process resources, the heat recycling increase the overall efficiency of the biomass input to the pulp mill.

The lower carbon dioxide emissions come both from the heat recycling and the use of biomass. The fuel substitution is in compliance with national Swedish climate strategy, supported by a high carbon dioxide tax for domestic use of fossil fuels. During 2008, the tax was 1008 SEK/ton (100 €/ton), giving very high heating costs when natural gas or heating oil are used.

In 1998, the annual carbon dioxide emissions from fossil fuels were more than 90000 ton coming from heat supply to industrial buildings and buildings in the municipality of Varberg. The current annual reduction of carbon dioxide emissions from substituted fuels have been estimated to 36000 ton. The fossil carbon dioxide emission from the existing district heating system has been estimated to 4500 ton/year, giving a total reduction with 31500 ton or 88%. The reduction of nitrogen oxide emissions has been 20 ton/year.

In Europe and North America, buildings use mostly natural gas and heating oil directly in boilers for heating. This use gives specific carbon dioxide emissions between 70 and 95 g per MJ heat. The corresponding figure for the whole Varberg district heating system is only 10 g/MJ.

The total population in the town of Varberg and the four villages is about 36000. Hence, the current specific reduction amounts to 0.9 ton carbon dioxide per year and capita. The average specific carbon dioxide emission in Sweden is 6 ton per year and capita. Hereby, the district heating system in Varberg has also succeeded to lower the community carbon dioxide emissions with about 15%.

Another benefit has been that the use of district heat will reduce the fire risk from local use of natural gas and heating oil.

The average heat use in multi-family buildings were 480 MJ/m<sup>2</sup> during 2007 in the Halland county according to Statistics Sweden. Since the Varberg district heating system has only 27% primary energy share in the supply, the specific primary energy supply is only 130 MJ/m<sup>2</sup>. This is significantly lower than other heat demands in Europe.

During the transmission project, one new and innovative technological solution was used. A special pressure exchanger (invented by Bror-Arne Gustavsson) was installed for reducing the risk of water hammer in the transmission pipeline.

The developing strategies for the future are

- With respect to heat deliveries, our goal is to increase to 540 TJ in 2015.
- An agreement has been met with the pulp mill to install a 10 MW flue gas cooler in the pulp mill chimneys in order to get some medium temperature waste heat as complement to the current low temperature waste heat. The new waste heat temperature will extend from 80°C to more than 90°C from November 2009.
- With respect to the total heat supply, our goal is to increase the industrial waste heat from 375 TJ to 550 TJ (90% of the total supply). The current amount of natural gas to the district heating system is around 10%. Our goal is to change our heat generation using biomass, biogas and bio-oil peak energy instead of natural gas. The goal is to fulfil this before the end of 2015.
- Further lower return temperature in the major distribution network in order to increase the utilisation of low temperature waste heat from the pulp mill and to lower the distribution heat losses. Our

goal to the end of 2010 is to decrease the return temperature to below 40°C.in order to increase the supply of industrial waste heat energy.

- With respect to carbon dioxide emissions, our goal is to increase the reduction to 45 000 tons until 2015. This corresponds to a 50% reduction compared to the 1998 level.

## Customer relations

The largest district heating customer is Varberg Bostads AB, the major housing company in Varberg. They own more than 5100 flats and about 150 premises with a total building space of 383000 m<sup>2</sup>. The managing director Robert Hörnquist characterise their relations to Varberg Energy in the following manner:



“Varbergs Bostad has the best of relations with Varberg Energy. The close and trustful cooperation has lasted for many years. We try to find energy optimal solutions for our properties. Varbergs Bostad is very satisfied with the business relation with Varberg Energy. There are close and very good relations between the companies since many years and we discuss different questions in a prestige less way. Through the good cooperation, Varbergs Bostad have been able to protect the environment save a lot of energy and money.

There is a direct communication between the companies. The contacts have developed into deep relations between the colleagues in the two companies. Varbergs Bostad feel that Varberg Energy is in the forefront when it comes to development in the energy area and are eager to share their knowledge. Varbergs Bostad feel that they always get information regarding courses and seminars the might be of interest to them. Varbergs Bostad was, together with amongst others Varberg Energy, one of the founders of EMC, The coalition for Energy and Environment. EMC is an important part for the development of the energy area in the Halland county.”




Each autumn, Varberg Energy has individual meetings with all their large customers and the local real estate association. Within the city planning, we cooperate with city planners, developers, and constructors. Our activities and long term planning is discussed annually with the Municipality Board and Assembly.

## General documentation

District heating is one of many activities within Varberg Energy in order to create a sustainable energy supply within the municipality of Varberg. The business idea of Varberg Energy is:

*With customer focus, good ethics, business management, high quality of supply, Varberg Energy supplies energy and broadband solutions. Varberg Energy works actively for a sustainable community with own generation of renewable energy.*

Varberg Energy supports this business idea with the following activities:

- Varberg Energy has been certified according to ISO 14000 since 2001.
  - Varberg Energy received the award for the best Swedish district heating company (Årets fjärrvärmeföretag) in 2005
  - Varberg Energy has participated in the national district heating quality assurance program (Reko Fjärrvärme) since 2006.
  - Varberg Energy was one of the eight founding companies in 2007 of EMC( Energi- och Miljöcentrum). This is the regional business coalition for energy, environment, and climate change issues. Today more than 45 companies are members of this network.
  - Varberg Energy has been certified according to OHSAS 18001 since 2008. This is an international occupational health and safety management system.
  - Varberg Energy is an active owner and operator of wind power mills and some small hydro power plants. Annual electricity generation amounts to 51 GWh in wind power and 28 GWh in hydro power. All electricity sales to end customers have a wind and hydro origin and are marketed with our own trademark VIVA since 2008.
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- Varberg Energy participates in a local biogas plant by using district heat for its internal process heat demand, giving a higher yield of biogas. Hereby, Varberg Energy has proven that it is possible on the margin to indirectly run vehicles on district heat. This plant is

planned to be in commission in the end of 2010 and the annual generation of upgraded biogas is 72 TJ.

## Conclusion

Varberg Energy has succeeded to reduce the local carbon dioxide emission with almost 90% for the district heating customers connected during less than 10 years. This reduction has been accomplished by using district heating system technology to recycle heat from a large pulp mill and by using biomass as fuel in heat generating boilers. However, we do not intend to end with our results. We are walking on a path containing further improvement.



**Picture 3. The medieval Varberg Castle was connected to the district heating system in 2006. The beach bathing house remains to be connected.**

Varberg September 19, 2009

Carl-Arne Pedersen

