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Self-consumption enhancement of residential photovoltaics

Using battery storage and electric vehicles in communities

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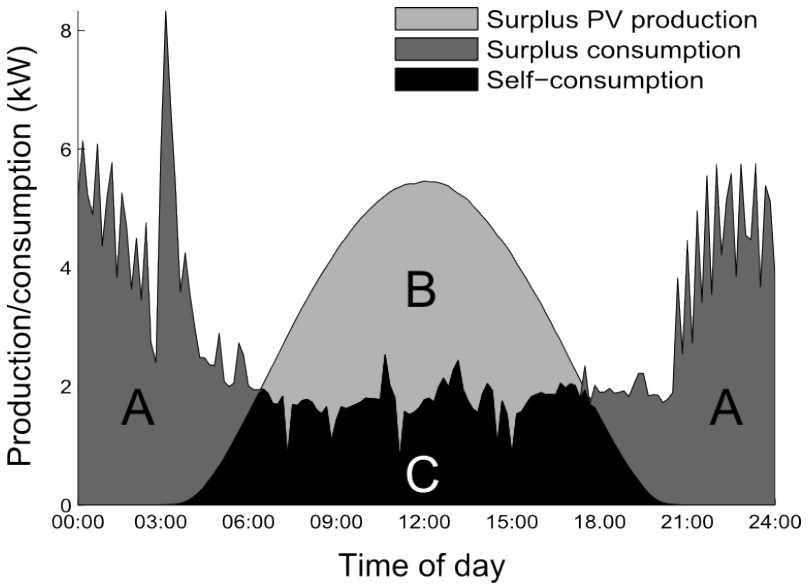
Self-consumption, how and why?

- Micro-producer consume their “own” electricity
- No taxes and fees
- Reduced stress on the power grid?
- Ways to higher self-consumption
  - Energy storage
  - Load shifting



Studied cases

Community of houses with

a) individual connection to grid
   - ➢ *No storage*

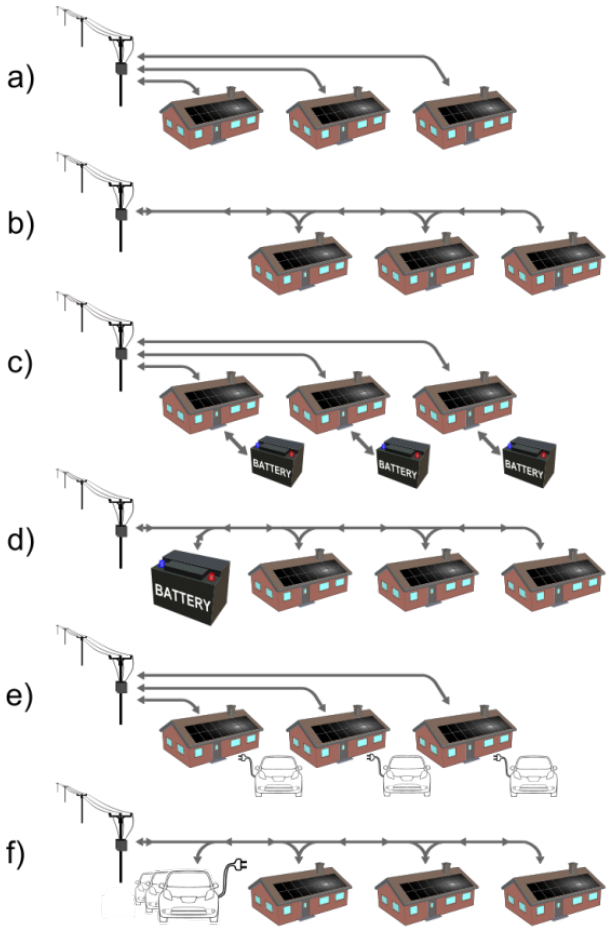
b) shared connection to grid
   - ➢ *No storage*

c) individual connection to grid
   - ➢ *Individual battery storages*

d) shared connection to grid
   - ➢ *Shared battery storage*

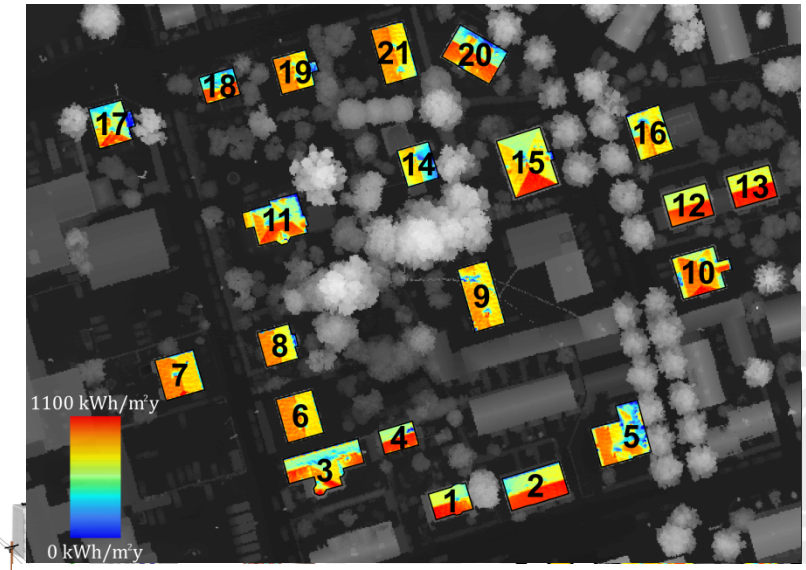
e) individual connection to grid
   - ➢ *Individual EV charging*

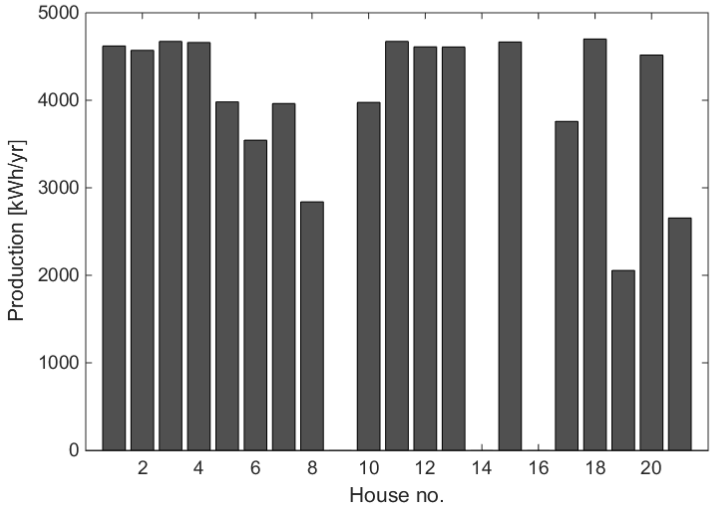
f) shared connection to grid
   - ➢ *Shared EV charging*



Identification of rooftops

- Geographical Information System (GIS)
- Based on LiDAR and irradiance data
- Rooftop segments of 10-30 m^2
  - 1.5-4.5 kW_p photovoltaics per house
  - Approx. production 1,500-4,500 kWh yearly





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Simulation

- Simulation on one-minute basis
- Measured consumption data for 21 detached houses during approx. one year
  - Mean consumption 14,500 kWh
  - Heating consume > 50 % in majority of houses
- Measured irradiance data

Electric vehicle (EV) and storage

- Electric vehicle
  - Nissan Leaf, 21 kWh battery
  - Synthetic home-charging patterns
  - No “smart” charging
  - No vehicle-to-grid (V2G)
- Stationary battery banks
  - Lead-acid
  - 4 kWh per household (2.8 kWh usable)
  - No “smart” charging

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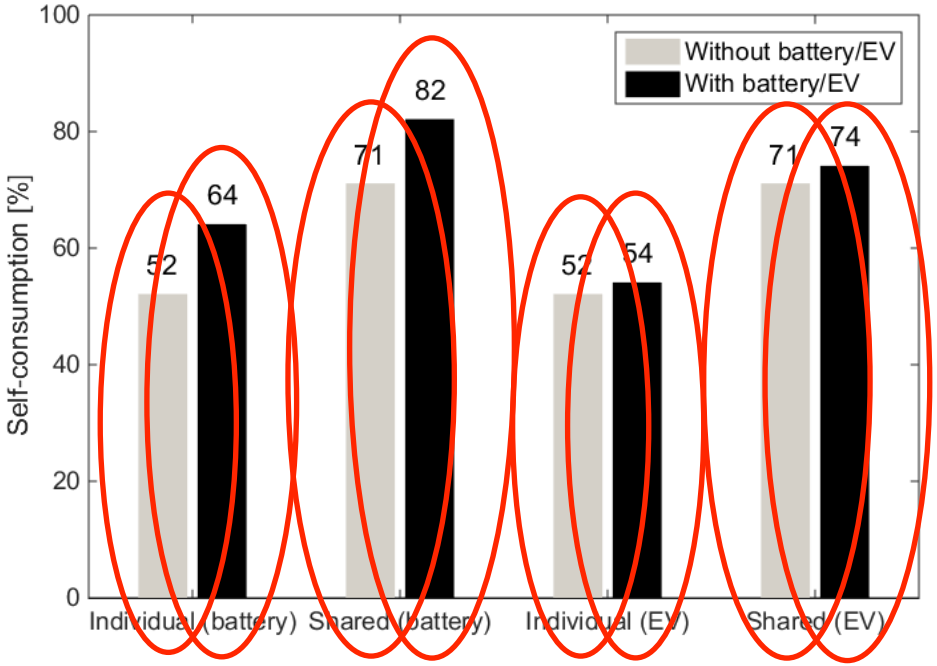
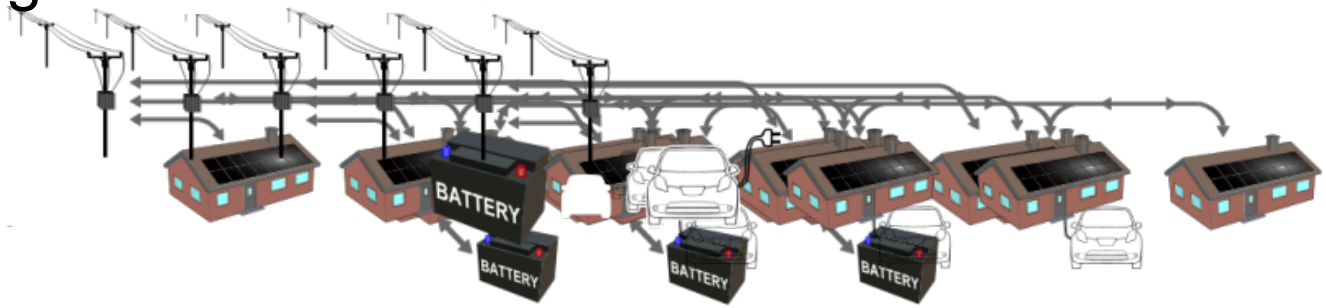
Results

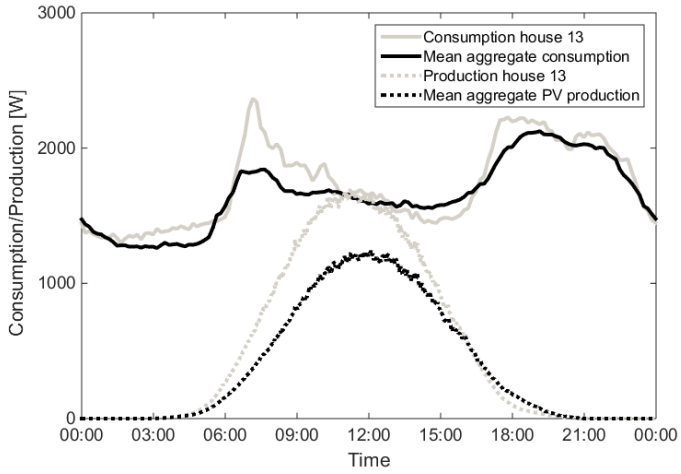
- Self-consumption with batteries or EVs
- More “difficult” to increase high self-consumption
- Minor effect on self-consumption with EV charging

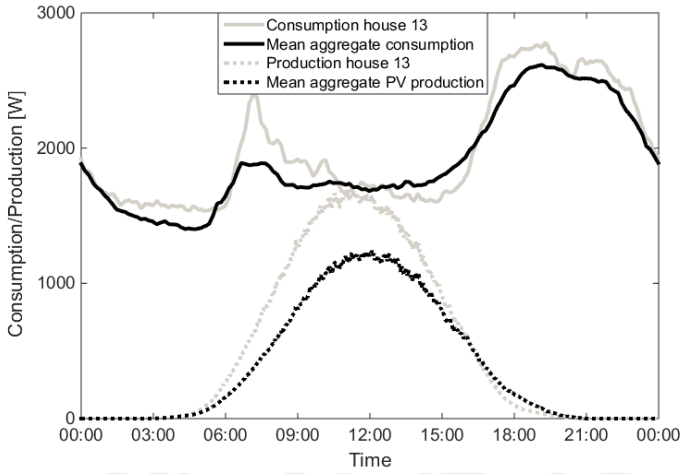




Yearly mean over one day

- Smoothing effect of consumption
  - Higher self-consumption
  - “Share” PV electricity
- EV charging in the evening/night
- No surplus PV production on yearly basis





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Economic assessment

- Price of electricity (mean 2010-2014, no fixed costs)
  - Buy: € 0.11
  - Sell: € 0.06
- Example: 75 % self-consumption with batteries
  - 144 kWh battery when individual (18 houses)
  - 17 kWh battery when shared
- 63 % higher revenue when using shared battery
  - € 4.6 per kWh individual batteries
  - € 7.5 per kWh shared batteries

Thank you for listening!

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