Water Electrolysis & Water

Hét Nationale Watersymposium – VEMW

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Enabling emission-free industries

Our Vision & Mission

To enable the full **decarbonization of industry** and the transition to a truly circular economy, by supplying safe, reliable and affordable **green hydrogen** supplies and circular **chemistry solutions**

HyCC

Joining forces to create a new leader in green hydrogen

NOBIAN

Leader in essential chemicals with 100+ years experience in electrolysis

Macquarie Green Investment Group

Global investment group focused on accelerating the green transition

50% 50%

HyCC

The Hydrogen Chemistry Company

A leading provider of green hydrogen and circular chemistry solutions with over 1 gigawatt under development.

Strong pipeline built on robust customer engagement

HyCC

Green hydrogen projects

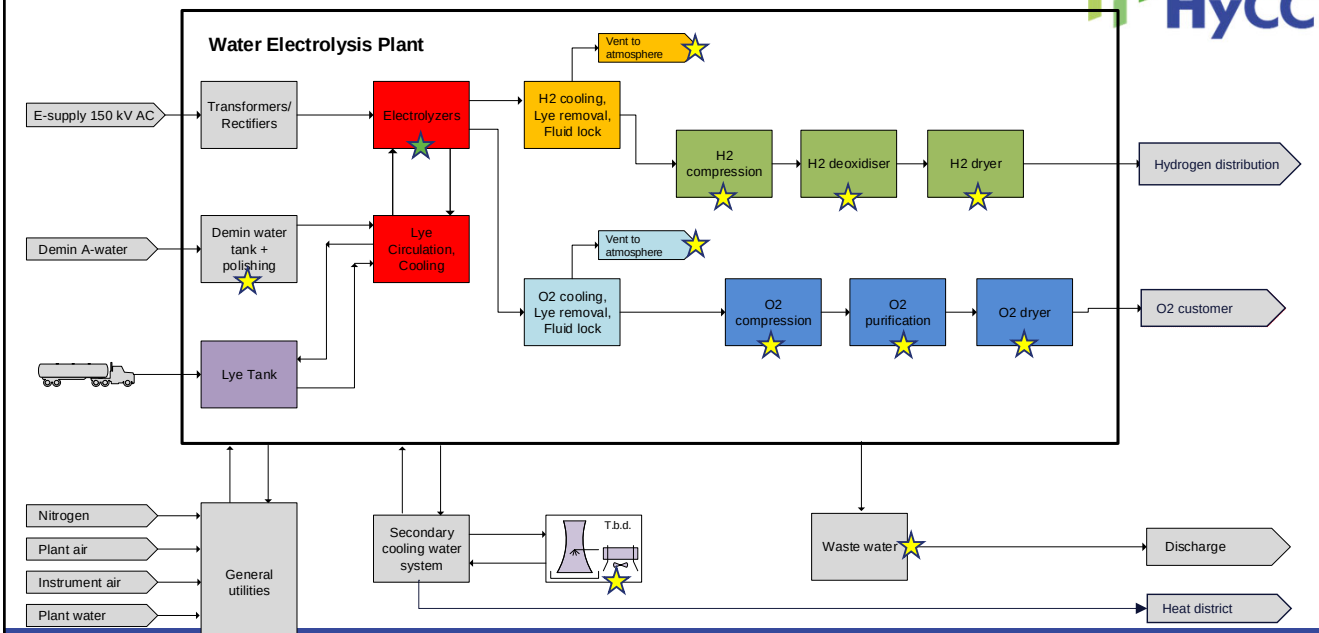
R&D	20 MW	40 MW	100 MW	250 MW	500 MW	
Carbon2Chem MW test center	Djewels	H_2eron	H_2ermes	H2-Fifty	H_2era	GreenRoot
ISPT, thyssenkrupp	OCI, gasunie	KLM, SKYNRG, SHV ENERGY	TATA STEEL, Port of Amsterdam	bp	Port of Amsterdam	VNG

IPCEI project

IPCEI project

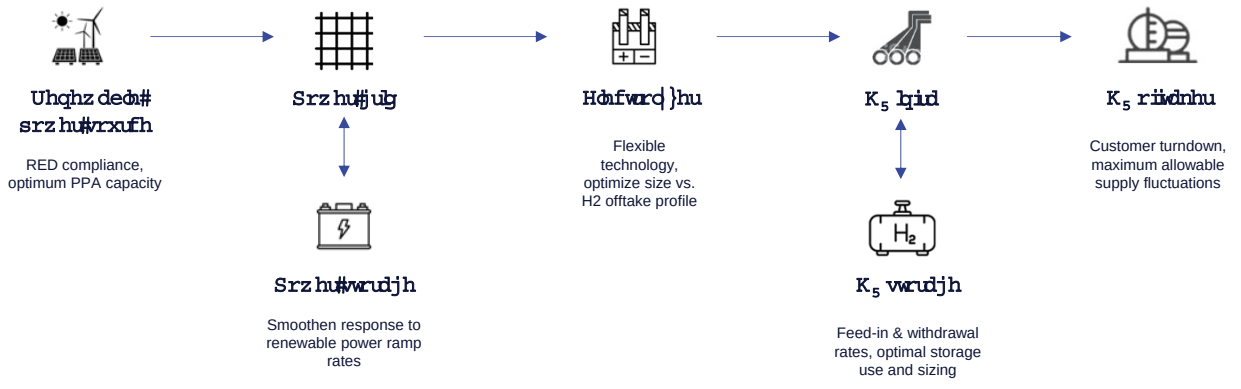
On track to reach **gigawatt scale**

Water electrolysis process in a nutshell



We have experience in optimizing electrolyzers on power flexibility markets

We optimize the flexibility in the entire upstream value chain to shape an intermittent renewable power source to match a (mainly) stable offtake of green hydrogen



Water in the electrolysis process

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How much demi-water do we use

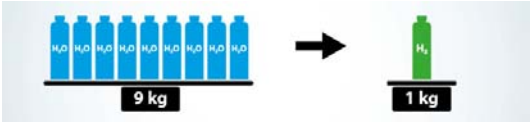
- For 1GW this is 200 m^3/h ≈ 17.000 households (In comparison - Rive rhine 10.000.000 m^3/h)
- Is this a significant societal impact? Does this compete with drinking / farming water?
- Energy required to purify water → 0,1% of the electrolysis process
  - 0.4 -1.4 MW depending on the source: Ground water, river water, sea water

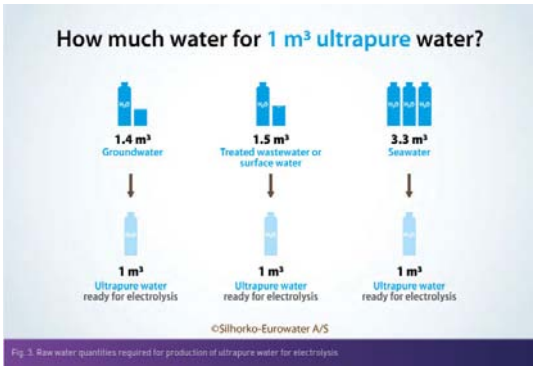
Other water sources

- Cooling water – depending on technology – once through, cooling tower or closed system air fin banks
- Water locks – continuous flow
- Firewater

Waste streams & recovery

- Recovery of condensate streams where possible
- Cooling tower bleed stream (techn. dependent)
- Purge streams and water locks cannot all be recycled





Picture reference: Hydrogen Tech World, Issue 6, October 2022

Demi-water technology is critical for the electrolysis process

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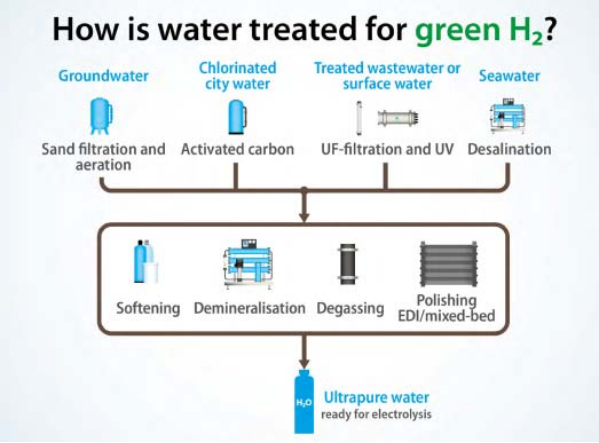
- New infra (pipeline and transport pumps) are required to transport water to production sites are required.
- Ppb level impurities (e.g. Fe, Mg, Ca, Si) influence the performance of electrolysers
- Purity is significantly higher than the traditional boiler feed water purities more common to industry (e.g. <<1 µS/cm instead of 2 µS/cm)
- Treatment / regeneration / concentration results in significant water discharge streams
- Little experience with intermittent operation



Picture reference: Hydrogen Tech World, Issue 6, October 2022

Cooling technology, the safe option is air fin banks in NL

- Outdated BAT leads to much discussion – heat loads to surface water, energy efficiency or water discharge with chemicals, what is most critical
- Once through systems lead to high thermal loads on surface water (limited possibilities in NL for large heat loads)
- Cooling towers are relatively silent, efficient, require limited plot space, however they require chemical treatment of the water and a bleed stream which are environmentally suboptimal
  - Zero chemical dosing on large systems is not yet mature
  - Chemical usage and thickening factor need to be optimized
- Air fin banks with closed liquid system are a safe option – noise issues need to be addressed and energy consumption needs to be acceptable.

Cooling Tower Design Calculations - Height of Packing & Air Flow Rate (chempds.blogspot.com)
Picture reference: Hydrogen Tech World, Issue 6, October 2022

Environmental impact & Water discharge

A water electrolysis plant has a number of environmental aspect to take into account when looking at permitting (a.o.):

- Noise
- External safety contours
  - Fire and explosion prevention and protection philosophy
- NOx (mainly during the construction phase)
- Water Discharges
- Energy efficiency (will come later when operational benchmarks come into play)

When selecting plots and technologies for the installation we need to balance these aspects:

- Access to surface water for discharge of water streams makes design more reliable
- Without water access trucking out very clean discharge water streams is required

Key Take-Aways

- Water electrolysis will be developed at large scale in NL – this requires a significant amount of ultrapure water → we need to discuss where this sits in the broader context of fresh water usage
- Permitting (MER and WaBo) requirements in NL needs to be an integral part of the technology selection process
- The location determines the possibilities to take-in and dispose water
- Water usage / savings can be realized at the cost of additional energy usage and capex – No clear overarching BAT on this topic

Thanks for your attention