W.E. DISTRICT
Heating & cooling solutions

Demonstration site: LULEÅ (Sweden)

Fuel cell powered data center with Excess heat integration in existing district heating

Climate Zone:

Northern European Weather

Sweden has reached the climate goals from the Kyoto protocol. The main reason for this success in climate politics is the nation-wide expansion of efficient district heating, supplied by non-fossil energy sources. Accounting for half of Swedish heating, district heating has gone from being almost exclusively powered by fossil fuels in the 1980s, to using renewable energy and recycled heat for 90% of its demand in 2017.

Therefore, the challenge for this demo-site is to use fuel cells to apply an innovative waste heat recovery experiment. Excess heat will be recovered from a data centre in Luleå to feed into an existing local district heating network, while generated electricity power will be used for the data centre.

Solide oxide fuel cell technology

to generate electric power & heat

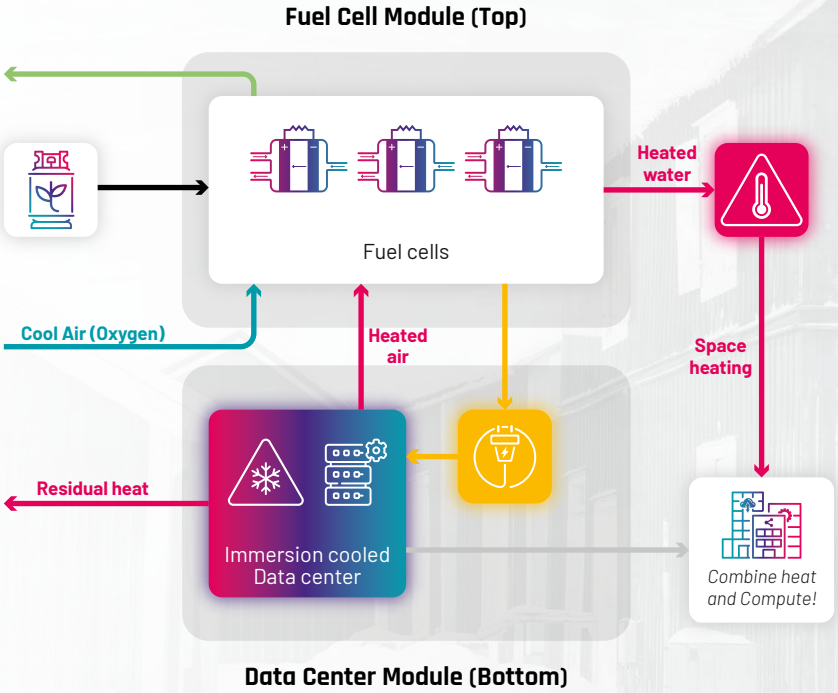
Liquid cooling technology

to recover excess heat from the data centre

Intelligent energy management system

to control flow of heat and electricity

Demo-site block diagram



Legend

Biogas | Hot | Cold | Compute data | Electricity | Carbon dioxide

Components

Fuel Cell Module

(Top Container)

- 9 Biogas Solide Oxide Fuel Cells
- Air preheated by data center
- Connection to space heating of the large adjacent building.
- Water supply
- Exhaust (carbon dioxide, water vapour)
- Parallel grid connection of fuel cells.

Data Center Module

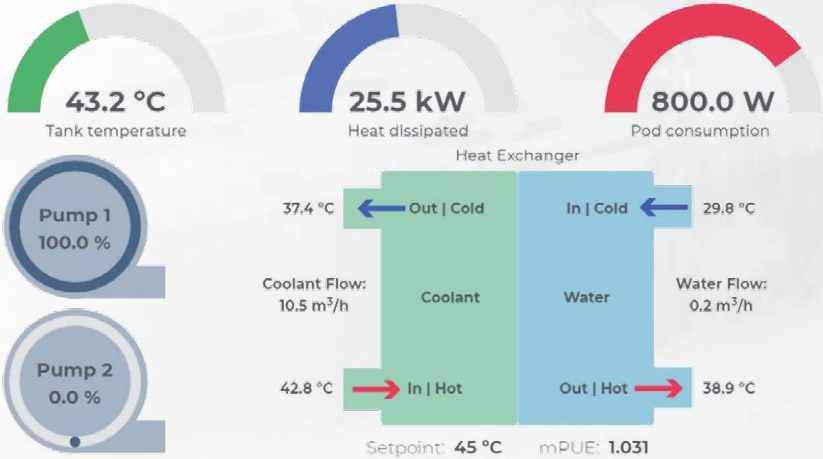
(Bottom Container)

- Data center servers are immersed in a dielectric liquid.
- Uses a hydrocarbon dielectric coolant
- Operates a ficticious workload for the demostrator
- Dry cooler attached to excess heat.

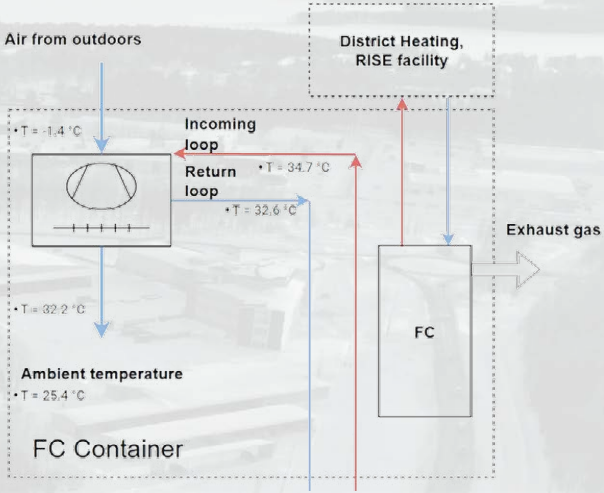
Renewable Data center heat and power system

The Data Center module (below) preheats the incoming water from the above fuel cell container (FC) from 29.8°C to 38.9°C via a heat exchanger. The temperature from the dielectric liquid coming from the immersed data center servers decreases at the same time from 42.8 to 37.4°C.

The fuel cell container (FC) is preheated by the hot water from below. The single phase solide oxide fuel cells generate at the same time electricty for the data center below while the heat is being used for the district heating. The exhaust gas from fuel combustion is emitted.



From the Submer immersion cooling control

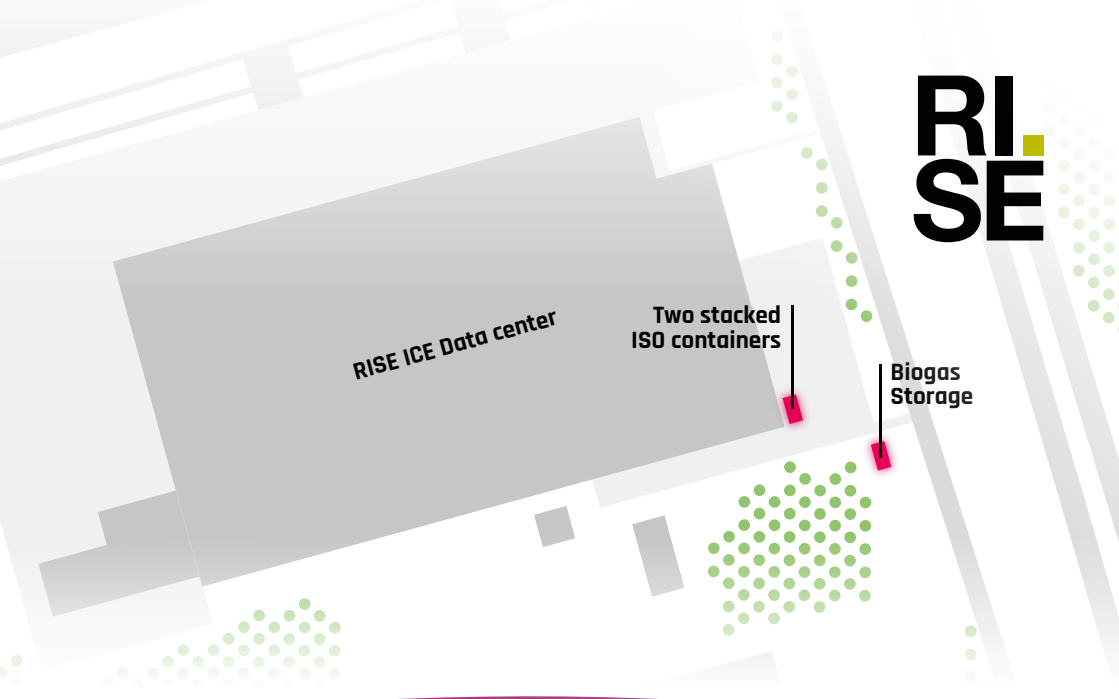


Advantages

- Independently powered data center with fuel cells that only requires fuel (Biogas or hydrogen)
- Renewable solution with low Green House Gas emissions (fuel dependent)
- Waste heat from data center is used for preheating
- Waste heat of fuel cells can be used for District heating
- Intelligent management systems utilizes surpluses into local systems

Coordinators

- Jon Summers (Scientific Lead of the ICE data center lab)
- Jonas Gustafsson (Research program manager)



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