Green Oxygen for Wastewater Treatment

Barwon Water Jacobs

Evaluating Electrolysis-Derived Oxygen for Aeration in Wastewater Treatment: Lessons learnt

Next Water Conference 2025

Presented by

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Project Overview

OXYGEN FOR WASTEWATER TREATMENT

Barwon Water captures, dries and compresses the oxygen from the Viva electrolyser and transfers it across to the Northern Water Plant.

Barwon Water

WASTEWATER TREATED

Oxygen is then used to enrich the air used in the wastewater treatment process which generates recycled water.

Barwon Water

VIVA ENERGY HUB

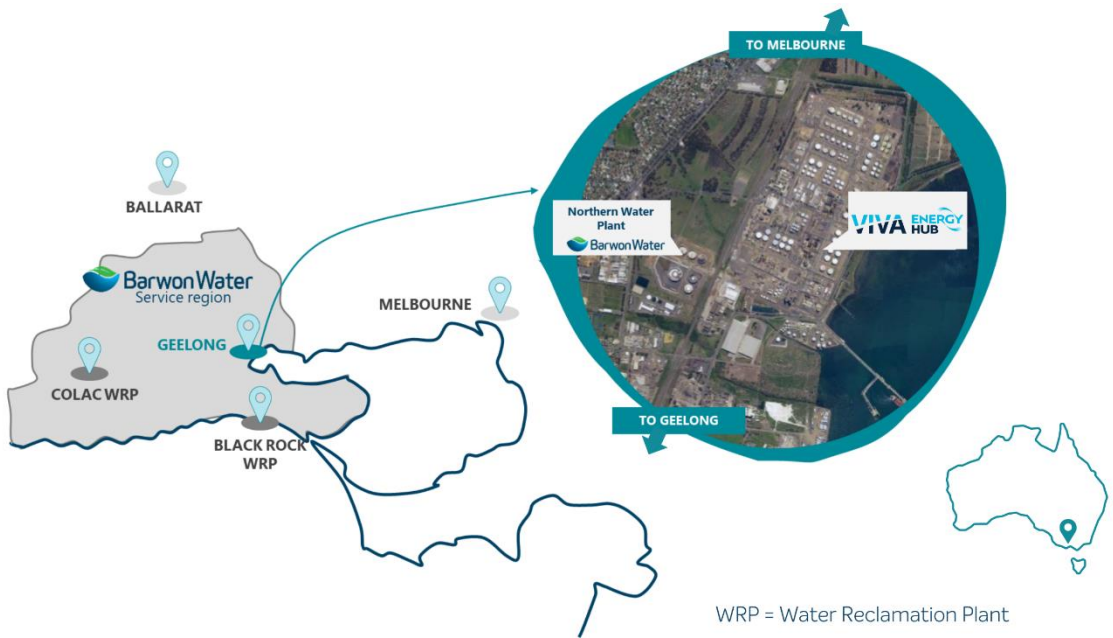
Viva Energy is able to offer hydrogen refuelling and electric vehicle recharging for heavy transport vehicles powered by renewable energy.

VIVA ENERGY HUB

RECYCLED WATER FOR HYDROGEN / OXYGEN PRODUCTION

Recycled Water is used by Viva Energy's 2.5MW electrolyser where the hydrogen and oxygen molecules in water are split into hydrogen gas and oxygen gas.

VIVA ENERGY HUB



WRP = Water Reclamation Plant

Consultant Partner

Jacobs

Knowledge Sharing Partners

WATER SERVICES ASSOCIATION OF AUSTRALIA

Water Research Australia

W-I-O-A Australia EXCELLENCE IN OPERATIONS

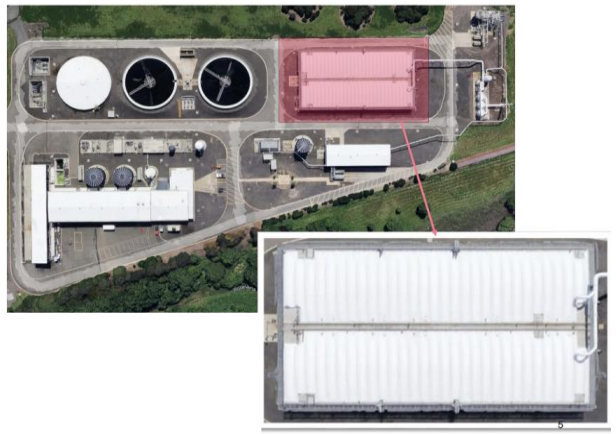
intelligent water networks 10+ years

Funding Partners:

Australian Government Australian Renewable Energy Agency ARENA

intelligent water networks 10+ years

RMIT UNIVERSITY



Wastewater Treatment Banefits:

- Improved biological reactor performance → capital deferral benefits
- Reduced nitrous oxide emissions
- Opex saving through reduced energy consumption & biosolids production

Project Staging

Stage 1 – Key deliverables:

- Functional Design
- Demonstration Trial Protocol
- Techno Economic Model Development

Stage Gate Decision — **WE ARE HERE**

Stage 2 – Key Deliverables:

- Infrastructre Delivery & Commissioning
- 2-year Demonstration Trial

1. High purity oxygen advantages and unknowns

Potential advantages from the use of high purity oxygen in wastewater treatment:

- Improved oxygen transfer efficiency & reduction in energy use for aeration;
- Improved oxygen transfer at high MLSS;
- Improved biokinetics providing faster treatment rates at higher MLSS concentrations and shorter hydraulic residence times;
- Decreased sludge production as more complete oxidation to CO_2 is achieved; and
- Improved performance characteristics that minimise sludge bulking and biomass foaming problems

(The use of pure oxygen for aeration in aerobic wastewater treatment: a review of its potential and limitations, May 2020, G. Skouteris et al.)

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Key process response unknowns:

- Microbial response and long-term effluent quality
- Sludge production and sludge settleability – in particular these, with the improved oxygen transfer at high MLSS - offer opportunity to increase treatment capacity within existing bioreactors

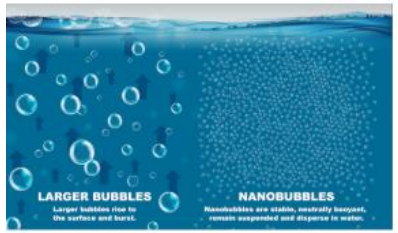
2. Oxygen Delivery Technologies & Selection Considerations

- Simple enhanced pure oxygen aeration initially proposed
- **35 % O_2 enrichment (standard of design limitation)** through blowers gave limited gains
- Undertook technology scan and options assessment
- **Shortlisted Supersaturation systems** - achieve near-complete O_2 dissolution.

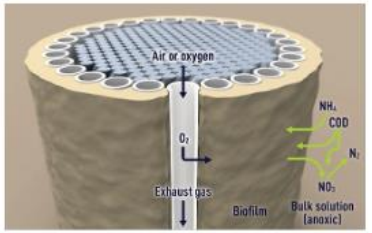
Fine bubble diffuser

Speece cone

SDOX



Nanobubbles



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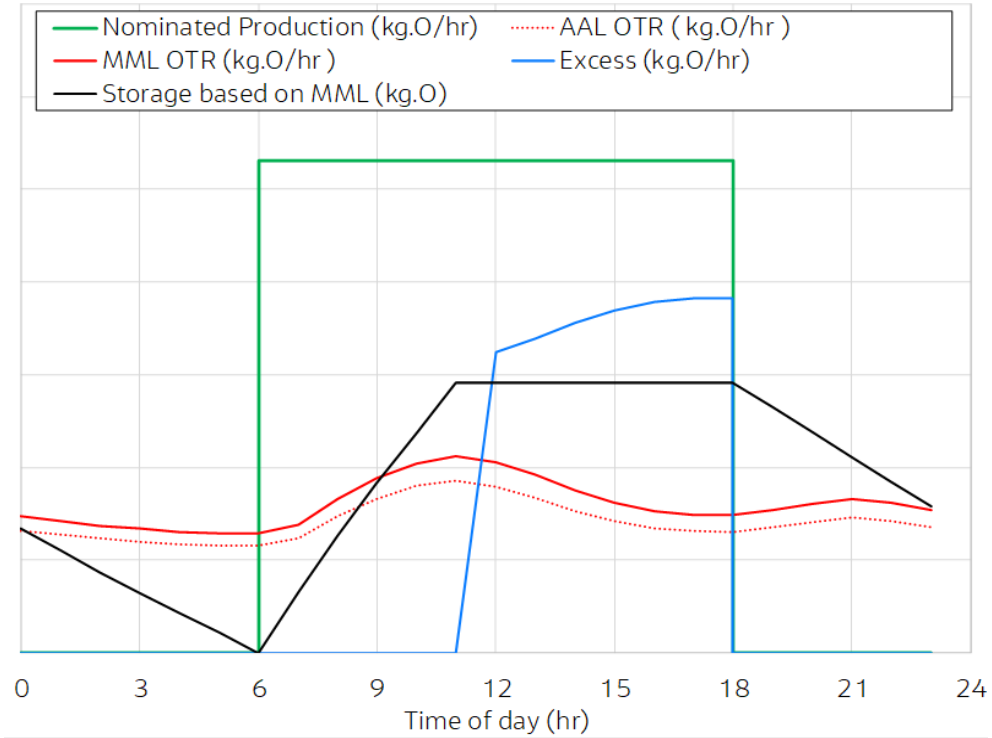
3. Managing Oxygen Production vs Wastewater Oxygen Demand

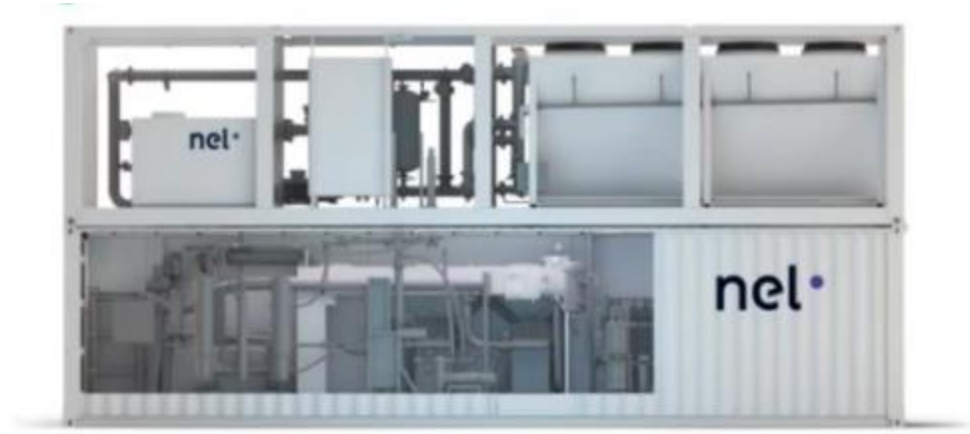
- Electrolyser operation is driven by hydrogen market needs and green energy pricing, not wastewater demand.
- Mismatch between O_2 supply and aeration demand could require buffer storage (particularly with smaller electrolyser units 1-2MW)
- Real-time monitoring and control essential for stable performance.
- Long-term reliability depends on hydrogen market maturity and utility–industry coordination.
- Alternative back-up pure O_2 supply may be required depending on security of supply from electrolyser



Illustrative oxygen production, demand and storage requirement graph

4. Infrastructure Compatibility and Integration Challenges

- Capturing oxygen from "hydrogen-focused electrolysers" - product guarantees and warrantees must be protected
- Oxygen-enriched aeration introduces specific safety and operational risks that must be carefully managed
- Safety, materials and licensing are critical considerations during design and operation
- Working outside typical areas for Water Authorities, Water design consultants and water industry Contractors



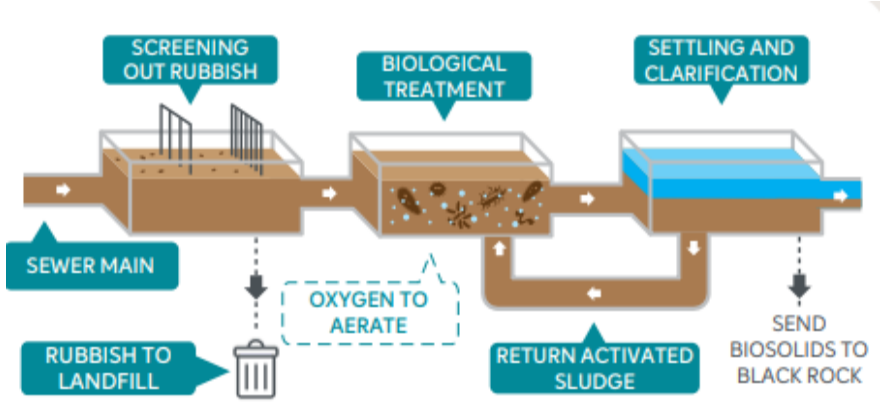
Side cutaway view of MC500 Electrolyser Enclosure and optional Thermal Control System – installation may vary

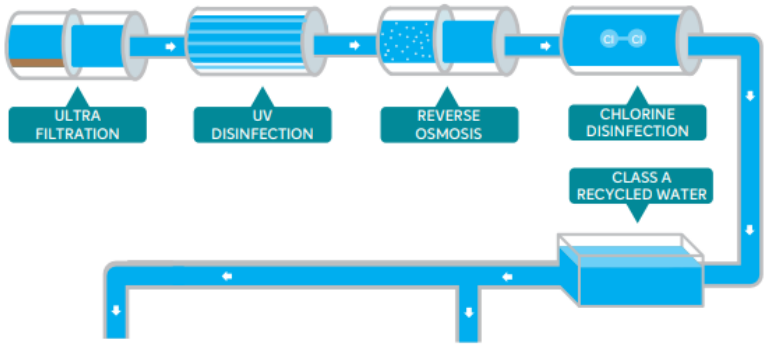
Conclusions and Next Steps

- Knowledge gained through Stage 1 has been valueable.

- Stage 2 – generate knowledge and data that reduces the technical and commercial risk of investing in oxygen systems for wastewater treatment.

Barwon Water - Northern Water Plant

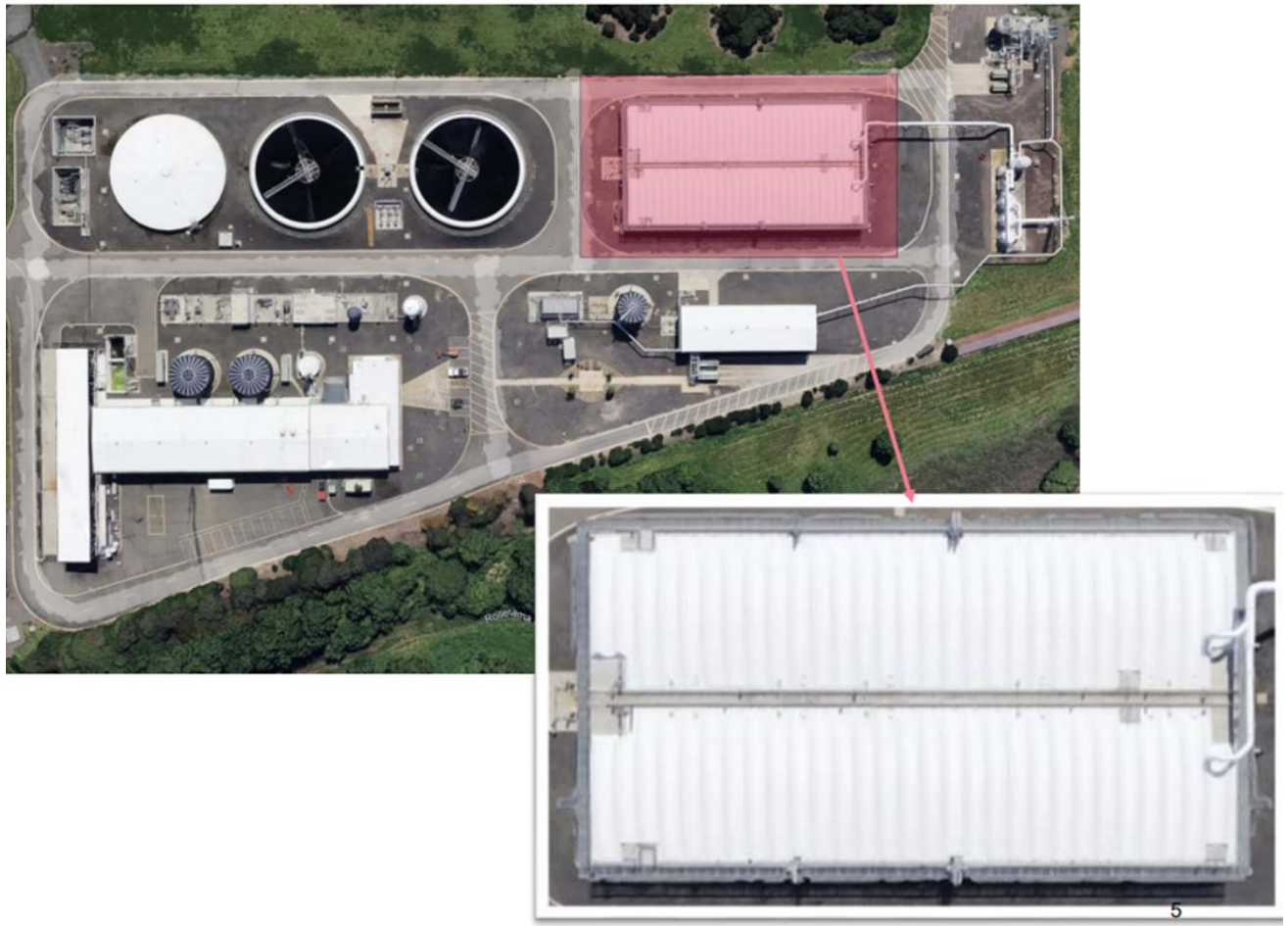




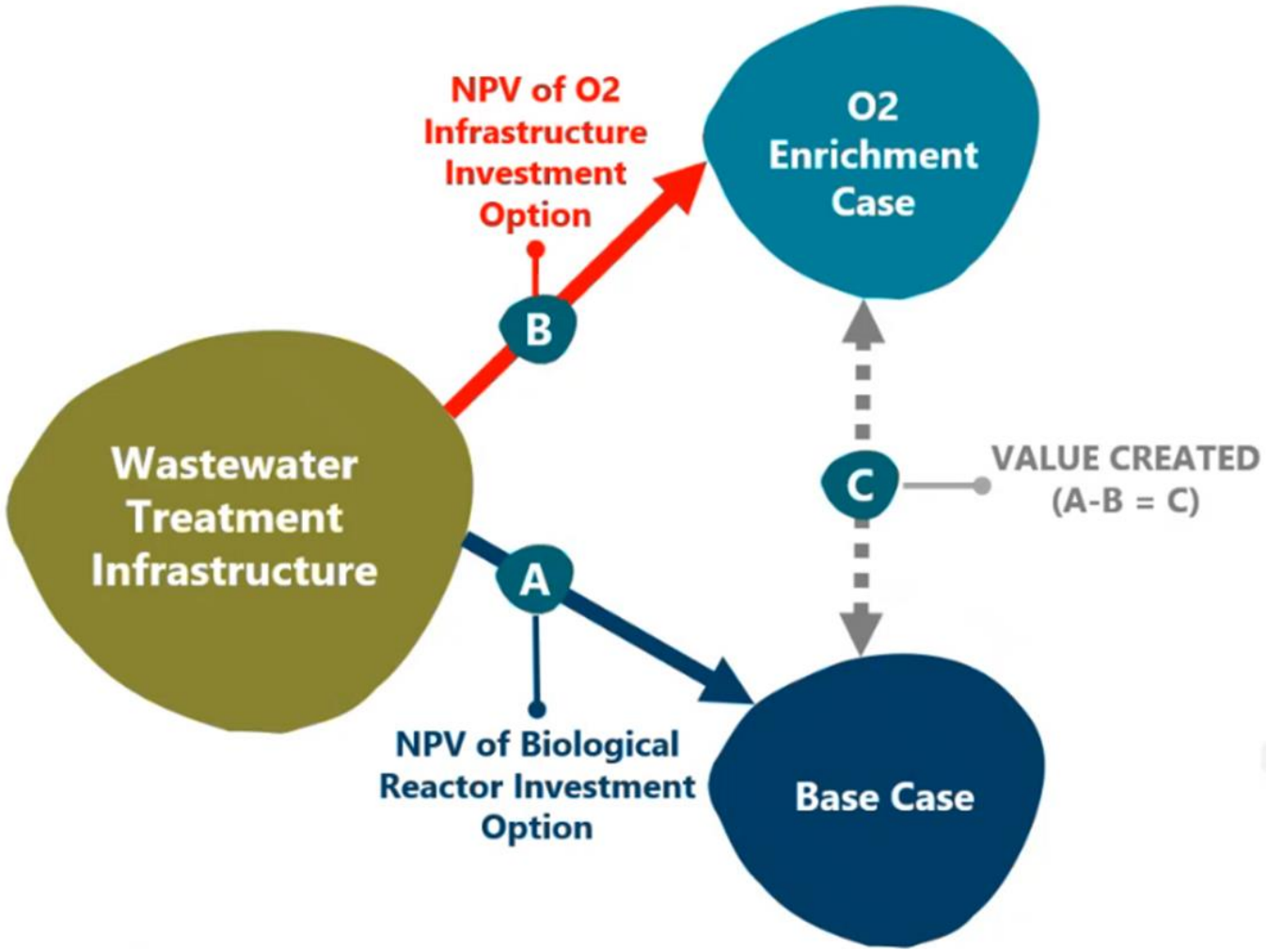
VIVA ENERGY HUB

Class A recycled water is supplied to Viva Energy to support the refinery processing, and soon will be used to generate renewable hydrogen and oxygen.

Additional recycled water is then used for sports complex irrigation, including the Stead Park Sporting Reserve.



Commercial Model



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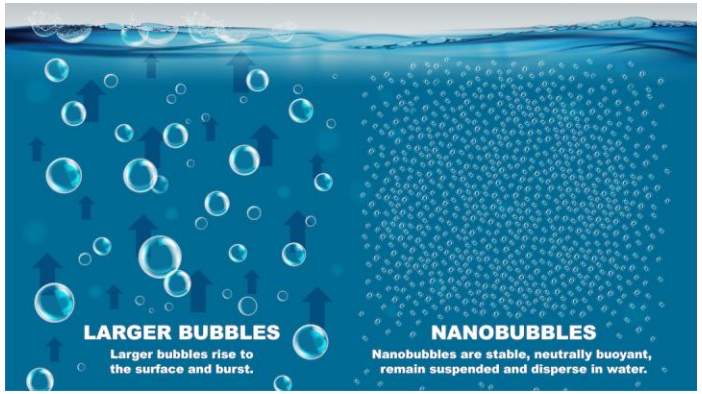

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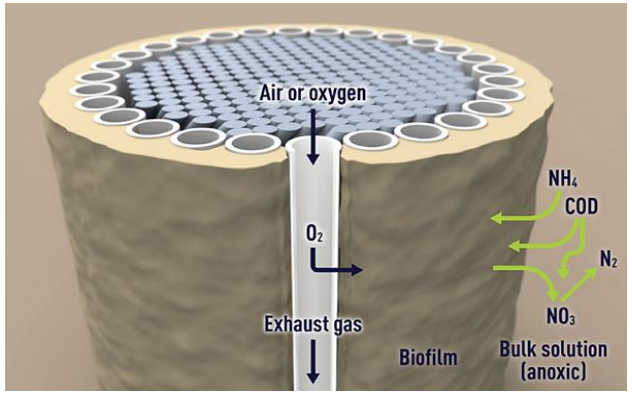

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