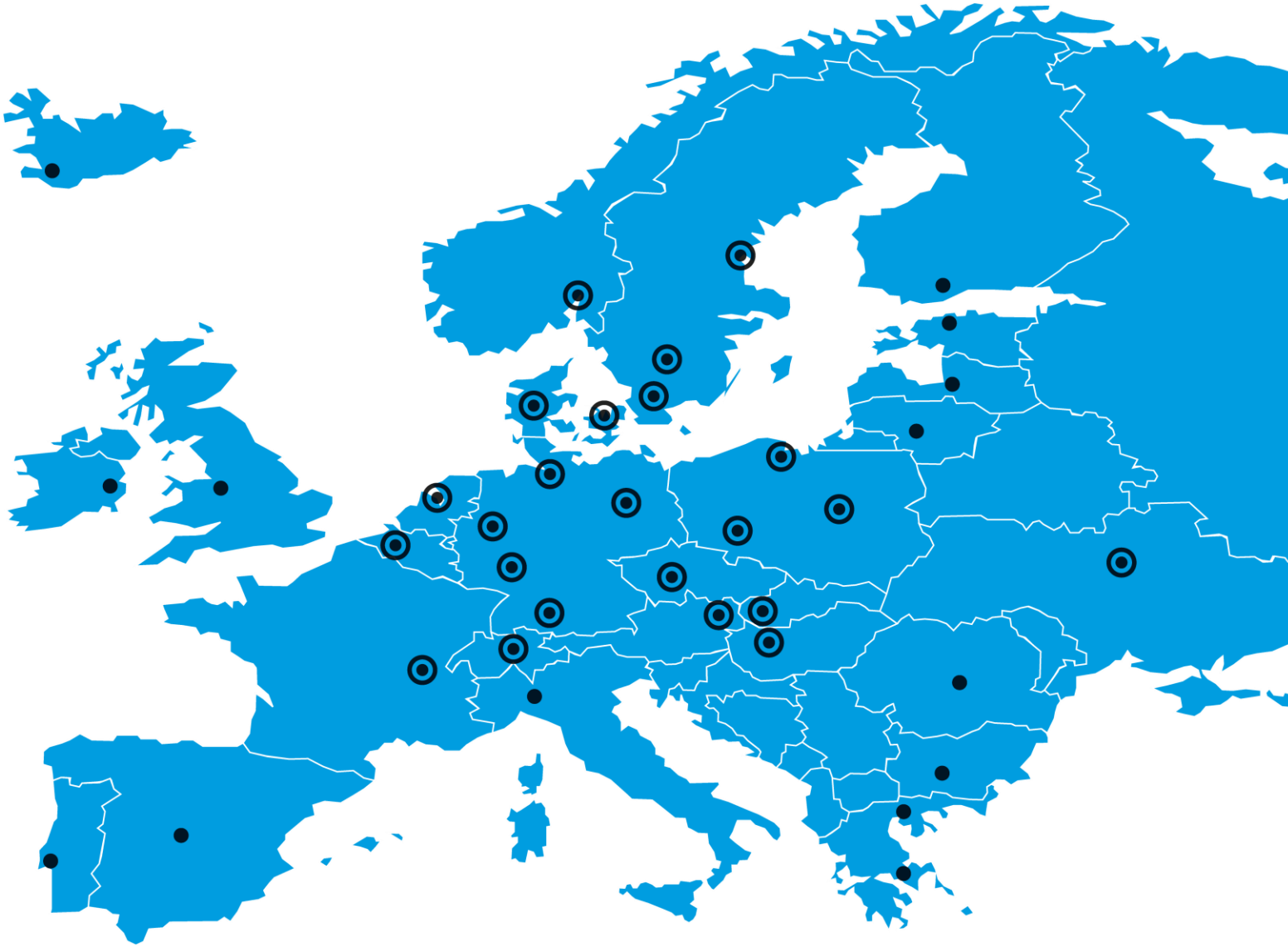




***EUROWATER***  
A GRUNDFOS COMPANY

Water for green hydrogen – What you need to know





## We are close to you!

23 sales and service offices  
in 14 countries

Independent distributors in 18  
countries

Since 2020, EUROWATER has been a part of Grundfos, supporting Grundfos' global ambitions to pioneer solutions for the world's water and climate challenges, and improve the quality of life for people.





# WHY is there no green hydrogen without WATER?

**How much electrolyser capacity is needed  
to convert existing use of grey hydrogen  
to green hydrogen (115 Mton)?**

**How much ultrapure water is needed?**



# WHY is there no green hydrogen without WATER?

And we need a lot more hydrogen  
than what we are using today

**Power  
need**

**1,150 GW**

**Ultrapure  
water need**

**207,000 m<sup>3</sup>/h  
1,035,000,000 m<sup>3</sup>/yr**

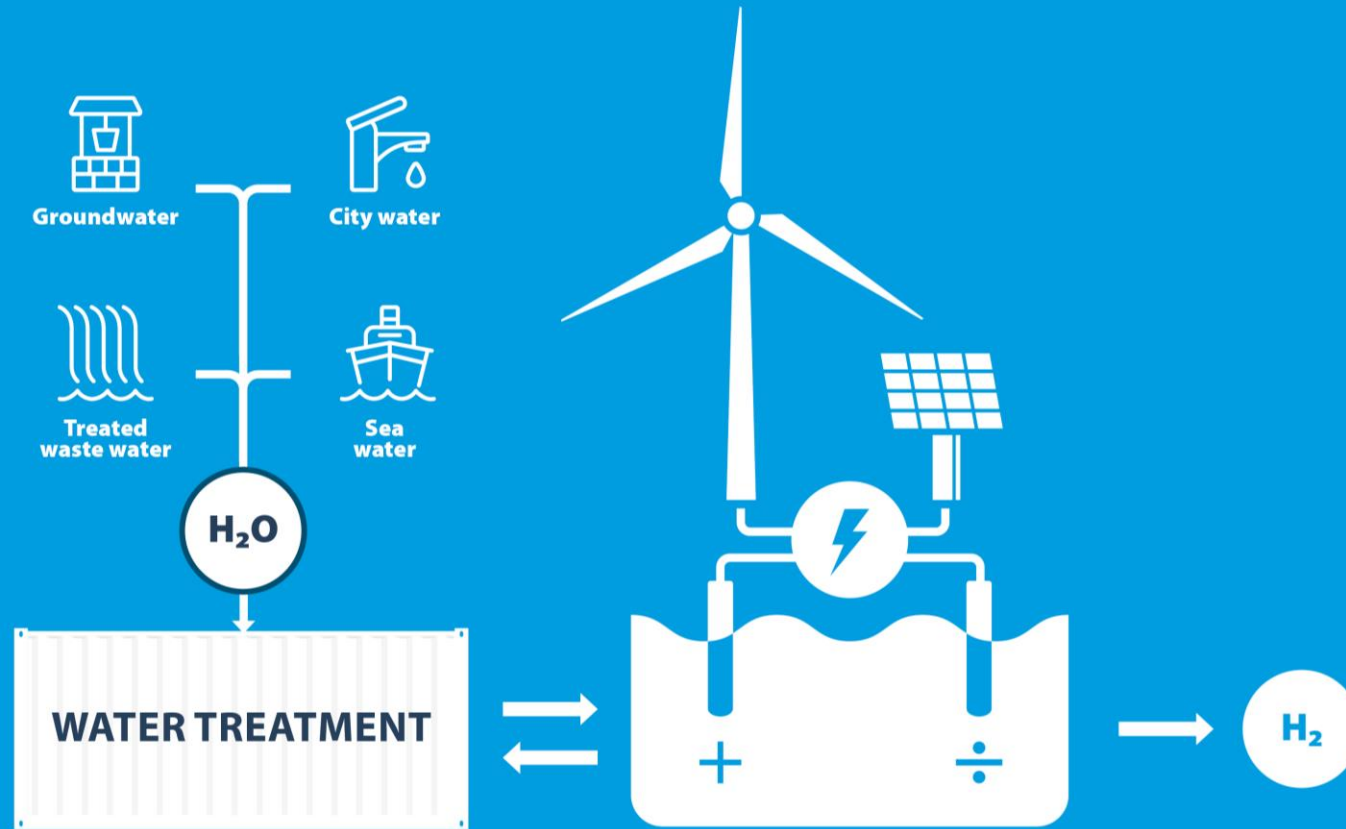


More than 50  
frame-mounted plants  
for containerized PEM  
systems (1-5 MW)

> 300 MW  
Electrolyser  
capacity



> 90  
Water  
treatment  
plants



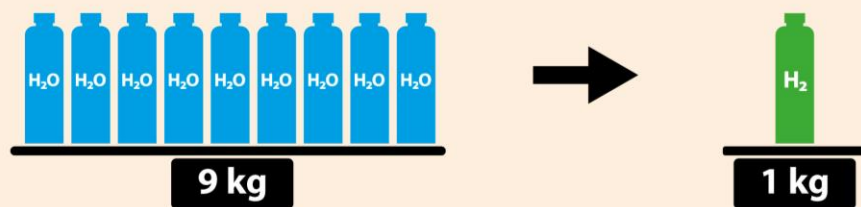
*Water treatment for green hydrogen*

# Water quantity for electrolyzers

## Rules of thumb for designing your water treatment system

### Power-to-X

How much ultrapure water to produce  $H_2$ ?

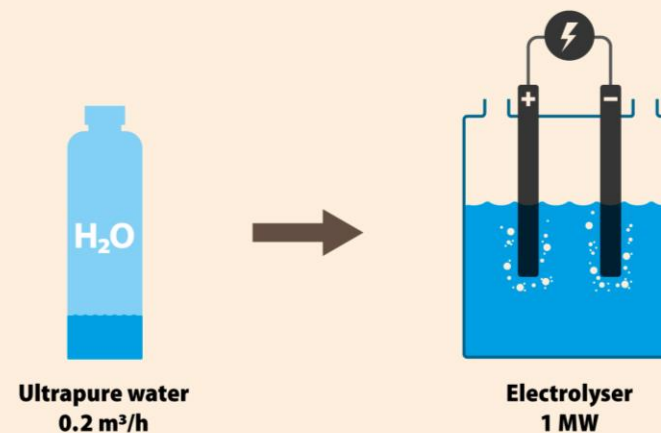


Electrolysis of 9 kg ultrapure water results in 1 kg hydrogen.

©Silhorko-Eurowater A/S

### Power-to-X

How much ultrapure water per MW electrolyser?



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# Where should water come from?

## Water and energy consumption for different raw waters

### Power-to-X

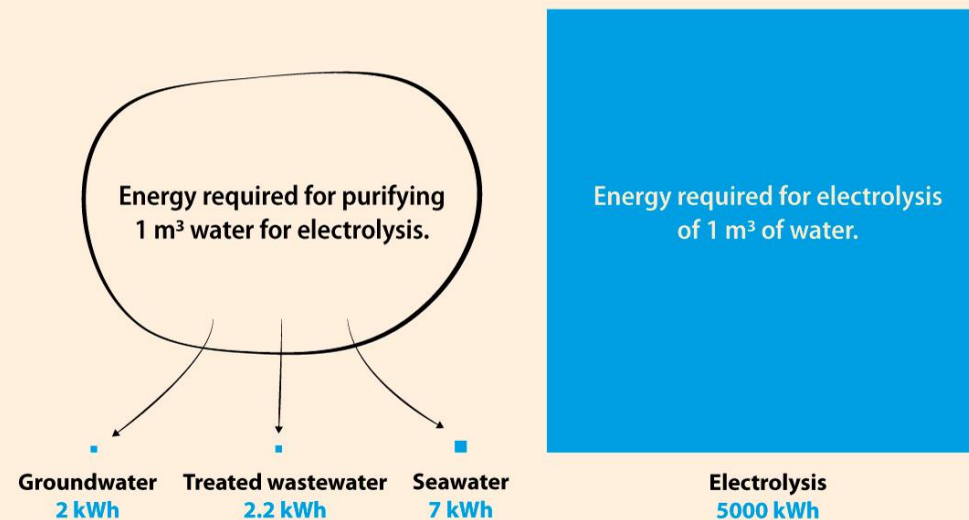
How much water for 1 m<sup>3</sup> ultrapure water?



©Silhorko-Eurowater A/S

### Power-to-X

Electrolysis and water treatment



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# Water quality for electrolysis

## WHAT AFFECTS WATER QUALITY REQUIREMENTS?

### Impact of electrolyser system

- Type of electrolysis technology (eg. AWE, PEM, SOEC,..)
- Electrode material
- System design (flow temp., pressure)
- Brand of electrolyser (eg PEM X vs PEM Y)
- ....

### Impact of molecules/ions in water

- Deactivation of electrolyser
- Reduction of electrolyser efficiency
- Blocked transport of protons
- Increased need for cleaning
- Increase of electrolyser OPEX
- ....

Parameter	Unit	ASTM Type I	ASTM Type II	ASTM Type III	ASTM Type IV
Conductivity	μS/cm	0.056	1.0	0.25	5.0
Resistivity	MΩ-cm	18	1.0	4.0	0.2
TOC	μg/L	50	50	200	No limit
Sodium (Na)	μg/L	1	5	10	50
Chloride (Cl)	μg/L	1	5	10	50
Silica (SiO <sub>2</sub> )	μg/L	3	3	500	No limit

A starting point, but not a true standard for electrolysis

## RULE OF THUMB

### Alkaline electrolysis

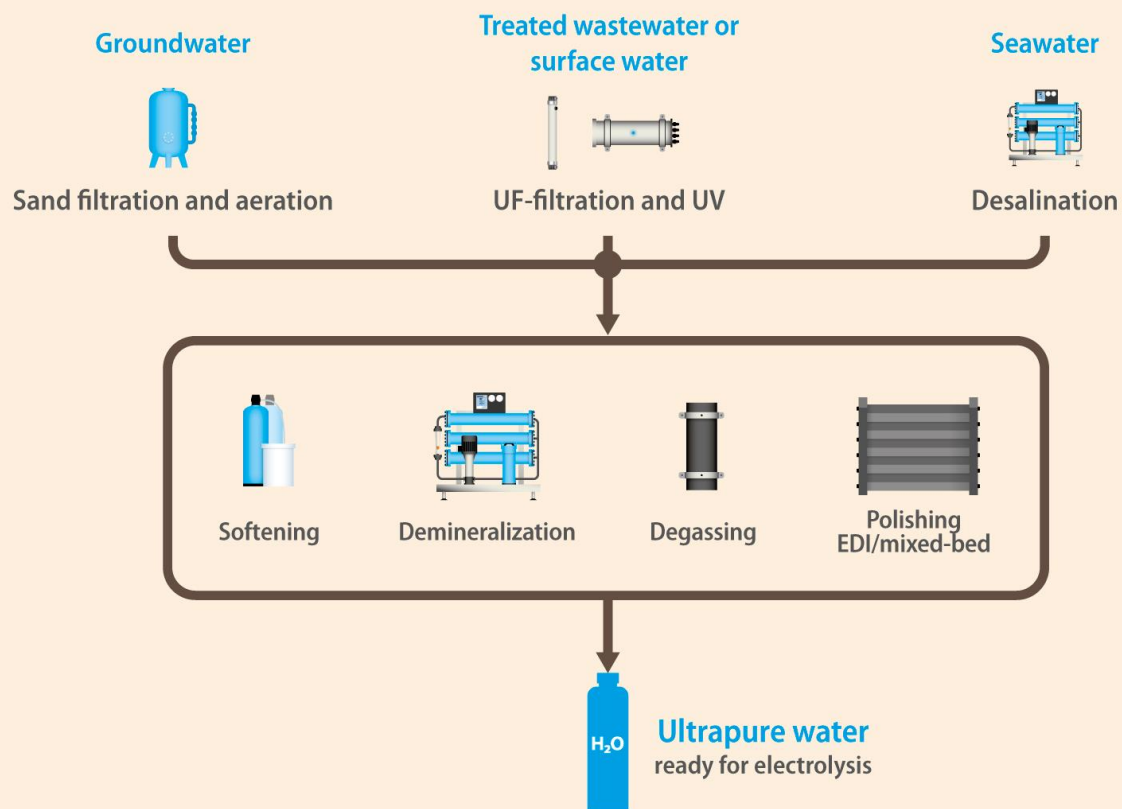
< 1.0 μS/cm

### PEM & advanced AWE

< 0.1 μS/cm

*“No electrolyser has ever been damaged by water that was too pure”  
H. T. Madsen*

# How is water treated for green H<sub>2</sub>?



©Silhorko-Eurowater A/S

## Two step process

### 1. Pretreatment

Aim: Convert variable input source to stable water quality.

Quality should resemble drinking water quality

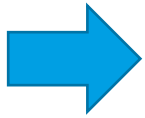
### 2. Polishing

Aim: Remove all contaminants that can affect the electrolyser



# Water treatment technology options

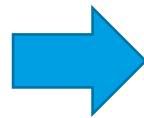
**Filtration & active carbon**  
*Particles, chlorine*



**Softening**  
*Hardness*



↕  
**Anti scalant**



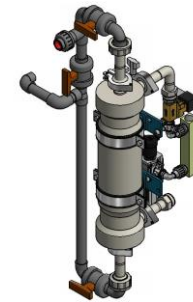
**Reverse osmosis (RO)**  
*Salts, SiO<sub>2</sub>, TOC (>95%)*



↕  
**DPRO**



**Degassing (MDU)**  
*N<sub>2</sub>, CO<sub>2</sub> (70-80%)*



↕  
**NaOH dosing**



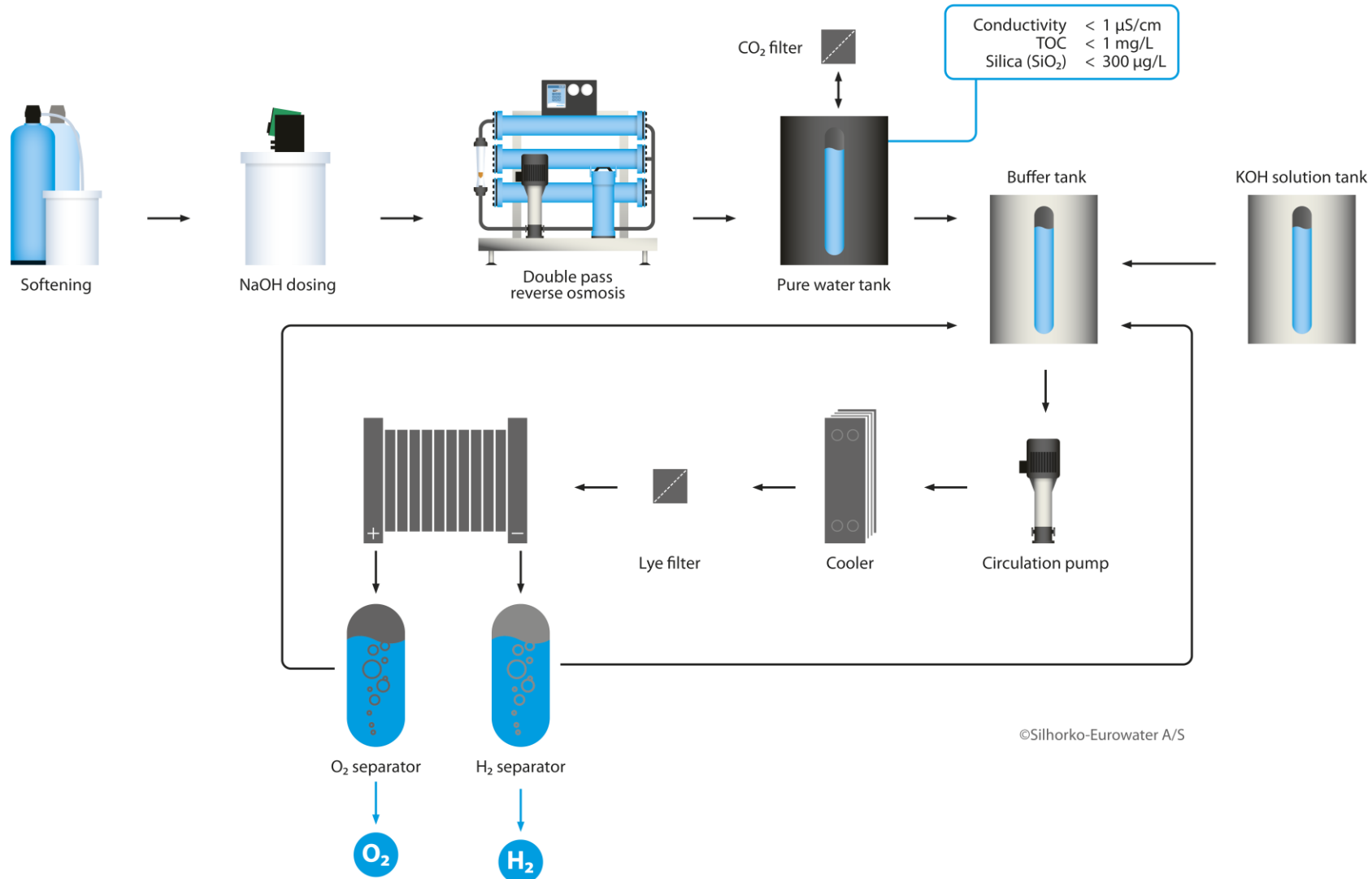
**Mixed bed**  
*Salts, SiO<sub>2</sub>*



↕  
**EDI**

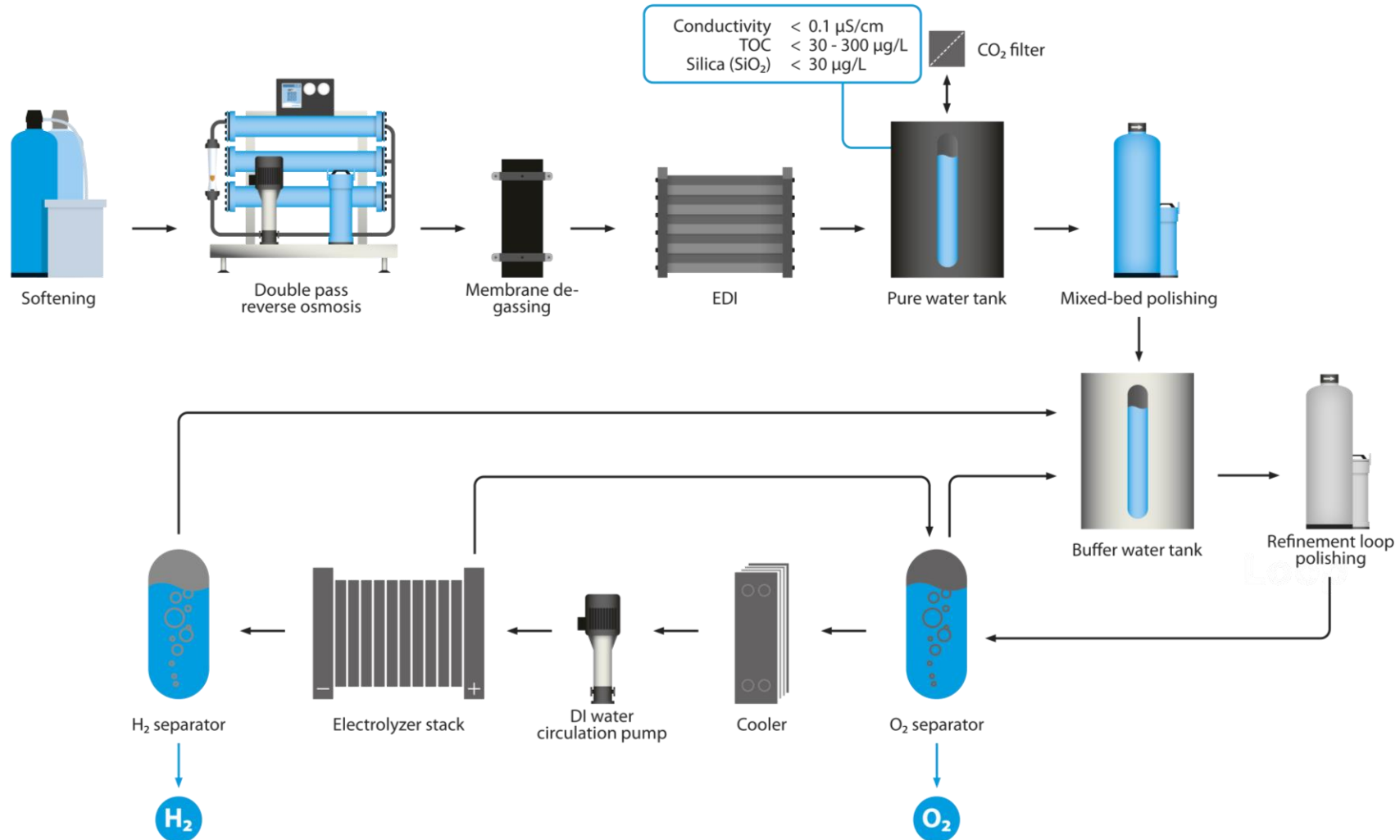


# Water treatment for alkaline electrolysis





# Water treatment for PEM electrolysis



Standard solution

## 1-5 MW | PEM Water treatment suitable for integration in container solutions

### What

Standardized solution for production of ultrapure water.

### Challenge

System must be compact and very flexible to handle different water resources and consumption.

---

### EUROWATER solution

- › Softening unit type SM62
  - › Reverse osmosis type RO B1-3
  - › Membrane degassing unit type MDU
  - › 2 x Mixed-bed type EUREX 61
- 

See more references  
at [eurowater.com](https://eurowater.com)





## 3x3 MW | Alkaline Containerized solution for Power-to-Gas facility

### What

Customer upgrades biogenic CO<sub>2</sub> to CH<sub>4</sub>

### Challenge

Upgrade city water to ultrapure water quality. Specific challenges: chloride and CO<sub>2</sub> content in raw water.

---

### EUROWATER solution

- › Softening unit type SM82-F
  - › Brine tank
  - › Double-pass reverse osmosis type DPRO B2-8/6
  - › Grundfos CRNE pump
  - › Membrane degasser for CO<sub>2</sub> removal
  - › Pump station
  - › CIP unit
- 

Download reference  
at [eurowater.com](https://eurowater.com)





## 20 MW | Alkaline Ultrapure water for green fuels and refining

### What

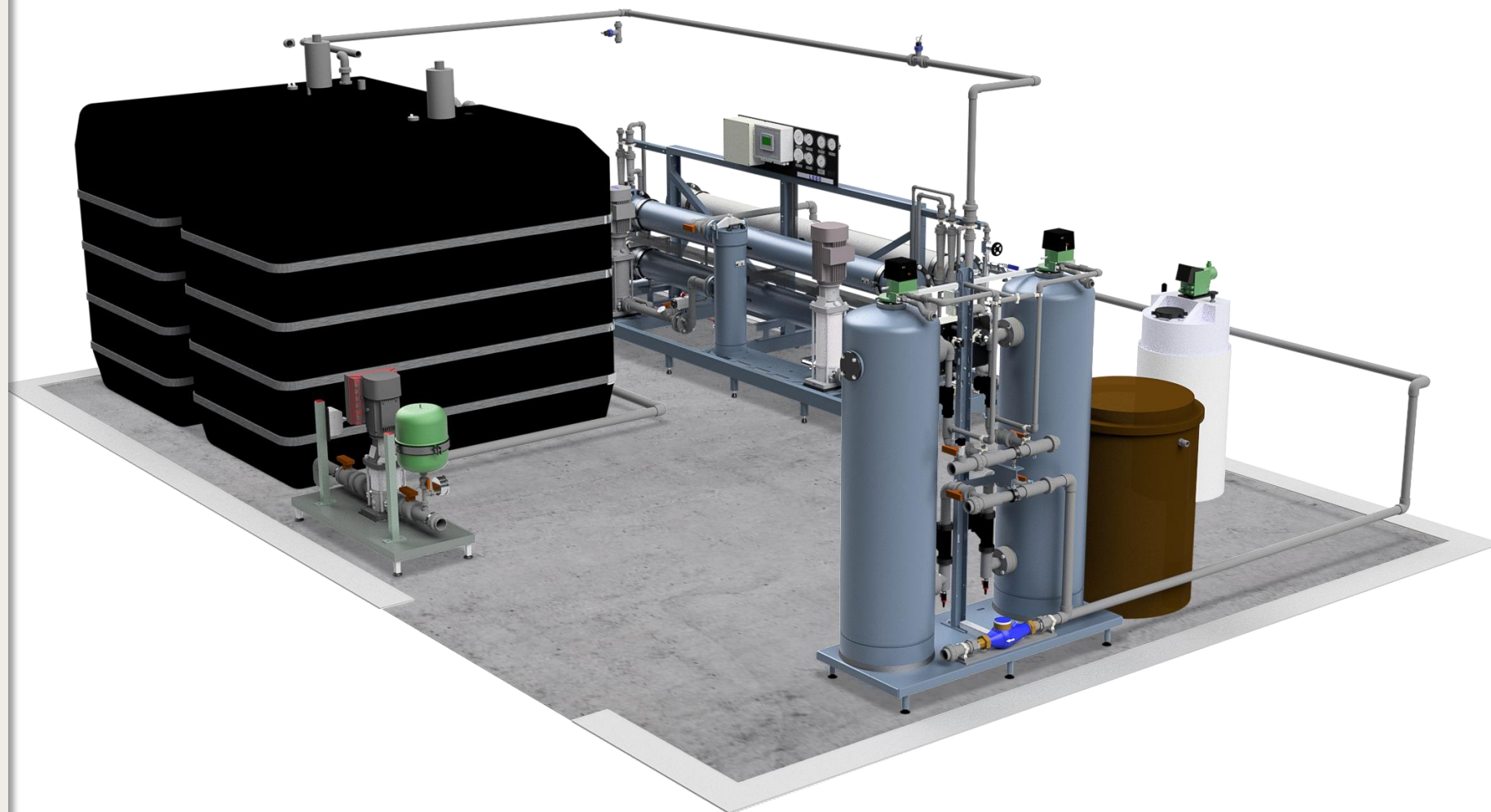
HySynergy provides large-scale hydrogen production for zero-emission fuel and reducing the carbon footprint in refining.

### Challenge

Produce 4 m<sup>3</sup>/h ultrapure water at < 5 µS/cm starting from city water. Special attention to hardness, chloride and CO<sub>2</sub>.

### EUROWATER solution

- › Softening unit type SMH 602-F
- › Brine tank
- › Double-pass reverse osmosis type DPRO C3-6/3
- › Dosing tank with mixer
- › Dosing pump
- › Feed water tank 2 x 5000L
- › Booster pump





## 50 MW | PEM

# Ultrapure water for green methanol

### What

The world's first large-scale commercial e-Methanol production facility for shipping fuel and mobility.

### Challenge

Produce 10 m<sup>3</sup>/h ultrapure water at <0.1 µS/cm starting from groundwater. Special attention to metal ions, organics and CO<sub>2</sub>.

---

### EUROWATER solution

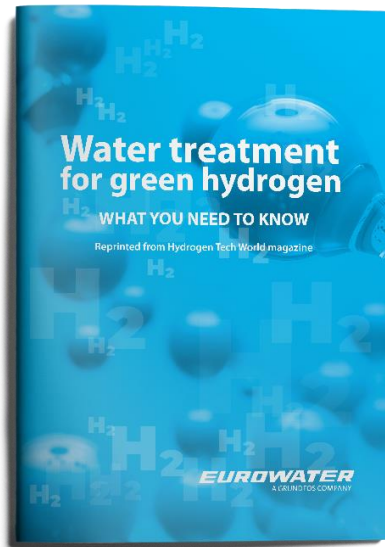
- › Antiscalant dosing
  - › Reverse osmosis unit type RO C3-9
  - › Reverse osmosis unit type RO-PLUS C3-12+3
  - › Membrane degassing unit type MDU
  - › Electrodeionization unit type EDI 2-5000e
  - › Mixed-bed polisher type EUREX
- 

Download reference  
at [eurowater.com](https://eurowater.com)

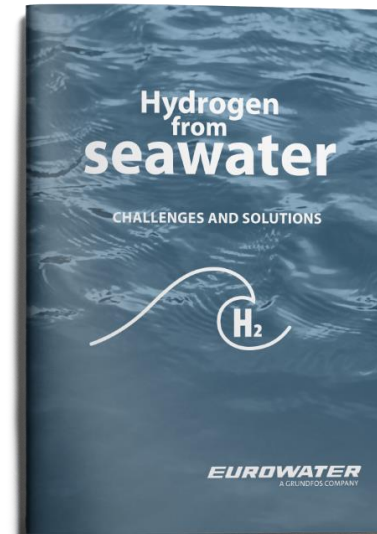
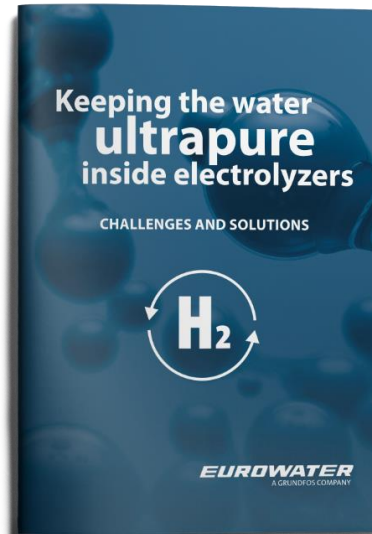


*A special surprise!*

# Deep dive into water for hydrogen



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*If you want to know more*