



University of
Southern
Queensland

International Research Collaboration in Clean Energy and Sustainability

Professor John Bell

Deputy Vice-Chancellor (Research and Innovation)

March 2024

Acknowledgement of Country

UniSQ acknowledges the First Nations of southern Queensland and their ongoing connection to Country, lands, and waterways. We pay deep respect to Elders past and present.

UniSQ at a glance

26,000 students

15% international students

800 Higher Degree (Research) students

\$38 million research income (2023)

THE Ranking 351-400

THE Young Universities 55

QS Ranking 410

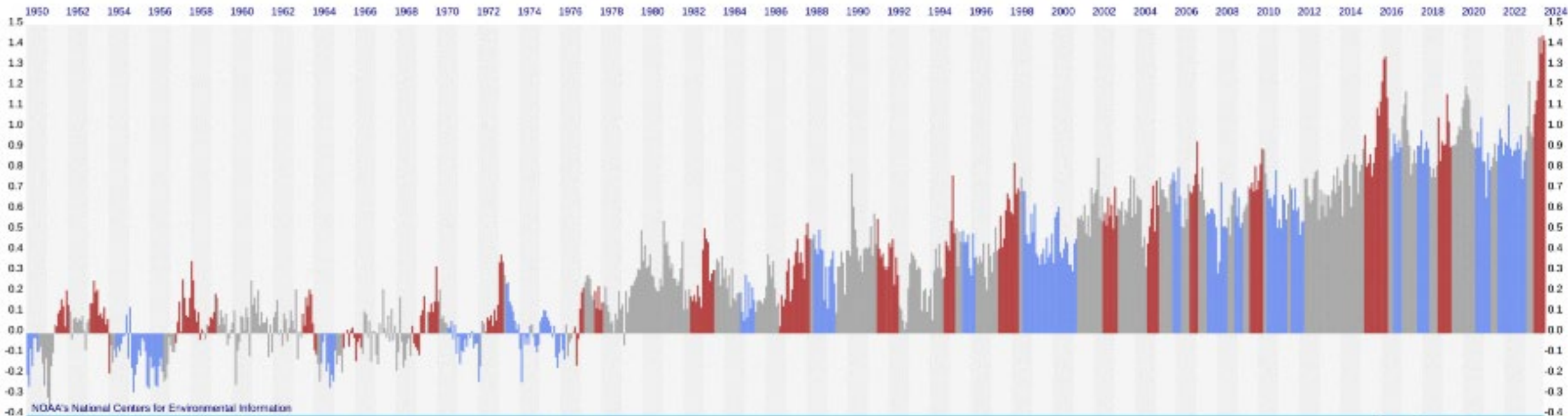


UniSQ Collaboration with Colombia

Institution	Co-authored publications	Field-Weighted Citation Impact
Universidad de los Andes Colombia	9	13.17
Universidad Nacional de Colombia	4	17.84
Universidad Javeriana	3	53.7
Centro Internacional de Agricultura Tropical	2	10.8
Instituto Nacional de Salud	2	33.96
Universidad de Cartagena	2	33.96
Universidad de Ciencias Aplicadas y Ambientales	2	33.96
Universidad de la Sabana	2	1.44
Corporación Colombiana de Investigación Agropecuaria - Agrosavia	1	3.85
Fundación Universitaria Konrad Lorenz	1	2.55
Ministerio de Vivienda, Ciudad y Territorio	1	4.68
Universidad Manuella Beltrán	1	2.55
Universidad de Antioquia	1	0.72
Universidad del Rosario	1	2.55

Climate Change/Global Warming

March 21 2024, NOAA Report



Global Surface Temperature Departures (°C), colored by monthly ENSO values
Jan 1950 through Dec 2023

El Niño Months
ENSO Neutral Months
La Niña Months

Clean Energy in Australia

2021 ACOLA Report

- Goal is net zero by 2050



Combining the strengths of Australia's Learned Academies



Australian Academy of Technology & Engineering



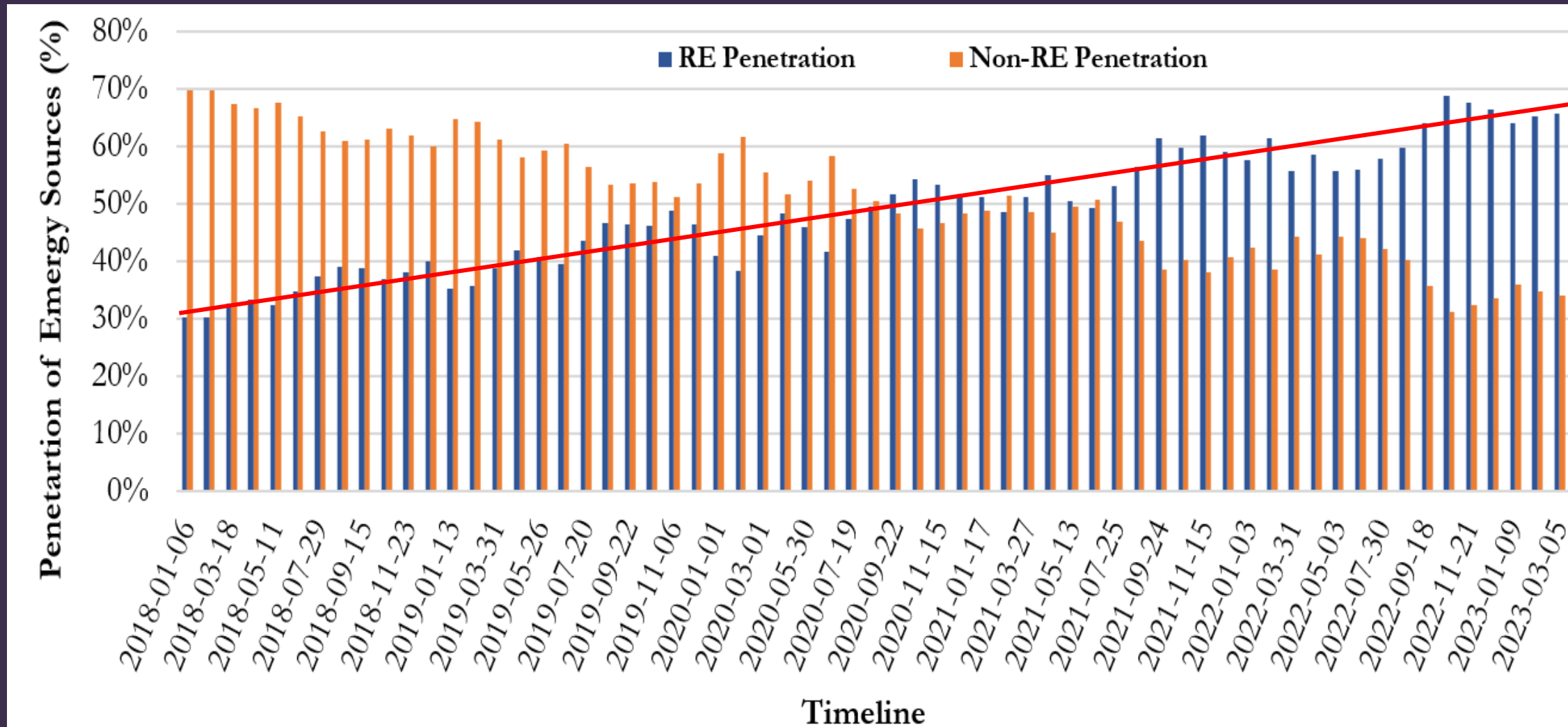
Australian Academy of Health and Medical Sciences

Executive summary

Australia's energy system is embarking on a transformation at a scale and rate that is unparalleled. Nations, leaders, industries and communities acknowledge the imperative to address global climate change through an "energy transition".¹ The goal is to reach 'net zero emissions' (nominally by 2050 or earlier) to halt further global greenhouse gas emissions, which are contributing to rising global temperatures and causing potentially irreversible damage to our societies, physical infrastructure and ecosystems.

... and the renewable transition is happening at scale

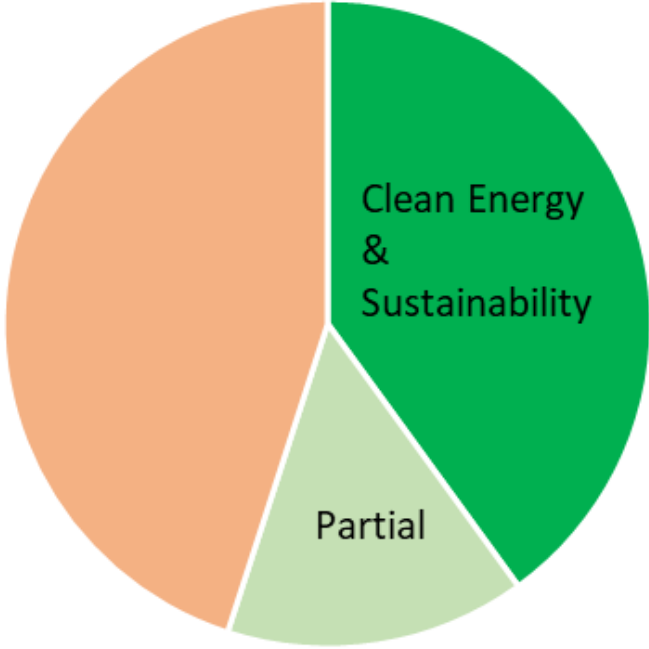
National Energy Market Data



Research Funding in Australia

a snapshot in Clean Energy and Sustainability

Industry Transformation Research Hubs- #

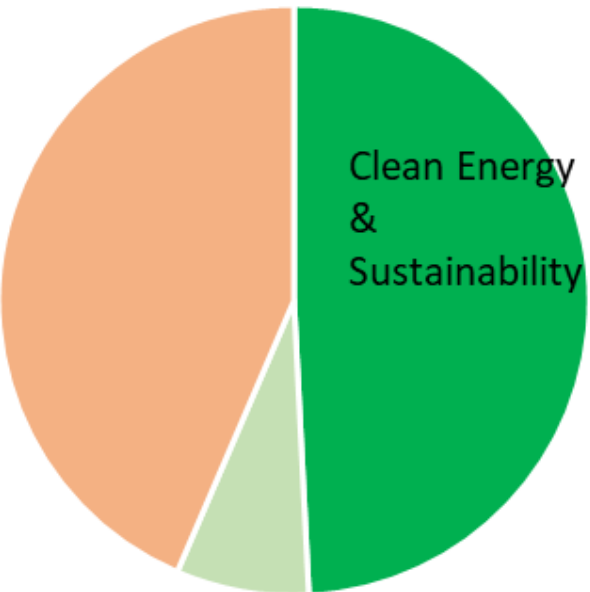


ARC Investment: \$42million (+\$12 million in “partial” Hubs)



March 2024

CRC Program Investments - Clean Energy & Sustainability



CRC Program Investment : \$574million (+\$85 million in “partial” CRCs)

Other Specific areas

Hydrogen – 8 hydrogen hubs across Australia + \$2 billion hydrogen headstart program

Electric Vehicles – new fuel efficiency standards



Neoen Victorian Big Battery (Moorabool)
Retrofit (ARENA)

RUN Universities and Clean Energy

- Research across almost all areas across our Universities
- Combined our RUN Universities have similar capability and strength as larger Australian Universities



Real Research Strength

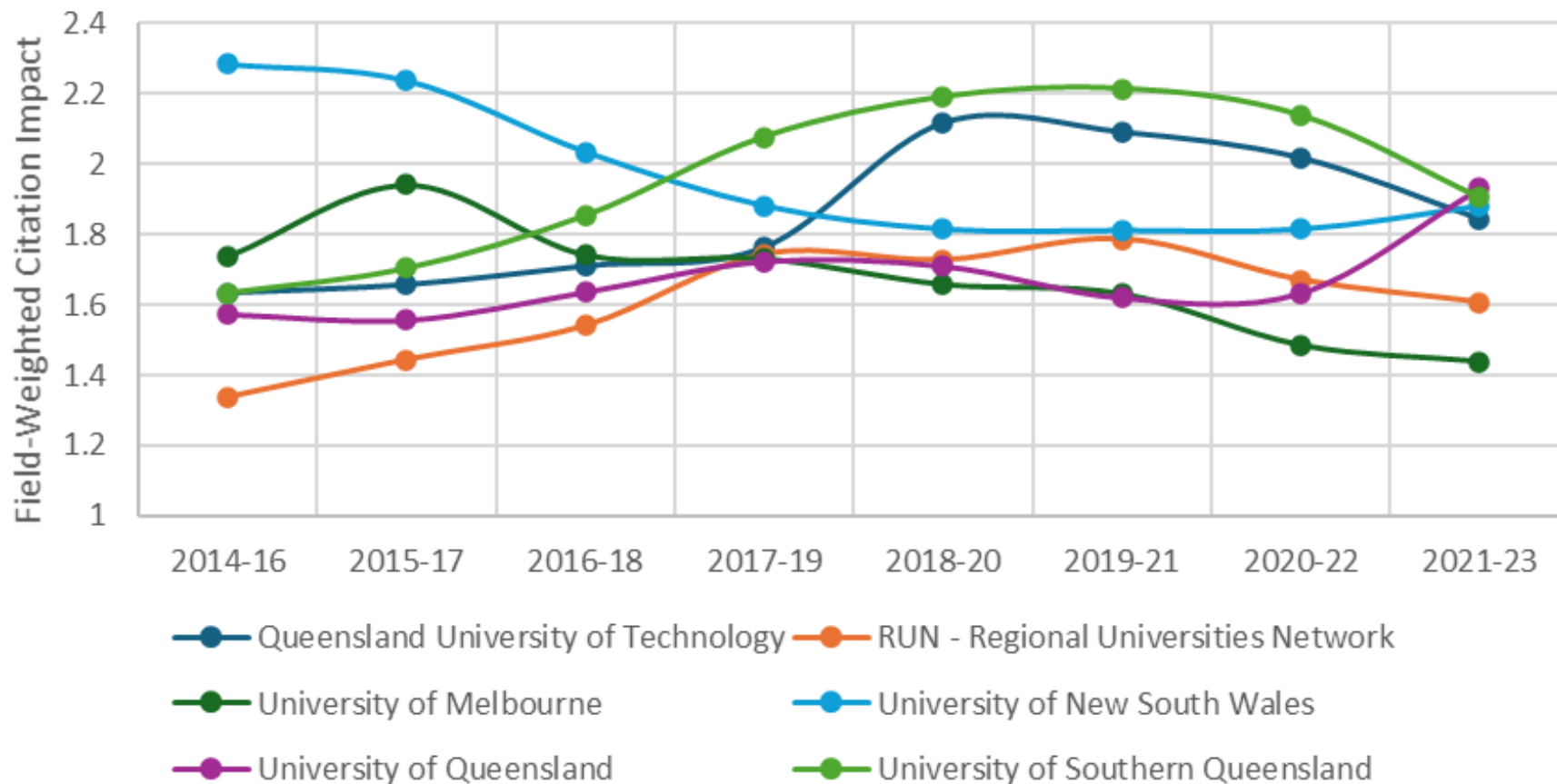
184 papers/yr

UNSW: 331

UQ: 235

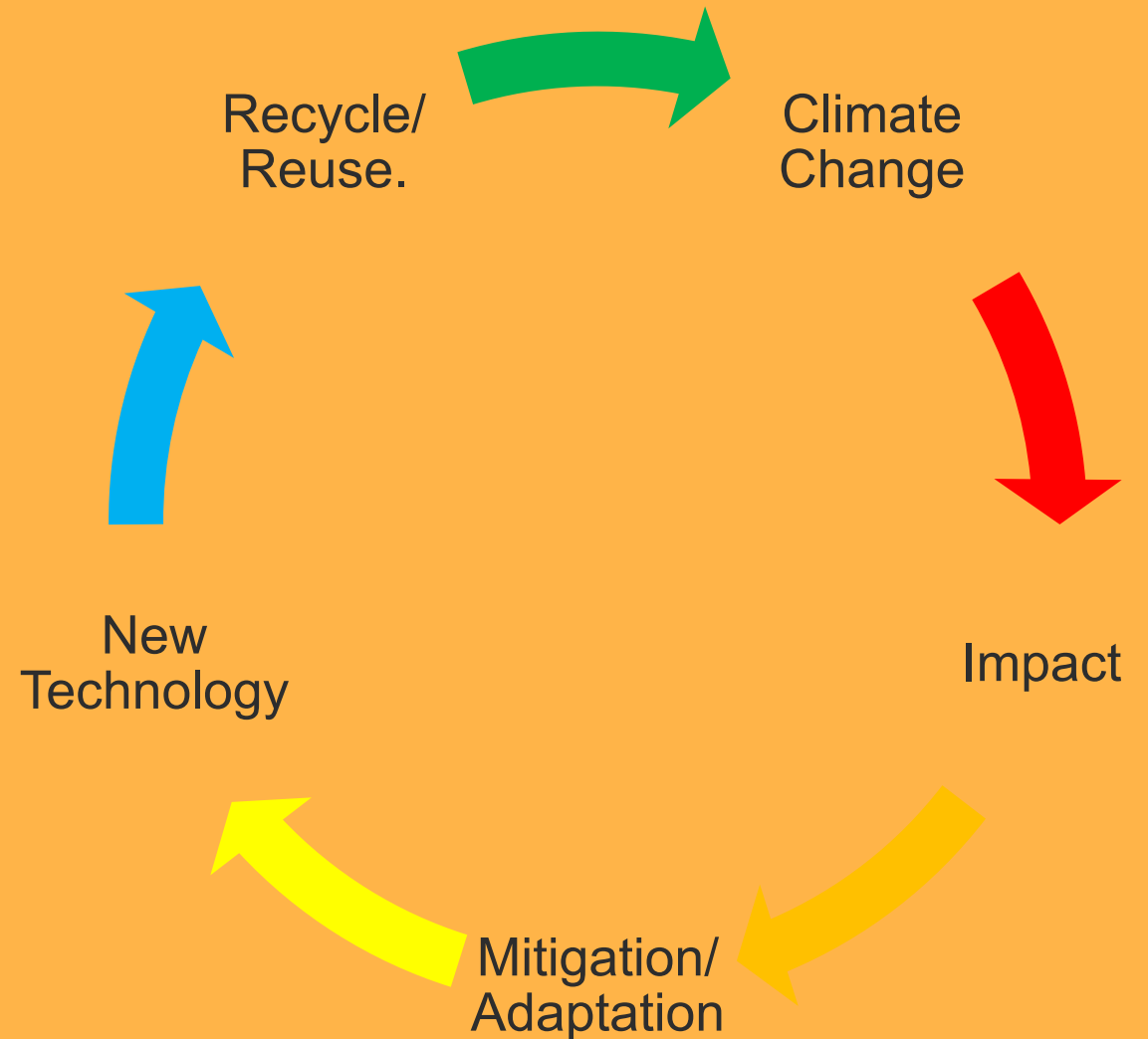
Sydney: 162

RUN Universities and some other Australian Universities - Energy



Sustainability is more than clean energy

- Climate change has impacts on almost every human activity
- UniSQ focusses on understanding climate change, assessing impacts, developing mitigations, adaptations and technologies, and recycling of waste
- Across agriculture, health, energy and infrastructure



University of Southern Queensland Flagships

Space and Defence
IAESS

Agriculture and
Environment

Regional Development
IRR

Health
IRR

Space Agriculture: Advanced
in Controlled Environment A



Future Drought Fund Innovation Hub: \$20 million
collaboration building on USQ's Climate Science and
Regional
Economic Development
Strengths.



UniSQ Flagship Mapping

Space and Defence

1-3, 8, 9

Agriculture and Environment

2, 3, 4, 8, 9

Regional Development

2, 4, 5, 6, 7, 9



Agriculture and Environment (#1, #5, #8)

1. Climate change impacts on coffee production
2. Energy and Resource Recycling



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Global leaders in coffee research

Climate impacts on coffee production



Developing solutions to manage climate
risk.

Close collaborations with AGROSAVIA (Colombian Agricultural Research Corporation) on “*Preparing Colombian coffee production for climate change: Integrated spatial modelling to identify potential robusta coffee (Coffea canephora P.) growing areas*”

Hosting and co-supervising Universidade Vila Velha (Brazil) students undertaking research on environmental sustainability in coffee landscapes

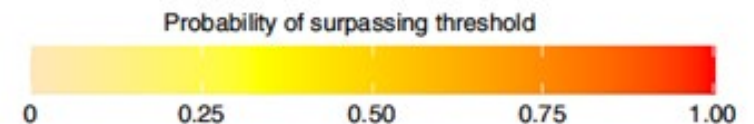
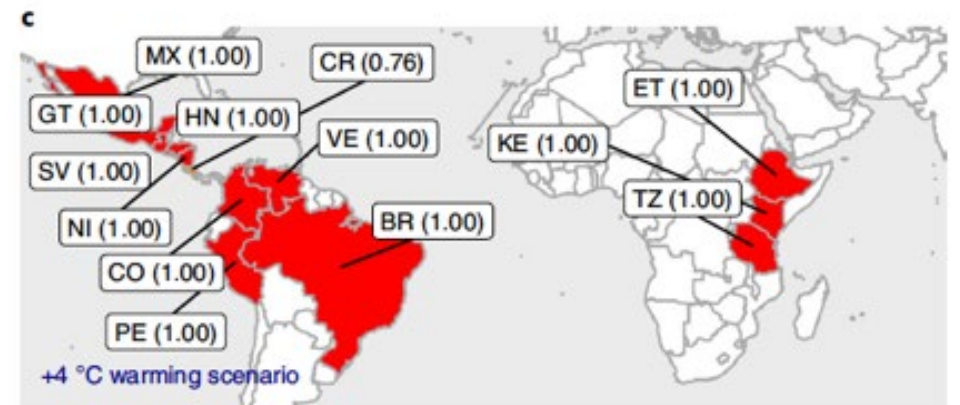
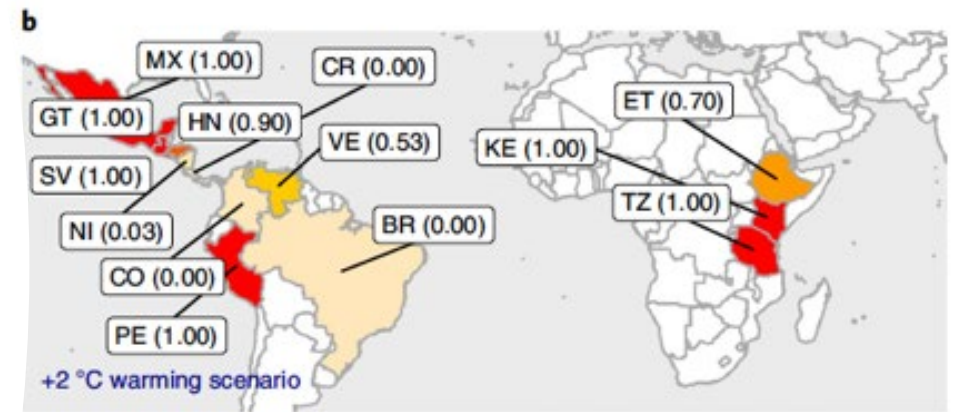
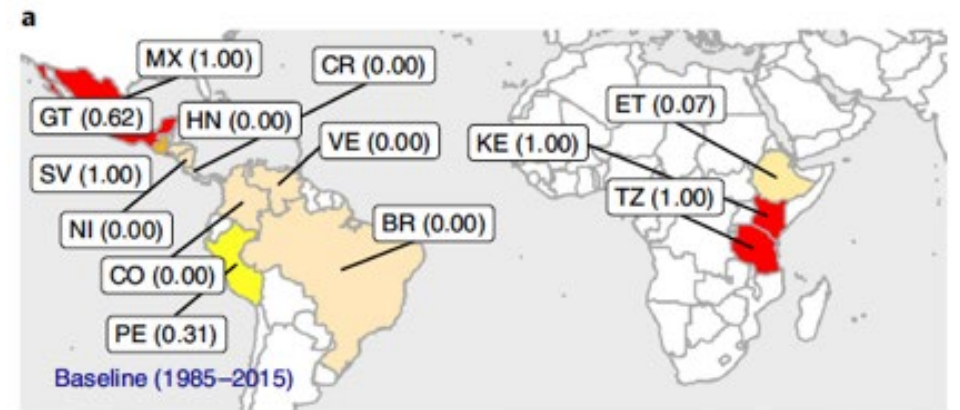


Centre for Applied Climate Science

Climate change poses to coffee productivity.

Figure shows the probability that a countries Arabica coffee producing areas will pass a critical climate threshold reducing productivity - Important implications for South America's top coffee producing countries.

Where should we be growing coffee in South America in a changing climate?



nature food

Article

Vapour pressure deficit determines critical thresholds for global coffee production under climate change

Jarrold Kath¹, Alessandro Craparo², Youyi Fong³, Vivekananda Byrreddy⁴, Aaron P. Davis⁵, Rachel King⁶, Thong Nguyen-Huy⁶, Piet J. A. van Asten⁷, Torben Marcussen¹, Shahbaz Muehtaq¹, Roger Stone¹ and Scott Power^{1*}

Received: 16 January 2022
 Accepted: 9 September 2022
 Published online: 13 October 2022

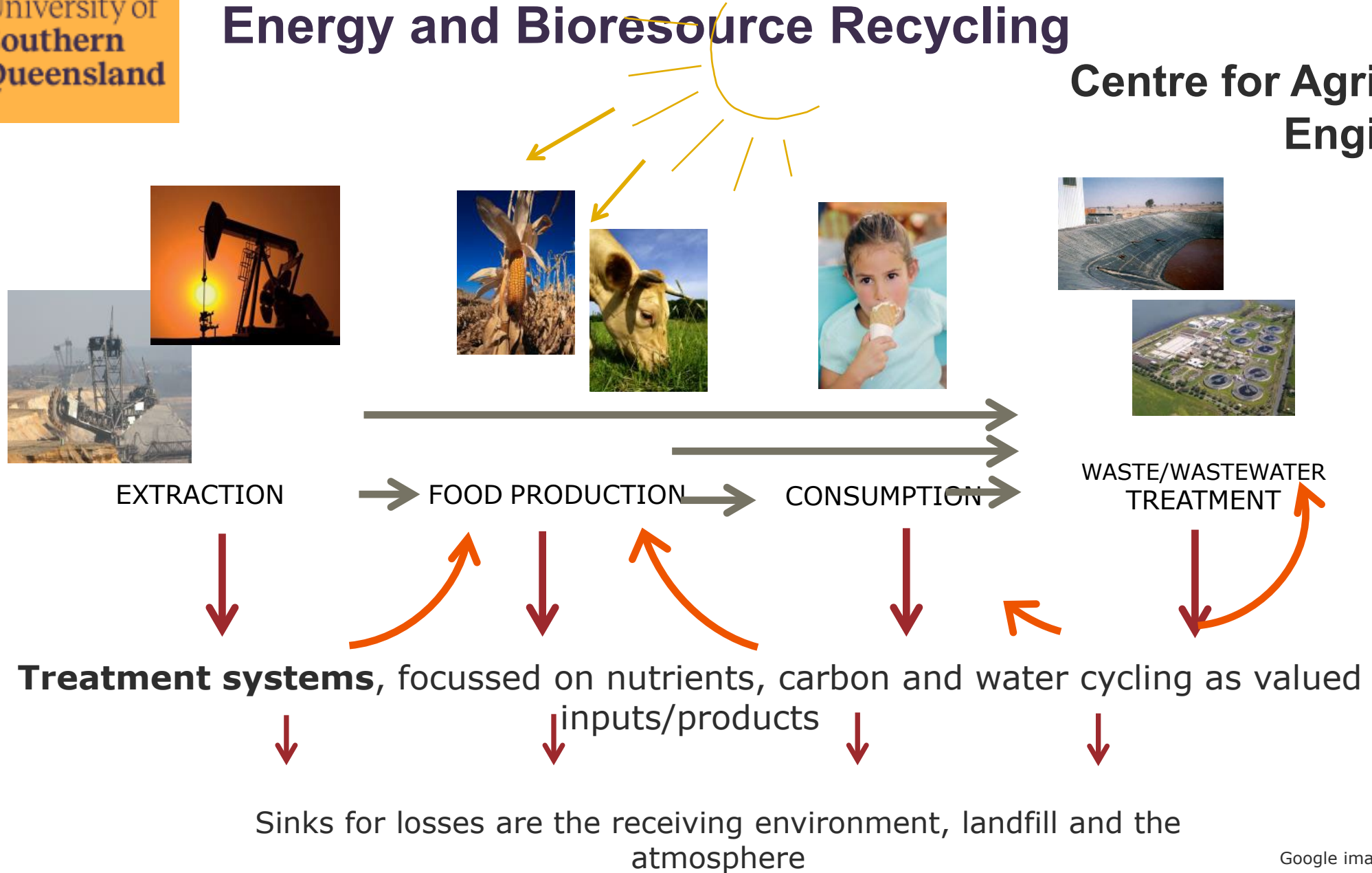
Check for updates

Our understanding of the impact of climate change on global coffee production is largely based on studies focusing on temperature and precipitation, but other climate indicators could trigger critical threshold changes in productivity. Here, using generalized additive models and threshold regression, we investigate temperature, precipitation, soil moisture and vapour pressure deficit (VPD) effects on global Arabica coffee productivity. We show that VPD during fruit development is a key indicator

<https://doi.org/10.1038/s43016-022-00614-8>

Energy and Bioresource Recycling

Centre for Agricultural
Engineering





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Research focus

Research focuses on transformation of organic waste to capture renewable energy (bioenergy) and resource recovery from local, national and international perspectives.

- This aligns with industries move to a low carbon future and reduced activities that result in greenhouse gas emissions

Broad funding base (Rural R & D Corp, State Gov and Fed Gov) and CRCs (End Food Waste CRC and Zero Net Emissions in Agriculture CRC)

- Research includes optimisation of anaerobic digestion (biogas), gasification, landfill diversion of organics [food organics and garden organics (FOGO)]; wastewater treatment and production of biofertilisers (biochar and digestate)
- The research has been applied to livestock and cropping sectors (both on and off farm), water utilities, local councils, and health sectors

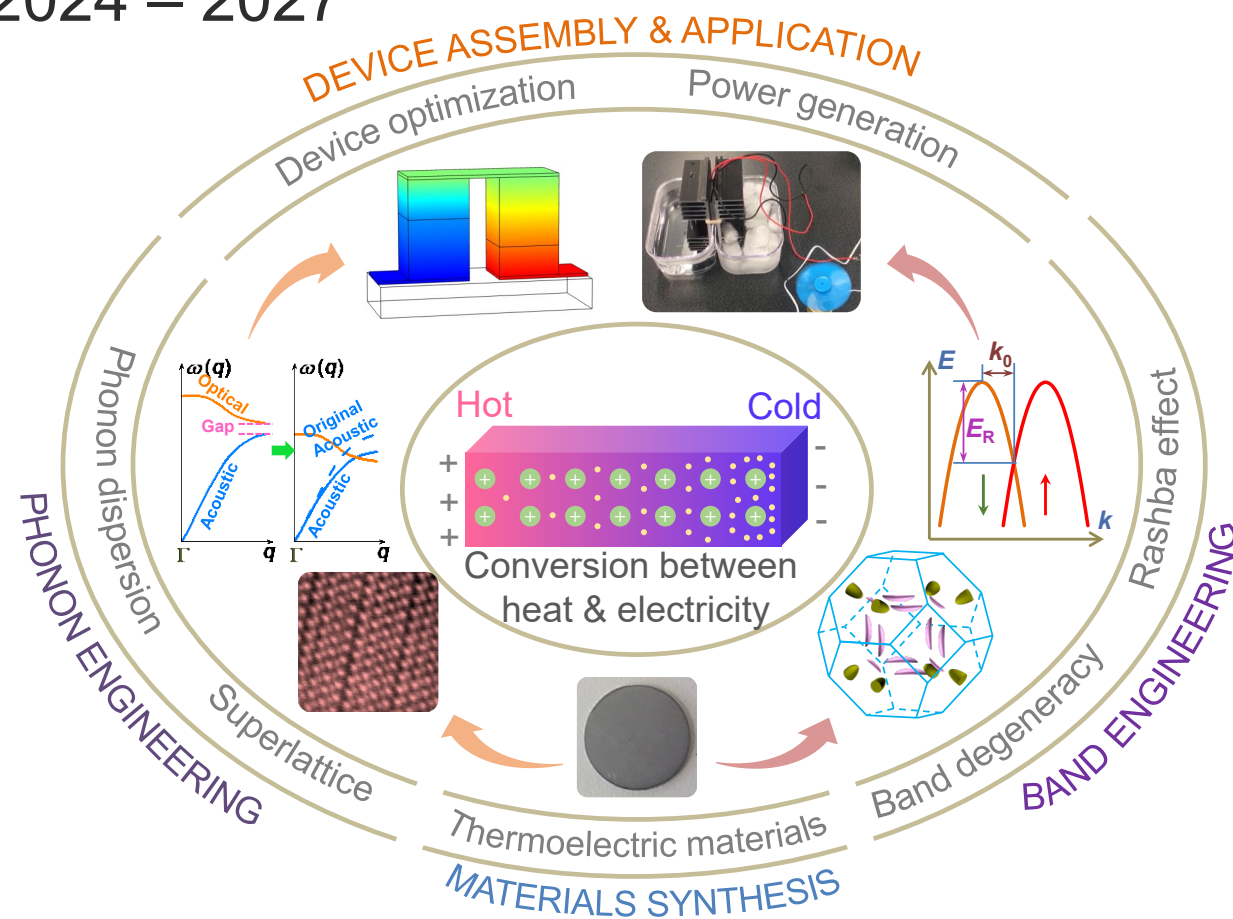
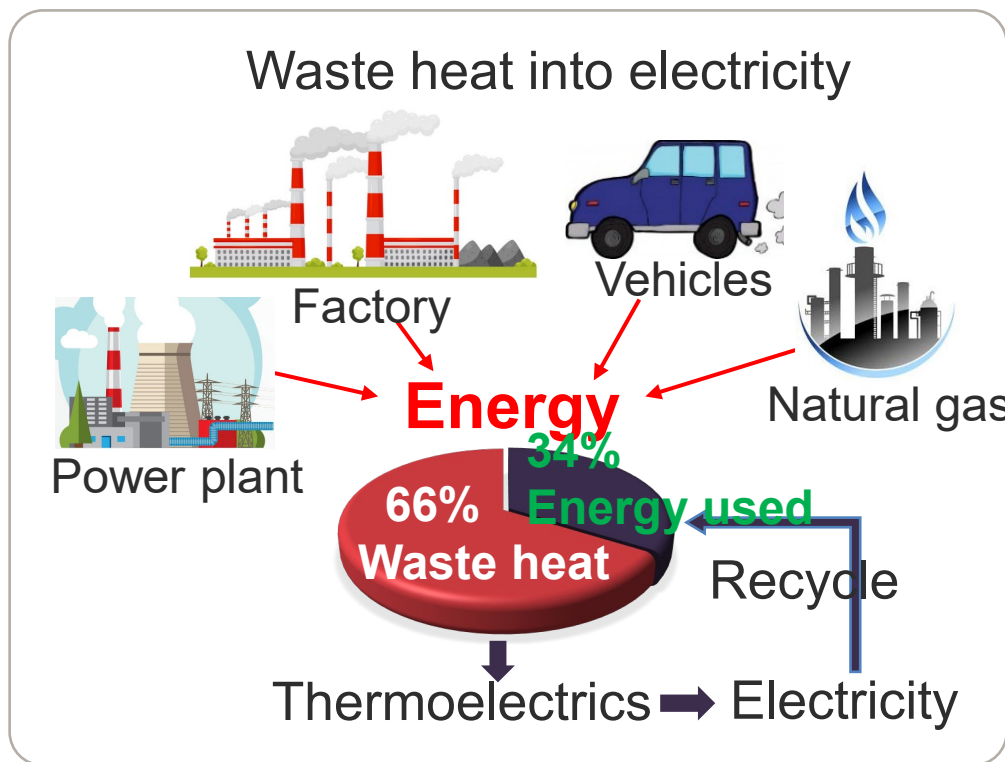
UniSQ Research- Energy Technology (#1 and #3)

1. Thermoelectric Technology – for energy generation and cooling
2. Battery technology and integration



Thermoelectrics: waste heat into electricity

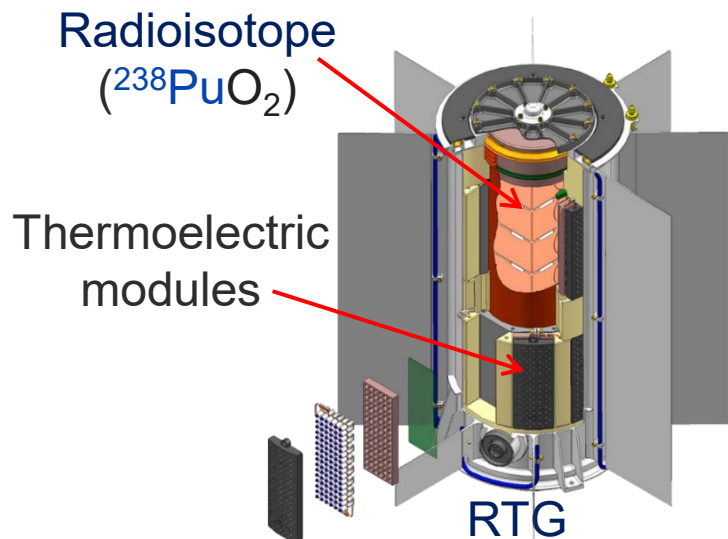
/Prof Min Hong - ARC FT230100316, 2024 – 2027



Centre for Future Materials

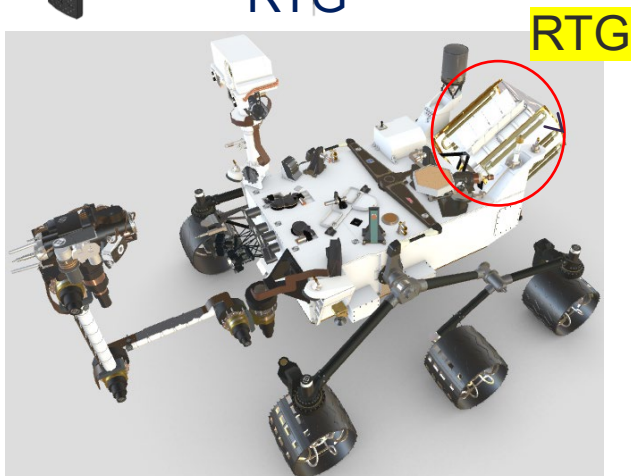


Radioisotope thermoelectric generator (RTG)



Voyager 1 in 1977
RTG will work until 2025.

iLAuNCH,
Trailblazer
Program,
2023-2025



Mars probe "Curiosity"



RTG is the only steady power supply for space probes running for over 30 years.

CATEGORIZATION OF STORAGE TECHNOLOGIES (Hossain et al. 2020; AEMO 2022b)

Type ¹	Duration ²	Response time ²	Storage Type				
			DS	CS	SS	MS	LDS
PHES	hrs-mon	Sec-min				✗	✗
CAES	hrs-mon	Sec-min			✗	✗	✗
FES	Sec-min	Sec		✗			
Fuel cells	hrs-mon	Sec		✗	✗	✗	✗
BES	hrs-mon	milli-sec	✗	✗	✗	✗	✗
SES	Sec-hrs	milli-sec	✗	✗			

¹ PHESS: Pumped Hydro Energy Storage; CAES: Compressed Air Energy Storage; FES: Flywheel Energy Storage; BES: Battery Energy Storage; SES: Supercapacitor Energy Storage

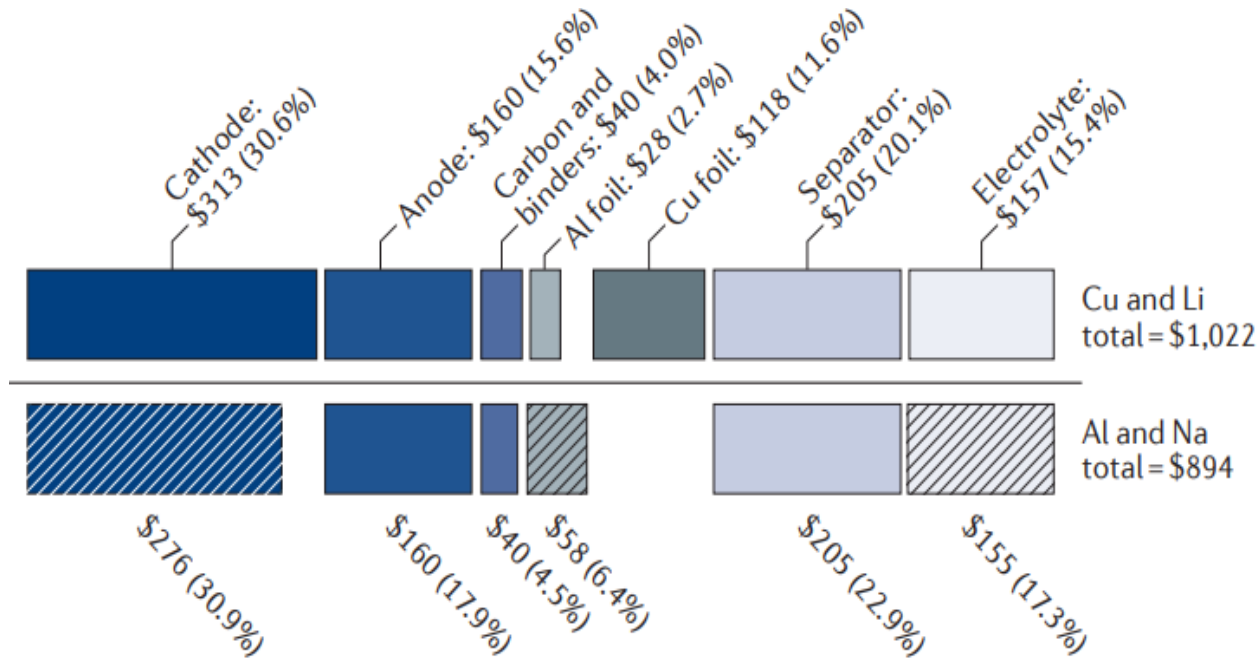
² Mon : Months ; Sec : seconds ; Min : Minutes

Type	Description
Distributed (DS)	Non-aggregated Behind the meter battery installations
Coordinated (CS)	Coordinated via VPP arrangements behind-the-meter battery installations
Shallow (SS)	Grid-connected energy storage (< 4 hr storage capacity)
Medium (MS)	Grid-connected (4-12 hours storage) Valued for energy value with intra-day energy shifting capabilities
Long Deep (LDS)	Grid-connected (>12 hours storage) for valued for long-period storage

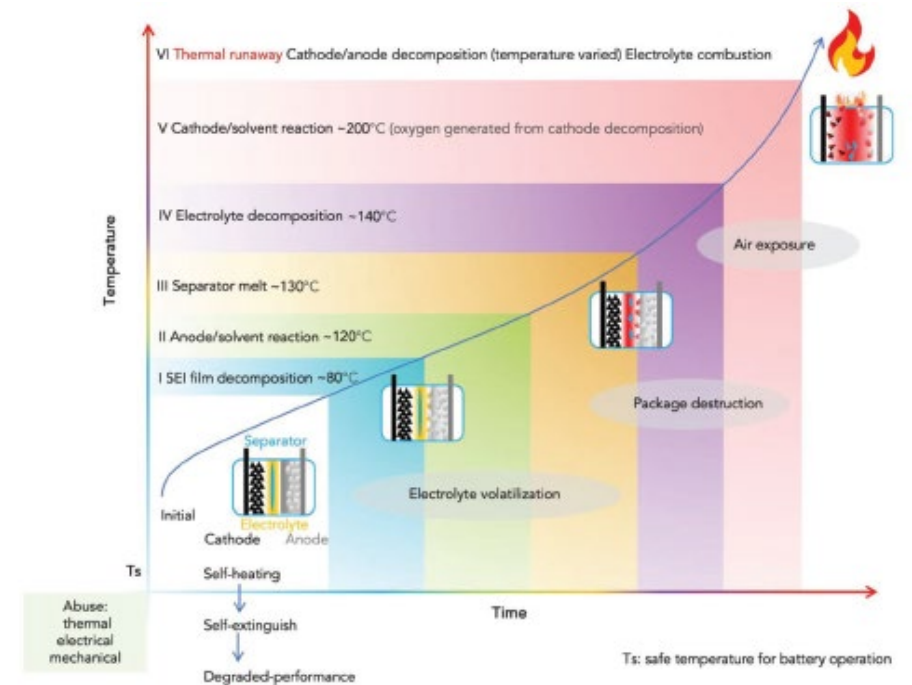
Centre for Future Materials

Why sodium ion?

Cost – not just Li vs Na



Safety



Working with a Zero Emissions Development on SIB – aims are threefold:

1. Eliminate the electrolyte (15% cost)
2. Use Novel HPA separator/electrolyte
3. Waste material source for C

Questions



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[unisq.edu.au](https://www.unisq.edu.au)

<https://www.unisq.edu.au/research>

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