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| Testo di partenza  \*NON tradurre il testo evidenziato in giallo | Testo tradotto dal candidato | Spazio a disposizione del correttore | Penalità |
| **Hydrogen Production and Uses**  **(Updated November 2021)** |  |  |  |
| Hydrogen is not found in free form (H2) but must be liberated from molecules such as water or methane. It is therefore not an energy source and must be made, using energy. It is already a significant chemical product, about half of annual pure hydrogen production being used in making nitrogen fertilisers via the Haber process and about one-quarter to convert low-grade crude oils (especially those from tar sands) into liquid transport fuels. There is a lot of experience handling hydrogen on a large scale, though it is not as straightforward as natural gas. |  |  |  |
| Most hydrogen today is made by steam reforming of natural gas or coal gasification, both with carbon dioxide (CO2) emissions. Future demand will be mainly for zero-carbon hydrogen. Plans for increased hydrogen production are essentially based on electrolysis using electricity from intermittent renewable sources. Off-peak capacity of conventional nuclear reactors or other power plants can also be used. In future, a major possibility for zero-carbon hydrogen production is decomposition of water by direct use of heat from nuclear energy, using a thermochemical process enabled by high-temperature reactors. |  |  |  |
| The rapidly-growing demand for hydrogen by oil refineries and chemical plants favours technologies with low costs. Limited hydrogen pipeline networks already exist, allowing production facilities to be some way from users. |  |  |  |
| According to the International Energy Agency (IEA)1, in 2018 demand for pure hydrogen was about 74 million tonnes (Mt), of which 38.2 Mt was used in oil refining and 31.5 Mt in ammonia production. There was a further 42 Mt of demand for hydrogen mixed with other gases such as carbon monoxide. Of this, 12 Mt was used in methanol production and 4 Mt in direct-reduced iron (DRI) for steel. |  |  |  |
| Like electricity, hydrogen is an energy carrier (but not a primary energy source). Hydrogen has some potential to replace oil as a transport fuel and in other applications. It is the preferred fuel for fuel cell electric vehicles (FCEVs), though portable storage at vehicle scale is a challenge. Hydrogen can also be used in internal combustion engines. |  |  |  |
| While hydrogen can replace liquid hydrocarbons, it is never as energy-dense or convenient to store and transport. However, it does compare well with batteries, which is why it and hydrogen-based liquid fuels have a lot of potential. |  |  |  |
| Electricity and hydrogen are convertible one to the other as energy carriers. However, the overall efficiency of electricity-hydrogen-fuel cell-electricity is no more than 40%. One approach to mitigate intermittency of wind and solar electricity is to make hydrogen by electrolysis and feed this into the gas grid, the power-to-gas strategy. It has been suggested that most electricity from wind might be used thus, greatly simplifying electrical grid management. |  |  |  |
| In future some hydrogen produced for fuel may be converted into ammonia as a more energy-dense carrier medium volumetrically for trade or long-term energy storage. The mass energy density of hydrogen is 120 or 142 MJ/kg\*, compared with methane 50 MJ/kg, propane 46 MJ/kg and ammonia 19 MJ/kg. Volumetrically, the energy density of hydrogen is low – 10.8 or 12.75 MJ/Nm3 (or as liquid: 8.5 or 10.0 MJ/L)\*\*. Ammonia is the main hydrogen derivative in consideration for transport. |  |  |  |
| \*Lower (net heat of combustion) and higher (gross heat of combustion) heating values, respectively |  |  |  |
| \*\*Nm3 = normal cubic metre (0 °C temperature and 1.01325 bar (i.e. 1 atmosphere) pressure. |  |  |  |

Fonte: https://world-nuclear.org/information-library/energy-and-the-environment/hydrogen-production-and-uses.aspx

Destinatario : tecnici del settore