Thirsty hydrogen in a circular economy

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Aquatech Amsterdam– March 2025

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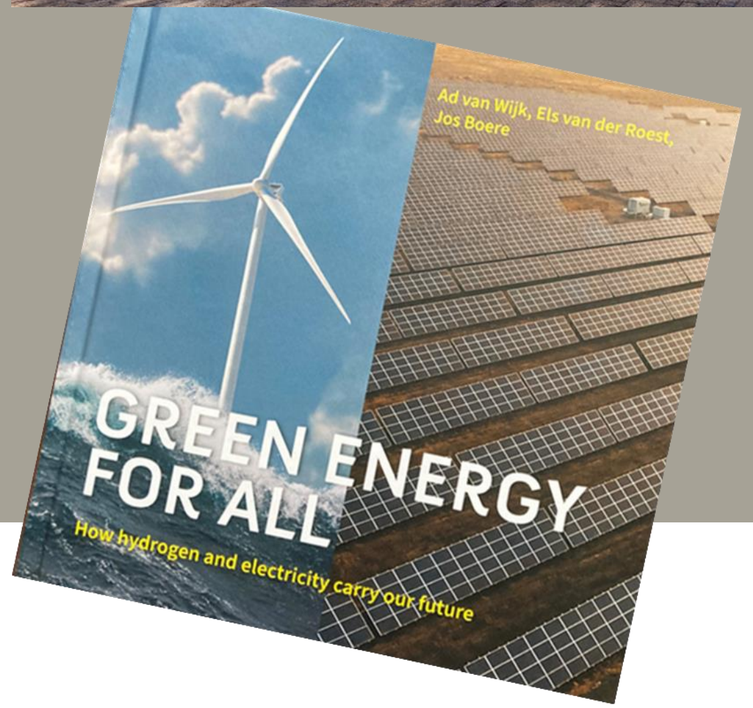
EnergyLabNL

About Allied Waters

PROFILE (WWW.ALLIEDWATERS.COM)

- Driving the circular economy, since 2015
- *“Sustainability and economics going hand in hand”*

- Sister company of KWR Water Research
- Co-founder of **Hysolar**, producer and supplier of green hydrogen in Nieuwegein, NL



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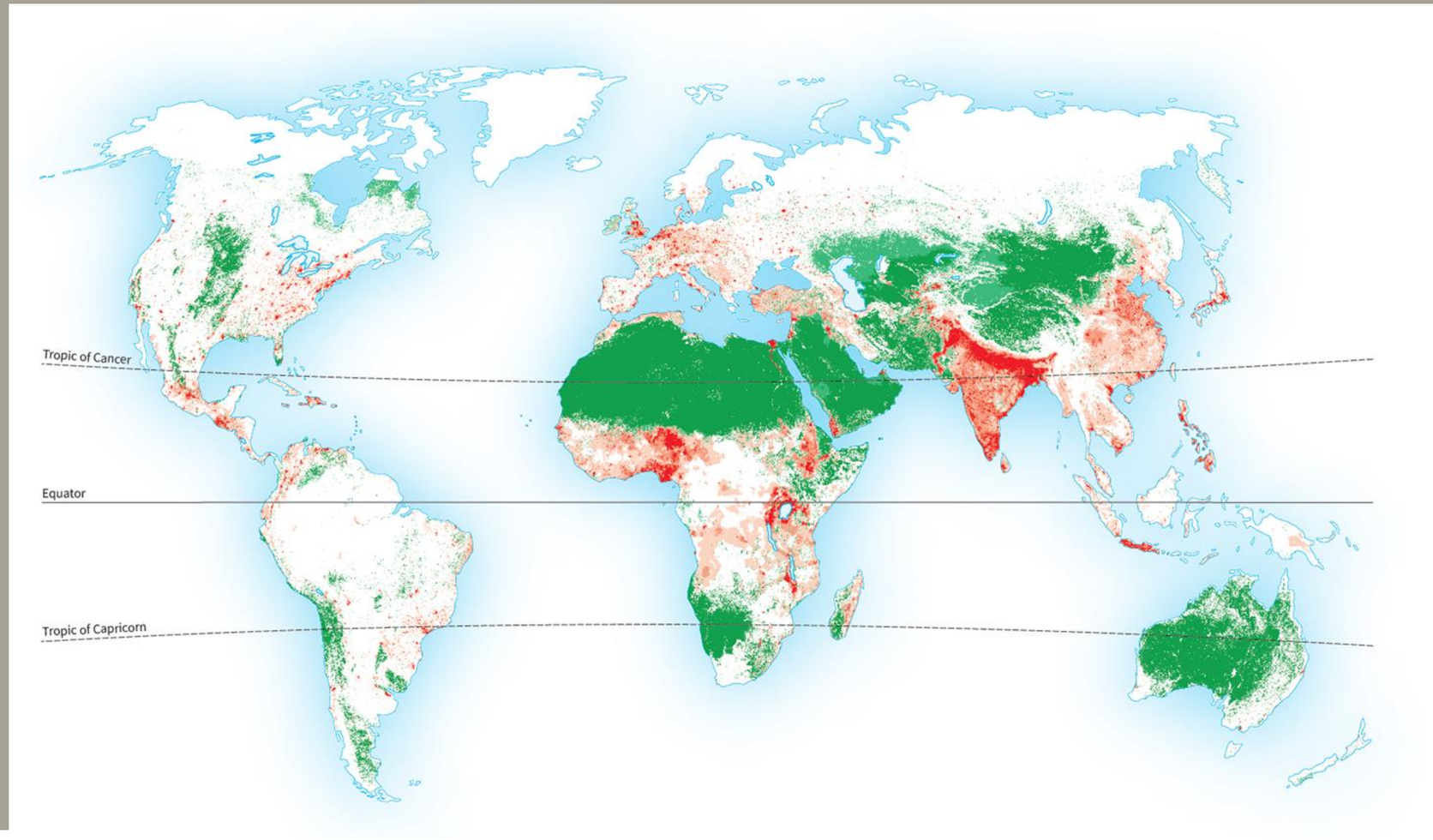
Why hydrogen?

HEAT MAP SOLAR ENERGY 2100:
DEMAND VERSUS AVAILABILITY

- Green: **surplus**
- Red: **shortage**

We need an energy carrier to bridge the gap in time and place

Interactive map:
HeatMap PV



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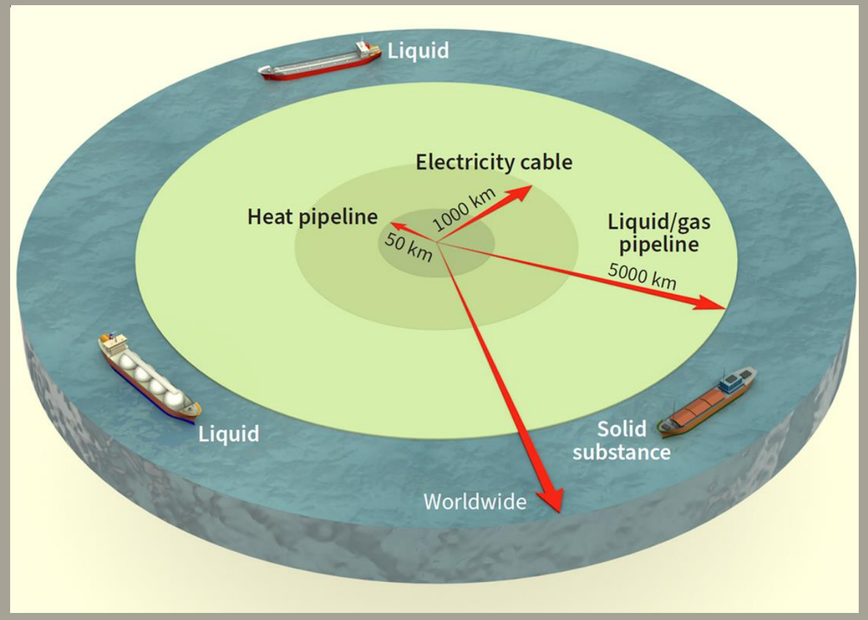
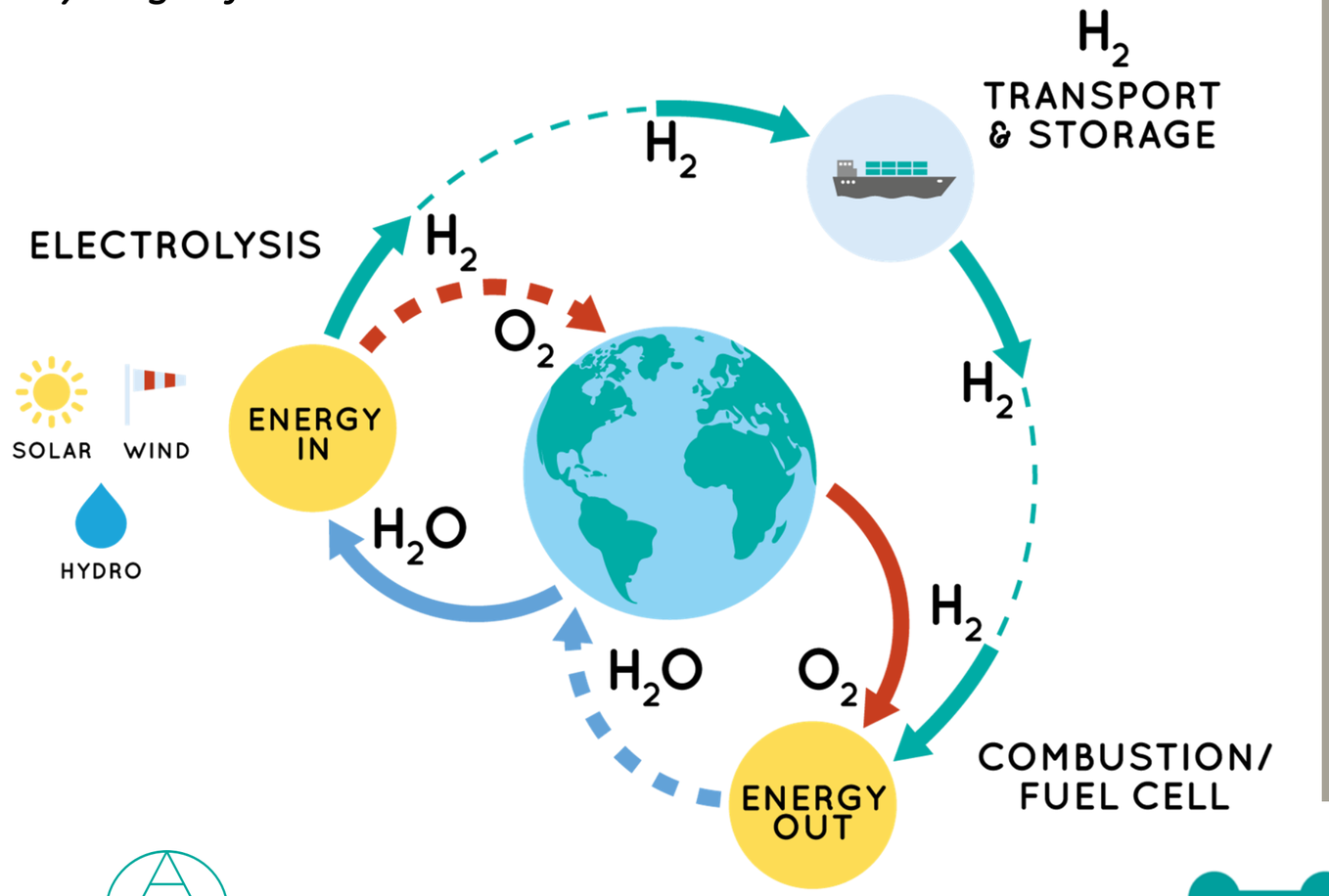
Hydrogen transport

the hydrogen/water cycle



"Temporarily borrowing hydrogen from water"



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Hydrogen production

starting with ultrapure water!

Ultra pure water, H_2O

Green electricity

Hydrogen, H_2

Oxygen, O_2

Heat

Stoichiometrically: 18 kg water yields 2 kg H_2 and 16 kg O_2

Strongly depending on the type of electrolyser

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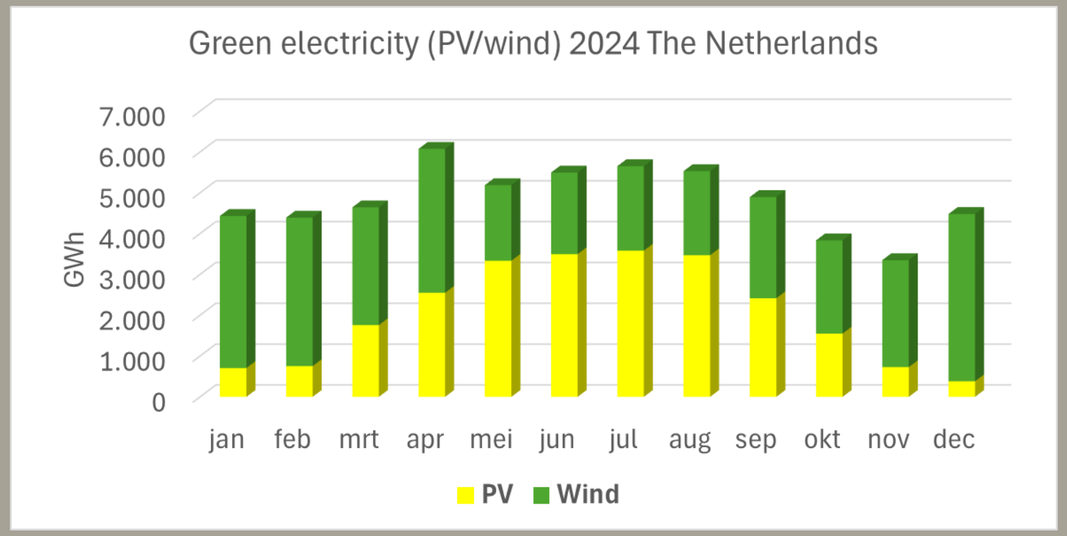
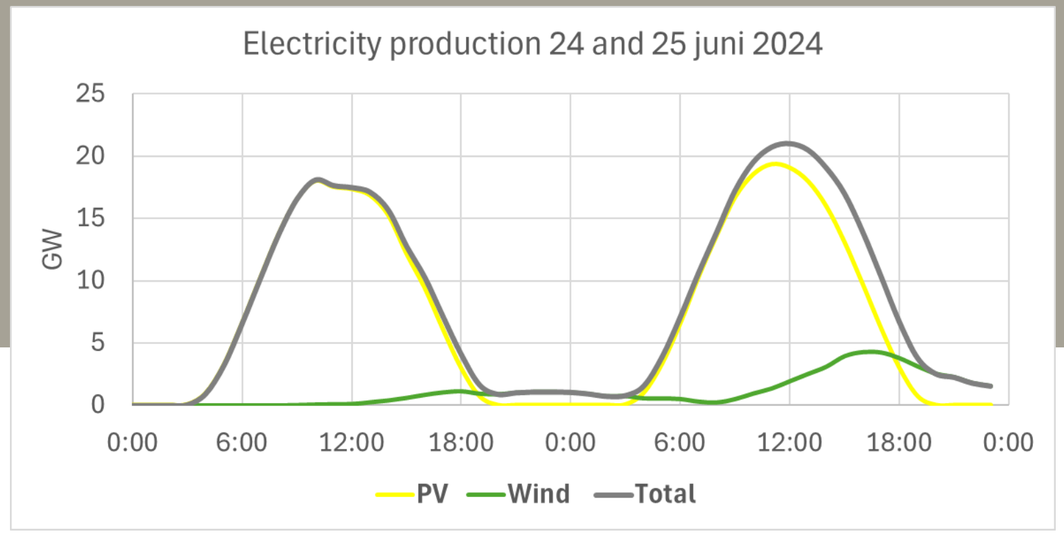
Hydrogen production

green electricity





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Hydrogen production

water

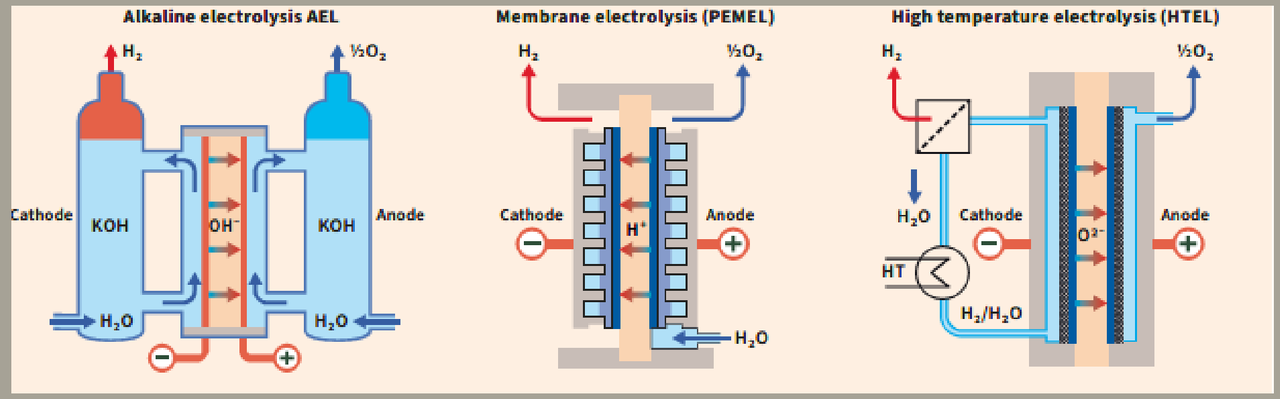
THE ROLE OF WATER

Cooling

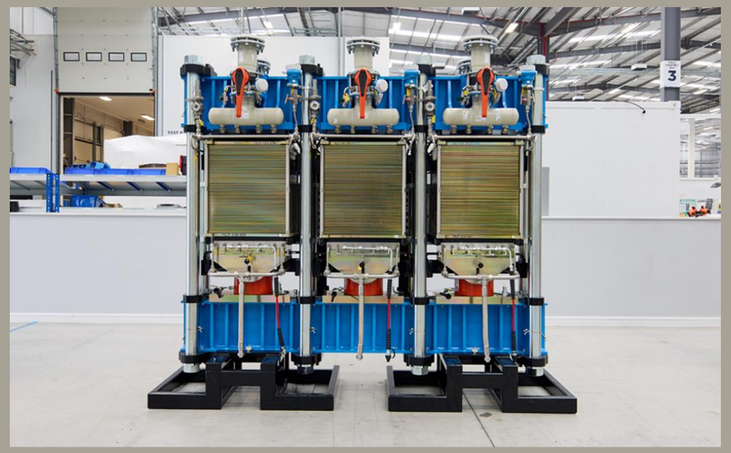
- YES, in a closed water loop, if heat finds a beneficial use
- The smart way: include beneficial destination of heat in the design process

Precursor

- Starting from raw water
- Treatment, working towards ultrapure quality (ASTM grade)
- Splitting into H_2 and O_2



Working principle of different types of electrolysers



Source: ITM

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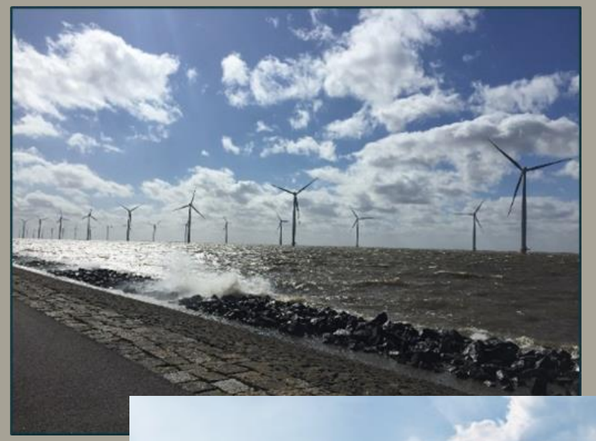
Hydrogen production

water sources

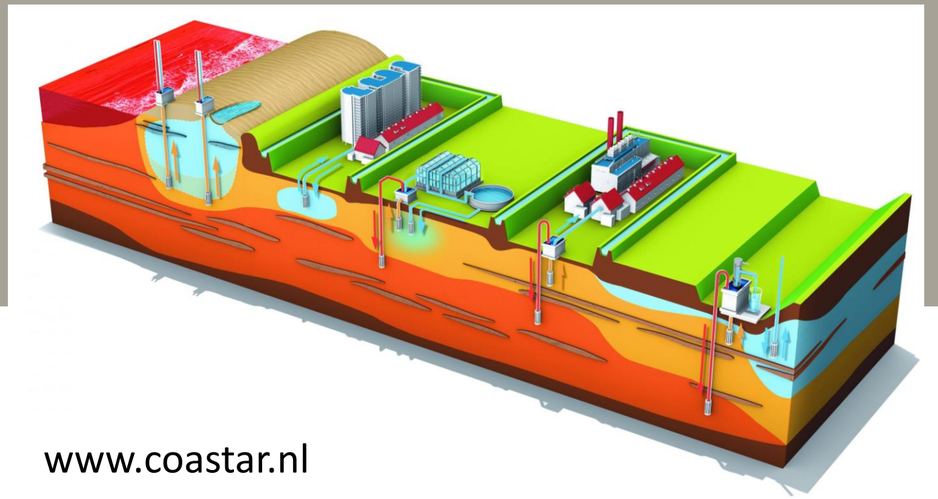


WHICH SOURCES?

- Ideally: the lowest content of salts and organics!
- In practice: any source, from rain water to surface water, sea water or effluent from a sewer plant
- No use of drinking water acc. to Dutch policy
- Selection of source strongly related to the location

WATER ON STOCK?

- If not continuously available, storage in the aquifer may help: the COASTAR® concept



www.coastar.nl

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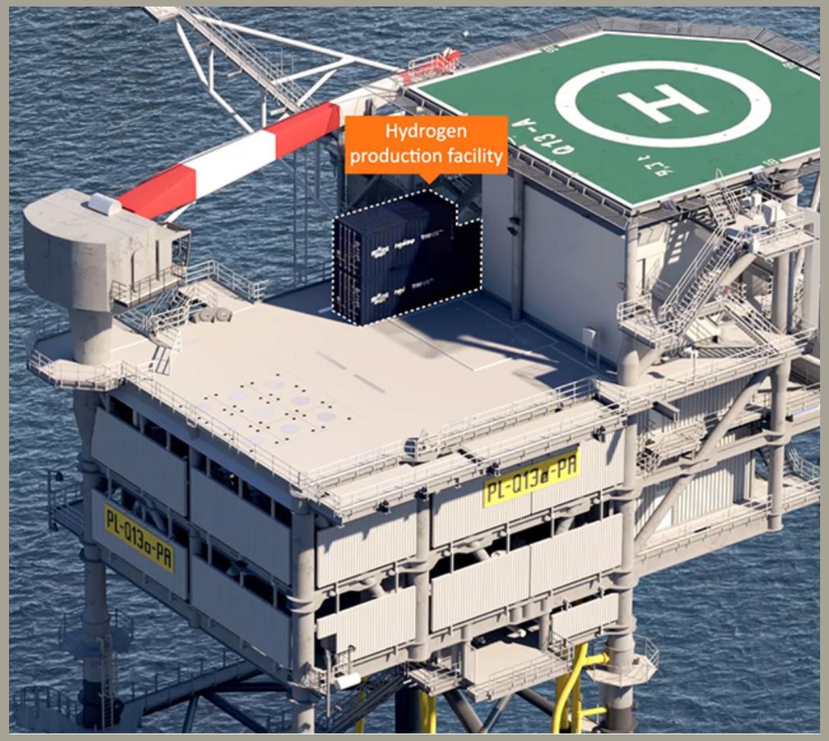
Hydrogen production

water treatment processes

SOME GUIDANCE

- Obviously, treatment processes are very much source and location dependant
- Opportunity: integrate any surplus heat in the demiwater/ultraputer water production, targeting recovery of valuables and/or ZLD (zero-liquid discharge)
- Typical final polishing steps: Ion Exchange (IEX) – Reverse Osmosis (RO) – Degassing – Electrodeionization (EDI)

PosHYdon project



Polishing step (Cummins)

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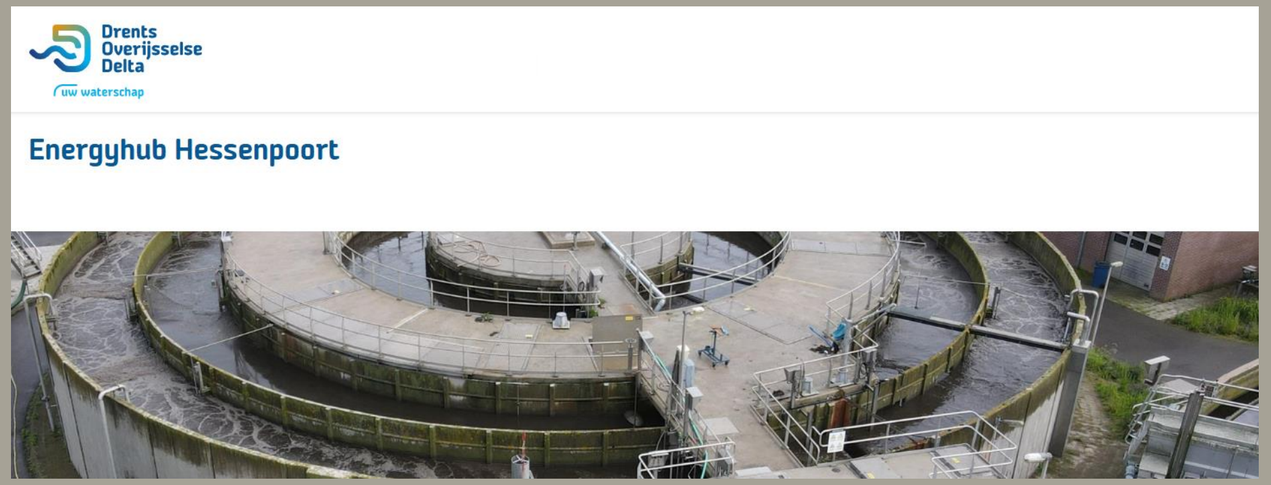
Hydrogen production
valorisation of by-products

OXYGEN

- Highly useful in e.g. sewage treatment plants: reducing energy use for aeration, reducing N_2O emissions
- Interesting case at Hessenpoort, NL

HEAT

- First priority is to reduce the amount of surplus heat, e.g. by process integration
- Any surplus heat, develop a beneficial use



Beneficial use of oxygen and heat at Hessenpoort sewage treatment plant, NL

Markets of green hydrogen

key segments: mobility and industry

DEMAND FORECAST THE NETHERLANDS ACCORDING TO CE DELFT (2024)

Year	Green hydrogen demand (ton/a * 1000)	Ultra pure water demand (m^3/a * 1000)
2026	1	9
2027	12	108
2028	53	482
2029	102	916
2030	150	1350

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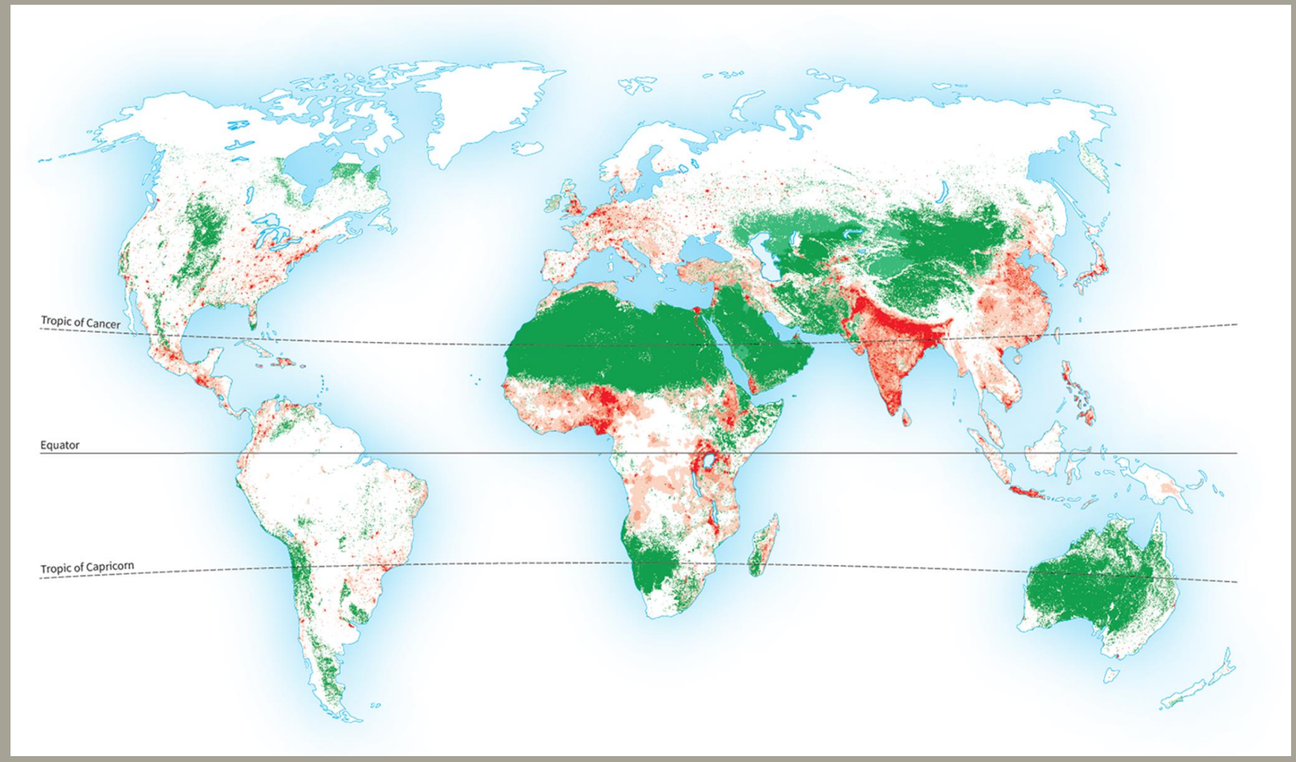
Thirsty hydrogen in a circular economy

take home messages

- Hydrogen, energy carrier bridging the gap in time and space of renewable energy
- Main markets until 2030: industry and mobility
- Key component: **ultrapure water**, produced from locally available water sources including municipal effluent
- Maximally integrate beneficial use of heat and oxygen



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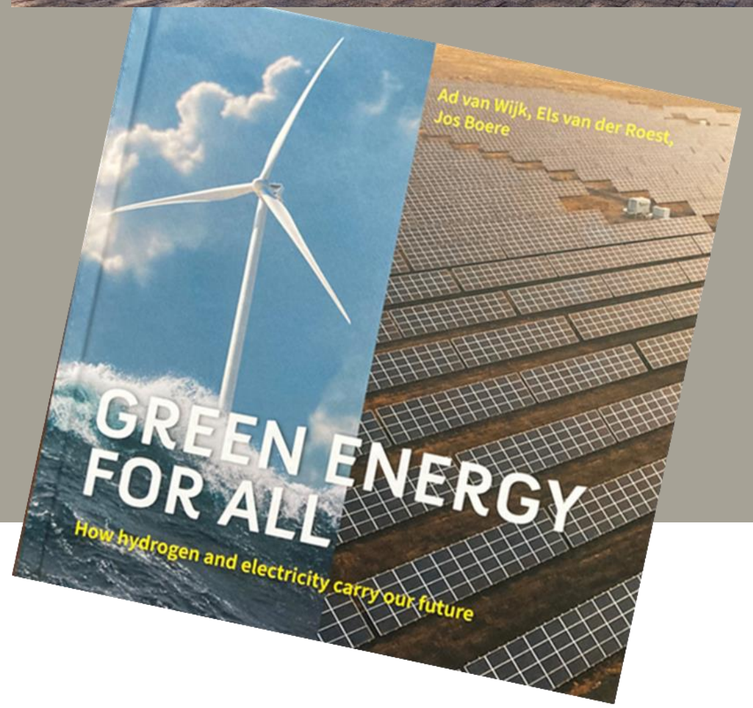

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