NEW APPROACHES FOR ENERGY MANAGEMENT AND GRID INTEGRATION FOR DECENTRALIZED ENERGY SYSTEMS

2018 Bucharest Symposium on Microgrids

Jan von Appen

Fraunhofer Institute for Energy Economics and Energy System Technology IEE
Motivation (1)

Digitalization, power-heat-storage systems and e-mobility provide new opportunities for prosumer oriented energy management.
Motivation (2)

Changing drivers for sizing and operation of RES increase the complexity of planning and operation for all involved actors.

- Changing price signals*

- Changing feed-in tariff
  - Continuous adjustment according to PV installation rates
  - Unclear if fixed FIT exists after 52 GW cap for PV has been reached (now: 44 GW)

- Grid integration

*Source: energy-charts
Motivation (3)

A threefold approach is prosed to enable better RES integration and improved energy efficiency for customers.

- New incentives for demand flexibility and automation of energy management
- Improved grid integration of RES and microgrids through optimal control
- Data-driven investment and operation decisions in RES, microgrids and e-mobility
 Agenda

- social energy management
- RES investment and operation
Agenda

- social energy management
- RES investment and operation
sema – Introduction

sema aims at motivating the adoption of different energy consumption patterns and facilitating energy savings.

sema (social energy management):

- Platform enabling participants to optimize their energy consumption through room heating management and electricity monitoring
- Personalized feedback on energy usage and points for adjusted energy consumption
- Electricity demand:
  - High RES generation = high sema level
  - More points for energy consumption when sema levels are high
  - Motivation for higher demand flexibility according to RES generation
sema – Setup and field test

sema runs on the open-energy management platform OGEMA developed by Fraunhofer IEE.

Source: Engel (2018)
sema – Results for electricity demand

sema incentivizes shifting demand according to RES generation, but is limited by participants’ occupancies.

Comparison of electricity demand with low and high sema levels

- Up to 50% more demand in certain evening hours

Source: Engel (2018)
Agenda

- social energy management

- RES investment and operation
RES investment and operation – Approach

Optimally configured and operated decentralized energy systems provide a chance to generate value added for prosumers.

Tools for optimal sizing and operation of DER, microgrids and e-mobility

- Input
  - User model
  - Load data (e.g. from sema)
  - Building and RES data
  - Market and grid requirements
  - Investment and operational costs

- Optimization
  - Objection function depending on use case

- Results
  - DER sizing and operation
  - Incentive evaluation and suggestion
  - KPIs for prosumers, DNOs and utilities

Case studies:

- Optimal sizing and operation of residential PV systems with battery storage systems and heat pumps for different incentives
- Interdependencies between incentive design, sizing, operation and grid integration

Forecasts for load and prices for model-predictive controller
RES investment and operation – Results for investment

How do changing incentives impact the sizing and grid integration of residential PV systems (especially once the FIT is close to zero)?

Impact of reimbursement of PV grid feed-in on PV system size:

Impact of BSS and heat pumps on PV system size:

→ Rooftop PV potential might not fully captured in post-FIT world.

→ Sector coupling as a chance
RES investment and operation – Results for operation

Optimized control of decentralized power-heat-storage systems ensures such systems benefit from new incentives.

New incentives for operation of PV BSS battery and heat pump operation (market prices, peak charges and feed-in limits)

Combination of price and feed-in limit incentives to ensure a grid-friendly operation of decentralized power-heat-storage systems

Source: Appen (2018)
Summary and outlook

Energy demand flexibility can only be achieved through the right mix of user-focus, optimal control and automation.

- Optimization models for integrated planning and operation of decentralized energy systems and microgrids:
  - Strategic stakeholder behavior and interdependencies

- Automation of energy management:
  - Data analysis and integration via IoT
  - Integration into grid planning processes

- User-focused approaches for energy efficiency and grid integration:
  - New incentives and non-monetary approaches
Dr. Jan von Appen

- Head of Department Energy Management and Energy Efficiency
- Coordinator of Business Unit Decentralized Energy Management
- jan.vonappen@iee.fraunhofer.de

References

- www.ogema.org