ANALYSIS OF THE POTENTIAL MARKET FOR THE IMPLEMENTATION OF HYDROGEN SYSTEMS (ORH_2) IN MÉXICO

Marisol Rico-Cortez[1], Juan M. Sandoval-Pineda[2], Eduardo Oliva-López[1], Rosa González-Huerta[3]

[1] Instituto Politécnico Nacional, Escuela Superior de Ingeniería Mecánica y Eléctrica, Sección de Estudios de Posgrado e Investigación, Unidad Profesional "Adolfo López Mateos" Edificio 5 tercer piso; Del. Gustavo A. Madero; Col. San Pedro Zacatenco; C.P. 07738 México.

[2] Instituto Politécnico Nacional, Escuela Superior de Ingeniería Mecánica y Eléctrica, Sección de Estudios de Posgrado e Investigación Unidad Azcapotzalco, Av. de Las Granjas 682, Azcapotzalco, Santa Catarina, 02250 Ciudad de México, D.F.

[3] ESIQIE-IPN, Laboratorio de Foto-Electro catálisis, Unidad Profesional Adolfo López Mateos Edificio N°7, Gustavo A. Madero, Lindavista, 07738 Ciudad de México, D.F

ABSTRACT

Purpose: 27.9% of the energy produced worldwide is used in the transport sector. Consequently, the large amounts of CO_2 emitted to the atmosphere by the use of motor vehicles around the world, is one of the main causes of global warming. As a solution to this The Intergovernmental Panel on Climate Change estimates that by 2050 it may be possible for 77% of energy requirements to be replaced by renewable energy, which include the use of hydrogen. In the search to implement the development of technologies of high environmental impact, it has been selected the systems of in situ generation of hydrogen called Reactor Oxyhydrogen (ROH_2), as product in increasing demand and opportunity to develop and position this innovative technology within the next five years, so that in this research a potential market analysis is presented in order to know the feasibility for the commercialization of ROH_2 in Mexico.

Design/Methodology/Approach: As part of Phase I of the Integral Model for New Product (IMDPN), it was necessary to identify the potential market to determine the beginnings of this analysis, through a comprehensive review of scientific literature and the development of surveys as primary sources of research.

Findings: As a result of this study it was found that the demand for alternative energies, continues to increase due to the society's need to reduce the emission of pollutants to the environment. According to the results obtained from the surveys, 88% of the people answered that, they could buy the product, which means a great acceptance of the product of society. On the other hand, it is detected the need to obtain more financing in order to conclude with the stage of testing and adaptation of the product to accelerate the insertion of this technology to the market.

Originality: Research on the use of hydrogen energy is widespread, however, in Mexico, its share of the current energy system remains low relative to other similar sources of renewable energy. According to the information obtained, on the supply and demand of hydrogen, its presence is significant in some countries of the European Union, the United States and Japan. So, to detect a niche market in Mexico, is essential to create a business model and a logistics appropriate to the Society.

Keywords: Hydrogen, Marketing, Business Model, Transport Sector

Introduction

The demand for fossil fuels is increasing every day around the world, as a consequence has generated its exhaustion. This is one of the reasons why scientific research and technological development of alternative energies that can be used as complementary energy systems is important. Among a variety of resources, hydrogen is one of the most promising options to be used as an energy vector, in addition to its physical and chemical properties [1]

Despite its unique characteristics, the use of hydrogen as a fuel has not been promoted, especially in developing countries. In contrast, in some countries in Europe, in addition to the United States, a large

infrastructure and projects on this technology [2]. On the other hand, in countries like Brazil, Argentina and Australia, they have published long-term projections on economic benefits, through the use of hydrogen as fuel. According to these projections, a rapid introduction of Hydrogen would accelerate the creation of a Hydrogen economy. As a result, this article highlights the strong need to implement and extend the use of H2 in Mexico, with the purpose of generating economic progress both in society as well as in the scientific community. There are different ways to promote the use of hydrogen, such as the internet and the mass media, but first, the development of an Oxyhydrogen reactor as a functional product is necessary for the generation and use of H2. This product should be affordable and long lasting. In addition, they have to be carefully tested to ensure they can work under safe conditions, be competitive and represent a real alternative to reduce gasoline use and CO2 emissions. The introduction of a quality Oxyhydrogen reactor could be the key to opening up a new and unexplored market that could generate substantial benefits [3-6]. For this reason, a multidisciplinary group made up of students of manufacturing engineering and automotive engineering in collaboration with the Escuela Superior de Ingeniería Química e Industrias Extractivas y la Escuela Superior de Ingeniería Mecánica y Eléctrica Unidad Azcapotzalco del Instituto Politécnico Nacional in Mexico are developing a system which, through alkaline electrolysis, generates a mixture of hydrogen and oxygen (namely: Oxyhydrogen Gas), which is added at the entrance of the air of an internal combustion engine, with the intention of enriching the mixture Air-gasoline up to 15%. This is not the first attempt to achieve this goal [6-8]. This indicates that it is very important to introduce this product in the Mexican market. To achieve this objective, as a first step the market, the quantity of products to be supplied and the demand for the product [9] should be investigated. In that sense the preliminary results of hydrogen demand and supply in Mexico indicate that there is a great opportunity to commercialize hydrogen energy, at low cost. Meanwhile, the scientific community involved in this topic, should promote the use of hydrogen as a source of energy.

Development of market research

This research has been developed based on the foundations Integral Model of the New Product (IMDNP) as an initial part for the development of this new technology. The IMDNP consists of four phases:

1. Phase I- Market-Retro feeding. The customer emerges as the origin
2. Phase II - Product
3. Phase III- Process
4. Phase IV – Organization

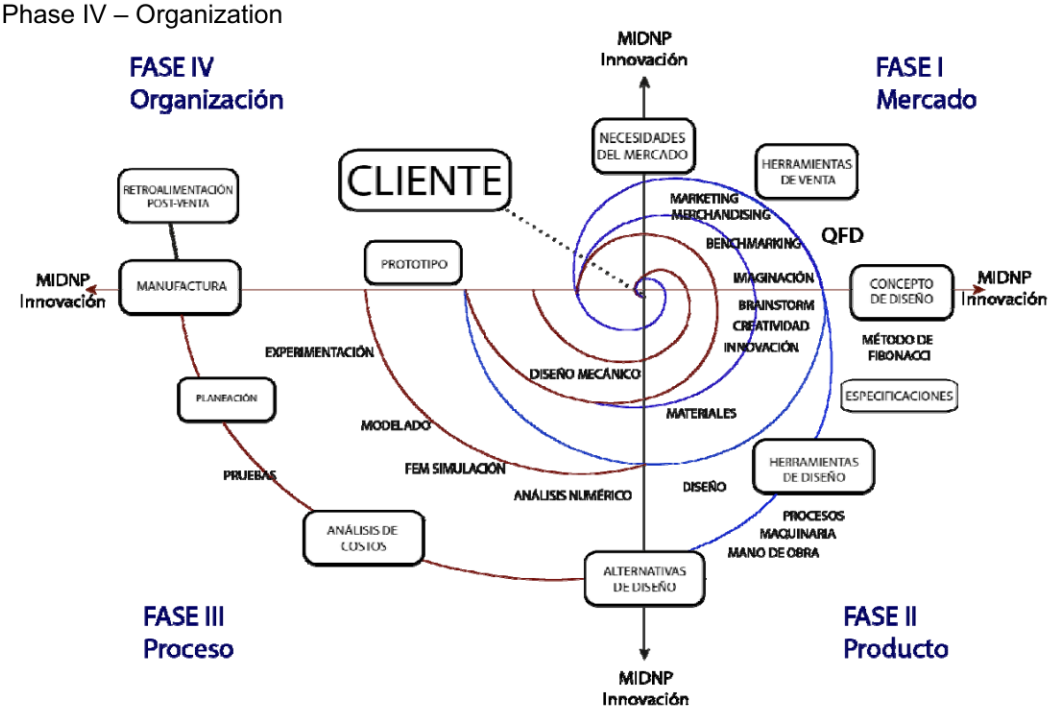

Figure. 1. Integral Model for design of the New Products (IMDNP)

These phases are cyclical and culminate in a feedback of each of them for their continuous improvement. In Figure 2, it is presented how these Phases represent the backbone of the Integral Model for the Design of New Products, where, Phase I includes the customer and the need of the market as the origin. It covers the study of the market and sales through tools such as marketing and benchmarking, with the aim of analyzing the environment of a new product.

Phase II is the conceptual development of the design, based on the results of the previous Phase, the client's requirements and specifications are analyzed, so the QFD methodology is applied, it is used because it has proven to be a very effective tool in customer analysis requirements with respect to the company's infrastructure. Once the requirements of the product are obtained, the creative part is to develop the concept of design, where imagination and creativity are extremely important. These steps involve a holistic and sustainable design as the environment requires ecological awareness in the generation of new products. Every day consumers are more demanding and more concerned about the preservation of land, so competition is stronger [35] Within Phase I, the market analysis is proposed, Figure 2 shows the steps of the methodology suggested by Baca [9], which is used to elaborate the market study.

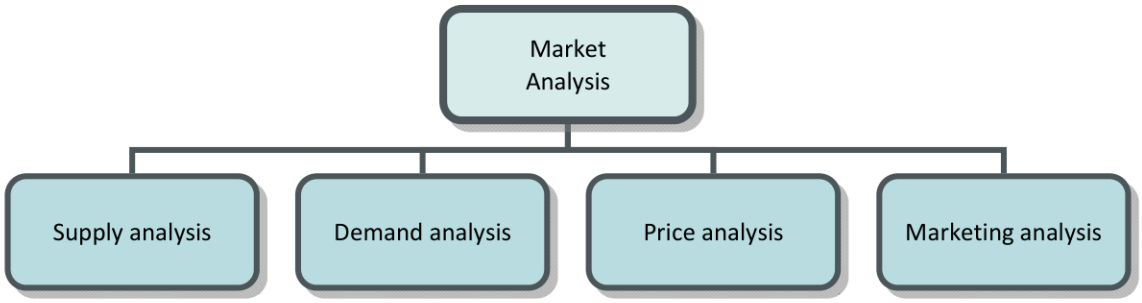

Figure. 2. Methodology for market research [9]

The present investigation begins by collecting all the information available in secondary sources related to the historical data of the supply as well as the demand in Mexico. Although there is not enough information on this topic. Consequently it was necessary to design a survey to know the opinion of potential customers.

Results

108 people were consulted, of the total sample, 62% were men and 38 were women. The question was asked about the gasoline expense that the potential customer makes weekly. Trends are depicted in Figure 2. The amount of money that 65% of respondents pay weekly for gasoline is between $ 300 and $ 500. So users can safely infer that an electrolysis system that generates more hydrogen is necessary and the return on investment happens quickly. Another question was about the number of cylinders of the car engine, to calculate the average possible size and cost of the alkaline electrolyzer. Most respondents responded that they have their own four-cylinder car.

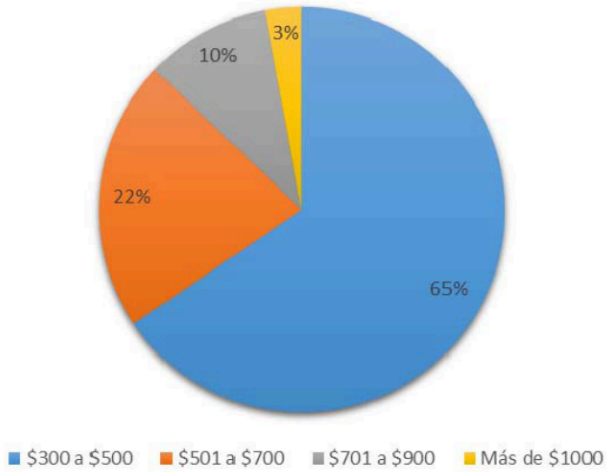

Figure. 3. Weekly Gasoline Spending

The fourth question is about the perception of hydrogen as fuel and testing fuel economy with hydrogen under safe and environmentally friendly conditions. Table 1 shows how interesting this idea seems to people.

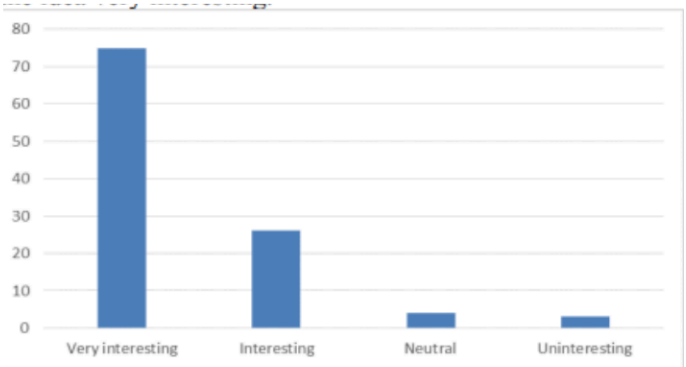

Table 1. Perception of the use of hydrogen mixed with fuel under safe and environmentally friendly conditions

The fifth question is very important, since it allows us to know about; Yes or no, people would invest in an electrolysis system. The responses were very satisfactory stating that 89% of people could probably invest in an electrolysis system, as long as they can save up to 11% gas, as shown in Figure 4.

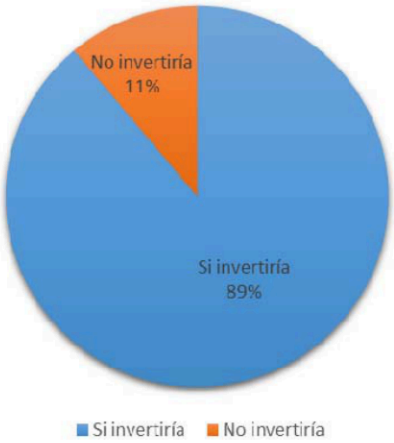

Figure. 4. Probability of investment in an electrolysis system

Question number six was designed to determine which aspects are most important when purchasing this type of product, the most important factors being the price and percentage of gasoline saved. Other factors that people consider important to acquire this device is the cost-benefit ratio.

The possibility of using hydrogen energy for economic and environmental benefits should be widely disseminated. In the seventh questionnaire question, people were asked how they would prefer to receive information about an Oxyhydrogen generator. The answers are clearly shown in Figure 5, where it is easy to see that the internet is the preferred way to receive this type of information. In this question the respondents could also choose more than one reference, with the intention of knowing the best way to know about the reactors Oxyhydrogen.

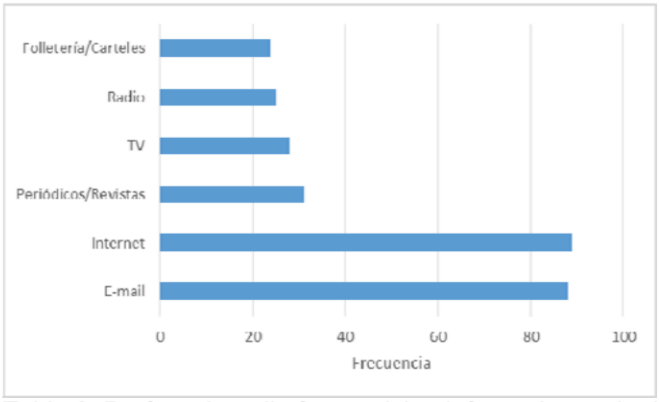

Table 2. Preferred media for receiving information on hydrogen and electrolysis systems

The eighth question showed, as shown in Figure 5, the price that people are willing to pay for the product mentioned. Most of them could pay on average $ 8000.00 for it, which shows the importance of optimizing the model to lower the price of the electrolysis system, without sacrificing quality and benefits for developers. Price ranges were calculated based on the functional prototype developed.

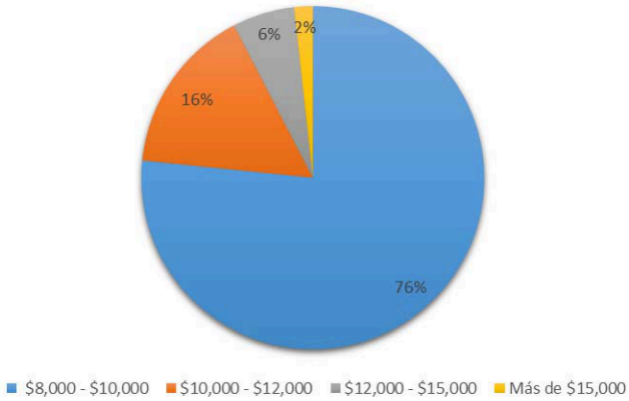

Figure 5. Price that the consumer could afford to pay for an Oxyhydrogen reactor

Finally, question 9 aims to know directly whether or not the consumer would buy the product. This question has only three options: yes, immediately, yes, after a while, and no, I might not buy it. Fortunately, 93% of people answered that they could buy the product, but 73% would expect it to be introduced to the market. As a consequence, it is essential to ensure the reliability of this technological product and as mentioned, to widely and actively disseminate the great advantage of the use of hydrogen to bring about a rapid introduction in the market.

Conclusion

Derived from the results obtained, the introduction of hydrogen in the market could be accepted by the company. This is the reason for the strong need to extend the use of hydrogen as a safe or complementary fuel. The first approach to people's preferences, allows us to know the main characteristics that a product should possess to succeed in the market: price and percentage of gasoline saved, but also, that the product is friendly to the environment and easy to use. This study also shows that the best way to advertise is online, in contrast to the preconceived idea that the best medium is television. As is well known, it is much cheaper to start with an internet advertising campaign instead of radio or television. As the surveys show, the optimization of the Oxyhydrogen system is crucial to reduce the sale price, due to all those involved in innovation processes (researchers, state and society [5]) that could have benefits of hydrogen energy. In sum, there is considerable market potential for Oxyhydrogen reactors in Mexico, and the scientific community has to develop products that are competitively priced and work under high safety standards.

Acknowledgements

To: 1. Government of México, 2. Instituto Politécnico Nacional, 3. Escuela Superior de Ingeniería Mecánica y Eléctrica (ESIME), 4. Escuela Superior de Ingeniería Química e Industrias Extractivas (ESIQIE), 5.Consejo Nacional de Ciencia y Tecnología (CONACyT), 6. Consejo Mexiquense de Ciencia y Tecnología (COMECyT) and Project SIP 20170047 and the organizers of International Conference on Logistics and Transport (ICLT) 2017.

References

- [1] Gutiérrez Jodra, L. El hidrógeno, combustible del futuro. Rev. R. Academia de Ciencias Exactas, Físicas y Naturales, 2005; 99: 49-67.
- [2] Bennaceur K., Clark B., M. Orr F., Ramakrishnan T.S., Roulet C., Stout E. El Hidrógeno: ¿Un futuro portador energético? Oilfield Review. Schlumberger 2005; 34-47.
- [3] Do Sacramento, E.M., Carvalho, P. C. M., De Lima, L. C. & Veziroglu, T.N. Feasibility study for the transition towards a hydrogen economy: A case study in Brazil. Energy Policy 2013; 62: 3-9.
- [4] K. biswas W., Thompson C. B., Islam N. M. environmental life cycle feasibility ssessment of hydrogen as an automotive fuel in Wenstern Australia. 2013; 38: 246-254.
- [5] Bozeman B., Rimes H., Youtie J. The evolving state-ofthe-art in technology transfer research: Revising the contingent effectiveness model. Research Policy 2015; 44: 34-49.

- [6] Ciniviz M., Köse H. Hydrogen use in internal combustion engine: a review. Academic Paper 2012; 1: 1-15.
- [7] White C.M., Steeper R.R., Lutz A.E. The hydrogen- fueled internal combustion engine: a technical review. International Journal of Hydrogen Energy 2006; 31: 1292-1305.
- [8] Das L.M. Near-term introduction of hydrogen engines for automotive and agricultural application. International Journal of Hydrogen Energy 2002; 27: 479-487.
- [9] Baca U. G. Evaluación de Proyectos. Mexico City: : Mc Graw Hill; 2009