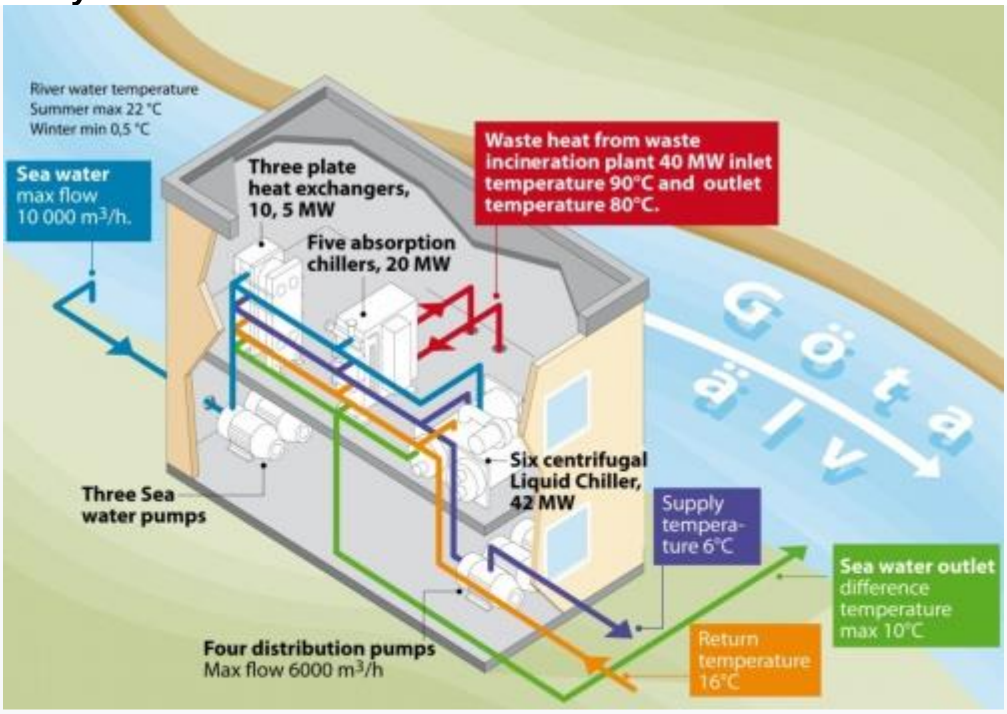
Cooling from river water in Gothenburg

The aim of this demonstrator is to produce cooling for the district cooling network by means of using river water in heat exchangers as cold source.

Asset

Idea and layout



Schematic illustration of free cooling with river water in Gothenburg[1]

In Gothenburg river water is used as a cooling source for both district cooling and to cool waste heat from the waste incineration plant. The river water temperature is approximately 3-4°C when used in the cooling centre for the production of district cooling and is taken from a depth between 20-50 meters. The temperature of the river varies however between 0.5-22 °C during the year. The system is therefore supplemented with absorption chillers for the production of cooling. The system has 5 absorption chillers that are driven with the help from the waste heat from the incineration plant. During the warmer summer months, the cooling production is also supplemented with electrical driven chillers to reach down to the wanted temperature. The combination of the different cooling systems results in low electricity consumption for the production of cooling.

The supply temperature of the district cooling grid is approximately 6°C. The buildings are then cooled by different heat exchange systems that cool the air. The warmed water returning to the district cooling grid has a temperature of approximately 16°C. The return temperature may vary and depends on factors such as how the building’s cooling system is dimensioned and operated.

To the right a schematic drawing of the cooling with river water in Gothenburg can be seen.

From the total delivered cooling capacity 22% comes from free cooling from the river Göta Älv, 47% comes from the absorption chillers using the waste heat from the waste incineration plant and 31% comes from electrical driven chillers.

Impact

The overall demonstrator’s performance is summarized in the following table according to 5 evaluation criterions. It can be noticed that the assignment of all the scores is directly linked to the values calculated for the Key Performance Indicators, except for socio-economic benefits where a qualitative assessment is carried out based on this cluster's indicators and on separate interviews.

Overall Impact	**Fair/Medium**				
Size [MWh/y]	1-100	100-1000	1000-5000	5000-10000	>10000
Primary Energy Savings	0-10%	10-20%	20-40%	40-60%	>60%
GHG Emissions Reduction	0-10%	10-30%	30-60%	60-90%	>90%
Pollutant Emissions Reduction	0-10%	10-30%	30-60%	60-90%	>90%
Socio-Economic Benefits	Low	Fair	Medium	High	Extrem

Replicability

Replication Potential

Replicability	Low	Medium	High
Authorizative easiness		X	
Adaptability to different climate conditions			X
Technology easy-to-implement (No needs of specific technical requirements)		X	
Easy-to-implement (No needs of specific technical requirements)		X	
Easy-to-operate (No needs of specific technical requirements)			X
Opportunity of integrating waste energy sources			X
CAPEX needed for the deployment of the solution			X

Technical Requirements

See Technical toolbox: River water cooling technology.
River water is used as a cooling source for both district cooling and to cool waste heat from the waste incineration plant. The river water temperature is approximately 3-4°C when used in the cooling centre for the production of district cooling and is taken from a depth between 20-50 meters. The temperature of the river varies however between 0.5-22 °C during the year.9 The system is supplemented with absorption chillers for the production of cooling. During the warmer summer months the cooling production is also supplemented with electrical driven chillers. The combination of the different cooling systems results in low electricity consumption for the production of cooling. The figure below shows the production of cooling in the central district cooling network in Gothenburg during different months of the year. Figure

Stakeholders[edit]

Stakeholders	Organization Name	Organization Type	Organization Domain	Benefits from demo
District heating network operator	Goteborg Energi AB	Publicly owned	Utility	N/A

Finance

Total investments around 40 M€ Pay back time < than 20 years

Lessons learnt

Demonstrator development

- Long project time from start to end; need for flexibility and adaptation of plans.
- The sales process is both resource- and time demanding. Establish customer contact at the right level.
- The district cooling system must be designed and dimensioned to ensure stable supply also during the expansion phase when the load is lower.
- The forecast for the total investment about 20% above initial budget.
- Customer over-estimate their needed power level (MW)

Demonstrator performance monitoring

Key Performance Indicators	
Delivered Cool	9 GWH/year
GHG emissions [%]	[to be determined]
Primary energy [%]	[to be determined]

Payback	20 year

References

1. Jump up↑ P. Arvsell. Göteborg Energi (2014) Cooling by river water, 11Goe demonstrator information.

CELSIUS contacts

CELSIUS partners contributing to this article: Göteborg Energi, D'Appolonia

For further engagement on this subject you are welcome to turn to your CELSIUS city contact person or use the contact form for guidance to relevant workshops, site visits or the expert team.