Algorithm Take Home Challenge

The Dev-Team wants to build a product for a new customer. In order to do this the team wants to build up an MVP. Your part of the MVP is to build an optimization problem and solve it. Your code should read in data and runs an optimization algorithm (formulated below). The results' analysis is not in the scope of this project. It is sufficient to extract the objective value as a final result. The program can be written either in julia or python. Take your best. Since this challenge is not very short we would like you to watch the time it takes you. Please do not spend over 5 hours on this challenge. If you cannot finish the challenge within 5 hours, we would encourage you to send us your result anyway.

The problem should present the operation of an energy system. The energy system of this customer that is considered in the MVP consists of the following components:

- Gasturbine (producing electricity)
- Photovoltaic Unit (producing electricity)
- Gas Boiler (producing heat)
- Electric Boiler (producing heat, using electricity as an input)

On the consumption side, we have given a heat and an electricity demand. For electricity, we are looking at an isolated system. Therefore, electricity can only be provided by the Gasturbine and the Photovoltaic Unit.

Input Data:

Within the data folder, there are 4 different CSV-Files. 2 represent a time-series for the demands (heat_demand.csv and electricity_demand.csv), 1 presents the availability of the photovoltaic unit (photovoltaic_availability.csv) and the last one contains all parameters of the components in the system (parameter.csv).

The parameter capacity always refers to the output capacity of the component.
The photovoltaic availability is given as the share that is available in the respective hour (1 → full capacity available, 0 → no capacity available)

The price for using gas should be taken as a constant value of 35 €/MWh.

Optimization Problem:

In the following, you will find the operational equations for the optimization problem. The problem is solved within a single energy balance. Extend the model by formulations to properly consider the gas price.

The objective functions should minimize the overall costs.

Operational Equations:

Gas Boiler:
0 <= Generation(heat)(t) <= capacity

Electric Boiler:
0 <= Generation(heat)(t) <= capacity
Generation(heat)(t) = Input(electricity)(t) * efficiency

Gasturbine:
0 <= Generation(electricity)(t) <= capacity

Photovoltaic:
0 <= Generation(electricity)(t) <= capacity * availability(t)

Electricity demand:
Consumption(electricity)(t) = electricity_demand(t)

Heat demand:
Consumption(heat)(t) = heat_demand(t)

Annotations

In this challenge, we will not be focussing exclusively on the result. Above all, we are focussing on the quality of the code, comprehensibility and expandability.