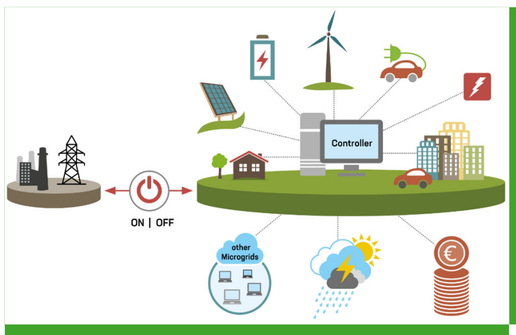


# Smart Microgrid Controller and Microgrid Research Laboratory

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Area 2.3 – Microgrids and Smart Energy Communities

## Microgrid Controller

To ensure that energy is optimally used on site in local energy grids/microgrids and to achieve cost and/or emission reduction targets, the technologies are controlled by **predictive** and **adaptive microgrid controllers**. Based on real-time measurement data as well as load, generation, market and weather forecasts, the optimal deployment plan for the local energy grid is thus calculated using **mathematical optimization algorithms**. Synergies of different technologies and sectors (electricity, heating, cooling, mobility, etc.) are taken into account, resulting in **high energy efficiency** in the system.

In terms of the controller, a **scalable, low-cost** and **easily deployable approach** is pursued.

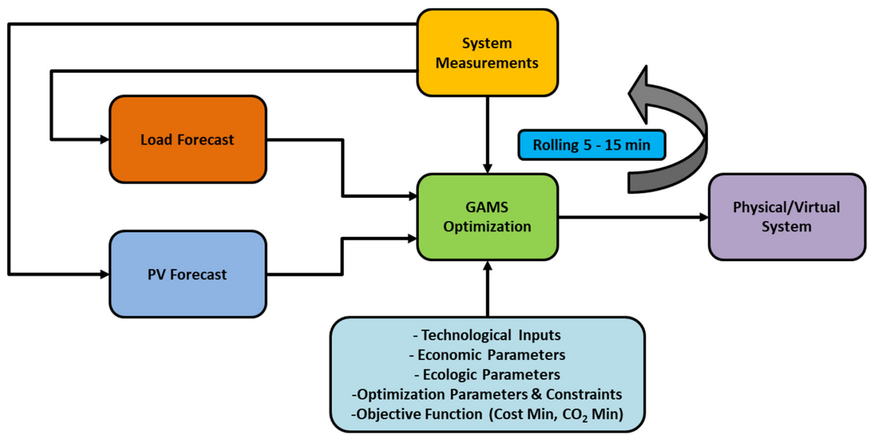


Fig. 1: Model Predictive Control (MPC) Framework

## Microgrid Research Laboratory Wieselburg

In the project *Microgrid Research Laboratory for 100% Decentralized Energy Supply*, the planning, implementation and verification of a microgrid took place at the Wieselburg site. It comprises two buildings and multiple technologies from different energy sectors.

The Microgrid Lab serves as:

- test site for the development of products and services such as the microgrid controller and various operating strategies
- test bed for further hardware and software components.

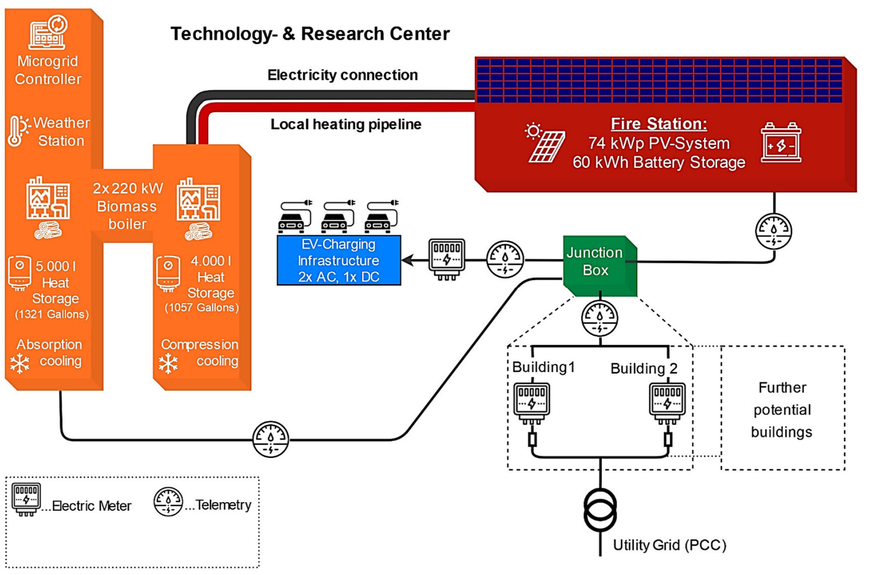


Fig. 2: Microgrid Research Laboratory Wieselburg

In course of the project, the control algorithms were successfully implemented and further tested at other locations:

- University of California San Diego – Campus
- Cellular Energy System SEBA Mureck – Energy Community
- Maria Rain Energy Community – KELAG

## Big Picture

In the research laboratory, the following methods were developed and established, on which the microgrid controller is based:

- standardized data acquisition and processing
- forecasting methods using machine learning and AI
- control algorithms based on mathematical optimization

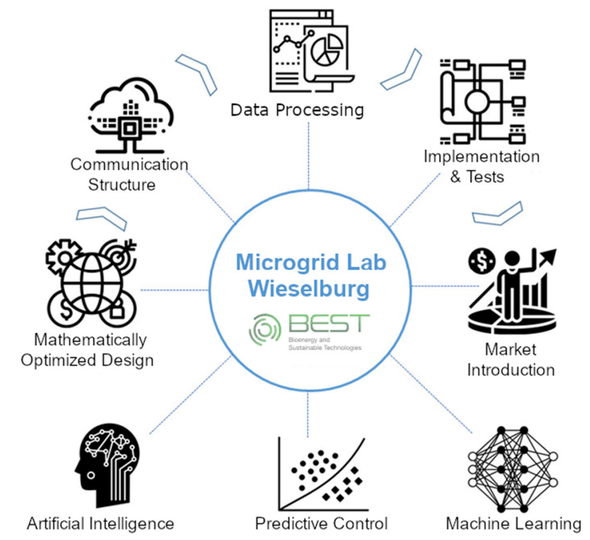


Fig. 3: Project Objectives and Project Areas

The model predictive control (MPC) framework enables the controller to be adaptive to varying framework conditions, e.g. spot market prices, in order to achieve optimal economic/emission savings as shown in the graph below.

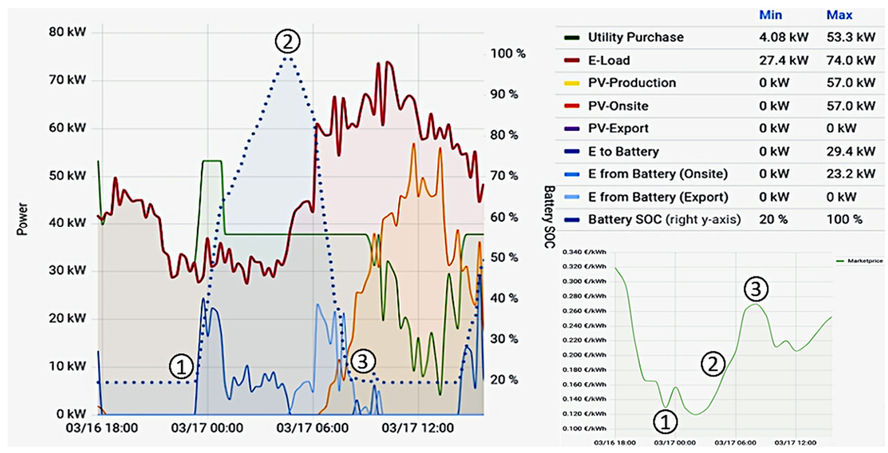


Fig.4: Adaptive Control

In Fig. 4, the adaptive controller behavior is shown as follows:

(1) Spot price reaches minimum level, battery starts charging
(2) Spot price level rises, battery starts discharging
(3) Battery is discharged

## Outlook

In addition to the existing technologies as photovoltaics, battery storage, and charging stations, the integration of other distributed technologies is being pursued, such as the **storage and use of hydrogen**. Furthermore, the smart microgrid controller is intended to be used in **renewable energy communities**.

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