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Article

Social acceptance and acceptability of photovoltaic panels for recharging / discharging electric vehicles

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Abstract: The introduction of electric vehicles (EVs) initially raised concerns among the public, but they have since gained widespread acceptance. Over the past decade, the EV market has grown significantly, making EVs one of the most promising solutions for reducing greenhouse gas emissions in the transport sector. To meet the increasing energy demand driven by this growth, photovoltaic-powered charging stations (PVCS) could provide a sustainable solution by supplying charging terminals with clean energy. As this technology is still relatively new, both technical assessments and studies of the social acceptability of PVCS should be conducted simultaneously to evaluate their feasibility and improve public awareness. Therefore, this study aims to assess the social acceptability of PVCS and identify their perceived limitations from the public's perspective. The proposed system mainly consists of photovoltaic (PV) panels, stationary energy storage, and a connection to the public grid as a backup power source. Nearly 900 participants from diverse backgrounds took part in the study. The results show that most respondents are willing to charge their EVs using solar energy. However, this acceptance depends on future user needs and expectations. The findings also confirm concerns regarding the use of PV energy for EV charging, particularly with respect to system efficiency, recycling, and lifespan.

Keywords: social acceptance; social acceptability; photovoltaic; charging station; societal impact; survey; smart charging

1. Introduction

The Paris Agreement aims to reduce greenhouse gas emissions in order to limit the rise in global temperature [1]. Achieving this goal by 2050 requires major changes in the sectors that produce the highest emissions, especially electricity generation and transportation, which are responsible for about 34 % and 23 % of global emissions, respectively [2].

In France, electricity production generates relatively low carbon emissions and represents only 18 % of national CO_2 emissions, while the transport sector is the largest source, accounting for 30 % [3]. This highlights the urgent need for cleaner transportation solutions.

In this context, electric vehicles (EVs) are considered an important option for reducing emissions from transport. However, their environmental impact depends not only on how the vehicles are manufactured, but also on the electricity used to charge them [4]. According to [5], EVs usually produce lower lifecycle CO_2 emissions than conventional gasoline vehicles, even in regions where electricity generation is still carbon-intensive. Their environmental benefits become even greater as cleaner energy sources are added to the electricity mix.

The continued expansion of the EV market will inevitably increase electricity demand and, consequently, emissions associated with power production if conventional energy sources continue to dominate [6]. For this reason, supplying charging stations with renewable electricity has become essential. Integrating photovoltaic (PV) panels into charging infrastructure offers a practical way to decrease dependence on the traditional power grid while providing cleaner energy for EV charging [7].

However, solar energy production changes depending on weather conditions and time of day, so PV panels alone cannot always provide a reliable power supply for charging vehicles. A better solution is to use microgrid-based charging systems that combine renewable energy sources, battery storage systems, and a connection to the main electricity grid [8]. These systems can also include user interfaces that allow information sharing and help manage energy use in real time, improving both system operation and the user experience [9].

As a result, intelligent infrastructures for recharging EVs (IIREVs) can support the energy transition, especially in urban areas such as office buildings and shopping centers, where vehicles are usually parked for several hours and can benefit from locally produced solar electricity. At the same time, the integration of photovoltaic-powered charging stations (PVCS) represents more than a technical innovation; it is also something that can influence society and everyday mobility habits. For this reason, recent studies on PVCS focus not only on technical performance, but also on social, environmental, and behavioral aspects related to the use of electric vehicles and solar charging systems.

2. Materials and methods

The authors of [10] highlight that societal conditions and human factors must be taken into account when designing systems based on PV technology. In this regard, the social acceptance of PVCS is essential for their large-scale adoption and effective implementation.

Understanding how people perceive, feel about, and behave toward using solar energy for EV charging is important for policymakers, industry stakeholders, and urban planners [11]. This acceptance plays a key role in how quickly these technologies are adopted. In the case of EVs powered by PV, acceptance depends not only on environmental benefits, but also on factors such as cost, convenience, reliability, and visual impact [12]. High social acceptance can speed up the shift toward sustainable energy systems, while resistance may slow progress even when the technology is advanced.

Studies on the social impact of EVs have recently received increasing attention because of their scientific and political importance. This topic covers several related concepts, including *social impact*, *social acceptance*, *social acceptability*, *social cost*, and *user experience*.

"Social acceptance" generally refers to the level of public support for a technology. It is usually measured through surveys that assess people's willingness to adopt or use the technology.

In contrast, "social acceptability" refers to how a technology is judged according to social norms, values, and beliefs. It considers whether a project is seen as appropriate and compatible with people's daily lives and with the values of society. This aspect is often explored through interviews, discussions, or social observations [13,14].

In this study, social acceptability and social acceptance are examined in two complementary stages. Social acceptability is explored first through the qualitative survey (Section 4), using open-ended questions that allow participants to freely express their opinions, concerns, and expectations. The results of this survey were then used to develop the closed-ended questions for the quantitative survey (Section 5). This second stage measures social acceptance by assessing respondents' willingness to use and support the proposed technology. In this way, social acceptability explores people's perceptions, while social acceptance measures their level of support.

While numerous studies address general EVs and drivers' attitudes, relatively few have concentrated on IIREVs. Most existing research primarily examines EVs in general, exploring factors such as drivers' attitudes, charging infrastructure, and adoption barriers. A comprehensive benefits analysis [15] demonstrated that integrating EV charging with PVCS can significantly lower charging costs and deliver exceptional economic performance. Beyond economic gains, societal benefits—such as energy savings and environmental advantages—are particularly notable, with impacts that extend far beyond the immediate financial benefits of the charging station itself.

A study [16] identified several important barriers to EV adoption, especially the high cost of batteries and the limited availability of charging infrastructure. Similarly, a recent global review on EV adoption [17] showed that the main barriers to public acceptance are the lack of charging stations and the limited driving range of EVs.

In addition, Ashby et al [18] analyzed nearly 100,000 Twitter posts published between 2018 and 2022 about EV charging. The study found that, although many users were optimistic about improvements in charging technology and infrastructure, problems such as broken chargers, occupied stations, poor performance in cold weather, and reduced financial incentives still discourage people from adopting EVs.

Another recent data-driven study [19] also identified range anxiety, limited charging infrastructure, and vehicle cost as major obstacles to EV adoption. These results are supported by a Volvo consumer survey conducted in the United States [20], which found that 61 % of respondents would consider switching to EVs if charging stations were more available, while 48 % said they would be willing to pay more for faster charging times.

Overall, these studies show that charging convenience and accessibility play a key role in encouraging EV adoption.

All the aforementioned studies address the social impact and acceptance of integrating PV systems, EVs, and the charging network. Their primary focus is to identify and assess barriers limiting the widespread adoption of electromobility. However, several gaps in the existing literature on the social acceptance of PVCS become evident:

- A lack of surveys on this topic.

- An absence of studies that simultaneously target social acceptance and social acceptability.
- Insufficient research on the discharge of EVs to supply the grid.

This paper seeks to show the social acceptability and acceptance of PV energy for recharging EVs, IIREVs, and related services in urban areas, drawing insights from a study conducted within the same community in 2018 [21]. To facilitate and direct both the qualitative and quantitative surveys, a preliminary investigation into the societal impact of PV energy for recharging EVs was conducted at the beginning [22]. To sum up, the social acceptability and acceptance study will target three main focuses:

- What key objectives must be attained before implementing PV panels for recharging EVs?
- How will urban residents respond to the introduction of these IIREVs based on PV panels?
- What responses can be expected from stakeholders, and how will users adapt their habits to primarily utilize PV energy for recharging EVs?

The upcoming parts of this paper are organized as follows: Section 3 provides a description of the IIREVs powered by PV sources, followed by Sections 4 and 5, which address their societal acceptability and social acceptance, respectively. Section 6 discusses the project's limitations and improvement plans derived from the survey results. Finally, the last section presents conclusions and perspectives.

3. Intelligent EV charging infrastructures powered by PV panels

Figure 1 presents an IIREV, designed as a small-scale microgrid composed primarily of PV panels, stationary battery storage, and a connection to the utility grid. The system is managed by a smart energy management platform that coordinates power flows between the PV installation, the storage units, the public grid, the EVs, and nearby buildings, thereby ensuring efficient and reliable energy distribution [9].

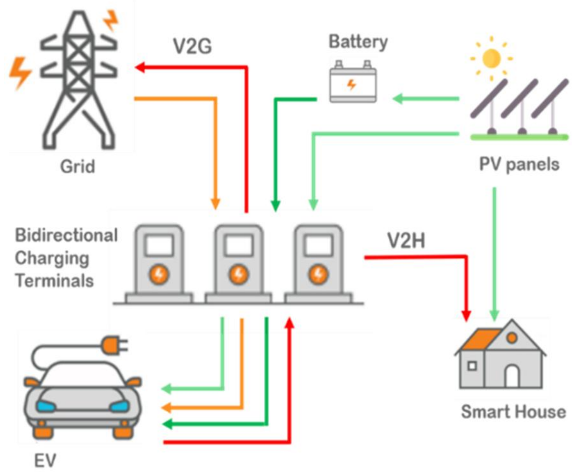

Figure 1. IIREV based on PV panels and its interactions.

When PV generation exceeds the charging demand of connected EVs, the surplus electricity can either be stored in the stationary batteries or exported to the utility grid.

Beyond supplying renewable electricity for vehicle charging, IIREVs can therefore also provide additional value by injecting PV energy into the grid and supporting it during periods of high electricity demand.

Consequently, IIREVs enable flexible charging strategies that adapt both to grid conditions and to users' mobility needs. This so-called "smart charging" approach gives priority to locally generated PV energy and determines the charging profile according to the state of charge of the stationary batteries, grid conditions, and even weather forecasts in order to optimize system operation and reduce charging costs [9].

Moreover, considering the EV battery as a flexible load, the energy management system can shift charging periods to maximize the share of PV electricity used while avoiding electricity consumption from the grid during peak hours. Conversely, the EV battery can also operate as a temporary energy storage unit. Within predefined operational limits and while considering user requirements, part of the battery capacity can be utilized to support the electrical grid through vehicle-to-grid (V2G) services or to supply power to residential and commercial buildings through vehicle-to-home/building (V2H/V2B) applications [23].

V2G functionality could help stabilize the electricity network by contributing to frequency regulation, peak shaving, and voltage support [24]. At the building scale, V2H services may reduce local demand peaks and provide backup power during outages. Although many studies highlight these potential benefits, large-scale deployment of V2G remains limited, and only a small number of pilot projects have tested these strategies under real operating conditions.

The main challenge today lies in the installation and deployment of PV-powered EV charging infrastructures, where technical, economic, environmental, and social factors must all be considered simultaneously. Preliminary studies are therefore essential before implementation. Such studies generally rely on pre-dimensioning tools capable of evaluating solar irradiation, geographical location, power constraints, economic viability, and environmental indicators such as carbon emissions and energy savings [25]. Nevertheless, important questions remain regarding the willingness of users to adopt these services and the barriers that may hinder their broader development.

4. Social acceptability of recharging EVs with PV-powered charging stations

The first phase of this study focuses on the social acceptability of emerging technologies. It is based on two complementary elements: an assessment of the societal impact and a qualitative survey. These initial steps provide the foundation for the second phase of the research, which investigates social acceptance through a quantitative survey. The analysis of the societal impact of charging EVs using PV panels includes identifying the main issues, examining the surrounding context, determining the stakeholders involved, and highlighting the potential limitations of this technology. At the same time, the qualitative survey, carried out with a small group of participants, aims to explore their perceptions, concerns, and expectations.

4.1. Societal impact of recharging EVs with PVCS

The aim of this analysis is to identify how stakeholders perceive the proposed innovation and to determine their expectations and requirements. The IIREVs project combines two complementary innovations: the use of PV energy for EV charging and the integration of V2G / V2H services supplied mainly by PV electricity. As a result, the project creates direct and indirect interactions among a wide range of stakeholders involved in these technologies. These include equipment suppliers, manufacturers, installers, and construction companies, as well as electricity producers and grid operators. Public authorities and agencies responsible for the energy transition and infrastructure maintenance are also concerned. In addition, the project involves end-users, including current and future EV drivers, building owners, and companies operating PV-powered charging stations.

The societal impact analysis highlighted several expectations and challenges related to the deployment of PV panels for EV charging. At the socio-economic level, the relatively high purchase cost of EVs remains a major barrier to adoption. Although EVs are initially more expensive than conventional vehicles, charging them with electricity generated locally by PV panels is generally less costly than relying on imported fossil fuels.

Political and regulatory factors also play an important role in encouraging the transition toward cleaner mobility. Many governments are introducing stricter measures against polluting vehicles while simultaneously offering subsidies and other financial incentives to encourage EV adoption.

From a technological perspective, ongoing research seeks to address the main limitations of these systems, particularly the efficiency of PV panels and the lifespan of EV batteries. These developments are expected to improve the accessibility, performance, and long-term sustainability of EV charging infrastructures.

Finally, environmental considerations strongly support the use of EVs and PV-powered charging systems. Their lower environmental footprint compared with conventional transport solutions encourages both the diffusion of EVs and the wider integration of solar energy. Taken together, these economic, political, technical, and environmental dimensions underline the interdisciplinary character of the transition toward more sustainable transportation systems.

4.2. Qualitative survey

The qualitative interview is devised to gather individuals' thoughts and opinions on the use of PV panels for recharging EVs. It is presented as an open-ended questionnaire, allowing participants to freely express their views, concerns, and expectations without being limited by predefined answers. The main purpose of this stage is to identify new ideas and generate hypotheses rather than test them. The themes identified during the interviews are then used to develop the closed-ended questions for the quantitative survey, allowing these issues to be measured across a larger sample. The ultimate objective is to understand how people perceive the use of PV panels for recharging EVs and associated services such as V2G, in order to better predict future user behavior and identify potential barriers at an early stage.

The interviews were carried out by students from the Urban Department of the Université de Technologie de Compiègne, France. The questions were divided into three sections: a general introduction to the project, a segment focused on PV energy and the associated V2G and V2H systems, and a final section containing specific inquiries tailored for professionals and institutions. A total of 55 stakeholders participated in the interviews, including three institutions, seven private companies, and 45 users.

Interviewees were recruited through the personal and professional networks of the research team and participating institutions, using a purposive sampling approach designed to capture a range of stakeholder types (institutions, private companies, and individual users) rather than statistical representativeness of the general population. Each interview was recorded or transcribed live, then coded by the interview team using a three-category scheme — appealing/positive, neutral, or unfeasible/negative — based on the participant's overall response to the closing project-evaluation question. This coding provides the basis for the percentages reported in **Figure 2**.

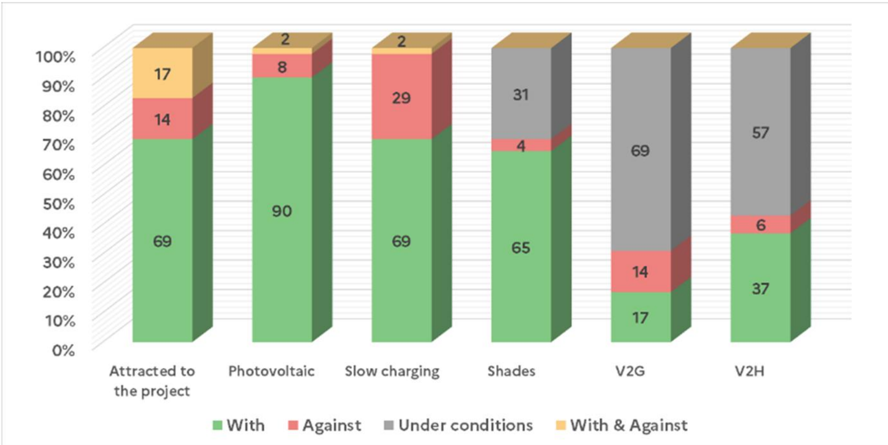

Figure 2. Qualitative interview feedback trend graph.

The individuals interviewed demonstrated a clear understanding of the project. As depicted in **Figure 2**, 69 % of the sampled participants found the project appealing after its presentation. Participants who showed a positive attitude toward the project mainly highlighted its environmental benefits and the use of locally produced energy. For example, some described it as "an advantage to consume local energy" and stated that it would "help reduce our carbon footprint and address pollution issues." The possibility of sharing surplus energy with other users was also seen as a positive aspect of the project, with one participant describing it as an act of solidarity. In contrast, participants with a neutral or negative attitude mainly expressed concerns about the compatibility of the project with current charging habits, particularly the use of slow charging. For example, one participant stated that "a recharge done in several stages is not compatible with how people live today." Other participants expressed doubts about the performance of PV energy, asking whether solar energy "is like wind power—does it not really generate anything?" Some participants also raised concerns about the availability of charging stations, for example, stating that "city-center charging points are pointless; nobody has time to hunt for one."

Notably, their primary attraction lies in the ecological aspect, particularly when discussing the utilization of PV energy and the sharing and optimization of electricity. Despite the positive opinions, others found this utopian project financially and socially unfeasible due to the changes in habits that are too significant and premature at this stage of electromobility development. This qualitative survey successfully illuminated the needs and expectations of future users of PVCS, setting the stage for the subsequent quantitative survey.

5. Quantitative survey

The quantitative survey seeks to gather feedback on PVCS and their associated services, building on the results of the qualitative survey. It explores topics such as travel habits, electromobility challenges, environmental impact, expectations for IIREVs, charging locations, EV ownership, V2G discharge, PV energy charging, and urban parking shades. Its main purpose is to test the hypotheses identified during the qualitative phase.

A questionnaire consisting of 33 closed-ended questions with predefined answer options was developed. It covered personal information, travel habits, IIREVs, PV energy use, and the main attractions and barriers identified during the qualitative survey.

To reach a wide range of participants, the questionnaire was shared through the research team's personal network, the UTC Facebook group, the City of Compiègne Facebook group, and QR codes placed in public areas. Participation was voluntary, and respondents were recruited using a non-probability convenience and snowball sampling approach. Therefore, the sample was not intended to be statistically representative of the general population, as reflected in the age distribution discussed in Section 5.1. This approach was considered appropriate for this exploratory study, whose main objective was to test the hypotheses generated during the qualitative phase rather than to produce population-level estimates.

A total of 864 responses were collected over 30 days. The data were analyzed using descriptive statistics (frequencies and percentages). When relevant, the results were also presented according to demographic characteristics such as age, place of residence, and vehicle ownership. No inferential statistical tests were performed because of the non-probability sampling design. This limitation is discussed in Section 6.

5.1. Profiles of the respondents

Figure 3 displays representation across all age groups. However, the proportion of 15–25 years olds differs from France's actual age distribution. This overrepresentation stems from the survey's social network distribution, which is unsuitable for those over 60 due to the online format. Notably, although present, this overrepresentation is not significant, given that young people will be directly impacted by this innovation in the future.

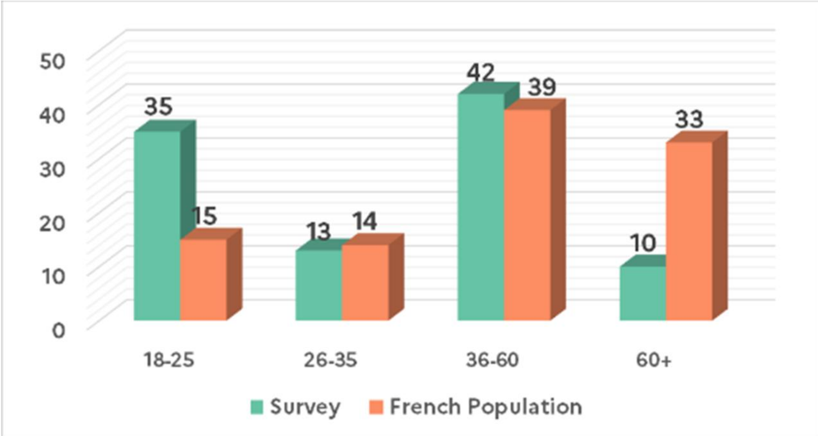

Figure 3. Age distribution of the respondents.

An examination of the respondents' socio-professional distribution in **Figure 4** shows a noticeable prevalence of students and staff, likely influenced by the project network. This trend may also be justified by the notion that vehicle purchases often hinge on individual social status constraints.

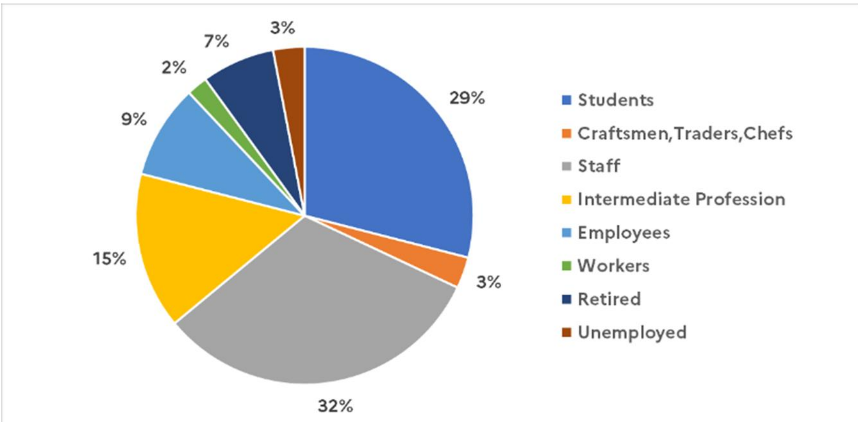

Figure 4. Socio-professional distribution of the respondents.

Furthermore, as depicted in **Figure 5**, 57.9 % of respondents prefer combustion or hybrid vehicles for practical daily transportation. Examining respondents' residences reveals a predominant presence in rural areas and small cities, emphasizing the preferred vehicle choice for these settings. There is a noteworthy surge in public transport use, reaching 30.4 %. Notably, 75 % of this group resides in medium-sized or large cities, where navigating car traffic is intricate. Additionally, the percentage of individuals cycling to work has doubled since 2019, now standing at 16.2 %. This shift may be attributed to the impact of the COVID-19 pandemic, highlighting the adaptability of the French population in changing their mobility habits.

Figure 6 illustrates responses to the final question in this section, addressing the primary barriers hindering individuals from acquiring an EV. The outcomes emphasize concerns about EV range, cost relative to traditional vehicles, and the lack of charging infrastructure. Users remain cautious about undertaking lengthy EV journeys without extended stops for battery recharging, contributing to ongoing reservations in adopting EVs. Notably, environmental considerations, at 31.5 %, signal an increased awareness among respondents about ecological aspects. This shift reflects a growing consciousness of environmental concerns and suggests a maturing perspective on EV adoption.

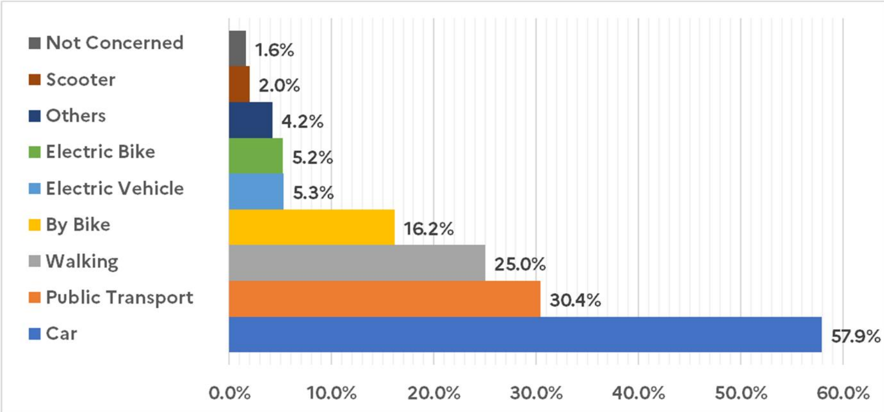

Figure 5. Daily mean of travel.

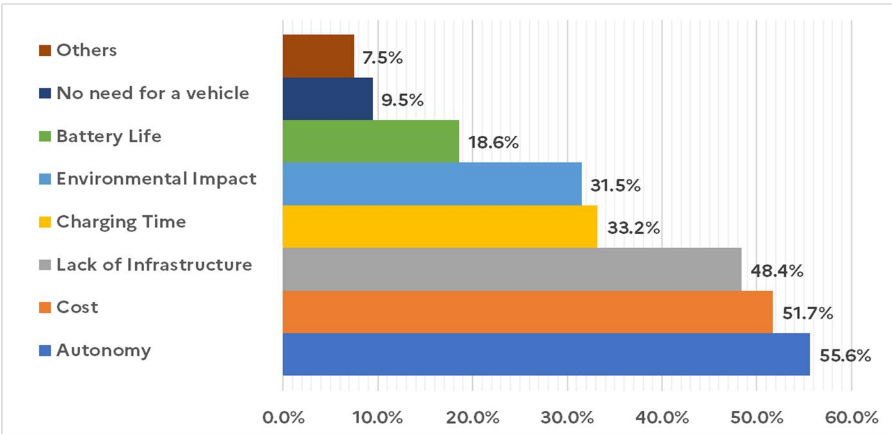

Figure 6. Main obstacles to the acquisition of an EV.

5.2. Generalities on IIREVs: Discharge / charge

This segment of the quantitative analysis explores the public's perceptions of IIREVs and associated discharge services, like V2G and V2H. The study focuses on the conditions that would foster acceptance of regular vehicle discharging and recharging, alongside the benefits users expect after discharge.

Respondents were asked to select the charging-terminal features they considered most important. The most frequently selected attributes were location, availability, and charging mode, with each chosen by approximately 59 % of respondents. This indicates that no single feature clearly dominates user preferences, as these three characteristics are valued to a similar extent. User demographics also influence priorities, with older individuals placing greater importance on ease of use, while younger respondents prioritize fast charging.

Figure 7 highlights respondents' preferred locations for charging terminals, prominently featuring the workplace. Given that EVs typically remain parked throughout the day, aligning IIREVs with slow charging optimizes the utilization of PV energy. The residence ranks second in preference, followed by highway stops. Nevertheless, there is a noteworthy concern expressed by some users regarding the installation of IIREVs in city centers to encourage the use of public transportation, cycling, or walking.

The discharge approval question was asked twice: first at the beginning of the V2G/V2H module, before any information about compensation or user-control options was provided, and again at the end of the module, after several questions about possible compensation schemes (bill deduction, free parking, financial payment) and the proposed information interface had been answered. Initially, 78 % of respondents gave a positive or conditional response, with 62 % selecting the conditional option ("yes, under certain conditions"). After the compensation and control mechanisms had been presented, 83 % of respondents answered "yes," while 17 % remained negative. This increase suggests that acceptance of V2G/V2H discharge is not fixed and can be improved by clearly communicating available compensation and providing users with a greater sense of control over the process. This point is discussed further in the Conclusion.

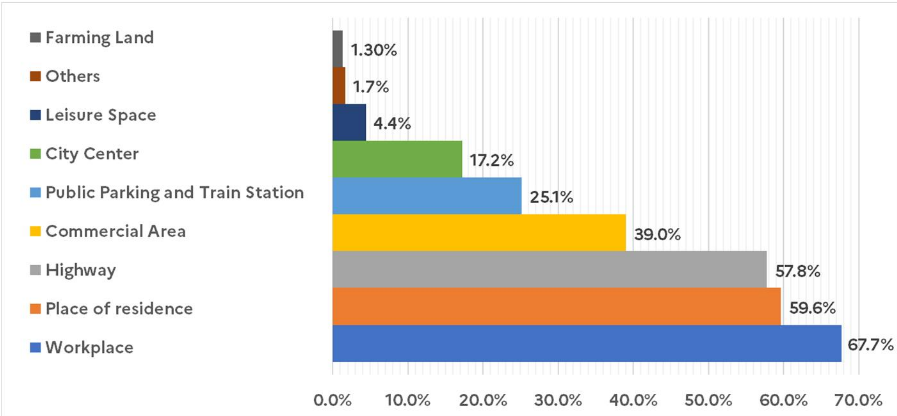

Figure 7. Location preference of the IIREVs based on PV panels.

Half of V2G/V2H-accepting drivers are willing to discharge without added cost, while only 31 % seek financial benefits. The primary motivation is not necessarily financial gain. Only 4 % unequivocally accept discharge without conditions, indicating a general preference for favorable terms or benefits associated with the process.

In fact, the survey inquired about desired compensation for energy contributions to V2G/V2H services. Thus, 60 % favored deduction on the electricity bill, aligning logically with discharged EV battery electricity. Free parking ranked second (52 %), as citizens are drawn to services that are becoming increasingly rare and expensive in cities. Financial compensation (39 %) and tax deduction (33 %) followed. Additionally, 65 % expressed interest in knowing the destination of battery energy, suggesting this information could motivate EV users to share electricity. In conclusion, respondents display overall tolerance to V2G/V2H, contingent on having sufficient energy and being informed via an interface, underscoring the importance of obtaining user consent in advance.

5.3. Integration of PV panels and shade structures

The final section of the questionnaire focuses on PV panels integrated into a shade structure. Three-quarters of respondents believe that their involvement in the project is influenced by the use of renewable energy. During the qualitative interviews, many participants expressed doubts about the capacity and reliability of PV energy, citing issues related to interruptions and inconsistent generation. These concerns are particularly relevant for users who charge their vehicles at night and, consequently, show limited interest in PV energy. As shown in **Figure 8**, efficiency and recycling issues constitute the main perceived obstacles to the use of PV panels.

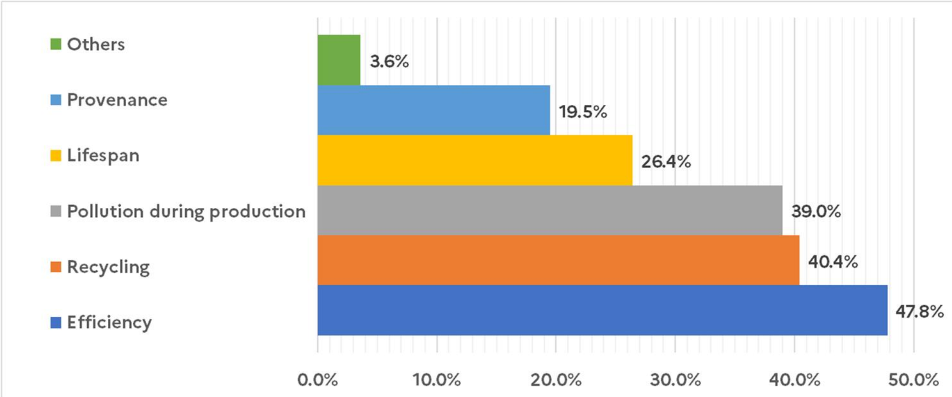

Figure 8. Main obstacles to the use of PV panels.

The results of the quantitative survey confirm our hypotheses, with efficiency emerging as the primary concern (47.8 %). Recycling of PV panels is perceived as a significant barrier (ranked second, at 40.4 %), as misinformation affects public perception, leading to concerns about recycling feasibility. Pollution during PV production ranks third (39 %). Finally, the lifespan and origin of the panels are also factors, with 26.4 % and 19.5 % of respondents, respectively, citing these as considerations.

Regarding car parking shade structures with PV sources, 95 % do not view them as an obstacle to project adherence. A minority cites aesthetic concerns, but 81 % of them would still support PV panels integrated into a shade infrastructure if asked in advance. Respondents were asked about potential bothersome locations for shade installations, with half having no concerns. For the other half, tourist areas, agricultural zones, city centers, and residential areas are seen as disruptive, while cinemas, stadiums, highway gas stations, supermarkets, shopping malls, and workplaces pose no issues for the installation of PV panels integrated into a shade infrastructure.

In the end, the quantitative survey results reveal strong social acceptance of the PVCS. Seventy-eight percent favor V2G/V2H discharge, while 95 % accept EV recharge through PV energy. Similarly, 95 % support shading structures with PV panels. EV users' express interest in discharge during parking, with 75 % willing to recharge during low consumption periods for financial compensation. Those interested in V2G/V2H services prefer no additional costs, and some view it as an opportunity for financial gains. About 75 % believe public authorities should own and manage PVCS for recharging/discharging EVs. Respondents emphasize the need for a user-friendly graphical interface, prioritizing information on vehicle autonomy and battery state, with additional details being less crucial as long as the interface remains simple.

5.4. Targeted study

Of the 864 respondents, only 46 individuals (approximately 5 %) were full EV drivers. These participants were asked to complete an additional section of the survey, where they provided insights into their driving habits and offered perspectives on the project's limitations from their unique standpoint.

EV drivers identified the limited availability of charging stations and extended charging times as significant barriers to driving an EV. Notably, the latter concern aligns with the project's objective of optimizing slower charging periods to maximize the utilization of PV energy. Respondents indicated that the installation of shade structures at their workplaces could effectively address this issue. Thus, the long parking times offer a chance to use smart charging solutions, which can improve the use of PV energy during recharging. Their insights about the project's barriers are similar to those of all the respondents and will be discussed further in the next section.

6. Project limits

This last section is dedicated to comprehending the subject and acknowledging its constraints. As depicted in **Figure 9**, only 9.73 % still maintain the belief that there are no limitations to the development of PV panels integrated into a shade infrastructure for recharging/discharging EVs in France. In contrast, 35.62 % express concerns about the high investments and costs associated with the development, installation, and maintenance of these facilities, considering them as the most significant limits of the project. The cost of purchasing an EV remains higher than that of a traditional internal combustion vehicle. Additionally, owning an EV often incurs extra expenses, such as installing charging stations or PV systems for home charging. Moreover, the installation costs of charging infrastructure remain high, as most of the product are imported. Although government incentives are available, they are not enough to greatly reduce the upfront cost of owning an EV. The public has difficulty imagining the benefits of these structures, mainly because their implementation would require significant changes in habits.

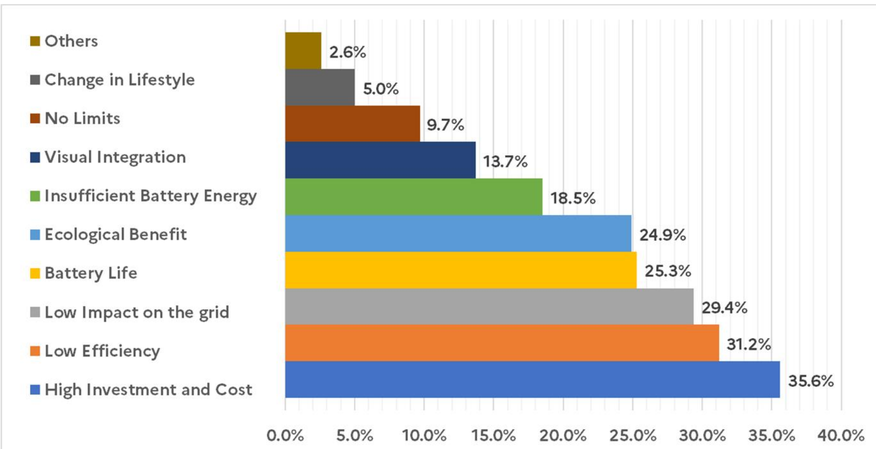

Figure 9. Project limits.

Although PV energy is considered a "noble" solution for sustainable electricity production, its intermittent power generation remains a concern, impacting the project's overall progress. This variability in efficiency poses challenges that must be addressed to ensure reliable energy availability (31 %). Additionally, the indirect ecological impact remains a limitation, particularly due to the environmental impact during the manufacturing process of EVs, batteries and PV (25 %).

Concerns about battery lifespan and the risk of insufficient remaining energy in the EV battery post-discharge are recognized as limitations of the project. These issues should be further examined in future studies, which should aim to develop charging strategies that maximize PV utilization while fully addressing user needs and expectations.

At the end, a general question about the project's complexity enables the evaluation of whether the participants correctly understood the topic. The more they understand, the more valuable their answers are for the study. Overall, 80 % of respondents answered "yes," which indicates greater confidence in survey results.

Concerning potential improvements to the project, participants suggest addressing weaknesses to enhance social acceptance. This includes establishing a business model between operators and users that adapts the charging pricing and benefits from V2G services and implementing a communication plan to promote electromobility based on PV sources and inform individuals about new technologies. Additionally, some propose the need for an appropriate interface to simplify operations and control EV batteries. These suggestions appear intriguing and could be the focal point of new research.

7. Conclusion

This paper directly engaged the population to understand their tendencies, aiming to formulate specific hypotheses regarding the current acceptance of electromobility, the integration of PV panels for recharging EVs, and associated services. The findings revealed that 80 % of the population supports the utilization of PV energy, emphasizing its environmental impact. Concerning V2G/V2H services, individuals express a willingness to share their energy under specific conditions and in exchange for financial compensation. Notably, a higher level of acceptability for PVCS is observed when the general public is questioned before the installation of these infrastructures. The researchers' efforts and the analysis of this survey will set up new studies to test the relevance and feasibility of these emerging trends.

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