GLOBAL WATER SUMMIT 2025

ACCELERATING INVESTMENT

12 - 14 May 2025 | Paris, FR

Membrane Crystallizer

Paradigm Change for Brine Valorisation

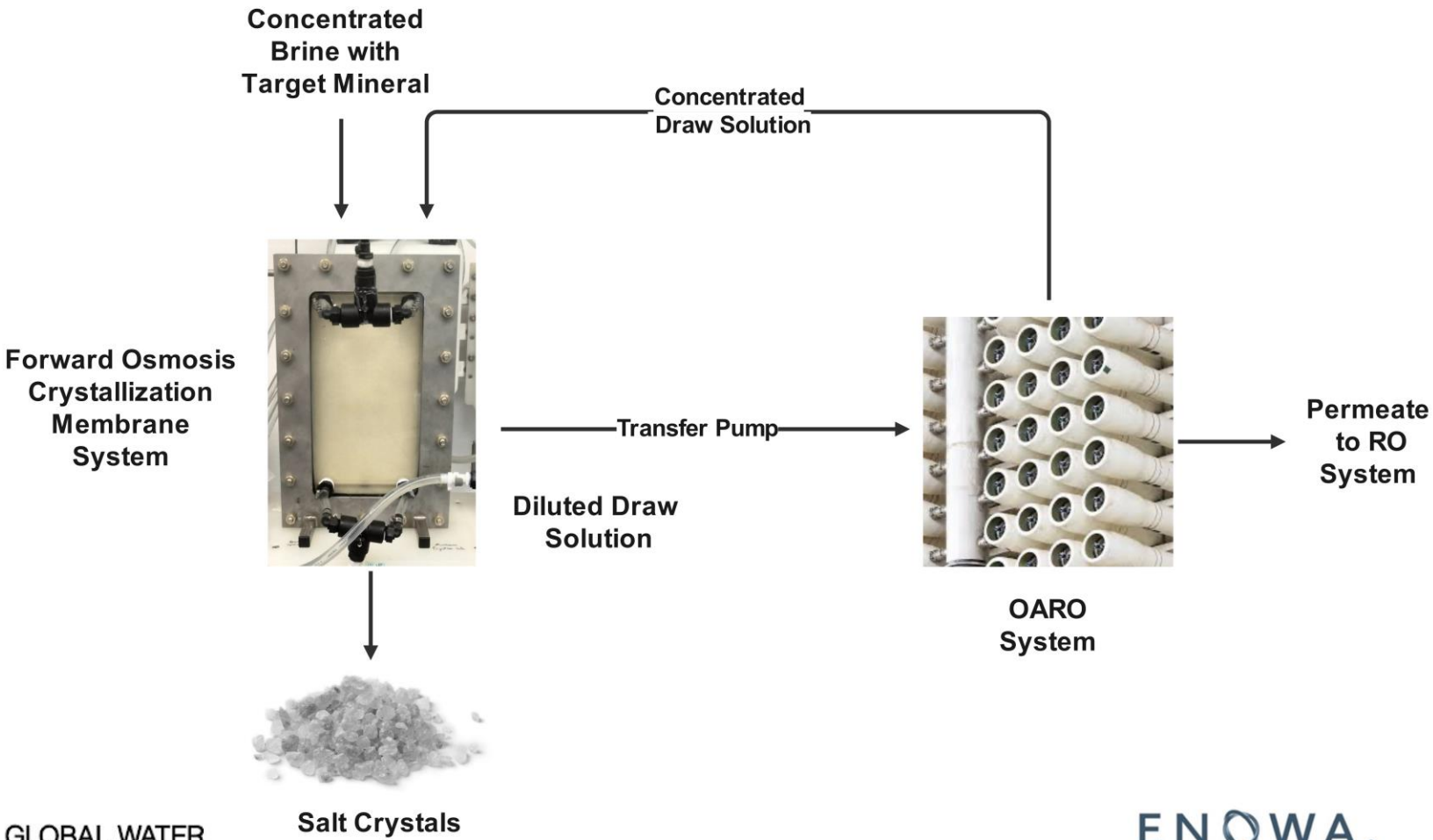
Nikolay Voutchkov

Executive Director

NEOM Water Innovation Center, KSA

GWI GLOBAL WATER INTELLIGENCE

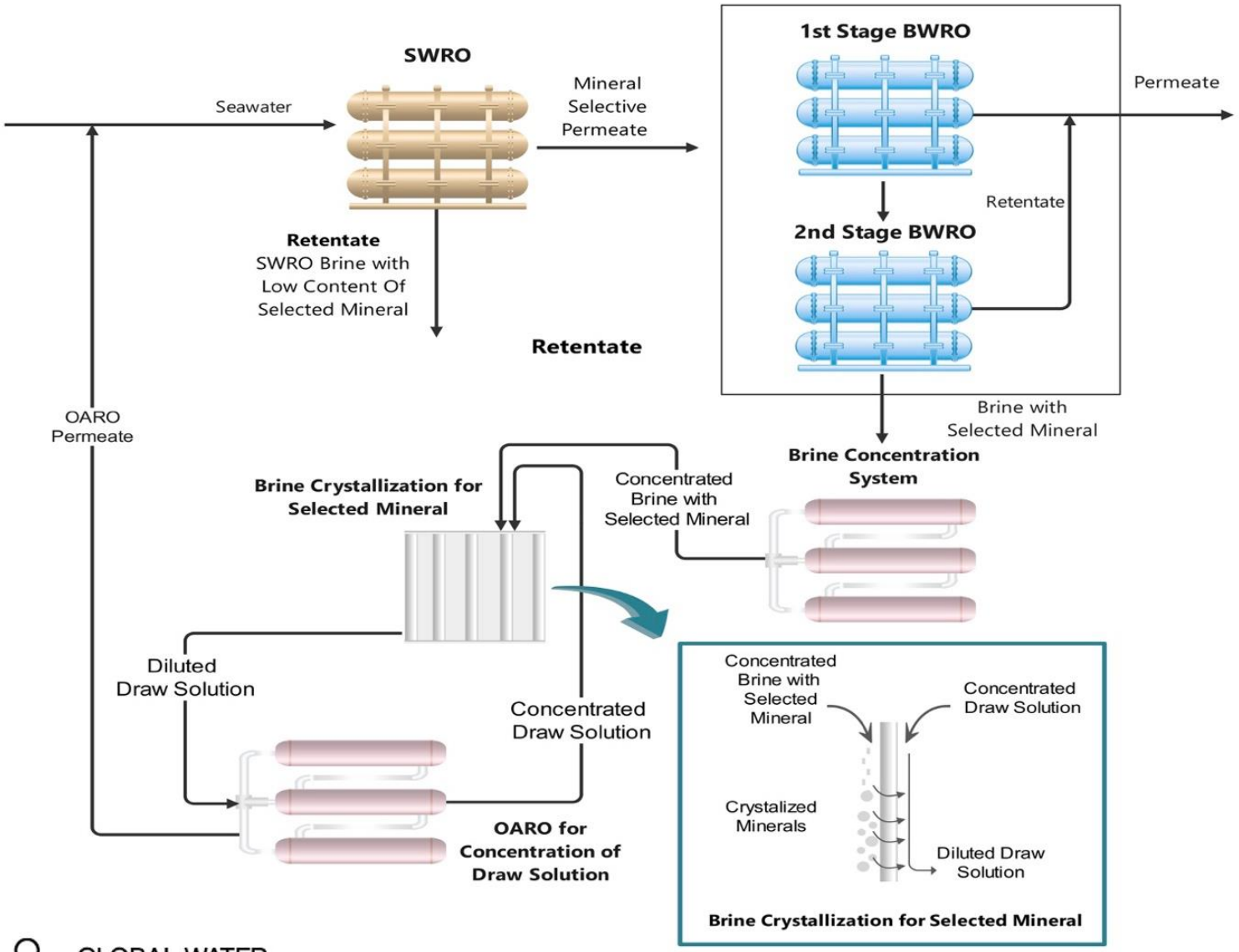
What Is It? –
Membrane Crystallization System which Uses 10 times Less Energy than Thermal Crystallizers

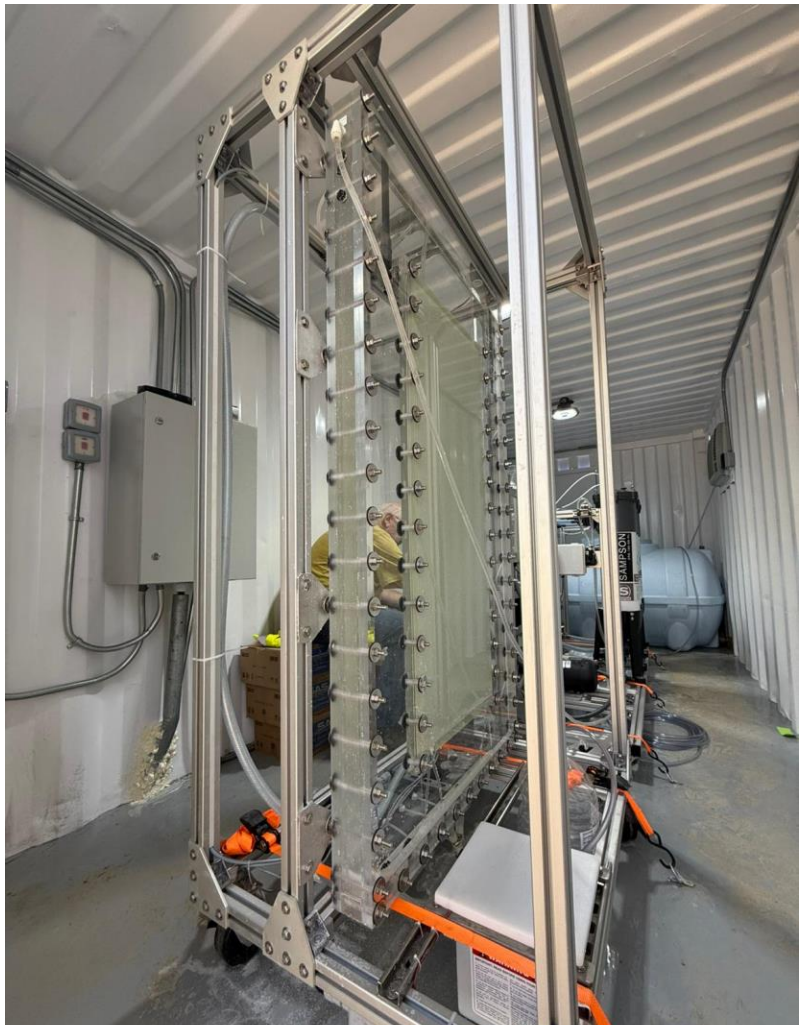


Total Energy Use for Salt Crystallization
7.5 kWh/m³
vs.
75 to 80 kWh/m³
For Thermal Crystallization

- **Separation by Froward Osmosis**
- **Cellulose Triacetate Membranes**
- **Draw Solution – $MgCl_2$**
  Produced from Seawater Using Selective SWRO Membranes & Recovered by OARO
- **Purity of Crystallized Minerals** – 99.6% to 99.9%
- **Mineral Crystal Size Controlled by Surface Tension of Membranes**

Membrane Crystallization System – Feasible, Flexible and Scalable





Membrane Crystallization System – Feasible – 1,000 m^3/day Duba Desalination Plant, Saudi Arabia

Capacity: 40 kg of NaCl/day – 99.6% purity
Flux: 1.5 to 2 Lmh
Feed pressure: 0.1 bar.
$MgCl_2$ draw solution: 90 kg,
Circulation Vacuum: 0.8 bar

Cost of NaCl Production Reduced from US$38/ton to US$20/ton
Market Price of NaCl = US$65/ton

Cooling Tower for Reconcentration of Draw Solution

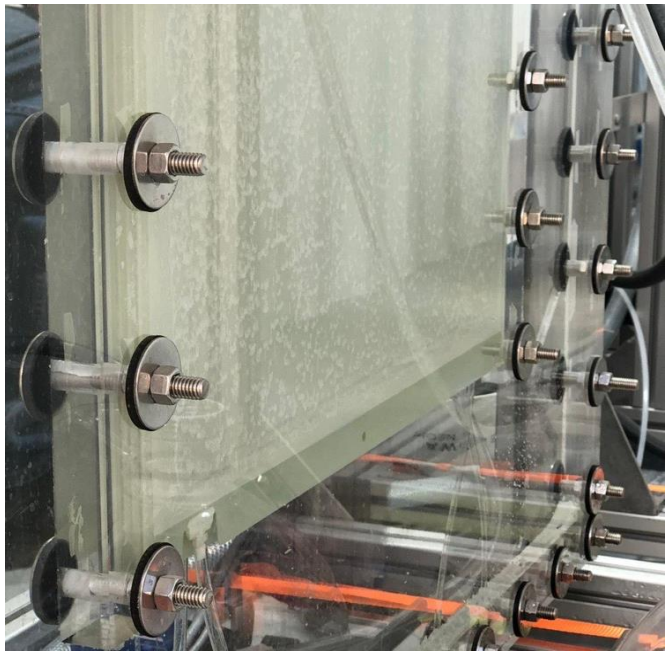
Duba Valorization Plant Crystallizer

Feed Salinity: 200-250 ppt,

Concentrated Salinity: 400-450 ppt,

FO Unit Power – 5 kWh/m^3

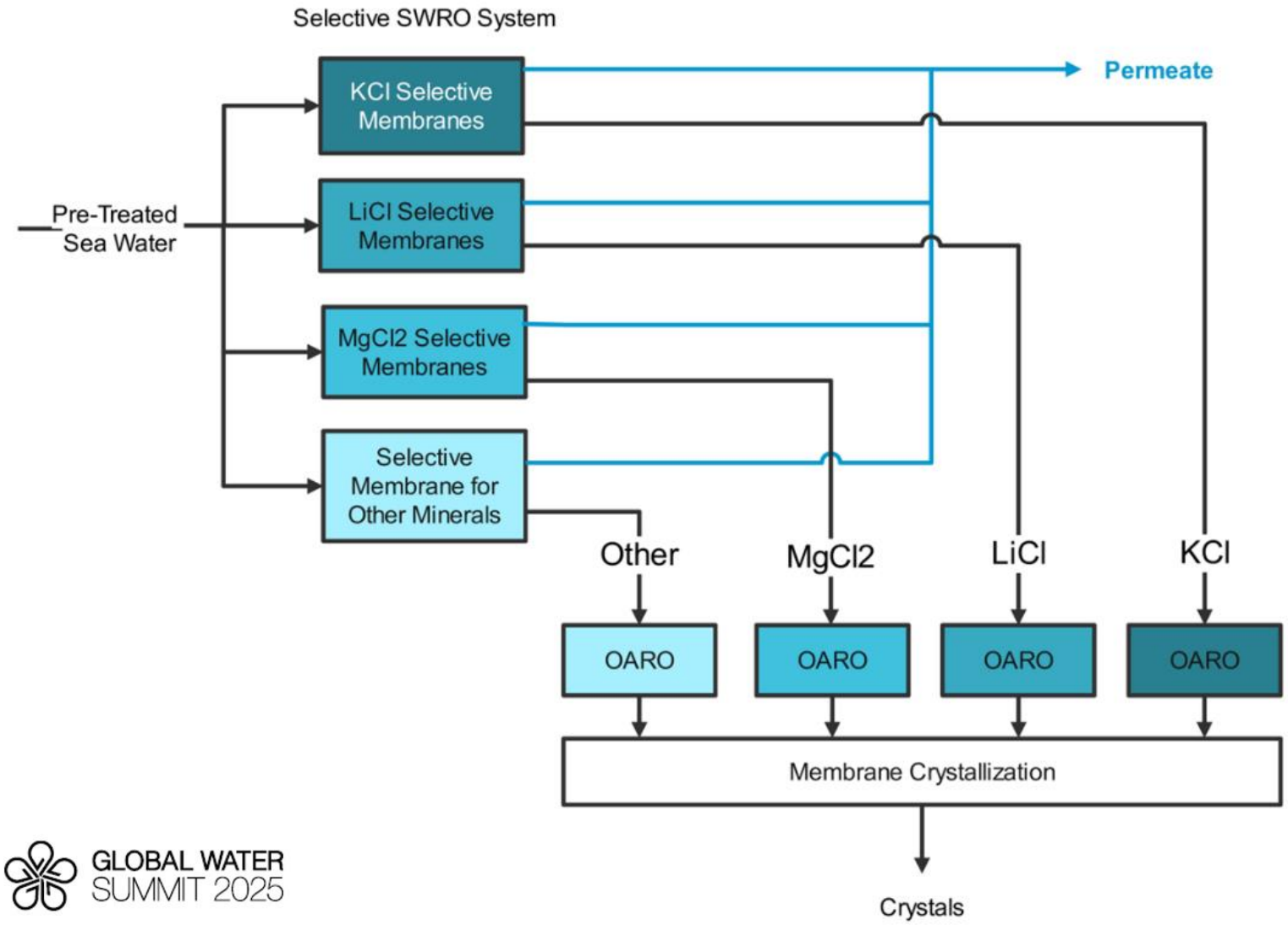
Draw Solution Recovery Power – 2.5 kWh/m^3



GLOBAL WATER SUMMIT 2025

Changing the Paradigm of Desalination by Multifunctional Mineral Selective SWRO Membranes

EVOLVING from Desalination to Desalination & Brine Valorization Plants



GLOBAL WATER SUMMIT 2025

Recognized with Global Prize of Innovation in Desalination & IDRA Award in December 2024

Membrane Crystallizer Development – Next Steps & Costs

- Initial MBC System Piloting – To be Completed by September 2025 - US$1.2 million Needed
- Developing Prototype Commercial Crystallizer Membranes - April 2026 – US1.9 million
- Test Membrane Crystallizer System for Temperature & Water Quality Impacts - May 2026 – US1.6 million
- Obtain Patent – January 2027 – US$450,000