HYDROGEN PRODUCTION & WATER CONSUMPTION

MYTHS VS. REALITY

1

MYTH

Electrolysis uses vast amounts of water

DEBUNKED

FACT

Based on the atomic properties of water, 1 kg of hydrogen requires 8.92 litres of water. If the 10 million tons (MT) hydrogen production target of the EU's Hydrogen Strategy is reached by 2030, 89 million tons of water would be used by electrolysis. This would represent 0.00478% of all annual freshwater resources of the EU, 0.0432% of all annual French freshwater resources and 0.0288% of all annual precipitation (i.e. rainfall) in the EU27. [1]

Small scale

1 kg of Hydrogen

~50 kWh electricity

~ 9 litres of demineralised water

1 kg of hydrogen

15 kg of sponge iron for clean steel
5.65 kg of ammonia based fertilizer

1 kg of hydrogen

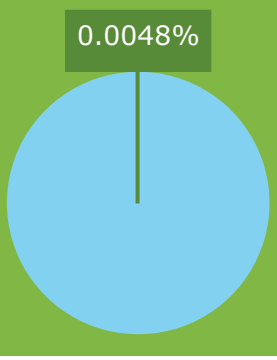
Nine litres of water would be enough to produce H2 to travel 100 km with FCEV or refine enough diesel for 40 km

Large scale: EU Hydrogen Strategy 2030 target

10 million tons of hydrogen

89 million tons of demineralised water

% of EU (2017) freshwater resources needed for electrolysis of 10MT of hydrogen by 2030



Comparing water consumption for electrolysis with other energy processes, the water footprint of certain fossil-based pathways exceeds that of hydrogen. [2] Crude oil recovery and diesel refining uses around 40% more water than the production of green hydrogen per unit of energy. This means that nine litres of water would be required to refine enough diesel to travel for 40 km or produce enough hydrogen to travel 100 km. [3] From a circular economy perspective, hydrogen technology doesn't consume water as water is produced, in its purest form, at the end of the cycle. It also avoids water contamination associated with various fossil-fuel processes.

PAREMA
Partenariat énergétique Maroco-Allemand
Deutsch-Marokkanische Energiepartnerschaft

2

MYTH

Electrolysis uses freshwater resources only

DEBUNKED

FACT

Currently, electrolyser technology uses highly purified water. This does not mean, however, additional strain on freshwater systems.

The water needed for large-scale electrolysis, can be provided by any water resource (sea water, wastewater, etc.) once demineralised via reverse osmosis (RO) plants. [4] Continuous development of adjoint water desalination plants, alternative modes of low-grade and saline surface water electrolysis, [5] and water provision via wastewater treatment plants provide evidence of their feasibility and cost-effectiveness. [6]

For example, Portugal's National Hydrogen Strategy envisions the production of relatively large amounts of hydrogen (2-2.5 GW of electrolyser capacity by 2030). However, their strategy also fully considers how the necessary water can be sourced, as the participation of Aguas de Portugal, the state company which treats the majority of Portuguese wastewater, clearly indicates. [7]

Portuguese Case Study: National Hydrogen Strategy and Wasterwater Treatment Plant

Rationale: Wastewater treatment plants can also provide necessary water for electrolysis

Production of wastewater (2018): 602 million m3 (Aguas de Portugal):

- To achieve Portugal's National Hydrogen production target, electrolysis would only consume 1% of the entire wastewater production of Aguas de Portugal.
- Aguas de Portugal's wastewater treatment plants alone could fulfil 675% of the water requirements (89 million m3) for achieving the EU target of 10MT of green hydrogen by 2030.

3

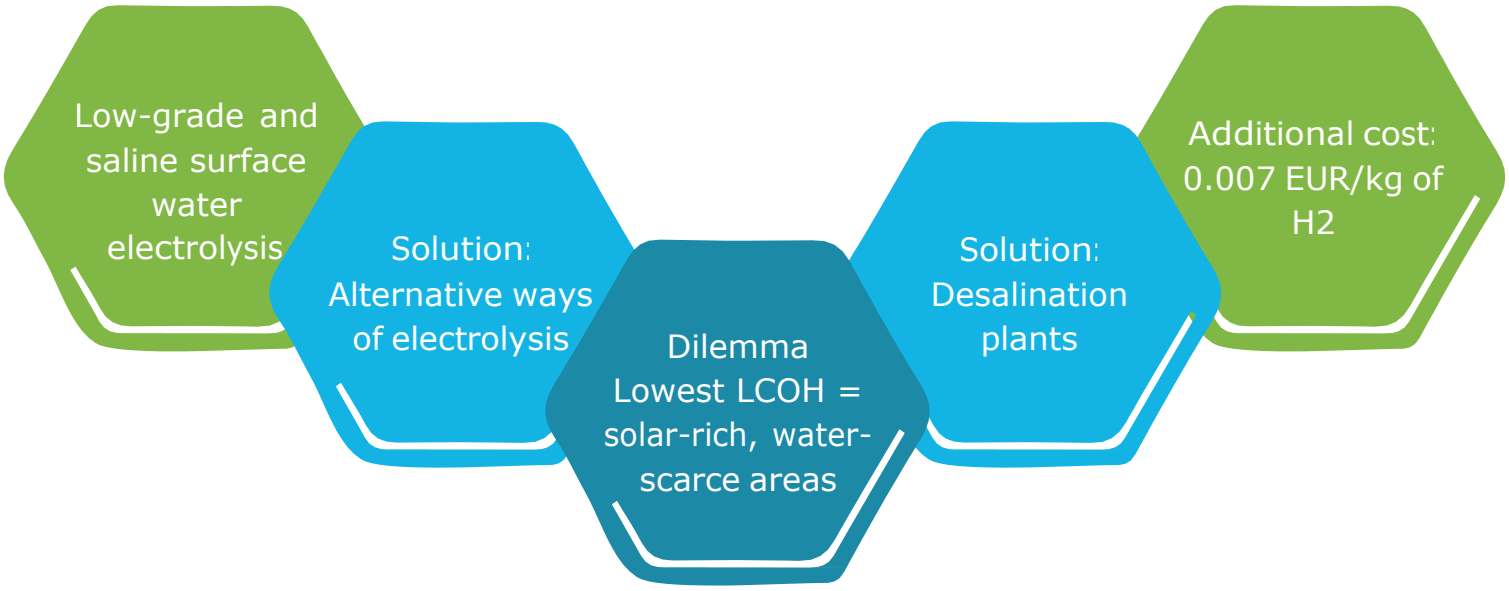
MYTH

Electrolysis is bound to create water stress in water scarce regions

DEBUNKED

FACT

At first glance, large scale and cost-competitive clean hydrogen production seems to face the dilemma that the lowest "Levelised Cost of Hydrogen (LCOH)" can only be achieved in solar rich and water scarce areas. This dilemma can be solved with relatively little cost by adding the above-mentioned desalination plants at the electrolyser site to minimise water stress. [8] The total cost for water desalination is around 0.8 EUR/m3, which then adds 0.007 EUR/kg to the production cost of hydrogen. This investment acts as a precautionary instrument to shield local population from water resource deprivation. In fact, should the need exist, waterdesalination plants for electrolysis could be planned to produce water not just for the production of hydrogen, but also for local use as a fresh water resource for human consumption and/or irrigation, thus creating multiple benefits to the local area.



[1] https://ec.europa.eu/eurostat/statistics-explained/index.php/Water_statistics#Water_abstraction
[2]https://www.researchgate.net/publication/283014981_Development_of_a_Life_Cycle_Inventory_of_Water_Consumption_Associated_with_the_Production_of_Transportation_Fuels
[3] While also taking into account the efficiency difference between an Internal Combustion Engine (30%) and a Fuel-Cell (60%)
[4] https://www.sciencedirect.com/science/article/abs/pii/S0960148120303487 ("The water scarcity footprint of hydrogen is 3,000 times less than the quantity reported in the literature.")
[5] https://www.nature.com/articles/s41560-020-0550-8
[6] https://dre.pt/home/-/dre/140346286/details/maximized
[7] https://www.endseurope.com/article/1697878/interview-portugal-plans-become-green-hydrogen-powerhouse
[8] https://repository.tudelft.nl/islandora/object/uuid:9d1225b7-65ed-44d2-b9c9-d60cfce64a5f