

GREEN FUELS AND HYDROGEN AS AN ALTERNATIVE TO FOSSIL FUELS: ADVANTAGES AND DRAWBACKS ON AN ENVIRONMENTAL POINT OF VIEW.

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Green fuels derived from vegetable resources (biomass) is an alternative to fossil fuels. They can be used directly as motor fuels or energetic fuels or for the production of “green” hydrogen.

Motor fuels: green fuels are already used as additives to fossil fuels. Bioethanol and its ether derivatives (specially, ethyl-tertio-butyl ether, ETBE) is an oxygenated additive to gasoline. It is mainly produced by fermentation of plants containing polyols (beet, sugar cane,...) or starch (wheat, corn, potatoes, rice,...). In 2002, the world production of ethanol was 331 Mhl, essentially in Brazil (37%) USA (25%) and only 11% in Europe (21 Mhl). Bioesters (methyl or ethyl esters of vegetable oils) are used as additives to Diesel oils. The European production in 2002 was 1.07 MT. The net CO₂ emission is reduced by 2.5 T per T of bioester in gasoil and by 2.7 T CO₂ per T of ethanol in gasoline. The objective in Europe is to reach 5.75% of green fuels in motor fuels in 2010.

Energetic fuels: green fuels can be produced from wood, lignocellulosic crops and agricultural byproducts. The world resources in wood are close to 150×10⁹ T. About 3×10⁹ T of renewable fuels would be available every year in substitution of fossil fuels (10×10⁹ TOE consumed per year). However, biomass has to be gasified into hydrogen or other gases for practical applications (other than direct combustion).

Hydrogen is the most abundant element of the Universe, mainly present in the interstellar gases and stars (75 at.% in Sun). Every second, in Sun, 700×10⁶ T of hydrogen are consumed by a nuclear fusion reaction producing 695×10⁶ T of helium while 5×10⁶ T are converted into energy representing 2×10³⁶W dissipated in the solar system. About 10¹⁸W come on Earth: this is the very primary source of energy. By contrast, hydrogen is relatively rare on Earth (0.9 at.%), essentially combined to carbon in fossil fuels, oxygen in water and both in biomass. For environmental reasons, the replacement of fossil fuels by green fuels is a key to the development of H₂-fuel in the future.

Virtually, green fuels present a decisive advantage in term of global pollution. However, the balance is far to be nil in term of CO₂ emission: biofuels production requires both chemicals inputs (fertilizer, pesticide, water for irrigation,...) and energetic inputs (transportation, steam and electricity for the processes,...).

Moreover, the biomass oil industry is not a mature industry (in comparison to the fossil oil industry) and most processes may largely be improved. Also, biomass produces rather diluted carbon resources and great efforts for managing and rationalizing the agricultural policy will be mandatory to create good conditions for a modern Energy Industry.

Finally, it will necessary to adapt the “bio-petrochemistry” to biofuels industry and to develop new processes for chemical applications and chemical syntheses from molecules present in biofuels. Among these molecules, glycerol (by-product of biodiesel) and some alcohols (by-products of biogasoline) are the most pertinent examples of products whose economy will be upset by the introduction of biofuels.