



## Hydrogen fuel – Production, Energy and its Uses

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Hydrogen fuel may be a zero-emission fuel burned with oxygen. It are often utilized in fuel cells or combustion engines. it's begun to be utilized in commercial cell vehicles, like passenger cars, and has been utilized in cell buses for several years. it's also used as a fuel for spacecraft propulsion. The energy released enables hydrogen to act as a fuel. In an electrochemical cell, that energy are often used with relatively high efficiency. If it's used simply for warmth, the standard thermodynamics limits on the thermal efficiency apply.

Hydrogen is typically considered an energy carrier, like electricity, because it must be produced from a primary energy source like solar power, biomass, electricity (e.g. within the sort of solar PV or via wind turbines), or hydrocarbons like gas or coal.[5] Conventional hydrogen production using gas induces significant environmental impacts; like the utilization of any hydrocarbon, CO<sub>2</sub> is emitted. At an equivalent time, the addition of 20% of hydrogen (an optimal share that doesn't affect gas pipes and appliances) to gas can reduce CO<sub>2</sub> emissions caused by heating and cooking.

### Production

Hydrogen fuel are often produced from methane or by electrolysis of water.[9] As of 2020, the bulk of hydrogen (~95%) is produced from fossil fuels by steam reforming or partial oxidation of methane and coal gasification with only a little quantity by other routes like biomass gasification or electrolysis of water.

However, this reaction releases fossil CO<sub>2</sub> and carbon monoxide gas into the atmosphere which are greenhouse gases exogenous to the natural carbon cycle, and thus contribute to global climate change. In electrolysis, electricity is run through water to separate the hydrogen and oxygen atoms. Obtaining hydrogen from this process is being studied as a viable thanks to produce it domestically at a coffee cost.

### Energy

Hydrogen is locked up in enormous quantities in water, hydrocarbons, and other organic matter one among the challenges of using hydrogen as a fuel comes from having the ability to extract hydrogen efficiently from these compounds. Now, steam reforming, which mixes high-temperature steam with gas, accounts for the bulk of the hydrogen produced.[15] This method of hydrogen production occurs at temperatures between 700-1100°C, and features a resultant efficiency of between 60-75%.[16] Hydrogen also can be produced from water through electrolysis, which is a smaller amount carbon intensive if the electricity wont to drive the reaction doesn't come from fossil-fuel power plants but rather renewable or atomic energy instead. The efficiency of water electrolysis is between about 70-80%, with a goal set to succeed in 82-86% efficiency by 2030 using proton exchange membrane (PEM) electrolyzers.

Once produced, hydrogen are often utilized in much an equivalent way as gas - it are often delivered to fuel cells to get electricity and warmth, utilized in a combined cycle turbine to supply larger quantities of centrally produced electricity or burned to run a combustion engine; all methods producing no carbon or methane emissions.[20] In each case hydrogen is combined with oxygen to make water. this is often also one among its most vital advantages as hydrogen fuel is environmentally friendly, the warmth during a hydrogen flame may be a radiant emission from the newly formed water molecules. The water molecules are in an excited state on initial formation then transition to a ground state; the transition releasing thermal radiation. When burning in air, the temperature is roughly 2000 °C (the same as natural gas). Historically, carbon has been the foremost practical carrier of energy, as hydrogen and carbon combined are more volumetrically dense, although hydrogen itself has 3 times the energy density per mass as methane or gasoline. Although hydrogen is that the smallest element and thus features a slightly higher propensity to leak from venerable gas pipes like those made up of iron, leakage from plastic (polyethylene PE100) pipes is predicted to be very low at about 0.001%.

The reason steam methane reforming has traditionally been favoured over electrolysis is because whereas methane reforming directly uses gas, electrolysis requires electricity. because the cost of manufacturing electricity (via wind turbines and solar PV) falls below the value of gas, electrolysis becomes cheaper than SMR

### Uses

Hydrogen fuels are often wont to power stationary power generation plants, or provide an alternate to gas for heating applications.

Hydrogen fuel also can provide locomotion for liquid-propellant rockets, cars, trucks, trains, boats and airplanes, portable cell applications or stationary cell applications, which may power an electrical motor. The issues of using hydrogen fuel in cars arise from the very fact that hydrogen is difficult to store in either a high tank or a cryogenic tank. Alternative storage media like within complex metal hydrides are in development.