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An efficient district cooling station

Tartu, Estonia

IN A NUTSHELL

Using the freshness of the city river to keep a district cool while reducing CO_2? That is how the city of Tartu innovatively tackles climate change mitigation with its district cooling station.

Background

The City of Tartu is situated in Southern Estonia, in Tartu County. A university town, it is the second biggest city in Estonia by the number of residents, and it is also a pole of attraction for both the county and Southern Estonia overall.

In March 2014 Tartu joined the Covenant of Mayors to promote sustainable development and create a more active public image of the city, voluntarily taking on an obligation to promote the actions related to sustainable energy and the use of renewable energy in its territory.

Co-funded by Intelligent Energy Europe, the city developed an Action Plan for Sustainable Energy Management 2015-2020. It sets general strategic targets by 2020 through smart and conscious consumption which are:

- decrease CO_2 emissions by 20% which is 108,159 tCO_2/y in comparison to 2010
- consume 200,000 MWh less energy in final consumption per year
- increase the share of renewable energy from 38% in 2010 to 45% by 2020

These have been subdivided into more specific targets, amongst them target No.1 whereby the city commits to ensure a sustainable supply of district heating and district cooling based on renewable energy sources.

How does it work in practice?

Tartu city centre's cooling station aims to produce and supply cooling for commercial buildings, shopping centres, hotels, etc. It opened in 2016. District cooling has several advantages over traditional cooling, primarily in energy efficiency. Tartu's district cooling station produces cooling using traditional industrial equipment as well as cold river water. Tartu's city centre hosts a variety of public buildings, including a water park, a theatre, four shopping centres, a science centre, and numerous office buildings.

Tartu cooling station
(credits: Tartu City Government)

TARTU

Population: 99680	***Area*** 153,2 km^2
Signatory to the Covenant of Mayors since: 2010	***CO_2 emission reduction target:*** 20% by 2020

The buildings have different energy consumption peaks, which allows for energy consumtion optimisation. The cold water of the Emajõgi River can be used as a free cooling source (energy from nature) from October to April. When water from the Emajõgi cools the water in the cooling network to the appropriate temperature (6 °C), there is no need to use industrial cooling equipment. When the water of the Emajõgi warms up, the equipment kicks in.

Tartu's city centre meets several criteria for successful district cooling:

- The city centre is sufficiently densely populated;
- It will become even more densely populated in the future;
- New buildings guarantee a high energy density: 7 kW/m (the average being 1.8-5.5 kW/m);
- Fortum Tartu AS, which has been responsible for producing, distributing and selling heat in Tartu since 1 August 2013, is also the owner of riverside property.
- In autumn, winter and spring, the river water is directly used for general cooling. In summer, the river water is used for cooling turbo compressors, which circulate the water in the network, and then cooled by electric heat pumps .

Estimated benefits:

District cooling is estimated to reduce traditional cooling energy costs by roughly 70-80%. Through the SmartEnCity project, the district cooling station was fitted with solar panels to produce electricity for the station.

The power of the district cooling station is max 13 MW. At the moment it is connected to costumer network with a capacity of 5.7 MW and therefore operating on half of its capacity. The current span of the district cooling network is about 3 km and is growing rapidly.

The energy savings generated are around 70% in comparison with local cooling installations. The district cooling plan reduces the use of primary energy by more than three times. Electricity savings amount to about 900 MWh per year and the estimated reduction of CO_2 is around 6,000 t/year.

The temperature of the water returned to the river is on average 4.4 °C warmer than that of the incoming water. The water use of the district cooling system is around 0.18%, i.e. 436 m3/h. At worst, the water temperature in the outflow area rises by 0.09 °C. In order to reduce the environmental impact, the outlet pipe should be located in a faster-flowing part of the river.

The construction of the station was financed mainly by loans as well as partly self-financed by Fortum. The installation of heat pump and solar panels was partially financed by the Horizon2020 project SmartEnCity.

KEY FIGURES

70% of energy savings compared to other cooling installations

900 MWh/year electricity saved

6,000 t/year CO_2 emission reduction

70 kW solar power capacity

FINANCING THE PROJECT

Financing source(s):
Loans; own finance of Fortum Tartu AS; funding from Horizon2020 project 'SmartEnCity'

Total amount:
Total amount of construction costs: €3,500,000

Return on investment:
70 to 80% reduction of energy cooling costs

Estimated payback period:
15 years

USEFUL LINKS

- https://www.tartu.ee/en/sustainable-tartu#renewable-energy
- SmartEnCityN project : https://smartencity.eu/

CONTACT

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