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## HYDROGEN FUEL

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### ABSTRACT

The Department of Energy's (DOE) hydrogen and gasoline mobileular sports are presented, focussing on key objectives and progress. Recent effects at the value, durability, and overall performance of gasoline cells are discussed, along side the popularity of hydrogen-associated technology and cross-slicing sports. DOE has deployed gasoline cells in key early markets, inclusive of backup energy and forklifts. Recent analyses display that gasoline mobileular electric powered vehicles (FCEVs) are amongst the maximum promising alternatives to lessen greenhouse fueloline emissions and petroleum use. Preliminary evaluation additionally indicates that the entire value of possession of FCEVs can be corresponding to different superior automobile and gasoline alternatives.

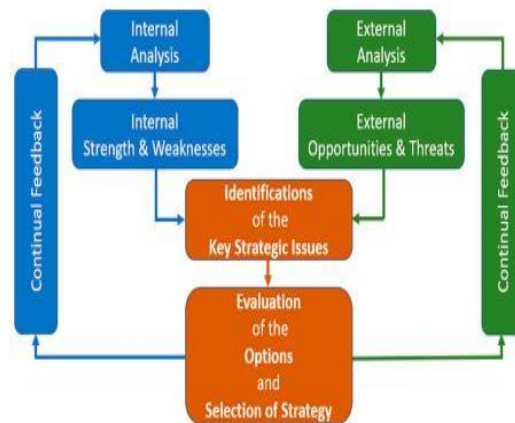
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### 1. INTRODUCTION

Unconventional electricity reassets have received and could hold to advantage an growing percentage in electricity structures across the world, because of each the studies and political efforts concerned in their development, in addition to because of the charge will increase of electricity acquired through conventional methods. The number one electricity reassets, commonly known as renewable, are the ones reassets observed withinside the herbal environment, to be had in genuinely limitless portions or regenerated via herbal processes, at a quicker fee than they may be consumed. Officially identified renewable energies originate from the Sun's rays, the inner temperature of the Earth or the gravitational interactions of the Sun and the Moon with the oceans In this context, we're presently searching out options for acquiring electricity through the use of technologies that provide most efficiency, excessive reliability and minimal pollution. Such a technology, taken into consideration at the instant the cleanest, via which sustainable electricity may be acquired, is primarily based totally on gas cells As gas cells develop, hydrogen-primarily based totally electricity manufacturing has emerge as a reality The destiny hydrogen-primarily based totally financial system offers hydrogen as an electricity provider inside a stable and sustainable electricity system. Humanity is at the verge of a brand new generation characterised through superior technologies and new fuels. We will witness new and absolutely exceptional approaches of manufacturing and the use of electricity. The electricity will be generated through reassets with genuinely 0 pollution. Hydrogen may be taken into consideration as a artificial gas, wearing secondary electricity in a destiny generation after the fossil gas financial system.

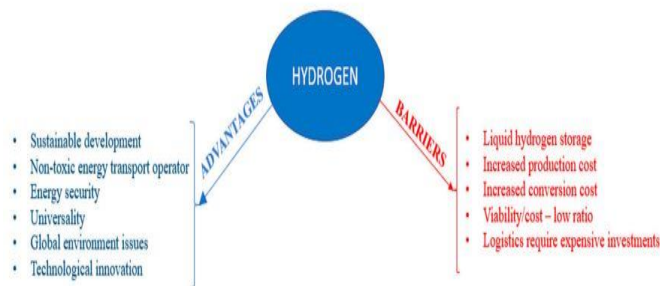
### GLOBAL VIEW OF FUEL CELLS AND CLEAN ENERGY TECHNOLOGIES

The Department of Energy's Office of Energy Efficiency and Renewable Energy invests in smooth electricity technology to enhance the economy, guard the environment, and decrease dependence on foreign oil. A unmarried method can not remedy the electricity demanding situations going through the nation, so DOE helps studies and improvement of a portfolio of smooth electricity technology. Hydrogen and gasoline cells are an essential component of the smooth electricity portfolio. Hydrogen may be made from some of numerous home resources, and gasoline cells can generate energy efficaciously from some of fuels, consisting of biogas, herbal gas, propane, methanol, diesel, and hydrogen. DOE's Fuel Cell Technologies (FCT) Program helps a balanced portfolio of sports that address diverse near-, mid-, and longer-time period packages for gasoline cells. The gasoline mobileular subprogram helps R&D efforts to lessen fee and boom sturdiness of gasoline cells utilized in transportation, stationary, and portable packages. The hydrogen gasoline subprogram helps efforts to generate hydrogen from renewable resources, and decrease the fee to keep and supply hydrogen. This paper will describe the R&D efforts as nicely as cross-slicing sports within side the Fuel Cell Technologies Program.



**FUEL CELL MARKETS**

Various analyses assignment that the worldwide marketplace for gas cells should mature withinside the subsequent 10–20 years, with sales withinside the billions of greenbacks in line with 12 months for stationary, transportable, and transportation packages. Increased marketplace penetration should result in nearly 200,000 jobs withinside the US via way of means of 2020 and nearly 700,000 jobs via way of means of 2035. In the close to term, all packages of gas cells want federal assist. Applications of hydrogen and gas cells wherein a fee proposition may be found, which includes emergency backup energy and forklifts, want much less federal assist and may be commercialized sooner. The era for other packages, which includes transportable energy, isn't always as mature and could want persisted federal assist. In the close to term, all packages of hydrogen and gas cells want federal studies and development (R&D) assist. Interest in easy power technology, which includes gas cells, solar, wind, hybrid electric, biofuels, hydrogen, and geothermal, has been developing in latest years. A degree of the extent of hobby of non-public enterprise is the range of patents issued for revolutionary concepts. The range of US patents for easy power technology in 2011 changed into at an all-time excessive of 2,331, i.e. 24% better than in 2010. The maximum easy power patents had been for gas mobileular technology, with two times as many because the second-area holder, solar, which had just 360 patents in 2010 and 540 in 2011. In the marketplace, there was a 36% growth in MW shipped globally, and a 50% growth in MW shipped withinside the US from 2009 to 2010.

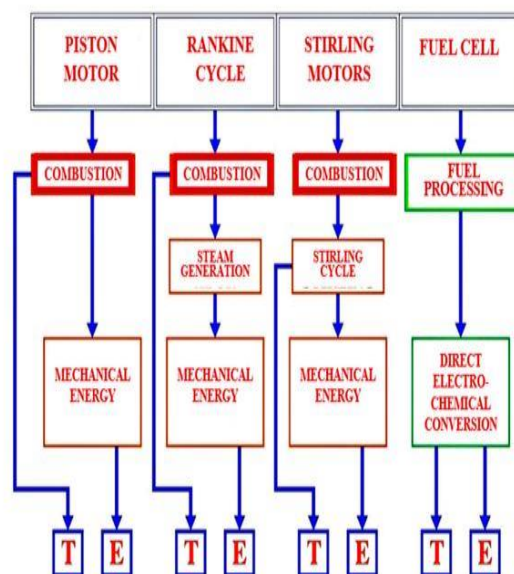


**THE DOE HYDROGEN AND FUEL CELLS PROGRAM**

The Fuel Cell Technologies Program is pursuing some of pathways to generate hydrogen for gasoline cells. These pathways encompass each disbursed manufacturing withinside the close to time period and significant manufacturing in the long time period. The Program's hydrogen threshold fee is 2–4/kg, to be aggressive with superior hybrid motors. Electrolysis, bio-derived liquids, and herbal fueloline reforming can generate hydrogen withinside the close to time period. The projected excessive extent fee of hydrogen produced with the aid of using those pathways is visible in. The fee consists of compression, storage, and doling out for disbursed technologies, and the fee of shipping is blanketed for significant manufacturing. The levels correspond to variability withinside the fee of the feedstock. The pathways estimated for significant manufacturing encompass electrolysis and biomass gasification. The fees of generating hydrogen from the ones pathways want to return back down considerably to attain the edge fee and be aggressive with the fee of different fuels. One of the most important troubles stopping the extensive adoption of hydrogen-powered gasoline mobileular motors is the shortage of infrastructure. Several alternatives for early hydrogen infrastructure were proposed. In the primary choice, hydrogen is produced at a significant place and then introduced to the factor of use. In this case, hydrogen might be introduced with the aid of using a tube trailer to a station at which a low extent of hydrogen, 200–three hundred kg/day, is sold; might fee much less than 1 million; and provide hydrogen for around 7/kg. In the lengthy time period, the extent might growth to 400–500 kg/day and the hydrogen might fee 5/kg. The 2d fundamental choice might be disbursed manufacturing, wherein hydrogen is produced on the factor of use and generated with the aid of using steam methane reforming or electrolysis. Other alternatives encompass trigeneration, wherein hydrogen is co-produced in conjunction with warmth and energy from herbal fueloline or biogas feedstock.

## FUEL CELL

One of the important thing problems stopping mass commercialization of gasoline cells is the excessive fee of the device. The Program video display units the fee of eighty kW gasoline mobileular structures for transportation packages to assess development in its R&D efforts. The fee is projected to 500,000 gadgets produced according to year. In 2011, the projected fee of an eighty kW gasoline mobileular device for light-responsibility cars become 49/kW, better than the target of 30/kW required to be aggressive with today's cars. The projected fee is greater than 30% decrease than the estimate in 2008. Since the advent of gasoline mobileular cars might be at a quantity decrease than 500,000 gadgets according to year, the fee become projected at special production rates. At a thousand cars according to year, the device fee is around 219/kW, while at 30,000 cars according to year, the fee is 82/kW.



## TECHNOLOGY VALIDATION

The Technology Validation subprogram evaluates the overall performance and sturdiness of hydrogen and gas mobileular structures below real-international running conditions. Past sports withinside the subprogram encompass driving gas mobileular cars on the street and on dynamometers, shelling out hydrogen from refueling stations, and then assessing the reputation and development of every technology. Since the Learning Demonstration attempt began, the gas mobileular electric powered cars had been pushed over 3.6 million miles and that they operated ~2500 hours on average. Over 151,000 kg of hydrogen had been produced or distributed on the stations, despite the fact that now no longer all of the hydrogen become used withinside the Learning Demonstration cars. The assessment attempt has for the reason that accelerated to different forms of gas mobileular cars, together with gas mobileular buses in cooperation with the Department of Transportation and forklifts placed at a Department of Defense warehouse. The Technology Validation subprogram additionally video display units the overall performance and sturdiness of desk bound gas cells. The National Renewable Energy Laboratory (NREL) has evaluated records from the Technology Validation Program and from the gas cells deployed the use of investment from the American Recovery and Reinvestment Act of 2009. NREL companions with end-customers and gas mobileular builders to create records units and composite records merchandise of the gas mobileular structures running below real-international conditions. NREL observed that the gas mobileular structures in backup energy operated 1100 hours on average, with a projection to 2400 hours for a 10 gradation in voltage (a metric created to reveal sturdiness at a hard and fast modern density). Fuel mobileular cars averaged 2700 hours of operation, with a projection of 4000 hours for a 10% drop in voltage, that is drawing near the DOE sturdiness goal of 5000 hours for transportation gas cells. Fuel mobileular-powered forklifts operated greater than 4000 hours with a projected time to 10% voltage drop of almost

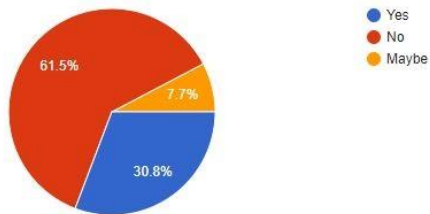
15,000 hours, even as gas mobileular structures used for high energy (1–10 kWe residential mixed warmth and energy and dispensed era gas mobileular structures) operated 7000 hours, with over 11,000 hours. For quick stacks, NREL observed that the projected hours are among 3000 and 5000 hours for all packages besides high energy. imparting high energy and backup energy lasted 6000 hours, while gas mobileular structures in forklifts had been projected to ultimate 17,000 hours. A very promising new hobby withinside the Program is a mixed warmth, hydrogen, and energy (CHHP) device, mounted on the Orange County Sanitation District in Fountain Valley, California. The gas mobileular device operates on hydrogen from anaerobic digestion of municipal wastewater, and is illustrated in. The unit generates warmth, electricity, and hydrogen with 54 efficiency (hydrogen plus energy) whilst running in hydrogen co-manufacturing mode. With a compressor placed onsite, the unit can provide one hundred kg/day to refuel gas mobileular cars. The public-get admission to shelling out station become set up with the aid of using the project crew of Air Products, Fuel-Cell Energy, and the National Fuel Cell Research Center at UC Irvine.

**MARKET TRANSFORMATION**

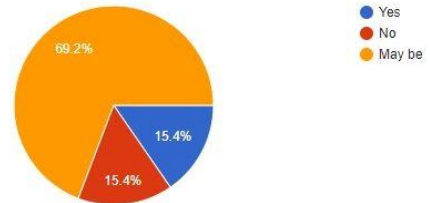
In 2009, the Fuel Cell Technologies Program awarded 40 million of funding from the 2009 American Recovery and Reinvestment Act (ARRA) to put in gas mobileular systems throughout the United States. The US Congress surpassed the ARRA to create new jobs withinside americaA and hold cutting-edge ones, spur monetary activity, and invest in long-term monetary growth. Including organisation rate-share, the whole funding for gas mobileular deployment is \$96 million. The gas cells were deployed withinside the subsequent early market applications: materials handling, backup electricity, residential and small commercial combined heat and electricity (CHP), portable electricity, and auxiliary electricity. More than a thousand gas mobileular systems are currently operational, and the majority are used for backup electricity at telecommunications webweb webweb sites and in forklifts for materials handling. Most of the gas mobileular systems are deployed in California, Pennsylvania, and Texas. As of December 2011, the forklifts have been operated for almost 1 million hours. The ARRA duties were quite a achievement in the case of the forklifts, due to the fact the corporations which used them now plan to put in more than 3000 additional gas mobileular-powered forklifts on their own, without federal funding. The safety rate of gas mobileular-powered forklifts is lower, the labor rate to refuel the forklift is lots lower, and the net present charge of the whole device rate is lower. In addition, the gas mobileular-powered forklifts generate a lot much less greenhouse gases than conventional internal combustion engine (ICE) and battery electric forklifts.

**SURVEY RESULTS**

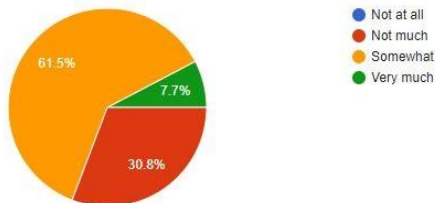
Do you know that we can make Hydrogen fuel using Hydrogen?



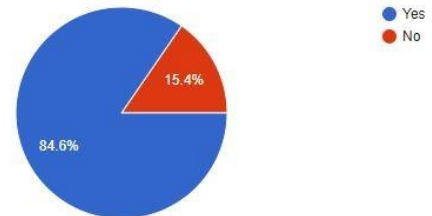
Can hydrogen fuel cause harm to environment



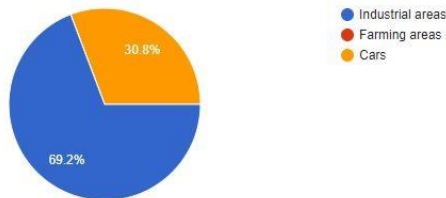
How efficient is hydrogen fuel compare to fossil fuel?



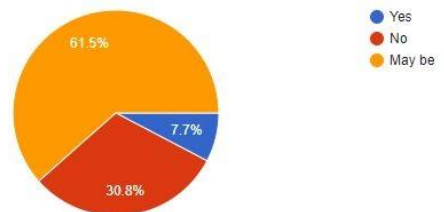
Is hydrogen fuel renewable?



In which areas we can use hydrogen fuel?



Can Hydrogen Fuel come from water?



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## 2. **CONCLUSION**

Hydrogen and gasoline mobileular era have superior significantly during the last fifteen years. At the worldwide level, this location keeps to stand widespread challenges—technical, industrial and infrastructure-related—that want to be conquer earlier than gasoline cells can recognize the entire ability of which they're capable. Policy makers have blanketed hydrogen and gasoline mobileular at the map of destiny energy techniques and feature already taken under consideration the truth that gasoline cells have superb actual ability and can correctly meet the technical, social, financial and environmental goals withinside the context of the multidisciplinary idea of sustainable development.

## REFERENCES

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