Green hydrogen (New vision for clean energy)

Raudh Jamal Raheem.

University of technology,Chemical Engineering Department ,Iraq/ Baghdad

* *Corresponding authors: raudhjamal@gmail.com*

Abstract: this paper discusses the near future of green Hydrogen starting from its production to the way it will stored and its use in clean energy production . The paper compares the use of hydrogen with the conventional types of fuels that being used nowadays and presents the challenges that faces this technology as well as the safety considerations .the need of a new technology to provide energy is increasing with time , Because of the various processes that people have been used in many aspects like electricity, motor engines , industries . the CO2 emissions increased and it continues increasing With time , Scientists and countries are collaborating to involve green hydrogen in producing clean fuels and storing energy .Depending on this type of hydrogen , scientists are working to produce electricity and heat to households with the same efficiency and power but without harming the environment with pollutants . The hydrogen will be the feedstock, and the only by-product of this process will be the water . It's a new renewable source that will work together with solar and wind energy which expected to be fully used by the year 2050

Keywords: Green Hydrogen , CO2 emissions , Decarbonizing , Clean energy , Sustainable energy .

1. Introduction

Hydrogen is a non-toxic colourless gas , Even when it's referred to as a green hydrogen. it's the most abundant element in the universe , about 90% of all atoms being hydrogen atoms . Hydrogen has been used in many processes contributing with another components for centuries[1,3] . But Now the world is seeking a new renewable energy source from this element . First use of Hydrogen was to fuel the first internal combustion engine over 200 years ago,And it has been an integral part of the energy industry since the mid-20th century when it takes place in oil refining [1]. These are the gray and blue forms of hydrogen that used in energy. Although these two colours of hydrogen are used in many life applications. They are not clean sources due to CO2 emittance to the atmosphere. To save the environment , the Climate and human health . A new way to use this component is being .explored, and so called green hydrogen

Table 1: The results of using the three different colours of hydrogen.[1]

Colour	Grey hydrogen	Blue hydrogen	Green hydrogen
Production	Split natural gas into CO2 and hydrogen.	Split natural gas into CO2 and H2 Residual gases also in H-vision scope.	Split water into hydrogen by electrolysis powered by wind and sun .
Result	CO2 emitted in the atmosphere	CO2 stored or re-used	No CO2 emitted

2. Materials and Methods

This technology is based on the generation of hydrogen through a chemical process Known as electrolysis . the first demonstration of water electrolysis and fuel cells came to the minds of . engineers was in the 1800s

The process is explained by these four stages[9]

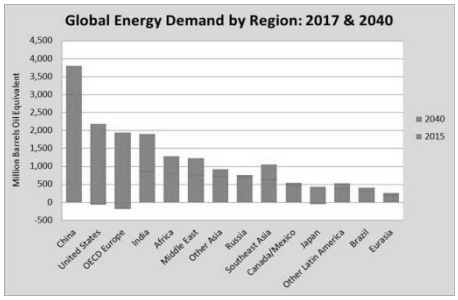
1- To conduct the electricity ,the water used in the electrolysis must contain salts and .minerals

2- The Two electrodes are immersed in water and connected to a power source and a direct .current is applied

3- The decomposition of hydrogen and oxygen happens when the electrodes attract ions with .an opposite charge to them

4- During the electrolysis process ,an oxidation-reduction reaction occurs due to the effect of .the electricity

Carbon dioxide emissions rates are increasing day by day, and decarbonizing the planet is one of the goals that countries around the world have set and want to achieve by 2050 by reducing CO2 emissions in many methods, including giving rise to green Hydrogen and using it as a sustainable energy source[2] . once we highlight the use of more clean energies , we make .better impacts on the environment



Fig[1]: Global energy demand by region2017-2040.[9]

The latest estimate by IEA (International energy agency) which was published at the end of 2019, Predicted that global energy demand will increase by between 25% and 30% by 2040 . And if this happens by an economy which fully depends on coal and oil then it means more CO2 , stronger changes in climate , and more global warming[9] . Since we need more electricity and energy for our way of life , thinking about a cleaner way to obtain energy is the goal .And this method of obtaining green

Hydrogen from electrolysis would save the 830 million tons of CO2 that is emitted when . using fossil fuels to produce it

3. Results and Discussion

3.1 Challenges facing this technology:

1- Production cost:The way to produce hydrogen from low-carbon energy is costly at this period , Some possible solutions is to improve the hydrogen production process by high temperature environment which can lowers the production cost of carbon-free hydrogen

.2- Hydrogen infrastructure: is slow to develop which hinders widespread adoption

. 3- Hydrogen supplier: is totally supplied from natural gas and coal nowadays

4- Countries economies: some cannot handle the cost of renewable energies and continue .using the traditional types of fuels

3.2 Green Hydrogen as energy storage:

The most common use of green hydrogen is to use it for electricity production via fuel cells. But there are many scientific challenges.If the hydrogen is produced from renewable , clean energy via electrolysis, there will be an efficiency trouble , the AC-to-AC round-trip efficiency will falls to around 35 percent, and for the efficiency that can be achieved with batteries, it will be far below the 95 percent[7].However Recent studies have found that hydrogen can be used as energy storage for more than 13 hours, while Sun power is available only in the morning , and wind power blows more in springs, hydrogen is the most viable technology for storing energy over lenghthly periods. Therefore, the use of hydrogen will not only help reducing pollutants emissions from the plant , because once it is done , it will help countries economically , this is especially true After the pandemic[4]. When electricity converted into hydrogen by electrolysis , the hydrogen will stored to be re-electrified any time . Small amounts of hydrogen can be stored in pressurized vessels , solid metal hydrides or .nanotubes . While large amounts of hydrogen can be stored in under-ground caverns[11]

3.3 Green Hydrogen safety considerations ? Is it safer than conventional fuels?

Certainly, no fuel is 100% safe . But green hydrogen has been shown to be safer comparing it .to the conventional fuels in many aspects[6]

1- Toxicity: Hydrogen is not toxic, unlike conventional fuels , for example when it comes to its using in vehicles as a hydrogen fuel cells, hydrogen will produces only water, while .vehicle that use the other conventional fuels generates harmful air pollution

2- Lightness : Hydrogen is 14 times lighter than air and 57 times lighter than gasoline vapor. So This means that when hydrogen released, it will rise and disperse rapidly, and will re-ducing the risk of ignition at ground level, in the other-hand propane and gasoline vapor are .heavier than air, and more likely to remain at ground level, increasing the risk of fires

3- Radiant Heat: Hydrogen has a lower radiant heat than gasoline, meaning the air around the flame of hydrogen less hot than gasoline flame. So, the risk of hydrogen secondary fires is .lower

4- Explosive Potential: Hydrogen has a higher oxygen requirement for explosion than fossil fuels. Hydrogen needs oxygen concentrations between 18 and 59 percent to explosive while .gasoline can be explosive even when oxygen concentrations between 1 and 3 percent

3.4 Shift to the hydrogen economy:

Table 2: Comparison made by hyundai to discuss the differences between green hydrogen . economy and the current carbon economy[8]

Type of economy	Carbon economy	Hydrogen economy
Energy paradigm	Fossil fuel (gasoline,coal,gas)	Hydrogen-centered
Energy supply	Concentrated	Distracted
competition	Raw material development	Technology and economy development
How green	Emits greenhouse gas and pollutants like CO2,NOx,Sox,etc.	Eco-friendly , by product = water (H2O)

4. Conclusions

Each sustainable and renewable energy that has been used to produce electricity , has its limiting conditions , Solar energy can Provide us electricity only during daylight, similarly, turbine powered by wind depends on the suitable wind speed , thus, finding a new sustainable- clear energy source which can provide electricity in all conditions is the goal , Green Hydrogen is being used in china as a fuel for some types of vehicles . And it's expected to be used for trains, aircrafts, lorries, buses in the future . While hydrogen is being used in chemical industries to manufacture ammonia and fertilizer , petrochemical industries to produce petroleum products and in the Steel industries , Green hydrogen will takes place to lower the aggressive effects of these industries on the environment . Studies and many projects are now aim to replace the natural gas network with a green Hydrogen network to provide electricity and heat to households without pollutant emissions . Economically , all renewable energies started with and then it started to decrease . And it's not different for Green hydrogen .It's our mission to make our plant healthier and cleaner , Technology could make human lives easier but in the other hand it is harming the environment , Global warming danger is increasing so the time to use renewable-clean energies is started now

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