Behavior Based Appliance Modelling

With the shift to renewable, weather-dependent energy resources, we can no longer adjust energy generation based on demand without losses. We are therefore forced to adjust the electric load according to generation. This requires the use of all flexibilities in the electric grid. This includes the shifting of time-shiftable consumers in their execution or the retention of energy via electric storage systems. Due to the number of electrical consumers within a power grid, autonomous solutions are necessary for that purpose.

In the CoSES laboratory we have the opportunity to develop and evaluate such autonomous control solutions. It contains a MicroGrid, consisting of 5 buildings, with the subsystems for heating, cooling, transportation and electricity [1]. To avoid damaging the equipment in the lab by newly developed energy management algorithms and to get a faster response on the efficiency of these algorithms, the buildings of the lab were modeled and validated with the data from the systems in the lab [4].

In the simulations, however, only the heating systems are controllable so far. The electrical consumption of the buildings, due to the execution of electrical loads by residents, is predefined via load profiles. The building simulation developed by the Open Modelica based simulation application "SimulationX" should be extended to include electrical appliances (consumers) that can be influenced via control algorithms.

Your work:

- Searching for data of electrical appliances in buildings [5]
- Literature review for behavioral modeling methods, e. g. stochastic model based on measured data [2], [3]
- Modeling of non-shiftable, power-shiftable and time-shiftable appliances in the SimulationX building models

Requirements:

- Soldi knowledge of building energy modeling using the Modelica modeling language
- Self-motivation

References:

[1] V. S. Perić *et al.*, "CoSES Laboratory for Combined Energy Systems At TU Munich," in *2020 IEEE Power & Energy Society General Meeting (PESGM)*, Aug. 2020, pp. 1–5. doi: 10.1109/PESGM41954.2020.9281442.

[2] D. Fischer, T. Wolf, J. Scherer, and B. Wille-Haussmann, "A stochastic bottom-up model for space heating and domestic hot water load profiles for German households," *Energy and Buildings*, vol. 124, pp. 120–128, Jul. 2016, doi: 10.1016/j.enbuild.2016.04.069.

[3] J. D. Honold, "Energiemanagement in Wohngebäuden – Vergleich von zentraler und verteilter Entscheidungsfindung," Technische Universität München, 2021. Accessed: Feb. 22, 2023. [Online]. Available: https://mediatum.ub.tum.de/1578321

[4] https://github.com/DZinsmeister/CoSES_thermal_ProHMo

[5] https://github.com/k-nut/nilm-datasets/blob/master/nilm-datasets.csv