BLUE ECONOMY
COOPERATIVE RESEARCH CENTRE

Offshore Renewable Energy Systems in the Australian Blue Economy Co-operative Research Centre

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CSIRO Oceans and Atmosphere
CRC Offshore Renewable Energy Systems Program Leader

Transforming Australia's Blue Economy

- Global Blue Economy value x2 by 2030, $3t USD
- A paradigm shift in how marine protein is produced is needed *now* – scalable, sustainable offshore aquaculture
- Offshore renewable energy: solutions for off-grid applications
- Offshore engineering: building on experience
- This CRC brings together industry, R&D and government to develop compelling triple-bottom-line solutions

An Industry-Led Initiative

Large Industry

HUON AQUACULTURE
Petuna SEAFOODS & GOURMET PANTRY
tassal GROUP
xylem Let's Solve Water
pitt&sherry

Government & Industry Growth Centres

Department of State Growth
Tasmanian Government
FIAL

Medium Industry

H2U
ITM POWER Energy Storage | Clean Fuel
Kelp Industries
OPTIMAL
oysters TASMANIA
DEME Dredging, Environmental & Marine Engineering
DNV·GL
PEARL PRODUCERS ASSOCIATION Australian South Sea Pearls
AMET Australian Marine Energy Taskforce
pacific ESI www.esi.com.au

Research

UNIVERSITY of TASMANIA AUSTRALIA
THE UNIVERSITY OF QUEENSLAND AUSTRALIA
CSIRO
Griffith UNIVERSITY
THE UNIVERSITY OF WESTERN AUSTRALIA
MACQUARIE University

Small Industry

saitec offshore technologies
ACS AUSTRALIA
Carnegie CLEAN ENERGY
BMT Clarity from complexity
Southern Blue Reef Pty Ltd
Enhancing the environment
SKRETTING a Nutreco company

International

ALBATERN Wave Energy
sabella
OceanPixel
New Zealand King Salmon
SINTEF
ECSFRI CAFS
MaREI Centre for Marine and Renewable Energy
NUS National University of Singapore
GHENT UNIVERSITY
Plant & Food RESEARCH RANGAHAU AHUMĀRA KAI
THE UNIVERSITY OF AUCKLAND NEW ZEALAND
MERIC marine energy research & innovation center
CAWTHRON The power of science
AUT UNIVERSITY
SINGAPORE

$78m cash + $181m in-kind + $70m CRC contribution = 10 year, $329m partnership

The Research Programs

#1 Offshore Engineering & Technology ($67.9M)

#2 Seafood and Marine products ($65.9M)

#5 Sustainable Offshore Developments ($62.8M)

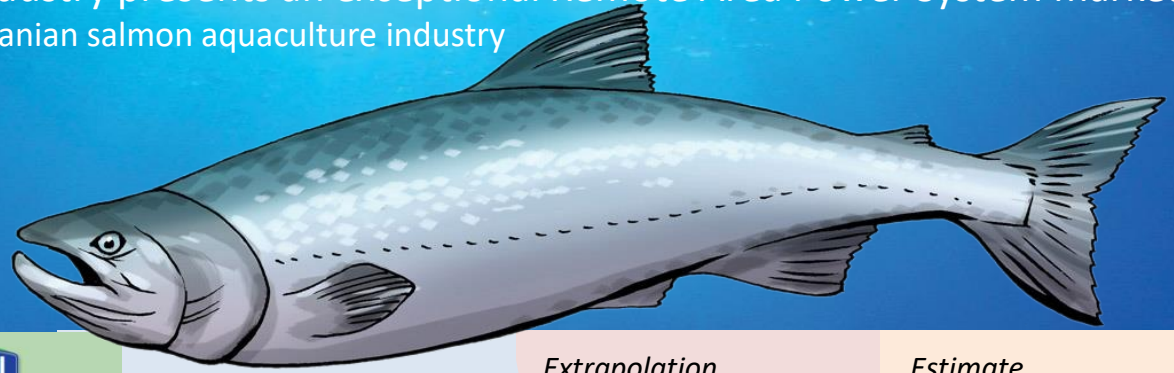
#4 Environment & Ecosystems ($65.9M)

#3 Offshore Renewable Energy Systems ($66.0M)

Energy Demand

Offshore industry presents an exceptional Remote Area Power System market

e.g., the Tasmanian salmon aquaculture industry



2018 TASSAL Production:
30883 HOG tonne

Energy demand:
14.34 GJ/HOG tonne

Diesel demand:
6.5 GJ/HOG tonne

Emissions:
1.04 T CO2e/HOG tonne

Extrapolation

TSGA 2018 Production:
~63000 HOG tonne

Energy demand:
253 GWh

Diesel demand:
115 GWh

Emissions:
66 kT CO2e

Estimate

Annual Diesel Expenditure:

$39m

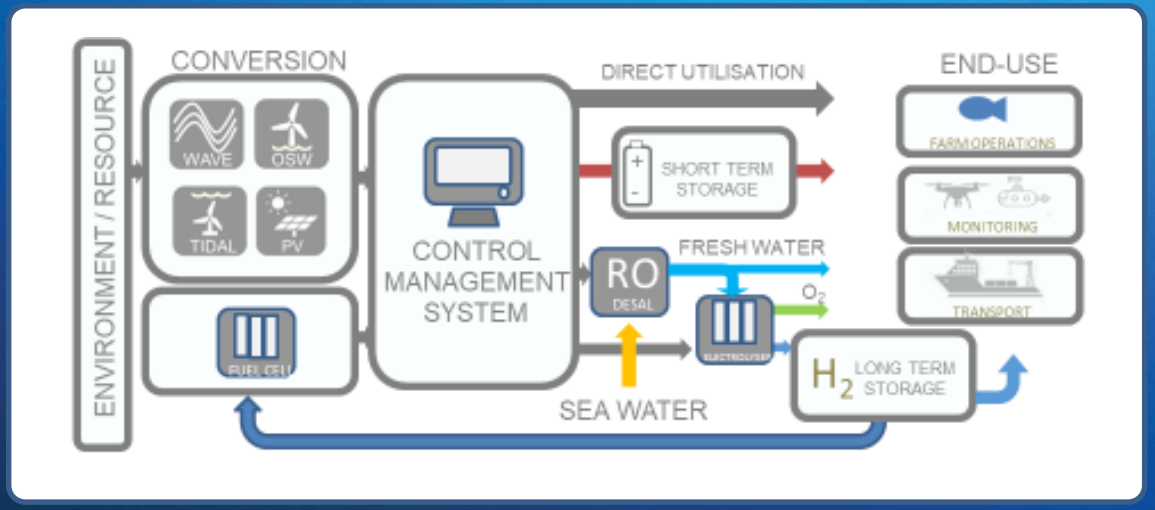
Assumed diesel cost
$AUD 340/MWh (Lazard, 2017)

Diesel usage: Predominantly barge operations to service biomass, RO desalination and venturation

2030 Tasmanian Salmon Production Target: 100,000 HOG tonne (Norwood, 2017)

Program 3: Offshore Renewable Energy Systems

Objective:
Identify, develop and demonstrate offshore renewable energy systems capturing generation, storage and control aspects optimised for co-located offshore operations.



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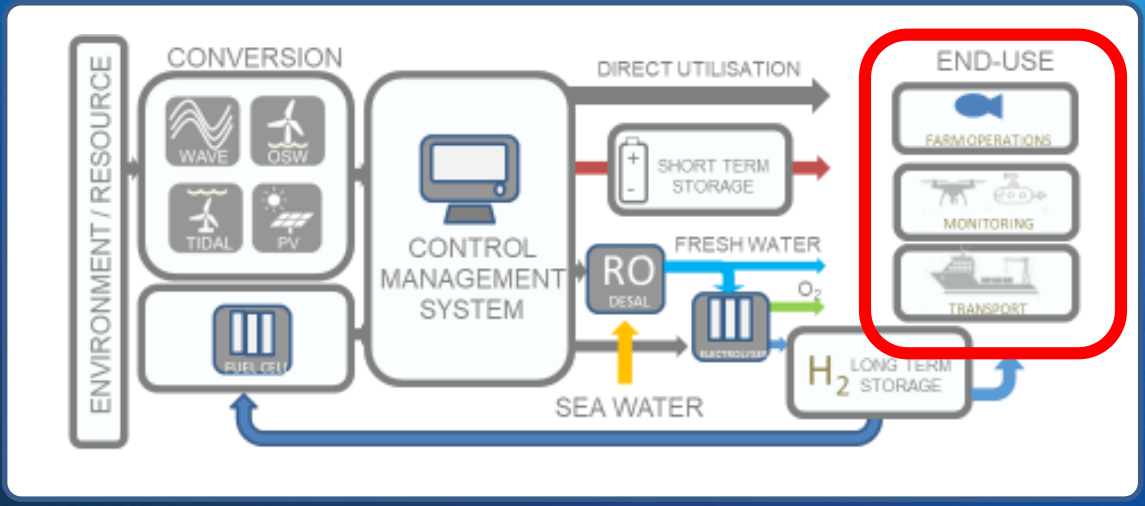

A: Energy demand:

Assess offshore industry energy demand - Market assessment; Energy demand modelling; Future scenarios.

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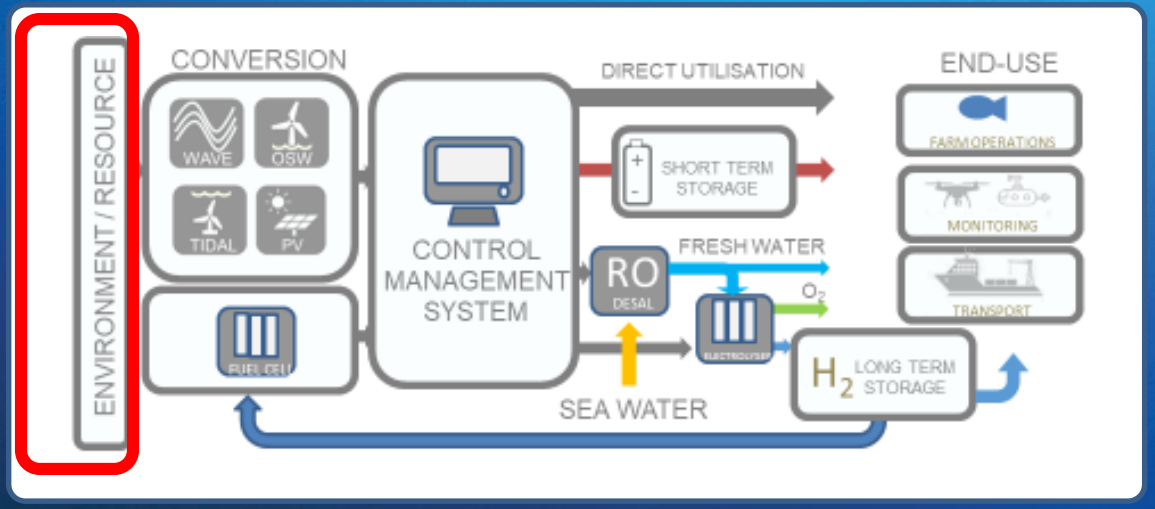

A: Energy demand:
B: Energy availability:

Resource characterisation; Site optimisation; Resource prediction and Monitoring for Energy Management; Climate scenarios.

Program 3: Offshore Renewable Energy Systems

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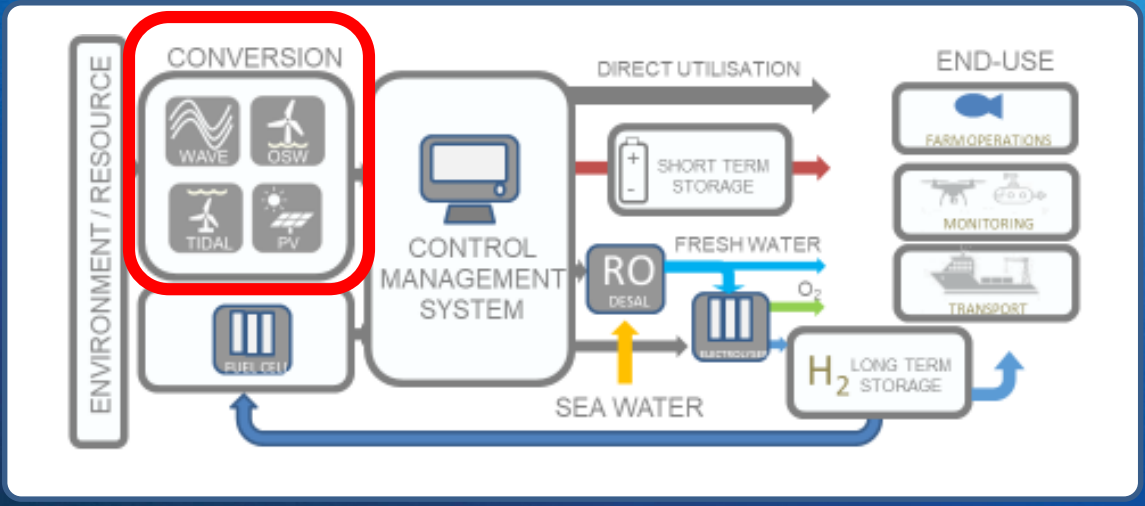

A: Energy demand:

B: Energy availability:

C: Conversion technologies:

Advance the design, performance, survivability, reliability and cost of Offshore Renewable Energy Converter (OREC) technologies (e.g., wind, wave, tidal, solar) with consideration of off-shore industry end-user (e.g. aquaculture) requirements.

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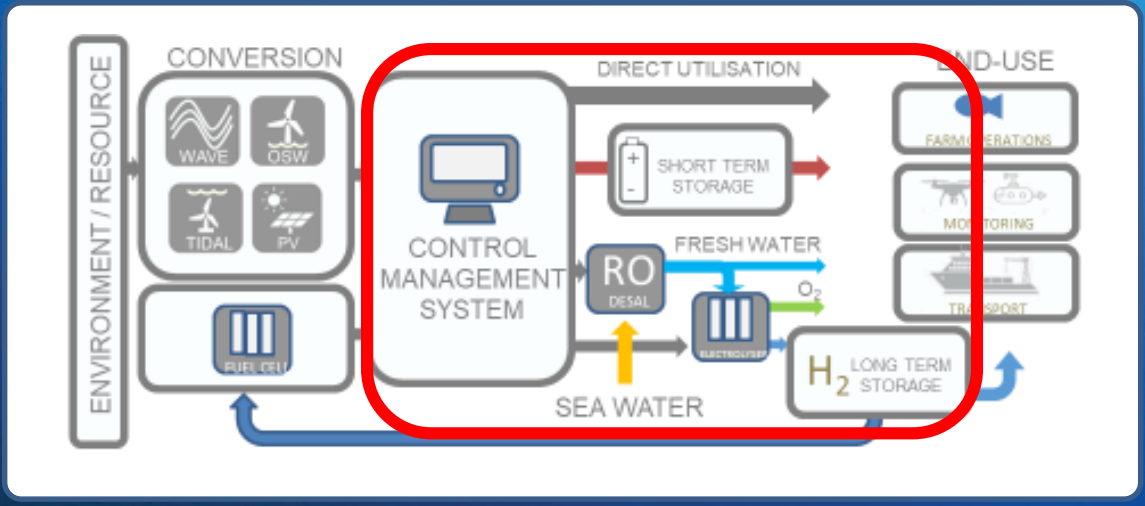


A: Energy demand:

B: Energy availability:

C: Conversion technologies:

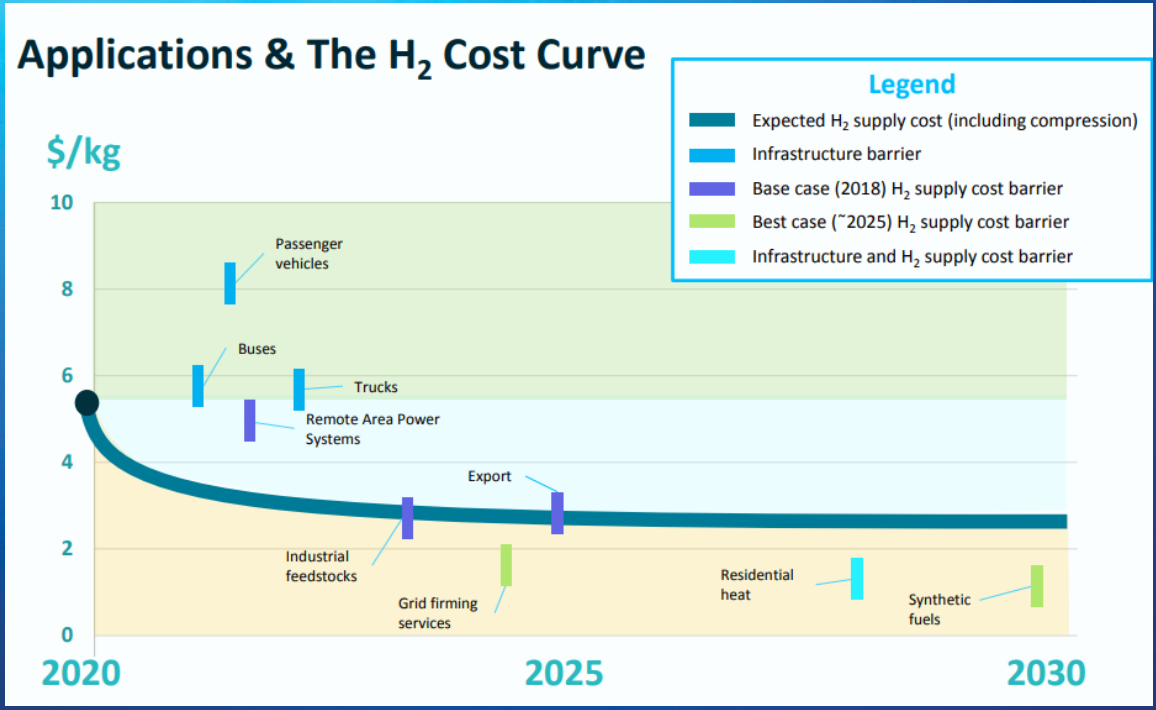
D: Control systems:

Developing energy management strategies and control systems for integrated offshore renewable energy systems (Hybrid systems; Energy storage, including hydrogen applications; intelligent control to balance generation and demand of e.g., power, freshwater, oxygen)

Demonstration of Offshore Hydrogen Driven RAPS

Hydrogen advantages:

- Aquaculture co-benefits
  - RO desalination
  - O_2 requirements.
- Near cost-competitive with diesel
- Long term storage
- Scalable
- Tolerates harsh environments
- Potential for centralised and decentralised RAPS models
- Can service multiple operations on site (e.g., stationary electricity, transport, other fuel - e.g., monitoring drones)



CSIRO National Hydrogen Roadmap, 2018

Building off Existing investments

UNIVERSITY of TASMANIA | AMC Australian Maritime College

Maritime Test Facilities

- 33m vessel BlueFin
- 100m/5ms^{-1} Tow tank
- 35m Model Test basin
- Marine energy precinct
- Strong connections to other international facilities

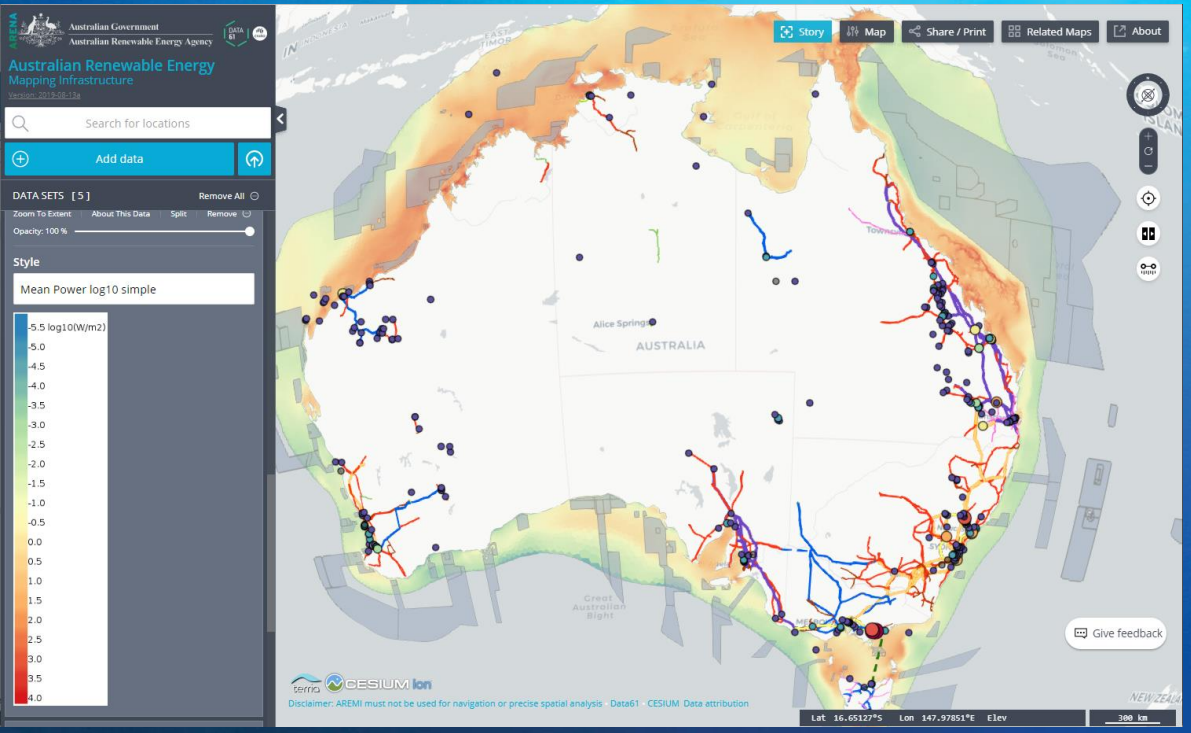
Building off Existing investments

Sir Samuel Griffith Centre

Nathan Campus
Griffith University
Queensland

Installed operational hydrogen microgrid
- 376 kW Solar array (1124 panels)
- Li-ion Battery storage (1.31 MWh)
- Hydrogen storage;
    - metal-hydride 120kg H_2 (~1.3 MWh)

Building off Existing investments



AREMI: Australian Renewable Energy Mapping Infrastructure

Offshore resources and market opportunities explored

Expected Outcomes

MARKET OPPORTUNITIES

Australia is well positioned to deliver growth in offshore renewable energy systems in targeted global 'blue economy' markets through Asia and the Pacific.

Development of offshore renewable energy systems can contribute to necessary decarbonisation of Australia's offshore industry sector.

Construction, operations and maintenance requirements of an offshore renewable energy industry will create jobs and transition opportunity for other declining offshore industries.

EXPECTED OUTCOMES

Development and testing of marine energy conversion devices suited to offshore conditions that support energy export and storage, and that support aquaculture.

- Support offshore aquaculture through supplies of lower cost energy and ancillary products.
- Contribute to the cost of offshore infrastructure through the development of exportable energy carriers.
- Design and development of renewable energy conversion devices; optimal offshore storage solutions and export products and micro-grid architecture solutions and control systems for intelligent management of integrated end-user demands.

Please get in touch if you have interest

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