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Alternative Energy: Is a Solution to the Climate Problem?

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1. Introduction

Our position is clearly in favor of alternative energy and they can and must be the solution to fossil fuels, as well as a means of slowing climate change which we are witnessing.

The world is doing many efforts to mitigate climate change, researching and developing various sources of the renewable energy such as wind, photovoltaic, solar, tidal, geothermal, aero thermal, bioenergy, undimotriz or hydropower, They will be overshadowed by the use of some countries like China or India of massive amounts of coal, which generate huge emissions of CO₂. This can lead to result in many developed countries resort to the use of coal to be competitive in this field.

As shown in multiple studies, alternative energy may be the weapon of the future in energy production, fossil fuels being relegated to a residual employment. Many countries are turning to so-called intelligent buildings for energy saving, with photovoltaic solar panels that provide electrical energy to the building or buildings with geothermal energy. This is still starting.

Other countries are designing models for efficient energy production from the oceans and seas, tidal energy or undimotriz energy. Although, like other renewable energies are in initial processes.

This leads us to consider for the moment, as it indicates, are alternative energy, namely, they not yet ready to be a substitute for fossil fuels and for the time being complementary energy from fossil fuels. At this time, these energies can not make the various societies to abandon the use of petroleum and its derivatives as energy.

We in this chapter we will try to address not a source of renewable primary energy, but an energy vector, the hydrogen. This, in the future may be the replacement of fossil fuels.

However, despite the efforts of some countries, we are still far from turning the hydrogen energy future, and being the main energy source that solve our energy problems and climate change.

2. Hydrogen and energy

Hydrogen is the most abundant chemical element in the universe and under normal conditions is in a gaseous state. The hydrogen is the most common and ubiquitous of the chemical elements. Hydrogen is an inexhaustible energy. Despite being the most abundant, but he is not pure in the nature, but is present as molecular or ionic.

As noted Jodra Gutierrez (2005:50) the hydrogen reservoir in pure state is found in Jupiter. It is inaccessible for the moment.

Therefore, hydrogen is not a primary source of energy but a vector, and therefore needed to obtain chemical decomposition of the element that he is associated. The most common way to find the hydrogen is in the water, to obtain it must be separated from oxygen by supplying an electric current (electrolysis) on a primary energy source.

A cost effective way to obtain hydrogen is to use renewable energy sources (wind, solar, geothermal, and so on.).

On consideration of hydrogen as an energy vector appropriate to highlight a number of characteristics: 1) low boiling points and proximity to the critical temperature. 2) Low densities of gas and liquid, 3) the content of deuterium, which may be one of the foundations of nuclear fusion (Jodra Gutiérrez, 2005: 50-51).

The most attractive features to hydrogen as a transmitter of energy are in cleaning. In the absence of carbon in the transition process to generate energy that does not produce CO₂ emissions. Secondly, it is energy potential (Valero-Matas, 2010:433). Cleaning and energy potential opened up great expectations for climate change advocates, and some car companies saw a new kind of engine with hydrogen fuel. Science and technology have spent decades trying to find or design suitable components to make hybrid vehicles competitive with petrol cars. For now, hybrid cars are powered by so-called fuel cells or fuel cells.

3. The hydrogen economy and social impact

When we refer to the social effects produced by something, it should define what is going to be evaluated, then proceed to the analysis of the facts. This requires a life cycle assessment and impact of technology, becoming part a series of elements such as economic, environmental, social, health, risk, human needs, sensitivity, development objectives of society and political impacts decision making.

Therefore, taking these issues on the horizon, and emphasizing that the implementation of technology can never make the risks significantly outweigh the potential social, as any damage to the citizenship for their implementation, and undermining their quality of life instead of getting beneficial technologies reported. Reflect on the effects of the hydrogen economy.

Depending on what the source of production of hydrogen vary substantially the price. Given this fact we must ask two questions: If the question is to eliminate energy dependence on fossil fuels, or reduce the emission of CO₂ into the atmosphere. According to the election, the effects on the social impact vary substantially. If the intention is to reduce emissions of greenhouse gases as stated in previous sections, the current method of producing hydrogen via natural gas is the most profitable. Companies, universities and research centers continue to explore different components to reduce costs, making it competitive and produce fewer emissions of CO₂.

Another way is through acquiring hydrogen from biomass. The energetic use of the biomass is the gasification, which allows obtaining gas of synthesis (CO + H₂). The synthesis gas obtained can be used as direct fuel, as well as H₂ source or chemical feedstock to make other fuels. The production of hydrogen by gasification of biomass is an interesting option, it has the advantage over the conventional (steam methane reforming of water) to use a waste and not a chemical feedstock. It arises as a hope to the energy consumption, though it issues CO₂ there diminishes the dependence of the fossil fuels. It has an important disadvantage, his corrosive effect reducing considerably the life of the fuel cells and pipelines of transport.

On the other hand, if you wanted to eliminate the dependence on fossil fuels and emit no CO₂, the process is quite different. To achieve carbon-free hydrogen the most common is water, and electrolysis treatment. This method requires a lot of energy to break water molecule and split it into hydrogen and oxygen. The power supply either through renewable energy or nuclear energy is higher than that after the hydrogen is exploited. For example, a kilogram of hydrogen produced through natural gas comes to cost about 2 €, where 45% of its production is due to the cost of natural gas. According to the current price of electricity, a kg of hydrogen produced by electrolysis would cost about 5€, where 85% of product cost is the price of energy. In other ways, depending on a broad range of factors, an estimate would be around roughly between 3.5 € per kg to 8 € per kg of hydrogen.

To this must be added transportation costs, marketing, so on This issue is important to reference when analyzing the economic impact of a product over another. This will appreciate the difference in cost and economic impact on a society.

Another investigation that is under development is the production of hydrogen from green algae. More than 60 years ago it was discovered that a microscopic green algae, -whose scientific name is *Chlamydomonas reinhardtii* and we all know as the ponds scum -, can split water into hydrogen and oxygen in laboratory conditions. The possibility of using algae as microscopic power plants were the brainchild of Hans Gaffron, who observed in 1939, "for reasons unknown at this time, which stopped producing algae began producing oxygen and hydrogen for a short period. Green algae have a hydrogen-producing enzyme known as iron-iron hydrogenase which has evolved a structure that makes its particularly susceptible to attacking oxygen molecules. Green algae can produce hydrogen gas, H₂, in a process called "biophotolysis" or "photobiological hydrogen production. This process is carried out by photosynthetic enzymes, which split water to get electrons, photons excite electrons, and finally, use these electrons to reduce 2H⁺ to H₂. The scientific challenge associated with this approach to hydrogen production is the enzyme that actually releases the hydrogen, called "reversible hydrogenase, is sensitive to oxygen. The process of photosynthesis, of course, produces oxygen and this normally stops the production of hydrogen very quickly in green algae. A team of biologists led by Raymond Surzycki Jean-David Rochaix and the University of Geneva, and Cournac Laurent and Gilles Peltier, both from the Atomic Energy Commission, National Center for Scientific Research and the University of the Mediterranean, the algae cell research "*Chlamydomonas reinhardtii*" that through the use of copper in the cells to block the generation of oxygen, it achieves a cycle of hydrogen production.

Algae to produce hydrogen, they must have sunlight and be in an anaerobic environment (without oxygen) to prevent oxygen toxicity to the top eventually responsible for hydrogen production. The alga synthesizes up "hydrogenase" that is ultimately responsible for producing hydrogen by combining with electrons derived from photosynthesis.

Another strategy is to modify the hydrogenase using genetic engineering to be more tolerant of oxygen

One might screen microorganisms in nature for the presence of oxygen-tolerant hydrogenases. The genes of these enzymes could then be introduced into algal cells and tested for hydrogen production under less stringent anaerobic conditions. This is the case of Dr. Melis of the University of Berkeley has managed to "design" a seaweed that contains less chlorophyll density, or that is, is more transparent. This means that sunlight can penetrate deeper into the mass of algae without being stopped by floating on the surface layer, leading to increased production of hydrogen in the amount of algae. Genetic modification of algal

chlorophyll density decreases from 600 to 300 in the chloroplasts, the body of the cell where photosynthesis takes place. During normal photosynthesis, the algae use sunlight as energy to convert CO₂ in water and glucose, besides providing oxygen to the atmosphere and a small amount of hydrogen.

According to Melis acres of algae could produce about 200 kilograms of hydrogen for day. To realize a balance sheet of the production of hydrogen not only attends to the final values of consumption and money-cost, also involved and the resources needed for production. In this case, tons of water needed to produce hydrogen fuel. Only in the United States was estimated in 2006 (Norskov and Christensen, 2006:1322-1323) about 150 million tons water per year to meet the transportation needs, if this is added, the demand for buildings, business and domestic use, consumption shoots to 500 million tons per year in USA. Does society and water resources and energy are prepared to meet this challenge, the hydrogen economy?

The fuel cells, they are the gadgets needed to transform chemical energy through a substance into electrical energy, and make it work external combustion engine. Currently, there are different types of fuel cells, suitable to various needs and demands. As the alkaline fuel cell (AFCs) that performs better. NASA uses this type of fuel cell in their space activities, but presents a major problem, its high price. Why is this price so high? Basically its components, the catalysts used are platinum / ruthenium, electrodes contain large amounts of noble metals, for example, the anode can be made with platinum and palladium, and gold and platinum cathode, if this is happening worldwide, decreasing costs is impossible, because the demand for gold, platinum, palladium and ruthenium are fired, increasing the value of these metals by the scarcity and the need to use. In the case of reaching the market, would be a matter of asking him, because if the oil runs out, the noble metals also. And on this there is a greater lack of durability. In the immediate future no one can see a drop in prices in the world there are millions upon millions of cars and their production is increasing.

In an attempt to make viable hydrogen-powered vehicles, automotive companies have developed a technology stack PEM (Proton Exchange Membrane) rather the product cheaper. The problem is not solved completely, because the platinum catalyst remains. Returning to the same matter, and if you choose to design all hybrid cars with this type of batteries, the fired platinum price, increasing the cost of the fuel cell. Enter the fray again the question of durability. Platinum is perishable and we are talking about millions of cars and piles of life between 10 and 15 years at best, and do not forget that the noble metal platinum is a finite.

At this point, several developments have occurred in lower prices and fuel cell performance without precious metals from catalysts. The research of Barnett and Zhan (2006) have developed a new fuel cell solid oxide, or SOFC, that converts iso-octane, high-purity compound similar to gasoline, hydrogen, which is used by the cell to energy. Also developed by the team of Michel Lefèvre et al., which have taken a giant step to reduce costs, using new catalysts that use iron instead of platinum without performance degradation. Iron-based catalysts for the oxygen-reduction reaction in polymer electrolyte membrane fuel cells have been poorly competitive with platinum catalysts, in part because they have a comparatively low number of active sites per unit volume. We produced microporous carbon-supported iron-based catalysts with active sites believed to contain iron cations coordinated by pyridinic nitrogen functionalities in the interstices of graphitic sheets within the micropores (2009: 72).

Store large amounts of hydrogen safely and cheaply, and enable its use (through fuel cells or direct combustion) is another challenge for this product. Hydrogen can be stored in different ways: aerated, high pressure compressed, liquid, by chemical or carbon nanostructures (Fakioglu, Yürüm y Veziroglu, 2004: 1373-1374). Currently, hydrogen is the most used aerated, transported in cylinders and high pressure gas. This form of storage is not optimal if you are used as energy for a vehicle, due to the high volume of these cylinders. If the interest is in providing a group of houses (as they currently do propane tanks) will need a silo which will triple the amount currently used by the propane storage tanks. This is easy to observe, one must look at the main tank (where the liquid hydrogen) of the space shuttle, whose volume is greater than the aircraft itself¹. Gasified hydrogen tanks must be made with special materials that maintain safety and avoid the risk (Kreith y West, 2004). The chemical composition involves hydrogen use by many transition metals and alloys to store hydrogen in metal hydrides. This process presents a major problem, the heavy weight of the storage system as a result of low levels of hydrogen retention are achieved (Conte, *et al.*, 2004:6).. Finally, carbon nanostructures involve inserting inside a solid material at a temperature and pressure to later extract it with other values of pressure and temperature. This form of storage can accumulate a larger amount of hydrogen in volumes of the above dimensions. It is not the optimal model, although recent research has put a glimmer of hope to the nanoparticles such as hydrogen storage system (Aguay y Ares, 2008).

The liquid hydrogen and hydrogen gas under pressure are the most widespread in the storage and transportation of hydrogen. In the case of hydrogen gas under pressure for transport, some suggest the network of natural gas pipelines. This is not possible because the natural gas will still be using for many years. In the course of doing so for the same natural gas pipelines, they do not serve as the fragility of the steel in the hydrogen makes the pipes require special insulation, carbon fiber for example. Therefore implies a high cost. The other option corresponds to submit to high pressure and hydrogen storage. For transporting liquid hydrogen needs to be exposed to hydrogen at a temperature of -252 degrees Celsius, that is to say, cryogenic fuel. In the United States, NASA and companies working with liquid hydrogen is transported in cryogenic tanks either truck, rail car or barge specially prepared. Bossel and Eliasson (2003) advise against this practice as domestic consumption for two reasons: 1) The power consumed by a tank of pressurized hydrogen becomes a significant fraction of the energy content of hydrogen consumed. For example, for a supply of 40 kilometers, the energy used in the route of supply is equal to 20% of the hydrogen energy delivered. 2) You need a great transport fleet. As the ratio of 15 trucks of hydrogen for a fuel truck 25 tons. Select this possibility is irrelevant and irrational. First, the truck fleet overflows traffic; its implementation would entail a considerable increase in jobs. Secondly, the hydrogen fuel would shoot.

Safety is another important principle in assessing the impact of technology on society. As announced in its day Beck (1998) we face the risk society, it symbolizes not take more risks than necessary, and many are the result of side effects of technology. Regarding the safety of hydrogen there is no common approach. Some as Braun (2003:114) attest to the high security of hydrogen compared to other fossil fuels, and indicate that the numbers of accidents

¹ NASA to reduce the weight and volume, special alloy used the product too expensive. The current alloy of aluminum and lithium, which approximate price hydrogen tank is approximately \$ 6 million.

resulting from hydrogen are currently about 1%. In contrast, other theorists believe hydrogen more dangerous than gasoline (Hordeski, 2005:25).

Hydrogen cars are the best opportunities in life, certain companies Ford, Toyota, Honda, Volkswagen, Chrysler, and so on. have developed hybrid cars combining petrol and electric power, reducing fuel consumption and therefore CO₂ emission. These cars have greatly two problems: 1) the need to introduce two motors inside, increasing the size and reduce the space for passengers or trunk, 2) the price of a hybrid between 12,000 € and 18,000 € more than a petrol or diesel, depending on model and automobile company.

Another idea lies in the use of clean hydrogen, ie 100% hydrogen car, whose impact will be of another magnitude. As happens with vehicles powered by gasoline or diesel fuel will need storage, but in the case of hydrogen as the volume is larger deposit is needed a larger and heavier, added to the engine problem, determine the size of the vehicle. For benefits equal to their gasoline counterparts need more power, resulting in higher consumption and cost. A liquid, the evaporation capacity of hydrogen is very high. A NASA study (Los Alamos) showed that in ten days had evaporated hydrogen from a tank car.

The environmental impact to a hydrogen economy would be the ideal of sustainability, but only when conditions were appropriate. And this is not the case. To stop issuing between 70% and 80% of CO₂ into the atmosphere, it would mean the possibility of regeneration in a relatively small space of time, as well as, improve air quality in cities, especially the most polluted as Mexico. Even with only operate worldwide with hydrogen cars, only the issuer would reduce greenhouse gases by 20%. These values refer to hydrogen fuel with no carbon. Not taken into account, the hydrogen obtained from natural gas. If your application is given in optimal conditions, the hydrogen would be a sustainable energy vector.

Political action of this magnitude, in a globalized world where oil is currency, and the big multinationals of oil and oil producing countries are strangling the world economies, it would happen to be a history. The decision would not prevent the various problems announced by Rifkin (2002). Some of them even become worse over. Rifkin declares that with the economy of the hydrogen it was coming near to a social justice, prosperity and equality.

This will not happen; the hydrogen economy requires a very high technological level which lacks the most disadvantaged countries and oil producing countries. The formation of the citizens of these countries is very limited. Therefore continue to rely on the industrialized countries (first world). Second, if the technological and production levels depend on first world countries, how will they be able to produce such materials, wind turbines, photovoltaic systems, water electrolysis, fuel cells, and so on? Especially, when some living on the threshold of subsistence, and even below. How can promise the power of freedom? The incursion of the hydrogen economy in society will produce an unprecedented social change and energy; we might even attend a social revolution. Your application will not only transform the concept of energy also ways of life.

4. Hydrogen economy may be the solution to dependence on fossil fuels?

There is every reason to not consider the economics of hydrogen energy as XXI century, for example

- a. The inability to produce hydrogen for all cars in the world. And not just the millions of existing vehicles, but the millions of cars to the growing demand from China and India (remember that these countries are the main cause of increased oil).
- b. The necessary water to produce this quantity of hydrogen. We are before a problematic substance since it is the water. His shortage has led to the War to several countries. With the time they will be sharpening before the major shortage of this liquid.
- c. The cost to address the need to produce hydrogen through electrolysis. This is not resolved in the same terms as the oil where a plant can refine million tons of crude oil. The hydrogen production plants have less capacity, so it will require thousands.
- d. The number of hydro and other tools necessary for citizens to fill up your fuel tank, regardless of the proposal (more media than real), Rifkin (2002) that all citizens have a hydrogen charger at home or with a proximity 10 meters.
- e. The costs in their development, production, storage, distribution networks, product modification and furnishings of everyday life (adjustment of housing supply hydrogen, cooker, washing machine, and so on).

Today, most hydrogen is produced from natural gas through steam reforming of methane, and although this can be understood as a first foray into the hydrogen economy, represents only a modest reduction in emissions from automobiles hybrid vehicles. Along with this model also can use the electrolysis of water, heat, wind, geothermal, solar and biomass processing (using a variety of technologies ranging from reforming to fermentation).

The Biomass processing techniques can benefit greatly from the wealth of research carried out over the years in refining and fuel conversion of liquid and gaseous fossil. Biomass can be easily converted into liquid fuels, including methanol, ethanol, biodiesel and pyrolysis oil can be transported easily and generate hydrogen on site. Although biomass is clearly (and necessarily) sustainable, it can be transformed into the hydrogen supply taking into account the amounts required for global hydrogen supply. Fundamentally, the limitation of food as it has been observed with ethanol driving up grain prices. Still, even if they can pay the money, would leave the neediest people without food. On the other hand, continues to emit CO₂ to the atmosphere, to a lesser extent. It is clearly not sustainable. Hydrogen energy may not be a substitute for fossil fuels by the huge amount of problems and impossibilities that make it unfeasible

Hydrogen energy may not be a substitute for fossil fuels by the huge amount of problems and impossibilities that make it unfeasible. The hydrogen economy was again a false alarm, before the world need to address energy issues have taken place in the world. This may be another case like cold fusion. Where they had placed many hopes, it did not produce environmental impact of nuclear waste were not hazardous and generated large amounts of energy.

In 1989, Pons and Fleischman scientists announced they had achieved cold fusion production with the corresponding energy release. It was all a hoax. Why?, it is quite clear, when in the 70's of last century opened the door to cold fusion research, scientists, politicians, enterprises, and so on, saw it, the energy solution and began to demand

research, funds and materials to address the issue. After much money spent, time and human capital, it has not seen results. To avoid abandonment of the project, the researchers invented the fraud. Hopes were cooled cold fusion. Although there is research but are being developed with less enthusiasm and expectations of previous years. Pass the same to the hydrogen economy, this will not be a hoax but it will be a succession of isolated research and she will not be motivated by a project of general interest. At the bottom of this issue, there is another political reality commercial interests, and do not forget the politics and economics, is that the potential importance of hydrogen as an energy carrier may seem exaggerated, but very significant. The energy value of hydrogen as a substitute for oil is the main objective of the policies of OECD countries, occupying a secondary interest environmental benefit (Andrews, 2005:24). Like there is no economic profitability, the project will suffer a drop, though, this energy carrier is important to keep clean our planet from greenhouse gases.

5. Conclusions

The future of energy is now a major concern in Western societies. The increasing economic development had in the world -especially for industrial development in the India, China and Brazil- as a result of globalization, it has brought an increase of the energy consumption, and with the current model is not able to cope in the next years.

The direct effects have been a progressive rise in energy prices and an increase in CO₂ emissions. Given this reality, there is a consensus on the need to make to develop a new energy map where renewable energize control yourself take the place: solar energy, wind energy, tidal energy, biomass energy, and so on., hydrogen and even nuclear energy, and thus cope to the demand and energy supply care for the environment. For a decade it seems that research on renewable energy is new, It is, as if it was own of the 21st century. But we must not forget that the 1973 oil crisis also entailed to the emergence of many investigations to find one or more energy to help us to leaving from fossil fuels.

The oil crisis in 1973 prompted research on biological hydrogen production, including photosynthetic production, as part of the search for alternative energy technologies. Green algae were known as light-dependent, water-splitting catalysts, but the characteristics of their hydrogen production were not practical for exploitation. A continuous gas flow system designed to maintain low oxygen concentrations within the reaction vessel, was employed in basic studies, but has not been found practically applicable (Greenbaum, 1988).

Based on such research is developing the hydrogen economy is still far from being the energy of the future

The efforts being made by developed countries are inadequate and in our opinion. are more oriented to solve political problems which really become energy, as said Rifkin (2002), freedom.

Obama decided to drop in 2009 to aid the investigation of the hydrogen economy for the electric car, since it perceived as more viable, especially more profitable.

Europe has established in the year 2020, 20% of the energy consumed comes from renewable energy and from 100% in 2050. From the perspective of maintaining a clean

environment is good news, but in order to achieve this there must be a common policy designed to achieve sustainable development using renewable energy, and for this it is necessary to provide a large global project, the style of the Manhattan Project, United States. If countries get to work on a large project, possibly within ten years would have a commercially viable hydrogen economy. But today, this seems more like a siren song that a reality.

Not only is the hydrogen energy that we can draw from this dependence on oil, and consequently to reduce CO₂ emissions, there are many other alternative energy sources, which were developed in the past, and as of today, research and employment is very low. In 1870, geothermal energy, took a quantum leap, as scientists saw it as a good source of energy, then increased research to study the ground thermal regime. It was not until the twentieth century, and the discovery of radiogenic heat (heat balance). In 1967 he was inaugurated in the Race, France, and the first floor of harnessing the tides (tidal energy).

O wave energy, which knowledge dates from the French Revolution, however, does not begin to be studied in depth until the late twentieth century.

Concerns about clean energy are creating a collective imagination, demand for countries to seek energy alternatives, and we do not stop to think about the economic and political interests of big oil companies. Automation's companies discussed the many efforts towards a hydrogen economy, and what we observe, is that this companies go years in it, and we still have a viable production car of its kind.

Somehow, as noted Sovacool and Brossmann with respect to the hydrogen economy that we have a fantasy, because really, this fantasy can be raised to other renewable, because as more actions are not undertaken research, joint and, if possible, we will occur as in 1973, which passed the mouth of alternative energy, return to the use of fossil fuels, and only when you run out of oil we'll worry about unease heavily on energy research.

Possibly, it is not hydrogen or renewable energies that will save the planet, but fusion energy, but as happens with hydrogen are still far from that reality. For the present time, which we can do is, to apply rational policies of energetic use. This one is the most positive mechanism to reduce the emission of greenhouse effect, until the longed energy of the freedom does not come

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This book provides an interdisciplinary view of how to prepare the ecological and socio-economic systems to the reality of climate change. Scientifically sound tools are needed to predict its effects on regional, rather than global, scales, as it is the level at which socio-economic plans are designed and natural ecosystem reacts. The first section of this book describes a series of methods and models to downscale the global predictions of climate change, estimate its effects on biophysical systems and monitor the changes as they occur. To reduce the magnitude of these changes, new ways of economic activity must be implemented. The second section of this book explores different options to reduce greenhouse emissions from activities such as forestry, industry and urban development. However, it is becoming increasingly clear that climate change can be minimized, but not avoided, and therefore the socio-economic systems around the world will have to adapt to the new conditions to reduce the adverse impacts to the minimum. The last section of this book explores some options for adaptation.

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