Simulation of distributed energy storage in the residential sector and potential integration of gas based renewable energy technologies using Modelica

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In-order to analyse the distributed production and storage of energy in de-centralised clusters, Modelica has been used to model buildings with micro Combined Heat and Power (μ-CHP) systems as their primary heat energy source. The classification of the buildings involve generalising their size based attributes and using experimental overall convective heat transfer coefficients (Defraeye et al., 2011). The output power of μ-CHP systems and the dimensions of the storage units are chosen corresponding to the building size to account for space heating, warm water demand and power storage requirements. To store the power locally, battery models are integrated and a power interface system has also been developed. Decentralised storage potential is modelled using distributed Power-to-Heat (PtH) as a storage strategy. As an initial part of analysing distributed storage potential, various house types with μ-CHP units are simulated with measured weather dependent boundary conditions. Subsequently, potential integration of distributed storage into a larger storage strategy involving the electrical grid and the gas grid is discussed where the μ-CHP units could act as an interface enabling a symbiotic relationship between the power grid and the gas grid.

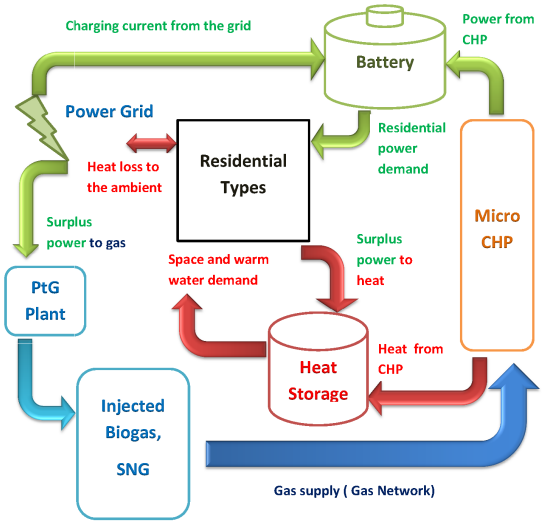

Figure 1. Concept diagram of distributed storage strategy

References

Thijs Defraeye, Bert Blocken, and Jan Carmeliet. Convective heat transfer coefficients for exterior building surfaces: Existing correlations and CFD modelling. *Energy Conversion and Management*, 52(1):512–522, 2011. ISSN 01968904. doi: 10.1016/j.enconman.2010.07.026. URL http://dx.doi.org/10.1016/j.enconman.2010.07.026.