D2.4: Use cases evaluation from the users' perspective

06/2024 (M54)

D2.4: Use cases evaluation from the users'perspective

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Technical References

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[1] PU = Public

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This project has used a standard methodology already developed in INTERPRETER project (Grant Agreement number: 864360), following EU recommendations. Ad hoc modifications were added to comply with the Grant Agreement conditions for INCIT-EV (Grant Agreement number: 875683).'

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0 EXECUTIVE SUMMARY

This document is the deliverable “D2.4 - Use cases evaluation from the users' perspective” of the H2020 project INCIT-EV (project reference: 875683).

The main objective of this deliverable is to report the methodology and results used to evaluate the innovative charging solutions developed in INCIT-EV. The validation has recruited 60 participants including EV and non-EV users as well as professional drivers. The evaluation has been based on the physiological signals recorded during the presentation of the innovative solutions. Five different concepts were evaluated: 1) dynamic inductive charging in urban environments (low speed charging); 2) dynamic inductive charging in highways (high speed charging); 3) static inductive charging; 4) bidirectional charging; and 5) smart systems for load planning.

The results obtained in the study indicate that there is a concept that is the clear favorite of drivers: Both on a conscious and non-conscious level, the winning concept is “**High-speed lane with wireless charging**”. At a non-conscious level, it is the one that obtains the highest score for valence (attraction) and impact (differentiation). On a conscious level, with an average score of 8.13/10 and a purchase/use intention of 7.8/10, it is the concept that obtains the best scores. Furthermore, at the attribute level, it is the one that obtains the highest score in half of them and the one that obtains the highest average attribute score (8/10).

The rest of the concepts present results inferior both at the neuro level and at the declarative level, without there being a clear second concept winner not a clear concept loser.

The delivery of this deliverable is done in accordance with the description in the Grant Agreement Annex 1 Part A with no time deviation and no content deviation from the original planning.

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ACRONYM LIST

Table 1Acronym List

Acronym	Definition
AC	Alternative Current
BVP	Blood Volume Pulse
DC	Direct Current
EEG	Electroencephalography
EV	Electric vehicle
GSR	Galvanic Skin Response
V2G	Vehicle to Grid

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1 METHODOLOGY

1.1 Context

Task 2.4 aimed at evaluating the developed charging solutions of INICIT-EV, namely inductive charging and smart charging. The original idea was to take advantage of the installations at the demo sites to evaluate hands on experiences of end users. This original plan had to be modified due to two reasons. First, those installations that were ready for demonstration did not have a direct impact on the user experience. For instance, smart charging does not modify the charging experience, and, in the final demo, participants were not even given the option or aware of the user of smart charging. Second, the TRL of inductive charging demonstrators were not ready for end users evaluation.

As a result, task 2.4 has developed an alternative methodology to evaluate these concepts without having access to the technology, but still involving end users. This deliverable reports the methodology and results obtained.

1.2 Goals of the study

The main goal of the study is to find out how drivers (professional and non-professional) evaluate different charging concepts that were developed in the project. In this way, the study lets us know which concept is the most appealing to each kind of driver, both from a conscious and a non-conscious perspective.

As secondary goal, the study has explored how the driver's mental image of the concept matches with the actual realization of the concept that has been done in the project. Lastly, the concepts have been examined from a communication point of view, identifying which words have been attractive, impactful, and relevant for the driver, so that this knowledge can be used to communicate the concepts better.

1.3 Sample and place of study

Sixty participants took part in the study: 45 general drivers and 15 professional drivers. Of these, 15 drove electric vehicles and 45 drove other vehicles.

The study happened in Zaragoza (Spain), a city that is a European test case with a population that matches the European average fairly well. It has been classified as a follower city in the context of the INCIT-EV project (see D2.5 for more information).

1.4 Systems

To carry out this study, the following technologies were used (see Figure 1):

1. **Diadem** (Bitbrain technology). Wearable and mobile dry-EEG headset with 12 channels over pre-frontal, frontal, parietal and occipital brain areas, optimized for the estimation of emotional and cognitive states.

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2. **Ring** (Bitbrain technology). Wearable and wireless device for real-time monitoring of electrodermal activity (GSR) and cardiac activity (BVP).
3. **Spark** (Tobii technology). Screen-based eye-tracker designed to analyze the visual response to stimuli displayed on a screen.

Figure 1: Technologies used to record user physiological signals.

1.5 Neurometrics

Emotional impact: Physiological impact (excitation vs calm) produced by a specific stimulus. It is related to surprise or differentiation.

Affective valence: Degree of attraction experienced during the presence of a stimulus or experience. It varies from a “positive/pleasant” extreme to a “negative/unpleasant” extreme.

Engagement: Degree of involvement or connection between the person and the stimulus or experience. The range of values is between no attachment or "connection" to complete involvement on the part of the person in the stimulus or experience. In this context, we interpret it as personal relevance.

Emotional activation: Physiological activation produced by an experience over time. It goes from a state of calm to a state of excitement. In this context, it usually captures the ability of a concept to interest a consumer.

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1.6 Concepts

We selected three technologies from INCIT-EV developments. Our focus was on inductive charging, where we proposed three different concepts: static inductive charging in public areas, dynamic charging in urban environments at low speed and dynamic charging at high speed in highways. We also evaluated bi-directional charging emphasizing the advantages for storing and managing energy in an efficient way while reducing costs. The last concept targeted the use of smart apps and planners to ease the burden of trip planning.

For each concept we prepared a text that was narrated and an image supporting the narration. We evaluated five concepts directly related to the main innovation technologies developed in the INCIT-EV project, namely three use cases related to inductive charging. Another two concepts addressed the vehicle to grid advantages in managing energy and smart technologies to ease the planning and use of EV vehicles for the users. We present the materials that were evaluated hereunder.

Concept 1. Urban wireless dynamic charging

The text for this concept was;

> *Imagine never having to worry about charging station issues or high parking costs in urban environments. We present our revolutionary solution: Urban Dynamic Charging in the City!*
>
> *With our electrified urban lane sections, charging your electric car is almost as easy as driving. Simply pass over it and let the magic happen. Forget searching for charging points and the hassle of stopping at charging stations! The city becomes your personal charging hub. Recharge your vehicle with public electricity and pay easily through an app!*
>
> *With our solution, you get enough autonomy for day-to-day activities. Plus, you reduce energy and parking costs!*
>
> *The future of electric mobility lies in a worry-free driver!*

The visual material used to support this concept is shown in Figure 2Figure 3.

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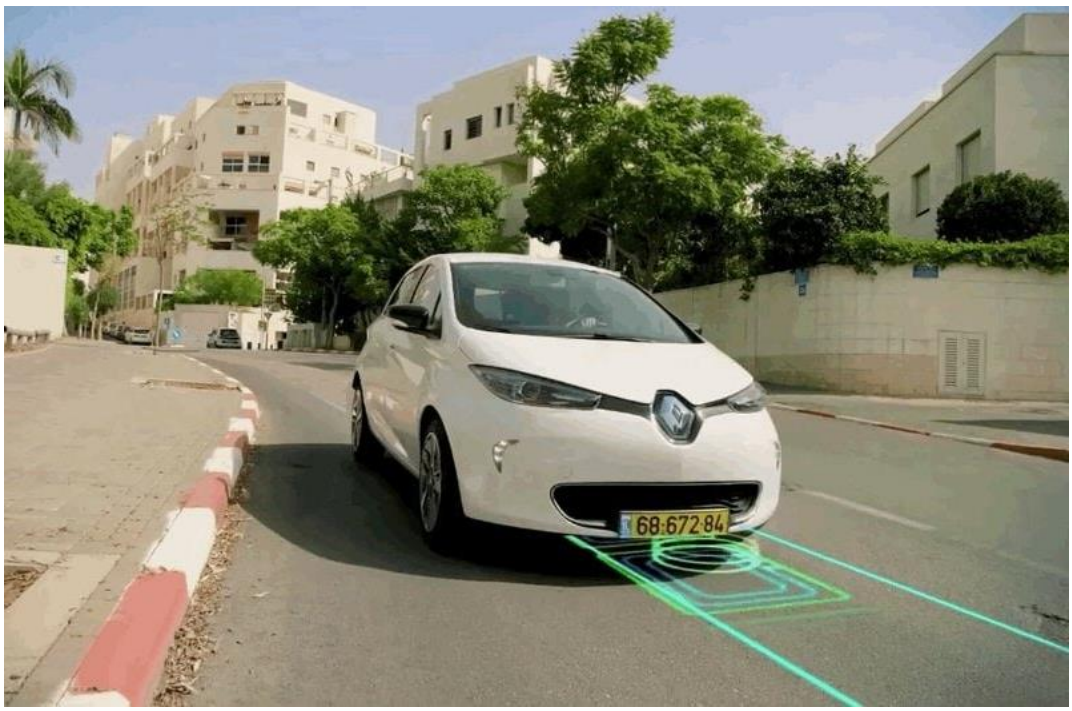

Figure 2: Concept 1. Urban wireless dynamic charging

Concept 2. High-speed lane with wireless charging

The text for this concept was;

> Do you think you're ready for a worry-free trip? We present our revolutionary wireless charging system on highways and expressways, designed to make your long journeys simpler and more convenient than ever.
>
> You no longer need to plan where to find charging points. With our new system, charging your vehicle's battery is as easy as driving. No interruptions, with your own full autonomy to your destination!
>
> Additionally, we offer extra services like internet connection so you can always stay connected while traveling. We provide the convenience of knowing the service bill while you charge, no surprises at the end of the road.
>
> With our wireless charging solution on highways and expressways, traveling long distances has never been easier. Enjoy the freedom, enjoy the roads, and enjoy traveling free from planning!

The visual material used to support this concept is shown in Figure 3.

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Figure 3: Concept 1. High-speed lane with wireless charging

Concept 3. Static inductive charging

The text for this concept was;

> Are you a professional driver? Imagine never having to worry about charging station problems. We present our revolutionary solution: Static Inductive Charging!
>
> With our inductive charging technology strategically located at taxi and bus stops, you do not need to waste time starting or stopping the charge. Take advantage of the wait at the taxi stop to charge while you are parked or moving forward in the queue, with the semi-static charge at each position in the queue there is a charger! Charging ends automatically the moment you get back on the road.
>
> No matter the traffic in the city or long trips, you will always have access to charging at no cost.
>
> Stop competing for charging points and avoid waiting times that become effective work time. An intuitive application will guide you to the nearest charging points, ensuring you are always ready for the next run.
>
> The best Static Inductive Charging System is specially designed for you. Optimize your work performance and ignite your future!

The visual material used to support this concept is shown in Figure 4

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Figure 4: Concept 3. Static inductive charging

Concept 4. Bidirectional charging

The text for this concept was;

> Are you looking for an intelligent and sustainable way to charge your electric vehicle? We have the perfect solution for you! Bidirectional charging.
>
> Bidirectional charging connected to a large electrical grid turns cities into giant distributed batteries, with electricity in constant motion. What if we can keep energy circulating so as not to depend on fossil fuels from other countries?
>
> Share your electricity with the grid when you don't need it! If prices fluctuate, receive economic compensation.
>
> Bidirectional charging not only creates a network of renewable energy cooperation but also allows you to store excess electricity in your batteries sustainably to create a personal self-consumption system connected to your home.
>
> Contribute to efficiently using the country's energy resources, saving on expenses, and making the distribution system sustainable for the environment.

The visual material used to support this concept is shown in Figure 5

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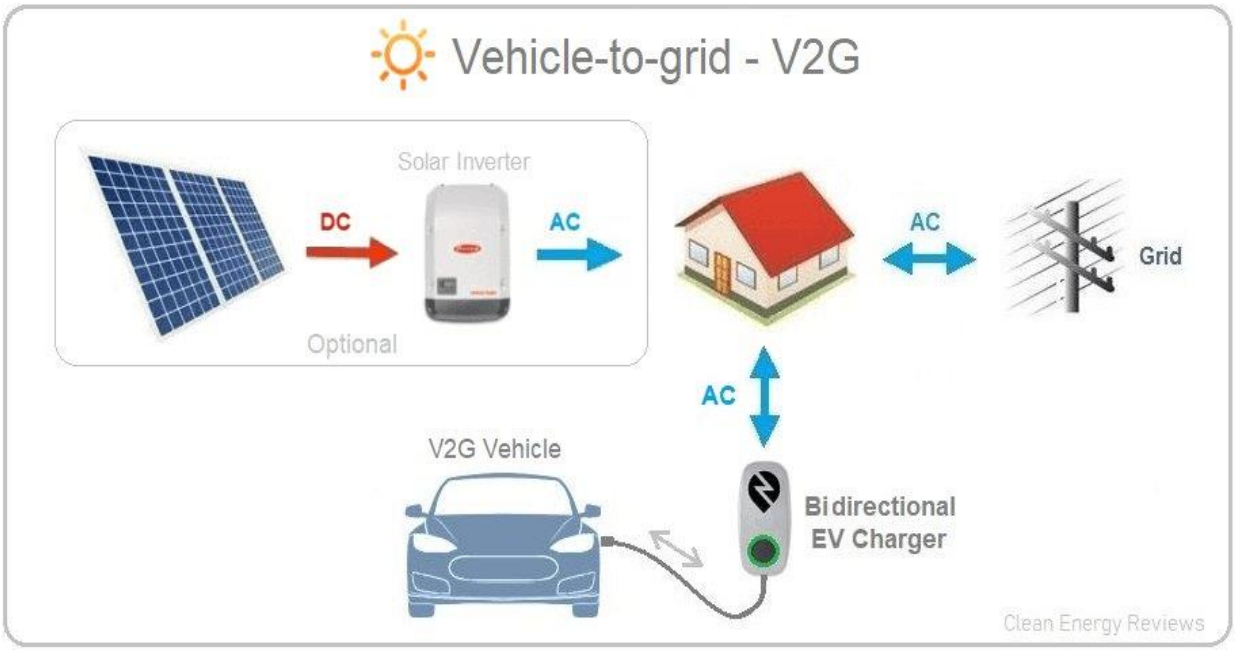

Figure 5: Concept 4. Bidirectional charging

Concept 5. Artificial intelligence for load planning

The text for this concept was;

> Can you imagine a world where your electric vehicle is always ready for any unplanned adventure? We present our revolutionary artificial intelligence designed to keep your car charged at all times , no matter where you are!
>
> Our intelligent system analyzes your itinerary. This system knows all the possibilities to keep the vehicle in optimal condition and suggests the best charging plans according to the route you will take.
>
> Have a coffee when you are at an ultra-fast charging point. You can check the stops, see how long it will take to reach them, the cost of the route, evaluate options, and choose the one that interests you the most!
>
> If there is a change of plans, you can reschedule the route. Our AI knows all the smart charging types in the area, their price, and availability. The more it knows your usual routes, the more you will optimize your benefit!
>
> Let artificial intelligence organize your charging method and frequency! Say goodbye to anxiety! The future of electric charging is a peaceful life!

The visual material used to support this concept is shown in Figure 6.

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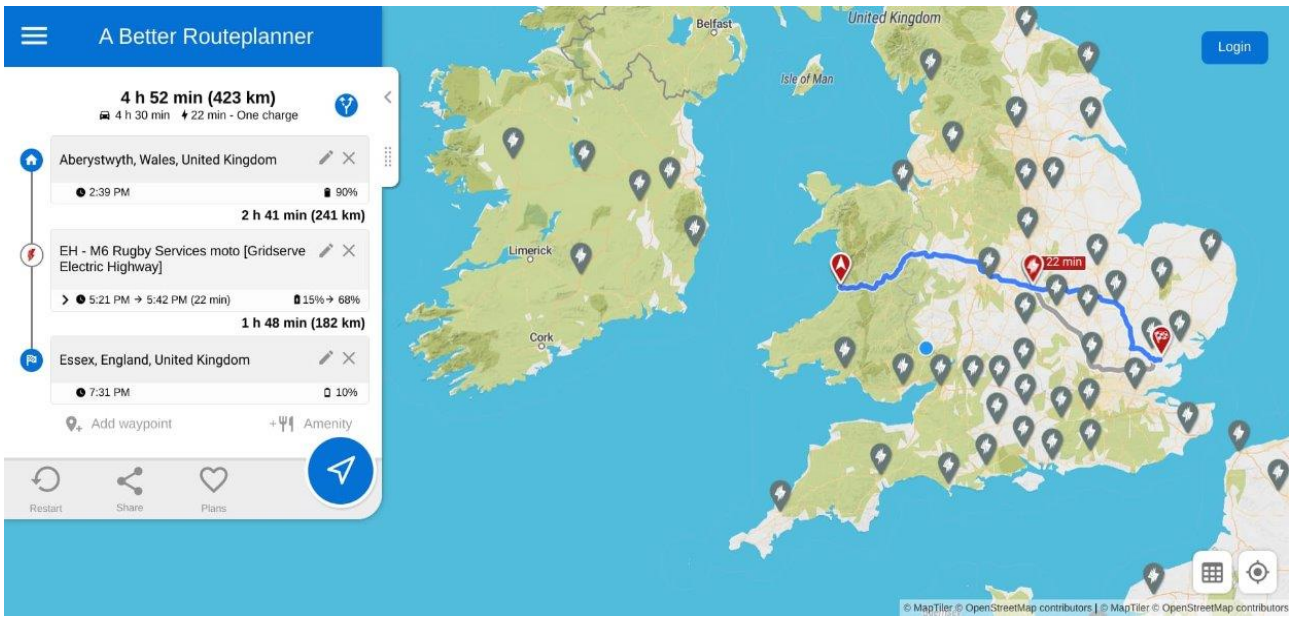

Figure 6: Concept 5. Artificial intelligence for load planning

1.7 Experimental protocol

The following figure shows a schematic of the experimental protocol:

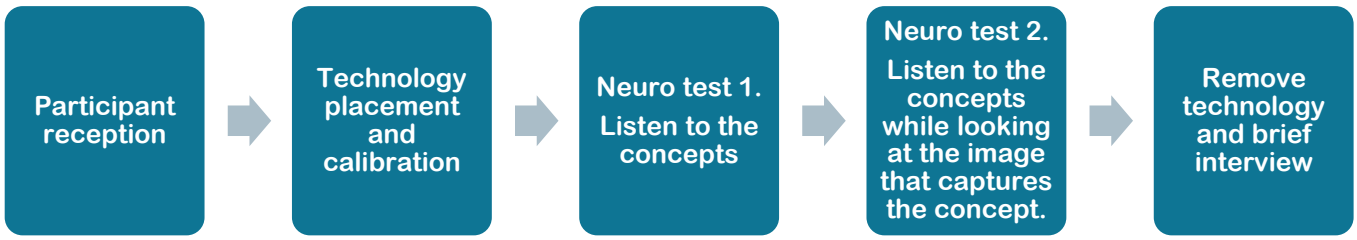

Figure 7 Scheme of the experimental protocol

Step 1. Reception of the participant. The researcher receives the participant in the laboratory, briefly explains the experiment and provides the informed consent document for signature.

Step 2. Technology placement and calibration. The researcher places the technologies on the participant (headband and ring). The eye-tracker is placed under the screen. Subsequently, it proceeds to calibrate the technologies (eye-tracker, diadem and ring).

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Step 3. Neuro test 1. The participant listens to the concepts. The stimulation protocol of this test consists of showing a preparation screen (black screen with a cross in the center) for 3 seconds, a black screen while listening to the concept (variable duration depending on the length of the concept), relaxation screen (black screen with the word RELAX in the center) for 8 seconds. This protocol is repeated for each concept. All participants are stimulated with all concepts, but the order of stimulation is randomized to avoid bias due to the order of exposure. This test allows us to understand how each concept is perceived in the minds of drivers.

Step 4. Neuro test 2. The participant listens to the concepts again, but in this case while viewing the corresponding image. The stimulation protocol is identical to the previous one, with the only change that while listening to the concept the screen is not black, but with the image that represents the concept the participant is listening to. This test allows us to understand, comparing with the results of the previous test, to what extent the drivers imagined the concept of the mode shown to them.

Step 5. Remove the technology and brief interview. At the end of the neuro tests, the technology is removed, and a brief interview is carried out to complement the neuro results. For this, Likert scales from 1 to 10 were used, asking for each concept:

1. Rate how much you like this concept from 1 to 10, with 1 being “I don't like it at all” and 10 being “I love it.”
2. Rate the purchase/use intention under this context and these conditions from 1 to 10, with 1 being “I would have no intention of buying/using it” and 10 being “I would be very interested in buying/using it.”
3. Rate each of the following benefits for this concept from 1 to 10, with 1 being “the concept does not convey this benefit to me” and 10 “the concept completely conveys this benefit to me.”

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2 GLOBAL RESULTS

2.1 NEURO RESULTS

2.1.1 Neuro response to narrated concepts

The two concepts that, on average, have obtained a better non-conscious response have been “high lane speed with wireless charging” and “artificial intelligence for load planning”. Both concepts are the ones that transmit the most valence (positive emotion) and greater impact (differentiation).

The least favourable concept positioning was “bi-directional charging”, which everyone found less appealing and somewhat less distinctive.

Anyway, the differences are not very big, as we are talking about +/-2 points in valence (all the concepts are neutral in their range) and an impact range of +/- 5pts (not very significant for this kind of metric).

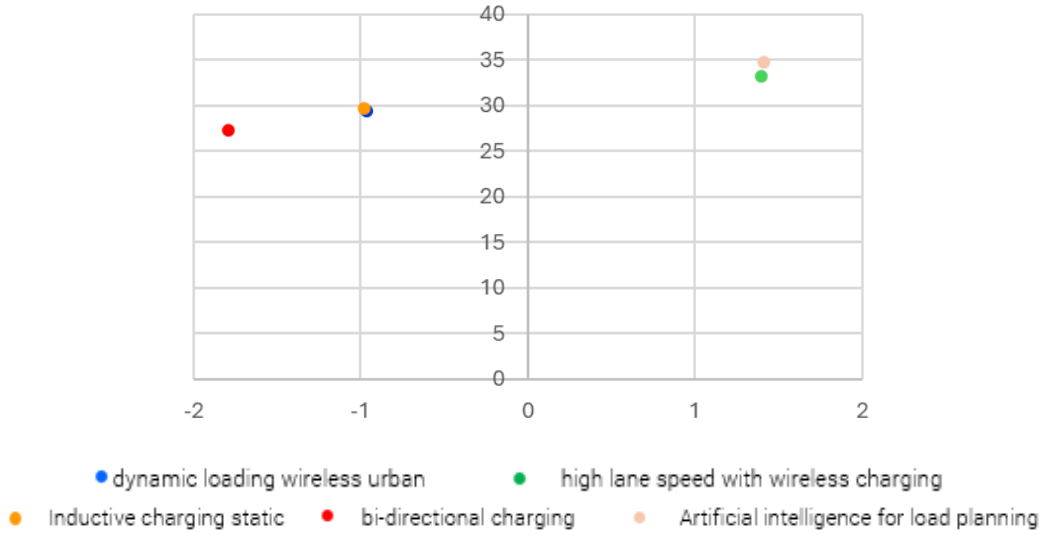

Figure 8: Positioning emotional of each concept (audio only)

2.1.2 Neuro response to narrated concepts spoken with image support

In general, showing the image makes the concepts less attractive, this means that in the driver's mind the concept was imagined in a more attractive way than what has been shown to them. The only concept that has improved when the image is shown is “bi-directional charging”, which goes from being the worst concept to being the third best.

When the image is shown, the winning concepts in “audio only” remain so (being “high speed wireless charging” and “artificial intelligence for load planning”), while when the image is shown the concept that

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becomes perceived as the worse is “dynamic charging wireless urban”, followed by “inductive charging static”.

In this case, it is observed that when the image is introduced a difference between concepts important in valence (with a range of +2/-6 points).

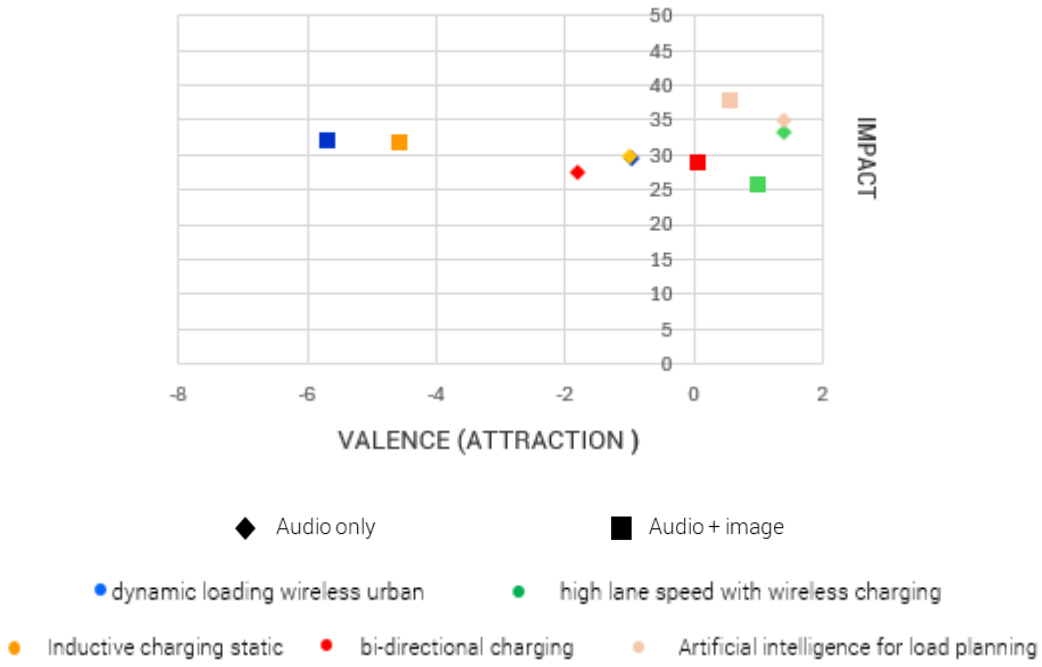

Figure 9 Emotional positioning of the concepts spoken (audio only) vs concepts spoken while the image is shown (audio+image)

2.2 Declarative results

2.2.1 Pleasantness level

When asked about the level of satisfaction, the winning concept is “high lane speed with wireless charging” with a score of 8.13/10. However, all concepts are scored with scores higher than 7, with the concept “artificial intelligence for load planning” being the one that scores with the lowest score (7/10).

2.2.2 Purchase/use intention

When asked about the level of purchase/use intention, the winning concept results in “dynamic charging wireless urban” with a 7.89/10. Again, the differences between the scores of the different concepts are not especially large, being the concept “artificial intelligence for load planning” the one which scores with the lowest score (6.55/10).

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2.3 Detailed results by concept

2.3.1 Concept 1. Dynamic load urban wireless

When analyzing the **emotional activation** when listening to the concept, it is observed that the concept begins with increasing interest (in green), the presentation of the concept manages to maintain interest (in orange) but when the explanation begins, the drivers begin to disconnect and continue disconnecting until the end (in red).

Imagine never having to worry about charging station issues or high parking costs in urban environments. We present our revolutionary solution: Urban Dynamic Charging in the City!

With our electrified urban lane sections, charging your electric car is almost as easy as driving. Simply pass over it and let the magic happen. Forget searching for charging points and the hassle of stopping at charging stations!

The city becomes your personal charging hub. Recharge your vehicle with public electricity and pay easily through an app!

With our solution, you get enough autonomy for day-to-day activities. Plus, you reduce energy and parking costs!

The future of electric mobility lies in a worry-free driver!

Furthermore, when **analyzing word by word**, it is observed that:

- "Electrified urban lane" is the concept that is perceived as having the greatest engagement (greatest personal relevance).
- "Forget searching for charging points"; "through an app"; and "reduce energy and parking costs" are the concepts that are perceived most positively (greater attractiveness)
- "the hassle of stopping at charging stations" and "through an app" are the concepts that generate on average a greater impact (greater differentiation).

The **declared average score** is 7.89/10 and the **purchase/use intention** is 7.89/10.

When analysing the different **attributes** in a declarative way, it is observed that all the scores are between 6.5 ("Allows the use of any type of tourism") and 8.9 ("Innovative") (see Figure 10 for details).

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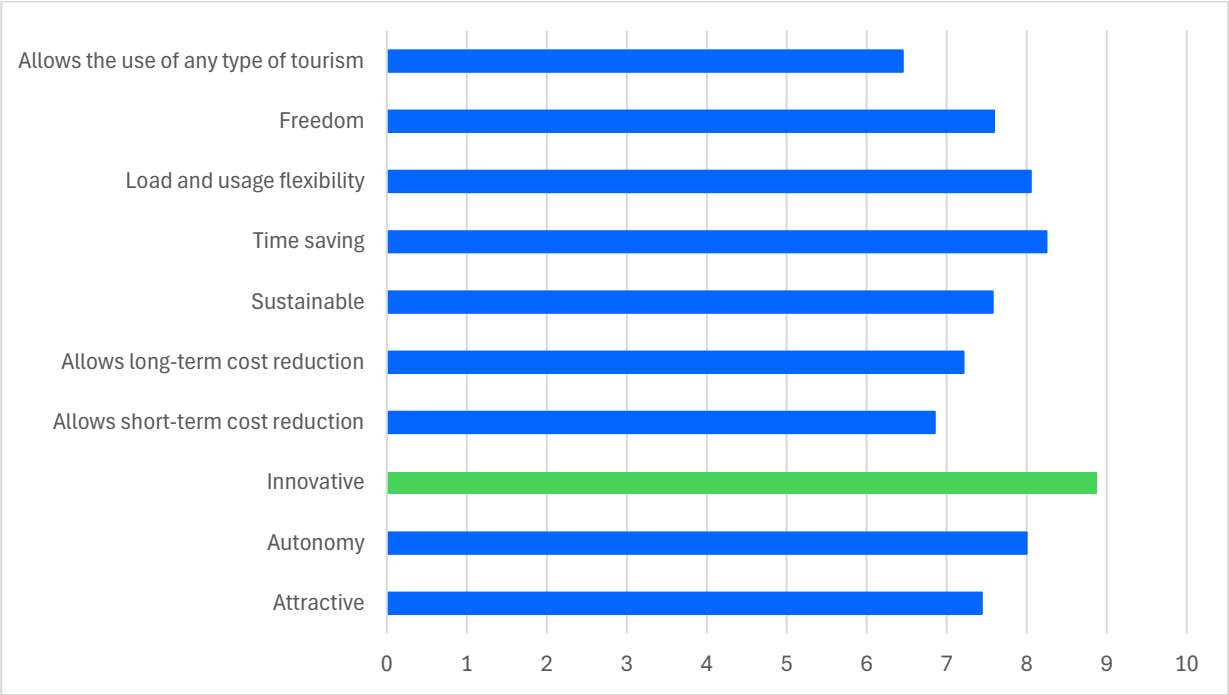

Figure 10: Attributes associated with concept 1. Dynamic load urban wireless

2.3.2 Concept 2. High speed lane with wireless charging

The analysis of the **emotional activation** while listening to the concept shows that the concept begins with increasing interest (in green), the end of the presentation of the concept causes the drivers to disconnect (in red). However, the extra services maintain the interest until practically the end (in orange). Enjoy the freedom makes you disconnect (in red), however the closure is powerful and re-engages (in green).

Do you think you're ready for a worry-free trip? We present our revolutionary wireless charging system on highways and expressways, designed to make your long journeys simpler and more convenient than ever.

You no longer need to plan where to find charging points. With our new system, charging your vehicle's battery is as easy as driving. No interruptions, with your own full autonomy to your destination!

Additionally, we offer extra services like internet connection so you can always stay connected while traveling. We provide the convenience of knowing the service bill while you charge, no surprises at the end of the road.

With our wireless charging solution on highways and expressways, traveling long distances has never been easier. Enjoy the freedom, enjoy the roads, and enjoy traveling free from planning!

Furthermore, the word by word **analysis** shows that:

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- "full autonomy"; "connected while traveling"; enjoy the roads" "enjoy traveling" are the concepts that are perceived as having greater engagement (greater personal relevance).
- "worry-free trip" and "knowing the service bill" are the concepts that are perceived most positively (greater attractiveness)
- "Connected while traveling"; "knowing the service bill"; "no surprises at the end of the road"; "Free from planning" are the concepts that generate on average a greater impact (greater differentiation).

The **declared average score** is 8.13/10 and the **purchase/use intention** is 7.8/10.

When analyzing the different **attributes** in a declarative way, it is observed that all the scores are between 6.9 ("Allows the use of any type of tourism") and 8.7 ("Autonomy").

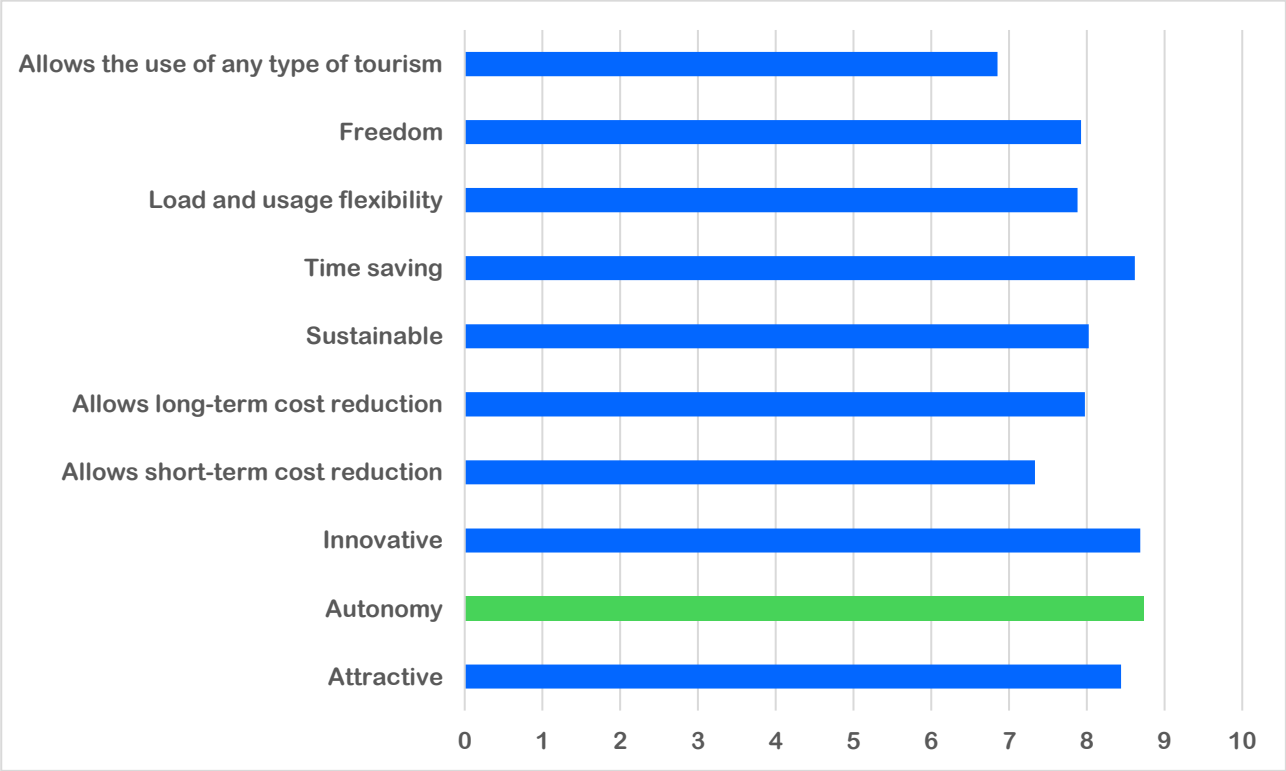

Figure 11: Attributes associated with concept 2. High speed lane with wireless charging

2.3.3 Concept 3. Static inductive charging

In this concept, the **emotional activation** during the narration reveals that the concept begins with increasing interest (in green), however the presentation of the concept causes drivers to begin to disconnect (in red). Interest manages to maintain slightly when It is explained that the load ends automatically (in orange), but then drops back to the end (in red).

Are you a professional driver? Imagine never having to worry about charging station problems. We present our revolutionary solution: Static Inductive Charging!

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With our inductive charging technology strategically located at taxi and bus stops, you do not need to waste time starting or stopping the charge.

Take advantage of the wait at the taxi stop to charge while you are parked or moving forward in the queue, with the semi-static charge at each position in the queue there is a charger! Charging ends automatically the moment you get back on the road.

No matter the traffic in the city or long trips, you will always have access to charging at no cost.

Stop competing for charging points and avoid waiting times that become effective work time. An intuitive application will guide you to the nearest charging points, ensuring you are always ready for the next run.

The best Static Inductive Charging System is specially designed for you. Optimize your work performance and ignite your future!

Furthermore, when **analyzing word by word** , it is observed as:

- "Strategically located" is the concept that is perceived as having the greatest engagement (greatest personal relevance).
- "never having to worry"; "charge while you are parked or moving forward in the queue"; "automatically"; and " Stop competing for charging points" are the concepts that are perceived most positively (greater attractiveness)
- "professional driver" is the concept that generates on average a greater impact (greater differentiation).

The **declared average score** is 7.98/10 and the **purchase/use intention** is 7.07/10.

When analysing the different **attributes** in a declarative way, it is observed that all the scores are between 5.8 ("Allows the use of any type of tourism!) and 8.2 ("Innovative").

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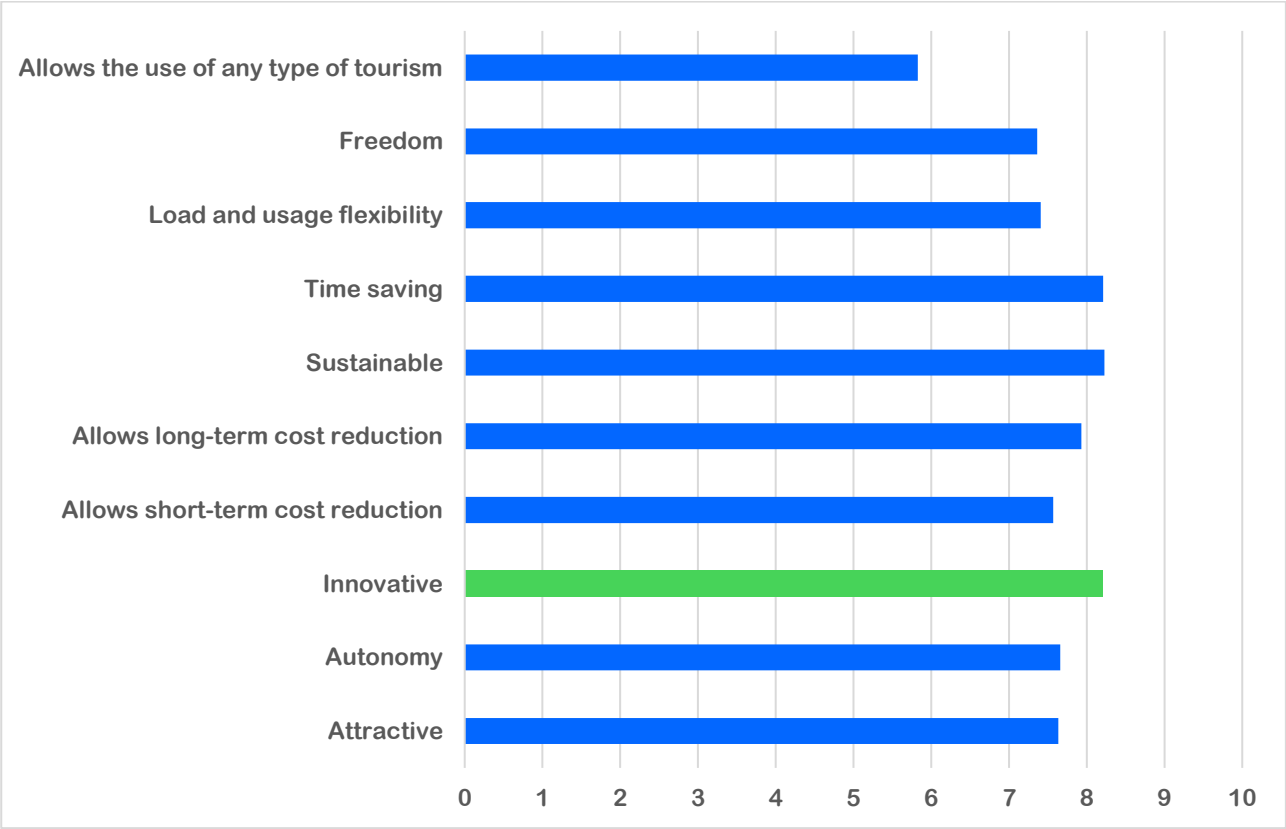

Figure 12: Attributes associated with concept 3. Static inductive charging

2.3.4 Concept 4. Bidirectional charging

The **emotional activation** of the fourth concept indicates that the concept begins with increasing interest (in green), the presentation of the concept manages to maintain interest (in orange) but when the explanation begins, the drivers begin to disconnect (in red). The concept again maintains interest when talking about price fluctuation and economic compensation, and interest is maintained until the final part where it is disconnected again.

Are you looking for an intelligent and sustainable way to charge your electric vehicle? We have the perfect solution for you! Bidirectional charging.

Bidirectional charging connected to a large electrical grid turns cities into giant distributed batteries, with electricity in constant motion. What if we can keep energy circulating so as not to depend on fossil fuels from other countries?

Share your electricity with the grid when you don't need it! If prices fluctuate, receive economic compensation.

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Bidirectional charging not only creates a network of renewable energy cooperation but also allows you to store excess electricity in your batteries sustainably to create a personal self-consumption system connected to your home.

Contribute to efficiently using the country's energy resources, saving on expenses, and making the distribution system sustainable for the environment .

Furthermore, when **analyzing word by word** , it is observed as:

- “perfect solution for you” and “ electrical grid” are the concepts that are perceived as having greater engagement (greater personal relevance).
- “intelligent and sustainable way to charge”; “Bidirectional charging”; and “Contribute to efficiently” are the concepts that are perceived most positively (greater attractiveness)
- “Economic compensation” and “Contribute to efficiently” are the concepts that generate on average a greater impact (greater differentiation).

The **declared average score** is 7.38/10 and the **purchase/use intention** is 7.13/10.

When analyzing the different **attributes** in a declarative way, it is observed that all the scores are between 6.5 (Allows he use of any type of tourism) and 8.6 (sustainable).

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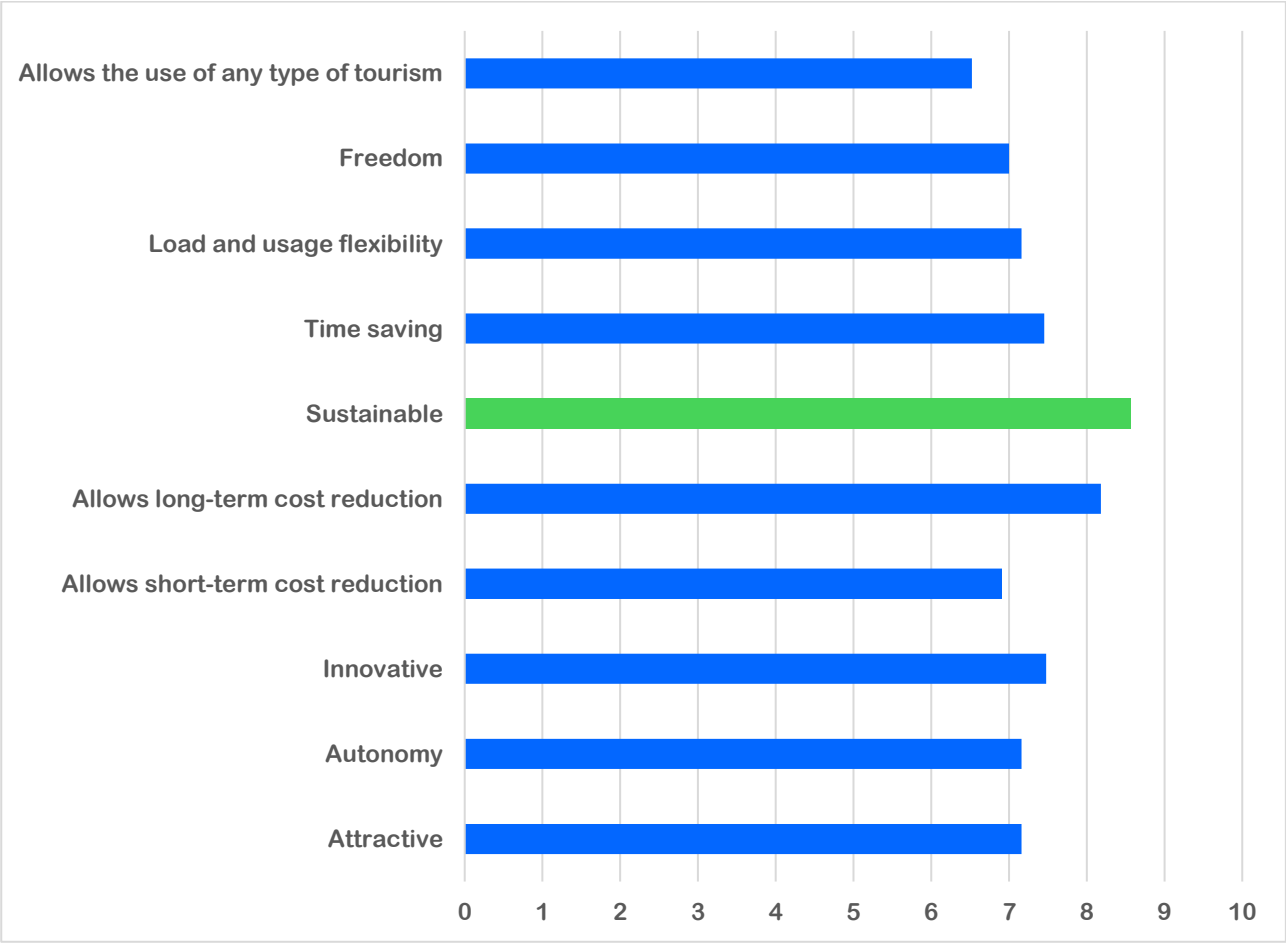

Figure 13: Attributes associated with the concept 4. Bidirectional charging

2.3.5 Concept 5. Artificial intelligence for load planning

The **emotional activation** of this last concept again begins with increasing interest (in green), the beginning of the presentation of the concept causes the interest to increase (in red), however, the interest remains constant since half of the explanation until almost the end (in orange) where interest is increased in the closing (in green).

Can you imagine a world where your electric vehicle is always ready for any unplanned adventure? We present our revolutionary artificial intelligence designed to keep your car charged at all times , no matter where you are!

Our intelligent system analyzes your itinerary. This system knows all the possibilities to keep the vehicle in optimal condition and suggests the best charging plans according to the route you will take.

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Have a coffee when you are at an ultra-fast charging point. You can check the stops, see how long it will take to reach them, the cost of the route, evaluate options, and choose the one that interests you the most!

If there is a change of plans, you can reschedule the route. Our AI knows all the smart charging types in the area, their price, and availability. The more it knows your usual routes, the more you will optimize your benefit!

Let artificial intelligence organize your charging method and frequency! Say goodbye to anxiety! The future of electric charging is a peaceful life!

Furthermore, the word by word analysis shows that:

- "artificial intelligence" and "intelligent system" are the concepts that are perceived as having greater engagement (greater personal relevance).
- "electric vehicle is always ready"; "best charging plans"; and "future of electric charging" are the concepts that are perceived most positively (greater attractiveness)
- "electric vehicle is always ready"; "all the possibilities to keep the vehicle in optimal condition"; and "optimize your benefit" are the concepts that generate on average a greater impact (greater differentiation).

The **declared average score** is 7/10 and the **purchase/use intention** is 6.55/10.

When analyzing the different **attributes** in a declarative way, it is observed that all the scores are between 5.36 (Attractive) and 8.4 (Sustainable).

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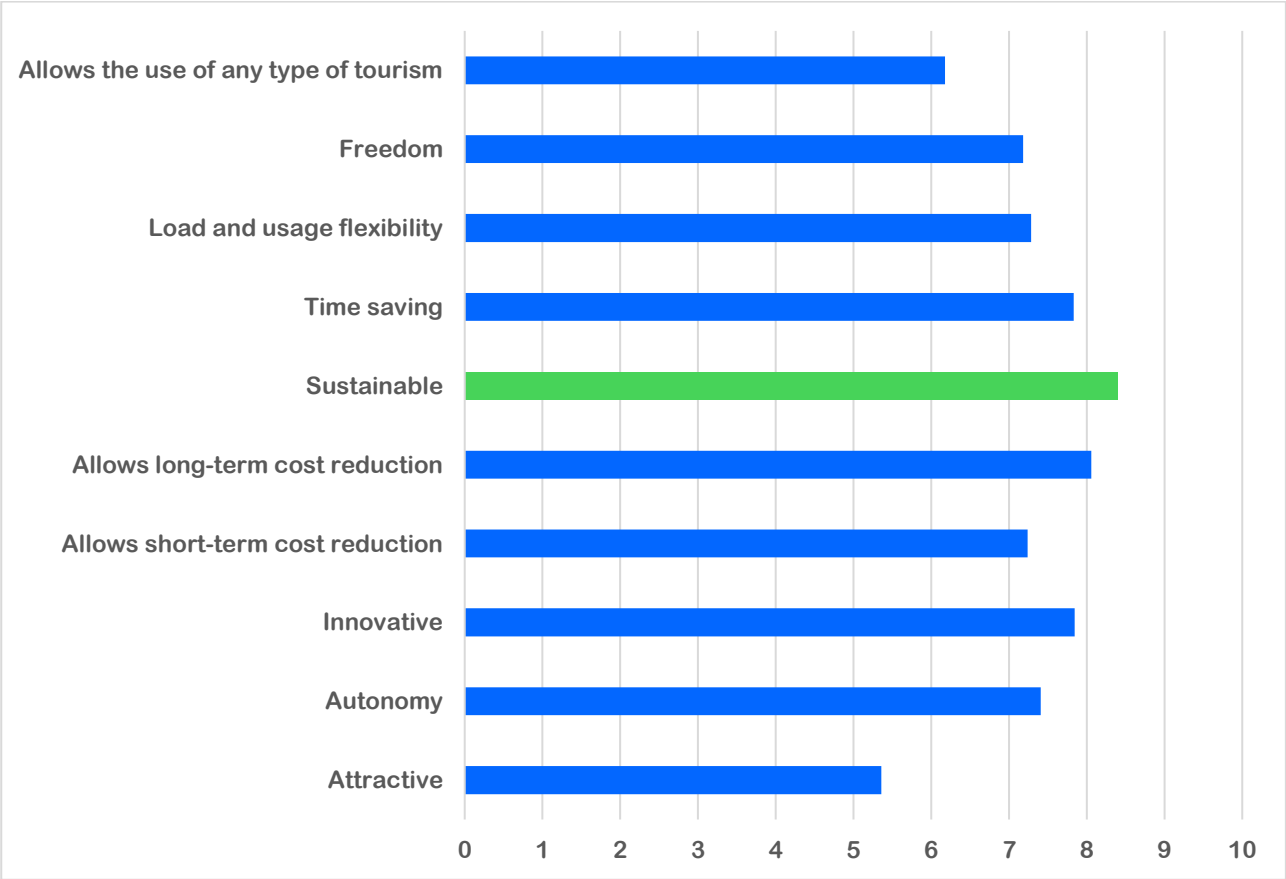

Figure 14: Attributes associated with concept 5. Artificial intelligence for load planning

2.4 Conclusions on general results

On both a conscious and non-conscious level, the winning concept is "**High-speed lane with wireless charging**". At a non-conscious level, it is the one that obtains the highest score for valence (attraction) and impact (differentiation), in addition, at the discourse level it is capable of generating or maintaining interest a little more than half of the time. On a conscious level, with an average score of 8.13/10 and a purchase/use intention of 7.8/10, it is the concept that obtains the best scores. Furthermore, at the attribute level, it is the one that obtains the highest score in half of them and the one that obtains the highest average attribute score (8/10).

As for the rest of the concepts:

- The concept **"Urban wireless dynamic charging "** would be the second favourite level conscious (with some scores very similar to the following). It has an average liking score and average purchase / use intention score of 7.89. The average in attributes is 7.6, obtaining the best score in 2 of the 10 attributes evaluated (although also gets the score further low in other 3 attributes). As for the neuro response, it is a concept that works in an acceptable way (emotion neutral) but that does not achieve to hook in his description. Additionally, when the concept image is displayed valence declines in an

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important way. That is, the drivers imagine a concept implementation different from the one presented and the one that is presented disappoints him/her.

- The concept "**Static inductive charging"** would be the third favourite on a conscious level (with very similar scores to the previous one). It obtains an average rating of liking of 7.98 and purchase/use intention of 7.07 (note that this concept is aimed exclusively at professional drivers, which would explain an intention to use significantly lower than that of liking). At the attribute level, it does not obtain the best score in any and obtains the worst score in "Allows the use of any type of tourism" which gets a 5.8 (again, this would be explained because it is a concept aimed at professional drivers). On average, the attribute score is 7.6. Regarding the neuro results, once again we find an acceptable concept (neutral emotion in audio) that loses positioning when the image is shown. Again, we would find ourselves with expectations when listening to the concept that are not met when viewing the image. At the discourse level, we observe a discourse that is not capable of engaging in most of the description.
- The "Bidirectional**" concept charging**" is a concept that has an average score of 7.38 and a purchase/use intention of 7.13. At the attribute level, it is the one that obtains the worst score in 6 of the 10 attributes and does not obtain the best score in any. On average, the attribute score is 7.4/10. At a non-conscious (neuro) level we observe that it is the concept that works the worst when listening to the audio alone, however, we observe a significant improvement when the concept is presented with the image, which suggests that the description of the concept, without being accompanied from an image, it is not understood. At the discourse level, it is able to maintain interest in almost half of the description.
- The concept "Artificial **intelligence for load planning**" presents very different results at conscious and non- conscious level. On the one hand, it is the concept with the worse score at conscious level. It has an average grade of 7/10, an intention to use of 6.55/10 and when looking at the attributes is the one that on average is least recognized (7.3/10). Although it does not get the best grade in any of the attributes, it is neither the worse except in one of them. The neuro analysis of non-conscious reactions, it ranks second. In this sense, we observe how in the detailed analysis of the concept, the different characteristics offered by the application of artificial intelligence to route planning generates a greater interest than the number of smaller advantages of other solutions. Another aspect that may also be favoring this concept is familiarity. In the end, we are presenting a concept that resembles to some extent others that we already know (google maps and similar, including the functionality of the load recommendation) and the large expectations created around artificial intelligence. At a non-conscious level, more familiar concepts are usually better valued.

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3 SEGMENTED RESULTS

3.1 Previous observation

Two segments were analysed: professional vs. non-professional drivers and electric vehicle vs. non-electric vehicle drivers. However, it should be noted that the segments were not well balanced. Of the sample N=60, only 15 were professional drivers vs. 35 non-professional drivers. As for electric vehicle drivers or non-drivers, out of the sample N=60, only 15 were electric vehicle drivers.

This means that segmented results (especially in those segments with small sample sizes) should be considered as trend results and not as representative results.

3.2 Drivers Professionals vs non- professional drivers

On a conscious level, the differences in average rating of liking and average rating of purchase/use intention show practically no differences between professional and non-professional drivers (differences of less than 0.25 points). It is especially striking that the differences are minimal in the "Static inductive charging" concept, which is designed exclusively for professional drivers, and yet the average rating for liking is 8.00 (professionals) vs. 7.86 (non-professionals) and the average rating for purchase/use intention is 7.03 (professionals) vs. 6.92 (non-professionals).

At the non-conscious level, we observed greater differences in emotional positioning. At the valence level, the concepts "High-speed lane with wireless charging" and "Bi-directional charging" present very similar results, however professional drivers are much more attracted by the concepts "dynamic loading wireless urban" and "Inductive charging static", while they are less attracted by the concept "Artificial intelligence for load planning". At the impact level, professional drivers are less impacted by the concepts "dynamic loading wireless urban" and "Inductive charging static", suggesting that they are more familiar with them.

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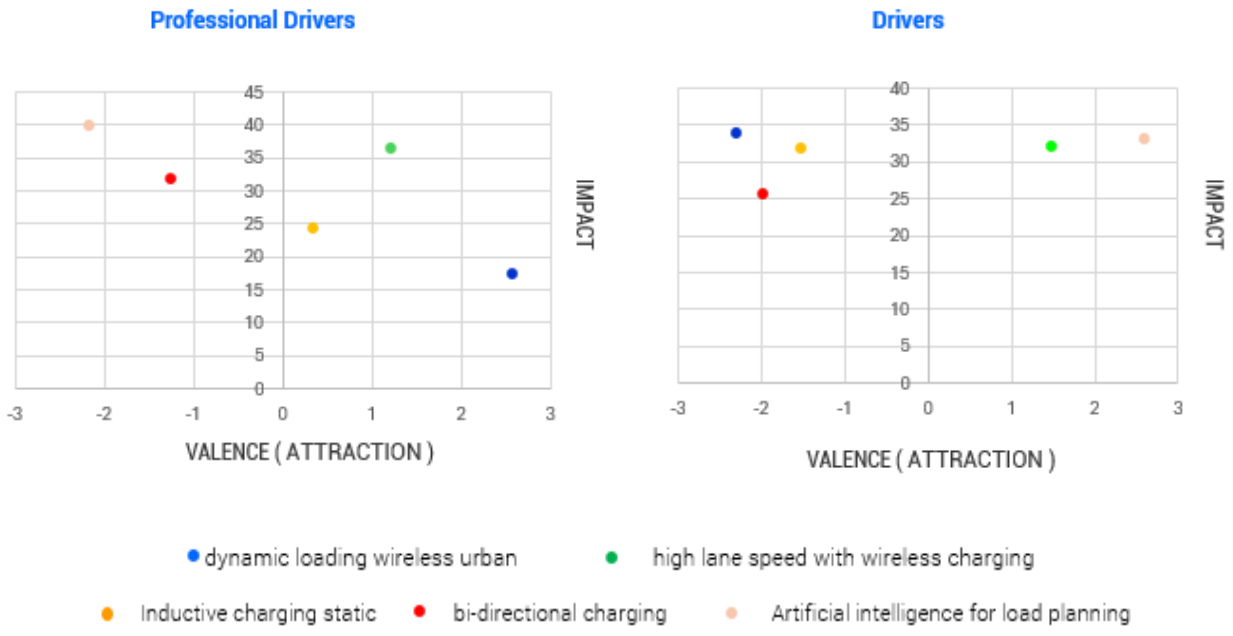

Figure 15: Differences between professional and non- professional drivers at a non- conscious level

3.3 EV drivers vs non EV drivers

At the conscious level, the differences in average rating of liking and average rating of intention to purchase/use present practically no differences between drivers of electric vehicles and drivers of other types of vehicles (differences of less than 0.1 points).

At a non-conscious level, we did observe differences in emotional positioning. At the valence level, only the concept "High-speed lane with wireless charging" shows a similar result. However, drivers of electric vehicles are less attracted to most of the concepts presented than drivers of other types of vehicles (while remaining neutral emotional responses in all cases). This means that the value of the solutions is greater in the imagination of non-EV drivers than on EV drivers. Finally, from the analysed concepts, only in "inductive charging static" we observe a slight improvement in valence in electric vehicle drivers vs. other vehicle drivers. This is probably due to a higher relative weight of professional drivers within the group of EV drivers.

At the impact level, we observe that in general, EV drivers show less impact compared to drivers of other types of vehicles, suggesting that EV drivers are more familiar with innovation in charging aspects than non-

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EV drivers.

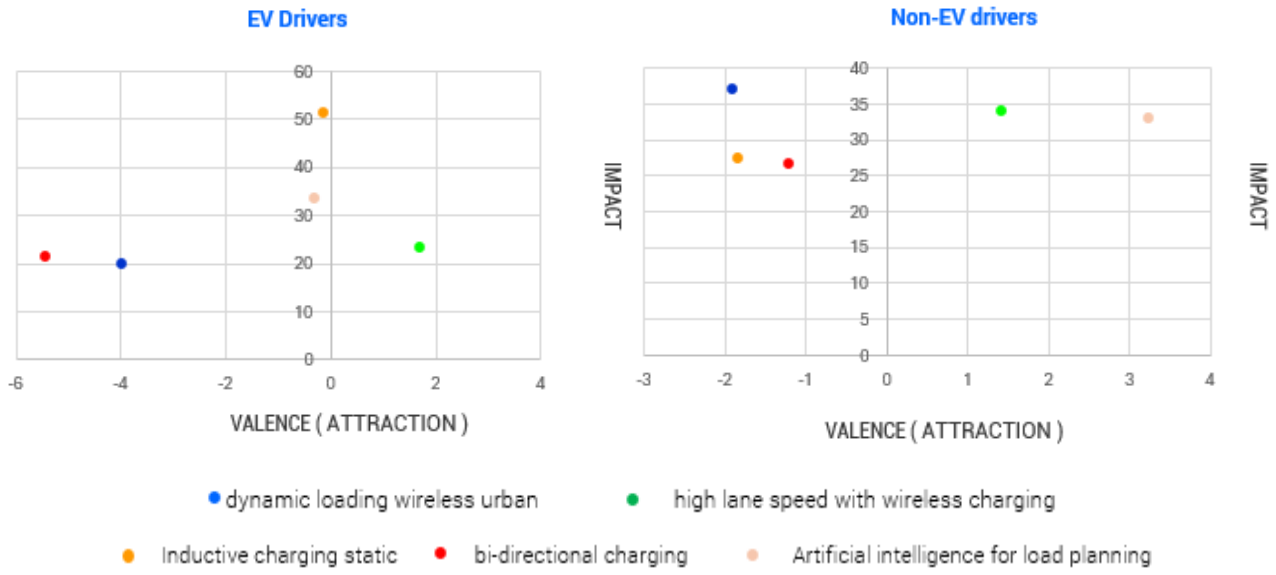

Figure 16: Differences between EV and non-EV drivers at a non- conscious level

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4 CONCLUSIONS

The study carried out has used consumer neuroscience techniques and declarative techniques to analyse 5 concepts related to the charging of electric vehicles investigated in the project.

The clear winner, both at conscious and non-conscious level, is "**High-speed lane with wireless charging**". At a non-conscious level, it obtains the highest score for valence (attraction) and impact (differentiation). In addition to this, at the discourse level it generates and maintains the interest of participants longer than the other concepts, a little more than half of the time. At a conscious level, with an average score of 8.13/10 and a purchase/use intention of 7.8/10, it is the concept that obtains the best scores. Furthermore, at the attribute level, it is the one that obtains the highest score in half of them and the one that obtains the highest average attribute score (8/10).

As for the rest of the concepts, they offer worse results both at a conscious and non-conscious level. Furthermore, with the used techniques it has been detected that the description of the concepts "dynamic charging wireless urban" and "Inductive charging static" generate expectations that are not met when viewing the image that represents the concept; while the description of the concept "bi-directional charging" is not understood, and its perception improves significantly when viewing the image associated to the concept.

Finally, the "Artificial intelligence for load planning" presents a dissonance between the conscious level perception and the not conscious one. For the former, it ranks last, and yet, for the latter, it is the second best. A possible explanation for this could be that this concept has a larger number of benefits compared to the rest. Although their value is probably smaller than those of other concepts, quantity may compensate for quality. Additionally, familiarity or preconceived ideas about this concept (or artificial intelligence) also may be the cause of a better response emotional.

In addition to the global results global, some insights from the different segments that participated are interesting, namely the differences between professional drivers vs. and non- professional drivers and EV vs non-EV drivers. Please note that the segments of professional drivers and EV drivers were lower than those other segments (15 vs 45), so results must be interpreted with caution. Conscious level results did not reveal any significant difference between the two segmentations. However, the consumer neuroscience techniques did show some differences.

Professional drivers value further the concepts "dynamic charging wireless urban" and "Inductive charging static", while they feel less attracted by the "Artificial intelligence for load planning" concept. At the impact level, professional drivers are seen less shocked by the concepts "dynamic charging wireless urban" and "Inductive charging static", which suggests that they are further familiar with the concepts themselves.

Regarding the differences between EV and non-EV drivers, EV drivers feel less attracted to most of the concepts presented than drivers of combustion vehicles (while still being neutral emotional responses in all cases). This means that the value of the solutions is greater in the imagination of non-EV drivers than in EV drivers. These results suggest may be interpreted in two different directions. On one hand, non-EV drivers' fear for charging is greater than the fear of experienced EV drivers. The second potential interpretation is that EV drivers have greater knowledge of the technologies, and their expectations are somehow muffled by previous experiences. The latter interpretation is supported by the fact that, in general, electric vehicle drivers present less impact compared to drivers of other types of vehicles, which suggests that EV drivers are more familiar with innovation in charging aspects than non-EV drivers.

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