

Assignment 5 – Optimal equipment sequencing Building Energy Management and Optimization BLDG 530 I

Your client operates a district heating and cooling plant. The operators want to decide which boilers and chillers should be turned on to deliver the forecasted heating and cooling demand. The boilers operate with natural gas, and the chillers operate with electricity. The plant contains four large boilers and five large chillers. Each equipment has a unique non-linear part-load efficiency curve and capacity. Boilers 1 to 3 have a heating capacity of 6.6 MW, and Boiler 4 has a capacity of 3.1 MW. Chillers 1 to 5 have 2.8, 2.7, 3.2, 3.5, and 4.9 MW, respectively. The client is asking you to prepare a look-up table to help operators decide which boilers / chillers shall be turned on given a heating / cooling load forecast (e.g., if heating load will be 10 MW, turn on boilers 1 and 2).

1. Use the part-load efficiency / COP data provided and develop part-load efficiency curves, second-order polynomials should be sufficient. ($y = a \cdot x^2 + b \cdot x + c$ where y is the efficiency or COP, x is the part-load ratio, and a , b , and c are regression parameters to be estimated)
2. Formulate an optimization problem to maximize the overall plant efficiency to deliver a given heating / cooling load. Idealize the equipment efficiencies with the part-load efficiency curves developed in step 1. Your constraints are individual equipment capacities, and your objective is to maximize the efficiency.
3. Transfer the optimization logic you formulated in step 2 to a Matlab or Python script. Develop a look-up table to determine which boilers and chillers shall be switched on to maximize the plant efficiency at 1 MW heating and cooling load increments (i.e., 1, 2, 3, etc.).

Submit a PDF explaining the analysis and the script file. The Matlab / Python script shall read the data provided to you, carry out analysis, and generate relevant figures. Working in groups is acceptable and encouraged but this is an individual assignment – copying and plagiarism will not be tolerated.