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Short Communication

Assessing the social acceptance of hydrogen for transportation in Spain: An unintentional focus on target population for a potential hydrogen economy



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Diego Iribarren ^{a,*}, Mario Martín-Gamboa ^a, Javier Manzano ^a, Javier Dufour ^{a,b}

^a IEA HIA Task 36, Systems Analysis Unit, Instituto IMDEA Energía, 28935, Móstoles, Spain

^b Department of Chemical and Energy Technology, ESCET, Rey Juan Carlos University, 28933, Móstoles, Spain

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ABSTRACT

The assessment of public perception and social acceptance of hydrogen energy systems is crucial to avoid reluctance to the deployment of hydrogen technology and infrastructure. However, the number of regional studies evaluating these aspects is scarce. This work aims at assessing the attitude of the Spanish society towards the potential role of hydrogen for transportation. A quantitative approach was followed through the design and open electronic distribution of a survey with 12 closed-ended questions. The final size of the sample involved 1005 respondents. The analysis of the responses provided relevant information under three main aspects: perception of the concept "hydrogen"; supporting attitude towards the implementation of hydrogen technologies and infrastructure; and determining factors for the purchase of a hydrogen vehicle. Overall, the respondents are willing to accept hydrogen as a key energy carrier within the energy and transport sector. Nevertheless, further policy, industry and research efforts are required in order to overcome current obstacles hampering the success of hydrogen. The results of this study may be relevant not only to hydrogen stakeholders and decision-makers in Spain but also to counterparts in other regions without strong initiatives towards a well-established hydrogen economy.

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Introduction

Environmental, economic and social concerns about the performance of the energy sector (e.g., climate change and energy security) show the need for a transition towards a sustainable energy system [1,2]. This change is especially relevant to the transport subsector, which accounts for half of the oil consumption worldwide. In this respect, the promotion and consolidation of alternative transportation fuels that

* Corresponding author. Tel.: +34 91 7371119.

E-mail address: diego.iribarren@imdea.org (D. Iribarren).

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progressively replace fossil fuels is a critical aspect in order to reduce significantly the dependence on fossil sources and the undesired emissions associated with the transport subsector [3]. Current efforts in the field of energy research and policy aim at developing and supporting solutions that enable this transition [4,5]. Among these alternatives, hydrogen emerges as a potentially clean energy carrier with a high specific energy content [6], but its suitability as a transportation fuel is conditioned by the use of green sources and methods for hydrogen production [3,4,7].

Furthermore, other barriers need to be overcome. Current hydrogen infrastructure accounts for around 16,000 km of pipelines in several countries such as Belgium, France, Germany and the United States [8]. Nevertheless, the distribution network is insufficient or non-existent in most regions worldwide. In this sense, one of the major challenges for a well-established hydrogen economy refers to the costcompetitive rollout not only of technological solutions for hydrogen production and storage, but also of the infrastructure required for distribution and use (e.g., refuelling infrastructure) [1,3,8].

In addition to the need for technical infrastructure, public support at the global and regional level is crucial to the success of hydrogen as an alternative transportation fuel in the mid- and long-term [9]. Addressing public perception and social acceptance appropriately is of paramount importance to avoid reluctance to the deployment of hydrogen technology and infrastructure, which would most likely result in costly delays and enforced changes with respect to initial plans. However, most of the available studies on public perception regarding the mobility sector address the social acceptance of (battery) electric vehicles. There is therefore a lack of regional studies evaluating the public awareness and social acceptance of hydrogen as an actual option for sustainable mobility [10].

Within this context, the present work complements previous regional studies on the social acceptance of hydrogen [9–13] by evaluating the position and attitude of the Spanish society towards the potential role of hydrogen for transportation. This study presents data and statistical results of a survey that can be relevant not only to hydrogen stakeholders and decision-makers in Spain but also to counterparts in other regions without strong initiatives for a well-established hydrogen economy.

Material and methods

Countries such as Germany [10], the Netherlands [11], UK [2,12], USA [9] and Australia [13] have already analysed the implementation and acceptance of hydrogen technologies. At the European level, the HYRREG Project [14] —an initiative funded by the European Commission to boost the hydrogen economy in Southwestern Europe— also addressed the performance of surveys on the social perception of hydrogen. However, in the case of Spain, this type of analysis is limited to the studies by Germán and Navajas [15] and Ferri Anglada [16], which used discussion (inexpert) groups and expert groups, respectively, showing the lack of public knowledge about hydrogen technologies [15] and the positive engagement of Spanish stakeholders in the transition towards a hydrogen economy in Spain [16]. The present work uses a different (and complementary) methodology, following a quantitative approach through the design and open distribution of a closed-ended questionnaire in order to subsequently identify key aspects affecting the social acceptance of hydrogen for transportation in Spain.

The structure and questions of the survey took into account previous studies on the social acceptance of new technologies within the mobility sector (e.g. [2,10,13–15,17], and car magazines and websites), but it was fully adapted to the specific objectives of the study. Thus, 12 closed-ended questions (i.e., for each question the respondent chooses one of the response categories provided) were formulated and embedded in 4 topic blocks as shown in Table 1. These four blocks provide information on: (i) the survey respondent, (ii) the general opinion of the respondent about hydrogen, (iii) the attitude of the respondent towards the actual deployment of hydrogen, and (iv) the willingness of the respondent to purchase a hydrogen vehicle.

The first topic block involves common questions providing general information about the respondent: age range ("18 to 35", "36 to 50", "51 to 65" or "over 65"), education level ("high school", "university" or "another condition"), transport habits ("private vehicle", "public transport" or "on foot/bicycle"), and hydrogen awareness ("yes" or "no").

The second set of questions focuses on the general opinion ("yes", "no" or "don't know/no answer") of the respondent about the appropriateness of hydrogen energy for public transport and its environmental suitability.

The third topic block involves three questions about the attitude of the respondent towards the deployment of hydrogen technologies and infrastructure in terms of: preferred strategy for hydrogen production ("centralised production", "on-site production" or "don't know/no answer"), acceptance of local refuelling hydrogen stations ("yes, regardless of proximity", "yes, but away from residential areas" or "definitely not"), and acceptance of an affordable tax for implementing hydrogen in the public transport system ("definitely", "yes, but not through a new direct tax" or "definitely not").

The last topic block contains three questions about the purchase of a hydrogen vehicle in terms of: main motivating factor ("government subsidies", "operation and maintenance cost", "personal environmental commitment", "lifestyle and appearance", "safety and features", "urban benefits such as free car park and special lanes" or "no motivation"), main barrier ("higher cost than conventional technology", "worse features than conventional technology, e.g. range, power and refuelling time", "lifespan and reliability", "safety", "availability of refuelling stations" or "don't know/no answer"), and purchase intention ("next car will be a hydrogen vehicle", "not until a better access to refuelling infrastructure", "not until mass market penetration with affordable prices", "preference for other green alternatives" or "never a hydrogen vehicle").

The survey was designed to take 5–10 min for completion, thereby increasing the probability of participation. It was electronically distributed by the IMDEA Energy Institute (located in Móstoles, Madrid) via e-mail, institutional website, scientific blogs ("Madri + d Energy and Sustainability" blog), and social networks (LinkedIn, Twitter and Facebook). Electronic distribution was chosen in order to guarantee a wide Download English Version:

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