SEGMENT BY SEGMENT ELECTRIFICATION & NEED FOR SMART CHARGING

Future of Charging Symposium
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TU Eindhoven

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Amsterdam
URBAN TECHNOLOGY RESEARCH PROGRAM
CHARGING INFRASTRUCTURE RESEARCH

► Applied research, sector focus

► Research fields:
  1. Monitoring
  2. Roll out planning
  3. Effect studies
  4. Energy modelling
  5. Sector studies
  6. Design/Engineering

► Projects: IDOlaad, SEEV4City, U SMILE, SIMULaad, DC charging plaza

► Partners: G4 cities/MRA-e & div. companies
SECTOR BY SECTOR ELECTRIFICATION
1 TAXIS: VOLUNTARY AGREEMENT: 3000-4000 ELECTRIC TAXIS IN 2025
WHAT HAPPENED END OF 2014 IN AMSTERDAM DISTRICT: “NIEUW WEST”?

[Graph showing kWh charged from 2012 to 2016 for different districts in Amsterdam.]
MEASURES: (I) PICKUP SPOTS FOR ‘CLEAN’ TAXIS, (II) FASTCHARGERS
GROWTH OF ELECTRIC TAXIS FROM 300 (2017) TO 800 (2018)
FACILITATION WITH FAST CHARGERS
FACTOR 3 GROWTH IN FAST CHARGE SESSIONS PER DAY (2017-2018)
UPTO 35 FAST CHARGE SESSIONS PER DAY ON FASTCHARGERS (AVG ~20)
FAST CHARGING DURING THE DAY

2018 Q3

Number of charge sessions per hour vs. Hour

Average number of sessions per day

Address
- Europaboulevard 10
- Hobbemakade 121
- Overschiestraat 172
- Stationsplein 51
- Strawinskylaan 6
- Transformatorweg 28
IMPLICATION: 4 FOLD INCREASE OF E-TAXIS IN 6 YEARS TIME

► Facilitate in (i) fast chargers and (ii) regular public chargers
► Fast charging during ‘natural’ waiting moments (lunch time, line waiting)
► Upgrade 50kW chargers to 175kW chargers
► Support TTO’s shifting to charging on own premises
2 CARSHARING

- Car2go - 300 Smart fortwo (from 2013)
- Car4share - 100 Hyundai Ioniq (until Jan 2019)
- Fetch - 200 Renault Zoe (from Jan 2019)
CHARGING FREE FLOATING CARSHARING SCHEMES

Charge sessions:
- Shorter connection times
- Less kWh’s charged/session
- Day-charging
- Filling up spaces in charging infra
CARSHARING: IDLE TIME DIFFERS PER NEIGHBORHOOD (AMSTERDAM)

Chargers close to:
- Chargers close to train stations
- Close to main roads
- Charging plazas/hubs

Limited fast charging.

CITY LOGISTICS & GREEN DEAL ZES (ZERO EMISSION CITY LOGISTICS)

- 876,000 vans in Netherlands & 140,000 trucks
- 0,3% is electric
- Zero emission zones by 2025
- For Amsterdam: 30,000+ vehicles on a monthly basis

*Where and how do they charge?*
E-VANS IN NETHERLANDS

► Average trip: <75km/day
► 85% of vans likely to manage with range of 175km
CONSTRUCTION RESPONSIBLE FOR >50% OF KMS DRIVEN

Aandeel in kilometers per (sub)segment

1. Bouw - Grote bedrijven: 29%
2. Bouw - Kleine bedrijven: 25%
3. Vers - Groothandel: 2%
4. Vers - Kleine specialist: 9%
5. Vers - Thuisbezorging: 1%
6. Stukgoed - Kleine leveringen: 3%
7. Post en pakketten: 2%
8. Facilitair: 2%

TNO, CE Delft, Connekt, 2018
STEPWISE APPROACH: INFRASTRUCTURE FOR CITY LOGISTICS

1. Driving patterns (per sector)
2. Electric demand
3. Most likely charging mode (home, depot, public, fast)
4. Impact on grid

First conclusions:
► Facilitate charging at home (>50% of vans)
  ► Surrounding big cities
► Enable fast charging:
  ► Depots & corridor
  ► Hotspots at clients
► Facilitate charging at building locations
► Power Capacity = location-attractor
CONCLUDING: SEGMENT BY SEGMENT

- Customized charging infrastructure required
  - Distinct differences in segments
  - Distinct difference with current personal vehicles

- Combination of home (public) charging, depot charging, fast charging
  - Location, location, location
  - Requires simulation of possible synergies

- Niche applications
  - Charging at building sites
  - Hotspot locations (multi-delivery sites)
  - Smart charging solutions (hotpots)
HOW TO CHARGE SMART?
NATIONAL DATA RESEARCH SMART CHARGING STRATEGIES

Optimization of Smart Charging strategies for the grid, sustainable energy and energy price

- Youssef El Bouhassani
- Peter van Bokhoven
- Jan Dam
- Jeroen Groot
- Robert van den Hoed
- Ruud Noordijk
- Nazir Refa
A SESSION IS CHARACTERISED BY 5 PARAMETERS. (I) START CONNECTION, (II) START CHARGING, (III) END CONNECTION, (IV) END CHARGING AND (V) CHARGING POWER.
THE POSTPONE STRATEGY
SHIFTS A CHARGING SESSION TO A LATER MOMENT
CUT AND DIVIDE STRATEGY
SPLITS A CHARGING SESSION INTO SMALLER SESSIONS AND RESCHEDULES THESE IN THE CONNECTION TIME.
SLOWER CHARGING REDUCES THE POWER, MAKING CHARGING TIME LONGER
THE V2G STRATEGY
DISCHARGES THE BATTERY AT MOMENTS WHEN IT IS PROFITABLE TO DO SO.
IN AN IDEAL SITUATION THE STRATEGIES CAN BE COMBINED

CONCEPTUAL
SMART CHARGING AND OPTIMIZATION GOALS

SMART CHARGING STRATEGIES

Postpone strategy
A session is postponed. The shift is a percentage of the potential to Smart Charge.

Cut and divide strategy
A session is cut into smaller sessions and distributed over the total connection time.

Slower charging strategy
The maximum power for a charging session is reduced so the speed of charging is lower.

PERFORMANCE INDICATORS

Net congestion
How can Smart Charging be used to reduce peak load.

Charging sustainably
How can Smart Charging be used to use more sustainable energy sources.

Cheaper charging
How can Smart Charging be used to optimize for APX prices.
12 MLN TRANSACTIONS SPLIT IN:
(I) START TIME AND (II) CONNECTION DURATION

At what time does a charging session start?
How long does a session last?
THE HEATMAP CAN ALSO BE VISUALISED AS A HEIGHT MAP. HOW TO CLUSTER?
CLUSTERING WAS DONE BY USING DIFFERENT METHODS (A.O. DBSCAN, GAUSSIAN MIXTURE MODELS).

GMM’s proved more accurate in making distinct clusters (8-9 clusters)
WHEN OPTIMIZED FOR SUSTAINABLE ENERGY (SOLAR), MORNING SESSIONS ARE SHIFTED THE MOST
WHEN OPTIMIZING FOR POWER DEMAND, THE EVENING SESSIONS ARE SHIFTED THE MOST.
WHEN OPTIMIZING FOR **APX PRIZES**, PART OF THE MORNING SESSIONS AND MOST OF THE EVENING SESSIONS ARE SHIFTED.
CONCLUSIONS SMART CHARGING

► Forecasting connection times key to applying smart charging
  ► With no/limited effect on EV driver

► Accuracy of predicting connection times up to 80%
  ► Based on several forecasting techniques (weighted averages, linear modelling, classification techniques)

► Optimization strategies differ in their effect on postponement
  ► Further study on cut and divide and reduced power (2019)

► Report available at www.mra-e.nl:
OPEN DATA ON PUBLIC CHARGER UTILIZATION: EVDATA.NL

MRA-Electric

The MRA-E project bureau was established in 2012 by the Amsterdam Metropolitan Area to promote electric transport and realise a network of charging points in the provinces of Noord-Holland, Flevoland and Utrecht.

MRA-E now works with 80 municipalities in the three provinces. A project-based approach in which both knowledge and costs are shared enables MRA-E to achieve results which are beyond the reach of the individual municipalities working alone. The project bureau coordinates joint tendering processes, for example, for the installation of charging stations.

There is an intensive collaboration with public and private partners. The MRA-E project bureau is the regional centre of expertise, listening ear and source of information. It is the driver of change, with direct access to all the know-how needed to ensure the success of electric transport.

Rotterdam Region

Nineteen municipalities in the province of Zuid-Holland cooperate with regard to the roll-out of public charging infrastructure ("Samenwerkende Gemeenten Zuid-Holland"), with the municipality of Rotterdam being the main contractor. This partnership has been organizing tenders for commercial parties since August 2012 with the purpose of realising a public charging infrastructure. Until December 2020

https://www.evdata.nl/data/
UTILIZATION: #STATIONS, #SESSIONS, #RFIDS, #KWHS
**INDICATORS:** KWH/SESSION, KWH/STATION, RFID/STATION, KWH/RFID

Charged kWh per session, yearly

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<th>City</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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Charged kWh per session

Source: www.evdata.nl
EXAMPLE: GROWTH IN KWH/STATION:
CHECK OUT EVDATA.NL
QUESTIONS