



OFFSHORE HYDROGEN PRODUCTION

FLOATING JACK-UP SYSTEMS AS MARITIME HYDROGEN FACTORIES

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Hydrogen as a green energy store, generated from pure water and renewable energy, is considered a future-oriented fuel and commodity in a climate neutral energy economy.

Floating hydrogen factories produce green hydrogen sustainably from offshore wind energy and ocean water on large industrial scale.

Self-sufficient jack-up units equipped with power management, seawater desalination, pure water conditioning, electrolyzers and compressing stations provide 100% green hydrogen filled in transportable standard containers for direct use in demand-driven circular economies.

- no land consumption
- mobile and flexible systems
- self-sufficient and carbon neutral energy supply
- pipeline independent turn-key-solution
- directly applicable for better workload of offshore windfarms
- green investment with high market rate of return



TOPICS

- Hydrogen Electrolysis
- Offshore Seawater Desalination
- Case Study Floating Offshore Hydrogen Factory
- Maritime Systems Investors Information

Ocean, Wind and Water – Naturell Source Of Green Hydrogen

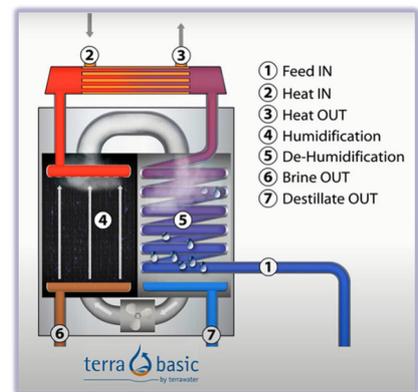


In an electricity driven process called electrolysis pure water can be split into its elements hydrogen H_2 and oxygen O_2 . If power from renewable resources is applied to the machine 100% green hydrogen is produced. However, electrolyzers must only be feed with pure water to avoid scaling and corrosion of inner cell parts. Even drinking water still contains too many minerals that would negatively disrupt the process.

Both tap water and desalinated sea or brackish water need to be conditioned on the required water qualities prior to use in the electrolysis process.

Proven technology for large scale sea and brackish water desalination is the reverse osmosis principle. In a multi-stage process membrane systems powered by high pressure separate salty water into a concentrated brine, which is feed back to the source, and a pure water fraction, which meets the required process water qualites.

Smaller amounts of ultra pure water as needed in building block design applications may be produced cost effectively in a single-stage chemical free humidification and condensation process using the electrolyser`s waste heat.



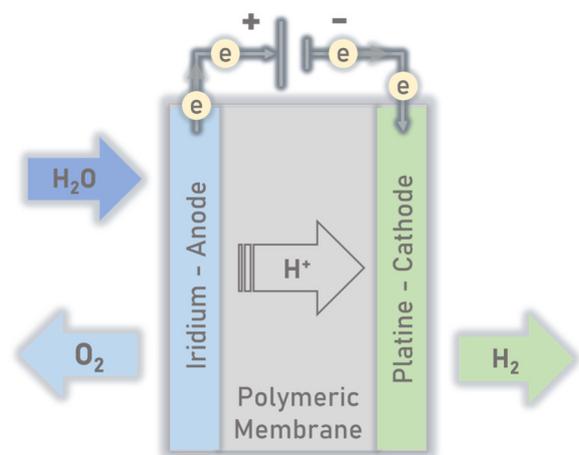
Hydrogen Electrolysis

The electrolysis process splits pure water into hydrogen H_2 and oxygen O_2 consuming electrical energy.

Core element of an electrolyser is the Proton Exchange Membrane (PEM) which is permeable for hydrogen molecules. For large outputs multiple membrane stacks are working together in modular constructions.

Regarding hydrogen output PEM electrolyzers achieve high efficiencies even if input current fluctuates as is practice with renewable energy sources like wind and solar power.

Compressed hydrogen as tradable commodity can be transported gas bottled to any point of use.



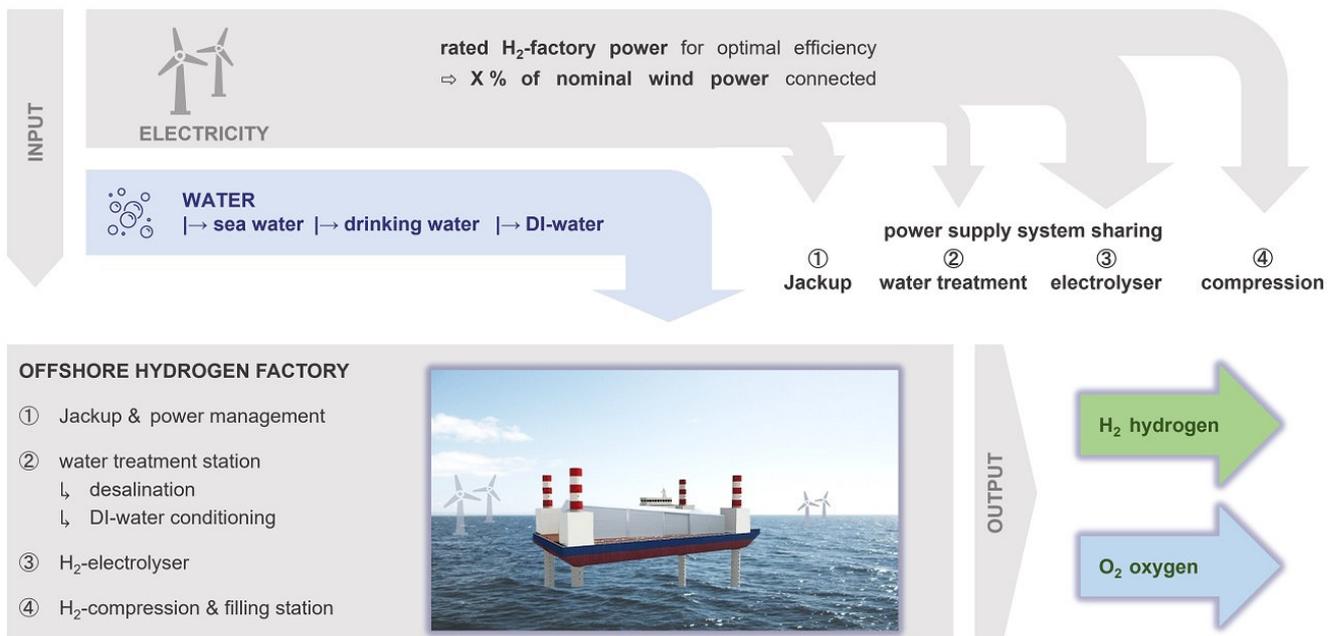
PEM Electrolysis Principle
Proton Exchange Membrane

Floating Offshore Hydrogen Factory

Renewable offshore wind power is most reliable and cost efficient energy source to operate PEM electrolyzers for green hydrogen production stable on high load rates.

Maritime hydrogen factories are tailored as scalable units with all equipment need to produce green hydrogen from wind energy and ocean water only. Systems move close to an electricity hand-over point of an offshore windfarm for connecting to the wind power. Independent on submarine cable and pipeline connections the offshore factory provides gas bottled hydrogen which can be shipped containerised to harbours with hydrogen hubs for direct use in circular economies.

As constant power consuming units self-contained offshore hydrogen factories may increase the economic efficiency of new and existing windfarms as well.



Jack-Up

Moving to the desired position, a jack-up fixes its legs on sea floor and lifts the platform up for operation. Jack-up is the ideal offshore system for 100% green hydrogen production in close vicinity to renewable resources like offshore windfarms.

The jack-up system provides modern accommodation layout for the operating crew and can be fully customized to the application's requirements.

A modular building-block design of all required components for green hydrogen production is redundant system. For maintenance or during times of lower output demands single trains can be taken out of operation without need to shut down the entire installation.

Such design guarantees high availability and reliability even in rough seas. Feeder vessels can moor at the jack-up, loading gas bottled hydrogen in containers from buffer stocks.

MARITIME HYDROGEN SYSTEMS

Offshore hydrogen and drinking water projects are designed and calculated according to the requirements of the application. With our team of experienced financial and technical experts, we advise interested investors and support them professionally in the development of promising projects.

contact

Dipl.-Ing. Hans-Ulrich Baldes
cell phone: +49(0)1520 29 25 741
e-mail hub@sobek-tec.de
web www.sobek-tec.de

Dipl.-Ing. Wolfgang Kiebert
cell phone: +49(0)172 42 22 416
e-mail ask@kiebert.de
web www.kiebert.de

imprint

Hans-Ulrich Baldes
Sobek-Tec Engineering Consulting
Finkenweg 3
DE-52146 Würselen



Wolfgang Kiebert
Industrie- und Verfahrenstechnik
Kapellenstrasse 19
DE-54597 Auw bei Prüm



Investors Information

Floating offshore hydrogen factories are aimed to supply large quantities of 100% green hydrogen in tradable transport containers for direct use in circular economies.

Maritime Systems are addressed to public and industrial sectors with high need of green hydrogen, potential project developers, operators of maritime hydrogen factories and prospective customers of green hydrogen and desalinated seawater as well.

PROSPECTIVE HYDROGEN APPLICATIONS

- HYDROGEN AS FUEL
 - TRANSPORT AND MOBILITY SECTOR
- MATERIAL USE OF HYDROGEN IN INDUSTRIES
 - CHEMISTRY, REFINERY, GLASS, CEMENT, STEEL, OTHERS

Maritime offshore hydrogen factories are self-contained production sites with defined hand-over points. Systems are run and maintained by trained and experienced operation crews. Crew members provide all nautical skills and technical competences to manage offshore desalination and hydrogen electrolysis.

As business case, investment, operation and maintenance expenses of the entire system are borne by an associated company, which recover it by selling green hydrogen.

Design basis for offshore hydrogen factories and jack-up units is proven ship, plant and related machinery equipment which will be combined and adapted according to the project's and owner's requirements.

Investors benefit from well-calculated turn-key solutions with reliable production capacities guaranteeing high market rate of return. Customers in industries, municipalities and private sectors benefit from reliable hydrogen supplies at stable price level.

Driving factors for sustained increasing hydrogen demand is the common social resolution to decarbonize economies and changing consumption patterns in favour of climate neutral fuels and commodities.