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STREAM WEBINAR SERIES

DESALINATION: DEMYSTIFYING ITS CARBON FOOTPRINT

THURSDAY 24 OCTOBER 2024

ACKNOWLEDGEMENT

Sequana acknowledges the Traditional Owners of Country throughout Australia and pays respect to and recognises the contribution from their Elders past and present.

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AGENDA

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DESAINATION: DEMYSTIFYING ITS CARBON FOOTPRINT

1. Importance of desalination in addressing Australia's water future
2. Understanding Desalination
3. Environmental Impact of Desalination
4. ESG: Solutions to minimise carbon footprint
5. Case studies and success stories
6. Q&A Session

OUR SPEAKERS

EXPERTS IN DESALINATION, DECARBONISATION & PLANT MANAGEMENT

GARY CRISP

CHIEF ENGINEER, SEQUANA

46 years on, Gary is an internationally recognised expert in desalination and his wealth of knowledge has had a significant impact on Australia as it looks to secure its water future in the face of a changing climate through desalination.

IAN FILBY

NATIONAL PARTNER, ENERGY, DECARBONISATION & MAJOR PROJECT DELIVERY, SEQUANA

A decarbonisation leader with a focus on transformation and rehabilitation, Ian has gained deep knowledge and experience across both the private consulting and the public sector within the water industry.

JULIEN TAUVRY

PLANT DIRECTOR- VICTORIAN DESALINATION PROJECT (WATERSURE), SUEZ

At Suez, Julien is the Plant Director for Watersure, the operator of the Victorian Desalination Plant, the largest desalination plant in the southern hemisphere, and also the home of the VDP Ecological Reserve, one of the largest ecological restoration projects in Victoria. Julien has been working for more than 20 years on international water projects, including desalination.

IMPORTANCE OF DESALINATION IN ADDRESSING AUSTRALIA’S WATER FUTURE

INTRODUCTION

UNDERSTANDING DESALINATION

THE WHY

- Water Scarcity
- Population growth & urbanisation
- Drought & climate change
- Limited freshwater resources
- Agriculture & industry
- Decarbonisation

OVERALL

Desalination is **vital** in addressing **global water challenges,** ensuring a **stable water supply for drinking, agriculture**, and **industry** in regions where **freshwater is scarce.**

AUSTRALIA'S WATER FUTURE ON THE PATHWAY TO DECARBONISATION

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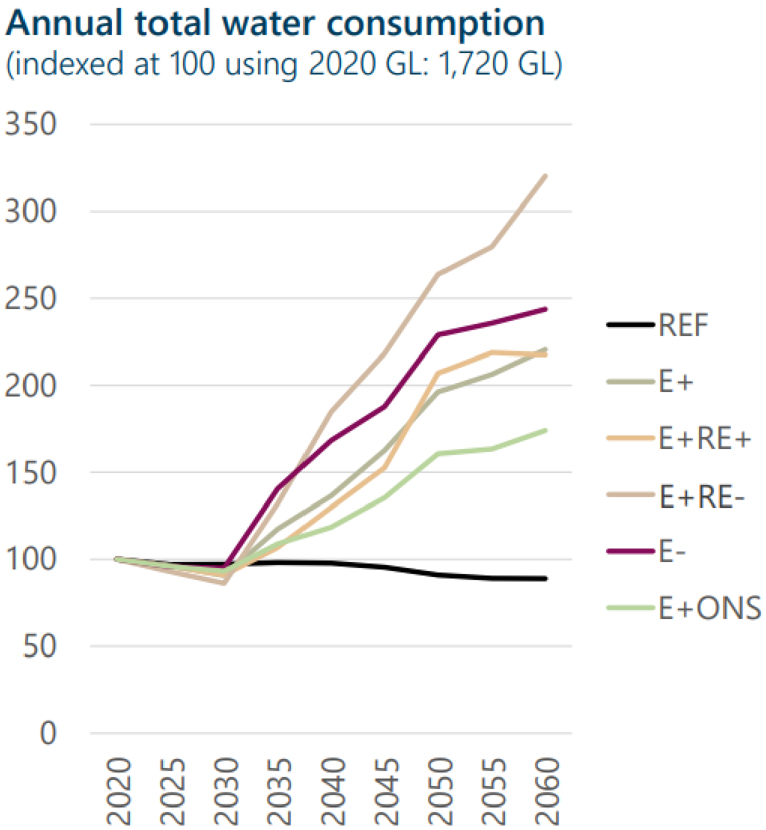
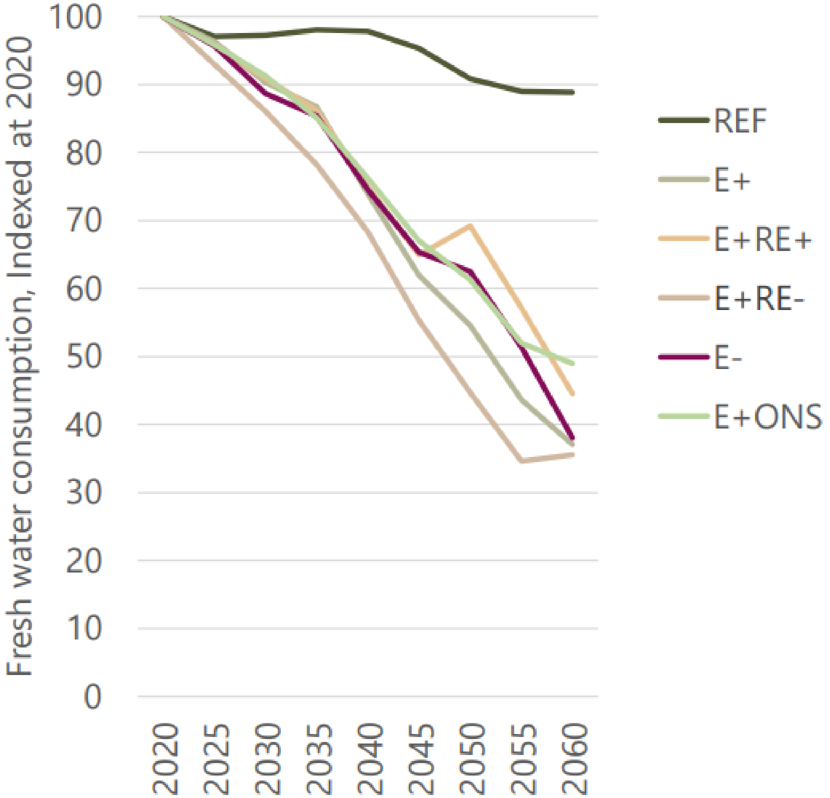
INCREASING NEED FOR WATER





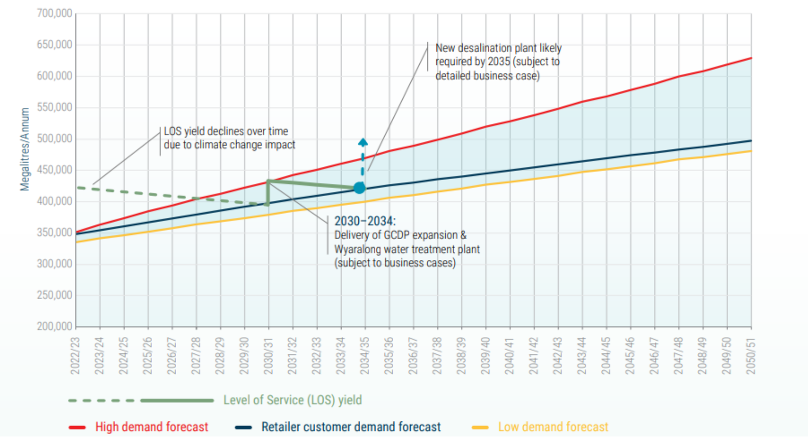
NET ZERO AUSTRALIA

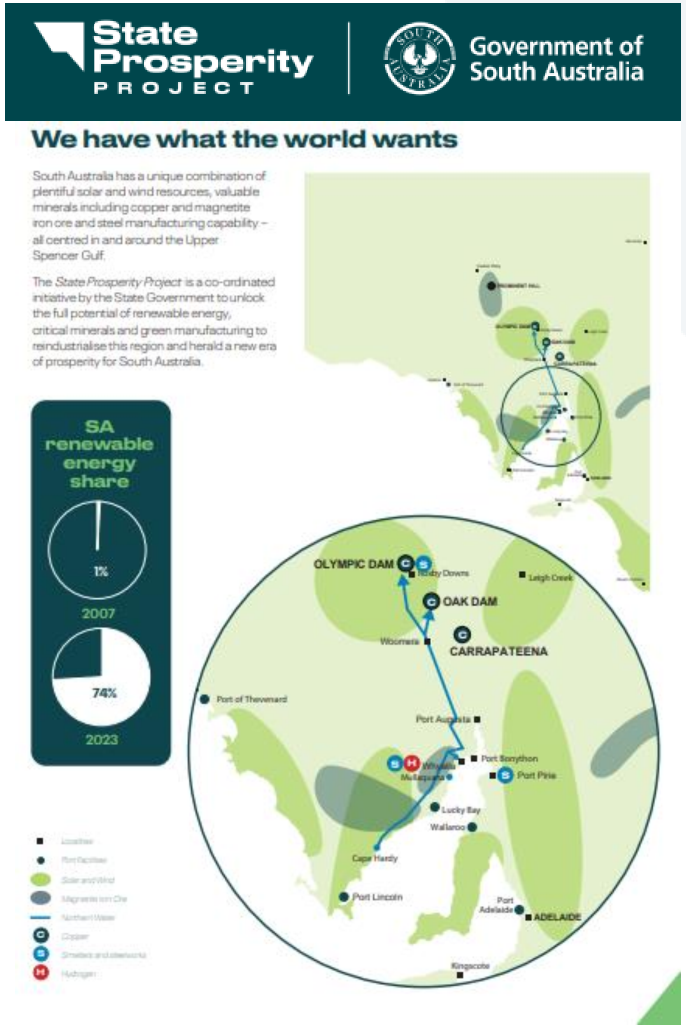
Source:
- Net Zero Australia

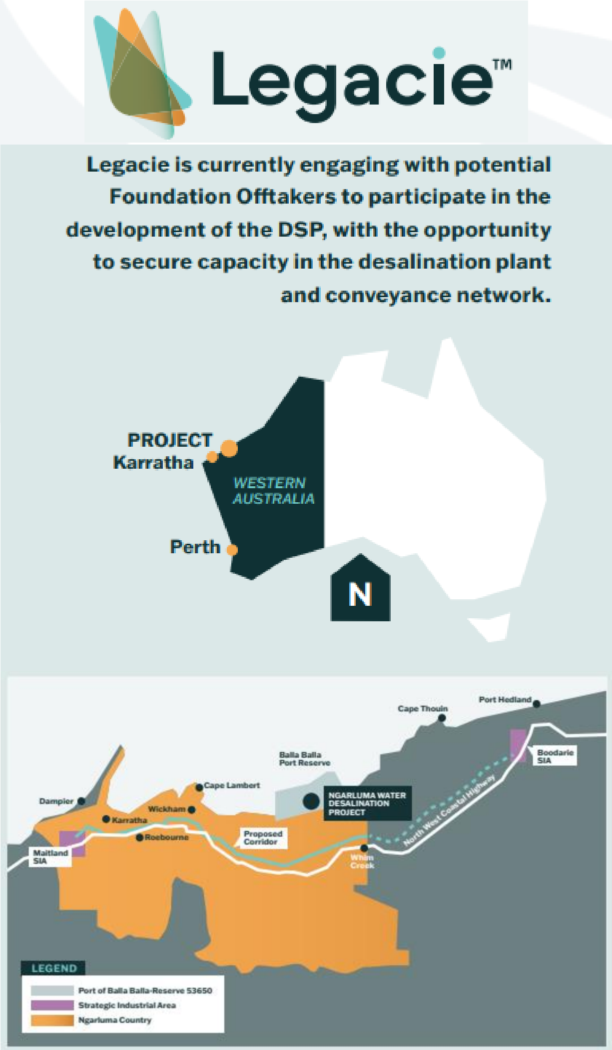
DESALINATION

UNDERSTANDING THE NEED

Figure 9 – Level of service yields including proposed future bulk water infrastructure upgrades







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UNDERSTANDING DESALINATION

GLOBAL TRENDS

DESALINATION TECHNOLOGIES

HOW IT WORKS

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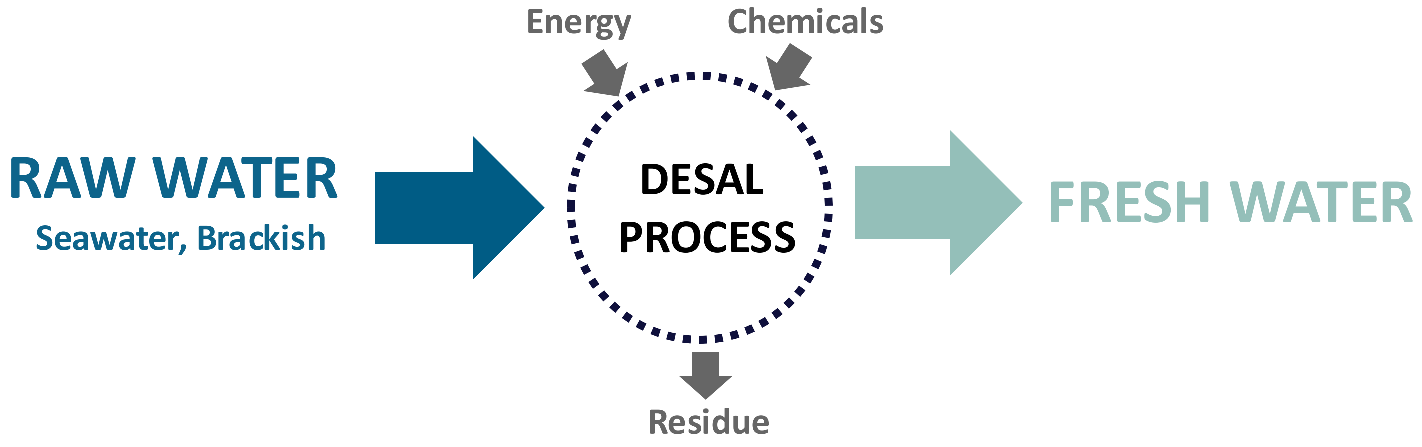
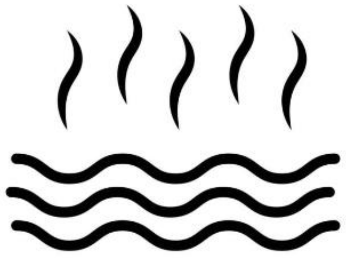
DESALINATION

It is the process **of removing salt** and other impurities from seawater or brackish water **to produce fresh, drinkable water**.

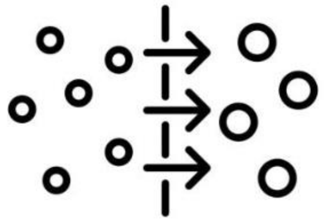


TWO MAIN CATEGORIES OF DESALINATION TECHNOLOGIES:



THERMAL DESALINATION

Involves heating water to produce steam, which is then condensed into freshwater (e.g. Multi-stage flash distillation (MSF), Multi-effect distillation (MED), Vapor compression distillation (VCD)).



MEMBRANE DESALINATION

Involves forcing water through semi-permeable membranes to remove salts (e.g. Reverse osmosis (RO), - Electrodialysis (ED), Forward osmosis (FO)).

TRENDS

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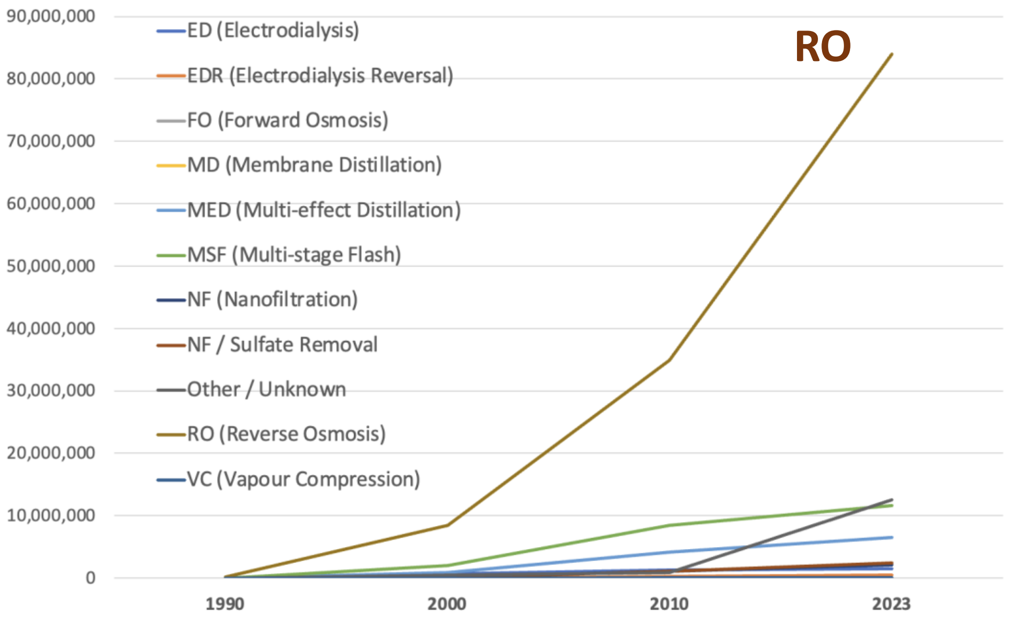
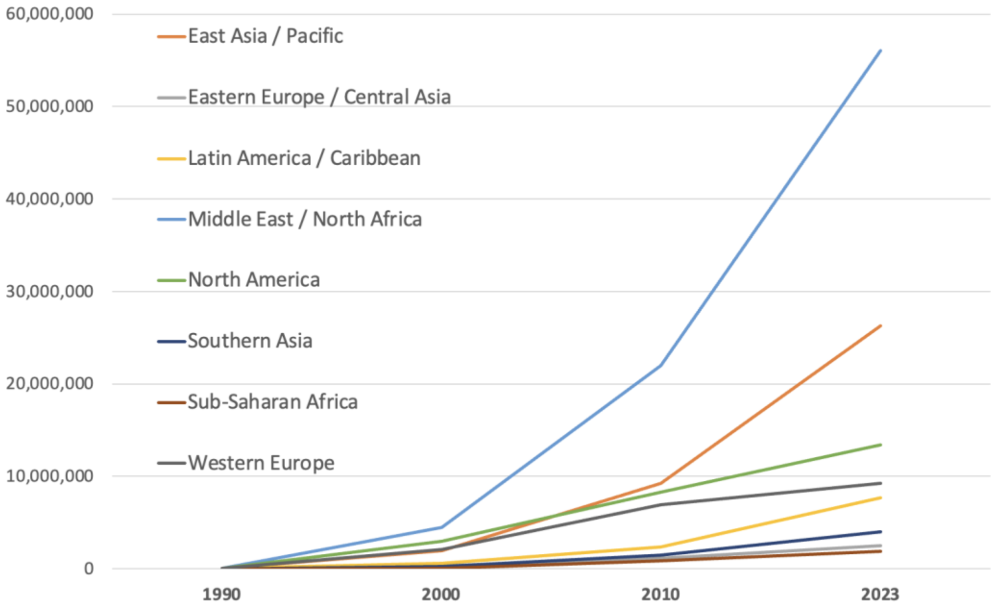
EMERGING PROCESSES

DESALINATION INSTALLED CAPACITY (M3/D) PER TECHNOLOGY



DESALINATION INSTALLED CAPACITY (M3/D) PER REGION



Innovative processes are emerging to improve efficiency, reduce energy consumption, and minimise environmental impact:

- Electrochemical desalination,
- Graphene and nanomaterial membranes,
- Forward Osmosis (FO) with energy recovery,
- Solar-powered desalination,
- Hybrid systems,
- Magnetic desalination.

Source:
- Global Water Intelligence (GWI)

EXPENDITURE FORECAST TO 2028

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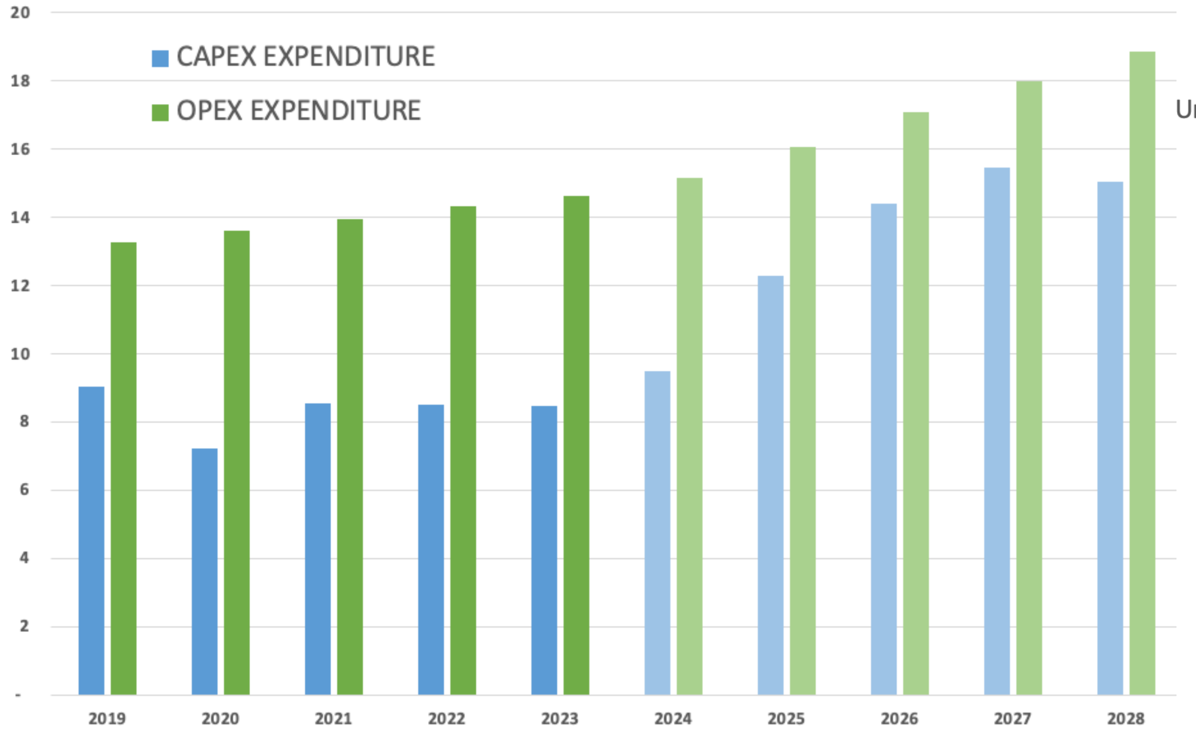
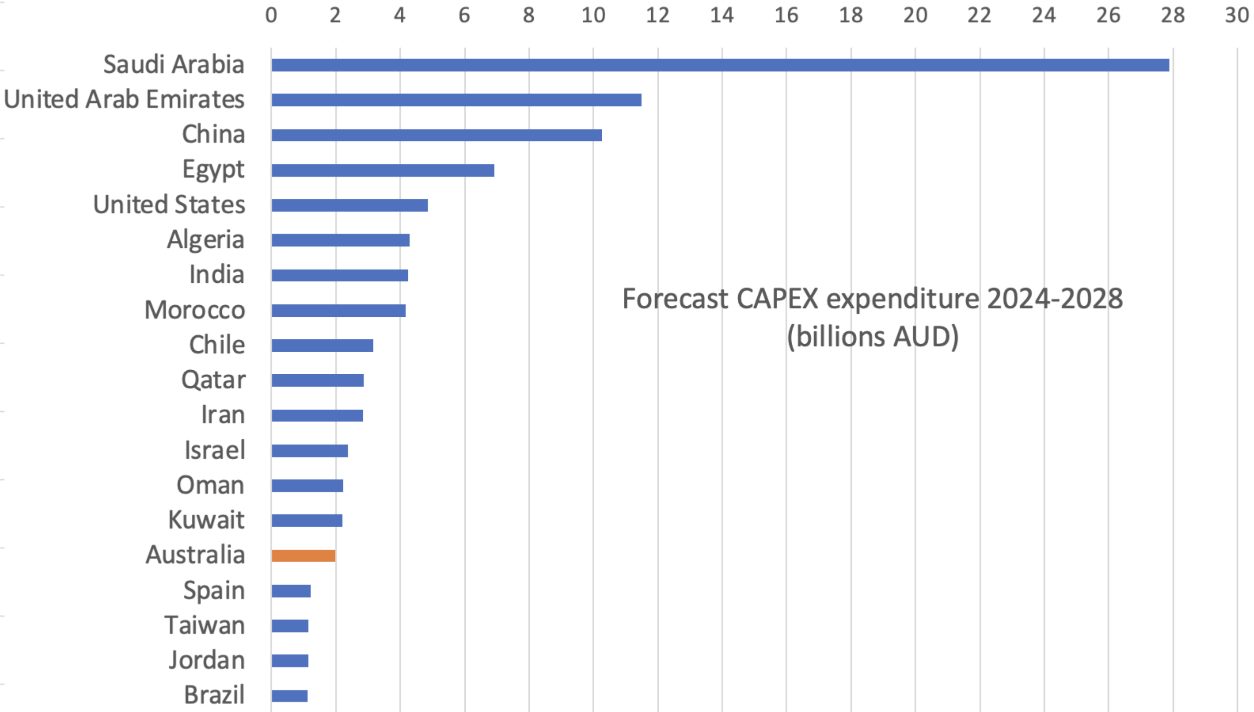
GLOBAL SCALE

GLOBAL EXPENDITURE (BILLIONS $ AUD)





- Forecast $60b (AUD) CAPEX expenditure globally over the next 4 years.

- Forecast for Australia: <$2B

Sources:
- GWI, Desaldata

ENVIRONMENTAL IMPACT OF DESALINATION

BRINE DISCHARGES, ENERGY CONSUMPTION & CARBON FOOTPRINT

ENVIRONMENTAL IMPACT OF DESALINATION

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BRINE DISCHARGES

PERTH: 2-YEAR MONITORING PROGRAM 2007-09

- Rhodamine dye tracer tests.
- Extensive far-field dissolved oxygen tests.
- Water quality testing.
- Diffuser performance testing.
- Whole Effluent Toxicity (WET) testing.
- Macrobenthic surveys.

All studies have proven that the **PSDP** has a **negligible impact** on the surrounding environment.

Impacts on seawater habitats can be limited by correct **site location selection,** a validated **diffuser design, and monitoring.**

Other plants around Australia have confirmed this approach with no reported impacts on the environment.

ENVIRONMENTAL IMPACT OF DESALINATION

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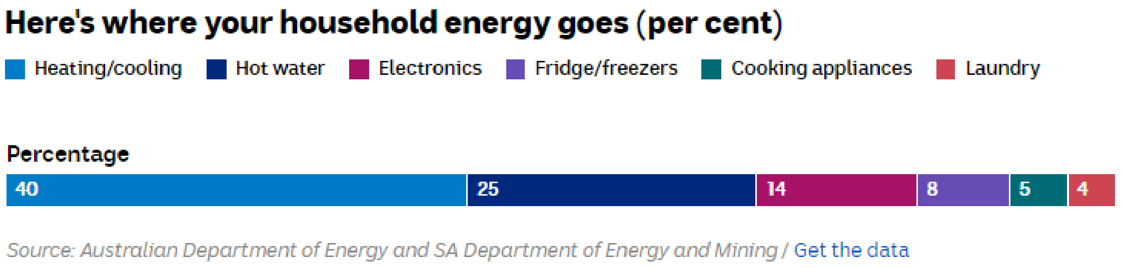
ENERGY CONSUMPTION

Process	Electrical (kWh/m^3)
SWRO	3.3 – 8.5
BWRO	1.0 – 2.5
Waste Water Reuse	1.0 – 2.5
Conventional	0.2 – 1.0
Water piped >400km	3.3

Source:
WSAA Urban water supply options for Australia 2020.pdf

Average Australian family household – Consumption		SWRO Water Production	Hypothetical energy use per household for	Desalinated Water Compared to Household Usage
Electricity [1]	Water [2]	SEC	Water Production via SWRO	
kWh per annum	kL per annum	kWh/kL	kWh per annum	%
5472	180	3.4	612	11

Sources:
1. Residential energy consumption benchmarks - Final report for the Australian Energy Regulator.
2. ABS – Water Account Australia 2020-21



If the average household was supplied 100% with desalinated water the energy required would be about equivalent to their electronics.

ENERGY DOES NOT EQUAL CARBON

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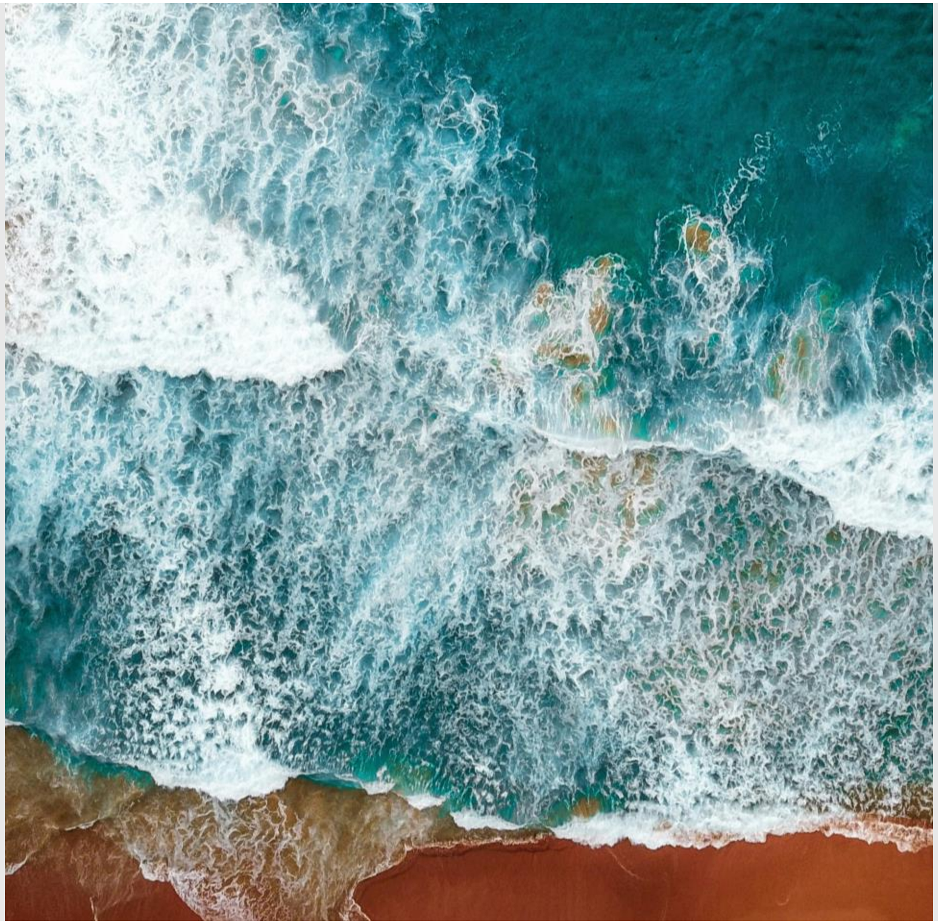
CARBON FOOTPRINT

Some proponents are looking to demonstrate their credentials via certification processes such as:

Infrastructure Sustainability Council

For a typical **50GL** pa plant construction represents **40,000t CO2eqv**, and annual operations **170,000t CO2eqv.** if unabated

Sources:
- IS Rating Scheme
- AWA Decarbonising desalination



Some studies **misrepresent the carbon footprint of desalination plants** in Australia by **not acknowledging the electricity supply** and **offset arrangements** and assume **grid-connected means grid CO_2 intensity**.

Some **off-grid solar-powered desalination plants** have claimed carbon footprints of **0.2 CO_2eqv/m^3**

Alkimos' recent EPA approval includes commitments to **achieve net zero** via **renewable energy (LGCs) and emissions offsets (ACCUs).**

Source:
- EPA Report 1739 - Alkimos Seawater Desalination Plant

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ESG: SOLUTIONS TO MINIMISE CARBON FOOTPRINT

ENERGY USE ANALYSIS, ENERGY EFFICIENCY IMPROVEMENTS, RENEWABLE ENERGY INTEGRATION & CIRCULAR ECONOMY

ESG: SOLUTIONS TO MINIMISE CARBON FOOTPRINT

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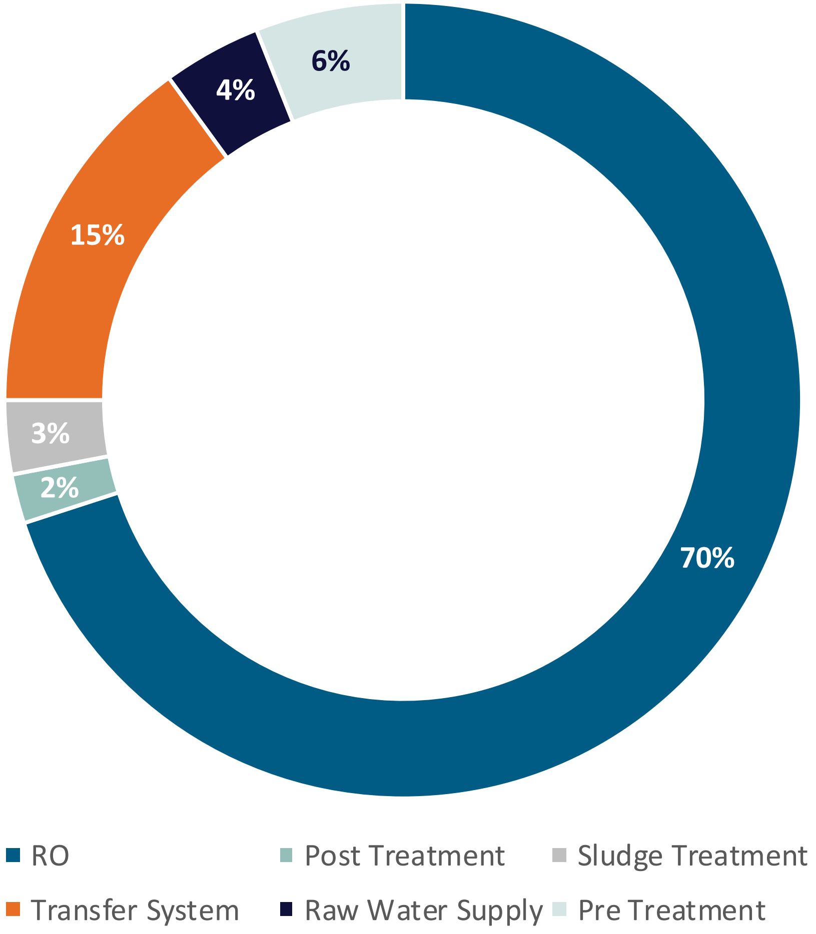
WHERE IS THE ENERGY USED IN THE DESALINATION PROCESS?

ENERGY CONSUMPTION:

- Supply of Raw Water.
- Pre-treatment.
- Desalination process (> 50%).
- Post treatment.
- Transfer of fresh water.
- Residue treatment.
- Other ancillaries.

Typical RO Desalination process-specific energy consumption:

1 to 6 kWh/m3



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EFFICENCIES FIRST

REDUCTION OF DIRECT ENERGY CONSUMPTION:

- Manage the gap between **raw water quality** and **Fresh Water quality targets.**
- **Treatment Plant location** (water source and customer proximity).
- Increased focus on **pre-treatment** to enable desalination optimum performance.
- **Membrane technologies improvements** (physical limits)
- **Energy recovery** devices.
- **High-efficiency electrical consumers** (VSD, pumps, electrical motors).
- Optimisation of **production profile** (timing and intensity).

OPTIMISE PROCESS / PROJECT DESIGN:

- **Plant Low** profile.
- Integration in the **environment**, maximising **biodiversity** in the project area.
- Selection of **material/re-use.**
- **Management of residue** (landfill vs other options, e.g. sludge thermal treatment).
- **Sourcing of chemicals** (scope 3 emissions).
- Management of **used consumables** (e.g. membrane, cartridge filters).
- **Increased design life of equipment** (including membrane) to reduce Whole Life cycle cost.

ESG: SOLUTIONS TO MINIMISE CARBON FOOTPRINT

RENEWABLE ENERGIES

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RENEWABLE

To meet net-zero targets new desalination plants will need to be supplied with renewable energy.

- Most proponents intend to do this via **PPAs**.
- Some are proposing an **integrated approach** where **renewable energy sources** are part of the project.

This can include onsite:

- Solar,
- Wind,
- Heat integration with adjacent industries,
- Brine outfall turbines,
- Use of AI and machine learning to support Operation and Maintenance optimisation.

ESG: SOLUTIONS TO MINIMISE CARBON FOOTPRINT

CIRCULAR ECONOMY

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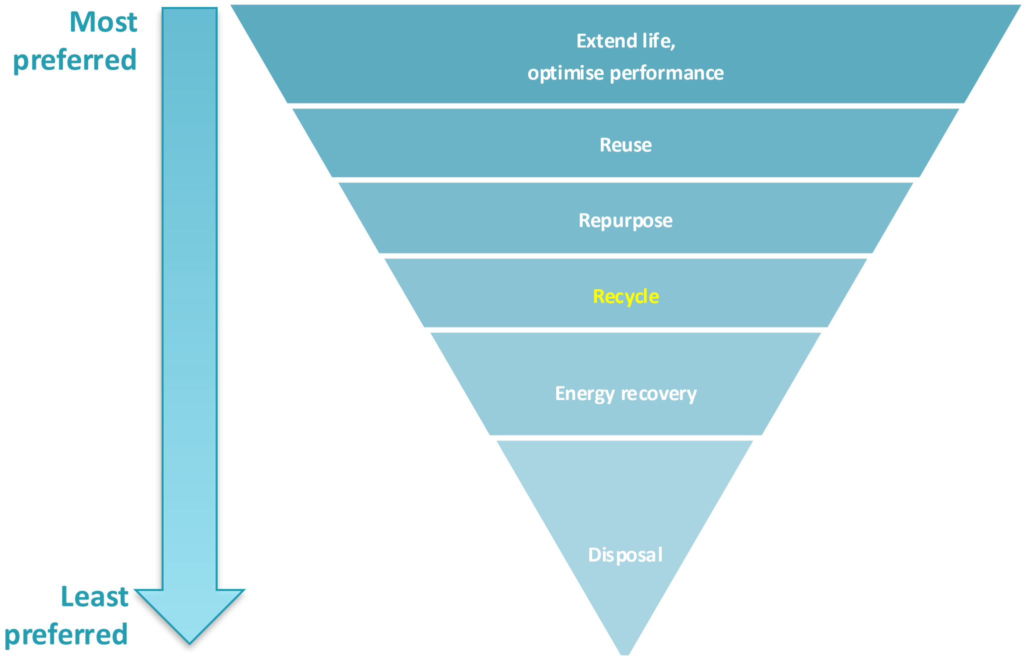
MEMBRANE RECYCLE

While no longer suitable for producing potable water, RO membranes can be recycled in many applications.

- Researching applications in road construction with Fulton Hogan.
- Utilised in construction materials.
- Endless creative sustainable end-uses…



CASE STUDIES AND SUCCESS STORIES

TRENDS

CASE STUDIES AND SUCCESS STORIES

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TRENDS

IN 2020, DUPONT WATER SOLUTIONS PRODUCED AND SUPPLIED DRY SWRO FILMTEC ™ ELEMENTS:

- The **first supplier** to offer **dry-tested SWRO elements**.

LG has produced **SWRO membranes** with bigger spaces maintaining membrane area, **to reduce energy**.

DUPONT™ Water Solutions Possibility Flows With Us

LG Chem | Water Solutions

CASE STUDIES AND SUCCESS STORIES

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TRENDS

AQUA 3D PRINTED MEMBRANE SPACERS

- **18% energy saving** compared to the conventional mesh spacers in a side-by-side test with conventional RO elements.
- **40% increased output** without increasing footprint due to a larger membrane area.
- **4x reduction in fouling/scaling** with optimised feed channels.
- **Winner** of Global Water Summit 2024 Breakthrough Technology Company of the Year.

Aqua Membranes
PRINTED SPACER TECHNOLOGY®

UCONN PRINTED MEMBRANES

- Electro-spraying is used to create **ultra-thin, ultra-smooth** polyamide membranes.
- Superior level of control over the **thickness and roughness** of the membrane.
- Less prone to **fouling.**
- **Require less energy** to pass water.
- **Less chemical volume** making membranes by printing when compared to conventional interf polymerisation.

UCONN

Connecticut Center for Applied Separation Technologies (CCAST)

CASE STUDIES AND SUCCESS STORIES

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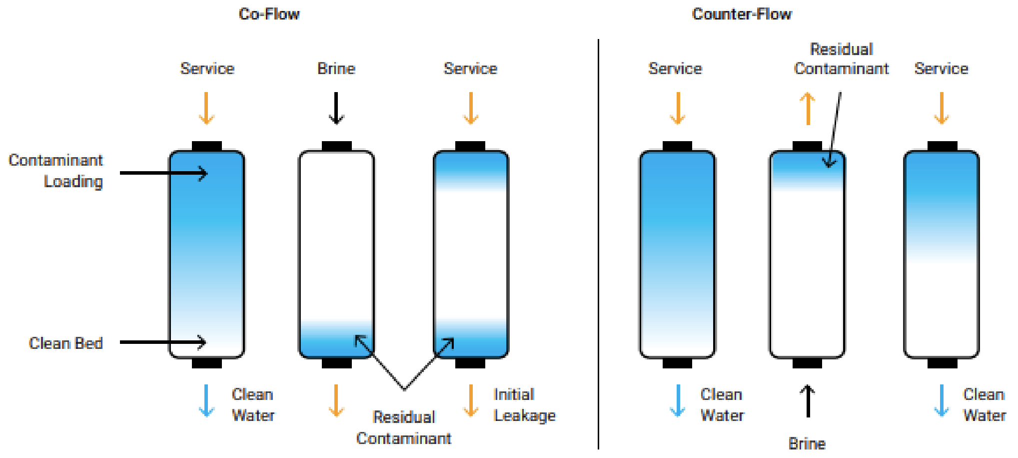
TRENDS

BROMIDE MANAGEMENT

- **ADWG requirements.**
- **Purolite Bromide Plus/9218** is a bromide-selective resin that removes bromide before water is disinfected and prevents the formation of bromated disinfection byproducts (DBPs).
- **Purolite** also offers resins for **Total Organic Carbon (TOC)** reduction to prevent the formation of other **DBPs.**
- Potential trials to be conducted to confirm if the second pass of an RO system can be eliminated **to reduce Capex and energy consumption** – especially for smaller SWRO plants.
- It has not been done in the world because no country other than **Australia** worries about **Bromide in SWRO product water** as much as we do. They are all about Boron.
- Result will be **lower energy intensity** if WQ requirements can be met.

Purolite®
An Ecolab Company

Cleaner Resin with Counter-Flow vs. Co-Flow Regeneration Modes



CASE STUDIES AND SUCCESS STORIES

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TRENDS - EMERGING PRE-TREATMENT SYSTEMS

CERAMIC MEMBRANES

- Submerged Ceramic Flat UF membrane systems can **eliminate five subprocesses** used in conventional pre-treatment.
- **More sustainable** using less energy, less embedded energy and chemicals, and almost eliminating solid waste – including membranes and cartridge filters with a **small physical footprint**.

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THANK YOU FOR JOINING US!

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