User requirements

D1.1: User requirements for USER-CHI solutions.

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Abstract

USER-CHI project is a user centric project aimed at developing new solutions for fostering the electric mobility all around European Union. As user centric, the project includes a user research task, focused on identifying key points and critical factors to develop the project products. This research tasks has basically included two type of duties: research activities involving intermediate and end users focused on collecting qualitative data and quantitative data, and a big data analysis on the use of charging points in five European cities that are part of USER-CHI consortium. The research work has been negatively influenced by the situation derived from the COVID-19 pandemic disease, what finally result in the delay of the chargers' usage data collection, and consequently the delay of the big data analysis. Anyway, the results obtained in the user research activities and a first analysis of the data collected from cities are presented in this report.

Keywords

Big Data Analysis, Charging Infrastructure Usage, User research, Qualitative research, Quantitative research, Co-creation, Field Diary, Delphi questionnaire, Survey

Copyright statement

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1. Introduction

This report presents the work performed by USER-CHI consortium members from February 2020 to October 2020, to define the users' needs and expectations related to project products. These months, covering from M1 and M9 of project planning, were coincident in time with the beginning of the global pandemic disease COVID-19. Although this situation affected some of the planned tasks, the employment of online tools for contacting with end users and intermediate users, allowed us to perform a successful user research, which is presented in the following section. For the Big Data Analysis complementing the user research, the plan had to be changed due to the availability of resources as will be pointed out in *Section 3*.

USER-CHI project is a user centric project aimed at developing new solutions for fostering the electric mobility all around European Union. As user centric, the project includes a user research task, focused on identifying key points and critical factors to develop the project products.

We have followed a basic strategy to perform this task and achieve our objective, consisting of user observation, collection of users' insights, firstly in an open way, secondly in an addressed way, and finally working with end users and intermediate users to generate ideas for developing USER-CHI products.

Observation tasks are described in section *2.1.1*, and the results obtained are presented in section *4.1*. The observation was performed by visiting EVs online chats, and we collected opinions from six different EU countries.

In users' insights collection, we differentiate between end users (EVs drivers and LEVs riders), and intermediate users (different professionals involved in the value chain of the charging process). The methodology applied for getting intermediate users' opinions regarding the charging process of EVs are presented in section *2.1.2.1*, and results in section *4.2*. On the other hand, the method to collect end users' perceptions is presented in section *2.1.2.2*, and results in section *4.3*.

Furthermore, we have performed a big survey involving more than 2,000 thousand users in six different EU countries, which is described in section *2.2*. The results obtained in this survey are presented in section *0*.

The work performed for generating ideas that overcome identified issues related to USER-CHI products is described in section *2.3*, and results are reported in section *4.6*.

Section 3 gives a first overview on the current status of the *Big Data Analysis* as a quantitative complement to the analysis with observed behaviour of charging station usage.

In *Section 5* we discuss about how to interpret the results we have obtained in the different tasks related to the user research, and our conclusions regarding this topic are presented.

2. User research

In this section, the different methodologies applied to extract information from users are presented. These methodologies are well known in social research, and are validated methodologies for performing the qualitative research and the quantitative research presented in the DOA document.

Table 1: Total number of responses collected in the user research's studies

		Intermediate Users	**End users**		
		Professionals & Technicians	EV drivers	ICEV drivers	LEV riders
Qualitative research	Netnography	---	Germany → 123 Norway → 175 Spain → 212	---	Spain → 111
	Delphi Questionnaire	Germany → 13 Finland → 12 Hungary → 20 Italy → 1 Spain → 9 UE country → 2	---	---	---
	Field Diary		Germany → 15 Finland → 12 Hungary → 7 Italy → 14 Spain → 62		Germany → --- Finland → 9 Hungary → 3 Italy → 5 Spain → 4
Quantitative research	Survey		Germany → 169 Finland → 54 Hungary → 117 Italy → 134 Spain → 142 Norway → 72	Germany → 188 Finland → 176 Hungary → 271 Italy → 113 Spain → 158 Norway → 202	Germany → 165 Finland → 103 Hungary → 167 Italy → 232 Spain → 174 Norway → 100
Co-creation	IBV session	Spain → 11	Spain → 3	Spain → 1	Spain → 1
	Consortium session	30			
Total number of users involved		**98**	(621+131+688+1108+941+5) **3494**		

To tackle the user research, mainly we have distinguished between intermediate users and end users, in different user profiles:

- Intermediate users: only one user profile, including professionals and technicians involved in the value chain of the charging process.
- End users: three different profiles, including
  - EV drivers
  - Internal combustions engine (ICE) drivers
  - LEV riders, including e-bikers, e-scooter riders and e-motorbike riders.

Table 1 summarizes the number of users that have participated in the initiatives included in the user research, which are described in the following sections. The users are classified per profiles and nationalities.

2.1 Qualitative research

User qualitative research aims to understand the whole process that a person has to confront when charging an electric vehicle. For understanding this process and its key factors and critical points, we have basically performed two types of interventions: observational interventions and inquire interventions.

By observing, we intend to learn about the problems the users have when tackling the charging process of an EV, in their diary life and in the context the employ the systems related to this charging process. Once we learned about the problems, we directly inquired them about reasons to have these problems, and if there are any functionalities, new ways of use or even strategies to overcome the failures they suffer when charging an EV.

2.1.1 Online observations

To perform the online observations we have applied *Netnography* [1]. This is an online research method aimed in understanding social interaction in contemporary digital communications contexts. Netnography uses the conversations occurring in social media platforms as data, substituting the traditional in-person observation techniques by interactions and experiences manifesting through digital communications.

As shown in *Figure 1*, for EV drivers the observations were performed in digital platforms of three different countries: Spain and Germany, representatives of big markets for vehicles at EU, and Norway which is the most developed market for EVs at EU. On the other hand, Netnography for LEV riders was performed in Spain, by visiting eight different forums (*Figure 3*).

Figure 1: Total amount of EV drivers participating in Netnography, and topics of interest mentioned.

SAMPLE	Germany	Norway	Spain
Users	123	175	212
Mentioned aspects	183	232	472
Average of mentions	1,5	1,1	2,2
Forums	5	1	3

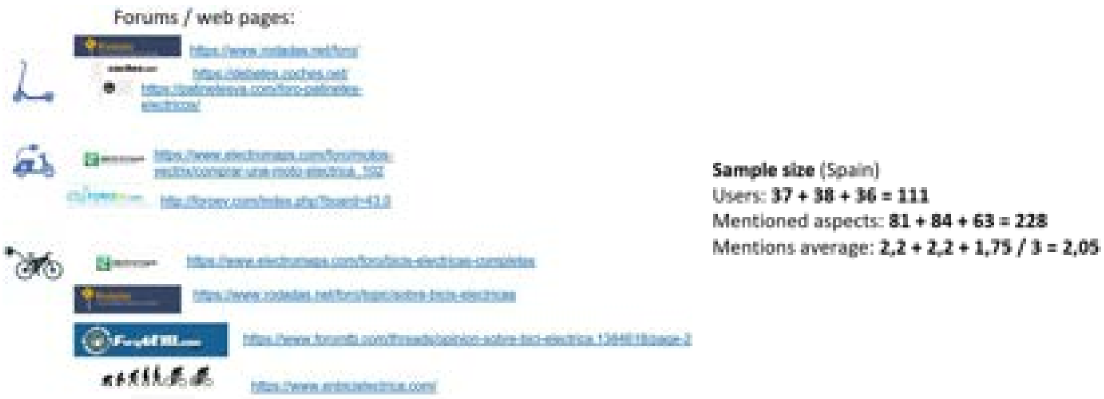
WEIGHT OF THE EV CHARGE ELEMENTS	Germany	Norway	Spain
Electric vehicle	28%	33%	50%
Infrastructures	70%	21%	37%
Incentives / Information	2%	46%	8%
Environment	0%	0%	5%

For EVs, we collected comments from more than five hundred users (*Figure 1*), in nine different forums (*Figure 2*). These comments were classified in four topics: Electric vehicle, Infrastructures, Incentives and Environment.

Figure 2: Forums in Spain (3), Finland (1) and Germany (5) visited for Netnography

The observations for LEVs riders were performed exclusively in Spain. 8 different forums were visited, collecting comments from more than one hundred users (*Figure 3*). The comments were classified in three different groups: eScooter, eMotorbike and eBike.

Figure 3: Total amount of LEV riders participating in Netnography, visited forums



The webpages and forums shown in *Figure 2* and *Figure 3* were visited from 3rd of February to 13th of March 2020. The results obtained in this observation task are presented in section *4.1*.

2.1.2 User insights

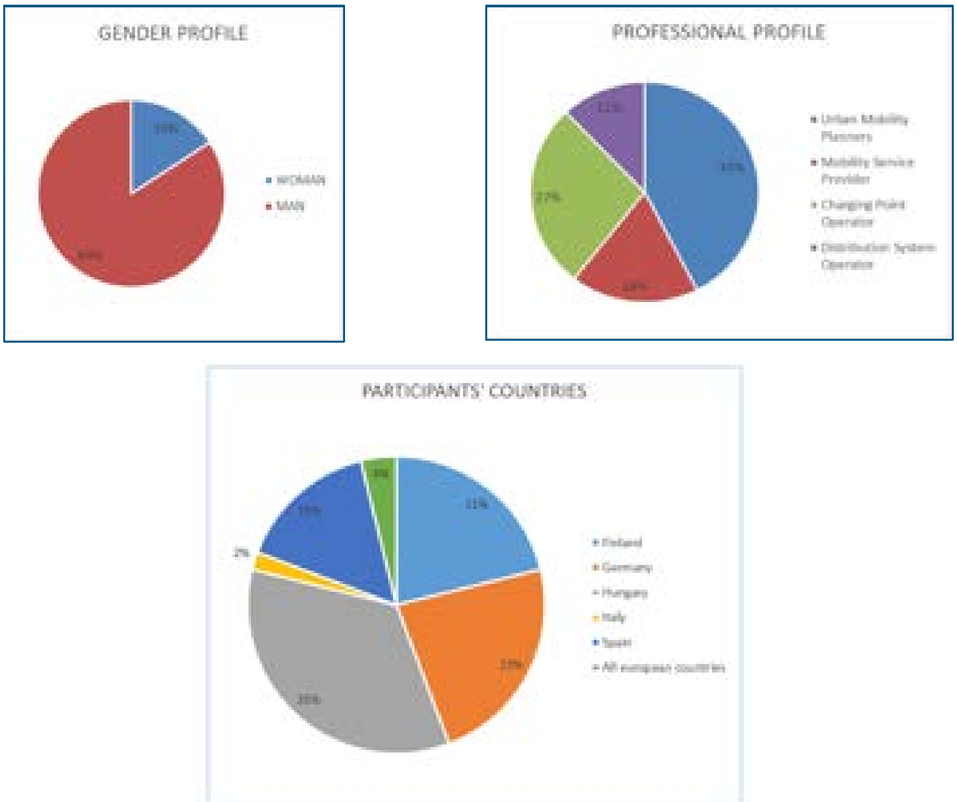
To identify user insights about problems and solutions related to charging an electric vehicle, our first plan was performing focus groups in five different countries. These countries were those that are represented in USER-CHI consortium by cities (Germany-Berlin, Finland-Turku, Hungary-Budapest, Italy-Rome, Spain-Barcelona). Due to COVID-19 pandemic disease situation, performing in-person meetings was not possible, so we proposed to get users' insights employing online methodologies. In addition, in order to increase the quality of the information collected in this step, we differentiated between intermediate users (professionals and technicians) and end users (drivers and riders), proposing a different online methodology for each group.

In general, the online interventions proposed were based on questionnaires, mainly including open questions. By employing these questions type, we intended to collect information without imposing or suggesting any predefined concept.

2.1.2.1 Intermediate users insights

To get technical information related to the charging process of an EV, we have applied Delphi methodology. This methodology foresees the participation of professionals and experts, who answer questions related to the state of the art of a technology, and how this technology is evolving.

Figure 4: Delphi's participants grouped per gender, professional profiles and nationality



For this purpose, we generated a questionnaire grouped in four blocks (*Annex 1*: Delphi questionnaire), including between five and ten questions per block. Each block was addressed to different professional profiles, which were: Urban Mobility Planner (UMP), Electro Mobility Service Provider (EMSP), Charging Point Operator (CPO), and Distribution System Operator (DSO). The questionnaire was uploaded in

SurveyMonkey online platform[1], available for participants who filled up the questionnaire in an anonymised way.

Technical project partners were asked to distribute the questionnaire among their contacts' network. As a result of this process, we got 27 completed questionnaires in Delphi's first round, and 30 completed questionnaires in Delphi's second (and last) round.

As shown in *Figure 4*, most of Delphi's participants were men, and work as urban mobility planner. By countries, Hungary, Germany and Finland have been the ones which higher percentage of participants. The results obtained in Delphi questionnaire are presented in section *4.2*.

2.1.2.2 End user insights

For gathering direct information from end users, we defined a Field Diary. A field diary is an open questionnaire that can be answered directly by users that access through an online platform, or can be fulfilled with the support of a third person, in an interview format (not necessarily in-person, but employing telematics channels).

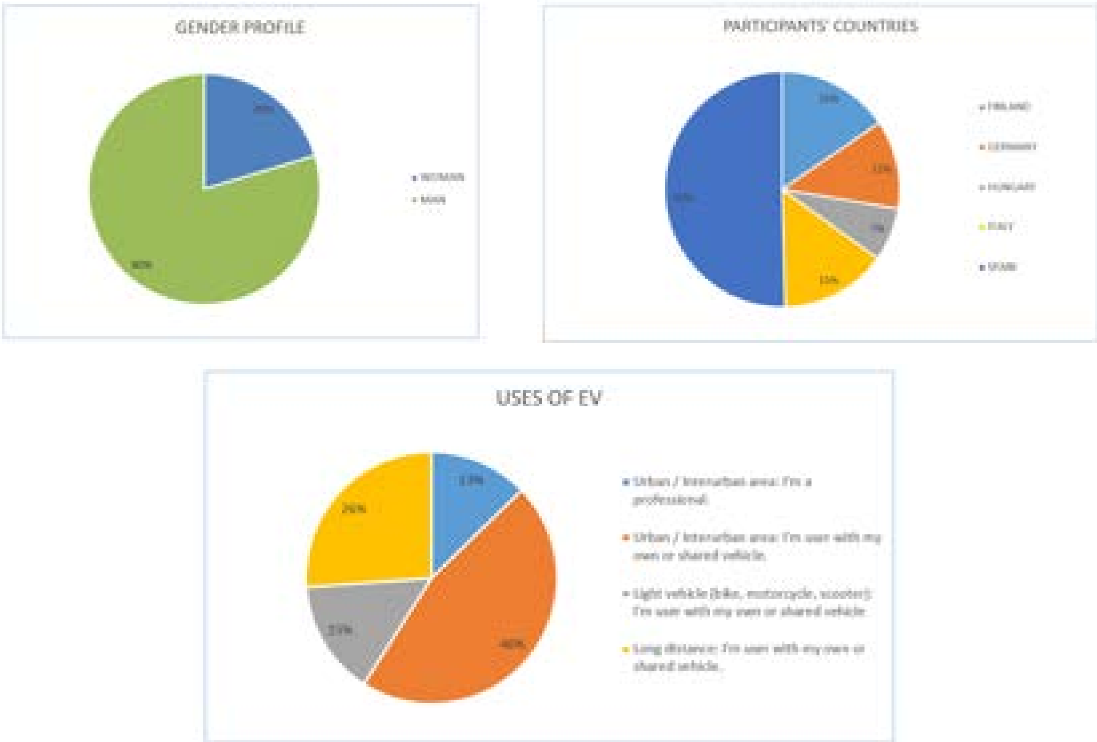
The *Field Diary* was uploaded in an online platform[1] (*Annex 2*: Field Diary), and the cities that are part of the project consortium (Barcelona, Berlin, Budapest, Rome, Turku) employed their citizens data base to contact users that matched the defined end user profile (*Table 2*). Each city was asked to contact a total number of 15 end users, corresponding to different profiles (*Table 2*). These users were invited by email or by a phone call, to fulfill the Field Dairy in an anonymized format.

Table 2: End user profile per city for Field Diary

City	Low range user professional	Low range user private	LEV user	Long range user
Barcelona	5	---	5	5
Berlin	5	5	---	5
Budapest	---	5	5	5
Rome	---	5	5	5
Turku	5	5	5	5

[1] https://www.surveymonkey.com/

Figure 5: Field Diary participants grouped per gender, nationality and uses of EV



As shown in *Figure 4*, most of *Field Diary* participants have been men, that own an EV an employ it for urban and interurban trips. By countries, participants from Spain covered half of the total sample, and the other half is distributed among participants from Finland, Germany, Hungary and Italy. The total number of participants have been 126 (*Table 3*), and most of them (107, 85%) were EV drivers. The sample size for LEVs riders was small, especially in the case of electric bike riders.

Table 3: Field Diary participants' description

Total number of participants: 126			**Ownership**	**Company car**	**Rent or shared**
Type of vehicles	EV	Car	73	27	7
	LEV	motorbike	6		1
		scooter	8	1	
		bike	3		
Frequency of use	5-7 days a week		43	15	
	3-4 days a week		10	2	1
	2 or less days a week		4	2	
	every month		1	1	1

less than 12 times a year	2

The results obtained in *Field Diary* are presented in *Section 4.3*.

2.2 Quantitative research

In order to obtain the relative weight of the most relevant aspects related to the charging process of EVs, we performed a survey in six different countries. These countries were those represented in USER-CHI consortium by cities (Barcelona-Spain, Berlin-Germany, Budapest-Hungary, Rome-Italy, Turku-Finland) and Norway, the most developed EV market in EU.

We have distinguished three end user profiles to be considered in this survey: EV drivers, Internal Combustion Engine Vehicles (ICEV) drivers, and LEVs riders. For every user profile we stablished a sample size objective of 100[2] users per city, summing up a total number of 1,800 participants.

We designed two different questionnaires: one addressed to EV drivers, and another addressed to ICEV drivers, including questions regarding driven experience and improvements (*Annex 3*: Survey). The maximum number of questions was limited to 50 questions for both cases. On the other hand, both questionnaires included six questions (one filter question and five specific questions), related to LEVs, so we have got LEVs information from both profiles, EV drivers and ICEV drivers.

To enroll all the required participants in the six countries, we employed the SurveyMonkey database. This database includes the option to select users, that meet given requirements. These requirements limit the guaranteed amount of survey's respondents, so we had to adjust our requirements to our objective sample size.

Table 4: Number of survey's respondents per country and user profile

Country	User profile	Number of answered questionnaires
Italy	EV driver	134
	ICEV driver	113
	LEV rider	232
Spain	EV driver	142
	ICEV driver	158
	LEV rider	174
Finland	EV driver	54

[2] This is the sample size per user profile stated in the DOA document

	ICEV driver	176
	LEV rider	103
Hungary	EV driver	117
	ICEV driver	271
	LEV rider	167
Germany	EV driver	169
	ICEV driver	188
	LEV rider	165
Norway	EV driver	72
	ICEV driver	202
	LEV rider	100

After buying the users panels, the platform takes a few hours (normally less than 24) in accomplishing the sample size. The different users' panels for each country were bought among the 20th of July and the 31st of July. *Table 4* presents the numbers of respondents collected for the survey, for each defined profile.

2.3 Generating ideas for USER-CHI solutions

Co-creation tasks aim to propose solutions for USER-CHI products, based on user needs and expectations. It is not expected that co-creation results produce a high level's definition of the product, but generate innovative product concepts, that include features and utilities overcoming problems identified in user research.

Co-creation requires a sensibilization stage, in order participants gain awareness on problems, malfunctions and unsolved issues related the system they are going to work on. Participants in a co-creation workshop are asked to read some documents some days before the session, as the most common way for achieving the sensibilization.

Figure 6 shows some of the slides we employ in the workshop performed at IBV headquarters, on 11th of September. Presenting these slides we intended not only participants gain awareness on charging infrastructure, but also present USER-CHI project objectives.

Figure 6: Information sent to workshop participants on 11th of September

Sixteen people participated in the co-creation workshop, with different user profiles: researchers, engineers and developers (ETRA and IBV) to end users (from Valencia, enrolled in IBV's users database). The participants where distributed in four tables (*Figure 7*), and every table worked on a product: INCAR user app, the Station of the Future, INSOC and INDUCAR.

Figure 7: Users working on USER-CHI products

A second online co-creation workshop was performed on 15th of October. Professionals of the project consortium participated in this workshop, aimed to assessing results generated in the session performed on 11th of September. As sensibilization information we employed the report of results generated in the first co-creation workshop (*Annex 6*: Co-creation's results report). The participants met in a virtual meeting platform, and assessed the product concepts generated in the first workshop by employing an online platform (*Mentimeter*[3]).

3. Big Data Analysis

The Big Data Analysis as Task 1.1.1 of the USER-CHI project aims at complementing the user driven approach with a quantitative data analysis that includes and uses back-end-data of charging infrastructure within the five pilot sites. The aim of this analysis is to match the charging point backend data provided by charging point operators (CPOs) with customer data provided by the E-Mobility Providers (EMP) or the Mobility Service Providers (MSP).

With this data, different types of charging technologies (e. g. AC, DC, street-lighting), different tariff systems, on-road and off-road charging and different sites (central city, suburbs, TEN-T corridors) ought to be analysed on their effects on charging behavior. Existing user detailed data about the charging habits should be derived, considering how much time is spent at a given location, at which timeframe, the recharge power, the electricity supplied, the vehicle and the connector type, etc.

The Big Data Analysis will support the optimised design of charging infrastructure (number of points, location, technologies, connectors, power) and also the associated services that could be offered to drivers while charging. The result of the big data analysis therefore is a key input for the upcoming work packages.

The foreseen provision of data for the Big Data Analysis by partly project external data providers turned out to be highly affected by the current worldwide Corona situation with worldwide lockdowns and the focus of many companies and administrations on coping with the general situation. During the task several

[3] https://www.mentimeter.com/

datasets could be gathered by and through project partners which however do currently not cover the desired depth (content), width (coverage), and quality needed to gather all information. In order to accomplish the goals of this task, a two staged approach for the big data analysis was therefore chosen to adapt to the shortcoming of the unplanned situation: The current first stage contains a description of the currently available datasets and some basis descriptives of the datasets. A second version of this deliverable is to be provided with more sophisticated quality handling and analysis of the data with respect to the different possible analysis dimensions.

For the analysis of the usage of charging stations within the five USER-CHI pilot cities, every city was asked to provide a dataset with locations and usage data of existing charging stations. The provided datasets give an insight on the location of charging stations in all pilot sites and differ in the quality of data and the dimensions covered.

The various datasets provided by the pilot sites differ in the variables and observations specified. This restricts analysis possibilities. In the following chapters the characteristics of the obtained data will be described to understand general possibilities and restriction for data-analysis.

3.1 Barcelona Data for the Big Data Analysis

3.1.1 Location of Charging Stations in Barcelona Metropolitan Area

For the Barcelona area, covering 21 charging stations was provided by AMB. The location of the charging points in the vicinity of Barcelona cover parts of the Mediterranean TEN-T corridor along the highways and near the Barcelona Airport El-Prat. The following *Figure 8* shows the location of the charging points within the Barcelona Area.

Figure 8: Locations of Charging Stations in Barcelona Metropolitan Area

3.1.2 Data Set

The dataset provided for the Barcelona metropolitan area is one of the more detailed within the five pilot sites, although covering only 21 charging stations. In the data set, each charging session is represented by one data set. An excerpt of the dataset is shown in the following *Table 5.* The observations include a charging point address as well as start-, stop-time and energy supplied [kWh]. Additional values for vehicle and model specifications were specified for roughly 50 % of the observations. Furthermore, a second dataset was provided with specific location information for individual charging stations. Here, longitude, latitude and loading type for each connector specified. The two datasets could be matched by the address. This made assigning an AC/DC loading type for every charging session possible.

Table 5: Barcelona dataset excerpt

Charging point	PdRR l'Hospitalet de Ll.: C. Salvador Espriu - Gran Via de les Corts Catalanes	PdRR l'Hospitalet de Ll.: C. Salvador Espriu - Gran Via de les Corts Catalanes	PdRR El Prat de Llobregat: Pl. Volateria (Mas Blau)	PdRR Gavà: C. del Progres, 54
Connector	1, CHAdeMO, 44 kW	1, CHAdeMO, 44 kW	1, CHAdeMO, 44 kW	1, CHAdeMO, 44 kW
Start time	31.12.2019 22:58	31.12.2019 21:25	31.12.2019 20:35	31.12.2019 20:18
Stop time	31.12.2019 23:21	31.12.2019 21:53	31.12.2019 20:52	31.12.2019 20:58
Duration (min)	24	29	18	41
Consumption (kwh)	10,7	17	5,2	20,4
Vehicle		NISSAN	MITSUBISHI	NISSAN
Model		LEAF	OUTLANDER PHEV	LEAF

3.1.3 First descriptives

In the following, chosen statistics in form of basic aggregates of the Barcelona data set are shown. It is to be mentioned, that no sophisticated quality assessment of the data was performed yet and all data sets seem to still contain at least some implausible values. Therefore, the presented aggregates can only give some first insights on the single data sets.

The Barcelona Dataset consist of 38.138 observations between 01.01.2019 and 31.12.2019.

Most of the charging session have a short duration with under 1 hour. The weekdays Monday to Friday account for each roughly 6.000 observations, while the weekends have less charging sessions with roughly 4.200 on Saturdays and 3.500 on Sundays.

Start- and Stop-time of the charging sessions are mostly distributed between 5:00 and 21:00.

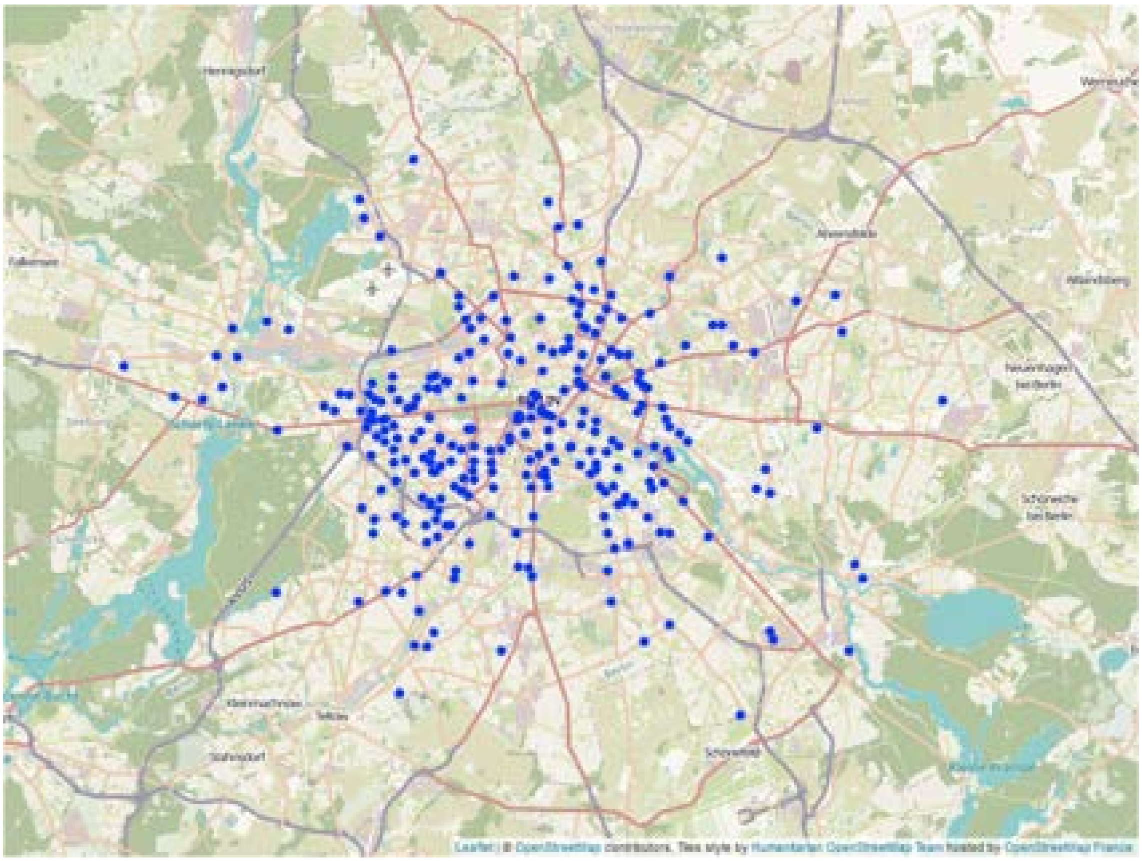
3.2 Berlin Data Set

3.2.1 Location of Charging Stations in Berlin

The following Figure 9 depicts the location of charging stations within Berlin. The dataset contains more than 300 charging point IDs of the CPO Allego. Allego operates as one of three CPOs within the Berlin Model for charging infrastructure.

In contrast to the Barcelona dataset, the Berlin Charging Points cover mostly inner city locations within the 900 km² city. As seen in *Figure 9*, a total of 306 points are covered in the analyzed data. The charging points outside the inner city area are mostly located near to main traffic roads.

Figure 9: Locations of Charging Stations in Berlin



3.2.2 Berlin Data Set

The Berlin dataset was provided in a comparable format to the Barcelona data. One charging session for every charge pole represents one observation. The following *Table 6* shows the structure of the data provided. The datasets contain a ChargePoleID, a Session ID, an MSP-ID, a session-start timestamp, a session-end timestamp, the session duration, the actual charging duration, the energy consumed during the session as well as the average power during the charging duration (all without unit).

In a second data sheet provided, the location for every station is specified with address and coordinates (latitude, longitude). There was also a second id defined in this data (field id). The charge pole id, seen in *Table 6*, is reused as a location id and some charging stations are lacking a location id and could not be matched. A rudimentary specification of the charging types possible on the station could be found in the second dataset. As this only specifies which charging types are possibly at a station with available connectors and the data provided did not specify the connector used at a station, no differentiation of AC/DC charging is possible. Here the average power can be a starting point for the further analysis.

Table 6: Berlin dataset excerpt

SessionId	**3091771**	**3115111**	**3128751**
ChargePoleId	DEALLEGO001027	DEALLEGO000185	DEALLEGO000105
MSPId	DETNM	DETNM	DETNM
SessionStart	25-09-2018 08:17:01	28-09-2018 16:57:15	30-09-2018 12:37:42
SessionEnd	01-10-2018 11:07:11	03-10-2018 13:02:07	01-10-2018 13:41:57
Sum of SessionDuration	146,84	116,08	25,07
Sum of ChargingDuration	3,76	3,51	3,01
Sum of ConsumedEnergy	9,93	10,03	10,55
Sum of AveragePower	2,641383899	2,85873129	3,510515616

3.2.3 First Descriptives

In the following, chosen statistics in form of basic aggregates of the Berlin data set are shown. It is to be mentioned, that no sophisticated quality assessment of the data was performed yet and all data sets seem to still contain at least some implausible values. Therefore, the presented aggregates can only give some first insights on the single data sets.

The Berlin Dataset consist of 117.704 observations between 01.10.2018 (stop-timestamp) and 31.12.2019. 12 charging sessions start at 1970-01-01 and end in November 2018 up to October 2019, implying that the start time is missing for these observations. 786 charging sessions in the dataset have no duration and no energy supplied. Therefore, a sophisticated quality test has to be performed in the second part of the analysis.

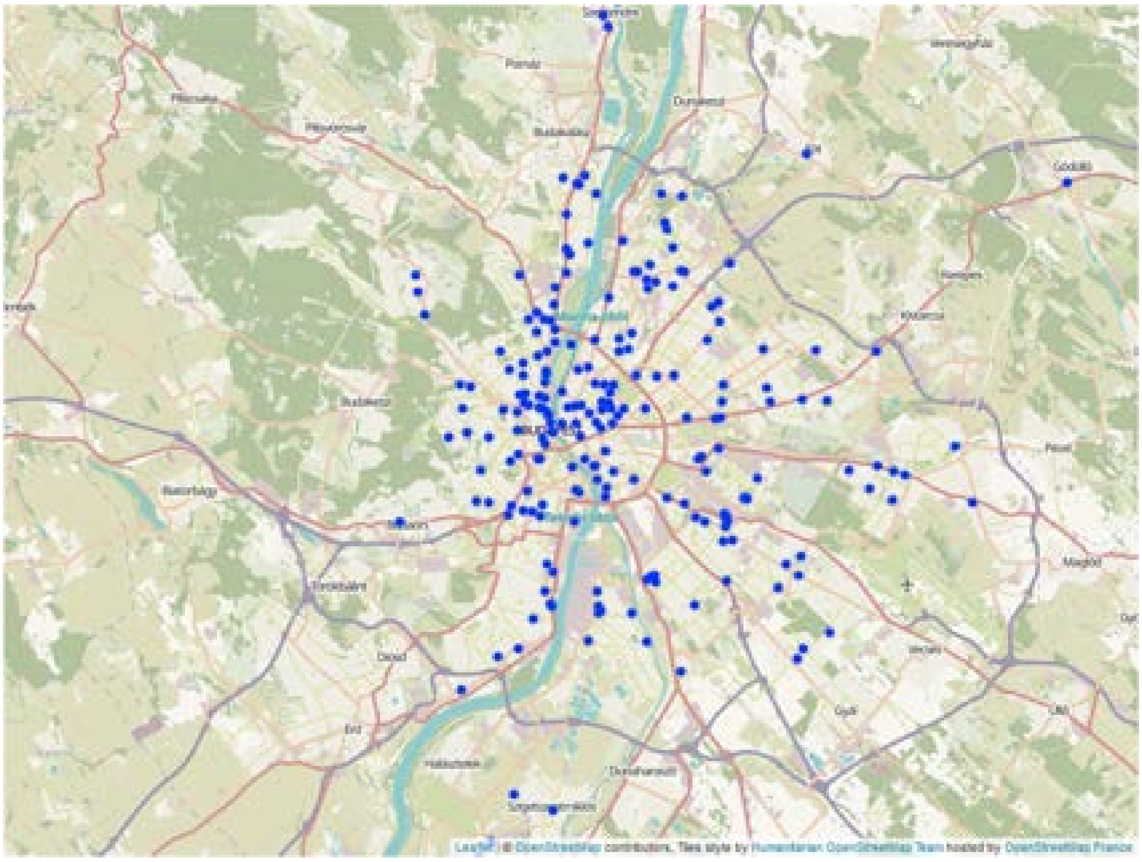
Neglecting the observed shortcomings of the dataset, and compared to the Barcelona dataset on a high level, the Berlin observations show longer charging durations with peaks at durations of 4 to 5 hours. Furthermore, more overnight charges (peak of stop time in the morning) are observed. As in Barcelona, the Berlin data shows an increase in energy supply during the observation duration.

3.3 Budapest Data Set

3.3.1 Location of Charging Stations in Budapest

For Budapest, so far only location data of charging points could be acquired. The total number of charging stations in Budapest is 163. Mainly located in the city center, and spread out into the west of the city, as shown in the following *Figure 10*.

Figure 10: Locations of Charging Stations in Budapest



3.3.2 Budapest Data Set

For charging stations in Budapest the charging power, type and location information were provided. The location was only given in form of an address and was manually located on the map.

Table 7: Budapest dataset excerpt

ZIP	1015	1027	1016	1011
Street name	Budapest, I. Kerület, Csalogány utca	Budapest, I. Kerület, Ganz utca 11-13.	Budapest, I. Kerület, Gellérthegy utca	Budapest, I. Kerület, Málna utca
Type	22kW DC	22kW DC	22kW AC	22kW AC

3.3.3 First Descriptives

For the Budapest pilot site, no usage data could be acquired so far.

3.4 Rome Data Set

3.4.1 Location of Charging Stations in Rome

With a total of 515 charging station ids the Rome dataset covers the most charging points of all pilot sites. This high number of designated charging stations is questionable, as of a lot of charging stations are located in small areas as can be seen in *Figure 12.* The dataset listed a total count of 16 charging points on this intersection.

Figure 11: Locations of Charging Stations in Rome

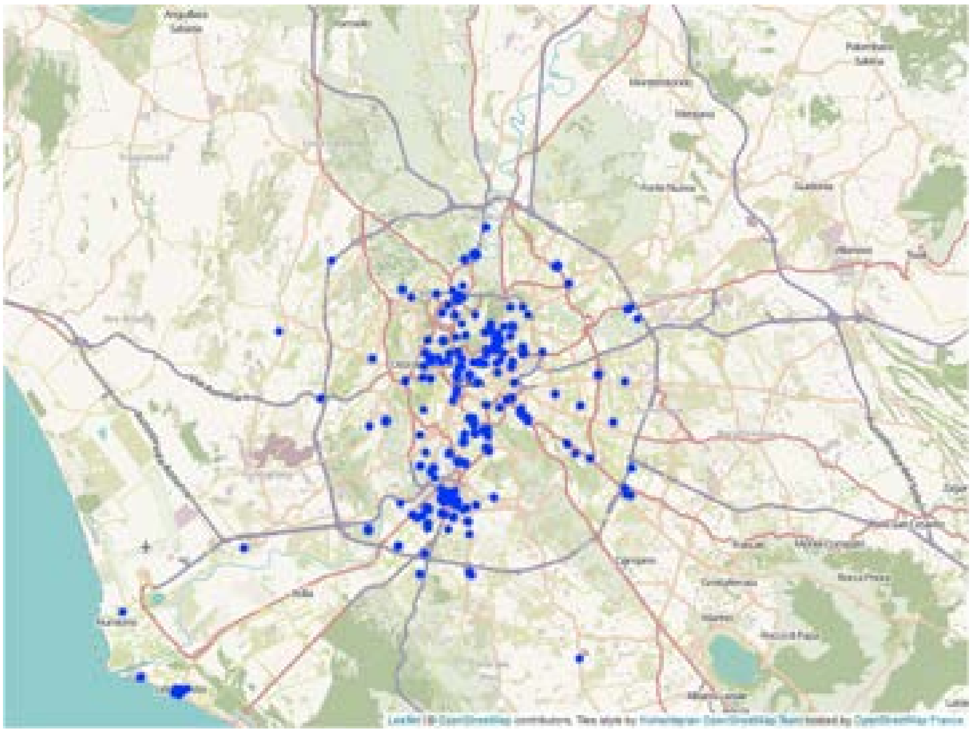
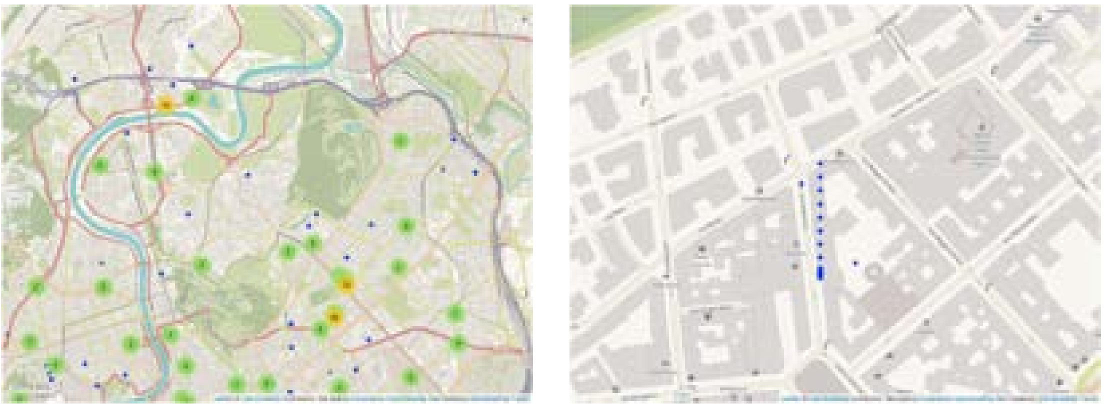


Figure 12: Rome: Overlapping charging points (clusters of charging points and single street)



3.4.2 Rome Data Set

The provided data from Rome contains one observation per charging station and day. As shown in *Table 8*, the individual charging station is defined by its serial number and some locational information, as address, longitude and latitude. Two variables define the charging session: number of recharges and energy supplied [kWh]. For roughly 17 % of the stations, even these values are missing, so that only the day on which most probably one or multiple charging session occurred is recorded. For three charging stations, addresses changed inconsistently between two values.

Table 8: Rome dataset excerpt

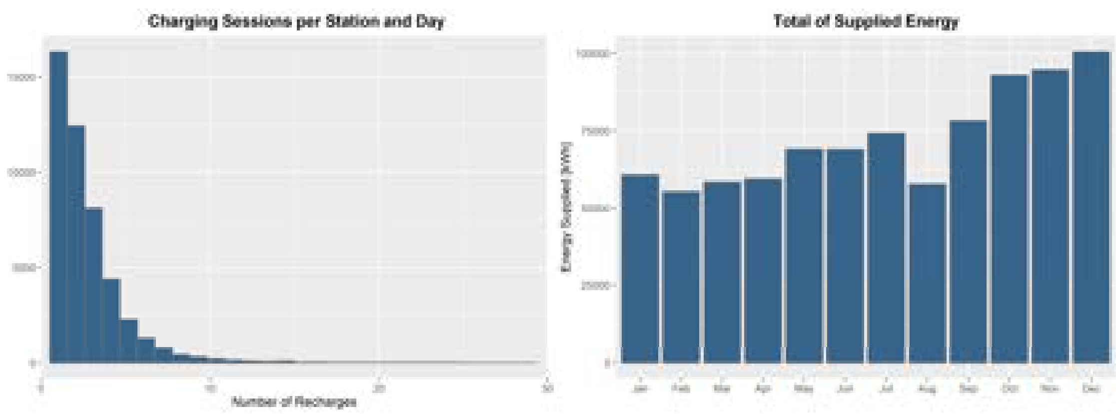
Serial number	17ZM32T77B3W000001	17ZM32T77B3W000001	17ZM32T77B3W000001
Region	Lazio	Lazio	Lazio
Province	Rome Metropolitan City	Rome Metropolitan City	Rome Metropolitan City
City	Rome	Rome	Rome
Address_name	Area Servizio Selva Candida GRA km 8 - TotalErg	Area Servizio Selva Candida GRA km 8 - TotalErg	Area Servizio Selva Candida GRA km 8 - TotalErg
Latitudine	41,957922	41,957922	41,957922
Longitudine	12,385885	12,385885	12,385885
Year	2019	2019	2019
Month	set	nov	dic
DayOfMonth	21	18	23
Number of recharges	15	22	12

Energy supplied (kWh)	314,5	301,89	296,47

3.4.3 First Descriptives

The following *Figure 13* shows summary statistics for the Rome data set. Due to the high aggregation of the data, only basic statistics can be done as depicted below. As in the other dataset, a general trend of a rise in energy consumed throughout the observation period is visible.

Figure 13: Basic Statistics for the Rome Dataset

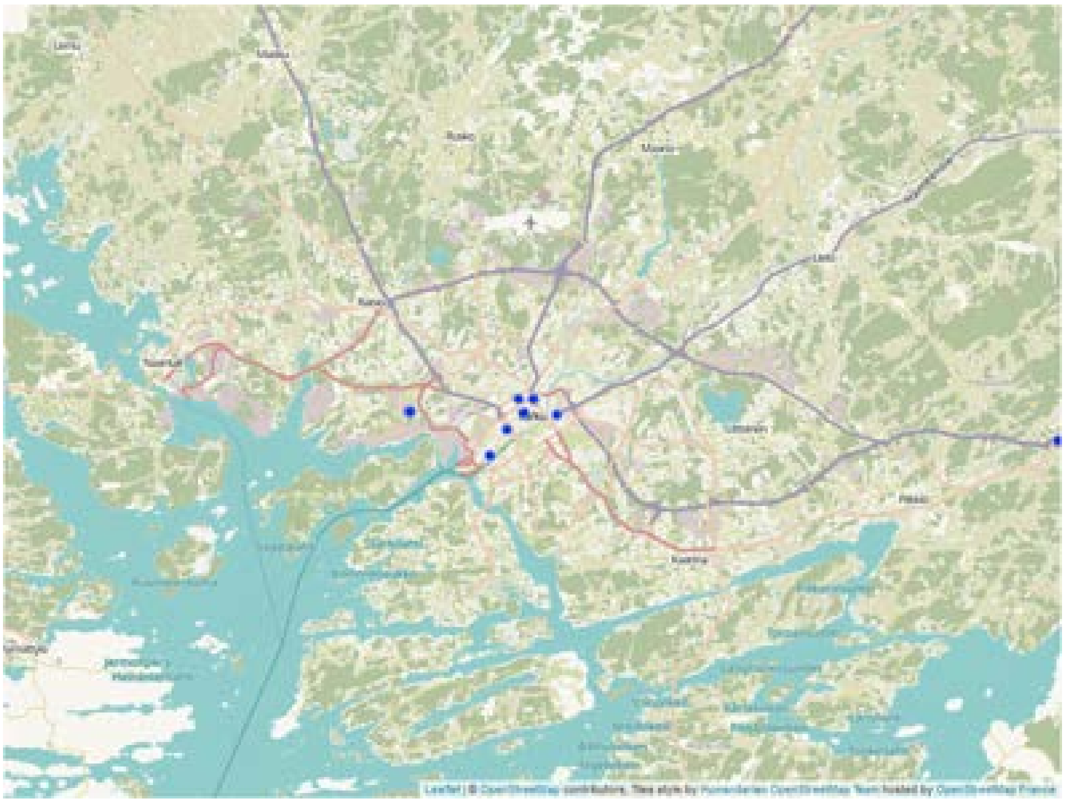


3.5 Turku Data Set

3.5.1 Location of Charging Stations in Turku

The smallest city of all pilot sites is Turku with a population of 190,000 people. This reflects in a dataset covering 18 charging stations spread out across the city. 17 of those are in the inner city and one outlying station.

Figure 14: Locations of Charging Stations in Turku



3.5.2 Turku Data Set

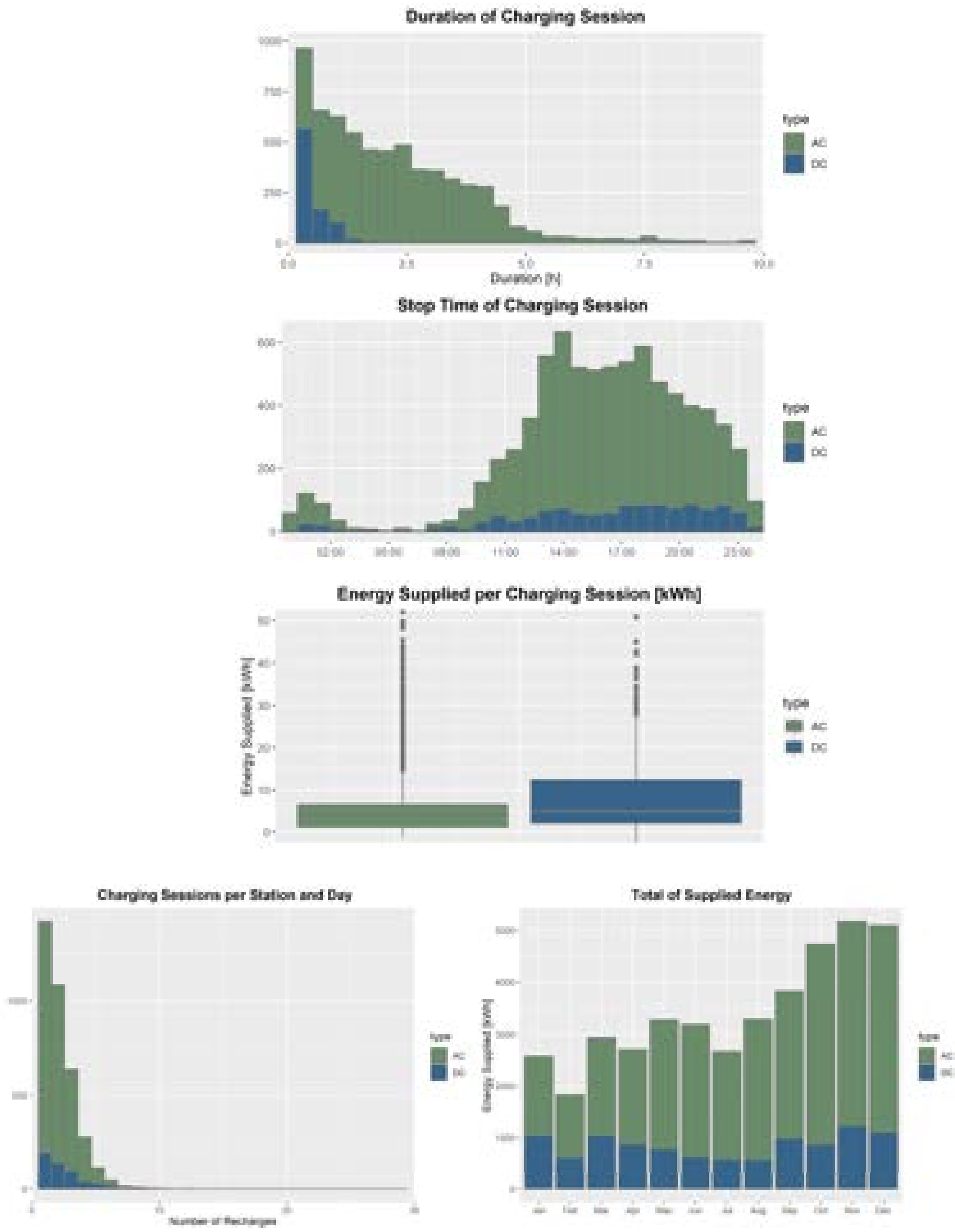
The dataset provided for Turku defined one observation for one loading session. Shown in *Table 9* for each station id, where a session was recorded, the start- and stop-time, energy supplied (Wh) and the charging type AC/DC were documented. As an information to locate the charging station only a station name assumed as the address were given.

Table 9: Turku dataset excerpt

Created	01.01.2019 01:47	01.01.2019 14:40	02.01.2019 07:34
Station ID	1100	1100	1140
Station name	Puutarhakatu 4	Puutarhakatu 4	Hämeenkatu 8
Start time	01.01.2019 01:47	01.01.2019 14:40	02.01.2019 07:34
Stop time	01.01.2019 01:47	01.01.2019 15:44	02.01.2019 11:55
Duration	1	64	262
Energy (Wh)	0	3270	6460
Plug type	AC	AC	AC

Cumulative energy (Wh)	0	3270	9730

Figure 15: Statistics for the Turku Data Set



3.5.3 First Descriptives

The following *Figure 15* shows chosen summary statistics for the Turku data set. While for the other datasets, AC/DC distinction has to be derived from the data, the Turku dataset allows for a direct comparison as is shown in the following graphs.

The duration and time of single sessions with AC-Connector is (on a high level) comparable with the main dataset of Berlin, while the sessions with DC-Connectors draw a comparable picture to Barcelona. The energy supplied per month throughout the observation period rises as in all other pilot sites.

3.6 Summary and next steps

In the first half of Task *1.1.1*, charging station location data for all five pilot sites as well as charging station usage data for four of the five pilot sites could be acquired. Due to the worldwide Corona situation, the Big Data Analysis could not be performed as was planned and the task needs to be extended. The analysis of the data therefore so far only covers basic views on the different data sets and first basic statistic. From the data it is apparent that quality, quantity, aggregation, technology and locations of the charging points and the data highly differs between the pilot sites.

The following *Table 10* depicts the summary statistics of the data sets acquired so far for the Big Data Analysis. The data provided give insights on the charging sessions within the different pilot sites and show basic patterns already on a high level.

Table 10: Summary Statistics

	Metro. Area Barcelona	Berlin	Budapest	Turku	Rome
Number of Stations	21	289	No usage data acquired yet	18	515
Number of Recharges	38.138	106.123		7.737	123.790
Mean of Recharges per Day and Station	6,88	2,30		2,14	2,17
Mean active Days	263,90	159,32		201,06	110,52

As the quality and quantity of data provided differs between the cities, a sophisticated quality analysis will be performed on all data sets and statistics will be chosen per pilot site. As was shown above, the dimensions of charging covered by the data differs, so that for each pilot site a different level of aggregation and analysis will be performed in order to derive general and transferable findings.

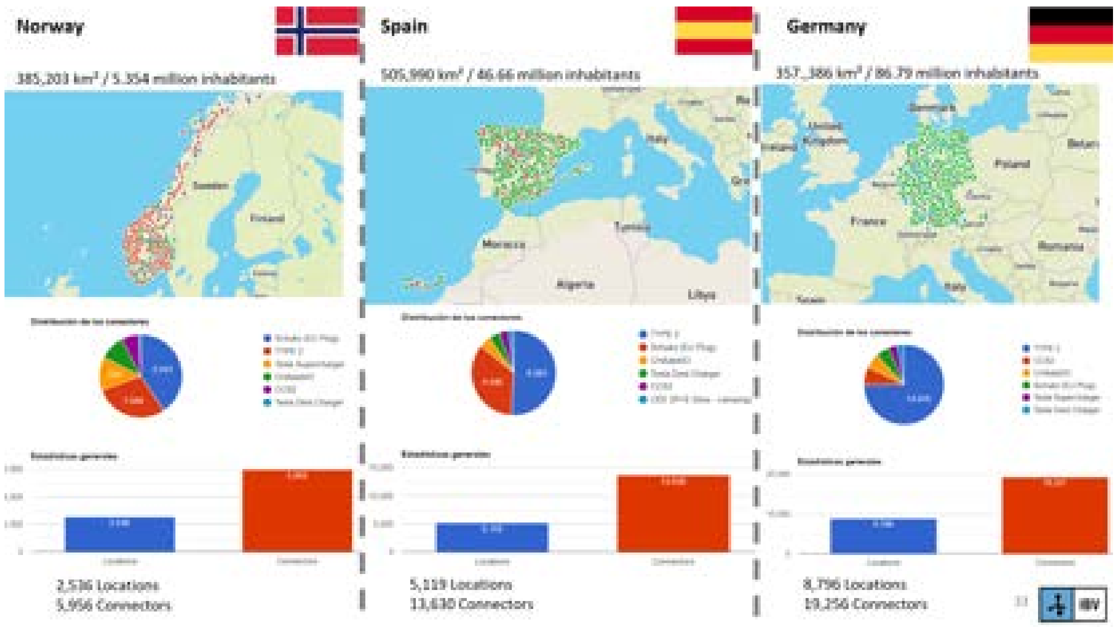
In the second half of this task, a sophisticated quality check based on the first findings will be done for each data set. Furthermore, the actual analysis will be designed and performed that will cover observed behavioural patterns of charging station usage and locational pattern, as far as observable from the data. The *Big Data Analysis* will therefore observe the usage of charging stations and derive insights for the design of the USER-CHI products.

4. Results

4.1 Netnography

Annex 4: Netnography results includes the full report presenting all the results obtained in Netnography. The results presented in this section (*Table 13*) are the most relevant comments, selected by importance and repetitiveness, of those expressed by end users in the forums visited.

Figure 16: Chargers distribution in Norway, Spain and Germany



The results presented in *Table 13* are organized in three sections: EVs, LEVs and Chargers Distribution. Although the situation regarding the quantity of chargers is quite different between Norway and Germany-Spain (*Figure 16*, *Figure 17*), users consider that the charging infrastructure is still an unsolved issue (*Figure 18*). This suggests that even in Norway, the charging infrastructure has no overcome the critical point that makes users perceive that it is not a problem anymore.

Regarding the charging process of the EV, results presented in *Table 13* suggest that users consider that there are two basic processes: charging for daily use in urban and interurban trips, and charging for long range trips. For daily use in short displacements the critical point is the availability of a charging point at home. Users consider that an EV without a charging point at home has no sense. On the other hand, for long range trips the key factor is superchargers (*Figure 19*). The possibility of getting high rates of charge in a few minutes (20-30 minutes), makes the users feel confident with electromobility for long range displacements.

Figure 17: Chargers per inhabitant in Norway, Spain and Germany

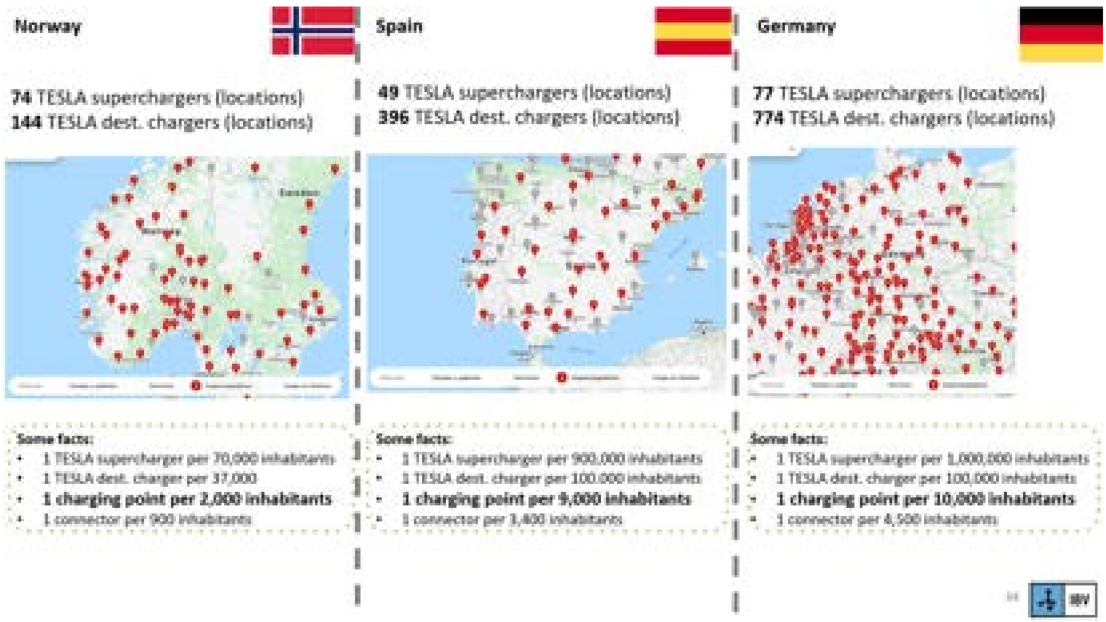
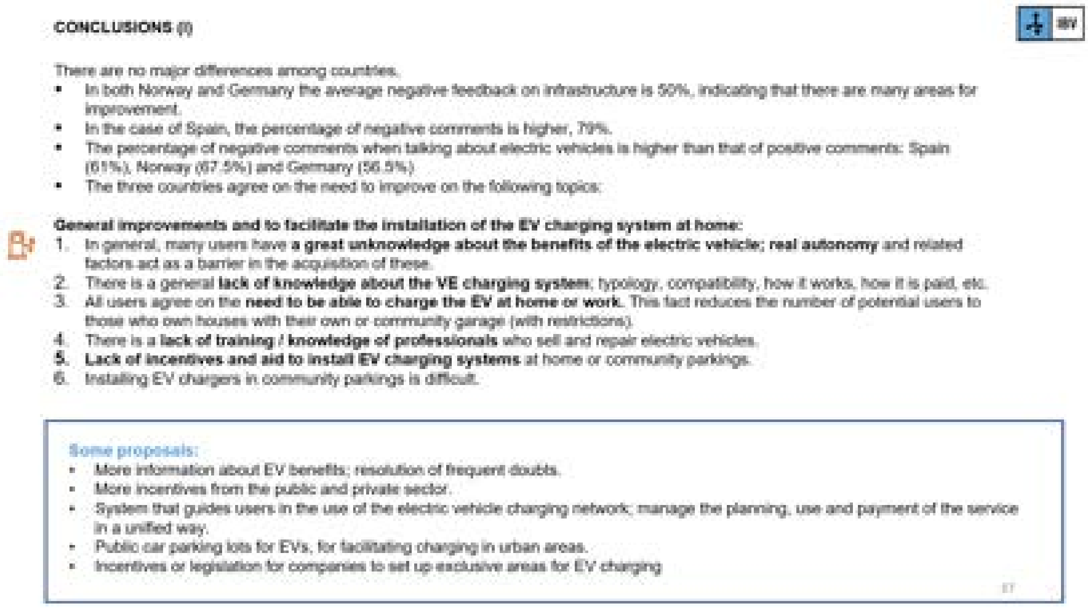
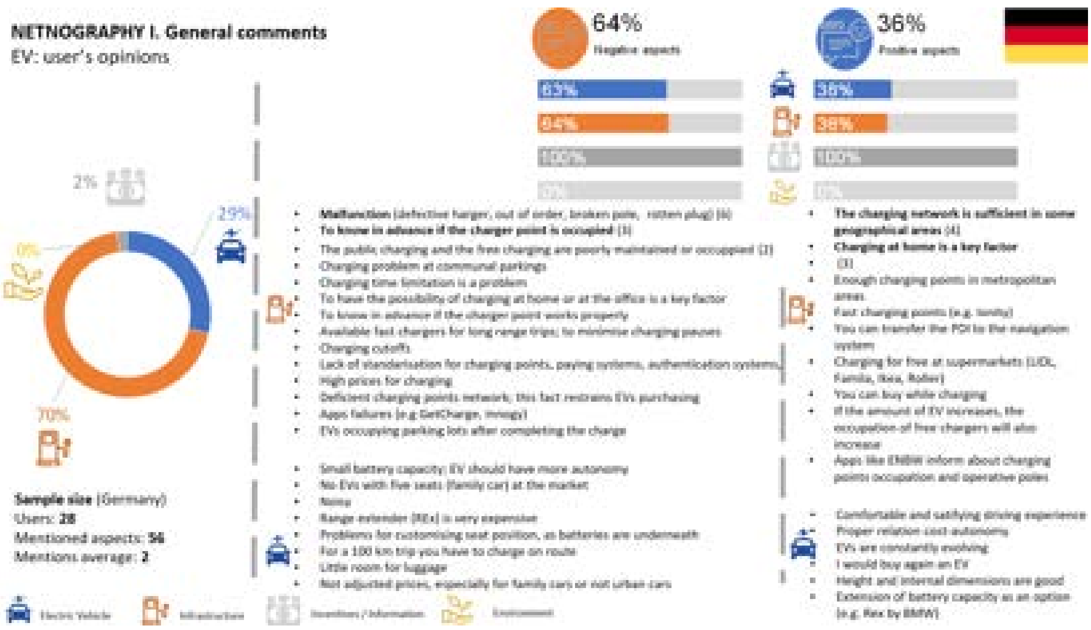


Figure 18: Differences among countries regarding charging infrastructure



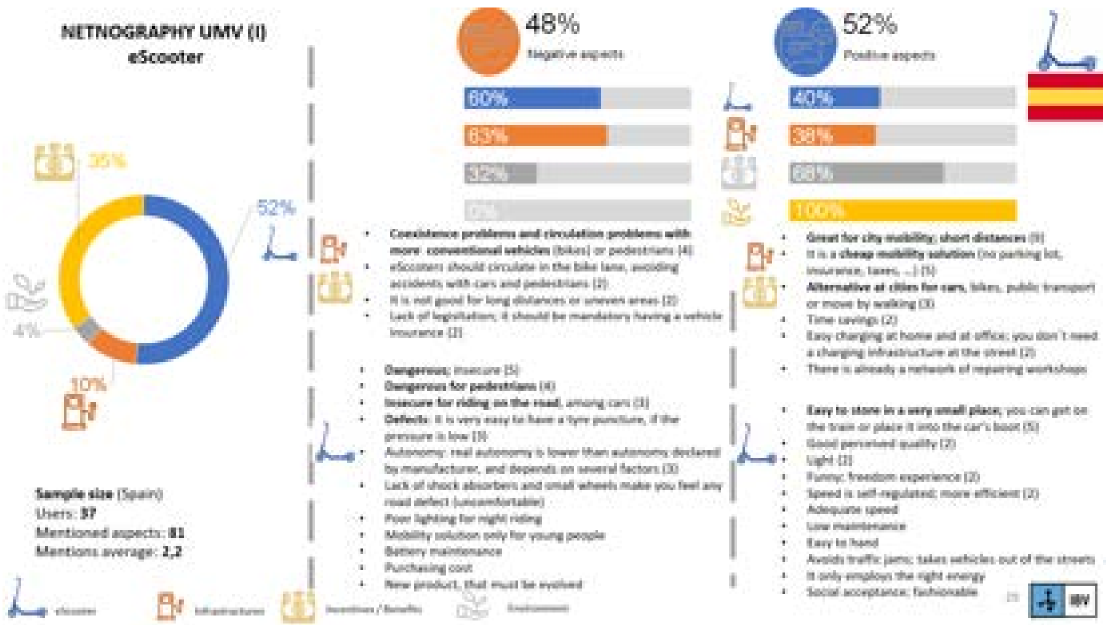
Another critical point for EVs users is the sure reservation to get a charge. At this moment is possible to make a reservation but the availability of the charging point when the user arrives is not guaranteed. Routing, making a reservation and paying employing a unique application is also a must for EV drivers.

Figure 19: Comments about charging infrastructure in Germany



Regarding LEVs, e-bikes are the best valued devices, as e-scooters are perceived as dangerous, and e-motorcycles as expensive. Charging of e-bikes is an improving topic, but the overweight of these vehicles compared to mechanical bikes is perceived as a weakness.

Figure 20: Comments about eScooter in Spain



4.2 Delphi questionnaire

4.2.1 Report of Delphi's results

USER PROFILE DESCRIPTION

Figure 4 shows the nationality and gender per user profile, of the different respondents of Delphi questionnaires (the two rounds).

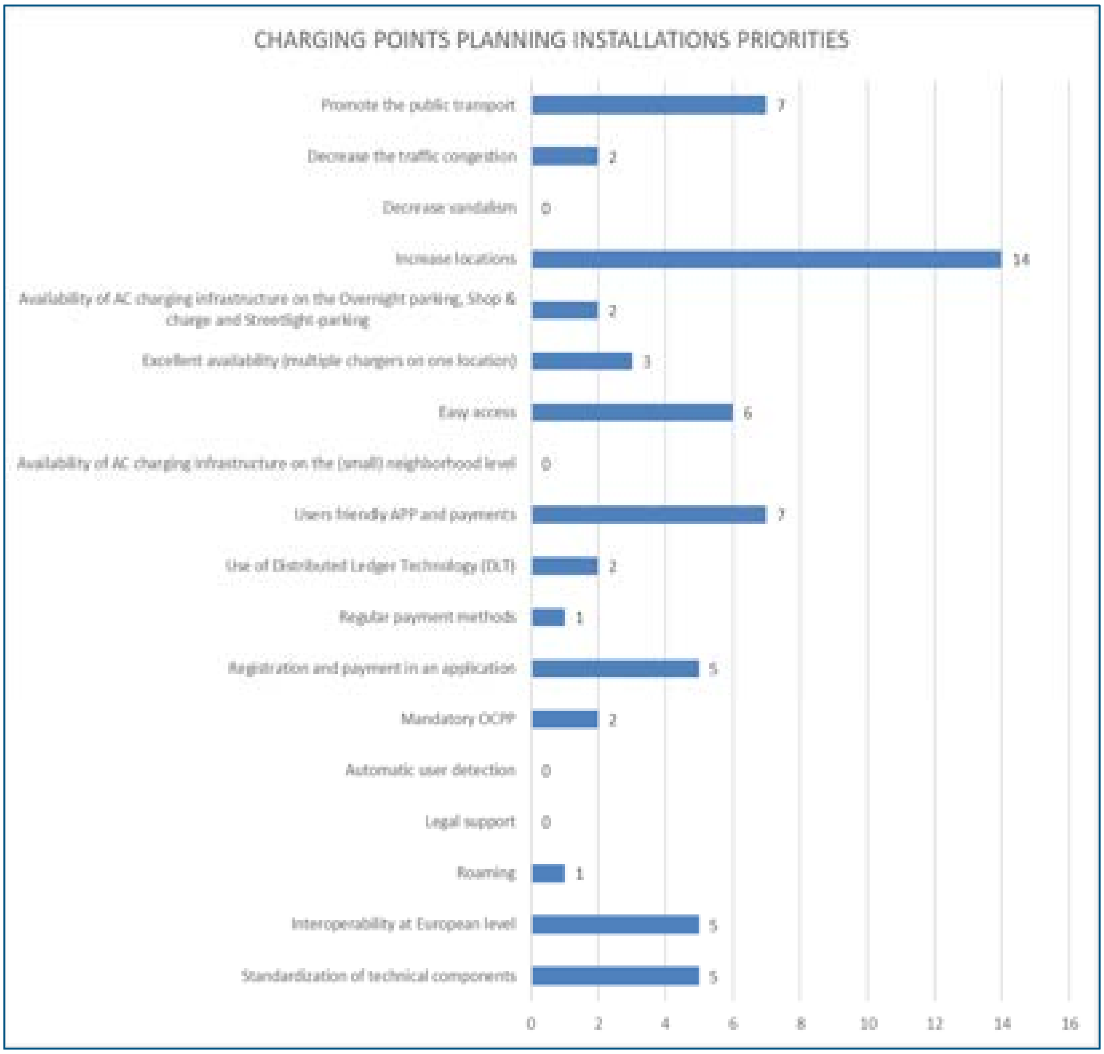
The first questionnaire of the Delphi study has been fulfilled by 27 European professionals, and 30 has been fulfilled by in the second round. The participants are mainly males, Urban Mobility Planners (28) and Charging Point Operators (18). The countries with the highest representation in the study are Hungary, Germany, Finland and Spain.

URBAN PLANS: MANAGEMENT

In the following paragraphs, the most relevant answers recollected regarding the management of Urban Mobility Plans are presented:

- The main concerns in the cities (*Figure 21*), at the moment, are increase location, electric public transport, users' friendly apps, easy access, e-cars for short and long haul and e-bike.
- The strategy to be followed by cities is based on the following priorities:
    - standardization of technical components,
    - interoperability at European level,
    - roaming,
    - legal support,
    - automatic user detection,
    - mandatory OCPP,
    - registration and payment in an application,
    - regular payment methods, and use of Distributed Ledger Technology (DLT).
- Implementing these strategies requires regulations at the EU level, national level and local level. In addition, it is necessary to develop technical tender requirements and decision-making based on a cooperative and holistic method, where all the agents are around the same table.
- Municipalities and regional governments are on charge of the strategy. Sometimes these institutions cooperate with suppliers, and agencies/departments for Environment, Sustainability or even Transport.
- Private users and mobility suppliers are on charge of building and managing charging stations. Mobility suppliers have different profiles: Service companies of AC and curb side chargers operated by the City, DC rapid chargers joint-ventures between the City and private charging companies and CPO selected in a tendering process.

Figure 21: Urban planners priorities



- Usually is allowed to build charging infrastructure by entities authorized by the municipal and regional governments, service providing companies, the city for AC and DC charging on public ground/streets.

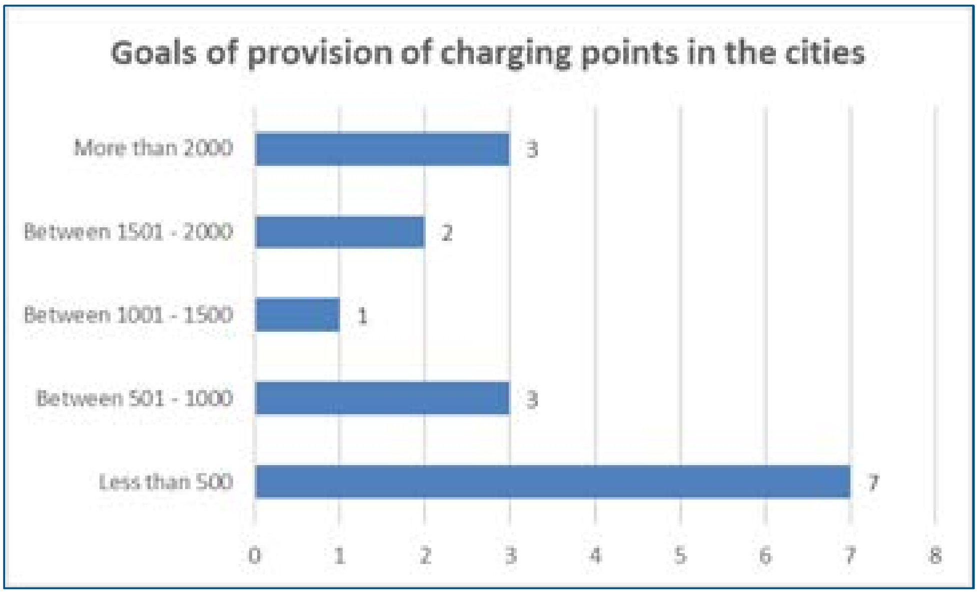
URBAN PLANS: PRIORITIES AND IMPROVEMENTS

In the following paragraphs, Urban Mobility Plans priorities and improvements are presented:

- Currently we can distinguish two basic strategies.: cities that no prioritize users; and cities that prioritize drivers with high inner-city mileage (e-taxis, delivery vans, electric freight vehicles, electric car sharing etc.). On the other hand, car sharing is the best option from planning perspective (reduce number of vehicles
- The professionals consider that we are in a first phase of basic network. Location of charging stations is based on demand of specific user groups (commercial, car sharing) and private users (charging at home).

- When the technology matures and the widespread use of the electric vehicle is viable, supply will have to be adjusted to demand: High power DC at the end points of the bus line, Low power DC at the bus depot, AC stations around the city.
- The logistics in public transport and utilities (included their own facilities and malls) is being updated and its improvement is a priority.
- It is also necessary to increase the EV autonomy, minimizing the number of charges required and the charging speed to reduce total charging time. Furthermore, is necessary to focus on areas with old town houses and multi-family building: AC near home/work address, DC good accessibility, close to main roads, away from housing, 300m radius around charging points with no other CPs.
- Another criterion to consider is the focus between the public/private space. Since public space is highly contested, there should as much charging infrastructure as possible be provided on private ground; or prioritize to use the public space.
- Wherever, the specific location should orient on the charging preferences of the users in semi-close distance and the demands through the day (may differ with regard to Centre and suburbs).

Figure 22: Estimated amount of charging points in cities

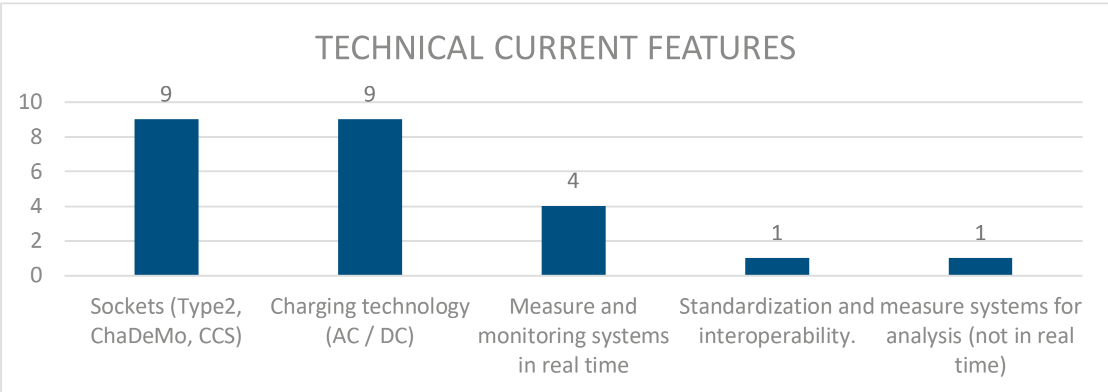


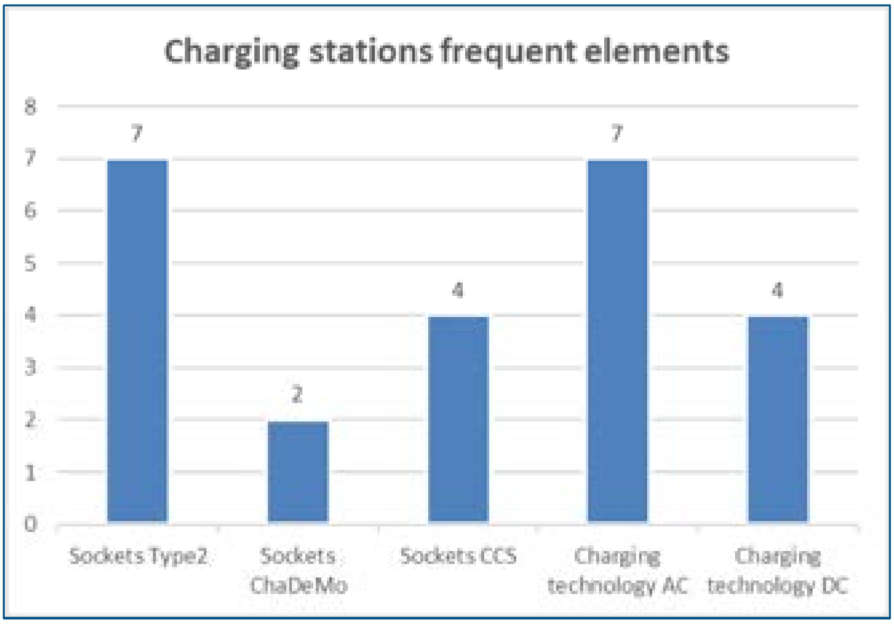
- The identified charging needs pending improvement are:
  - users friendly APP and payments,
  - good coverage,
  - availability of AC charging infrastructure on the (small) neighbourhood level,
  - easy access,

- excellent availability (multiple chargers on one location),
- overnight parking,
- shop & charge,
- and streetlight-parking.

In conclusion, the technology is not mature enough (for example, it is unknown whether with electric batteries it is possible to achieve the required charging speeds and autonomies), the electric vehicle with current technology is only possible for specific uses. And there are environmental aspects associated with EV that are not being adequately considered (for example, the use of EV does not eliminate congestion, that is eliminated by rational urban planning and public transport).

Figure 23: Socket features





TECHNICAL FEATURES OF CITIES' CHARGING INFRAESTRUCTURES

In the following paragraphs, the features of cities' charging infrastructure are presented:

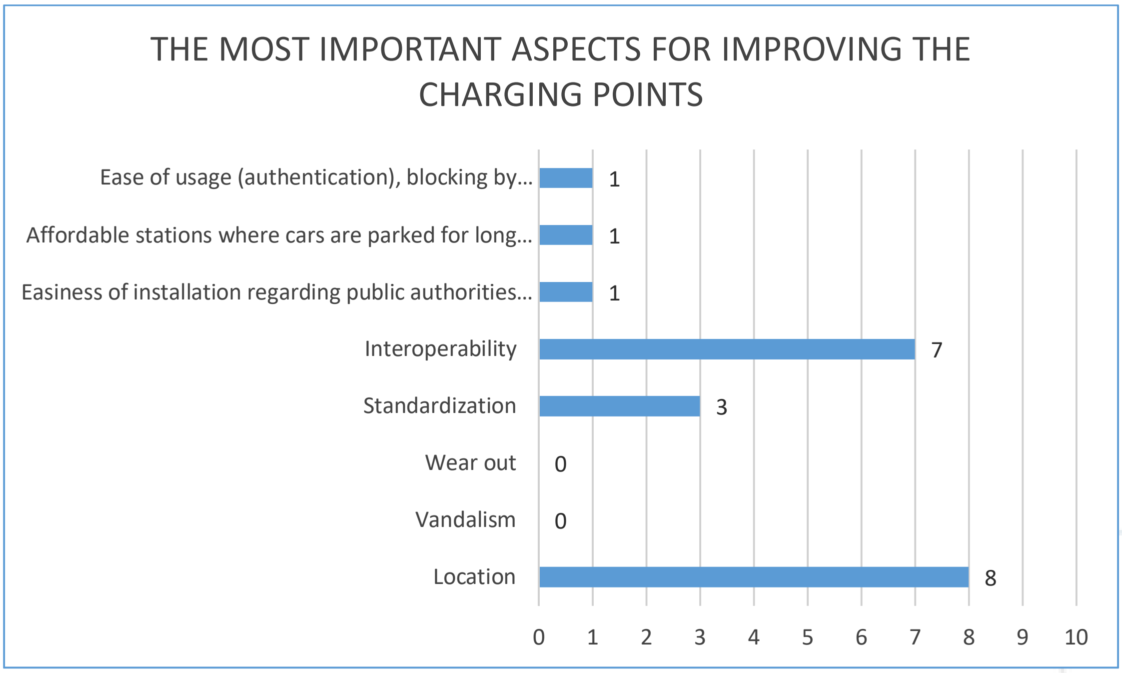
- In the cities, the number of charging points installed are mainly between 500 to 1000.

Table 11: Most common electric power supplied in charging stations

kW	Time
22	15-25 minutes
5 (the mean of charge)	15-25 minutes
50	15-25 minutes
50	20 minutes
3.6	Time varies a lot: during work day at office and during night at homes; and a few hours when visiting a shopping center.
50	Less than 1 hour or business time
11	3 hours

- The participants consider that between 6 - 12 % of all parking spaces should be equipped with charging possibility to sustain a 100 % electrified fleet in the city. The objectives are to achieve between 1,000 to 2,000 public and semi-public charging points in the city area.
- The key locations for charging stations are: shopping malls, parking lots, gas stations. curb side, public parking lots, and mobility hubs.

Figure 24: Aspects to improve the charging points



- It is necessary for the technology to mature (autonomy and charging speed) so that the general use of the EV with an acceptable number of charging points is possible.
- The most important features are the speed of the load in the vehicle and normal credit/debit card paying possibility with reasonable costs (it would ease the charging from several different apps and tags to normal buying with card).
- The Sockets (Type2, ChaDeMo, CCS) and the Charging technology (AC / DC) are the two most implemented current features (*Figure 23*).
- The most common electric power supplied to a charging point is shown in *Table 11*.
- The most important aspects for improving the current charging points are presented in *Figure 24*. Location, interoperability and standardization stand as the most relevant.

THE E-MOBILITY SERVICES FOR USERS

In the following paragraphs, the key aspects and priorities to provide Mobility Services are presented:

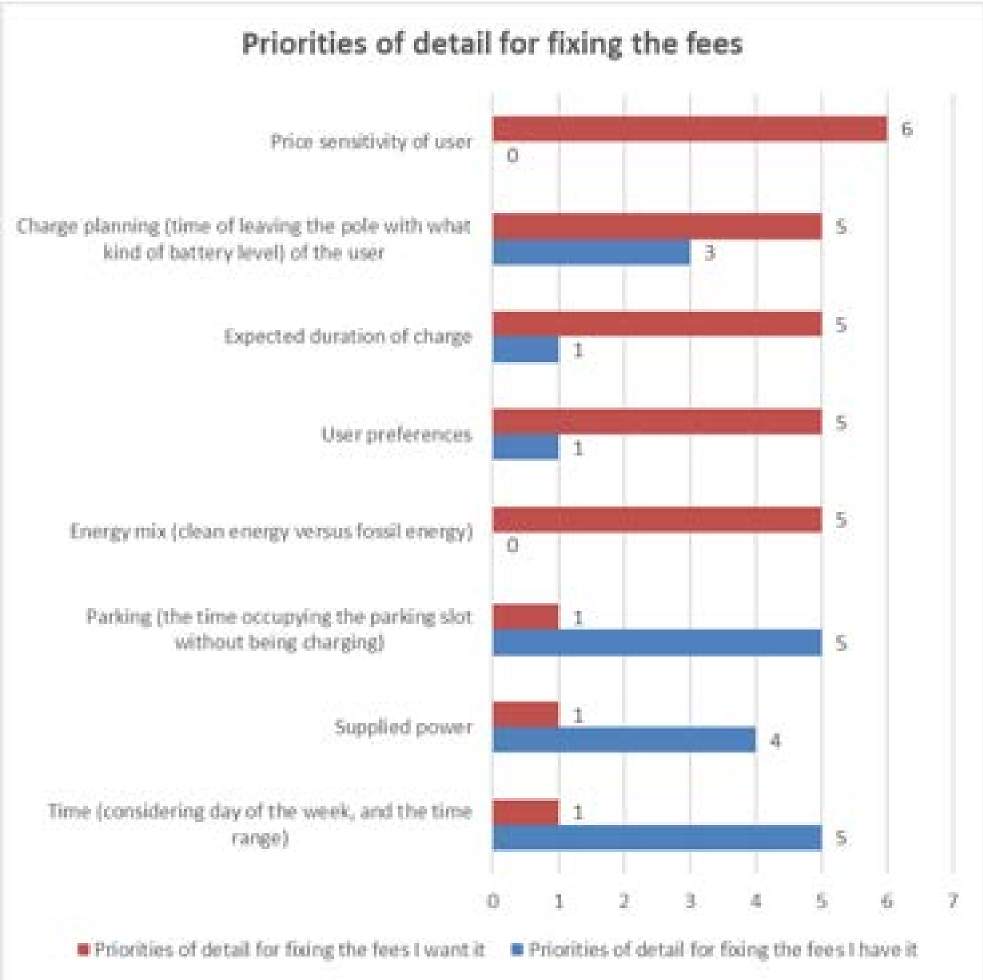
- The chance to lower down the power depending on the service package that customer is using are a valuable option, for example in locations that have limited power supply from the distribution network.
- The MSPs consider the most important features to provide are the speed of the load in the vehicle and normal credit/debit card paying possibility with reasonable costs (it would ease the charging from several different apps and tags to normal buying with card).
- For the MSP is interesting to provide:
    - Total charge at minimum time;
    - Total charge at lowest price (it is not reasonable to make charging time longer when there is scarcity for charging points and car parking spots in city Centres);
    - and Total charge at maximum percentage of renewable energy.
- One service is optimal when can be accessed remotely; it is possible to lower down the charging power dynamically and the payments go through the operating system. The customer starts the charging via mobile application or RFID tag and the points are operating 24/7.

INFORMATION FLOW AMONG THE MAIN ACTORS

In the following paragraphs, the key factors and priorities for information exchange among different actors are presented:

- The communication protocol between E-mobility Service Providers (MSP) and CPOs is based in two modalities: in person via phone and email, or using the system *Open Charge Alliance*.
- Regarding the kind of data or requirements from the DSO, it could be said that currently, in at least half of the cases, there are no established CPO-DSO communication protocols or they are not of interest (for example, only using 1x16A). DSO's do not send any data. They have their own energy meters.
- There are data requirements only in reserve markets which are organized via transmission system operators (TSO).

Figure 25: Topics related to fees fixation

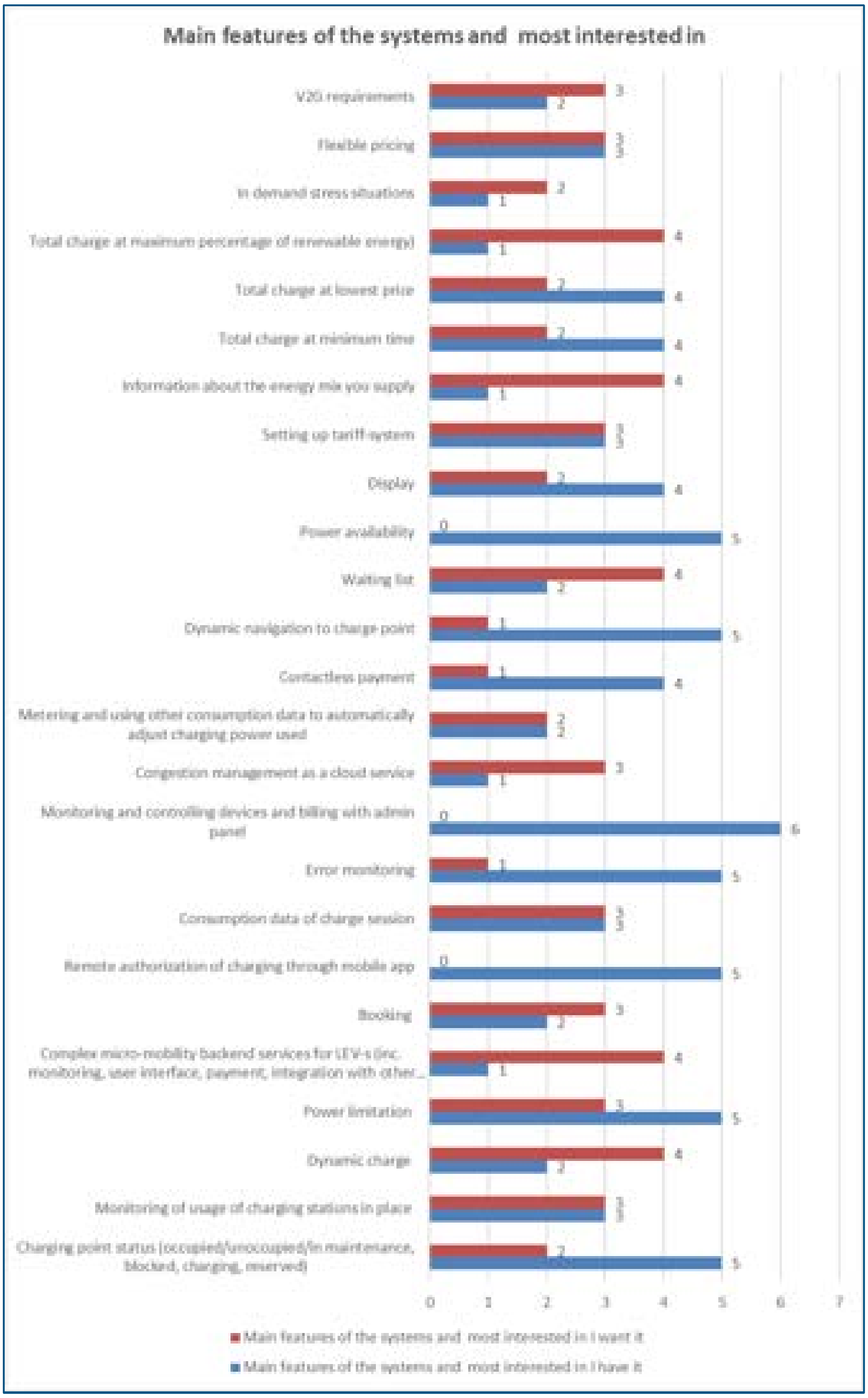


- It is identified experiences with use of APIs; integrated systems with the DSO as the operational integration in Martineque (continuously) or RLM connection, (each 15min).
- Currently, regarding the integration of the energy mix information in the charging management systems, there are two groups:
  - one, where sharing information is not necessary because is simple to purchase 100 % clean energy from the energy markets (6[4]), or because they choose a green energy supplier, certified green energy (renewable) is mandatory, so they do not have an energy mix;
  - and another (4[4]) where it is not available on their charging management system, because there is no integration that can tell when a customer changes their energy

[4] *Number of users agreeing with this statement*

contract, B2C charger owner's data would not even be GDPR compatible to automatically attain even if it was possible in practice.

Figure 26: Features of the charging system



- There is need for fast and accurate energy, and power metering so it is possible to authenticate the changes in power (up- or downshift in power).
- Frequently the voltage drops and the constant exchange of information is needed (e.g. PPAs at large charging facilities and exploring synergies between TEN-T and TEN-E networks, and smart charging).
- The type of data for sharing, identified by the participants, is:
  - In demand stress situations
  - Power limitations
  - Flexible pricing
  - V2G requirements (will form a completely new business segment for EV companies as it opens the instant demand response markets for DSO companies).
  - Energy origin /energy mix.
  - Energy amount to supply.

In a near future, the communication between the e-mobility agents (Urban Planners, MSP, CPO, DSO) and energy ecosystem data will be a key factor (9 of 10 consider that it is necessary). Smart grid requires online communication between all parties for serving EVs.

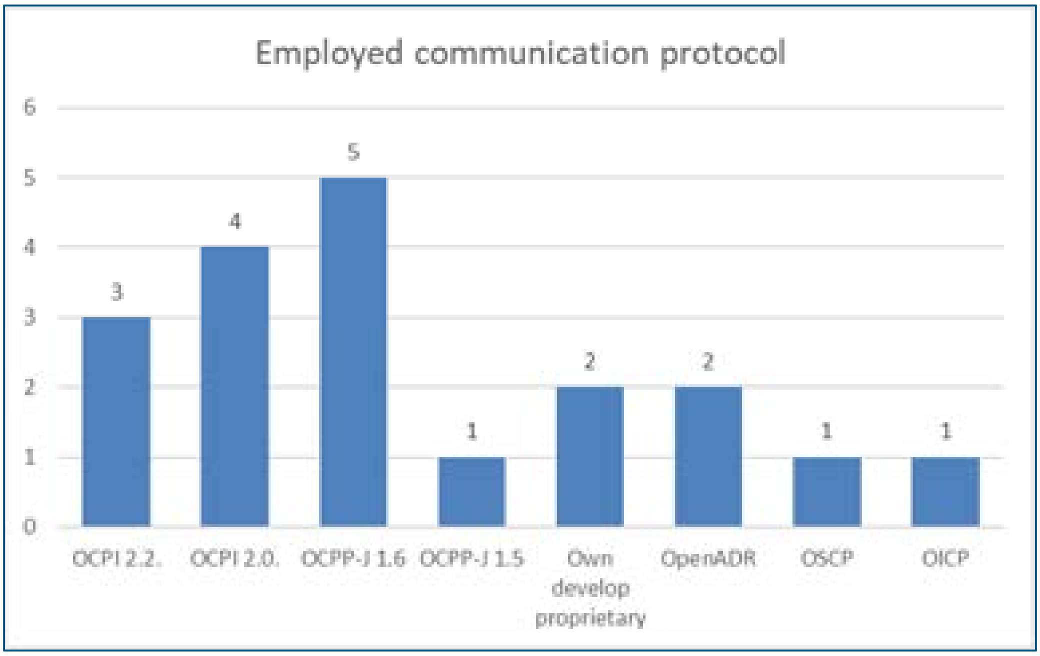
CHARGING POINT OPERATOR PROTOCOLS

In the following paragraphs, the most relevant answers regarding the Charging Points Operators protocols are presented:

The CPOs are open to accept a protocol change if it improves your service (if would not have to upgrade the already installed older devices and chargers, and if it has a standard like EVs). It is necessary to consider the impact and the improvements since effort for changes are high.

- Currently, the used protocols are (*Figure 27*):
  - OCPI 2.2.
    - Strengths: In this version it's possible to communicate as CPO the maximum actual charging power of the charge point in kW (if it is somehow limited) to the EMPs. OCPI 2.2 supports the concept of roaming hubs with different sub-operators;
    - Weaknesses: improved releases with more roles, smart charging options etc are required.
  - OCPI 2.0.
    - Strengths and Weaknesses: doesn't support the 2 strengths of OICP 2.2 (roaming hubs and communication of the actual charging power of an EVSE)
    - Weaknesses: Same as for OCPI 2.2 cost, requires technical knowledge; It has Open protocols; it is the first official protocol with roaming functionalities, enabling multiple use (CPO/EMSP).

Figure 27: Communication protocols



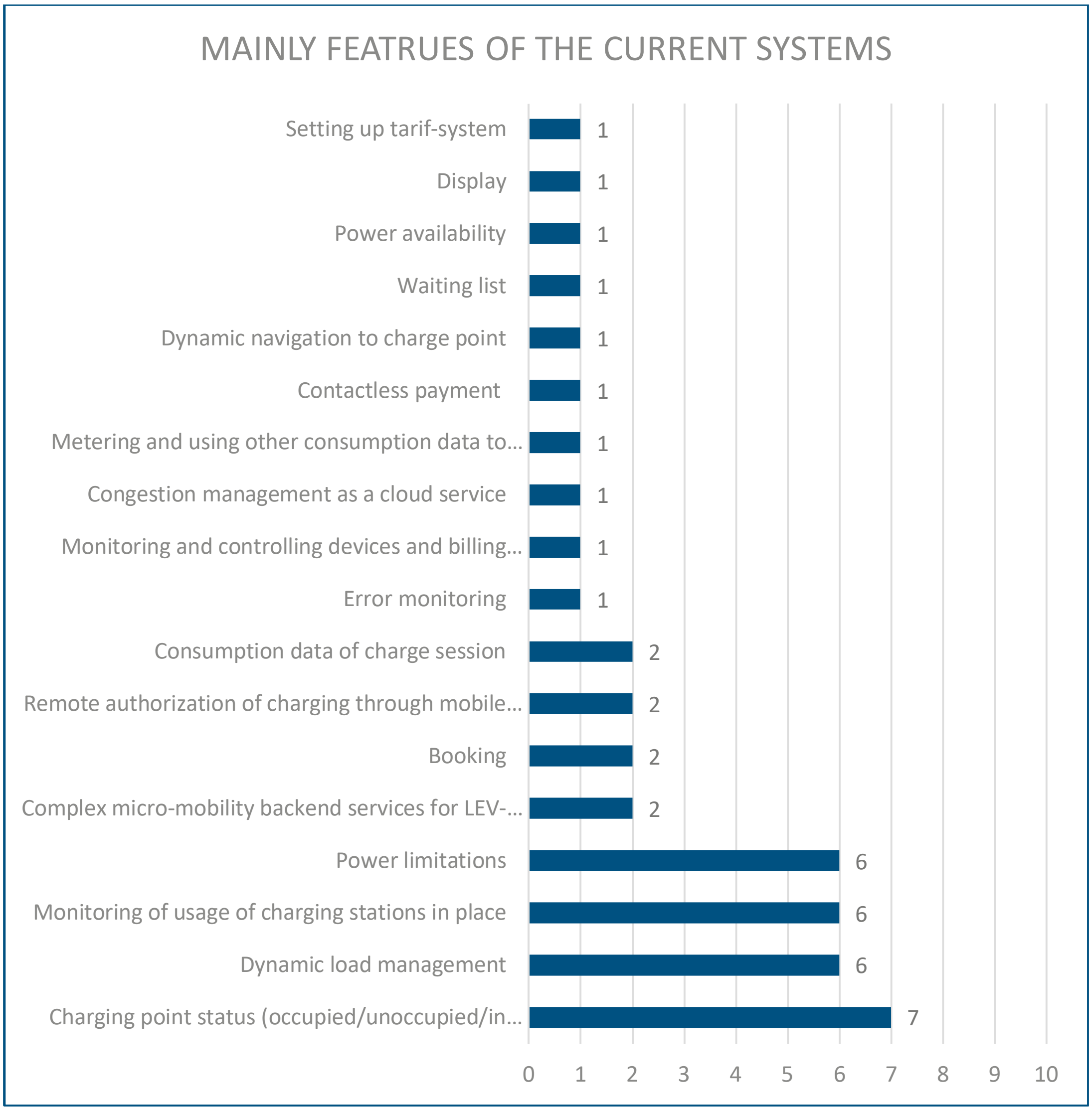
- Just important that our charging infrastructure is OCPP compliant.
- Other used versions as:
  - OCPP-J 1.6: is compatible with almost all charge points but lack of features. OCPP J-1.6 is wide spread.
    - Strengths: JSON over websockets, easy to set up a secure, persistent connection across varied networks
    - Weaknesses: not supported by old chargers. Implementations may vary across charger manufacturers.
  - OCPP-S 1.5:
    - Strengths: Widely supported by even old chargers Weaknesses: Requires a bidirectional communication link, both the central system and charger function as SOAP servers Proprietary ENSTO protocol: Strengths: Slightly more detailed information on certain charger aspects than are available on OCPP
    - Weaknesses: Used by only a single manufacturer, support for devices using the protocol is ending.
- Another protocol option is the own develop proprietary, strength is lower price of devices.

MAIN FEATURES OF THE CHARGING MANAGEMENT

The main features of the systems for charging EVs are:

- Dynamic charge. Frequently, they are based on the amount of energy to supply.

Figure 28: Features of the management system



- Differentiate consumption, through charging sets with a separate smart meter to have a dynamically changing and adapting DLM.
- It is necessary to consider the technical limitations and economic considerations of the location where charging infrastructure should be located.
- The CPOs consider the dynamic charging management could be advantageous for their business because makes possible the cost optimization. In some cases, it is already one of the most important factors in product development.
- Dynamic pricing could be interesting and also balance infrastructure utilisation, reduces station installation costs (the price difference using slower or faster charging speed is a valuable option).
- The most frequent parameters for fixing the fees are: the power supplied (kWh) and parking time.

- The buy of electricity with fixed price and fully renewable is a current practice, so it is not necessary for everyone.

Figure 28 shows the features of the current systems. The most frequent answers are charging point status, power limitation, dynamic load management, and monitoring of usage of charging. stations.

- Finally, a divided opinion is observed regarding the kind of information to provide related to the charging process of EV. Some CPOs consider these features are not a priority, but others consider there are lots to develop and in a near future new features/parameters will be added.
- Regarding the information options, the participants value positively the followings:
  - the ecological footprint;
  - reduction in CO2 emissions achieved;
  - charge planning;
  - time the charging infrastructure is blocked by a non-charging car;
  - the composition of the electricity mix;
  - and user preferences.

4.2.2 Main findings

The results presented in *Table 14* are the most relevant opinions, selected by importance and repetitiveness, of those expressed by the experts and technicians that participated in in the two rounds of Delphi's method.

Results presented in *Table 14* are organized in four sections. The first and the fourth correspond to the information provided by UMPs and DSOs respectively, while the information provided by EMSPs and CPOs is spread between the second section and the third section.

According to results shown in the first section of *Table 14*, urban mobility planners are committed with fostering electromobility, without losing the main aim of reducing traffic congestion in the cities. They assume that increasing the number of chargers is critical to make electromobility feasible, but fostering other mobility alternatives like LEVs or public transport is also necessary.

For EMSPs and CPOs electromobility requires that between 6 and 12% of available city parking lots are equipped with chargers. The most important features for these chargers are the speed of the charge and making available credit card payment. On the other hand, to improve the charging points requires a good selection of locations, interoperability and standardization of technical features. Regarding additional options for charging, minimum charging time, lowest price, maximum percentage of green energy, ecological footprint, reduction in CO_2 emissions, charge planning, time the charging infrastructure is blocked by a non-charging car, and user preferences are considered interesting features by some experts. These extra features require exchange of information among all the actors (EMSPs, CPOs and DSOs) through the protocol OCPI 2.2. At any case, accomplishing OCPP protocol should be a must for USER-CHI charging infrastructures.

Regarding the charging management, the most common parameters for fixing the charging fees are power supplied (kWh) and parking time.

4.3 Field Diary

4.3.1 Report of Field Diary's results

USER PROFILE DESCRIPTION

Figure 5 presents the gender, nationality and uses of EV of Field Diary participants. Additionally, *Figure 29* presents the educational background, family unit, and EV experience user profile of respondents.

Figure 29: Educational background, Family unit EV experience of Field Diary respondents

The online Field Diary study has been fulfilled by 123 European electric vehicle users. The profiles with the highest representation in the study are: man (80%), between 26-55 years (70%), with high school or college degree background (63%), with 1-2 years of experience (42%), urban driver (46%) with their own car (71%, *Table 11*).

Table 12: Type of EV and frequency of use

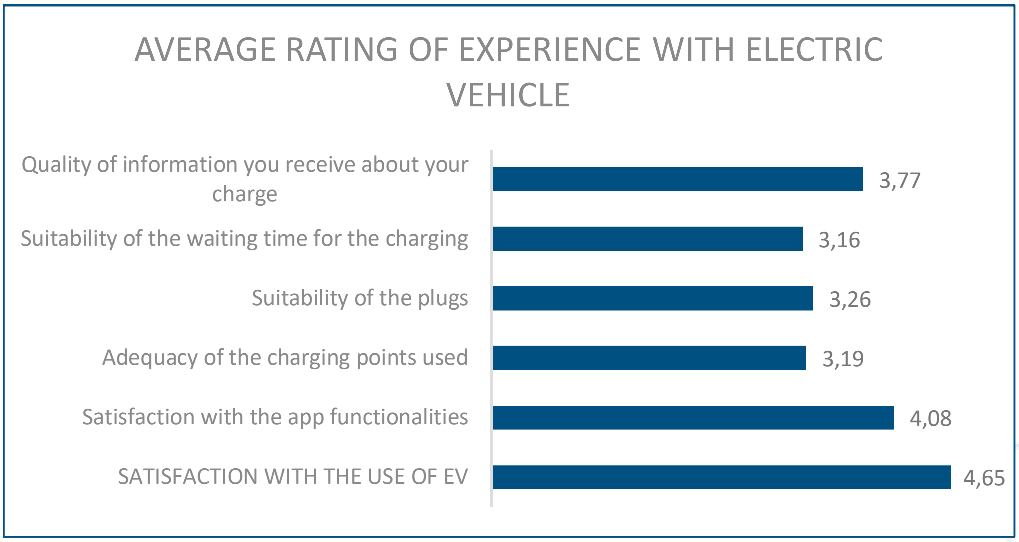
		IS MY PROPERTY	FROM MY COMPANY	FOR RENT OR SHARED
TYPE OF EV	CAR	73	27	7
	MOTORBIKE	6		1
	SCOOTER	8	1	
	BIKE	3		
FREQUENCY OF USE	5-7 DAYS A WEEK	43	15	
	3-4 DAYS A WEEK	10	2	1
	2 OR LESS DAYS A WEEK	4	2	
	EVERY MONTH	1	1	1
	LESS THAN 12 TIMES A YEAR			2

CHARGING EXPERIENCE RATING

In the following paragraphs, the most relevant answers recollected regarding the charging experience rating (*Figure 30*) are presented:

- The users of EV are highest satisfied with the EV experience in general. Almost all report that they will buy an electric vehicle again.

Figure 30: EV's charging experience



- All the valuated criterions are positive (ratings greater than 3 on a scale of 1 to 5). In particular the app functionalities get an average score of 4.08. It means that we are in a linear quality scenario, in which the improvement of the functionalities is well valued and will increase satisfaction.

CHARGING EXPERIENCE

In this section, the key aspects of the charging process are presented:

- LEVs: The usually users are proprietary of the vehicles that are used with a high frequency. The electrical charge is mainly done at home, the use of the LEV entails the non-use of apps, they recharging at home and not needing to plan the routes. The problems identified have been traffic safety and the ease of theft of these vehicles. In some cases, the participants commented on the need to have public chargers for their LEVs.
- EV: Many participants comment that they charge the vehicle at home and that one of the problems is the lack of charging infrastructure (few points in the city and on the road), in addition to the problems of finding the reserved space occupied and the low power of load. We found an exception in Tesla drivers who consider that the charging network and the app work efficiently. When charging away from home they use mainly the following charger options: charging stations, car parks and shopping centres.

Next, the keys related to the way in which the charge is planned and carried out, the problems that are identified and the proposals for improvement indicated by the participants are detailed.

But first, some literal contributions are shown to better understand the experiences of users.

HISTORIES

I love e-cars. A few years back I knew nothing about them, but after I met my partner I got thrown into this crazy life of converted cars, which does not always go as intended but which makes it even a bit funnier than having a normal factory-made e-car. The best features are the easiness of charging the car at home and that I don't have to fill up the car with stinky fuels (a few times a year I have to drive a van and the filling up feels so old-fashioned...), the silence, the fast acceleration, the economic efficiency. I can make a long list! I am sure that in the future when it becomes topical to buy my own car, it will be electrical. I do not see myself owning a car with any other driving force than electricity in the future. User profile: Millenial men.

If we want the majority of people to use e-vehicles and their charging stations, a payment card method should be created, no matter how difficult that would be. It would solve many issues which occur when using apps, weak Internet or SMS payment. Most drivers in Finland have a payment card and a card pre-authorization would work similarly to normal tanking. The fact that most stations require a smart phone excludes many drivers because they are not going to purchase a smart phone just because of this, if they do not already own one. Of course, this group of people is quite marginal but still I think that everyone should have the possibility to charge without owning a phone and an app. My parents are in their fifties but I am sure neither of them would start downloading an app at a station. Neither of them is capable of buying an app from the app store, but it's us kids who have helped them with it, so if they would be travelling alone it would be very hard for them to charge the car without pre-downloaded apps or tags. The service providers should really start to mind different users, different situations and different starting points. Even though you drive an e-car does not mean you have a smart phone or understand anything about them. At the moment the charging process is actually very discriminating because it requires the *skill to use a smart phone, which not all users have. Of course, you can learn how to use them but it does not help if you have for example borrowed an e-car from a friend and suddenly you should be able to charge it and apps are required everywhere. If it is impossible to have a debit card-based payment method at the stations then at least it should be possible to start the charging by phoning because the text messages so often fail*. User profile: Millenial woman.

In my family we only have one car which my partner mostly uses to drive to work. Our hooded, four-wheeled e-scooter comes in handy every time I need to go the grocery store, library or daycare with the children during rain or if we have something heavier to carry, which would be too difficult with a bike. The e-scooter replaces a car well in a smallish town in which we live in. The battery's endurance is good and I'm able to ride longer distances with it, too. The only obstacle is safety: I do not want to ride with it in streets which don't have cycling lanes. Also, the noise of the battery inside the scooter becomes a little bit annoying during longer distances. If I wanted to buy another e-vehicle, it would be a bike. User profile: LEV rider (woman).

I recharge practically always at the same point, next to a supermarket that is next to my house. I usually book 15min before. The charging point is AMB. During recharge time, I go with the children to the park or go shopping. At the moment I do not pay the recharge, it is free. User profile: Woman with children.

At home I have a charging point and near work a public fast charging point that I use sporadically. During recharging time at the public point, I take the opportunity to have breakfast in a coffee shop. User profile: Single woman or man.

For the vehicle the truth is that it is fantastic. The worst thing is that for my profession you have to take one that has great autonomy and the chargers in the metropolitan area do not work very well, there are many that take months to repair. Those in the metropolitan area are not very powerful except for some that in half an hour you can charge 125km but most of them are not worth going because they don't even reach 90 km / hour. Luckily there are Tesla chargers in my town otherwise it would be a problem. In short, if I had to depend on the chargers that are in the city and the area, I would not buy an electric car. User profile: Professional driver.

I have already repeated the purchase and will repeat it again when necessary. The best: The electric car has much better characteristics than a gasoline one, it never jerks, the response is immediate, maintenance is close to zero, consumption is much lower because it is more efficient, and at the same time more economical because it is electricity is cheaper than gasoline. The worst: The price, they are too expensive. Autonomy does not affect me, you must plan trips and be more aware of the lack of recharging points but it does not throw me back when deciding to buy an electric. User profile: Babyboomer man.

Buy again after 5 years of use. the worst experience (still today !!), are the charging infrastructure. User profile: Babyboomer man.

At some charging points, even though you have the charge reserved, when I arrived I had the seats occupied and I was unable to charge. The users of the vehicles in the square wait for the reservation to be exhausted to load them with the excuse that they have arrived earlier. The charging time for electric cars is high, with only 30min it is not enough for all models. Fortunately, Nissan has the CHAdeMO and with 30min I can already manage, although if no one comes I will leave it for a while, but I have seen users who stay up to 3 hours to charge the car. User profile: Man with children.

Clear and consistent instructions should be created and added to all the stations for all the users to see. The identification should be made easier (less apps, more options to pay with credit card), more signs and instructions at the stations. The traffic signs indicating the charging point and possible markings on the asphalt at stations should be unified and there should be a sign at the parking lots or parking halls to clearly indicate where the charging happens if it is not immediately obvious. Put up more signs to indicate the location of charging points. More double charges by the main roads, this would really decrease the chance of an occupied charging point. More quick chargers and clear signs and instructions. User profile: Young man with EV+LEV.

PLANNING THE CHARGE

In the following paragraphs, the mainly experiences in the planning charge are presented:

- Currently, the LEV users charge the vehicle at home and they don't need plan the routes. Usually they know their itinerary and enjoy the experience without having to resort to the charging infrastructure on a regular basis.

Figure 31: Example of App's route monitoring

- For the EV are a large number of apps with very diverse functionalities. Currently, not all of them offer reliable navigation, location and booking of charging points.

    - In apps, problems are detected to identify the chargers that exist, not all of them are offered by the apps. It doesn't appear in the search.
    - Charging points cannot be selected / filtered properly according to the type of charge (type of socket, power, status, price…).
    - It cannot be booked in the entire network of points, only in the charging points associated with the app.
    - It could be recommended a monitoring of the planned routes (*Figure 31*).
- The participants promote changes in the booking typologies for improve the access to the charging point, such as: increasing the charging time with booking, limiting the charging time with booking to 30 minutes and cutting off the supply when the time comes, making it possible to increase the charging / booking time if there is no waiting vehicles, issue an end of loading notice with booking.

ACCESS AND AUTHENTICATION

In the following paragraphs, the features of cities' charging infrastructure are presented:

- The participants claim better access and signage at charging points.
- Once the reservation has been done and reached the charging point, in many cases the driver finds the place occupied by:
    - Vehicles that have exceeded their pre-reserved charging time and are still charging (booking charging is usually limited to 30 minutes).
    - Electric vehicles that are not charging.
    - Fuel vehicles that use the place as parking.
- The participants consider that a charging method that does not require authentication should be provided, so that people who do not want to have a subscription and prefer to pay with a card.

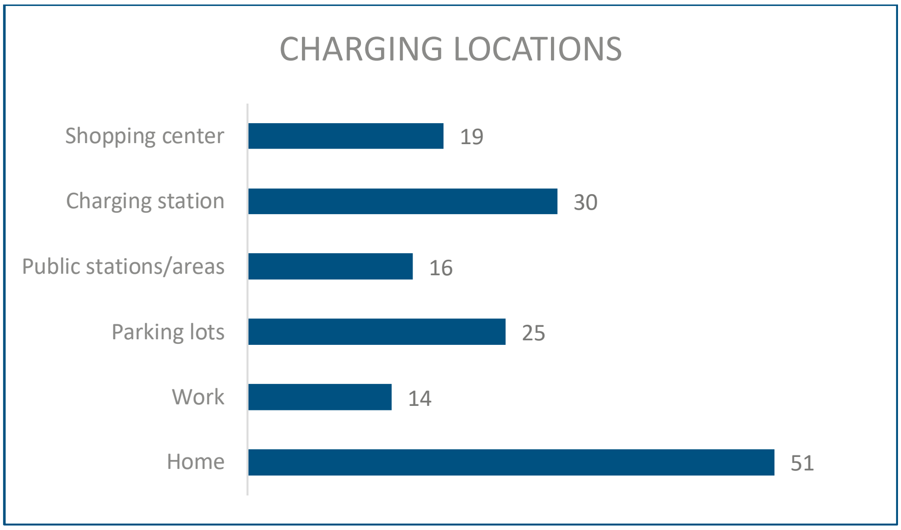
CHARGE PROCESS

In the following paragraphs, the key factors and priorities during the charge process are presented:

- Additional to home, participants mainly charge their vehicles in charging stations, parking lots and shopping centres (*Figure 32*).
- During charging, EV users do activities such as: have a coffee, shop, work, go to the park with the children, wait in the car, ...
- Participants do not detail charging monitoring experience. Feedback such as time remaining to complete the charge, percentage of charge in real time, incidents such as service interruption in real time are very valued. Some users consider that these features should be developed.
- The charging points there are usually at least two vehicle charging sockets, but they only admit one charge, so that if a vehicle starts charging at a charging point in use, the service is interrupted. This is another aspect that they consider should improve through outage information, increased power and allowing multiple vehicles to charge at the same time.

- In this stage, the type of socket is a critical point. To standardize the sockets developing only one model is another frequent aspect.

Figure 32: Usual charging locations



PAYMENT AND FEEDBACK

In the following paragraphs, the key factors and priorities for the payment stage are presented:

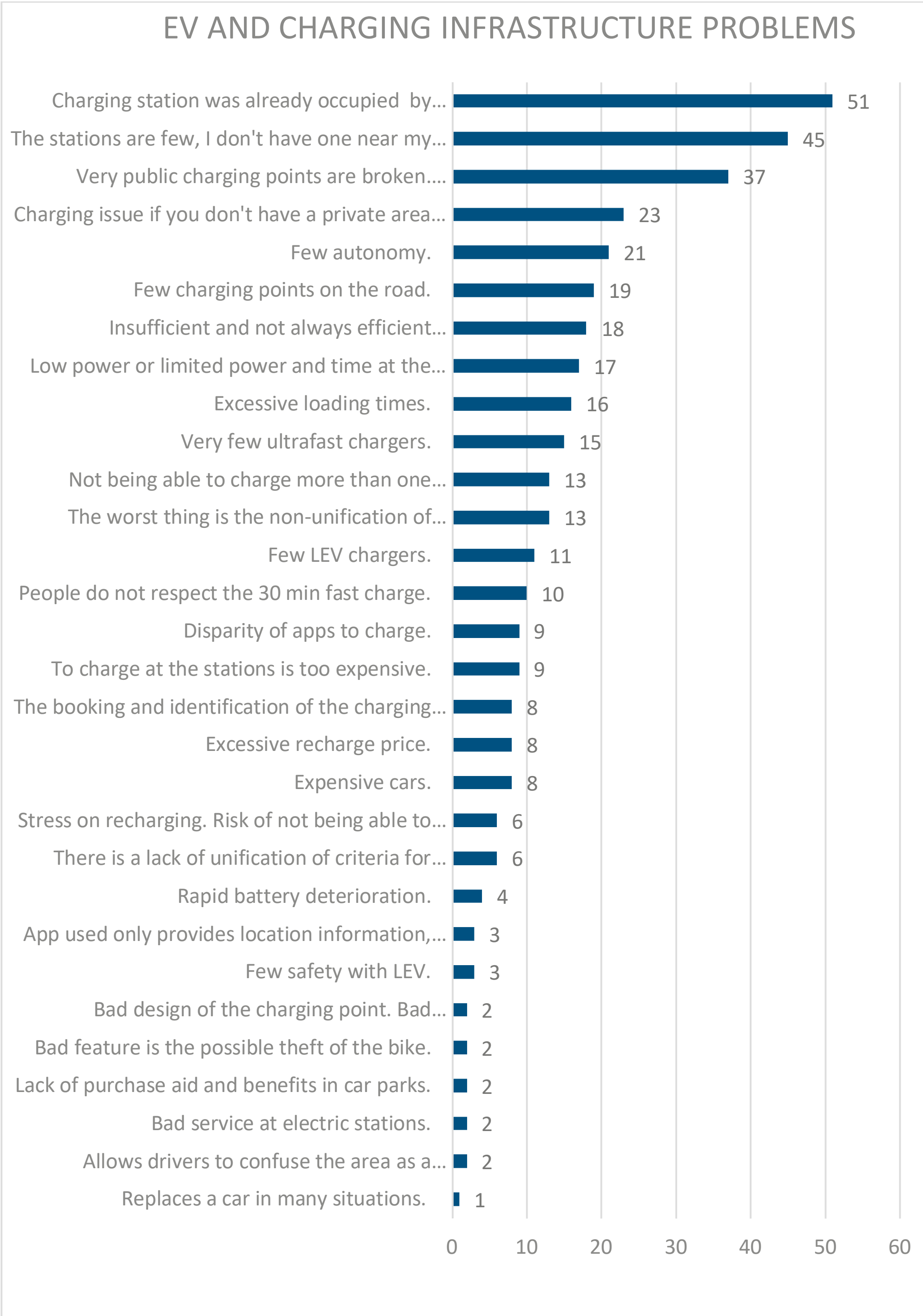
- Currently the participants usually pay through the app, by service contract. This modality of payment is well valued in general. The participants consider that there should be flat rates that improve the cost of sporadic charges.
- Regarding the payment system, some participants claim the possibility to pay with a card, not requiring a subscription to a specific charging network.
- Others proposals are related to the request for apps that unify all functionalities and providers.
- Maybe the only lack is the information provided (price, time, kW, …).

CHARGING INFRASTRUCTURE PROBLEMS

In the following paragraphs, the most relevant answers regarding the charging infrastructure problems are presented:

- The most frequent problems (with more than 20 participants referred it) are related with the infrastructure (except for the autonomy of the EV), in particular:
  - the booked charging station are already occupied by another vehicle,
  - few charging points (don't have near home),
  - very public charging point are broken, low car's autonomy,
  - few charging points of the highway,

Figure 33: Problems related to charging infrastructure



- few efficient charging points,
- low power or limited power,
- excessive charging time
- and few ultrafast chargers.

- By country, the following problems stand out:
    - Hungary: highlights the problems of booking (not well resolved) because of the occupation by cars that are not charging
    - Germany: highlights the problems of the occupation by cars that are not charging and charging station not in operation/broken.
    - Finland: highlights the problems of safety with LEV, no replacement of car in many situations of maintenance and the possible theft of the bike.
    - Italy and Spain: highlights the problems of charging infrastructure, few charging areas and occupied spaces.

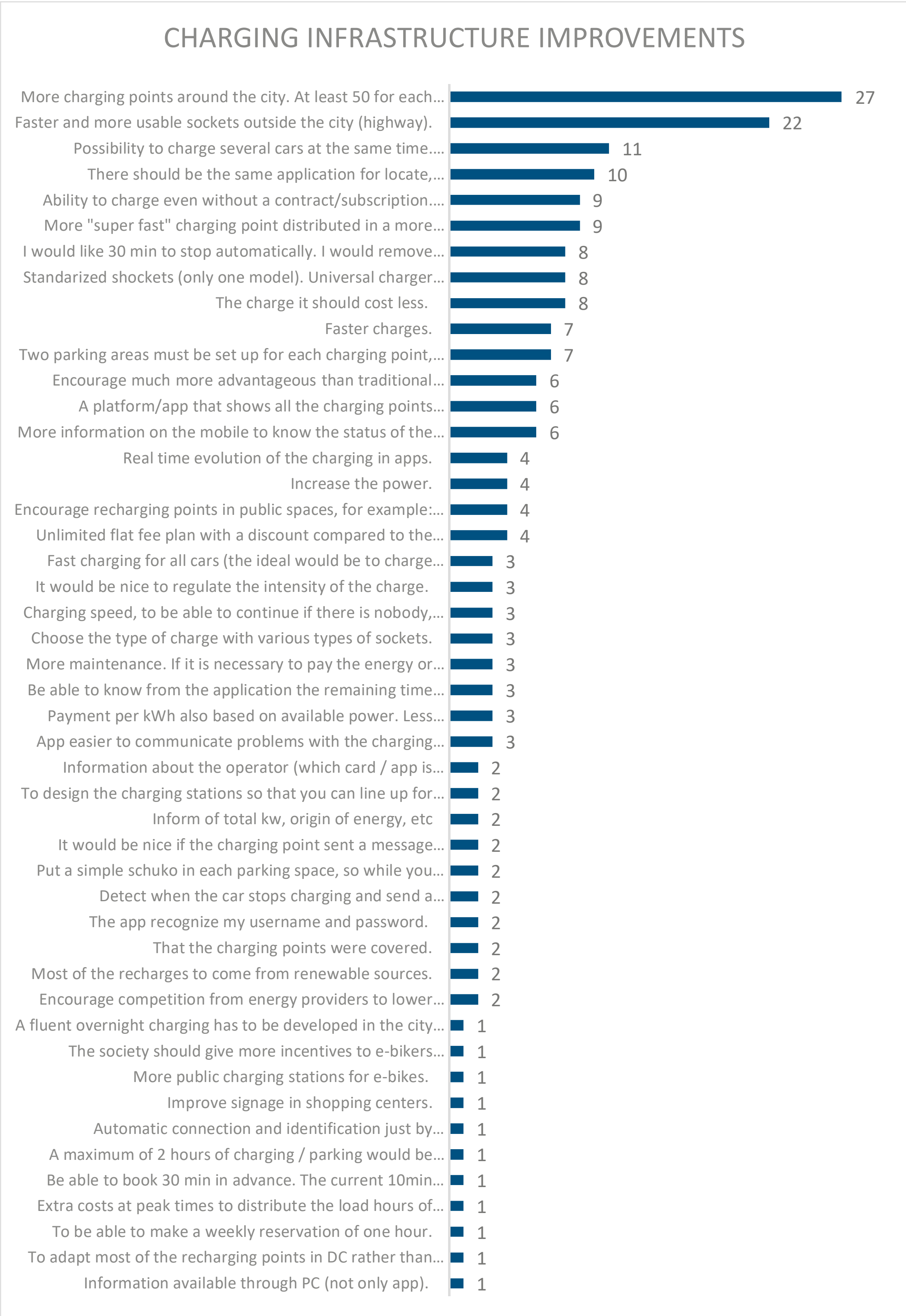
Figure 33 shows all identified problems with the number of mentions made by participants.

CHARGING INFRASTRUCTURE IMPROVEMENTS

In the following paragraphs, the most relevant claims regarding the charging infrastructure improvements are presented:

- The most frequent proposals are the increase of the charging points in the city and the highway, considering improve their faster and usability.
- The improvement more mentioned are:
    - More charging points around the city. At least 50 for each borough. Maybe in the city light poles.
    - Faster and more usable sockets outside the city (highway).
    - Possibility to charge several cars at the same time. Charging points with various types of socket that can be used simultaneously without derating.
    - There should be the same application for locate, navigate, to book the charge them more than 15min in advance, to configure the charge, monitoring the charge and pay the service.
    - Ability to charge even without a contract/subscription. The direct use of a credit card or debit card on the column could be valid without using the App in a way very similar to a petrol station.
    - More "super-fast" charging point distributed in a more intelligent way on the territory.
    - I would like 30 min to stop automatically. I would remove the reservation from the charging point and unplug the vehicle after half an hour.
    - Standarized sockets (only one model). Universal charger for all cars and charging points in all car parks, whether private or public.
    - The charge it should cost less.
    - Faster charges.
    - Two parking areas must be set up for each charging point, since there are two different types of sockets.
    - Encourage much more advantageous than traditional mobility (free recharges, no need to get a ticket since the vehicle is already identified with a blue 0 emissions label, all free tolls…).
    - A platform/app that shows all the charging points regardless of their brand, type of socket, ...
    - More information on the mobile to know the status of the charge.

Figure 34: Identified improvements for charging infrastructure



- All the improvement proposals are oriented to solve the identified problems.
- Many proposals are oriented to new functionalities for a better clear and reliable information in real time and easy the process.

Figure 34 details all the identified improvements proposed by respondents, with the number of mentions.

GENDER KEYS

If we specifically analyze the driving experience of women, it stands out that almost all female participants have children, only one of the participants is over 55 years old, their time of experience in an electric vehicle and driving frequency is similar to the global one (less time of experience is detected) and is detected more use of small vehicles (Renault Zoe, Nissan Leaf ...).

They carry out the charges at home or in shopping centers. It mainly concerns:

- the use of spaces reserved by vehicles that are not charging or occupying the space to charge without respecting the reservation;
- respect for the booked usage time (the reservation is 30 minutes and the user stay longer);
- the low charging capacity of the stations (you can only charge one vehicle, not several at the same time).

Also, they miss more faster charging (more ultra-fast chargers and higher charging power) and reliable information.

CONCLUSSIONS

The main features of the currently situation of the EV charging infrastructure are:

The use of the electric car requires charging planning, since, although many drivers have a charger at home, they need other charging points on their itineraries (charging stations, car parks, ...). The use of apps is a requirement for them.

- There are a large number of apps with very diverse functionalities. Currently, not all of them offer reliable navigation, location and booking of charging points.
  - In apps, problems are detected to identify the chargers that exist, not all of them are offered by the apps. It doesn’t appear in the search.
  - Charging points cannot be selected / filtered properly according to the type of charge (type of socket, power, status, price…).
  - It cannot be booked in the entire network of points, only in the charging points associated with the app.
- Once the reservation has been done and reached the charging point, in many cases the driver finds the place occupied by:
  - Vehicles that have exceeded their pre-reserved charging time and are still charging (booking charging is usually limited to 30 minutes).
  - Electric vehicles that are not charging.

      - Fuel vehicles that use the place as parking.

  - The participants promote changes in the booking typologies such as: increasing the charging time with booking, limiting the charging time with booking to 30 minutes and cutting off the supply when the time comes, making it possible to increase the charging / booking time if there is no waiting vehicles, issue an end of loading notice with booking ...
  - During charging, EV users do activities such as: have a coffee, shop, work, go to the park with the children, wait in the car, ...
  - Participants do not detail charging monitoring experiences that indicate: time remaining to complete the charge, percentage of charge in real time, incidents such as service interruption ... Some users consider that these features should be developed.
  - In the charging points there are usually at least two vehicle charging sockets, but they only admit one charge, so that if a vehicle starts charging at a charging point in use, the service is interrupted. This is another aspect that they consider should improve.
  - Regarding the payment system, the possibility of being able to pay with a card is claimed and not requiring a subscription to a specific charging network. These proposals are related to the request for apps that unify all services and providers.

In the case of LEV users, the experience is totally different. The use of the LEV does not require planning, so the app is not used regularly. Charging is done at homes, although they demand a more extensive, public and free charging infrastructure to cover the need to charge during the day. The problems identified are related to road safety and the possibility of theft of the LEV.

4.3.2 Main findings

The results presented in *Table 15* are the most relevant opinions, selected by importance and repetitiveness, of those expressed by the end users from five different countries that fulfilled the diaries.

Participants in the Field Diary express their satisfaction with electromobility, but they repeat some of the key points detected in the precedent research: charging at home (or even around home) is essential for employing the car in urban and interurban trips, and the use of the car in long range trips requires the availability of a good network of high performance's chargers and additional services. As car electromobility has three main components (cars, infrastructures and apps), these results suggest that the car is the most developed component, which has passed an acceptance threshold, while infrastructures and apps have not yet achieved this threshold.

Regarding additional services, users are thinking how to employ the time taken by the charge. This involves a charging station where different activities can be performed, ranging from work to leisure activities. During the charging time, users demand monitoring tools like *remaining time for charging*, *percentage of charge in real time* or *service interruption alarm*, in order they can manage this waiting time.

To ease the charging process, users foresee free access to charging points without subscribing, and credit card payments. On the other hand, there is a recurrent demand for a procedure that ensures the availability of a charging point when it has been booked in advance.

LEVs are employed in urban trips, and therefore are charged at home, although users demand a more extensive, public and free charging infrastructure.

Regarding gender issues, although most of participants were men, women concerns are represented by the results exposed in the precedent paragraphs. On the other hand, men and women have a similar driver profile, although women use to drive smaller car models.

Table 13: Netnography most relevant results

			Most relevant results
EVs	Differences among countries		• There are no major differences among the three countries (Finland, Germany, Spain). • In both, Norway and Germany, negative feedback on infrastructure (50%), shows many areas for improvement. • In the case of Spain, the percentage of negative comments is higher, 79%. • Negative comments are higher than positive, when talking about EVs: Spain (61%), Norway (67.5%), Germany (56.5%). • The three countries agree on the need to improve on the charging systems at home and on route.
	Charging system at home	Barriers	• There is a great unknowledge about the benefits of EVs or real autonomy; this a barrier for the acquisition. • There is a general lack of knowledge about the charging systems: typology, compatibility, how it works, or how to pay. • EVs must be charged at home and at worksite; infeasibility of home charge, inhibits the EV purchase. • There is a lack of training and knowledge of professionals who sell and repair EVs. • Lack of incentives and aid to install EV charging systems at home or community parkings. • Installing EV chargers in community parkings is difficult.
		Improvements	• More information about EV benefits; resolution of frequent doubts. • More incentives from the public and private sector. • System that guides users in the use of the EVs charging network: manage the planning, use and payment in a unified way. • Public car parking lots for EVs, for facilitating charging in urban areas. • Incentives or legislation for companies to set up exclusive areas for EV charging
	Charging systems on route	Barriers	• There are many different operators in each country; unified loading system, incompatibilities in access and payment methods. • Lack of maintenance, especially in the free EV charging infrastructure. More fast chargers are required • Users need to know if the charging points are busy; make a reservation. ICEVs occupy the parking lots for EVs. • There is a demand for some system or guide to help planning long range routes. • Managing the time required for charging EVs; to control the time the vehicle is going to be on charge, and charging power • Price regulation at private EV charging points; prices are too high. • Adequacy of service areas (charging points): with additional services.
		Improvements	• System that guides users in EV charging points, managed in an unified way: planning, use and payment • Improvement of the EV charging point network: more charging points, more fast chargers on route, and better maintenance. • Possibility of regulating power and time of EV charging point.

			• Adequacy of service areas. • Price regulation.
LEVs	Barriers	e-Bike	• Electric bicycle (68% of positive comments) is the best valued LEV: they are great for going to work or shopping. • The weight of e-bikes must be improved (greater than conventional bikes), and there is no variety of sizes. • They need charging every day, and the user has to handle a heavy bike or a detachable battery, what is not very ergonomic. • Batteries last only 3-4 years, and bike lanes in Spain are scarce or saturated with other LEVs
		e-Scooter	• The e-Scooter is the second best valued LEV, with 58% of positive comments. It is a great vehicle for cities and for short trips. • They are easy to store and transport due to their weight and folding frame. • They are considered dangerous by the users themselves, (falls), as well as dangerous for pedestrians. • In general, they have problems of coexistence and circulation with other vehicles and pedestrians.
		e-Motorcycle	• The e-Motorcycle collects more negative aspects (52%). • They have low autonomy and high price. • The charging infrastructure and the technical service are poor, and apps have a lot of failures.
	Improvements		• Free urban parking lots for bikes and electric motorcycles with charging points (to overcome the charging at home or work). • More electric bike and scooter lanes, and safer lanes. • Fast charging points well distributed throughout urban and road areas. • Managing the search for charging points, availability, occupancy and conservation status in a reliable way. • Standardized charging points for all EVs, including a simple and reliable payment process.
Chargers distribution and Typology		Barriers	• Norway is the country with the most charging points and connectors per inhabitant (1/2,000), including TESLA charger network. • Spain is the country with less charging points (including superchargers). Regarding connectors, there are as much as in Germany. • In general, there is an unequal distribution of charging points; more concentration in cities and richer regions. • In Germany, there seems to be a more equitable distribution throughout the territory. • The amount of chargers per inhabitant in similar in Germany (1/10,000) and Spain (1/9,000).
		Improvements	• Study on the distribution needs of charging points. • More EV charging points (faster charging) on the road, and not so much in urban centers. • Equitable distribution all around the different territories

Table 14: Delphi questionnaire's most relevant results

Most relevant results		
Urban mobility plans **UMP**	Management	• Cities main concerns are: Increase locations, Promote the public transport, Easy access, and Users friendly app and payments
	Priorities & Improvements	• Main pending improvements related to charging needs are: Good coverage, Availability of AC charging infrastructure on the (small) neighbourhood level, Overnight parking, Shop & charge, Streetlight-parking. • The technology is not mature enough; EVs with current technology are only feasible for specific uses. • Environmental issue inadequately addressed: congestion reduction. It requires urban planning and public transport.
Supporting Technologies **EMSP & CPO**	Cities charging infrastructure's technical features	• Between 6-12 % of all parking spaces should be equipped with charging possibility to sustain an electrified fleet in the city. • Key locations for charging stations: Shopping malls, Parking lots, Gas stations, Curb side, Public parking lots & Mobility hubs. • The most important features are: Speed of the load in the vehicle, and Normal credit/debit card paying. • Sockets Type2-ChaDeMo-CCS and AC/DC charging technology: the two most implemented current features. • Location, Interoperability and Standardization: the most important issues for improving the charging points.
	Services for users	• To lower the charging power depending on the service package that customer is using. • MSPs consider key features: The speed of the charge and Normal credit/debit card paying option • MSPs consider interesting features: Minimum time, Lowest price, and Maximum percentage of green energy. • Service remotely accessed: user starts the charging via mobile application and the points are operating 24/7.
	Information flow	• MSP-CPO communication protocol: via phone and email, or using the system *Open Charge Alliance*. • DSOs do not send any data. They have their own energy meters. • A fast and accurate power metering to authenticate the changes in power (up- or downshift in power). • Frequently the voltage drops and the constant exchange of information is needed. • The type of data for sharing is: In demand stress situations, Power limitations, Flexible pricing, V2G requirements, Energy origin /energy mix, and Energy amount to supply.
Charging Point Operators protocols **EMSP & CPO**	---	• Currently, the used protocols are: OCPI 2.2 and OCPI 2.0. Other used versions: OCPP-J 1.6 and OCPP-S 1.5. • OCPI 2.2 protocol allows communication of the maximum charging power in kW to the EMPs. OCPI 2.2 supports the concept of roaming hubs with different sub-operators. Improved releases with more roles and smart charging options are required. • USER-CHI charging infrastructure should be OCPP compliant.
Charging management **DSO**	---	• Most common features of the current systems: Charging point status, Power limitation, Amount of energy to supply, and Monitoring of usage of charging. stations. • CPOs: dynamic charging management could be advantageous, as facilitates cost optimization. • The most frequent parameters for fixing the fees are: Power supplied (kWh) and Parking time.

	• The buy of electricity with fixed price and fully renewable is a current practice. • Additional information provision is under discussion among CPOs. • Information options positively valued: Ecological footprint, Reduction in CO_2 emissions, Charge planning, Time the charging infrastructure is blocked by a non-charging car, Electricity mix, and User preferences.

Table 15: Field Diary's most relevant results

		Most relevant results
User profile		• EV driver's profile: man (80%), between 26-55 years old (70%), high school or college degree background (63%), with 1-2 years of experience (42%), urban driver (46%) with Its own car (71%).
Charging process rating		• The users of EVs are highly satisfied with the EV experience (average of 4.08 out of 5). Almost all report that they will buy an electric vehicle again.
Charging experience	Planning	• The use of the electric car requires charging planning for charges out of home. The use of apps is a requirement for them. • Many different apps are available with very diverse functionalities. Currently, not all of them offer reliable navigation, location and booking of charging points.
	Access & Authentication	• Once the reservation has been done and reached the charging point, in many cases the driver finds the place occupied. • Some users claim that charging without subscription would be an improvement (no personal data and paying with credit card).
	Charging process	• During charging, EV users do activities such as: have a coffee, shop, work, go to the park with the children, or waiting in the car. • Monitoring features (remaining time for charging, percentage of charge in real time, service interruption alarm) are required.
	LEV's charging process	• The use of the LEV does not require planning, so the app is not used regularly. Charging is done at homes, although they demand a more extensive, public and free charging infrastructure.
Problems		• Most frequent problems: the booked charging station is occupied, lack of charging points around home and in the highway, public charging points out of order, lack of efficient charging points (limited power, excessive charging time and few ultrafast chargers.
Improvements		• Most frequent proposals: the increase of the charging points in the city and in highways, improving usability and power (speed). • Other improvement proposals: to increase the performance of the current infrastructure.
Gender keys		• Almost all female participants have children, only one of them is over 55 years old. Driving frequency is similar to the global sample but their experience with an electric vehicle is slightly lower, and women use smaller vehicles (Renault Zoe, Nissan Leaf, ...). The global data represents women's concerns.

4.5 Survey

Annex 5: Survey's results report includes the full report of the results obtained in the survey. The results presented in this section are the most relevant answers, selected by importance and repetitiveness, of those expressed by the drivers and riders from six different countries, that participated in the survey.

4.5.1 EVs

The total EV sample is **688 EV users**, distributed among 6 countries: Finland, Germany, Hungary, Italy, Norway and Spain. (*Table 4*).

Considering geographical issues, we can divide the sample into three blocks:

- The **North of Europe** (Finland and Norway) is the **18,3% of sample**.
- **Central Europe** (Germany and Hungary) is the **41,6% of sample.**
- The **South of Europe** (Italy and Spain) is the **40,1% of sample**.

The sample is not stratified (neither by gender, nor age, nor geographic distribution), therefore the representation in terms of gender and age are geographically distributed according to the EV driver profile.

The sample is geographically concentrated in the capitals or main cities of each country studied. In addition, participants are also located in industrialized and wealthy areas of studied countries, as shown in *Figure 35*.

In Italy, the sample is concentrated in the Northern area, specifically in the Lombardy region, and also in the main cities such as Milan and Rome.

In Hungary, participants are mainly concentrated in the capital, Budapest.

In Germany, the sample is concentrated in the main cities such as Berlin, Munich, Frankfurt, Colonia and Hamburg. Above all, the largest concentration is in the West (North Rhine-Westphalia).

In Norway and Finland, the sample is concentrated in the main cities such as Helsinki and Turku (Finland), or Oslo and Bergen in Norway.

Finally, in Spain the sample is concentrated in the main cities such as Madrid, Barcelona and Valencia.

Figure 35: Distribution of EV drivers' sample

Age and Gender

Regarding participants per gender, the percentage of men is 61% and of women 39%. If we compare the number of EV drivers and ICEV drivers per gender, differences increase in Germany, Hungary and Norway. On the contrary, Italy and Spain minimize differences between men and women with the EV (*Figure 36*).

Figure 36: Differences of Gender (EV vs ICEV)

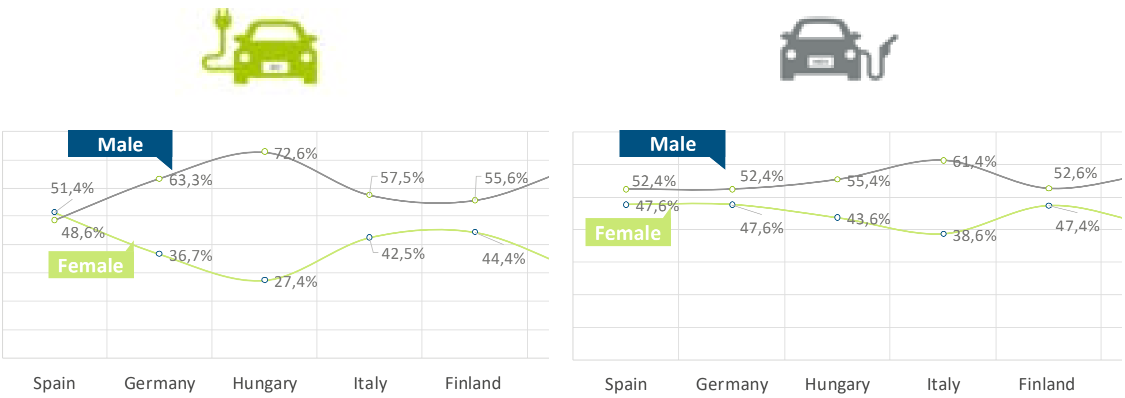
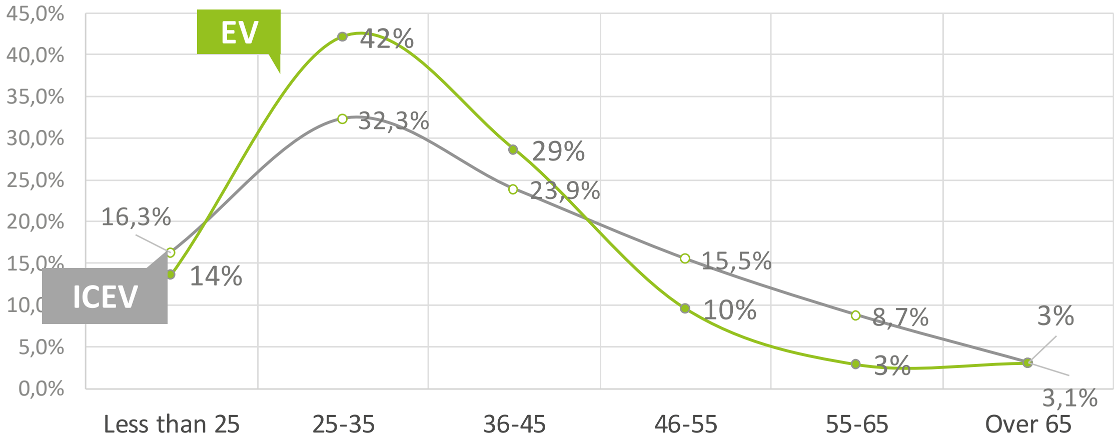


Figure 37: Age differences between EV drivers and ICEV drivers

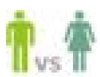


According to age, 71% of participants are between **25 and 45 years old**, and 56% are less than 35 years old. If we compare the sample of EV and ICEV drivers, EV drivers are younger than ICEV drivers (*Figure 37*).

Profile of EV driver

Most of respondents drive alone (57.6%) or with the family (51.3%). Only in the case of Spain, participants drive with the family (partner or partner with children) or with children rather than alone (*Table 16*). In Spain and Italy, the percentages of *driving with children* is significantly higher than in other countries. This result seems to be related with that shown in *Figure 36*, stating that in Spain and Italy there are as many women as man using EVs.

Table 16: EV's profile

	• In **Spain and Italy**, women significantly drive more with children. • In **Norway** there are no women who share a car. • In **Italy**, there are more men than women who go alone, and when they travel as a family, the man drives.

Regarding the **educational background**, **56.5%** of those surveyed (EV drivers) **have higher education,** against 41.3% of ICEV drivers. Therefore, **EV drivers have higher education than ICEV drivers**.

Figure 38: Differences in *It is my property* between EV drivers and ICEV drivers

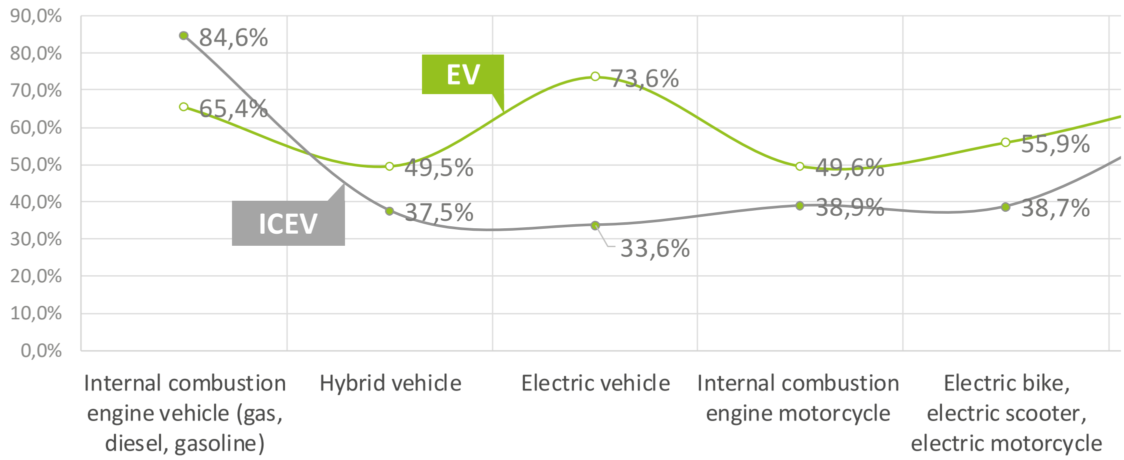
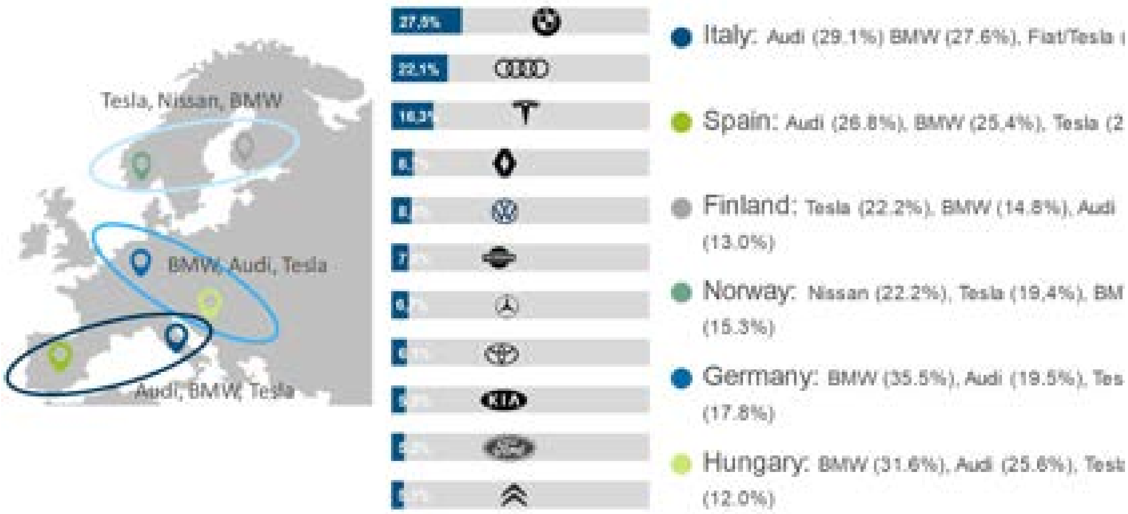


Figure 39: Most used car brands of EVs



The EV users **drive 5-7 days a week and the EV is its property**. ICEV drivers use their own car in a similar way (5-7 days a week and they are proprietaries), what suggests that the EV substitutes the ICEV.

On the other hand, **the EV driver is diverse in mobility resources**, as he uses different vehicle's technologies, in any case more than ICEV drivers (*Figure 38*).

The most used EV car are from premium manufacturers (high-end brands). These brands are (*Figure 39*) BMW (27,5%), Audi (22,1%) and Tesla (16,3%).

Satisfaction, Best and Worst aspects of EVs

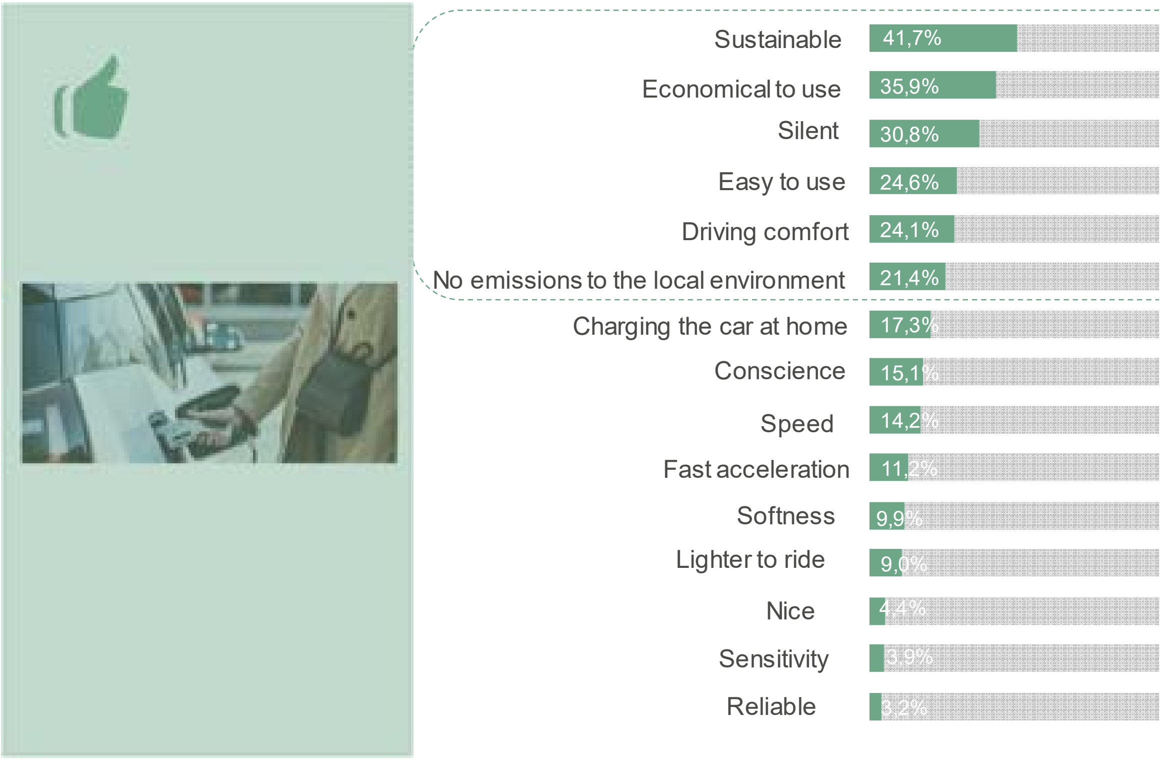
The satisfaction level with the EV is high, 4.4 out of 5.

Table 17: Satisfaction level per geographical area

- Satisfaction in **Southern Europe** is **4.5 on average**
- Satisfaction in **Central Europe** is **4.5 on average**
- In **Northern Europe** (Finland and Norway) **the average is lower (4.2**). They are more critical.

EV drivers participating in the survey consider that best aspects of EVs (*Figure 40*) are *Sustainable / No emissions to the local environment* (63.1%), *Economical to use* (35.9%) and *Silent* (30.8%).

Figure 40: Best valued aspects of EVs by EV drivers



On the contrary, the worst valued aspects of EV (*Figure 41*) are *it´s an expensive car* (35.3%), *low autonomy* (27.2%) and *low duration of batteries (*25.1%).

Figure 41: Worsts valued aspects of EVs by EV drivers

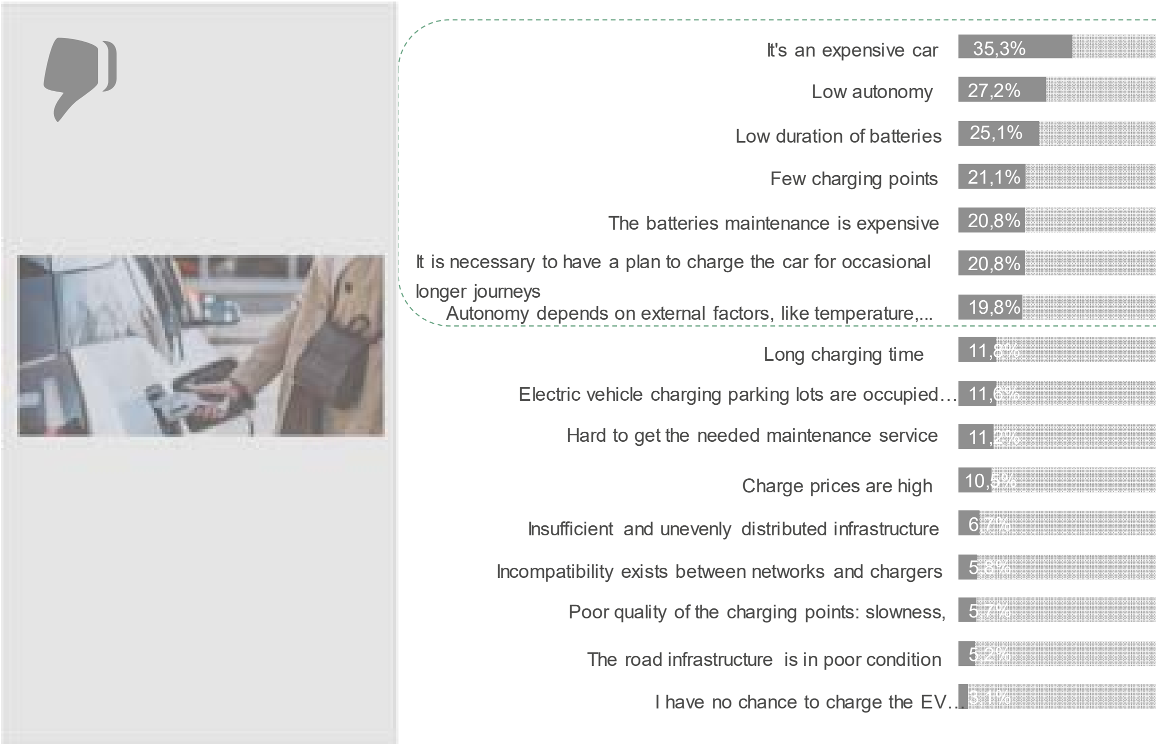


Table 18 summarizes the differences between EV drivers and ICEV drivers when assessing the EV.

Table 18: Main differences assessing the EV

Best aspects of EV

- The **differences between ICEV and EV drivers' ratings** are:
  - ICEV drivers consider it to be *Economical to use* more than EV drivers
  - Driving comfort is better rated by EVs
  - Questions related to *Sustainability* are best valued by EV drivers
  - The main motivation of EV drivers would be related to sustainability and ecology

Worst aspects of EV

- **EV drivers** consider the aspect *it's an expensive car* more critical than ICEV drivers
- **ICEV drivers** consider the aspects related to the autonomy of the batteries more critical; *Low autonomy* and *Low duration of batteries* are more critical for them
- Likewise, **EV drivers** consider the following aspects more critical: *Electric vehicle charging parking lots are occupied* and *Charge prices are high*

Consumer's purchase intention

93.7% of the sample of EV drivers would buy an EV again (*Figure 42*). The countries of Northern Europe (Finland and Norway) are those which show a lowest predisposition to buy an EV again (*Figure 43*). Anyway, values are high enough: Finland has a 3.19 average, and Norway has a 3.40 average.

EV users employ the vehicle in *Urban / Interurban area: I'm a user with my own vehicle* (54.2%); in Norway, this percentage is significantly higher (72%). Most of the respondents have been using the EV during the last two years (*have / use EV for 1-2 years*, 49.7%, and *less than 1 year*, 28.2%).

Figure 42: EV driver purchase intention

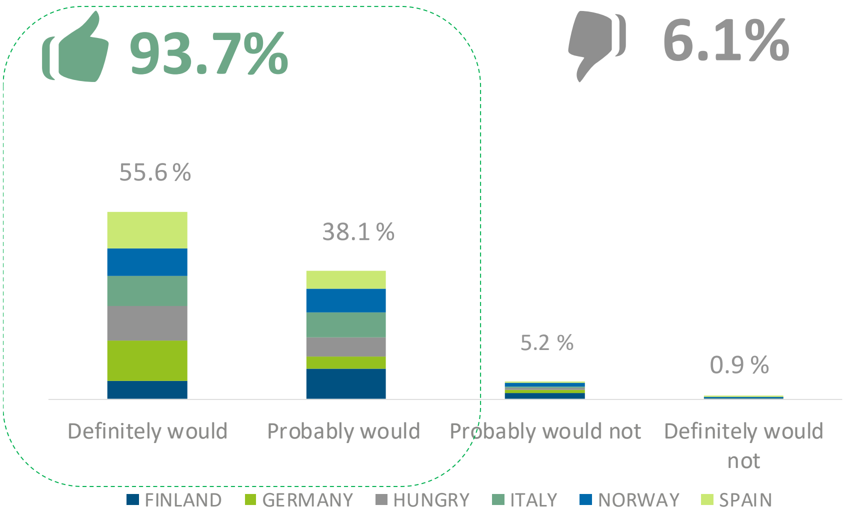


Figure 43: Predisposition to buy an EV again

Table 19 presents a purchase intention comparison of EV drivers and ICEV drivers. There is consensus among drivers for buying an EV as their next vehicle, although regarding the use of the vehicle, ICEV drivers employ it more for long distances.

Table 19: Purchase intention of EV drivers and ICEV drivers

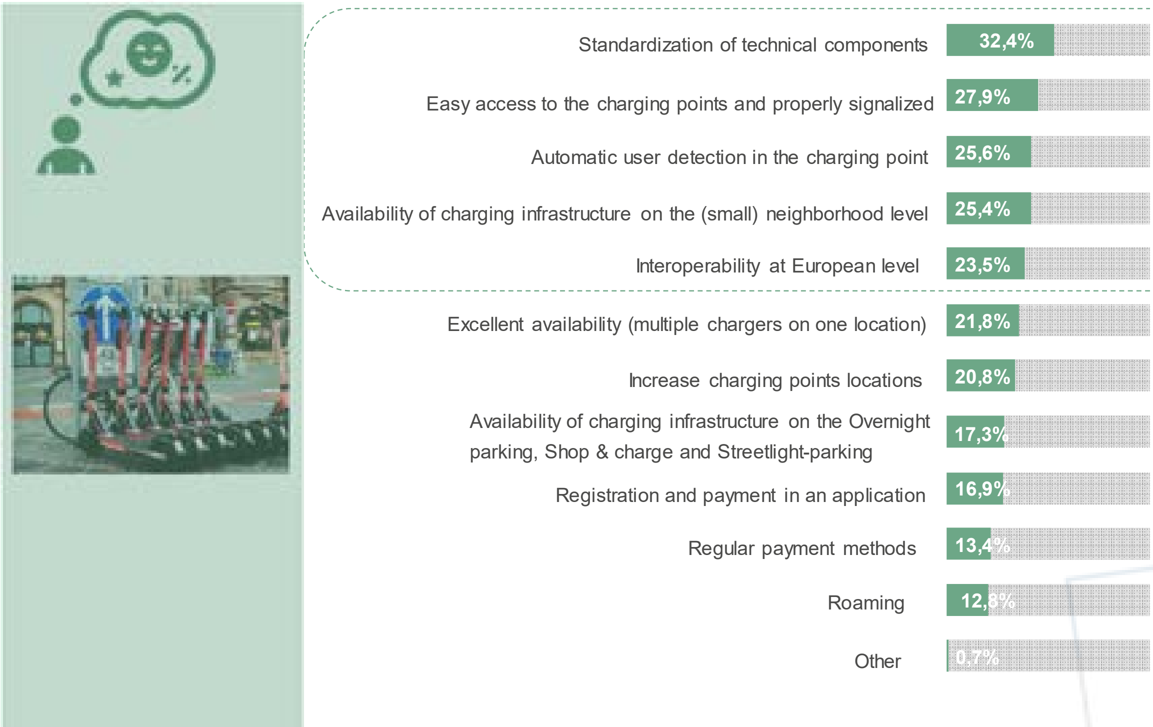
	• **Both EV and ICEV drivers would buy an EV as their next car.** • 93,7% of the sample of EV driver in front of 72.7% of the sample of the ICEV drivers. • **More professionals use EV than ICEV**, and **ICEV drivers** use it more for ***long distance: I´m user with my own vehicles***.

Electromobility plans

According to survey respondents (*Figure 44*), the most relevant aspects that the new generation of charging stations must have are:

- Standardization of technical components (32.4%)
- Easy access to the charging points and properly signalized (27,9%)
- Automatic user detection in the charging point (25,6%)
- Availability of charging infrastructure on the (small) neighborhood level (25,4%)
- Interoperability at European level (23,5%)

Figure 44: Most relevant aspects of new charging stations



In addition, EV users expect within the next 3 years to have access to between 200 and 1000 charging points in their city (56,2%).

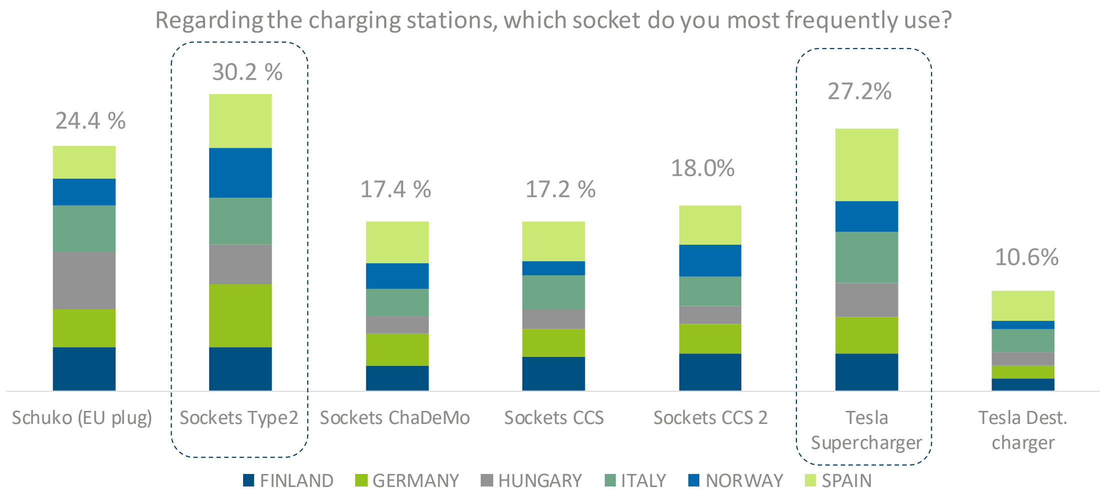
Charging infrastructures elements and technologies

Figure 45 presents the most common sockets per country, employed to charge the EVs. The most used sockets are *Sockets Type2* (30,2%) and *Tesla Supercharger* (27.2%). On the other hand, *Table 20* describes which are the most common sockets employed per geographical area. *Sockets Type2* and *Schucko (EU plug)* are the most employed system all around EU.

Table 20: Most used sockets per geographical area

- Most sockets used in **North of Europe** (Finland and Norway) are **Sockets Type2, Schuko (EU plug), Tesla Supercharger**
- Most sockets used in **Central Europe** (Germany and Hungary) are **Sockets Type2, Schuko (EU plug)**
- Most sockets used in **Suth of Europe** (Italy and Spain) are **Tesla Supercharger, Sockets Type2, Schuko (EU plug).**

Figure 45: Most used sockets per country



Service features

The main features of the system and the service that users employ today are (from highest to lowest percentage):

- Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved (43.3%)

- Monitoring of usage of charging stations in place (27.0%)
- Contactless payment (22.0%)
- Power limitation for obtain a lower price (21.4%)
- Complex micro-mobility backend services for Light Electric Vehicles (including monitoring, user interface, payment, integration with other smart city backend services*)* (18.2%)
- Consumption data of charge session (18.0%)

Table 21 presents the most relevant differences per country, of the system features employed by the users.

Table 21: Differences among countries in the system main features

- *Complex micro-mobility backend services for light electric vehicles (including monitoring, user interface, payment, integration with other smart city backend services)* significantly less used in **Finland (**9%) and **Norway** (4%)
- In **Spain**, the use of: *Energy limitation to obtain a lower price* and *Total charge in minimum time* stands out.
- In **Italy**, the use of: *Pre-reservation* stands out.
- In **Hungary**, the use of: *Energy availability* and *Display at the charging point* stands out.

On the other hand, the features that users claim to be more interested in are (from highest to lowest percentage):

- Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved *(*28.9%)
- Complex micro-mobility backend services for LEV (25.9%)
- Monitoring of usage of charging stations in place (25.6%)
- Power limitation for obtain a lower Price (21.5%)
- Pre-booking (20.2%)
- Contactless payment (18.2%)

Table 22: Differences among countries in the features the users are more interested in

- In **Spain**, there is greater interest in *Total load in minimum time*
- In **Norway**, there is more interest in *Total charge at the lowest price*

Figure 46: Differences between *the features they employ actually* and *the features they are more interested in*

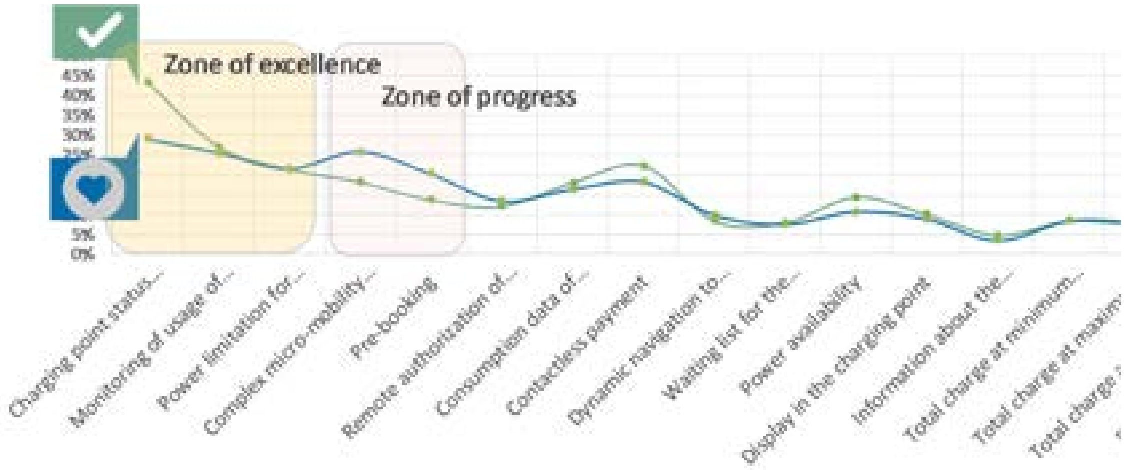


Figure 46 presents the differences between the features that users employ today and the features they are more interested in. The graph evidences two key areas standing out:

- **Zone of Excellence**: where are the features (employed today and those that condense more interest) which concentrate users preferences (three higher rates). These features are related with an excellence service, and they are:
    - Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved)
    - Monitoring of usage of charging stations in place
    - Power limitation for obtain a lower Price
- **Zone of Progress:** features to be addressed by priority due to their high interest in them. These features are:
    - Complex micro-mobility backend services for Light Electric Vehicles (inc. monitoring, user interface, payment, integration with other smart city backend services)
    - Pre-booking

Regarding the criteria for fixing fees, survey's participants stated that the main criteria employed today are:

- Time (considering day of the week, and the time range) (65%)
- Supplied power (54%)

The users stablished as wishing criteria:

- Parking (the time occupying the parking slot without being charging) (46%)
- Supplied power (42%)

Charging experience

According to *Figure 47*, where EV is most charged is *At home* (62%) and *Public parking* (31%). Where the EV is least charged is *At highways* (15%), *Private parking* (16%) and *Shopping center* (17%).This result highlights the idea that the availability of a charging point at home (private or public), is critical for using an EV.

In all the countries surveyed, charging away from home takes usually *Between 31 and 60 minutes* (33.6%) or *Between 26 and 30 minutes* (24.0%). In all surveyed countries, the charging power is *Between 6 and 25 kW* (37.5%) or *Between 26 and 50 kW* (34.2%).

Figure 47: Places where user usually charge

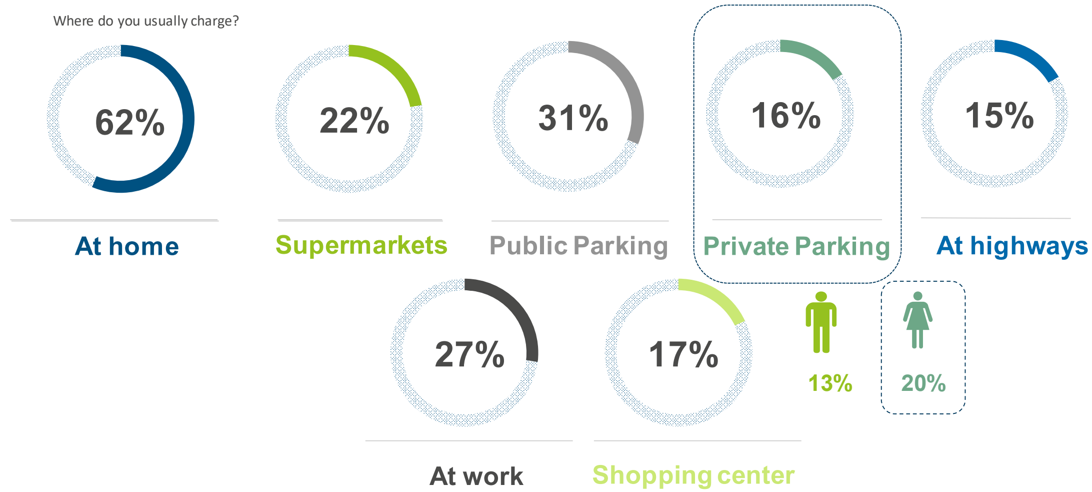


Table 23 shows differences among countries in the places where drivers usually charge. Regarding gender differences,

Table 24 presents some topics that are perceived differently between man and woman.

Table 23: Differences among countries in places where usually charge

- In **Finland**, EVs are charged more in *Supermarkets* and *Shopping centers*
- In **all countries** it is charged in *Public Parking* **except in Hungary and Norway**, which is charged less.
- In **Spain** it is the only country where it is significantly charged in *Private Parking*, more than in the rest of the countries.
- *At Work*, EVs are charged in **all countries except Italy and Hungary**

Table 24: Gender differences related to EV charge

vs	• Women park more in *private parking;* it could be related to security • Likewise, in **Norway** more women than men want points in supermarkets, perhaps because they go shopping more. • Women would like to have more charging points *At home;* it could be related to security.

In all the surveyed countries, there is a lack of charging points (*Figure 48*) in *Public parking* (52%), *Supermarkets* (40%) and *At highways* (41%). These locations correspond to places where users usually charge, what involves that the lack of charging points at there, is a relevant improvement in the charging network.

Figure 48: Locations where *users usually charge* vs *Lack of charging points*

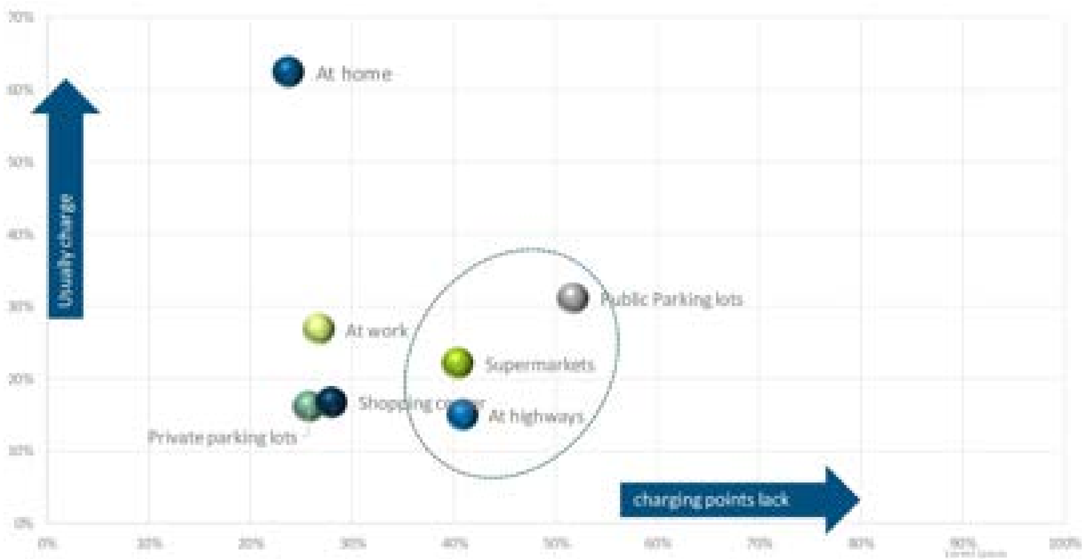
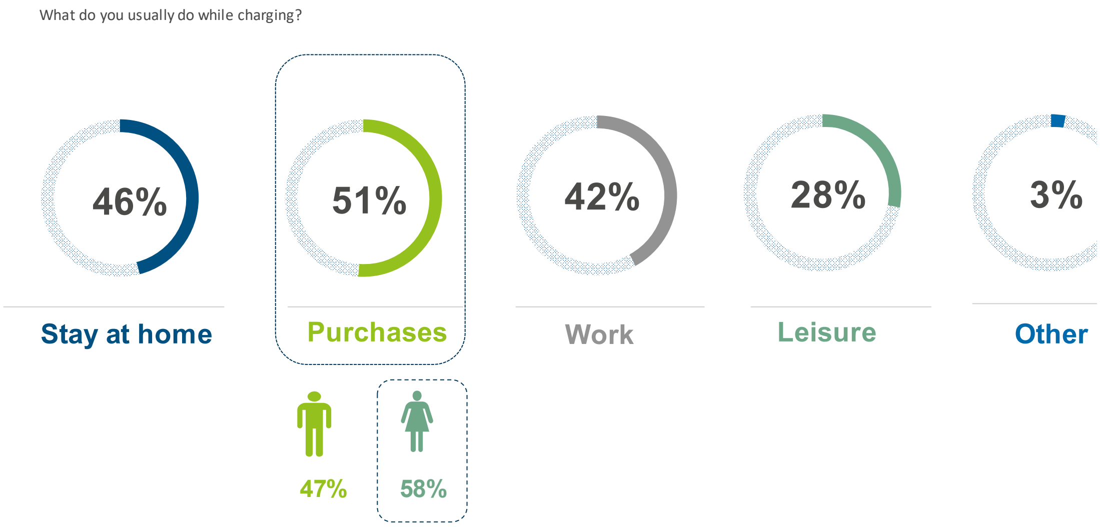


Figure 49 presents the main activities performed by the users while charging. Users mainly make *Purchases* (51%), *Stay at home* (46%) or Work (42%). Only users of two countries (Germany and Norway) *Stay at home* during the charging, as a first option.

Figure 49: Activities performed by users while charging

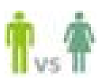


On the other hand, the main problems and challenges that confront users when charging their EV at CPs are (from highest to lowest percentage):

- Charging time is limited (30 minutes is not time enough for 100% charge) (30.4%)
- One plug per charging point. Simultaneous charge of EVs unavailable (27.0%)
- Lack of charging points (27.0%)
- Lack of information about availability (18.2%)
- Malfunction, lack of maintenance (18.0%)

In addition, Table 25 shows the main differences in the type of activities performed by women and men while charging.

Table 25: Differences in the activities performed by men and women

 	• **Women** charge more EV during *Purchases* (58%) than *Stay at home* (44%) • **Men** charge while *Stay at home* (47%) and while make *Purchases* (47%) • **Men** consider the *Low charging speed* point more problematic than women

In relation to charging apps (*Table 26*), their average rating is very high (4.2 out of 5). The most used apps are *Tesla* (23%) and *Easycharger* (15%). Some users do not use any app (14%), probably because they regularly do the same route.

The best rated apps are: *Virta* (4.5), *AMB* (4.5), *K-lataus* (4.5). *Ibil*, *Nextcharge*, *Duferco* and *Enel X* are also very well rated, with 4.4 out of 5.

Table 26: Apps rating per geographical area

	• In general, the North of Europe (Finland and Norway) are most critical than other parts of Europe (South and central Europe). • Average of App rate in North of Europe: 3.8 • Average of App rate in Central Europe: 4.2 • Average of App rate in South of Europe: 4.3

Figure 50: Ratings for the charging process per country

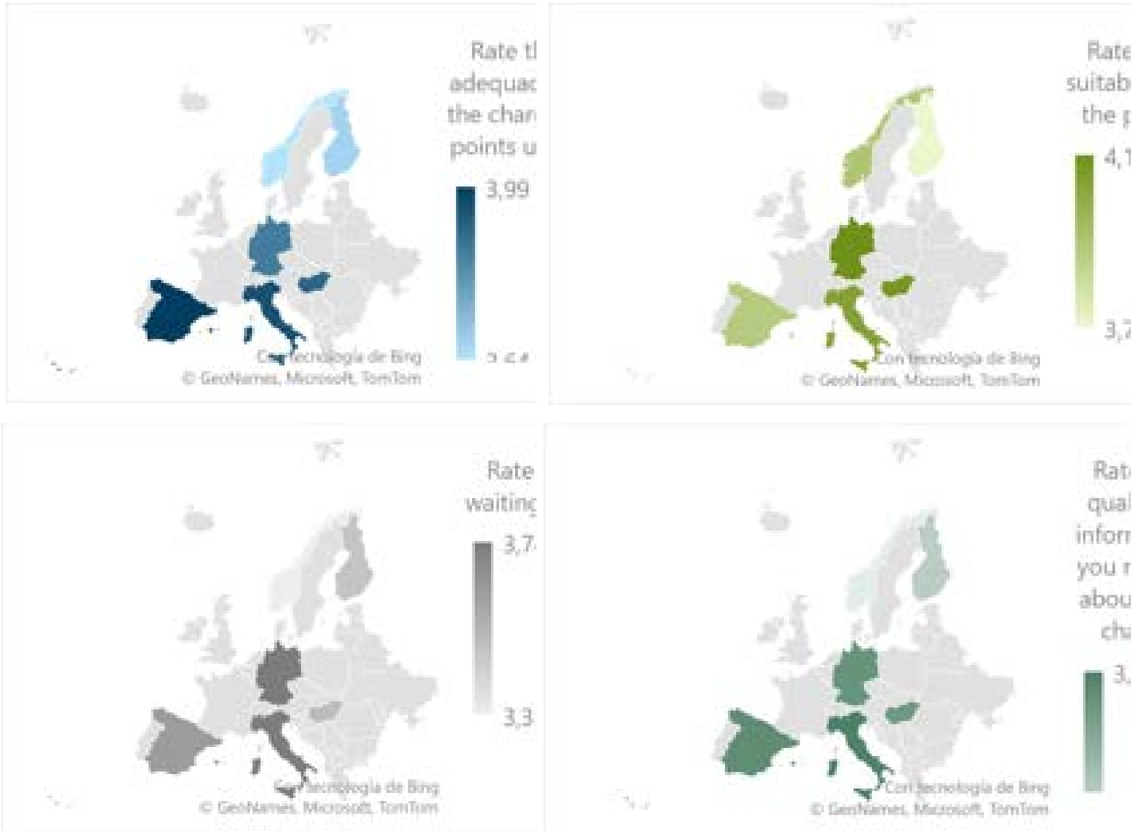
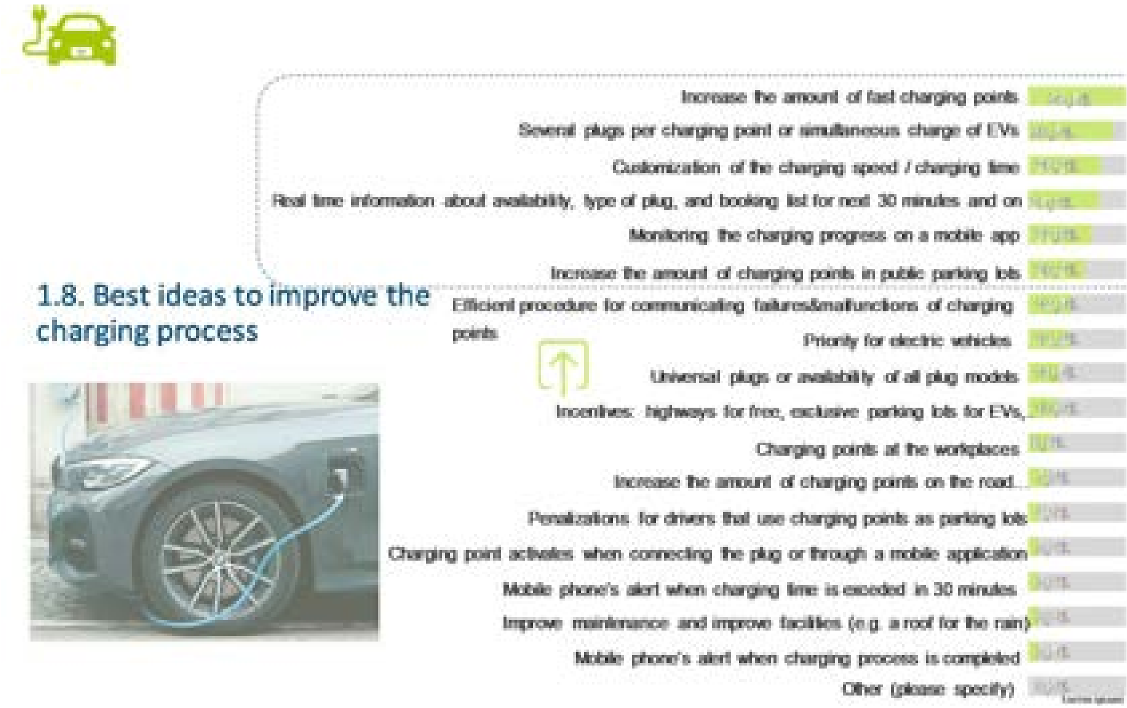


Figure 50 presents the ratings per country for diverse actions related to the charging process. The mean average values for these ratings are:

- The average of adequacy of charging points is 3.9 out of 5.
- The average of the suitable plugs is 4.0 out of 5.
- The average of the waiting time is 3.6 out of 5.
- The average of the quality of information about the charge is 3.8 out of 5.

In the countries of Northern of Europe, all ratings related to the charging process (*Figure 50*) are lower than in the rest of the countries in the study. This is a trend that appears along all the study.

Figure 51: Best proposals to improve the charging process



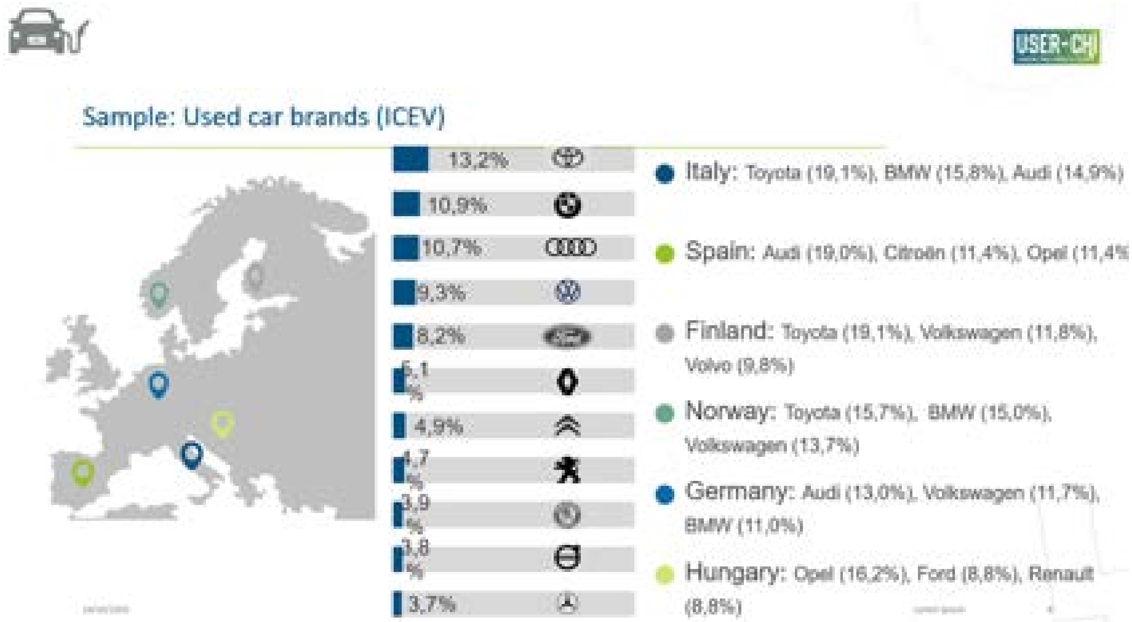
Best proposals to improve the charging process collected in all countries, are presented in *Figure 51* The ideas that concentrate a higher consensus are:

- Increase the amount of fast charging points (39.5%)
- Several plugs per charging point or simultaneous charge of EVs (30.5%)
- Customization of the charging speed / charging time (26.2%)
- Real time information about availability, type of plug, and booking list for next 30 minutes and on (25.6%)
- Monitoring the charging progress on a mobile app (22.8%)
- Increase the amount of fast charging points (20.2%)

4.5.2 ICEVs

A total number of 1,108 people (*Table 4*) has responded to the Internal combustion engine vehicle (ICEV) questionnaire. The participants are distributed between 55.2% men and 44.3% women. The most representatives age range are 25-35 years old with 32.3% of the users and 36-45 years old (23.9%). And, the most representative educational background of the ICEV driver sample are: High school degree (31.1%); College degree (.75) and Master degree (31.5%).

Figure 52: ICEV brands

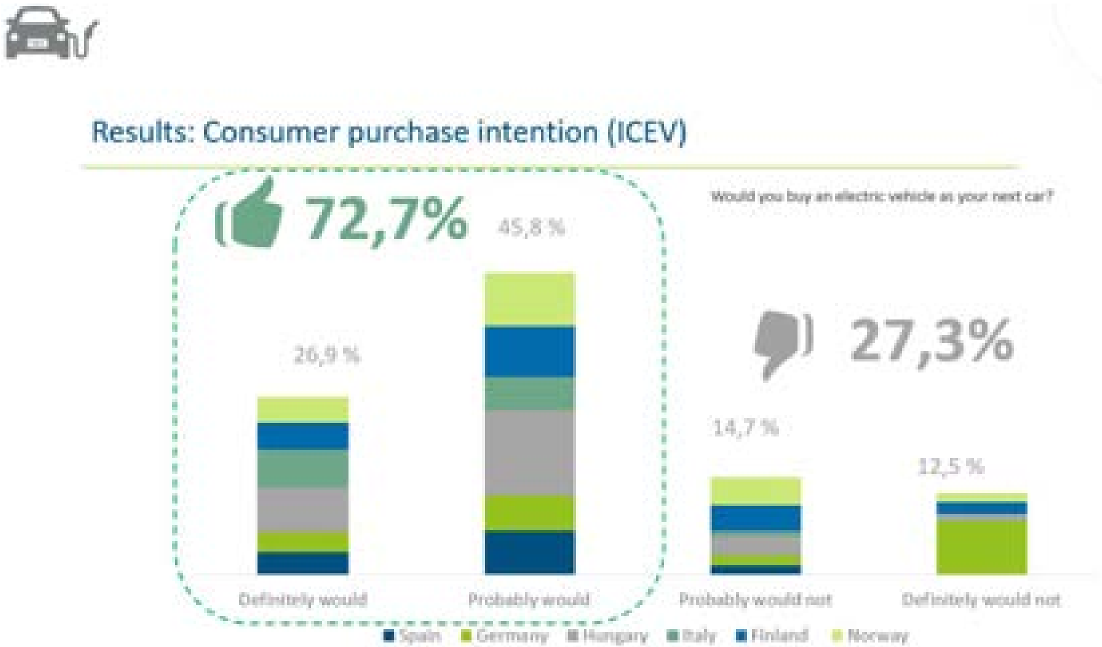


Most of the participants drive alone (56.5%) or with the family (52.7%). Only in the case of Spain is the most frequent mode of driving with a mate (69%), rather than alone (51%).

Regarding the experience of ICEV use, the ICEV is the type of vehicle with the highest frequency of use and the highest percentage of ownership: 84.6% of ICEV drivers are owner of the vehicle; 40.8% of ICEV drivers use the vehicle 5-7 days a week. The ICEVs are used for urban/interurban area (64.3%) and long distance (33.4%).

The most frequent ICEVs brands are (*Figure 52*): Toyota (13.2%), BMW (10.9%) and Audi (10.7%), although in Spain and Hungary Opel, Citroën, Ford and Renault are also among the most popular.

Figure 53: EV purchase intention (ICEV)



The satisfaction of ICEV drivers with their vehicles is a 4.4 on average on a scale of 1 to 5. Italy stands out with the highest average valuations (4.7) and Finland with the lowest (4.1). But the ICEV driver is open to the purchase of the EV (*Figure 53*). 72.7% of the participants consider purchase an electric vehicle (EV) in the future versus 27.3% that would not purchase an EV.

Figure 54: Best valued aspects of the electric vehicles (ICEV)

From the point of view ICEV drivers, the most relevant positive aspects[5] of electric vehicles are (*Figure 54*):

- Economical to use
- Sustainable
- Easy to use
- Silent
- No emissions to the local environment

Figure 55: Worst valued aspects of the electric vehicles (ICEV)

[5] The most relevant aspects are those which have a response rate greater than 20%

Figure 56: Required improvements for the electric vehicles (ICEV)

On the contrary, *Figure 55* shows, from the point of view ICEV drivers, the worst aspects of electric vehicles:

- Low duration of batteries
- Low autonomy
- Expensive car
- Batteries maintenance is expensive
- The need to have a plan to charge the car for occasional longer journeys

From the point of view ICEV drivers, the main improvements required by electric vehicles are (*Figure 56*):

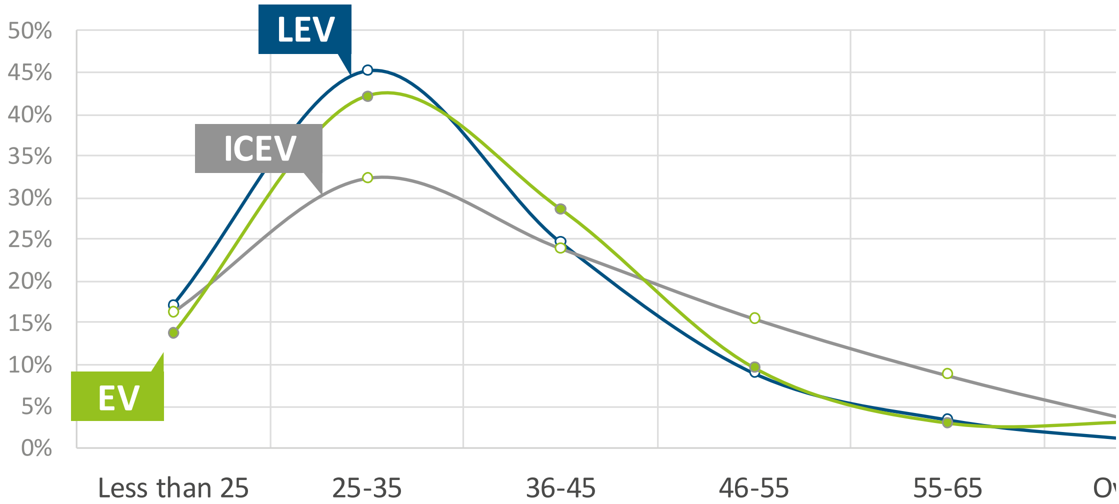
- Reduce the price of purchase (58.3 %)
- Increased autonomy of the car, batteries with more autonomy (40.8 %.)
- Incentives for purchase such as financial aid, or tax incentives (34.9 %)
- More fast chargers and better spread (30.1 %)

Although most of the worst valued aspects of EVs and required improvements focus on the car itself, some of them refer to infrastructure. In this sense, *More fast chargers and better spread* (*Figure 56*) is a direct reference to infrastructure, while *It is necessary to have a plan to charge the car for occasional longer journeys* (*Figure 55*) is an indirect reference.

4.5.3 LEVs

A total amount of 941 people (*Table 4*) has responded to the electric vehicle questionnaire. The participants are distributed between 60.4% men and 39.4% women. The most representative age range is 25-35 years old, which comprehends 45% of the users.

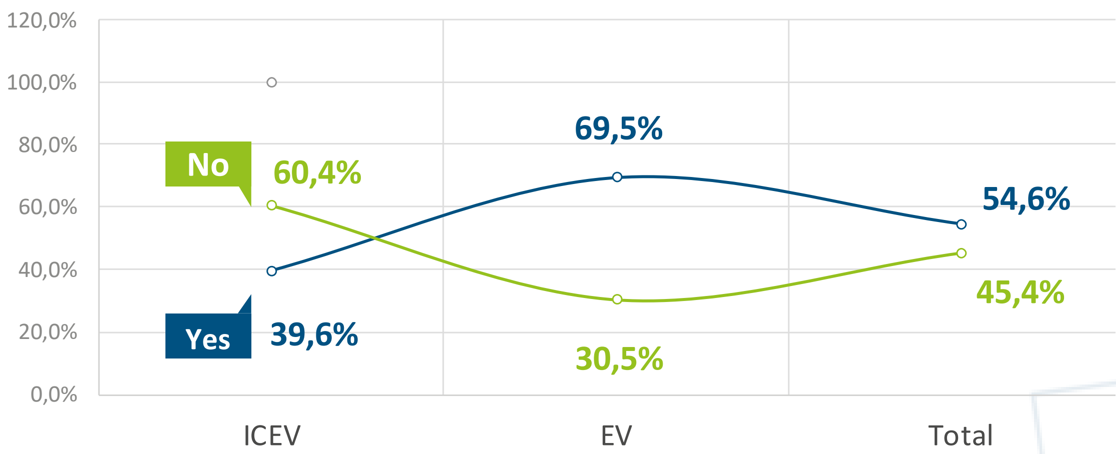
Figure 57: Age profile of LEV, ICEV and EV drivers



The most widely used LEV is the e-bike, which is ridden by 46.9% of the participants in the study. Mainly, the LEV used are in owned. The users have a low experience in the use of these vehicles: the 45.2% have 1-2 years driving and 32.7% less than 1 year.

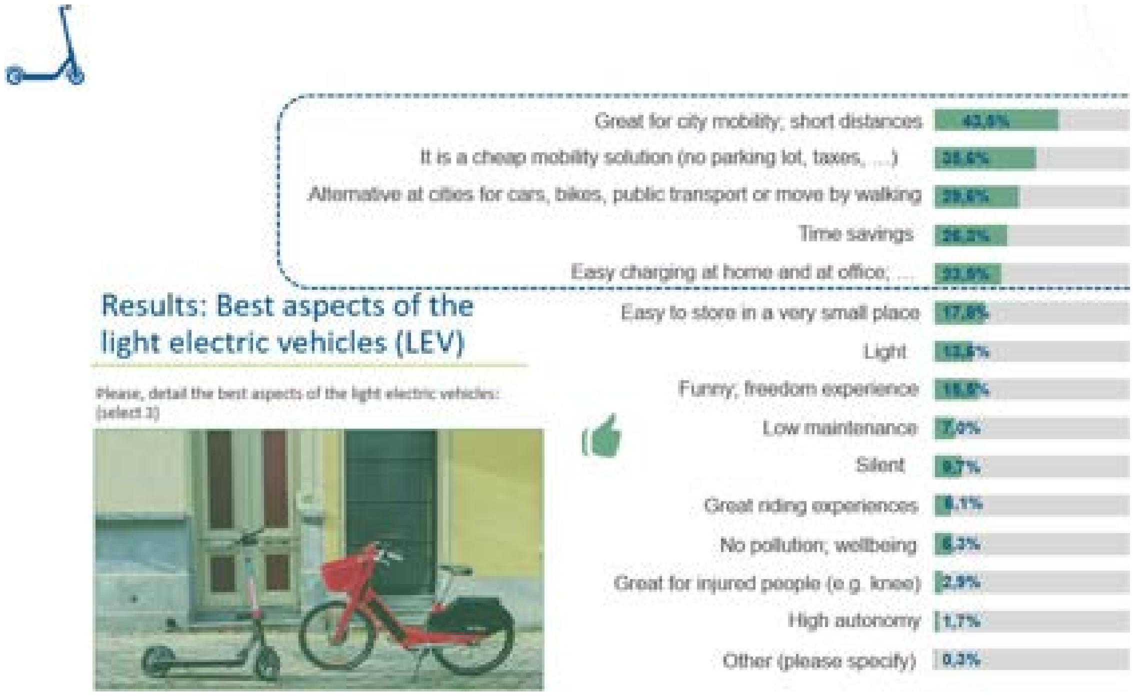
Figure 57 shows that the electric vehicle driver profile (LEV and EV) is slightly younger than the internal combustion vehicle (ICEV) driver profile.

Figure 58: Drivers who also are LEV riders



69.5% of the EV drivers also drive LEVs (*Figure 58*). In the case of ICEV drivers, only 30.5% of them ride also a LEV. This result suggests that EV drivers are more committed with sustainable mobility.

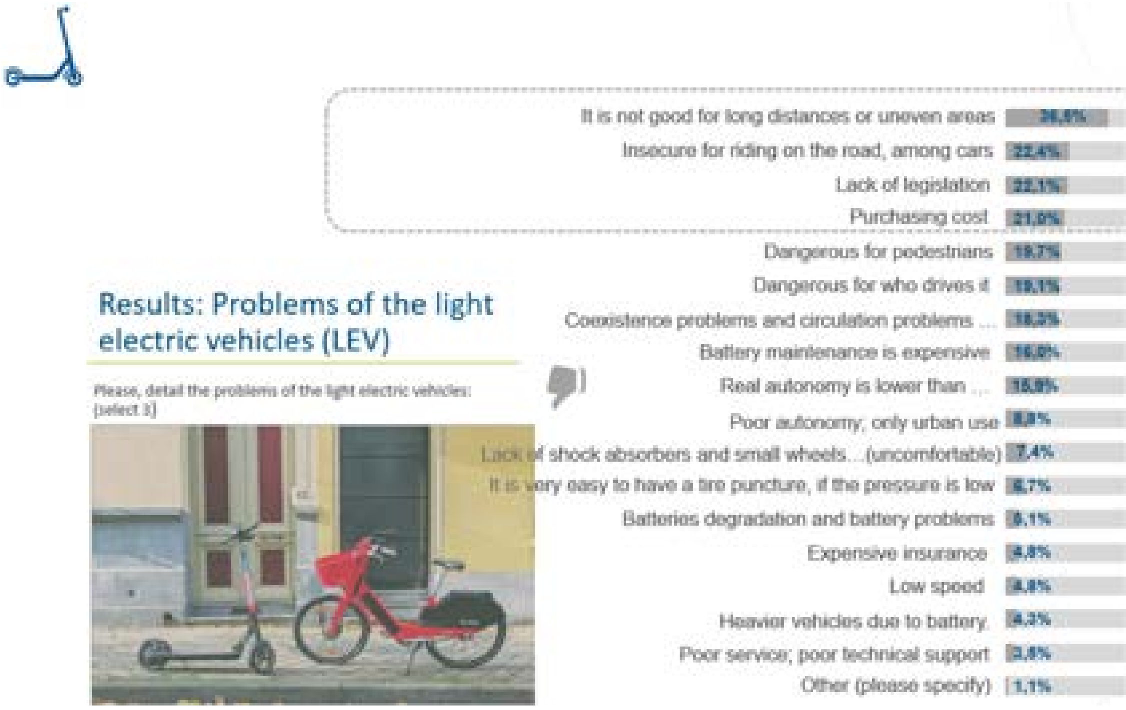
Figure 59: Best valued features for LEVs



The best valued features of the LEV are (*Figure 59*):

- Great for city mobility; short distances
- It is a cheap mobility solution (no parking lot, taxes, …)
- Alternative at cities for cars, bikes, public transport or move by walking
- Time savings
- Easy charging at home and at office

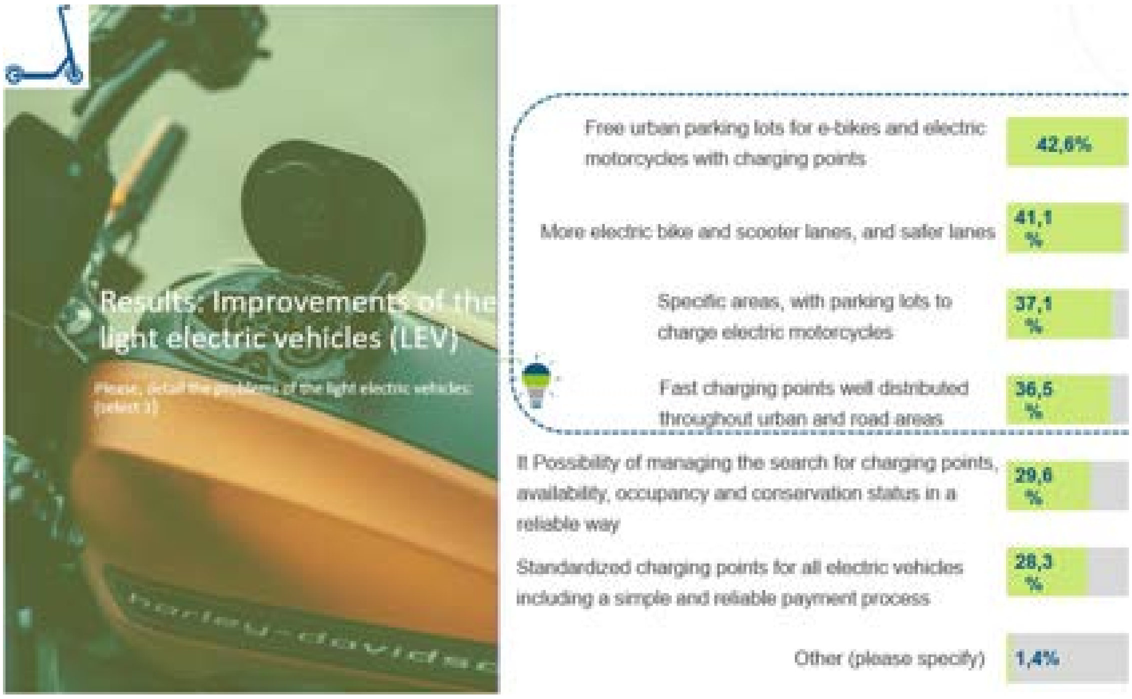
Figure 60: Worst valued features for LEVs



The main problems related to LEVs are (*Figure 60*):

- It is not good for long distances or uneven areas
- Insecure for riding on the road, among cars
- Lack of legislation
- Purchasing cost

Figure 61: Improvements for LEVs



In both cases, the results presented in Figure 59 and Figure 60 are consistent with the results obtained in Netnography, which are summarized in *Table 13*.

Figure 61 shows the main improvements for LEV identified by the users. The most relevant improvements of those presented in the graph are:

- Free urban parking lots for e-bikes and electric motorcycles with charging points
- More electric bike and scooter lanes, and safer lanes
- Specific areas, with parking lots to charge electric motorcycles
- Fast charging points well distributed throughout urban and road areas

4.6 Co-creation

4.6.1 In-person co-creation workshop

Annex 6: Co-creation's results report includes the full report of the results obtained in the co-creation workshop. In this section, we present a sketch per concept product generated during the co-creation workshop performed at IBV. To create these sketches, we have employed the prototypes generated by the users during the session, and the key concepts that guided the design of these prototypes.

Figure 62: INCAR user app and key concepts related to this sketch

Main concepts: Routing & CPs Mapping, User profile (Cars&Drivers), Charging utilities, Monitoring the charge, Paying options, Charging series

The sketch including the proposal for concept design of INCAR app is presented in *Figure 62*. This design is built on the following key concepts:

- It is not necessary subscription for using the app; the user can pay with a credit card with an Invited profile.
- A routing utility, which shows available CPs on a map
- User profile include all user's cars, and different drivers.
- The system matches the compatible CPs with user's cars
- The system shows all the options offered by the infrastructure when charging (user preferences and monitoring data)
- The system stores information related to charges, and generates outputs for the user (e.g. car consumption)

Figure 63 shows a concept design for the *Station of the future* (*SotF*). This concept design is addressed by the idea of a multi-activity area, where different activities (including leisure and professional) can be performed. LEVs charges and EV chargers are assorted in differentiated zones, and the terminal is an intermodal station. The future mobility is sustainable, so the whole building is in harmony with the natural environment.

Figure 63: Station of the future and key concepts related to the sketch

Main concepts: Charging EV&LEV, Intermodal, Sustainable, Additional services, Civic center

Figure 64 and *Figure 65* present the proposal generated for the new charging technologies: INSOC, a solar charging station for LEVs (eBikes, eScooter and eMotobike), and INDUCAR, an inductive charging station for cars. Users demand a secure parking for its bike, as it can be stored by night (no charge). The design is addressed by a big cover for placing the solar panels, and sustainability is also a critical concept for solar mobility. These facilities can take advantage of urban furniture, creating a modal hub if they are placed close a to a public transport station, or just an isolated charging point if the pole of a street light is employed. On the other hand, the inductive charge is foreseen in two basic modalities: dynamic charge and static charge. Dynamic charge is a on route charge, managed from the mobile phone, in signalized sections of the highway. Payment modality is an unsolved issue, as it could be based on different parameters (number of kilometers run, measured energy transferred, or time expended on the system). Static charge is a by-night charge for city neighborhoods, or a charge for long term parking in an airport or a train station.

Figure 64: INSOC station and keys concepts related to this sketch

Main concepts: Solar surface, Secure parking, Modal hub, Sustainable mobility, Urban Furniture

Figure 65: INDUCAR station and main concepts related to this sketch

Main concepts: Dynamic charge, Static charge, Long-term parking, On route information, App utilities

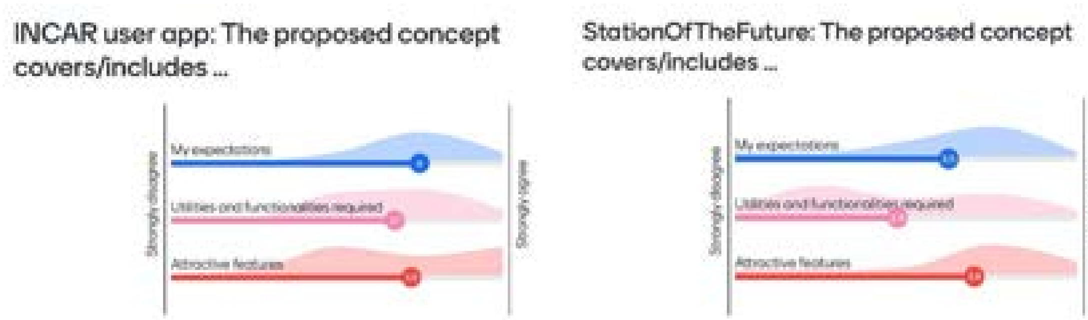
4.6.2 Virtual co-creation workshop

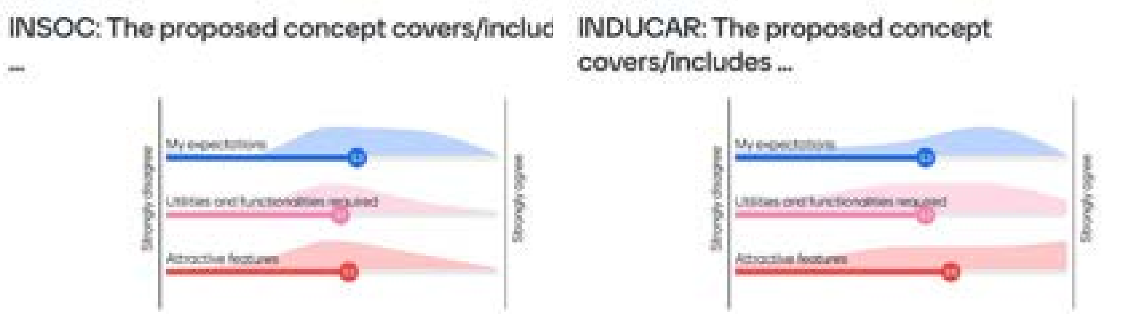
Figure 66 presents the general assessment obtained by the product concepts generated from in-person workshop results (*Figure 62*, *Figure 63*,

Figure 64 and *Figure 65* present the proposal generated for the new charging technologies: INSOC, a solar charging station for LEVs (eBikes, eScooter and eMotobike), and INDUCAR, an inductive charging station for cars. Users demand a secure parking for its bike, as it can be stored by night (no charge). The design is addressed by a big cover for placing the solar panels, and sustainability is also a critical concept for solar mobility. These facilities can take advantage of urban furniture, creating a modal hub if they are placed close a to a public transport station, or just an isolated charging point if the pole of a street light is employed. On the other hand, the inductive charge is foreseen in two basic modalities: dynamic charge and static charge. Dynamic charge is a on route charge, managed from the mobile phone, in signalized sections of the highway. Payment modality is an unsolved issue, as it could be based on different parameters (number of kilometers run, measured energy transferred, or time expended on the system). Static charge is a by-night charge for city neighborhoods, or a charge for long term parking in an airport or a train station.

Figure 64, *Figure 65*). All values but one (*Utilities and functionalities required* by *SotF*) are over 3, but in half of the criteria these values were not uniformly distributed, what involves that some participants strongly agreed with the proposal but some others strongly disagree. These are the cases for the *Attractive features* of *INCAR*, *Expectations* and *Utilities* of the *SotF*, and *Expectations*, *Utilities* and *Attractive features* of *INDUCAR*. All these aspects should be reviewed in order to investigate what features make some users reject this proposal.

Figure 66: Assessment's results of product concepts





Regarding improvements, *Figure 67* shows the list of features proposed by the participants to improve the product concepts. For INCAR platform participants identified that utilities involving *reservation*, *integration* and *pricing* are critical. In addition, there are interesting contributions like the *integration of INCAR platform in existing apps*, the inclusion of utilities related to the *state of charge of the vehicle battery* and fostering the employment of the platform by employing *gamification* strategies.

Figure 67: Improvements related to product concepts

For participants in the co-creation workshop, the *SotF* is a facility that should have at least two versions: one version for highways where station dimension is not critical, a one version for city centres, characterised by the need of optimising the occupied area. The highways version could include *wireless charging* or *vehicle battery change* as additional services to those presented in *Figure 63*. The *SotF* for city centres should focus on charging and intermodal transport. This facility should include an *intermodal ticketing point*, and a *last mile logistic hub* to facilitate the use of e-vans in city deliveries.

Regarding the INSOC station, there is no a consensus among participants about the improvements to modify the product concept presented in

Figure 64 and *Figure 65* present the proposal generated for the new charging technologies: INSOC, a solar charging station for LEVs (eBikes, eScooter and eMotobike), and INDUCAR, an inductive charging station for cars. Users demand a secure parking for its bike, as it can be stored by night (no charge). The design is addressed by a big cover for placing the solar panels, and sustainability is also a critical concept for solar mobility. These facilities can take advantage of urban furniture, creating a modal hub if they are placed close a to a public transport station, or just an isolated charging point if the pole of a street light is employed. On the other hand, the inductive charge is foreseen in two basic modalities: dynamic charge and static charge. Dynamic charge is a on route charge, managed from the mobile phone, in signalized sections of the highway. Payment modality is an unsolved issue, as it could be based on different parameters (number of kilometers run, measured energy transferred, or time expended on the system). Static charge is a by-night charge for city neighborhoods, or a charge for long term parking in an airport or a train station.

Figure 64. Reviewing all the contributions, we can extract the idea that *modularity* (*smaller solutions*) could be a very interesting design strategy for this facility, in the sense of developing a compact unit for charging a reduced number of vehicles (e.g. module for 4 vehicles), that can be mounted together in a given location, in order to achieve the required capacity. *Battery swapping*, *vandalism proof* and *private and sharing use* are also interesting features to enrich the concept. On the other hand, there are some technical restrictions to consider (*dso grid permit*, *grid connection*) when installing solar facilities in a public area where electric infrastructures exist.

In the case of *INDUCAR* (*Figure 65*) to guarantee the access to the facility (*park reserved to ev*, *control protection system*) is critical for most of the participants. This guarantee includes installing physical barriers in order to avoid the use of the parking lot to drivers who are not going to charge the battery, or a system for advising the user once the charge is finished. *Charging cost* was also considered critical for the inductive charge. On the other hand, it was noted by some of the participants that *dynamic charge* is out of the scope of USER-CHI project, and project effort should be concentrated in *static charge*.

4.6.3 Recollective session

Recollective is a commercial software[6], aimed to power innovative online research projects. Participants in the virtual co-creation workshop, were invited to present news ideas related to the product concepts presented, by participating in a Recollective session that was opened for a week time. The main contributions made by project partners to product concepts are presented in the following paragraphs.

SotF

- Three types of stations of the future must be developed. Stations at city entrances (large intermodal stations), stations in city centers (consolidated areas where it is not possible to

[6] https://recollective.com/

undertake new infrastructures) and road stations. Each of these modalities has different features.

- The charging station of the future can be incorporated in the existing urban environment, shifting the point of view on the identification of excellent locations rather than on the construction of new structures.
- We should identify key elements which should be always present in the stations of the future (e.g. charging points for EV and LEV, RES, internet connection or smart working positions).
- Others services (shops, leisure centers, parks) have less restrictive requirements, and could be already present in the location chosen for the station.
- The charging station of the future must prevent that utilization is impeded by parking violators. The profitability of charging infrastructure quickly drops if fully charged or non-electric vehicles occupy needed charging spots.

INSOC

- This product faces a big challenge: how to motivate users to use this infrastructure instead of leaving bikes in random places, as is frequent in some countries. This could be overcome by proposing some sort of reward, such as:
    - A discount voucher to use for the next bike rental or similar (if there is a fine, I think people would simply not rent the bike).
    - An integration of additional services such as charging opportunities for personal devices (e.g. smart phone, power banks, bike lights), lockers, a bike repair stand or a tire pump.
- Sun shade canopy or transparent photovoltaic (PV) panels as rain protection over the charging spots.

INDUCAR

- In general, these services access system could be connected to the app, and it is necessary to define how should the payment process work: the user pay before entering the charging lane, the user are subscript and have a fixed fee, ...
- For the static case, it is very important to have systems that prevent those who do not want to recharge the car from using the parking lot.
- For the dynamic case, it is necessary to analyse the viability of this service.

5. Conclusions

Results of user research are very consistent, and even repetitive, in the need of creating a higher performance charging points' network dense enough, that ensures the availability of a charging point once it has been booked in advance remotely. This requirement directly involves two out of three basic components of the electromobility: charging infrastructure and applications. The third component, the electric vehicle, seems to be in another level as users state its satisfaction with a product that, although being expensive, cover the users' expectations and is employed as a substitute product of the ICE vehicles. In addition, users' insights are quite similar regarding to LEVs, as they are perceived as light devices very useful for short city trips.

Survey's results evidence that ICEV drivers and EV drivers focus on different aspects when assessing vehicles. While ICEV drivers emphasize on car performance, EV drivers highlight the charging process. ICEV drivers perceive the batteries' autonomy as critical (more than EV drivers), and consider the EV to be economical. On the other hand, EV drivers consider the driving comfort of their EVs as higher. In any case, most of EV drivers (93.7%) and ICEV drivers (72.7%) would buy an EV as their next car.

If we analyse the results presented in the previous sections under a well-known quality model as the proposed by *Kano* [2], we come to the conclusions that the charging infrastructure and the apps have no yet fulfilled the quality *must-be requirements*. These *must-be requirements* are mainly:

- the availability of a dense charging point network in cities and in highways, including promoting the installation of charging points at drivers' home and in public and communal parking lots. For professional drivers the city charging network is critical, while for private drivers the most critical point is charging when they arrive home, in private chargers or public chargers,
- and a procedure for booking a charging point that ensures its availability when the driver arrives.

Not accomplishing the *must-be requirements* involves that the users consider the technology is not mature for the charging infrastructure of EVs, and they are not yet confident with electromobility. These conclusions do not affect LEVs electromobility, as they mainly are charged at home employing the domestic infrastructure.

Following the *Kano model*, we could consider as *one-dimensional requirements* for car electromobility:

- Charging point status: occupied-unoccupied-in maintenance, blocked, charging, or reserved.
- Increase the amount of fast charging points; fast charge in highways.
- Standardization of technical components and signalization
- Automatic user detection in the charging point.
- Between 6-12 % of city parking lots equipped with electric chargers; availability of charging infrastructure on the (small) neighborhood level.
- Include the managing of the charge at home in the apps.

- Paying with credit cards; contactless payment.
- Interoperability among charging points, at European level.
- Employing app's utilities without subscription.
- A unique application for routing, booking and paying; pre-booking.
- Several plugs per charging point or simultaneous charge of EVs.

In addition, *attractive requirements* for car electromobility would be:

- Additional services to perform activities when charging the battery. We could differentiate between:
    - services at urban charging points, like shopping malls or mobility hubs,
    - services at the charging points on route, in long range trip.

  This differentiation could be applied to the concept of SotF, as we should distinguish between services within a city, and services for highways.
- Monitoring utilities like *remaining time for charging*, *percentage of charge in real time, power limitation to obtain a lower price, different criteria for fixing fees,* or *service interruption alarm*, are interesting features for managing the waiting time when charging.
- Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.
- Additional information for the user like *minimum charging time*, *lowest price*, *maximum percentage of green energy*, *ecological footprint*, *reduction in CO_2 emissions*, *charge planning*, *time the charging infrastructure is blocked by a non-charging car*, and *user preferences* are considered interesting features by some experts. These extra features require exchange of information among all the actors (EMSPs, CPOs and DSOs) through the protocol OCPI 2.2.

On the hand, for LEVs electromobility we have identified the following *one-dimensional requirements*:

- Specific free charging points for LEVs in urban areas.
- Slighter e-Bikes (they are heavier than conventional bikes).
- Securer e-Scooters.

Regarding *attractive requirements*, for LEVs we have:

- In general, the EV electromobility *attractive requirements* can be applied to LEV electromobility.
- Complex micro-mobility backend services for LEVs (including monitoring, user interface, payment, integration with other smart city backend services).

Gender issues

Regarding the gender issues, we consider as relevant the following results:

- If we compare the number of EV drivers and ICEV drivers per gender, differences increase in Germany, Hungary and Norway. On the contrary, Italy and Spain minimize differences between men and women with the EV.
- In Spain and Italy, women significantly drive more with children.
- In Norway there are no women who share a car.
- In Italy, there are more men than women who go alone, and when they travel as a family, the man drives.
- Women park more in *private parking*. On the other hand, women would like to have more charging points *At home*. Both results could be related to security.
- Women charge more EV during *Purchases* than *Stay at home*. Men charge while Stay at home (47%) and while make *Purchases* (47%)
- Likewise, in Norway more women than men want points in supermarkets, perhaps because they go shopping more.
- Men consider the *Low charging speed* point more problematic than women.

USER-CHI products

The requirements presented in the above paragraphs following the *Kano model*, should be considered in the development of the USER-CHI products. With this aim, each USER-CHI product is related with those requirements which should be taken under consideration, in the following paragraphs:

- *CLICK*: Charging Location and Holistic Planning Kit.
    - Between 6-12 % of city parking lots equipped with electric chargers; availability of charging infrastructure on the (small) neighborhood level.
    - Increase the amount of fast charging points in public parking lots
    - A procedure for booking a charging point that ensures its availability when the driver arrives.
    - Paying with credit cards; contactless payment.
    - Services at urban charging points, like shopping malls or mobility hubs.
    - Monitoring tools like *remaining time for charging*, *percentage of charge in real time* or *service interruption alarm*, are interesting features for managing the waiting time when charging.
    - Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.

- Extra features require exchange of information among all the actors (EMSPs, CPOs and DSOs) through the protocol OCPI 2.2.
- The most common sockets are Sockets Type2, Schuko (EU plug), and Tesla Supercharger.
- The most common charging power is *Between 6 kW and 25 kW* or *Between 26 kW and 50 kW*.

- *INCAR*: Interoperability, Charging & Parking Platform.
  - Main concepts driving the *INCAR* concept: *Routing & CPs Mapping*, *User profile* (*Cars&Drivers*), *Charging utilities*, *Monitoring the charge*, *Paying options*, *Charging series*.
  - The most used apps for charging are *Tesla* and *Easycharger*, but the best rated apps are *Virta*, *AMB*, and *K-lataus*. These apps should be a reference for INCAR development.
  - *Must be requirements*:
    - Utilities involving *reservation*, *integration* (*a unique application for routing, booking and paying*) and *pricing* are critical (*must be requirements*).
    - Employing app's utilities without subscription.
  - *One dimensional requirements*:
    - Include the managing of the charge at home in the apps.
    - Paying with credit cards; contactless payment.
    - Additional services to perform activities when charging the battery.
    - Fast charge in highways.
    - Specific free charging points for LEVs in urban areas.
    - Interoperability among charging points.
  - *Attractive features*:
    - The *integration of INCAR platform in existing apps*, utilities related to the *state of charge of the vehicle battery* and *gamification* strategies.
    - Monitoring utilities like *remaining time for charging*, *percentage of charge in real time, power limitation to obtain a lower price, different criteria for fixing fees,* or *service interruption alarm*, are interesting features for managing the waiting time when charging.
    - Additional information for the user like *minimum charging time*, *lowest price*, *maximum percentage of green energy*, *ecological footprint*, *reduction in CO_2 emissions*, *charge planning*, *time the charging infrastructure is*

blocked by a non-charging car, and *user preferences* are considered interesting features by some experts. These extra features require information exchange among all the actors (EMSPs, CPOs and DSOs) through the protocol OCPI 2.2.

  - Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.

- *INSOC*: Integrated Solar-DC charging for LEVs.
  - Main concepts driving the *INSOC* concept: *Solar surface*, *Secure parking*, *Modal hub*, *Sustainable mobility*, *Urban Furniture*.
  - *Must be requirements*:
    - Technical restrictions to consider (*dso grid permit*, *grid connection*) when installing solar facilities in a public area where electric infrastructures exist.
    - Secure parking: charging points as secure parking lots.
  - *One dimensional requirements*:
    - Specific free charging points for LEVs in urban areas.
    - A procedure for booking a charging point that ensures its availability when the driver arrives.
    - Paying with credit cards; contactless payment.
    - Additional services to perform activities when charging the battery.
  - *Attractive requirements:*
    - *Modularity* (*smaller solutions* that can be enlarged easily), *Battery swapping*, *vandalism proof* and *private and sharing use*.
    - Modal hub: the solar charging station is placed close to other transport modalities (public or private).
    - The urban furniture as an existing infrastructure for hosting solar charging points (e.g. streetlights and benches).
    - Monitoring tools like *remaining time for charging*, *percentage of charge in real time* or *service interruption alarm*, are interesting features for managing the waiting time when charging.
  - Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.
- *INDUCAR*: Inductive Charging for e-Cars.
  - Inductive charge has two charging modalities: *Dynamic charge* and *Static charge*.

        - Dynamic charge is a on route charge, managed from the mobile phone, in signalized sections of the highway.
        - Static charge is a by-night charge for city neighborhoods, or a charge for long term parking in an airport or a train station.

    Dynamic charge is out of the scope of *USER-CHI* project.

    - Main concepts driving *INDUCAR* concept: *Static charge*, *Long-term parking*, *On route information*, *App utilities*.
    - *Must be requirements*:
        - To guarantee the access to the facility (*park reserved to ev*, *control protection system*) is critical. This guarantee could include installing physical barriers or a system for advising the user once the charge is finished.
        - *Charging cost* is also critical for the inductive charge.
    - *One dimensional requirements*:
        - Payment should be done with credit cards, although the payment modality is an unsolved issue, as it could be based on different parameters (number of kilometers run, measured energy transferred, or time expended on the system).
        - A unique application for routing, booking and paying.
        - Additional services to perform activities when charging the battery.
    - *Attractive requirements*:
        - Monitoring tools like *remaining time for charging*, *percentage of charge in real time* or *service interruption alarm*, are interesting features for managing the waiting time when charging.
    - Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.
- *SotF*: Station of the Future.
    - Main concepts driving the *SotF* concept: *Charging EV&LEV*, *Intermodal*, *Sustainable*, *Additional services*, *Civic center*.
    - the *SotF* is a facility that should have at least two versions: one version for highways where station dimension is not critical, a one version for city centres, characterised by the need of optimising the occupied area.
    - The highways version could include *wireless charging* or *vehicle battery change* as part of the additional services.

- The *SotF* for city centres should focus on charging and intermodal transport. This facility should include an *intermodal ticketing point*, and a *last mile logistic hub* to facilitate the use of e-vans in city deliveries.

References

[1] Robert V. Kozinets (1998),"On Netnography: Initial Reflections on Consumer Research Investigations of Cyberculture", in NA - Advances in Consumer Research Volume 25, eds. Joseph W. Alba & J. Wesley Hutchinson, Provo, UT : Association for Consumer Research, Pages: 366-371

[2] Kano, N., N. Seraku, F. Takahashi and S. Tsuji: "Attractive Quality and Must-be Quality", Hinshitsu. The Journal of the Japanese Society for Quality Control, (April 1984), pp. 39 -48.

Annexes

Annex 1: Delphi questionnaire

USER-CHI DELPHI QUESTIONNAIRE I

MAIN OBJECTIVE:

- To describe the main features of the charging devices and supporting applications available today, identifying their main weaknesses and improvement opportunities.
- To identify functionalities and features that overcome the identified weaknesses, and improve the charging process and services that are available today.
-

CONTENT STRUCTURE:

ELECTROMOBILITY PLANS / Urban Mobility Planners

- Which electric modes of transport are more suitable to be promoted in the urban environment? And which ones for the low-range and the long-range trips?
- What interoperability strategies should be implemented in the urban environment? And in the low-range and the long-range trips?
  - (*For example, one strategy could be to create an association of EMSPs and CPOs in the metropolitan area, or to establish cooperation agreements between different providers which operates nearby…*)
- Regarding the strategies identified in the precedent question, what type of planning require the charging infrastructure for implementing them?
- Within the planning process of charging stations in your city, which are the current features?

- Sockets (Type2, ChaDeMo, CCS); Charging technology (AC / DC); measure and monitoring systems in real time…
- Number of charging points installed currently
- Strategies of charging points location
- Users' needs to cover

- In your city, how is the charging infrastructure organized and planned?
  - Who is the responsible to plan strategies, coordinate actions and assign permissions
  - Who is the responsible to build and manage charging stations
  - Who are allowed to build charging infrastructure in the public / private space

- Which are your goals regarding the provision of charging infrastructure within the next 3 years?
  - Number of charging points (e.g. 1 station …per km², …per 100 inhabitants, …at every junction, …at every gas station, or: 300 charging stations in the city)
  - Location of charging points (in special areas: airport; housing areas; in public space; in living areas; in industrial areas; in every parking lot…)
  - Priority users (e.g. private owners, industrial owners, city administration, car sharing operators, scooter sharing companies, bike owners, cab drivers, delivery services…)

SUPPORTING TECHNOLOGIES / MSP (Mobility Service Provider)

- What communication protocol (and version) are you employing as MSP for communicating with CPOs (Charging Point Operators)? Would you accept a protocol change if it improves your service?

- Which are the main features and characteristics the system you are employing today have?

- Are you interested, as MSP, in adding the following features to your system? Do you consider these features as valuable?
    - The end user has the option of defining a *default charging profile.*
    - (This *default charging profile* involves end user can select some charging options, similar to those listed below:
        - Total charge at minimum time
        - Total charge at lowest price
        - Total charge at maximum percentage of renewable energy)
    - In some situations, the MSP is able to manage the power supplied to a customer by means of smart charging, according to MSP's own criteria. (For example, to limit the power supplied to specific groups of users).
- In your opinion, which other features (for end users and for CPOs) need to be developed for improving your service?

CHARGING POINTS / CPO (Charging Point Operator)

- Which communication protocol (and version) are you employing as CPO, for communicating with the poles and the MSPs?
    - OCPI 2.2
        - Strengths:
        - Weaknesses:
    - OCPP 2.0
        - Strengths:

        - Weaknesses:
    - Others:
        - Strengths:
        - Weaknesses:

Would you accept a protocol change if it improves your service?

- Which are the main features the system you are employing today have?
    - Charging point status (occupied / unoccupied), monitoring of usage of charging stations in place, dynamic charge, power limitations …

- Do you think the dynamic charge management could be advantageous for your business?
    - *For example, being able to control the power supplied to the poles depending on different factors: renewable energy production, energy prices, and special services for some users or chargers (fast vs low charging speed…)*.

- As CPO, do you have available today an infrastructure that allows the dynamic charge?
    - YES
    - NO
    - If YES, which is the kind of information you have available for characterizing the dynamic charge?
    - INPUTs (user preferences, energy mix, time …) and OUTPUTS (energy amount to supply …)

  - If NO, which is the kind of information you consider as relevant for characterizing the dynamic charge?

- Is there any kind of information related to the charging process of EV that is of your interest, but your current management systems cannot provide?
  - (For example, the ecological footprint of previous charges, the CO2 emissions of charges in a given period of time …)

- Do you receive any kind of data or requirements from the DSO (e.g. power limitations, grid status…)? What protocol or format is the one employed by DSO for sending these data?

- In a near future, when there is a higher deployment of the EV. Do you consider that communication between CPO and the DSO will be essential? Which is the kind of information they are going to interchange (e.g., power limitations, V2G requirements …)?

- What is the level of detail for fixing the fees (€ per kWh)? Which of these parameters do you usually use to define the different tariffs? Please, give us your opinion about these parameters for fixing fees:
  - Time (considering day of the week, and the time range)
  - Supplied power
  - Parking (the time occupying the parking slot without being charging)
  - Energy mix (clean energy versus fossil energy)

- Do you provide electricity from any energy renewable sources? Is the energy mix available in your charging management system? In case you have information about the energy mix you supply, how often do you receive it? If do not, do you consider that the integration of the energy mix information in your charging management system could be interesting in the near future?

- Which is the most common electric power supplied to a charging point in your facility/ies? Which is the most common charging time?

- In your opinion, which are the most important aspects for improving the charging points available today? Please, justify your answers.
    - Location
    - Vandalism
    - Wear out
    - Standardization
    - Interoperability
    - Others:

- Please, explain the guidelines you follow in order to locate future charging stations:

ENERGY, LOGISTICS AND STORAGE / DSO (Distribution System Operator)

- Which communication protocol (and version) are you employing as DSO, for communicating grid overloads, supply cuts or other issues?
    - TASE 2
        - Strengths:
        - Weaknesses:
    - Others:

- Strengths:
- Weaknesses:

- In a near future, when there is a higher deployment of the EV. Do you consider that communication between DSO and the CPO will be essential? Which is the kind of information they are going to interchange (e.g., power limitations, V2G requirements …)?

- In your opinion, which are the main measures to adopt, for facing the grid overloads that the EV deployment will bring?
  - To limit the charge of EVs when the grid is overload. The CPO manage the power supply under certain requirements of the DSO, that in return, will compensate somehow the CPO.
  - CPO and DSO continuously interchange information for avoiding grid overloads.

- In your opinion, which are the most feasible measures that will be adopted for increasing the employment of renewable energy sources, and increase the grid storage capacity?

- In your opinion, which are the most feasible measures that will be adopted for increasing the grid stability and robustness?

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

INTRODUCTION AND OBJECTIVES

Welcome to the second round questionnaire of Delphi method in USER-CHI project!!!

At this time, you have received the summary of the total results of the strategies, features and functionalities of the EV charging process.

Now, we need you to confirm, or modify this situation description and check some elements. Your participation will take you around 10 minutes.

MAIN OBJECTIVE:

· To validate the European EV Charging Infraestructure Map.

· To prioritize functionalities, features and improvement elements.

Ready to start?

1. Please, indicate the country where you carry out your professional activity:

Austria
Belgium
Bulgaria
Croatia
Republic of Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
Others (please specify)

2. Please, indicate your gender:

- Female
- Male
- Other

Other (please specify)

3. Please, indicate your professional profile: (You can mark several options)

- Urban Mobility Planners
- Mobility Service Provider
- Charging Point Operator
- Distribution System Operator

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

EUROPEAN EV CHARGING INFRAESTRUCTURE MAP VALIDATION

4. In your opinion, at what level, the summary of the European EV charging infrastructure map reflect the real situation:

- Extremely realistic
- Very realistic
- Somewhat realistic
- Not so realistic
- Not at all realistic

5. Please, comment, modify or assess the aspects of the results that you consider do not reflect the current situation:

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

ELECTROMOBILITY PLANS PRIORITIES

6. Within the process for planning the installation of new charging stations in your city, which are the current priorities? (Check the most relevant three options)

- [ ] Standardization of technical components
- [ ] Interoperability at European level
- [ ] Roaming
- [ ] Legal support
- [ ] Automatic user detection
- [ ] Mandatory OCPP
- [ ] Registration and payment in an application
- [ ] Regular payment methods
- [ ] Use of Distributed Ledger Technology (DLT)
- [ ] Users friendly APP and payments
- [ ] Availability of AC charging infrastructure on the (small) neighborhood level
- [ ] Easy access
- [ ] Excellent availability (multiple chargers on one location)
- [ ] Availability of AC charging infrastructure on the Overnight parking, Shop & charge and Streetlight-parking
- [ ] Increase locations
- [ ] Decrease vandalism
- [ ] Decrease the traffic congestion
- [ ] Promote the public transport
- [ ] Other (please specify)

7. Which are your goals regarding the provision of charging points within the next 3 years?

- Less than 500
- Between 501 to 1000
- Between 1001 to 1500
- Between 1501 to 2000
- More than 2000

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

CHARGING INFRAESTRUCTURE ELEMENTS AND TECHNOLOGIES

8. Which is the type of energy you provide?

- Renewable energy
- Energy mix

4

9. Regarding the charging stations, which are the most frequent elements?

- [ ] Sockets Type2
- [ ] Charging technology AC
- [ ] Sockets ChaDeMo
- [ ] Charging technology DC
- [ ] Sockets CCS
- [ ] Other (please specify)

10. Which communication protocol (and version) are you employing?

- OCPI 2.2.
- Own develop proprietary
- OCPI 2.0.
- OpenADR
- OCPP-J 1.6
- OSCP
- OCPP-J 1.5
- OICP
- Other (please specify)

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

SERVICE FEATURES

11. Which are the main features of the system you are employing today and which are the features you are most interestad in?

	I have it	I want to use it
Charging point status (occupied/unoccupied/in maintenance, blocked, charging, reserved)	☐	☐
Monitoring of usage of charging stations in place	☐	☐
Dynamic charge	☐	☐
Power limitation	☐	☐

5

	I have it	I want to use it
Complex micro-mobility backend services for LEV-s (inc. monitoring, user interface, payment, integration with other smart city backend services)	☐	☐
Booking	☐	☐
Remote authorization of charging through mobile app	☐	☐
Consumption data of charge session	☐	☐
Error monitoring	☐	☐
Monitoring and controlling devices and billing with admin panel	☐	☐
Congestion management as a cloud service	☐	☐
Metering and using other consumption data to automatically adjust charging power used	☐	☐
Contactless payment	☐	☐
Dynamic navigation to charge point	☐	☐
Waiting list	☐	☐
Power availability	☐	☐
Display	☐	☐
Setting up tariff-system	☐	☐
Information about the energy mix you supply	☐	☐
Total charge at minimum time	☐	☐
Total charge at lowest price	☐	☐
Total charge at maximum percentage of renewable energy)	☐	☐
In demand stress situations	☐	☐
Flexible pricing	☐	☐
V2G requirements	☐	☐

Other (please specify)

12. Which is the level of detail for fixing the fees that you have and which are the criteria you are interested in?

	I have it	I want to use it
Time (considering day of the week, and the time range)	☐	☐
Supplied power	☐	☐
Parking (the time occupying the parking slot without being charging)	☐	☐
Energy mix (clean energy versus fossil energy)	☐	☐
User preferences	☐	☐
Expected duration of charge	☐	☐
Charge planning (time of leaving the pole with what kind of battery level) of the user	☐	☐
Price sensitivity of user	☐	☐

Other (please specify)

USER-CHI Delphi II - CHARGING INFRASTRUCTURE OF ELECTRIC VEHICLES - VALIDATION

The questionnaire has finished. Thank you very much for your collaboration!!!

Check DONE

Annex 2: Field Diary

USER-CHI Diary - My experience with an electric vehicle

Thank you very much for participating in the improvement and promotion of the electric vehicle charging network in Europe that the User-Chi project is carrying out, and in particular, thank you for helping us to improve mobility in our city.

Ready to start?

USER-CHI Diary - My experience with an electric vehicle

MY USER PROFILE AS EV DRIVER

We want to know about you!!! Detail your characteristics as an electric vehicle user.

1. Please, indicate the city / municipality where you live:

2. Indicate your age:
   - Up to 25 years
   - Between 26 and 55 years
   - From 56 years and older
   - Specifically, how old are you?

3. Indicate your gender:
   - Female
   - Male
   - Others (specify)

4. Indicates if you have children and their age range:

- [ ] I have no children
- [ ] I have 1 or more children from 0 to 5 years old
- [ ] I have 1 or more children from 6 to 11 years old
- [ ] I have 1 or more children from 12 to 16 years old
- [ ] I have 1 or more children from 17 to 21 years old
- [ ] I have 1 or more children 22 years of age and older

5. Indicate the participant' educational background:

- ○ Primary studies
- ○ High school degree
- ○ College degree
- ○ Master's degree
- ○ Postgraduate degree
- ○ Doctoral degree - PhD

6. How long have you been using an electric vehicle?

- ○ Less than 1 year
- ○ 1-2- years
- ○ 3-5 years
- ○ More than 5 years

7. What uses of the electric vehicle do you identify with? (indicate all the uses you make)

- [ ] Urban / Interurban area: I'm a professional.
- [ ] Urban / Interurban area: I'm user with my own or shared vehicle.
- [ ] Light vehicle (bike, motorcycle, scooter): I'm user with my own or shared vehicle.
- [ ] Long distance: I'm user with my own or shared vehicle.
- [ ] Other (specify)

8. Indicate the type and frequency of electric vehicle used:

	Car model	Type of LEV (Light electric vehicles)	Frequency of use
It is my property			
It's from my company			
It is for rent or shared			

Others (specify other models and uses)

9. Please, rate your satisfaction with the use of electric vehicles:

10. Tell us in detail the best and worst of electric vehicles and your personal experience ... Will you buy an electric vehicle again?

USER-CHI Diary - My experience with an electric vehicle

MI EXPERIENCIA DE CARGA

11. Please, describe how you charge the vehicle: how you plan and book the charging point, how you get there, where you usually charge (at home, supermarkets, parking lots, on the road ...), what you do during charging time, how you make the payment ...

12. Detail what problems you endure during the charging process: (someone has occupied the space you had reserved, excessive charging time, there is no charge for light vehicles such as scooter, ...)

13. Please, rate your app:

Which is the app you use?

3

14. Please, rate the adequacy of the charging points used:

15. Please, rate the suitability of the plugs:

16. Please, rate the suitability of the waiting time for the charging:

17. Please, rate the quality of information you receive about your charge:

18. Please, detail your proposals and ideas to improve the charging process (being able to choose the type of charge such as time, type of energy ...; type of information on your charge that you would like to have; proposals for improving charging points and plugs ...)

19. Share with us some photo / video of your electric car, scooter, bike, motorcycle: show us some special or critical detail, some detail of the use... Please, avoid to show any personal information or personal image.

File size limit: 16MB. Allowable File types: PDF, DOC, PNG, JPG, JPEG y GIF

Choose File Choose File No file chosen

Annex 3: Survey

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

Welcome to the survey of the European research project USER-CHI. The aim of the project is to provide e-drivers with an optimal charging infrastructure and thus to promote the use of electric vehicles. By participating in the survey, you are not only supporting this Project, but also contribute to improving e-mobility in your city.

This survey aims to find out the opinion that citizens have about electric vehicles and their charging systems, in order to determine the charging processes currently carried out by e-drivers, but also to collect the insights that internal combustion engine's drivers have related to electric vehicles. We ask you in the following questionnaire to share your charging experience and your opinions.

MAIN OBJECTIVES:

- **To validate the European Electric Vehicle (EV) Charging Infrastructure situation.**
- **To prioritize functionalities, features and improvement elements in terms of planning, availability, accessibility and payment for the charging process.**

You can learn more about the project on https://twitter.com/userchi_h2020

Thank you very much for participating in the improvement and promotion of the electric vehicle charging network in Europe that the USER-CHI project is carrying out.

Ready to start?

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

USER PROFILE

We want to know about you!!!

1. Please, indicate the city / municipality where you live:

2. Indicate your age:

Less than 25

25-35

36-45

46-55

55-65

Over 65

3. Indicate your gender:

Female

Male

Others

4. When you drive your car, who are you usually travelling with? (a maximum of 3)

Alone

Shared with colleagues for getting to the office

Children

Mate

Family

Other

5. Indicate your educational background:

School finished without graduating

High school degree

College degree

Master's degree

Postgraduate degree

Doctoral degree - PhD

6. Indicate the type and frequency of vehicle used:

Internal combustion engine vehicle (gas, diesel, gasoline)

Hybrid vehicle

Electric vehicle

Internal combustion engine motorcycle

Others (specify other types and frequency of use)

Frequency of use:

Less than 12 times a year

Every month

2 or less days a week

3-4 days a week

5-7 days a week

Property:

It is my property

It is from my company

It is for rent or shared

7. Indicate your car brand: (

Abarth
Alfa Romeo
Alpina
Aston Martin
Audi
Bentley
BMW
Cadillac
Caterham
Chevrolet
Chrysler
Citroen
Dacia
Daihatsu
Ferrari
Fiat
Ford
Honda
Hyundai
Infiniti
Isuzu
Iveco
Jaguar
Jeep
Kia
KTM
Lada
Lamborghini
Lancia
Land Rover
Lexus
Lotus
Maserati
Mazda
Mercedes-Benz
MG
Mini
Mitsubishi
Morgan

Nissan
Opel
Peugeot
Piaggio
Porsche
Renault
Rolls-Royce
Rover
Seat
Skoda
Smart
SsangYong
Subaru
Suzuki
Tata
Tesla
Toyota
Volkswagen
Volvo
Other (please specify)

8. Indicate the model of vehicles used:

9. Please, rate your satisfaction with the use of your vehicles:

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

OPINION ON ELECTRIC VEHICLES CURRENTLY

What do you think of electric vehicles?

* 10. Please, detail the best aspects of the electric vehicles: (a maximum of 3)

Sustainable
Economical to use
Easy to use
Driving comfort
Speed
Softness
Silent
Conscience
Lighter to ride
Charging the car at home
Fast acceleration
Sensitivity
No emissions to the local environment
Nice
Reliable
Other (please specify)

* 11. Please, detail the worst aspects of the electric vehicles: (a maximum of 3)

It's an expensive car
Low autonomy
Low duration of batteries
Autonomy depends on external factors, like temperature, orography...
The batteries maintenance is expensive
Hard to get the needed maintenance service
It is necessary to have a plan to charge the car for occasional longer journeys
Few charging points
Long charging time
The road infrastructure is in poor condition
The road infrastructure presents deficiencies in maintenance
Electric vehicle charging parking lots are occupied by fuel vehicles or electric vehicles that are not charging
Charge prices are high
Incompatibility exists between networks and chargers
Poor quality of the charging points: slowness, impossibility of carrying out two charges at the same time and interruptions
Insufficient and unevenly distributed infrastructure
I have no chance to charge the electric vehicle at home or at the workplace; having the possibility of installing a charger in my parking lot

Other (please specify)

12. Would you buy an electric vehicle as your next car?

Definitely would

Probably would

Probably would not

Definitely would not

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

ELECTRIC VEHICLE

13. Next, we are going to ask you some questions related to the use of the electric vehicle. Do you have / drive an electric vehicle?

Yes

No

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

ELECTRIC VEHICLE EXPERIENCE

14. How long have you been using an electric vehicle?

Less than 1 year 1-

2- years

3-5 years

More than 5 years

15. For what purpose do you mainly use your electric vehicle? (indicate all the uses you make)

Urban / Interurban area: I'm a professional (passenger transport).

Urban / Interurban area: I'm a professional (parcels, deliveries, fresh food and goods).

Urban / Interurban area: I'm user with my own vehicle.

Urban / Interurban area: I'm user with shared vehicle.

Light vehicle (bike, motorcycle, scooter): I'm user with my own vehicle.

Light vehicle (bike, motorcycle, scooter): I'm user with shared vehicle.

Long distance: I'm user with my own or shared vehicle.

Other (specify)

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

ELECTROMOBILITY PLANS

16. Thinking in a new generation of charging stations: which are your expectations regarding features they should have? (Check the most relevant three options)

Standardization of technical components
Interoperability at European level
Roaming
Automatic user detection in the charging point
Registration and payment in an application
Regular payment methods
Availability of charging infrastructure on the (small) neighborhood level
Easy access to the charging points and properly signalized
Excellent availability (multiple chargers on one location)
Availability of charging infrastructure on the Overnight parking, Shop & charge and Streetlight-parking
Increase charging points locations
Other (please specify)

17. Which is your expectation regarding the provision of charging points in your city within the next 3 years?

Less than 200
Between 200 to 500
Between 501 to 1000
Between 1001 to 1500
Between 1501 to 2000
More than 2000

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

CHARGING INFRAESTRUCTURE ELEMENTS AND TECHNOLOGIES

18 Regarding the charging stations, which socket do you most frequently use?

- Schuko (EU plug)
- Sockets Type2
- Sockets ChaDeMo
- Sockets CCS
- Sockets CCS 2
- Tesla Supercharger
- Tesla Dest. charger
- Other (please specify)

Sockets Type2	Sockets ChaDeMo	Sockets CCS

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

SERVICE FEATURES

18. Which are the main features of the system you are employing today and which are the features you are most interested in?

- Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved)
- Monitoring of usage of charging stations in place
- Power limitation for obtain a lower price
- Complex micro-mobility backend services for Light Electric Vehicles (inc. monitoring, user interface, payment, integration with other smart city backend services)
- Pre-booking
- Remote authorization of charging through mobile app
- Consumption data of charge session
- Contactless payment
- Dynamic navigation to charging point
- Waiting list for the charging point
- Power availability
- Display in the charging point
- Information about the energy mix you supply
- Total charge at minimum time
- Total charge at maximum percentage of renewable energy)
- Total charge at lowest price
- Flexible pricing according to charging conditions
- Other (please specify)

19. Which are the criteria of detail for fixing the fees that you are interested in?

- Time (considering day of the week, and the time range)
- Supplied power
- Parking (the time occupying the parking slot without being charging)
- Energy mix (clean energy versus fossil energy)
- Expected duration of charge
- Charge planning (time of leaving the pole with what kind of battery level) of the vehicle
- Other (please specify)

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

CHARGING EXPERIENCE

20. Where do you usually charge?

- At home
- Supermarkets
- Public Parking lots
- Private parking lots
- At highways
- At work
- Shopping center
- Other (please specify)

21. How long do you usually take to charge when you don't charge at home?

Less than 15 minutes

Between 15 and 25 minutes

Between 26 and 30 minutes

Between 31 and 60 minutes

Between 1 and 2 hours

Between 2 and 3 hours

More than 3 hours

22. How much charging power do you usually use when you don't charge at home?

Less than 5 kW

Between 6 and 25 kW

Between 26 and 50 kW

More than 50 kW

Do not know

23. Where do you think charging points lack, and therefore should there be more?

At home

Supermarkets

Public Parking lots

Private parking lots

At highways

At work

Shopping center

Other (please specify)

24. What do you usually do while charging?

Stay at home

Purchases

Work

Leisure

Other (please specify)

25. Please, indicate any problems/challenges that you regularly experience when charging your electric vehicle at charging points. (Indicate the 3 main problems)

Charging time is limited (30 minutes is not time enough for 100% charge)

One plug per charging point. Simultaneous charge of EVs unavailable

Lack of charging points

Waiting times: booking and queues

Lack of information about availability

Malfunction, lack of maintenance

Bad design (bad coupling with the plug, charging point wrongly oriented)

Cars parked in charging points. Booking times are not respected

Bad connection. Charging failures

Low charging speed

Incompatibilities between plugs and cars

Other (please specify)

26. Which is the charging app you use?

AMB

Chargeway

Duferco

Easycharger

Electromaps

Enel X

EV charge

Ibil

Ionity

Juice pass

K-lataus

Nextcharge

Plugshare

Plugsurfing

Smou

Tesla

Virta

I do not use any apps

Other

27. Please, rate your app:

28. Please, rate the adequacy of the charging points used:

29. Please, rate the suitability of the plugs:

30. Please, rate the waiting time:

31. Please, rate the quality of information you receive about your charge:

32. Please, Indicate the best ideas to improve the charging process: (select 3)

Customisation of the charging speed / charging time

Several plugs per charging point or simultaneous charge of EVs

Increase the amount of fast charging points

Real time information about availability, type of plug, and booking list for next 30 minutes and on

Monitoring the charging progress on a mobile app

Efficient procedure for communicating failures&malfunctions of charging points

Increase the amount of charging points in public parking lots

Priority for electric vehicles

Universal plugs or availability of all plug models

Incentives: highways for free, exclusive parking lots for EVs, free charging points in highway

Charging points at the workplaces

Charging point activates when connecting the plug or through a mobile application

Increase the amount of charging points on the road, outside urban areas

Improve maintenance and improve facilities (e.g. a roof for the rain)

Mobile phone's alert when charging process is completed

Mobile phone's alert when charging time is exceeded in 30 minutes

Penalizations for drivers that use charging points as parking lots

Other (please specify)

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

LIGHT ELECTRIC VEHICLE

Next, we will ask you some questions related to the use of light electric vehicles. Do you ride a light electric vehicle? (eScooter, eBike, eMotorbike)

Yes

No

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

LIGHT ELECTRIC VEHICLE

33. What kind of light electric vehicle do you use?

eBike (own vehicle)

eScooter (own vehicle)

eMotorbike (own vehicle)

eBike (shared vehicle)

eScooter (shared vehicle

eMotorbike (shared vehicle)

34. How long have you been using an light electric vehicle?

Less than 1 year

1-2- years

3-5 years

More than 5 years

35. Please, detail the best aspects of the light electric vehicles: (select 3)

Great for city mobility; short distances

It is a cheap mobility solution (no parking lot, insurance, taxes, ...)

Alternative at cities for cars, bikes, public transport or move by walking

Time savings

Easy charging at home and at office; you don't need a charging infrastructure at the street / Some models have detachable batteries

Easy to store in a very small place

Light

Funny; freedom experience

Low maintenance

Silent

Great riding experiences

No pollution; wellbeing

Great for injured people (e.g. knee)

High autonomy

Other (please specify)

36. Please, detail the problems of the light electric vehicles: (select 3)

Coexistence problems and circulation problems with more conventional vehicles or pedestrians. It is not good for long distances or uneven areas

Lack of legislation

Dangerous for who drives it

Dangerous for pedestrians

Insecure for riding on the road, among cars

Real autonomy is lower than autonomy declared by manufacturer, and depends on several factors

Battery maintenance is expensive

Purchasing cost

Lack of shock absorbers and small wheels make you feel any road defect (uncomfortable)

It is very easy to have a tyre puncture, if the pressure is low

Poor service; poor technical support Expensive insurance

Poor autonomy; only urban use

High price

Low speed

Batteries degradation and battery problems

Heavier vehicles due to battery.

Other (please specify)

37. Please, detail the solutions to improve the use of light electric vehicles: (select 3)

Free urban parking lots for e-bikes and electric motorcycles with charging points

Specific areas, with parking lots to charge electric motorcycles

More electric bike and scooter lanes, and safer lanes

Fast charging points well distributed throughout urban and road areas

Possibility of managing the search for charging points, availability, occupancy and conservation status in a reliable way

Standarized charging points for all electric vehicles including a simple and reliable payment process

Other (please specify)

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

INTERNAL COMBUSTION ENGINE VEHICLE

38. Next, we will ask you some questions related to the use of an internal combustion engine car or a hybrid engine car. Do you drive a combustion car (gasoline or diesel) or a hybrid engine car?

Internal Combustion Engine car (gas, diesel, gasoline)

Hybrid car

No combustion/hybrid car

USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

INTERNAL COMBUSTION ENGINE VEHICLE

39. For what purpose do you mainly use your vehicle? (indicate all the uses you make)

Urban / Interurban area: I'm a professional (passenger transport).
Urban / Interurban area: I'm a professional (parcels, deliveries, fresh food and goods).
Urban / Interurban area: I'm a user with my own vehicle.
Urban / Interurban area: I'm a user with shared vehicle.
Light vehicle (bike, motorcycle, scooter): I'm a user with my own vehicle.
Light vehicle (bike, motorcycle, scooter): I'm a user with shared vehicle.
Long distance: I'm user with my own vehicle.
Long distance: I'm user with shared vehicle.
Other (specify)

40. What should be different related to electric vehicle or infrastructures for you to buy or lease an electric vehicle (100% electric)? (select 3)

Reduce the price of electric vehicles
More companies offering electric vehicle rental services
More information about its features (advantages and disadvantages)
Incentives for purchase such as financial aid, tax incentives
Other incentives: free parking / highways for free
Increased autonomy of the car, batteries with more autonomy
More fast chargers and better spread
Charging at home
Charging at the workplace
More car models / aesthetics Improved charging network
Standard components, shared by different manufacturers Improved technical support, and faster.
Other (please specify)

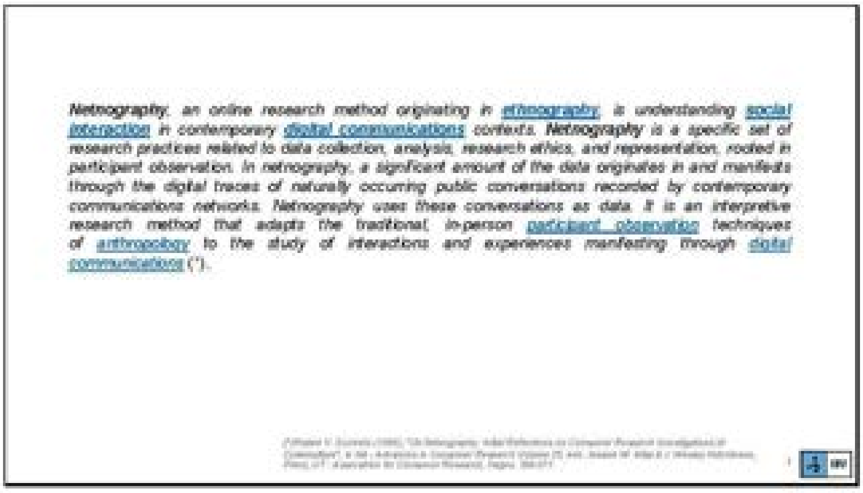
41. Additional comments related to electric vehicles or infrastructures:

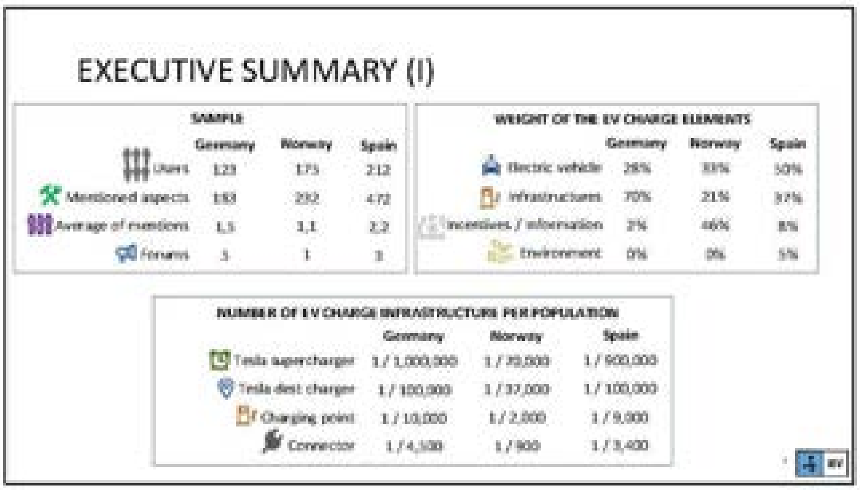
USER-CHI Survey - Study of the electric vehicle and charging infrastructure in Europe

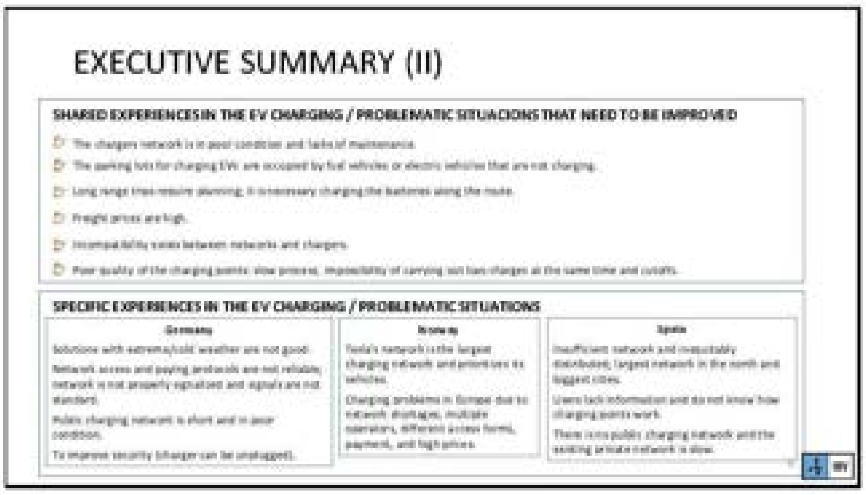
The questionnaire has finished. Thank you very much for your collaboration!!!

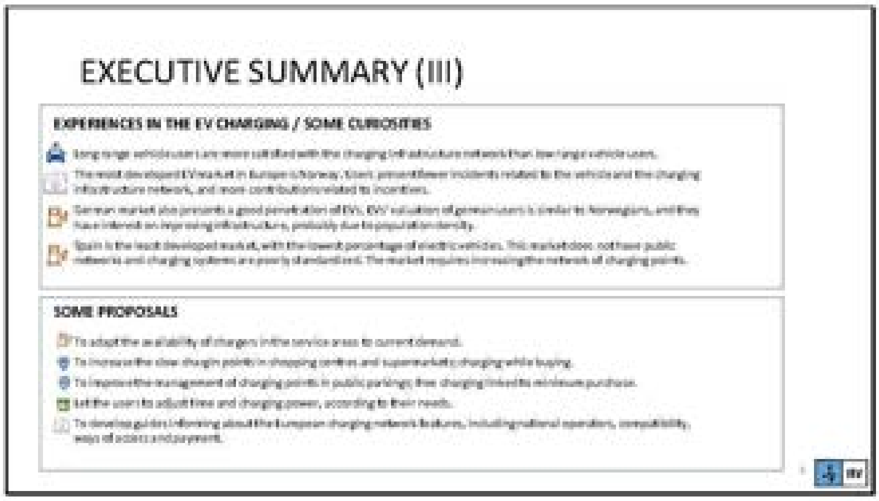
Check DONE

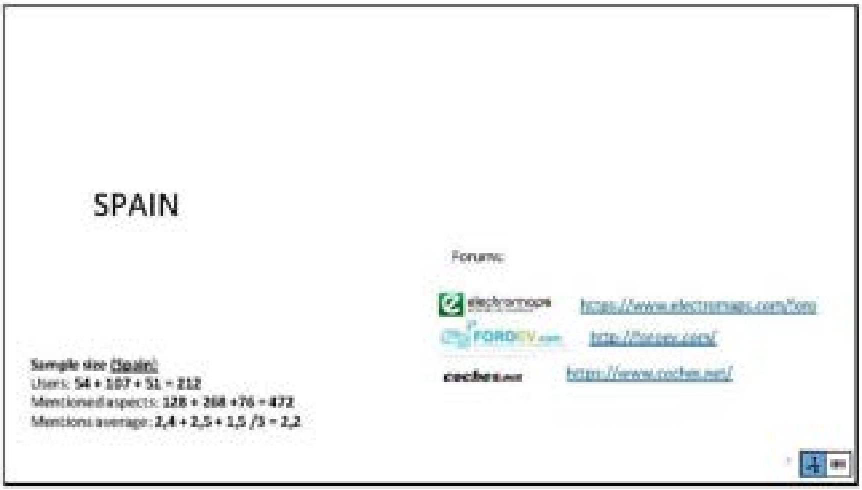
Annex 4: Netnography results' report

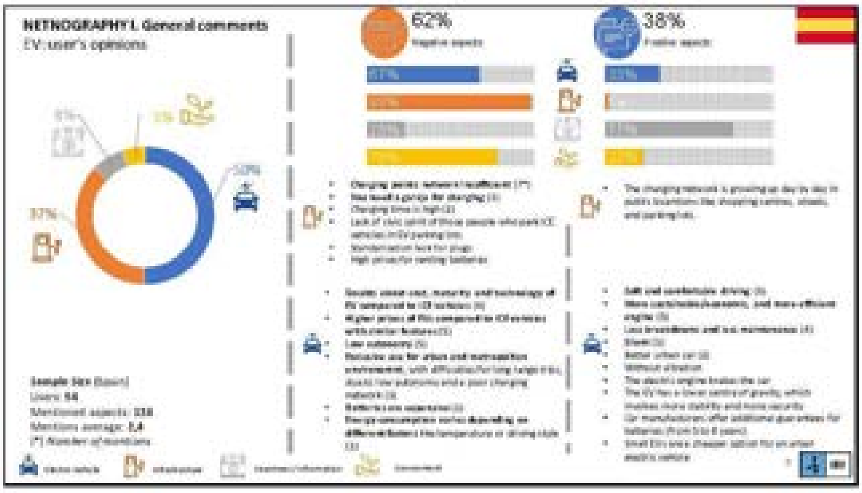


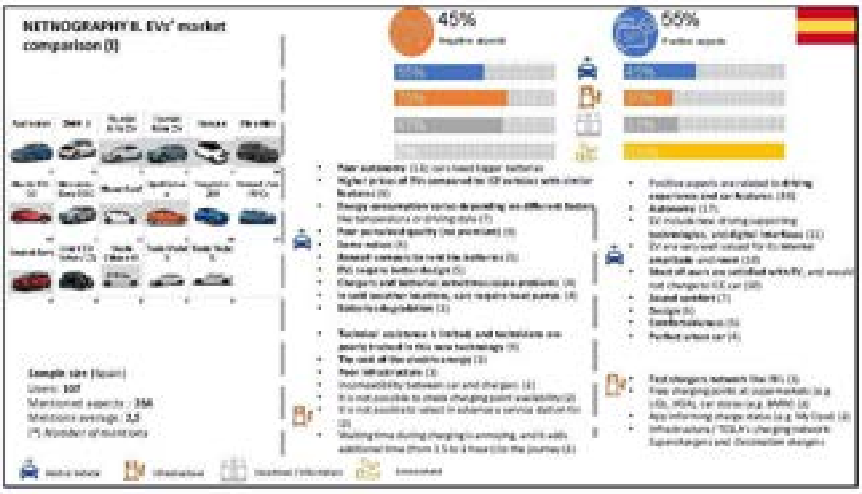

EXECUTIVE SUMMARY (I)
SAMPLE
Germany Norway Spain
Users 123 175 212
Mentioned aspects 183 232 472
Average of mentions 1,5 1,1 2,2
Forums 5 1 3
WEIGHT OF THE EV CHARGE ELEMENTS
Germany Norway Spain
Electric vehicle 28% 33% 50%
Infrastructures 70% 21% 37%
Incentives / information 2% 46% 8%
Environment 0% 0% 5%
NUMBER OF EV CHARGE INFRASTRUCTURE PER POPULATION
Germany Norway Spain
Tesla supercharger 1 / 1,000,000 1 / 70,000 1 / 900,000
Tesla dest charger 1 / 100,000 1 / 37,000 1 / 100,000
Charging point 1 / 10,000 1 / 2,000 1 / 9,000
Connector 1 / 4,100 1 / 900 1 / 3,400

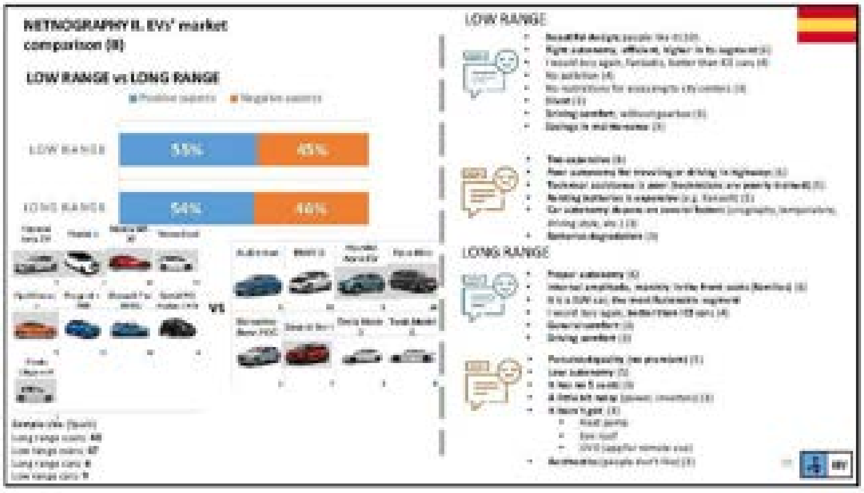

EXECUTIVE SUMMARY (II)
SHARED EXPERIENCES IN THE EV CHARGING / PROBLEMATIC SITUACIONS THAT NEED TO BE IMPROVED
The chargers network is in poor condition and lacks of maintenance.
The parking lots for charging EVs are occupied by fuel vehicles or electric vehicles that are not charging.
Long range trips require planning; it is necessary charging the batteries along the route.
Freight prices are high.
Incompatibility exists between networks and chargers.
Poor quality of the charging points: slow process, impossibility of carrying out two charges at the same time and cutoffs.
SPECIFIC EXPERIENCES IN THE EV CHARGING / PROBLEMATIC SITUATIONS
Germany
Solutions with extreme/cold weather are not good.
Network access and paying protocols are not reliable; network is not properly signalized and signals are not standard.
Public charging network is short and in poor condition.
To improve security (charger can be unplugged).
Norway
Tesla's network is the largest charging network and prioritizes its vehicles.
Charging problems in Europe due to network shortages, multiple operators, different access forms, payment, and high prices.
Spain
Insufficient network and inequitably distributed; largest network in the north and biggest cities.
Users lack information and do not know how charging points work.
There is no public charging network and the existing private network is slow.

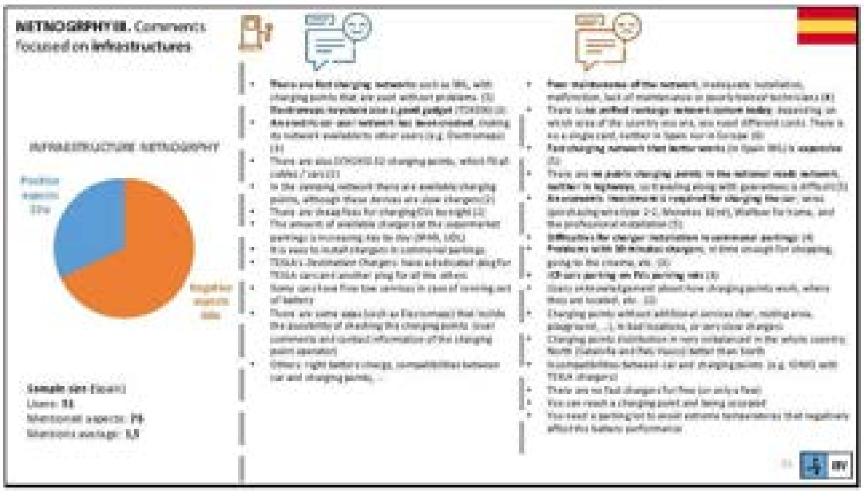

EXECUTIVE SUMMARY (III)
EXPERIENCES IN THE EV CHARGING / SOME CURIOSITIES
Long range vehicle users are more satisfied with the charging infrastructure network than low range vehicle users.
The most developed EV market in Europe is Norway. Users present fewer incidents related to the vehicle and the charging infrastructure network, and more contributions related to incentives.
German market also presents a good penetration of EVs. EV valuation of german users is similar to Norwegians, and they have interest on improving infrastructure, probably due to population density.
Spain is the least developed market, with the lowest percentage of electric vehicles. This market does not have public networks and charging systems are poorly standardized. The market requires increasing the network of charging points.
SOME PROPOSALS
To adapt the availability of chargers in the service areas to current demand.
To increase the slow chargin points in shopping centres and supermarkets; charging while buying.
To improve the management of charging points in public parkings; free charging linked to minimum purchase.
Let the users to adjust time and charging power, according to their needs.
To develop guides informing about the European charging network features, including national operators, compatibility, ways of access and payment.

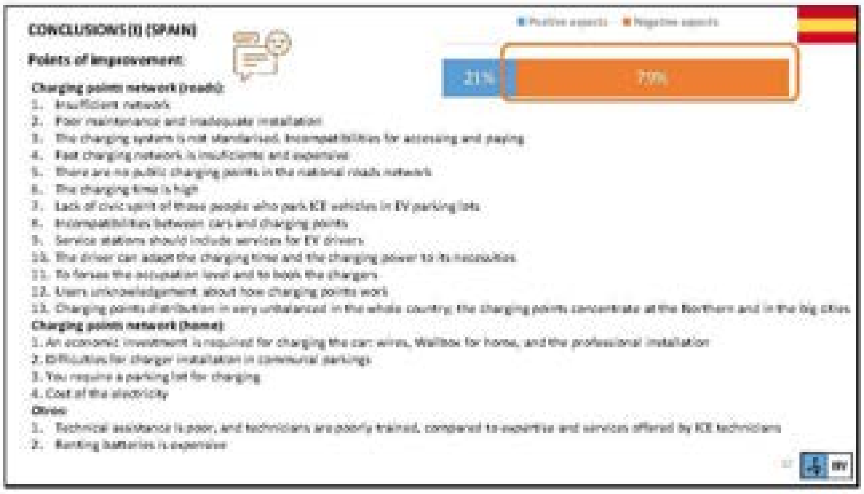

SPAIN
Forums:
https://www.electromaps.com/foro
http://forocev.com/
https://www.coches.net/
Sample size (Spain):
Users: 54 + 107 + 51 = 212
Mentioned aspects: 128 + 268 +76 = 472
Mentions average: 2,4 + 2,5 + 1,5 /3 = 2,2

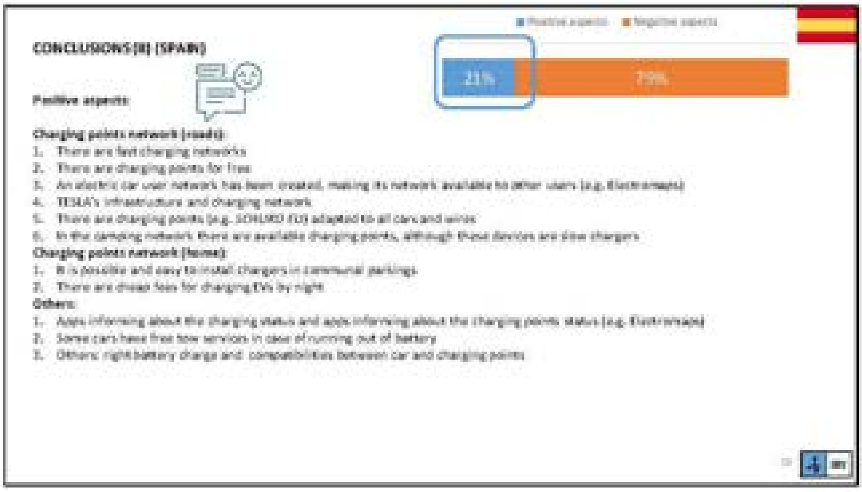

NETNOGRAPHY I. General comments
EV: user's opinions
62%
38%
Sample size (Spain)
Users: 54


NETNOGRAPHY II. EVs' market comparison (I)
45%
55%
Sample size (Spain)
Users: 107

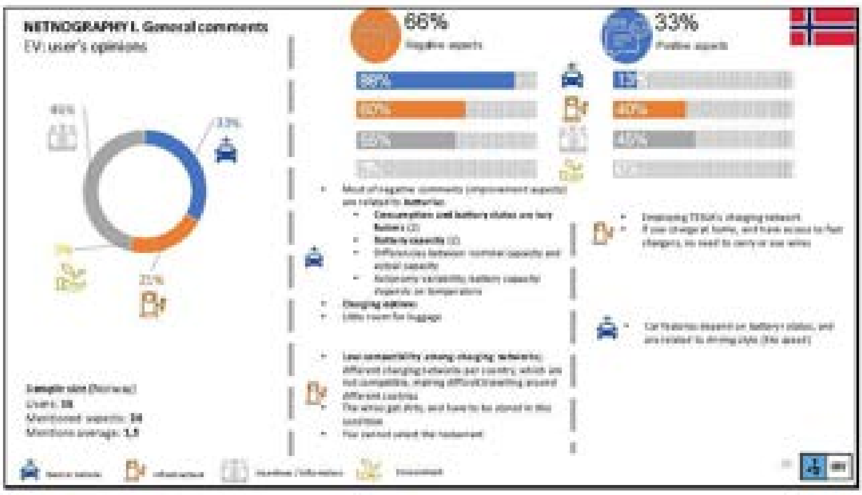

NETNOGRAPHY II. EVs' market comparison (II)
LOW RANGE vs LONG RANGE
Positive aspects
Negative aspects
LOW RANGE
55%
45%
LONG RANGE
54%
46%
VS
LOW RANGE
LONG RANGE

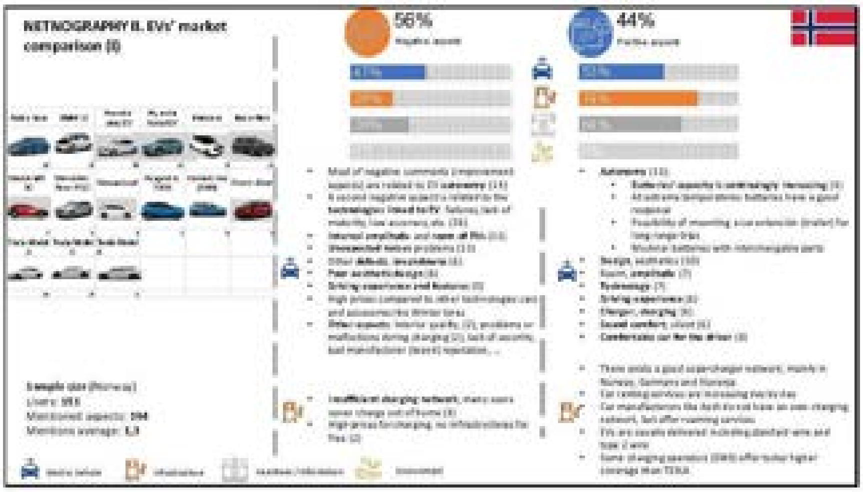

NETNOGRPHY III. Comments focused on infrastructures
INFRAESTRUCTURE NETNOGRAPHY
Positive aspects
Negative aspects

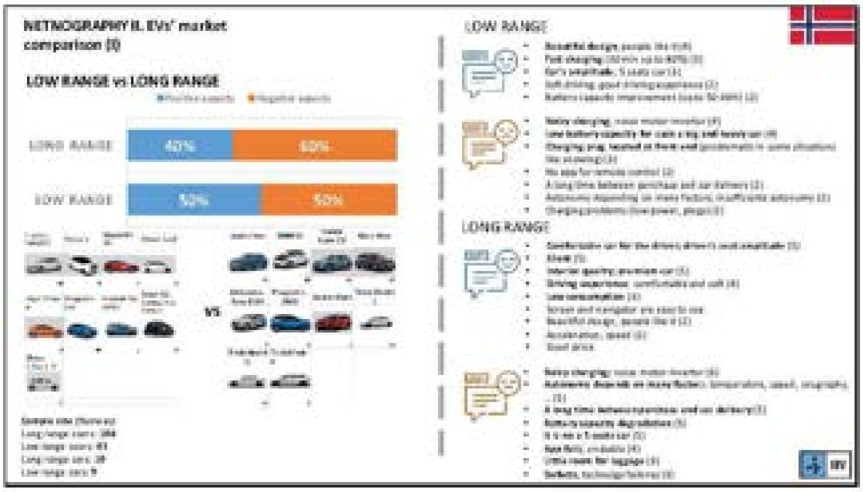

CONCLUSIONS (I) (SPAIN)
Points of improvement:
Positive aspects
Negative aspects
21%
79%
Charging points network (roads):
1. Insufficient network
2. Poor maintenance and inadequate installation
3. The charging system is not standarised. Incompatibilities for accessing and paying
4. Fast charging network is insufficiente and expensive
5. There are no public charging points in the national roads network
6. The charging time is high
7. Lack of civic spirit of those people who park ICE vehicles in EV parking lots
8. Incompatibilities between cars and charging points
9. Service stations should include services for EV drivers
10. The driver can adapt the charging time and the charging power to its necessities
11. To forsee the occupation level and to book the chargers
12. Users unknowledgement about how charging points work
13. Charging points distribution in very unbalanced in the whole country; the charging points concentrate at the Northern and in the big cities
Charging points network (home):
1. An economic investment is required for charging the car: wires, Wallbox for home, and the professional installation
2. Difficulties for charger installation in communal parkings
3. You require a parking lot for charging
4. Cost of the electricity
Otros:
1. Technical assistance is poor, and technicians are poorly trained, compared to expertise and services offered by ICE technicians
2. Renting batteries is expensive

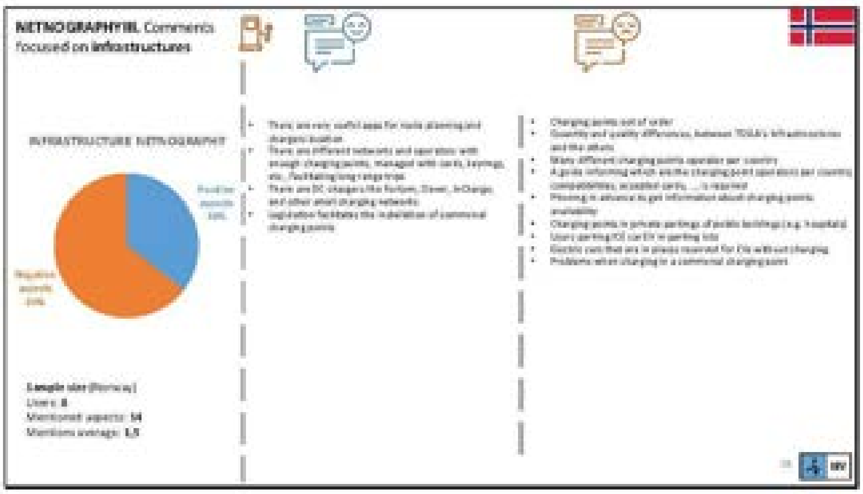

CONCLUSIONS (8) (SPAIN)
Positive aspects
Negative aspects
21%
79%
Positive aspects:
Charging points network (roads):
1. There are fast charging networks
2. There are charging points for free
3. An electric car user network has been created, making its network available to other users (e.g. Electromaps)
4. TESLA's infrastructure and charging network
5. There are charging points (e.g. SCHUKO EU) adapted to all cars and wires
6. In the camping network there are available charging points, although these devices are slow chargers
Charging points network (home):
1. It is possible and easy to install chargers in communal parkings
2. There are cheap fees for charging EVs by night
Others:
1. Apps informing about the charging status and apps informing about the charging points status (e.g. Electromaps)
2. Some cars have free tow services in case of running out of battery
3. Others: right battery charge and compatibilities between car and charging points

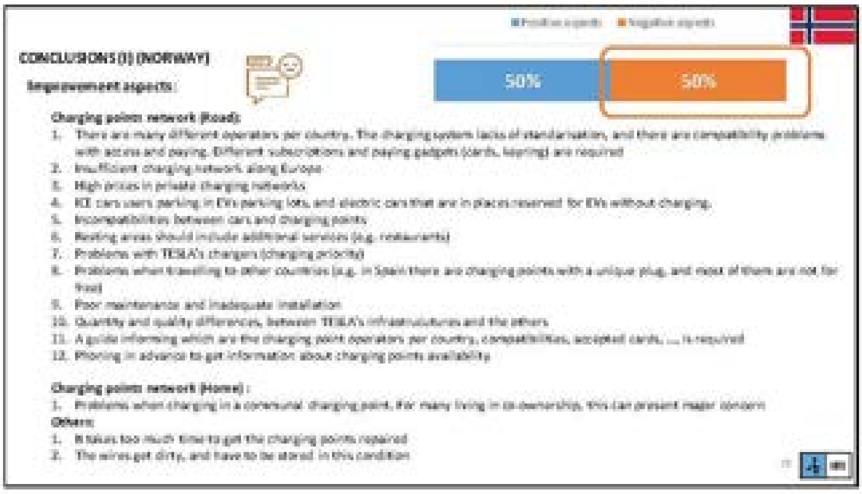

NORWAY
Forums:
https://elbilforum.no/index.php
Sample size (Norway)
Users: 16 + 151 + 8 = 175
Mentioned aspects: 24 + 194 +14 = 232
Mentions average: 1,5 + 1,3 + 1,5 /3 = 1,1

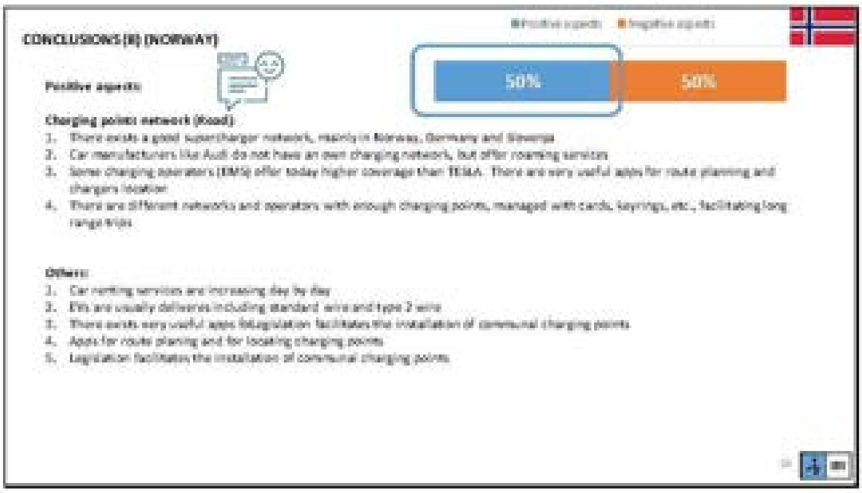

NETNOGRAPHY I. General comments
EV user's opinions
66%
Negative aspects
33%
Positive aspects
88%
60%
55%
40%
45%
33%
21%
Sample size (Norway)
Users: 16
Mentioned aspects: 24
Mentions average: 1,5


NETNOGRAPHY
EVs' market comparison
56%
44%

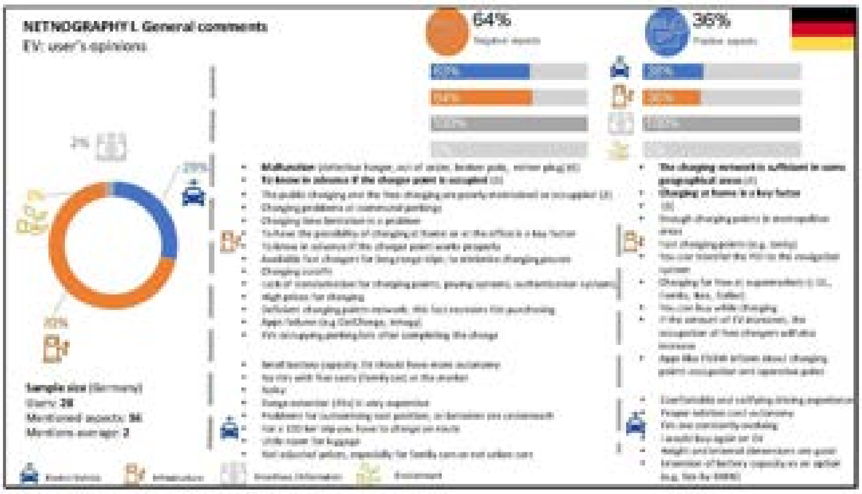

NETNOGRAPHY
EVs' market comparison
LOW RANGE vs LONG RANGE
LONG RANGE
40%
60%
LOW RANGE
50%
50%
VS
LOW RANGE
LONG RANGE

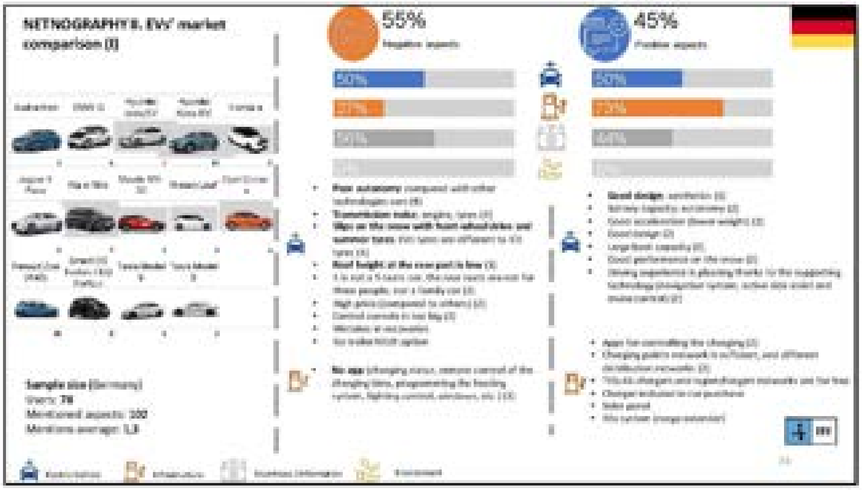

NETNOGRAPHY
Comments focused on infrastructures
INFRASTRUCTURE NETNOGRAPHY

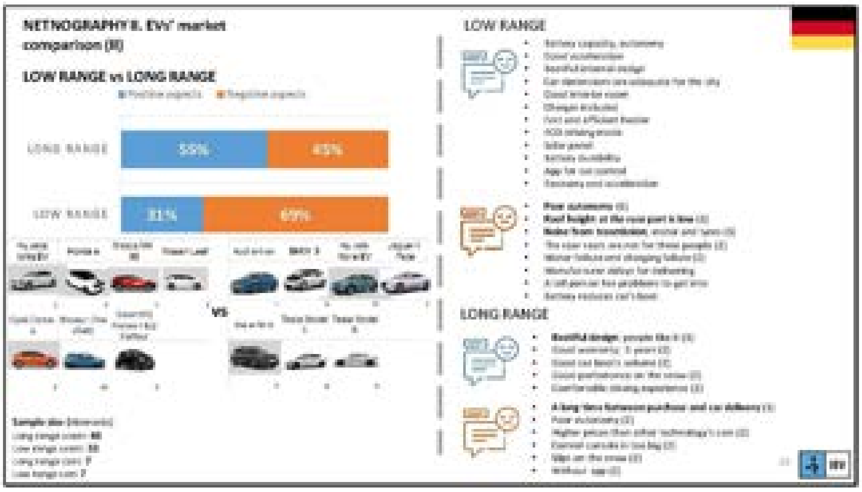

Positive aspects
Negative aspects
CONCLUSIONS (I) (NORWAY)
Improvement aspects:
50%
50%
Charging points network (Road):
1. There are many different operators per country. The charging system lacks of standarisation, and there are compatibility problems with access and paying. Different subscriptions and paying gadgets (cards, keyring) are required
2. Insufficient charging network along Europe
3. High prices in private charging networks
4. ICE cars users parking in EVs parking lots, and electric cars that are in places reserved for EVs without charging.
5. Incompatibilities between cars and charging points
6. Resting areas should include additional services (e.g. restaurants)
7. Problems with TESLA's chargers (charging priority)
8. Problems when travelling to other countries (e.g. in Spain there are charging points with a unique plug, and most of them are not for free)
9. Poor maintenance and inadequate installation
10. Quantity and quality differences, between TESLA's infrastructures and the others
11. A guide informing which are the charging point operators per country, compatibilities, accepted cards, ... is required
12. Phoning in advance to get information about charging points availability
Charging points network (Home):
1. Problems when charging in a communal charging point. For many living in co-ownership, this can present major concern
Others:
1. It takes too much time to get the charging points repaired
2. The wires get dirty, and have to be stored in this condition

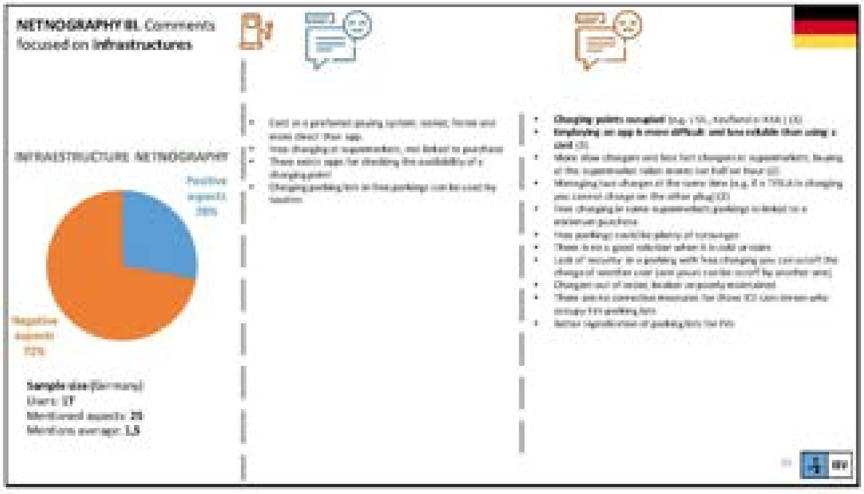

Positive aspects
Negative aspects
CONCLUSIONS (II) (NORWAY)
Positive aspects:
50%
50%
Charging points network (Road):
1. There exists a good supercharger network, mainly in Norway, Germany and Slovenia
2. Car manufacturers like Audi do not have an own charging network, but offer roaming services
3. Some charging operators (EMS) offer today higher coverage than TESLA. There are very useful apps for route planning and chargers location
4. There are different networks and operators with enough charging points, managed with cards, keyrings, etc., facilitating long range trips
Others:
1. Car renting services are increasing day by day
2. EVs are usually deliveries including standard wire and type 2 wire
3. There exists very useful apps forLegislation facilitates the installation of communal charging points
4. Apps for route planing and for locating charging points
5. Legislation facilitates the installation of communal charging points

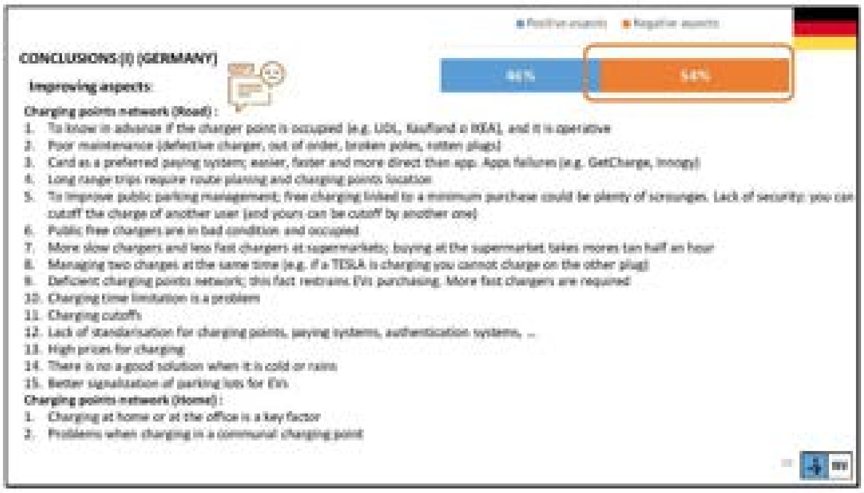

GERMANY
Forums:
https://elektroauto-forum.de/
https://www.goingelectric.de/forum/
https://www.elektroauto.community/forums/
https://ff-forum.de/
https://www.elektromobilitaet-forum.de/community/
Sample size (Germany)
Users: 28 + 78 + 17 = 123
Mentioned aspects: 56 + 102 + 25= 183
Mentions average: 2 + 1,3 + 1,4 /3 = 1,5

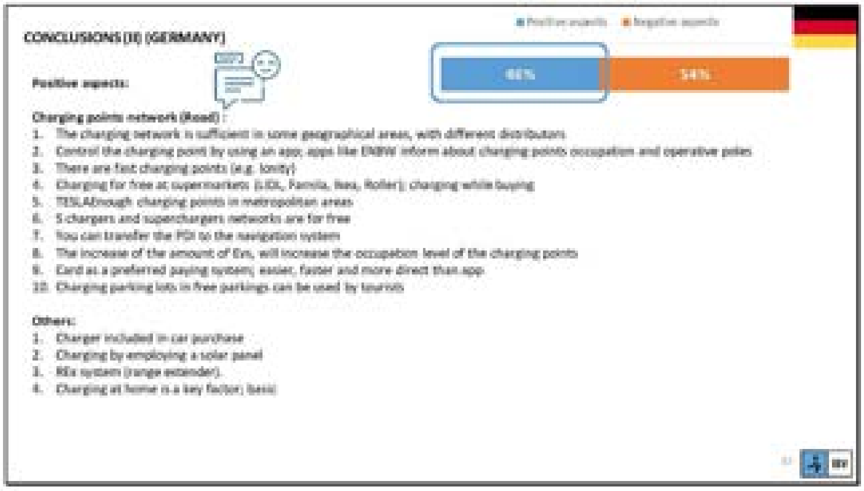

NETNOGRAPHY I. General comments
EV: user's opinions
64%
36%

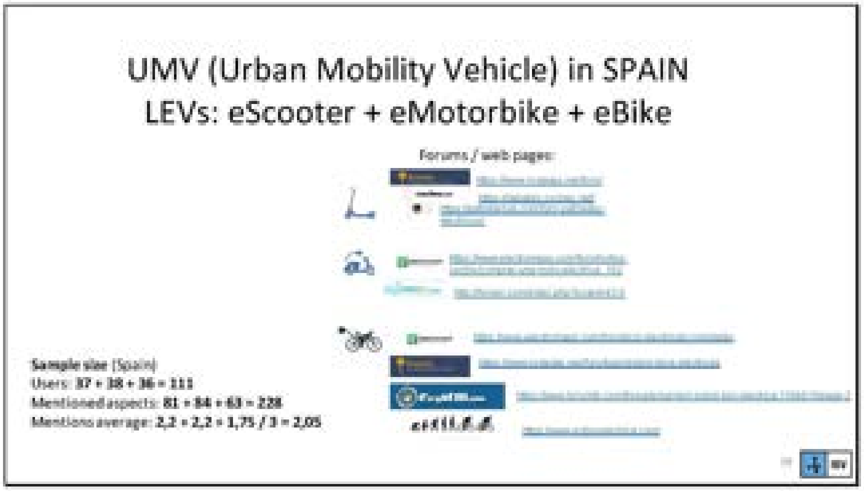

NETNOGRAPHY II. EVs' market comparison (I)
55%
45%

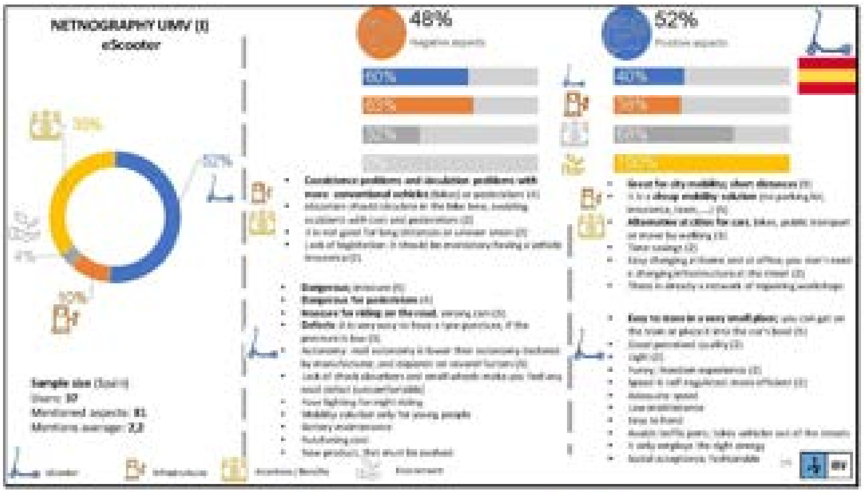

NETNOGRAPHY II. EVs' market comparison (II)
LOW RANGE vs LONG RANGE
LONG RANGE
55%
45%
LOW RANGE
31%
69%
VS
LOW RANGE
LONG RANGE

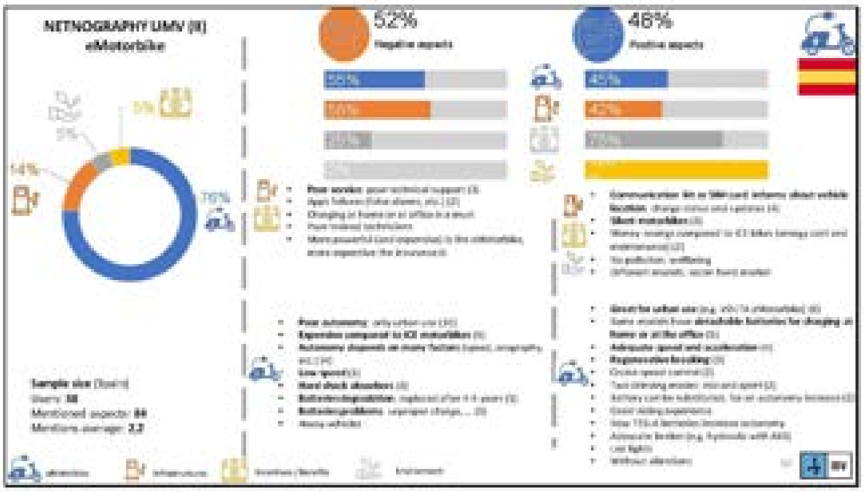

NETNOGRAPHY III. Comments focused on infrastructures
INFRAESTRUCTURE NETNOGRAPHY
Positive aspects 28%
Negative aspects 72%
Sample size (Germany)
Users: 17
Mentioned aspects: 25
Mentions average: 1,5
Charging points occupied
Employing an app is more difficult and less reliable than using a card

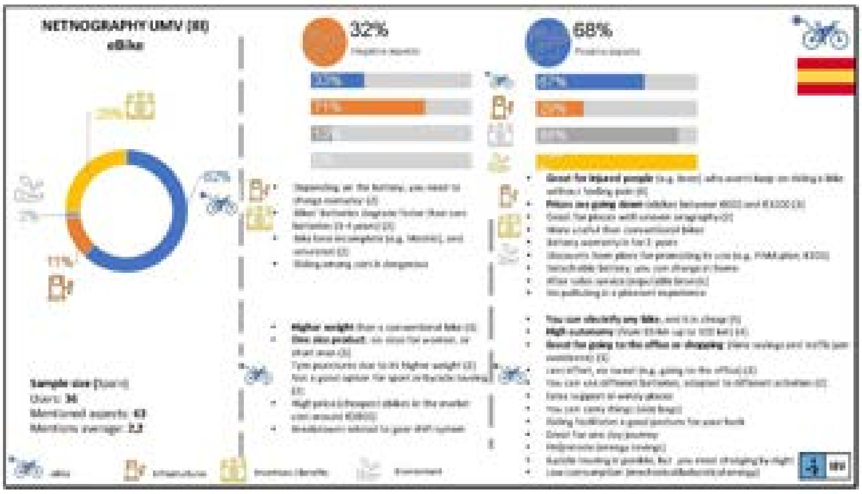

Positive aspects
Negative aspects
CONCLUSIONS (I) (GERMANY)
46%
54%
Improving aspects:
Charging points network (Road) :
1. To know in advance if the charger point is occupied (e.g. LIDL, Kaufland o IKEA), and it is operative
2. Poor maintenance (defective charger, out of order, broken poles, rotten plugs)
3. Card as a preferred paying system; easier, faster and more direct than app. Apps failures (e.g. GetCharge, Innogy)
4. Long range trips require route planing and charging points location
5. To improve public parking management; free charging linked to a minimum purchase could be plenty of scroungers. Lack of security: you can cutoff the charge of another user (and yours can be cutoff by another one)
6. Public free chargers are in bad condition and occupied
7. More slow chargers and less fast chargers at supermarkets; buying at the supermarket takes mores tan half an hour
8. Managing two charges at the same time (e.g. if a TESLA is charging you cannot charge on the other plug)
9. Deficient charging points network; this fact restrains EVs purchasing. More fast chargers are required
10. Charging time limitation is a problem
11. Charging cutoffs
12. Lack of standarisation for charging points, paying systems, authentication systems, …
13. High prices for charging
14. There is no a good solution when it is cold or rains
15. Better signalization of parking lots for EVs
Charging points network (Home) :
1. Charging at home or at the office is a key factor
2. Problems when charging in a communal charging point

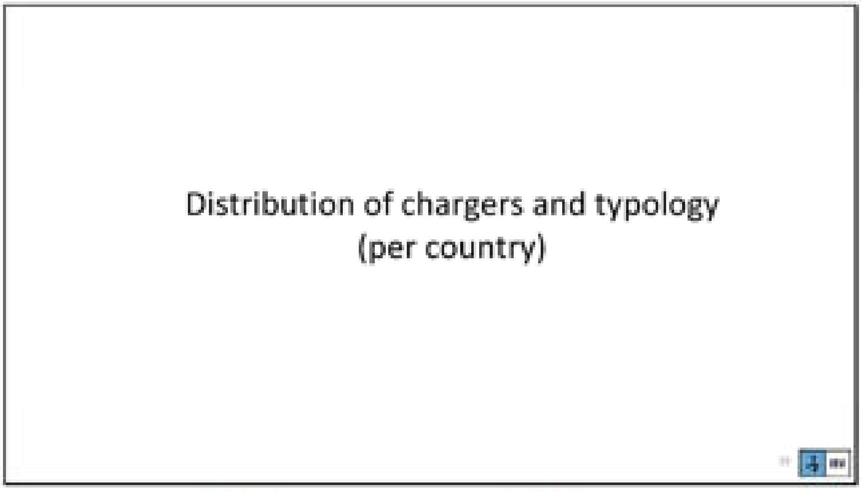

Positive aspects
Negative aspects
CONCLUSIONS (II) (GERMANY)
46%
54%
Positive aspects:
Charging points network (Road) :
1. The charging network is sufficient in some geographical areas, with different distributors
2. Control the charging point by using an app; apps like ENBW inform about charging points occupation and operative poles
3. There are fast charging points (e.g. Ionity)
4. Charging for free at supermarkets (LIDL, Famila, Ikea, Roller); charging while buying
5. TESLA:enough charging points in metropolitan areas
6. S chargers and superchargers networks are for free
7. You can transfer the POI to the navigation system
8. The increase of the amount of Evs, will increase the occupation level of the charging points
9. Card as a preferred paying system; easier, faster and more direct than app
10. Charging parking lots in free parkings can be used by tourists
Others:
1. Charger included in car purchase
2. Charging by employing a solar panel
3. REx system (range extender).
4. Charging at home is a key factor; basic

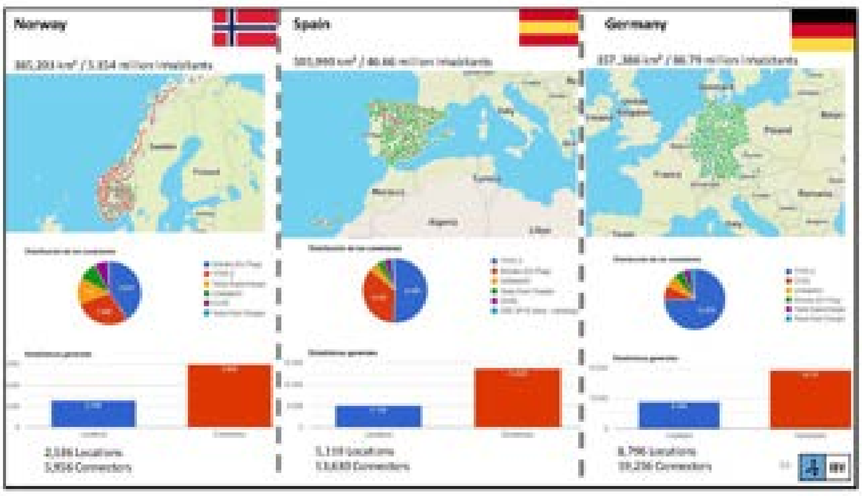

UMV (Urban Mobility Vehicle) in SPAIN
LEVs: eScooter + eMotorbike + eBike
Forums / web pages:
Sample size (Spain)
Users: 37 + 38 + 36 = 111
Mentioned aspects: 81 + 84 + 63 = 228
Mentions average: 2,2 + 2,2 + 1,75 / 3 = 2,05

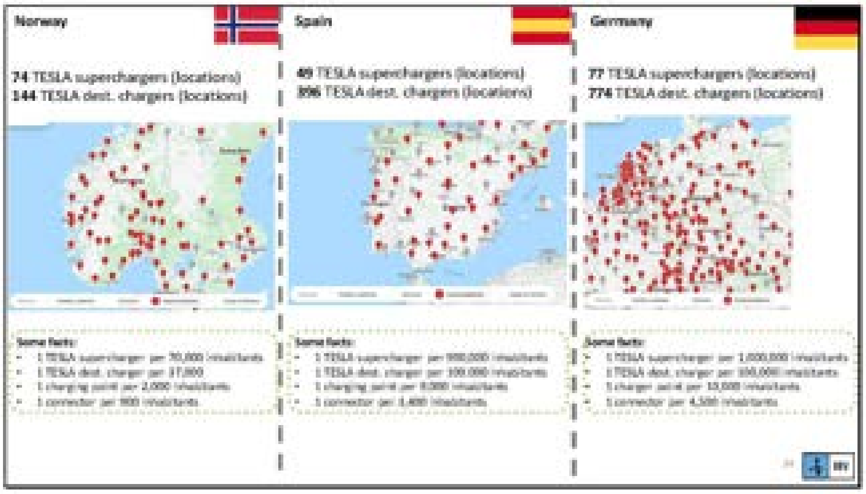

NETNOGRAPHY UMV (I)
eScooter
48%
52%
Sample size (Spain)

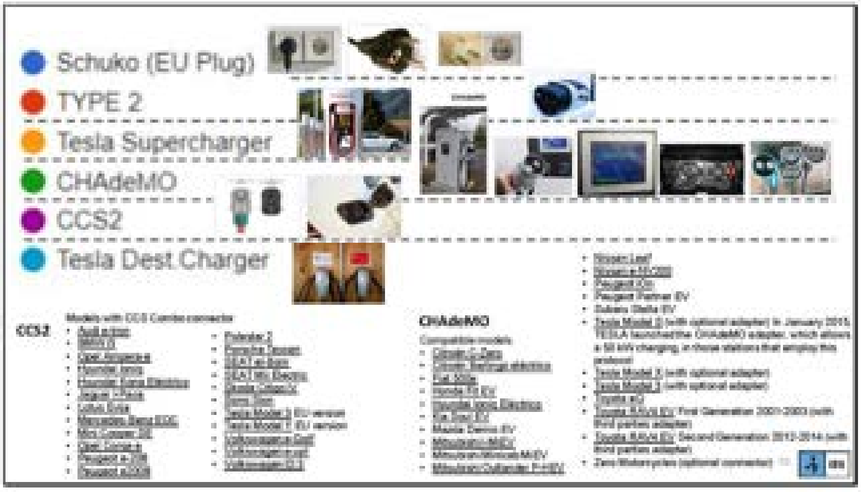

NETNOGRAPHY UMV (II)
eMotorbike
52%
Negative aspects
48%
Positive aspects
Sample size (Spain)

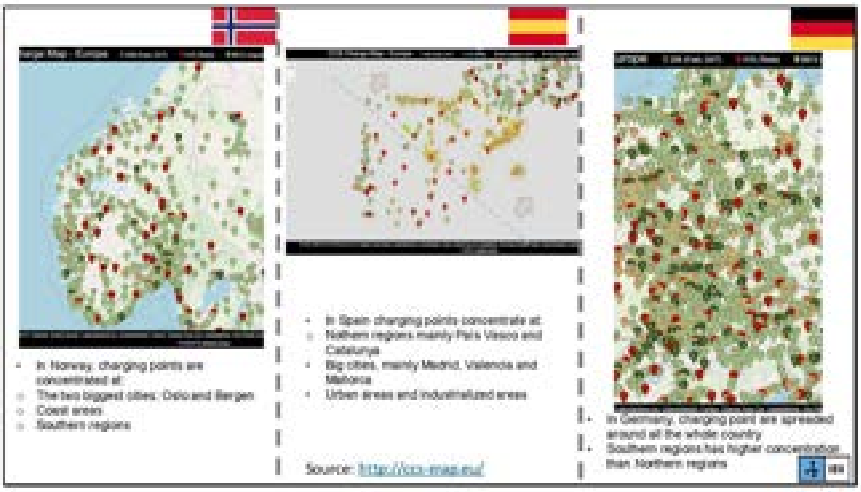

NETNOGRAPHY UMV (III)
eBike
32%
68%

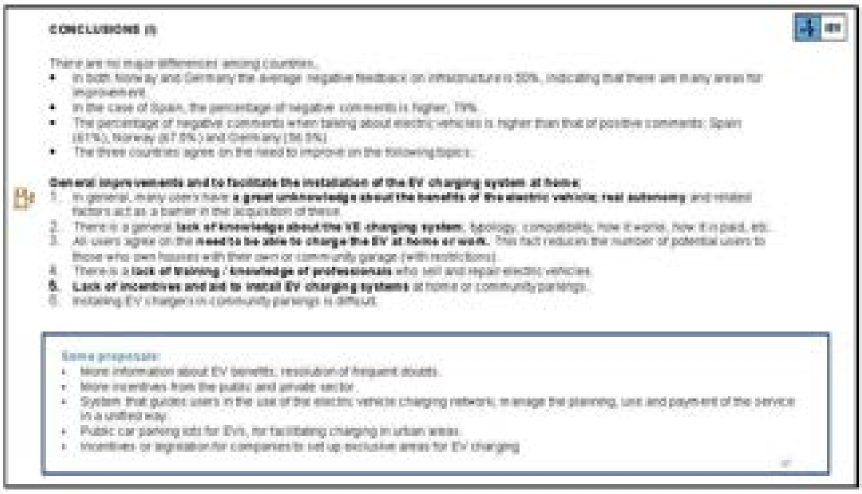

Distribution of chargers and typology
(per country)


Norway
Spain
Germany


Norway
74 TESLA superchargers (locations)
144 TESLA dest. chargers (locations)
Spain
49 TESLA superchargers (locations)
396 TESLA dest. chargers (locations)
Germany
77 TESLA superchargers (locations)
774 TESLA dest. chargers (locations)
Some facts:
Some facts:
Some facts:

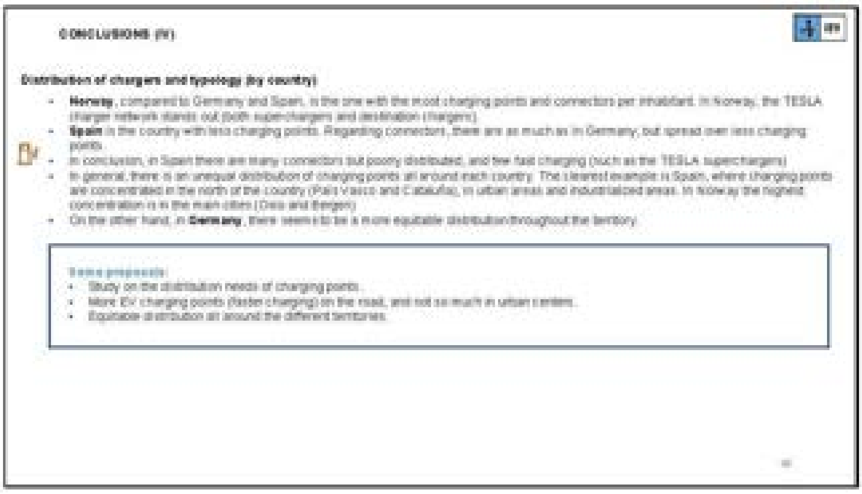

Schuko (EU Plug)
TYPE 2
Tesla Supercharger
CHAdeMO
CCS2
Tesla Dest Charger
CCS2
CHAdeMO


In Norway, charging points are concentrated at:
The two biggest cities: Oslo and Bergen
Coast areas
Southern regions
In Spain charging points concentrate at:
Nothern regions mainly País Vasco and Catalunya
Big cities, mainly Madrid, Valencia and Mallorca
Urban areas and industrialized areas
Source: http://ccs-map.eu/
In Germany, charging point are spreaded around all the whole country
Southern regions has higher concentration than Northern regions


CONCLUSIONS (I)
There are no major differences among countries.
In both Norway and Germany the average negative feedback on infrastructure is 50%, indicating that there are many areas for improvement.
In the case of Spain, the percentage of negative comments is higher, 79%.
The percentage of negative comments when talking about electric vehicles is higher than that of positive comments: Spain (61%), Norway (67.5%) and Germany (56.5%).
The three countries agree on the need to improve on the following topics:
General improvements and to facilitate the installation of the EV charging system at home:
1. In general, many users have a great unknowledge about the benefits of the electric vehicle; real autonomy and related factors act as a barrier in the acquisition of these.
2. There is a general lack of knowledge about the VE charging system: typology, compatibility, how it works, how it is paid, etc.
3. All users agree on the need to be able to charge the EV at home or work. This fact reduces the number of potential users to those who own houses with their own or community garage (with restrictions).
4. There is a lack of training / knowledge of professionals who sell and repair electric vehicles.
5. Lack of incentives and aid to install EV charging systems at home or community parkings.
6. Installing EV chargers in community parkings is difficult.
Some proposals:
More information about EV benefits, resolution of frequent doubts.
More incentives from the public and private sector.
System that guides users in the use of the electric vehicle charging network; manage the planning, use and payment of the service in a unified way.
Public car parking lots for EVs, for facilitating charging in urban areas.
Incentives or legislation for companies to set up exclusive areas for EV charging.


CONCLUSIONS (II)
To improve the EV charging infrastructure (on route, away from home):
1. There are many different operators in each country. Unified loading system, incompatibilities in access and payment methods. Currently, users need different subscriptions, cards and keychains to travel with their EV within a country and between countries.
2. Lack of maintenance, poor state of preservation, especially in the free EV charging infrastructure.
3. Users need to be able to know if the charging points are busy, and to be able to make a reservation.
4. There is a demand for some system or guide to help planning long range routes.
5. Improvement of free parking lots: security, maintenance, linking free parking to minimum purchases.
6. Managing the time required for charging EVs; to control the time the vehicle is going to be on charge, and charging power.
7. More fast chargers, and well distributed; there is an insufficient network of EV charging points, especially on the road.
8. Price regulation at private EV charging points; prices are too high.
9. Adequacy of service areas (charging points) with a place to eat, a resting area, etc.
10. Solutions to the lack of civic spirit of those drivers who occupy the parking lots for EVs, preventing EV charging.
11. In general, users demand solutions to incompatibilities between cars, charging points and chargers.
Some proposals:
System that guides users in EV charging points, managed in an unified way: planning, use and payment.
Improvement of the EV charging point network:
More charging points if the EV fleet increases.
More fast charging points on route, and better distributed by each territory.
Better maintenance.
Possibility of regulating power and time of EV charging point.
Unification of access systems, compatibility, payment, etc.
Adequacy of service areas
Price regulation


CONCLUSIONS (III)
Urban Mobility Vehicles
For UMVs, the one with the most positive aspects / comments is the electric bicycle (68% of positive comments), highlighting its suitability for people who have knee injuries, etc., for cities with slopes, and its autonomy compared to other vehicles (around 60-100km). They are great for going to work or shopping (you can carry weight) and any bike can be electrified. On the contrary, the weight must be improved (greater than conventional bikes), and there is no variety of sizes. Regarding infrastructure, it is important to know that they need charging every day, and the user has to handle a heavy bike or a detachable battery, what is not very ergonomic. Batteries last only 3-4 years, and bike lanes in Spain are scarce and / or saturated with bikes and other vehicles such as electric scooters (on the rise).
The electric scooter follows, with 59% of positive comments. It is a great vehicle for cities and for short trips. The user saves time and money (it is cheap), and they are easy to store and transport due to their weight and folding frame. On the contrary, they are considered dangerous by the users themselves, for possible falls (lack of stability, lack of shock absorbers, small wheels), as well as dangerous for pedestrians. In general, They have problems of coexistence and circulation with other vehicles / pedestrians.
The electric motorcycle is the one that has a greater number of negative aspects (62%) due to low autonomy, high price, and infrastructure problems related to charging (charging at home and / or work is a key factor), poor technical service and apps with a lot of failures.
Some proposals:
Free urban parking lots for bikes and electric motorcycles with charging points (to overcome the charging at home or work).
Green / blue areas, with parking lots to charge electric motorcycles (and EV).
More electric bike and scooter lanes, and safer lanes.
Fast charging points well distributed throughout urban and road areas.
Possibility of managing the search for charging points, availability, occupancy and conservation status in a reliable way.
Standardized charging points for all EVs, including a simple and reliable payment process.

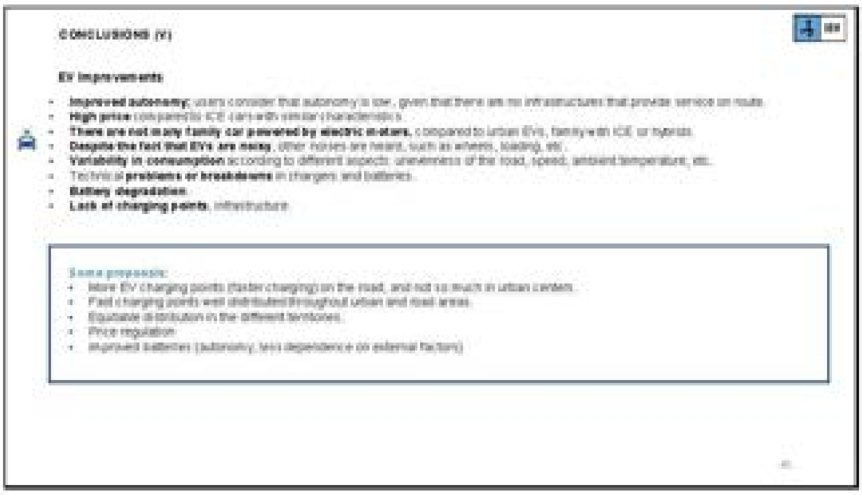


CONCLUSIONS (IV)

Distribution of chargers and typology (by country)

- **Norway**, compared to Germany and Spain, is the one with the most charging points and connectors per inhabitant. In Norway, the TESLA charger network stands out (both superchargers and destination chargers).
- **Spain** is the country with less charging points. Regarding connectors, there are as much as in Germany, but spread over less charging points.
- In conclusion, in Spain there are many connectors but poorly distributed, and few fast charging (such as the TESLA superchargers).
- In general, there is an unequal distribution of charging points all around each country. The clearest example is Spain, where charging points are concentrated in the north of the country (País Vasco and Cataluña), in urban areas and industrialized areas. In Norway the highest concentration is in the main cities (Oslo and Bergen).
- On the other hand, in **Germany**, there seems to be a more equitable distribution throughout the territory.

Some proposals:
- Study on the distribution needs of charging points.
- More EV charging points (faster charging) on the road, and not so much in urban centers.
- Equitable distribution all around the different territories.



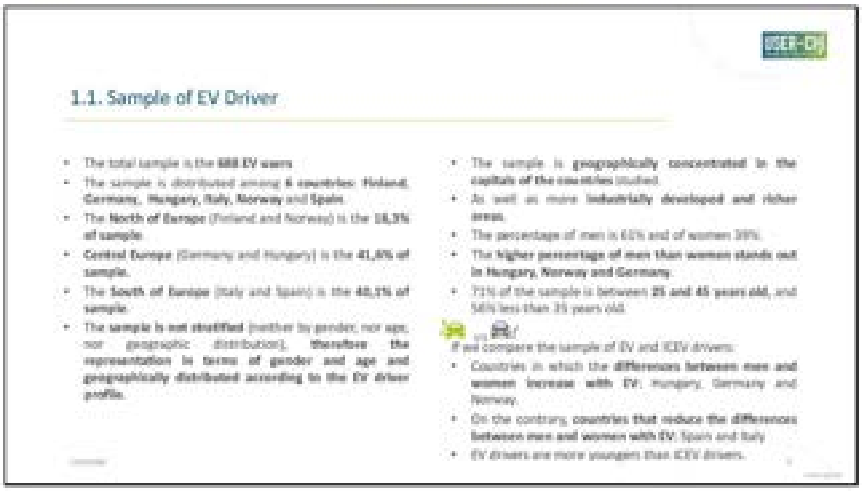
CONCLUSIONS (V)

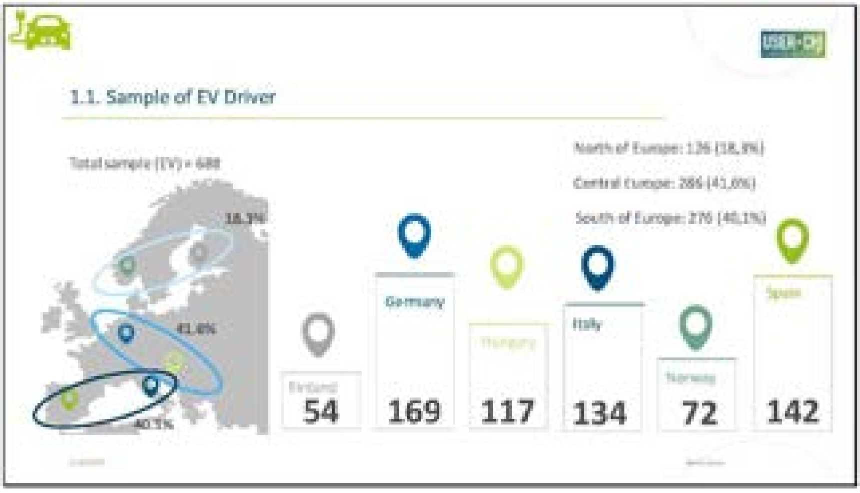
EV improvements

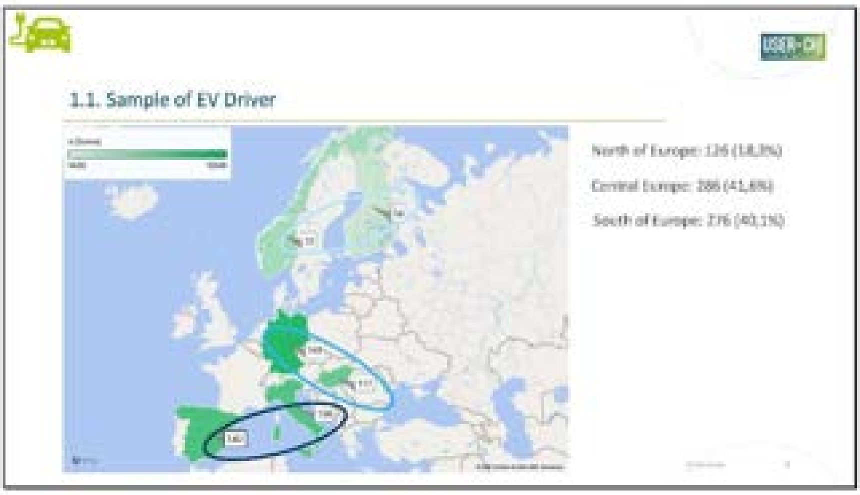
- **Improved autonomy**; users consider that autonomy is low, given that there are no infrastructures that provide service on route.
- **High price** compared to ICE cars with similar characteristics.
- **There are not many family car powered by electric motors**, compared to urban EVs, family with ICE or hybrids.
- **Despite the fact that EVs are noisy**, other noises are heard, such as wheels, loading, etc.
- **Variability in consumption** according to different aspects: unevenness of the road, speed, ambient temperature, etc.
- Technical **problems or breakdowns** in chargers and batteries.
- **Battery degradation**.
- **Lack of charging points**, infrastructure.

Some proposals:
- More EV charging points (faster charging) on the road, and not so much in urban centers.
- Fast charging points well distributed throughout urban and road areas.
- Equitable distribution in the different territories.
- Price regulation.
- Improved batteries (autonomy, less dependence on external factors).

Annex 5: Survey's results report

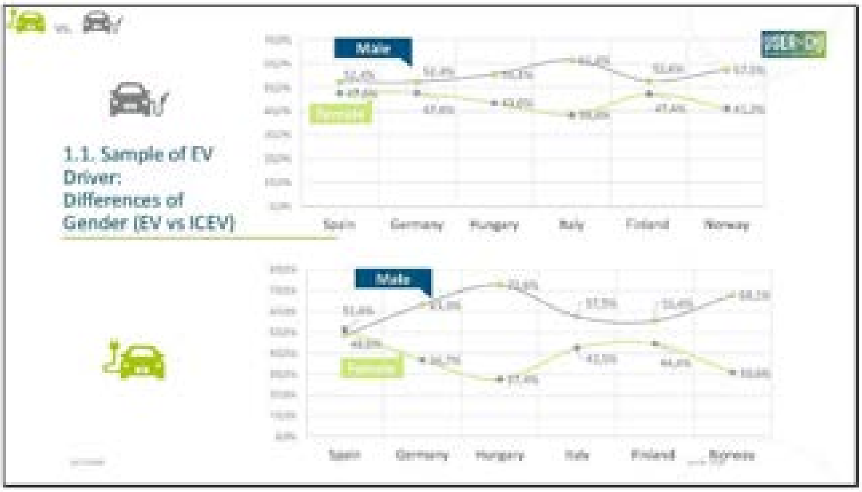


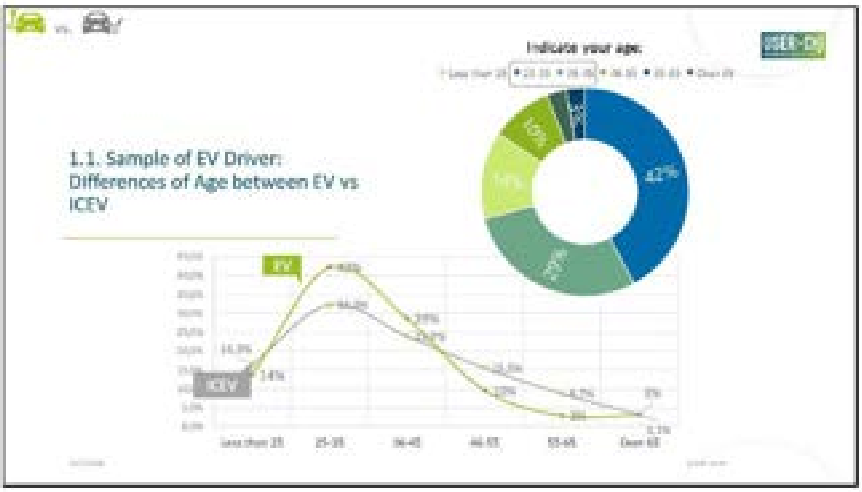

1.1. Sample of EV Driver
Total sample (EV) = 688
North of Europe: 126 (18,3%)
Central Europe: 286 (41,6%)
South of Europe: 276 (40,1%)
18,3%
41,6%
Finland
54
Germany
169
Hungary
117
Italy
134
Norway
72
Spain
142

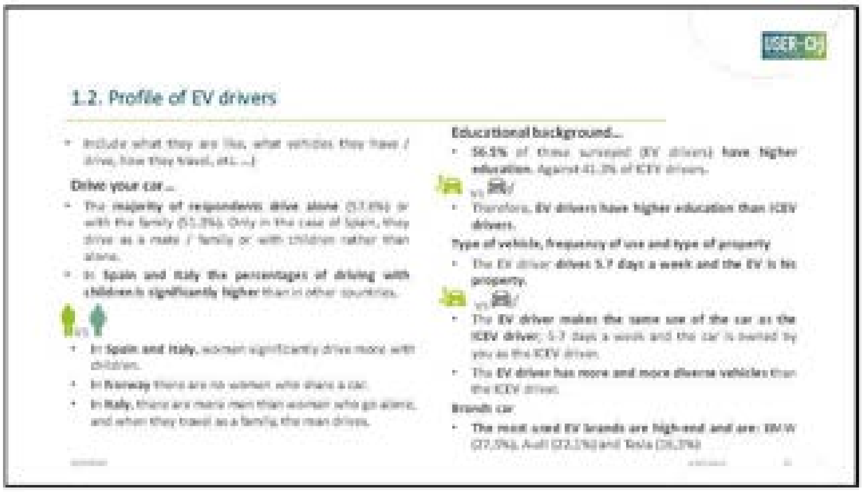

1.1. Sample of EV Driver
North of Europe: 126 (18,3%)
Central Europe: 286 (41,6%)
South of Europe: 276 (40,1%)

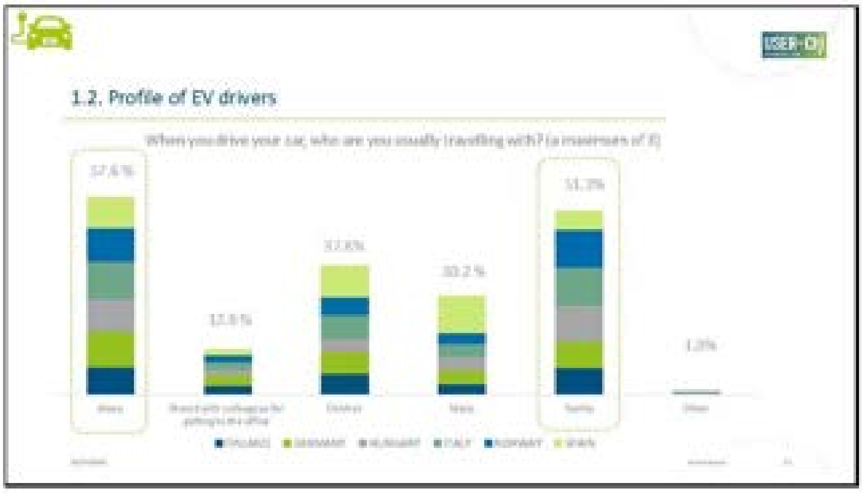

1.1. Sample of EV Driver
Sample location

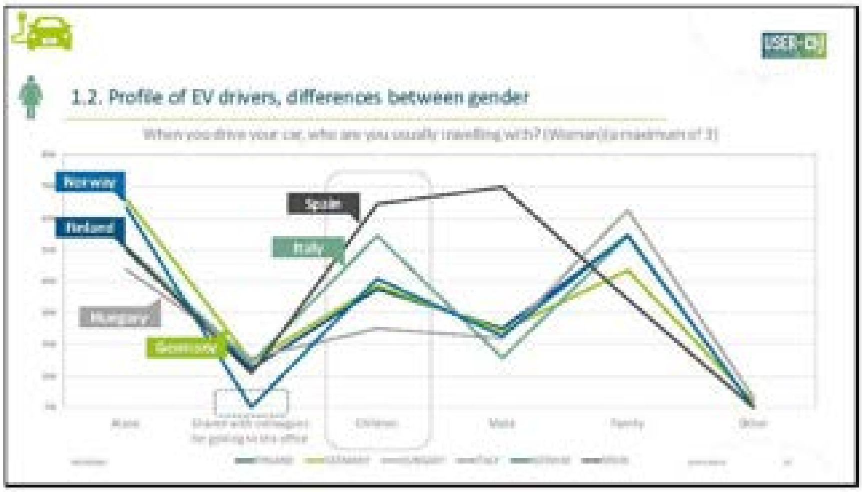

1.1. Sample of EV Driver
Male
60.6%
39.2%
Female

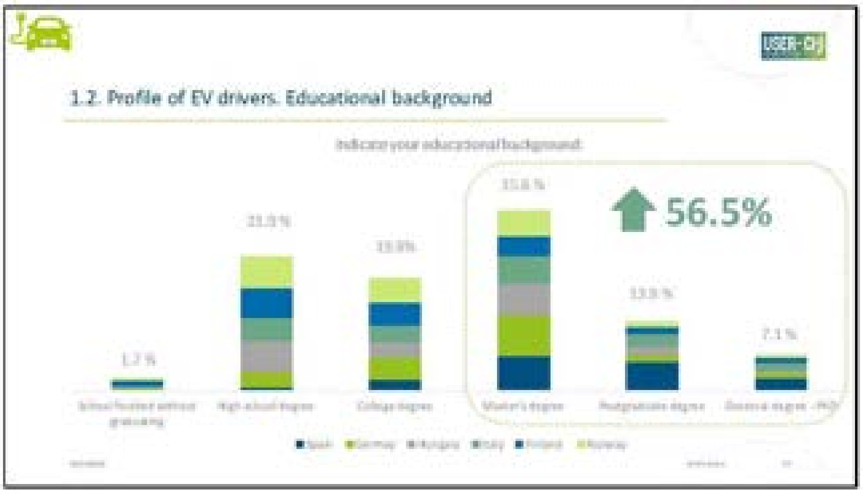

vs.
1.1. Sample of EV Driver: Differences of Gender (EV vs ICEV)
Male
Female
Spain
Germany
Hungary
Italy
Finland
Norway
Male
Female
Spain
Germany
Hungary
Italy
Finland
Norway

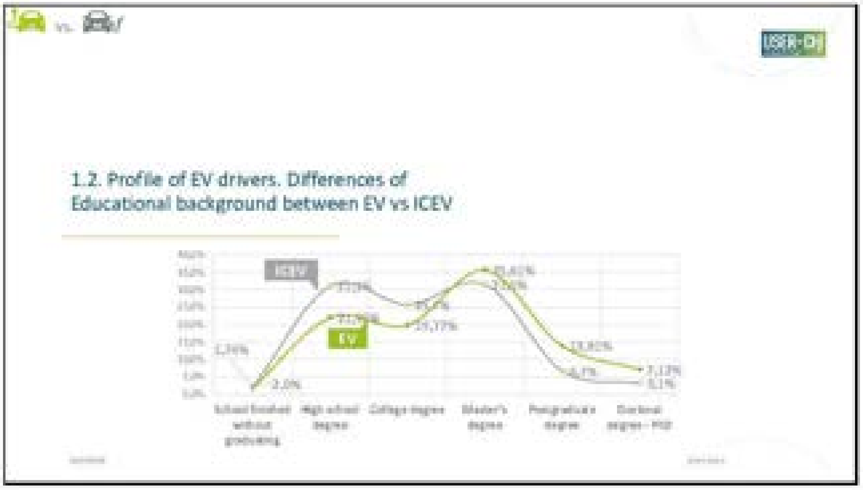

vs.
1.1. Sample of EV Driver: Differences of Age between EV vs ICEV
Indicate your age:
42%
EV
ICEV
Less than 25
25-35

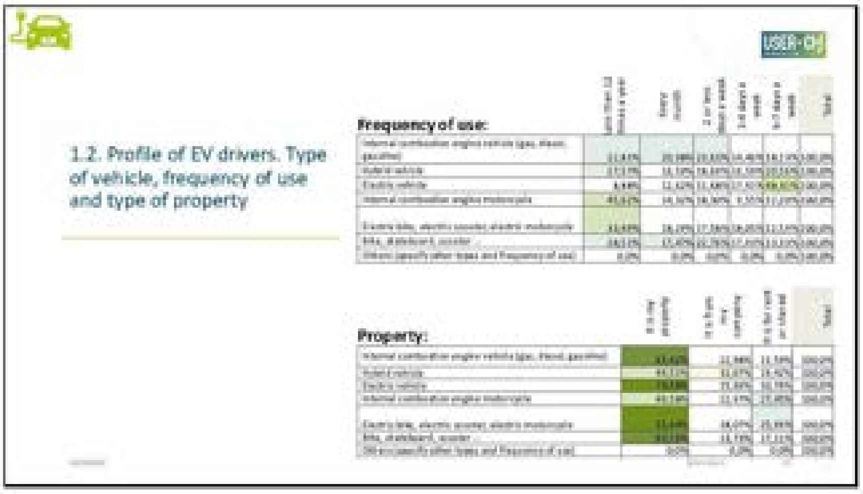

1.2. Profile of EV drivers
Drive your car…
Educational background…
Therefore, EV drivers have higher education than ICEV drivers.
Type of vehicle, frequency of use and type of property
Brands car

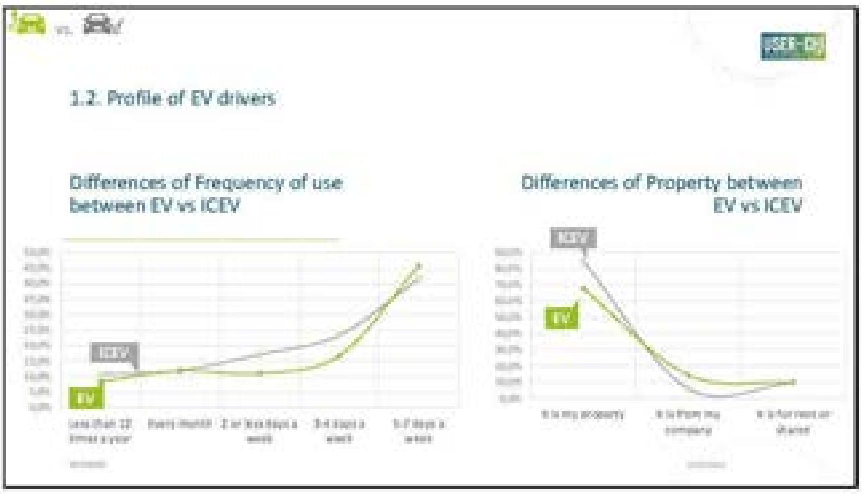

1.2. Profile of EV drivers

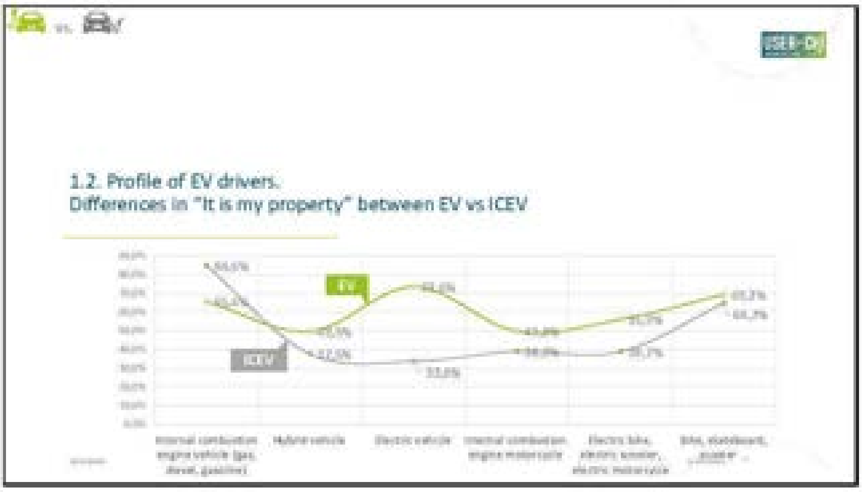

1.2. Profile of EV drivers, differences between gender
Norway
Finland
Spain
Italy
Hungary
Germany

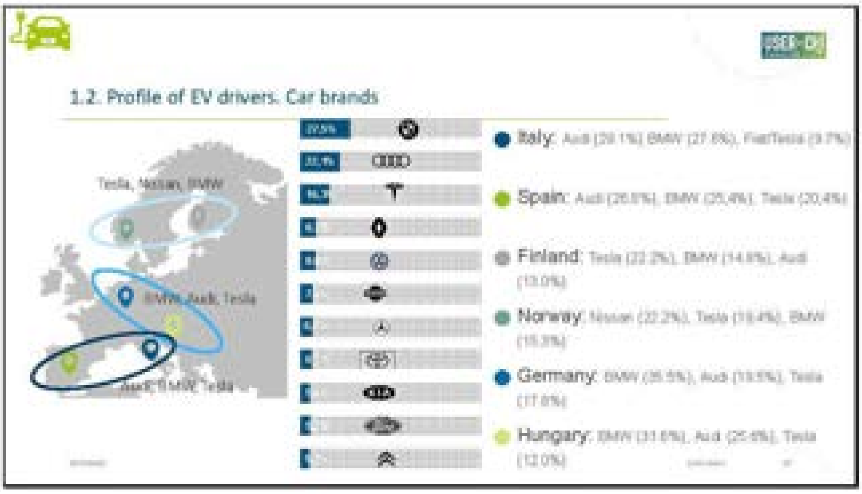

1.2. Profile of EV drivers. Educational background
Indicate your educational background:
56.5%
1.7 %
21.0 %
33.6 %
13.8 %
7.1 %
School finished without graduating
High school degree
College degree
Master's degree
Postgraduate degree
Doctoral degree - PhD
Spain
Germany
Hungary
Italy
Finland
Norway

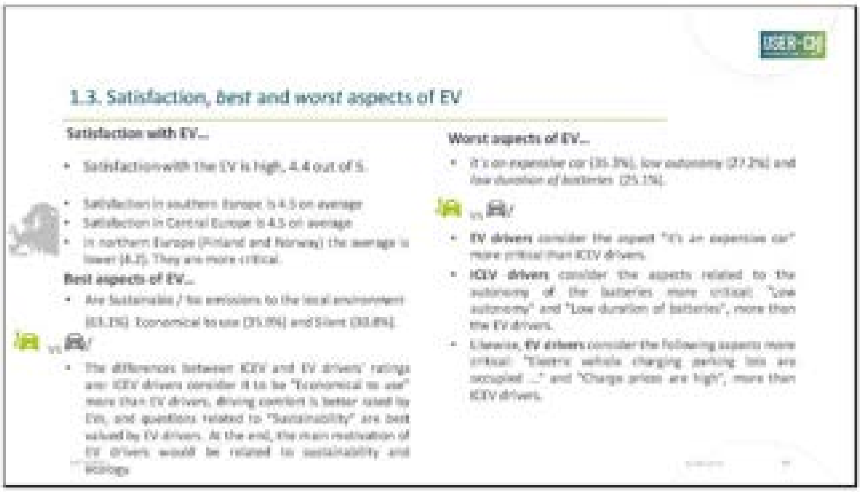

vs.
1.2. Profile of EV drivers. Differences of Educational background between EV vs ICEV
ICEV
EV
School finished without graduating
High school degree
College degree
Master's degree
Postgraduate degree
Doctoral degree - PhD


1.2. Profile of EV drivers. Type of vehicle, frequency of use and type of property
Frequency of use:
Property:


1.2. Profile of EV drivers
Differences of Frequency of use between EV vs ICEV
ICEV
EV
Differences of Property between EV vs ICEV
ICEV
EV


1.2. Profile of EV drivers.
Differences in "It is my property" between EV vs ICEV
EV
ICEV

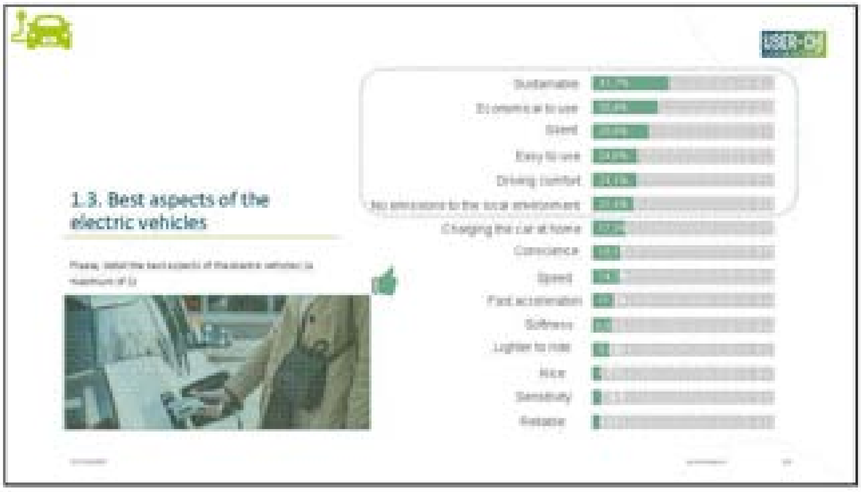

1.2. Profile of EV drivers. Car brands
Tesla, Nissan, BMW
BMW, Audi, Tesla
Audi, BMW, Tesla
Italy
Spain
Finland
Norway
Germany
Hungary

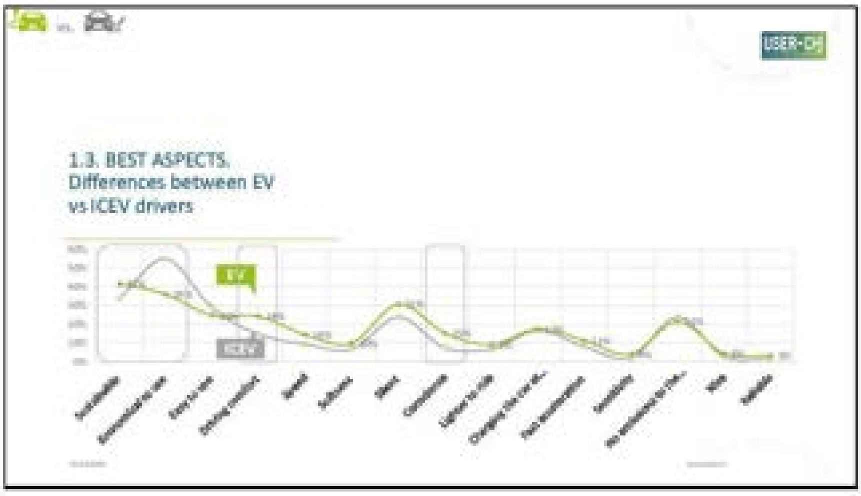

1.3. Satisfaction, *best* and *worst* aspects of EV
Satisfaction with EV…
Satisfaction with the EV is high, 4.4 out of 5.
Satisfaction in southern Europe is 4.5 on average
Satisfaction in Central Europe is 4.5 on average
In northern Europe (Finland and Norway) the average is lower (4.2). They are more critical.
Best aspects of EV…
Are Sustainable / No emissions to the local environment (63.1%), Economical to use (35.9%) and Silent (30.8%).
vs
The differences between ICEV and EV drivers' ratings are: ICEV drivers consider it to be "Economical to use" more than EV drivers, driving comfort is better rated by EVs, and questions related to "Sustainability" are best valued by EV drivers. At the end, the main motivation of EV drivers would be related to sustainability and ecology.
Worst aspects of EV…
It's an expensive car (35.3%), low autonomy (27.2%) and low duration of batteries (25.1%).
vs
EV drivers consider the aspect "It's an expensive car" more critical than ICEV drivers.
ICEV drivers consider the aspects related to the autonomy of the batteries more critical: "Low autonomy" and "Low duration of batteries", more than the EV drivers.
Likewise, EV drivers consider the following aspects more critical: "Electric vehicle charging parking lots are occupied …" and "Charge prices are high", more than ICEV drivers.


1.3. Satisfaction
with your vehicles (EV)
4.4
Mean of EV
Spain 4.6
Germany 4.5
Hungry 4.6
Italy 4.5
Finland 4.2
Norway 4.3

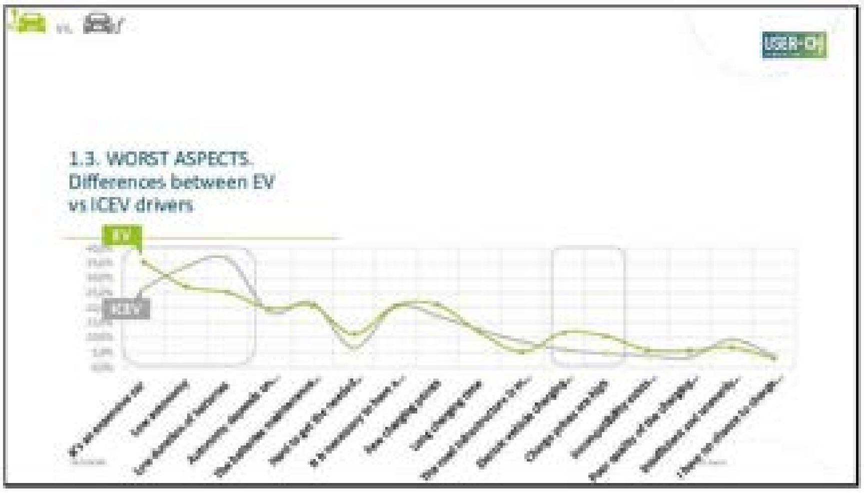

vs.
4.4
Mean of EV
4.4
Mean of ICEV
1.3. Satisfaction
Differences between EV
vs ICEV
EV
ICEV
Spain
Germany
Hungary
Italy
Finland
Norway

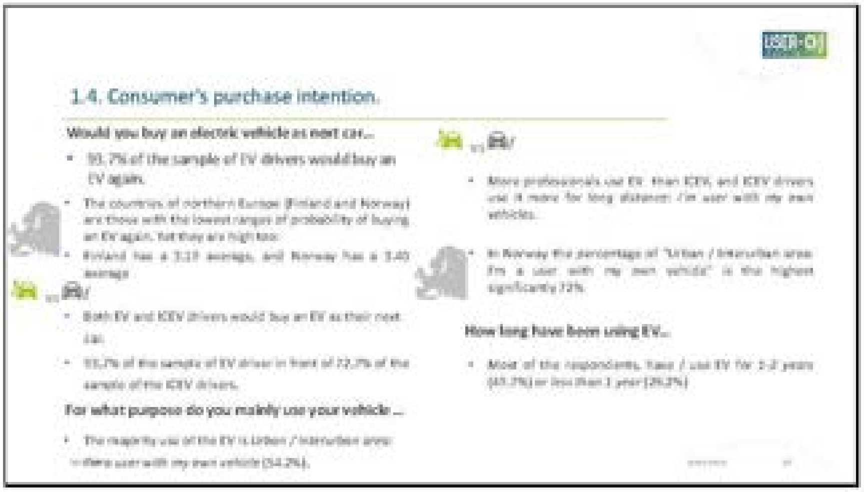

4.46
Mean of EV
4.53
Mean of ICEV
1.3. Satisfaction
Differences between
male vs female
FINLAND
NORWAY
ITALY
GERMANY
HUNGARY
SPAIN

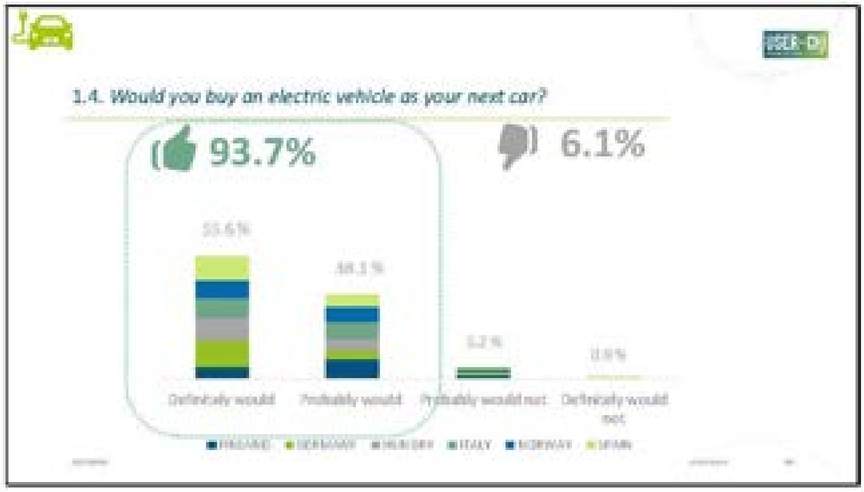

1.3. Best aspects of the
electric vehicles
Sustainable
Economical to use
Silent
Easy to use
Driving comfort
No emissions to the local environment
Charging the car at home
Conscience
Speed
Fast acceleration
Softness
Lighter to ride
Nice
Sensitivity
Reliable

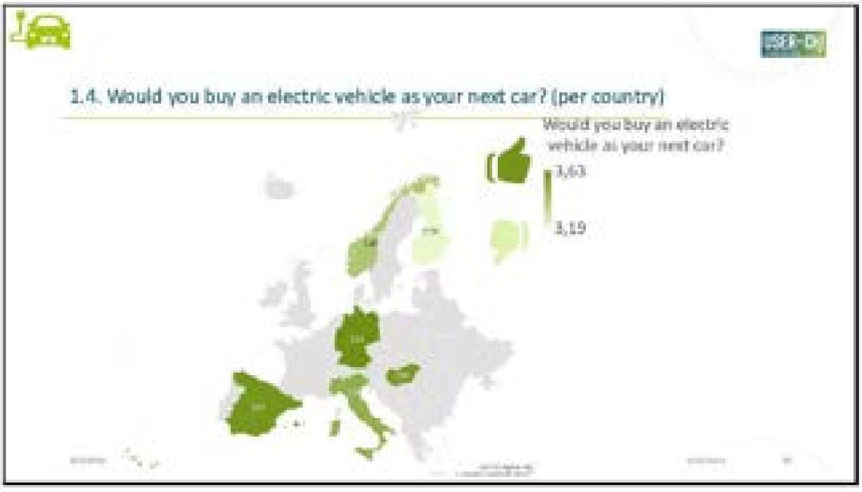

1.3. BEST ASPECTS.
Differences between EV
vs ICEV drivers
EV
ICEV

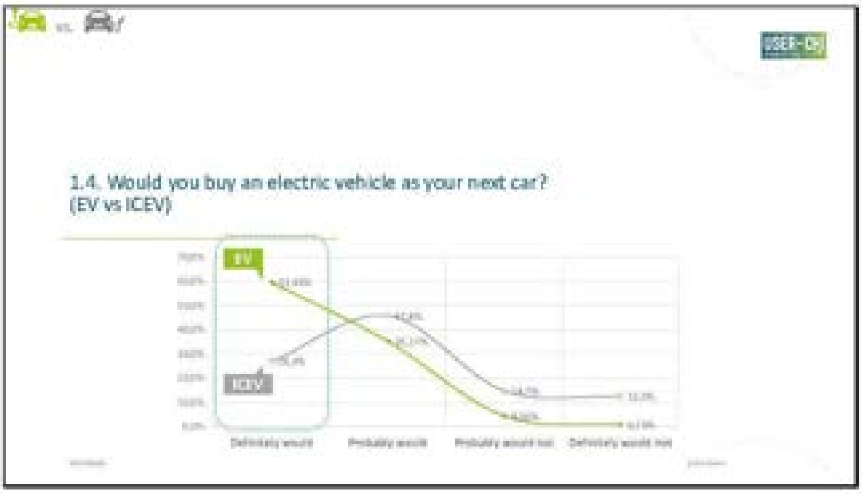

1.3. Worst aspects of the electric vehicles
It's an expensive car
Low autonomy
Low duration of batteries
Few charging points
The batteries maintenance is expensive
Long charging time
Charge prices are high
The road infrastructure is in poor condition

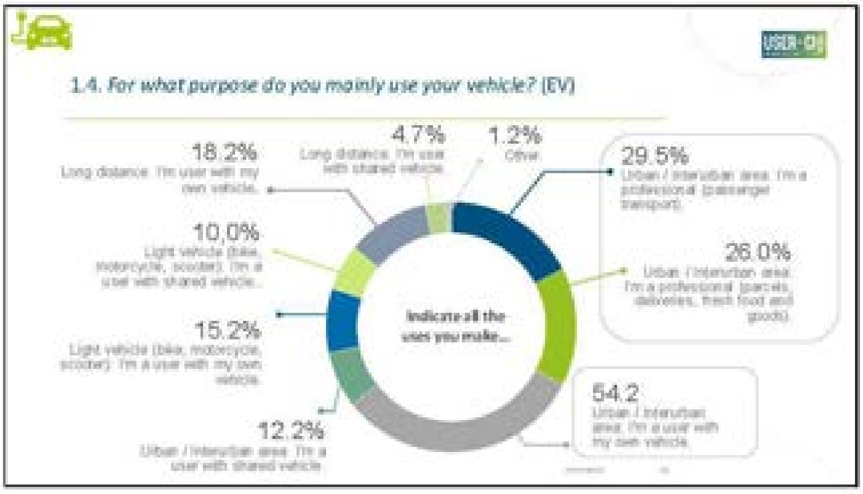

1.3. WORST ASPECTS.
Differences between EV vs ICEV drivers
EV
ICEV

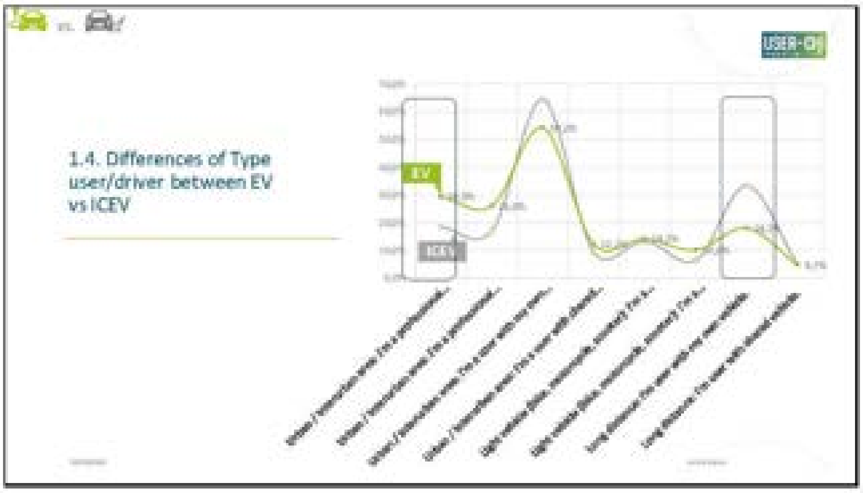

1.4. Consumer's purchase intention.
Would you buy an electric vehicle as next car...
For what purpose do you mainly use your vehicle ...
How long have been using EV...

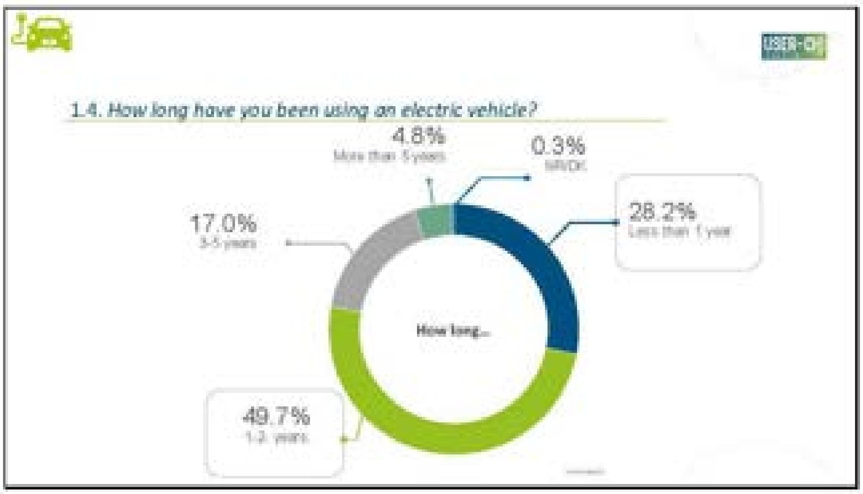

1.4. Would you buy an electric vehicle as your next car?
93.7%
6.1%
Definitely would
Probably would
Probably would not
Definitely would not
FINLAND
GERMANY
HUNGARY
ITALY
NORWAY
SPAIN

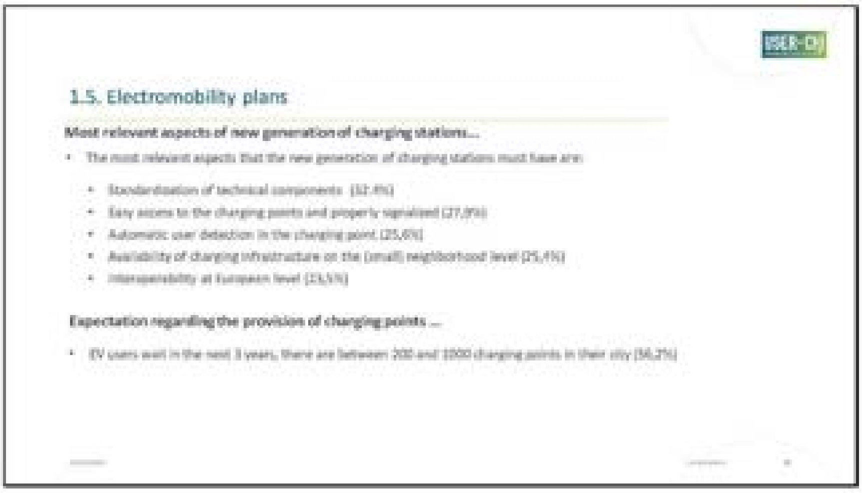

1.4. Would you buy an electric vehicle as your next car? (per country)
Would you buy an electric vehicle as your next car?
3,63
3,19


1.4. Would you buy an electric vehicle as your next car?
(EV vs ICEV)
EV
ICEV
Definitely would
Probably would
Probably would not
Definitely would not

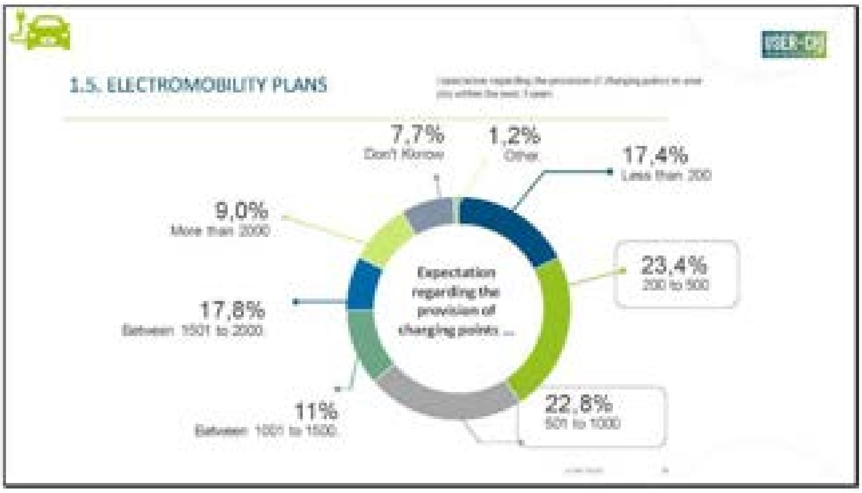

1.4. For what purpose do you mainly use your vehicle? (EV)
18.2%
4.7%
1.2%
Other
29.5%
10,0%
26.0%
Indicate all the uses you make...
15.2%
54.2
12.2%

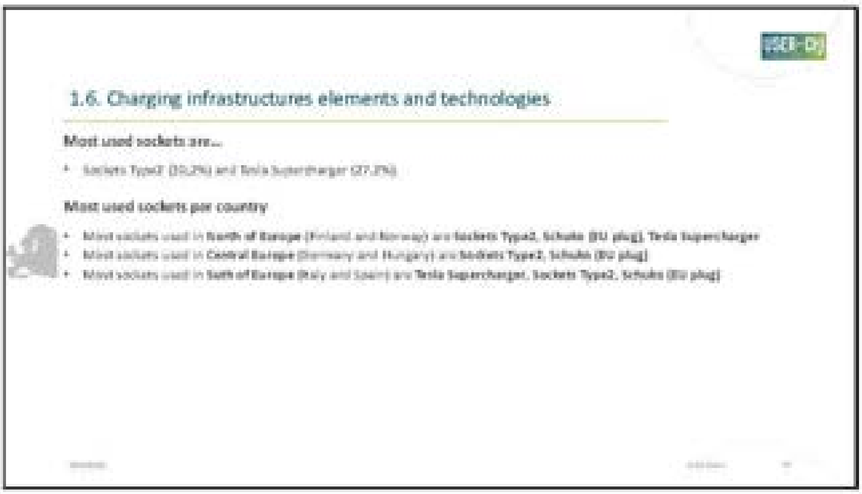

1.4. Differences of Type user/driver between EV vs ICEV
EV
ICEV

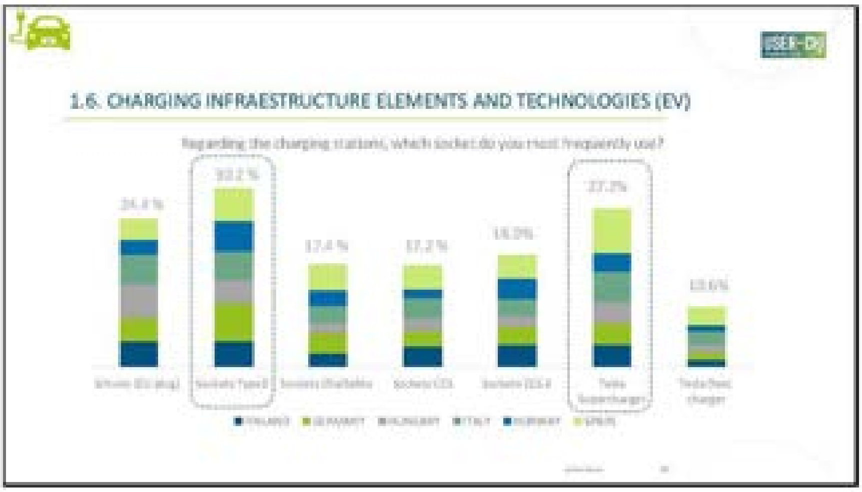

1.4. How long have you been using an electric vehicle?
4.8%
More than 5 years
0.3%
NR/DK
17.0%
3-5 years
28.2%
Less than 1 year
How long...
49.7%
1-2 years

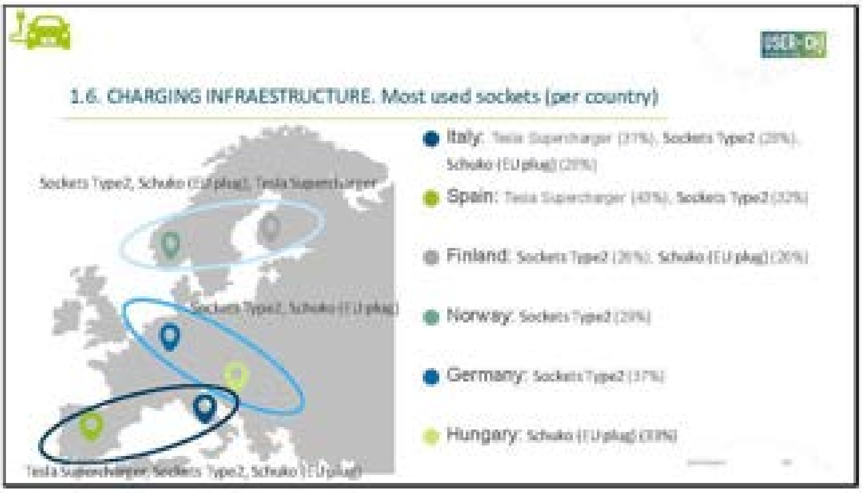

1.5. Electromobility plans
Most relevant aspects of new generation of charging stations…
The most relevant aspects that the new generation of charging stations must have are:
Standardisation of technical components (32,4%)
Easy access to the charging points and properly signalized (27,9%)
Automatic user detection in the charging point (25,6%)
Availability of charging infrastructure on the (small) neighborhood level (25,4%)
Interoperability at European level (23,5%)
Expectation regarding the provision of charging points …
EV users wait in the next 3 years, there are between 200 and 1000 charging points in their city (56,2%)

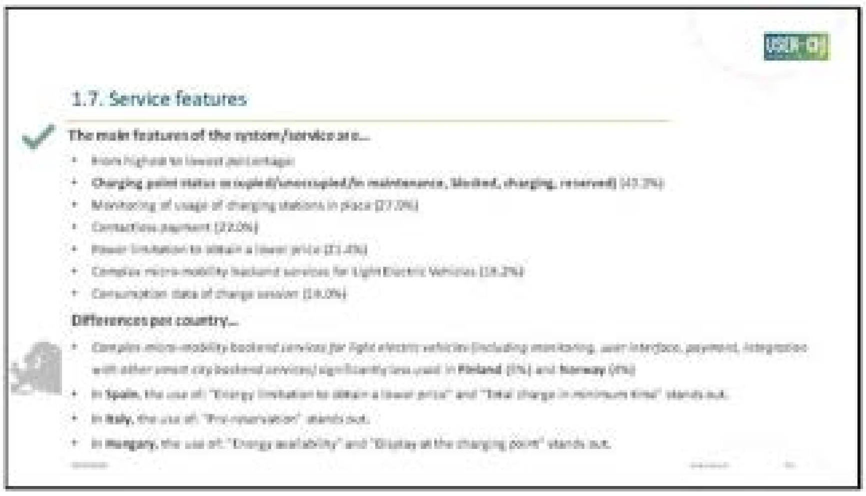

1.5. ELECTROMOBILITY PLANS
Standardisation of technical components
Easy access to the charging points and properly signalized
Automatic user detection in the charging point
Availability of charging infrastructure on the (small) neighborhood level
Interoperability at European level
Excellent availability (multiple chargers on one location)
Increase charging points locations
Availability of charging infrastructure on the Overnight parking, Shop & charge and Streetlight parking
Registration and payment in an application
Regular payment methods
Roaming
Other
35

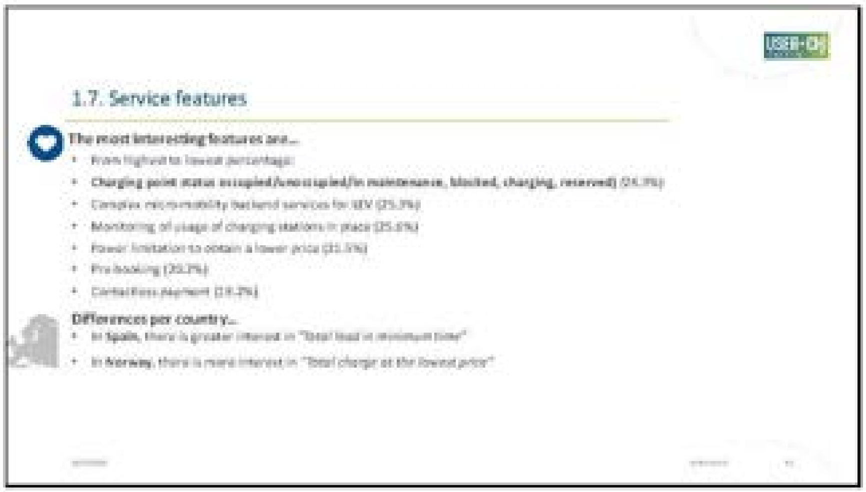

1.5. ELECTROMOBILITY PLANS
7,7%
Don't Know
1,2%
Other
17,4%
Less than 200
9,0%
More than 2000
23,4%
200 to 500
Expectation regarding the provision of charging points …
17,8%
Between 1501 to 2000
22,8%
501 to 1000
11%
Between 1001 to 1500

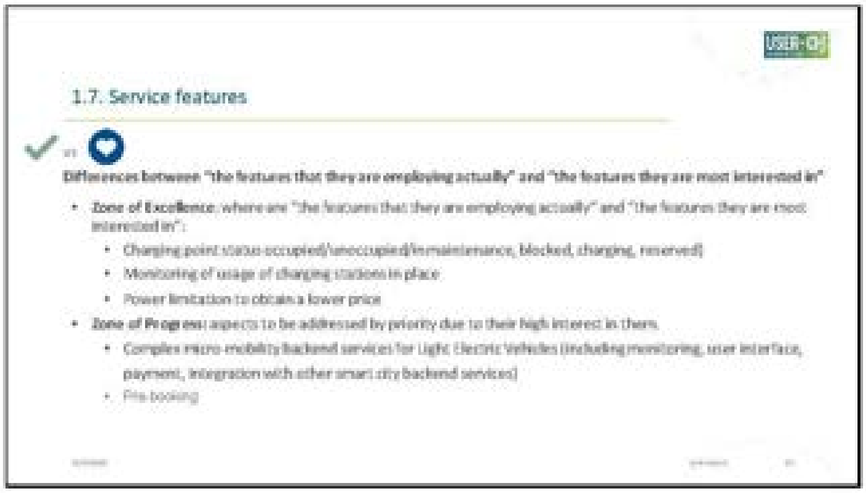

1.6. Charging infrastructures elements and technologies
Most used sockets are…
Most used sockets per country

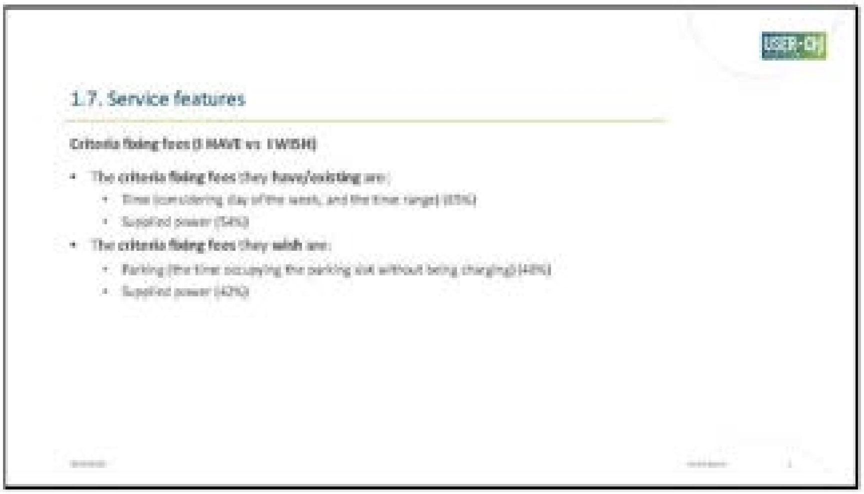

1.6. CHARGING INFRAESTRUCTURE ELEMENTS AND TECHNOLOGIES (EV)
Regarding the charging stations, which socket do you most frequently use?

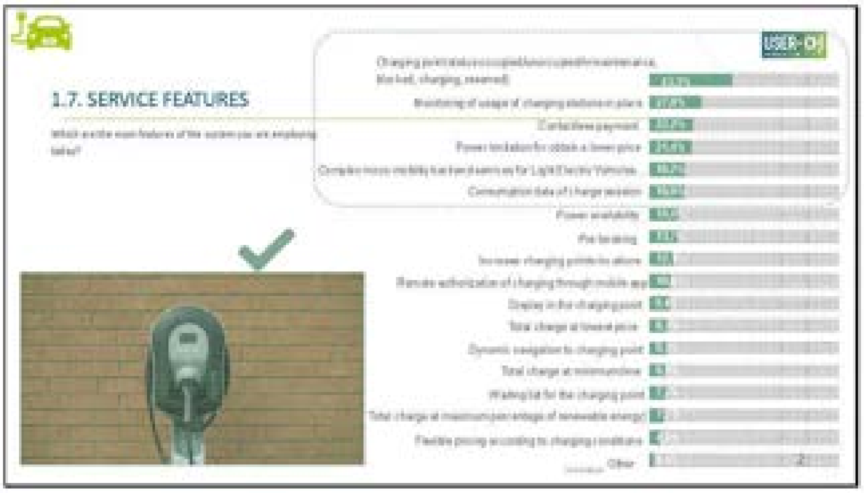

1.6. CHARGING INFRAESTRUCTURE. Most used sockets (per country)
Italy:
Spain:
Finland:
Norway:
Germany:
Hungary:

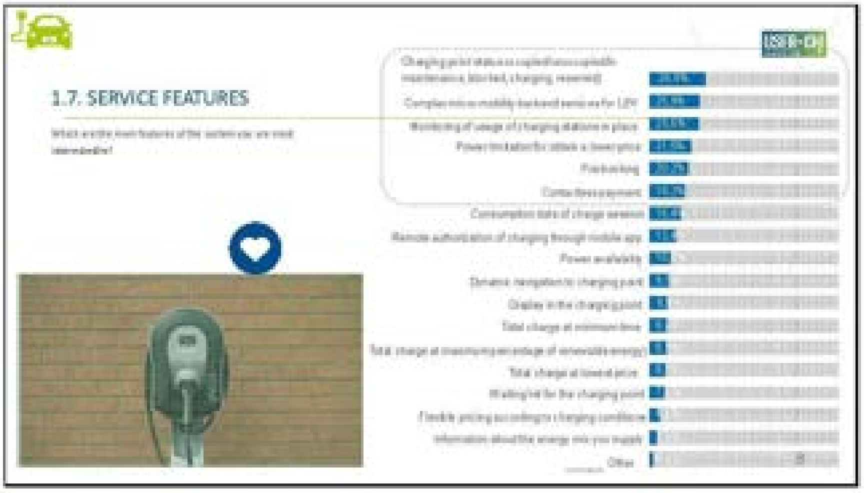

1.7. Service features
The main features of the system/service are…
Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved)
Monitoring of usage of charging stations in place
Contactless payment
Power limitation to obtain a lower price
Complex micro-mobility backend services for Light Electric Vehicles
Consumption data of charge session
Differences per country…
In Spain, the use of: "Energy limitation to obtain a lower price" and "Total charge in minimum time" stands out.
In Italy, the use of: "Pre-reservation" stands out.
In Hungary, the use of: "Energy availability" and "Display at the charging point" stands out.

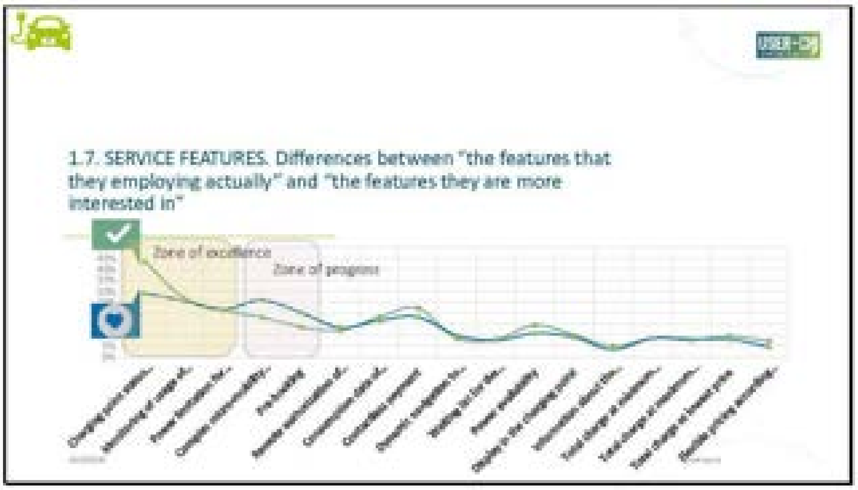

1.7. Service features
The most interesting features are…
From highest to lowest percentage:
Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved)
Complex micro-mobility backend services for LEV
Monitoring of usage of charging stations in place
Power limitation to obtain a lower price
Pre-booking
Contactless payment
Differences per country…
In Spain, there is greater interest in "Total load in minimum time"
In Norway, there is more interest in "Total charge at the lowest price"

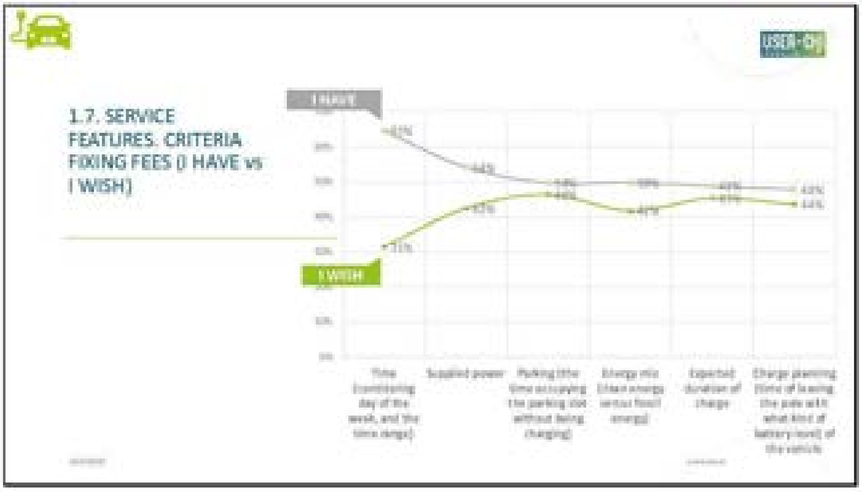

1.7. Service features
vs
Differences between "the features that they are employing actually" and "the features they are most interested in"
Zone of Excellence: where are "the features that they are employing actually" and "the features they are most interested in":
Charging point status occupied/unoccupied/in maintenance, blocked, charging, reserved)
Monitoring of usage of charging stations in place
Power limitation to obtain a lower price
Zone of Progress: aspects to be addressed by priority due to their high interest in them.
Complex micro-mobility backend services for Light Electric Vehicles (including monitoring, user interface, payment, integration with other smart city backend services)
Pre-booking

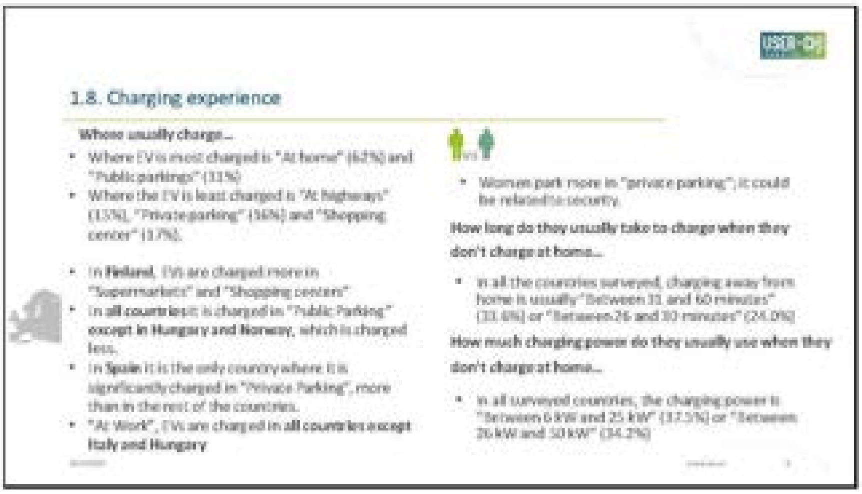

1.7. Service features
Criteria fixing fees (I HAVE vs I WISH)
The criteria fixing fees they have/existing are:
Time (considering day of the week, and the time range) (65%)
Supplied power (54%)
The criteria fixing fees they wish are:
Parking (the time occupying the parking slot without being charging) (48%)
Supplied power (42%)

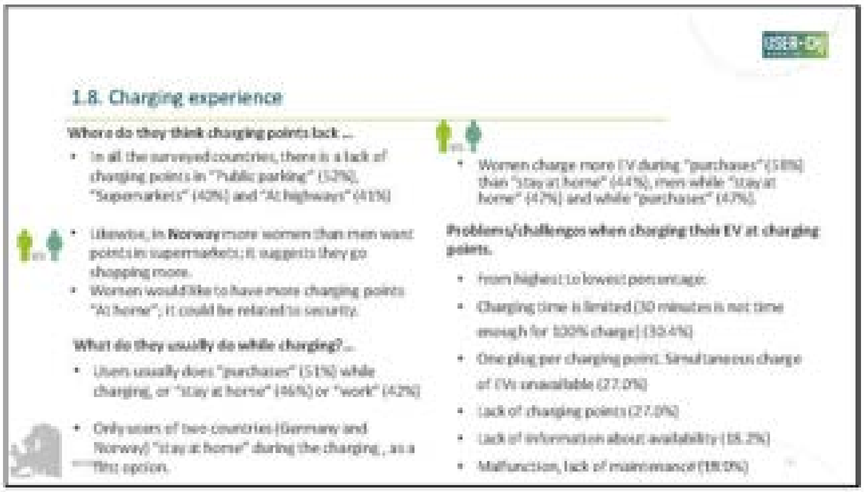

1.7. SERVICE FEATURES
Which are the main features of the system you are employing today?
Charging point status (occupied/unoccupied/in maintenance, blocked, charging, reserved)
Monitoring of usage of charging stations in place
Contactless payment
Power limitation for obtain a lower price
Complex micro mobility backend services for Light Electric Vehicles
Consumption data of charge session
Power availability
Pre-booking
Increase charging points to allow
Remote authorization of charging through mobile app
Display in the charging point
Total charge at lowest price
Dynamic navigation to charging point
Total charge at minimum time
Waiting list for the charging point
Total charge at maximum percentage of renewable energy
Flexible pricing according to charging conditions
Other

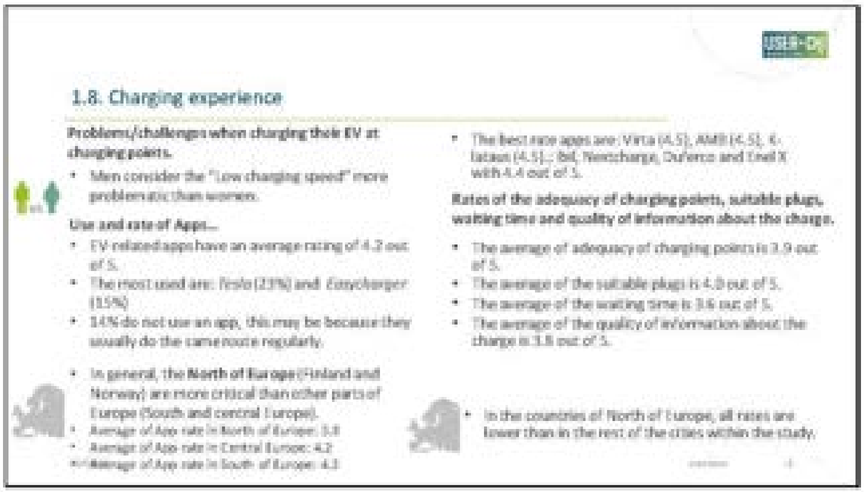

1.7. SERVICE FEATURES
Charging point status (occupied/unoccupied/in maintenance, blocked, charging, reserved)
Complex micro mobility backend services for LEV
Monitoring of usage of charging stations in place
Power limitation for obtain a lower price
Pre-booking
Contactless payment
Consumption data of charge session
Remote authorization of charging through mobile app
Power availability
Dynamic navigation to charging point
Display in the charging point
Total charge at minimum time
Total charge at maximum percentage of renewable energy
Total charge at lowest price
Waiting list for the charging point
Flexible pricing according to charging conditions
Information about the energy mix you supply
Other

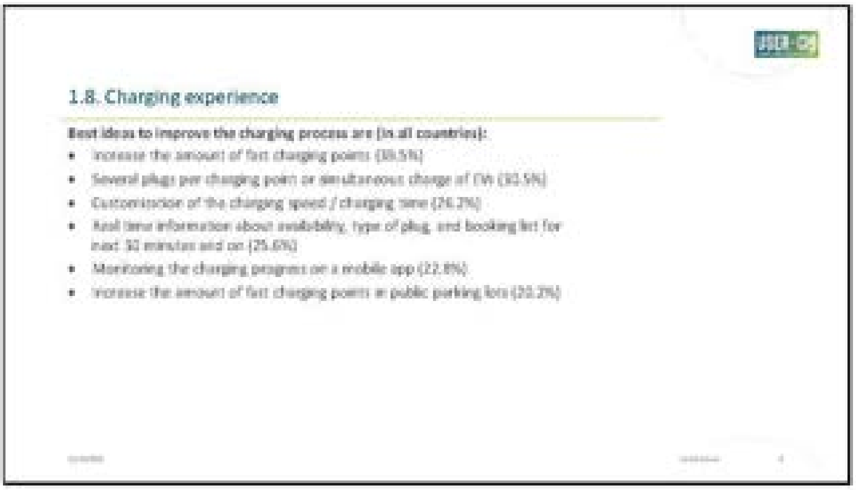

1.7. SERVICE FEATURES. Differences between "the features that they employing actually" and "the features they are more interested in"
Zone of excellence
Zone of progress


1.7. SERVICE FEATURES. CRITERIA FIXING FEES (I HAVE vs I WISH)
I HAVE
I WISH
Time (considering day of the week, and the time range)
Supplied power
Parking (the time occupying the parking slot without being charging)
Energy mix (clean energy versus fossil energy)
Expected duration of charge
Charge planning (time of leaving the pole with what kind of battery level) of the vehicle

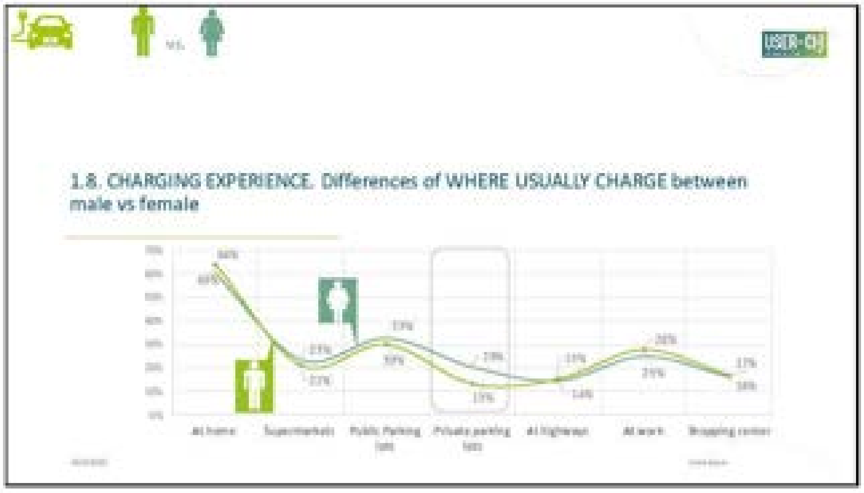

1.8. Charging experience
Where usually charge…
Where EV is most charged is "At home" (62%) and "Public parkings" (31%)
Where the EV is least charged is "At highways" (13%), "Private parking" (16%) and "Shopping center" (17%).
In Finland, EVs are charged more in "Supermarkets" and "Shopping centers"
In all countries it is charged in "Public Parking" except in Hungary and Norway, which is charged less.
In Spain it is the only country where it is significantly charged in "Private Parking", more than in the rest of the countries.
"At Work", EVs are charged in all countries except Italy and Hungary
Women park more in "private parking", it could be related to security.
How long do they usually take to charge when they don't charge at home…
In all the countries surveyed, charging away from home is usually "Between 31 and 60 minutes" (33.6%) or "Between 26 and 30 minutes" (24.0%)
How much charging power do they usually use when they don't charge at home…
In all surveyed countries, the charging power is "Between 6 kW and 25 kW" (37.5%) or "Between 26 kW and 50 kW" (34.2%)

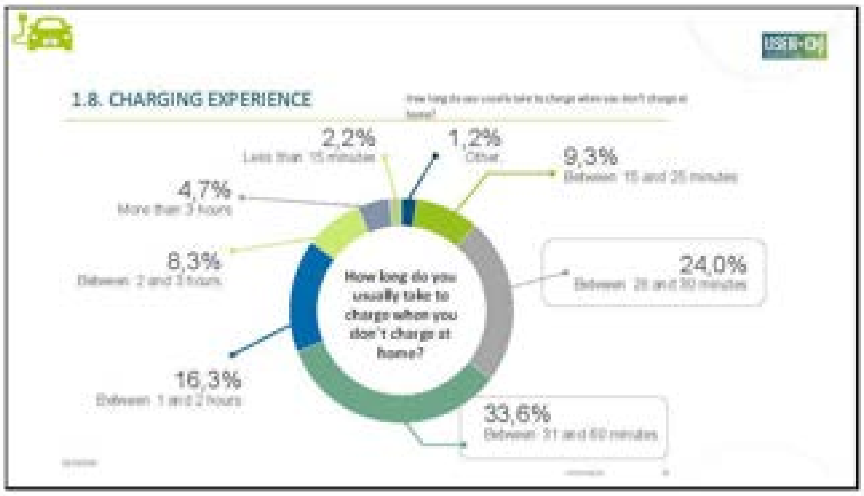

1.8. Charging experience
Where do they think charging points lack ...
In all the surveyed countries, there is a lack of charging points in "Public parking" (52%), "Supermarkets" (40%) and "At highways" (41%)
Likewise, in Norway more women than men want points in supermarkets; it suggests they go shopping more.
Women would like to have more charging points "At home"; it could be related to security.
What do they usually do while charging?...
Users usually does "purchases" (51%) while charging, or "stay at home" (46%) or "work" (42%)
Only users of two countries (Germany and Norway) "stay at home" during the charging , as a first option.
Women charge more EV during "purchases" (58%) than "stay at home" (44%), men while "stay at home" (47%) and while "purchases" (47%).
Problems/challenges when charging their EV at charging points.
From highest to lowest percentage:
Charging time is limited (30 minutes is not time enough for 100% charge) (30.4%)
One plug per charging point. Simultaneous charge of EVs unavailable (27.0%)
Lack of charging points (27.0%)
Lack of information about availability (18.2%)
Malfunction, lack of maintenance (18.0%)

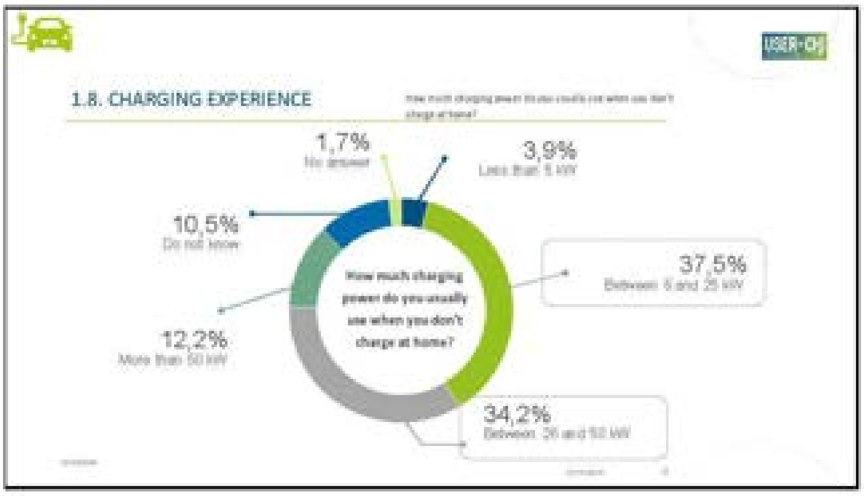

1.8. Charging experience
Problems/challenges when charging their EV at charging points.
Men consider the "Low charging speed" more problematic than women.
Use and rate of Apps...
EV-related apps have an average rating of 4.2 out of 5.
The most used are: Fisio (23%) and Easycharger (15%)
14% do not use an app, this may be because they usually do the same route regularly.
In general, the North of Europe (Finland and Norway) are more critical than other parts of Europe (South and central Europe).
Average of App rate in North of Europe: 3.8
Average of App rate in Central Europe: 4.2
Average of App rate in South of Europe: 4.3
The best rate apps are: Virta (4.5), AMB (4.5), E-lataus (4.5)...: Ibil, Nextcharge, Duferco and Enel X with 4.4 out of 5.
Rates of the adequacy of charging points, suitable plugs, waiting time and quality of information about the charge.
The average of adequacy of charging points is 3.9 out of 5.
The average of the suitable plugs is 4.0 out of 5.
The average of the waiting time is 3.6 out of 5.
The average of the quality of information about the charge is 3.8 out of 5.
In the countries of North of Europe, all rates are lower than in the rest of the cities within the study.


1.8. Charging experience
Best ideas to improve the charging process are (in all countries):
Increase the amount of fast charging points (39.5%)
Several plugs per charging point or simultaneous charge of EVs (30.5%)
Customization of the charging speed / charging time (26.2%)
Real time information about availability, type of plug, and booking list for next 30 minutes and so on (25.6%)
Monitoring the charging progress on a mobile app (22.8%)
Increase the amount of fast charging points in public parking lots (20.2%)


1.8. CHARHGING EXPERIENCE
62%
At home
22%
Supermarkets
31%
Public Parking
16%
Private Parking
15%
At highways
27%
At work
17%
Shopping center
13%
20%
10

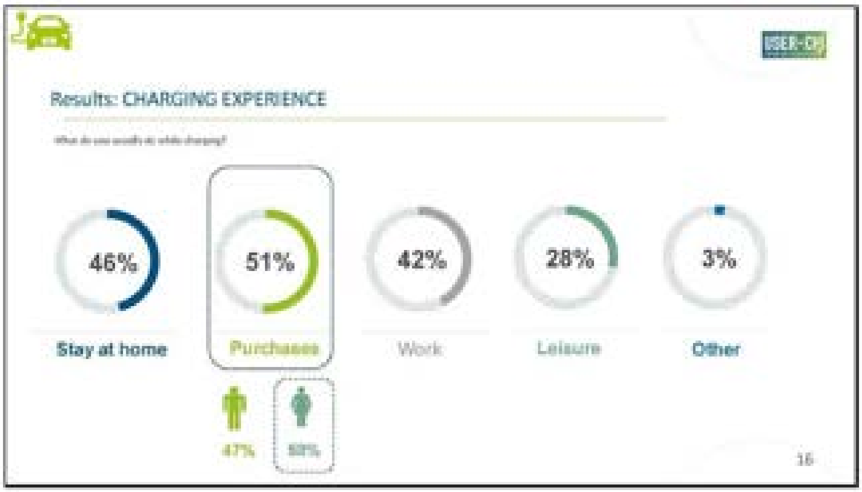

vs.
1.8. CHARGING EXPERIENCE. Differences of WHERE USUALLY CHARGE between male vs female
At home
Supermarkets
Public Parking lots
Private parking lots
At highways
At work
Shopping center

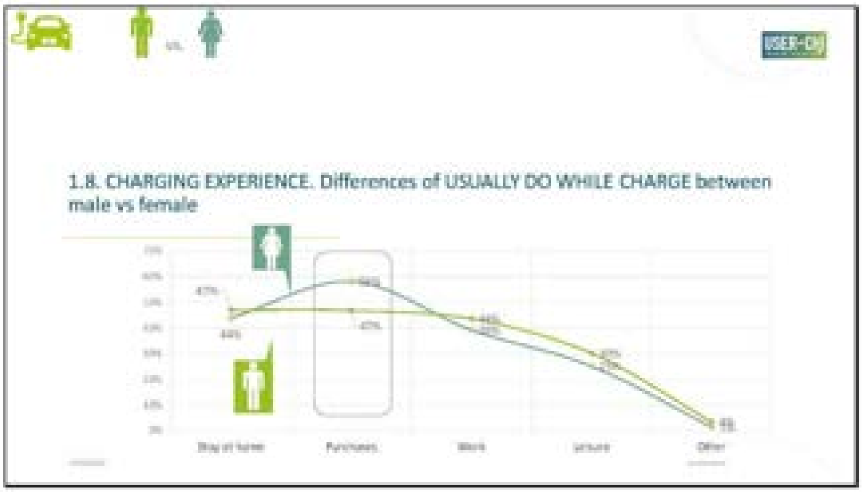

1.8. CHARGING EXPERIENCE
2,2%
Less than 15 minutes
1,2%
Other
9,3%
Between 15 and 25 minutes
4,7%
More than 3 hours
24,0%
Between 26 and 30 minutes
8,3%
Between 2 and 3 hours
How long do you usually take to charge when you don't charge at home?
16,3%
Between 1 and 2 hours
33,6%
Between 31 and 60 minutes


1.8. CHARGING EXPERIENCE
1,7%
No answer
3,9%
Less than 5 kW
10,5%
Do not know
37,5%
Between 6 and 25 kW
12,2%
More than 50 kW
34,2%
Between 26 and 50 kW
How much charging power do you usually use when you don't charge at home?


1.8. CHARGING EXPERIENCE
24%
At home
40%
Supermarkets
52%
Public Parking
26%
Private Parking
41%
At highways
27%
At work
28%
Shopping center
14

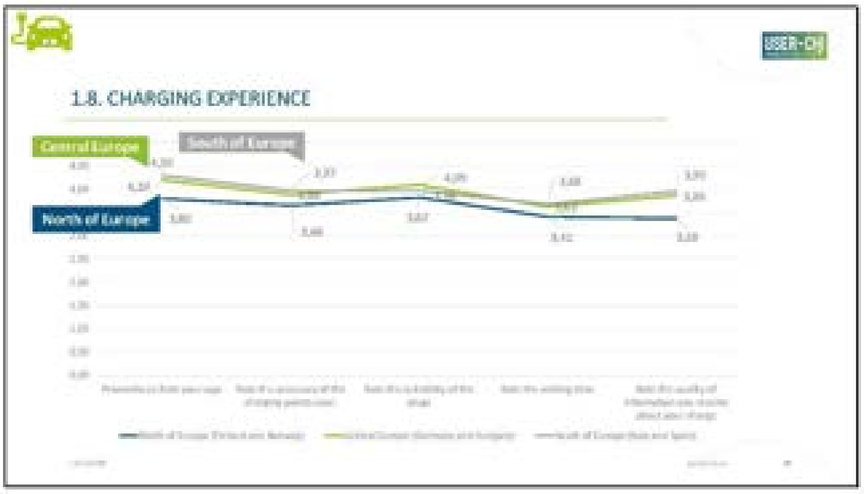

Results: CHARGING EXPERIENCE- Usually charge vs. Charging points lack
At home
At work
Public Parking lots
Supermarkets
At highways
Private parking lots
Charging points lack


USER-CHI
Results: CHARGING EXPERIENCE
46%
Stay at home
51%
Purchases
42%
Work
28%
Leisure
3%
Other
47%
16

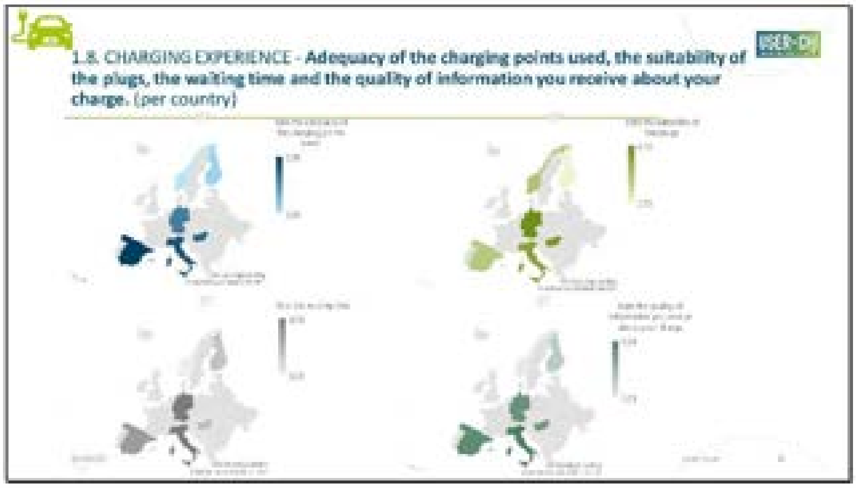

USER-CHI
1.8. CHARGING EXPERIENCE. Differences of USUALLY DO WHILE CHARGE between male vs female
Stay at home
Purchases
Work
Leisure
Other


USER-CHI
1.8. CHARGING EXPERIENCE
One plug per charging point. Simultaneous charge of EVs unavailable
Lack of charging points
Waiting times, booking and queues
Lack of information about availability
Malfunction, lack of maintenance
Cars parked in charging points. Booking times are not respected
Bad connection. Charging failures
Low charging speed
Incompatibilities between plugs and cars
Other
18


1.8. CHARGING EXPERIENCE -APPs
4.2
Rate of App
Tesla
Easycharger
I don't use app
Electromaps
EV charge
Chargemap
Enel X
Other


1.8. CHARGING EXPERIENCE
Central Europe
South of Europe
North of Europe

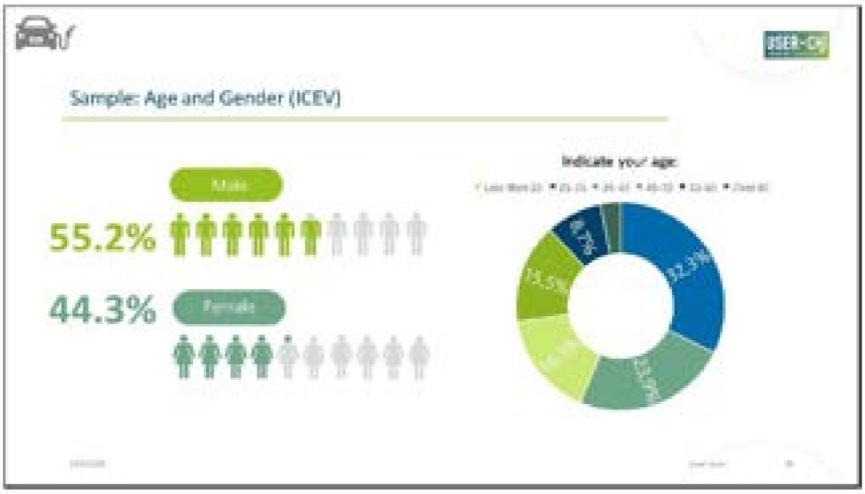

1.8. CHARGING EXPERIENCE
3.9
Rate the adequacy of the charging points used:
4.0
Rate the suitability of the plugs
3.6
Rate the waiting time
3.8
Rate the quality of information you receive about your charge

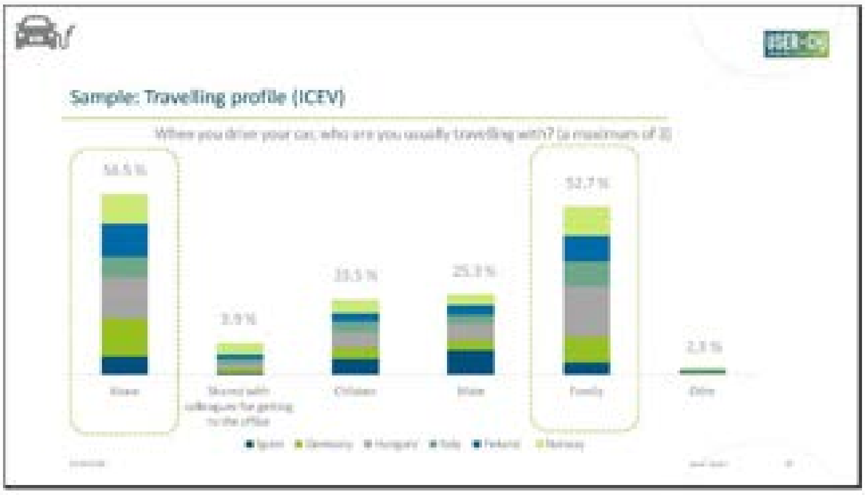

1.8. CHARGING EXPERIENCE - Adequacy of the charging points used, the suitability of the plugs, the waiting time and the quality of information you receive about your charge. (per country)

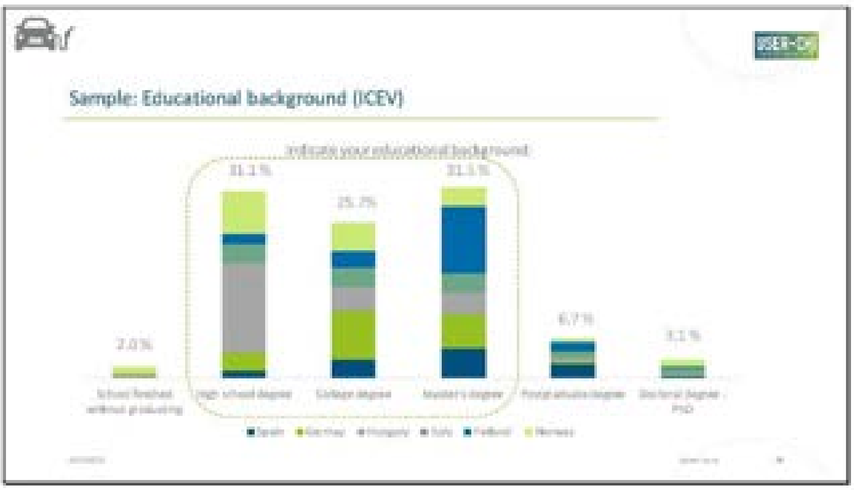

1.8. Best ideas to improve the charging process
Increase the amount of fast charging points
Several plugs per charging point or simultaneous charge of EVs
Customization of the charging speed / charging time
Monitoring the charging progress on a mobile app
Increase the amount of charging points in public parking lots
Priority for electric vehicles
Universal plugs or availability of all plug models
Charging points at the workplaces
Increase the amount of charging points on the road
Mobile phone's alert when charging process is completed
Other (please specify)

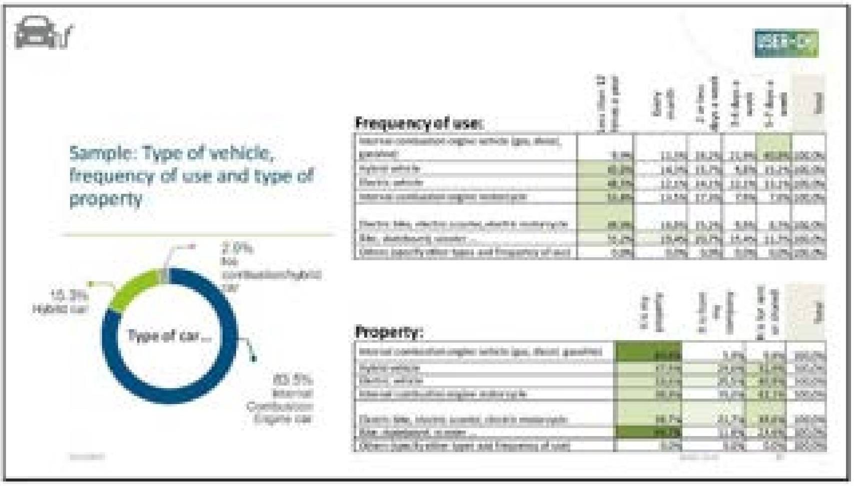

2. Survey results. Results of ICEV

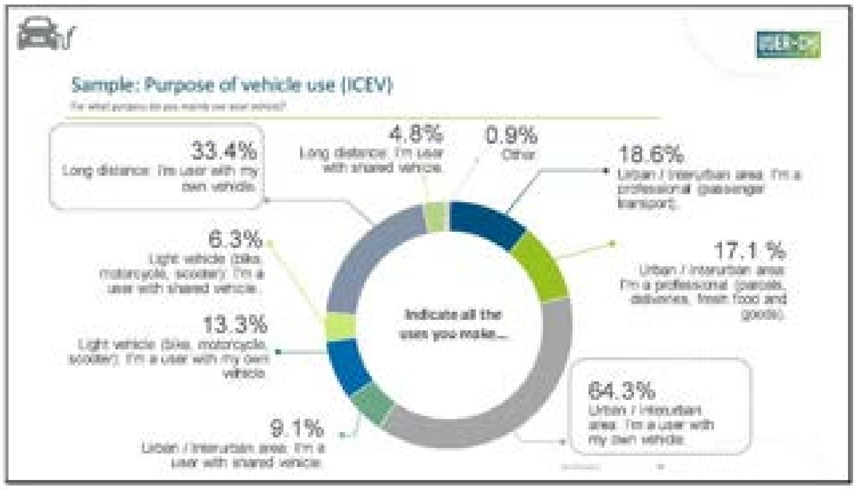

Sample (ICEV)
Total sample (ICEV) = 1108
Finland
176
Germany
188
Hungary
271
Italy
113
Norway
202
Spain
158

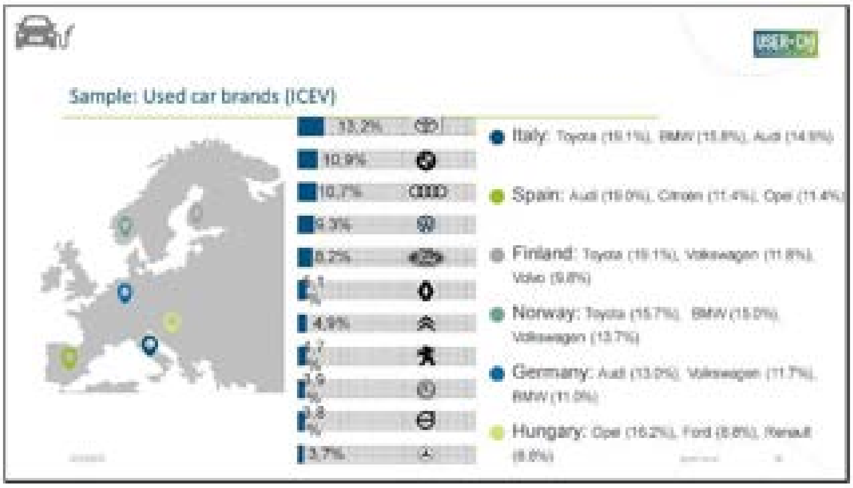

Sample: Age and Gender (ICEV)
Male
55.2%
44.3%
Female
Indicate your age:
8.7%
32.3%
15.5%
22.9%


Sample: Travelling profile (ICEV)
When you drive your car, who are you usually travelling with? (a maximum of 3)

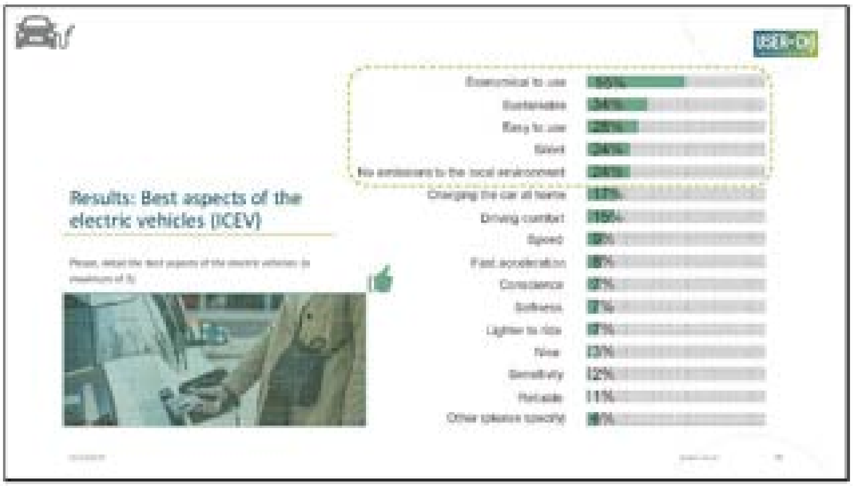

Sample: Educational background (ICEV)
31.1 %
25.7%
31.1 %
2.0 %
6.7 %
3.1 %

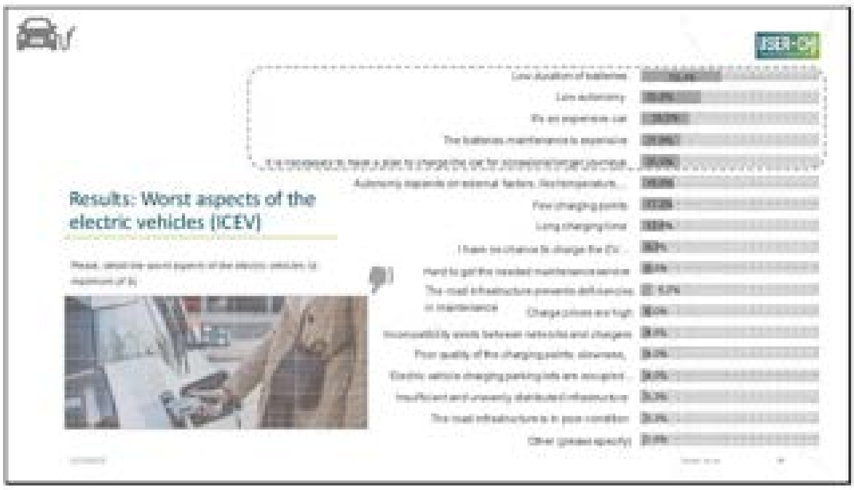

Sample: Type of vehicle, frequency of use and type of property
Frequency of use:
Property:
Type of car...
2.0%
15.3%
Hybrid car
83.5%
Internal Combustion Engine car

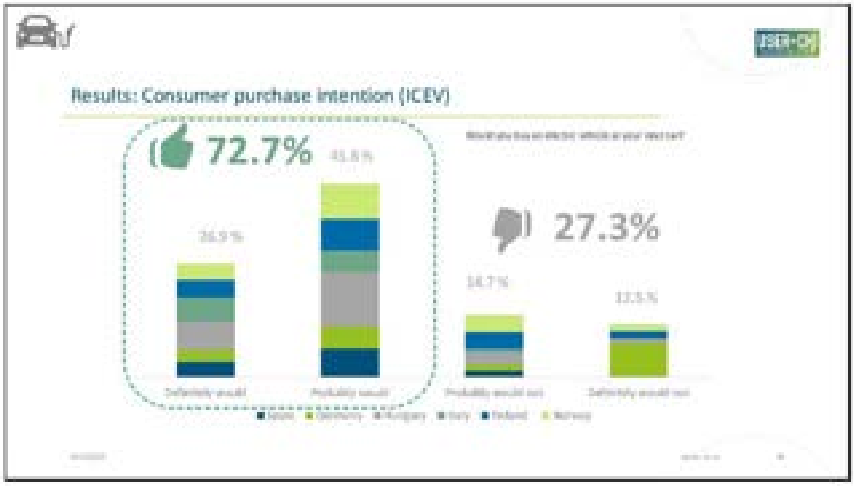

Sample: Purpose of vehicle use (ICEV)
33.4%
Long distance: I'm user with my own vehicle.
4.8%
Long distance: I'm user with shared vehicle.
0.9%
Other
18.6%
Urban / Interurban area: I'm a professional (passenger transport).
6.3%
Light vehicle (bike, motorcycle, scooter): I'm a user with shared vehicle.
17.1 %
Urban / Interurban area: I'm a professional (parcels, deliveries, fresh food and goods).
Indicate all the uses you make...
13.3%
Light vehicle (bike, motorcycle, scooter): I'm a user with my own vehicle.
64.3%
Urban / Interurban area: I'm a user with my own vehicle.
9.1%
Urban / Interurban area: I'm a user with shared vehicle.


Sample: Used car brands (ICEV)
13.2%
10.9%
10.7%
9.3%
8.2%
4.9%
3.7%
Italy: Toyota (19.1%), BMW (15.8%), Audi (14.9%)
Spain: Audi (19.0%), Citroën (11.4%), Opel (11.4%)
Finland: Toyota (19.1%), Volkswagen (11.8%), Volvo (9.8%)
Norway: Toyota (15.7%), BMW (15.0%), Volkswagen (13.7%)
Germany: Audi (13.0%), Volkswagen (11.7%), BMW (11.0%)
Hungary: Opel (16.2%), Ford (8.8%), Renault (8.8%)


Results: Satisfaction with your vehicles (ICEV)
4.4
Mean of CV
Spain 4.4
Germany 4.4
Hungary 4.3
Italy 4.7
Finland 4.1
Norway 4.3


Results: Best aspects of the electric vehicles (ICEV)
Economical to use
Sustainable
Easy to use
Silent
No emissions to the local environment
Charging the car at home
Driving comfort
Speed
Fast acceleration
Conscience
Softness
Lighter to ride
New
Sensitivity
Reliable
Other (please specify)


Results: Worst aspects of the electric vehicles (ICEV)
Low autonomy
Few charging points
Long charging time
Charge prices are high
Other (please specify)

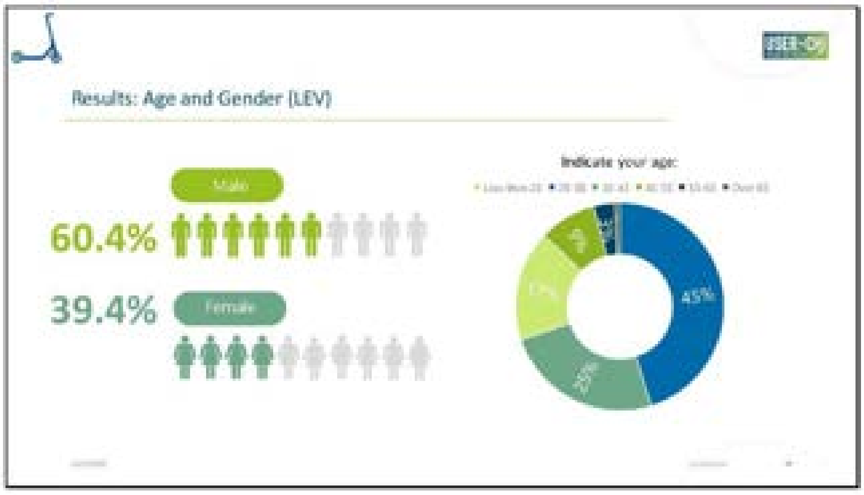

Results: Consumer purchase intention (ICEV)
72.7%
27.3%

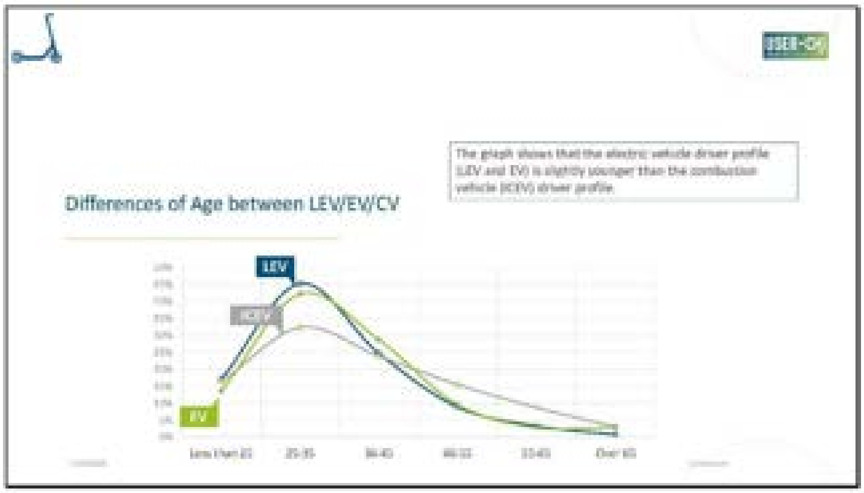

Results: Improvements for buy a 100% EV
Reduce the price of electric vehicles
Charging at home
Improved charging network
Charging at the workplace
More car models / aesthetics
Other (please specify)

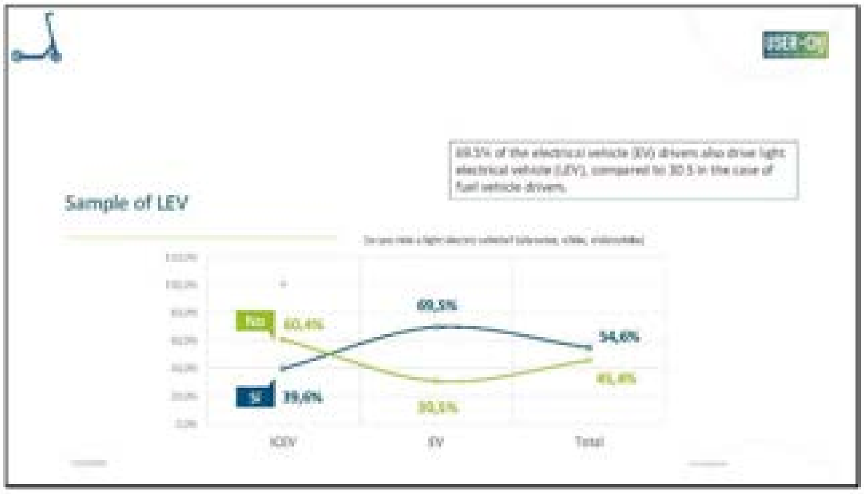

ICEV Conclusions
In both the best-rated aspects and the worst aspects and their improvements, the references to the electric vehicle itself stand out.
In particular, the improvement proposals highlight incentives for purchase EV, reduce the price or increase the autonomy.
Only one of four proposals are related to the infrastructure ("more fast chargers and better spread").
- Economical to use
- Sustainable
- Easy to use
- Silent
- No emissions to the local environment
- Low duration of batteries
- Low autonomy
- Expensive car
- Batteries maintenance is expensive
- The need to have a plan to charge the car in long journeys
- Reduce the price of purchase
- Increased autonomy of the car and batteries
- Incentives for purchase such as financial aid, tax incentives
- More fast chargers and better spread

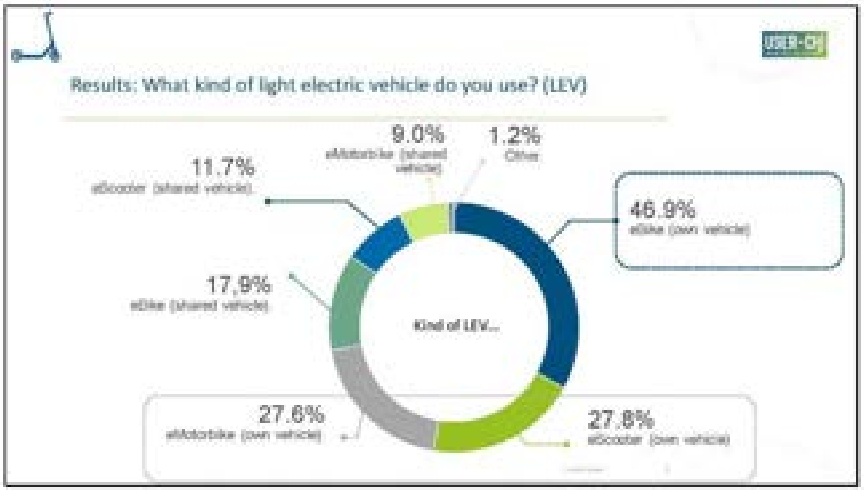

3. Survey results. Results of LEV

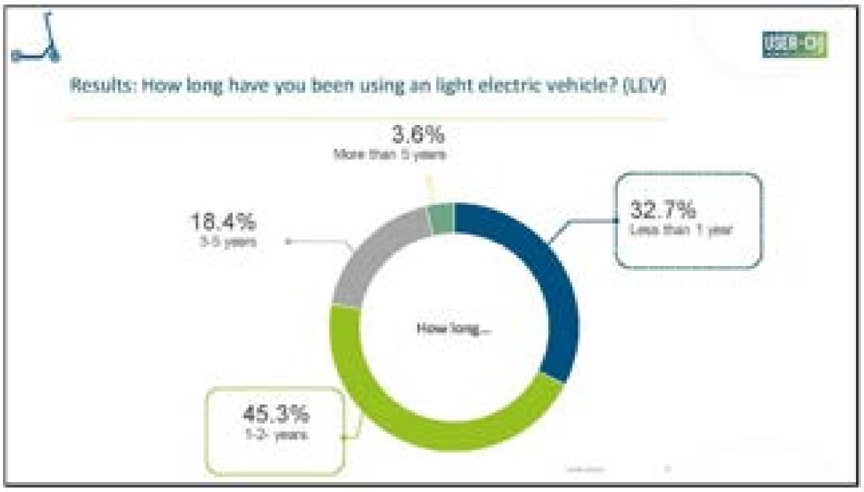

Sample (LEV)
Total sample (LEV) = 941
Finland
103
Germany
165
Hungary
167
Italy
232
Norway
100
Spain
174

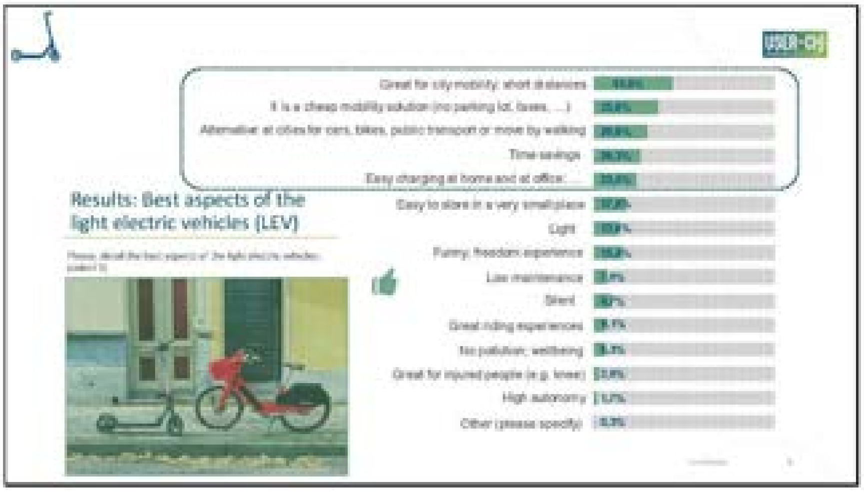

Results: Age and Gender (LEV)
Male
60.4%
39.4%
Female
Indicate your age:
45%
25%
17%

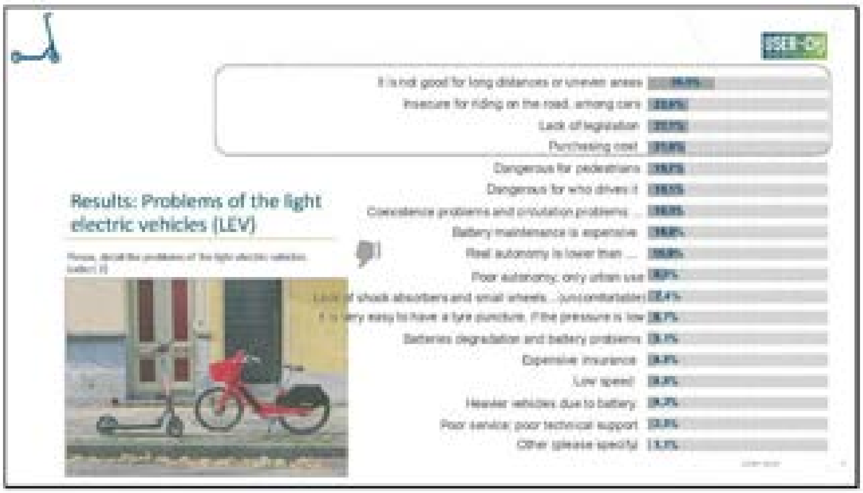

Differences of Age between LEV/EV/CV
LEV
ICEV
EV


Sample of LEV
No
60,4%
Sí
39,6%
69,5%
30,5%
54,6%
45,4%
ICEV
EV
Total


Results: What kind of light electric vehicle do you use? (LEV)
9.0%
eMotorbike (shared vehicle)
1.2%
Other
11.7%
eScooter (shared vehicle)
46.9%
eBike (own vehicle)
17.9%
eBike (shared vehicle)
Kind of LEV...
27.6%
eMotorbike (own vehicle)
27.8%
eScooter (own vehicle)


Results: How long have you been using an light electric vehicle? (LEV)
3.6%
More than 5 years
18.4%
3-5 years
32.7%
Less than 1 year
How long...
45.3%
1-2- years


Results: Best aspects of the light electric vehicles (LEV)
Great for city mobility: short distances
It is a cheap mobility solution (no parking lot, taxes, ...)
Alternative at cities for cars, bikes, public transport or move by walking
Time savings
Easy charging at home and at office
Easy to store in a very small place
Light
Funny, freedom experience
Low maintenance
Silent
Great riding experiences
No pollution; wellbeing
Great for injured people (e.g. knee)
High autonomy
Other (please specify)


Results: Problems of the light electric vehicles (LEV)
It is not good for long distances or uneven areas
Insecure for riding on the road, among cars
Lack of legislation
Purchasing cost
Dangerous for pedestrians
Dangerous for who drives it
Coexistence problems and circulation problems ...
Battery maintenance is expensive
Real autonomy is lower than ...
Poor autonomy, only urban use
Lack of shock absorbers and small wheels ...(uncomfortable)
It is very easy to have a tyre puncture, if the pressure is low
Batteries degradation and battery problems
Expensive insurance
Low speed
Heavier vehicles due to battery
Poor service; poor technical support
Other (please specify)

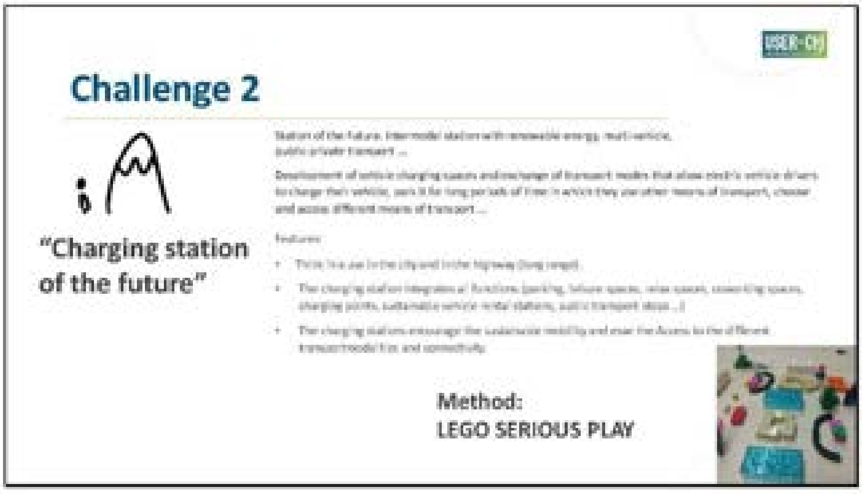

Free urban parking lots for e-bikes and electric motorcycles with charging points
More electric bike and scooter lanes, and safer lanes
41,1 %
Specific areas, with parking lots to charge electric motorcycles
37,1 %
Fast charging points well distributed throughout urban and road areas
36,5 %
Possibility of managing the search for charging points, availability, occupancy and conservation status in a reliable way
Standardized charging points for all electric vehicles including a simple and reliable payment process
Other (please specify)
1,4%

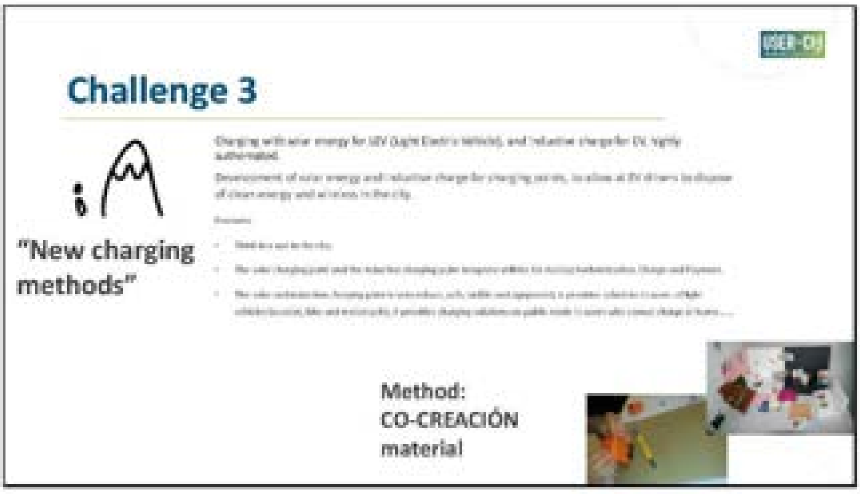

Conclusions
In both the best-rated aspects and the problems, the references to the light electric vehicle itself stand out. Proposals for improvement include those related to infrastructures:
- Great for city mobility; short distances with time savings
- It is a cheap mobility solution alternative at cities
- Easy charging at home and at office
- It is not good for long distances, uneven areas and insecure for riding on the road, among cars
- Lack of legislation and it is a expensive purchase
- Free urban parking lots
- More lanes and more safers
- Specific areas, with parking lots to charging
- Fast chaging points in urban and haighway areas

Annex 6: Co-creation's results report


The challenges


Challenge 1
“My charging management”
Method:
PAPER PROTOTYPING


Challenge 2
“Charging station of the future”
Method:
LEGO SERIOUS PLAY

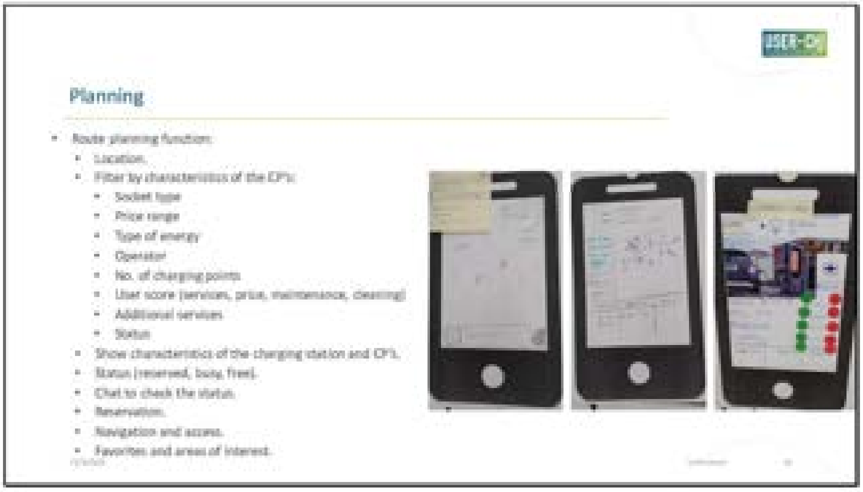

Challenge 3
"New charging methods"
Method:
CO-CREACIÓN
material


Personas
Persona 1 "Combined trips"
Persona 2 "Shared vehicle in the city"
Persona 3 "Family car for urban trips and long range trips"
Persona 4 "Professional use of an EV"


1. RESULTS – Challenge 1.
Charging management


General conditions
It should be able to use the functions of the app without registering and providing personal data.
The initial screen can reflect the content blocks with direct access or it can be the browser with a drop-down menu.
Screen design by functions:
User profile
Planning
Charging
Payment
Feedback

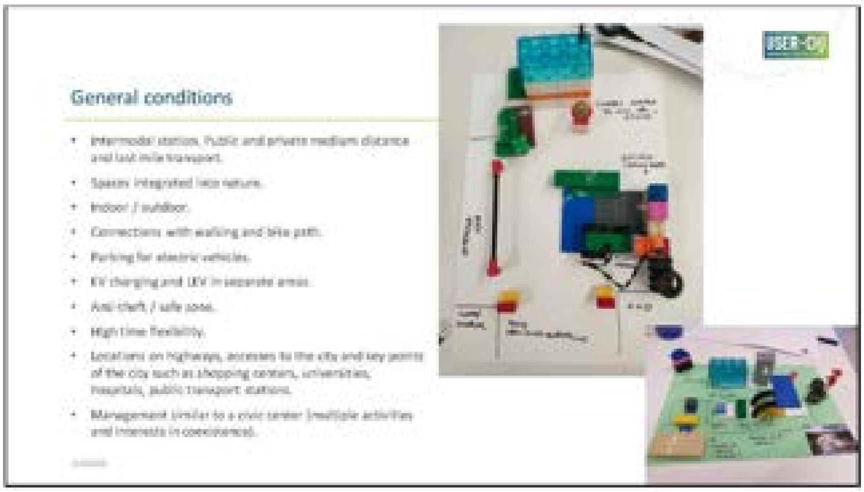

User profile
User profile function:
The user is registered, not the vehicle.
There is a vehicle characteristics registration screen:
Model
Socket type
kW for full charge
Autonomy
There are different types of user based on their characteristics and demands:
VIP
LOW COST
GREEN


Planning
Route planning function:
Location.
Filter by characteristics of the CP's:
Socket type
Price range
Type of energy
Operator
No. of charging points
User score (services, price, maintenance, cleaning)
Additional services
Status
Show characteristics of the charging station and CP's.
Status (reserved, busy, free).
Chat to check the status.
Reservation.
Navigation and access.
Favorites and areas of interest.


Charging, payment and feedback
Charge setting function:
Time
Power
Charge %
Real-time charge monitoring
Energy mix
Configurable notifications:
Notice X minutes before end of charge
Expected charge end time
Incidents (service stop, power drop, ...)

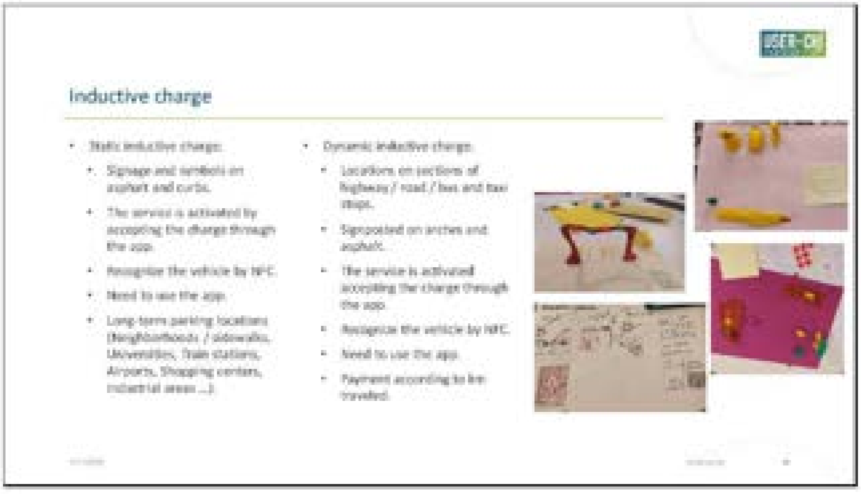

Charging, payment and feedback
Payment:
Suscription option
Credit card
Consumption history:
Initial and final charge percentage
Charging time
Km traveled
kWh / 100km

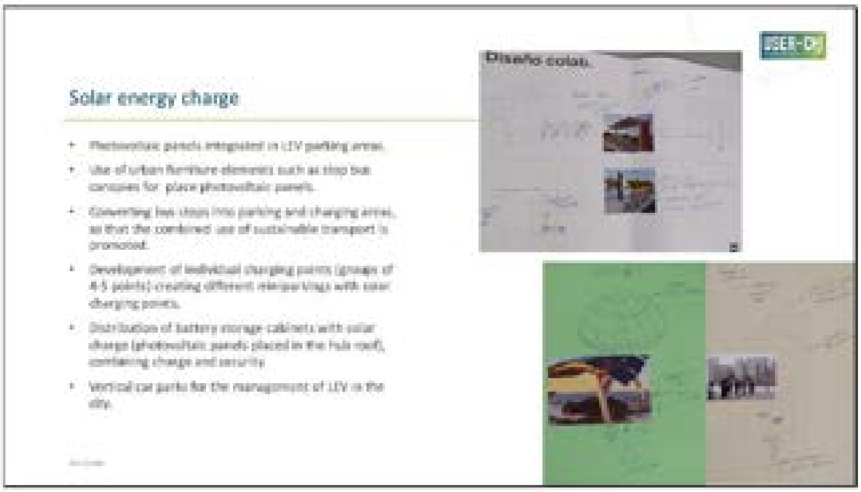

2. RESULTS – Challenge 2.
Station of the future


General conditions
Intermodal station. Public and private medium distance and last mile transport.
Spaces integrated into nature.
Indoor / outdoor.
Connections with walking and bike path.
Parking for electric vehicles.
EV charging and LEV in separate areas.
Anti-theft / safe zone.
High time flexibility.
Locations on highways, accesses to the city and key points of the city such as shopping centers, universities, hospitals, public transport stations.
Management similar to a civic center (multiple activities and interests in coexistence).


Services
Additional services:
Vehicle maintenance
Rental and shared vehicle area
Delivery service
Relax area / green area
Coffee shop
Physical activity zone
Playground
Coworking
Stores
WC


3. RESULTS – Challenge 3.
New charging methods


Inductive charge
• Static inductive charge:
• Signage and symbols on asphalt and curbs.
• The service is activated by accepting the charge through the app.
• Recognize the vehicle by NFC.
• Need to use the app.
• Long-term parking locations (Neighborhoods / sidewalks, Universities, Train stations, Airports, Shopping centers, Industrial areas ...).
• Dynamic inductive charge:
• Locations on sections of highway / road / bus and taxi stops.
• Signposted on arches and asphalt.
• The service is activated accepting the charge through the app.
• Recognize the vehicle by NFC.
• Need to use the app.
• Payment according to km traveled.


Solar energy charge
Diseño colab.
• Photovoltaic panels integrated in LEV parking areas.
• Use of urban furniture elements such as stop bus canopies for place photovoltaic panels.
• Converting bus stops into parking and charging areas, so that the combined use of sustainable transport is promoted.
• Development of individual charging points (groups of 4-5 points) creating different minipurkings with solar charging points.
• Distribution of battery storage cabinets with solar charge (photovoltaic panels placed in the hub roof), combining charge and security.
• Vertical car parks for the management of LEV in the city.


THANK YOU!
CONNECT WITH US:
Twitter: @Userchi_H2020
LinkedIn: https://bit.ly/2W7M3mW
Website: www.userchi.eu
Email: info@userchi.eu