Hogeschool van Amsterdam

Electric vehicle charging station success in existing networks

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Creating Tomorrow

Future Charging Research Project

- 4-year research project
- Aim: Developing and simulating scenarios for charging networks in urban areas in 2030
- Together with policy makers and industry

City of Amsterdam

City of Rotterdam

VATTENFALL

PARK n CHARGE

ENGIE

Charging infrastructure development

Scientific approach

- Blank canvas
- Optimisation strategies
  - Node-based
  - Flow-based
  - Etc.

  - See: Pagany, Ramirez Camargo & Dorner (2018) Islam (2015) or Shareef et al. (2016) for an overview

Industry approach

- Expand existing networks
- Direct demand approach
- Variation over time
  - Subsidies
- Direct need for profitability

Developing existing networks

- Need from industry and policy makers
- Long term plans
  - Increased speed of adoption
  - Direct demand approach no longer feasible
- Data-driven approach

Research question

“Which factors predict charging station succes for newly installed charging stations in existing networks?”

Charging station succes

- How to define charging station succes?
  - Energy sales only?
- Review of top-25 cited papers in the field

- Four major areas:
  - Energy
  - Users
  - Sessions
  - Occupancy

So what is a good measure of succes?

Energy

- Business case
- Clean km travelled

- Depends on battery capacity of frequent users

Users

- Easy to follow adoption curve

- Distinguish between frequent users and visitors

Sessions

- Direct need of charging

- Short sessions
- Convience charging (parking)
- Visitors

Occupancy

- Actual use
- Relation to parking

- Long occupancy – no chargng

Predicting succes of newly installed charging stations

Prediction:

Current strategy: Prediction of adoption rate (in certain area) -> Infrastructure demand

Exact timing is difficult
Change of policy

Strategy in this research:

Use current utilisation of charging infrastructure as a measure of infrastructure demand

Data

- Charging station data from june 2014- february 2020 (Covid-19 lockdown)
- Amsterdam , Rotterdam, Utrecht, The Hague
- 2218 newly installed charging stations (2 sockets each)
- 8.6 million charging sessions

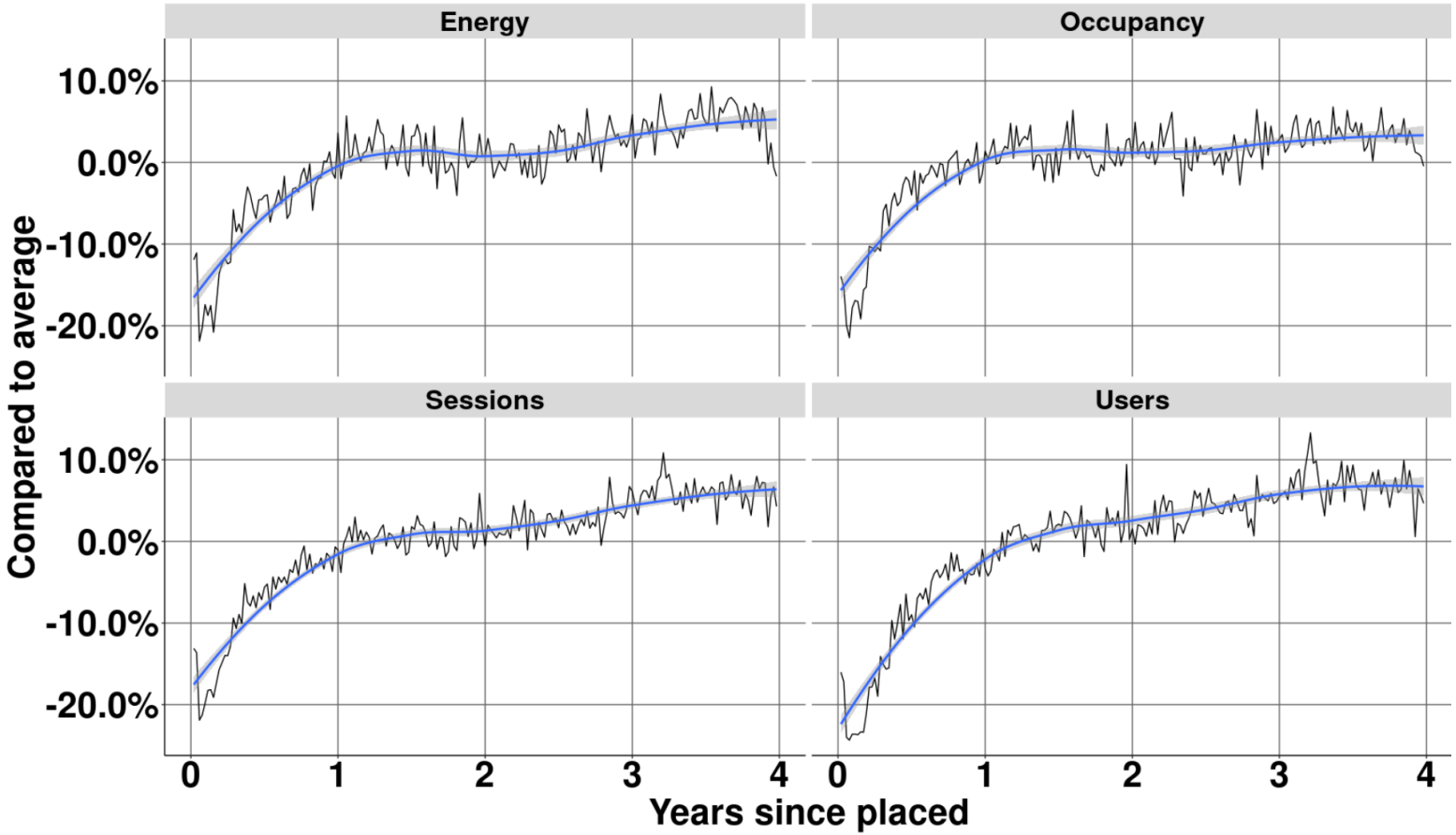
Data	Example
Charging station	EVB-276282
Location	Herengracht 202
GPS location	52.378871, 4.8921618
RFID-tag user	345
kWh	18.3
Time Started	01-01-2014 09:00
Time Ended	01-01-2014 17:15:00

Succes – relative to other charging stations

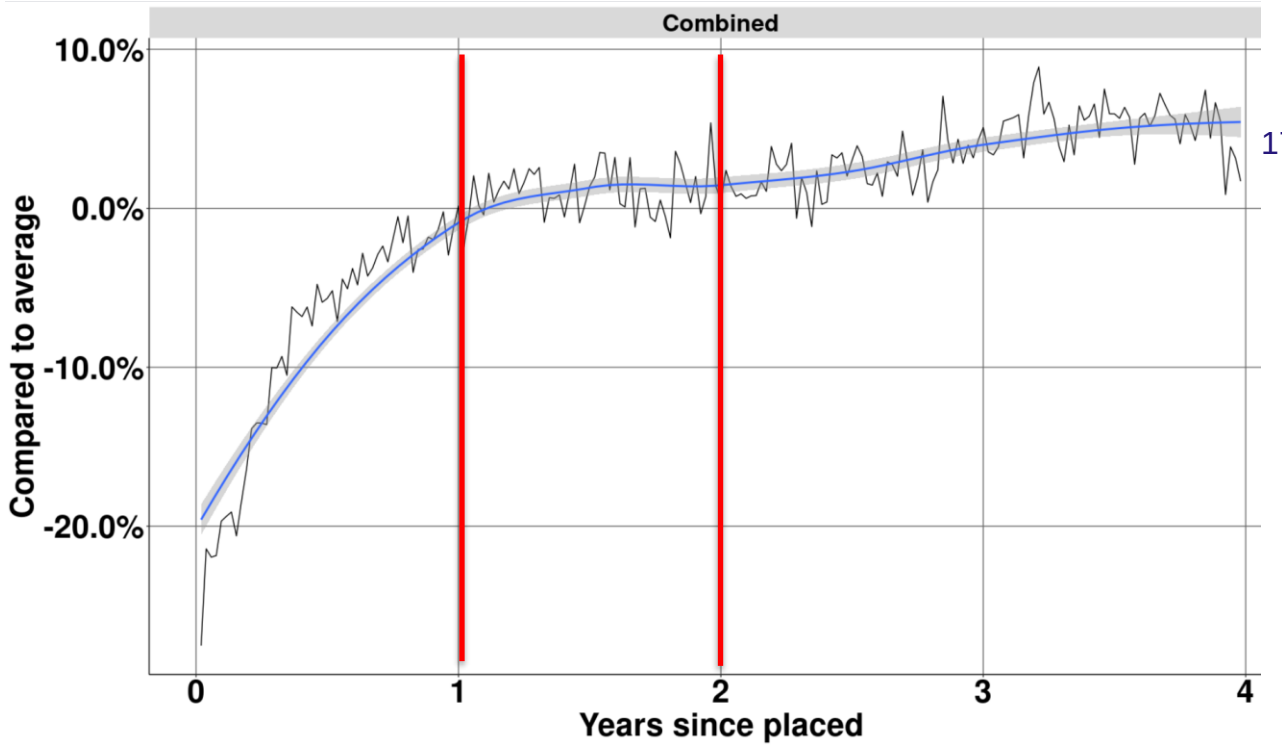
- KPI’s
  - Users
  - kWh
  - Sessions
  - Occupancy (in hours)

- Compared to average of all charging stations in the same month
- In respect to time since installation
- Relative score allows summing of KPI’s to a “Total score”

Performance relative to



Performance combined score



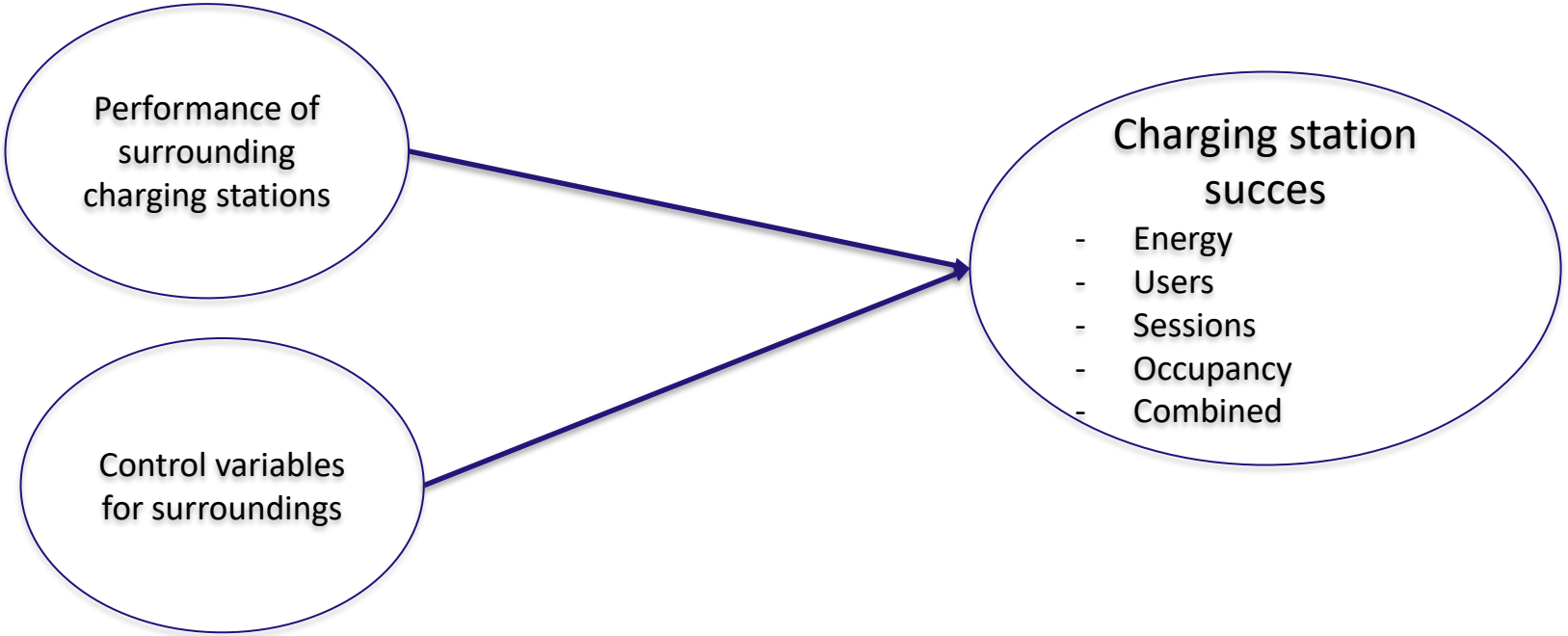
1716 stations

Predictors of charging station succes

Question: Are there any leads in the current use of charging stations – that predict succes of future installed charging stations?

- **Performance measured from 6 up to 3 months before installation**
- **Charging stations within 300 meters walking distance**
- **Same KPI's as measuring succes**
  - Energy – Users – Sessions – Occupancy
- **Additional variables**
  - Number of charging stations
  - *Cruising for charging stations*
    - Share of charging sessions not at the most used charging station
    - Measure for the pressure on the charging station

Model


Performance of surrounding charging stations
Control variables for surroundings
Charging station succes
- Energy
- Users
- Sessions
- Occupancy
- Combined

Results

Performance combined score

	Performance combined score	
Predictors	*Estimates*	*p*
(Intercept)	45.71	**<0.001**
Charging data variables		
No of charging stations	0.66	0.453
Charging sessions/station	0.03	0.904
Unique users/station	0.14	0.657
Occupation/station	0.04	**0.024**
Energy / station	-0.01	0.311
% sessions cruise	21.98	**<0.001**
Interactions		
No stations * Sessions	0.24	**<0.001**
No stations * Users	-0.22	**<0.001**
No stations * Occupancy	-0.02	**<0.001**
Control variables		
Paid Parking	18.59	**<0.001**
% of businesses	0.29	0.085
% of homes	-0.01	0.799
income	0.44	**<0.001**
Observations	1716	
R^2 / R^2 adjusted	0.172 / 0.166	

Results

Number of charging sessions

	Performance combined score	
Predictors	*Estimates*	*p*
(Intercept)	0.45	0.332
Charging data variables		
No of charging stations	0.01	0.278
Charging sessions/station	0.00	0.301
Unique users/station	-0.00	0.080
Occupation/station	0.00	0.339
Energy / station	-0.00	**<0.001**
% sessions cruise	0.30	0.332
Interactions		
No stations * Sessions	0.00	**<0.001**
No stations * Users	-0.00	**0.019**
No stations * Occupancy	-0.00	**<0.001**
Control variables		
Paid Parking	0.11	**0.001**
% of businesses	0.00	0.815
% of homes	0.00	0.501
income	0.00	**<0.001**
Observations	1716	
R^2 / R^2 adjusted	0.104 / 0.097	

Conclusions

- Charging station roll-out studies should take into account the current stock
- Charging stations succes is multi-dimensional

- Charging data has limited predictability on future charging station succes
  - Best option: Cruising for charging stations

- Income and paid parking remain the best predictors