

LAB 3

Data analysis to estimate
performance in migration from ICE to
EV

Goal

- We will estimate the impact on the users of the transition from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs)
- We want to assess if EVs can meet user needs
- For this, we consider real trips of users done with ICE vehicles from UnipolTech data
- We will reproduce these trips simulating the energy consumption of EVs and their charge

Datasets

UnipolTech dataset

- Data collected by company
 - **DO NOT share the data**
- Trips of 1000 vehicles in 2 months
 - About 1.41 million records
 - **NOTICE: It does NOT mean 1.41 million trips**



Data sample

vehicle_id	trip_id	start_time	stop_time	road	total_distance
1	0	2023-09-29 13:55:35	2023-09-29 14:11:42	E	14.31
1	0	2023-09-29 13:55:35	2023-09-29 14:11:42	U	1.47
1	1	2023-09-29 14:32:24	2023-09-29 14:34:31	U	0.03
1	2	2023-09-29 15:12:03	2023-09-29 15:26:55	E	2.60
1	2	2023-09-29 15:12:03	2023-09-29 15:26:55	U	2.00
1	3	2023-09-29 15:37:38	2023-09-29 15:57:26	E	2.24
1	3	2023-09-29 15:37:38	2023-09-29 15:57:26	U	2.01
1	4	2023-09-29 16:13:55	2023-09-29 16:13:58	E	0.00
1	5	2023-09-29 16:16:28	2023-09-29 16:16:30	E	0.00
1	6	2023-09-30 05:05:39	2023-09-30 05:28:37	E	0.00
1	6	2023-09-30 05:05:39	2023-09-30 05:28:37	U	1.21
1	7	2023-09-30 05:35:17	2023-09-30 05:35:20	U	0.00
1	8	2023-09-30 06:07:07	2023-09-30 06:33:53	E	3.98
1	8	2023-09-30 06:07:07	2023-09-30 06:33:53	U	1.10
1	9	2023-09-30 06:44:43	2023-09-30 06:44:51	E	0.00

Vehicle ID:
from 1 to 1000

Data sample

vehicle_id	trip_id	start_time	stop_time	road	total_distance
1	0	2023-09-29 13:55:35	2023-09-29 14:11:42	E	14.31
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Trip ID of the vehicle.

**FOR EACH VEHICLE:
start from 0**

Data sample

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Road	Type
U	Urban
E	Extra-Urban
A	Highway
-	Unknown

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Traveled distance

← Possibly outliers

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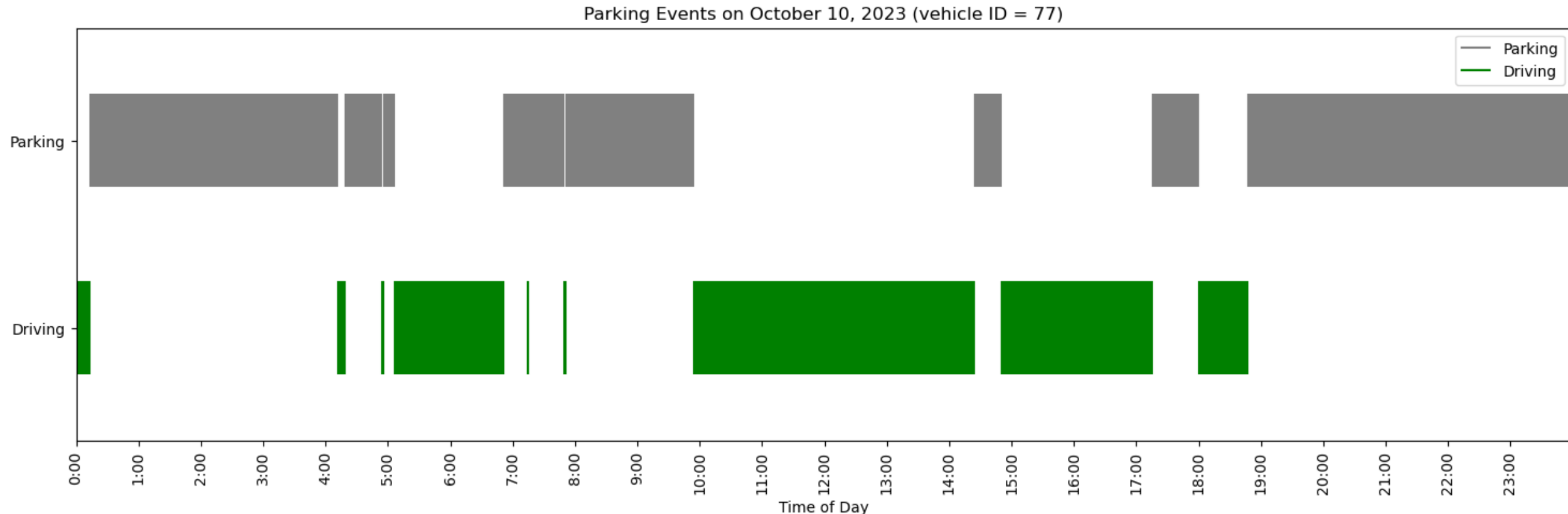


One trip with multiple different roads

Simulation

Simulation: transition to EV

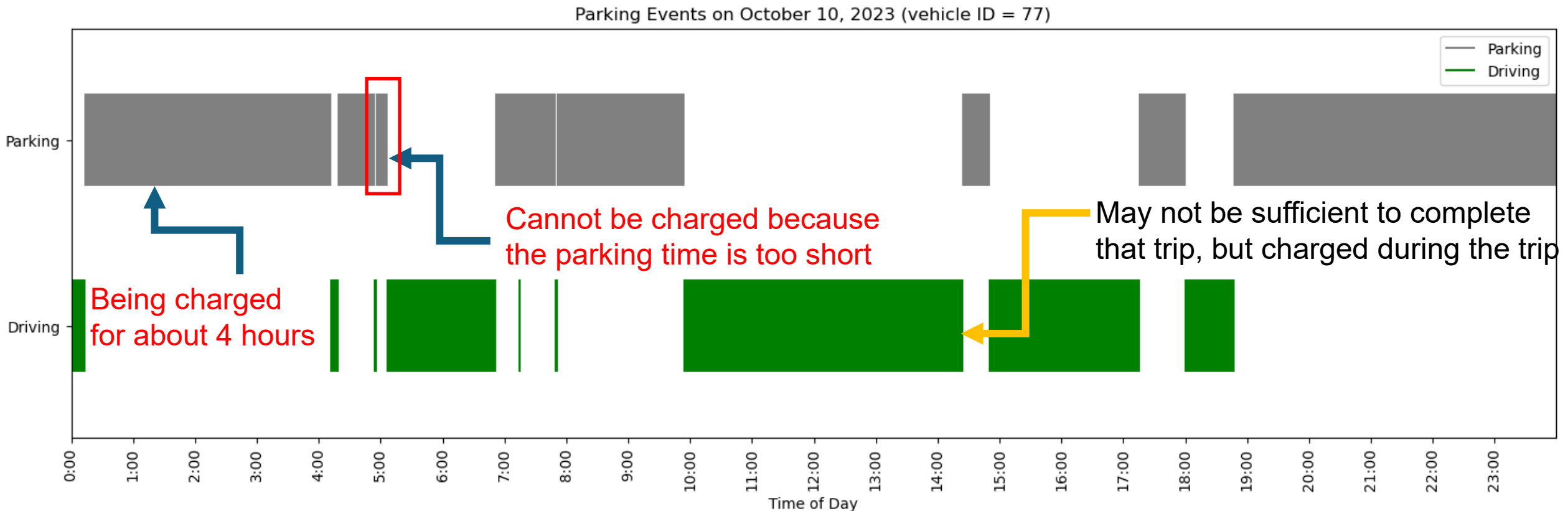
- An example usage behavior of a vehicle



Simulation: transition to EV

- Assume an **ideal scenario**

- The vehicle will be always close to the charging station when parked.
- The battery is full before the first trip of our collection.
- When power not sufficient for the trip, can be charged during the trip to complete it, then **0 power** after trip.



Simulation: transition to EV

- **Constraint**

- The vehicle can be charged only if the parking duration is larger or equal than **20 minutes**

- **Parameters of EVs**

- **Energy consumption**
- Useable Battery capacity
- Charging speed
- Charging power
- Fast charging speed
- Fast charging power
- Check <https://ev-database.org/>

Real Energy Consumption

between 93 - 189 Wh/km

City - Cold Weather	149 Wh/km
Highway - Cold Weather	189 Wh/km
Combined - Cold Weather	167 Wh/km

City - Mild Weather	93 Wh/km
Highway - Mild Weather	142 Wh/km
Combined - Mild Weather	116 Wh/km

Indication of real-world energy use in several situations. Cold weather: 'worst-case' based on -10°C and use of heating. Mild weather: 'best-case' based on 23°C and no use of A/C. For 'Highway' figures a constant speed of 110 km/h is assumed. The energy use will depend on speed, style of driving, climate and route conditions.

Road	Type
U	Urban
E	Extra-Urban
A	Highway
-	Unknown

You can consider also extra-urban, unknown as combined

Thank you