First steps with the Graphical User Interface (GUI) of AutoMoG

Setting Up the data of an energy system to use in GUI

To model and optimize a new energy system with the GUI, no changes in the source code are needed. However, you have to provide some specific files in a particular structure for the GUI to work correctly. In general, it is beneficial to orientate your new data structure on existing and working folders already used. The following steps sum up all essential information needed to set up a new energy system and start working with the GUI.

1. Create folder structure

- Go to …\automog\data and create a folder with the name of your energy system
- All other folders you may see in the given examples are automatically set up when using the GUI functions that produce data for them

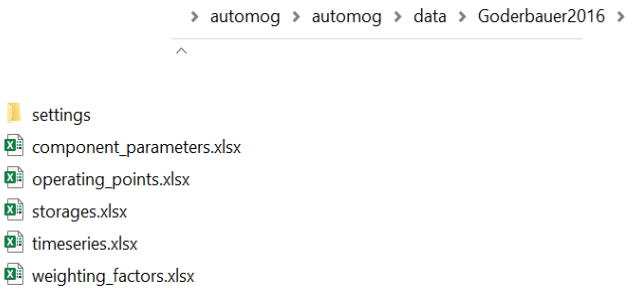
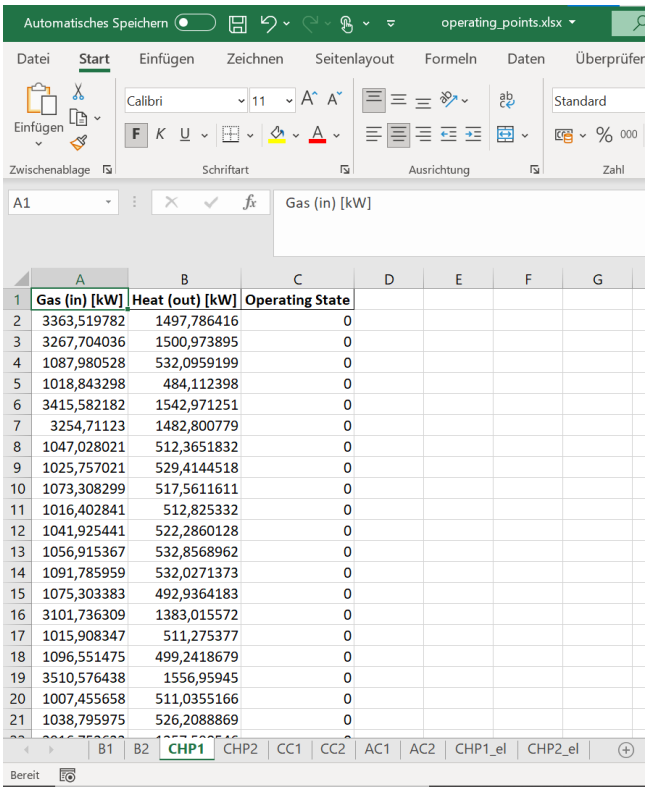


Figure 1: File system structure

2. Provide data files

The following files must be in your working directory with the exact names and types provided here if not stated otherwise. No changes in the source code are necessary. For each file, we note if it is mandatory to model and/or optimize your system:

- Excel file for operating points
  - Modeling: mandatory; Optimization: mandatory
  - The file contains the operating points of the components of your energy system
  - The file name can be chosen freely, as long as it is a ".xlsx" file, e.g., "operating_points.xlsx"
  - One sheet for each component of your energy system
  - Each sheet must contain one column with the input data and at least one column with the output data of the component
  - As the header of a column, use the name of the product and add 1 out of 3 keys:
    - (in) for a component input (e.g., "Gas (in)" for a gas boiler)
    - (out) for a component output (e.g., "Heat (out)" for a gas boiler)
    - (param) if the data is neither input nor output but a necessary parameter, e.g., the ambient temperature that affects the component performance ("Temperature (param)", see example "GuD_modeling_showcase")

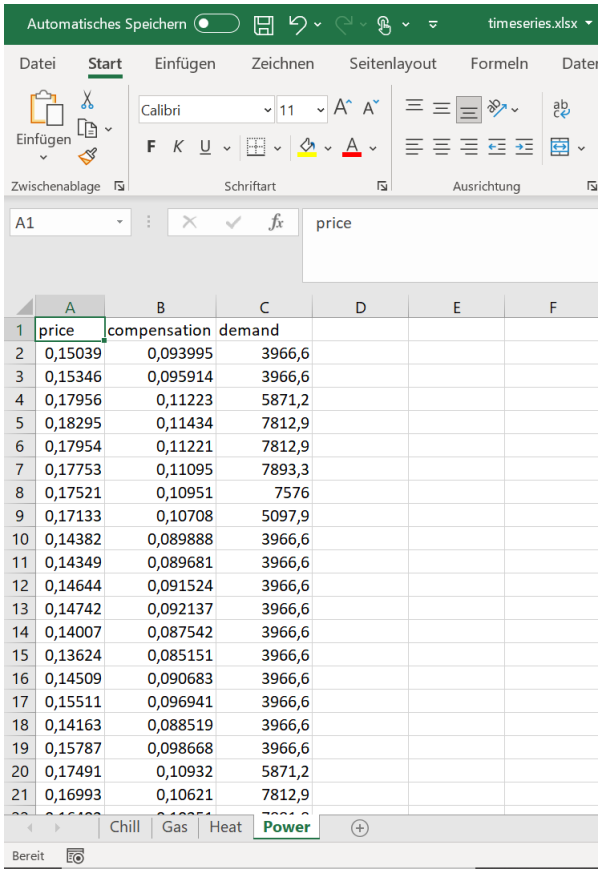


	A	B	C	D	E	F	G
1	Gas (in) [kW]	Heat (out) [kW]	Operating State				
2	3363,519782	1497,786416	0				
3	3267,704036	1500,973895	0				
4	1087,980528	532,0959199	0				
5	1018,843298	484,112398	0				
6	3415,582182	1542,971251	0				
7	3254,71123	1482,800779	0				
8	1047,028021	512,3651832	0				
9	1025,757021	529,4144518	0				
10	1073,308299	517,5611611	0				
11	1016,402841	512,825332	0				
12	1041,925441	522,2860128	0				
13	1056,915367	532,8568962	0				
14	1091,785959	532,0271373	0				
15	1075,303383	492,9364183	0				
16	3101,736309	1383,015572	0				
17	1015,908347	511,275377	0				
18	1096,551475	499,2418679	0				
19	3510,576438	1556,95945	0				
20	1007,455658	511,0355166	0				
21	1038,795975	526,2088869	0				

Figure 2: Excel file for operating points

- Optional: you may add units in square brackets for visualization in the GUI, e.g., "Heat (in) [kW]" (please note that the GUI does not recognize the units and does not perform any unit conversion)
- AutoMoG fits one function per sheet. The function is always fitted to the first column with "(in)" as key. The number of columns is arbitrary. However, the GUI can only visualize functions for sheets with 2 or 3 columns
- If you have a component with multiple functions that are connected (e.g., a CHP engine with a fixed power/heat ratio), you can define "subcomponents"
    - Create separate sheets for each input/output pairing. The names of the additional component sheets must include an underscore, which is used in the GUI to identify the "subcomponents" → see the CHP component in the "Goderbauer2016" example
- If you have different operating states you want to be considered, you can add a third column called "Operating State", in which you can put an integer number of the state this operating point belongs to
    - Every operating point needs to be assigned to a cluster to be able to load the data into the GUI
    - This column can also be automatically created with the clustering methods within the GUI

- Time series Excel file
    - Modeling: optional (only necessary for objective function mode); Optimization: mandatory
    - Excel files with a time series of demands, prices and compensation for products of the energy system
    - The name of the file must be "timeseries.xlsx"
    - One sheet for every input and output of the energy system
    - In each sheet, you can insert data in columns named "price", "compensation" and/or "demand", depending on which data exists and should be used. Note that the GUI will make assumptions based on which information are provided, e.g., if compensation for power is provided in the time series, the GUI includes the option to sell power



	A	B	C
1	price	compensation	demand
2	0,15039	0,093995	3966,6
3	0,15346	0,095914	3966,6
4	0,17956	0,11223	5871,2
5	0,18295	0,11434	7812,9
6	0,17954	0,11221	7812,9
7	0,17753	0,11095	7893,3
8	0,17521	0,10951	7576
9	0,17133	0,10708	5097,9
10	0,14382	0,089888	3966,6
11	0,14349	0,089681	3966,6
12	0,14644	0,091524	3966,6
13	0,14742	0,092137	3966,6
14	0,14007	0,087542	3966,6
15	0,13624	0,085151	3966,6
16	0,14509	0,090683	3966,6
17	0,15511	0,096941	3966,6
18	0,14163	0,088519	3966,6
19	0,15787	0,098668	3966,6
20	0,17491	0,10932	5871,2
21	0,16993	0,10621	7812,9

Figure 3: Time series Excel file

- Weighting factors Excel file
    - Modeling: mandatory for weighted error mode; Optimization: not necessary
    - In this file, the weighting factors used in the weighted error mode of the model generation are stored
    - The file name must be "weighting_factors.xlsx" or "weighting_factors.csv"
    - In each column, use the input as the header with the desired weighting factor below

- There has to be one weighting factor for every input
- There has to be only one sheet, of which the name is irrelevant

	A	B	C
1	Gas	Power	Heat
2	0,06	0,1617	0,075

Figure 4: Weighting factors Excel file

- Component parameters Excel file
  - Modeling: not necessary; Optimization: optional
  - With this file, you can consider additional parameters and constraints for the components: ramping rate, minimum downtime, minimum uptime, start cost, and revision
  - You can select in the GUI which of the provided parameters and constraints shall be active in the optimization
  - The name of the file must be "component_parameters.xlsx "
  - There must be one sheet for every component
  - Each column has a header with the explanation of the parameter, followed by the parameter's name in the optimization and its value
  - Use the format and the names as in the given examples (cf. figure 5)

	A	B	C	D	E	F
1	ramping rate	minimum downtime	minimum uptime	start costs	revision length	no revision length
2	rr	mdt	mut	sc	r_length	nr_length
3	"{'Power': 100, 'Heat': 100}"	10	10	1000	"[50]"	10

Figure 3: Component parameters Excel file

- Storage Excel file
  - Modeling: not necessary; Optimization: optional
  - With this file, you can add storage to your system
  - The file must be named "storages.xlsx"
  - There has to be only one sheet named "storages"
  - Use the names of the storage parameters and the same structure as in the given examples (cf. figure 6)

	A	B	C	D	E	F	G	H
1	storage	storage_product	max_vol	min_vol	max_load	max_unload	load_eff	unload_eff
2	S1	Heat	12000	0	2000	2000	0,99	0,99
3	S2	Power	200	0	200	200	0,975	0,975

Figure 4: Storage Excel file

3. Select new energy system when starting GUI

After finishing the setup, you can start the main method of the GUI as usual. Then, go to the folder you just created and select your operating points in the opening window.

With this info and the provided examples, you can hopefully use the basic functions of the GUI. There are more functions in the GUI to discover that are not extensively explained here. We still hope that the GUI is intuitive enough to make use of those functions.