

# Driving Flexibility: How Incentives Shape EV User Behavior and Reduce Grid Costs

Insights and Implementation from a Discrete Choice Experiment

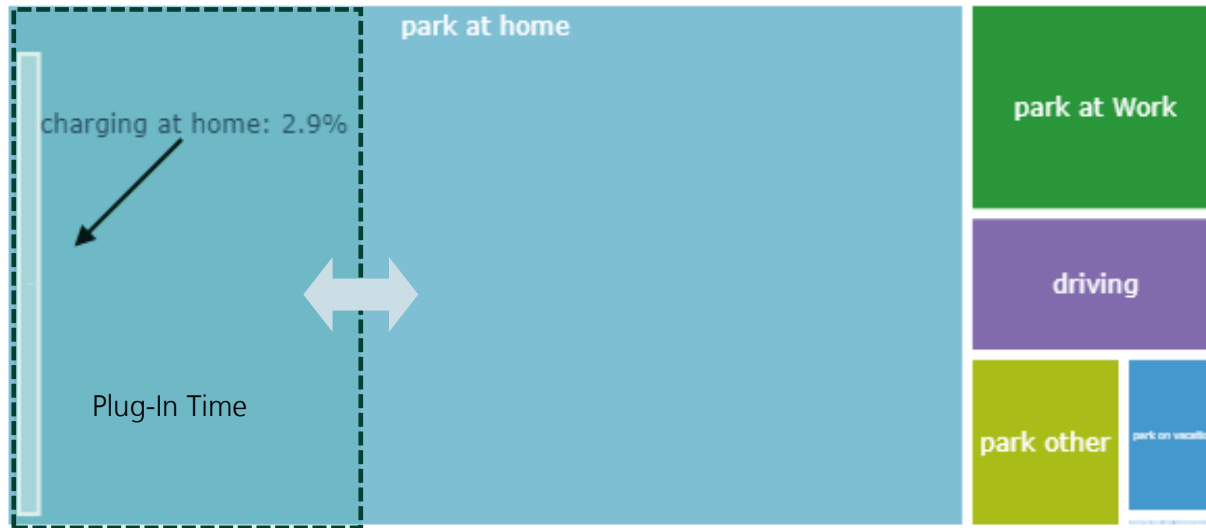
Michael von Bonin, 7. Mai 2025

# How to leverage EV Flexibility to avoid costly Grid Expansion

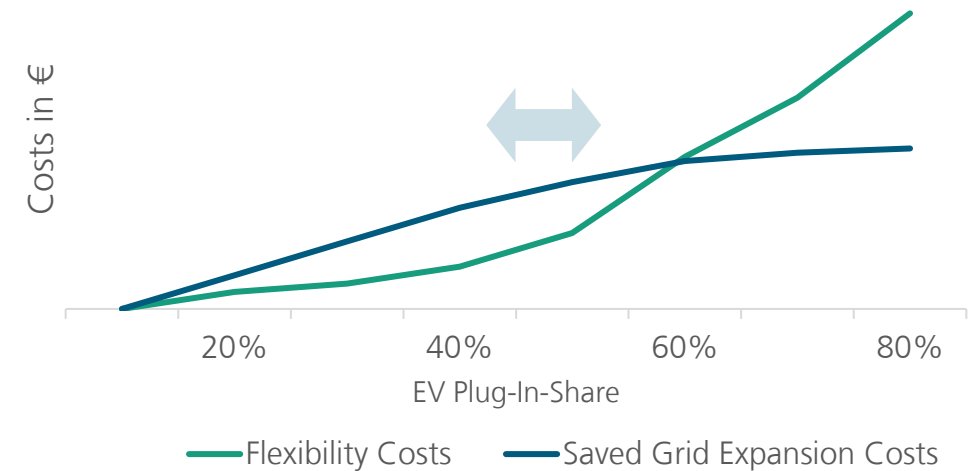
## Research Questions

1. What are EV user willing to pay for certain features of a V2G contract?
2. Influence of individual characteristics (e.g. PV ownership, income, gender, spatial type) ?

Vehicle Locations and Charging Time



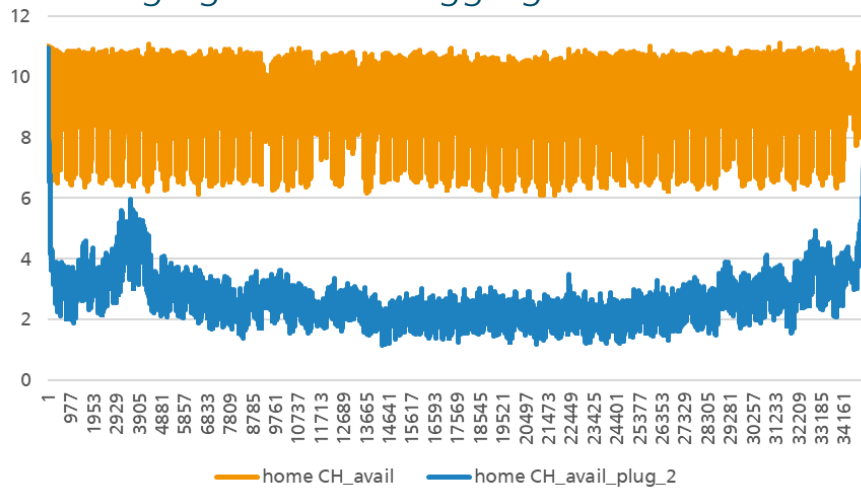
Costs for Flexibility vs. Grid Expansion



# What means Flexibility?

- Charging Power of plugged cars (11 kW homecharging)
- State of Charge limits for plugged cars (battery capacity, driving needs)

## Charging Power of Aggregated EV



**Flex Tariff 1:**

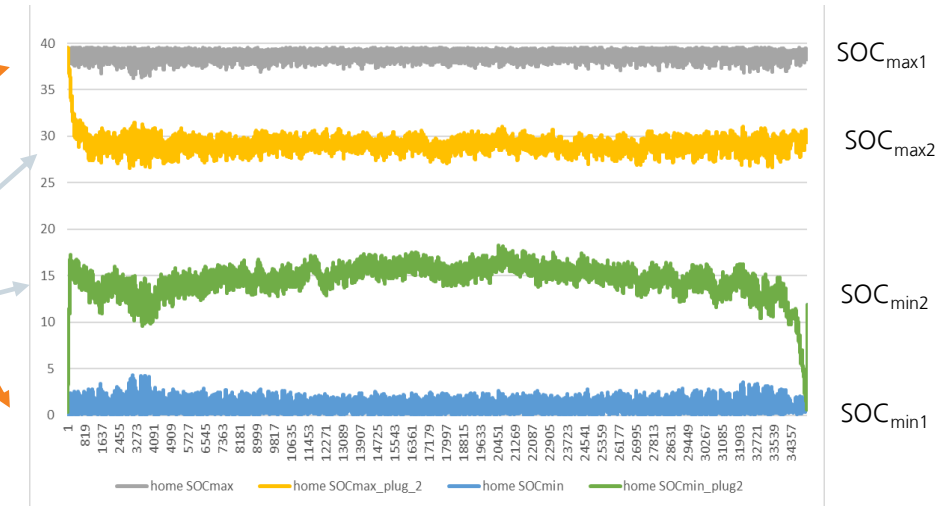
- Plug-In 420 h/month
- Safety Range 50 km

↑ + X €/month

**Flex Tariff 2:**

- Plug-In 150 h/month
- Safety Range 75 km

## SOC-Range of Aggregated EV

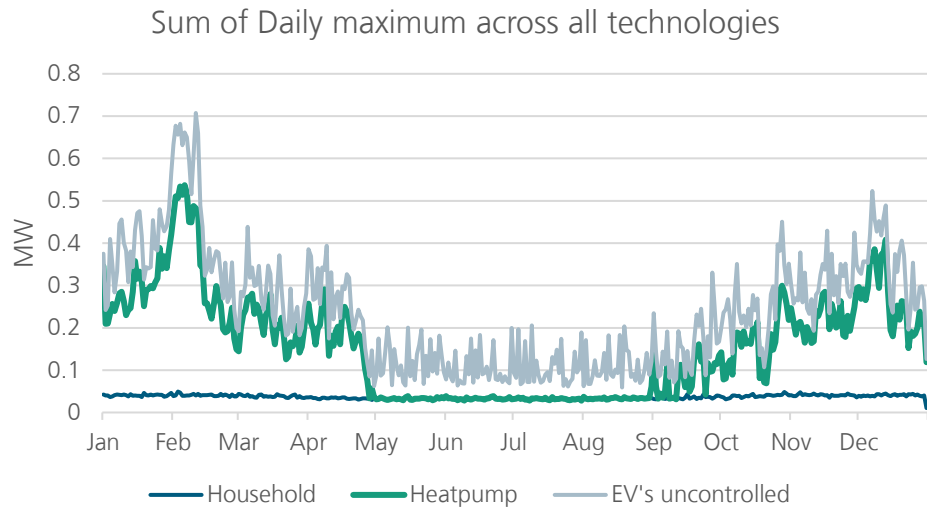


# Peak Load Reduction of Households

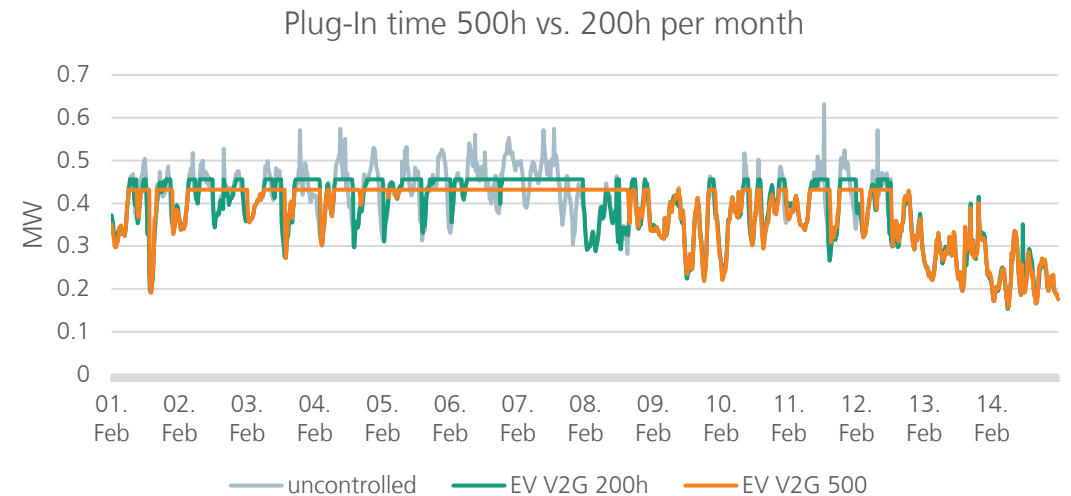
## Different Plug-In Behavior

### Scenario

- 100 households
- 24 heatpumps
- 55 E-KFZ



- uncontrolled: 0.63 MW
- V2G 200 h: 0,46 MW (-28%)
- V2G 500 h: 0,43 MW (-32%)



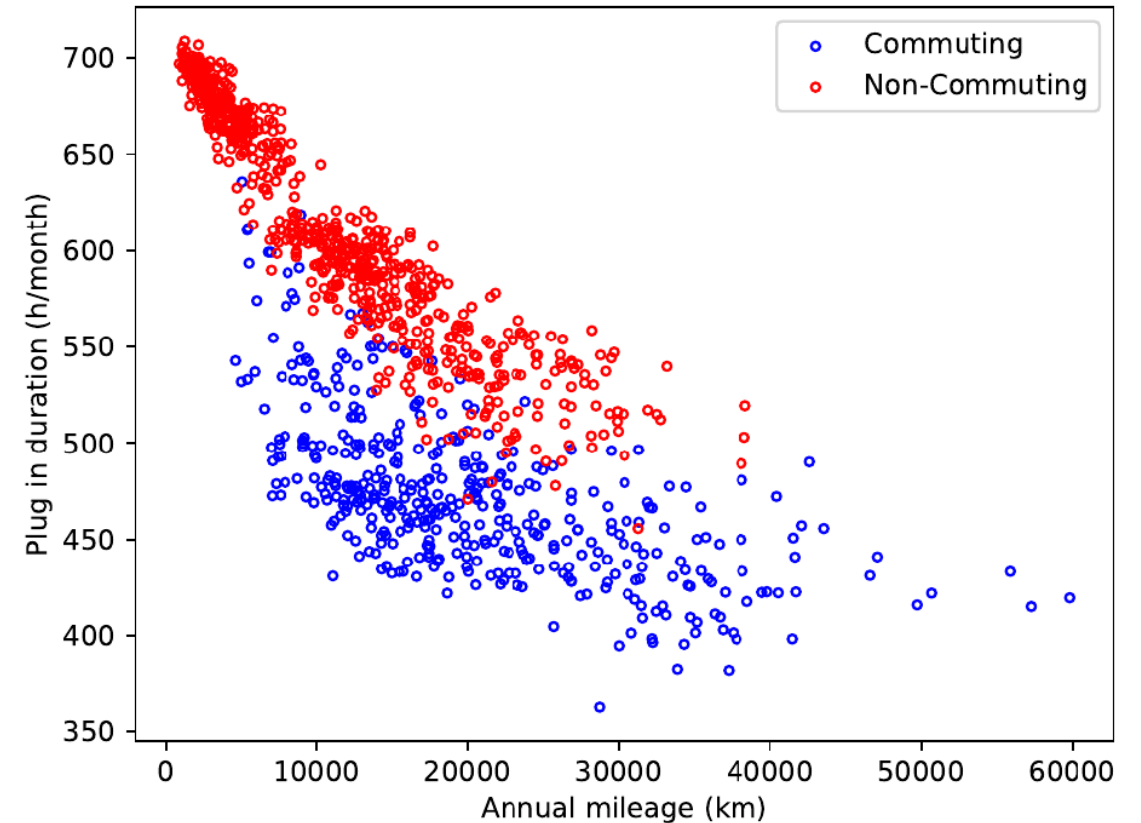
# Individual Characteristics of EV User

## Maximum Plug-In time of different user groups

- Plug In Time is limited by availability of charging infrastructure
- For home chargers parking time at home is relevant
- Correlation with annual mileage
- Longer home time on average for EV-users
  - Non-commuter
  - rural

	Urban	Rural	Germany
Commuter	534	588	535
Non-Commuter	615	627	619
Charge@work			77

Annual mileage vs Plug in duration home charging (1) (sample size: 1099)

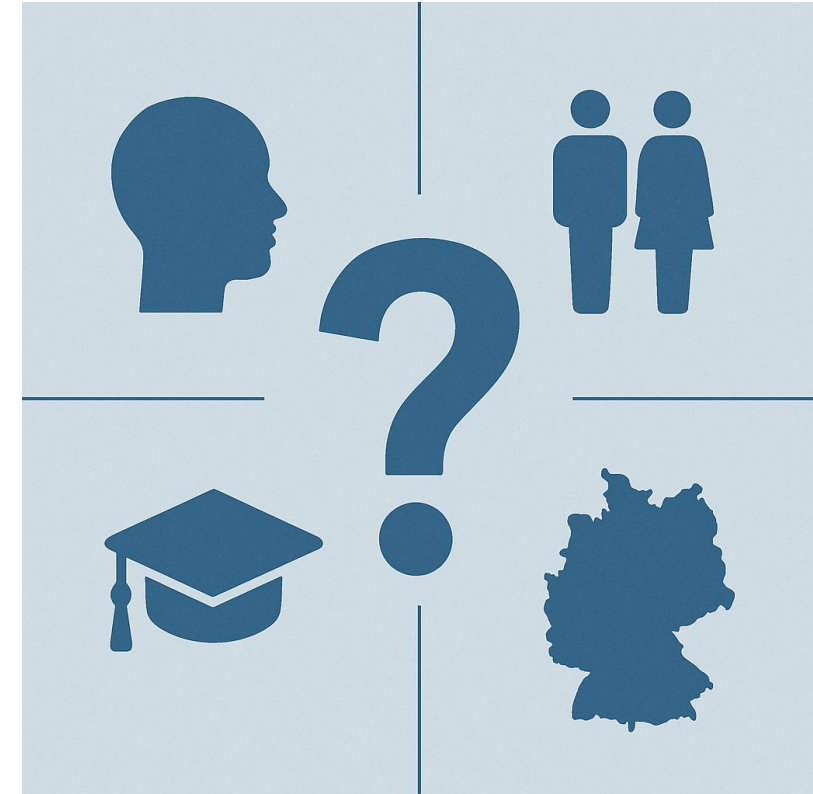




# Representative survey: sample and implementation

## Discrete Choice Experiment

- Population: Car purchase **decision-makers** in Germany
- **Representative** by
  - Age
  - Gender
  - Education (with / without university entrance qualification)
  - Region (federal state)
- Sample Size:  $N = 15,000$ .
- three additional **treatment groups** (grid stability, environment, and a combination of grid stability and environment)



# Why Stated Choice Experiments?

Problem:

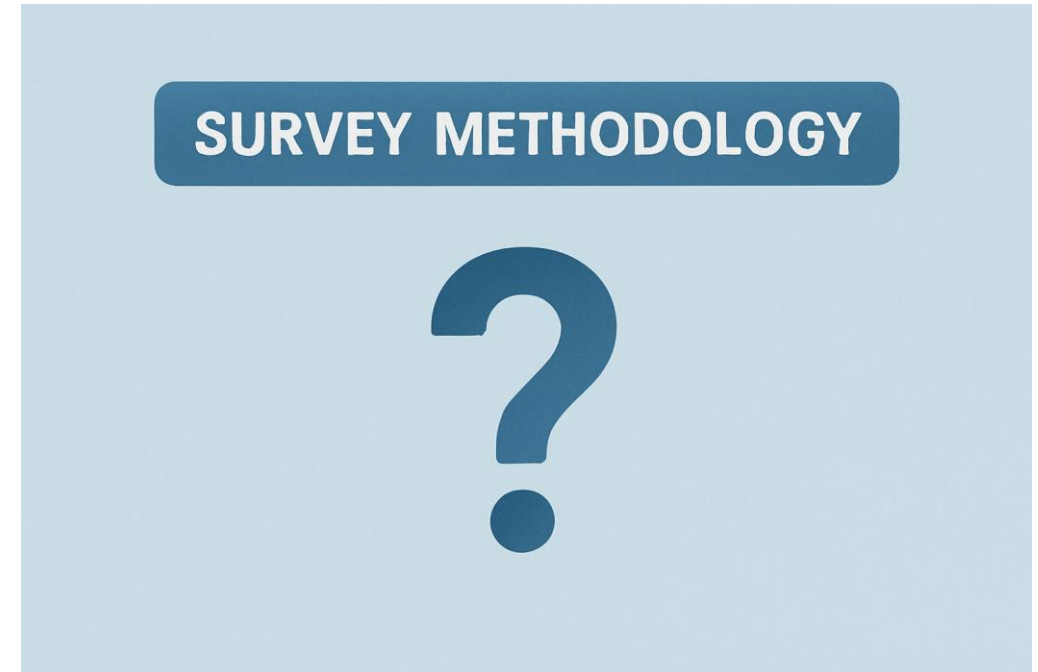
- Querying willingness to pay is often inaccurate and subject to various biases

Goal:

- Determine willingness to pay as accurately as possible
- Determine preferences regarding product features

Idea:

- Make selection decisions as realistic as possible
- Repeated enquiry of preferences across several alternatives
- Varying characteristics (attribute level)
- Isolation of the individual effects on preference



## Your choice now: What fits you best?

Attribut	V2G Contract A	V2G Contract B	V2G Contract C
Minimum monthly plug-In	300 h (10 h/day)	360 h (12 h/day)	240 h (8 h/day)
Monthly remuneration	50 €	20 €	80 €
Remuneration per additional hour provided in €	0 €	0,18 €	0,12 €
Guaranteed minimum range	150 km	125 km	75 km
Your Choice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

If you were offered this V2G car power contract in real life, would you actually sign up or keep your current car power contract?

Yes ☐

No ☒



# Attributes and Attribute Levels

Attribut	Unit	Level
Minimum monthly Plug-In duration	h/month	120 - 420
Monthly remuneration	€	20 - 95
Remuneration per additional hour provided	€	0 - 0,18
Guaranteed minimum range	km	25 - 150



# Survey Results

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## Key Findings

- Higher payments significantly increase the likelihood of choosing a V2G contract — as expected.
- Additional compensation has a strong influence on decision-making.
- Participants prefer contracts that guaranteed higher minimum driving range

## General Skepticism Toward V2G Car Electricity Contracts

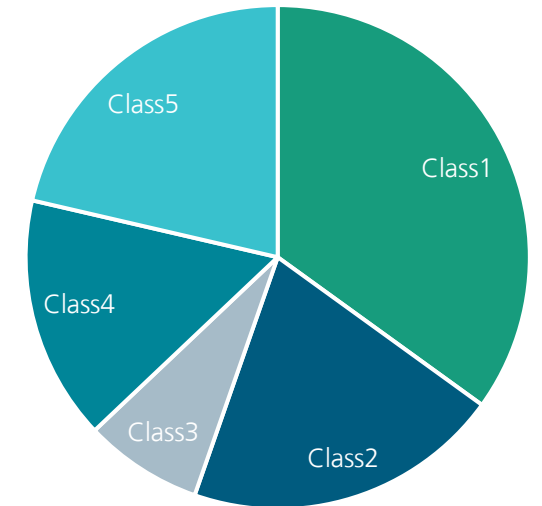
- 1,945 respondents (35.01%) **always** chose the **opt-out** in all six decisions.
- 1,347 respondents (24.73%) **never chose the opt-out** in any decision.

## Preference Heterogeneity

- Higher annual mileage and being female increases the likelihood of opting out.
- Owners of a wallbox or a larger household decreases this likelihood.
- Wallbox owners are more flexible regarding minimum plug-in duration and minimum range, while a reverse pattern is observed for PV (photovoltaic) owners.

# Clustering of Survey Participants

Class	Plug-In Duration	Minimum Range	Opt-out posture	Type	Percentage
1	Highly sensitive	Medium positive	Unwilling to participate	Not Convinced	35%
2	Moderately	Very high positive	Neutral to open-minded	Rational-Pragmatic	20%
3	Very sensitive	Low	Needs strong incentives	Comfort-focused	8%
4	Extremely sensitive	Extremely high	Neutral to positive	Performance-oriented	16%
5	Slightly sensitive	Low	Participation-friendly	Flexible Minimalist	21%



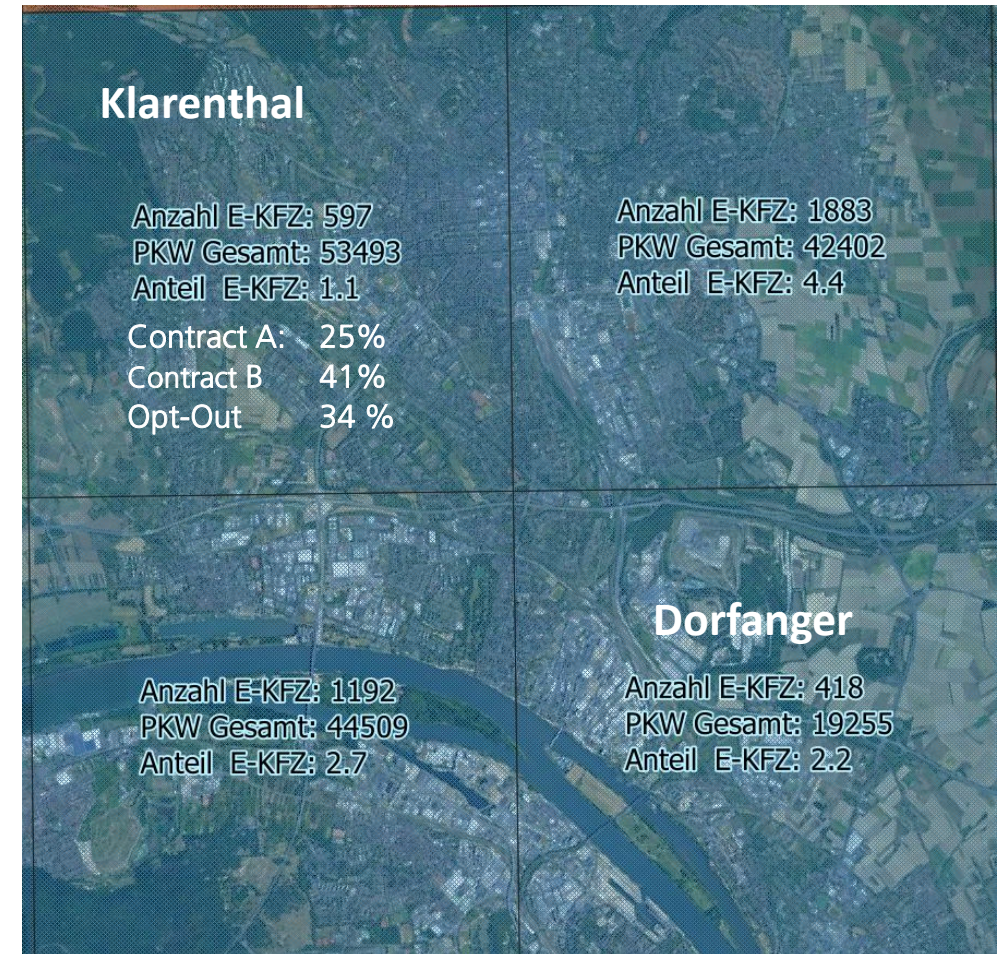
# Allocation of Flexibility – What next?

## Research Questions and Project theses

- **Extreme temperatures** put grids under so much pressure that regulation to integrate the consumer is unavoidable.
- **Allocation** of charging behavior and flexibility use according to socio-economics driving characteristics
- **Synergies** for revenues on the electricity market?
- Creating **cost-orientated grid charges** that set the right incentives

## Evaluation of Criteria for incentive regulation

- Utilisation of the network (example Sweden )
- Full load hour factor with costs and simultaneities





# Invitation for Stakeholder Workshop

## September 2025

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