
DALE

DALE ENERGY CONCEPT

Why revised concept of heat supply

- High heat production cost with CHP biomass compared with sales prize of district heating.
- Low sales price of CHP eletricity, when sold into the grid.
- Additional claims for reduced energy demand after PIMES contract from year 2009.
- A continous rapid development of the Dale area seems not likely.
- Extra investment costs for preparations could not be justified.

=> Necessity to lower the heat production cost.

Why a low temperature system?

- A low temperature system is more reliable during the operational phase.

- A low temperature heat pump tend to have longer life time due to lower pressure levels in the heat pump.

- Low temperature system is very flexible.

Why a low temperature system?

- The R717 heat pump designed for 55 °C can also deliver up to 65 °C! This could be a decision to make in the Energy Management system.

- Low temparature district heating netwoork has about 10% higher cost than with 70 °C. However the heat pump has lower investment cost.

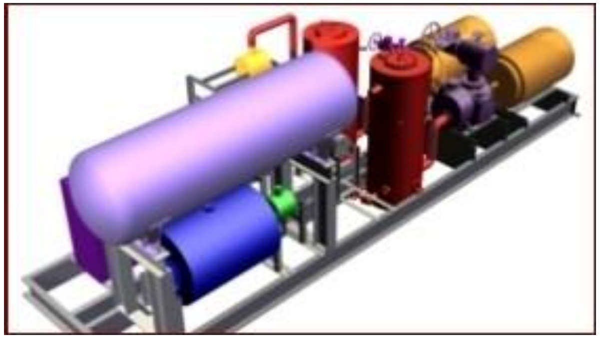
Energy components

Heat pump

- A 400 kW heat pump, with a natural refrigerant
- Will cover most of the energy demand in PIMES area
- Yearly production capacity 1,06 GWh.
  This is about 95% of produced district heating.
  The expected average COP for the heat pump will be about 4,2, which is 35-55% better than the most common systems in Norway

Recommendations for the heat pump

- Low temperature heat pump, with R717 and use of seaweater.
- Two stage design, with speed controlled piston compressors, for both high- and low pressure stage.
- The unit should be with superheater and subcooler, in addition to the condenser.

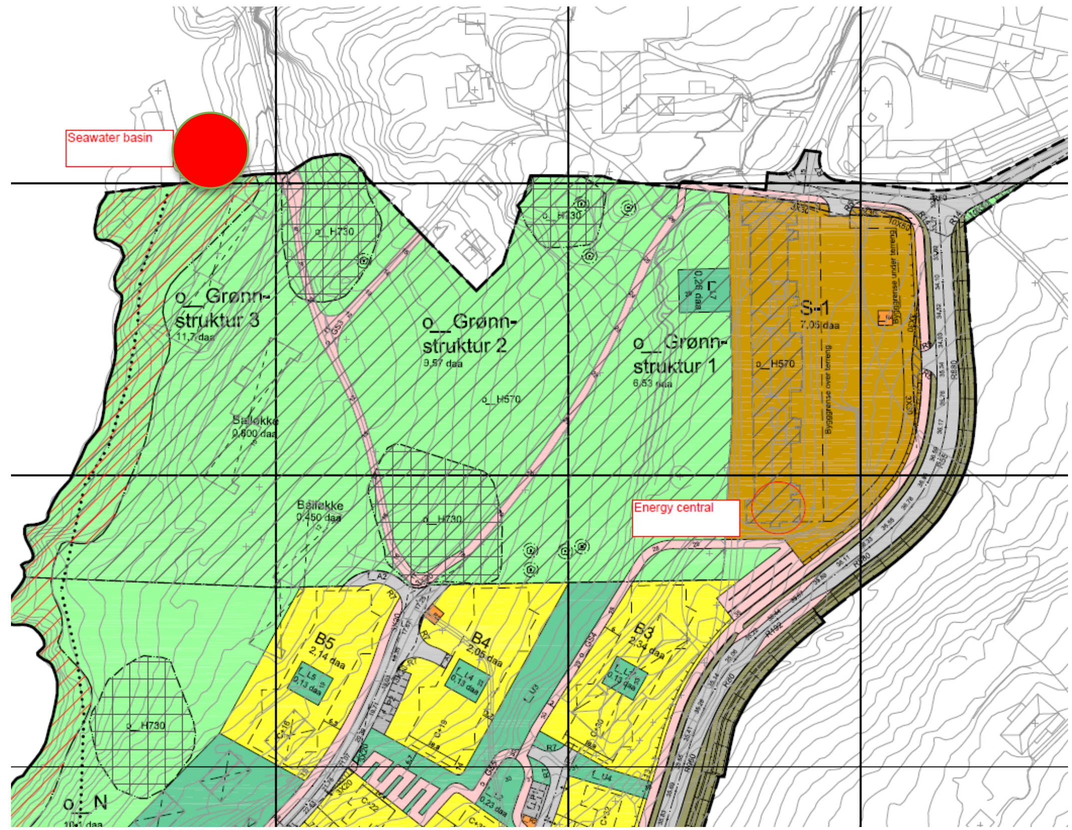


Sea water

- The heatsource for the heatpump will be seawater, which is the best local energy resource at Dale. A seawater basin is planned to be built near PIMES. This will be a solution which can be a basis for future development of Dale.

The Seawater basin

Possible visual solution



Accumulator tank

- 40 m3 accumulator tank
  will enable to reach this target

Photovaltaic panels

- Photovoltaic panels will be installed integrated on the roof of the 6 new multifamily buildings. The installation will cover 1.700 m2. The expected production from this plant is 200 MWh, which equals to 50% of the electricity demand to the heat pump, electronic boiler, and the operation of the seawater basin

Photovoltaic panels

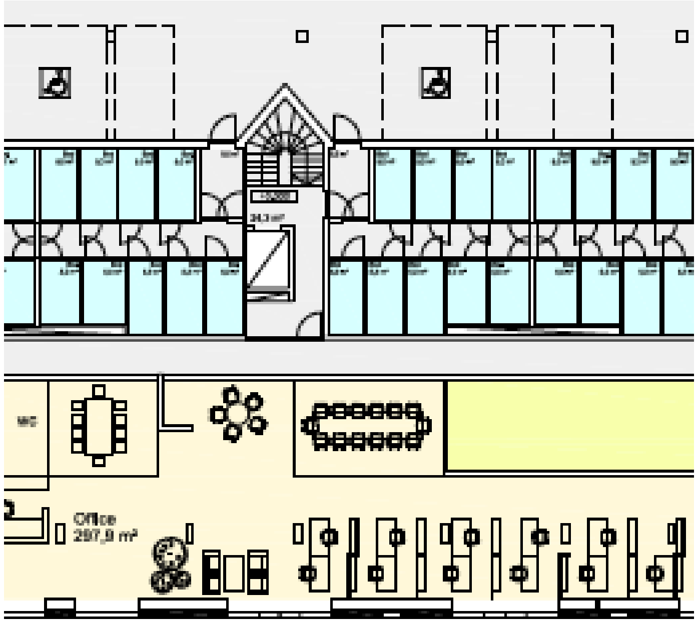
Micro-hydropower plant

- The old micro-hydropower plant at Dale, that was built in 1928 but ceased operation in 1967, will be reinstalled and operated. The plant is of historical value and is preserved. The micro-hydropower plant will only produce a limited amount of energy, but the energy will be delivered directly to the energy central

Peak load

- The peak load will be covered by a 400 kW electric boiler. The expected heat production with the electric boiler is only 56 MWh due to the large accumulator. The reserve load will be covered with the existing 900 kW LPG boiler, with a connection to the existing district heating network

Location



The potential for the heating central

- The energy central established for PIMES Dale could be done with about 92- 95 % reneweable heat supply.

- There will be potential for heat delivery to the double size of PIMES Dale, but the renewable share will fall to a normal level of 80%.

- Heating network should be adapted for connection to a future energy/heating center located centrally in future development area.

Transmission lines

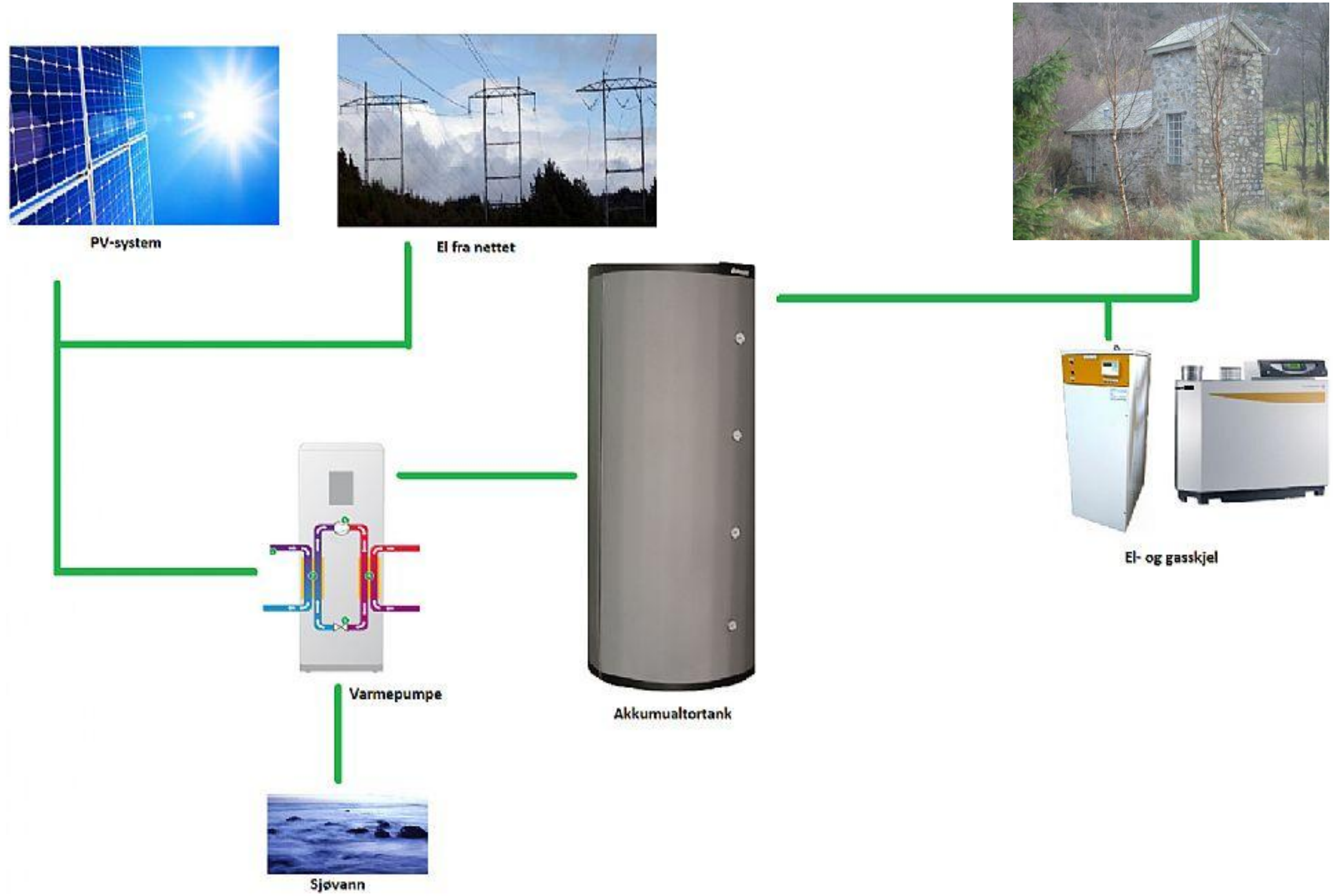
- The system of transmission lines is dimensioned for deltaT = 20K. Flow temperature, 55 °C

- When multi-family dwellings are located in close proximity to the energy plant, we may connect the multi-familiy buildings separate from the small houses.

- Advantages:
  - Without heat exchanger and expansion tank in the small houses
  - The water is kept pure in the energy central.

Separate transmission lines for multi-family dwellings and residence

Principal schema of Dale energy system



Cost estimate

Installed flat on tilted roof.
Installed power: 252 kWp. Exchange rate 7,50 kr/€.

Cost estimate	Optimistic	Realistic	Pessimistic
System price [€/kWp]	1,33	2,00	2,67
System price [kr/kWp]	9 975	15 000	20 025
Total investment[kr]	2 513 700	3 780 000	5 046 300
Production [MWh/år]	198	198	198
Profitability calculation: rate 4 %, 25 years			
Capital costs [kr/år]	160 907	241 965	323 024
Operating and maintenance costs, 2 %, [kr/kWh]	50 274	75 600	100 926
Costs for energy purchases[kr/kWh]	0	0	0
Total annual costs[kr/år]	**211 181**	**317 565**	**426 950**
Energy costs [kr/kWh]	**1,07**	**1,60**	**2,14**

DALE

Landsbyen ved fjorden