Decarbonising the Basin's irrigation regions

1BCRC Project 2024/CRC091

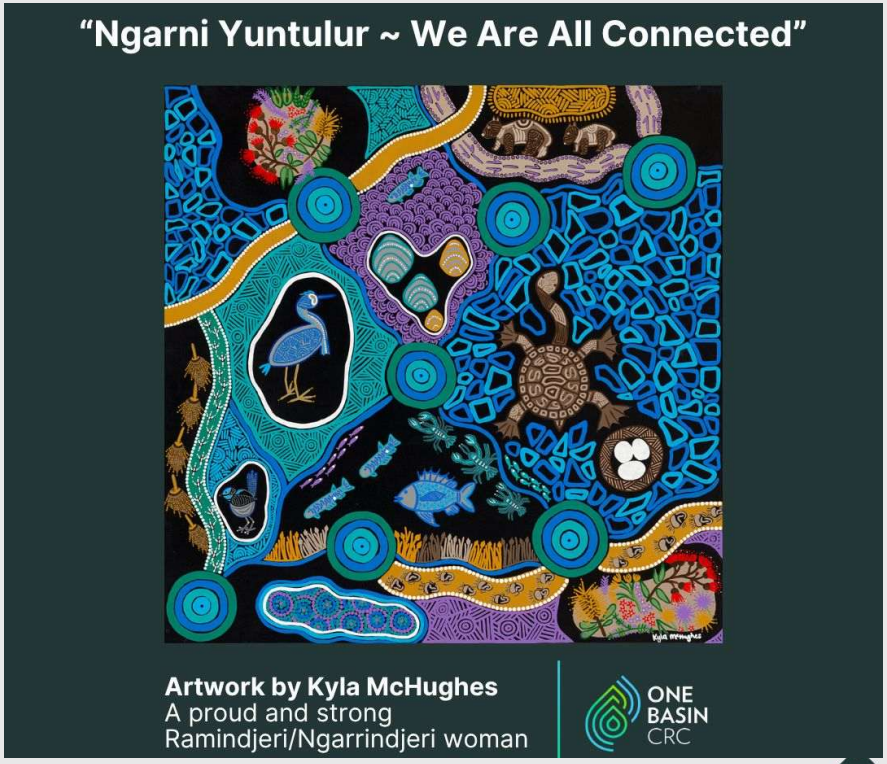


Acknowledgement of Country

We acknowledge and pay respect to the Traditional Owners of the Murray–Darling Basin and their Nations.

We pay respect to the Traditional Owners of the lands and the waters upon and around which our organisations are situated.

We acknowledge their deep cultural, social, spiritual, environmental and economic connection to their lands and waters. We pay respect to their Elders – past, present and future.

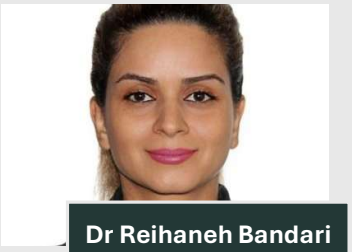


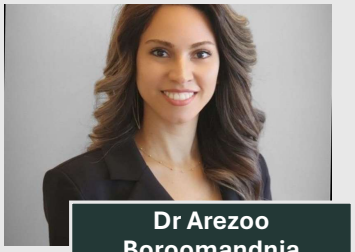
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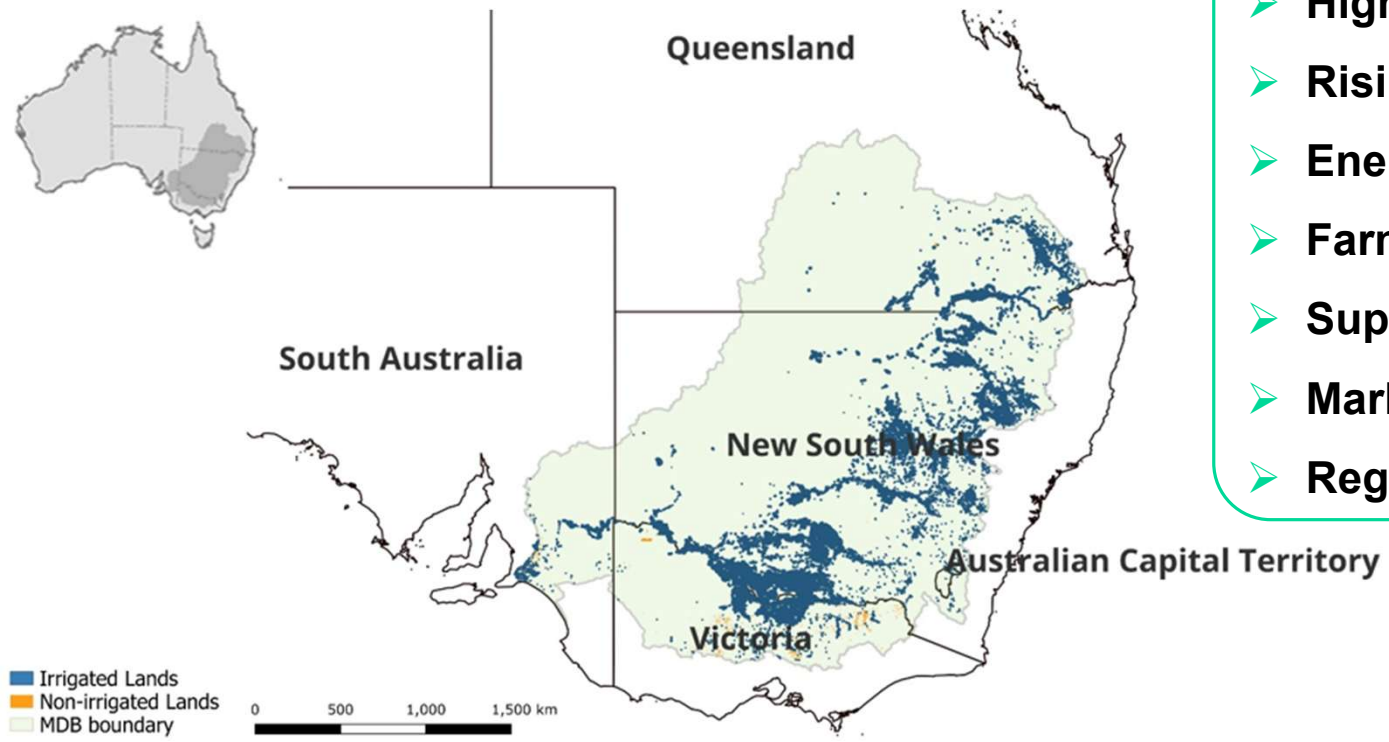

Julian Marchant


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Why decarbonisation matters



- **Net-zero targets**
- **High energy intensity of irrigation**
- **Rising energy costs**
- **Energy security & resilience**
- **Farm profitability**
- **Supply-chain pressure**
- **Market access & sustainability**
- **Regional decarbonisation priority**

Project objectives

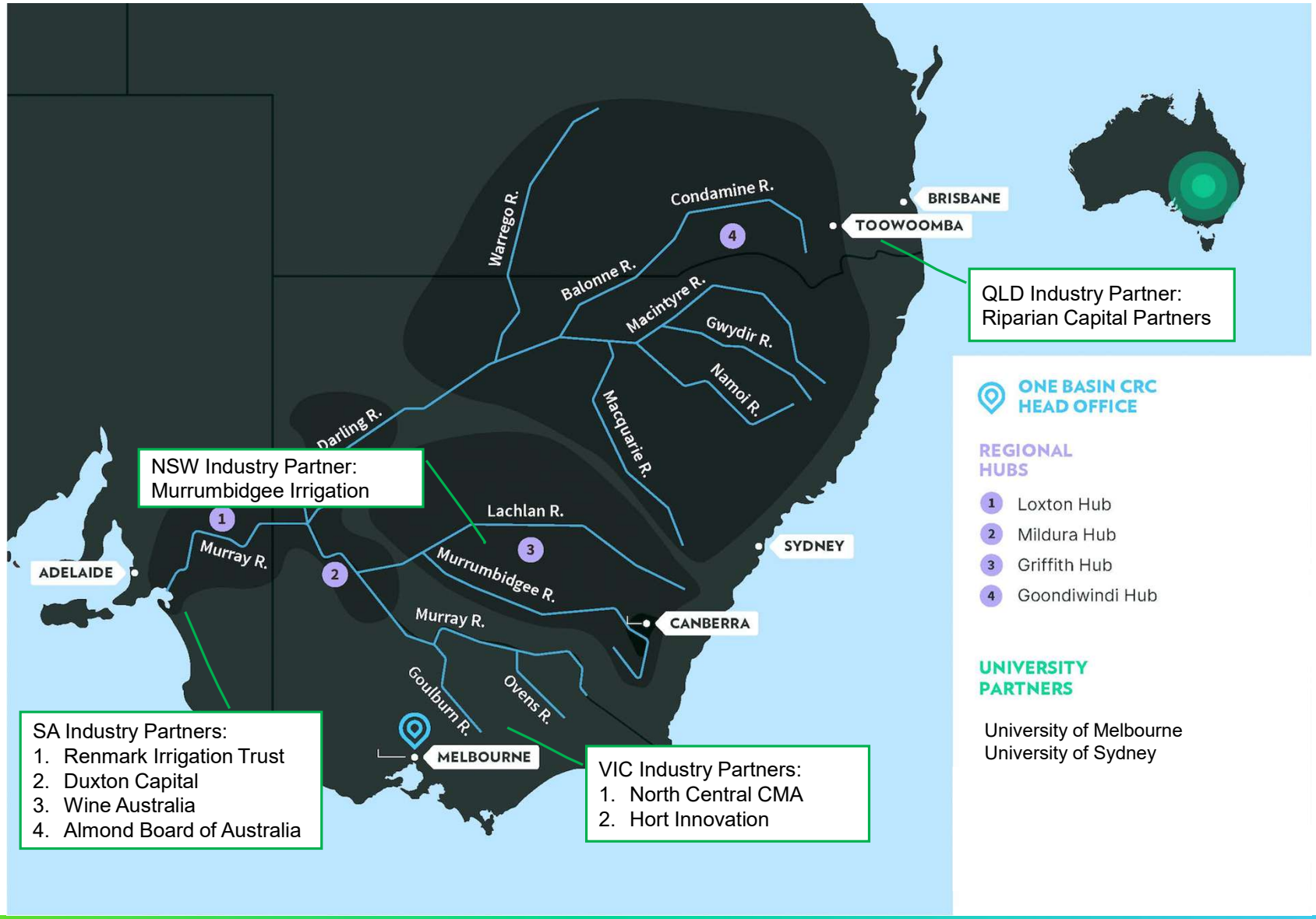
This project will focus on identifying and proving the most appropriate methods to decarbonise water-related activities in the Murray-Darling Basin's irrigation regions on two scales:

Stream 1: Scaling on-farm practices for decarbonising water use

Stream 2: Enabling basin decarbonisation of water use in irrigation regions



Stakeholders and regional engagement



What Do the Literature and Data Tell Us?



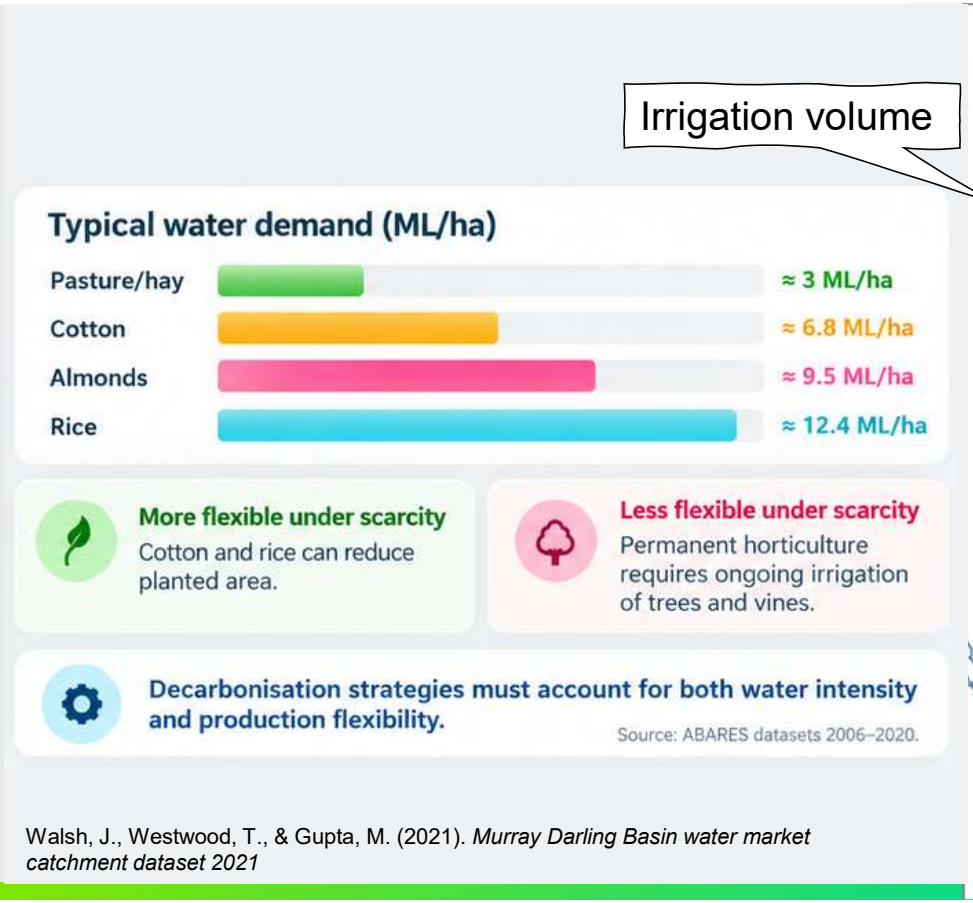
Agenda

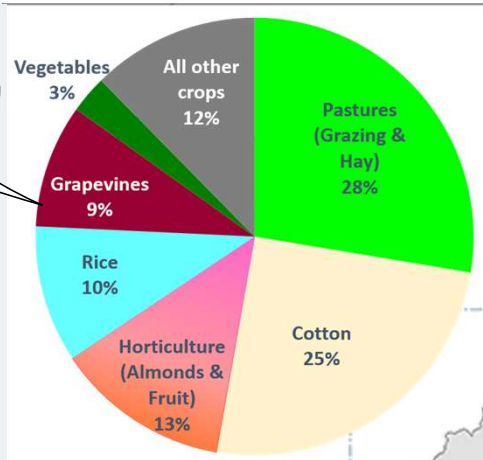


Literature and Data Analysis

- ✓ Crops, irrigation and water distribution network
- ✓ Northern versus Southern MDB
- ✓ Size of the prize
- ✓ Hotspot profiles and decarbonisation pillars

Crop mix across the MDB



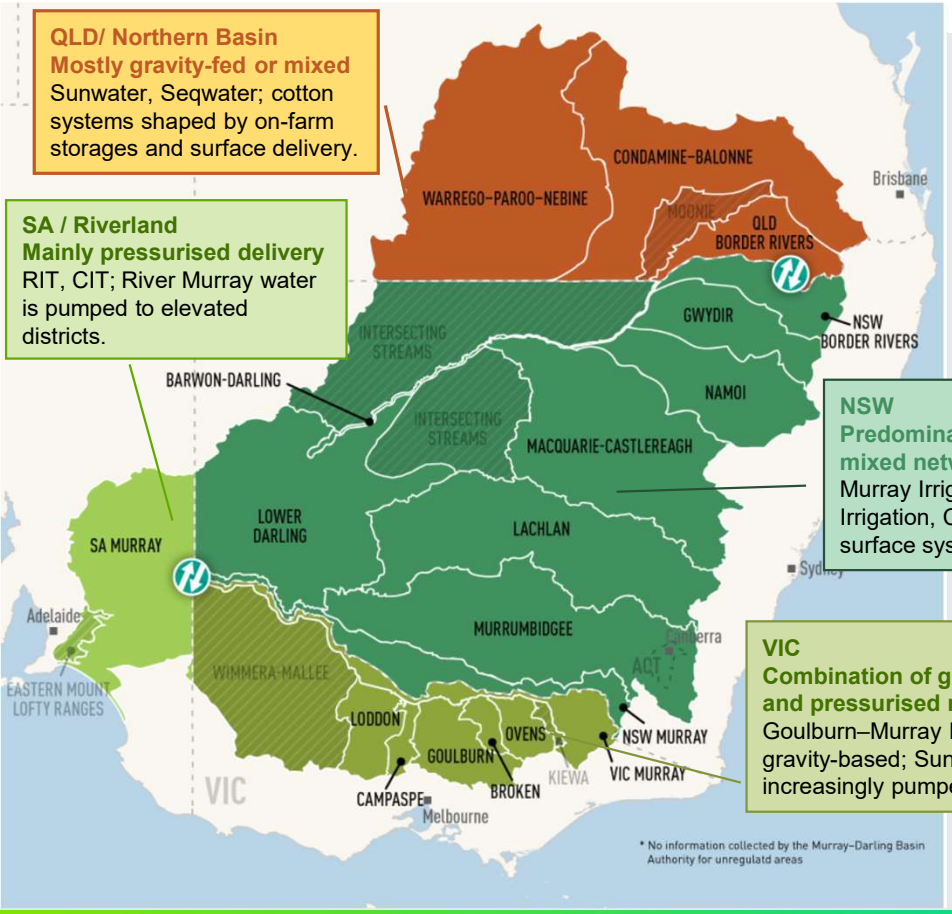


Walsh, J., Westwood, T., & Gupta, M. (2021). *Murray Darling Basin water market catchment dataset 2021*

Irrigation and water distribution network across the MDB

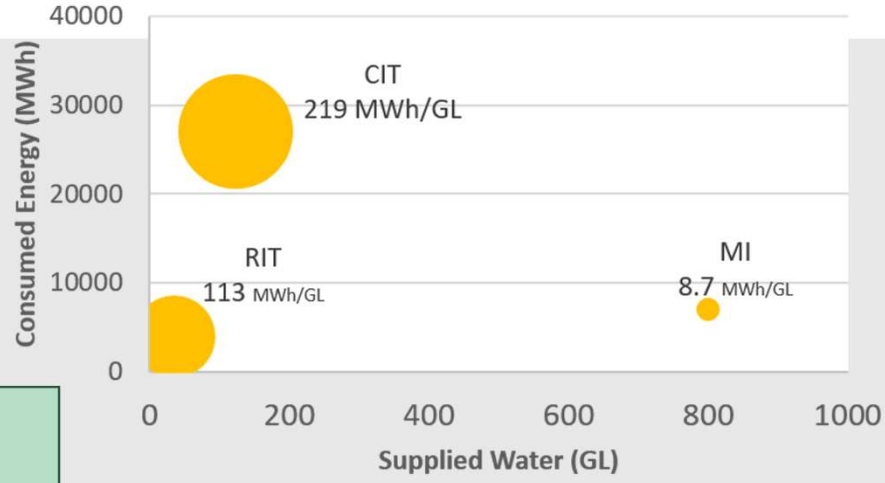
QLD/ Northern Basin
Mostly gravity-fed or mixed
Sunwater, Seqwater; cotton systems shaped by on-farm storages and surface delivery.

SA / Riverland
Mainly pressurised delivery
RIT, CIT; River Murray water is pumped to elevated districts.



NSW
Predominantly gravity-fed / mixed networks
Murray Irrigation, Murrumbidgee Irrigation, Coleambally; broadacre surface systems remain dominant,

VIC
Combination of gravity-fed and pressurised networks
Goulburn–Murray largely gravity-based; Sunraysia increasingly pumped and piped,



Network type matters as much as water volume: pressurised delivery usually needs more pumping energy than gravity-fed systems.
Most decarbonisation opportunities must be assessed in the context of local water-delivery infrastructure and irrigation method.

Northern versus Southern MDB

Northern MDB



Crop profile: more cotton-dominated broadacre systems

Irrigation method: mostly surface / gravity-fed systems

Energy hotspots: water harvesting, groundwater pumping, on-farm storage filling, transfer and tailwater recycling

Energy profile: generally lower field pressurisation, greater diesel exposure, and large, dispersed pumps

Water demand is often **more flexible and seasonal / variable**, as annual crops can reduce planted area.

Southern MDB



Crop profile: more pasture, rice and permanent horticulture

Irrigation method: more pumped and pressurised delivery, especially in horticultural districts

Energy hotspots: pumping, pressurisation, filtration and repeated delivery through drip / micro systems

Energy profile: greater grid-electricity exposure and more concentrated electricity loads, with higher energy intensity where water must be lifted and pressurised

Permanent horticulture is **less flexible**, with **more continuous demand** for perennial crops as orchards and vines require ongoing irrigation.

2.5×

more irrigation water used in the Southern MDB

Average across 2006–2020.

Water efficiency VS energy efficiency

ONE BASIN CRC

WATER EFFICIENCY

Use less water to achieve the required crop outcome.

Improved through better scheduling, cut-off timing, uniformity and reduced seepage, runoff or deep drainage.

≠

ENERGY EFFICIENCY

Use less energy to move and apply each ML of water.

Driven by pumping head, operating pressure, pipe friction, pump/motor efficiency and operating conditions.

Where the trade-off appears

Surface → pressurised irrigation

Water application ↓ 10–66%

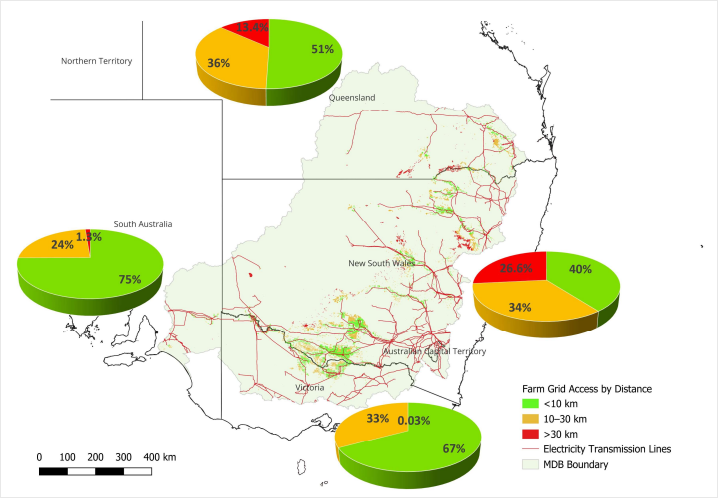
Energy use ↑ up to 163%

Context matters

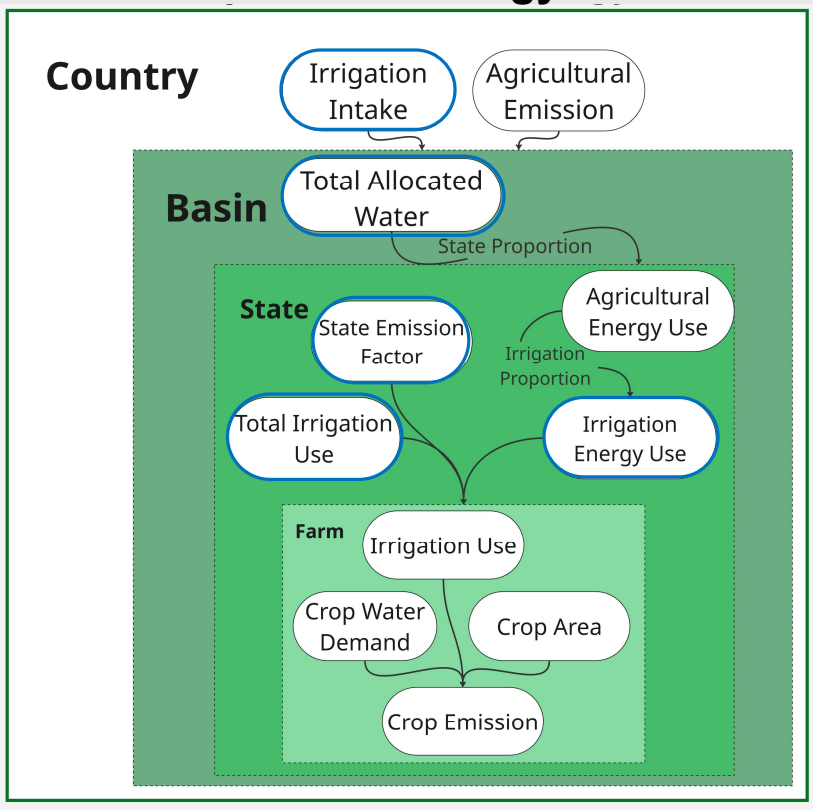
In groundwater systems, lower pumping volume can sometimes offset the added pressure requirement.

Size of the prize

Geospatial Analysis



Methodology

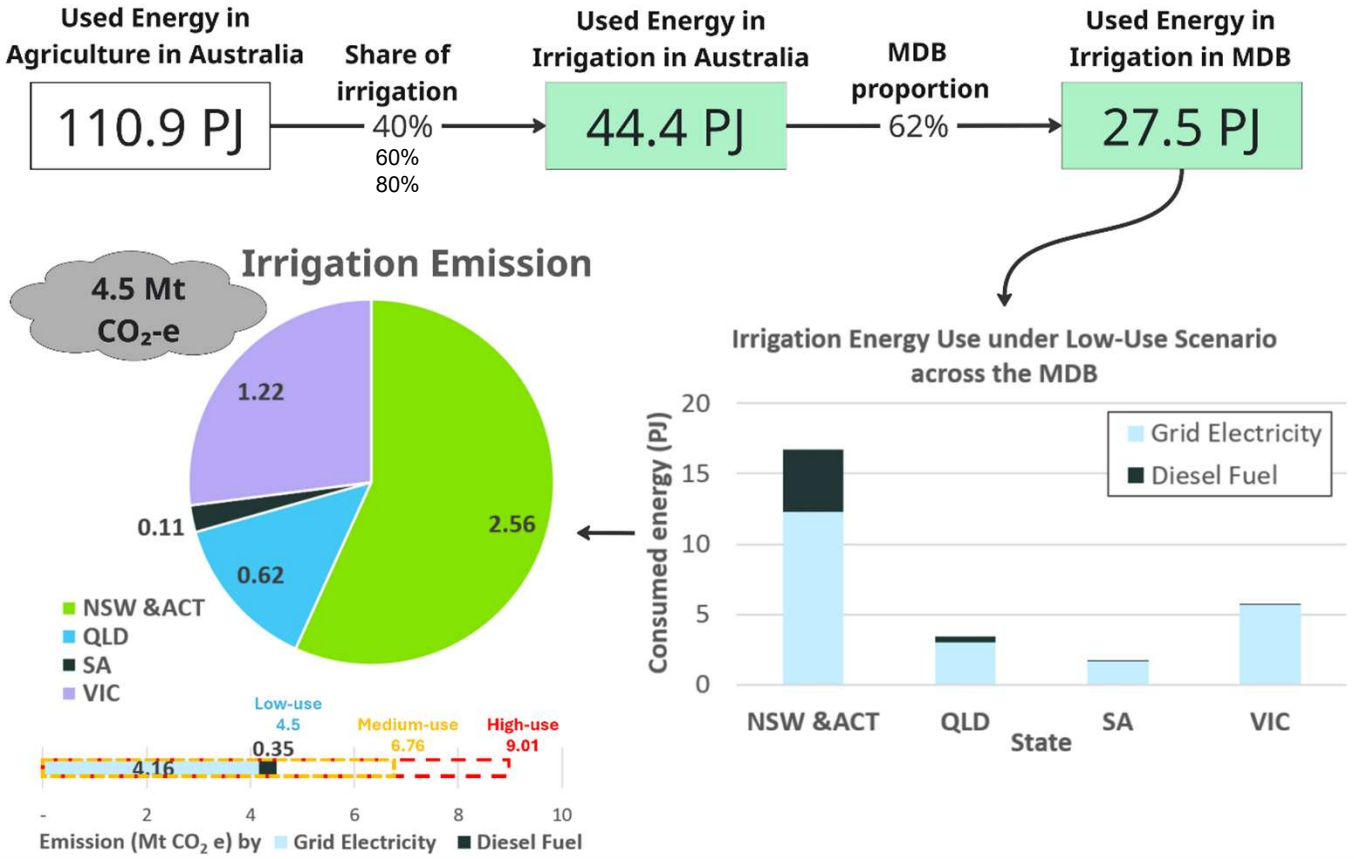


Data sources

ABS, MDBA, ARENA, Wine Australia, Australian Farm Institute, DCCEEW, AEMO, ABARES

https://iopscience.iop.org/article/10.1088/1748-9326/aea7b7

Size of the prize



- ✓ Estimated emission intensity: 0.53–1.06 t CO_2-e/ML
- ✓ Power-sector decarbonisation offers the largest mitigation opportunity
- ✓ Off-grid and fringe-grid areas require greater focus on diesel displacement.
- ✓ Decarbonisation pathways need to be region-specific

https://iopscience.iop.org/article/10.1088/1748-9326/aea7b7

Four hotspot profiles emerge

NSW — Largest absolute priority

- High irrigation activity
- Concentrated groundwater use
- Highest remote-grid exposure
- Hotspots often sit behind the farm gate

Scale + farm-gate focus
- Scale
- Remote-grid

SA — High energy intensity, high abatement potential

- Pressurised water delivery
- CIT/RIT high MWh/GL
- Excellent grid access
- Strong solar opportunity

High-value abatement
- Intensity
- Grid access

VIC — Large emissions but enabling policy

- Mix of gravity and pressurised systems
- Strong grid access
- Water corporations already under emissions obligations

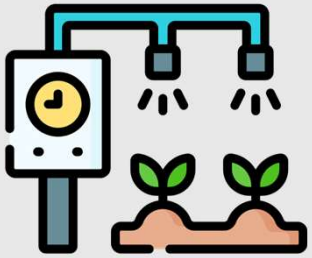
Policy-ready transition
- Scale
- Grid access

QLD — Dispersed / harder to electrify

- Gravity surface irrigation
- Energy in harvesting, transfers + storage
- Diesel + geographically dispersed pumping

Distributed solutions
- Dispersion
- Diesel exposure

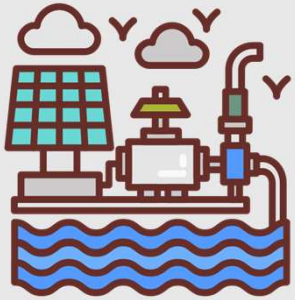
Decarbonisation pillars



Irrigation and Energy System Optimisation



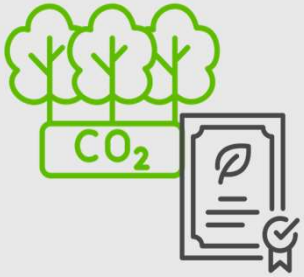
Electrification Fossil-fuel Displacement



Renewable Energy Energy Storage



Smart, Automated Flexible Irrigation



Carbon Management and Offsets

First priority: optimise before replacing infrastructure

MEASURE
Energy audit
Operating hours

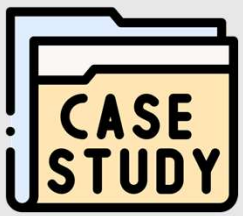
→

DIAGNOSE
Pump + hydraulics
Where are losses?

→

OPTIMISE
Retrofit + control
Lowest-cost gains

- Pump testing
- Better scheduling
- VSDs
- Reduce friction / head
- Pipe / suction design
- Surface-irrigation control
- Pressure control
- Tailwater / reuse



~40%
pumping energy reduction
Hydraulic changes
At some sites

10–15%
pump efficiency gains
Improved operating conditions

29.5 → 15.6
kWh/ML
Maintained delivery capacity

Renewable energies or electrification

What determines solar value?

1. **Generation ↔ pumping match**
2. **Load shifting**
3. **Tariffs + export limits**
4. **Seasonality + grid capacity**



- ✓ **60–70% energy-cost reduction** for solar pumping in an almond farm.
- ✓ solar–battery microgrids meet about **85% of electricity demand**, with diesel retained only for peak and backup supply.

Preferred hierarchy for MDB irrigation

1. **Direct renewable electricity**
   First choice where load matching works
2. **Water storage + flexible pumping**
   Shift energy use without storing electrons
3. **Battery / microgrid**
   For fringe-grid, reliability or peak support
4. **Hydrogen / bioenergy**
   Complementary regional options, not first choice for stationary pumps

What Do Stakeholders Tell Us?



Agenda



What happens on the ground?

01 Stakeholder engagement

02 Key findings

03 Real-world experiences

04 Barriers and investment decisions

05 Enablers and next steps

Listening Across the Basin: Four Regional Workshops

What matters across regions?

LOXTON n = 18 | SA

Horticulture

Drip irrigation



MILDURA n = 19 | VIC

Horticulture

Drip & micro-sprinklers



GRIFFITH n = 17 | NSW

Mixed agriculture

Surface & pressurised irrigation



GOONDIWINDI n = 20 | QLD

Cotton & grains

Large-scale surface irrigation



74
participants

Growers, agricultural and irrigation industries, energy stakeholders, researchers, service providers, policymakers and regional organisations.

WORKSHOP APPROACH

Facilitated discussions

Collaborative prioritisation

Documented insights (notes & recordings)

Stakeholder Engagement: Building the Evidence Base

~250
external contacts identified

119
direct engagements

25
interviews

4
Site visits

Extensive stakeholder outreach

- In-person
- Online • email • text
- Professional referrals
- Newsletters
- Regional field days

Interview mix

- 15 Farmers
- 9 Peak bodies, CMAs & irrigation districts
- 1 non-MDB farmer

What this achieved

- Broad geographic reach
- Multiple organisation types
- Direct farmer and sector insight

FINDING 1

The strongest motivation was not carbon!

PRIMARY MOTIVATION

- Lower energy and operating costs
- Better productivity and efficiency

ALSO IMPORTANT



- Reliability and resilience



- Labour savings and automation



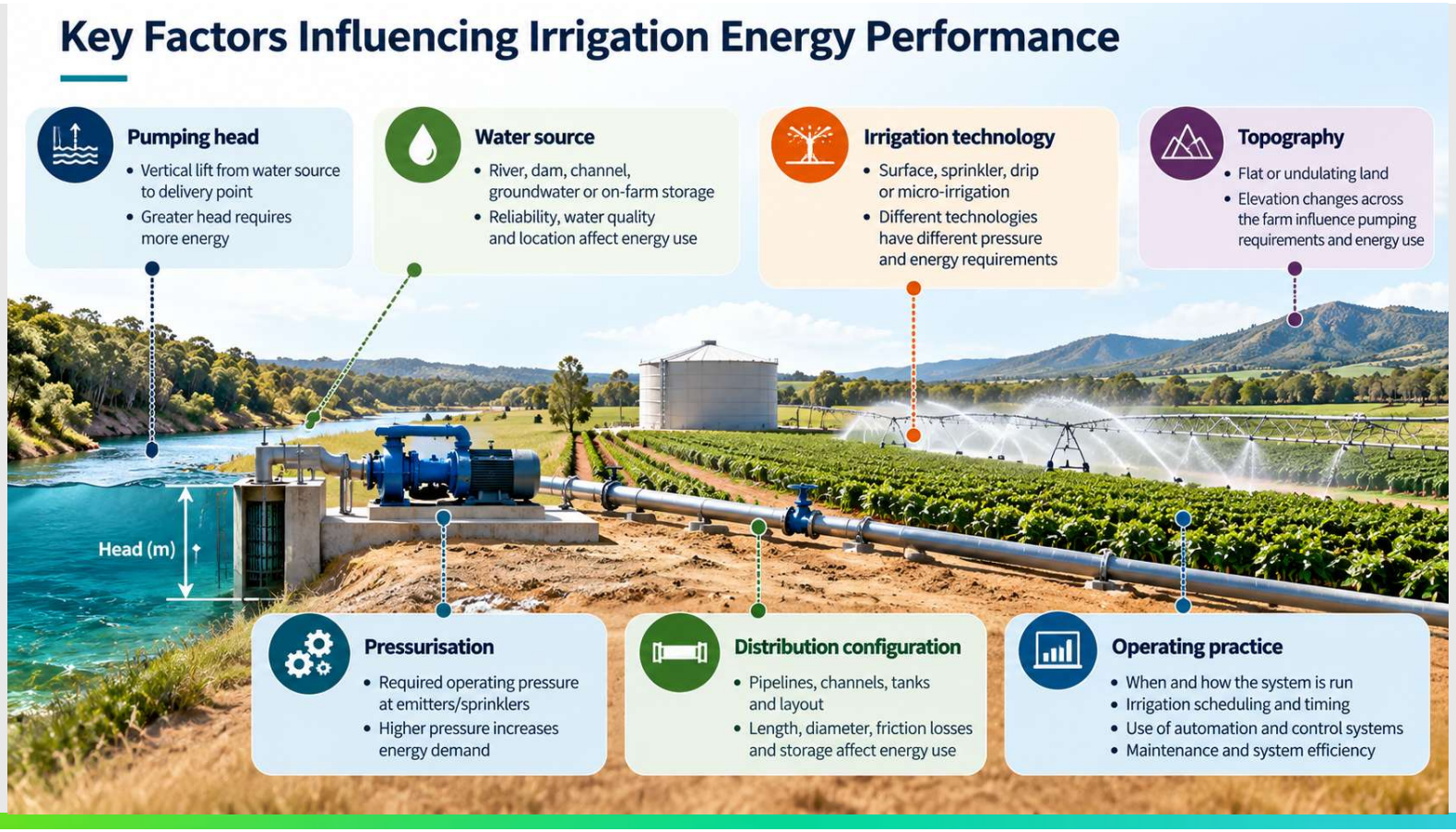
- Water availability and risk



- Market and supply-chain expectations

FINDING 2

Irrigation energy performance is highly context dependent!



FINDING 3

Decarbonisation is already happening- often incrementally!

Optimise

Pumps, VSDs, filtration and hydraulic design

Control

Automation, sensors and smarter scheduling

Supply

Solar PV, battery storage, microgrids and agrivoltaics

Transform

Electrification, shared infrastructure and new models



A low-carbon pathway often starts with making the existing system work better.

FARM EVIDENCE

From Investment to Impact: A Successful Solar Irrigation Journey



BARRIERS

Implementation Considerations & Constraints

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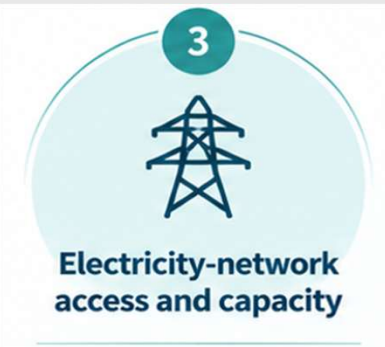
Capital availability and investment timing

- Limited available capital
- Upgrades tied to renewal cycles
- High upfront investment



Existing infrastructure and farm configuration

- Legacy infrastructure
- Compatibility challenges
- Multiple meters or titles



Electricity-network access and capacity

- High connection costs
- Regional network constraints
- Capacity and export limits



Irrigation control technology and integration

- Disconnected platforms
- Added management burden
- Integration complexity



Support, advice and project development

- Limited independent advice
- Difficulty assessing suitable options
- Uncertainty about feasibility

DECISION EVIDENCE

Why investments sometimes stall?

FARM A- SA

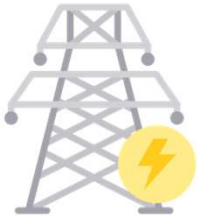


Solar + battery considered

~10–11 years expected payback

Investment did not proceed!

FARM B- NSW



Potential grid electrification

~$100,000 connection estimate

Connected to natural gas instead!

ENABLERS

What would accelerate the transition to low-carbon irrigation?

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1 Trusted advice



Independent
specific gui
on sui

2 Early feasibility

3 Demonstrations

Local demonstrations with real costs and results

Stakeholders called for practical support, not just more technology information!

4



Accessib grants, loans and investment support

ion



Growers, irrigation operators, networks and policy makers

Next Steps: From Evidence to Roadmap

1 Data Gathering & Analysis

Collect and analyse irrigation, water, and energy data.

2 Model Development

Develop model to assess irrigation energy systems and decarbonisation options.

3 Scenario Identification & Testing

Identify and test alternative technologies, operating strategies and future scenarios.

4 Demonstration Sites

Identify and showcase successful initiatives and practical lessons across the Basin.

5 Capacity Building

Share knowledge and strengthen capabilities among stakeholders.

6 Decarbonisation Roadmap

Bring together modelling, scenario results and stakeholder insights to guide pathways.

Thank you

