Perspektive korišćenja hidrogena u supstituciji fosilnih goriva

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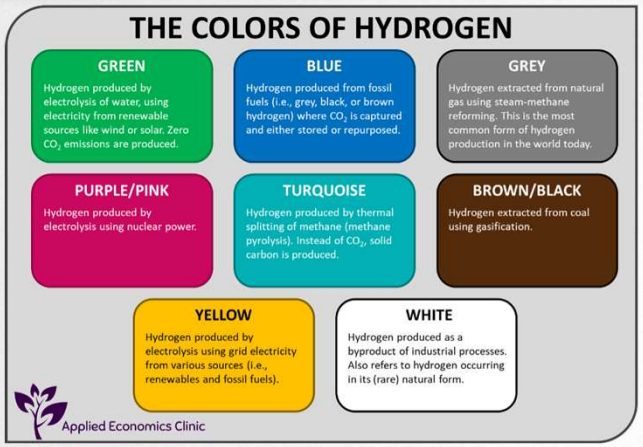
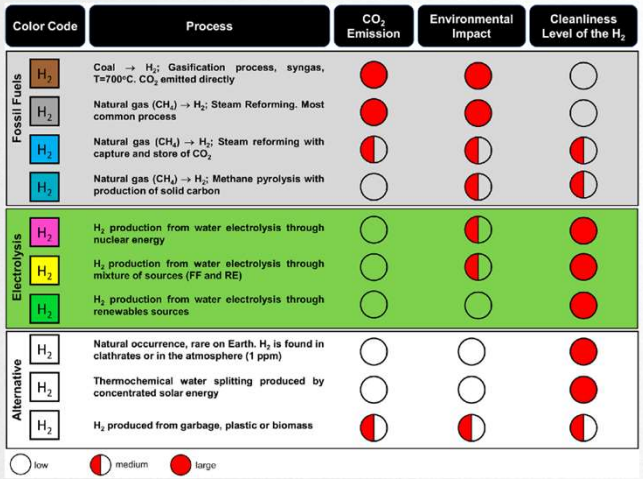
Hidrogen metode proizvodnje



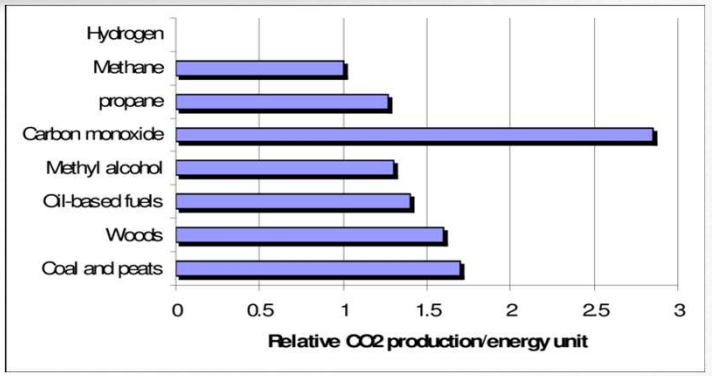


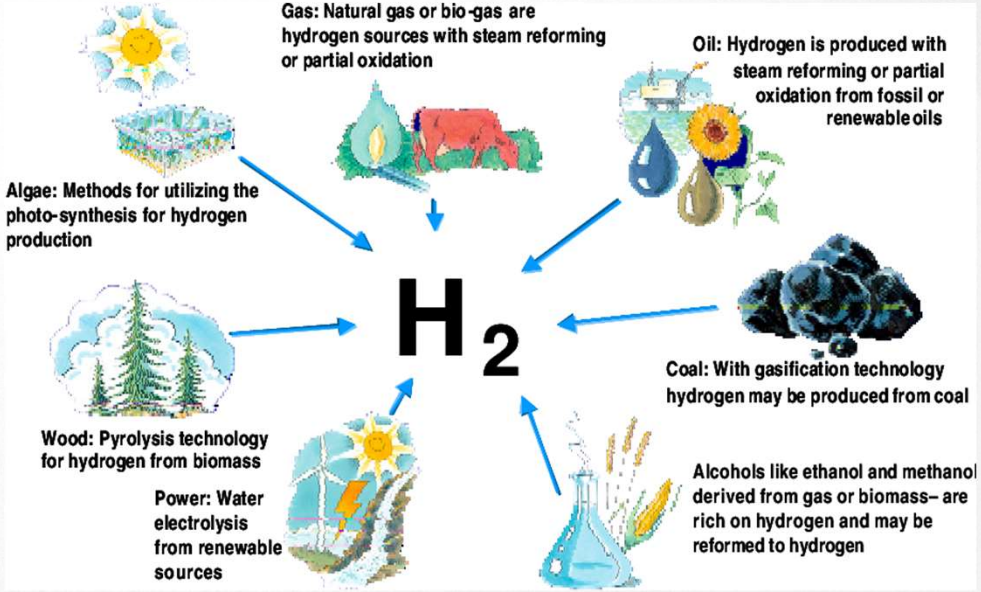
Metode proizvodnje:

- Gasifikacija ugljenika ili pretvaranje prirodnog gasa bez proizvodnje CO2
- Pretvaranje metana sa izdvajanjem ugljenika
- Elektroliza vode korišćenjem energije iz obnovljivih izvora
- Elektroliza vode korišćenjem nuklearnih izvora
- Piroliza metana koja proizvodi hidrogen i čvrsti ugljenik kao nusproizvod
- Gasifikacija i drugi procesi korišćenjem biomase

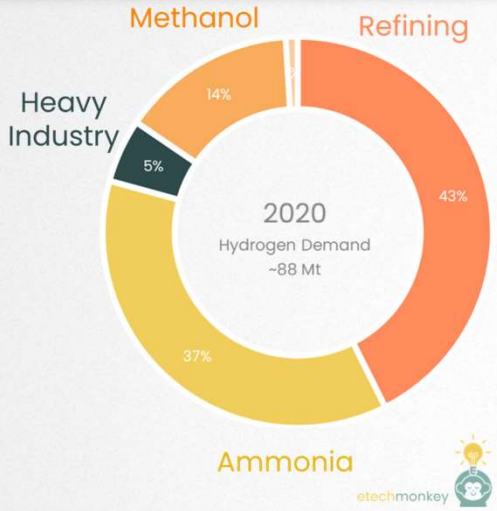
Efikasnost metoda proizvodnje hidrogena

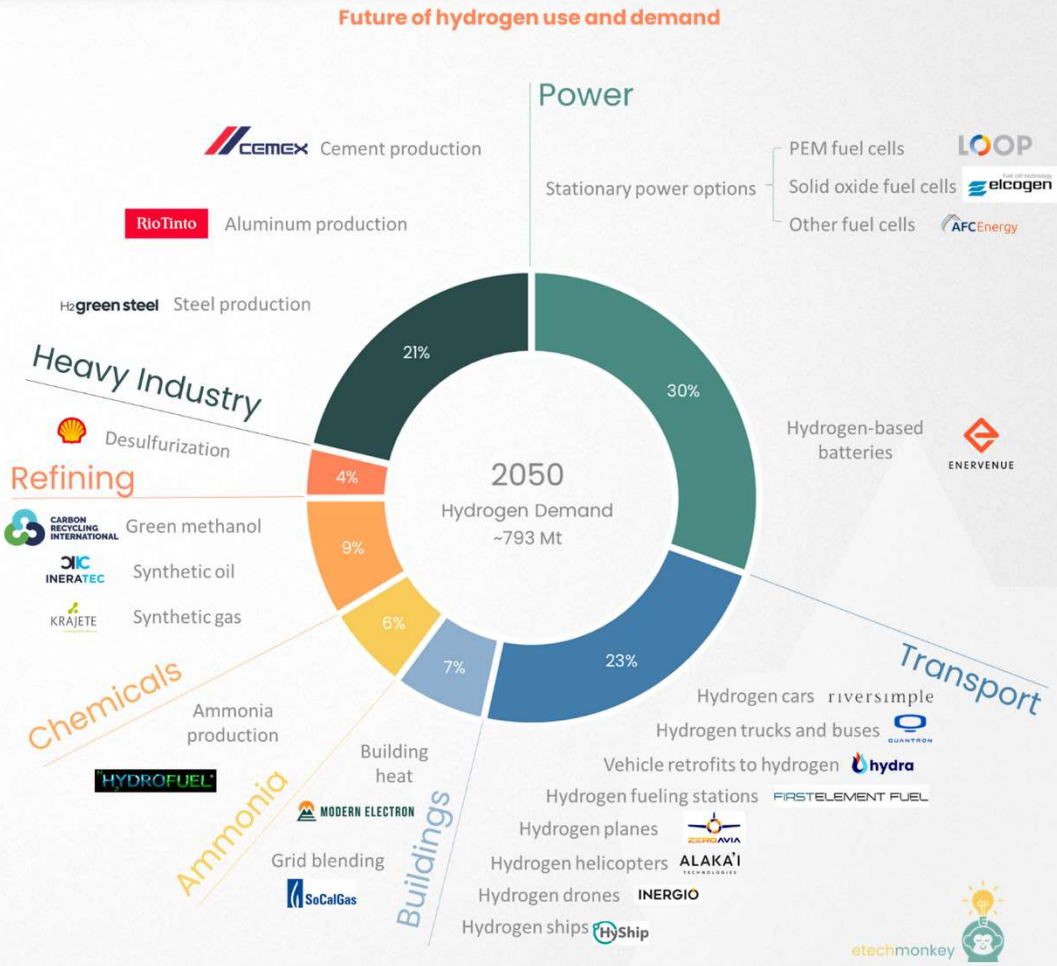
Process	Energy Required (kWh/Nm3) Ideal	Practical	Status of Tech.	Efficiency [%]	Costs Relative to SMR
Steam methane reforming (SMR)	0.78	2-2.5	mature	70-80	1
Methane/ NG pyrolysis			R&D to mature	72-54	0.9
H2S methane reforming	1.5	-	R&D	50	<1
Landfill gas dry reformation			R&D	47-58	~1
Partial oxidation of heavy oil	0.94	4.9	mature	70	1.8
Naphtha reforming			mature		
Steam reforming of waste oil			R&D	75	<1
Coal gasification (TEXACO)	1.01	8.6	mature	60	1.4-2.6
Partial oxidation of coal			mature	55	
Steam-iron process			R&D	46	1.9
Chloralkali electrolysis			mature		by-product
Grid electrolysis of water	3.54	4.9	R&D	27	3-10
Solar & PV-electrolysis of water			R&D to mature	10	>3
High-temp. electrolysis of water			R&D	48	2.2
Thermochemical water splitting			early R&D	35-45	6
Biomass gasification			R&D	45-50	2.0-2.4
Photobiological			early R&D	<1	
Photolysis of water			early R&D	<10	
Photoelectrochemical decomp. of water			early R&D		
Photocatalytic decomp. of water			early R&D		



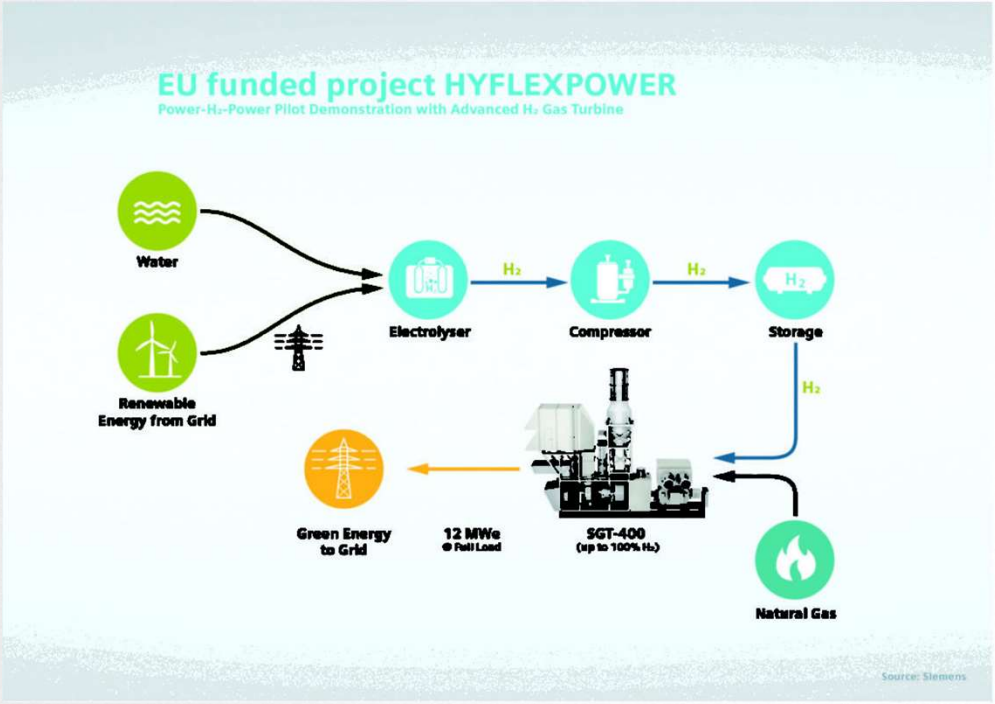


Korišćenje hidrogena 2020 vs 2050



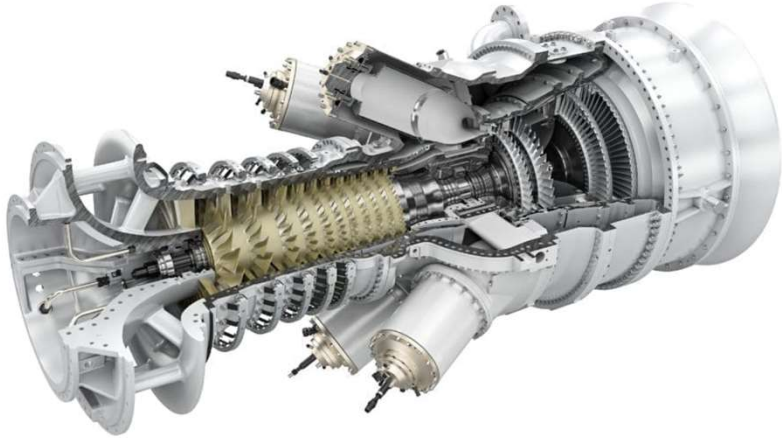


Zamena prirodnog gasa u gasnim elektranama (toplanama)

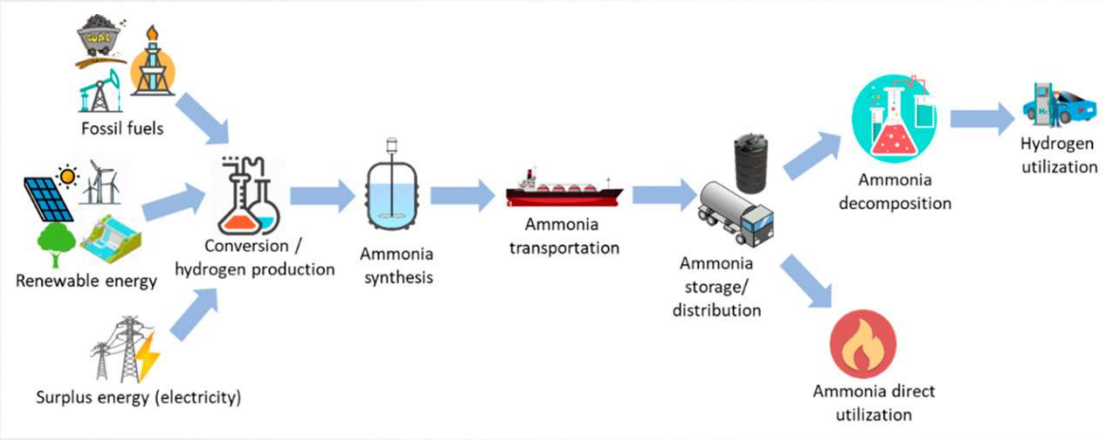


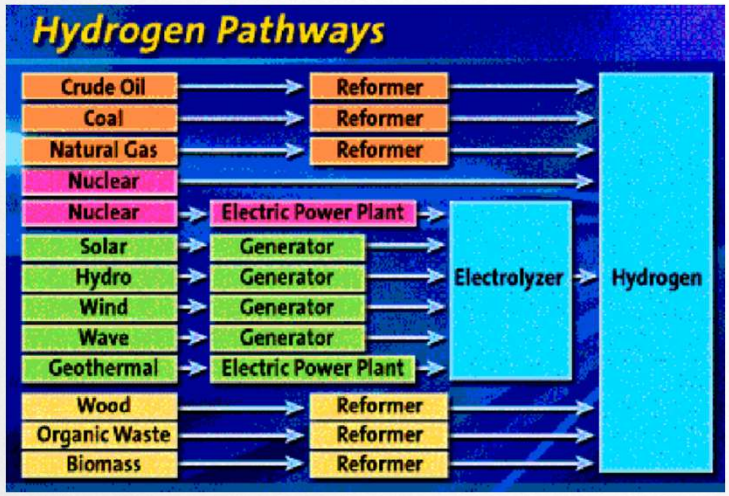
80% Hydrogen

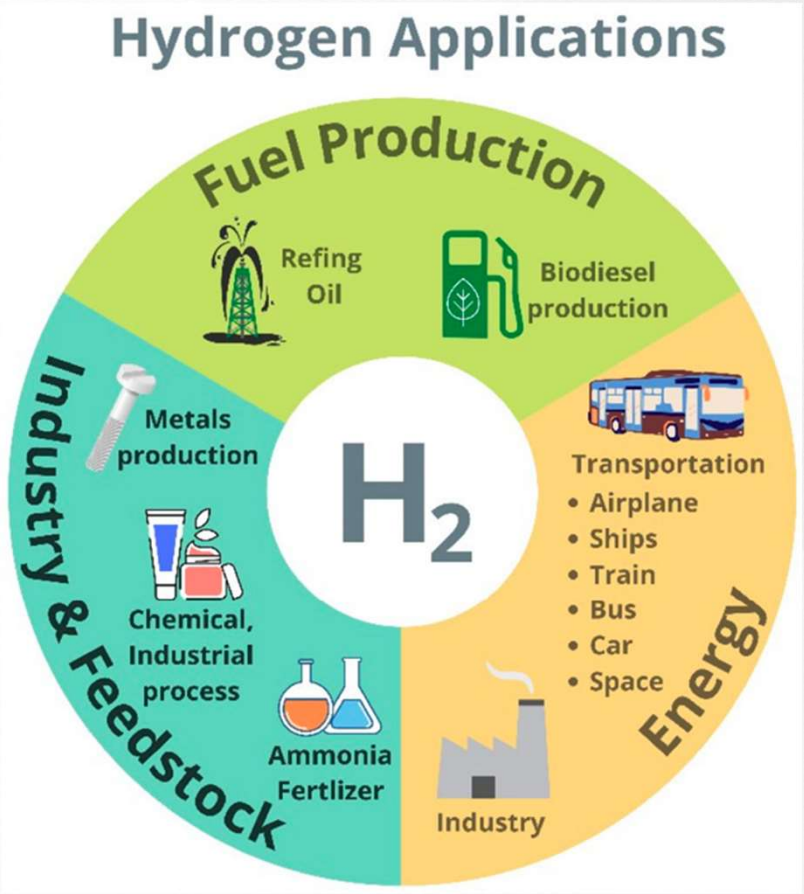
As part of the HYFLEXPOWER consortium, Siemens will upgrade an existing SGT-400 industrial gas turbine to generate electricity and thermal energy with stored hydrogen and demonstrate an industrial-scale power-to-H2-to-power solution.



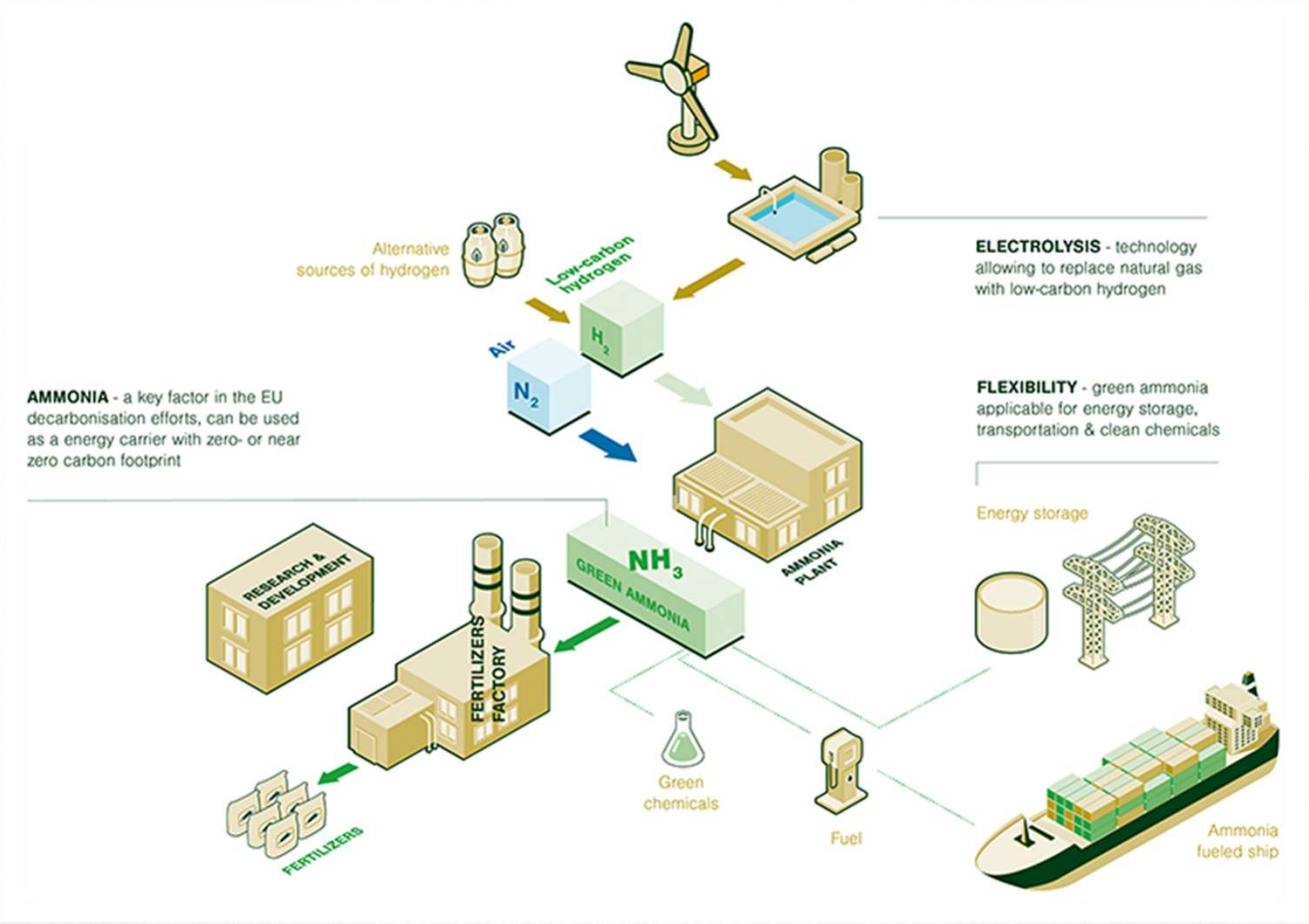
Amonijak kao storidž za hidrogen



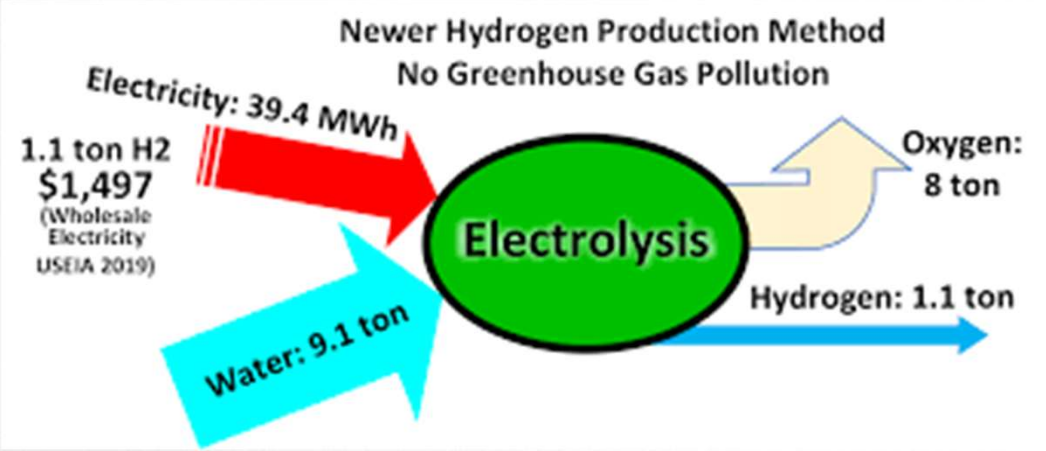




Proizvodnja veštačkog đubriva kao druga faza



Proizvodnja hidrogena



Ako samo proizvodimo hidrogen iz fotonaponske elektrane imaćemo cenu od oko 38 US$ po MWh.

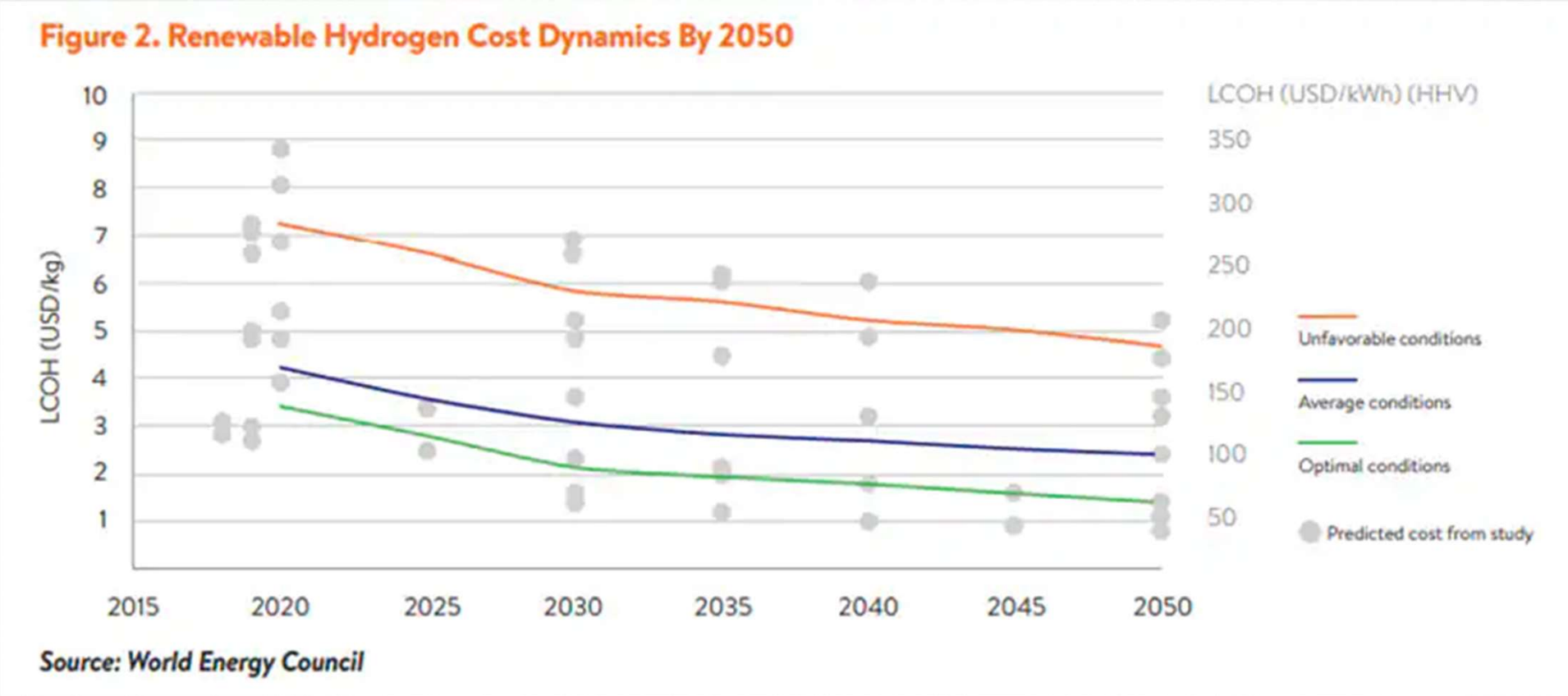
33.6 kWh electricity per 1 kg of Hydrogen

36.96MWh of electricity

6.3% of electricity loose

	$/gge (production costs only)	2011 Status	2015 Target	2020 Target	Ultimate Production Target
Distributed	Electrolysis from grid electricity	$4.20	$3.90	$2.30	$1-$2
	Bio-derived Liquids (based on ethanol reforming case)	$6.60	$5.90	$2.30	
Central	Electrolysis From renewable electricity	$4.10	$3.00	$2.00	
	Biomass Gasification	$2.20	$2.10	$2.00	
	Solar Thermochemical	NA	$14.80	$3.70	
	Photoelectrochemical	NA	$17.30	$5.70	
	Biological	NA	NA	$9.20	

Predikcija cena hidrogena



Jedan dobar pokazatelj

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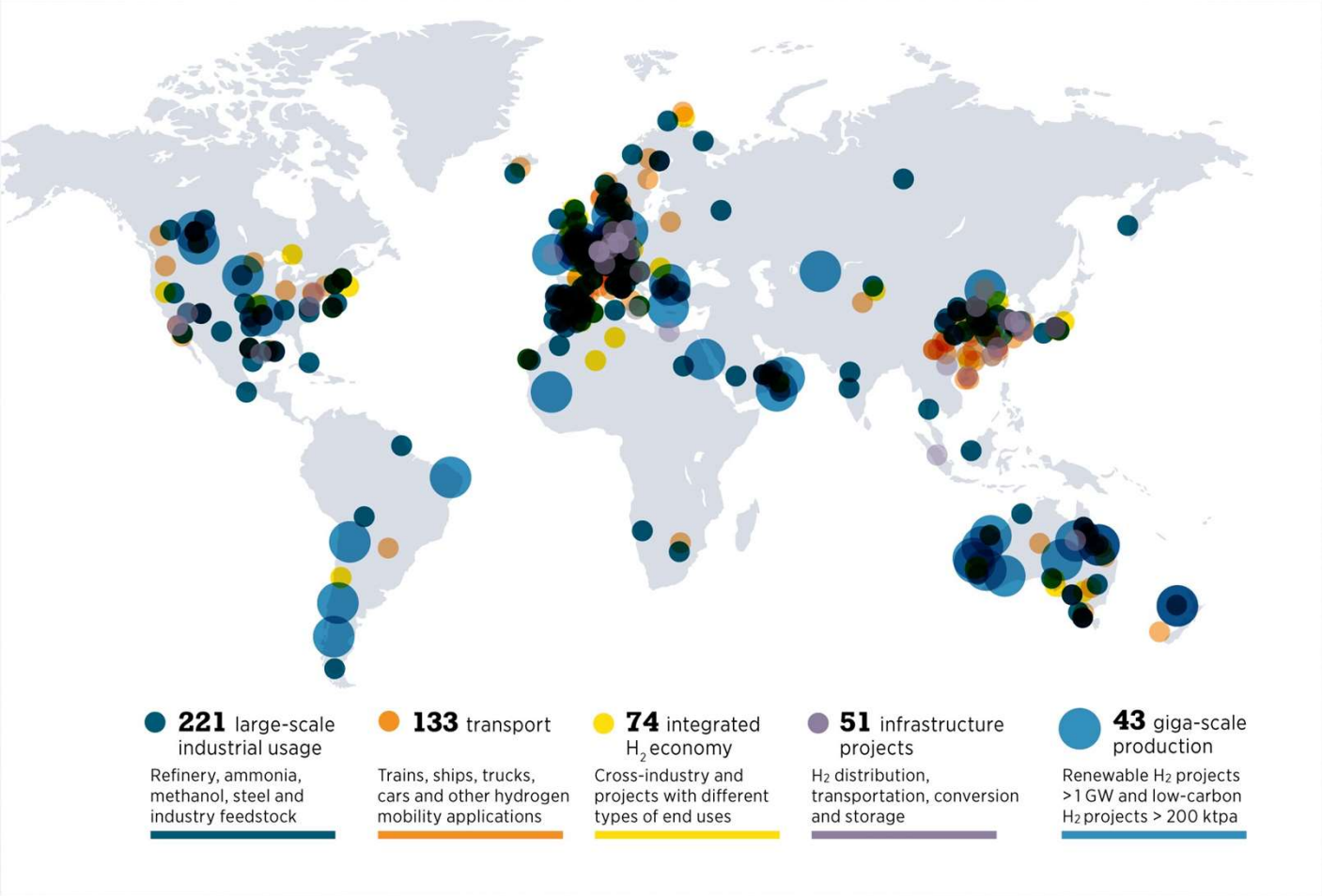
Country	Description
US	» The president signed the Bipartisan Infrastructure Law in November 2021; this includes USD9.5bn in funding for hydrogen » The Inflation Reduction Act (IRA) was enacted; section 45V was introduced to provide a production tax credit
Germany	Germany has positioned itself as a frontrunner in green hydrogen investments. The government has committed USD9bn to its National Hydrogen Strategy, supporting research, development and demonstration projects. The Federal Ministry of Education and Research has allocated USD338m to fund hydrogen research and innovation activities.
European Union (EU)	The EU is making significant investments in green hydrogen to accelerate the transition to a sustainable energy system. The Horizon Europe programme has earmarked USD1.09bn for clean hydrogen projects, focusing on research, development and market deployment. The EU Recovery and Resilience Facility will allocate a substantial portion of its USD891bn budget towards green hydrogen initiatives.
Australia	Australia's multidisciplinary energy business is increasingly developing and incorporating knowledge from other sectors, together with the government's pledge to invest USD812m in establishing a local hydrogen sector and the more than 100 hydrogen projects worth USD110bn that are now in development.
India	By 2030, India wants green hydrogen to account for 40% of all hydrogen consumption, and it wants to become the world's main location for producing, using and exporting green hydrogen and its by-products. In January 2023, India approved the National Green Hydrogen Mission, which aims to increase renewable energy capacity by around 125GW while also developing a green hydrogen production capability of at least 5MMT annually. The initial investment will be roughly USD2.4bn.
MENA	Nearly all MENA nations have developed a green hydrogen project plan to take advantage of the potential. Several programmes and initiatives are in operation, notably in Egypt, Morocco, Oman, Saudi Arabia and the UAE. A USD55bn pipeline of hydrogen projects is planned in the region, with 75% of them including green hydrogen.
Japan	By 2040, the Japanese government hopes to have 12m tonnes of hydrogen available annually, a sixfold increase from the current level. The government has committed to providing USD107bn in financing from both public and commercial sources over the next 15 years to support this project and create supply chains connected to hydrogen.

Jedan dobar pokazatelj

Several colossal green hydrogen production projects have been announced since the beginning of 2023 in China. Most of these green hydrogen plants will be located at Inner Mongolia where rich solar and wind power resource could be deployed to produce green hydrogen. The green hydrogen can be used to replace gray hydrogen in local chemical complex.

Trenutni broj projekata zelenog hidrogena



Pitanja?