Programm

TU Graz

Technische Universität Graz
Graz University of Technology

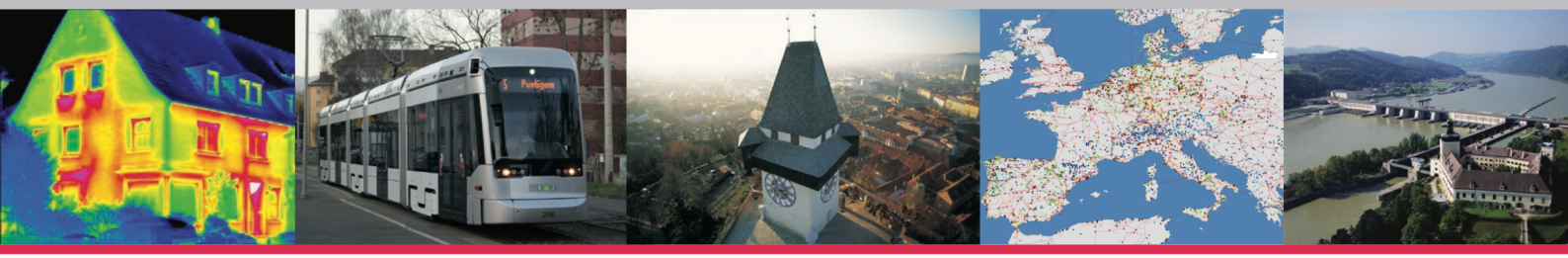
IEE

EnInnov2020

16. Symposium Energieinnovation

ENERGY FOR FUTURE - Wege zur Klimaneutralität

12.-14. Februar 2020 TU Graz, Österreich



OVE

oesterreichs energie.

WORLD ENERGY COUNCIL AUSTRIA

TECHNISCHE UNIVERSITÄT WIEN

SektoKop Net: Power 2 Heat

Cross-sector and coupled operation of electricity and heat networks

Frida Revheim, Daniel Schwabeneder, Georg Lettner

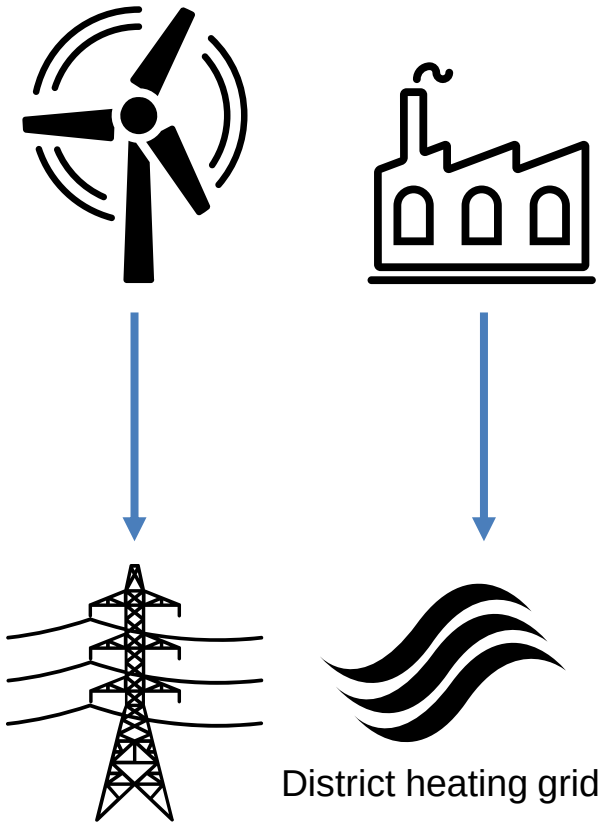
2020

revheim@eeg.tuwien.ac.at

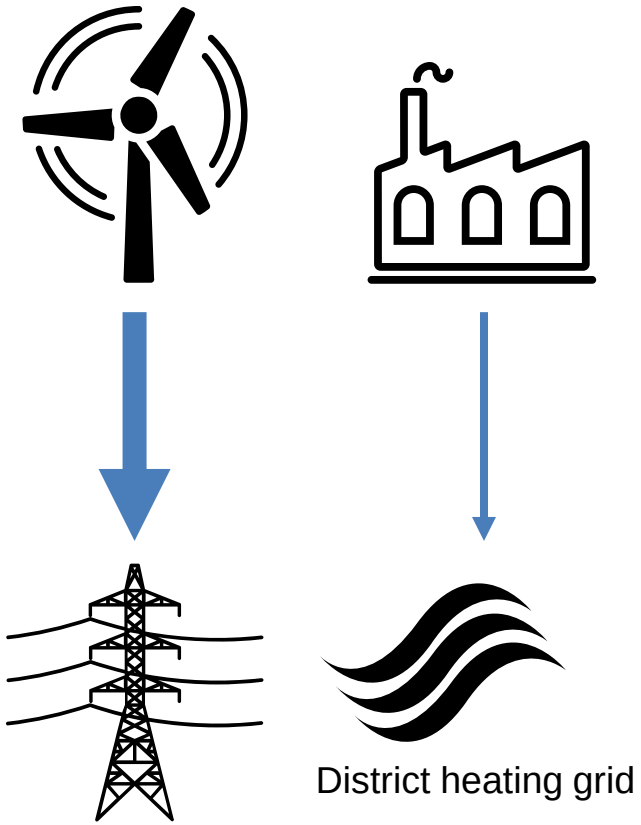
List of contents

Scenario overview

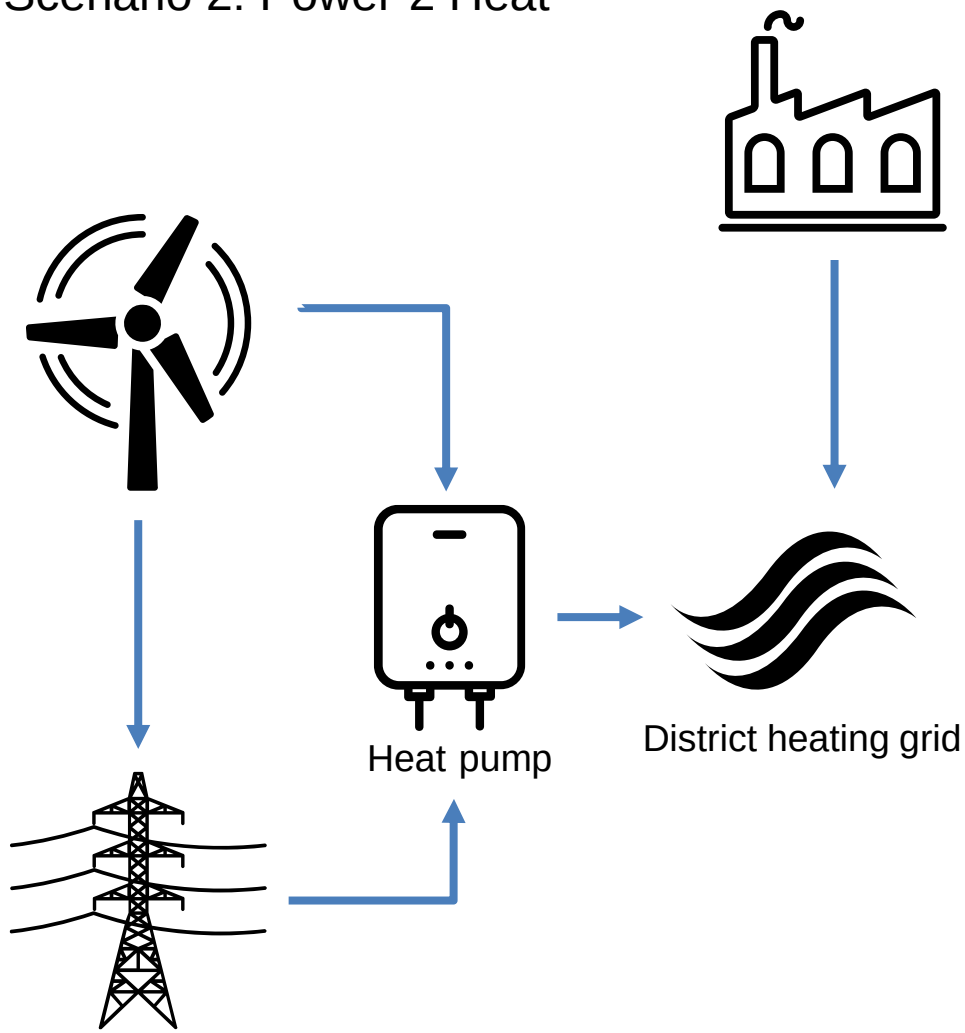
Baseline scenario



Scenario 1: increased power grid capacity



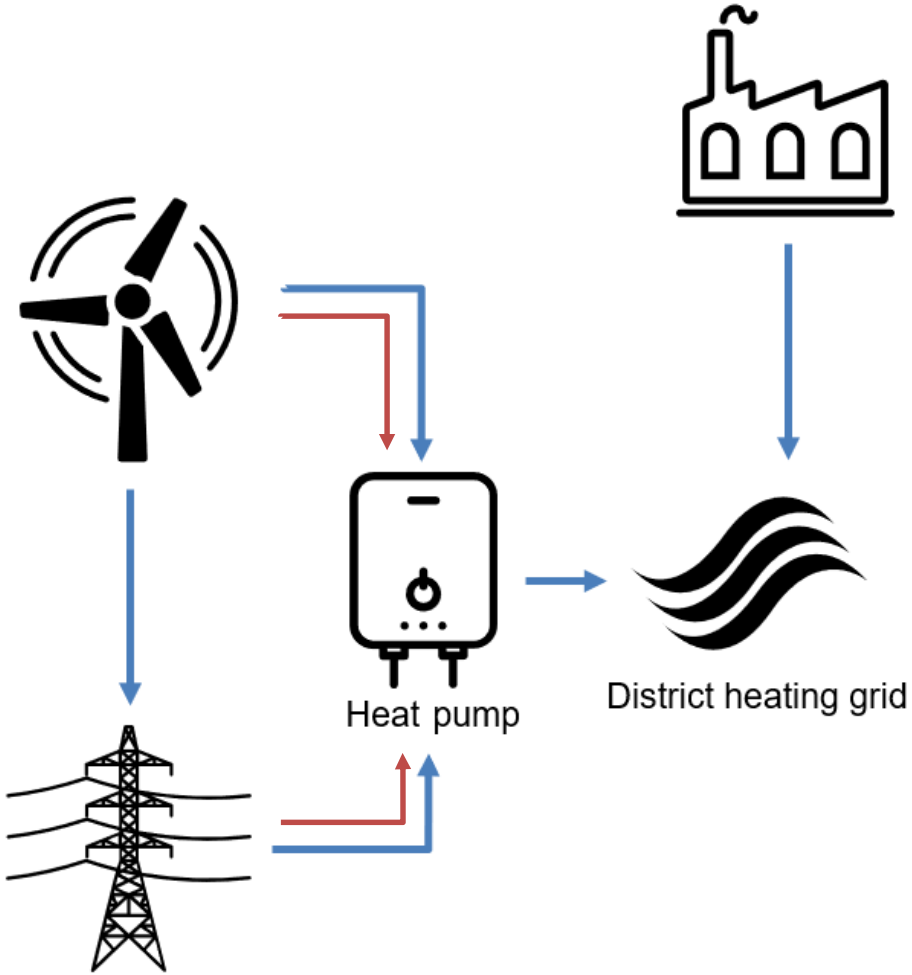
Scenario 2: Power 2 Heat



Scenario overview

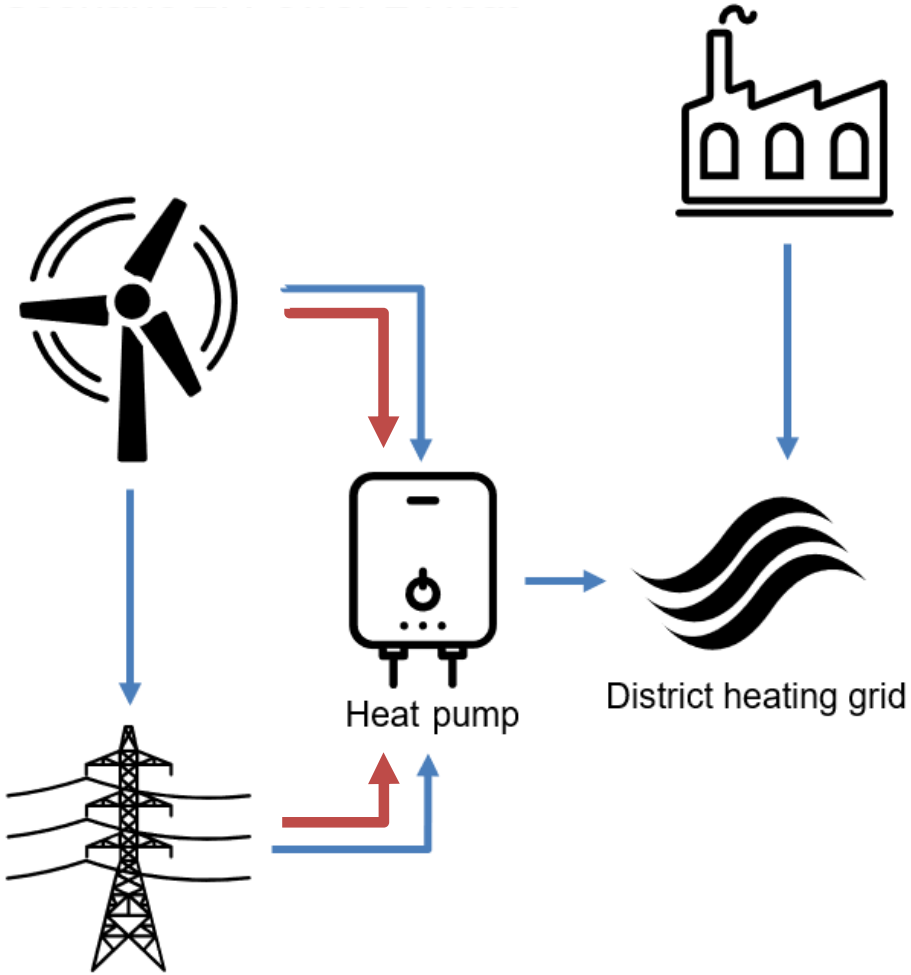
Scenario 3: Power 2 Heat with imbalance

- a fourth of the minimal electricity input reserved



Scenario 3*: Power 2 Heat with imbalance

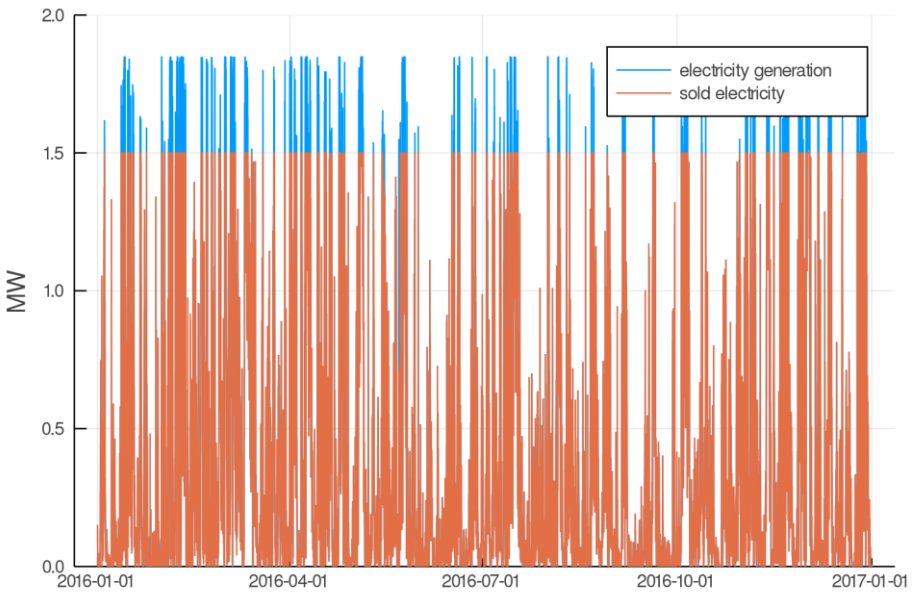
- half of the minimal electricity input reserved

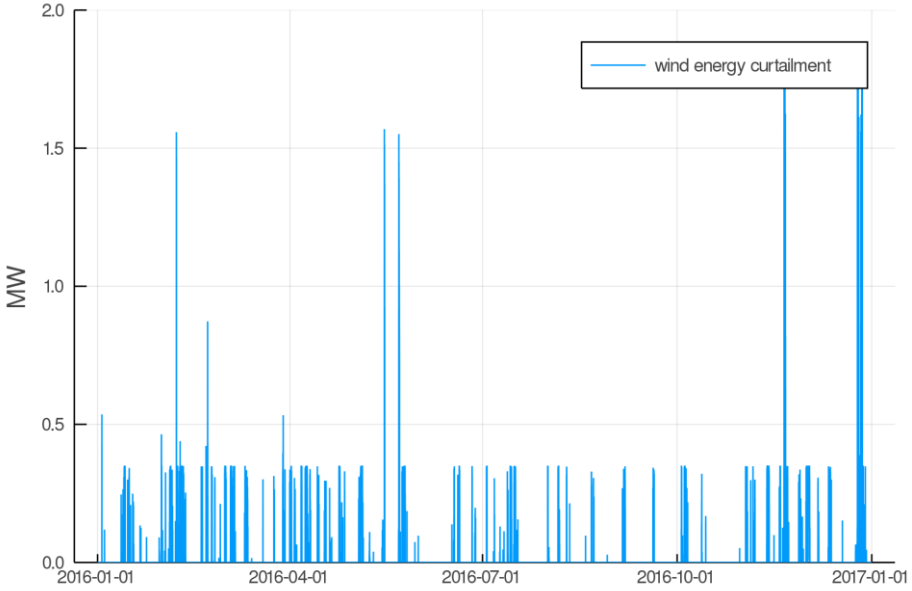


Assumptions

Parameter	Value
Power grid capacity	1.5 MW
Heat pump capacity	0.578 MW
COP	1.5-3.5
Alternative heat prod. cost	32 EUR/MWh (summer) 38 EUR/MWh (winter)
Grid level	5 – Burgenland
Grid tariff	13.0 EUR/MWh (SHT and WHT) 12.3 EUR/MWh (SNT and WNT)
Netzverlustentgelt	0.9 EUR/MWh
Netzentgeltkomponente Netznutzungsentgelt (Arbeit)	1.74 EUR/MWh
Netzentgeltkomponente Netzverlustentgelt	0.17 EUR/MWh

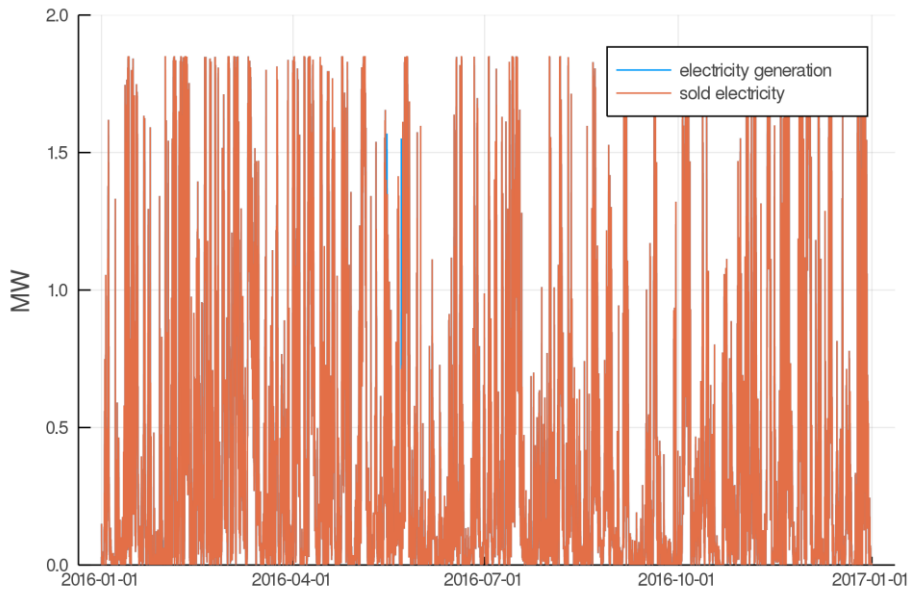
Baseline scenario

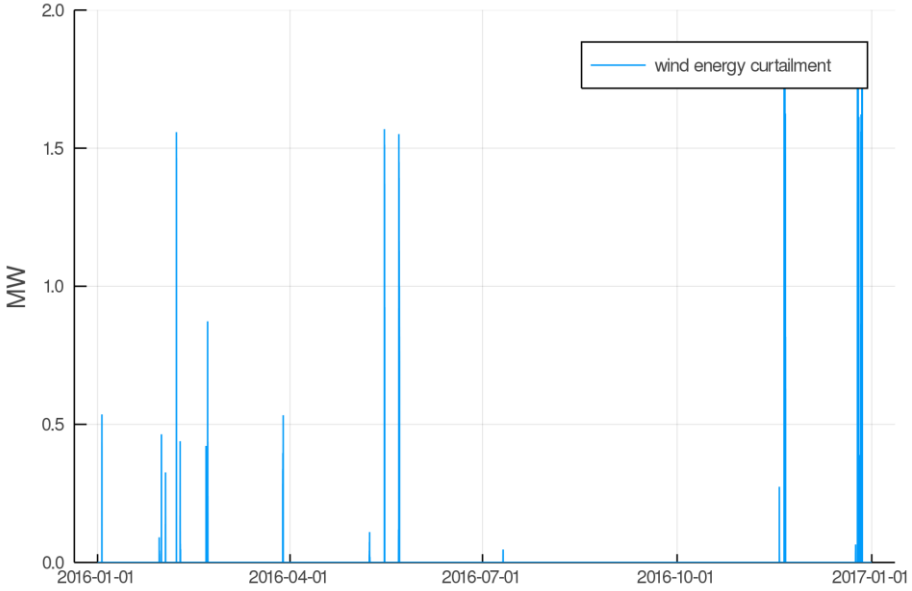




- No heat pump implemented and power grid capacity of 1.5 MW
- Windmill operator and DH-grid operator are separate actors
- The majority of the generated electricity is sold to the power grid, only limited by the grid capacity and negative electricity prices
- The curtailment peaks are a result of instances with negative electricity prices

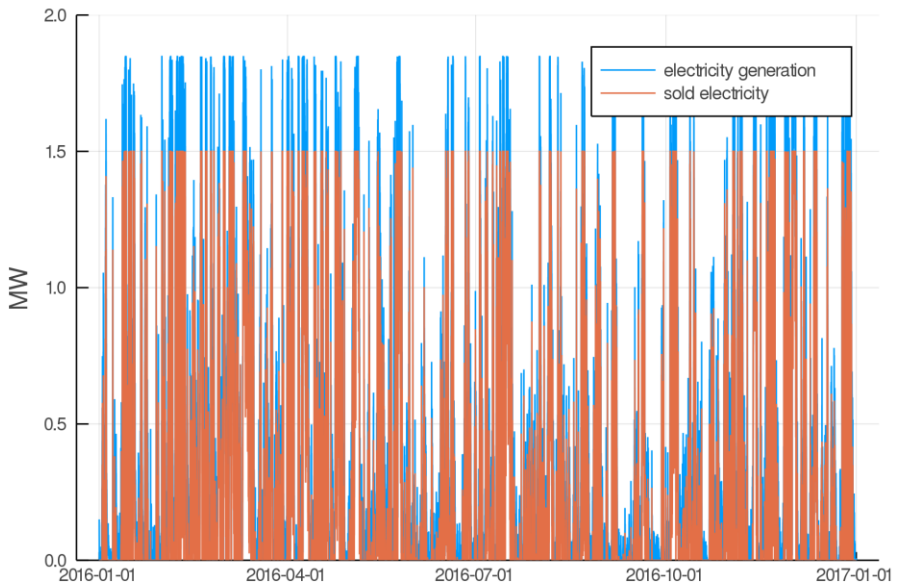
Scenario 1: Increased power grid capacity

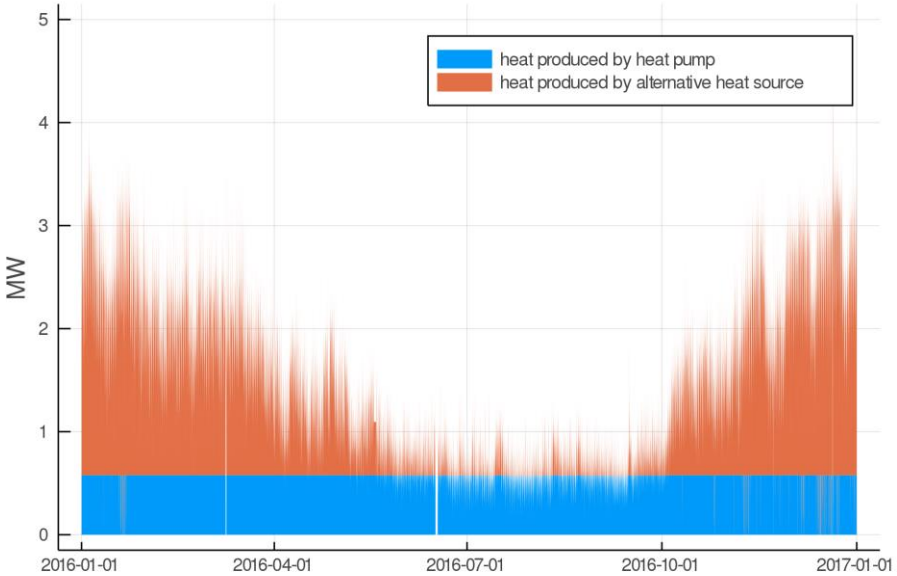




- Power grid capacity was increased (2 MW) to not limit transmission
- No heat pump implemented – heat demand is completely covered by an alternative heat source
- All generated electricity is sold to the power grid. Discrepancies are due to negative electricity prices
- Curtailment is due to negative electricity prices

Scenario 2: Power 2 Heat





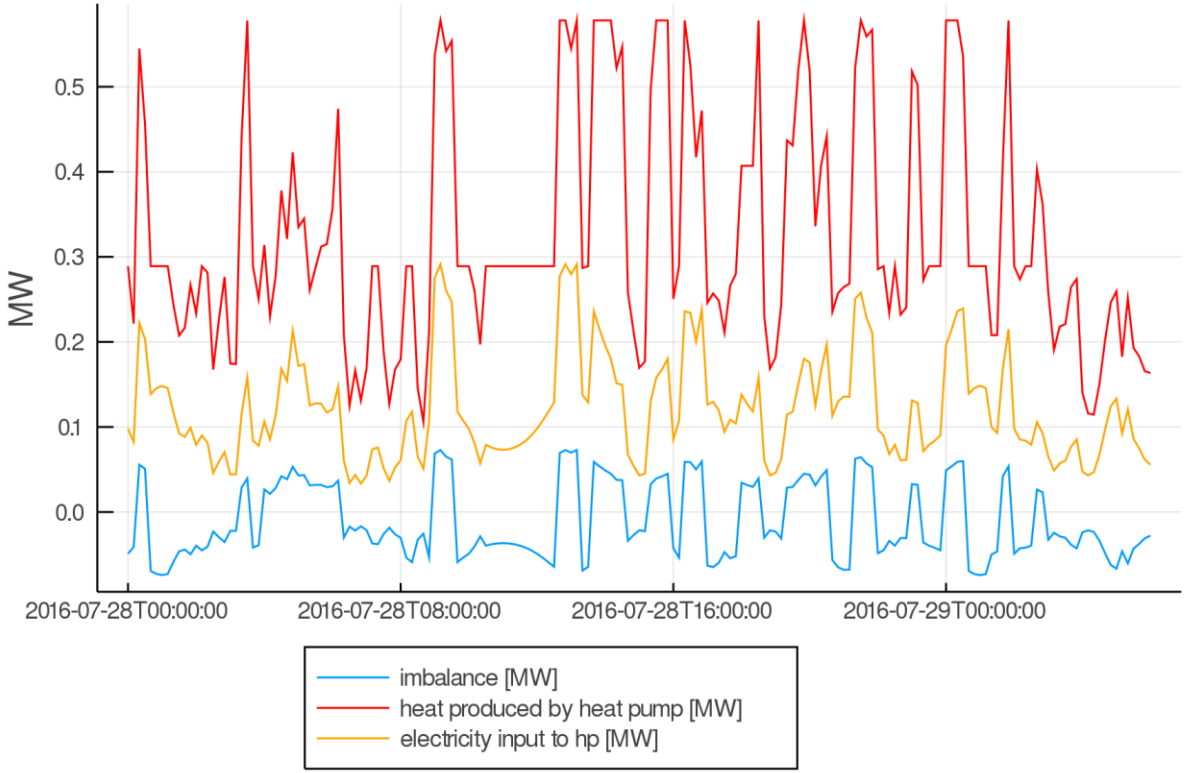
- A heat pump with 0.578 MW capacity is implemented, connecting the windmill and DH-grid operators
- Amount of electricity sold from windmill to power grid is restricted by power grid capacity (1.5 MW) and the requirement to meet heat demand
- Negative electricity prices also influence the quantity of electricity being sold to the grid
- The amount of heat produced by the heat pump is limited by the heat pump capacity
- The remaining heat demand is covered by an alternative heat source

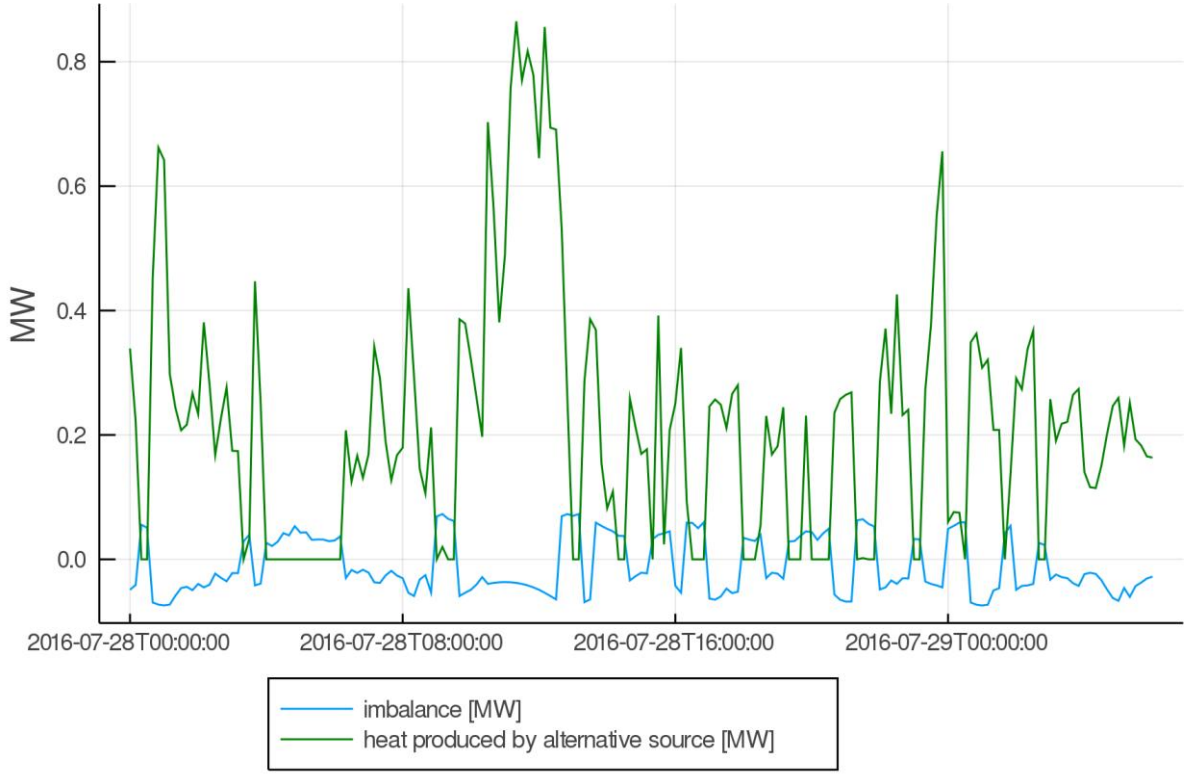
Scenario 3: Imbalance

- Heat pump capacity, equaling a fourth of the minimum electricity input into the heat pump, is reserved for imbalance regulation

- Negative imbalance → low amounts of electricity being fed into the heat pump → reduced heat pump production → high amounts of alternatively produced heat

- Positive imbalance → high heat pump production → reduced need for alternatively produced heat



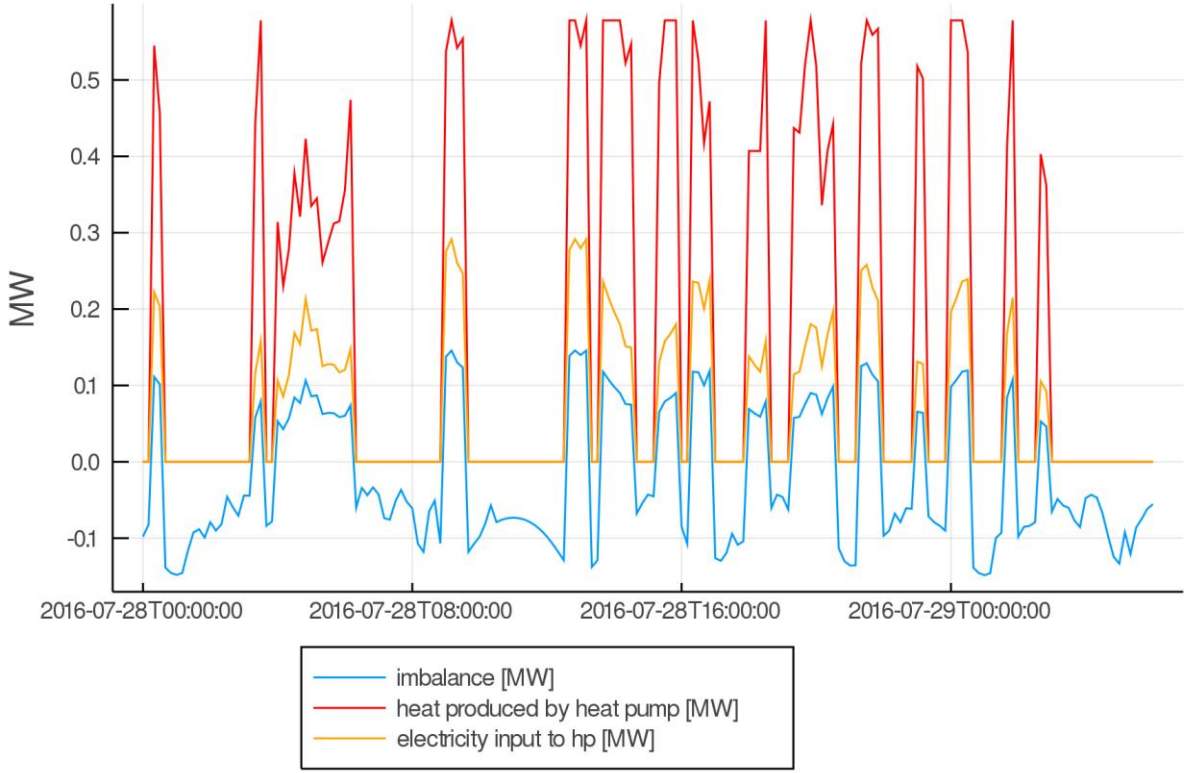


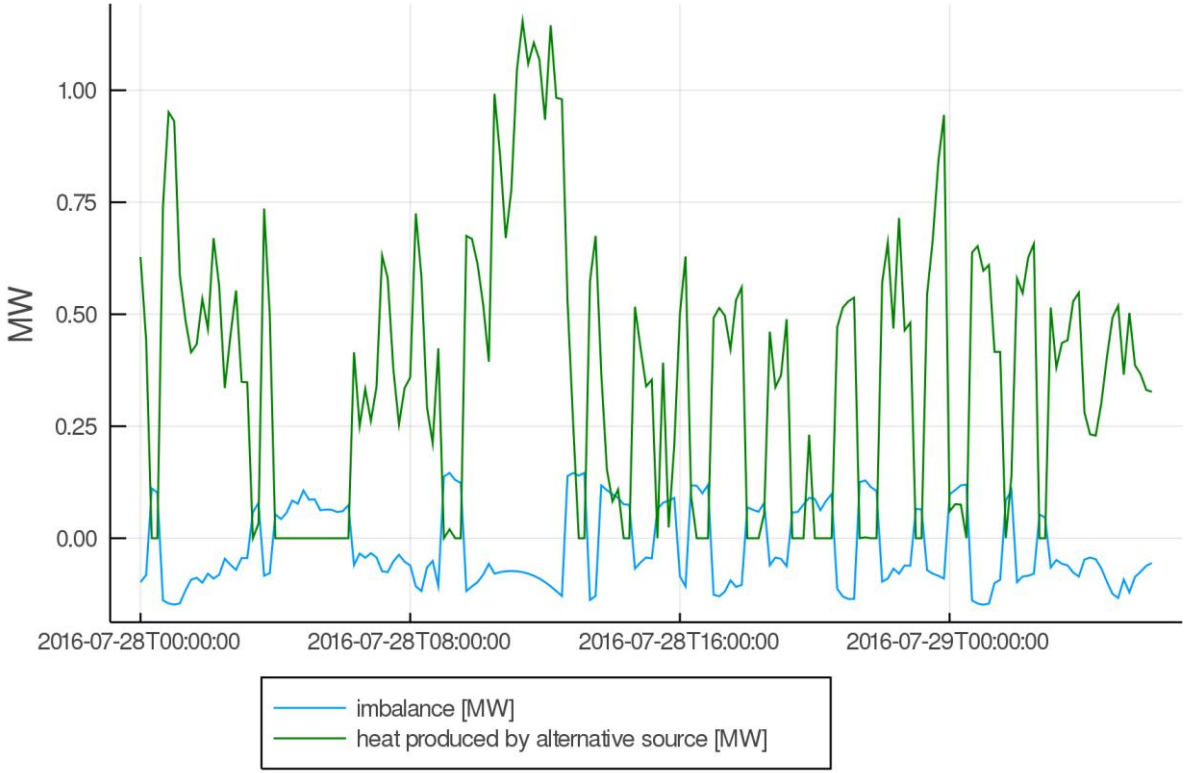
Scenario 3*: Imbalance

- Heat pump capacity, equaling half of the minimum electricity input into the heat pump, is reserved for imbalance regulation

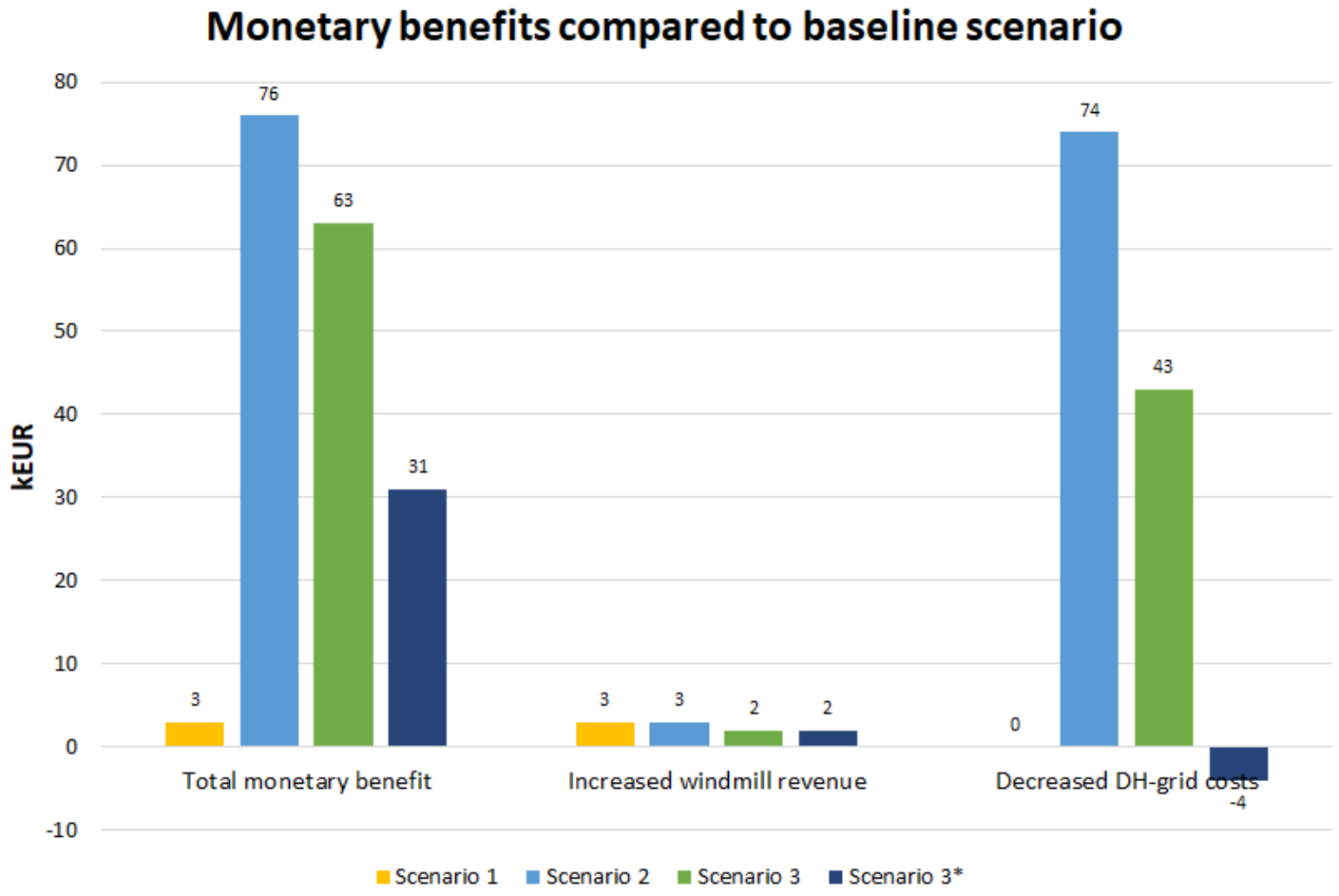
- Negative imbalance → no/low electricity being fed into the heat pump → no/low heat pump production → high amounts of alternatively produced heat

- Positive imbalance → high heat pump production → reduced need for alternatively produced heat





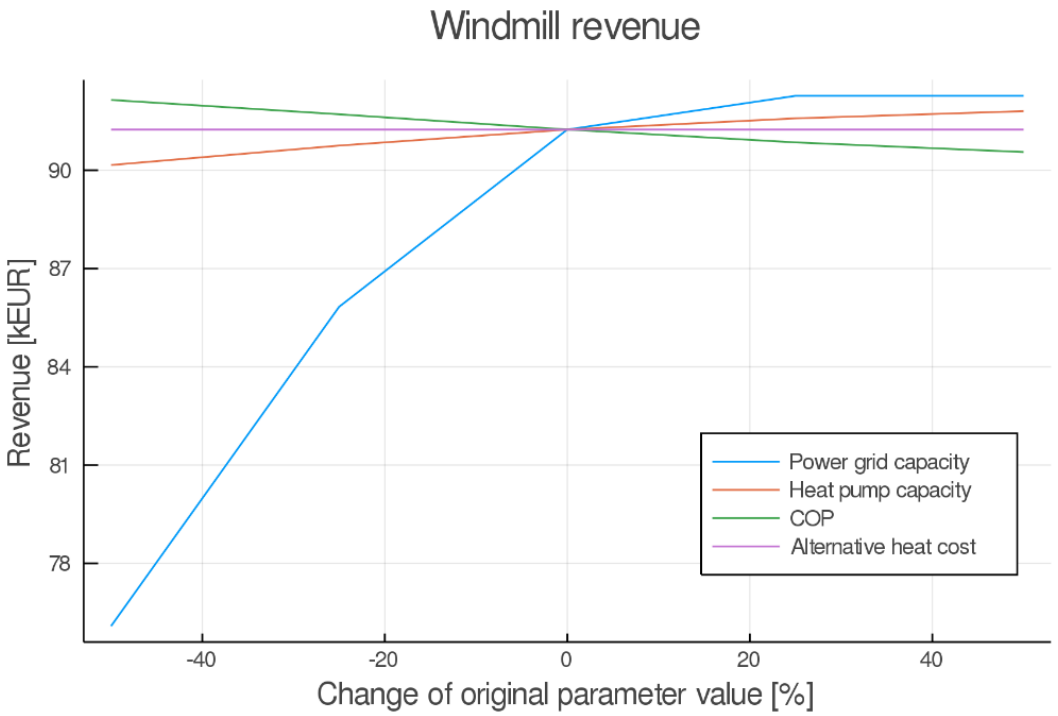
Comparison of results

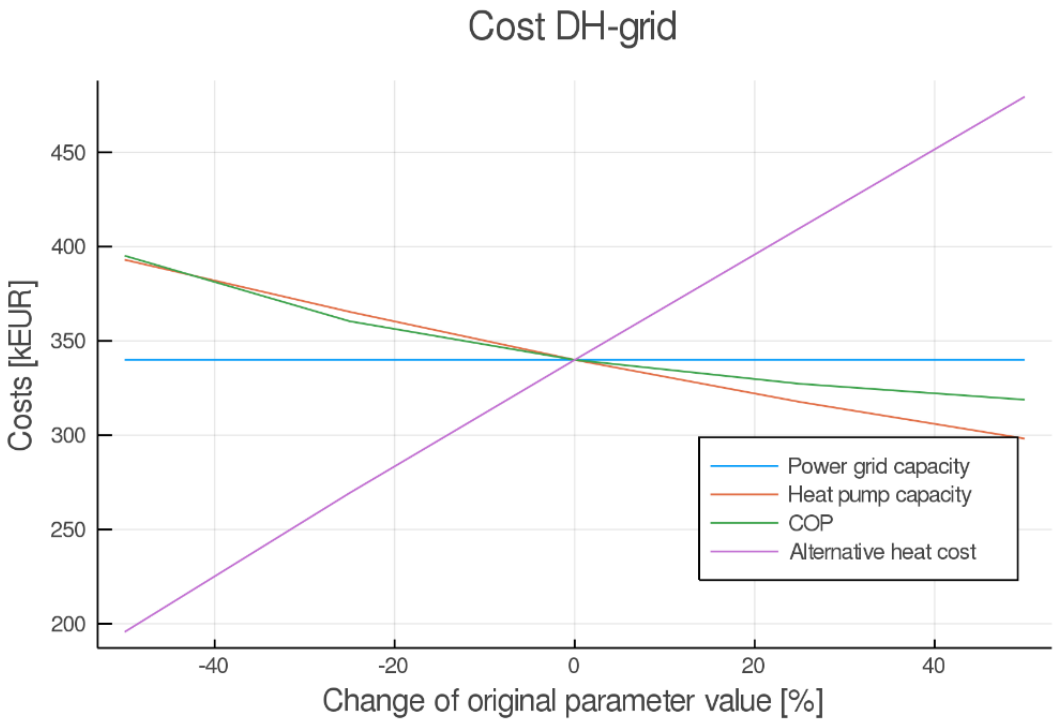


- Implementation of a heat pump increases total benefit compared to baseline scenario
- Increase in windmill revenue is greatest without imbalance regulation
- DH-grid costs are significantly reduced when implementing a heat pump
- The amount of heat pump capacity reserved for imbalance regulation significantly affects the DH-grid costs

Sensitivity analysis: Scenario 2 - P2H

- Parameter values were altered by ± 25% and ± 50% of their original values
- Windmill revenue is mostly affected by reductions of the power grid capacity
- Alternative heat cost has a major impact on DH-grid costs, followed by heat pump capacity and COP





Further work

- Power 2 Gas
  - Implementing power 2 gas technology
  - Can sell gas to both gas grid and gas boiler
  - Gas boiler is connected to the DH-grid and gas grid connected to a CHP facility
- Hybrid model
  - Combination of P2H and P2G

Sources

Icons were created by:

- Windmill by Vectors Point from the Noun Project
- Transmission Tower by Arthur Shlain from the Noun Project
- Heat by Alexander Skowalsky from the Noun Project
- Heating plant by Ralf Schmitzer from the Noun Project
- Heating by Begin sapdian from the Noun Project

Assumptions were obtained from:

- Esther Werderitsch (Energie Burgenland) - heat pump capacity
- Rechtsinformationssystem des Bundes (RIS) – grid tariffs and fees

Frida Revheim, MSc

TU Wien
Energy Economic Group, EEG
Gußhausstraße 25-29 / E370-3
1040 Vienna, Austria

Email: revheim@eeg.tuwien.ac.at
Web: http://www.eeg.tuwien.ac.at