

BENCHMARKING CHARGING INFRASTRUCTURE UTILIZATION

ELECTRIC VEHICLE SYMPOSIUM 29, MONTRÉAL

RICK WOLBERTUS

ROBERT VAN DEN HOED

PREVIOUS WORK

- GROWING FIELD OF STUDIES ON EV CHARGING USING DATA FROM TRAILS OR ACTUAL USAGE (GERMANY, UK, USA, IRELAND, AUSTRALIA, JAPAN ETC.)
- LIMITED WORK WITH FOCUS ON CHARGING INFRASTRUCTURE UTILIZATION
- LARGE DIFFERENCES BETWEEN HOME/WORKPLACE AND PUBLIC CHARGING UTILIZATION
- EARLY COMPARISONS ON ROLL-OUT STRATEGIES (STRATEGIC VS DEMAND DRIVEN, LOCATION SELECTION)



AMSTERDAM

Start	<i>febr 2012</i>
Charge Stations	824
Charge Sessions	901.390
Monthly	42.643

UTRECHT

Start	<i>dec 2013</i>
Charge Stations	263
Charge Sessions	169.166
Monthly	11.601

THE HAGUE

Start	<i>juni 2013</i>
Charge stations	429
Charge Sessions	217.872
Monthly	15.664

METROPOLE REGION

Start	<i>feb 2014</i>
Charge Stations	722
Charge Sessions	390.423
Monthly	51.121

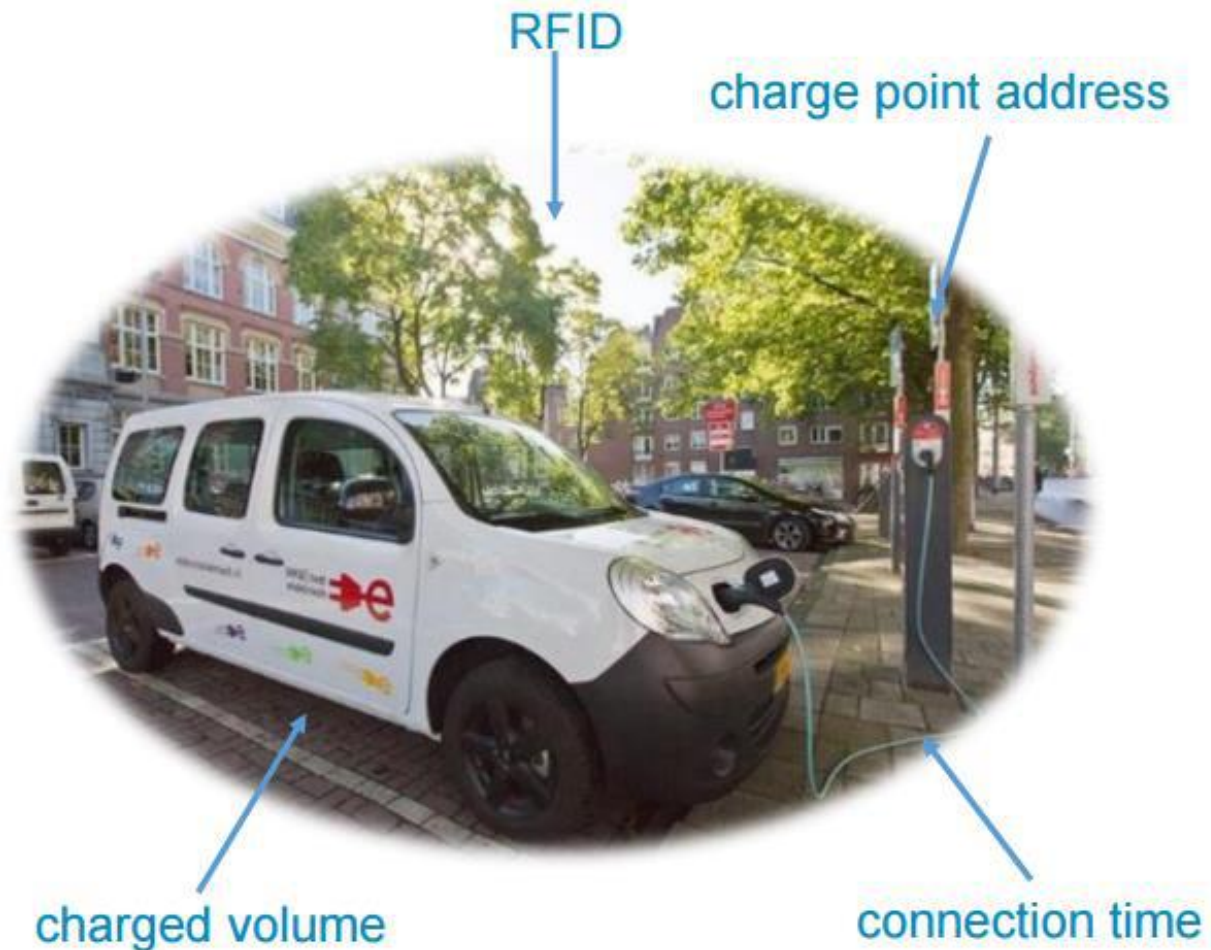
ROTTERDAM

Start	<i>dec 2012</i>
Charge Stations	~500
Charge Sessions	288.924
Monthly	19.079

GRAND

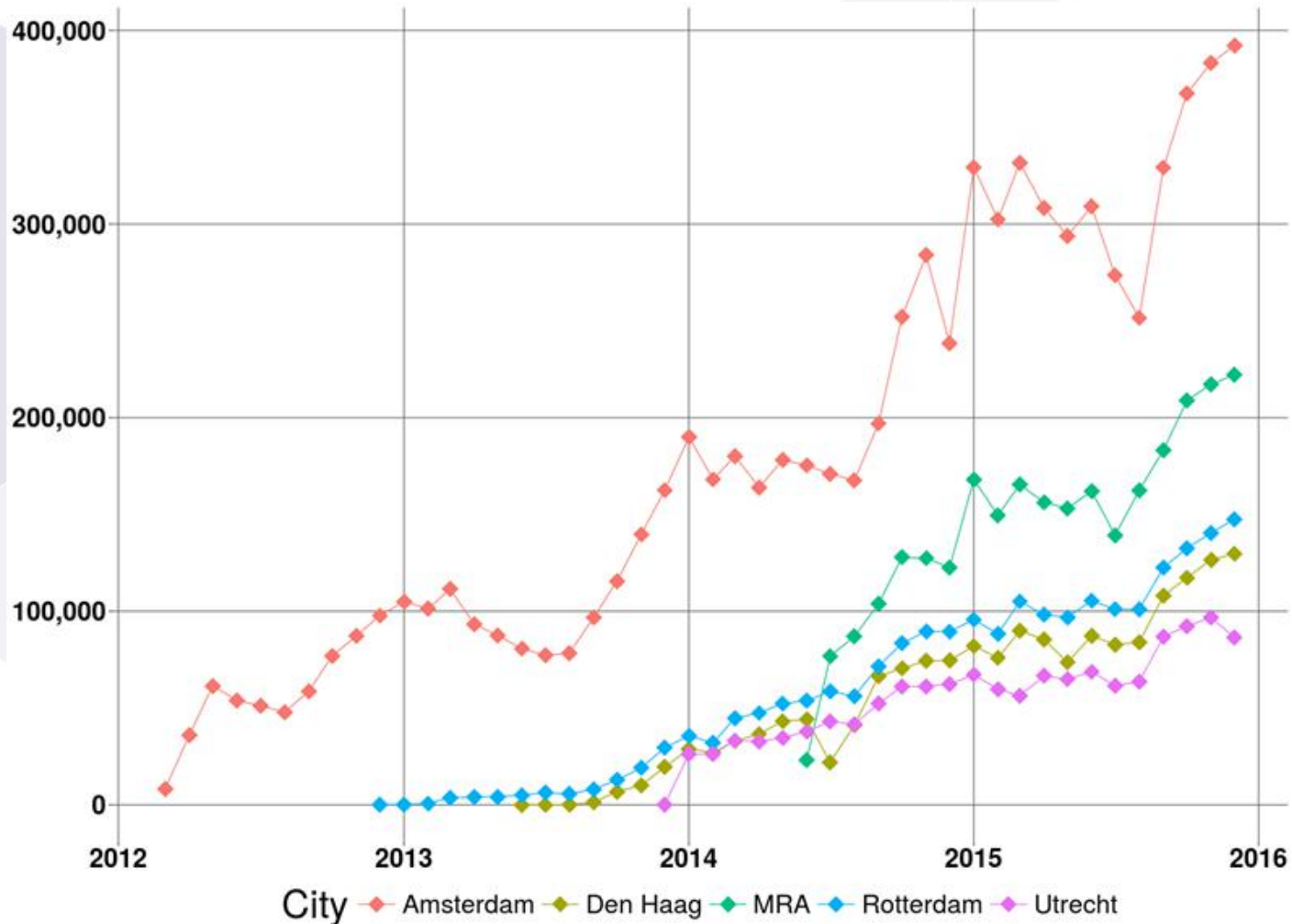
Charge Stations	2855
Charge Sessions	1.967.775
Monthly	140.108

Parameter	Example	Explanation
Charge point address	Admiralengracht 44	Address of the charge point
Charge point operator	Nuon	Owner of the charge point
charge service provider	Essent	Owner of the used charge 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
charge time	0:14:23	Time the car is actually charge
RFID	60DF4D78	RFID code of a charge card



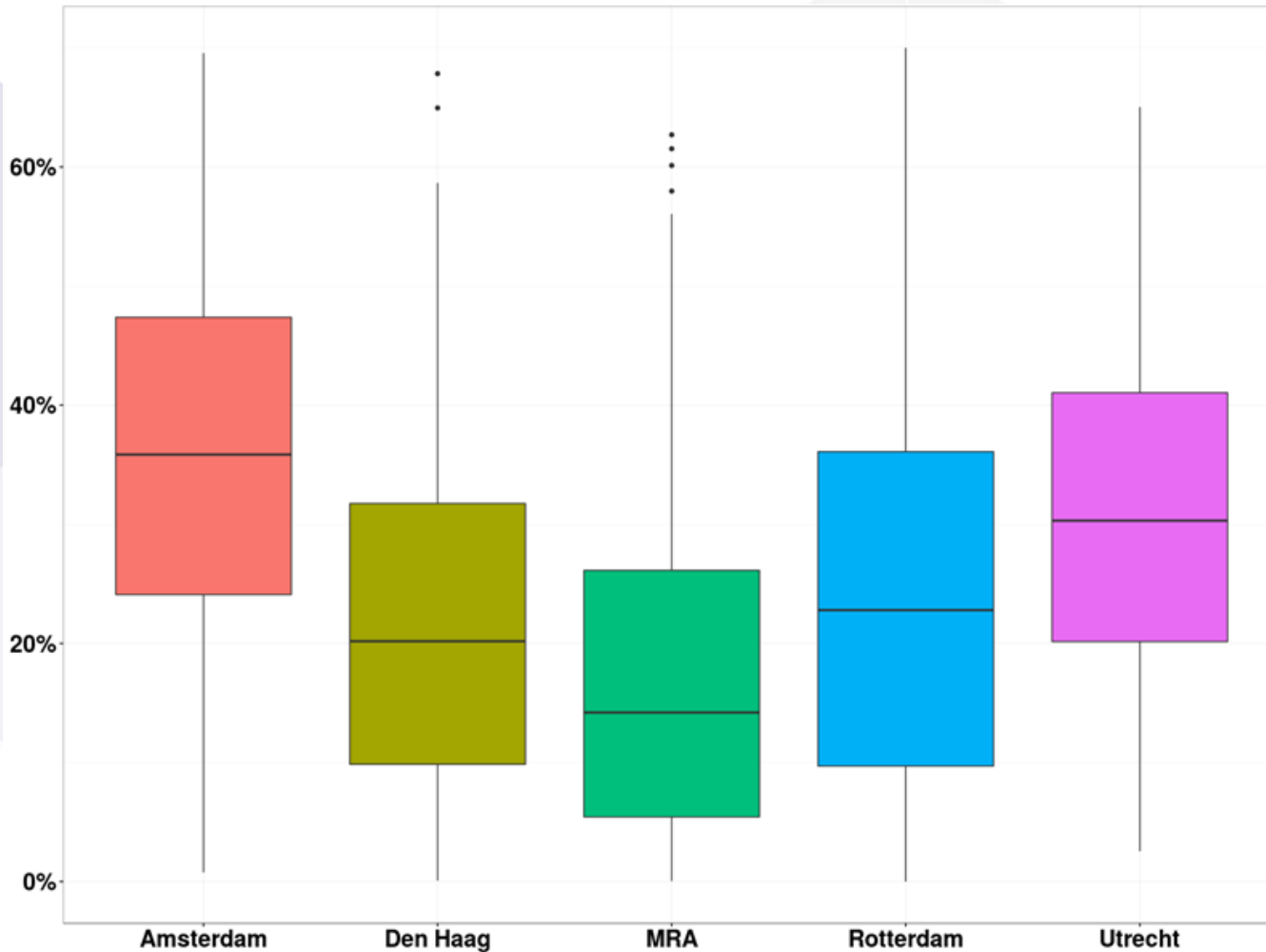
RESULTS : SUSTAINABILITY GOALS

AMOUNT OF KWH CHARGED



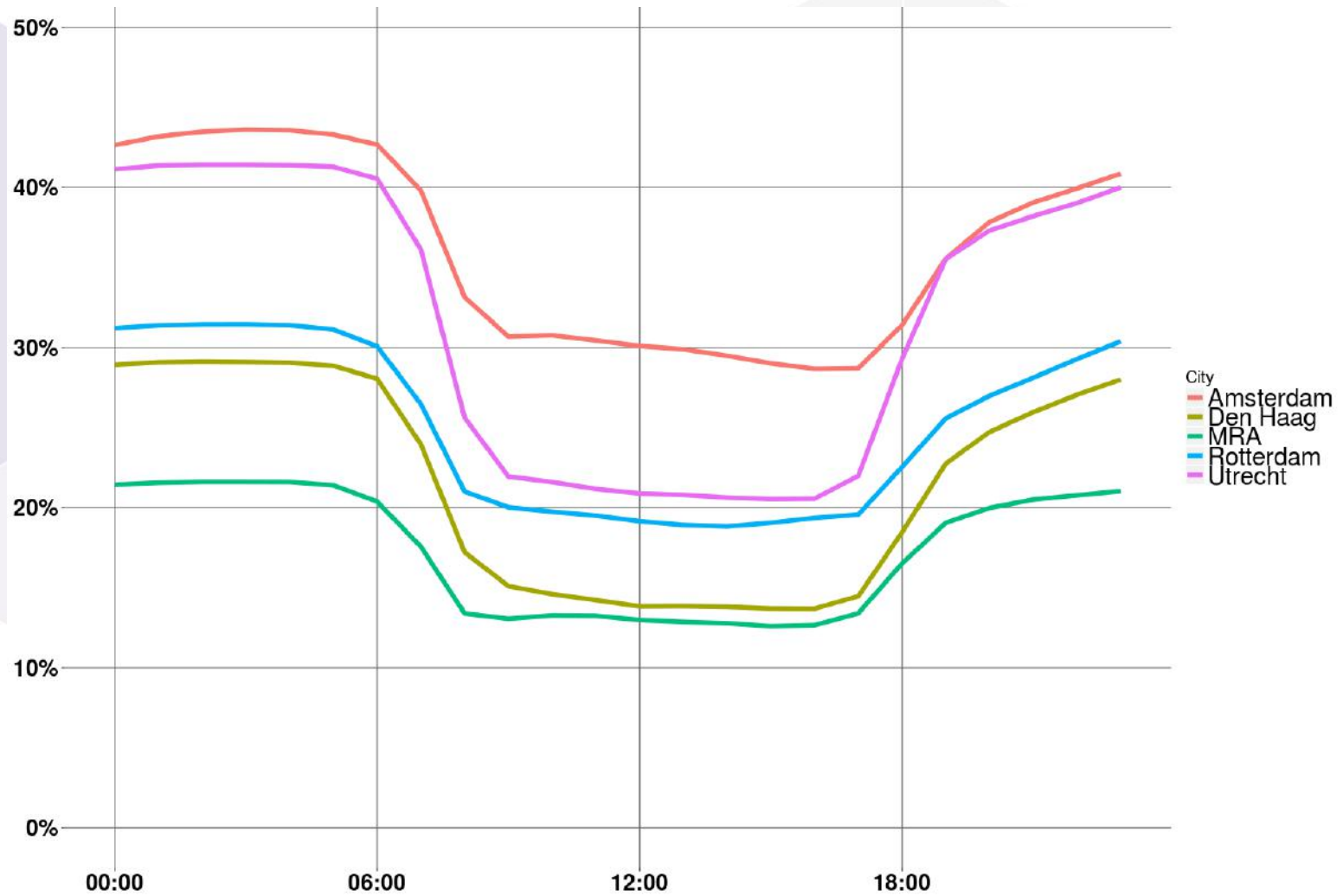
RESULTS :MANAGE PUBLIC CONCERNS

CHARGING STATION OCCUPANCY



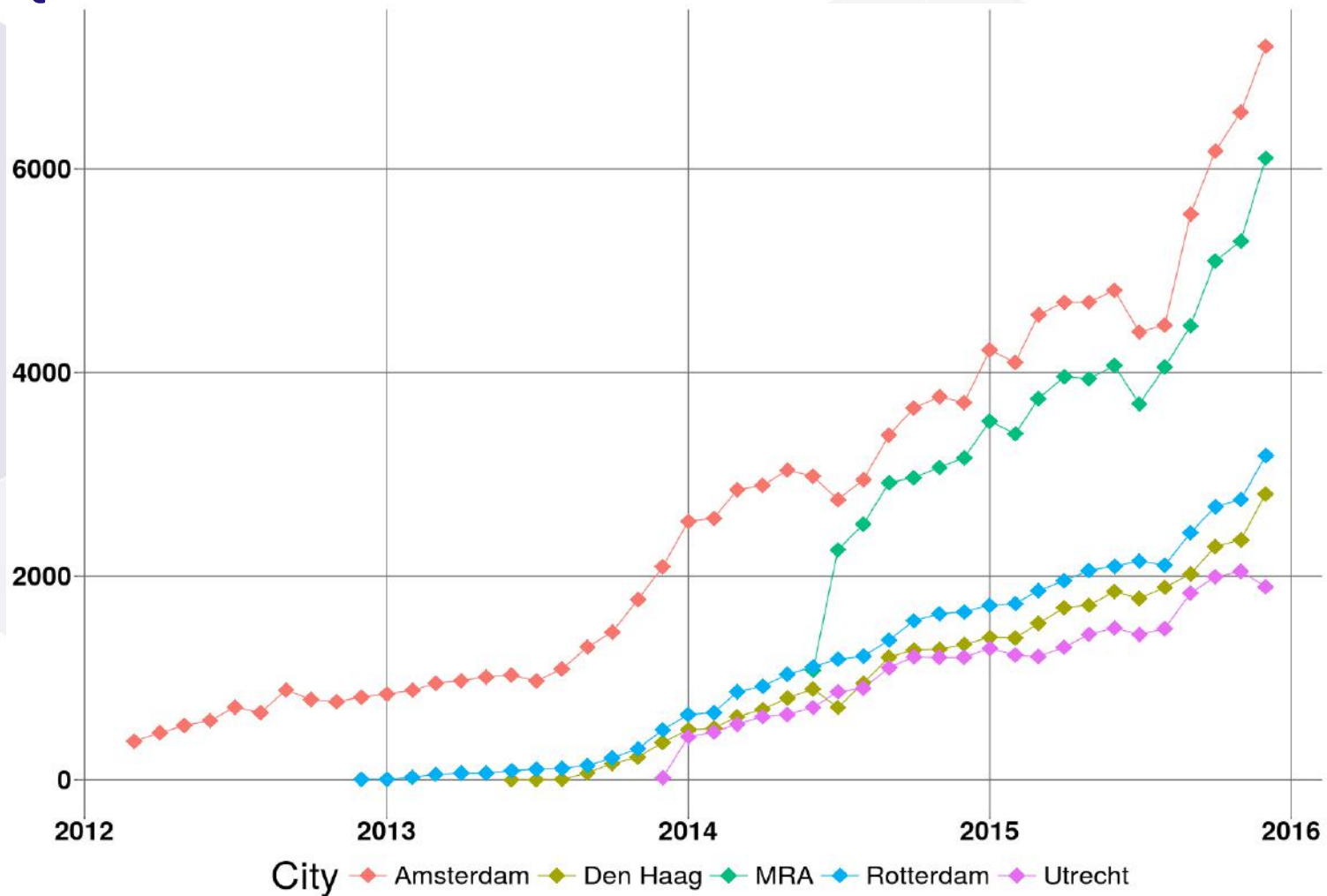
RESULTS :MANAGE PUBLIC CONCERNS

CHARGING STATION OCCUPANCY



RESULTS: FACILITATE E-MOBILITY

UNIQUE USERS



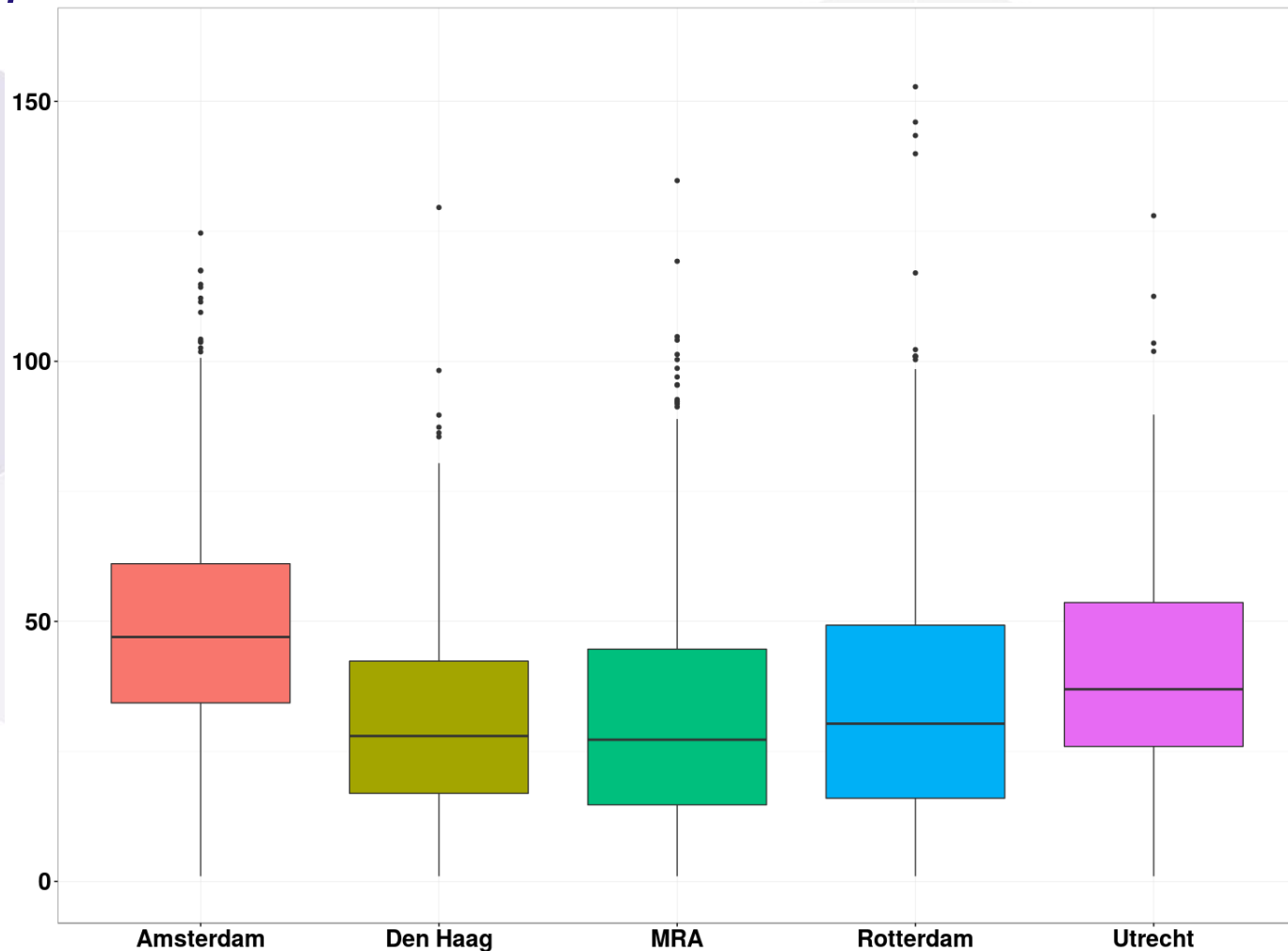
RESULTS: FACILITATE E-MOBILITY

UNIQUE USERS PER CHARGING STATION

City	Charging stations December 2015	Average unique users/ charging station/month
Amsterdam	764	7,81
Rotterdam	477	5,37
The Hague	420	5,13
Utrecht	244	7,48
MRA	668	7,00

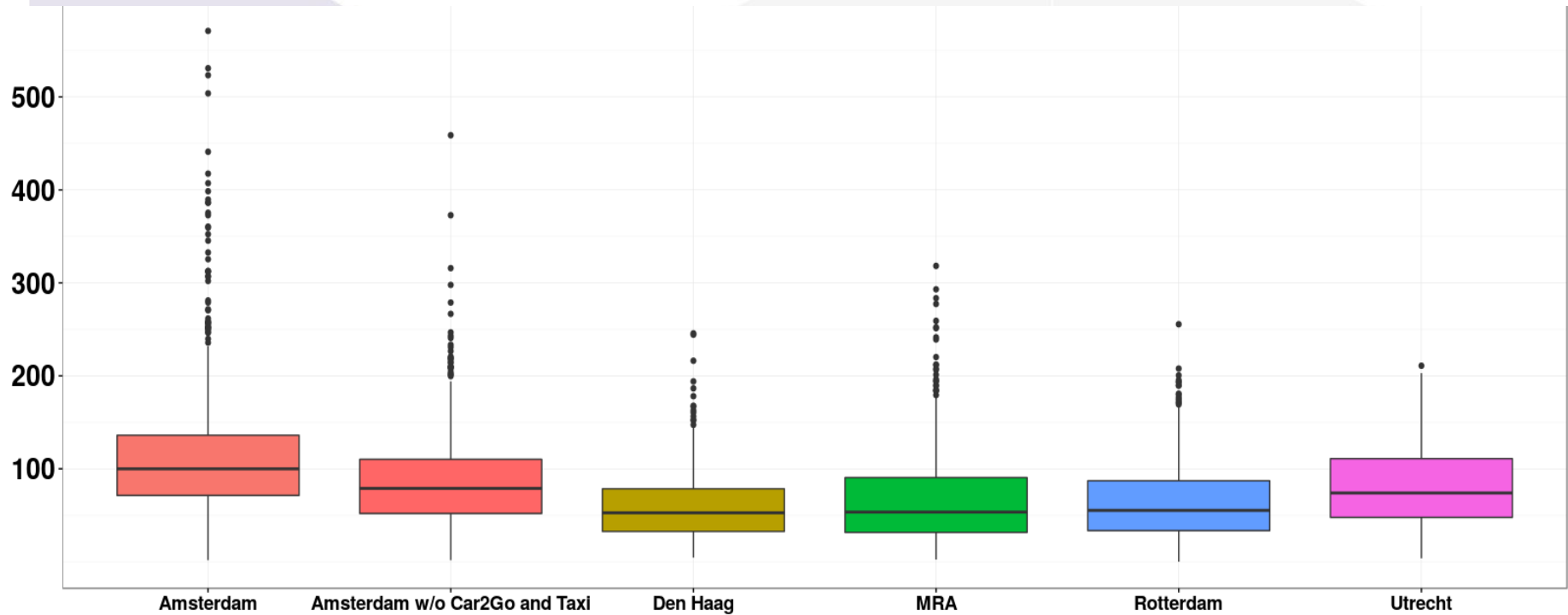
RESULTS: FACILITATE E-MOBILITY

CHARGING SESSIONS PER CHARGING STATION PER MONTH



RESULTS: FACILITATE THE BUSINESS CASE

AMOUNT OF KWH CHARGED PER WEEK



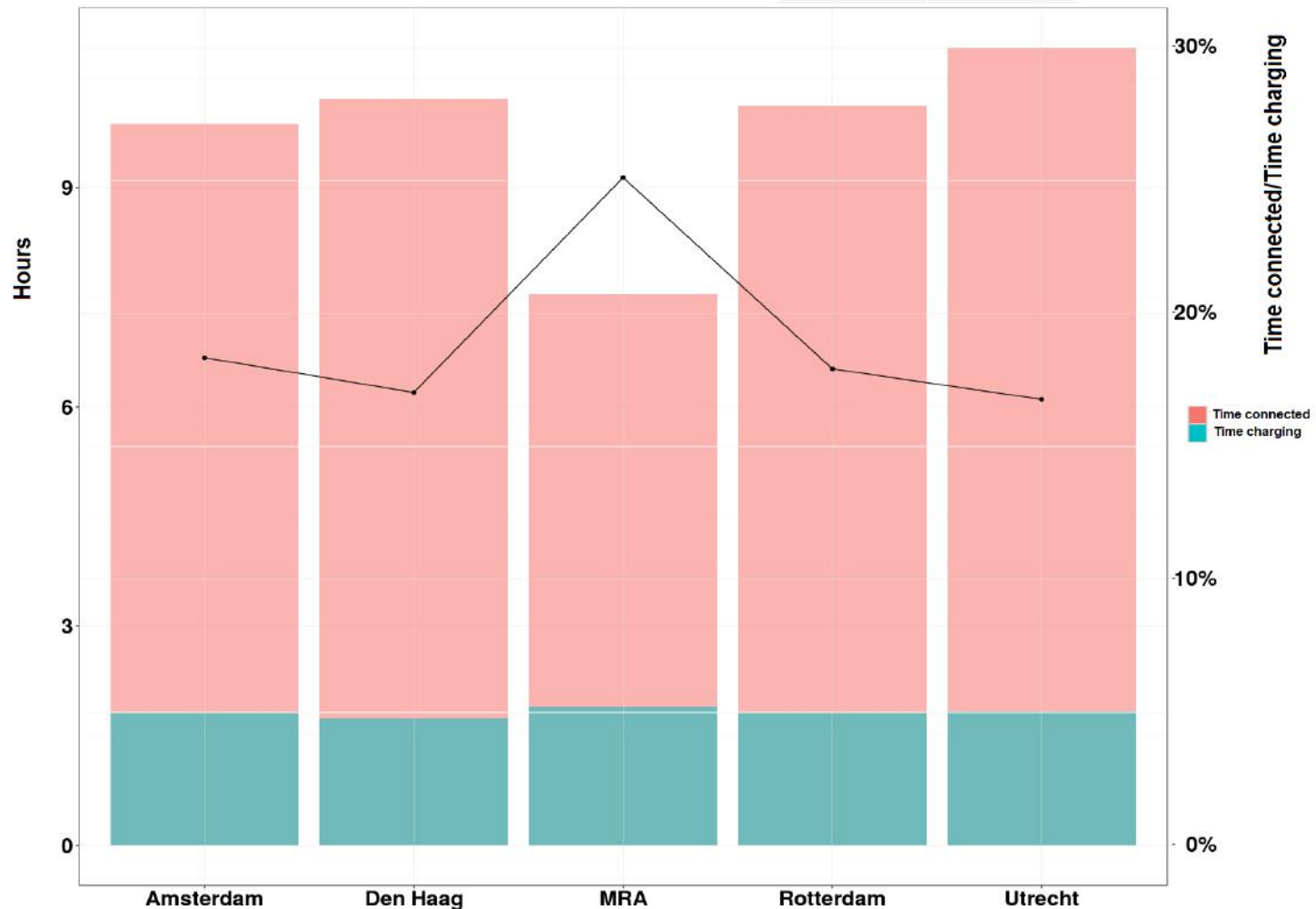
RESULTS: FACILITATE THE BUSINESS CASE

KWH PER SESSION

City	kWh/session	Average battery capacity
Amsterdam	9,83	11.56
Amsterdam w/o Car2Go & Taxi	9,00	11.45
The Hague	8,09	9.74
MRA	8,66	10.15
Rotterdam	7,62	9.82
Utrecht	8,19	9.67

RESULTS:

TIME CONNECTED VS TIME CHARGING



CONCLUSIONS

- DIFFERENCES BETWEEN CITIES IN EVERY ASPECT: KWH, OCCUPANCY, SESSIONS ETC.
- AMSTERDAM CLEAR FRONT-RUNNER IN ALMOST EVERY ASPECT
- DIFFERENT ROLE-OUT STRATEGIES MATTER!
- ADDED VALUE OF OTHER MODES OF E-TRANSPORT (CAR SHARING, TAXI)
- BUSINESS CASE REMAINS DIFFICULT
- ADDITIONAL RESEARCH
 - Additional underlying variables to compare cities (income, pop. density, public facilities, etc.)
 - Comparing neighbourhoods within/between cities
 - How to interperate KPIs?

CONCLUDING

- INSTRUMENTAL ROLE OF DATA SCIENCE IN ROLL OUT OF CHARGING INFRASTRUCTURE:
 - Monitoring
 - Benchmarking
 - Pattern recognition
 - Anomaly detection
 - Forecasting
 - Simulation
 - Policy evaluation
- FOR MORE INFORMATION: **WWW.IDOLAAD.NL**



Google Chrome browser window showing a Shiny application running in RStudio. The address bar displays `prddtech0002jct.hva.nl:8787`.

The RStudio interface includes the following components:

- Source Editor:** Contains R code for a Shiny application. The code includes a URL to a Stack Overflow question, a login form, and a server function that checks user credentials.
- Environment:** Lists loaded data frames and their dimensions:
 - `All_vulner...`: 39118 obs. of 12 variables
 - `All_vulner...`: 24655 obs. of 12 variables
 - `All_vulner...`: 12378 obs. of 12 variables
 - `Data_locat...`: 1 obs. of 6 variables
 - `Location_skey`: int 5045
 - `Address`: Factor w/ 5061 levels "110"
 - `City`: Factor w/ 417 levels "Aa en Hun...
 - `CityChargesessions`: Factor w/ 778 levels
 - `Latitude`: num 52.1
 - `Longitude`: num 4.32
 - `Leadpaal_K...`: 111 obs. of 3 variables
 - `Leadpaal_K...`: 5 obs. of 25 variables
 - `Leadpaal_K...`: 111 obs. of 3 variables
 - `Leadpaal_K...`: 5 obs. of 17 variables
 - `Username`: 43 obs. of 13 variables
- Files:** Shows a file explorer with folders like `.R`, `DataCrunch`, `Jupyter`, `Martijn`, `Others`, `R`, and `Voorraad`.
- Console:** Displays warnings about closing unused R00BC handles and the source code for the Shiny application.