Call for applications: Global District Energy Climate Awards

COVER SHEET

Name of the system:	District Cooling in Gothenburg
Location of the system:	City of Gothenburg
Type of ownership:	Owned by Göteborg Energi, a 100% owned company by the municipally of Gothenburg
Adress to persons submitting the portfolio:	Anna Svernlöv, Göteborg Energi Henrik Frohm, Capital Cooling

PHOTOGRAPHS OF SYSTEM FACILITIES

See appendix 1.

SYSTEM DESCRIPTION

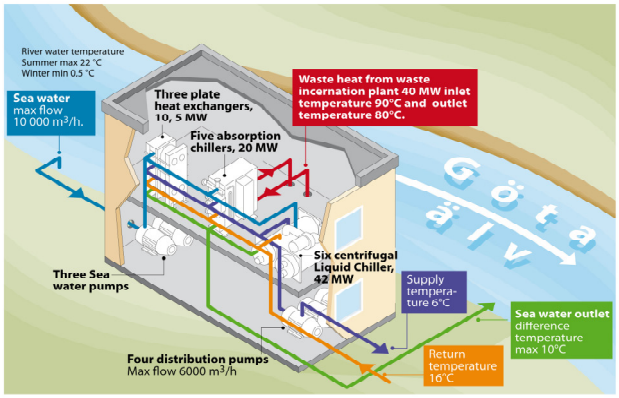
District Cooling was established in Gothenburg already in 1995. Decentralized cooling units based upon chiller absorption technology served limited building complex with district cooling. Between 1995 and 2006 in total 16 decentralized "cooling islands" were established in the city of Gothenburg providing about 40 buildings with 40 MW cooling demand and 50 GWh cooling energy yearly.

During 2006 a business development program was performed in order to investigate the possibilities to upgrade the decentralized cooling islands into a large scale District Cooling system and at the same time expand the market areas and the system to a 100 MW system. The following main goals were defined:

- Connect 100 MW cooling to an integrated large scale system
- Design a system with the flexibility to upgrade to 150 MW
- Install new production capacity corresponding to around 60 MW
- Decrease CO2 emissions by at least 25 000 ton annually

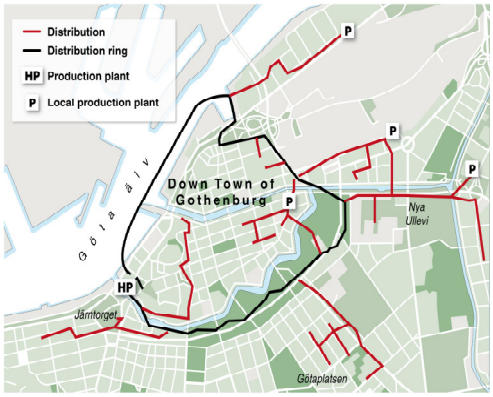
The business development program was a joint co-operation between Göteborg Energy and Capital Cooling. As a part of the business development new market areas were secured by bilateral contracts, e.g. with the Sahlgrenska hospital in Göteborg and "Rättscentrum" covering more than 15 MW.

In 2007 the board of directors decided to invest in a large scale District Cooling system of 100 MW equivalent to 2 500 000 sqm building area. The market potential for the whole city of Gothenburg was estimated to 250 MW (6 000 000 sqm building area). The large scale centralized District Cooling system was taken into operation in September 2007 where four of the decentralized cooling islands now were integrated to the large scale system. Today 2011 about 70% of the system's capacity is contracted and sold. The main idea is to use local sources for cooling that otherwise would be wasted or not used, in order to offer the local market a competitive and high-efficient alternative to the traditional cooling solutions.



The project has chosen a system solution that have a low electrical energy input and also optimized the production in line with the consumers needs. The production of DC takes place in one main production unit and in local production units (former cooling islands). The long term total production cooling capacity is planned to be 85 MW. The district cooling supply temperature is 6 degrees and the return temperature is 16 degrees. The main production plant is designed to produce the cooling energy demand using free cooling from Göta Älv with a flow of 10 000 m3/hour. In the summer the sea water temperature in Göta Älv is too high for production of District Cooling and to secure the supply temperature of 6 degrees the main production plant is equipped with mechanical chillers. Absorption chillers are designed for a capacity of 20 MW and centrifugal sea water cooled chillers are designed for a capacity of 42 MW. The integrated former cooling islands have an installed capacity of 23 MW (divided in 50 % electric chillers and 50 % absorption chillers). The ambition is to expand the production capacity as the market demand is increasing.

The distribution system is designed to supply cooling to a market of 150 MW. The total distribution system will be completed in 2015. (See map to the right)



Design facts of the distribution system:

- Design flow 8000 m3/h
- Flow speed is 2.2 m/s
- Differential temperature designed for 9 degrees
- Plastic pipes and pre-insulated standard steel pipes
- The pressure class is PN 10 (bar)
- Dimension max pipe 700 mm
- Total pipe length 22 000 m

DATA AND WRITTEN DESCRIPTION OF THE SYSTEM SUCCESS

The energy balance for the system can be describes as:

	Energy GWh	Percentage of Produced cooling
Cooling delivery	121	100%
Free cooling	43	36%
Electrical Chillers	35	29%
Absorption chillers	45	37%
Losses	-2	-2%

Table 1, cooling sources

	Energy GWh	Percentage of Produced cooling
Electrical consumption	8,3	7%
Distribution	1,6	1,3%
Cooling water	2,4	2,1%
Electrical Chillers	3,5	2,9%
Absorption chillers	0,4	0,3%
Auxiliary & losses	0,5	0,4%

Table 2, electrical consumption

Performance factors	
SSEER	14,6
PRF	0,2

Table 3, Performance factors

SSEER = Seasonal System Energy Efficiency Ratio. This states the output of yearly useful cooling energy per unit of yearly electrical energy input in the system.

PRF = Primary Resource Factor. Compares the consumption of non-renewable energy needed to produce the cooling energy

Source: www.svenskenergi.se SOU 2008 Ett energieffektivare Sverige

Comparing to individual building units (customers' alternative to DC) the environmental impact of the District Cooling system in Gothenburg is a success story:

	District Cooling	Customer Alternative
Cooling energy demand (MWh/year)	121	121
SSEER	14,6	2,8
Electrical energy demand (MWh/year)	8300	43200
CO2 emissions (tons/year)	7900	35400
Refrigerant (tons)	17	33

Table 4, Environmental impact key-figures

Source: www.svenskenergi.se SOU 2008 Ett energieffektivare Sverige

District Cooling in Gothenburg is a sustainable and energy efficient way of providing cooling for cities and commercial centers of different kinds:

- District cooling contributes in reaching CO2 targets
- District cooling is a growing business in a growing cooling market
- District cooling offers substantial benefits for customers but also for other stakeholders in the society

CUSTOMER AND MARKET

The potential in the planed DC area is around 150 MW where the 20 largest property owners have a potential of around 75%. The customers are commercial building owners, such as shopping malls, hotels, offices and also public buildings. The average customer has a cooling capacity demand of 600 kW and an energy demand of around 650 MWh per year. The smallest connected customer has a capacity demand of 60 kW and the largest customer has 11,500 kW. When the DC system is in fully operation around 150 – 200 buildings will be connected to the system. Today around 50 buildings are connected to the system and around 60 MW of cooling is contracted.

The DC product is highly appreciated by the customer and their main reasons for choosing DC, except that it is competitive, are:

- Simplicity – They just need a sub station and they only have to pay for what they use
- Safe - Noting that breaks down, it just works and they don't have to maintain any complex machinery
- Environmental friendly – reduce CO2 emissions with up to 80 % and remove all their refrigerants from their buildings

GENERAL DOCUMENTATION

More information about the system can be found at:

www.goteborgenergi.se

www.capitalcooling.se

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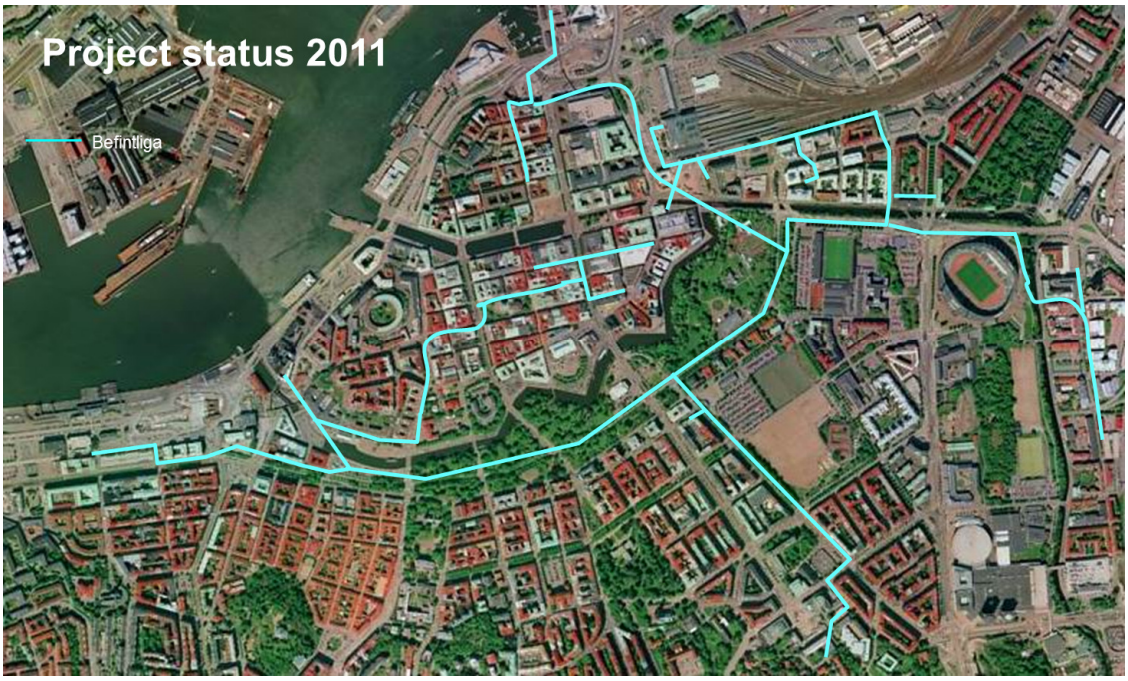
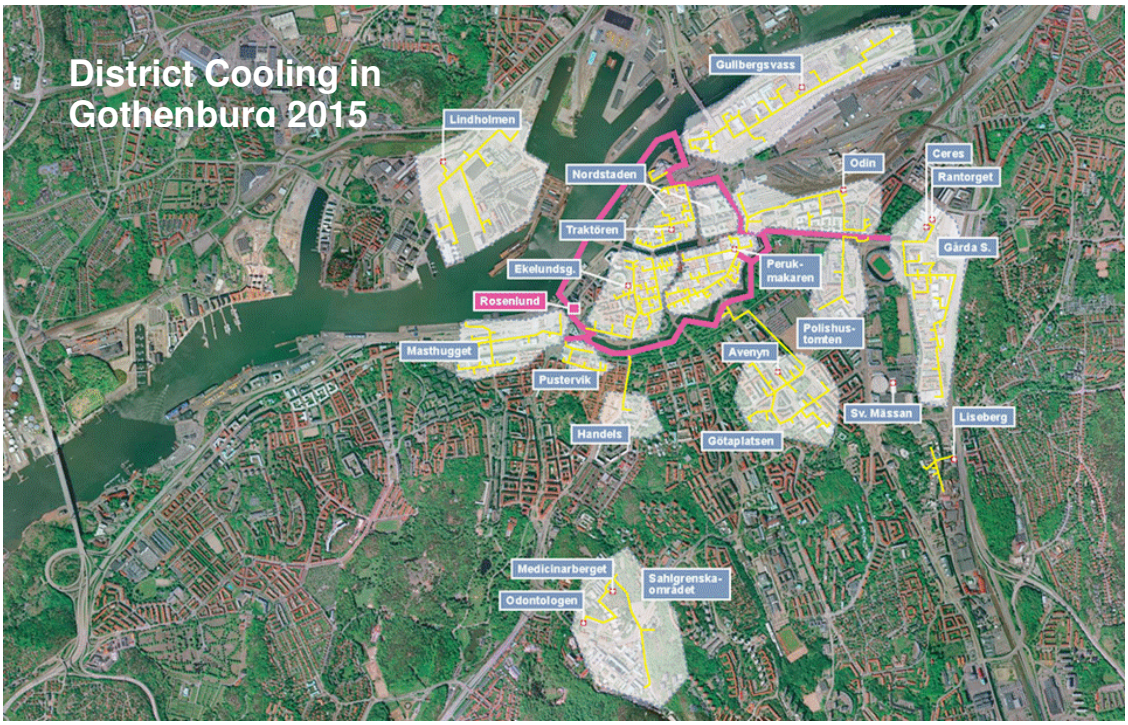
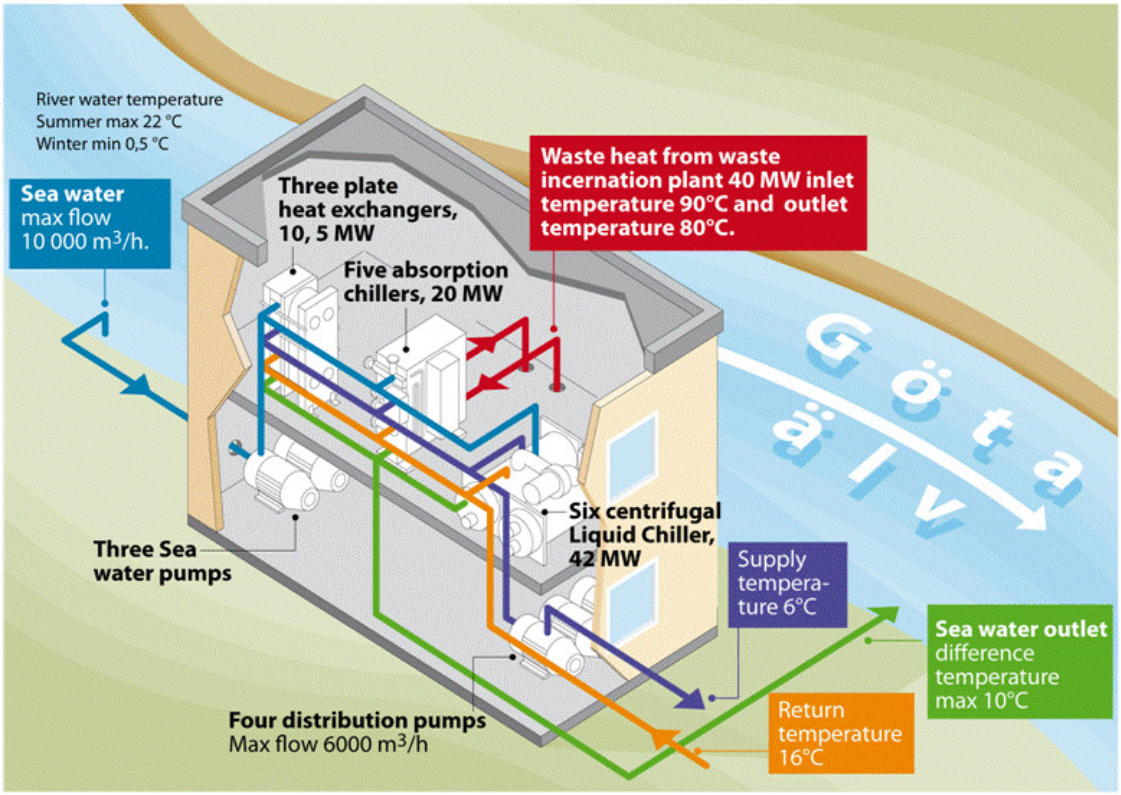


Picture 1, map of DC network 2011



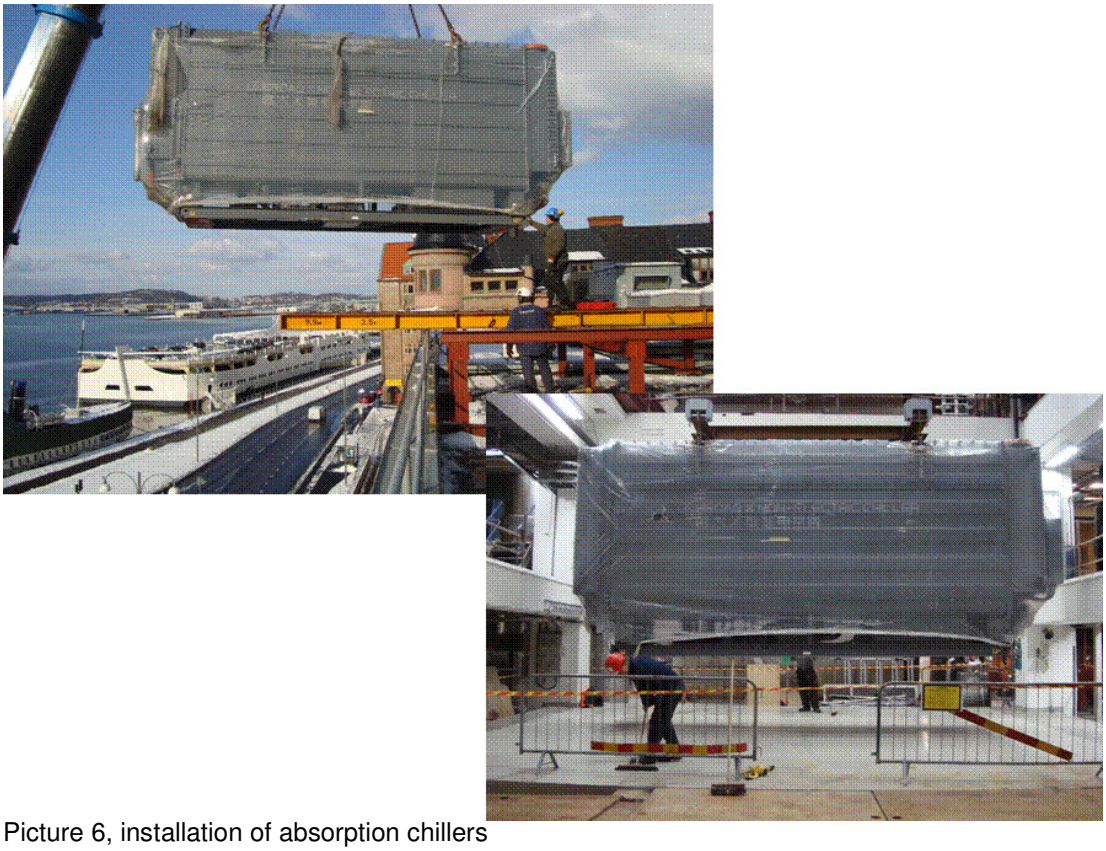
Picture 2, planned market area in 2015

Picture 3, DC production plant integrated with Cogen plant (Rosenlundsverket)



Picture 4, technical system design

Picture 5, the free cooling lake water intake



Picture 6, installation of absorption chillers

Picture 7 District Cooling pipes in downtown Gothenburg