2023 IEEE PES ISGT-Europe

October 23rd-26th, 2023, Grenoble, France

A Computational Implementation for Creating Electric Vehicles Profiles

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25-10-2023

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Paper №: A8808GC

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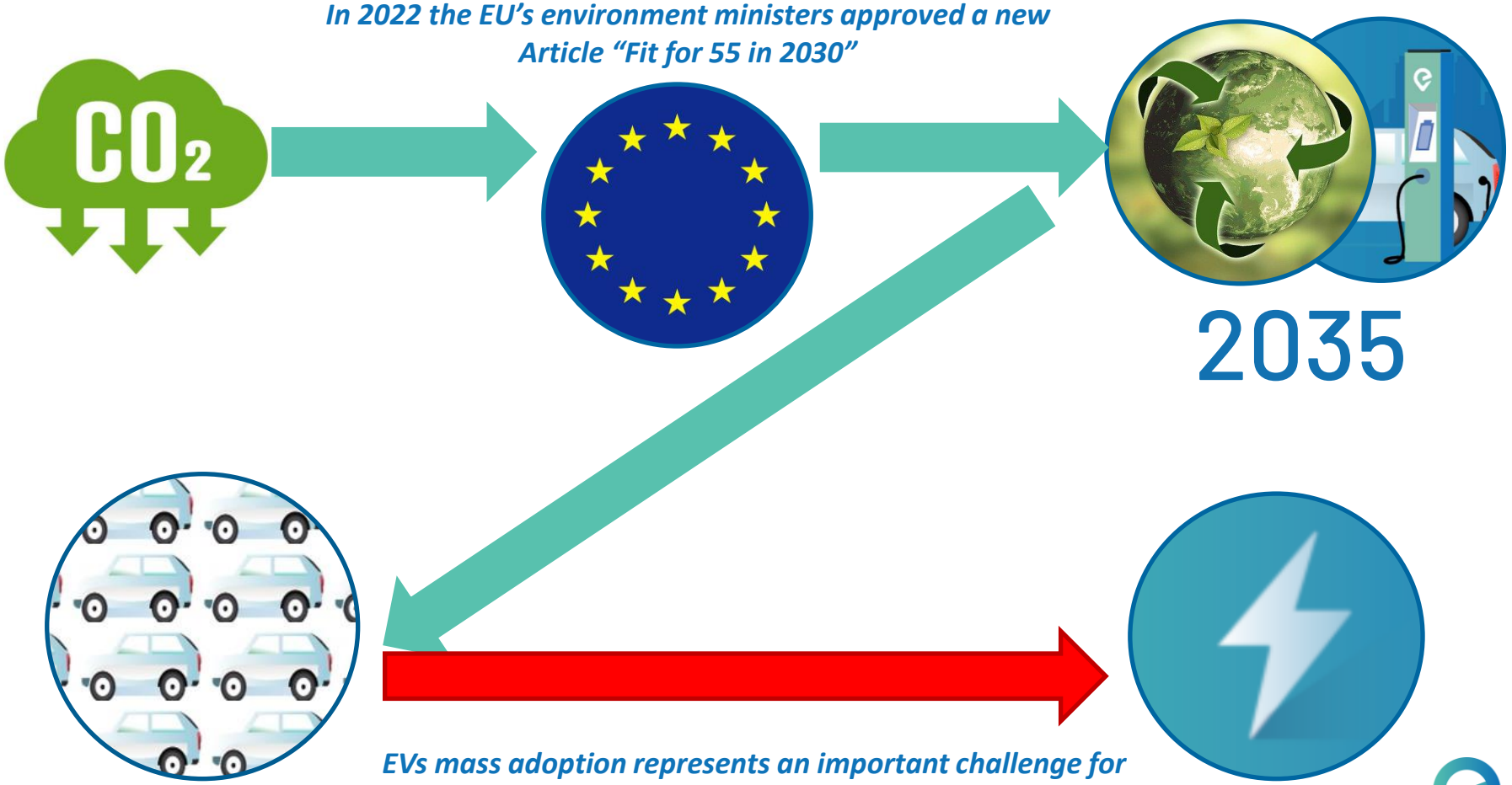
Motivation

In 2022 the EU's environment ministers approved a new Article "Fit for 55 in 2030"



EVs mass adoption represents an important challenge for the power system, mainly due to the uncertain nature created by user behavior

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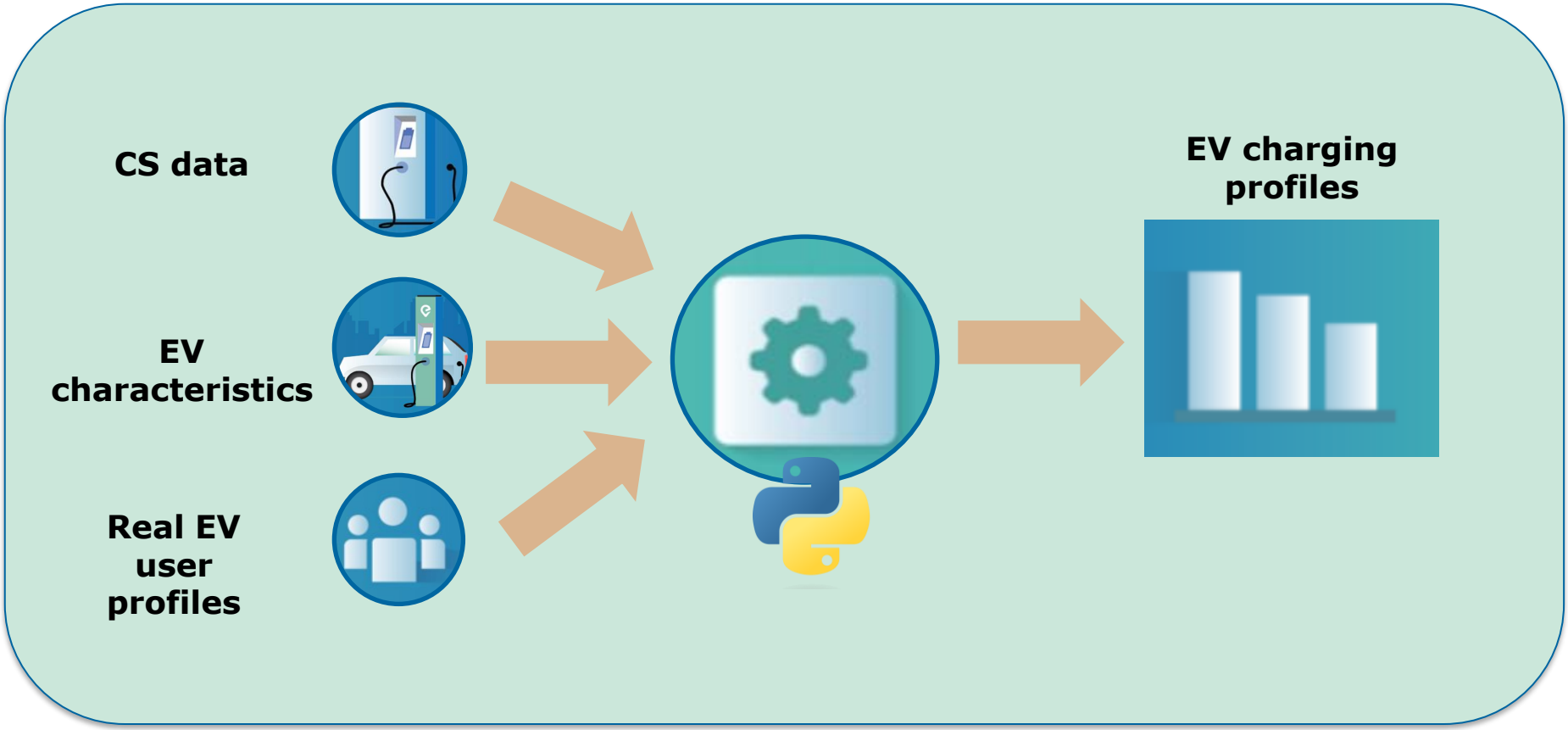
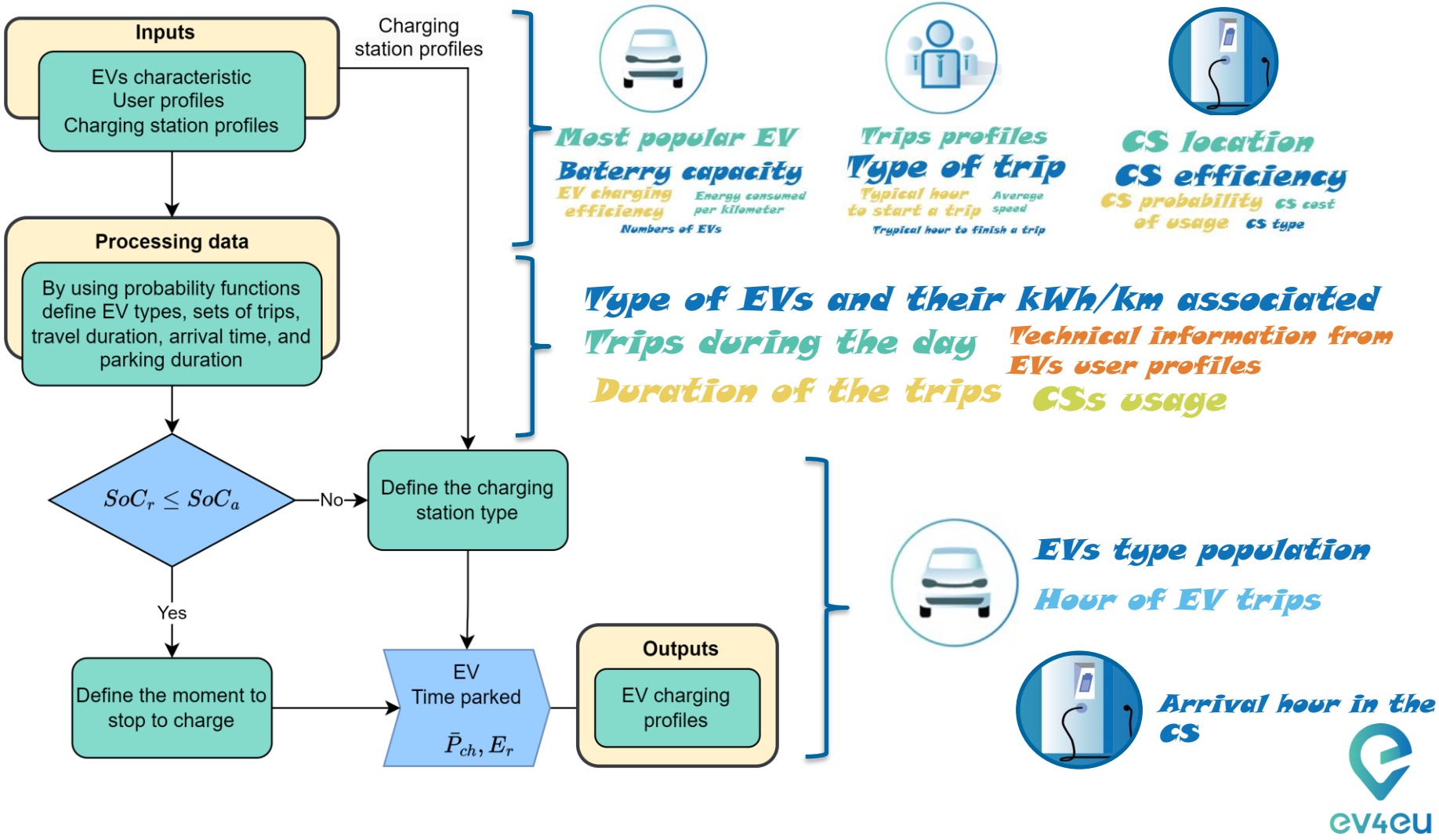
Proposal


CS data
EV characteristics
Real EV user profiles
EV charging profiles

Electric Vehicles Profiles Generation



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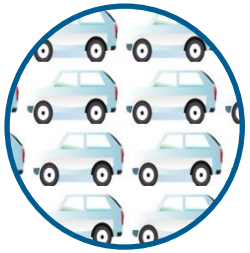
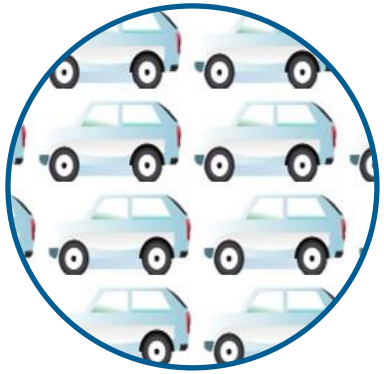
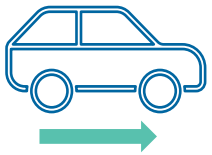
Case Study



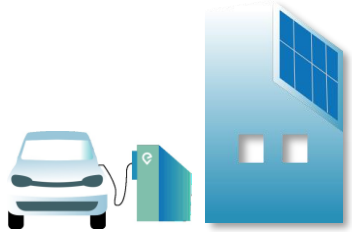
A small EV population, with 100 EVs, with weekday charging profiles, and considering three days of simulation.



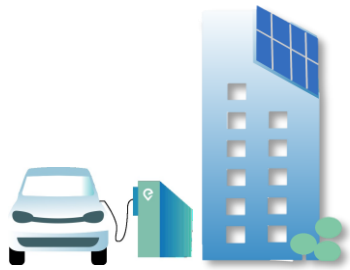
A big EV population with 16146 EVs, both weekday and weekend charging profiles were tested



The average distance traveled per day was set to 46km/day



64% of the EVs charge at home



36% of the EVs charge at the workplace.

In both cases, relying on private charging stations

Case Study

TABLE I: Charging station profiles (Public)

Charging type	Locations	Charging time	Power	LV Fee	MV Fee	Units	%
Ultrafast	Highway	t<1h	P>=150kW	€0,2964/charge	€0,297/charge	120	2.33
Fast	Shopping area	1h<=t<1h30min	22kW<=P<150kW	€0,2964/charge	€0,297/charge	2235	43.40
Semi-fast	Comercial area	t<4h	7,4kW<=P<22kW	€0,2964/charge	€0,297/charge	2263	43.94
Normal	Public area	t>8h	P<7,4kW	€0,004/min	**	532	10.33
		Total				**5150**	**100**

TABLE II: Charging station profiles (Private)

Charging type	Locations	Charging time	Power	LV Fee	MV Fee	Units	%
Fast	Private Housing Zone	1h<=t<1h30min	22kW<=P<150kW	€0,2964/charge	€0,297/charge	3	4.05
Semi-fast	Private Housing Zone	t<4h	7,4kW<=P<22kW	€0,2964/charge	€0,297/charge	71	95.95
		Total				**74**	**100.00**

TABLE III: Most used EV models

Model	Battery Type	Number of EVs	Share (in percent)
Tesla	BEV	2195	14%
Peugeot	BEV	1378	9%
BMW + BMW I	BEV	1362	8%
Mercedes-Benz	BEV	1284	8%
Hyundai	BEV	826	5%
Mercedes-Benz	PHEV	3279	20%
BMW + BMW I	PHEV	2505	16%
Volvo	PHEV	1764	11%
Peugeot	PHEV	980	6%
Wolkswagen	PHEV	573	4%

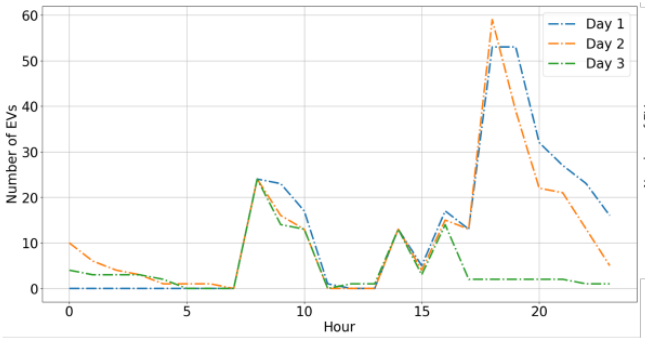
TABLE IV: EV user profiles for Weekdays

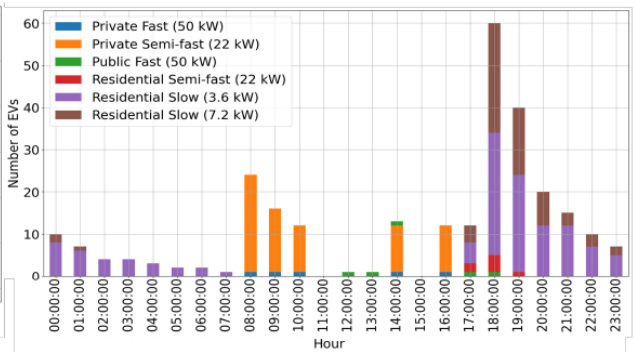
Profile	Trip hours	User Type	Trip Type
Home 1	8h, 18h	Charge at home	Short
Home 2	5h, 19h	Charge at home	Medium
Home 3	8h,10h,12h,15h,17h	Charge at home	Short
Home 4	8h, 10h,19h	Charge at home	Long
Home 5	8h,10h,19h	Charge at home	Short
Work 1	8h, 10h,14h,16h,18h	Charge at home/work	Long
Work 2	9h,19h	Charge at home/work	Medium
Work 3	10h,20h	Charge at home/work	Medium

TABLE IV: EV user profiles for Weekends

Profile	Trip hours	User Type	Trip Type
Home 1	10h, 20h	Charge at home	Short
Home 2	11h, 15h	Charge at home	Medium
Home 3	8h,21h	Charge at home	Short
Home 4	12h, 13h,20h	Charge at home	Long
Home 5	8h, 10h,19h	Charge at home	Short
Home 6	9h,14h	Charge at home	Long
Home 7	11h,19h	Charge at home	Medium
Home 8	12h,21h	Charge at home	Medium

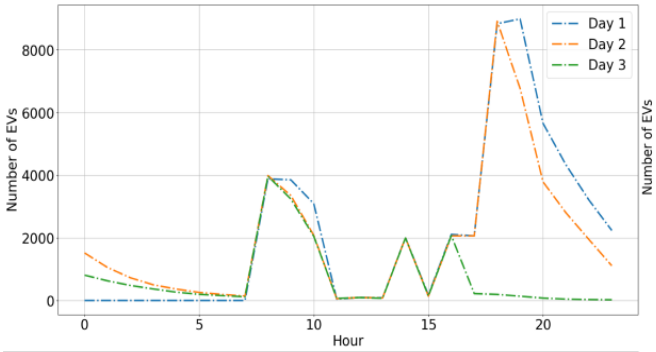
Results

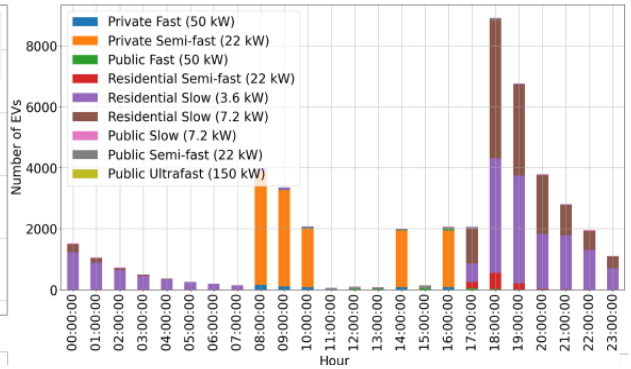


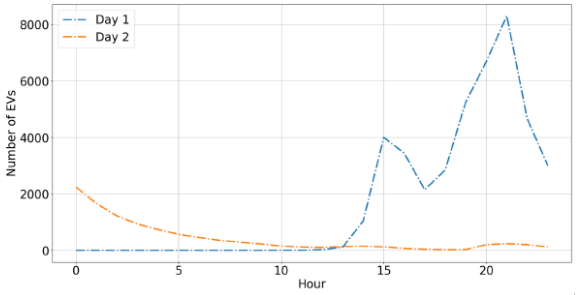


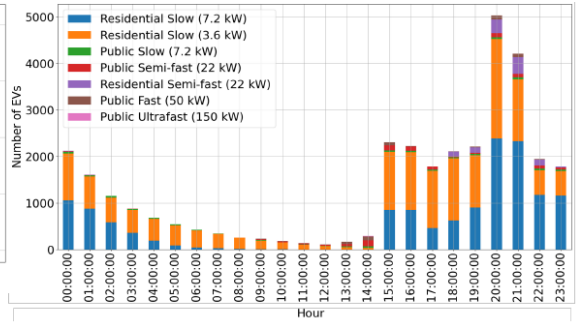
EV charging profiles (left side) and Charging stations usage (right side). For a population of 100EVs during weekdays

EV charging profiles (left side) and Charging stations usage (right side). For a population of 16140 EVs during weekdays









EV charging profiles (left side) and Charging stations usage (right side). For a population of 16140 EVs during a weekend

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Conclusions

The computational tool proposed can create several reliable EV charging profiles that follow the distributions of the input data

The scalability of the computational tool is verified since for the big EV population (1614 EVs), the results indicate the same performance as in the case of the small EV population

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THANK YOU