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Designing Future Transportation Enabling Moto Touring Activities with Electric Vehicles: Results from Questionnaire and Field Testing

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Abstract

Motorcycle touring represents a significant leisure and social activity across Europe, involving a vast number of individual and group participants. The transition to electric mobility, which is currently affecting passenger cars, is going to involve motorcycles in the next few years. This study aims to assess the feasibility of touring with electric-powered motorcycles and understand European motorcyclists' attitudes toward electric motorcycles. The study involved test rides with commercially available ePTWs in typical touring conditions, followed by an online survey distributed in different languages to motorcycle clubs and social media. Field evaluations yielded empirical insights into the performance of electric motorcycle technologies, while the survey provided detailed data on riding habits, usage patterns, and user concerns regarding future adoption. These findings serve as a strategic resource for stakeholders to advance vehicle and infrastructure development, ultimately supporting a sustainable evolution of the motorcycle sector.

Keywords: Powered-Two-Wheelers; moto touring; electric vehicles; attitude towards electric motorcycling; survey; field testing

1. Introduction

The electrification of transportation has gained increasing attention in recent years as we all seek sustainable alternatives to conventional vehicles powered by internal combustion engines. Together with the development of alternatives for the other modes of transport, in the last decade, Powered-Two-Wheelers (PTWs—which include mopeds, scooters, and motorcycles) were also the object of research and technological development towards low-emission solutions. In the last few years, electric mopeds, with their efficient electric drivetrains, reduced CO_2 and noise emissions, and potential cost savings, emerged as an effective solution for urban mobility [1]. Also, electric mopeds and motorcycles have earned interest from both consumers and manufacturers thanks to the reduced noise and significant engine performance.

The diffusion of electric PTWs (ePTWs) among users is restrained by several factors [2], mainly the cost of the vehicles and the well-known "range anxiety", common to all battery vehicles [3]. Specifically, economic factors and perceived ease of use have been identified as key issues related to consumer adoption of electric PTWs [1], which were identified as a promising solution for users' mobility, especially if employed in sharing schemes and promoted by local, regional, and national government policies [1].

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Regarding the manufacturers and technological challenges of the development of ePTW, the key factor is related to the balance between the weight of the battery pack and the range. Like every battery-operated electric vehicle, electric PTWs need to refill their energy supply periodically. Nowadays, three different technologies are available: conductive charging (AC or DC), inductive charging (stationary or dynamic), or battery swaps. However, for ePTWs, mainly conductive charging and battery swap are becoming popular: conductive charging is the derivative technology from electric cars, while battery swapping [4], thanks to the reduced size and weight of ePTWs' batteries, is a cost-effective solution for energy supply. Current technologies for battery electric PTWs reach values of 150–200 Wh/kg. These characteristics already enable a nominal range of 150–200 km, considering on average 80 kg of batteries per PTW and the average energy consumption of ePTWs. In the near future, energy density and specific energy will grow substantially [5], allowing lighter battery packs and longer ranges. Based on interviews with OEMs, improved energy density of batteries will be initially used to achieve lighter vehicles and dynamic behaviour similar to current internal combustion engine PTWs, and only afterwards to extend vehicles' range.

Despite some technological and social issues related to ePTWs still needing to be addressed by policymakers and manufacturers, the trend of registrations of ePTWs in Europe is rapidly increasing [6]. Even if the numbers (both in absolute and proportion of EVs) are much lower compared to cars, indicating a substantial delay between the diffusion of electric powertrains between cars and motorcycles, the increasing diffusion of ePTWs is remarkable, especially for mopeds, which already reached a high proportion among new registered PTWs [7]. In this scenario of increasing diffusion of ePTWs without ranges comparable to conventional PTWs, it is essential to plan a smooth transition to safeguard the possibility of using PTWs for activities that have a relevant social and economic impact.

This is the case of motorcycle touring activities, which have emerged as a distinctive form of tourism, impacting both the economic dynamics of host communities and the sociality of users [8]. From a social perspective, motorcycle touring fosters positive interactions between people: tourists often engage with local communities, promoting cultural exchanges and responsible tourism, while motorcycle touring has given rise to the formation of motorcycle clubs and enthusiast groups, creating spaces for shared interests, solidarity, and knowledge exchange. On the economic front, motorcycle touring has the potential to stimulate local economies and contribute to local businesses (accommodations, restaurants, and fuel stations). The economic impact extends to the employment sector, generating job opportunities in tourism-related industries and allowing destinations to gain recognition, so that communities can use this form of tourism to diversify their economies and improve infrastructure [9].

In this fast-changing transportation system moving towards electrification, moto-touring activities might be severely affected in the near future due to the limited range of vehicles and the lack of charging infrastructures. This paper aims to assess the technical feasibility of moto-touring with ePTWs and understand the attitude of European motorcyclists towards alternative-fuelled motorcycles, in order support the design of a new transportation system allowing moto-touring activities.

2. Materials and Methods

This study combined two different methodologies—field testing and surveys—with the goal of assessing, respectively, the technical feasibility of moto-touring with ePTWs and the attitude of European motorcyclists towards alternative-fuelled motorcycles (Figure 1). In this section, both methodologies are presented.

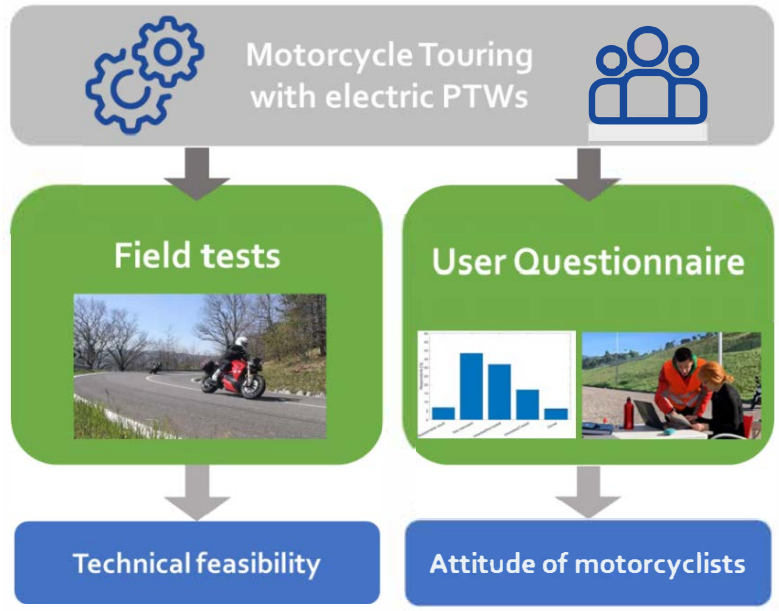


Figure 1. Methodological approach employed for this study.

2.1. Field Test Methods

The test was designed as a one-day ride intended to reproduce a route performed in a typical touring event, as those organized by FIM (Fédération Internationale de Motocyclisme). The activity aimed to collect real data regarding the energy consumption of current ePTWs technologies, which might be different from those declared by manufacturers in standard riding cycles. Data regarding vehicle position, speed, vehicle dynamics parameters, and energy consumption were recorded for both vehicles for the entire duration of the ride. To capture these metrics, a RaceTechnology DL1 Club data logger (100 Hz sampling rate with 20 Hz GNSS positioning) was employed on the Zero Motorcycle, while the Energica motorcycle was equipped with a CSS2 IMU data logger (20 Hz). These devices provided continuous recording of positioning and dynamics via integrated accelerometers and gyroscopes. In the absence of CAN-bus decodification, energy consumption and vehicle usage data were recorded manually from the onboard computers during each rider-change stop. Data synchronization between the two platforms was maintained via GNSS timestamps, and a 10 Hz Butterworth low-pass filter was applied to the acceleration data during MATLAB (R2021b) analysis to ensure signal clarity. In the second part of the study, this information was used to define, based on real data collected from field testing, a proposal for a viable touring event with ePTWs (see Section 4) and to provide the informative video employed in the survey with real data and images of ePTWs touring rides. The route and the ride were organized based on the information provided by the members of the FIM Europe Commission for touring activities, which is mainly responsible for coordinating touring activities and projects in Europe. Also, the route was planned considering vehicles' range and charging stations located in areas suitable for breaks similar to those made in organized touring events. A rotation among three different riders along the route was employed in order to consider different riding styles within the predefined pace of the tour, characterized by an average riding speed of approximately 50 km/h.

The test was performed employing two models from two different manufacturers of electric PTWs among the more widespread ones in Europe, which were contacted through dealers operating in the urban area of Florence, Italy. The first test vehicle employed in the test ride was an Energica Eva Ribelle (Figure 2A–C), a naked motorcycle provided with an electric motor capable of 222 Nm torque and 169 hp peak power, weighing 260 kg including

a lithium polymer battery with a maximum capacity of 21.5 kWh. The second test vehicle was a Zero DSR Black Forest (Figure 2D), a light Dual Sport adventure motorcycle provided with an electric motor capable of 146 Nm torque and 70 hp peak power, weighing 190 kg, including a lithium polymer battery with a maximum capacity of 14.4 kWh (Figure 2). For the sake of avoiding systematic rider weight and riding style influence, which can affect the vehicle range during testing, the riders changed vehicles after the scheduled stops every time.

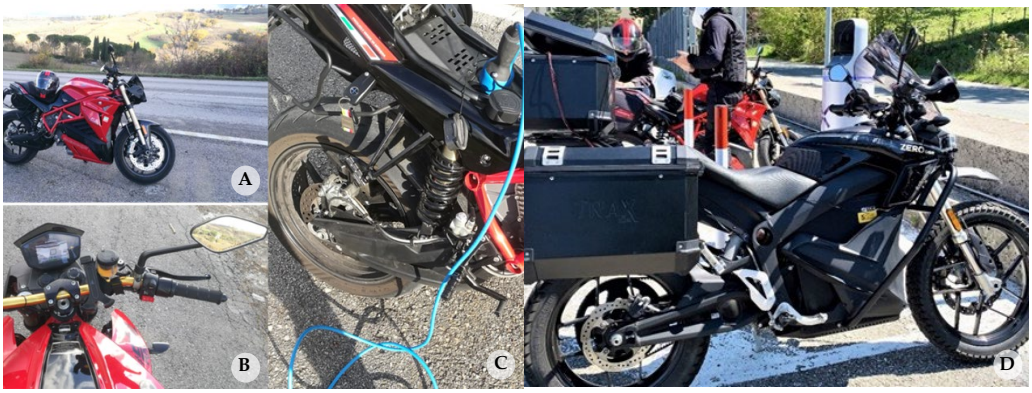


Figure 2. Test vehicles: Energica Eva Ribelle (**A**–**C**) and Zero DSR Black Forest (**D**).

The ride started from nearby Florence and reached Bologna through typical rural roads frequented by motorcyclists due to the curves and panorama. After a stop in the town of Monghidoro and a lunch break in Bologna (both stops were also employed for charging the vehicles), the second part of the ride consisted of the way back to Pistoia. The overall length was 218 km (Table 1 for details). The tour was conducted on 24 April under typical spring meteorological conditions, with ambient temperatures ranging from 9 °C to 22 °C, no precipitation, and wind speeds below 18 km/h throughout. The route consisted exclusively of paved extra-urban roads, characterized by low traffic density, as the test took place on a weekday outside of peak hours. The topographical profile included a cumulative elevation gain of 2870 m and a cumulative descent of 2881 m, providing a representative sample of varied terrain gradients.

Table 1. Summary of riding data for the two test vehicles.

	Energica EVA Ribelle	**Zero DSR "Black Forest"**
Ride length [km]	218	218
Ride duration [h]	4.3	4.3
Average speed [km/h]	50	50
Riding modes used	Urban/Eco/Sport	Sport/Eco
Battery usage including recharge [%]	90	107 *
Total energy consumption [kWh]	19.4	15.4
Average energy consumption [Wh/km]	89.0	70.7
Energy cost [€]	11	8.5
Time for charging during the day [min]	28	30 + 35 *
Time for charging at the end of the day (estimate) [min]	33	50

* Data for the Zero motorcycle reflect the cumulative total of two charging sessions (30 and 35 min, respectively); consequently, the total energy usage reported exceeds 100% of the nominal battery capacity.

2.2. Survey

The second part of the study consisted of an online survey among motorcyclists participating in touring events and gatherings to assess their attitude towards touring activities with ePTWs. The study obtained ethical approval from the Ethics Committee of the University of Florence (Written opinion N. 212, 25 March 2022). The questionnaire was translated and made available for participants in six languages: English, French, German,

Italian, Spanish, and Greek. The questionnaire was mainly distributed by FIM Europe through its informative channels and links with the specialized press in all European countries. The invitation to participate in the survey was also spread through email and social media by the research team (e.g., LinkedIn and Facebook). The overall answers collected by the survey's closure (22 December 2022) were 1251. The overall average time to answer the questionnaire was about 26 min, in line with what was indicated in the Explanatory Statement (25 min).

2.3. Questionnaire Structure and Contents

The questionnaire was divided into different sections, corresponding to different topics. After the explanatory statement and the response to the consent form, participants were required to answer questions divided into five sections: demographic information; information regarding riding habits and usage of PTWs; information regarding owned motorcycles; information regarding participation in touring activities and gatherings with motorcycles; information regarding participants' knowledge of current technologies, performances of ePTWs, and their attitude towards usage of ePTWs for touring activities and gatherings. Operationalization of variables utilized various scale types: nominal scales for categorical data like nationality and gender; ratio scales for age and experience; and 5-point Likert scales to evaluate video clarity, usefulness, and quality. Interest and previous experience were measured via binary (yes/no) scales, while technical perceptions (such as range and charging time) and purchase intent were captured using ordinal bins and 4-point scales. Concerns regarding sound and battery technology were identified through multiple-choice selections from a predefined list of technical and sensory attributes.

At the end of these five sections, participants were required to watch a three-minute-long informative video (in English but with subtitles available in all the other languages of the survey) regarding the experience of touring activities with ePTWs. The video was prepared by the research team, based on the data and media collected during the test ride. Some questions were repeated after participants watched the video; we aimed to achieve a before-and-after analysis of questionnaire data, using the video as an easily viable surrogate of field testing ePTWs for all the participants. The video was intended to summarize the experience of touring activity performed with today's electric motorcycles, highlighting differences and similarities with conventional internal combustion engine PTWs. In the final section, participants were required to answer again some of the questions answered in the previous section before the video and provide a short assessment of the video.

The video is available online at the following link: https://www.youtube.com/watch?v=6JeHYrDU43U, accessed on 20 February 2026.

2.4. Data Selection and Analysis

Before the data analysis, the 1251 answers were filtered to remove 494 incomplete responses not suitable for the analysis, since the attitude of those users would influence only a portion of the answers, and that would also hamper the cross-tabulation of the responses. To ensure data quality, a systematic exclusion process was applied to the 1251 initial responses. Specifically, 117 participants exited the survey immediately after the informed consent without providing any data. A further 115 respondents abandoned the questionnaire after partially completing the demographic and general riding sections, while 232 completed the demographic section but provided no information regarding touring events. Finally, 30 respondents completed the sections on electric motorcycling in touring but exited before the final concluding section. Due to the lack of core data regarding the primary research objectives (touring behaviour and e-motorcycle percep-

tion), these 494 incomplete entries were excluded to maintain a robust and consistent dataset for analysis. A comparative analysis between the final sample and the excluded entries revealed no systematic bias. Geographical distributions remained stable, with minor shifts in country representation (e.g., Italy +2.0%, Sweden −1.4%, England +0.7%, and France −5.3%). Gender distribution was also consistent, with 94% male in the included sample versus 92% in the excluded group. These negligible differences suggest that the exclusion of incomplete responses did not significantly distort the study's demographic profile.

Further responses were also removed from the analysis because they did not meet the inclusion criteria of the study: 52 answers were removed because they came from people outside Europe; 74 responses were removed because they came from people who declared to have never participated in touristic gatherings. In conclusion, 631 responses were included for the full data analysis.

In the "Electric Motorcycles" section of the survey, nine pairs of questions with a specific formulation were included to be analyzed employing the Kano Model [10]. This model allows for understanding how some attributes (in this study, implementable changes or features of future touring activities involving ePTWs) are considered among respondents, and it classifies them into five different categories: (i) Must-be: requirements that the participants expect and are taken for granted. If they are satisfied, participants are just neutral, but when they are missing, they are dissatisfied; (ii) One-dimensional: requirements that result in satisfaction when fulfilled and dissatisfaction when not fulfilled; (iii) Attractive: requirements that provide satisfaction when achieved fully, but do not cause dissatisfaction when not fulfilled because normally they are not expected; (iv) Indifferent: requirements that refer to aspects that are neither good nor bad, and they do not result in either participant satisfaction or dissatisfaction; (v) Reverse: requirements that provide dissatisfaction when present.

3. Results

3.1. Field Test Data

In Table 1, a summary of the riding data for the two test vehicles is reported. For both vehicles, the same route was travelled with a similar touristic pace adopted by three different riders, based on indications obtained by members of the FIM Europe Touring Commission. No passengers and light luggage were boarded on the two vehicles. The different energy consumptions and times required for charging were due to the differences in the vehicle charging technology and onboard charging adapters.

Recharge data was retrieved from official charging station invoices and displays. The Zero Motorcycle underwent two AC charging sessions at a nominal power of 20 kW: the first session (35 min) delivered 3.60 kWh (SOC range 66–93%), while the second (30 min) delivered 3.43 kWh (SOC range 75–99%). The Energica motorcycle performed a single DC fast-charge session at a nominal power of 50 kW, delivering 7.57 kWh in 28 min (SOC range 57–97%). Regarding energy efficiency, average segment consumption ranged between 34 and 78 Wh/km for the Zero and 50–120 Wh/km for the Energica, reflecting the variability of the route profiles.

3.2. Questionnaire Results

The results of the survey analysis are presented in this section, with a focus on the demographics of participants, riding habits, and motorcycles owned, touring activities, and opinions on electric PTWs.

3.2.1. Demographics and Riding Habits of Participants

The survey involved participants from almost all of Europe, even if the majority of them were from Italy (58.8%), Sweden (17.9%), the UK (8.7%), France (3.5%), and the Netherlands (2.1%). Participants were 6% female and 94% male, with levels of education of mainly upper secondary degrees (48%) or university degrees (46%). They were mainly (84%) in the range of 40–70 years of age, with an average of 31 years of riding experience. Further, 88.5% of them were members of motorcyclist associations or clubs.

Participants in the questionnaire, being mainly people interested in touring activities, largely reported the use of PTWs for leisure or travel (69%), while just about 13% of them use PTWs for commuting, and 6% for sport. Coherent with leisure riding motivations, participants reported riding mainly for the passion for motorcycling (90%), riding pleasure (83%), and touring (73%). On average, participants declared owning more than two motorcycles (2.5). About 38% of respondents own and use Touring/Sport touring PTWs, 20% crossovers/adventure, and road standard motorcycles (16%). Less than 10% of participants use cross/enduro, sport, cruiser/custom, or scooter style. The average engine displacement (in cc) is about 900; a vast majority of respondents owned large engine displacement motorcycles (1000–1200 cc), while a minority of participants rode PTWs with smaller engine displacement, generally about 600 cc.

3.2.2. Touring Activities

Respondents indicated a wide variability in participation in touring events, ranging from once every few years (26%) to more than five per year (18%). Participants indicated that they joined organized touring activities mainly for social reasons: meeting new people (60%) and riding with other people and friends (58%). Also, the areas covered with tourist rides play a role in the participation in gatherings (Figure 3). Consistent with motivations, the parameters most valued by respondents were also linked with the touring activities ("Routes and Itineraries" for 75% of respondents, "Organization" for 40%), and social activities ("People" and "Social activities" for, respectively, 53% and 35% of respondents). On average, participants indicated that the ideal daily mileage of riding for touring activities is 316 km (SD 160 km).

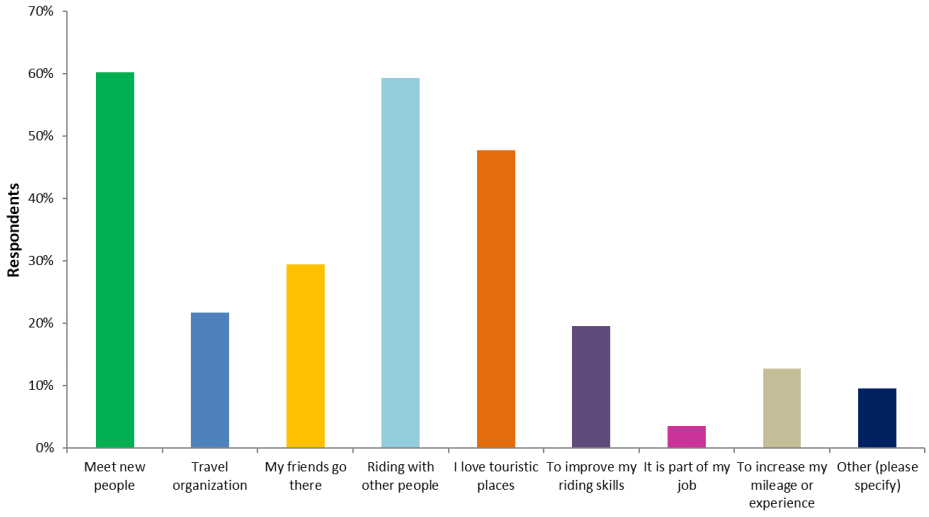


Figure 3. Motivations to participate in organized touring events.

3.2.3. Electric Motorcycles

In order to investigate users' attitudes towards ePTWs, three questions were asked to investigate whether participants were interested in or have already used ePTWs: (i) "Have you ever been interested in electric motorbikes? (e.g., by reading articles in magazines, watching videos, visiting exhibitions. . .)", (ii) "Have you ever tested an electric motorcycle?"; and (iii) "Do you own an electric motorcycle?". Based on the answers to these questions (yes/no), the respondents were divided into 5 groups: 38% of participants declared to be not interested in ePTWs, 32% declared to be interested but never tested ePTWs, 18% declared to be interested and already tested ePTWs, 6% of respondents were owners of ePTWs, and 7% of them provided a questionable answer (questionable results include those who declared to have tested ePTWs but not interested or to be owners and never tested ePTWs). "Short range", "Lack of charging stations" and "Time for charging" were indicated by participants as the main issues that create concerns towards performing touring activities with electric PTWs (Figure 4).

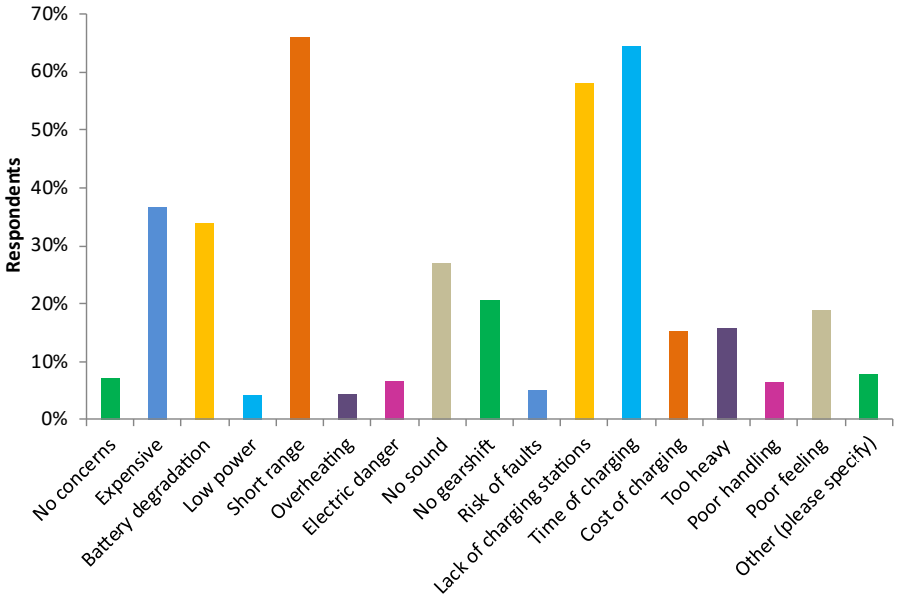


Figure 4. Respondents' concerns about using electric motorcycles for touring activities.

Participants were therefore asked what their estimation of the capacity of current PTWs is in terms of range and charging times. Interestingly, the average values indicated were approximately in line with the performances of current technologies (Figures 5 and 6). A straightforward 'above/below average' approach was used to binarize open responses regarding range and charging time, in order to further analyze users' estimation with interest for ePTWs. A positive association between "interest for ePTWs" and estimation over the average for range (OR: 2.48, 95% CI: 1.35–4.55) and under the average for charging time (OR: 0.55, 95% CI: 0.25–1.20) was also found, even if the latter was not statistically significant, indicating this specific perception did not reach the threshold for empirical significance. This can be interpreted as those more interested in ePTWs generally having a better assessment of ePTW performances (Figures 5 and 6).

Regarding the importance of the "sound" produced by their motorcycles, participants gave a rating of 3.7 on a scale from 1 to 5. An association was found between those who indicated "Interest in ePTWs" and those who indicated "Low importance of Sound" (OR: 3.52, 95% CI: 2.2–5.6), and between those who responded "Have tested ePTWs" and "Low importance of Sound" (OR: 2.53, 95% CI: 1.64–3.91).

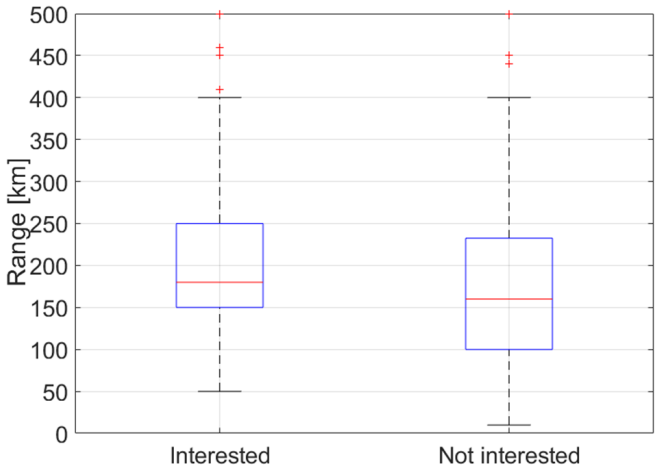


Figure 5. Participants' estimation of the range of current ePTWs: comparison between respondents interested/not interested in ePTWs.

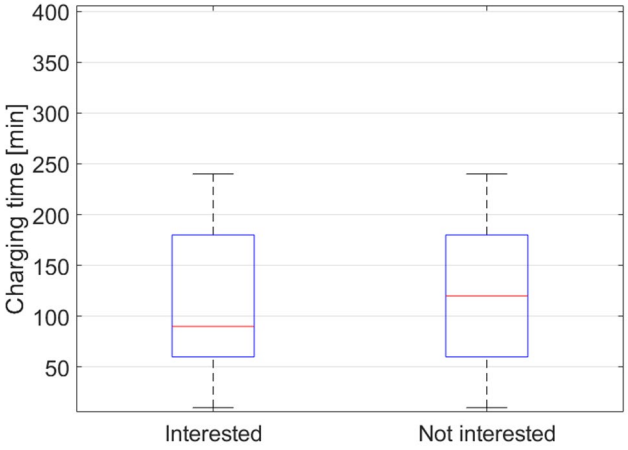


Figure 6. Participants' estimation of the full charging time of current ePTWs: comparison between respondents interested/not interested in ePTWs.

3.2.4. Electric Motorcycles and Touring Activities

The Kano model [10] was employed to analyze answers on nine implementable changes or features to incorporate a share of ePTWs in touring activities. Figure 7 displays the results for eight categories; one category ("30 min charging stop during the day") was excluded from the plot as 48% of respondents provided 'Questionable' results. According to the standard Kano evaluation matrix, a result is categorized as Questionable when response pairs are contradictory (e.g., stating both 'I like it' and 'I dislike it' for the same feature). These results, which likely reflect ambiguous wording or participant misunderstanding, were excluded from the final analysis due to insufficient reliability. The results indicate that generally, participants are not very interested in innovations/variations to touring activities related to ePTWs. Promotions for participation in touring activities with ePTWs and opportunities to rent ePTWs are considered of limited interest by the participants. Also, the possibility of stopping during a one-day tour to charge the batteries or limiting the route length to 150 km is considered an option to be avoided.

The analysis of the responses regarding the timeframe for a possible purchase of an electric PTW indicated that 48% plan to buy one within 10 years (including also those that already own ePTWs), while 10% in 11–20 years. However, 5% indicated they would buy an ePTW in more than 20 years, and 37% would never buy an electric PTW.

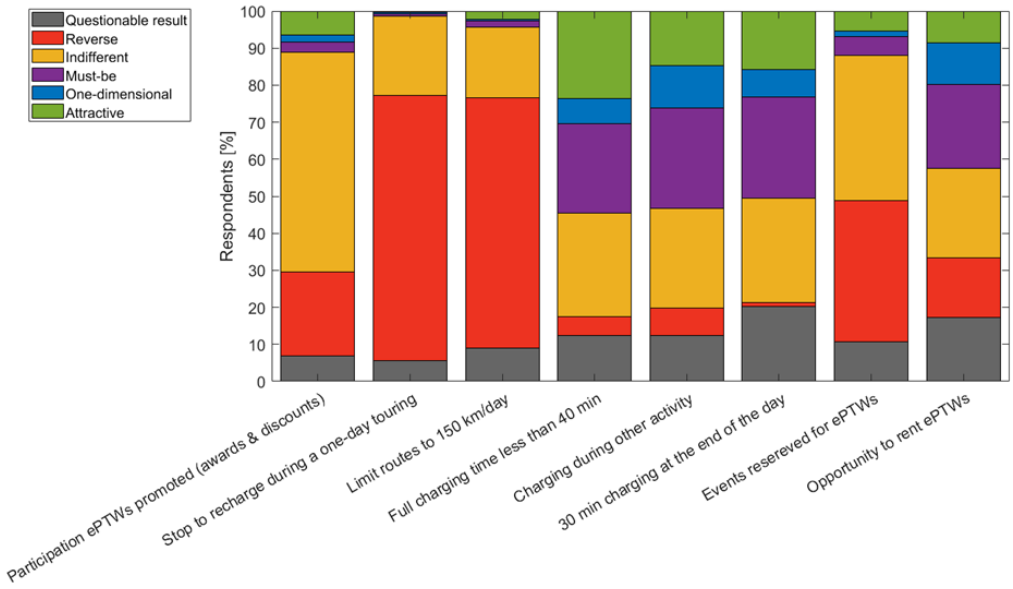


Figure 7. Respondents' attitude towards implementable changes or features of touring activities performed with ePTWs.

The whole sample of respondents was then separated into two groups representing north-central Europe (n = 221 respondents from Austria, Belgium, Czech Republic, Denmark, Finland, Germany, Hungary, Iceland, Ireland, Netherlands, Norway, Poland, Romania, Slovakia, Sweden, and the United Kingdom) and southern Europe (n = 410 respondents from Bulgaria, Cyprus, France, Greece, Italy, Malta, Portugal, and Spain). This partition was performed in order to achieve two groups with comparable numbers. A finer subdivision into groups was not possible because of the uneven distribution per country. The analysis of participants' attitude toward ePTWs revealed that in the north-central European countries, there was a higher interest in ePTWs: 73.6% of respondents declared to be interested in ePTWs, with 35.5% who already tested ePTWs, including 10.5% owners of ePTWs. In the southern European countries, in contrast, just 48.5% declared to be interested in ePTWs, with 17.1% who already tested ePTWs and 3.5% of owners. These results are also confirmed by the ePTW purchase timeframe declared by respondents: in north-central European countries, more than 60% of respondents were considering buying an ePTW within the next 10 years, compared with about 40% in southern European countries (see Figure 8).

Exploring the hypothesis of areas forbidden to internal combustion engine PTWs [11], when asking whether participants could be interested in using ePTWs to ride in those areas, a vast majority of participants interested in ePTWs (68%) indicated that they would be happy to use them in such areas. Just a small percentage of those not interested in ePTWs (15%) would accept using ePTWs in areas forbidden to internal combustion engine PTWs.

After watching the informative video, participants were again asked some questions regarding ePTWs. However, with the respondents already well informed about ePTWs, most of the participants' opinions did not change: 74% indicated that their opinion regarding ePTWs after watching the informative video was "about the same", while 14% and 12% reported, respectively, better and worse opinions. The evaluation of the potential range and required charging time of current technologies for ePTW were slightly improved after watching the video, with reduced variability in answers among participants: before watching the video the median range was estimated at 170 km (SD: 105 km) and after watching it was 200 km (SD: 82 km), while before watching the video median charging time was 100 min (SD: 73 min) and after watching the video it was 60 min (SD: 58 min). On

average, participants declared to have watched 80% of the video. This detail was confirmed by the visualization statistics of the video.

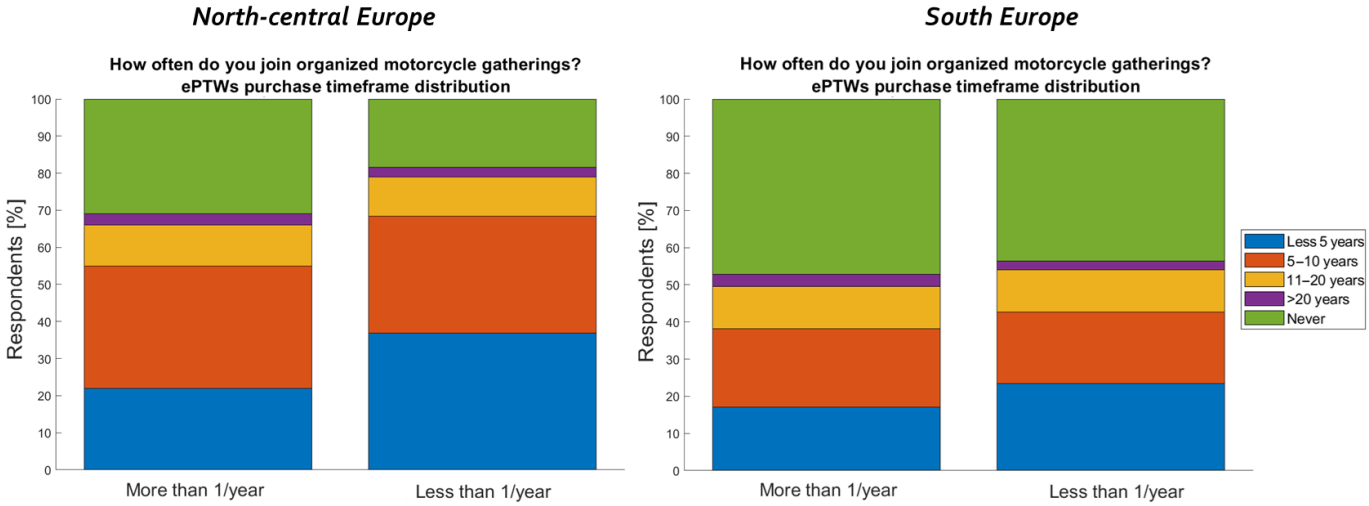


Figure 8. Respondents' ePTWs purchase timeframe distribution separated by frequency of participation in organized gatherings: comparison between north-central Europe and south Europe.

4. Discussion

This study focused on examining the technical feasibility and exploring the attitude of European motorcyclists towards moto-touring with current electric Powered-Two-Wheelers (ePTWs) technologies. Organized touring events, such as those promoted by FIM, are generally characterized by routes in rural areas ranging between 200 and 300 km per day, with a long lunch break and other short breaks for refuelling and visits along the way. These features are partially incompatible with current ePTWs, characterized by a more limited range due to charging time and charging station availability. To achieve the feasibility of these touring activities with ePTWs, it is therefore necessary to plan breaks and routes, considering stops for charging and charging station availability in relation to the number of ePTWs involved, both during and at the end of the day. By conducting field testing and a survey, we aimed to gather valuable insights into the perceptions and preferences of riders engaging in such events and the potential of current electric vehicles, in order to foster the design of a transportation system allowing moto-touring activities with future vehicles.

The field testing activity allowed for identifying the potential of current motorcyclists to perform moto-touring with ePTWs through a demonstration consisting of a single-day route, three riders, and two specific ePTW models. Depending on specific vehicle technologies and battery capacity, daily touring rides of 200–250 km can be performed with current electric motorcycles, with up to one hour of stopping for charging during the day, considering these vehicles and a riding pace with a 70–90 Wh/km consumption. These findings can be considered representative of the tested conditions, representing standard moto-touring activities, while other tests are required to achieve a broader generalization. Factors such as battery capacity, charging standards, ambient temperature, and road gradients significantly influence results. Future research should incorporate diverse climatic conditions and sensitivity analyses regarding charging power and energy consumption to broaden the scope of these findings. Based on market numbers provided by manufacturers [12] and the scientific literature, it is imaginable that in a five–ten years timeframe, the technological development of vehicles and batteries (which can achieve specific energy up to 450 Wh/kg and energy density up to 1100 Wh/l [5]), together with the development of infrastructures pushed by passenger car requirements [13], will allow for riding experiences and

vehicle dynamics characteristics very similar to those obtained with internal combustion engine motorcycles, allowing touring rides of 300–400 km without stops for charging, and a 30 min or less charging time.

The analysis of the survey, which was answered by people from all over Europe, allowed for identifying touring event users' characteristics: leisure riders who ride mainly for the passion for motorcycling, riding pleasure, and touring. They reported a wide variability in participation in organized touring events, and the main reason for joining touristic gatherings was societal, such as meeting and riding with new people and friends. Concerning ePTWs diffusion, just 38% of participants indicated being not interested in ePTWs, while the majority declared to be interested, and about 25% have already tested or are owners of ePTWs. This is confirmed in the timeframe they reported to plan to move to ePTWs: 50% plan to buy one within ten years (also including those that already own ePTWs), while about 40% of participants indicated that they will never buy an ePTW. This plan, however, seems unrealistic compared with the current market figures [12], indicating a potential positive bias towards ePTWs among respondents.

When considering new measures to facilitate the transition to electric powertrains for PTWs in touristic gatherings, participants were not very attracted by innovations: promotions for participation in touring activities with ePTWs and opportunities to rent ePTWs are considered to be of limited appeal by participants. Most of the ideas proposed for future events involving ePTWs were not considered of interest, indicating that there is little to do to promote the introduction of ePTWs to touring activities. Most probably, it is necessary to wait for their market penetration, technological development, and progressive modification of riders' habits.

The analysis of participants' attitudes toward ePTWs revealed that in the north-central European countries, people are already well informed about ePTWs, there is a higher interest (70% are interested in ePTWs, and almost 10% are already owners), and more than 60% of respondents consider buying an ePTW within the next ten years. This indicates that in these areas of Europe, there is a more positive attitude toward ePTWs, and their diffusion in the next decade might be higher compared to southern Europe [14]. New experimental touring activities promoting ePTWs should therefore be organized and designed in these countries or for the citizens of those countries.

It is important to note, however, that the questionnaire sample may not be fully representative of the general European motorcycling population. The high concentration of respondents from specific regions, namely Italy and Sweden, along with a significant gender imbalance, suggests a selection bias likely linked to the dissemination through specific FIM and social media channels. While these results offer valuable insights into the sampled group, they should be viewed as an exploratory characterization of this specific demographic rather than a direct generalization of the entire motorcycling population.

Despite the potential risk of item fatigue associated with the 26 min completion time, the consistency of response patterns across survey blocks and the low incidence of illogical entries in the final sections indicate that data reliability remained within acceptable limits for this study. Based on the results of the study, we elaborated on a use case involving the organization of a touring event, considering a short-term scenario (2023–2026), involving 200 PTWs divided into five riding groups of 40 and with a 7% penetration rate of ePTWs. The following hypotheses were formulated based on the literature and data results of the study: (i) 15 kWh vehicle battery capacity and a cautious approach were ascertained by considering utilizing only 75% of ePTWs available battery capacity—this is intended to avoid prolonged charging times (from charging up to 100% of the battery) and to prevent battery depletion below 15%; (ii) estimated energy consumption 90 Wh/km; (iii) two charging stations at each stop location during the day, with an average charging

power of 17.6 kW; and (iv) four charging stations at the end of the day, with an average charging power of 4.8 kW. Considering these hypotheses, touring with ePTWs can be achieved with a maximum daily mileage of 125 km without requiring charging, but if we plan for each group of riders to have a charging stop of 40 min during the lunch break and another stop of 20 min during the day, the maximum daily mileage can be extended up to 250 km, considering that stops are primarily aimed at providing a partial charge to all ePTWs (using a top-up charging strategy) and would utilize only two available fast charging stations. At the end of the day, charging the ePTWs can be achieved using four low-power charging stations, requiring a total charging time of 8.2 h overall (approximately 2 h per vehicle), or utilizing fast charging stations would reduce the charging time to 2.5 h overall. This scenario is, however, strongly influenced by the battery capacity of PTWs and the power of charging stations: we considered values already available with current technologies, but the fast-developing electric transportation sector could achieve better performances in the near future [5]. These scenarios will require that stops along the route are planned near villages big enough to have at least the number of fast charging stations we considered, and with that, each riding group will need about 20 min of time distance along the route or to use different charging stations during the day. With current technologies, both in terms of charging infrastructure and vehicles' range, touring activities involving a limited proportion of ePTWs (up to 10%) are already feasible by just introducing an additional 30 min break for charging during the day and planning the other breaks, including a longer lunch break, where charging stations are available.

5. Conclusions

This research provides a comprehensive analysis of the technical drivers and attitude factors shaping the future of electric motorcycle (ePTW) touring. Our findings suggest that while the ePTWs considered in this study for field testing possess the potential to deliver experiences comparable to conventional internal combustion engine motorcycles, a successful transition over the coming decade requires a nuanced approach that accounts for regional disparities in user perception and strategic market alignment. A significant paradox emerged: although touring enthusiasts exhibit a foundational receptivity toward electrification, they remain a discerning group, largely resistant to altering established riding habits. Consequently, the broad adoption of ePTWs for long-distance travel is contingent upon further technological advancements in vehicle performance and the expansion of dedicated charging infrastructures. By illustrating the viability of ePTWs beyond urban commuting, this study establishes a roadmap for the sustainable integration of electric mobility into the global moto-touring landscape.

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