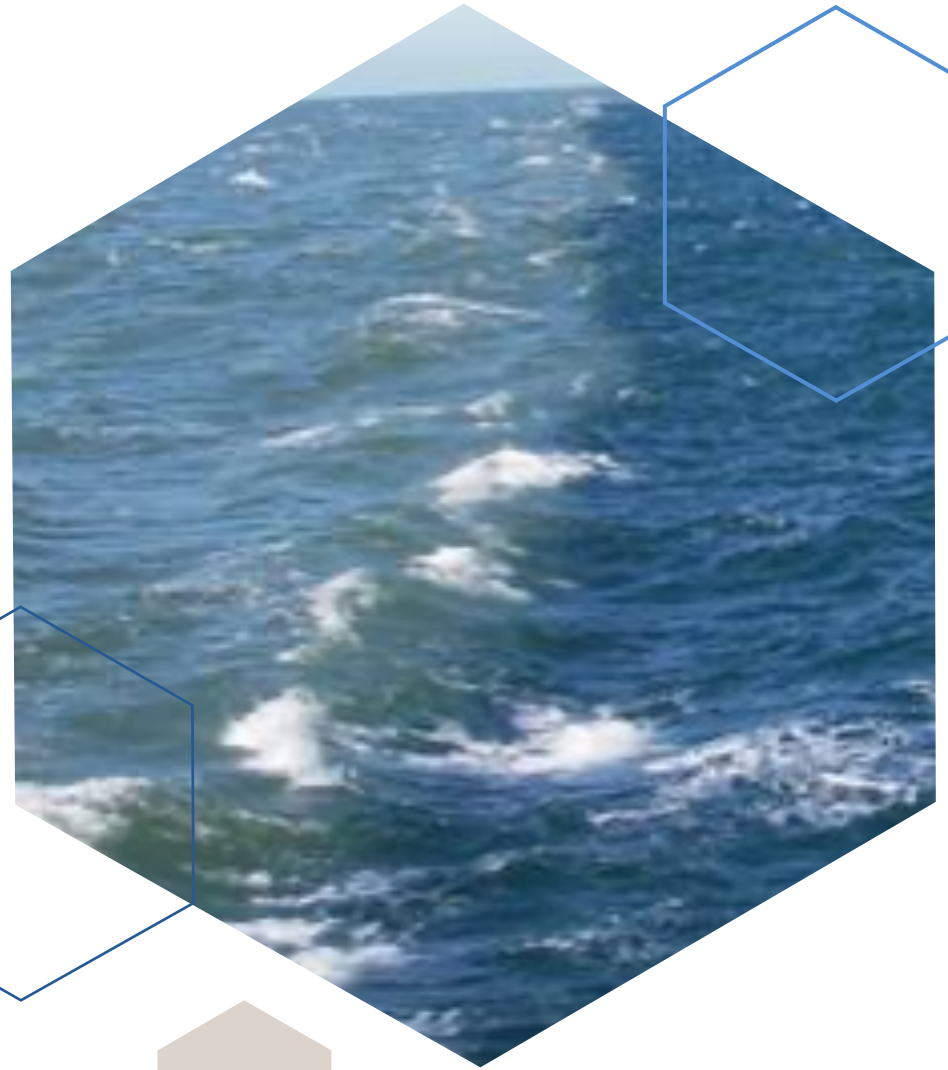
Blue Energy

REDSTACK

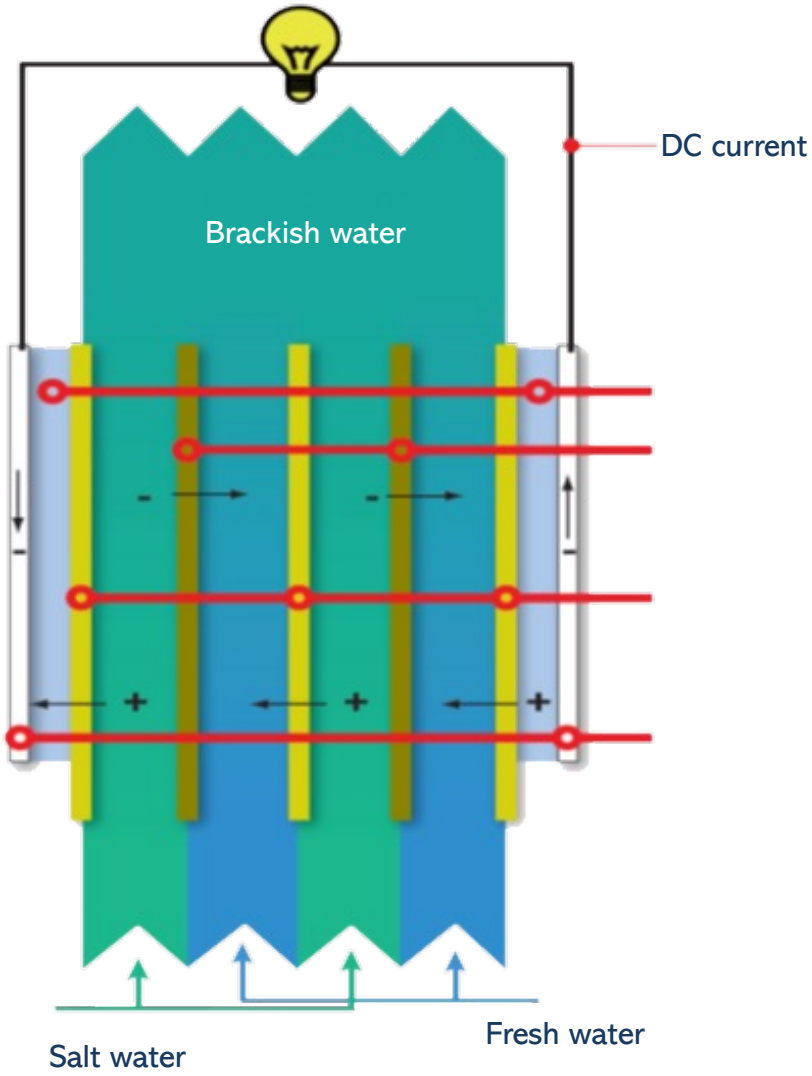
Blue Energy Powering Our Sustainable Future



About Blue Energy

- Energy from 2 waterflows with **difference in salt concentrations**
  - River Water and Sea Water
  - Treated water from municipal sewage waste treatment plant and Sea Water
  - River Water and Brine Water (discharge water from salt manufacturing facilities/ De-salination plants)
  - Fresh water discharge from Hydro projects and Sea Water

- Based on **Reverse Electro Dialysis ("RED")**
- Produces **DC Current**
- Produces **Full Continuous Power/ Round The Clock Power**



Global Potential of Blue Energy

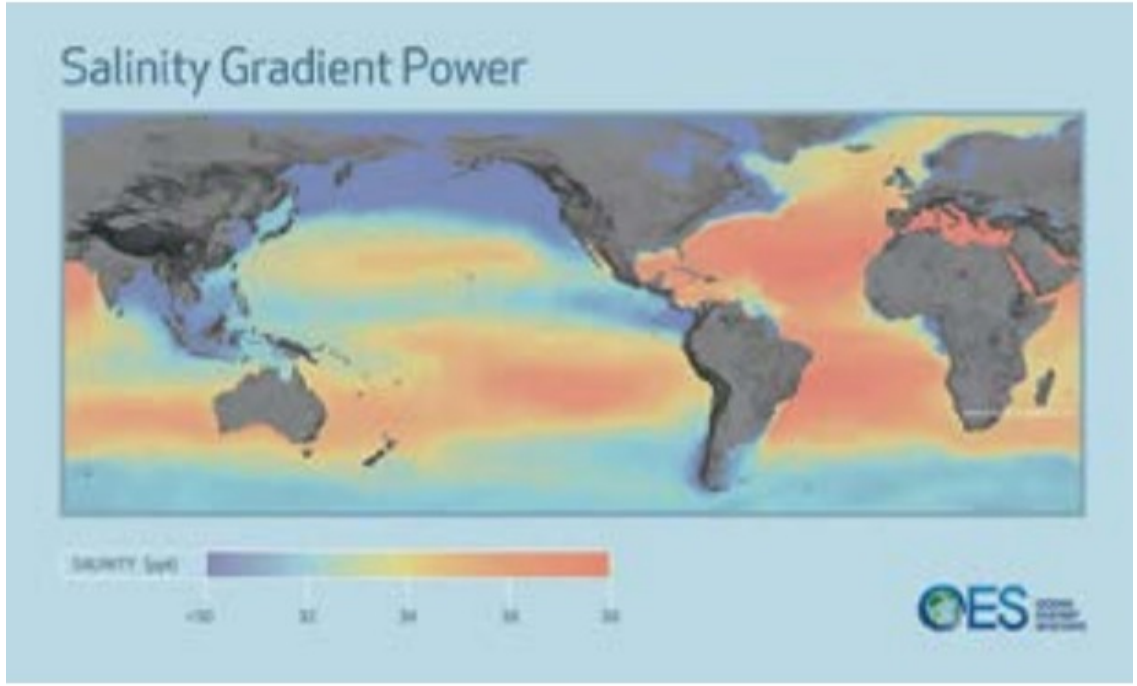
- The Global Potential of Blue Energy is estimated to be **3.2 TW**.
- The potential estimated for Asia is **1 TW**

Continent	Theoretical Potential		Technical Potential	
	[GW gross]	[TWh gross/year]	[GW gross]	[TWh gross/year]
Europe	241	2,109	49	395
Africa	307	2,690	63	503
Asia	1,015	8,890	208	1,663
North America	479	4,195	98	785
South America	969	8,492	199	1,589
Australia*	147	1,291	30	242
World	**3,158**	**27,667**	**647**	**5,177**

*Incl. Oceania
The theoretical amount has to be adjusted for technical feasibility and environmental impacts

Source: IRENA

Estimated salinity gradient differences in oceans and seas worldwide (IEA-OES, 2014)



Source: International Energy Agency – Ocean Energy Systems (IEA-OES), 2014)

Blue Energy Pilot Project

2004

REDstack team started working with WETSUS Institute to test the possibility of generating electricity through Reverse Electro Dialysis, in laboratory

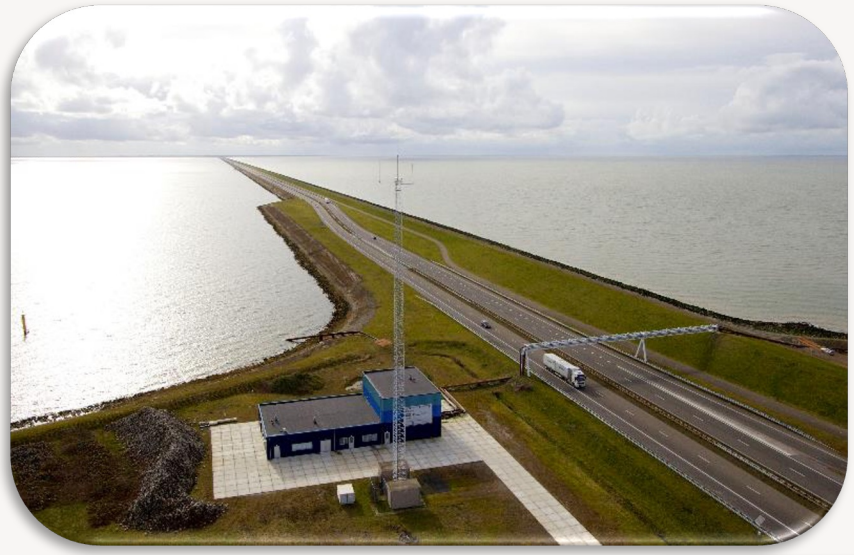
2014

- Commissioned World's First Blue Energy project (TRL 7).
- Project inaugurated by King William Alexander
- Awarded Dutch National Icon

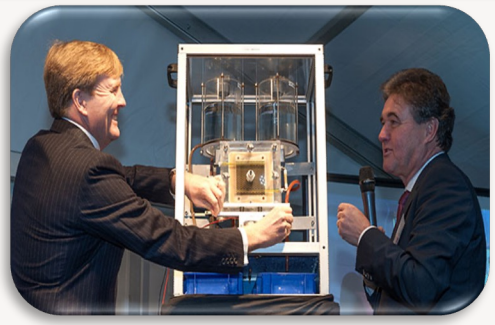
2022

- Upscaled the project by 2000x
- Resolved the initial set of challenges faced, with design optimization
- In process to develop MW scale demonstration project

Pilot plant (TRL7) at Afsluitdijk, where River Rhine is meeting North Sea (Netherlands)





Observations from Blue Energy Pilot Project

365x24x7 Power	Zero Degradation	High Capacity Utilization Factor	Negligible Ecological Impact	O&M Cost
The Blue Energy projects are designed on the base load flow of rivers, therefore, has the opportunity to develop 365x24x7 power, without any battery storage requirements.	The Pilot Project has been in successful operation for 3 years, and not witnessed any degradation, whatsoever. The performance of the project is at the same level at the time of COD.	The Pilot Project has been observed to generate CUF of more than 99%. The project has an aux consumption of 25%, therefore, the net output expected from a project 75% CUF.	The Pilot Project has been set up in the Afsluitdijk, where River Rhine is meeting North Sea. This area has been declared as UNESCO protected site. Ecological survery has been conducted by DELTARES and NIOZ, and has confirmed negligible ecological impact.	The Operations and Maintenance cost of the Blue Energy is low, and is comparable to any water treatment plant. The O&M cost is estimated to be 1% of total capex on civil and 3% of the total capex on the mechanical and electrical side

2023 - Upscaling of Blue Energy Pilot Project

INVESTMENT

Since the first start of the first PhD-experiments in the laboratories at WETSUS in 2004, a total amount of more than **50 million Euros** has been invested in developing the technology.

UPSCALING

REDstack B.V. shall be investing another **11 million Euros** to expand the capacity of the Pilot Plant. The company shall invest into manufacturing **industrial size** stack, and use about 12 of such industrial size stack, to enhance the existing pilot project capacity by 16 times.

PROCESS DESIGN

With the upscaling of Pilot Project, by adding 12 big industrial stack membranes, the process design shall be established, which shall be used for the MW scale Demonstration Project.

Blue Energy's Role in Energy Transition

Full Sustainable

Generates energy by using different water sources

365x24x7

Designed on base load of low of river, to ensure full continuous power

Predictable

Highly predictable energy yield, due to predictable flow of river

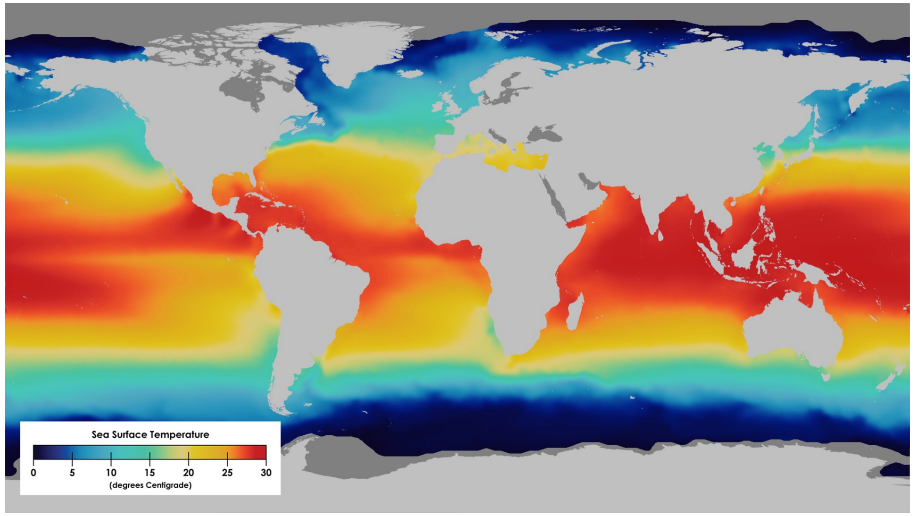
No Battery Storage Needed

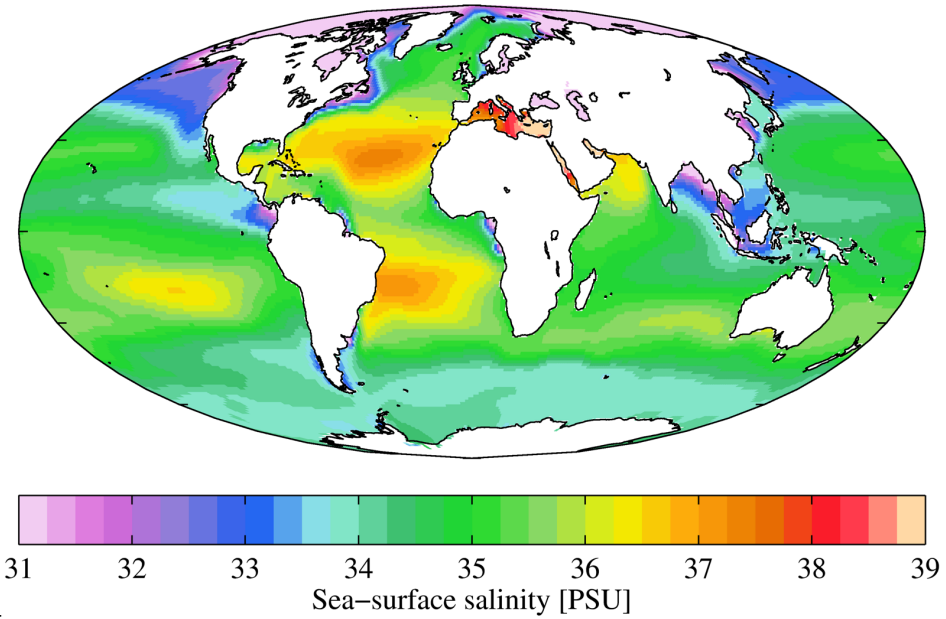
The projects do not require any battery energy storage. It can generate round the clock power

No Conversion Loss

The electricity generated is in the form of Direct Current (DC), which can be directly used by the Industries or Hydrogen Electrolysers

APAC Region – a Preferred Blue Energy Destination





Proximity to Equator

- The South Asian and South East Asian countries enjoy closer proximity to the equator.
- The sun's rays strike Earth's surface most directly at the equator, resulting in warmer temperatures.
- The regions of highest rainfall are found in the equatorial zone and the monsoon area of Southeast Asia.
- The salinity content of the oceans are high.

Warm Sea Water Enhances Efficiency

- For Blue Energy projects, warmer climatic conditions are more suitable, as it enhances the efficiency of the project.

Supply chains

- 2/3rd of the project components can be sourced locally, from start on;
- For large scale installation, REDstack could undertake local manufacturing of membrane stacks.

Thank you

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