



## A Mini Review : Hydrogen as Promising Green Energy Source

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### ABSTRACT

From fossil fuels are cheaper than renewable energy resources but on combustion produce large amount of CO<sub>2</sub>. Instead of traditional fuels, Hydrogen is a promising alternative renewable resources and environmental friendly. It has a number of good features. Therefore research community interested in potential usage of hydrogen as green energy source. In this review we have focused on hydrogen is an alternative green energy source. The objective is to understand the role of hydrogen in today and future scenario.

**Keywords :** Hydrogen, renewable, green energy, emission, energy

### I. INTRODUCTION

World Bank data reveals that in the last 50 years, CO<sub>2</sub> emissions (metric tons per capita) have increased from 3.09 to 4.99 in the world[1]. Due to increasing industrialization increases large scale of CO<sub>2</sub> emission shown in figure 1.

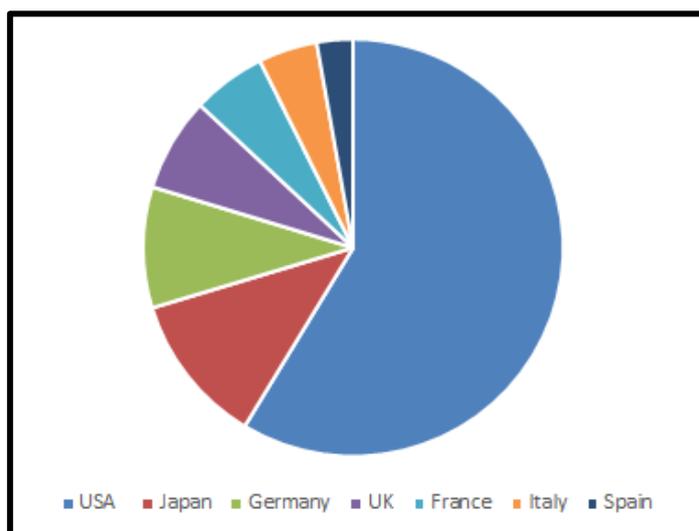


Fig 1. Emission of CO<sub>2</sub> by industries in the countries

According to report of India Energy Outlook 2021, due to an expanding economy, population, urbanization and industrialization, India has largest increase in energy demand than any other country. It also third largest energy consuming country in the world. Use of energy has doubled since 2000, with 80% of demand still being met by coal, oil and solid biomass. It has brought a serious impact on the environment. In this context, India's CO<sub>2</sub> emissions will be increased up to 50% in 2040 [2, 3]. It already feeling their effects on air quality and health in some metro cities. Modern renewable sources of energy have started option for clean and efficient energy production [4].

## II. HYDROGEN – PROMISING RENEWABLE SOURCE OF ENERGY

Hydrogen is one of the most abundant element on the earth, and it plays a vital role in the sustainability of lifecycle. The hydrogen atom is made up by a single proton and a single electron. As such, it is very abundant, but it doesn't really exist as a separate form of matter. Instead, it is usually combined with other elements. To separate hydrogen gas from its companion substances takes a lot of effort, but it produces a powerful, nearly clean source of energy. As a gas, it can be used in fuel cells to power engines [5].

Hydrogen gas is extracted from water by a technique known as electrolysis, which involves running a high electric current through water to separate hydrogen and oxygen atoms. The electrolysis process is quite expensive since it involves high energy expenditure [6]. The energy used to generate electricity in the electrolysis process is harnessed from fossil fuels like natural gas, coal, or gasoline [7]. Their combustion produces Pollutant in large quantities such as SO<sub>2</sub>, N<sub>x</sub>O<sub>y</sub>, CO and CO<sub>2</sub> shown in table I & II. Renewable energy sources like hydropower, wind and solar to ensure there are no greenhouse gas emissions and help in reduction of CO<sub>2</sub> emission [8].

TABLE I PERCENTAGE EMISSION OF POLLUTANT IN COMBUSTION OF FUEL (kg/kg OF FUEL)

Fuel	CO <sub>2</sub>	SO <sub>2</sub>	N <sub>x</sub> O <sub>y</sub>	H <sub>2</sub> O
H	0	0	0.016	7
C	1.893	0.012	0.008	0.66
CH <sub>4</sub>	2.75	0.03	0.007	2.15
C <sub>8</sub> H <sub>18</sub>	3.09	0.010	0.012	1.25

## III. ROLE OF HYDROGEN IN NET ZERO EMISSIONS BY 2050

The key parameters of decarbonizing the global energy system are energy efficiency, renewables and hydrogen based fuels. The important role of hydrogen in net zero emission conditions is evident from its increasing contribution to reducing total emissions. By increasing the demand for hydrogen and renewable energy technology for its production, hydrogen and hydrogen based fuels will be able to reduce 60 Gt CO<sub>2</sub> emissions in 2021 to 2050 [9]. Green hydrogen arises as game changer in this filed.

TABLE II RELATIVE ANALYSIS OF MAIN POLLUTANT EMISSION BY THE INDUSTRIES

State	Sulphur dioxide	Nitrogen oxides	Carbon oxide	Carbon dioxide
USA	23,200	20,300	77,400	4,166,000
Japan	1314	1435	--	831,000
Germany	3200	3100	8650	666000
UK	4670	1812	8891	517000
France	3460	1847	5200	404000
Italy	3205	1506	5487	322000
Spain	3756	792	3780	198000

#### IV. OPPORTUNITIES IN GREEN HYDROGEN

Green Hydrogen is more expensive than grey. Gray hydrogen produced from natural gas but it has less environmental sustainability. Green hydrogen does not require fossil fuels, it is a good solution to decrease CO<sub>2</sub> emission.

Among the potential energy alternative, hydrogen is a one of the clean fuel. It simply produces water as byproducts on combustion as shown in figure. as shown in figure 2.

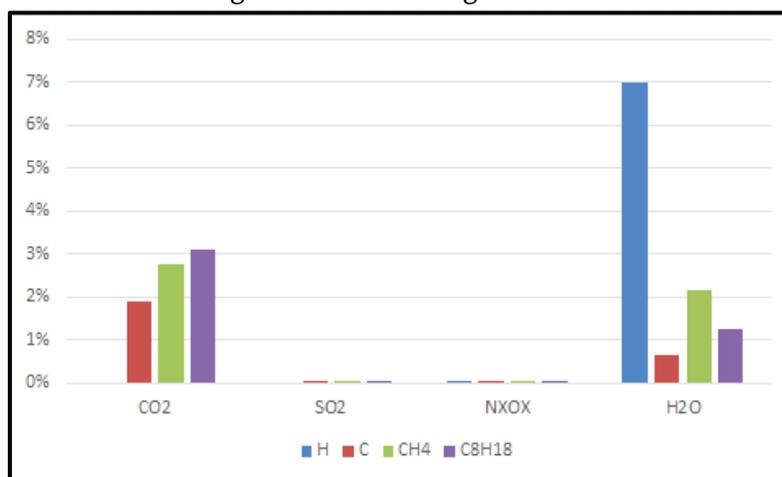


Fig. 2. Percentage emission of pollutant in combustion of fuel (kg/ kg of fuel)

#### V. METHODS OF PRODUCTION OF HYDROGEN BY USING GREEN CHEMISTRY

Molecular hydrogen is directly not available in nature, so it has produced by different ways. All methods of hydrogen production are not always green because some of the methods have CO<sub>2</sub> byproduct. On the basis of energy sources, hydrogen production is mainly divided into 4 categories such as electrical, thermal, biological and hybrid[10]. Production of hydrogen by electrolysis process, thermal decomposition process, photochemical water splitting[11], bio-photolysis[12] are green.

## VI. IMPACT OF COVID-19 ON DEVELOPMENT IN ENERGY SECTOR

Pandemic of COVID-19 impact on every sector of world. The drop in demand in 2020 affect all fuels consistently. Energy demand across the world dropdown by 6% in 2020. Economies are expected to see rapid recoveries in energy demand, but now energy demand is remains below 3%. **Recently global hydrogen consumption is still less than 2% of global energy. But according to the Hydrogen Council, this consumption could reach 25% by 2050.**

Analysis by the International Energy Agency (IEA) finds that the cost of hydrogen production from renewable electricity might decrease 30% by 2030 as a result of declining costs of renewables and the scaling up of hydrogen production.

## VII. CONCLUSION

Today's demand is that to identify abundant, reliable, affordable, green sources of energy for future. In context to increasing demand of energy, production of green hydrogen play crucial role in long-term energy strategies of the nations. Day by day increases commercial demand for clean hydrogen and development in research, lower the production cost and attracting investors. It will help to reduce gap between supply and demand. In this way hydrogen energy will be able to solve the environmental problems that damages all the ecosystems on earth. Green hydrogen will be future ecofriendly, efficient, sustainable energy source.

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