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The 27th INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION
BARCELONA
17th-20th November 2013

Data analysis on the public charge infrastructure in the city of Amsterdam

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Data mining: Making sense of 135.000 charge sessions.

- Provide first analysis of use patterns in a strongly developed public charge infrastructure:
  - 520 charge points
  - 2100 (PH)Evs including 282 Car2Go
- Discuss implications for policy makers and EV-stakeholders.
- Present future work on how to optimize the roll-out public charge infrastructure.

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‘Amsterdam Electric’ Program: Driven by air quality & EU limits on urban planning

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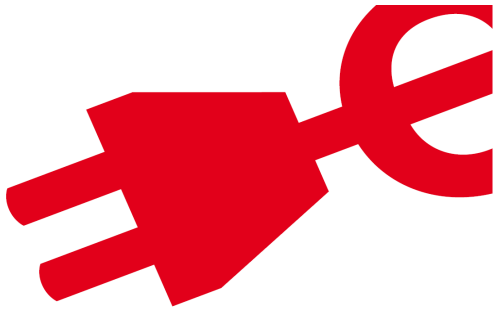
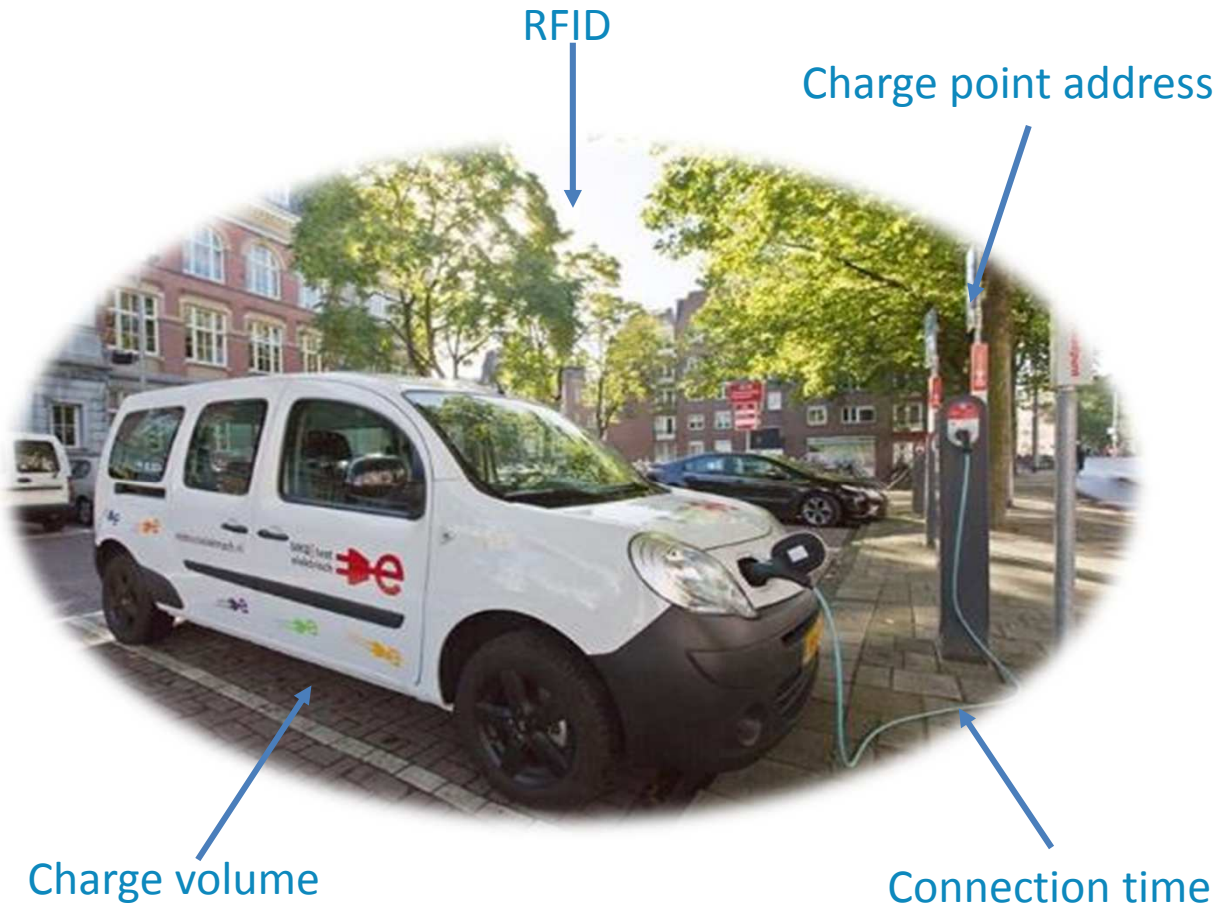
'Amsterdam Electric' has lead to leading position in public charge infra



- 2009-2011:
  - Placement of 100 charge points
  - Facilitate early adapters
  - Policy measures (a.o. free parking, subsidies)
- 2012-2015
  - 1000 charge points (2015) – currently 520
  - Focus on market segments
  - Large scale EV-demo's (Car2Go, Nissan Leaf)

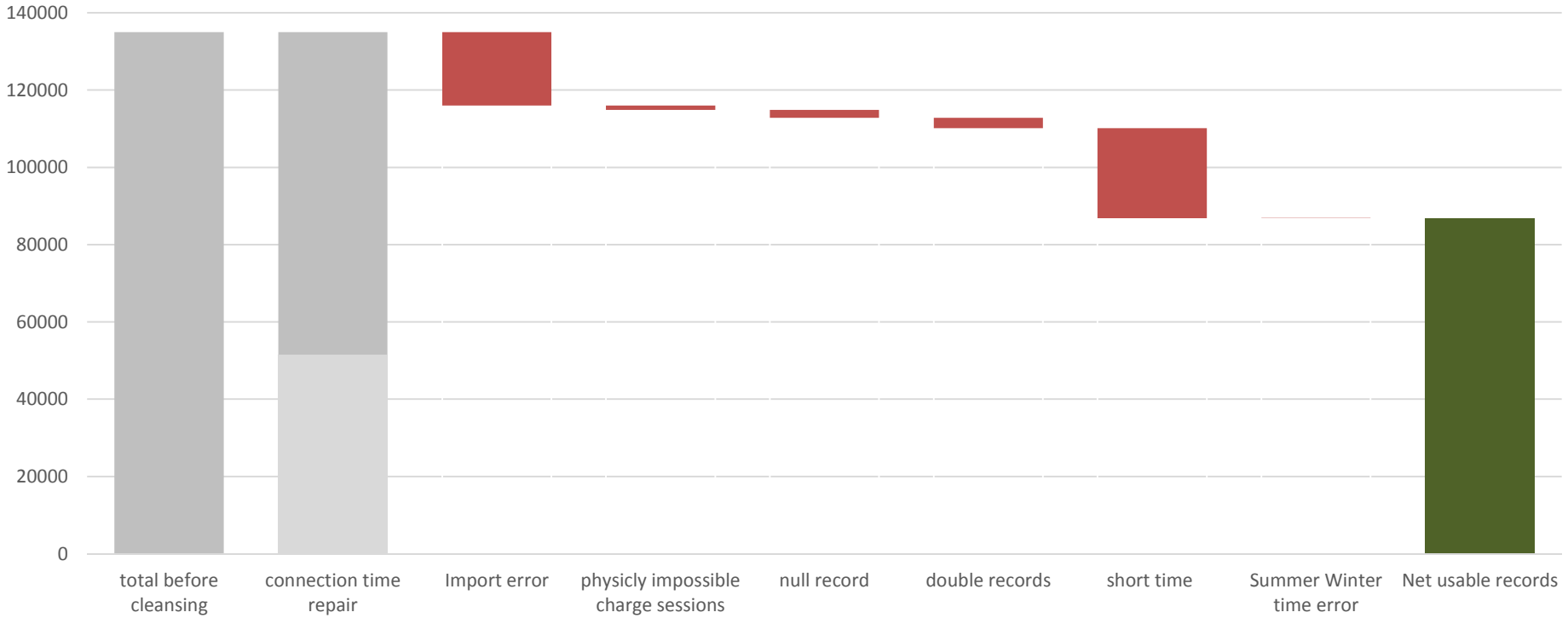
The data: Gathered by the charge point operators

Parameter	Example	Explanation
Charge point address	Admiralengracht 44	Adress of the charge point
Charge point operator	Nuon	Owner of the charge point
Charging service provider	Essent	Owner of the used charging card
Charge point city	Amsterdam	
Charge point postal code	1057EW	ZIP code of the area of the charge point
Volume	0,86	Charged energy [kWh]
Connection time	0:14:23	Time the car was connected
Start Date	18-04-2012	Date the session started
End Date	18-04-2012	Date the session ended
Start Time	23:20:55	Time the session started
End Time	23:35:18	Time the session ended
Charging time	0:14:23	Time the car is actually charging
RFID	60DF4D78	RFID code of a charging card



Out of 135,000 records a subset of 90,000 records was suitable for analyis

Causes of ~30% data removal per error type

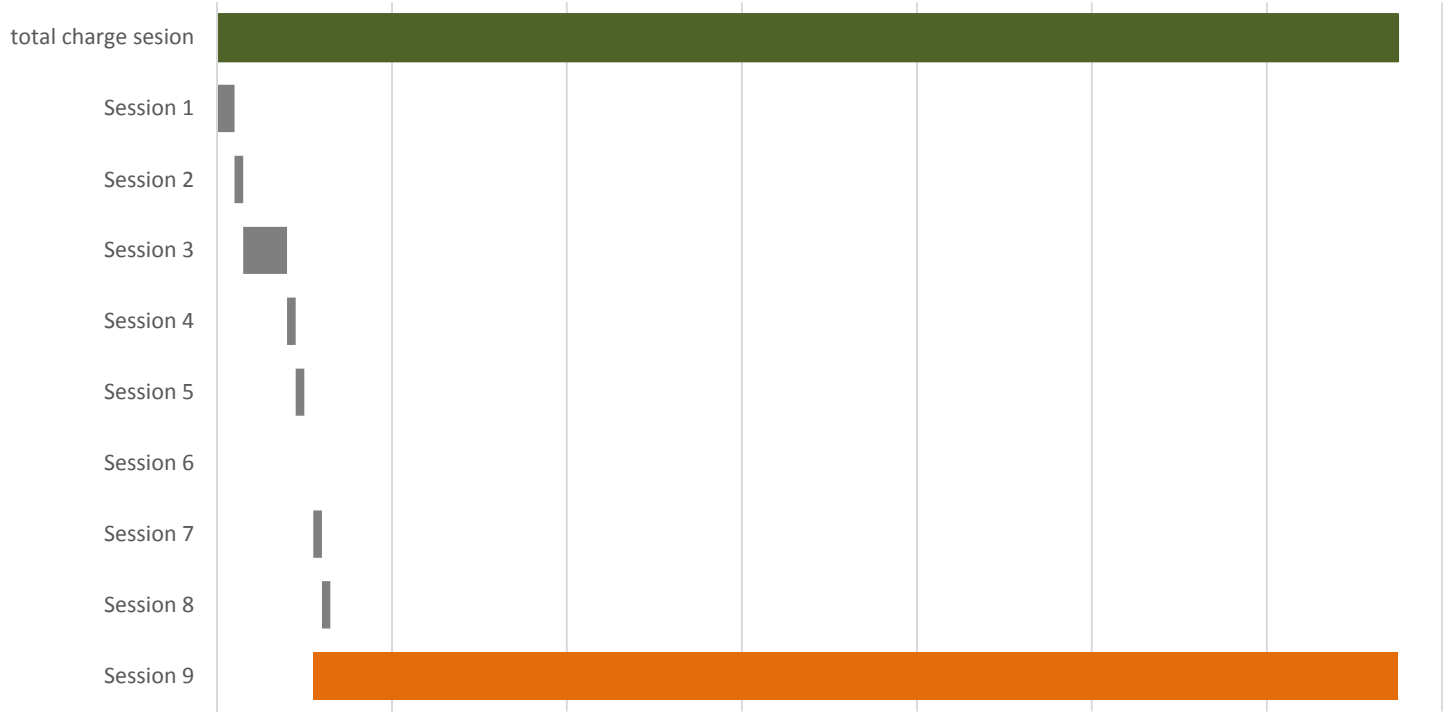


Source: Charge infrastructure forecast database

Note: connection time could be repaired, the rest of the records were deleted.

A data crawling algorithm was used to repair adjacent short time charge sessions

Example of short time algorithm



The crawling algorithm checks on adjacent short times.

e.g. session 6 is an null session, yet adjacent to several short sessions before and after.

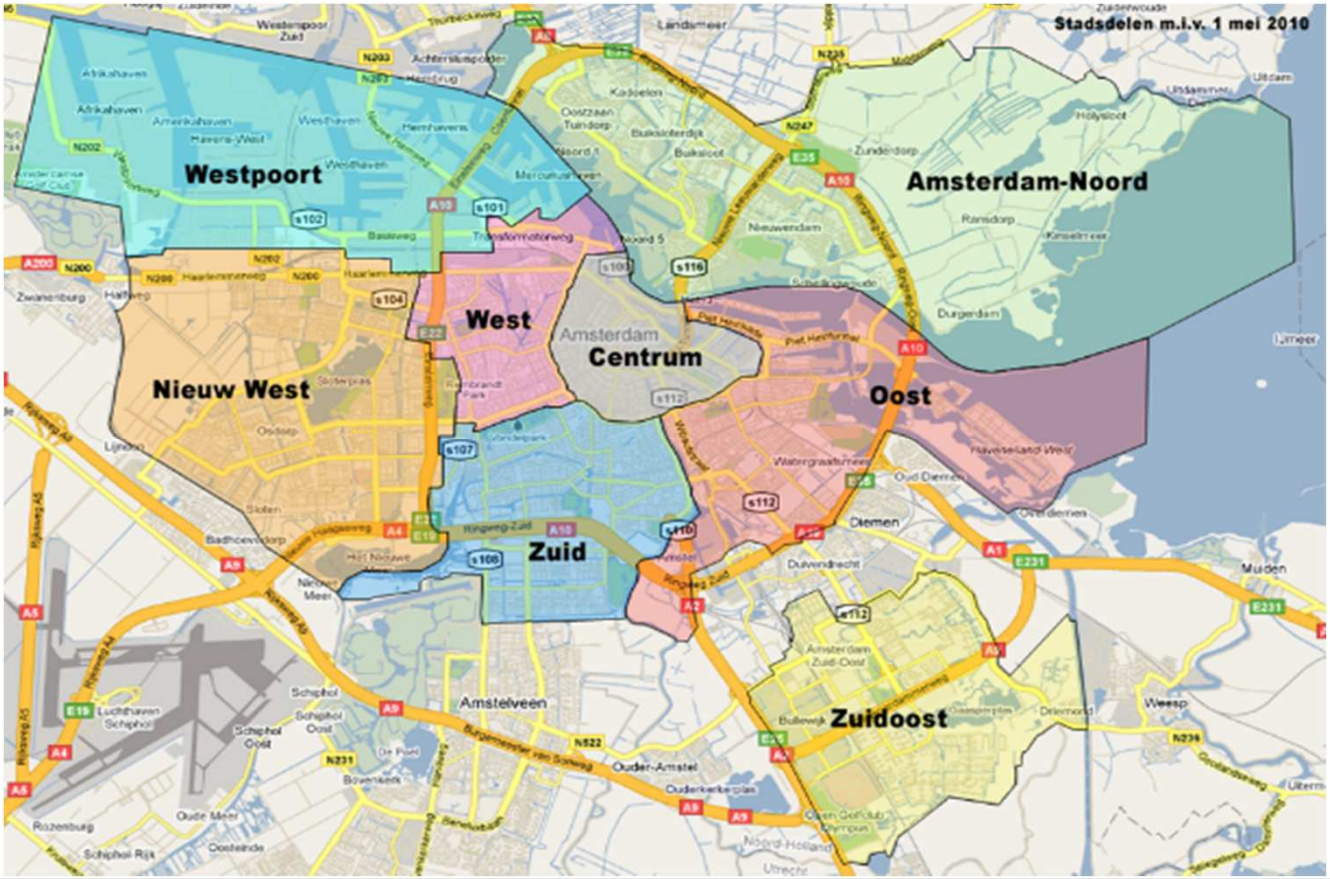
The algorithm influences the # charge sessions as well, and thus the mean session duration.

Source: Charge infrastructure forecast database

Note: Our hypothesis is that loose cable connections and information transfer issues cause this problem.

A comparison between four large districts and the rest of A'dam was made

Map of Amsterdam with city districts highlighted

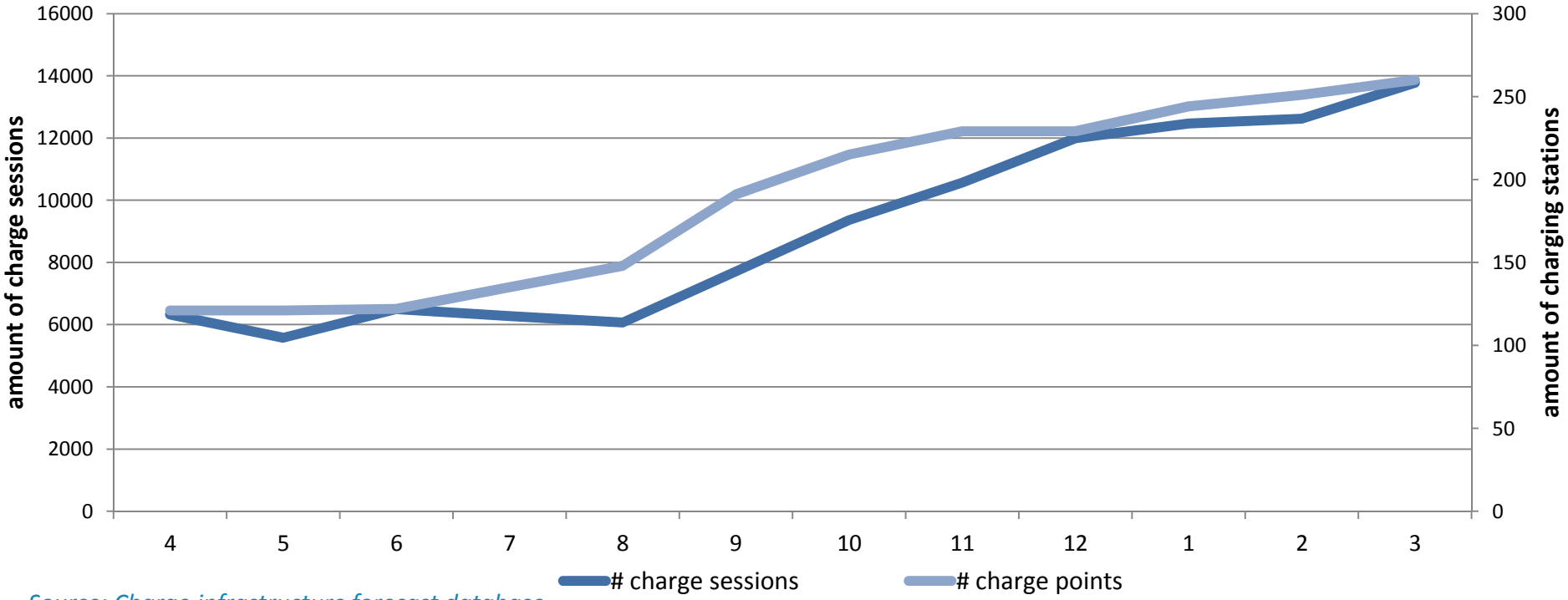


The Amsterdam city center is divided in several districts. The east, west, south and center have highest use rates of EV public charge stations.

Amsterdam is known for its lack of private parking space in the districts near the city center, which leads to higher amounts of public charge stations.

Both #stations as wel as #sessions doubled within one year (all districts)

 # charge sessions vs # charge stations (April 2012-March 2013)



Source: Charge infrastructure forecast database

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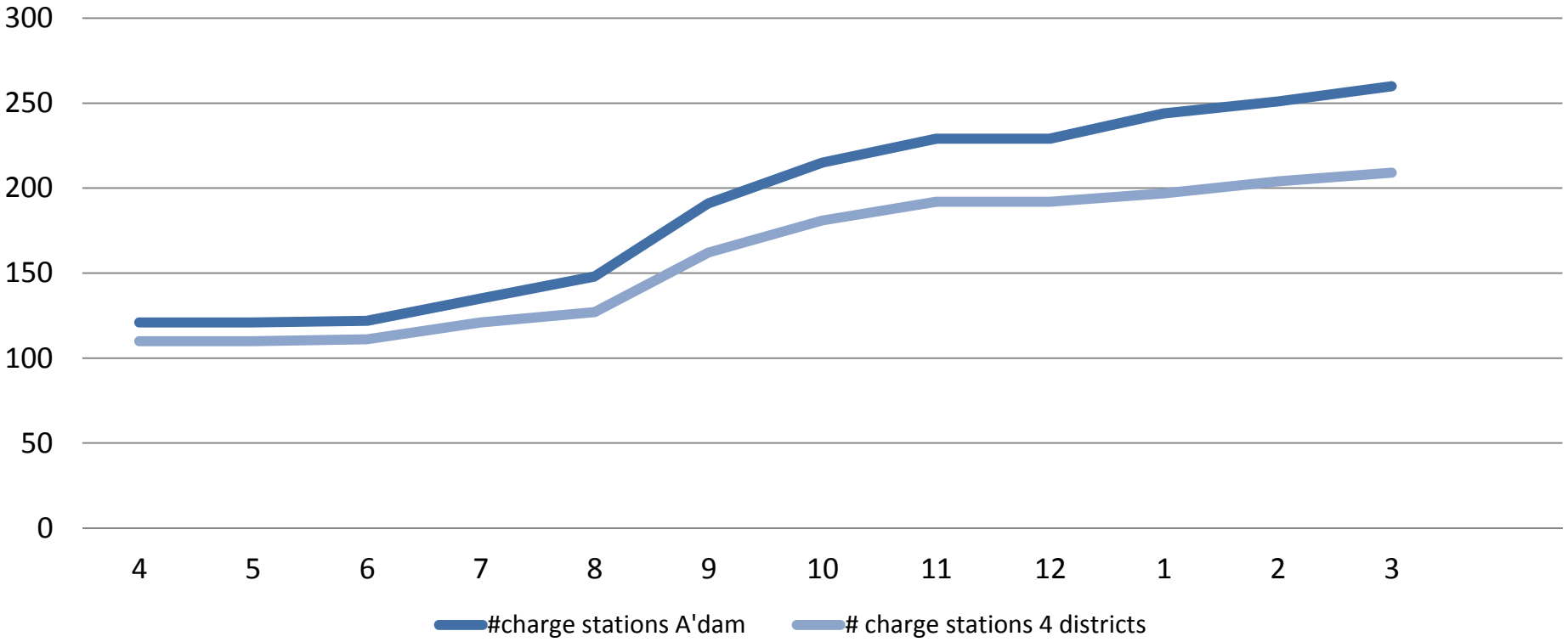
More than 80% of all charge stations are found in the four largest districts

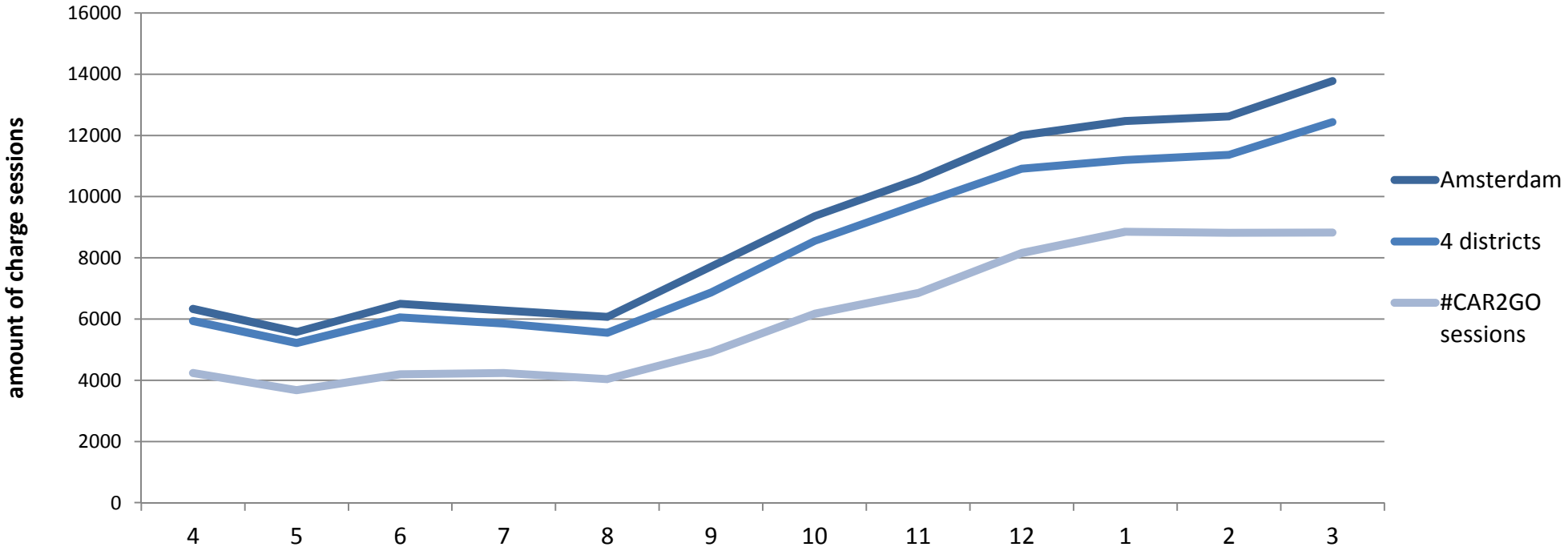
 # charge stations from April-2012 to March-2013



Source: Charge infrastructure forecast database

More than 85% of all charge sessions took place in the 4 largest districts.

 # charge sessions 4 largest districts vs. all districts vs. Car2Go



Source: Charge infrastructure forecast database

Car2Go is responsible for 66% of all charge sessions, with less than 15% of total amount of EV's charged in the region.

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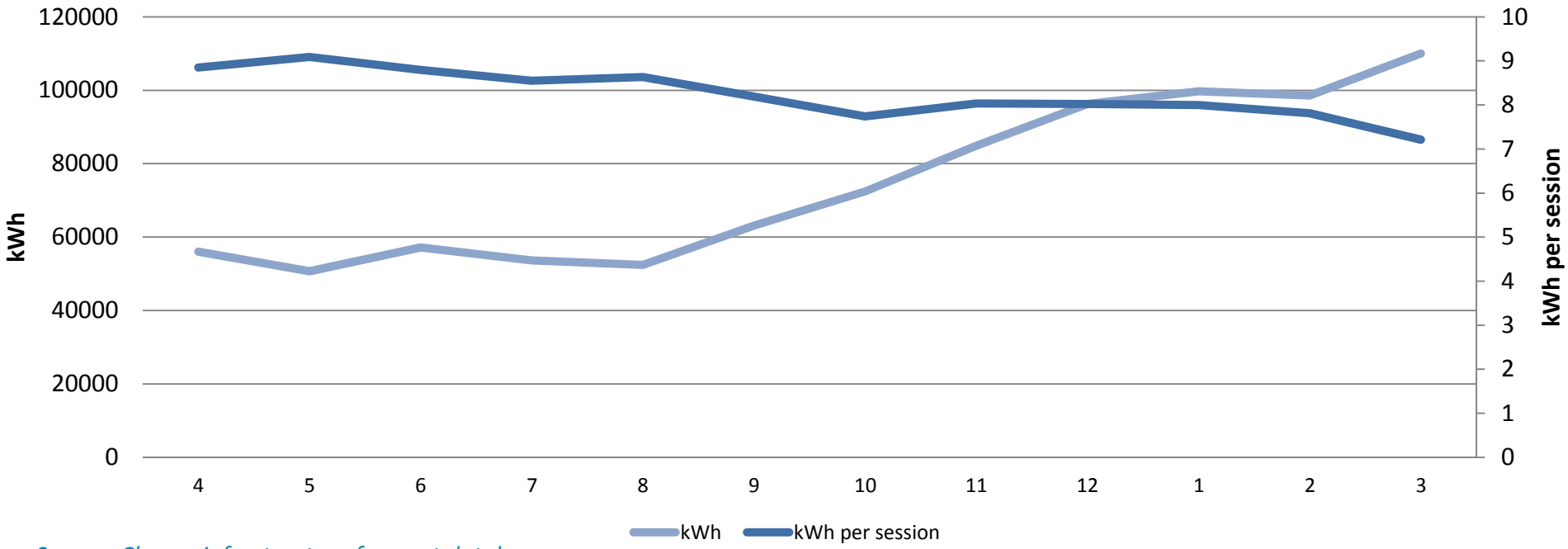
The amount of energy charged nearly doubled to 11MWh/month.

Amount of energy charged (All districts; April 2012-March 2013)

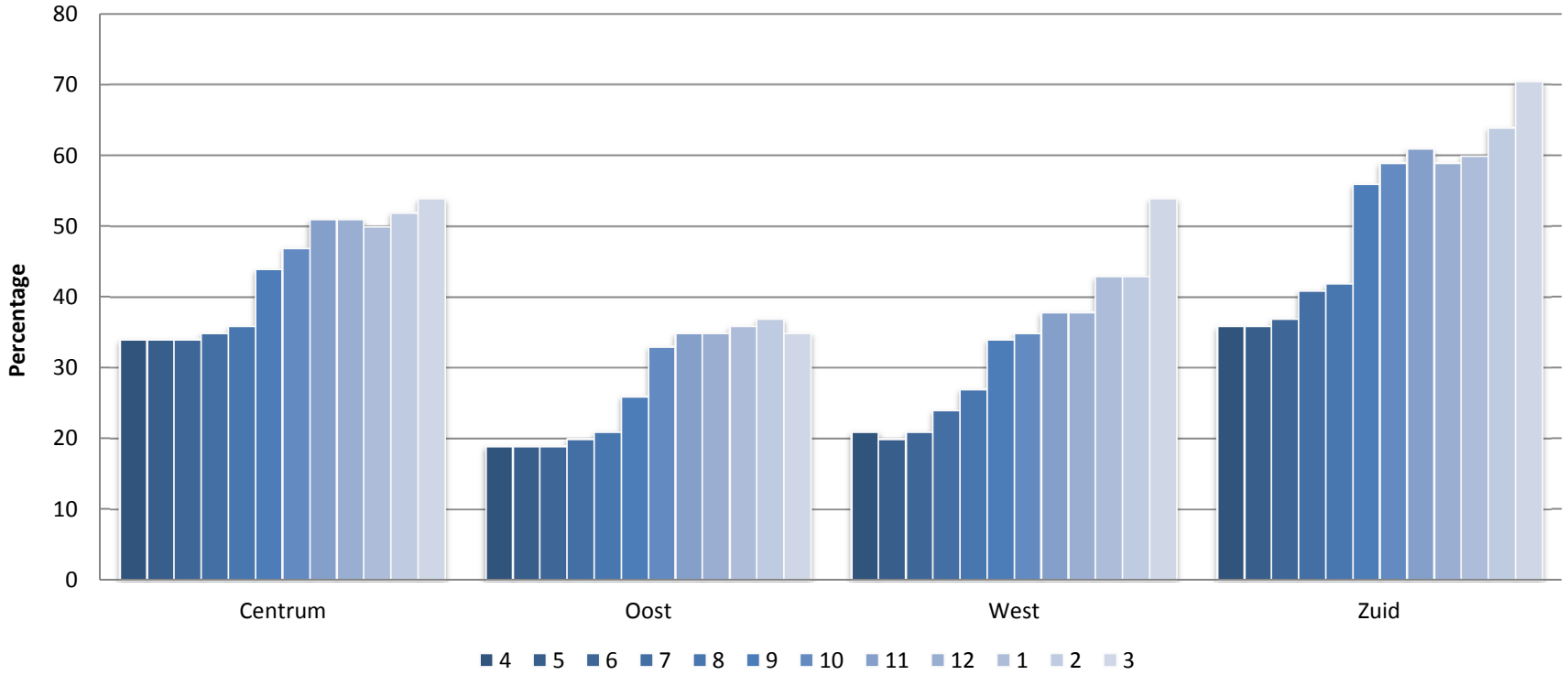


Source: Charge infrastructure forecast database

Note: In total 894MWh was charged over the course of the focus year, representing ~4,9Mln zero emission kilometers facilitated.

A significant growth of capacity utilization is visible (4 large districts)

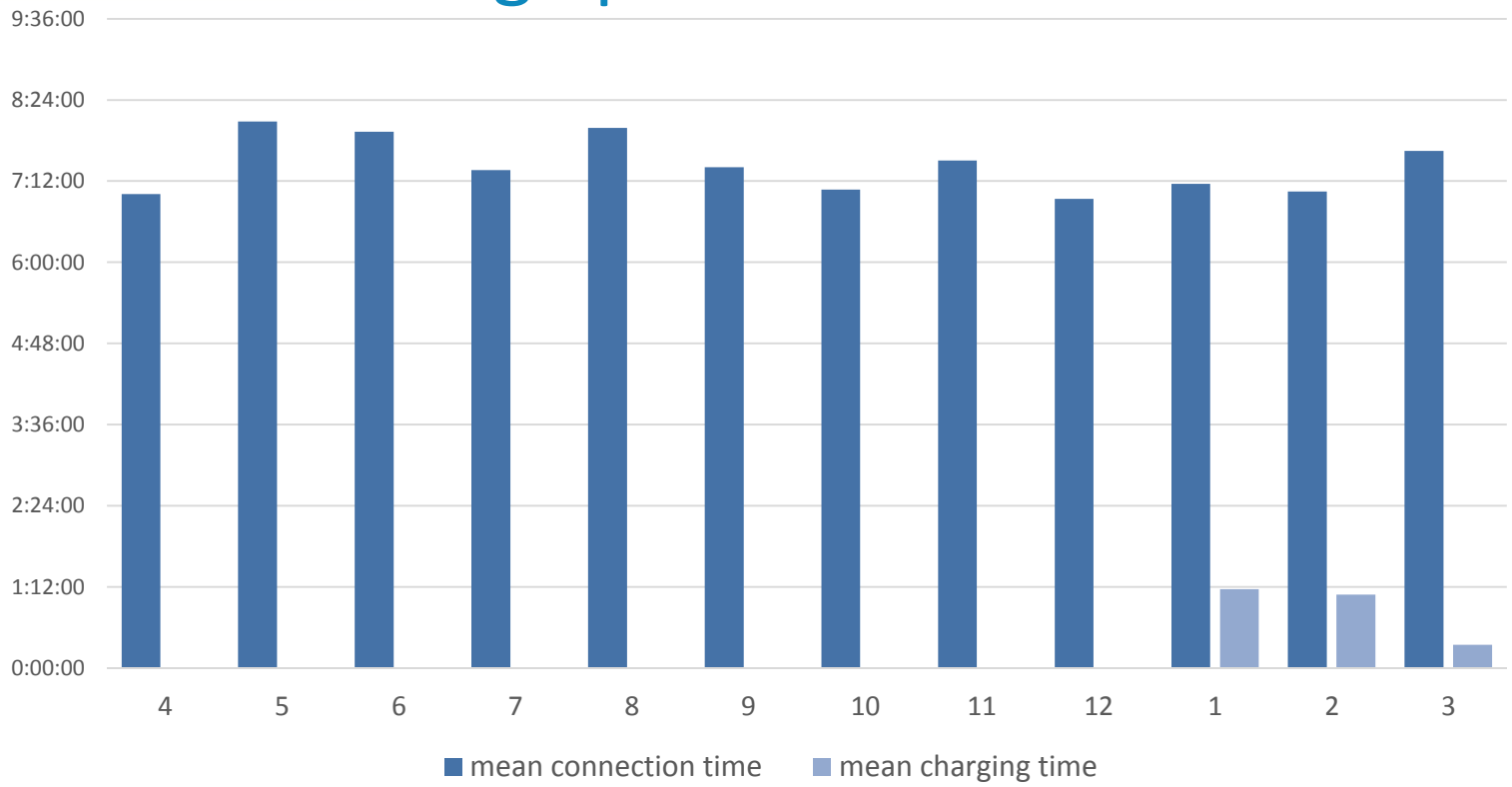
Capacity utilization degree of charge stations (April 2012-March2013)



Source: Charge infrastructure forecast database

Average capacity utilization varies from 28% (East) to 51% (South); the latter implying that half of the total time its charge points were occupied by (PH)EVs

Main concerns is Charge Utilization: on average less than 1 hour a day per charge point.



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Conclusion: The database enables monitoring and optimizing the rollout of charge infrastructure

1. ***Steady growth*** in charge points, charge sessions and kWh's.

2. ***Public infrastructure*** has enabled 4,9 mln zero emission km's.

3. ***Capacity utilization*** is increasing; and supports policy makers in extension strategies of infrastructure.

4. ***Charge utilization*** is main concern; requiring additional incentives.

5. ***Car2Go***; plays a major role in optimizing the use of charge infra ('filling the gaps').

Future work will focus on forecasting charge point efficiency

Goal: Analysis and model to enable effective roll out of charge infra:

- Comparing with other cities/regions
- Modeling of influencing factors (integrate databases, statistics).
- Applying mathematical models to forecast effectiveness of newly installed charge points.
- Translating energy profiles to business models (e.g. load profiles)
- Validate and test particular (academic) metrics concerning charge models and smart grids.

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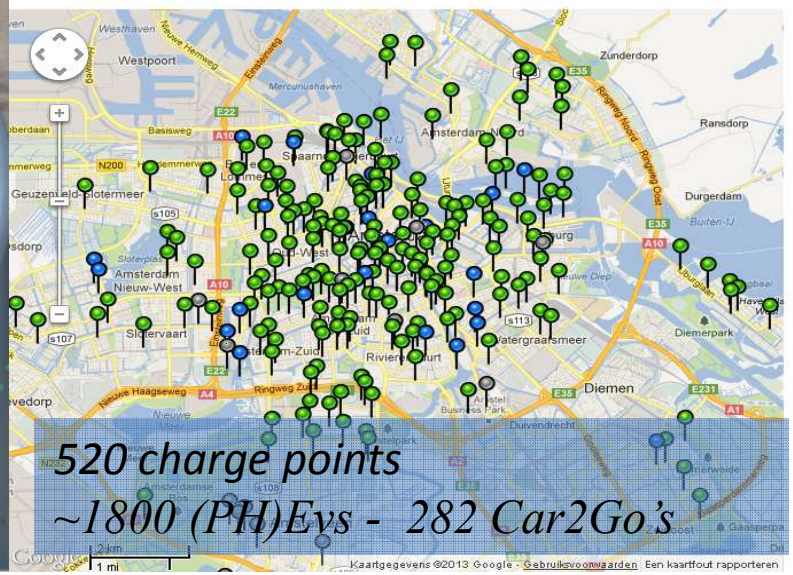
Key characteristics Amsterdam Case: Demand-driven, Subsidies & Car2Go

Demand driven placement of charge points

Car2Go sharing scheme



520 charge points

~1800 (PH)Evs - 282 Car2Go's