

# Economics of Residential Cogeneration Systems

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## Motivation

- Micro cogeneration technology (micro-CHP) is becoming ready for market entry.
- Micro-CHP: higher efficiency in residential energy consumption.
- Suitable for a specific housing segment: older buildings with substantial heat load and preferably with a gas connection.
- Conversion technologies at micro level: Stirling engines, internal combustion engines and fuel cells.
- The potential costs and benefits to the different involved actors are unclear.
- In our research potential costs and benefits in different business models are quantified via simulation studies.
- Objective: provide insight for the involved actors and policy makers.

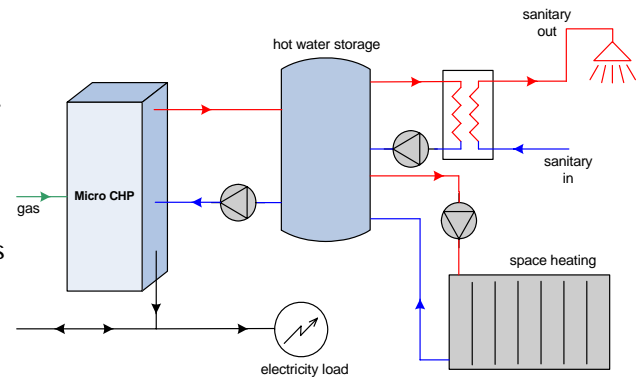


Figure 1: In-house micro-CHP configuration

## Approach

- Identification of possible coordination regimes and business models pertaining to micro-CHP application.
- Mathematical system modelling and simulation studies.
- System boundary: cluster of micro-CHP households and an aggregating load serving entity (aggregator).

## Example: stand-alone operation

- Stirling micro-CHP local control mode: thermal-led, with modulating engine output.
- Both space heat and domestic hot water taken from one central hot water storage (Figure 1).
- Monte Carlo simulation with cluster of households.

## Example: results

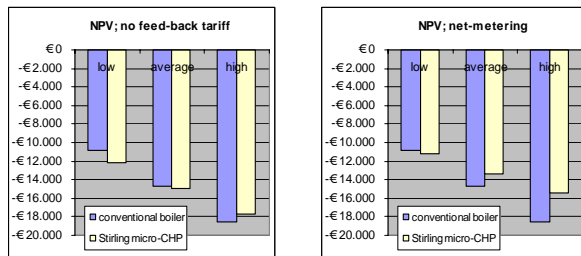


Figure 2: NPV of residential energy costs over system lifetime, relative to investment costs, for households with low, average and high energy demand. Without (left) and with (right) net-metering.

- Inv. costs: conventional boiler: 2000 €, micro-CHP: 5000 €.
- With NPV of variable energy costs (gas, electricity import/export) over system lifetime of 15 years, micro-CHP is economically attractive for households with substantial heat and electricity consumption.

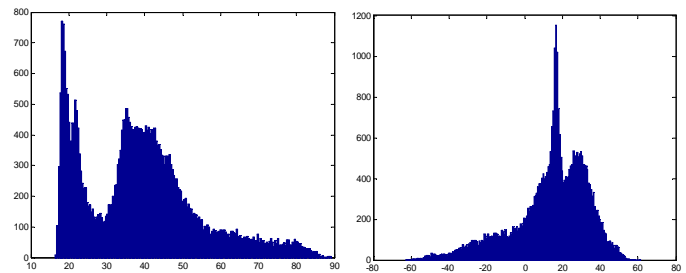


Figure 3: Frequency distribution of cluster load (100 households). Frequency in [# 15 min. periods/year]. Net-consumption without micro-CHP (left) and with micro-CHP (right)

- Significant peak load reduction from micro-CHP application.

## Future work

- Further quantification of cost savings for aggregator due to decreased need for buying peak-power.
- More intelligent control: active participation of distributed resources in market trading activities of aggregator can further reduce operational costs of micro-CHP.
- Fuel cells vs. Stirling technology.

Figure 4: Towards active participation of residential resources

