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

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Motivation (1)

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

Smart home

Interoperability

Interfaces

Open source

Flexibility

Data security

Building automation

IoT

Optimization

Smart grid

ML

AI

Web services

Usability

Smart meter

Pictures: Tesla, SMA, Vaillant

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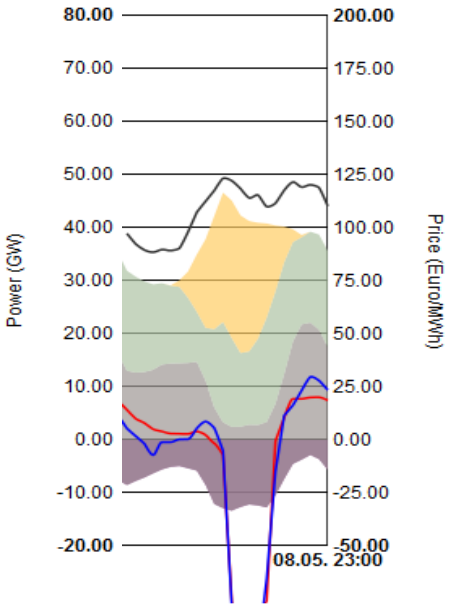
Motivation (2)

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

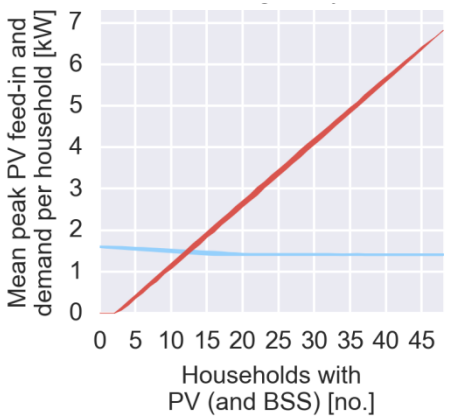
Changing price signals*



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

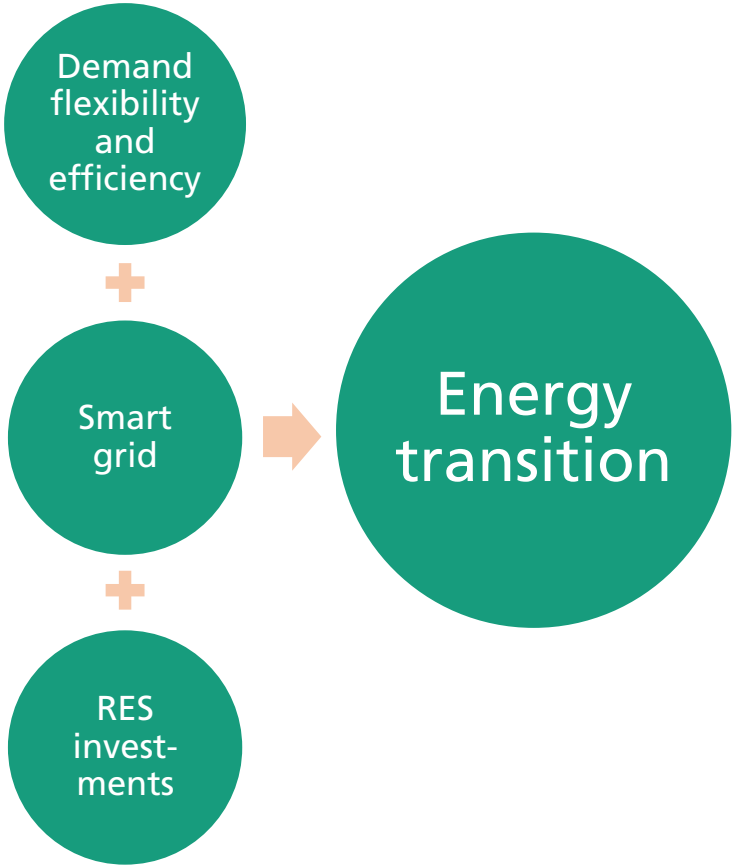


*Source: energy-charts

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

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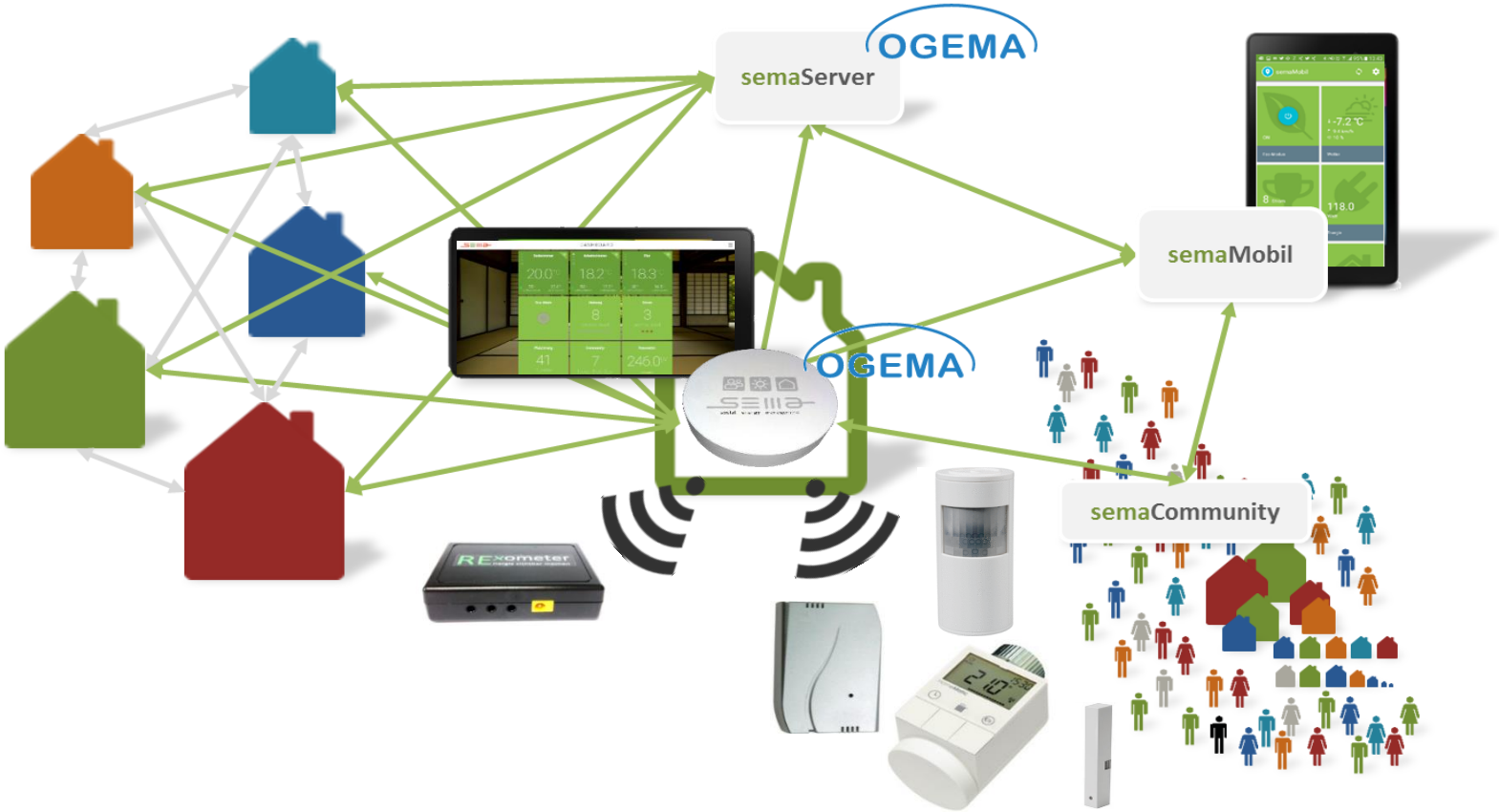
sema aims at motivating the adoption of different energy consumption patterns and facilitating energy savings.

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

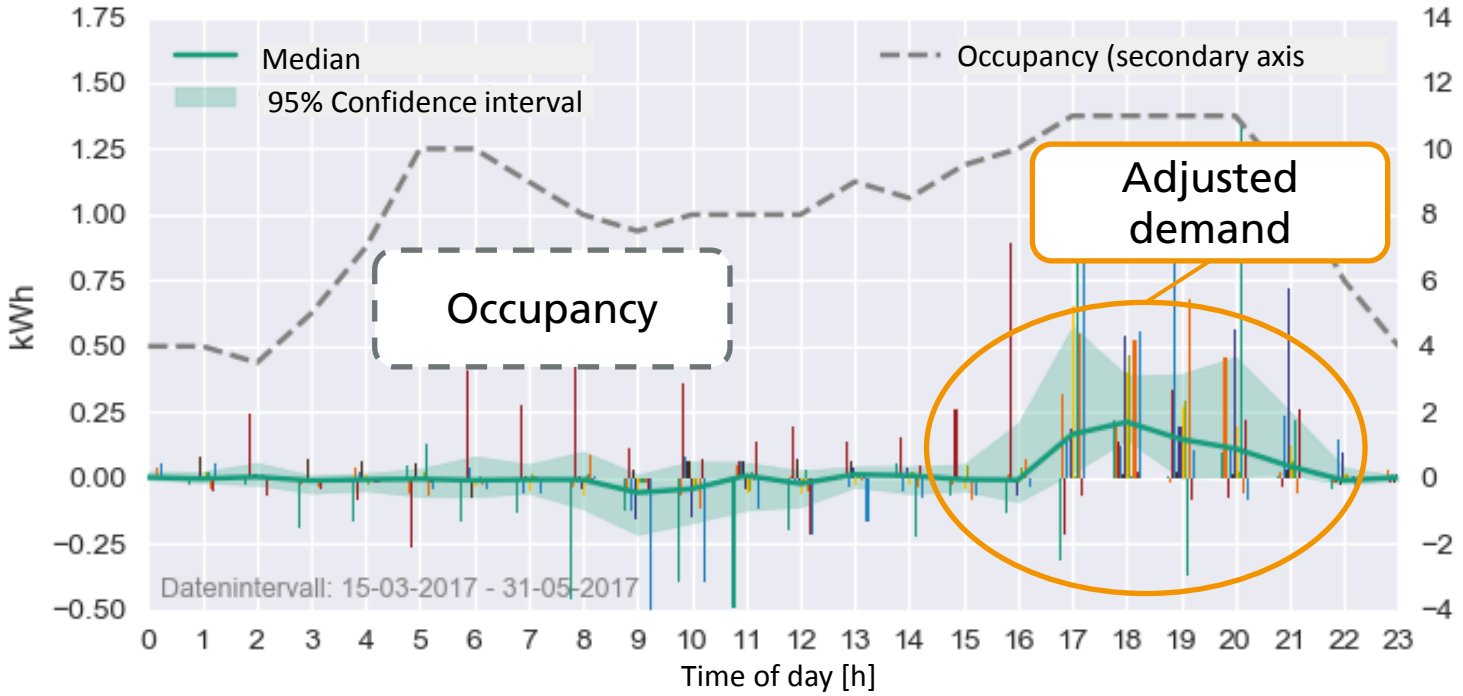
sema runs on the open-energy management platform OGEMA developed by Fraunhofer IEE.



Source: Engel (2018)

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)

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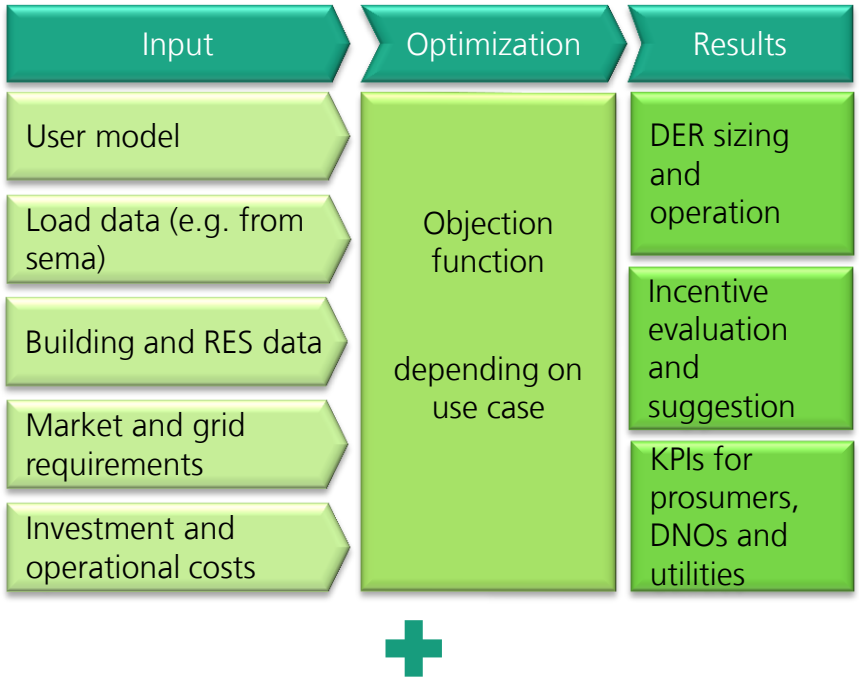
Optimally configured and operated decentralized energy systems provide a chance to generate value added for prosumers.

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



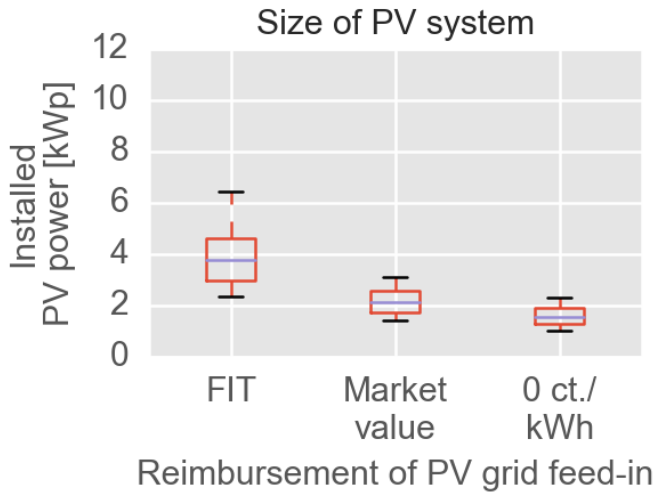
Forecasts for load and prices for model-predictive controller

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

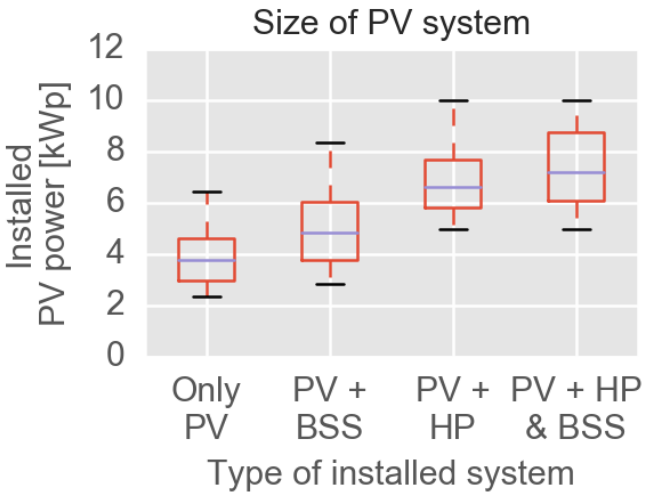
How do changing incentives impact the sizing and grid integration of residential PV systems (especially once the FIT is close to zero)?

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



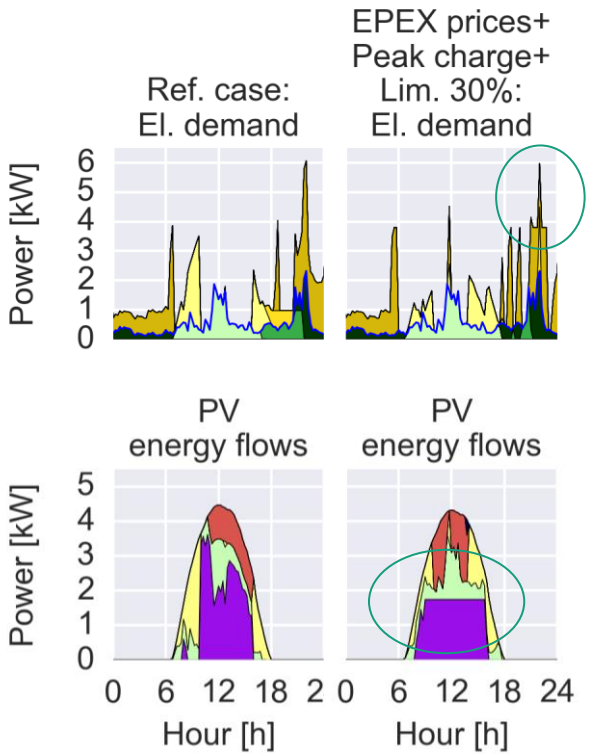
➡ Rooftop PV potential might not fully captured in post-FIT world.

Impact of BSS and heat pumps on PV system size:



➡ Sector coupling as a chance

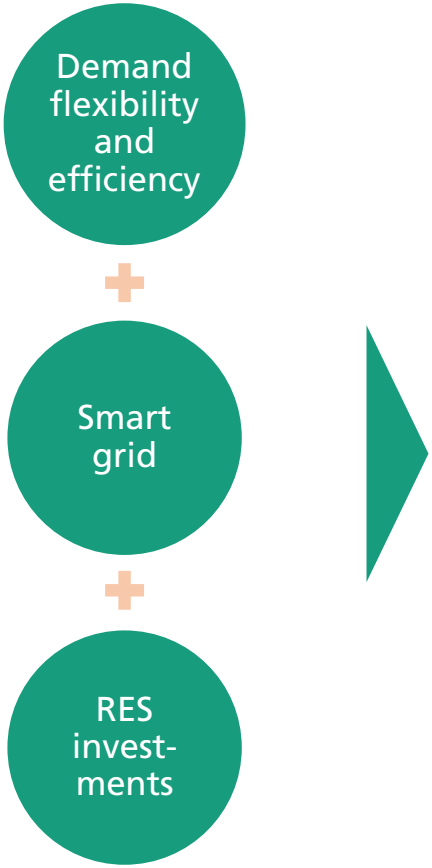
Optimized control of decentralized power-heat-storage systems ensures such systems benefit from new incentives.



- 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)

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

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References

- S. Engel, D. Nestle, E. Dörre, J. von Appen. “sema – Erkenntnisse aus dem Betrieb eines social energy management system“, 15. Symposium Energieinnovation, Graz, Feb. 2018.
- J. von Appen. “Incentive design, sizing and grid integration of residential PV systems with heat pumps and battery storage systems”, 15th International Conference on the European Energy Market (EEM), Lodz, Jun. 2018.
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