

ElectroDialysis for water desalination



June 2021



REDstack's mission is to turn technology leadership into global market leadership of process technology and Ion-Exchange Membrane Stacks

- 2005: spin-off of Wetsus, European Centre of Excellence in Sustainable Water Technology
- 2014: built the world's first operating Blue Energy pilot plant
- 2016: received Dutch National Icon award as reward for being a Dutch impact scale-up company
- Participation in 20 national and international R&D projects
- Filed and acquired 15 patents
- Core know-how: electrodialysis process design, membrane application and stack performance
- Founder is single shareholder, involved since the foundation of the company
- Team of experienced professionals, both in water industry and renewable energy industry
- Partnerships with Arcadis (global civil design and engineering company) and Aqua Battery (sustainable battery supplier)



Pure Water Group (PWG) and REDstack belong to the same holding, combining strengths and opportunities to increase added value



100%

PURE WATER GROUP



100%

RED STACK



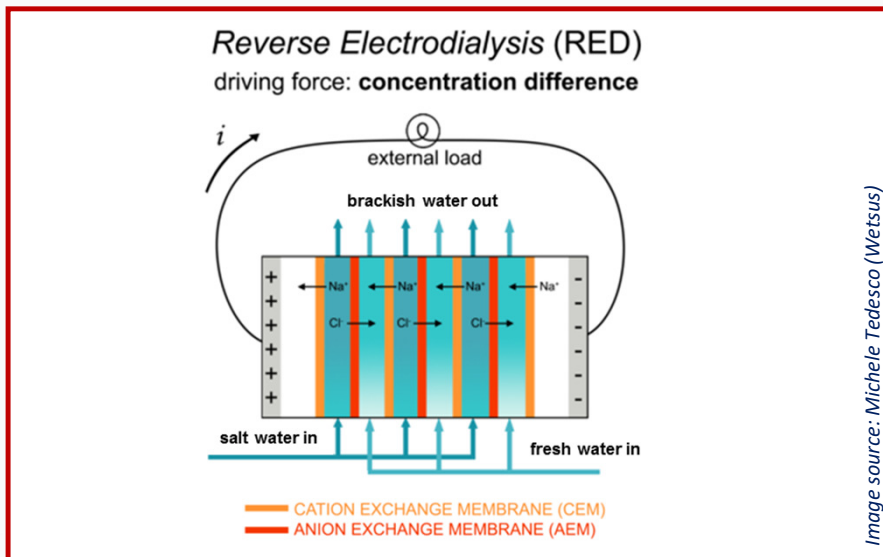
W&F Technologies BV is a company specialized in the development of (bio)electrochemical systems for water treatment, energy and resource recovery, and bioelectrosynthesis, based on ED-technology.

Pure Water Group BV focuses on design, manufacturing and sales of professional skid-mounted process-units and engineered solutions for ultra-pure water production, using EDI modules and ED membrane stacks.

REDstack BV develops, produces and provides membrane stacks and process engineering for water desalination and renewable energy generation, based on ED and RED technology.

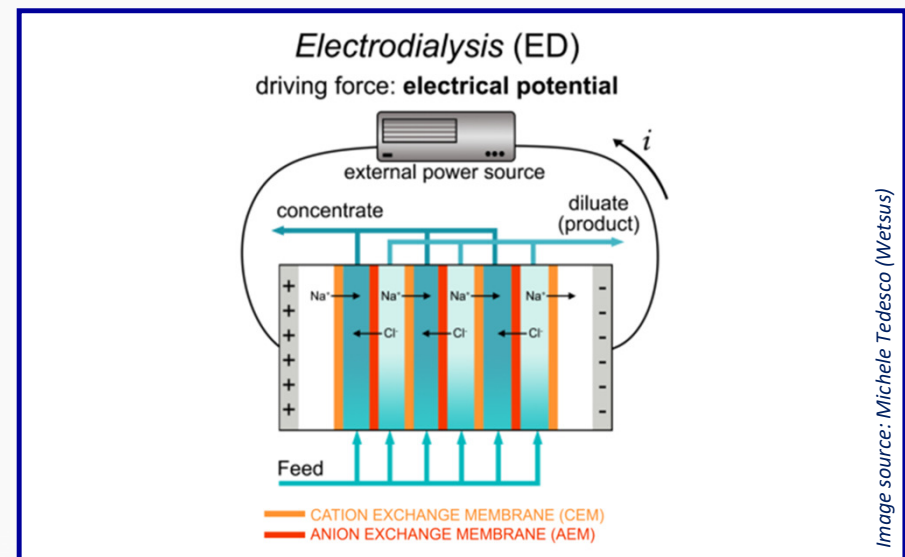
AquaBattery BV has developed a 100% sustainable electrical storage system, solely using water and table salt, and membrane stacks based on ED and RED technology (REDstack is sole supplier).

REDstack's technology is deployed in 2 market segments: Renewable Energy Generation and Water Desalination



Reverse ElectroDialysis (RED) generates Blue Energy:

1. fresh and salt water are combined
2. charged ions flow through selective membranes
3. membranes are placed in a stack
4. a voltage difference is created between electrodes



ElectroDialysis (ED) produces desalinated water:

1. salt water flows between selective membranes
2. membranes are placed in a stack
3. an electrical potential is applied between electrodes
4. charged ions are forced to separate from the water

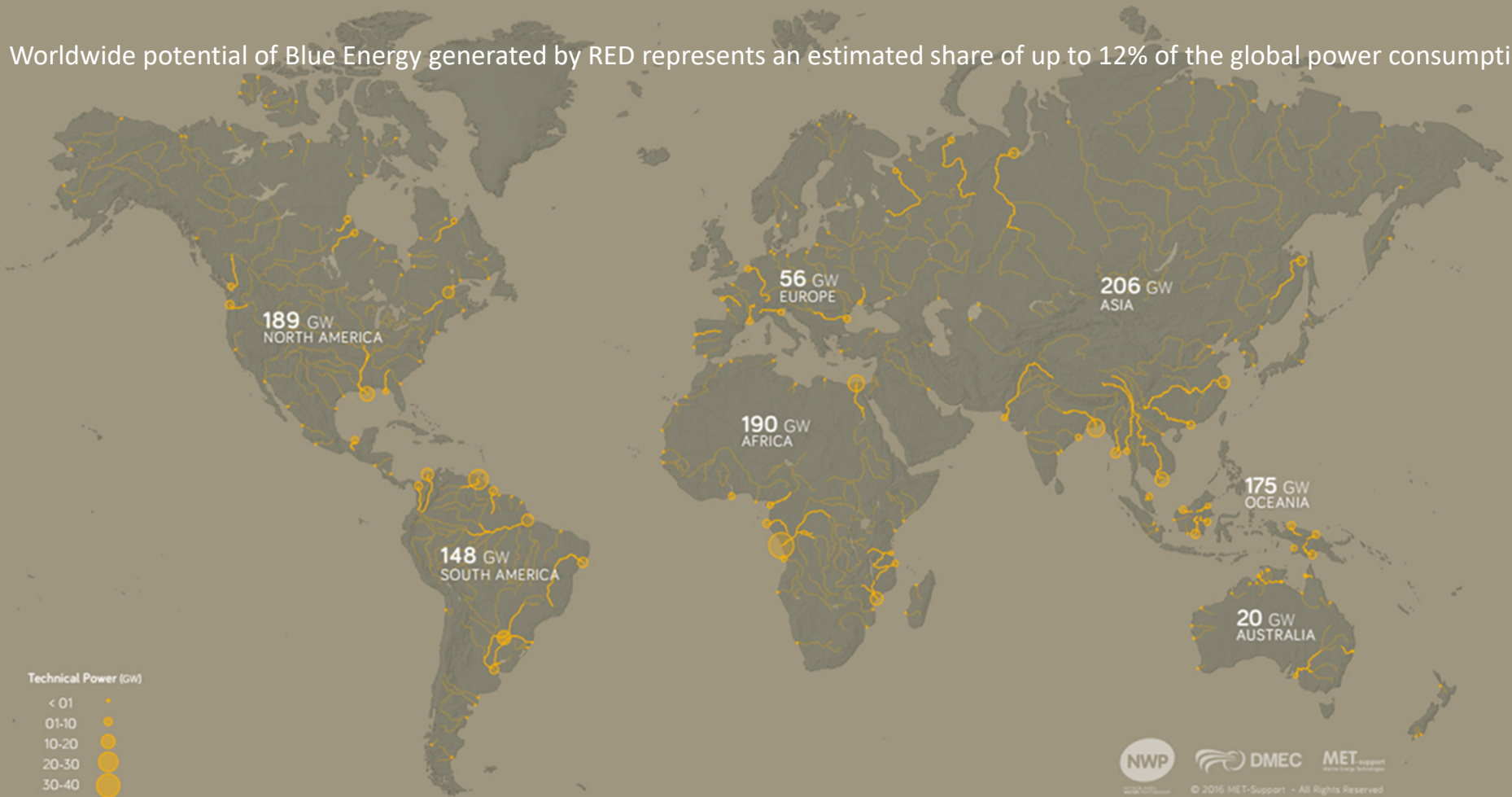
One generic tube-stack design is applied for both RED and ED configurations



SALINITY GRADIENT ENERGY WORLDWIDE POTENTIAL (1TW)



Worldwide potential of Blue Energy generated by RED represents an estimated share of up to 12% of the global power consumption





The world's first operating Blue Energy pilot plant



The Waddenzee is part of the North Sea, a National Park and UNESCO Heritage.

REDstack's pilot plant for Blue Energy

The Ysselmeer is the largest freshwater lake in The Netherlands.

Brackish water out

Seawater in

Freshwater in

- The Afsluitdijk is a dam of 32 km
- It forms a crucial part of Dutch water management infrastructure
- REDstack has to comply with many strict environmental and safety regulations

Impression of the pilot plant facility



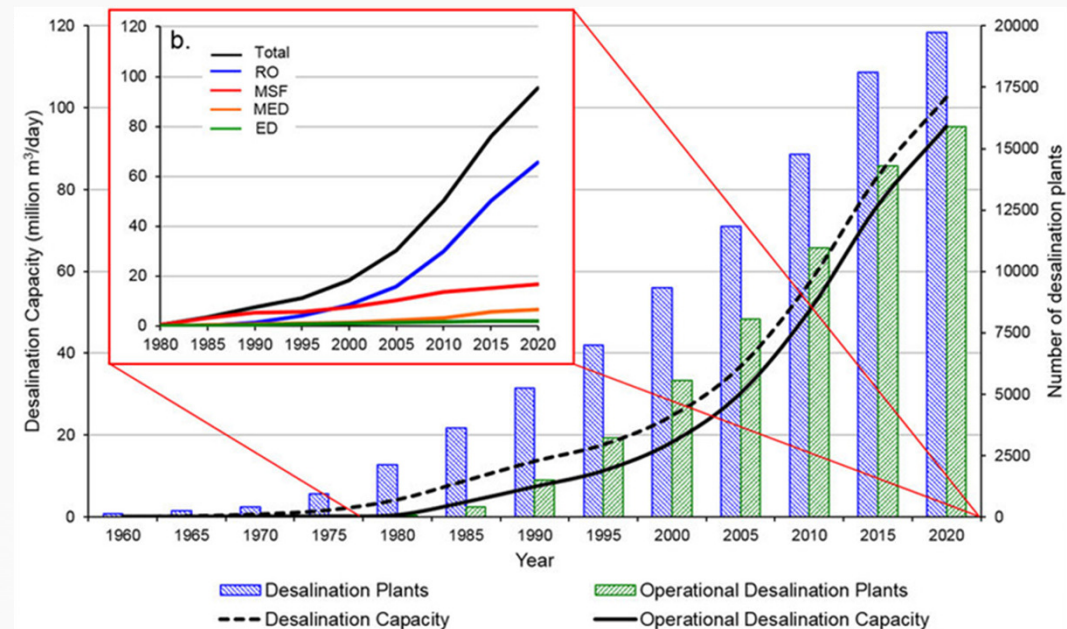
REDstack's ElectroDialysis (ED) technology has been applied in desalination applications and demonstrated in the REVIVED project

- H2020 programme: nanotechnologies, advanced materials and production
- Project size: € 9.8 mln, 51 months, 10 consortium partners
- 3 configurations:
 - PhotoVoltaic powered BW desalination system
 - Integrated (R)ED-RO systems for SW desalination
 - Multistage ED for SW desalination



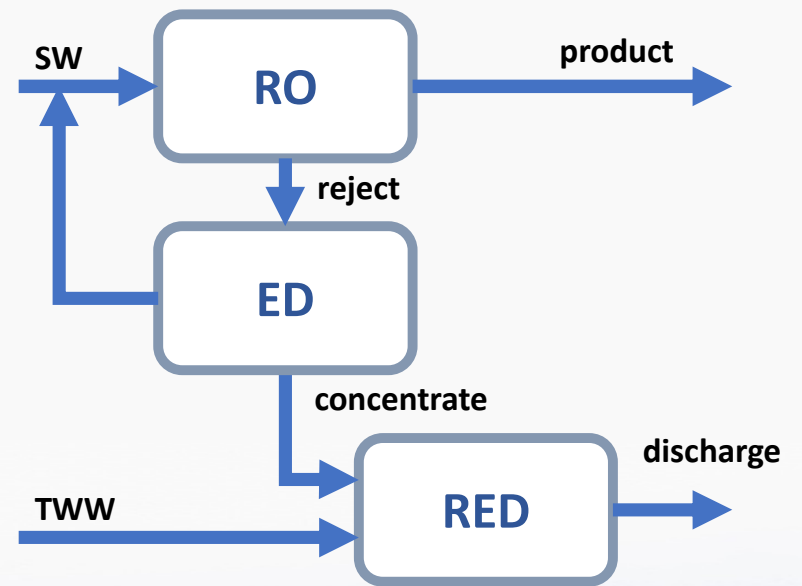
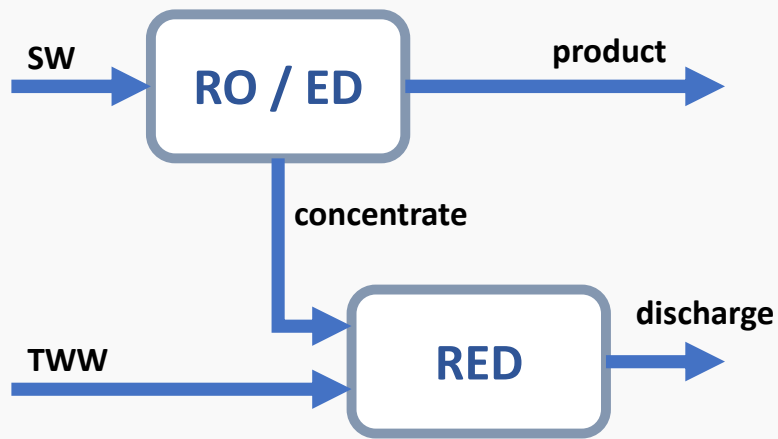
Interest in ElectroDialysis increases due to growing environmental restrictions

1. ED reduces carbon emissions:
 - Low energy consumption (kWh/m³)
2. ED offers flexibility in desalination level
3. ED increases water recovery:
 - Contribution to Minimum Liquid Discharge (MLD) and Zero Liquid Discharge (ZLD) in combination with other technologies
4. ED increases recycling of chemicals:
 - Nutrients and chemicals are maintained and can be recycled

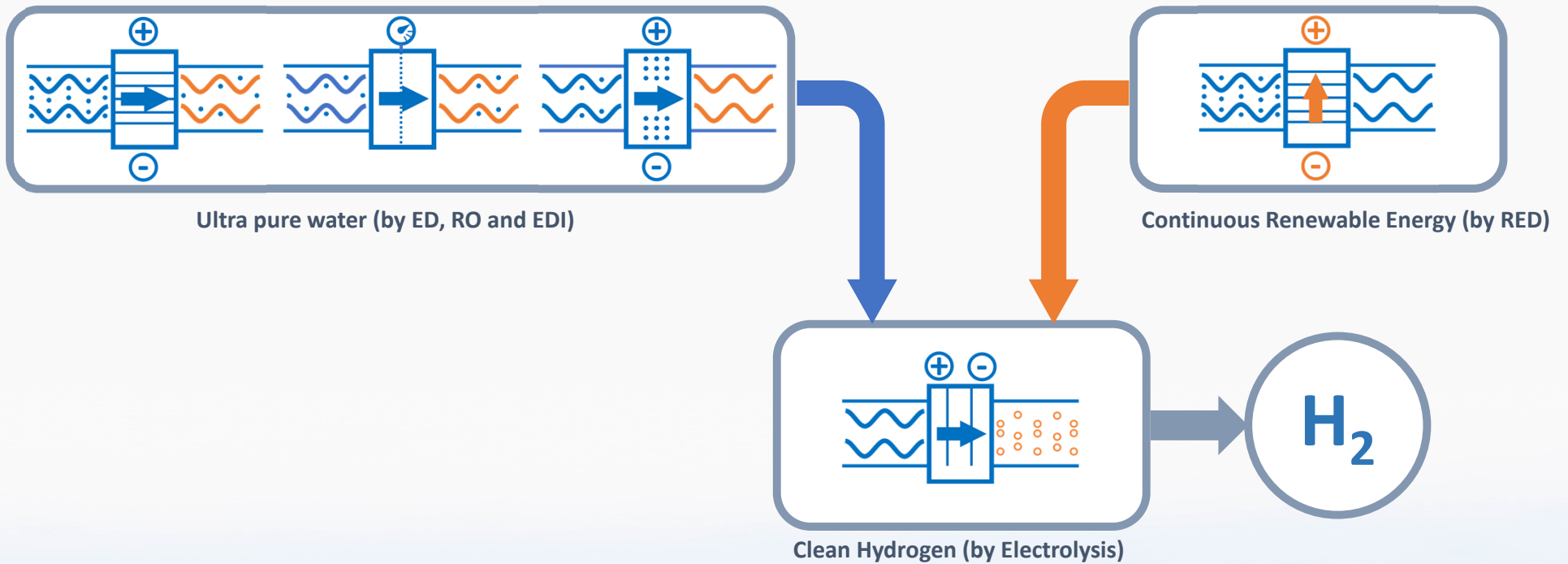


Source: *The state of desalination and brine production: A global outlook*
https://www.researchgate.net/figure/Trends-in-global-desalination-by-a-number-and-capacity-of-total-and-operational_fig3_329476006

Hybrid system configurations further increase potential for water recovery and reduction of energy consumption



REDstack's ED and RED membrane stacks enable clean hydrogen production, by providing continuous renewable energy and purified feedwater



Thank you for your attention!

REDstack B.V.
Graaf Adolfstraat 35-G
8606 BT Sneek (NL)
Tel: +31 (0)515 745 582
Email: Request@REDstack.nl
Web: www.REDstack.nl