Hogeschool van Amsterdam

The long-term effects of COVID-19 lockdowns on electric vehicle charging behaviour

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EVS35
OSL2022

Creating Tomorrow

Introduction

Hogeschool van Amsterdam

URBAN TECHNOLOGY

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This research is part of the RAAK-SIA funded Future Charging project, led by the Research Group Energy & Innovation, Centre of Expertise Urban Technology, Faculty of Technology, at the Amsterdam University of Applied Sciences.

Background

Charging Network & Data

Large dataset of all public transaction in the four largest municipalities of the Netherlands.

Over 7.5 million sessions analyzed for this study.

Location, RFID (hashed), duration, starttime, endtime, kWh charged

Local COVID-19 policies

Mask mandates, 1.5 meter distance, quarantine protocols

On-and-off work from home policies

Lockdowns (nightclubs, fashion stores, restaurants, theme parks etc.) and partial lockdowns
Curfews

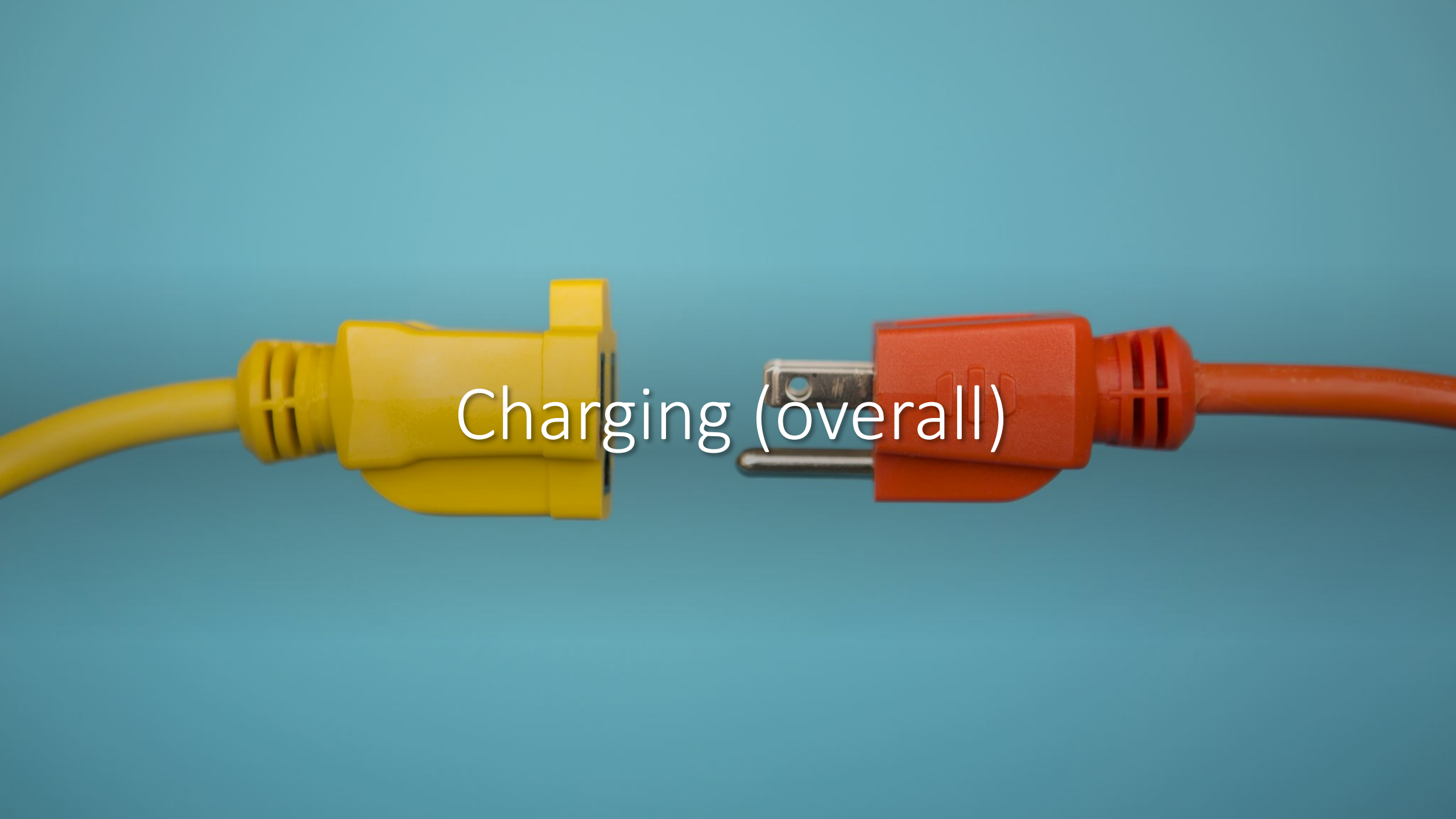
Research Question

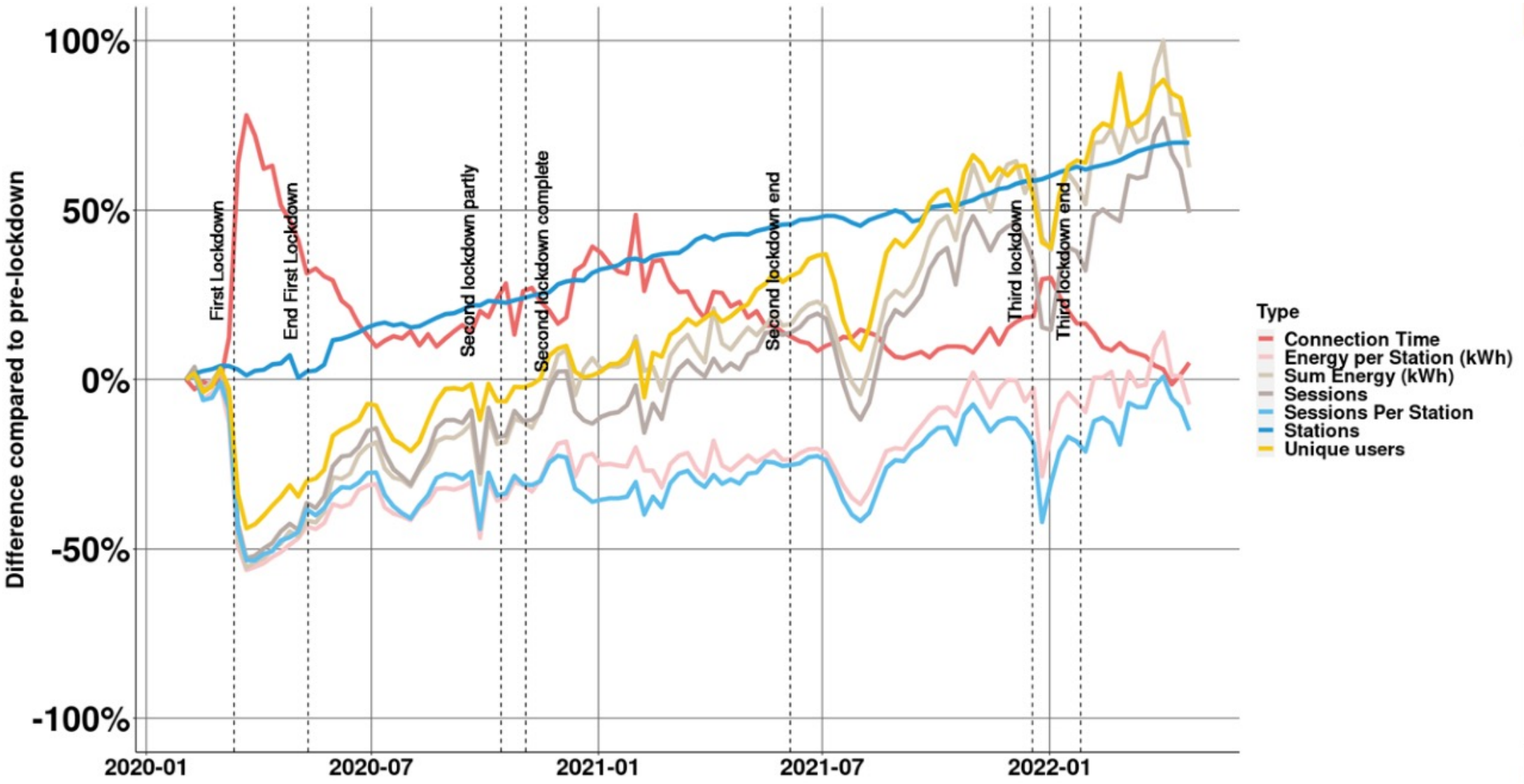
What is the short- and long-term impact of COVID-19 lockdowns on electric vehicle charging behaviour?

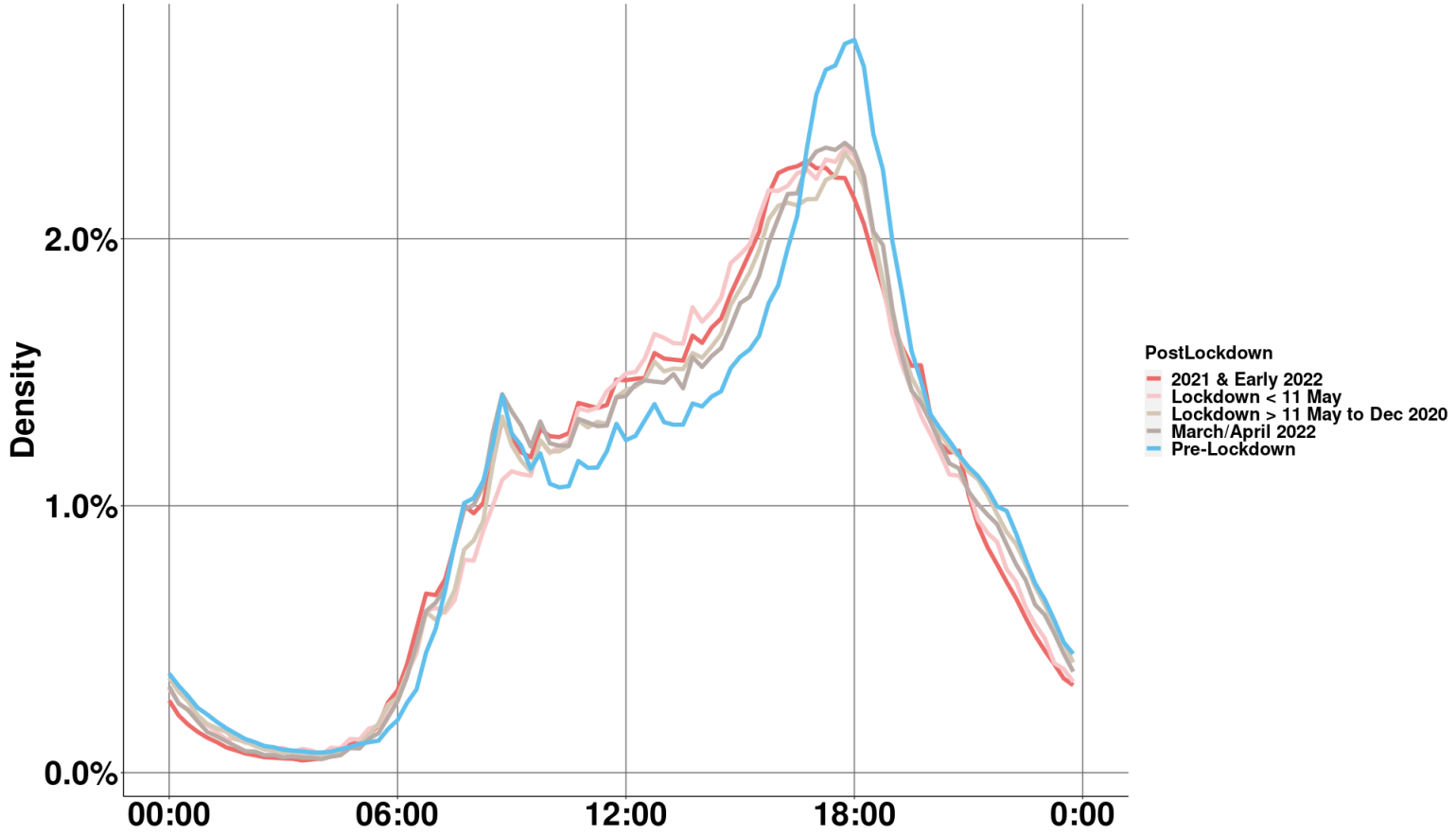
What are the long-term implications of COVID-19 on the charging ecosystem?

Analysis

1. Overview of charging during COVID-19
2. Sales comparison: kWh charged on the public EV charging network compared to petrol sales related to fossil traffic
3. Office comparison: analyzing the effects of work from home policies on work-related charging
4. User group comparison: comparing the effects for taxi drivers and shared vehicles
5. Analysis of the effect of curfews on charging demand during the evening

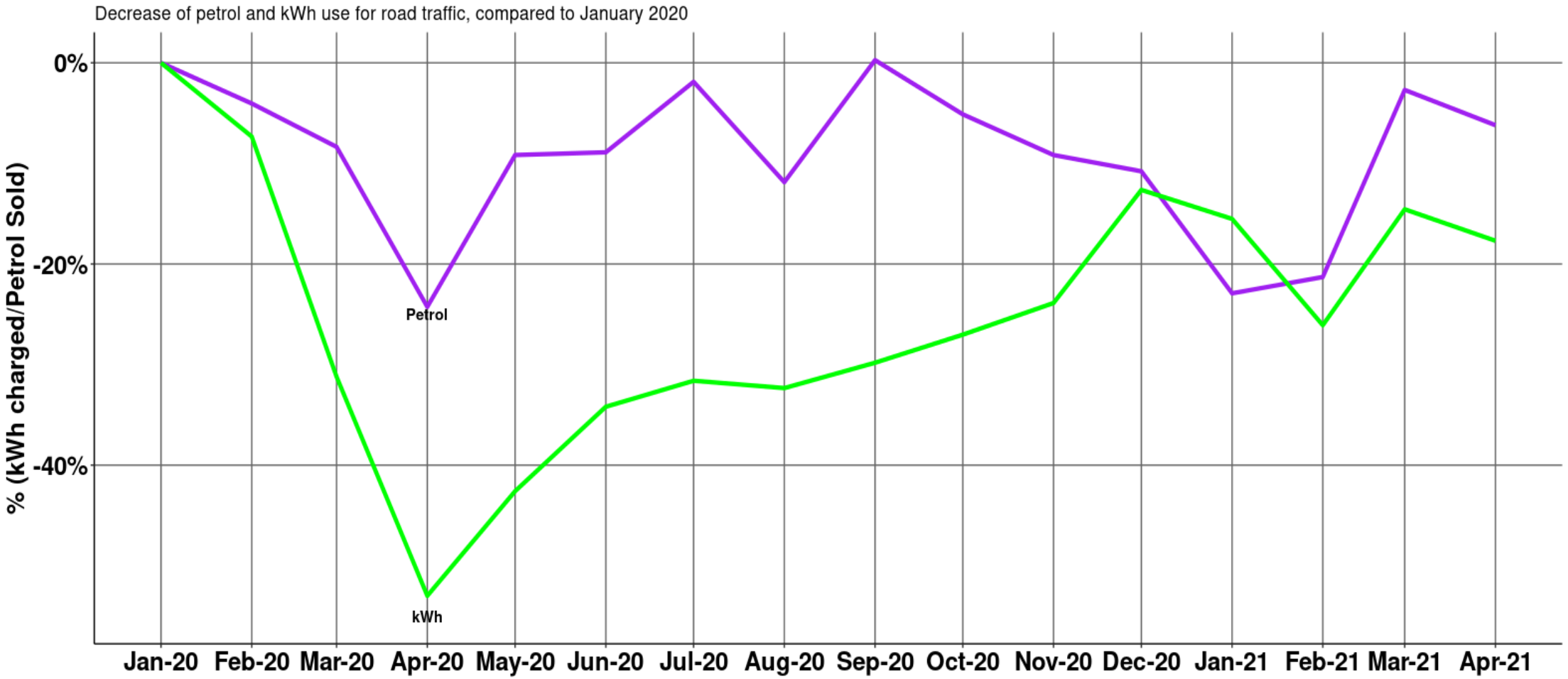

Charging (overall)


Difference compared to pre-lockdown
100%
50%
0%
-50%
-100%
2020-01
2020-07
2021-01
2021-07
2022-01
First Lockdown
End First Lockdown
Second lockdown partly
Second lockdown complete
Second lockdown end
Third lockdown
Third lockdown end
Type
Connection Time
Energy per Station (kWh)
Sum Energy (kWh)
Sessions
Sessions Per Station
Stations
Unique users



Date	Sessions/user	Energy/ Session (kWh)	Connection Time	Unique number of charging stations/user	Sum of Energy charged (kWh)	Number of unique neighbourhoods visited
January 2020	14.9	16.5	12.7	3.2	221	1.94
March 2022	10.9	17.0	11.9	2.6	159	1.58

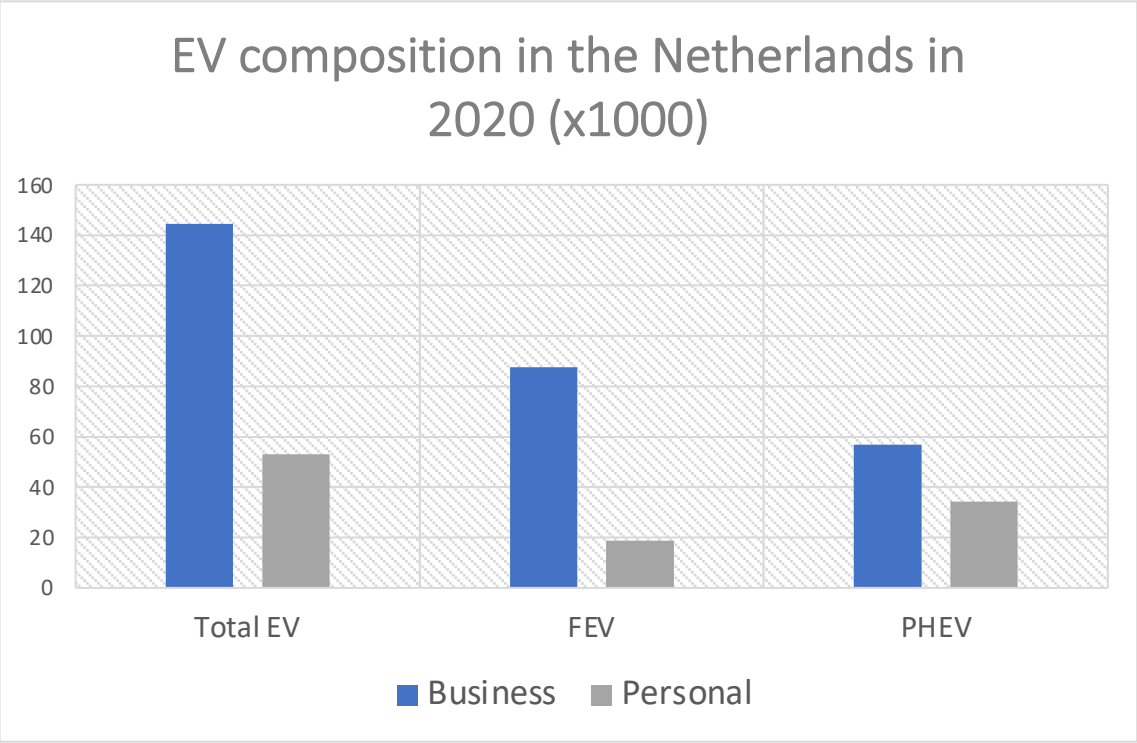
Fuel comparison



Petrol data provided by Dutch Central Bureau of Statistics

January 2020 is the reference point (0%), and only charging points that existed from this reference point were considered in the analysis, to minimize growth effects

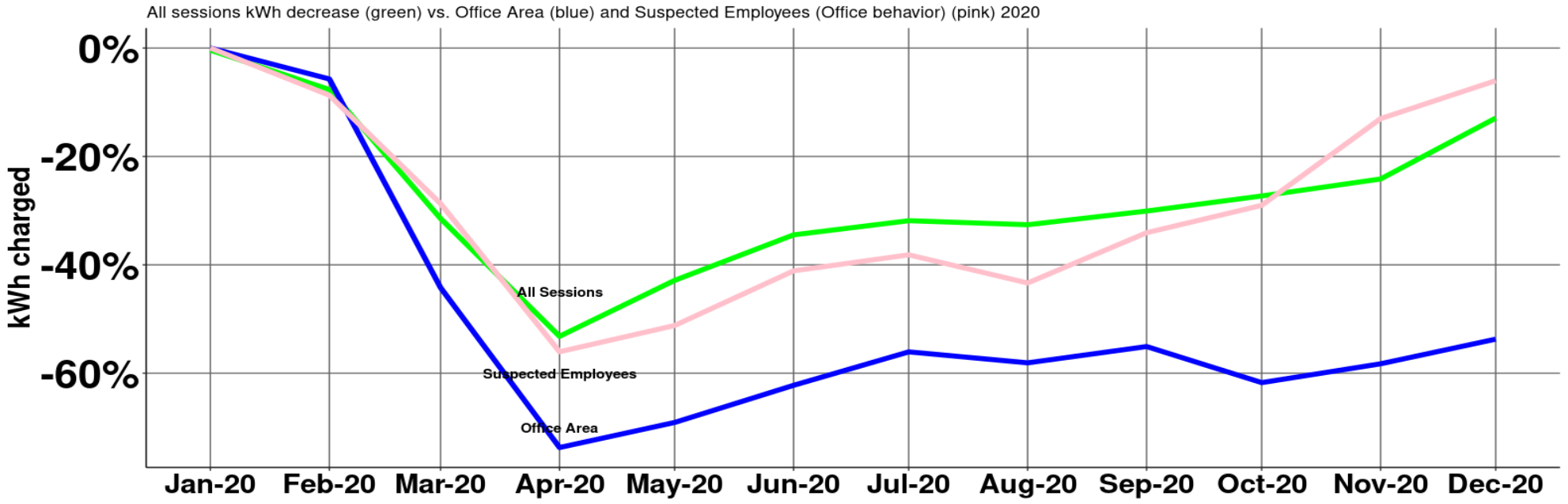
Office comparison

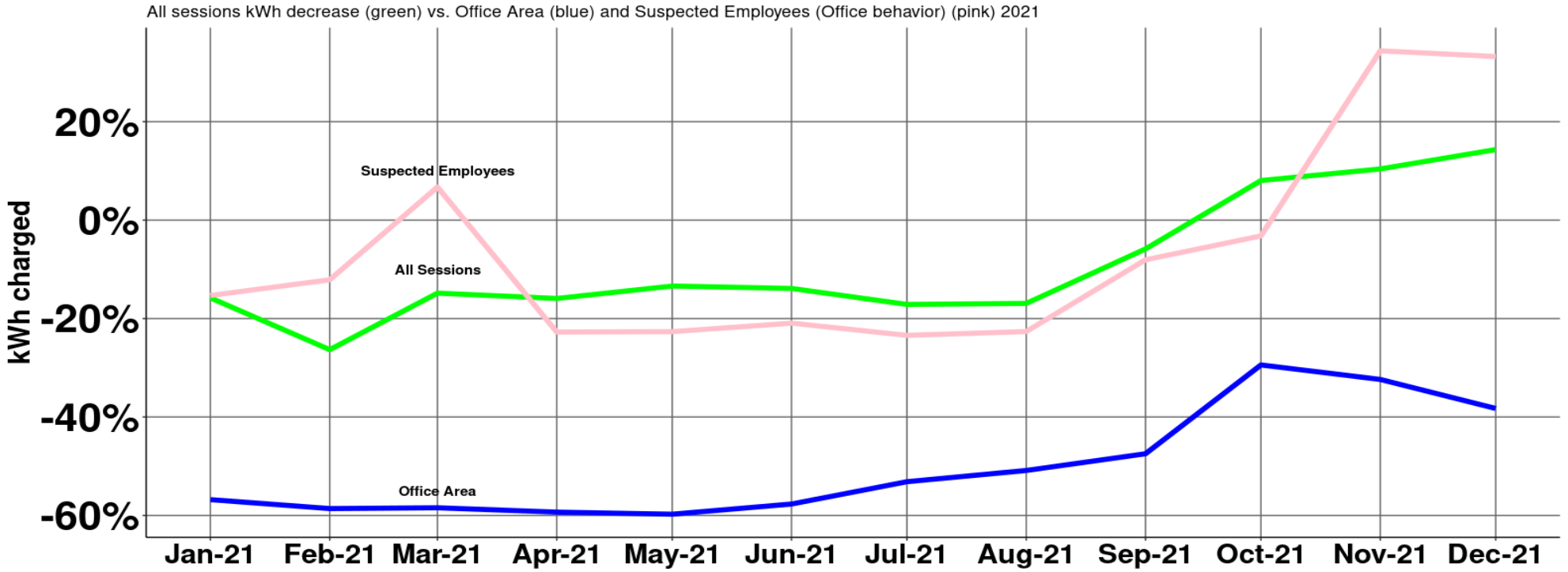


Sloterdijk Office Area I

EV composition data (Dutch Central Bureau of Statistics, 2021)

Comparison group	**Parameters**
All sessions (full set)	All public charging data
Sloterdijk Office Area	All charging from 17 charging points in an office location
Suspected employees (office/commuters)	All charging sessions during weekdays (mon-fr), starting between 7-10AM and connected between 3-10 hours





Suspected employees: Behaviour-based selection (8% of sessions marked)

Office area:
All activity at 17 chargepoints at the 'Bedrijventerrein I Sloterdijk (Amsterdam, NL) '

January 2020 is the reference point (0%), and only charging points that existed from this reference point were considered in the analysis, to minimize growth effects

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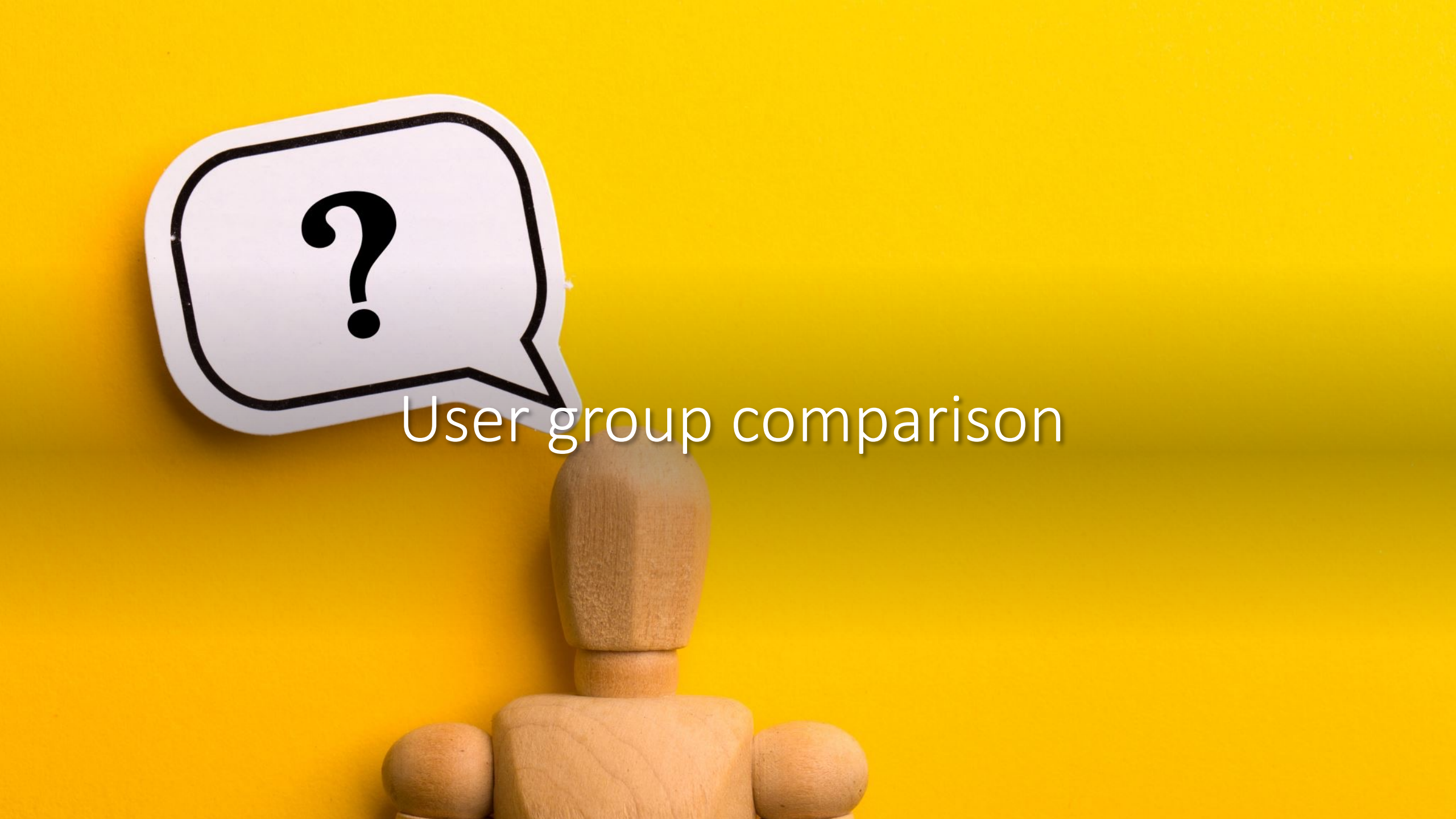
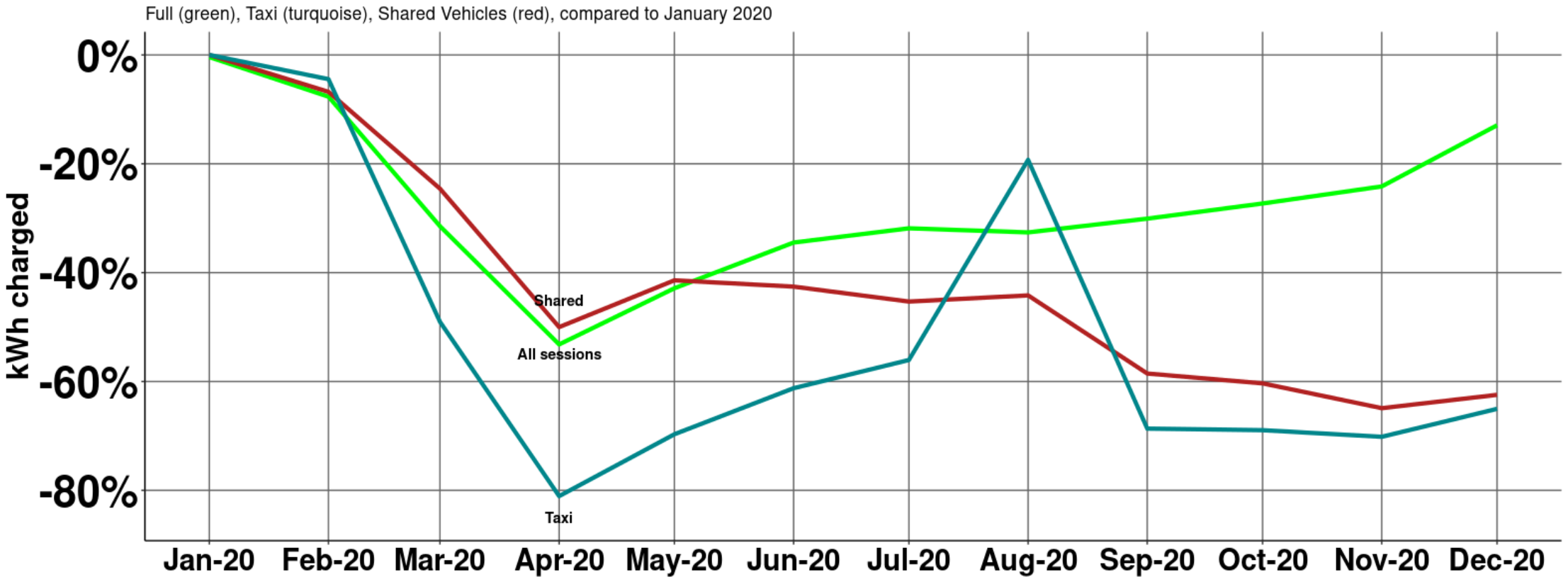

User group comparison

Electric Shared Vehicles
Fleet location: city of Amsterdam
Sample size: 185 RFID cards
Measured: Jan-Dec 2020

Electric Taxi Drivers
Location: active in Amsterdam
Sample size: 630 RFID cards
Measured: Jan-Dec 2020



January 2020 is the reference point (0%), and only charging points that existed from this reference point were considered in the analysis, to minimize growth effects

“decline in airborne traffic, limited access to restaurants and cafes [….] and other consequences of corona measures have led to a 90% decline in street taxi work.” (TaxiPro, 2020)

“Despite the overall decreased number of taxi drivers, the percentage of electric taxi’s has stayed the same in 2020” (Taximonitor, Municipality of Amsterdam, 2020).

Taxi driver Marko has no money to buy food: 'Should I get rid of my animals later?'

VIDEO **Marko van Kesteren (51) is an independent taxi driver in Amstelveen. His taxi has been standing still since the pandemic broke out. He received corona support from the government, but it stopped from 1 October. He now receives food stamps from the Red Cross .**

Phaedra Werkhoven Oct 11 2021 Last update: 11-10-21, 12:03

AD, 2021

Curfews

Curfews

Coronavirus measures will be extended

News item | 23-03-2021 | 19:30

extended. There will be one minor adjustment: as of 31 March the curfew will start one hour later, at 22.00 instead of at 21.00. The government is

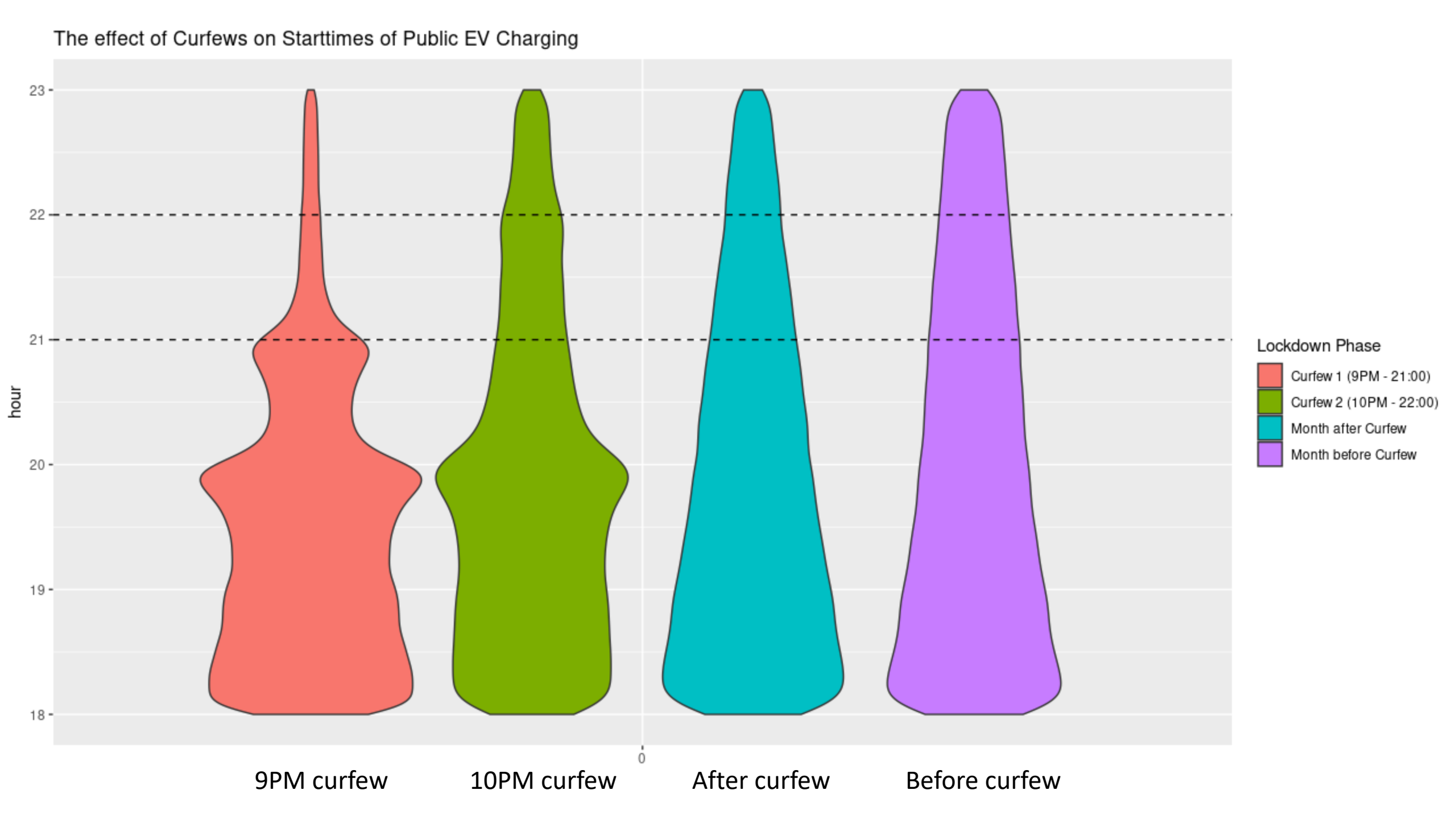
Government of the Netherlands

Home > Latest > News >

Night-time curfew as of Saturday 23 January

News item | 22-01-2021 | 13:50

On Saturday 23 January a night-time curfew will come into force throughout the Netherlands. The House of Representatives consented to


The effect of Curfews on Starttimes of Public EV Charging
hour
23
22
21
20
19
18
0
9PM curfew
10PM curfew
After curfew
Before curfew
Lockdown Phase
Curfew 1 (9PM - 21:00)
Curfew 2 (10PM - 22:00)
Month after Curfew
Month before Curfew

Curfew in numbers

- **Peak hour demand migration:** Charging that started between 7PM - 8PM increased with *40-47%* during both phases of the curfew (compared to before- and after measurements)

- **Evening demand migration:** The first curfew decreased charging that started between 9PM - 10PM with *57%*. The second curfew did not differ from the before- and after measurements

- **Late evening demand migration:** The first curfew also decreased charging that started between 9PM-12AM decreased with *68%*, whereas the second curfew barely differed from the before- and after measurements

Conclusion

Summary and Interpretation

- Lockdowns made charging activities drop significantly (up to 50%)
- Electric vehicles were more affected than petrol vehicles. Potential explanations: the uptake of (mostly fossil) logistics, and the high % of business EVs
- The charging activities in the office area dropped significantly
- Taxi drivers were the most affected user segmentation.
- Curfews affected demand during peak hours, and the 9PM curfew diminished the demand in the later evening.

Long-term implications

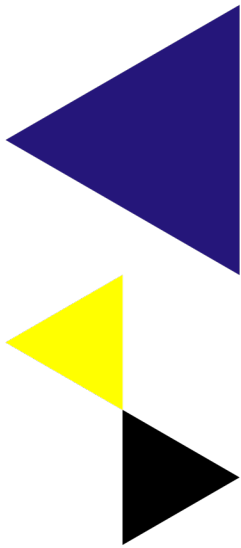
- EV drivers are still charging less and at fewer different locations, and the charging activities in the office area were not fully recovered yet by the end of 2021 (mobility/commuting shift).

- Charging patterns changed during pandemic and recovery:more charging throughout the day, lower % during peak hours (affected peak demand).

- Uptake of new EV adoption throughout the pandemic, leading to higher occupation rates and the kWh numbers going over 100%, compared to pre-corona in some cases (adoption trend continues).

- Taxi drivers were the most affected user segmentation. We observed that many of the RFID's used for 2020 analysis are now 'inactive' (long-term sector impact).

Thank you!



Summary Statistics	Before Curfew ~1.5 month sample	First Curfew ~ 2 month sample	Second Curfew ~1 month sample	After Curfew ~1 month sample
Sample size (# of sessions)	700,633	910,988	314,976	340,565
# of sessions that started between 7PM – 8PM	37,477	70,828	23,453	20,207
Percentage	5.3%	7.8%	7.4%	5.9%
# of sessions that started between 8PM – 9PM	30,052	40,526	16,958	15,283
Percentage	4,3%	4,5%	5,4%	4.5%
# of sessions after 9PM	54,530	22,828	25,153	22,646
Percentage	7,8 %	2,5%	7,9%	6.6%
# of sessions that started between 9PM-10PM	24,660	13,786	11,361	11,046
Percentage	3.5%	1.5%	3.6%	3.2%