BEST

Bioenergy and Sustainable Technologies

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Competence Centers for Excellent Technologies

Bundesministerium
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NIEDERÖSTERREICH

Das Land Steiermark

SFG
NEUES DENKEN. NEUES FÖRDERN.

BEST
Bioenergy and
Sustainable Technologies

Microgrid Lab – Wieselburg, Austria

MIA Online Event

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stadtgemeinde wieselburg

FACHHOCHSCHULE WIENER NEUSTADT

eco plus

bau.energie.umwelt cluster niederösterreich

technopol wieselburg

Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich.

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Challenges

Change of energy system:

- Microgrids
- Cellular Energy Systems
- Local Energy Communities

Benefits of local energy systems:

- high efficiency since generation and loads are close to each other,
- good integration of volatile renewables,
- increased reliability,
- sectoral coupling,
- regionalisation

… but limited possibilities to bring local energy communities into reality

Why Microgrids/ Local Energy Communities?
Regional Energy: Electricity, Heating, Cooling

Why Microgrid Lab?

The project “Microgrid Lab Wieselburg” enables a real application for the developments of following two ongoing research topics:

- ***planning and optimization software tool** for microgrids*
- ***Supervisory MPC controller***

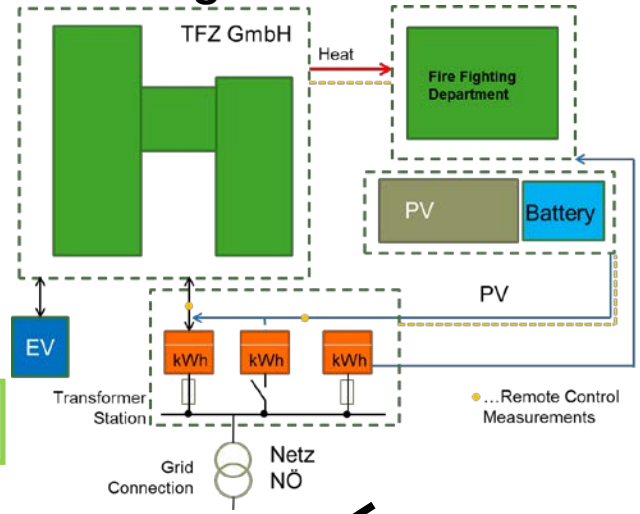
planning

improvement

testing

further development

Microgrid testbed:



development of control algorithms, technologies and services for microgrids

Objective: Real-life microgrid testbed

- Technology- und Research Centre (tfz) Wieselburg and the new firefighting department
- Living Lab for testing biomass heating system, PV, electric storage, solar thermal, heat storage, abs. chiller, heat pumps, EVs, building/communication technologies
- Multiple buildings are connected and energy sharing will be tested
- Regionality and knowledge building
- MPC strategies together with utilities, local communities, and industry are tested

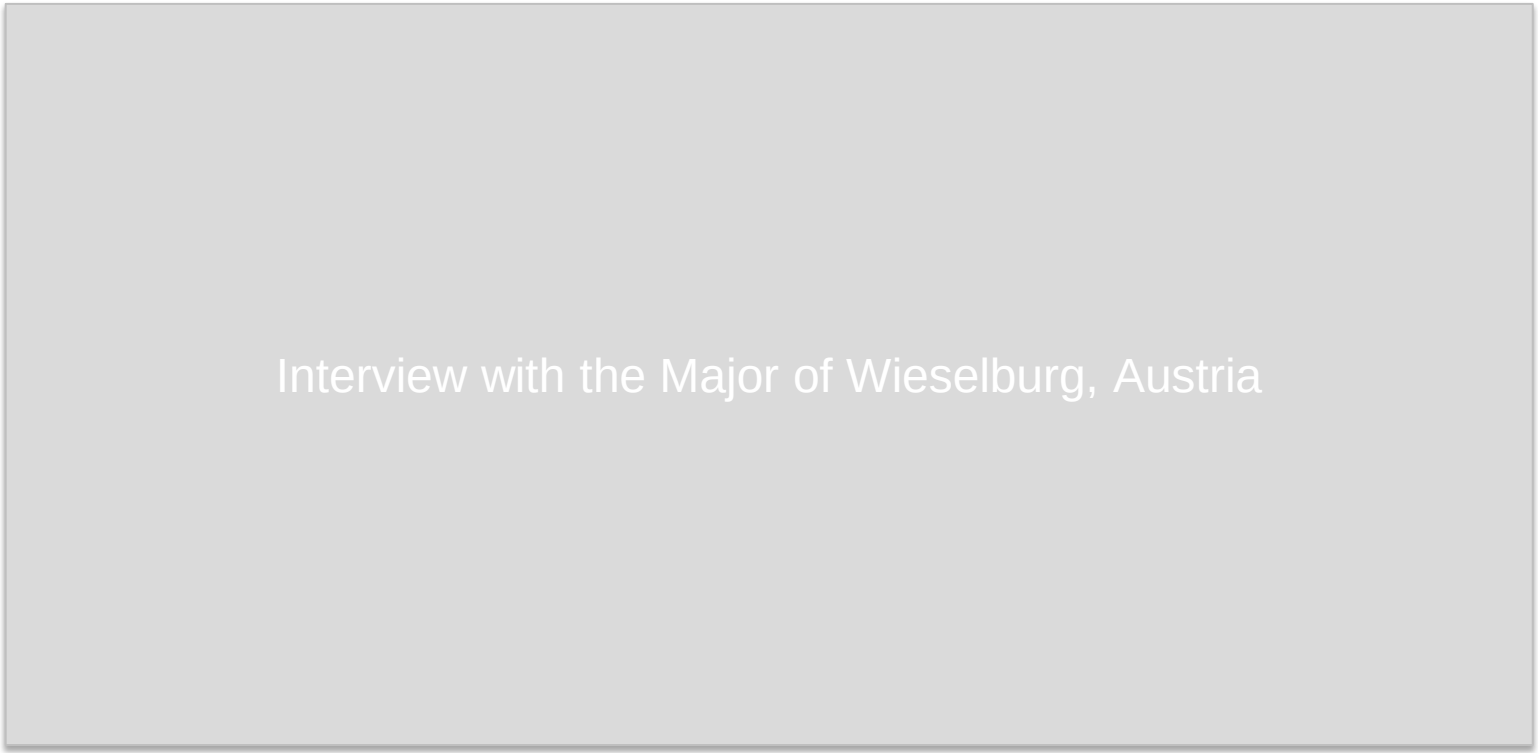
➢ Technology- and Research Center (tfz)

direct use of PV-electricity

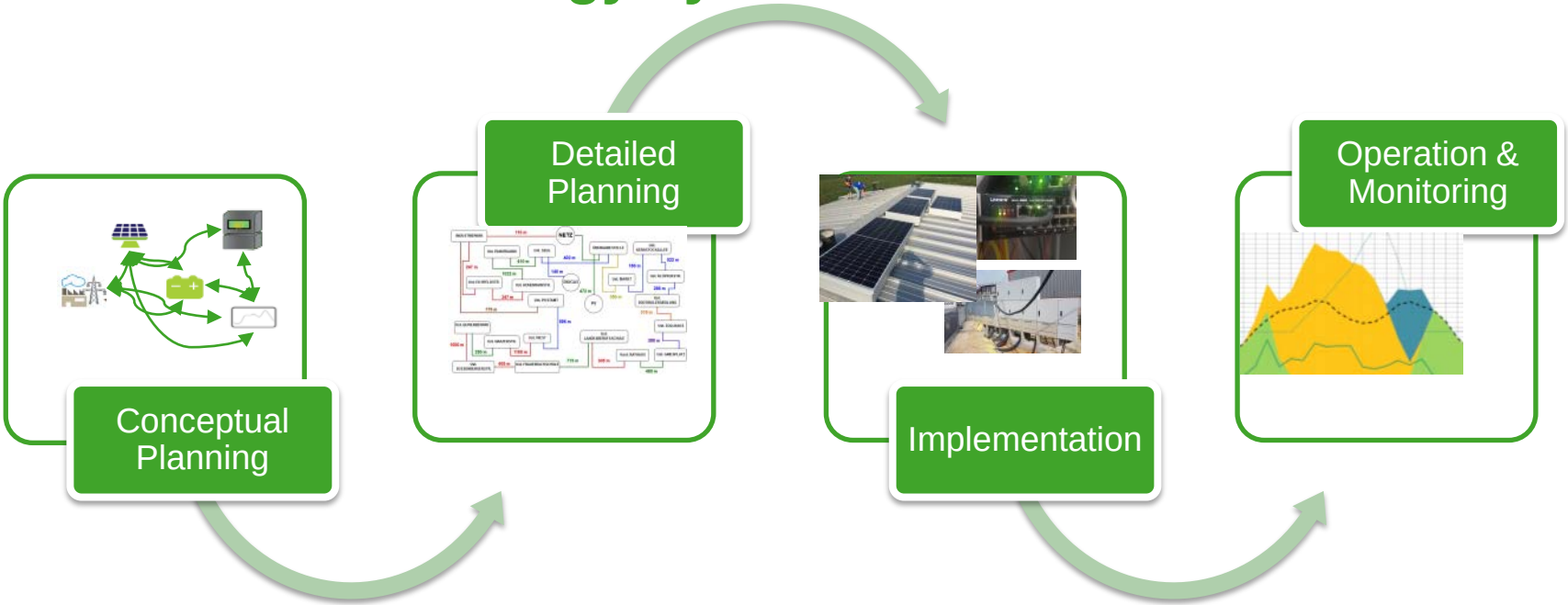
enough capacity for district heat

➢ New fire fighting department next to tfz

Voices of stakeholders



Steps for a successful realization of decentralized energy systems



Planning technologies for the Microgrid Lab

current situation:

biomass boilers
2 x 220 kW

100% public
electricity grid

emissions: 90t CO_2/a
energy costs*: 78 000 €/a

OPT EN GRID

target function: CO_2 minimization**

Microgrid lab 100%:

biomass boilers
2 x 220 kW

optimised with new technologies:

74 kWp PV

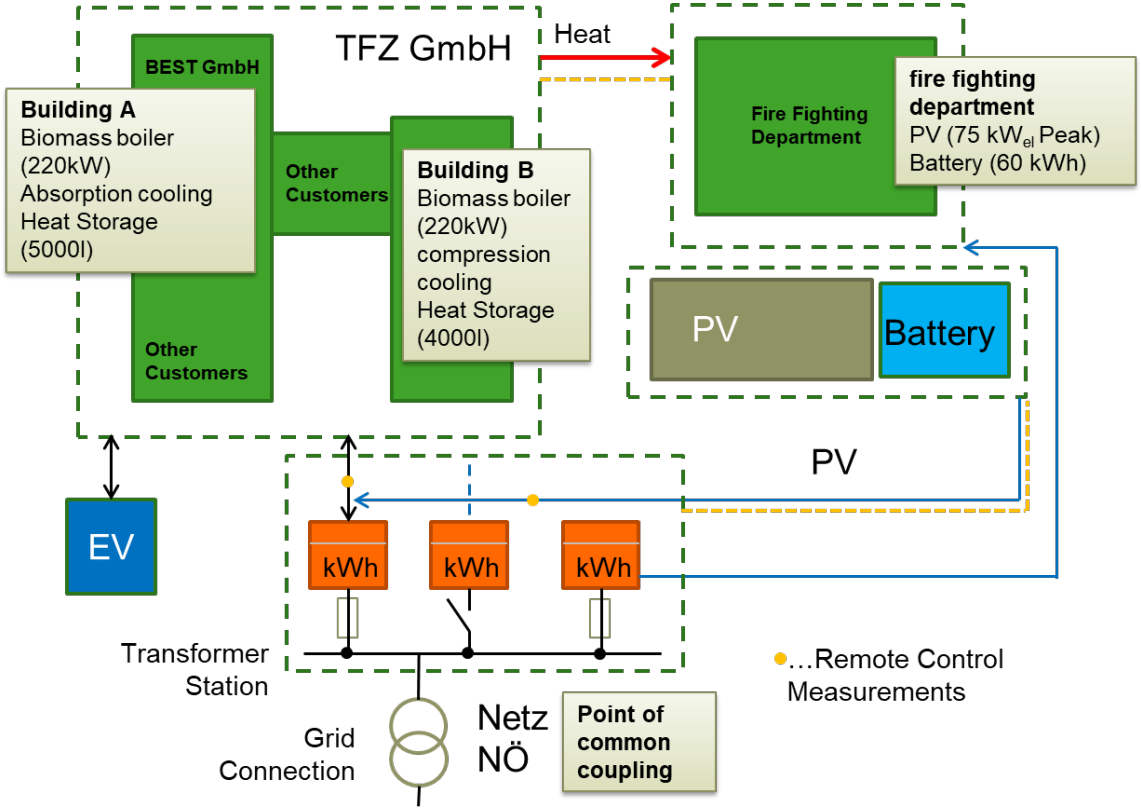
60 kWh battery storage

~75% public electricity grid

emissions : 74t CO_2/a **-18%**
energy costs*: 68 800€/a **-12%**

*including amortisation of investments
**limited to max. 500m² roof area

Setting up the Microgrid Lab – Implementation



Setting up the Microgrid Lab – Implementation

installation of PV

battery

microgrid connection point

district heating installations

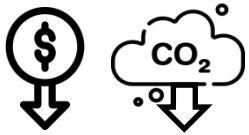
new firefighting department

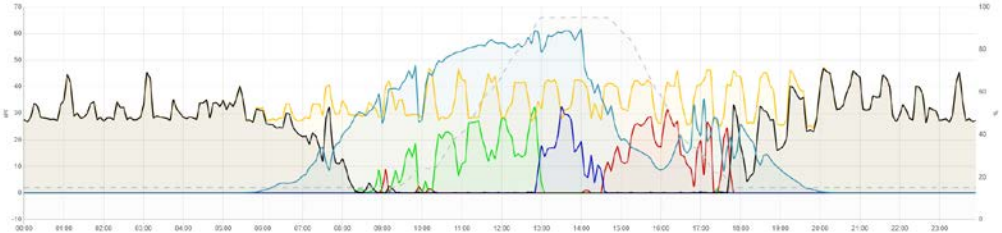
point of common coupling

Operation and Monitoring

- Implementation of microgrid controller algorithms (MPC)
- Assess the performance of the Control Activities
- Learn through Artificial Intelligence (AI)
- Adaption of the underlying Optimization Constraints and Equations to increase performance

- Monitoring of electricity, heating and cooling demands; evaluation of user behaviours
- Verification and improvement of optimization based planning software tool





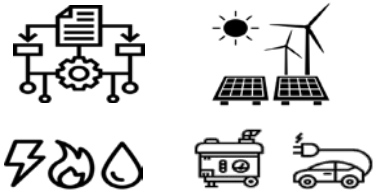
Introduction: Supervisory Control of Microgrid

Holistic Optimization and Control Approach

- Coordinated Dispatch of Distributed Energy Resources (DER) Technologies
- Cost Minimization
- CO2 Reduction
- Increased penetration of Renewable Energy Technologies

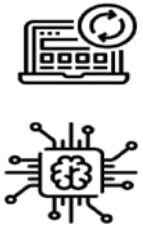
Mathematical Algorithms

- Integrate important DER Technologies (e.g. PV, Wind, Solar Thermal, CHP Systems, EVs, etc.)
- Provide Control subject to the objectives of the Stakeholders (e.g. Utility, Grid Operator, etc.)



Adaptive High-Level Supervisory Controller

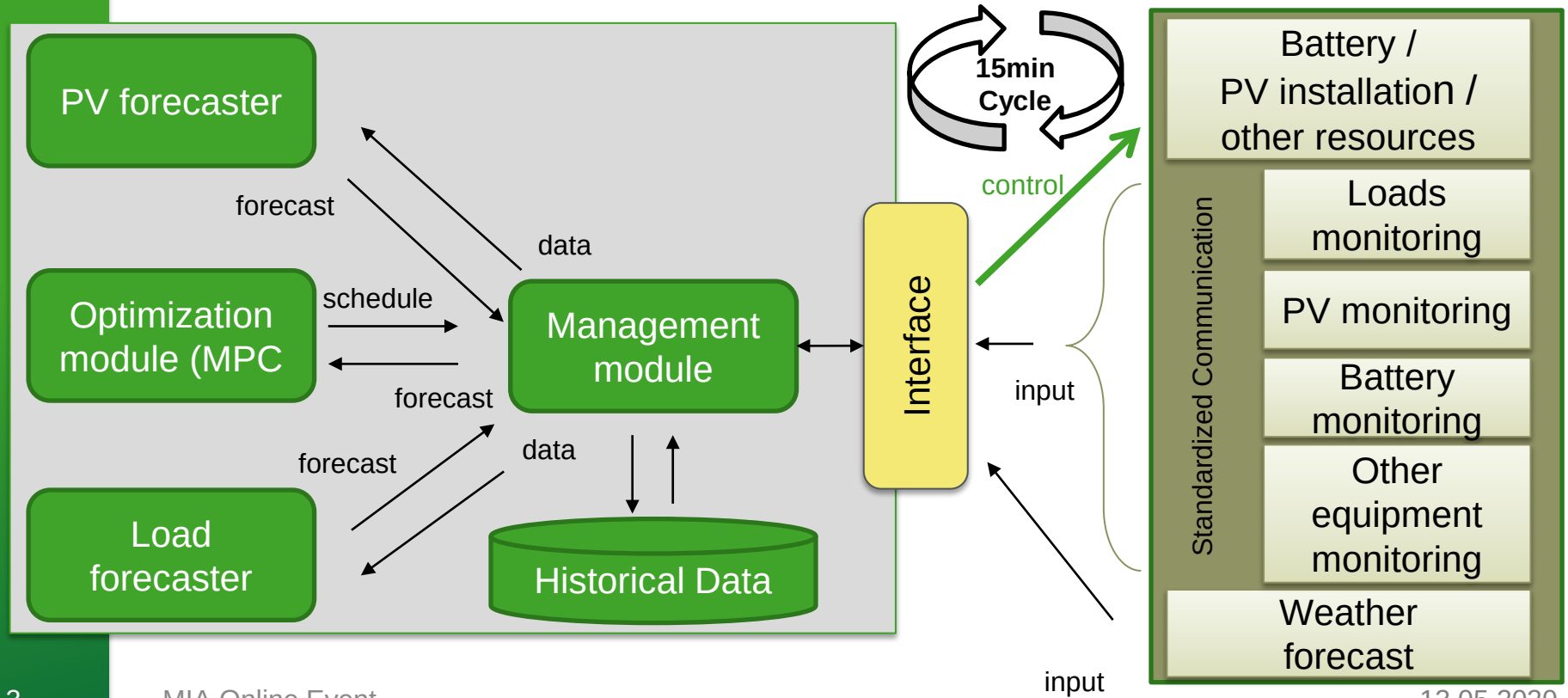
- Assess the performance of the Control Activities
- Learn through Artificial Intelligence (AI)
- Adapt the underlying Optimization Constraints and Equations to increase performance



Real Time Operation and Testing

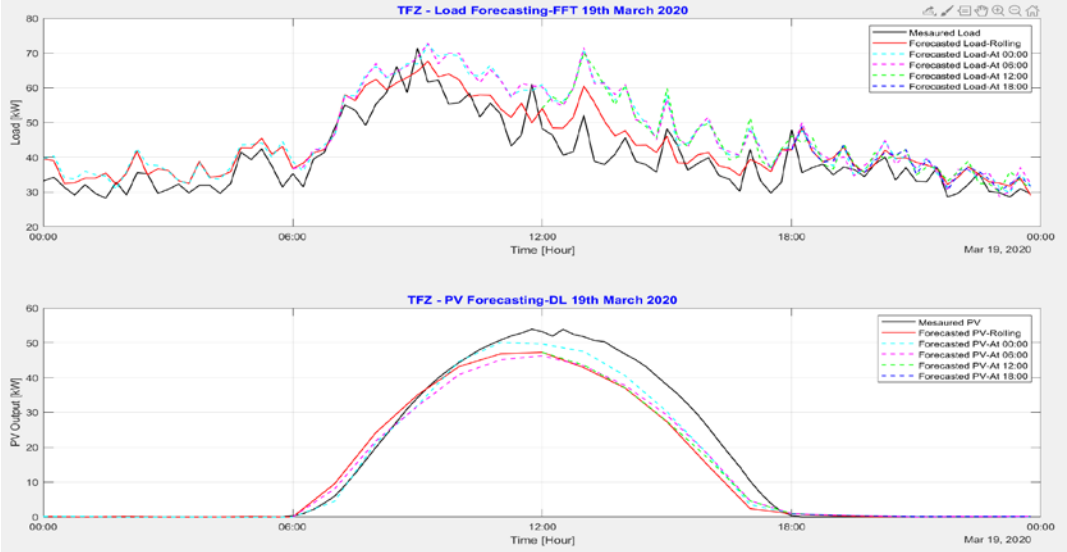
Microgrid Lab Technologie und Forschungszentrum (TFZ) Wieselburg, Austria

MPC Controller at the Microgrid Lab



Load and PV Forecasting

- Load Forecasting
  - Fast Fourier Transform Method
- PV Forecasting
  - Deep Learning Method



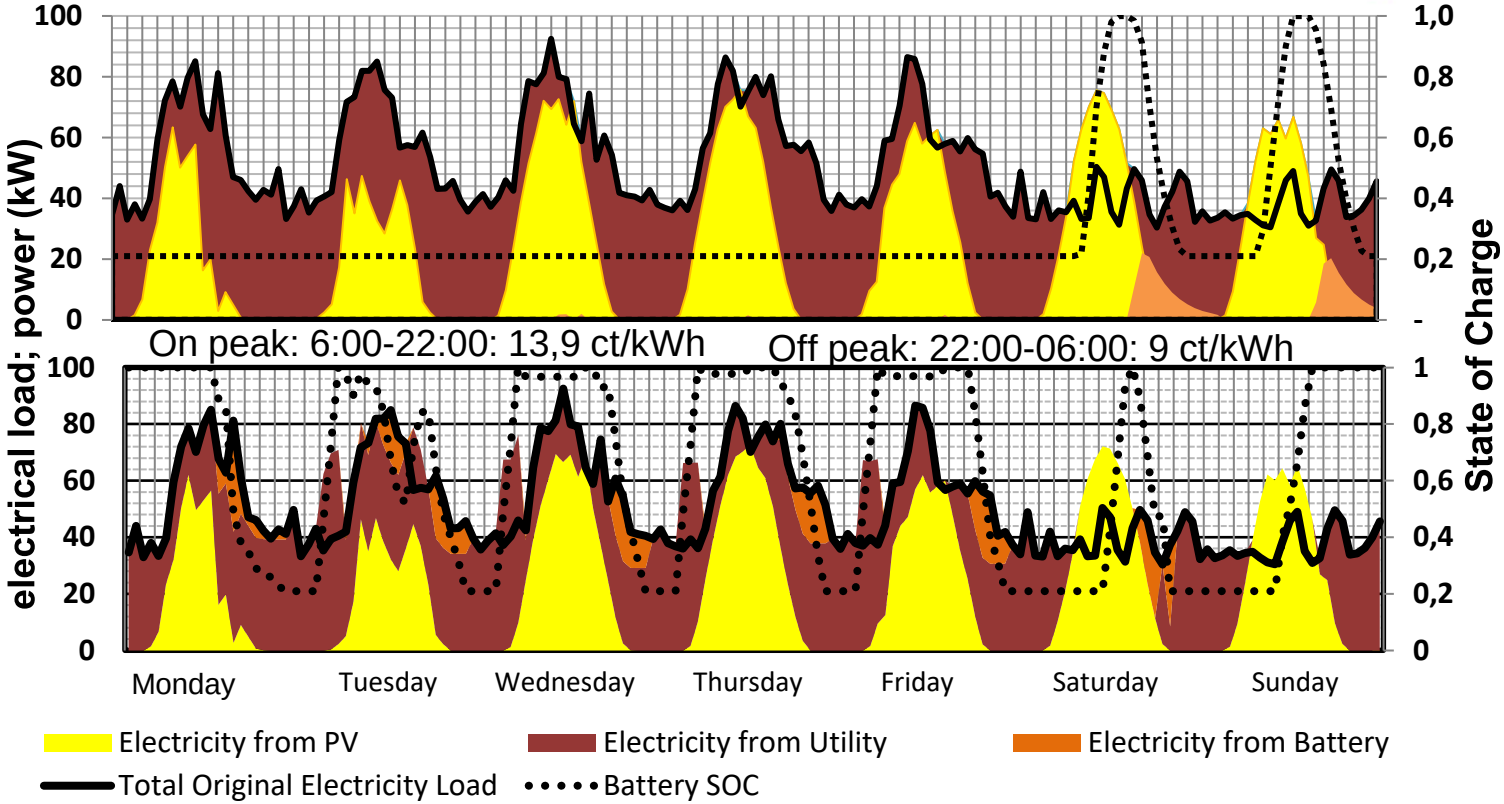
Load Forecast Accuracy
RMSE = 5.53 kW

PV Forecast Accuracy
RMSE = 4.89 kW

MPC Controller in Action at Microgrid Lab

1) standard load controller

2) example: advanced microgrid controller

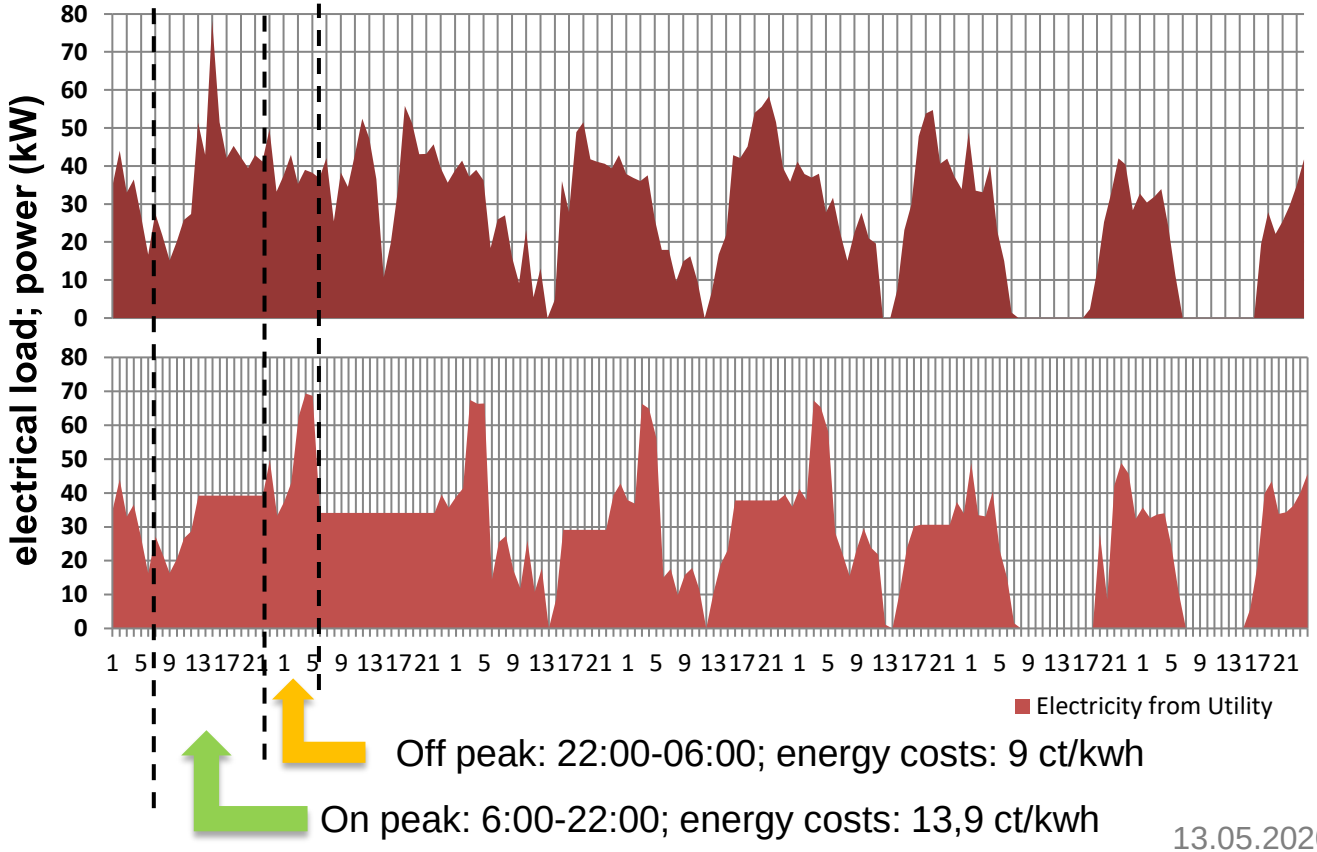


Outlook: development of advanced controller

1)
standard
load controller
€672.-/week

2) example:
advanced micro-
grid controller
€592.-/week

-12 % cost reduction



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Conclusions

Local energy communities (microgrids) have huge positive potential, but can reach a very high level of complexity

A variety of different ways to cover energy consumption with DERs

Standardization needed

Simple and standardized MPC methods to control assets

Open communication needed

The Microgrid Lab will act as testbed for technology providers and manufactures as well as different energy suppliers and new emerging sectors