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SENTER FOR MATERIALVITENSKAP OG NANOTEKNOLOGI

Can Water be the Coal of the Future?

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«Water will be the Coal of the Future»



Jules Verne, 1874

...water will one day be employed as a fuel, that hydrogen and oxygen that constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable. Someday the coal rooms of steamers and the tenders of locomotives will, instead of coal, be stored with these two condensed gases, which will burn in the furnaces with enormous caloric power...I believe, that when the deposits of coal are exhausted, we shall heat and warm ourselves with water... Water will be the coal of the future....

Mysterious Island, Pierre-Jules Hetzel Publisher; Paris, France: 1874

...if in a distant future the supply of coal becomes completely exhausted, civilization will not be checked by that, for life and civilization will continue as long as the sun shines! If our black and nervous civilization, based on coal, shall be followed by a quieter civilization based on the utilization of solar energy that will not be harmful to progress and to human happiness...

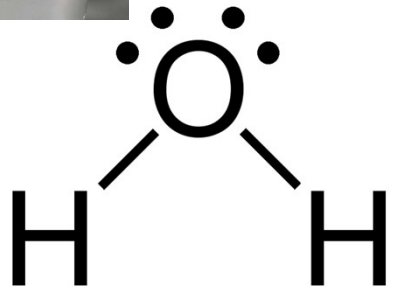


G. Ciamician

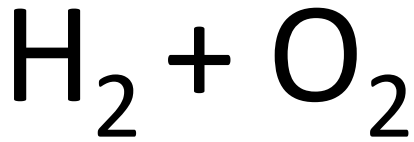
Giacomo Ciamician, 1912
University of Bologna

- Giacomo C. *The Photochemistry of the Future*. *Science*. 1912;36:385–394
- Venturi M., Balzani V., Gandolfi M.T. *Fuels from Solar Energy. A dream of Giacomo Ciamician, the father of photochemistry*; *Proceedings of the 2005 Solar World Congress*; Orlando, FL, USA. 6–12 August 2005

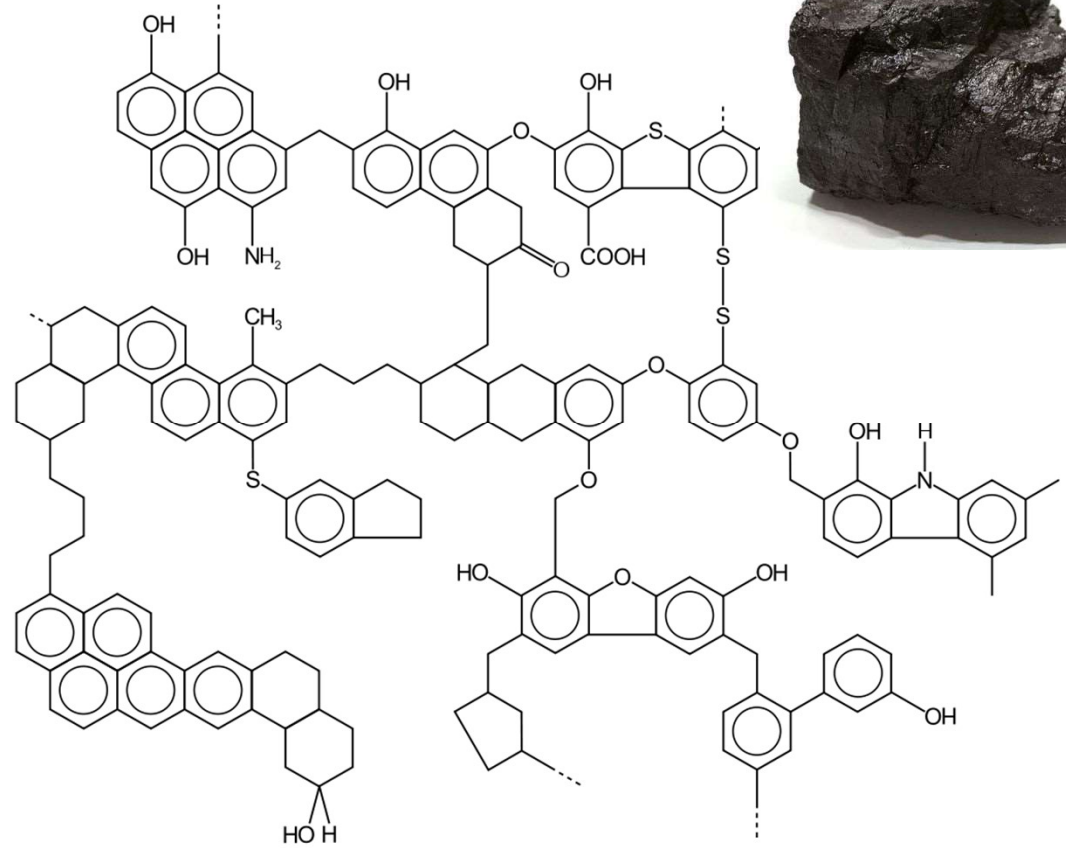
Facts



Electrolysis



143 MJ/Kg



26-33 MJ/Kg

Facts



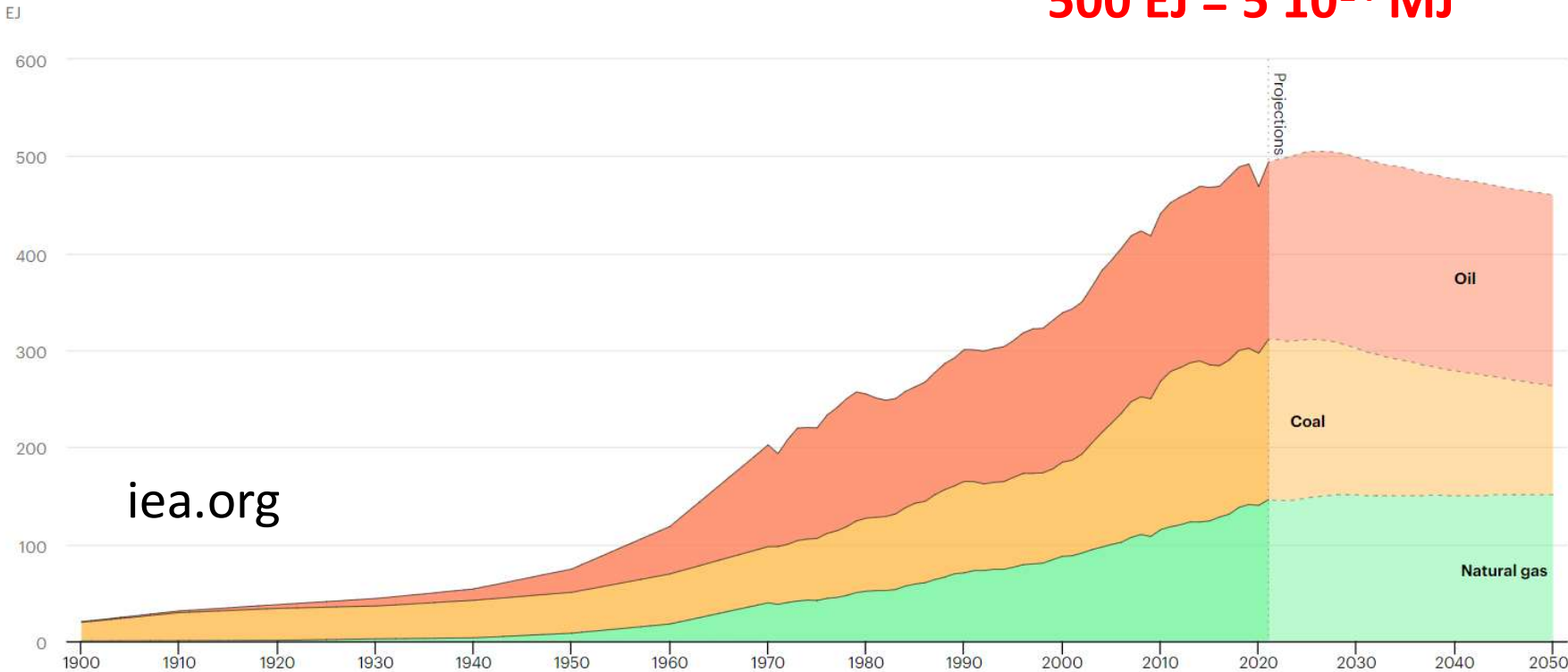
1700 kJ/100 g

17 MJ/Kg

Facts

Fossil fuel demand in the Stated Policies Scenario, 1900-2050

1 EJ = 10¹² MJ
500 EJ = 5 10¹⁴ MJ



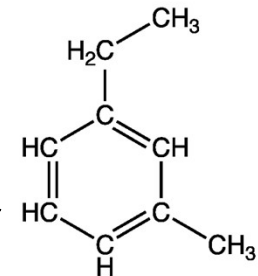
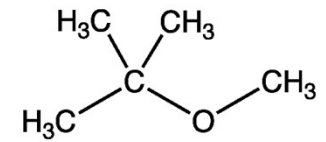
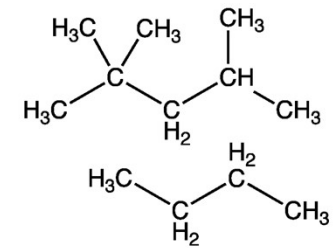
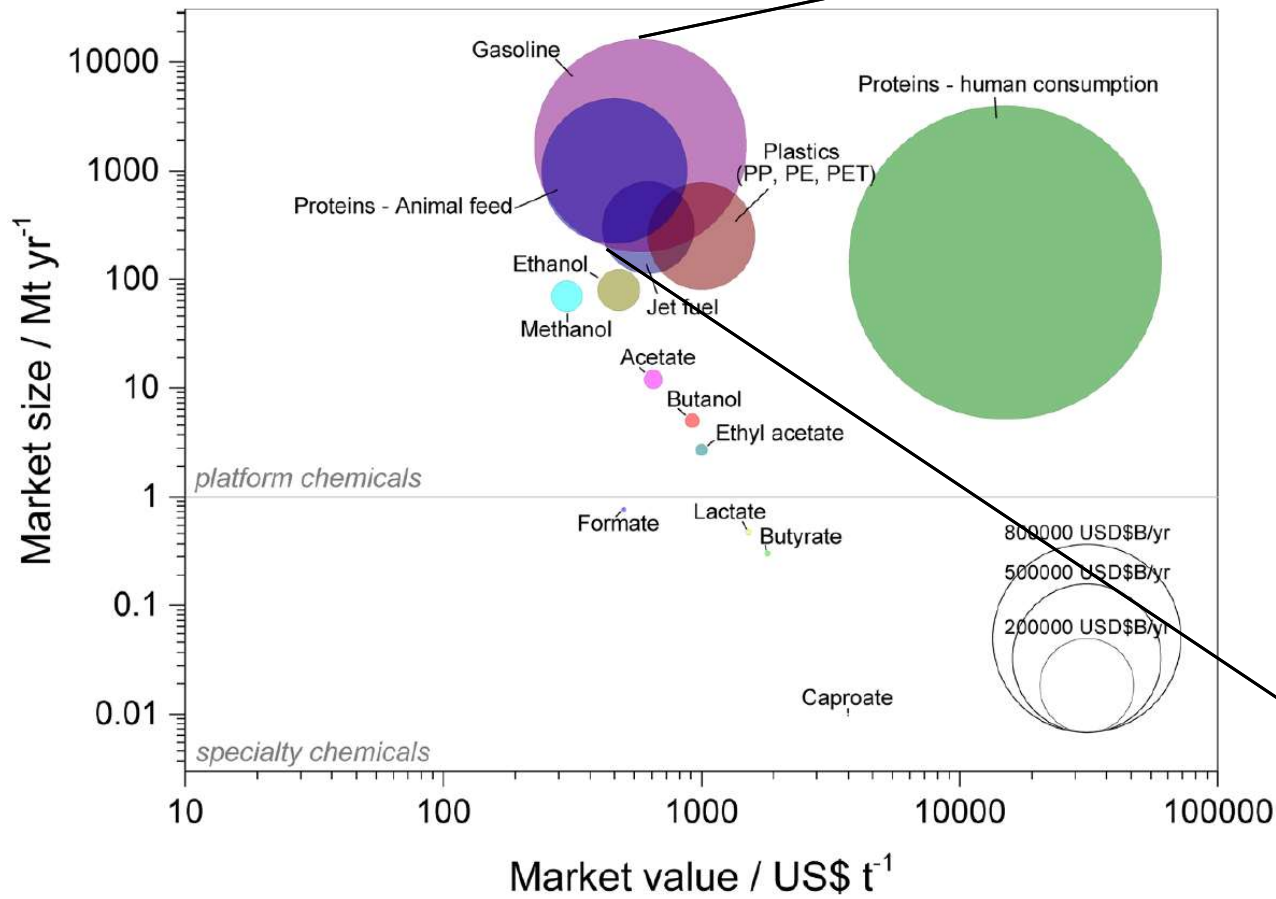
Hydrogen

A high energy density fuel that burns to **water** - Water can be photo-electrolysed back to **H₂**

Gravimetric and volumetric energy densities of different fuels

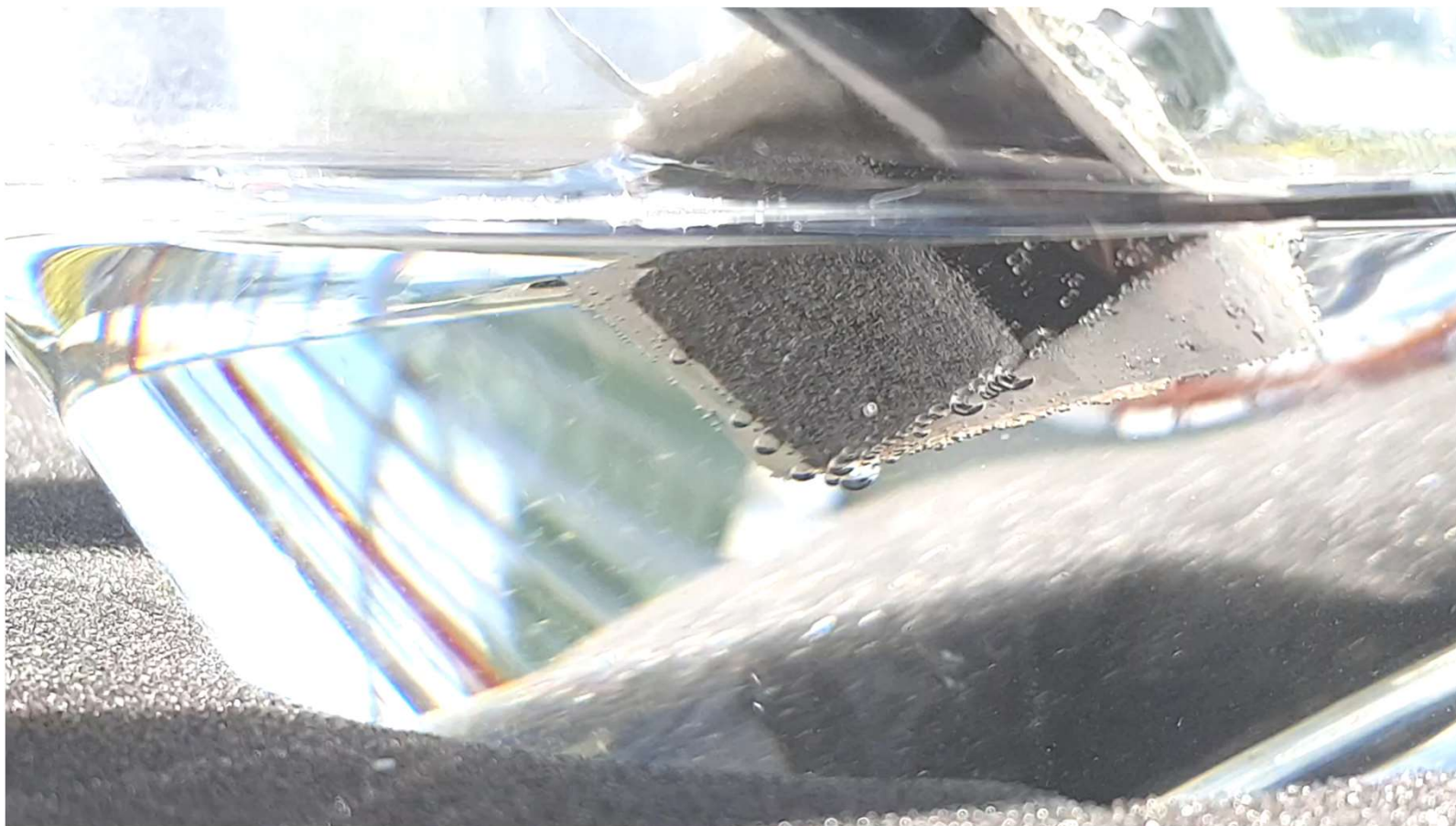
Fuel	Gravimetric (MJ/Kg)	Volumetric (MJ/L)
Coal	24	-
Wood	16	-
Gasoline	44	35
Diesel	46	37
Methanol	20	18
Natural Gas	54	0.036
Hydrogen	143	0.011

Chemicals & chemical energy



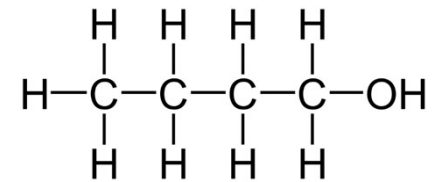
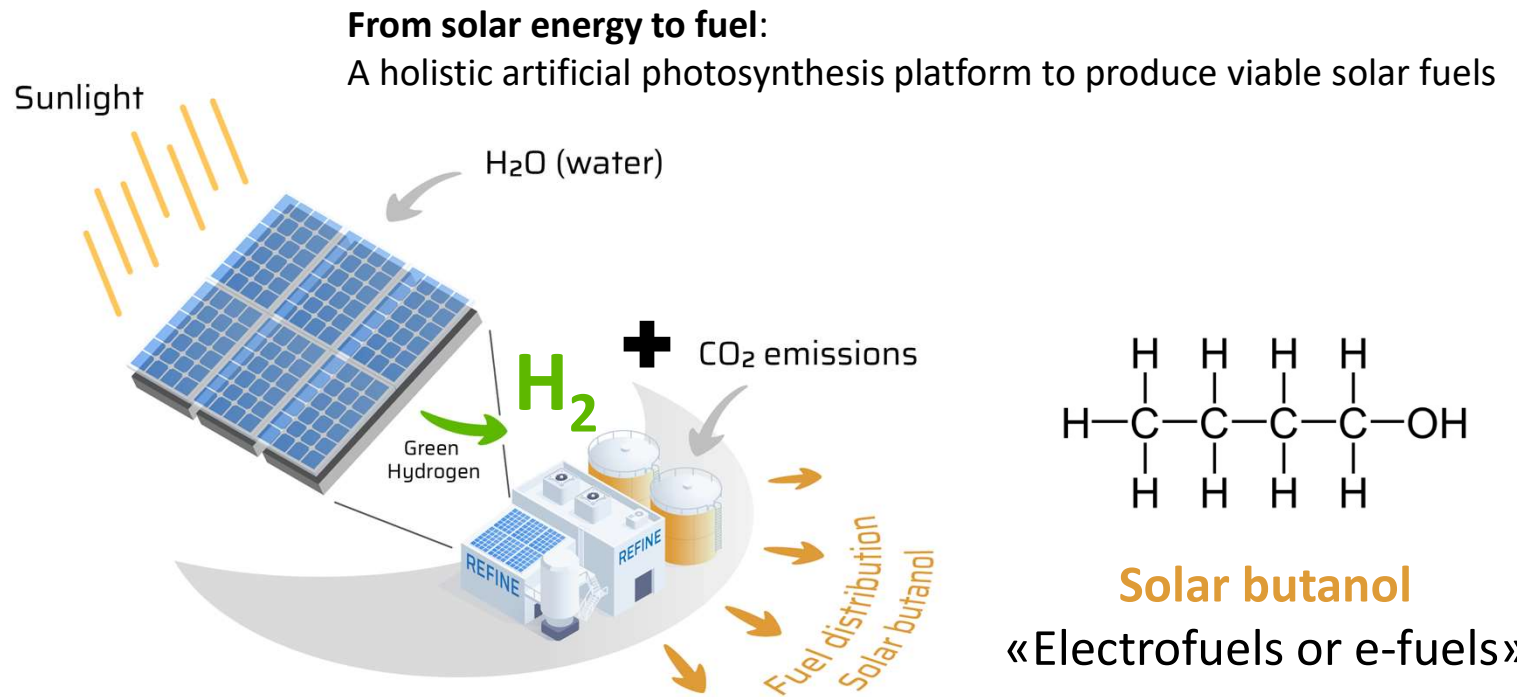
Wikipedia

Water electrolysis and H₂ production at UiO



J. Zhu, A. Chatzitakis et al., ACS App. Mater. Interfaces, 2021, 13 (17), 20313

Our efforts



Solar butanol
«Electrofuels or e-fuels»

Artificial Photosynthesis Platform System

Solar butanol production in a 4G biorefinery



This project has received funding from the European Union HORIZON Research and Innovation Actions under grant agreement ID 101122323