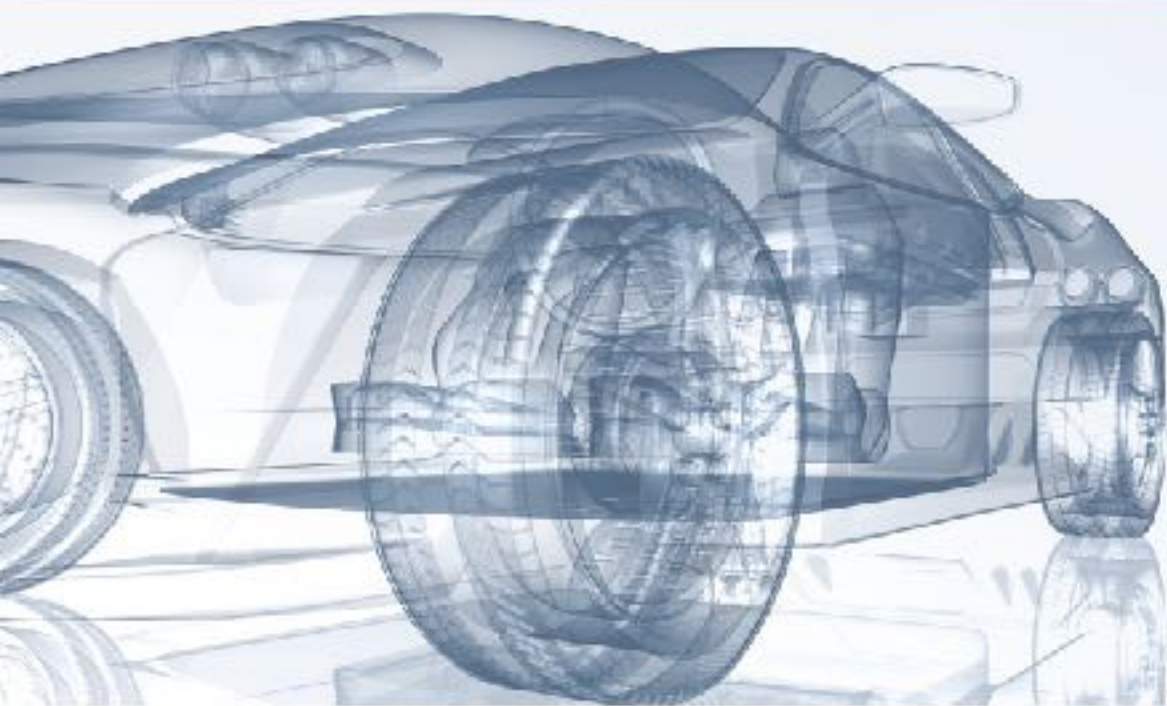


evs 30



The 30th International
Electric Vehicle
Symposium & Exhibition

October 9–11, 2017
Messe Stuttgart, Germany

www.evs30.org

Sponsored by

DAIMLER



BOSCH
Innovation for all

GRUPE RENAULT

MAHLE

EnBW



SWAROVSKI

Estimating the charging profile of individual charge sessions of Electric Vehicles in the Netherlands



1. Introduction

1. Charging profile & research gap

2. Application

2. Methods

1. Theoretical model

2. Dataset

3. Results

1. Environmental effects

2. Charging point effects

3. Battery degradation

4. State-of-Charge effect

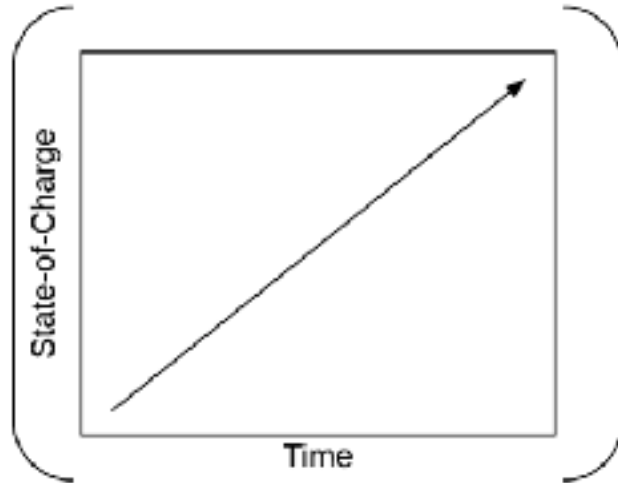
4. Conclusion



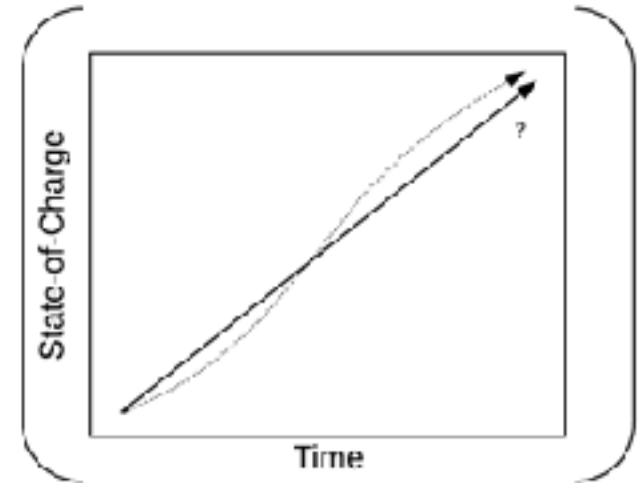
Jerome Mies, Jurjen Helmus & Robert van den Hoonaard

The research gap emphasizes the difference between theoretical/lab research and real world practice

Left shows the theoretical charging profile according to the literature

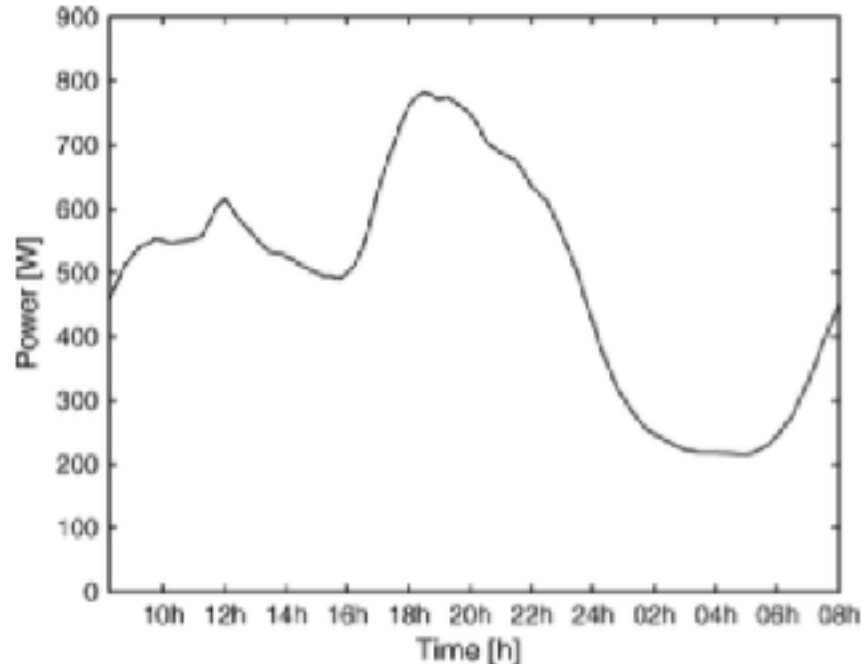


Right shows the possible influence on the charging profile



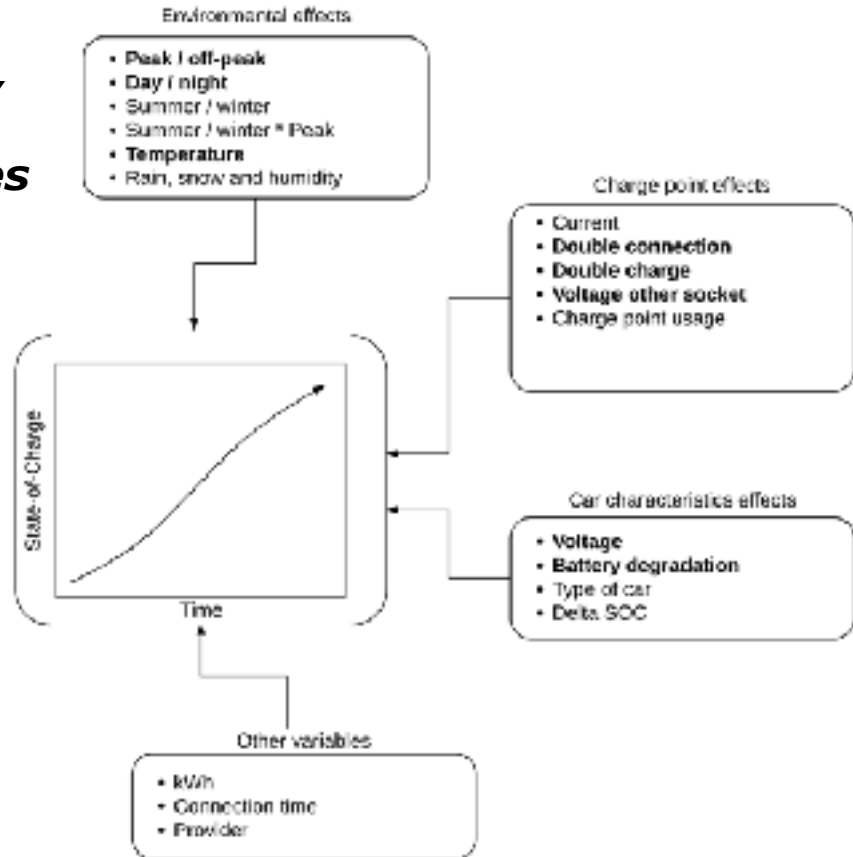
Real profiles are required in order to optimize charging infrastructure management

Smart charging and peak shaving are preferably done on real data



The method of this research to look at various variables influencing the charging profile

Exploring some variables, and trying to explain the effects of certain variables



The used dataset used Dataset

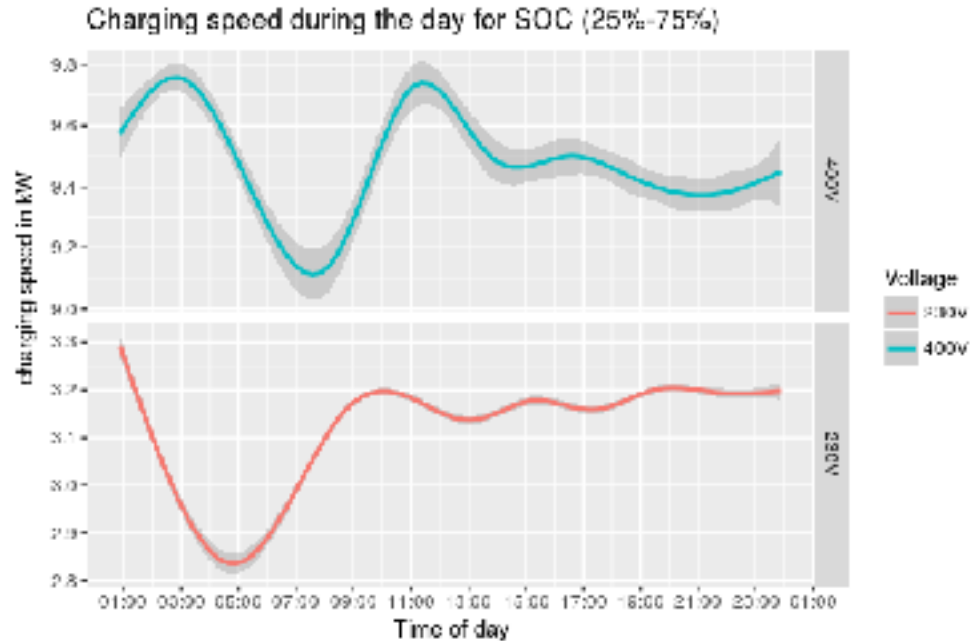
- ***4.8 million records of metervalues***
- ***128.000 records of charging sessions***
- ***4.700 uniaue RFIDs***

Parameter	Example	Explanation
Radio Frequency ID (RFID)	01B0011223312345	RFID code of a charging card
Chargepoint ID	AL101	ID Code of a charging station
Socket ID	1	Code of used socket
Metervalue	6205309	Meter value in Wh
Timestamp of meter value	2016-01-04 08:24:58	Time of the specific meter value
Transaction ID	1255503	Code of unique charging session

Table: Key parameters

Charging speed differs during day

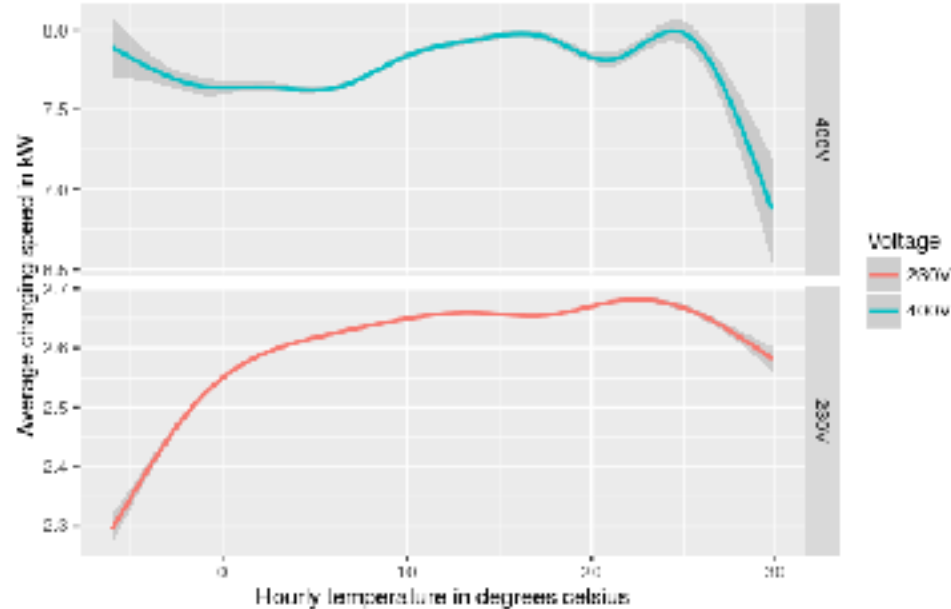
Charging speed is lower during the night with peaks up to 3% (400V) and 10% (230V).



Temperature affects charging speed

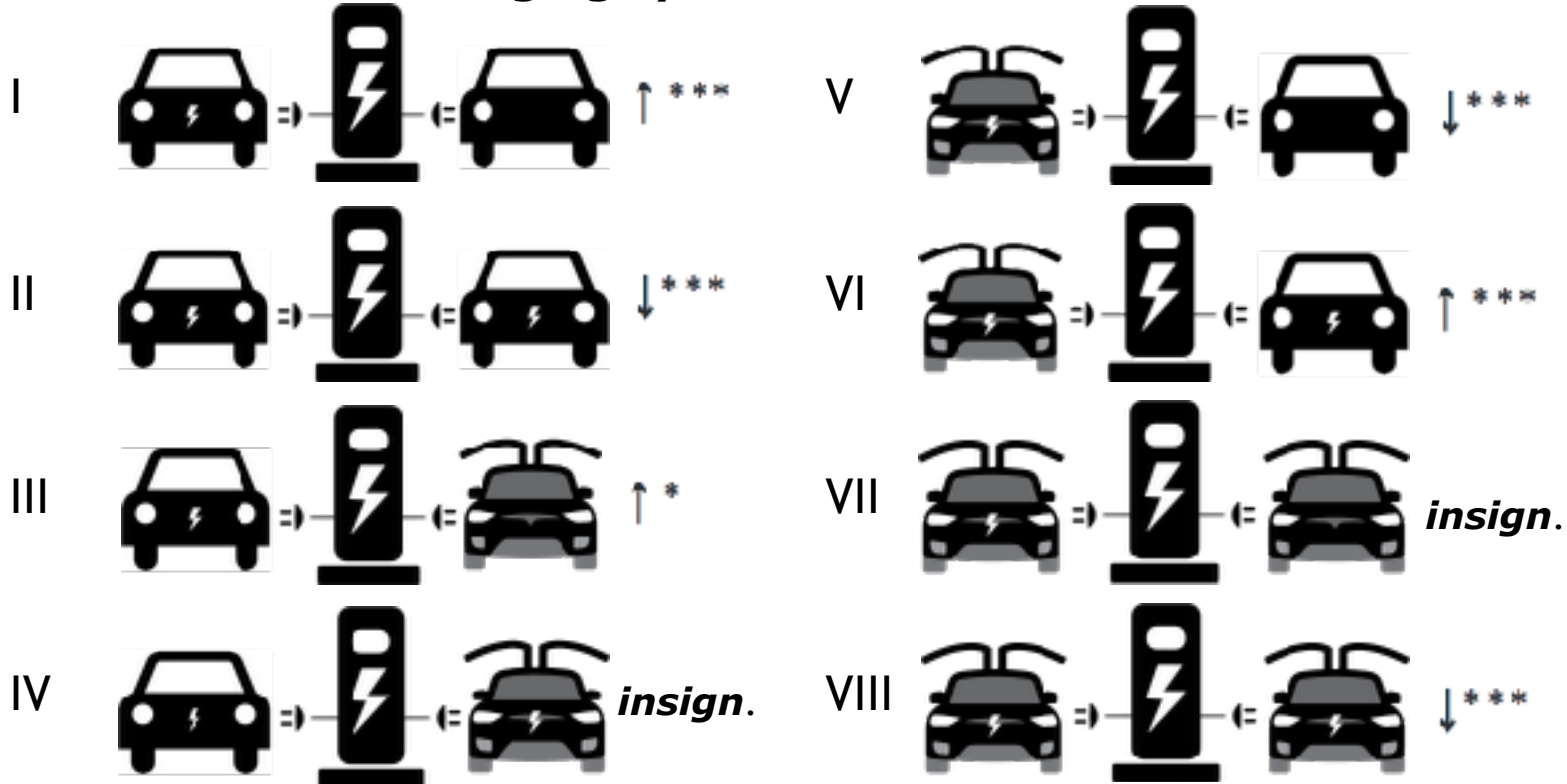
Cold temperatures affect 230V cars negatively, while high temperatures significantly decrease the charging speed of 400V cars (up to 10%).

Non-linear relationship hourly temperature and average charging speed

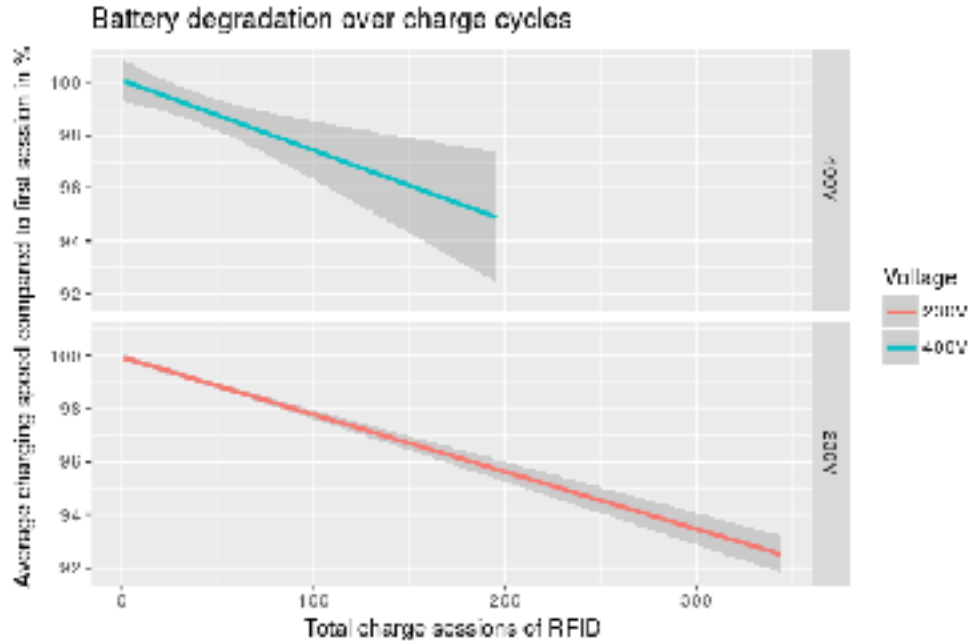


From the data it appears that the profile is affected by different charging situations

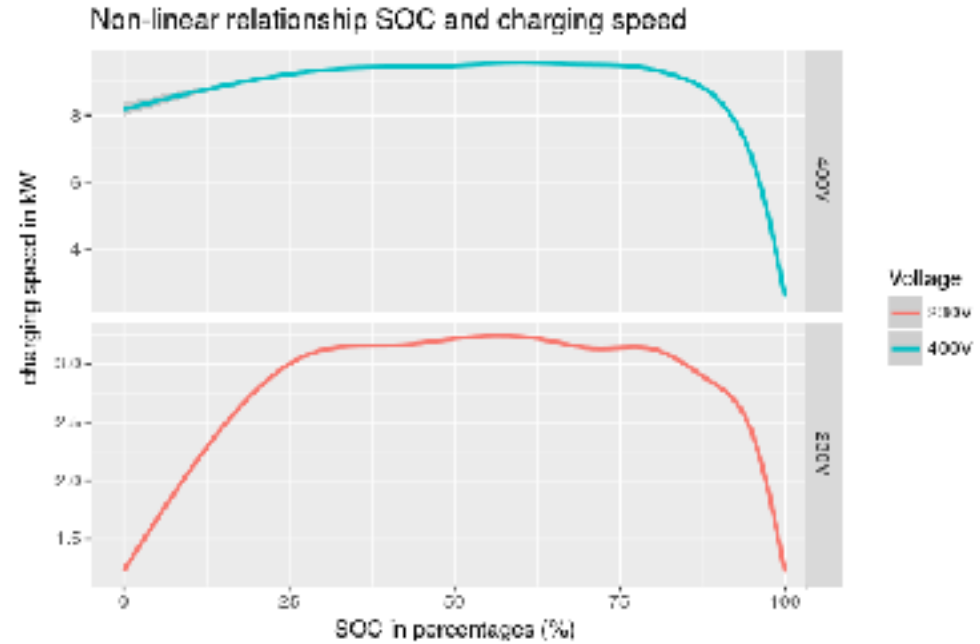
Being 400V or 230V car and charging or just being connected results in different charging speeds



Charging more often results in lower charging speed
Battery degradation, is especially significant for 230V cars:
Having charged more than 300 times results in ~6% lower charging speed



The State-of-Charge highly impacts charging speed
Being 0-25% charged for 230V cars means lower charging speed, while above 90% the charging speed drops for both 230V and 400V cars



Conclusion

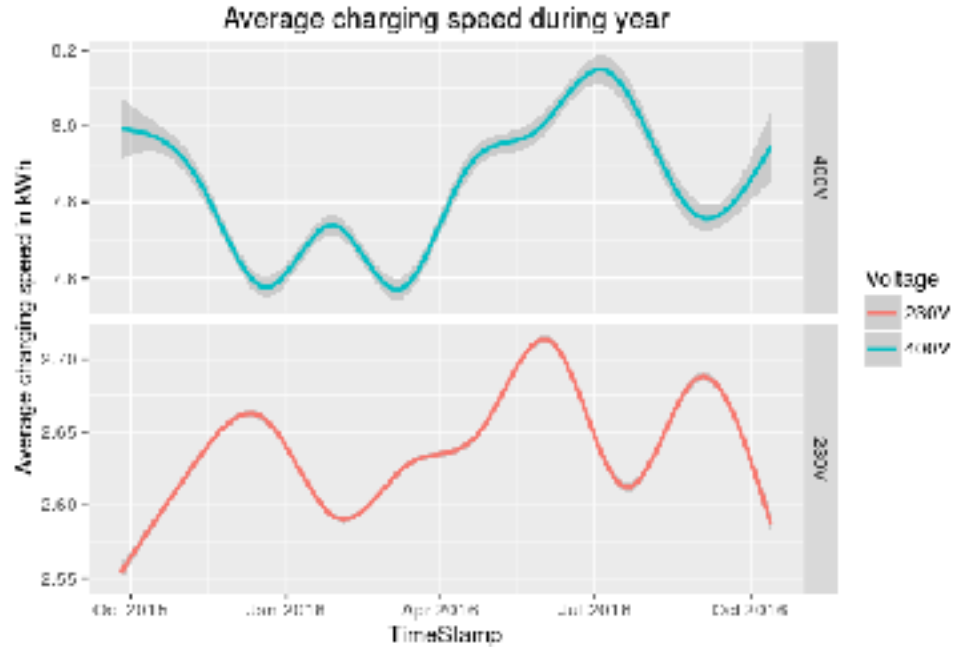
Variables influencing charging behavior

- **Time**
 - **During the day there is a higher charging speed, especially during peak hours**
- **Temperature**
 - **Between 20-25 degrees Celsius charging speed is fastest**
- **Chargepoint effects**
 - **Charging speed differs for various situations**
- **Battery degradation**
 - **Suggests decaying charging speed**
- **State-of-Charge**
 - **State-of-Charge influences charging behavior, especially for 230V cars**

Jerome Mies, Jurjen Helmus & Robert van den Hoed



Charging speed differs during the year
Especially significant for 400V cars during winter



During peak time, charging speed is higher
Charging speed is clearly higher during peak time for 230V cars

