MAXIMIZE THE EFFECTS OF DISTRICT HEATING DEMAND RESPONSE IN MULTI-ENERGY OPTIMIZATION

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Dipartimento Energia

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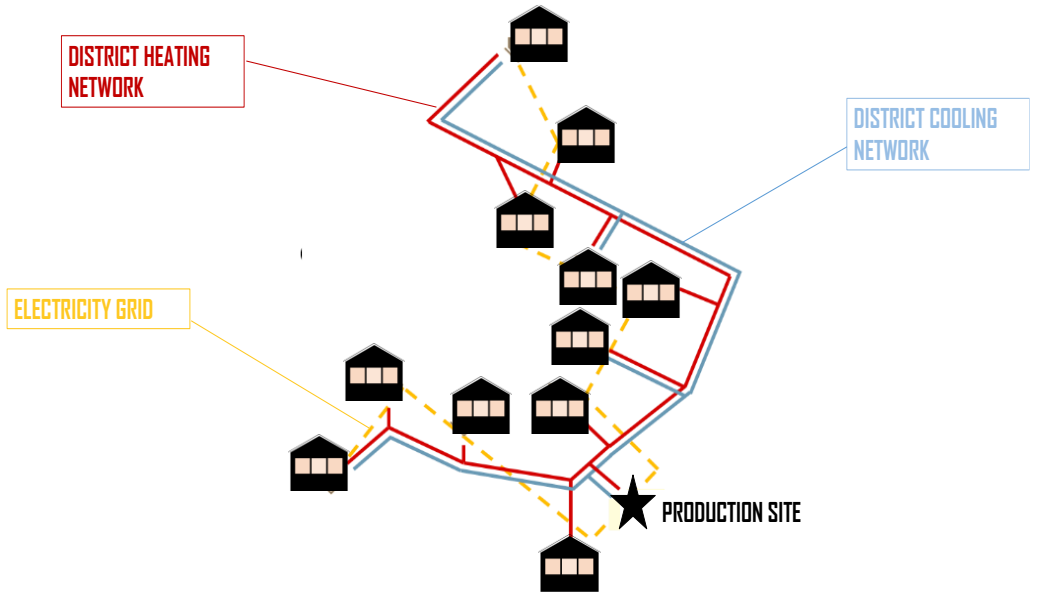
THE FRAMEWORK (A MULTI-ENERGY DISTRICT)

3 ENERGY VECTORS

(HOT, COLD, ELECTRICITY)

AND THE RESPECTIVELY GRIDS



THE TECHNOLOGIES

TECHNOLOGIES FOR ENERGY VECTOR CONVERSION:

COMBINED HEAT AND POWER PLANT (CHP),

HEAT ONLY BOILER (HOB),

PHOTOVOLTAICS (PV)

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GOALS

APPLY
DEMAND SIDE MANAGEMENT
IN A SMART WAY

OPTIMIZE THE
ENERGY PRODUCTION
(COLD, HOT AND ELECTRICITY)

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DEMAND SIDE MANAGEMENT ON DISTRICT HEATING THERMAL LOAD

FORECAST OF THE BUILDING THERMAL DEMAND

DEMAND SIDE MANAGEMENT IS APPLIED TO ACHIEVE A SPECIFIC GOAL (E.G. PEAK SHAVING, COST REDUCTION ETC)

CASE A -DSM BEFORE THE OPTIMAL PRODUCTION-

FORECAST OF THE BUILDING THERMAL DEMAND

DEMAND SIDE MANAGEMENT IS APPLIED IN A FRAMEWORK OF PRODUCTION OPTIMIZATION

CASE B -DSM COMBINED TO THE OPTIMAL PRODUCTION-

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THE AVAILABLE TECHNOLOGIES

GRIDS

ELECTRIC GRID

THERMAL GRID

COLD GRID

ENERGY SYSTEM

PHOTOVOLTAIC (PV) PANEL

GRID PURCHASE

STORAGE UNITS

ELECTRIC CHILLER

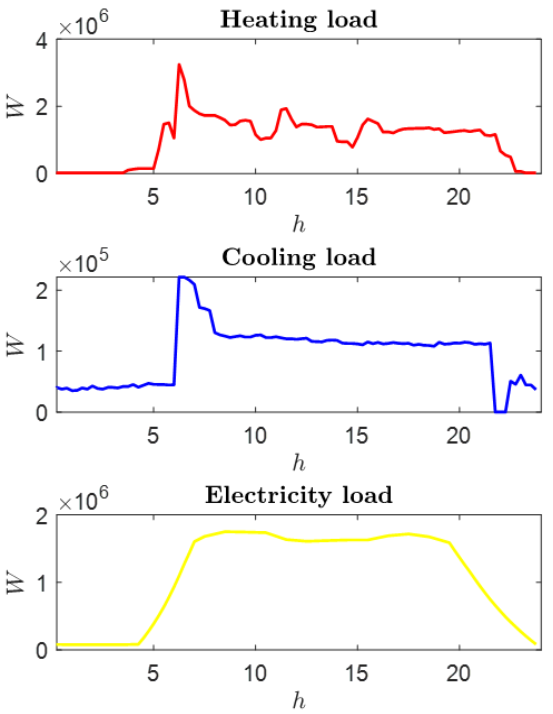
BOILER

ABSORPTION CHILLER

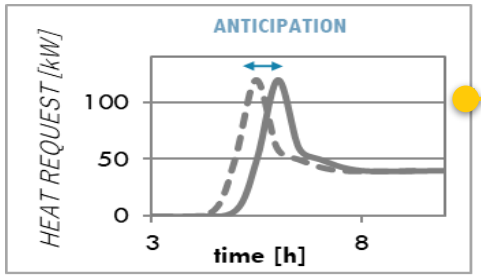
COMBINED HEAT AND POWER (CHP)

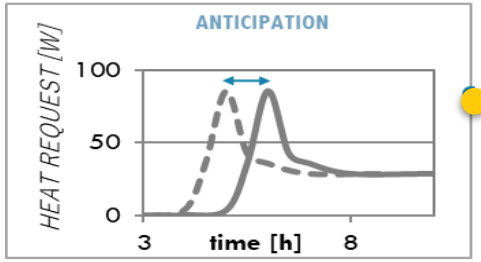
GAS HEAT PUMP (GHP)

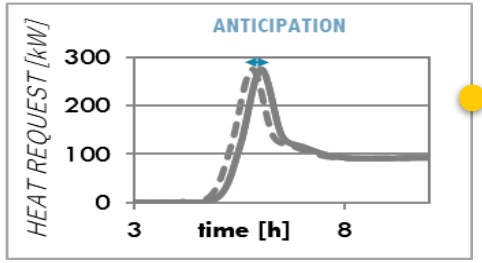
DEMAND

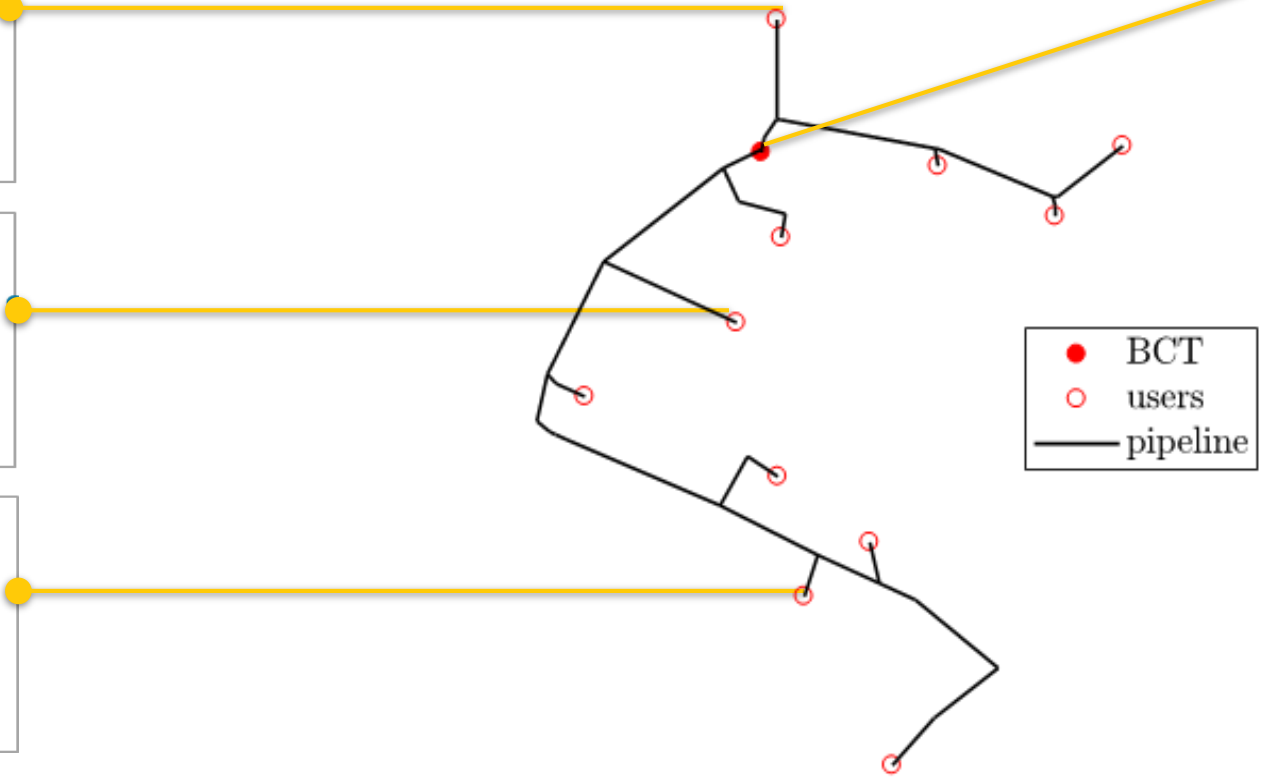


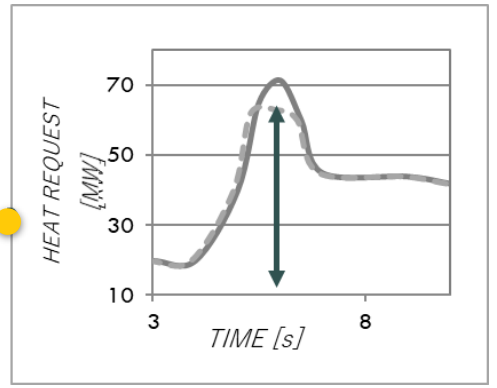
DEMAND SIDE MANAGEMENT











FIND THE BEST DEMAND SIDE MANAGEMENT OPTION

THERMAL NETWORK SIMULATION

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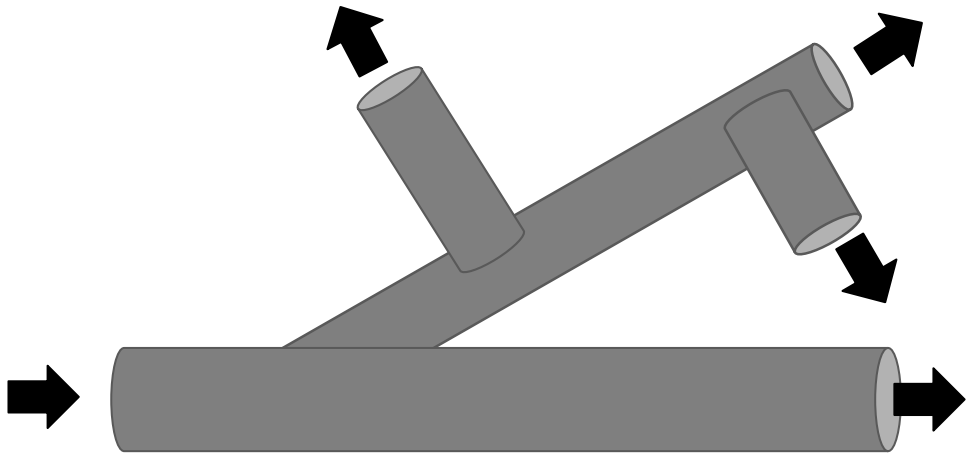
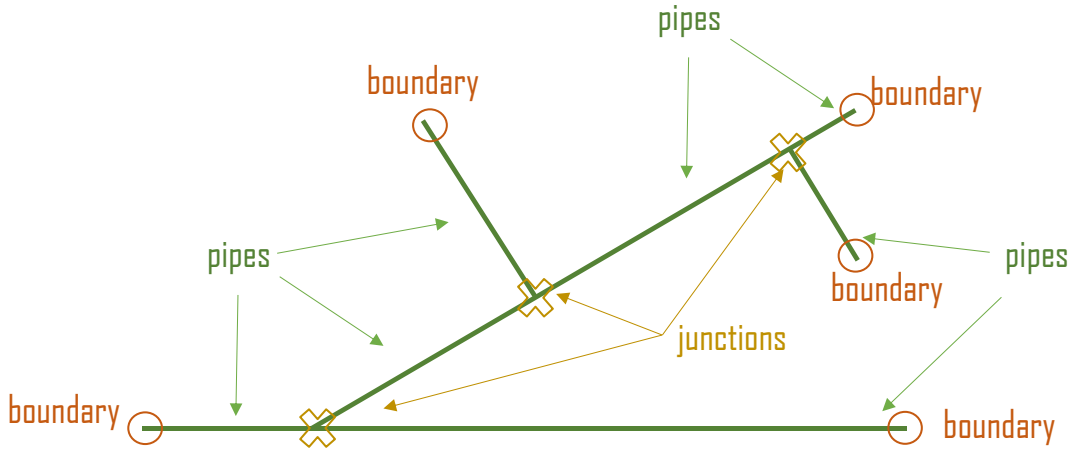
DISTRICT HEATING NETWORK MODEL

- **Physical** model of the heating network
- Based on **conservation equations** of mass, momentum and energy
- **Graph Approach**





OPTIMIZATION

CASE A

DSM BEFORE THE OPTIMAL PRODUCTION

SELECTION OF THE BEST **DEMAND SIDE MANAGEMENT (FOR PEAK SHAVING)**

SELECTION OF THE BEST A) TECHNOLOGY LOADS AND B) POWER ABSORBED BY THE GRID (COST MINIMIZATION)

BEST MANAGEMENT

CASE B

DSM COMBINED TO THE OPTIMAL PRODUCTION

SELECTION OF THE BEST A) TECHNOLOGY LOADS AND B) POWER ABSORBED BY THE GRID

SELECTION OF THE BEST **DEMAND SIDE MANAGEMENT**

COMBINED OPTIMIZATION FOR COST MINIMIZATION

BEST MANAGEMENT

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RESULTS

NO STORAGES

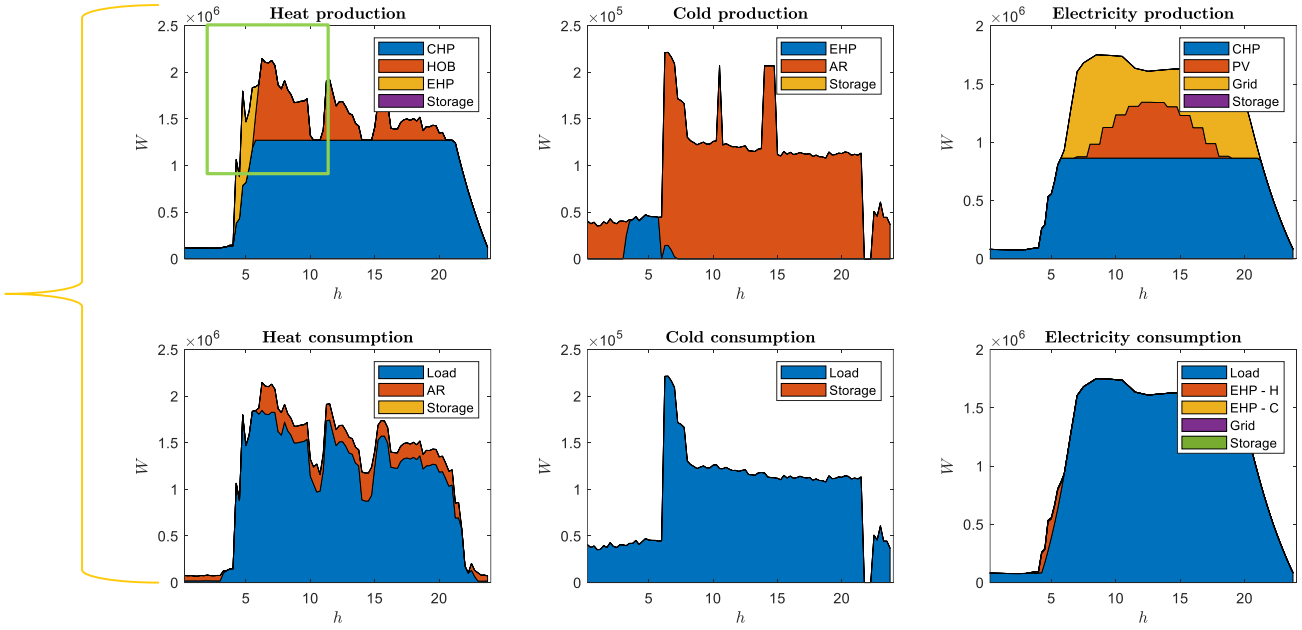
CASE A
DSM BEFORE THE OPTIMAL PRODUCTION

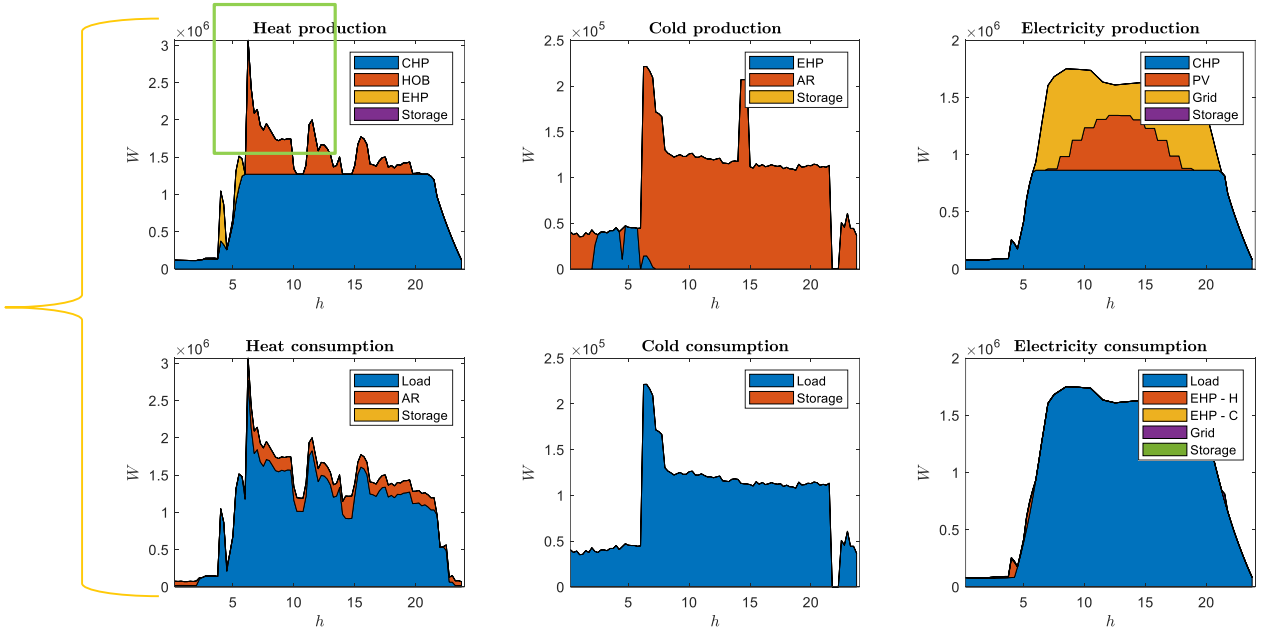
2439 €/day

VARIATION IN COST IS ONLY -**0.3%**

CASE B
DSM COMBINED TO THE OPTIMAL PRODUCTION

2431 €/day





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RESULTS

WITH STORAGES

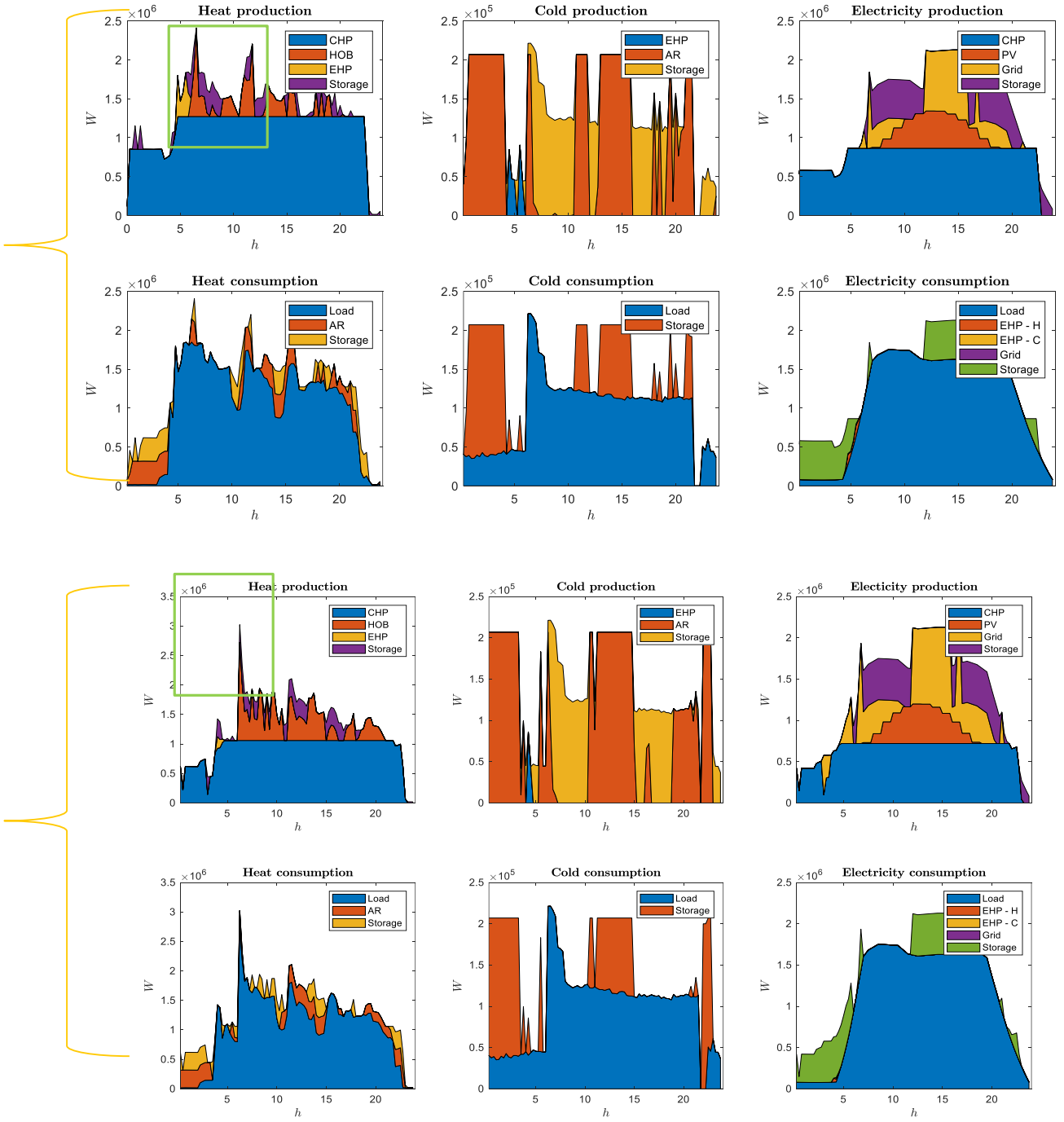
CASE A
DSM BEFORE THE OPTIMAL PRODUCTION

2370 €/day

VARIATION IN COST IS **-2.5%**

CASE B
DSM COMBINED TO THE OPTIMAL PRODUCTION

2428 €/day



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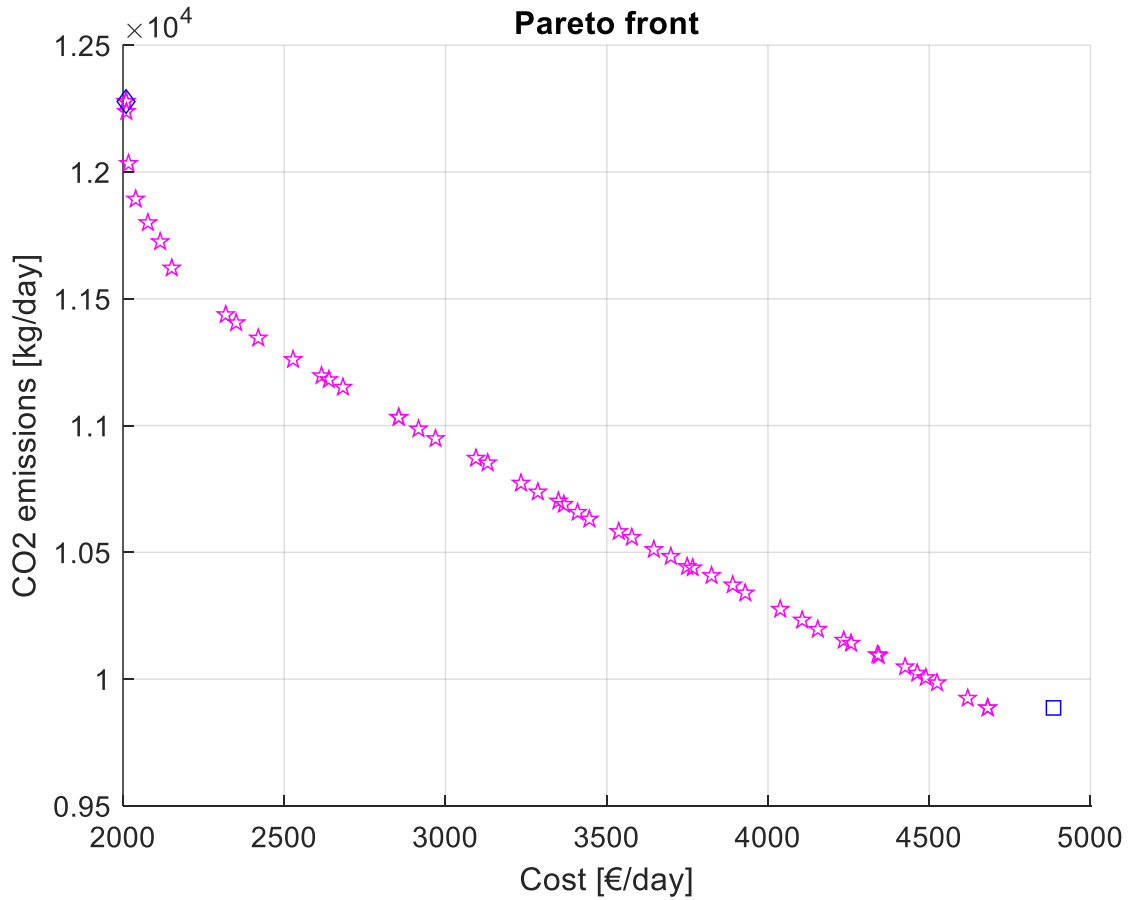
RESULTS

- **MULTI-OBJECTIVE OPTIMIZATION:**

ECONOMIC OPTIMIZATION

ENERGY OPTIMIZATION



CONCLUSION AND NEXT STEPS

- DSM is a useful approach to reduce thermal peaks
- The benefits can significantly enhanced if DSM combined with a production optimization (especially in case of storage availability)
- The objective functions (environmental and economic) can be in discordance; in this case a multi-objective optimization is a suitable approach

THANK YOU FOR YOUR ATTENTION

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