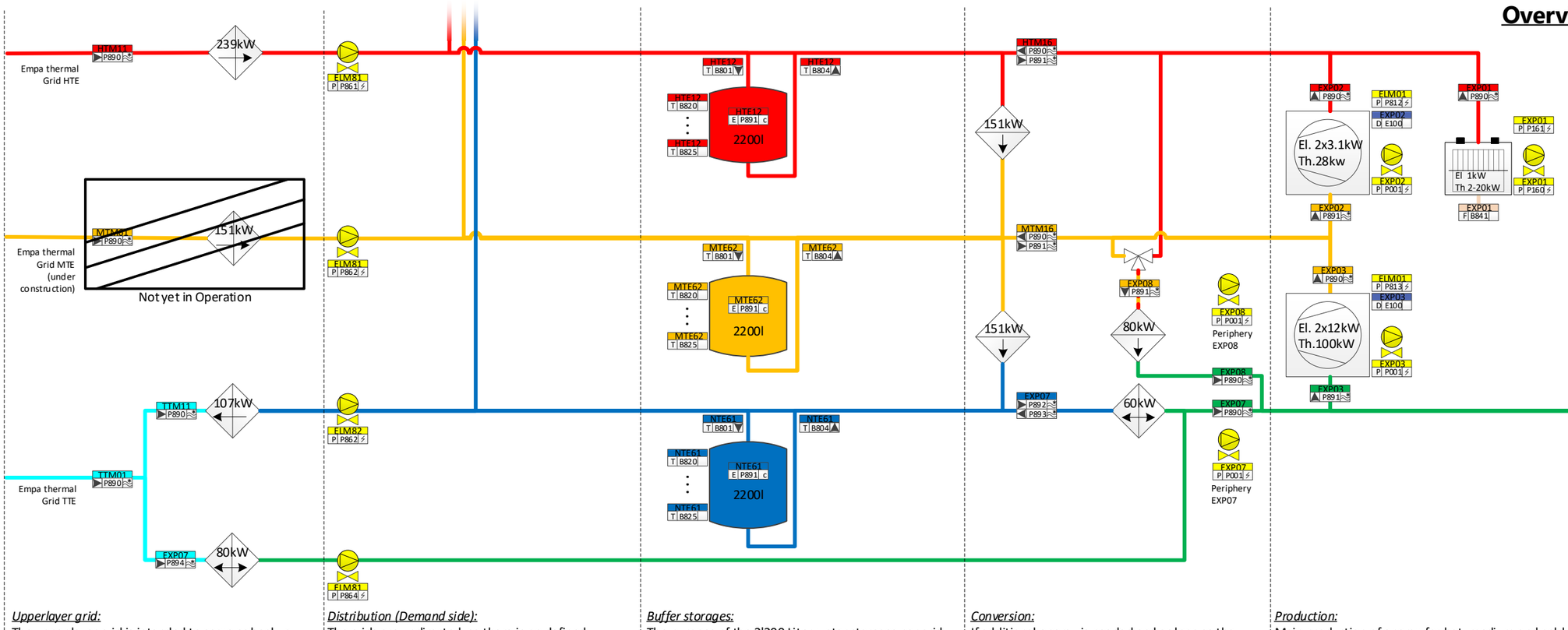
Overview ehub district energy setup



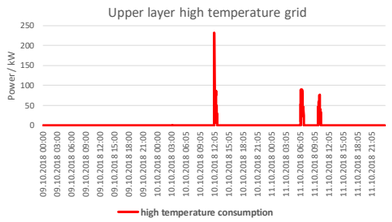
Measurements:
Default temporal Resolution in SQL db: 1min

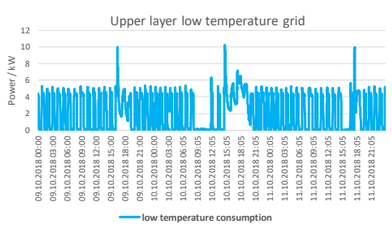
Max el. temporal Resolution: 5ms
Typical accuracy: 1.5%

Max temp. temporal Resolution: 2s
Typical accuracy: 6%*)

*) Restrictions/Conditions apply

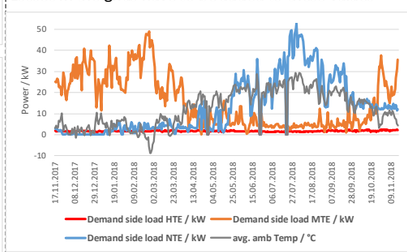
Upperlayer grid:
The upper layer grid is intended to serve as backup, when not enough local capacity is present, or when additional load profiles have to be created for research.
Low temperature can be considered a source and a sink of energy. High temperature and medium temperature are only laid out to be a source.





Distribution (Demand side):
The grids are undirected, so there is no defined feedline or return line. The flow is defined according the heat/cold demand. Two distribution shafts cover the south and the north part of NEST. Two Circulation pipes per grid (one on the hot side, and one on the cold side) keep the temperature levels throughout the grid.
The diameters of the installed pipes is large compared to the demanded power. This results in low flowrates and thus large (time) delays if energy needs to be transported from production to storage and/or consumption site.
Average demand is for:
- High temp.: 3.7kW
- Medium temp.: 28.9kW (in winter)
- Low temp.: 27.4kW (in summer)

Losses in the grids have to be added to these values



high temp. grid
hot side 60°C (max. 90°C)
cold side 45°C

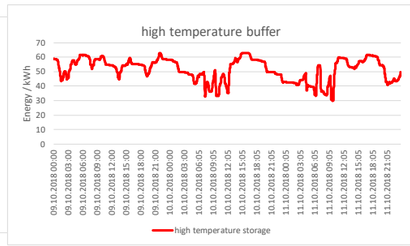
medium temp. grid
hot side 35°C (max. 38°C)
cold side 25°C (max. 28°C)

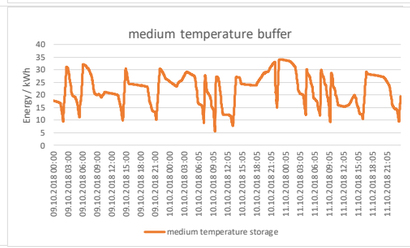
low temp. grid
hot side 14°C (min. 7°C; max. 28°C)
cold side 8°C (min. 2°C max. 18°C)

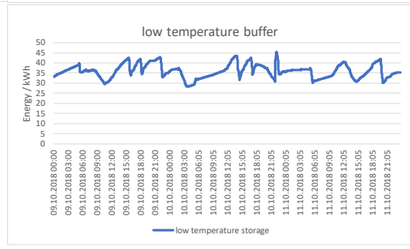
low temp. grid
hot side 13°C
cold side 7°C

Glycol grid
temp. depending on used storage
(min. -7°C; max. 80°C)

Buffer storages:
The purpose of the 2'200 Liter water storages per grid is to keep the defined temperature levels/spread per grid within range. So, the buffers are not intended to be energy storages, but only small buffers.

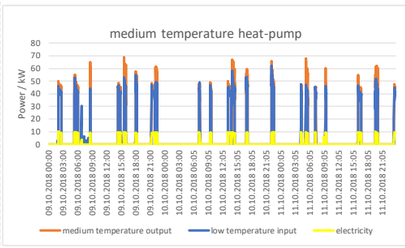


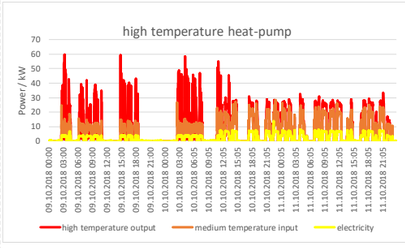




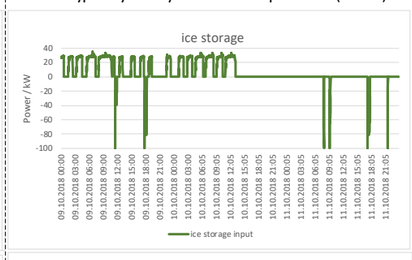
Conversion:
If additional energy is needed and as long as the upper layer medium temperature grid is not in operation, medium temperature energy is generated by converting it down from the high temperature grid. The glycol grid can be charged with eigther high, medium or low temperature.

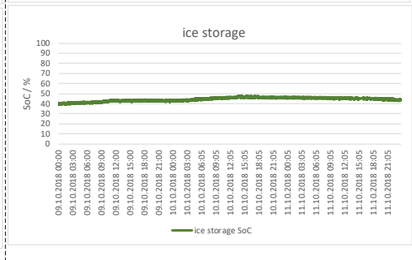
Production:
Main production of energy for hot, medium and cold temperature grid
Fuelcell is usually off due to low power rating and high wear off
High temperature heat pump: operated 0%,50% or 100% power
Medium temperature heat pump: operated 0%, 20...100% power





Storage:
The storages are typically operated as seasonal storage
The maximal power of each ground heat exchanger is 14.6kW charge and 9.7kW discharge
Thermpipe 7kW charge and 4.7kW discharge
Ice storage 20kW charge and 30kW discharge
The ground heat exchangers and thermpipe can be charged with 80°C
But are typically fed by medium temperature (~30°C)





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11.02.19 update / hep