Supplementary Materials

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1 Expression of the thermal resistances

The detailed expressions of the thermal resistance of the HES and radiator related to the mass flow rates in (32) and (33) are:

$$R_{i,t}^{HES} = \frac{\dot{m}_i c_p e^{\frac{kA_i^{HES}}{\dot{m}_{i,t}^{HES} c_p}} - \dot{m}_{i,t}^{HES} c_p e^{\frac{kA_i^{HES}}{\dot{m}_i c_p}}}{\dot{m}_i c_p \dot{m}_{i,t}^{HES} c_p \left(e^{\frac{kA_i^{HES}}{\dot{m}_{i,t}^{HES} c_p}} - e^{\frac{kA_i^{HES}}{\dot{m}_i c_p}} \right)} \tag{32}$$

$$R_{i,t}^{RAD} = 1/\left[\dot{m}_{i,t}^{SHN} c_p \left(1 - e^{-\frac{kA_i^{RAD}}{\dot{m}_{i,t}^{SHN} c_p}} \right) \right] \tag{33}$$

where kA represents the heat transfer coefficient multiplied by the area of the HES and the radiator.

2 Configuration of the system

The configuration of the system and the cost functions of CHPs can be found in **System Configurations.xlsx**. The topology is defined in **topology.py**

3 Decentralized optimization on a 44-node system

Fig. 1 shows the sketch of a 44-node system. For brevity, only supply water pipelines are presented and the return pipelines are of symmetric topology. 9 nodes(1, 6, 7, 13, 23, 28, 29, 30, 31) are equipped with CHPs and HPs and thses nodes strongly couple the two systems together.

The iteration trajectories is shown in Fig. 2. The number of iterations does not vary greatly compared to the 17 node system. The overall solving time is acceptable

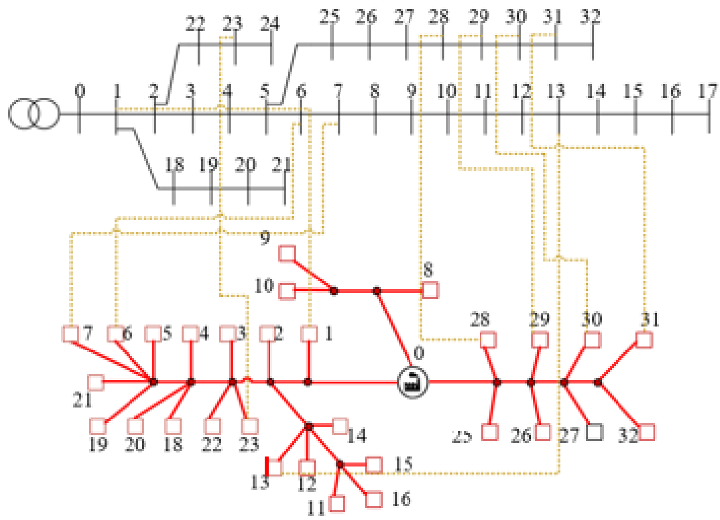

Figure 1: The sketch of a 44-node system

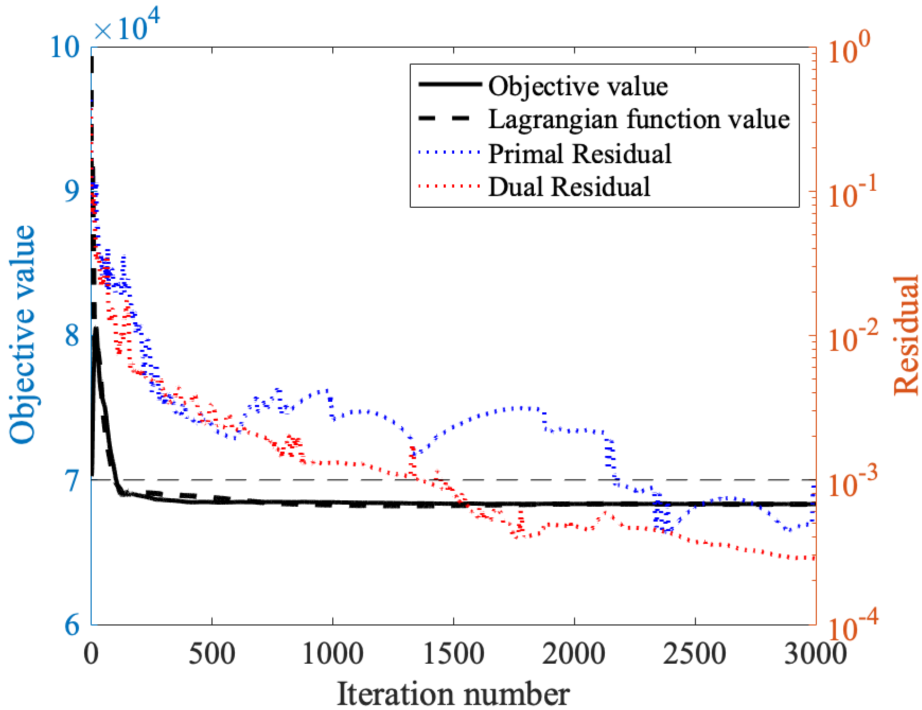

Figure 2: Iteration trajectories of the 44-node system