

INTEGRATED DEMAND-SIDE AND PRODUCTION OPTIMIZATION OF COMPLEX DISTRICT HEATING AND COOLING NETWORKS



**POLITECNICO
DI TORINO**

Dipartimento
Energia

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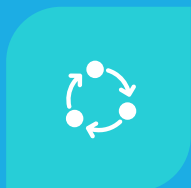
THE GOAL



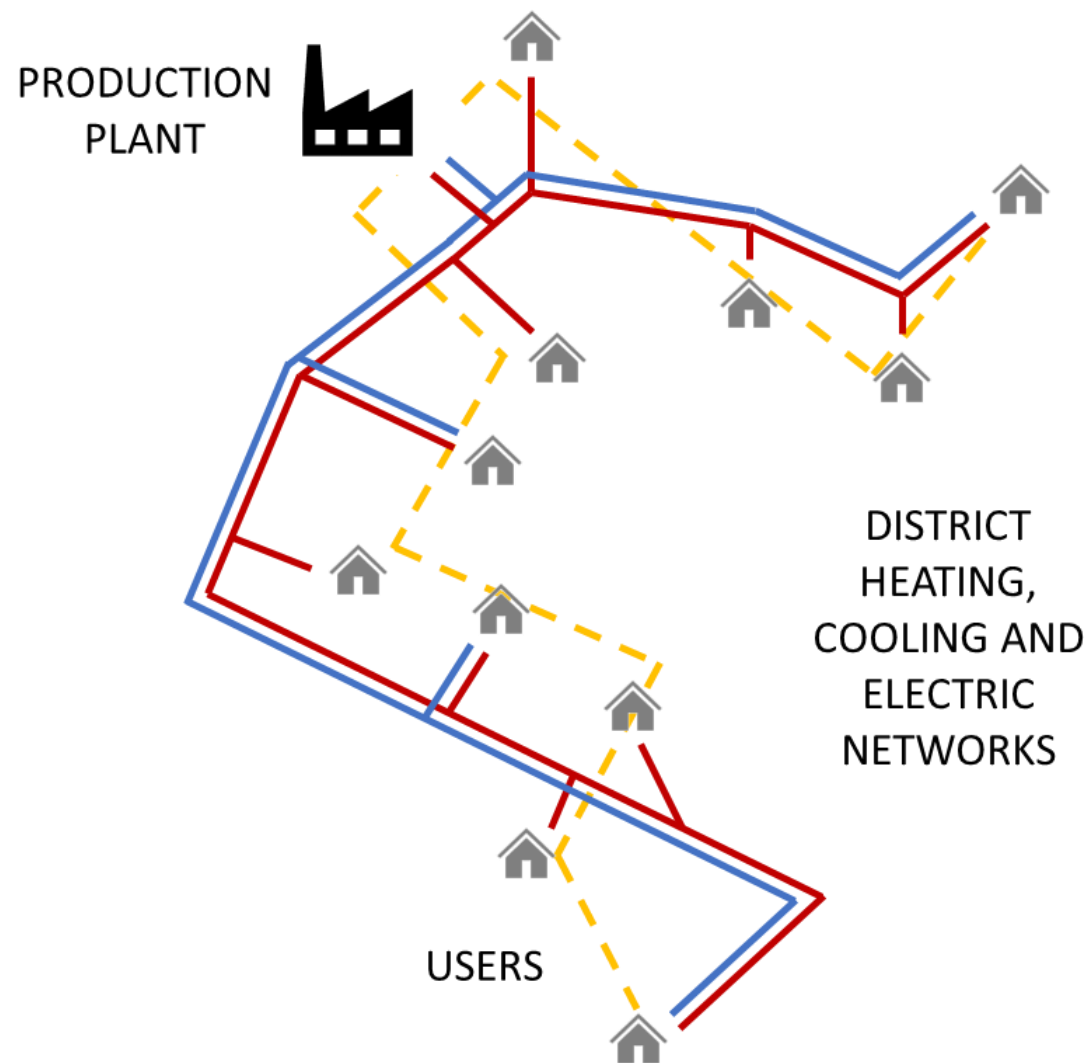
SATISFY THE DAILY HEAT, COOLING AND ELECTRICITY DEMAND OF THE **USERS**



FIND OUT WHICH IS THE OPTIMAL OPERATION OF THE **PRODUCTION PLANT**



DEVELOP A **GLOBAL OPTIMIZATION TOOL**, TAKING INTO ACCOUNT ALL MAJOR ELEMENTS OF THE SYSTEM



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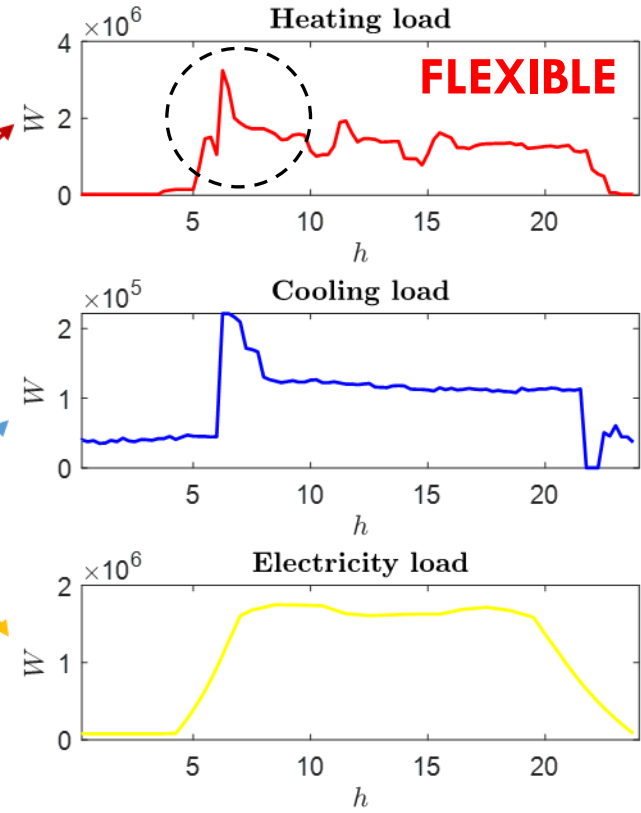
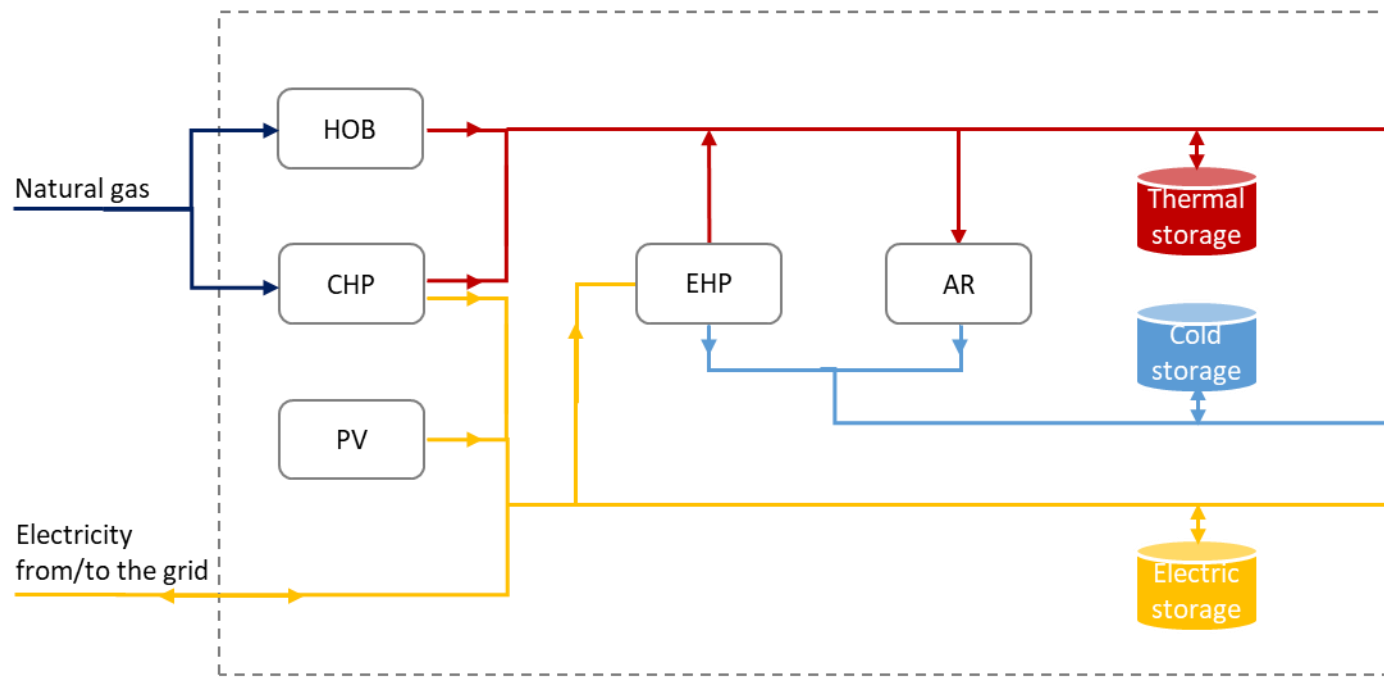
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THE PRODUCTION PLANT



Assumption: constant efficiencies \rightarrow Linear Programming



DEMAND SIDE MANAGEMENT



Find the best set of **anticipations** in order to minimize the **peak request**

DISTRICT HEATING NETWORK MODEL

Physical model of
the heating network

Based on
conservation
equations of mass,
momentum and
energy

Pseudo-dynamic
approach

Graph theory

Applied both to the
supply and return
lines of the district
heating network



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GLOBAL OPTIMIZATION TOOL

1. DEMAND SIDE MANAGEMENT OF DISTRICT HEATING USERS

Goal: to find the best set of anticipation time of the buildings

Strategy: genetic algorithm

2. DH NETWORK MODEL

Goal: to simulate the network behavior and to obtain the thermal load at plant level

Strategy: thermo-fluid dynamic model

3. PRODUCTION OPTIMIZATION

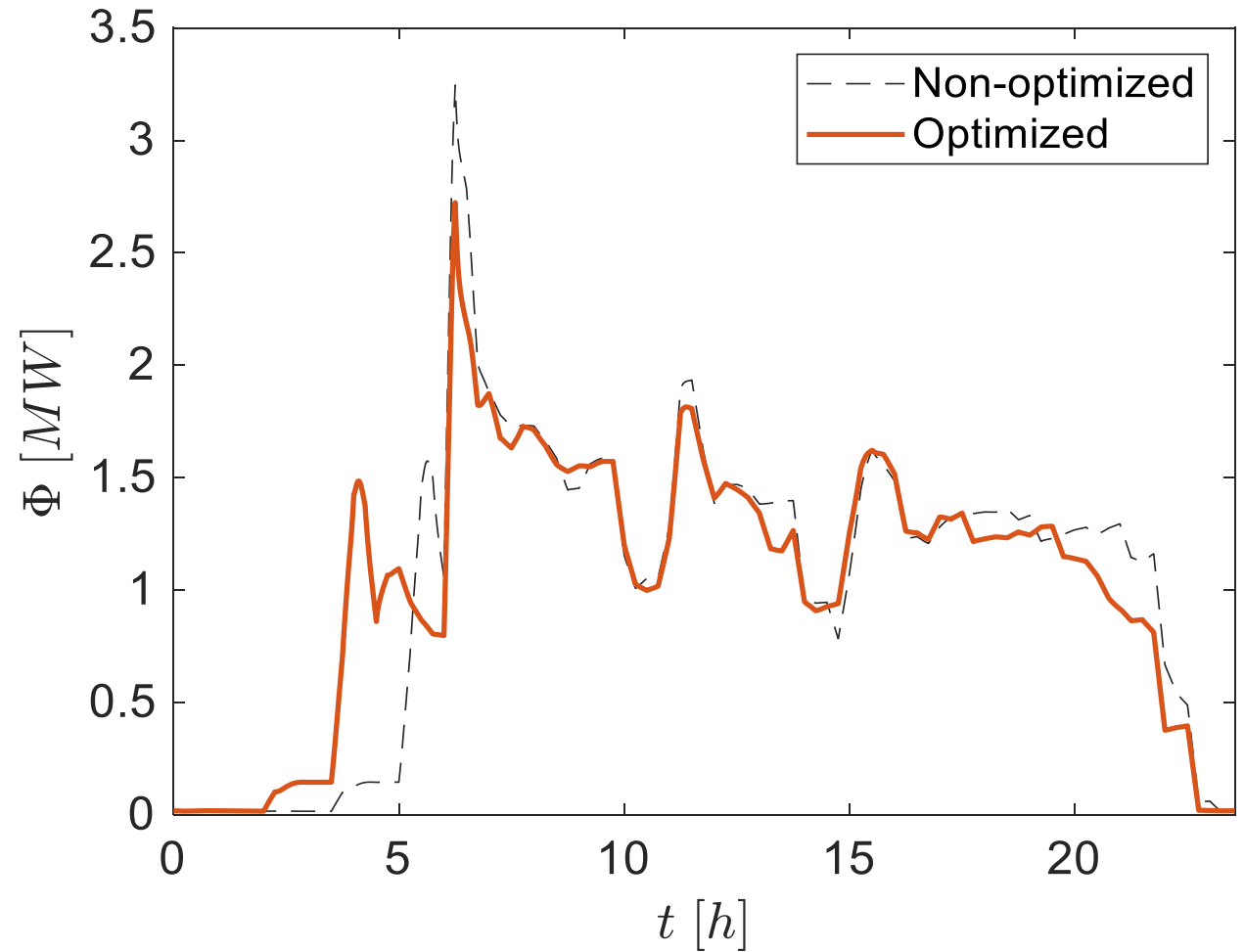
Goal: to determine, given a set of production units, which ones must be switched on in order to minimize an OF

Strategy: linear programming algorithm



RESULTS

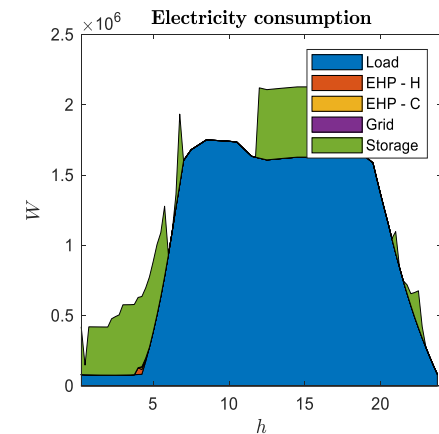
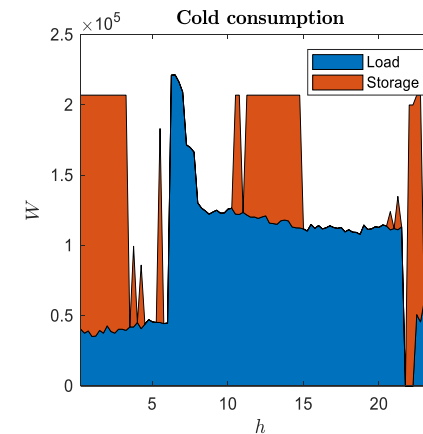
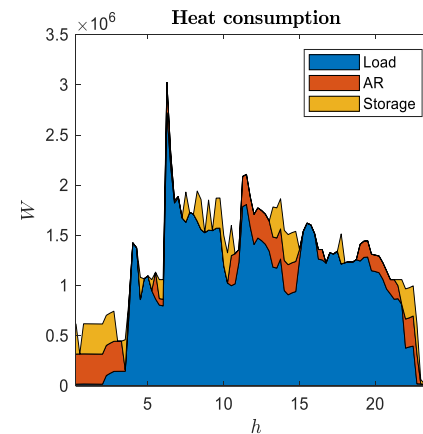
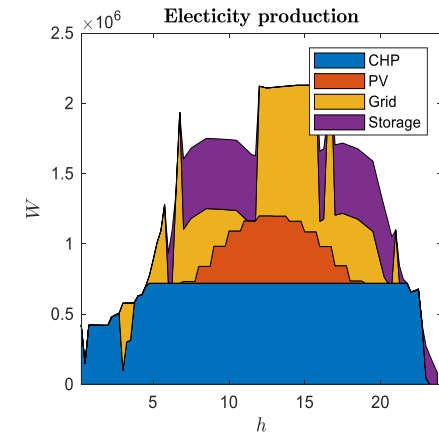
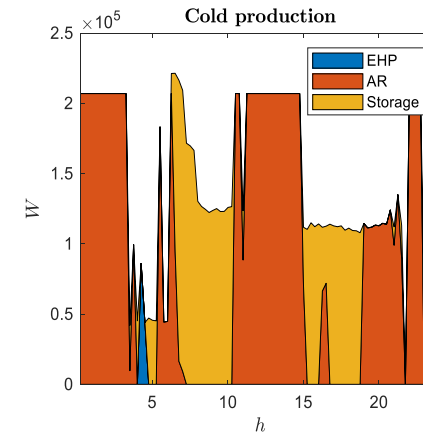
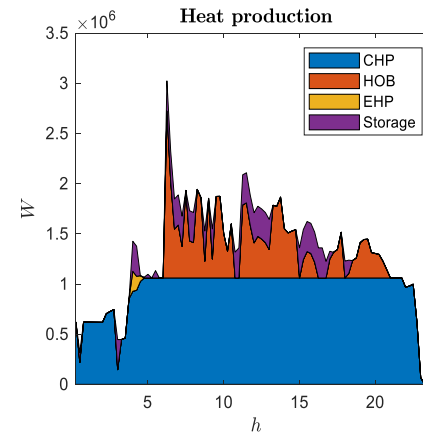
- Modification of the plant thermal load
- 15.6 % peak reduction in the thermal demand



RESULTS

- Smart management of the production units
- Significant cost reductions

Description	Storages	Production Optimization	DSM	Integrated approach	Total cost [€/day]	Reduction
Base case					2782.6	
Production optimization	✓	✓			2471.1	-11.2%
Sequential approach	✓	✓	✓		2427.0	-12.8%
Proposed approach	✓	✓	✓	✓	2368.6	-14.9%





The proposed approach brings to promising results



Improvements can be further enhanced by enlarging the flexibility of end-users



The model could be applied to larger systems in order to obtain more relevant results at a global level

CONCLUSIONS



Also the cooling and electricity loads can be assumed flexible



Number and complexity of production units can be increased



Non-linearities can be introduced in the model (MINLP)



The production units can be imagined as distributed along the district energy network

FUTURE WORKS

THANK YOU FOR YOUR
ATTENTION



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