CHALLENGES IN ADOPTION OF DISTRICT COOLING IN DENSELY POPULATED AREAS

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GOAL

Minimization of investment/operational costs

Optimized positions of the heat pumps

Optimized number and positions of booster pumping stations

PROCEDURE

- Demand
- Definition of design parameters and constraints
- Network model programming
- Optimization

1- DEMAND

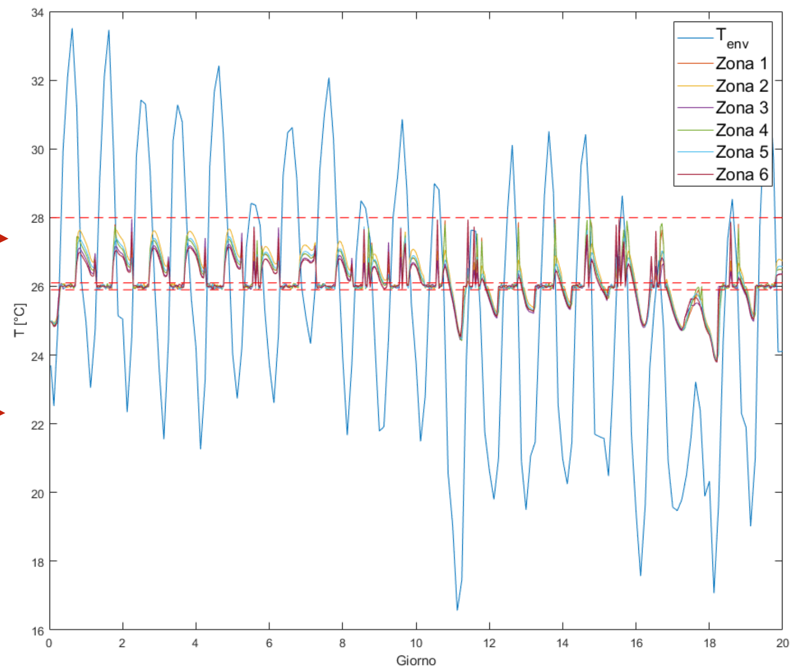
BUILDINGS CHARACTERISTICS (e.g. volume, shape, age, orientation)

METEREOLOGICAL DATA (temperature, solar radiation)

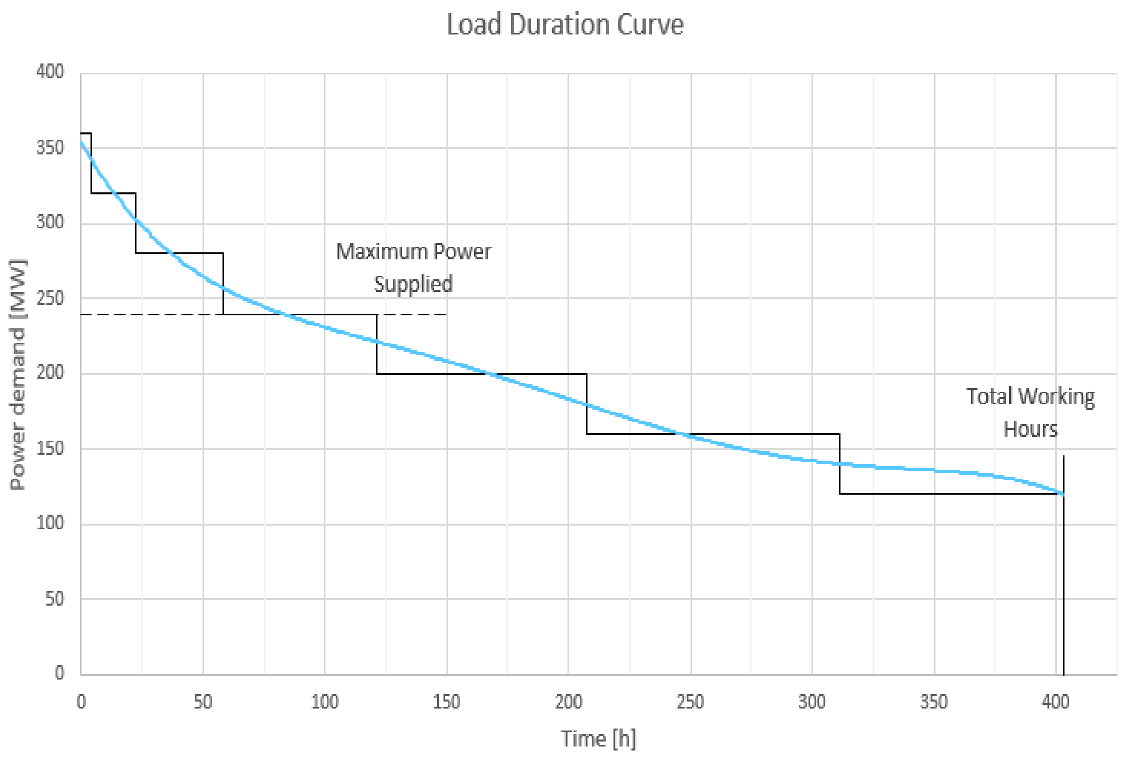
COMPACT MODEL

Cooling demand

Indoor temperature

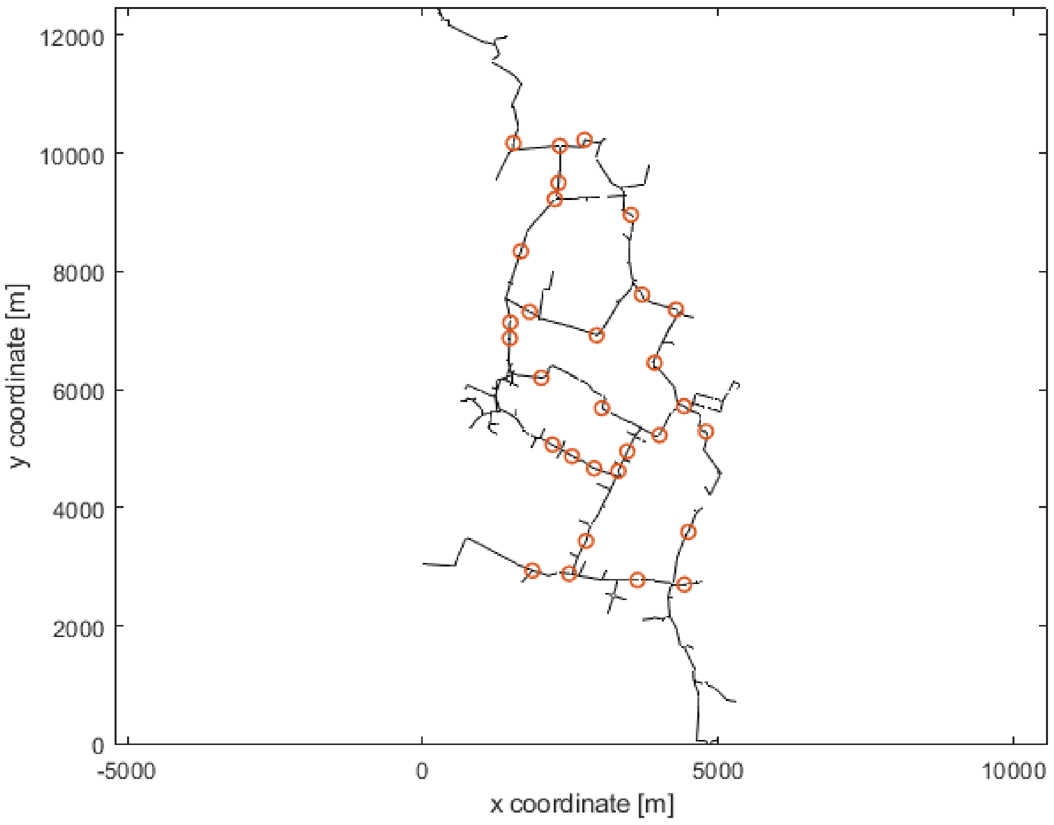


1- DEMAND



Load Duration Curve
Power demand [MW]
Time [h]
Maximum Power Supplied
Total Working Hours
0
50
100
150
200
250
300
350
400

2- POSSIBLE LOCATION OF HEAT PUMPS



Function variables:

- 30 possible positions of heat pumps

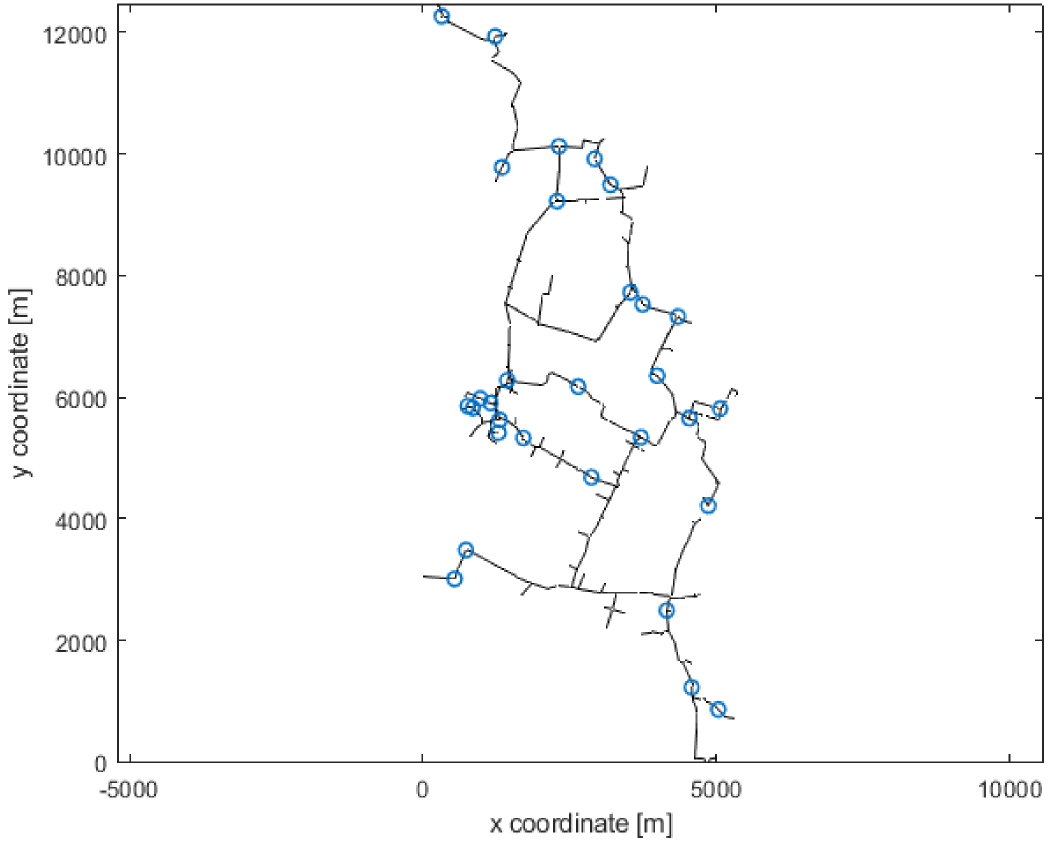
Objective function:

- Cost of the network

Constraints:

- 11 heat pumps
- Max of 3 HP per site

2- POSSIBLE LOCATION OF BOOSTER PUMPS



Function variables:

- 60 possible positions for booster pumping stations

Objective function:

- Minimum pumping power required

Constraints:

- 1.5 bar < pressure < 16 bar
- Limited number of pumps

3- COMPACT DETERMINISTIC MODEL RESULTS WITH SHEADING

The model used for solve the fluid dynamic and thermal problem of the network is based on the conservation equations: continuity, momentum and energy.

$$\Sigma G_{in} - \Sigma G_{out} = G_{ext}$$

$$AG + G_{ext} = 0$$

$$(p_{in} - p_{out}) = \frac{1}{2}\left(\frac{L}{D}f + \beta\right)\frac{G|G|}{\rho S^2} - \tau$$

$$A^T P = \Delta P$$

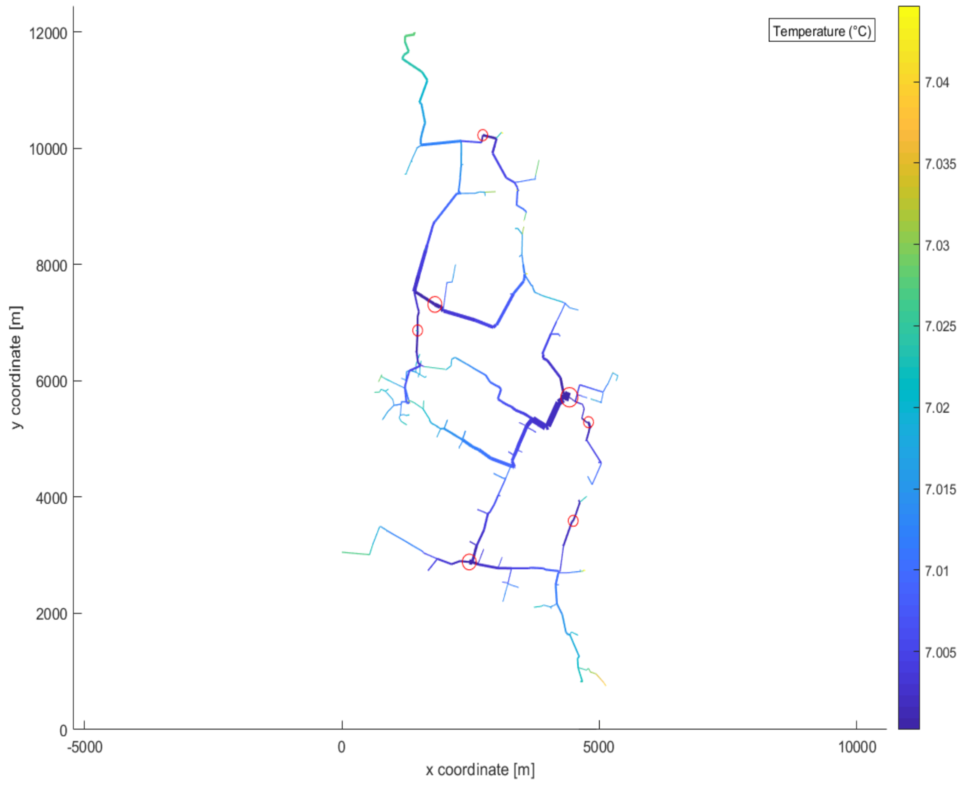
$$A_{1k}^T P = P_{imp}$$

$$\Sigma GcT = U(T - T_{env})$$

$$KT = g$$

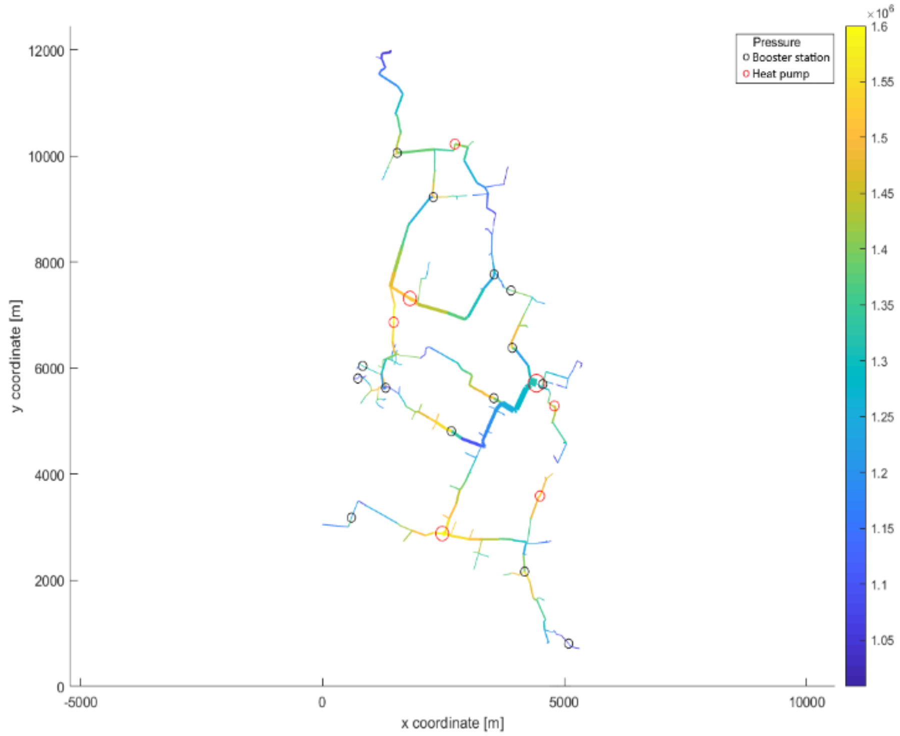
4 – OPTIMIZATION RESULTS

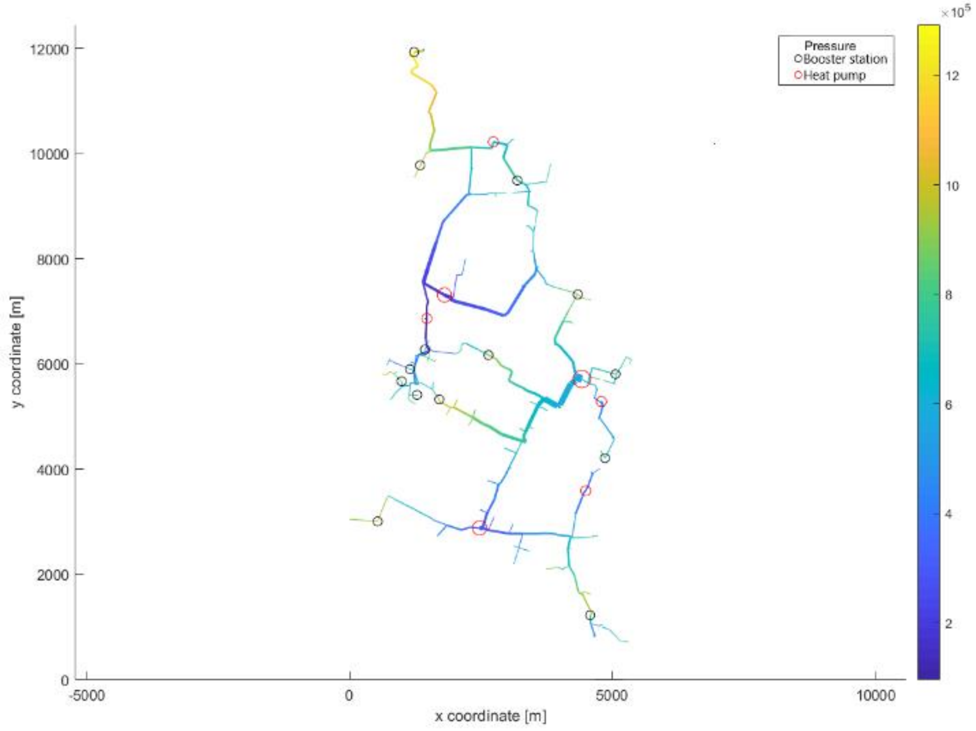
Temperature evolution of the fluid along the network with optimized position with heat pumps



4 – OPTIMIZATION RESULTS

Pressure evolution of the fluid along the network with optimized booster pumping station positions





CONCLUSIONS

Configuration	Heat loss [MW]	Average diameter [m]	Pumping cost [M€]	Pipes cost [M€]	Total cost [M€]
Centralized production	1,2	0,512	66,1	21,6	88,7
Optimized positions	0,7	0,313	31,4	13,5	44,9

THANK YOU FOR THE ATTENTION