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

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

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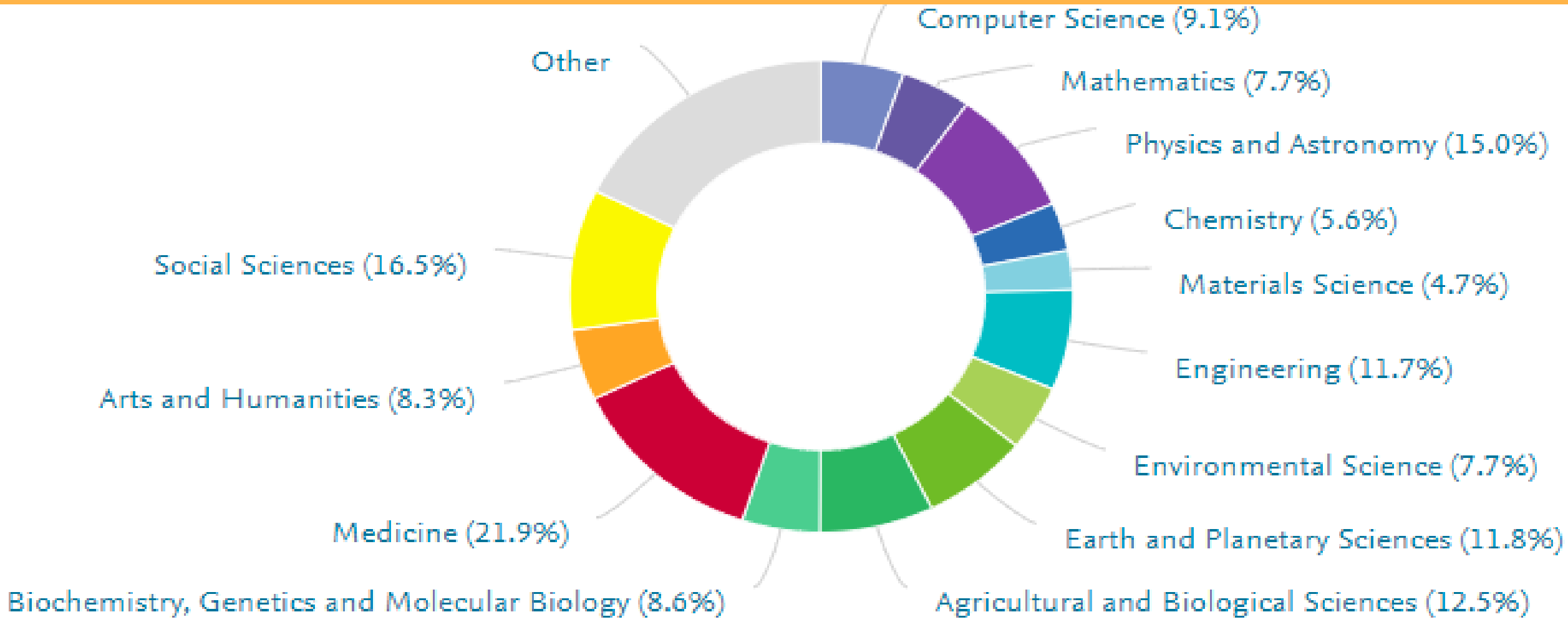
UniSQ Collaboration with Chile

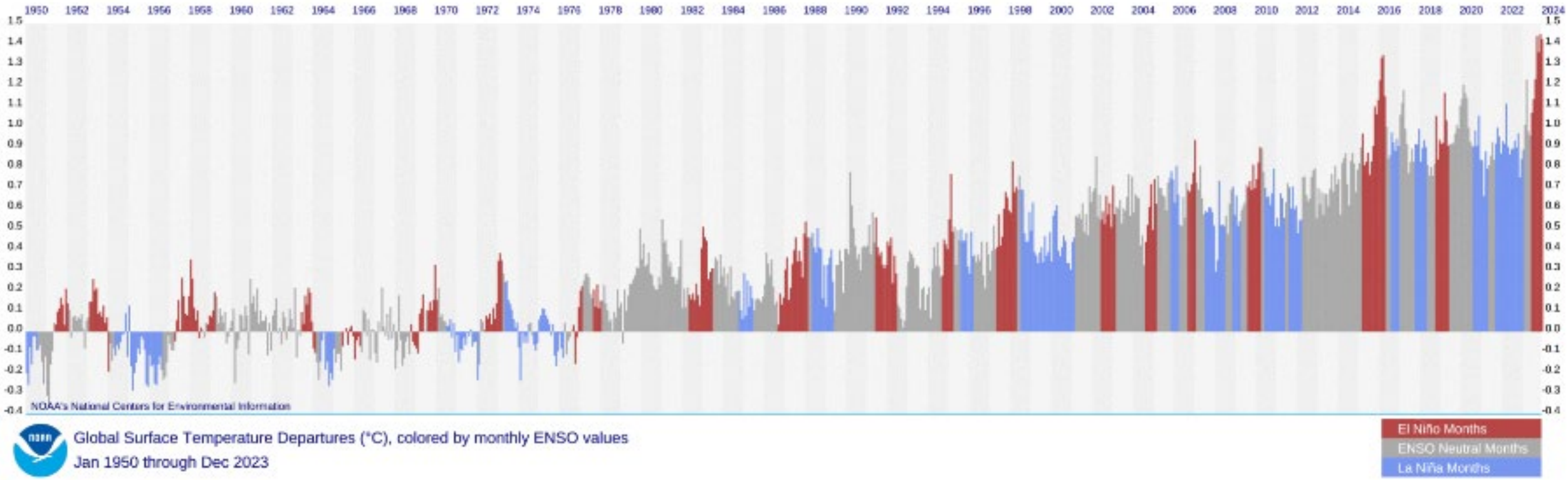
Institution	Co-authors publ…	Co-authors at the University of Southern Queensland	Field-Weighted Citation Impact
Pontificia Universidad Católica de Chile		23	1.63
Universidad de Chile		26	2.94
Universidad Adolfo Ibáñez		20	1.65
Instituto Milenio de Astrofísica	14	18	2.19
Universidad Católica de la Santísima Concepci…	10	12	1.37
Universidad Católica del Norte	10	13	1.3
Universidad Andrés Bello	8	6	1.81
Universidad Diego Port…	8	11	2.81
Universidad May…	7	7	18.34
Universidad de At…	7	14	2.68
Universidad Técnic… …María	5	4	1.73
Universidad de Con…	5	4	1.67
Universidad Austral d… Chile	4	3	8.88
Universidad de Antofagasta	4	7	8.62
Atacama Large Millimeter/submillimeter Array	3	2	1.91
Universidad Autónoma de Chile	3	2	22.64
Universidad de Santiago de Chile	3	5	11.23
Universidad Santo Tomás, Santiago	2	4	2.11

30 collaborating Institutions 101 co-authored publications

Average Field-Weighted Citation Impact 3.93



Climate Change/Global Warming March 21 2024, NOAA Report



Clean Energy in Australia

2021 ACOLA Report

- Goal is net zero by 2050

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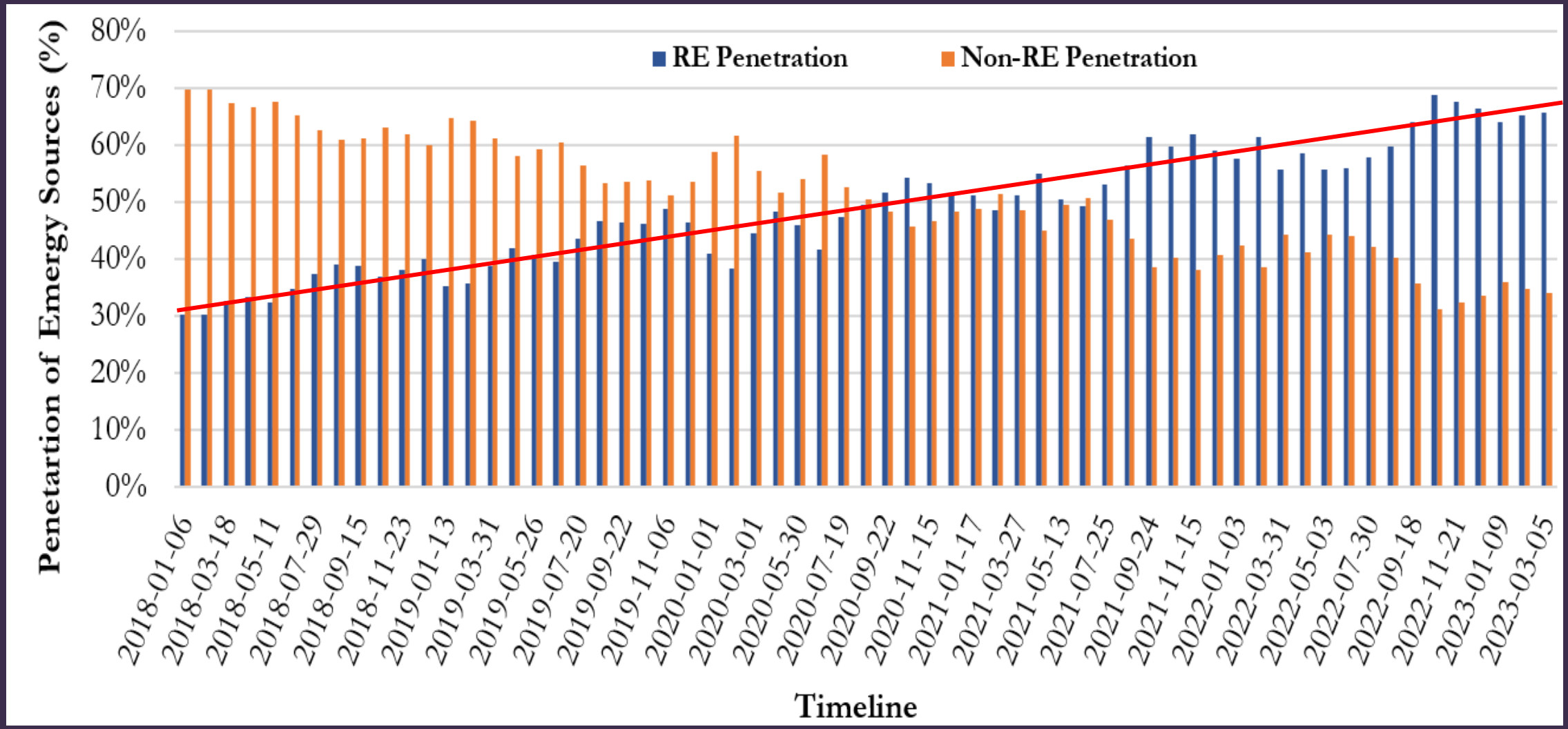
… and the renewable transition is happening at scale

National Energy Market Data



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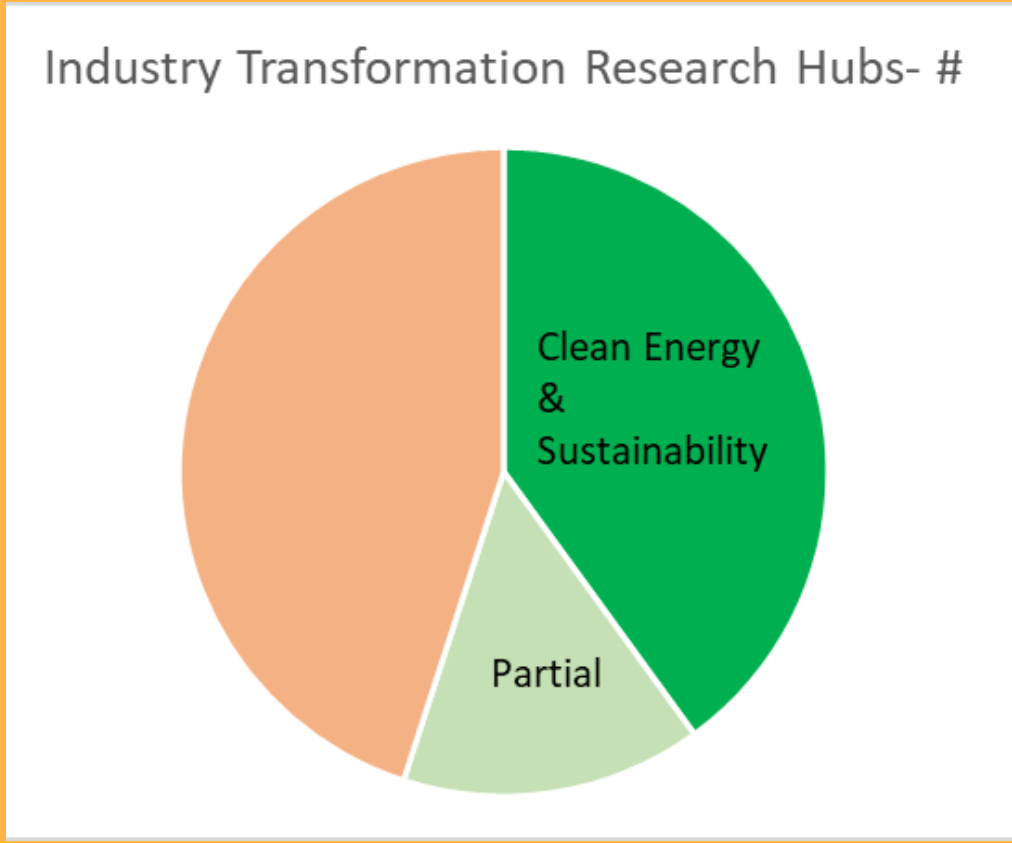
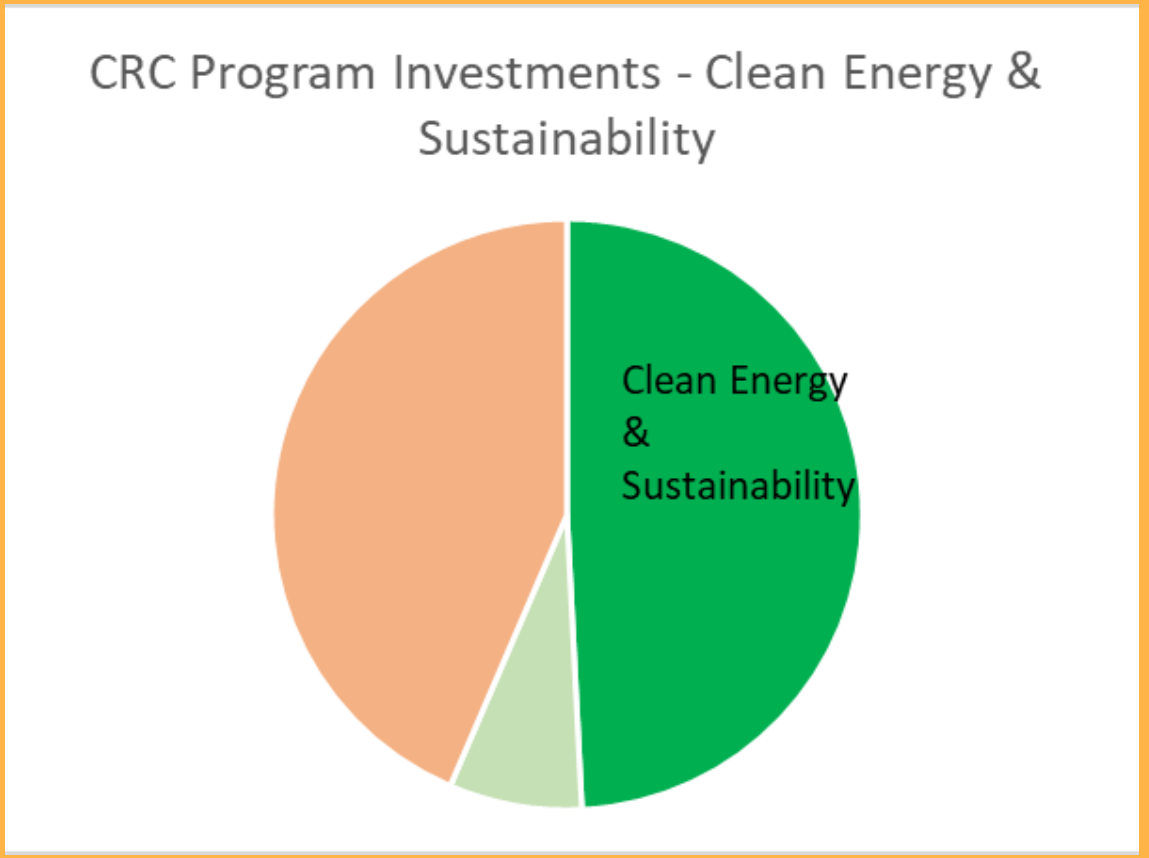
Research Funding in Australia

a snapshot in Clean Energy and Sustainability



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



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

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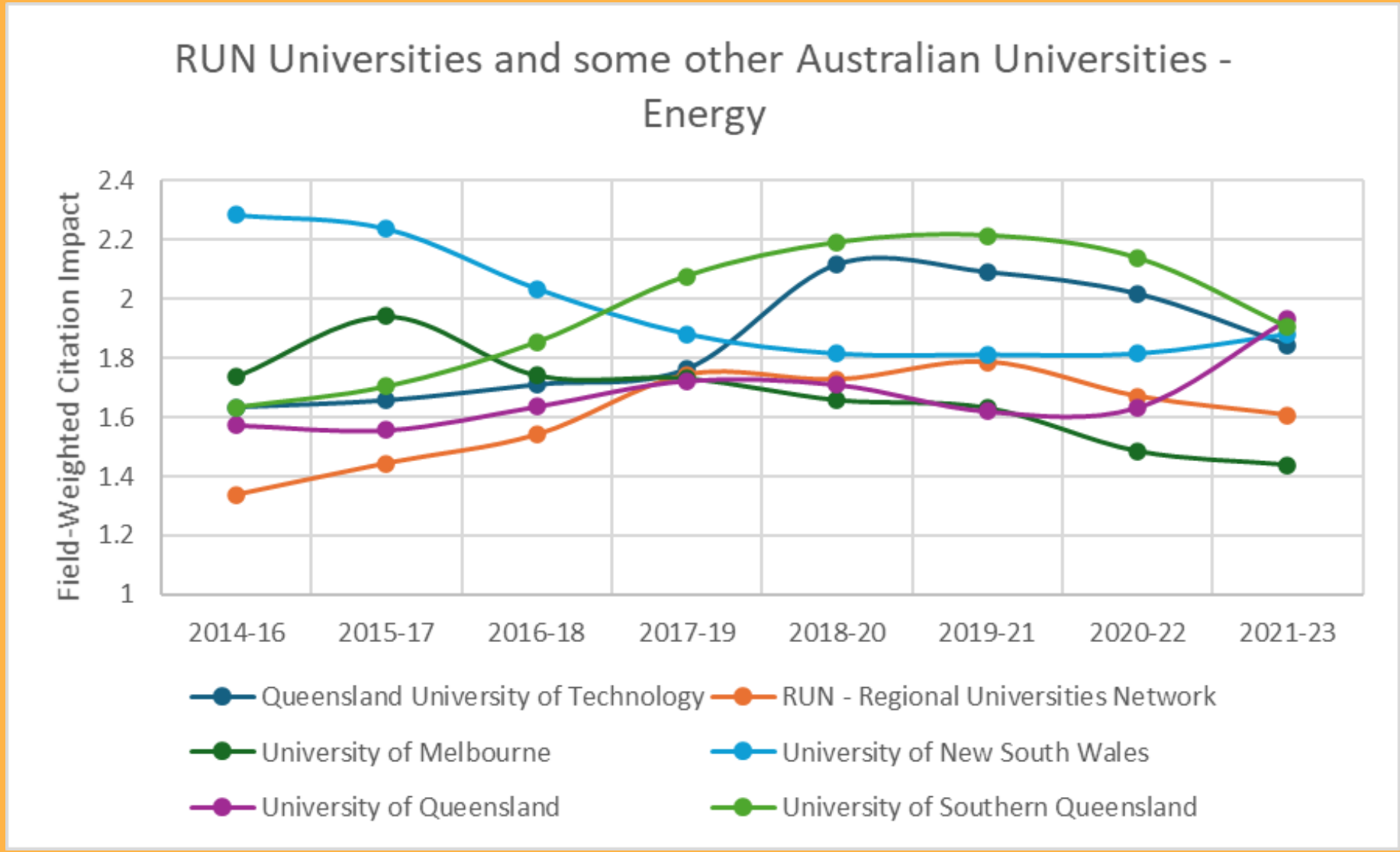
RUN Universities and Clean Energy

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

Real Research Strength

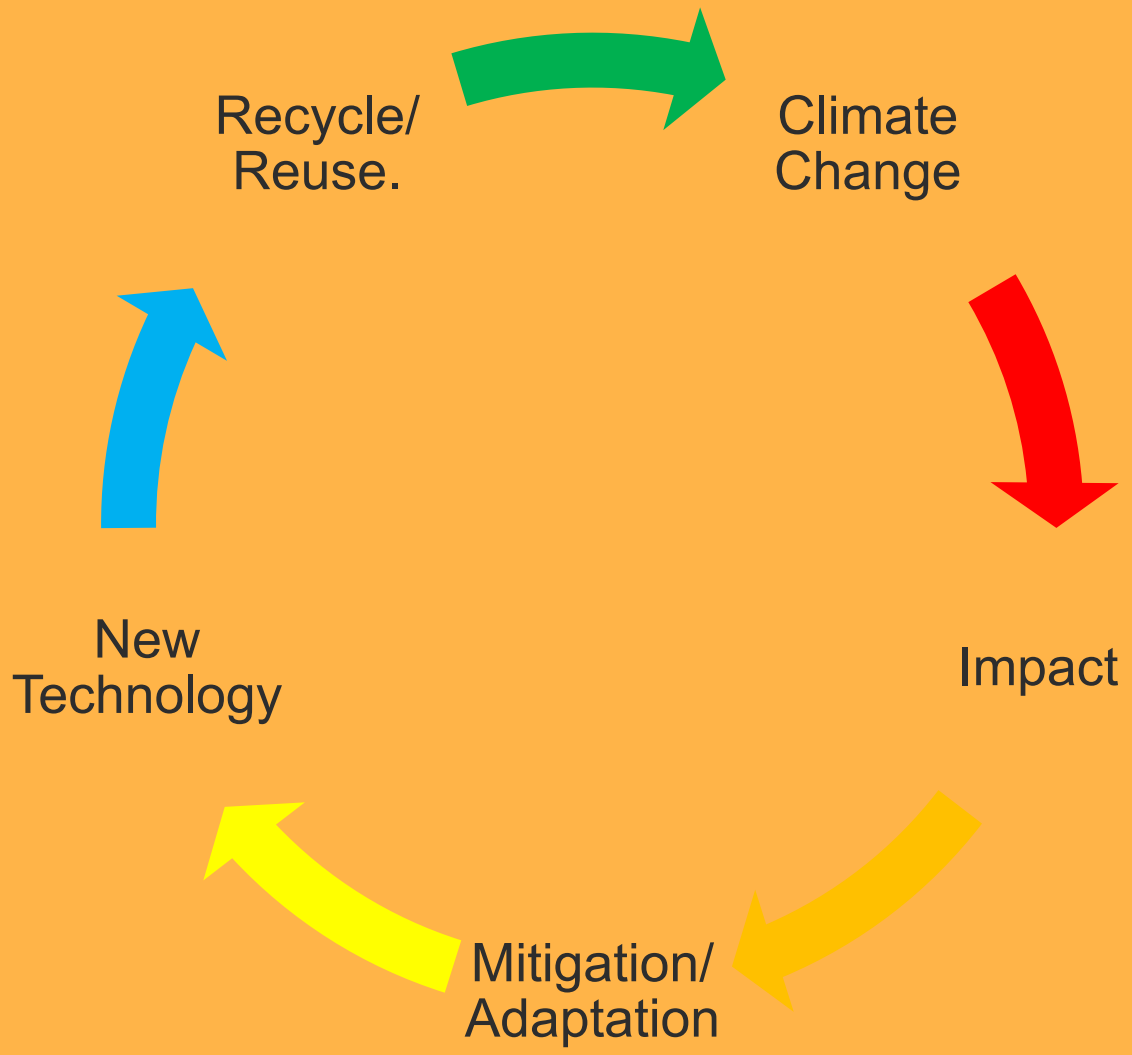
184 papers/yr

UNSW: 331
UQ: 235
Sydney: 162



Sustainability is more than clean energy

- Climate change has impacts on almost every human activity
- UniSQ focusses on understanding climate change, assessing imacts, 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: Advanc
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*"

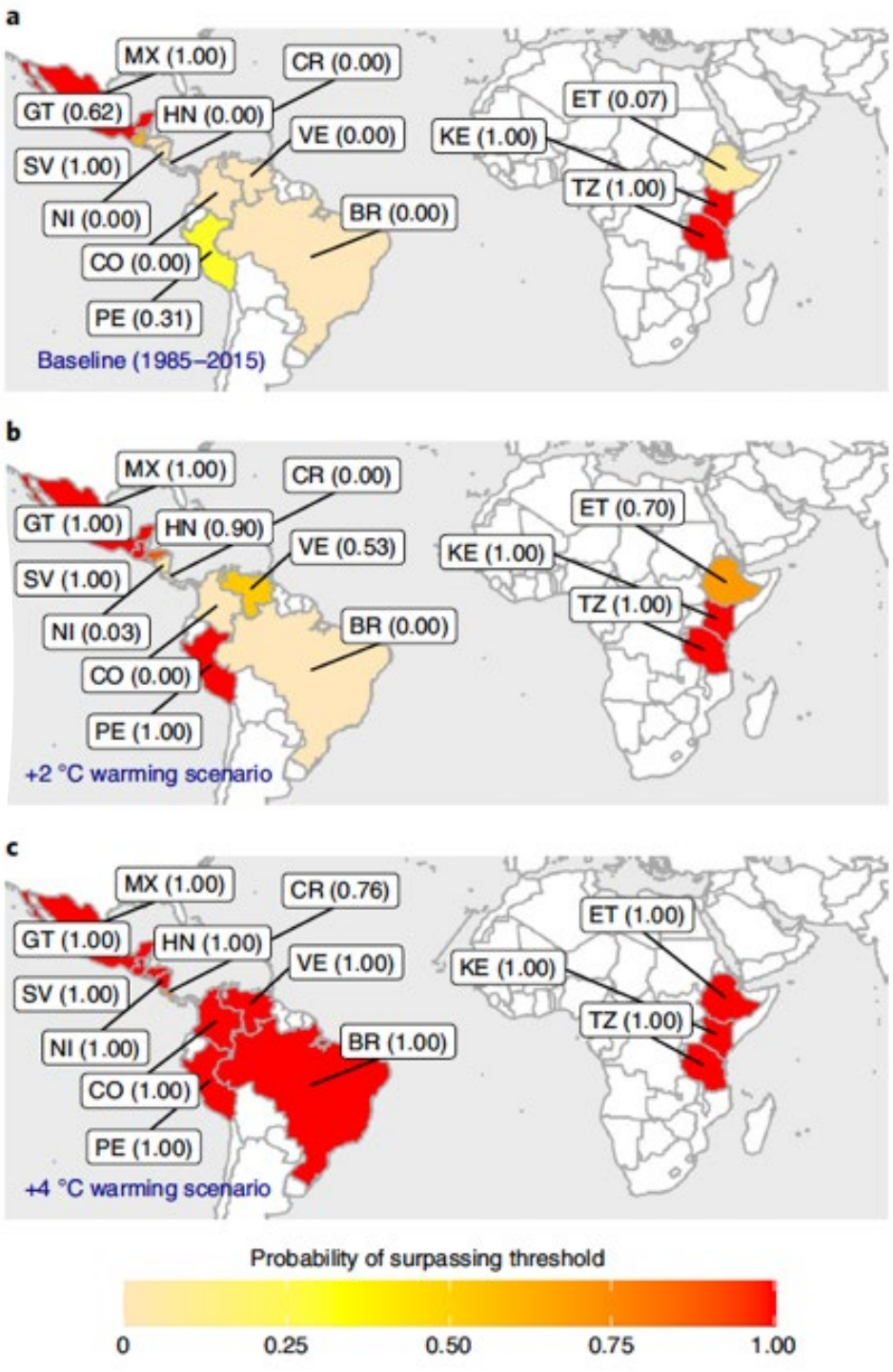
Hosting and co-supervising Universidade Vila Velha (Brazil) students undertaking research on environmental sustainability in coffee landscapes

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?



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Energy and Bioresource Recycling

Centre for Agricultural Engineering





EXTRACTION → FOOD PRODUCTION → CONSUMPTION → WASTE/WASTEWATER TREATMENT

Treatment systems, focussed on nutrients, carbon and water cycling as valued inputs/products

Sinks for losses are the receiving environment, landfill and the atmosphere

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Google images various

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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

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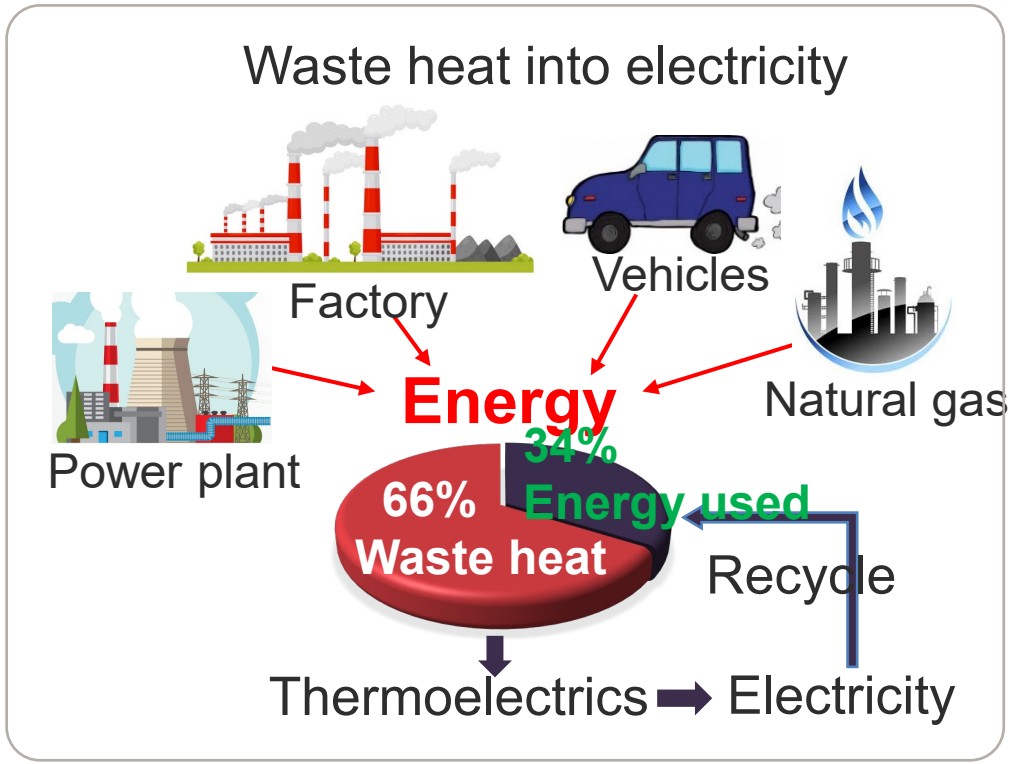
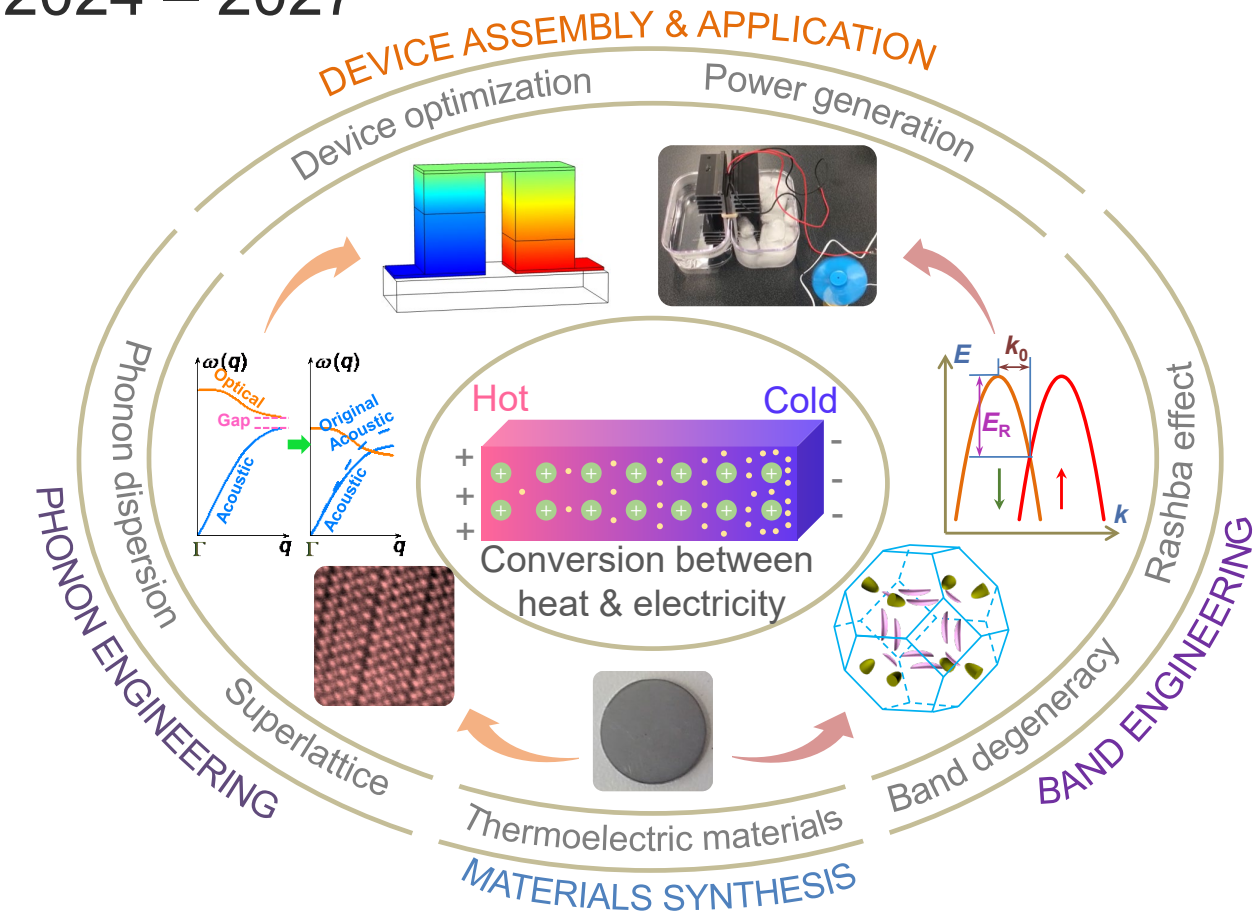
Thermoelectrics: waste heat into electricity

/Prof Min Hong - ARC FT230100316, 2024 – 2027

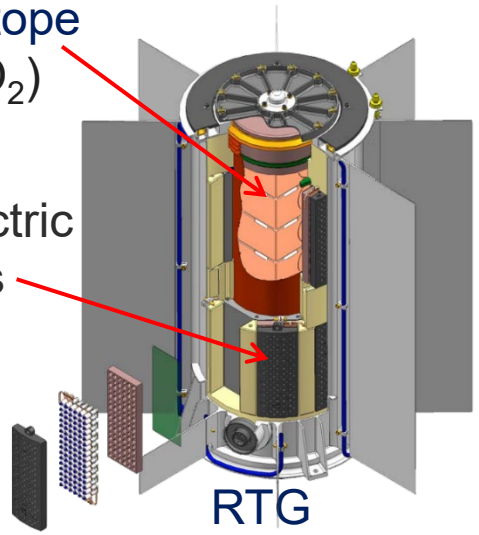


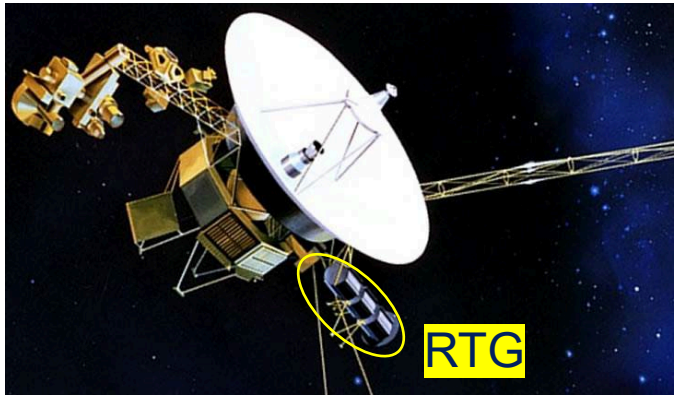


Centre for Future Materials

UniSQ

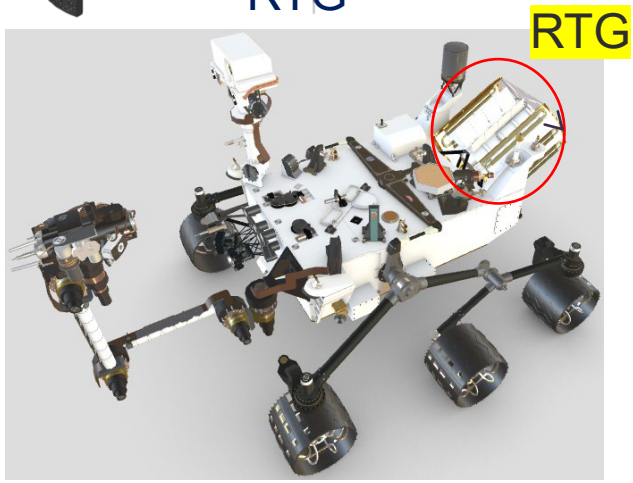
Radioisotope thermoelectric generator (RTG)





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.

www.nasa.gov; *Nature Materials* 2021, 21, 503–513; *Science* 2019, 365, 495-498.

Battery Technology – system integration

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

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SafeREnergy
ARC RESEARCH HUB FOR SAFE AND RELIABLE ENERGY

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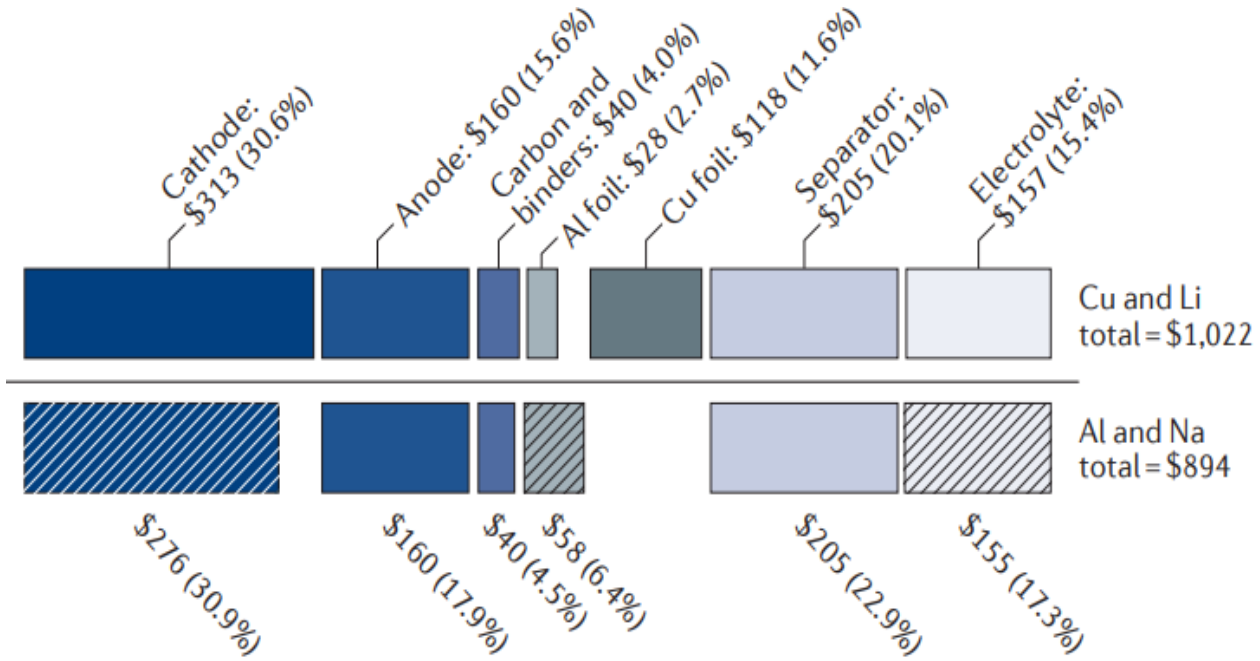
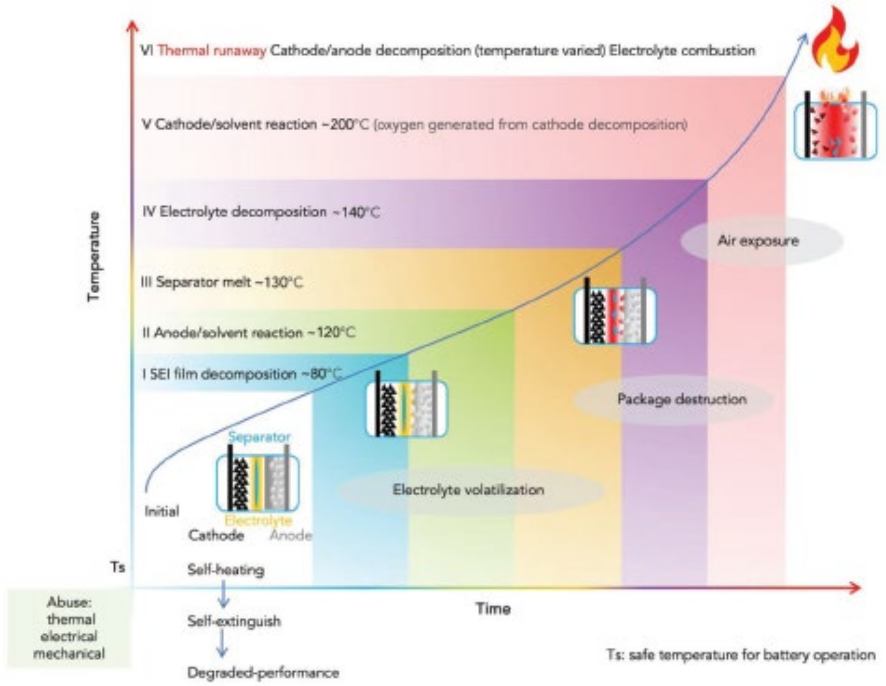
Battery technology – sodium ion batteries

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

CRICOS: QLD 00244B, NSW 02225M TEQSA: PRV12081