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## ENGAGING THE HYDROGEN ECONOMY FOR ECONOMIC AND ECOLOGICAL GROWTH

**Manoj Kumar Upadhyay<sup>1</sup>, Dr. Sravan Kumar Kandi<sup>2</sup>**

**Department of Management**

**<sup>1,2</sup>OPJS University, Churu, Rajasthan**

### **Abstract**

A hydrogen-based energy system is recognized as a feasible and attractive choice for efficiently, cleanly, and safely delivering high-quality energy services in a wide variety of applications while achieving sustainability goals. Hydrogen is also an excellent companion to electricity. Both are high-quality energy carriers that are carbon-free and emit little or no pollutants at the time of use. The main objective of this research to identify similarities and differences among existing views and to propose potential hydrogen visions for India's future energy systems and gain a better understanding of the ambitions and roadmaps for advancing the hydrogen economy in India for clean and green growth. A descriptive research design has been implemented in the study to address research objective. In the case of hydrogen in India, some research has been done, and a prospective comparison technique based on PESTLE elements has been employed. To predict future possibilities, the "scenario approach" is employed in strategic planning and future research planning. The findings showed that hydrogen's usefulness as an engine fuel, based on the results of the current experimental work. Hydrogen fuel is well suited for spark ignition engines and also performs well in compression ignition engines.

**Keywords-***Hydrogen, Energy, Fuel, Economy, sustainable development, Green economy*

### **Introduction**

#### **Background of the Study**

A hydrogen-based energy system is recognized to be feasible and fascinating selection made for efficiently, cleanly, and safely delivering high-quality energy services in a wide variety of applications while achieving sustainability goals. The notion of sustainable development has developed into a directional principle for a habitable future world in which human requirements are satisfied. Addressing the sustainability dilemma needs a long-term vision and the integration of several components (Nikas, and et.al., 2021). One of them is energy. Sustaining a sustainable global energy system is increasingly becoming a key concern and policy priority. However, the development of a sustainable international energy system is a slow, long-term procedure which involves fundamental reorganization of the system's existing structure.



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As of now, the transportation industry accounts for roughly one-quarter of worldwide primary energy consumption and associated CO<sub>2</sub> emissions, with the great bulk of those emissions coming from road transportation. Transport is also responsible for around 20% of the predicted rise in both global energy consumption and greenhouse gas emissions through 2040, according to the International Energy Agency. The transportation industry currently accounts for around a quarter of global primary energy consumption and CO<sub>2</sub> emissions, with road transport accounting for the majority of these emissions. As per International Energy Agency, transportation holds nearly 20% of the predicted growth in worldwide energy consumption and greenhouse gas emissions by 2040 (Ooshima and et.al., 1998). In International Energy Agency, there are presently over 900 million light automobiles on the road worldwide (excluding two- and three-wheelers), and by 2050, more than 2 billion vehicles are estimated to be on the road, making gasoline the most extensively used main fuel. Reducing the transportation sector's reliance on oil would boost the economy.

### **Literature Review**

As per the view of Akkerman and et.al., (2002) Sequential darkest and picture graph fermentation is a notably current method for generating organic hydrogen gas. Two-degree fermentation affords some the blessings over unmarried-degree darkest- or picture graph-fermentation techniques. The effluent from darkish fermentation with inside the synthesis of hydrogen has a sufficient amount of natural acids for picture graph fermentation. As a result, the constraint imposed with the aid of using the provision of natural acids could be abolished. When structures are coupled, better hydrogen manufacturing yields may be produced. Additional natural acid utilization with the aid of using picture graph-fermentative microorganisms may also bring about advanced effluent nice in phrases of COD. However, the machine needs to be tightly controlled to make sure that the media composition and ambient situations are surest for the process's microbial components.

In the opinion of Chang, Lee, Lin, (2002) the amount of ammonia in anaerobic fermentation effluent need to now no longer exceed the inhibitory restriction for photosynthetic microorganism. Yokoi located a more hydrogen output (4.5 mol/mol glucose) while *C. butyricum* and *Rhodobacter* had been co-cultured, as compared to unmarried degree darkish fermentation (1.9 mol/mol glucose) and sequential-step fermentation (3.7 mol/mol glucose) of starch (Yokoi 1998-b) Additionally, the pH of the combined fermentation was maintained close to 7, that's an advantage over the -degree fermentation method. However, the important thing troubles are the disparities in natural acid manufacturing/intake



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prices and therefore the feasible buildup of natural acids with inside the media.

According to the view of Fascetti and et.al., (1998) Combining fermentation and photosynthetic microorganism may also bring about an incorporated machine able to optimizing hydrogen output (Yokoi et al. 1998). In this sort of machine, anaerobic fermentation of carbohydrates (or natural wastes) creates intermediates which include low-molecular-weight natural acids, which can be eventually converted to hydrogen with inside the 2d segment in a photo bioreactor with the aid of using photosynthetic microorganism.

Laniak, and et.al., (2013) stated that hoto-fermentative microorganism can utilize moderate with inside the wavelength variety 400-one thousand nm (seen and near-infrared) that differentiate from algae and cyanobacteria (400-seven hundred nm; seen). The Technique of creating positive mild distribution and restriction self-shading with inside the fermenter might be to distribute the mild with an optic fiber wherein mild is transferred into the fermenter and disbursed from with inside the fermenter. Photo fermentation with Rhodobacter spheroids calls for mesophyll conditions. The gain of the optical fiber photo-bioreactor is that radiant heat-benefit may be managed through dumping greater mild and filtering out wavelengths which cannot be utilized by the organisms.

Nath, Kumar, Das, (2005) offered an overview of the types of occupations required to develop a green economy in the United States, focusing on six critical techniques for combating global warming. The research explored six green strategies: cellulosic biomass fuels, retrofitting buildings, solar energy, mass transportation, wind energy, and energy-efficient autos. The research gathered data on job circumstances in 12 distinct states.

### **Research Aim and Objective**

This research aims at finding hydrogen economy for clean and green growth of environment. Along with it, this research has following objectives of study:

- To study the current hydrogen system in India, including its developments, difficulties, and stakeholders and gain a better understanding of the ambitions and roadmaps for advancing the hydrogen economy in India for clean and green growth.
- To identify similarities and differences among existing views and to propose potential hydrogen visions for India's future energy systems.



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## **Research Methodology**

Research approach is a systematic and logical method for unraveling the research problem. It might be comprehended with reference to how the research was finished logically. As research is a systematic investigation for acquiring significant data, the accomplishment of a research is incredibly reliant on its procedure. The outlining and sticking to the suitable approach all through enhance the nature of a research. This part manages the methodological proceedings of the present examination. The points of interest of research design and the different advances that are received in concentrate the research problem alongside the rationale behind them are portrayed. A long history of mutual dependence exists between hydrogen and energy, beginning with the invention of the First inner combustion engines greater than 2 hundred years in the past and progressing to emerge as an essential detail of the cutting-edge refining industry. It is lightweight, storage, and strength dense, and it emits no dangerous pollution or greenhouse gases immediately into the atmosphere (Otsuki and et.al., 1998). However, for hydrogen to make a significant contribution to easy strength transitions, it should be familiar in sectors in which its miles now lacking in huge quantities, inclusive of transportation, buildings, and electricity production, among others. To predict future possibilities, the "scenario approach" is employed in strategic planning and future research planning. Following the idea generating phase of this approach, comes the scenario analysis phase, which analyses the many potential prospects inside a scenario.

### ***Research Design***

The first type of quantitative research is descriptive research, which aims to collect measurable information in order to conduct statistical analysis on a sample of the general population. It is a widely used market research instrument that allows us to gather and define the characteristics of a demographic category. Descriptive research design has been applied by researcher to address research objective in this study.

### ***Data Collection***

First hand observation of the constructs has been obtained through primary data, while secondary data has been utilized for the study's foundation, research gap, the identification of important constructs, and the development of the conceptual framework. For the primary data, a questionnaire was used, while secondary data was gathered from sources such as published papers and publications.



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### ***Data Analysis***

In the case of hydrogen in India, some research has been done, and a prospective comparison technique based on PESTLE elements has been employed. The use of vision comparison is a modification to an existing idea. Back casting studies frequently produce paths as a result of their findings. With roadmaps that situate actions in time, this study takes the back-casting approach to the next level. The roadmaps allow bottlenecks and drivers to be identified.

### **Result and Discussion**

The following conclusions have been taken from the examination of hydrogen's usefulness as an engine fuel, based on the results of the current experimental work: By and large, hydrogen fuel is well suited for spark ignition engines and also performs well in compression ignition engines. The Most Appropriate Electrode and Electrolyte Selection Six distinct electrolytes and five distinct electrodes are used in this experiment. When silver is used as an electrode, this  $\text{NaHCO}_3$  electrolyte produces more hydrogen. While the other five electrolytes produce more hydrogen, nickel works as an electrode material. In this case, dilute Sulphur acid produces more hydrogen due to the increased corrosion of the nickel electrode. This results in a decrease in the life of the electrode material. The overall results indicate that potassium hydroxide is the best electrolyte and nickel is the best electrode material; as a result, hydrogen fuel cells are built for various engines. Petrol and LPG are used as primary fuels in the experiment, while hydrogen fuel is used as a supplemental fuel.

Our reliance on fossil fuels is blamed for international warming. Growing public and authorities knowledge, in addition to electricity protection and fee stability, all make contributions to the want for an easy economic system to transition far from fossil fuels. Hydrogen is a transporter of electricity, now no longer a supply of electricity. The electricity required to extract hydrogen could be absorbed via way of means of the hydrogen generated. Hydrogen is a storable, transportable, and usable fuel line that has evolved the ability for use as an opportunity electricity garage and transport device, dubbed the Hydrogen Economy. Despite the reality that hydrogen is a zero-carbon electricity supply on the factor of consumption, its easy electricity index (cleanness) is depending on the manufacturing pathway and the electricity had to manufacture it. Numerous assessments, case studies, and roadmaps, in addition to studies and breakthroughs with inside the R&D industry, show the hydrogen economic system's endured



growth. However, the take a look at of the literature famous that almost all of papers centered on discrete ranges of the hydrogen cycle in place of at the whole lifespan. The take a look at makes a enormous contribution via way of means of growing a singular hydrogen cycle version this is provided as 4 corners of a rectangular-formed incorporated complete so one can spotlight the interconnectedness and interdependence of numerous hydrogen lifecycle levels and related subsystems. Hydrogen Square (HydS) is a 4-stage (rectangular nook) device that consists of manufacturing, garage, safety, and use, in addition to purification and compression as subsystems. These subsystems might also additionally live in a single or greater corner of the HydS and have to be covered into any pathway choice preference as an extra cost. However, the study of the literature reveals that the majority of papers focused on discrete stages of the hydrogen cycle rather than on the entire lifespan. The first nook of the HydS version becomes mentioned when it comes to the alternative corners and the purification subsystem on this evaluation takes a look at it. The end reached become that the hydrogen generating nook dictates the cleanness of the electricity contained with inside the hydrogen generated. However, the alternative HydS corners might also additionally make contributions to pollutants during the hydrogen's round-ride cycle.

### **Conclusion**

This is beneficial due to the fact there's no unique application for financing hydrogen technology studies, improvement and implementation. Until at this second the primary economic aid turned into confidence via way of means of the countrywide authority for scientifically studies, different ministers like: economy, delivery and improvement, do now no longer finance studies and improvement projects. With few exceptions, there isn't always an actual and fruitfully cooperation among social actors with inside the discipline Sustainable use of neighborhood assets and the implementation in their personal studies associated with hydrogen technology is intended. To be capable of enforcing hydrogen generation and economy, Hydrogen is a rising electricity service that allows you to aid the decarbonization of the worldwide electricity and commercial sectors hence, generating hydrogen from renewable electricity reassess is of the top hobby today. Hydrogen manufacturing is the primary nook inside the proposed HydS version that's interconnected and interdependent on the opposite 3 corners of the HydS. The choice of hydrogen manufacturing pathway has to take into account the opposite foremost tiers of the entire hydrogen electricity device represented via way of means of those different 3 corners.





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