

Tomorrow's Energy: A Review on Solar-Hydrogen Fuel Cell Technologies for Sustainable Future

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Abstract -- *It is considered as key contribution for condition and maintainable improvement. In procedure of creating vitality we are contaminating condition which is currently a noteworthy issue alongside exhaustion of petroleum derivatives. The answer for above issue is a utilization of normally accessible non-contaminating and non-draining vitality source. One such kind is regular hydrogen fuel which is richly accessible through sun powered beams and water which can be gathered store productively with propelled innovation Energy is the key component of cooperation amongst nature and society. The sunlight based hydrogen fuel is productively and adequately utilized as a part of a large portion of the created nations, such an idea must be executed in India to satisfy the vitality necessity despite the fact that we don't have propelled innovation to store hydrogen fuel which is dangerous in nature. This paper additionally exhibits the conceivable future hydrogen vitality use for better condition and practical advancement of nation.*

Key Words -- *Energy, fuel cell, hydrogen, life cycle assessment, environment, economics, sustainable development.*

I. INTRODUCTION

Consistently sun sends enormous measure of vitality as warmth and radiation called as sun oriented vitality. It is endless wellspring of vitality which is accessible at no cost. The real preferred standpoint of sun oriented vitality is that it is resound agreeable and discovered richly in environment. The factor is that daylight can specifically gathered into sun oriented vitality with the utilization of little and small photovoltaic sun powered cells. Presently we are dependant totally on the petroleum products which may depleted in future yet we can't envision an improvement without vitality so there is prerequisite to build up a few innovation which offers us a proceeds with vitality without intrusions for the improvement of our nation. The sun is a huge round vaporous cloud made of hydrogen and helium iotas the outflow of vitality is because of the combination activity amid the process of combination for hydrogen particles

consolidates to frame helium. The brilliant vitality from combination is free from contamination. Vitality is a key component of the collaborations amongst nature and society and is viewed as a key contribution for the condition and reasonable improvement. Ecological and supportability issues traverse consistently developing scope of contaminations, risks and eco-framework corruption factors that influence territories going from neighbourhood through provincial to worldwide. Some of these worries emerge from perceptible, endless consequences for, for example, human wellbeing, while others originate from genuine or saw natural dangers, for example, conceivable unintentional arrivals of unsafe materials. Numerous ecological issues are caused by or Related to the creation, change, and utilization of vitality. Forex. Corrosive rain, stratospheric ozone consumption, and worldwide environmental change. As of late, an assortment of potential answers for the current natural issues related with the unsafe contamination outflows has advanced. Hydrogen vitality frameworks show up to be the standout amongst the best arrangements and can assume a noteworthy part in giving better condition and manageability.

II. SUSTAINABLE DEVELOPMENT

Improvement requires adequate supply of clean moderate vitality assets that don't cause negative social effects what's more; supplies of such vitality assets as non-renewable energy sources and uranium are limited. Vitality sources, for example, daylight, wind and falling water are by and large thought to be inexhaustible and subsequently feasible over the moderately long haul. Squanders and biomass energizes are likewise typically seen as practical vitality sources. Squanders are convertible to helpful vitality shapes through such advancements as waste to

vitality cremation offices. Condition affect is related with expansive vitality source usage in a perfect world society needs practical improvement use just vitality assets that discharge least emanation to nature. Be that as it may, since all the vitality asset may some way or another prompt environmental impact, expanded effectiveness with respect to ecological outflow and their negative effect. For a similar administration or items asset usage and contamination is typically connected with expanded proficiency. Supportability regularly prompts neighbourhood and national experts to consolidate ecological thought into vitality arranging. The need to fulfil fundamental human needs and yearning joined with expanding total populace, will make Sustainable the requirement for effective execution of practical improvement expanding obviously.

III. VARIOUS HYDROGEN ENERGYRELATED CRITERIA THAT ARE ESSENTIALLY TO ACHIEVING SUSTAINABLE DEVELOPMENT IN A SOCIETY FOLLOW

Ecological and manageability instruction and preparing.

- Appropriate vitality and vitality systems for better productivity.
- Promoting earth plan innovations.
- Development of feasible hydrogen economy infrastructure.
- Commercially feasible and reliable hydrogen vitality framework, including, stockpiling and utilize.
- A reliable supply of financing and motivating forces.
- Academic-industry-government partnership programs.
- Policy improvement for supportable vitality programs.
- Appropriate checking and assessment apparatuses.

Natural concern is essentially connected to feasible improvement movement that constantly debases the condition. For instance, the combined effect on

condition of such exercises frequently leads after some time to wellbeing, biological and different issues. Plainly, a solid connection exists amongst effectiveness and ecological effect since, for the administrations and items, less source use and contamination is typically connected with expanded productivity. Note that enhanced vitality effectiveness prompts decrease the vitality misfortunes. Most productivity change delivers coordinate ecological advantages in two ways.

- Operating vitality input prerequisites are lessened per unit yield, and contamination produced is correspondingly diminished.
- Consideration of the whole life cycle for vitality assets and advances recommend that enhanced effectiveness diminished natural effect amid most phases of the life cycle.
- That is the reason surveying the future hydrogen advancements, for example, power devices over their whole life cycles basic to get right data on vitality utilization and outflow amid different life cycle stages, to decide upper hands over cutting edge advances, and to create future situation for the better supportability. In late year, the expanded affirmation of mankind reliance with nature has been grasped in the idea of practical improvement with vitality constituting a need for keeping up and enhancing way of life all through the world, the boundless utilization of non-renewable energy sources may have influenced the planet in routes for more critical than first idea. Notwithstanding that sensible effects of digging and penetrating for petroleum products and releasing squanders from handling and refining activities, the "green houses" gases made by consuming these fills is viewed as real commitment a worldwide worming threat. Global warming and extensive scale environmental change have complexity for the natural pecking order disturbance, flooding and climate occasions. for example, hurricanes .clearly usage of hydrogen and energy component.

Advancements can diminish ecological Damage and accomplish manageability. Such advances basically don't devour fuel, add to an Earth-wide temperature boost, or create generous waste as long as hydrogen is delivered through clean and sustainable power source assets. In this regard, hydrogen and power module innovations can give more proficient, ecologically benevolent and reasonable contrasting options to convectional vitality advancements, especially petroleum derivative driven ones. Hydrogen and fuel cell advancements have an essential part to play in meeting the future vitality needs in both rural and urban regions. The improvement what's more, usage of such advances ought to be given high need, particularly in the light of expanded familiarity with the unfriendly condition affect and political results of petroleum product age the requirement for appropriate vitality improvement is expanding quickly on the planet. Actually, boundless utilization of this innovation is critical for accomplishing supportability in the vitality areas in both developing and industrialized nations. These advancements are key segment of supportable improvement for four fundamental reasons:

- They have various focal points, for example, vitality productive and perfect with sustainable power sources and conveys for suture vitality security, monetary development and reasonable improvement
- They by and large reason considerably less ecological effect than other traditional vitality sources and advances .The assortment of hydrogen and energy component advances gives an adaptable exhibit of alternative for their utilizing different application.
- Hydrogen can't be drained in light of the fact that the fundamental source is water. On the off chance that utilization deliberately in proper application it can give a completely dependable and practical supply of vitality uncertainly. Incontrast, fossil fuel and uranium sources are lessened by extraction of utilization.
- These advancements support framework decentralization neighbourhood and individual arrangement that are to some degree autonomous of national arrange, in this manner upgrading the adaptability of the framework giving monetary and ecological advantages to little confined populace. Likewise, the little size of the necessity regularly decreases the time required from introductory outline to task, giving more noteworthy flexibility is reacting to eccentric development as well as changes in the vitality request. It is vital to take note of that on the off chance that we create hydrogen through convectional advances utilizing petroleum products, this won't make hydrogen naturally clean in that they may cause some weight on the earth as far as contamination emanations, strong squanders, asset extraction, or other ecological interruptions. By and by, the general utilization of these advancements more likely than not can give a cleaner and more maintainable vitality framework that expanded controls on ordinary vitality frameworks. Money related motivation ought to be given to diminish in advance venture responsibilities and foundation costs for generation, transportation, appropriation, stockpiling and utilize. Advances can decrease ecological Damage and accomplish manageability. Such innovations basically don't expend fuel, add to an Earth-wide temperature boost, or create considerable waste as long as hydrogen is delivered through clean and sustainable power source assets. In this regard, hydrogen and energy unit advances can give more productive, ecologically favourable and economical contrasting options to convectional vitality innovations, especially petroleum derivative driven ones. Hydrogen and fuel cell advances have a critical part to play in meeting the future vitality needs in both rural and urban regions. The advancement what's more, usage of such innovations ought to be given high need, particularly in the light of expanded attention to the unfriendly condition affect and political outcomes of

petroleum product age the requirement for reasonable vitality improvement is expanding quickly on the planet. Truth be told, across the board utilization of these innovation is vital for accomplishing maintainability in the vitality areas in both developing and industrialized nations. These advances are key segment of feasible improvement for four fundamental reasons:

- They have various focal points, for example, vitality effective and perfect with sustainable power sources and conveys for suture vitality security, monetary development and supportable advancement
- They by and large reason significantly less natural effect than other customary vitality sources and advancements .The assortment of hydrogen and energy component innovations gives an adaptable cluster of choice for their utilizing different application.
- Hydrogen can't be drained on the grounds that the essential source is water. On the off chance that utilization precisely in suitable application it can give a completely solid and manageable supply of vitality uncertainly. Incontrast, fossil fuel and uranium sources are decreased by extraction of utilization.

These advances support framework decentralization nearby and singular arrangement that are to some degree autonomous of national arrange, in this way improving the adaptability of the framework giving monetary and natural advantages to little separated populace. Likewise, the little size of the necessity frequently lessens the time required from starting outline to activity, giving more noteworthy flexibility is reacting to erratic development and additionally changes in the vitality request. It is vital to take note of that on the off chance that we deliver hydrogen through convectional advancements utilizing petroleum derivatives, this won't make hydrogen innately clean in that they may cause some weight on the earth as far as contamination emanations, strong squanders, asset extraction, or other ecological

interruptions. In any case, the general utilization of these innovations probably can give a cleaner and more practical vitality framework that expanded controls on ordinary vitality frameworks. Monetary motivating force ought to be given to diminish in advance venture duties and foundation costs for generation, transportation, appropriation, stockpiling and utilize.

IV. FUEL CELLS AS HYDROGEN ENERGY SYSTEMS

Power module innovation is perfect, calm, and adaptable one and is as of now serving humankind in assortment of helpful ways. By and by, creation volume is low and expenses are too high open help is expected to help produce starting interest this cycle.

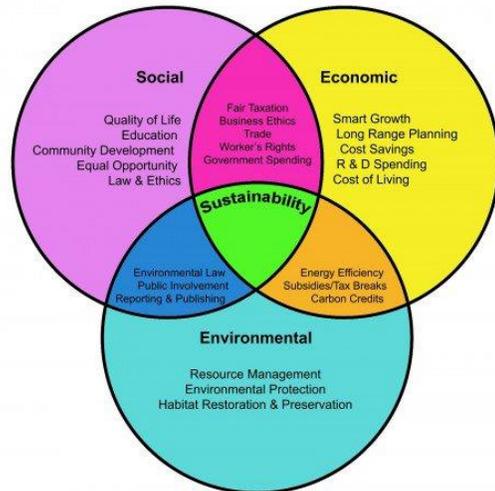


Fig 1: - Key factors of sustainable development under global sustainability

The market car control and stationary age transformation gear is the biggest market for capital gear on the planet. Energy units and power device powdered vehicle will be financial development pioneer in the coming decades securing amazing work for a large number of individuals. Energy components are impressively effective power makers and make power in one basic advance, with no moving parts and at low temperature. The burning process utilized by conventional power plants: A fuel is scorched at high temperature to make warm, the warmth vitality is changed over into mechanical vitality, and that

mechanical vitality is into electric vitality Since energy units don't combust non-renewable energy sources, they are known as perfect power makers, they produce none of the corrosive rain are exhaust cloud creating poisons that are the unavoidable side-effect of consuming coal or oil or flammable gas. On a fundamental level, a fuel cell works like a battery. Not at all like a battery, it doesn't rundown or requires energizing, produces vitality as power and warmth insofar as fuel is provided. The power module Converts substance vitality straightforwardly into power without burning by joining oxygen from the air with hydrogen gas. It produces power insofar as fuel, as hydrogen, is provided. The main side-effects are water and warmth. No contaminations are created if unadulterated hydrogen is utilized. Be that as it may, low levels of nitrogen oxides are discharged, however more often than not in the imperceptible range. The carbon dioxide discharge are moderately low in view of high proficiency and are in the concentrated shape, encouraging catch hydrogen can be delivered from water utilizing sustainable sun based, wind, hydro or geothermal vitality. Hydrogen likewise can be removed from anything that contains hydrocarbons including fuel, gaseous petrol, biomass, landfill gas, methanol, ethanol, methane and coal based gas. The sort of power devices are normally recognized by the electrolyte that is used and can be arranged into two principle classifications, in light of their working temperature, for example, low temp energy components (e.g., 60-250°C) and high temperature fuel cells(e.g., 600-1000°C). Low temperature energy components have gained critical ground in transportation application because of their fast begin times, minimized volume and lower and lower weight contrasted with high temperature energy units.

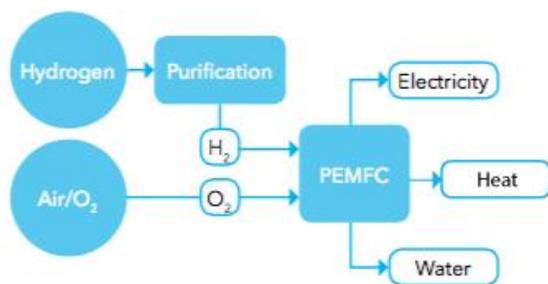


Fig 2:- Operation of a fuel cell, converting hydrogen and oxygen (from the air) into electricity, water, and heat.

The normal sorts of low temperature power devices are proton trade layer fuel cells, phosphoric corrosive energy units, basic fuel cells, unitized regenerative energy units, coordinate methanol fuel cells. The high temperature power devices are more effective than low temperature ones in creating electrical vitality. In addition, they give high temperature squander warm, which is an advantage in stationary cogeneration applications, but presents an issue for transportation applications. Two common ones are liquid carbonate energy units and strong oxide electrolyte power modules Operation of a power module, changing over hydrogen and oxygen (from the air) into power, water, and warmth.

V. HYDROGEN SAFETY

Hydrogen is naturally not any more unsafe than numerous different powers. Its distinctive qualities require diverse security hardware and systems, yet all powers have some potential for mishaps; in the event that they didn't consume, they would not be much use as a fuel. Hydrogen is utilized worldwide in the oil and concoction businesses and somewhere else. It was likewise routinely utilized as a part of the USA as a fuel (a segment of "town gas") before gaseous petrol turned out to be broadly accessible. Town gas is still utilized as a part of a few nations. Also, hydrogen positions amongst propane and methane (petroleum gas) in security. The physical properties of hydrogen make its security attributes fairly not the same as those of different powers. Its low thickness implies that it tends to rise and scatter into the atmosphere in case of a release, as opposed to staying in a "puddle" close to the ground. This builds security in very much ventilated applications. Its low thickness likewise implies that a hydrogen blast discharges less vitality in a given volume than a blast of different fills, and contrasted with gas or flammable gas, hydrogen requires considerably higher fixations noticeable all around to deliver a blast as opposed to only a fire. Moreover, hydrogen's low start temperature and combustibility over an extensive variety of fixations make releases a critical fire risk, particularly in kept spaces for example, a carport. Since it is clear and

scentsless, spilling hydrogen will probably go undetected than a hole of gas or most different energizes. Indeed, even the fire of consuming hydrogen is undetectable. Systems of break recognition have been and keep on being an examination need. A straightforward approach is to include an odorant like that additional to petroleum gas, or potentially a colorant, or both. Any expansion may degrade to some degree from the ecological tidiness innate to unadulterated hydrogen, notwithstanding, and added substances would should be picked with care to abstain from devastating other vital highlights. For instance, contaminants may diminish the proficiency and additionally lifetime of a power device.

VI. CONCLUSION

The advantages of hydrogen and power device frameworks is featured of utilizing the standards of thermodynamics (particularly vitality) and life cycle appraisal to evaluate their enter parts in reasonable advancement. The following concluding comments, which will probably be helpful to scientists, scientists and designers and in addition approach and decision producers, can be drawn from this investigation:

- Moving towards feasible improvement requires that environmental issues be settled. These problems cover a ceaselessly developing scope of air pollution, water contamination, strong squanders, toxins, ecosystem degradation, and stretch out finished ever-more extensive zones.
- Sustainable improvement requires a manageable supply of vitality assets that, in the long haul, is sustainable available at sensible cost and can be used for allrequired undertakings without causing negative societal impacts. Vitality assets, for example, sun based, wind, hydro, and biomass are for the most part thought to be inexhaustible and therefore practical over the moderately long haul. The use of these sources in hydrogen generation will be a key factor in reasonable improvement.

- Assessments of the manageability of procedures and systems, and endeavours to enhance maintainability should be situated to some degree upon thermodynamic standards, and especially the experiences uncovered through energy analysis.
- For social orders to accomplish or endeavour to achieve sustainable development, exertion ought to be committed to developing hydrogen and power module advancements. Inexhaustible energy utilization in hydrogen generation can give potential answer for current ecological problems. Advanced hydrogen and energy component advancements can provide earth capable choices to conventional vitality frameworks, and in addition more flexibility and decentralization.

To understand the vitality, vitality, financial and environmental advantages of hydrogen and fuel cell technologies, a coordinated arrangement of exercises ought to be conducted including research and development, technology appraisal, models improvement and technology exchange. These can be gone for improving efficiency, encouraging the substitution of these technologies and other naturally amiable energy currencies for more hurtful ones, and enhancing the performance and execution attributes of these advances.

REFERENCES

- [1] Dincer, I. "Technical, environmental and exergetic aspects of hydrogen energy systems". International Journal of HydrogenEnergy, Vol. 27, 2002, 265-285. [2] Hart, D. "Sustainable energy conversion: fuel cells-thecompetitive options". Journal of Power Sources, Vol. 86,2000, 23-27.
- [3] Pehnt, M. "Assessing future energy and transport systems: the case of fuel cells. Part I: methodological aspects".International Journal of Life Cycle Assessment, Vol. 8, No.5,2003, 283-289.
- [4] Baretto, L., Makihira, A., and Riahi, K. "The hydrogeneconomy in the 21st century: a sustainable development
- [5] EIA (Energy Information Administration).(2005). Officialenergy

- statistics from the U.S. Government. Via http://tonto.eia.doe.gov/steo_query/app/p_ricepage.htm.
- [6] Conte, M., Iacobazzi, A., Ronchetti, M., Vellone, R. "Hydrogen economy for a sustainable development: state-of the-art and technological perspectives". Journal of PowerSources, Vol.100, 001, 171-187
 - [7] Weiss, M.A., Heywood, J.B., Drake, E.M., Schafer, A., and AuYeung, F.F. (2000). "On the road in 2020", MIT EL 00-003, Energy Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139-4307.
 - [8] IEA (International Energy Agency). (1999). "Automotive fuels for the future: the search for alternatives", IEA-AFIS, Paris.
 - [9] Spath P.L. and M.K. Mann. (2001) Life cycle assessment of hydrogen production via natural gas steam reforming. National Renewable Energy Laboratory, Report No NREL/TP-570-27637. U.S. Department of Energy Laboratory.
 - [10] Sorensen, B. "Total life-cycle assessment of PEM fuel cell car". Denmark: Energy and Environment Group, Roskilde University; 2004