Sustainable production Vertical city - Cooling by river water in Rotterdam

This is an article about a CELSIUS Demonstrator.

Cold is centrally generated through three water-cooled compression chillers through a cold water inlet connected to the river New-Meuse. Cold to the homes is provided through a distribution set with a metered connection.

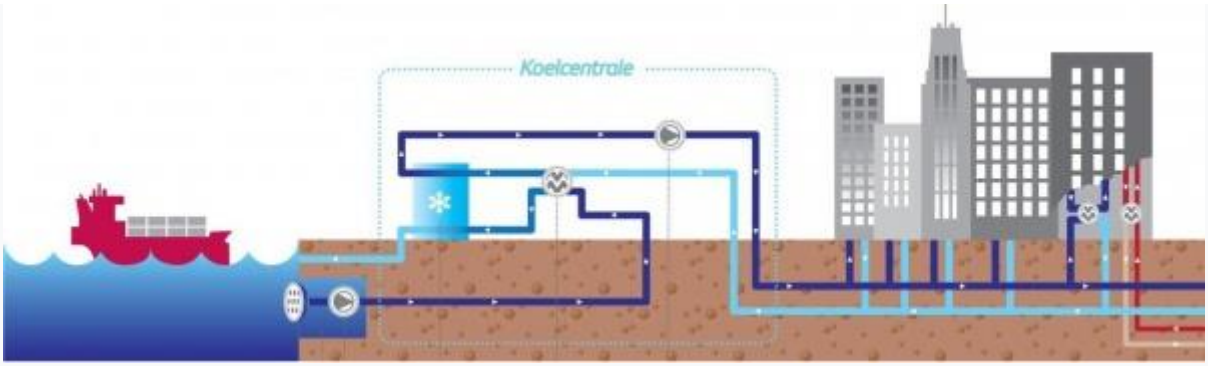
Contents

[hide]

Asset[edit]

Idea and Layout[edit]

De Rotterdam Vertical city was finished in late 2013 taking four years to complete. The building is constructed as a city on its own and has a total floor space of 160,000 m2 realised on a very small footprint of only 5,500 m2. It's the most densely build part of the Netherlands with a floor space index of 32. It consists of 240 apartments, 60,000 m2 offices, 1,500 m2 for restaurants and cafés, 278 hotel rooms, cultural institutions, 5,000 m2 shops, 2,500 m2 fitness-area and 670 parking-spots. The building has a mixture of functions that require both heating and cooling to sustain a good indoor climate.



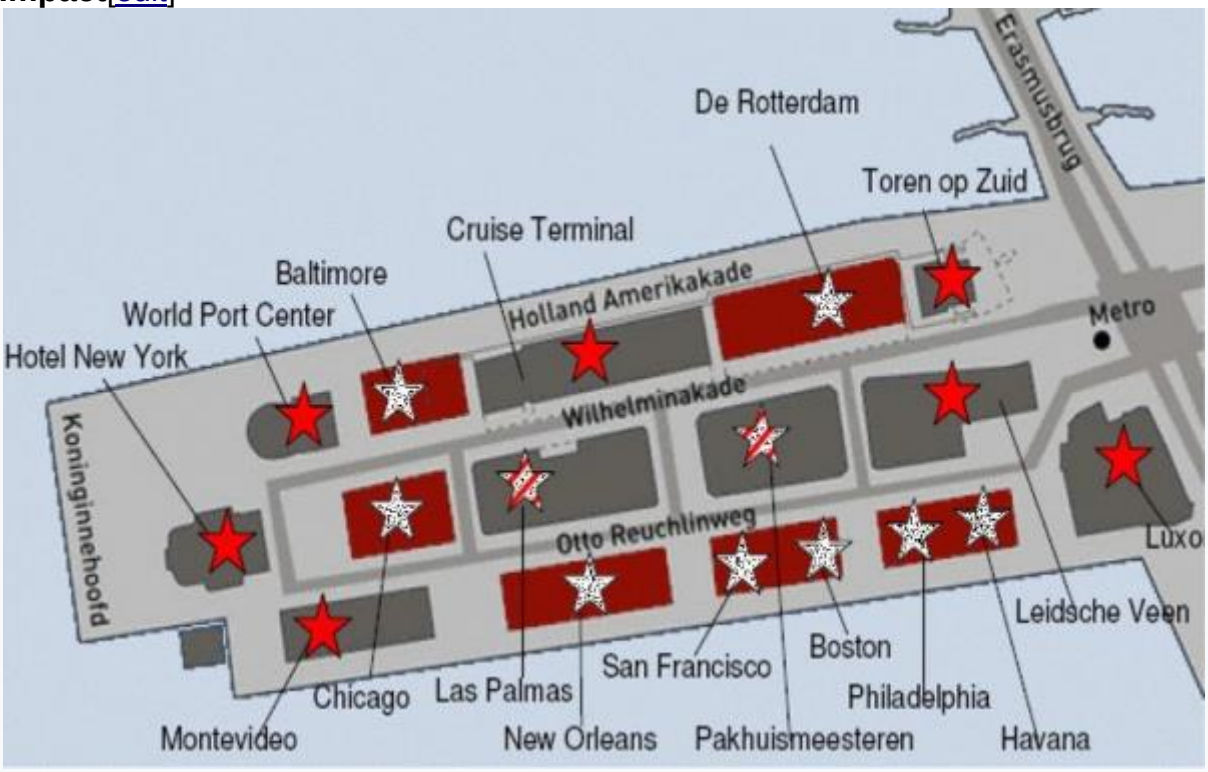
Scheme of cooling solution Vertical City

Water from the nearby river, Maas, is used for free cooling of the De Rotterdam Vertical city. The river water that is used has a temperature that varies between approximately 3 - 27°C during one year. The river water is pumped through a coarse filtration system to prevent solids and fish in the river from getting sucked into the water pumping system. Thereafter the water is processed

through an antifouling system that uses chlorine as the antifouling agent. The water continues through a second stage of filters before passing through a heat exchanger. Problems during the early stage of the project occurred with small organisms, such as clams, that passed through the filter system. When settled, the organisms grew causing problems in the system. An environmental friendly extra anti-fouling step is used to solve this: thermic shocks. This method is used to prevent small organisms and clams from growing inside the system. The small eggs of the clams can pass the filtering system and stay inside the heat exchanger system. When growing they obstruct the flow in the system. By periodically raising the temperature to a high degree in a short term, called thermic shock, the clams and other small organisms are unable to hold their grip on the inner surface of the system and are flushed out.

The system is also connected to electrically driven water cooled screw compressor chillers used when the river water temperature is too warm and supplementary cooling is needed. The river water chills the cooling medium that passes through the chillers which in its turn chills the water that is distributed to the buildings. The buildings are then cooled by different heat exchange systems that cool the air. The river water is returned to the river after passing through the chillers and heat exchanger. The water supplied to the building has a temperature of approximately 8-12°C while the returning warmed water has a temperature of approximately 16°C.

Impact[edit]



Masterplan cooling around Vertical City (aka De Rotterdam)

When the river temperature is below 9°C the buildings are cooled with free cooling only. When the river temperatures vary between 9-15 °C a combination of free cooling supplemented with chillers are used while when the river temperature reaches above 15°C only chillers are used to cover the cooling demand of the buildings. In accordance to the energy company, Eneco, the coefficient of performance, COP, varies from a COP of 5 when only the chillers are used and can reach up to a COP of 40 when only free cooling is used.

In the basement of Vertical City a large space is reserved to have large compression chillers and a bigger Cooling from river water network. All new buildings close to Vertical City will be connected to that. 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[edit]

Replication Potential[edit]

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[edit]

Important, of course, is that water is available close to the building. Since the water temperature is not very high, longer distances can be used because the thermal losses will still be small. Read more in the Technical Toolbox

Stakeholders[edit]

Stakeholders	Organization Name	Organization Type	Organization Domain	Benefits from demo
Developer	MAB/OVG development	Private company	Real estate development	Fulfil the high ambition wishes of potential clients
Designer	OMA	Private company	Architecture	Fulfil the wishes of the customer, iconic building
Engineering cooling system	Eneco	Energy company	Energy	Implement innovative energy solutions and good showcase
Local government	City of Rotterdam	Municipality	City development, environmental issues/regulations	Good showcase and more sustainable energy supply

Read more[edit]

Introduction to District Energy

- Cooling from excess energy

Technical Toolbox

- River water cooling technology

Case studies

- Cooling from river water in Gothenburg
- District cooling in Helsingborg, Sweden - a ReUseHeat example

CELSIUS City Supporters

- RESCUE Project

CELSIUS contacts[edit]

CELSIUS partners contributing to this article: City of Rotterdam

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.

Categories:

- Rotterdam
- CELSIUS Demonstrators
- Cooling
- Production
- Renewable energy