MODELLING THE ADOPTION AND DIFFUSION OF HEAT AND ELECTRICITY SELF-SUPPLY FOR VARIOUS REPRESENTATIVE CONSUMERS AND ITS EFFECTS ON THE ELECTRICITY MARKET

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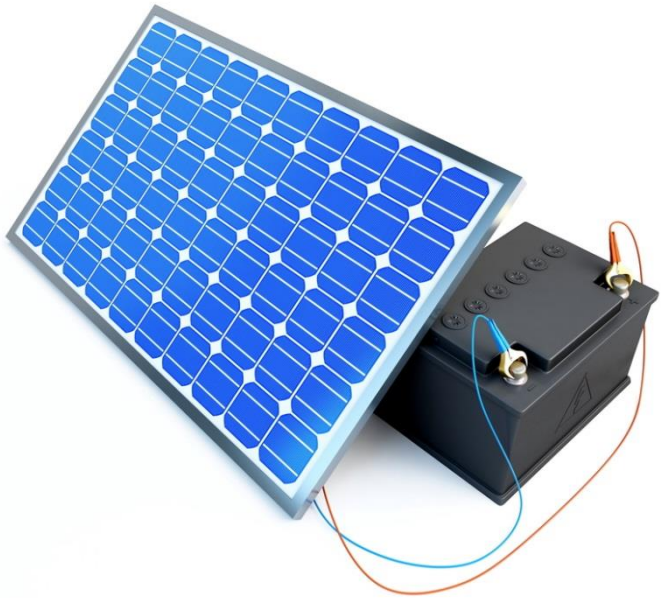
Wien, den 4. September 2017



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Agenda

- Motivation
- Methodology
- Results concerning the expansion of self-supply
  - Distribution effects
- Conclusion

Note: For the sake of brevity, this is only an overview of our research.

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Motivation

- Declining cost for PV and battery storage
- Phase-out of RES-subsidies (**EEG** subsidy) in the foreseeable future in Germany

→ Uncertain development of the situation for users of self-supply
→ Effects on the system level uncertain
→ **New situation for self-supply**

→ Re-evaluation required!

Motivation

What does literature say?

- Studies mostly focused on analyses with only 1-2 technologies for specific situations or consumers
  - Tenor: increase of the self-consumption rate is *crucial*!

  →but: only a few studies examine the details

- Only few „system analyses“
  - many qualitative articles regarding system effects
  - few quantitative conclusions

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Methodology

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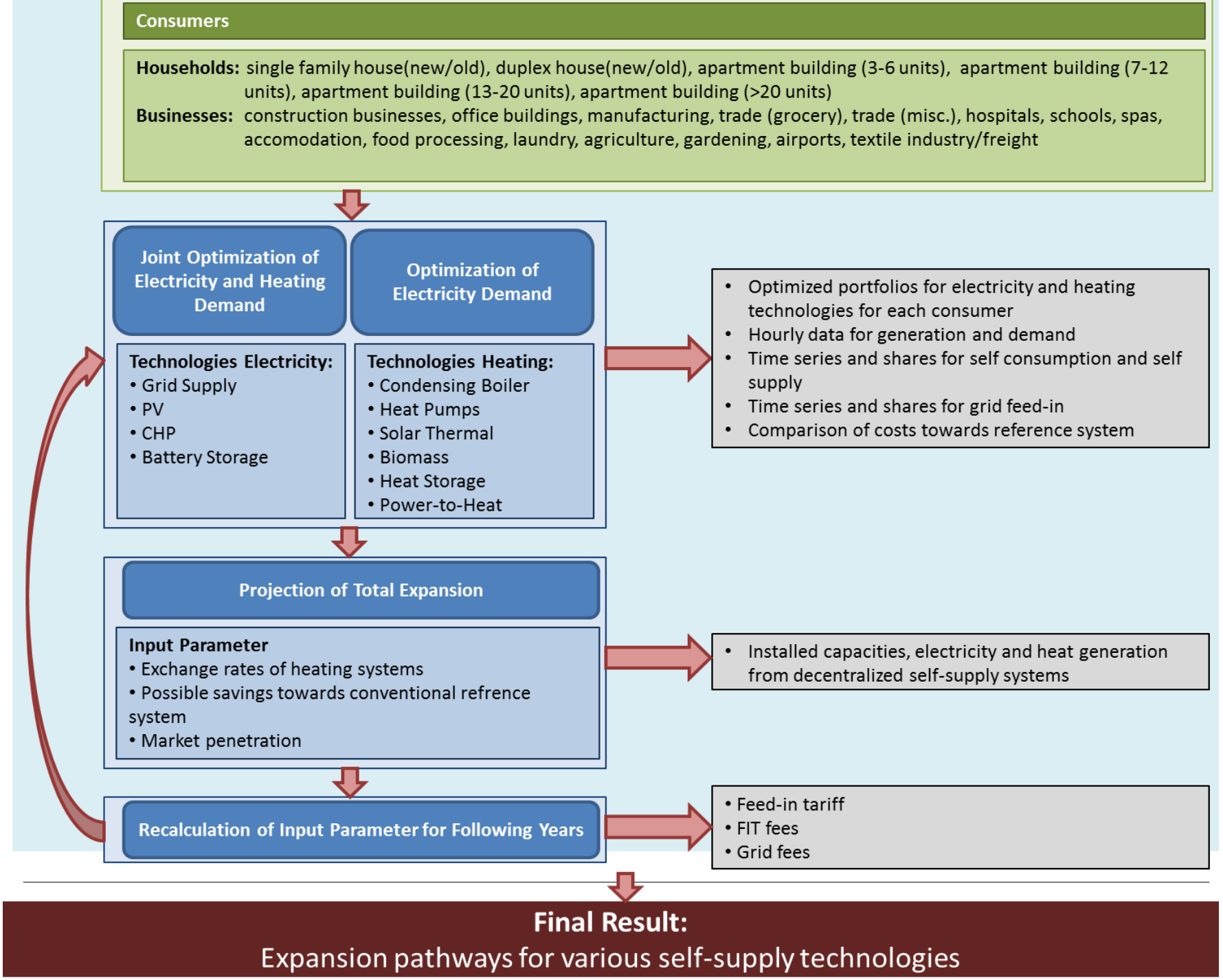
Consumers
Households: single family house(new/old), duplex house(new/old), apartment building (3-6 units), apartment building (7-12 units), apartment building (13-20 units), apartment building (>20 units)
Businesses: construction businesses, office buildings, manufacturing, trade (grocery), trade (misc.), hospitals, schools, spas, accomodation, food processing, laundry, agriculture, gardening, airports, textile industry/freight
Joint Optimization of Electricity and Heating Demand
Optimization of Electricity Demand
Technologies Electricity:
• Grid Supply
• PV
• CHP
• Battery Storage
Technologies Heating:
• Condensing Boiler
• Heat Pumps
• Solar Thermal
• Biomass
• Heat Storage
• Power-to-Heat
• Optimized portfolios for electricity and heating technologies for each consumer
• Hourly data for generation and demand
• Time series and shares for self consumption and self supply
• Time series and shares for grid feed-in
• Comparison of costs towards reference system
Projection of Total Expansion
Input Parameter
• Exchange rates of heating systems
• Possible savings towards conventional refrence system
• Market penetration
• Installed capacities, electricity and heat generation from decentralized self-supply systems
Recalculation of Input Parameter for Following Years
• Feed-in tariff
• FIT fees
• Grid fees
Final Result:
Expansion pathways for various self-supply technologies

Methodology – Scenario Definition

- „Business-as-usual“ (BAU) scenario as a reference
  - all regulations and funding are kept as-is
  - moderate estimations on price development
  - + sensitivity analysis

- Szenario „system-benefical measures“:
  - Grid fees: higher base price, lower variable cost
  - Maximal feed-in restriction of 50% PV peak capacity
  - Electricity tax and concession fees on self-comsumed power

- Minimum & Maximum scenario
  - to estimate a corridor of development

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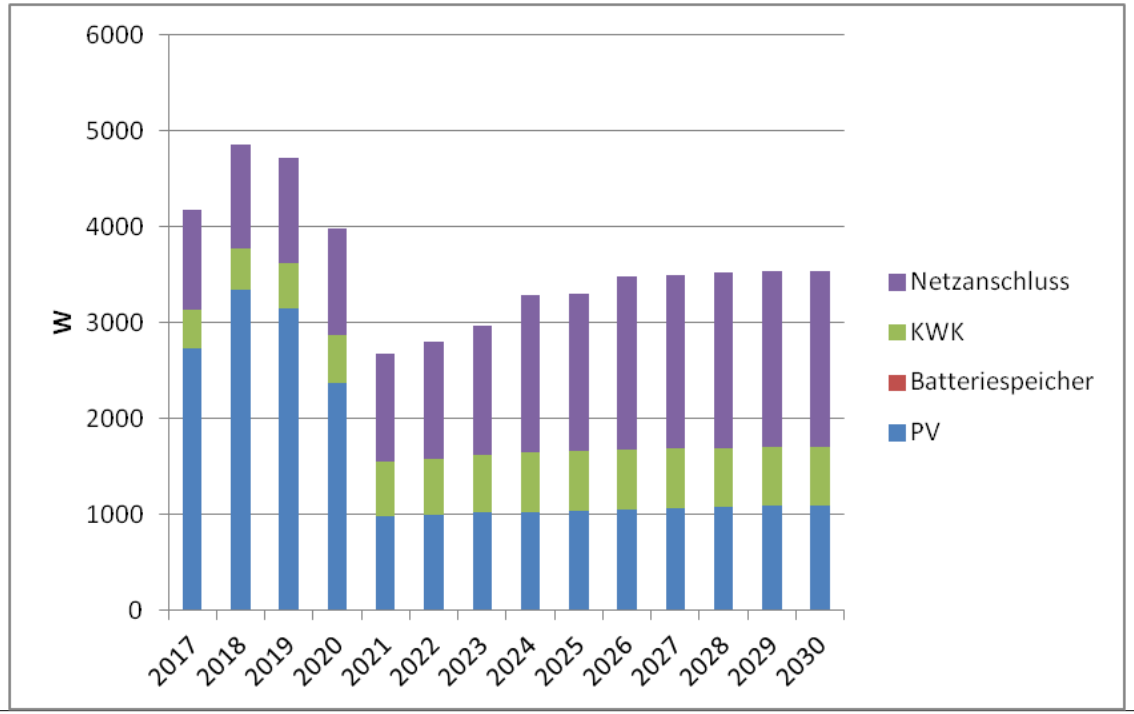
BAU-Szenario

- Closer look on **consumer type „single family house (old) “**
  - by far most common type in Germany
- Installed capacity electrical:



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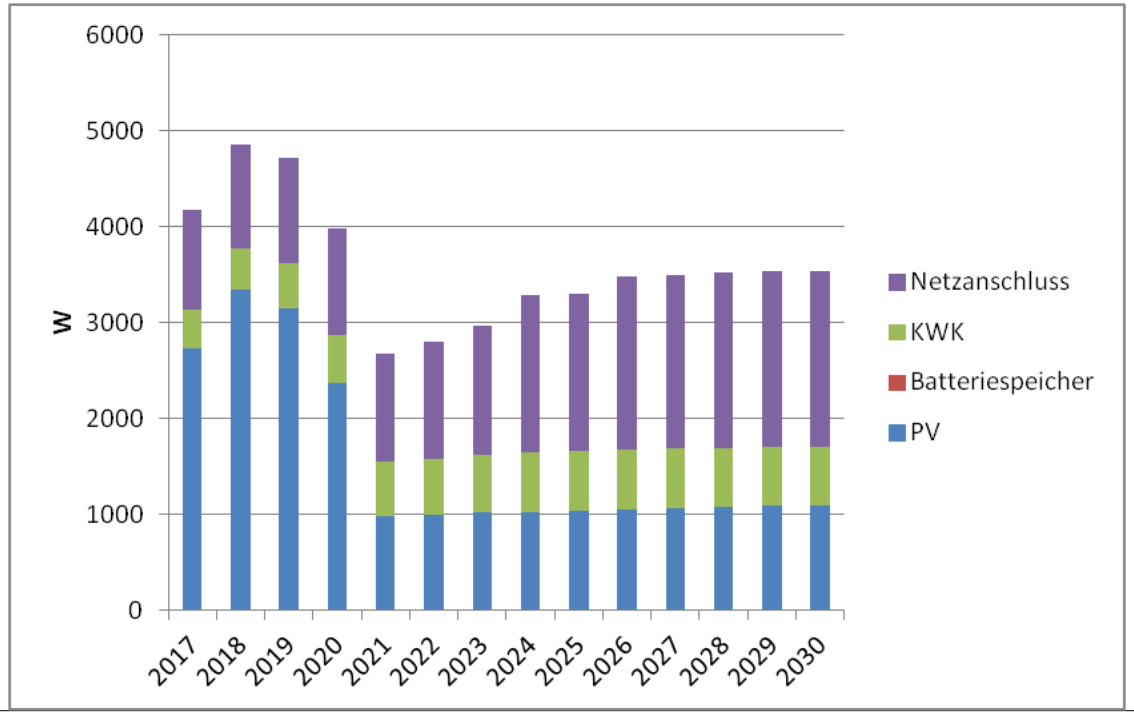
BAU-Szenario

- Electricity demand met through PV, CHP and grid supply



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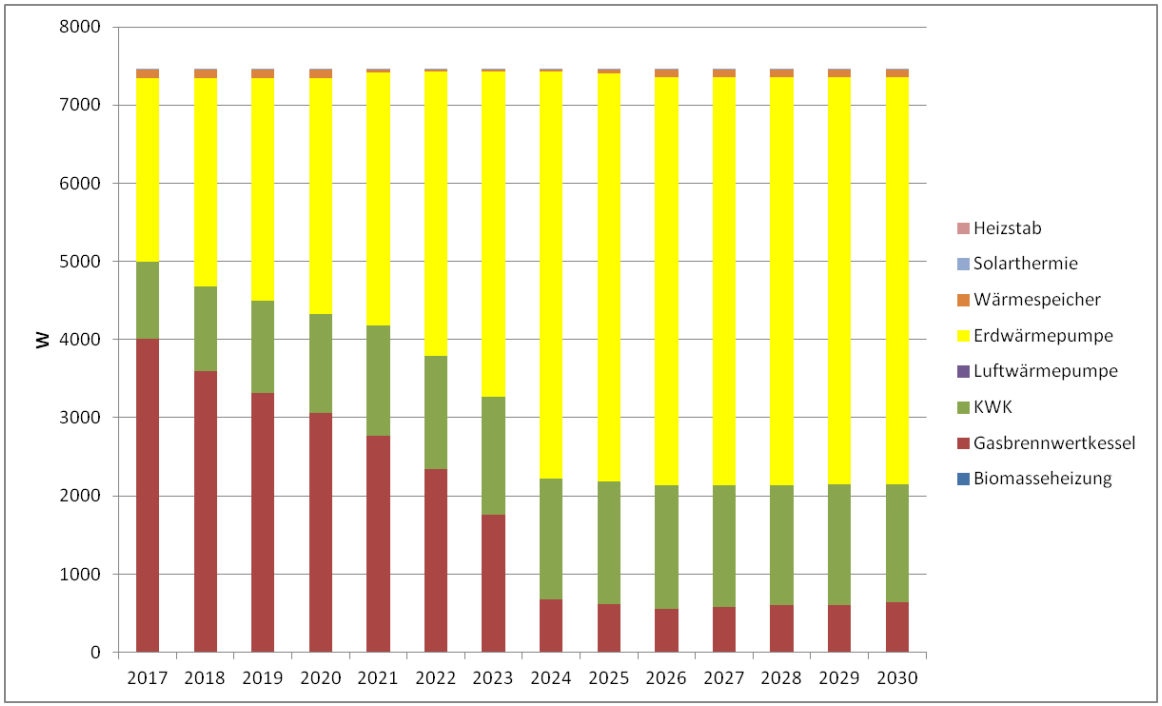
BAU-Szenario

- Heating demand mostly met through condensing boiler, CHP and heat pump
- Combining PV/CHP & heat pump enhances self-consumption ratio



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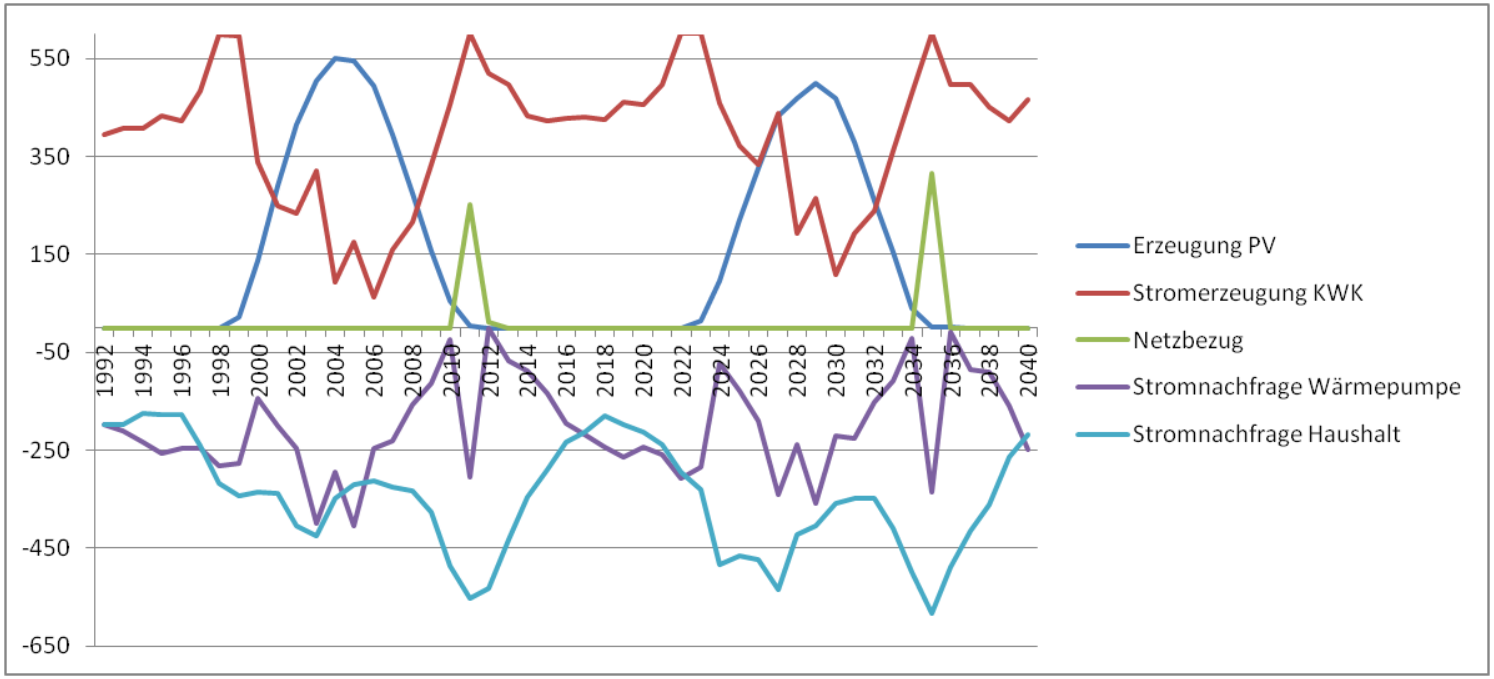
BAU-Szenario

- Combining PV/CHP & heat pump enhances self-consumption ratio
- Example: hourly demand on two days in spring 2030
  - heat pump mostly running on PV/CHP electricity



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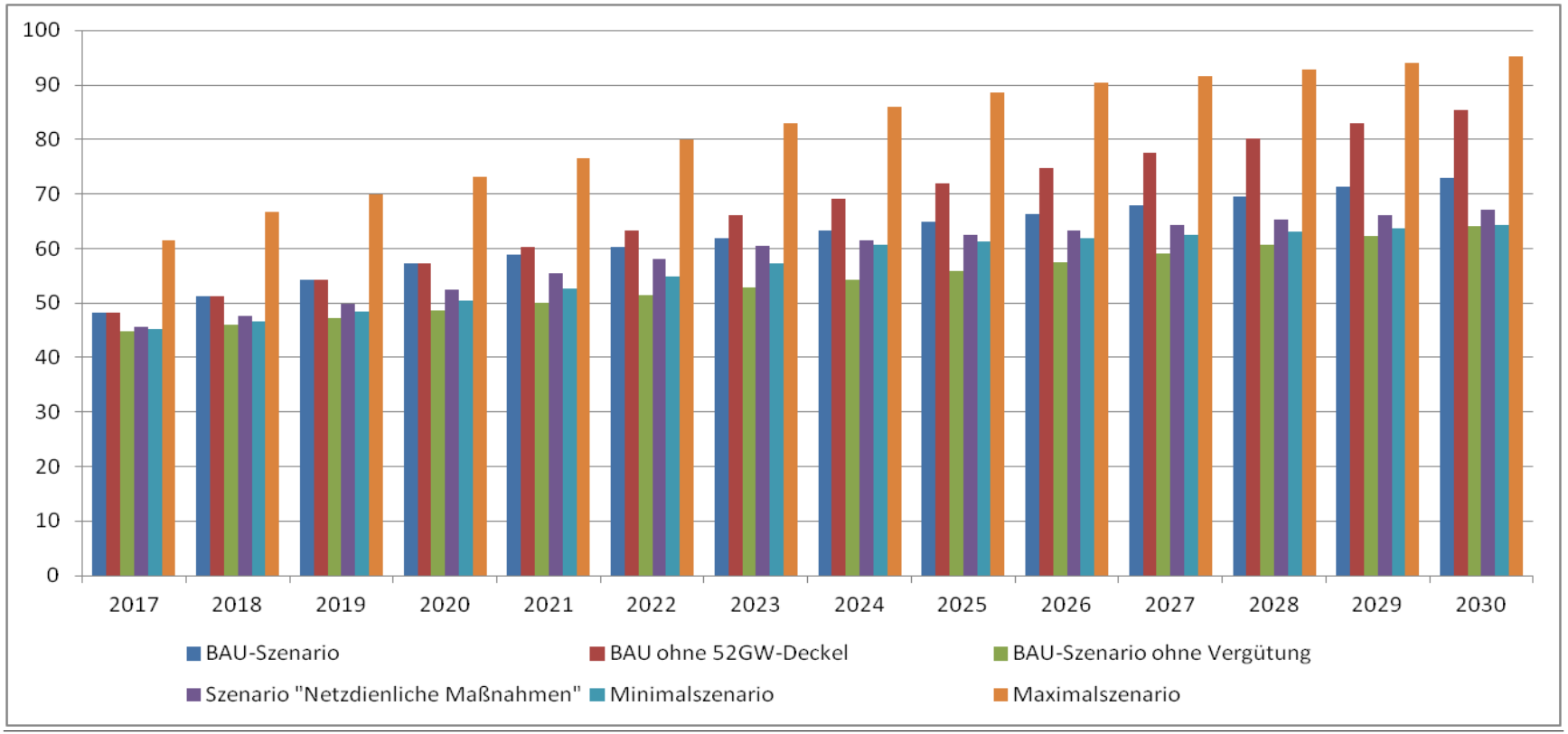
Comparison PV expansion pathway

- Installed Capacity PV in the scenarios



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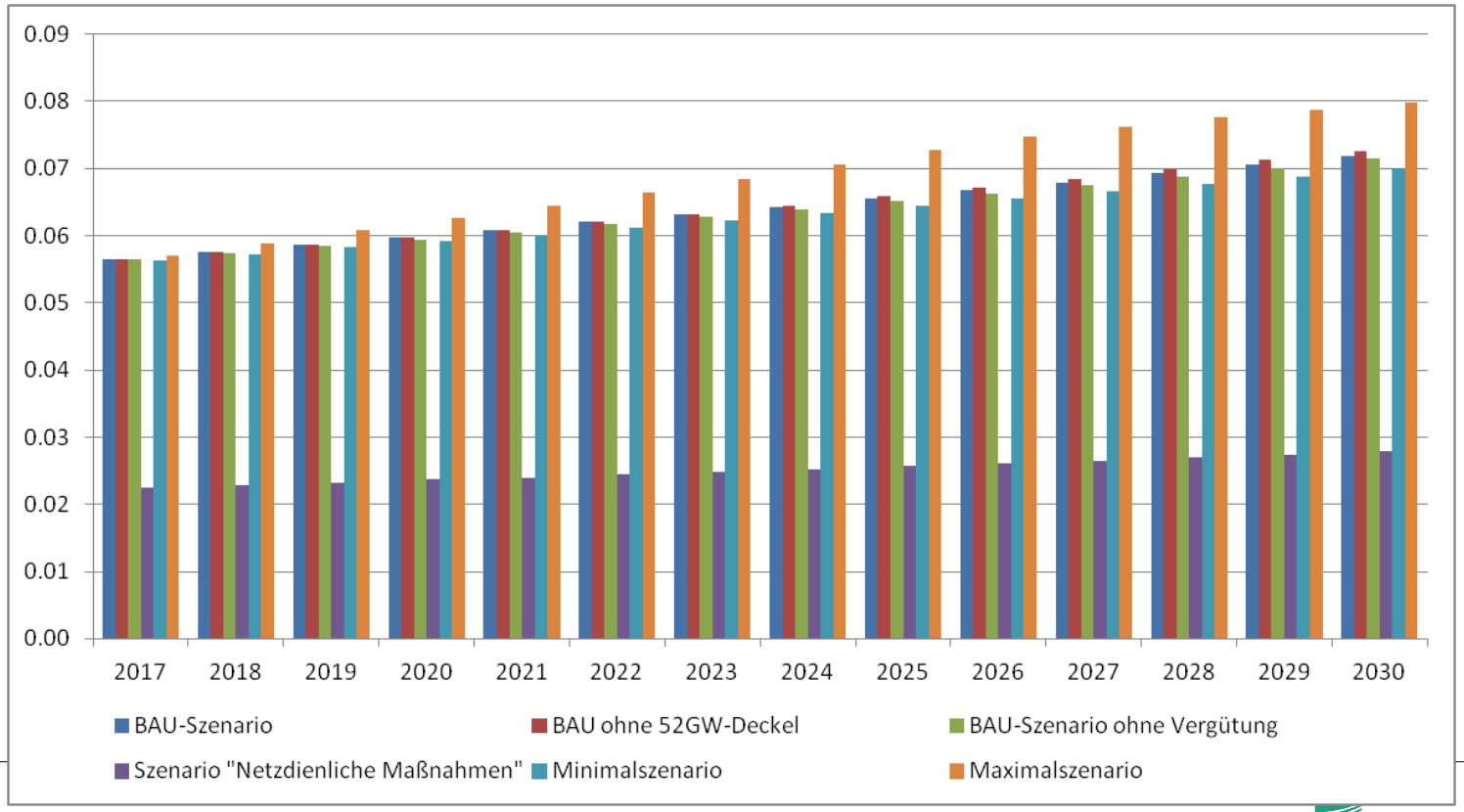
Grid Fees – Development

- Steady increase of grid fees due to expanding self-supply
- But only slightly differences between Min and Max scenario
- (Exception: Szenario „system-benefical measures“ exogeniously lowered)



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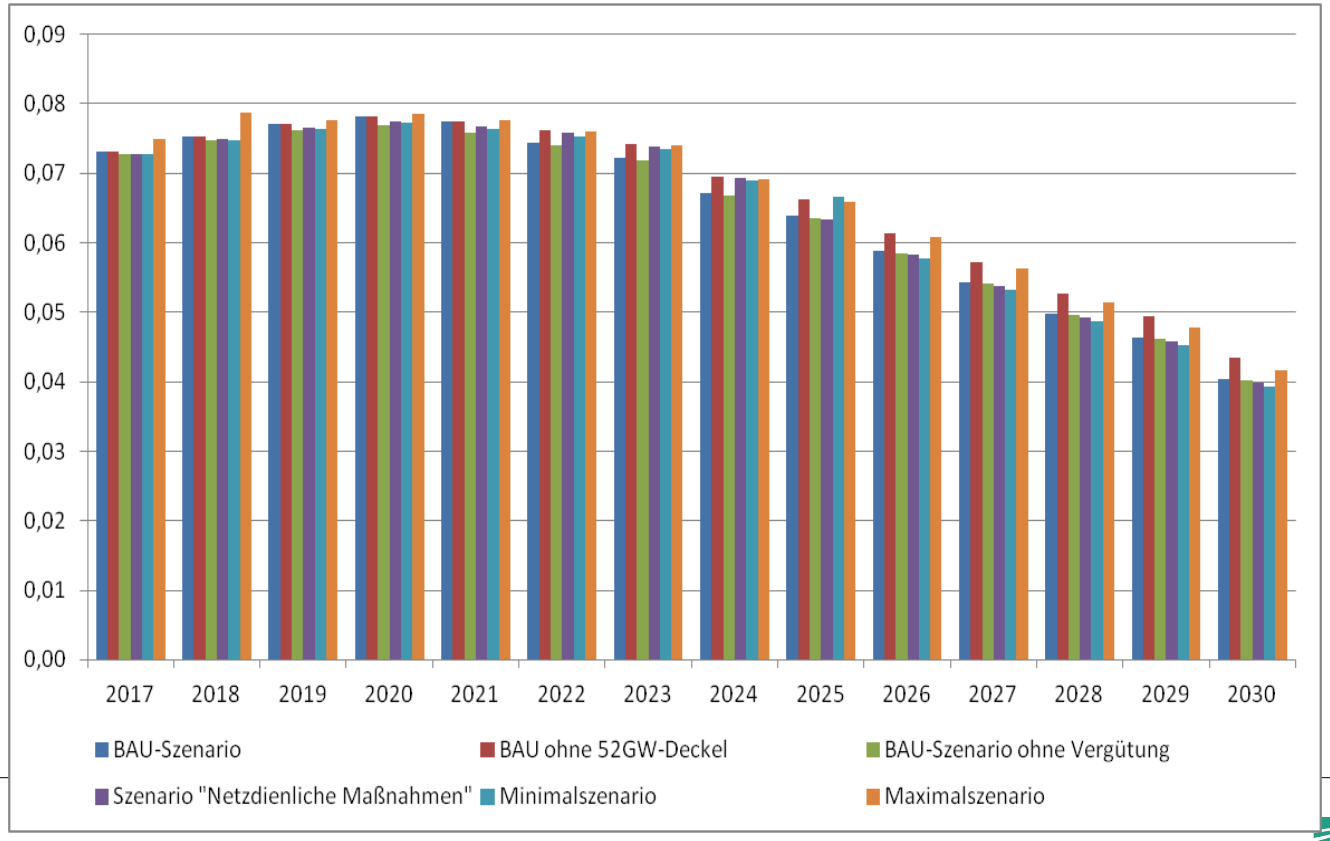
EEG levy - Development

- Slight increase of EEG levy, decline from 2021 on
- In BAU Szenario, EEG levy slightly over reference path
- Only slightly differences between scenarios (max. 0,23 €c/kWh in 2030)



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Conclusion

- Under current conditions there will be **no extreme expansion of self-supply**
- Main reason: **rentability relying on high self-consumption rate – given for small systems!**

- Even when assuming high cost reduction, **battery home systems expansion is limited**

- Only moderate influence on grid fees and EEG levy
- Only moderate effects on energy system

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Thank you for your attention!

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