Target in Annex 57

The project investigated the flexible use of heat pumps in buildings and district heating networks for participation in various electricity markets, as well as the technical boundary conditions for this

Annex 57

https://heatpumpingtechnologies.org/annex57

Start 11/2020
End 12/2023

Participating countries
- Denmark (Lead)
- Germany
- Austria
- Sweden
- Netherlands

Tasks	Content
Task 1: Energy market analysis	• Elaboration of energy situation and trends • Overview of existing and future heat sources
Task 2: Case studies and best practice examples	• Screening and characterization of existing DH systems, demo systems and R&D projects of flexibility applications with HPs
Task 3: Development of representative and promising solution concepts	• Analysis of different concepts for flexible HP operation • Evaluation of case studies
Task 4: Evaluation of different flexibility options	• Analysis of possible applications of HPs technologies and their application markets
Task 5: Evaluation of business models and analysis of barriers	• Implementation barriers including non-technical obstacles and discussion solutions to overcome barriers • Derivation of innovative business models

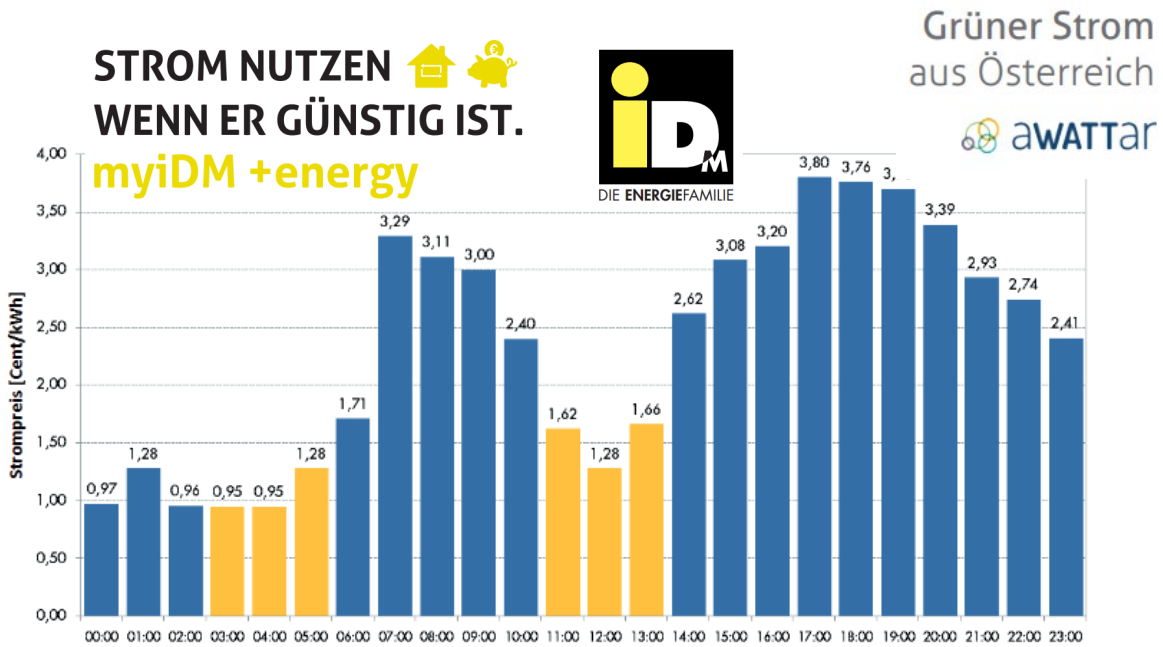
General overview
Potential applications for flexible heat pump use

Price signals and fields of applications		Prerequirements	Implementation effort	Indicative profitability
Spot Markets	Day-ahead	• Variable tariffs • DA-price projection • Coordination btw trading & supplier	Low	Low
	Intraday			
Balancing markets	Primary	• Pooling & PQ • Load Control • Settlement • DSO-Veto	High	Medium
	Secondary			
	Tertiary			
Imbalance settlement		• Imbalance responsibility • Short-term load control	High	Low
Local flexibility markets		• Flexibility market in place?	High	?
Maximise own consumption (PV, Energy community)		• Weather & load projection • Energy community: settlement	Low	Medium

Existing business models by country

Exemplary Business Model

Proven business model in practice: **Exploit variable spot market prices**



https://www.idm-energie.at/wp-content/uploads/2021/03/Flyer_myidm-energy_Feb20.pdf

- iDM Energiesysteme" is an innovative Austrian heat pump manufacturer located in Eastern Tirol. Their product "myiDM +energy" aims to consume electricity preferably when electricity prices are low
- Prerequisite for participation is an iDM heat pump with the corresponding software version, as well as a smart meter and an internet connection. Further, the consumer needs a variable electricity tariff. Currently, the system supports three Austrian electricity suppliers with flexible tariffs.
- The heat pump system can use the heating buffer, the domestic hot water storage as well as thermal building masses as energy storages to shift electricity consumption in time

Innovative business models

Two main innovative business models have been identified

Local flexibility markets

Support of the distribution grid

Provision of balancing services

Heat pumps can be aggregated (in case of small-scale applications) to provide balancing services to the transmission grid

Innovative business models - business canvas

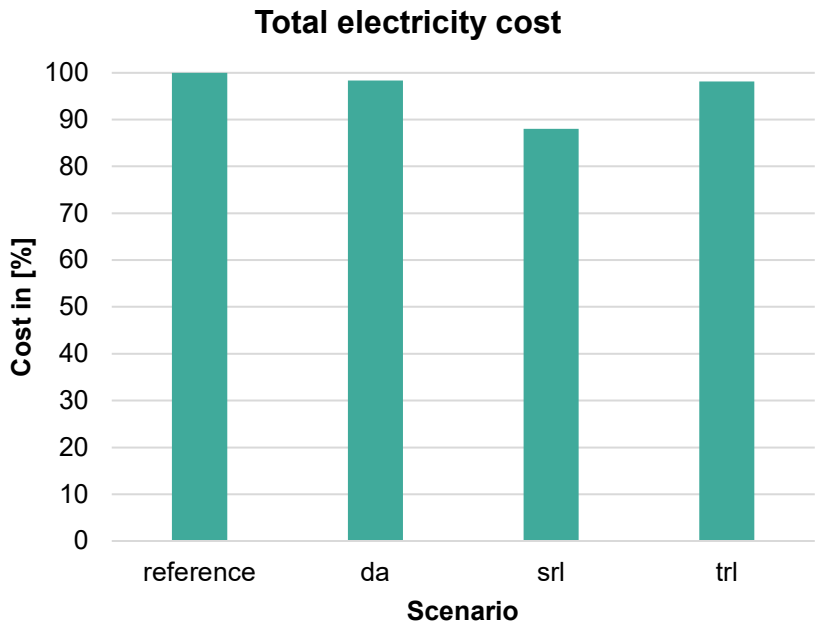
Provision of balancing services: Pooling of small scale heat pumps

Business model applicable for: Balancing service providers

PROBLEM	SOLUTION	UNIQUE VALUE PROPOSITION	UNFAIR ADVANTAGE	CUSTOMER SEGMENTS
• Increased need for balancing power & energy in the electricity system due to volatile renewable sources • Fast reaction times and high reliability are required.	• Heat pumps can provide balancing services, either on their own (large-scale heat pumps) or aggregated (small scale heat pumps)	• Supporting the electricity grid • Lowering the heat costs • Free additional heat in case of negative balancing reserve • Use of renewable technologies	• Cost reduction for end customers without negative impact on their comfort • No additional hardware costs in case of smart heat pumps	• Household and commercial customers • Heating grid operators • Heating plant operators
	KEY METRICS • Provided balancing power. • Activated balancing energy. • Reduction in electricity costs (energy & grid costs)		**CHANNELS** • Cooperations with heat pump manufacturers and installers • Raising awareness of customers through marketing	

COST STURCUTRE	REVENUE STREAMS

• Fixed costs:
  ○ Personnel
  ○ IT-costs
  ○ Connection to the balancing market
  ○ Connection to an aggregator (small scale heat pumps)
	• Revenues from providing balancing services
	• Reduced electricity grid costs
	• Reduced electricity energy costs



Innovative business models - business canvas

Local flexibility markets: Support of the distribution grid

Business model applicable for: DSO

<table>
<tr><th>PROBLEM</th><th>SOLUTION</th><th>UNIQUE VALUE PROPOSITION</th><th>UNFAIR ADVANTAGE</th><th>CUSTOMER SEGMENTS</th></tr>
<tr><td rowspan="3">• Grid constraints due to too much electric load during certain hours of the day
• Increased electrification of transport and heating sector further increases possible load problems</td><td>• Offer interruptible tariffs to customers and curtail their consumption during critical times or offer time-variant grid tariffs to incentivize curtailment.</td><td rowspan="3">• Relatively easy implementation
• Improvement of local grid situation without any additional costs</td><td>• No direct competition since DSO is fixed for each customer</td><td rowspan="3">• Households</td></tr>
<tr><th>KEY METRICS</th><th>CHANNELS</th></tr>
<tr><td>• Reduction in electric load during critical times</td><td>• Raising awareness of customers through marketing</td></tr>
<tr><th colspan="2">COST STURCUTRE</th><th colspan="3">REVENUE STREAMS</th></tr>
<tr><td colspan="2">• Reduced earnings from grid tariffs
• Usually, second electricity meter is necessary</td><td colspan="3">• Reduced or delayed costs for grid reinforcement measures</td></tr>
</table>

Barriers of flexibility use

During the project, a number of barriers were identified and grouped

Ecomomic barrier	Low savings potential (Day-ahead)	Grid tariffs consist a large share of the electricity bill	Risk of end-user intervention	Maintenance costs	Reduced efficiency
Regulatory barrier	Local flexibility markets not yet developed	Regulatory changes not yet foreseeable	Country-specific regulatory barriers	Minimum bid size	Aggregation, supplier, trading and imbalance
Further barriers	Knowledge of operators	Cyber-Security	Acceptance of end-users	Incentives and information from OEM	Further measures for digitailisation required
Technical barriers	Time	Power / Efficiency	Temperature	Location	

High barrier Medium barrier Low barrier

Summary and conclusion

- Flexibility provision with heat pumps is a very relevant topic across Europe at the moment
- Some types of flexibility services of them are already at a high market readiness level and can form the basis of successful business models in the near future
- The most commonly applied business model in the analyzed case studies was a combination of spot market participation and the provision of balancing services. This business model was already used in various research projects in Sweden, Denmark, Austria and Germany
- Provision of various balancing services showed promising reductions in overall energy costs
  - In Sweden, different types of FCR and aFRR showed the highest cost reduction, while mFRR was slightly less profitable
  - In Denmark, aFRR showed the best results, followed by FCR and then mFRR
  - In Austria, aFRR showed significantly higher cost reductions than mFRR