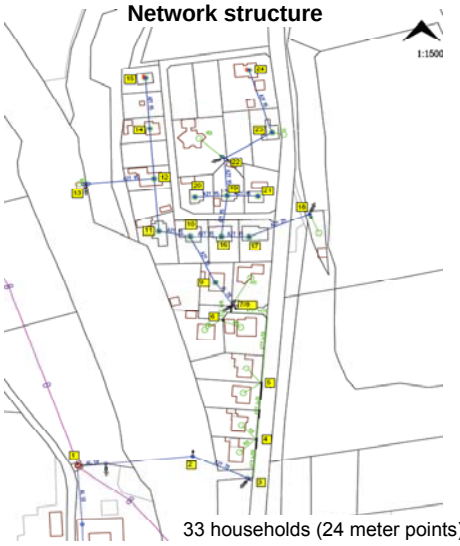
Economic and Ecological Evaluation of Competing Smart Grid Solutions

The European energy system is facing great challenges with respect to the enhanced utilization of renewable energy sources (RES). Limited capacities of the power network infrastructure due to the intermitting provision of RES are a major obstacle for achieving even higher shares of decentralized energy production. In addition to an appropriate adaptation and modernization of the power network, the distribution network plays a decisive role in future structures and intelligent system solutions, which offers a range of options for the integration of a decentralized generation (DG) of RES. The approach addresses the technical, economic and ecological aspects of smart grids, which serve as an interface between DG and the consumer.

The evaluation includes

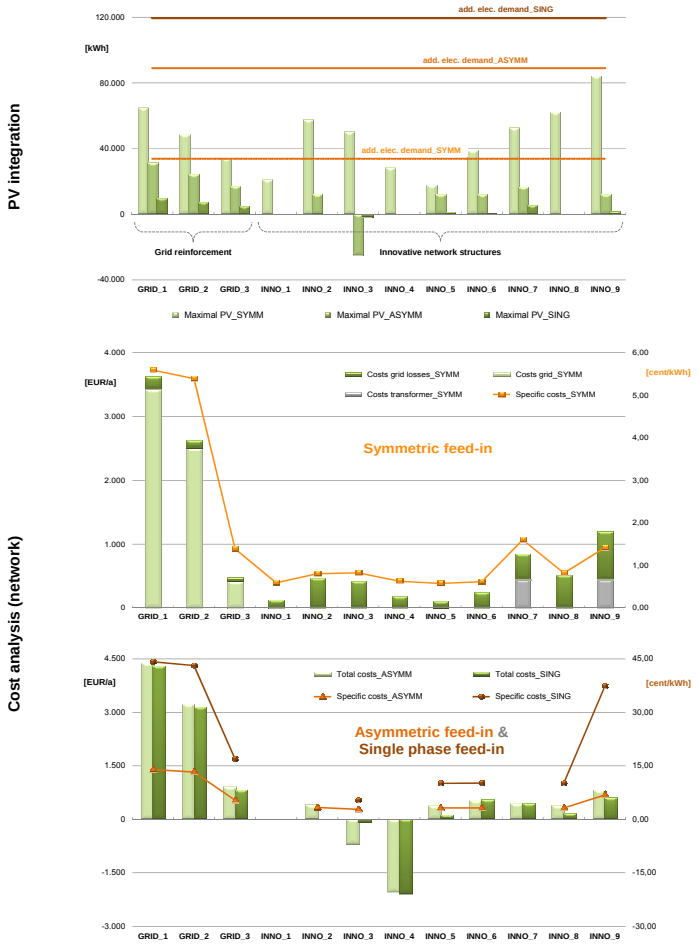
a. **the analysis of the maximum DG into the LV-grid,**
b. **the evaluation of necessary preconditions for the enhanced integration of decentralized, small scale facilities, and**
c. **the economic and ecological assessment of an enhanced integration of RES into intelligent power grids.**

Network structure



33 households (24 meter points)
~132 MWh energy demand

Economic analysis



Methodological approach

Technical analysis

- Selection of network structures
- Development of system solution scenarios
- Consumer behaviour: measured load profiles
- Supply behaviour: photovoltaic (PV) profiles
- Symmetric, asymmetric and single phase feed-in
- Simulation model based on load flow analysis

Economic and ecological analysis

- Based on the technical results → potentials of scenarios
- Results based on additional effects to reference scenario (existing grid incl. Max. PV)
- Identification of necessary network infrastructure components
- Economic eval. based on typical investment and operating costs
- Ecological eval. based on the emission reduction potential

Investigated scenarios

GRID_1: Doubling existing network
GRID_2: Consistent cabling cross-section (150) for network
GRID_3: Consistent cabling cross-section (150) for line 1→2→3
INNO_1: Reactive power (Q) control funct. of voltage (U)
INNO_2: INNO_1 + communication between PV facilities
INNO_3: Reactive power (Q) control funct. of active power (P)
INNO_4: INNO_1 + adapted INNO_2 (func. of grid topology)
INNO_5: Active power (P) control funct. of voltage (U)
INNO_6: INNO_5 + communication between PV facilities
INNO_7: Adaptable distribution transformer
INNO_8: INNO_1 + INNO_5
INNO_9: INNO_7 + INNO_8

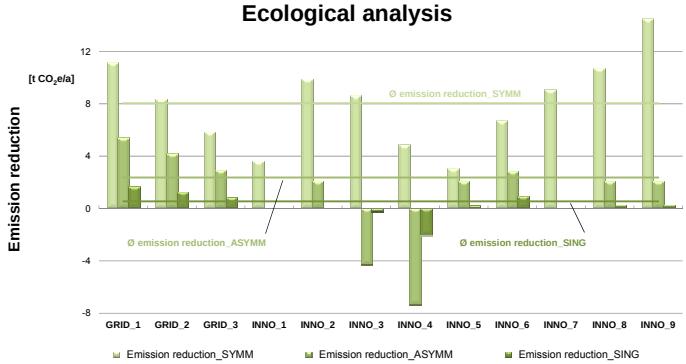
Results

- Economic and ecological assessment for symmetric, asymmetric and single phase feed-in of PV
  - Symmetric feed-in → best case
  - Single phase feed-in → worst case

Further steps

- Elaborated assessment of a second network structure (mix of households and other buildings)
- Detailed cost/revenue analysis from PV
- Analysis further DG technologies
- Extrapolation of results for Austria

Ecological analysis



Partners

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Energy Institute at the Johannes Kepler University of Linz
Markus Schwarz | schwarz@energieinstitut-linz.at | Tel.: +43 735 2468 5664
Andrea Kollmann | kollmann@energieinstitut-linz.at | Tel.: +43 735 2468 5660
Altenberger Straße 69 | A-4040 Linz
Web: www.energieinstitut-linz.at, www.energyefficiency.at