International conference on

Circular Economy for Climate and Environment
CECE 2025

Abstract Booklet

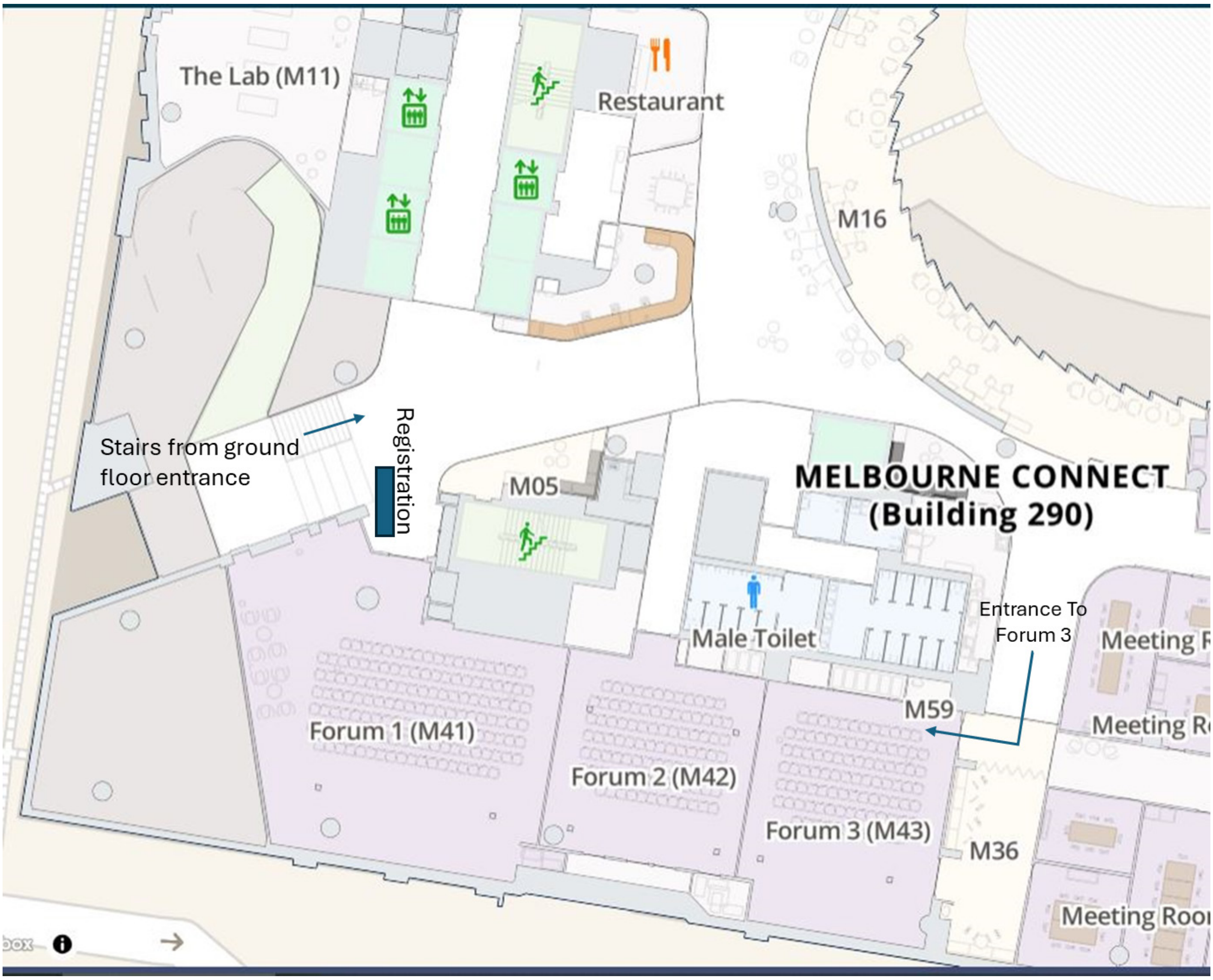
22 – 24 Sep 2025

Melbourne Connect
The University of Melbourne

Victoria, Australia

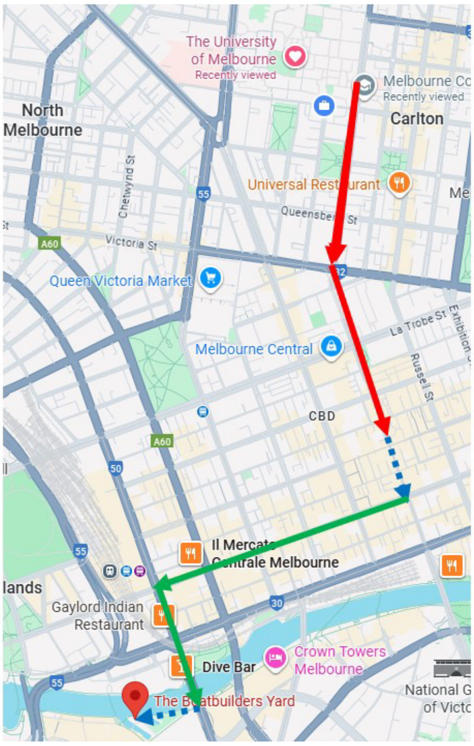
Contents

Venue Map (Mezzanine Floor of Melbourne Connect)



Directions to Welcome Drinks:

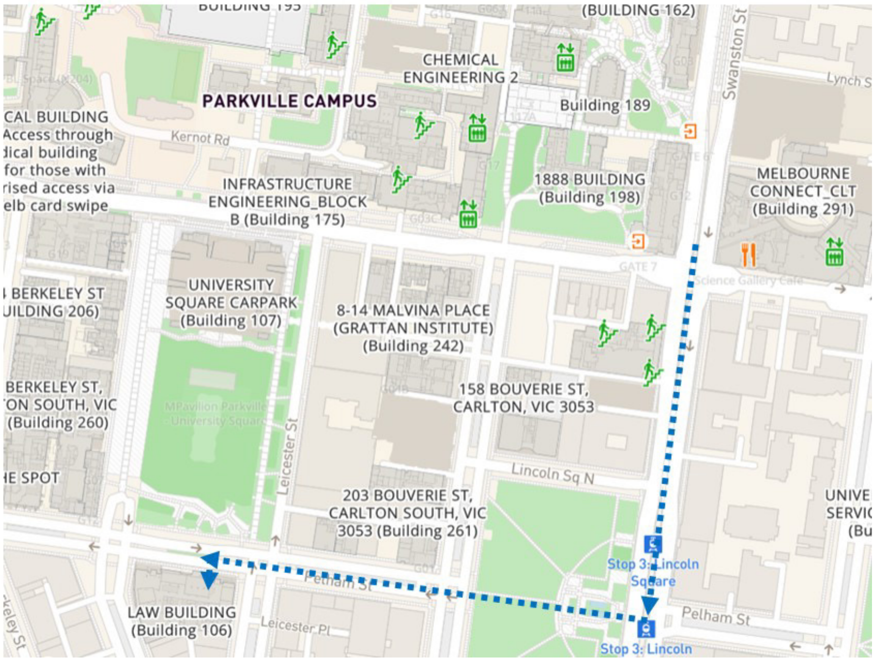
1. Catch any tram down Swanston St to the Bourke Road stop (the Collins Street stop is currently closed due to trainworks)
2. Walk about 100 m to Collins Street
3. Catch a No. 12 or 109 tram down Collins Street. These trams turn down Spencer Street.
4. Get off at Stop # 124A Casino/MCEC/Clarendon St
5. Walk along the river, about 300 m



Directions to the Gala Dinner (University House, Woodward Centre)

Directions to Gala Dinner (University House, Woodward Centre):

1. Walk down Swanston St (about 250 m)
2. Walk through the park and continue down Pelham St (about 250m).
3. Enter the Law Building and take the lift to Level 10



Welcome note from the conference chairs

Dear CECE2025 delegates,

We warmly welcome you to the third International Conference on Circular Economy for Climate and Environment Conference (CECE 2025), hosted at the University of Melbourne.

Building upon the success of CECE 2024, this year's event offers a unique platform for interdisciplinary discourse on circular economy applications across various sectors.

CECE 2025, a joint initiative of the University of Melbourne and the ARC Research Hub for Nutrients in a Circular Economy, brings together thought leaders from academia, industry, government, and NGOs. Our conference aims to foster collaboration, knowledge sharing, and innovation in the field of circular economy and climate.

We have curated a diverse program featuring plenary sessions, keynotes, panel discussions, workshops, oral presentations, poster sessions, a gala dinner, prestigious CECE awards and technical tours. Renowned experts will share their insights on the latest advancements in circular economy and inspire us towards a more sustainable future.

As you embark on this intellectual journey, we encourage you to actively engage in networking, collaboration, and the exchange of ideas. Together, we can shape a more circular and sustainable world.

We want to acknowledge our Platinum (ARC NiCE Hub), Gold (ARC Research Hub for Smart Fertilisers), Silver (Metallium) and Bronze (Incitec Pivot Fertilisers) sponsors for supporting this event.

We look forward to welcoming you to CECE 2025 and wish you a productive and enriching conference experience.

Thank you.

CECE2024 Chairs

Prof Stefano Freguia
University of Melbourne

Professor Sandra Kentish
University of Melbourne

Our CECE 2025 sponsors

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- A/Prof Stefano Freguia - UoM
- Prof Sandra Kentish - UoM
- Prof Mikel Duke - VU
- A/Prof Sherub Phuntsho - UTS
- Dr Ibrahim El Saliby - ARC NiCE Hub, UTS
- Dr Veera Koskue - UoM
- Dr Helena Wang - UoM
- Dr Franz Wohlgezogen - UoM
- A/Prof Malindu Sandanayake - VU
- A/Prof Ehsan Yaghoubi - VU

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- A/Prof Min Zheng - UNSW
- Prof Qilin Wang - UTS
- Ms Leonie Williams - Melbourne Water
- A/Prof Adrian Oehmen - UQ
- Dr Yanyan Zhao - CSIRO
- A/Prof Jianfeng Mao - UoA
- Dr. Parama Chakraborty Banerjee - Monash Uni
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- A/Prof Pooria Pasbakhsh- UoM

Student volunteers

- Habib Amidu
- Pravin Bolne
- Xichao Zhang
- Yi Zhang
- Xuhui Zhu

Conference full programme

Scan for most updated programme

Day 1: Monday 22 September 2025

17:00	**Registration** Boatbuilders Yard, Southbank
17:00 - 19:00	**Welcome drinks** Boatbuilders Yard, Southbank

Day 2: Tuesday 23 September 2025

8:00	**Registration**	
8:30-9:00	**Opening ceremony**	
9:00-10:00	**Plenary Session 1 (Forum 1-2-3)** Speaker 1: **Sean O'Malley**, Circular Economy Manager, Coles Group, "Circularity in Coles" Speaker 2: **Ian Dagley**, CEO, Solving Plastic Waste CRC, "Industry-driven research collaborations to solve Australia's plastic waste problem" Chair**: Sandra Kentish**, The University of Melbourne	
10:00-10:30	Morning tea break (Forum 1-2)	
	Forum 1-2 – Plastic Recycling	**Forum 3 – Circular Water**
	Chair: **Sandra Kentish** (University of Melbourne)	Chair: **Mikel Duke** (Victoria University)
10:30-10:50	Keynote: **Jeroen Wassenaar** (Cleanaway Waste Management) Developing Circular solutions for rigid and flexible plastic packaging	Keynote: **Jason Cotton** (Intelligent Water Networks) The water sector circular economy imperative
10:50-11:10	Keynote: **Minoo Naebe** (Deakin University) Plastics at the end of life: challenges and opportunities for recycling	Keynote: **Michael Thomas and Kerryn Lester-Smith** (Barwon Water) H_2O 360°: Rethinking water projects
11:10-11.30	Keynotes conversation chaired by **Sandra Kentish**	Keynotes conversation chaired by **Mikel Duke**
11:30-11:45	**Abbas Rezamand**, University of Melbourne Waste tyre permeable kerbs	**Linda Zou, Victoria University** Removal of pharmaceutical compounds by catalytic chitosan nanocomposite membranes from wastewater
11:45-12:00	**Sina Mehdifar**, University of Melbourne PTFE conversion to value-added products using low emission liquid metal systems	**Bhavya Karumanchi,** RMIT Sustainable Sulfate Removal from Wastewater Using Tannin-Iron Functionalized NF-270 Membrane
12:00-12:15	**Yeong Ni Hng**, University of Melbourne Characterisation and Upcycling Strategies for Decommissioned Subsea Flexible Flowline Polymers	**Benjamin Fox/Walter Jehne**, Regenerate Earth The Soil Energy Network: Can Canberra's Underground Sponge Create Cooler Cities?
12:15-12:30	**Rebecca Patrick (presented by Urvi Thanekar)**, University of Melbourne Insights from Sustainable Healthcare Research Priority Setting Workshop: Materials Efficiency and Circularity	**Qiang Fu**, University of Technology Sydney Advanced Interfacial Solar Evaporation for Sustainable Water Production and Mineral Recovery

12:30-12:45	**Ayesha Obaid**, RMIT Machine Learning-Guided Catalyst Discovery with LCA Integration for Hydrogen Production from Plastic Waste: A Sustainable Circular Economy Approach	**Linitho Suu (presenting for Youngkwon Choi)**, University of Technology Sydney Development of resource recovery technology from high-concentration wastewater using F-SMDC with anti-solvent and electro-crystallization
12:45-13:00	**Shima Jafarzadeh**, Deakin University Solving Two Problems, One Solution: Transforming Food Waste into Active Biodegradable Plastics with Carbon Dots	**Marzieh Namdari**, University of British Columbia Process Simulation of Circular Carbon Capture and Conversion
13:00-14:00	Lunch break (Forum 1-2)	
	Forum 1-2 – Circular Construction	**Forum 3 – Nutrient Recycling**
	Chair: **Ehsan Yaghoubi** (Victoria University)	Chair: **Ho Kyong Shon** (University Technology Sydney)
14:00-14:20	Keynote: **Andrew Kiesel** (Tonkin Taylor) Sustainability in pavement design and construction	Keynote: **Roya Khalil** (Incitec Pivot Fertilisers) Advancing Circular Agriculture through Enhanced Efficiency Fertilisers
14:20-14:40	Keynote: **Dan Hill** (University of Melbourne) Australian Reduction Roadmap	Keynote: **Django Secombe** (Sydney Water) Rethinking Nutrient Management in Water Utilities—From Linear Removal to Circular Recovery
14:40-15:00	Keynotes conversation chaired by **Ehsan Yaghoubi** and **Malindu Sandanayake**	Keynote: **Deli Chen** (University of Melbourne)
15:00-15:15	**Yaser Mohammed Rageh Gamil**, Monash University Malaysia Construction Waste generation hotspots detection using image processing assisted by BIM-VR toward greener construction projects	Keynotes conversation chaired by **Ho Kyong Shon**
15:15-15:30	**Angelique Milojevic,** University of Technology Sydney Reimagining Waste: House Deconstruction and Timber Reuse as Part of a Circular Economy Strategy	**Kashif Rasool**, University of Technology Sydney Maximizing Single-Cell Protein Yield from Agricultural Waste: Strain Selection, Pretreatment Optimization, and Scalable Bioreactor Production
15:30-15:45	**Zohreh (Venus)Shakeri**, University of Melbourne Enhancing Mechanical and Environmental Performance of Pervious Concrete Pavements for Sustainable Urban Infrastructure	**Sandra Kentish**, University of Melbourne Achieving circularity in dairy processing
15:45-16:00	**Zahra Kamali**, Victoria University Fire-Resilient Asphalt Pavements Using Recycled Aggregates: A Comparative Study of Fire Performance, Mechanical Properties, and Environmental Impacts	**Weonjung Sohn**, University of Technology Sydney Source-separated urine in pilot-scale membrane bioreactor and production of urine fertiliser: Impact of hydraulic retention time
16:00-16:15	**Foad Ghasemi**, Victoria University	**Serhiy Marchuk**, University of Southern Queensland

	Unveiling Asphalt Surface Temperature Under Climate Extremes: A Comparative Study of Linear and Evolutionary Models	Nitrogen fertilising potential of source-separated human urine
16:15-16:30	**Noushin Islam**, Victoria University Construction and Demolition Waste Management Practices in Australia: A Systematic Literature Review	**Veera Koskue**, University of Melbourne Bioelectroconcentration for nutrient recovery from human urine: Up-scaling from laboratory to pilot scale
16:30-17:00	Afternoon tea break (Forum 1-2)	
17:00-18:00	Sustainability campus tour + NiCE Loo Lab Meet at Melbourne Connect Mezzanine level	
18:30-21:30	Gala Dinner University House, Woodward Centre	

Day 3: Wednesday 24 September 2025

8:30	**Registration**	
9:00-10:00	**Plenary Session 2 (Forum 1-2-3)** Speaker: **Matthew Snell**, Group Manager Circular Economy, South East Water Chair**: Stefano Freguia**, The University of Melbourne	
10:00-10:30	Morning tea break (Forum 1-2)	
	Forum 1-2 – Battery Recycling	**Forum 3 – Supply Chain and Governance**
	Chair: **Helena Wang** (University of Melbourne)	Chair: **Franz Wohlgezogen** (University of Melbourne)
10:30-10:50	Keynote: **Simon Adams** (Metallium) A Scalable Technology for Critical Metal Recovery from Black Mass and E-Waste	Keynote: **George Panas** (University of Melbourne) Overcoming barriers and challenges for a circular economy
10:50-11:10	Keynote: **Aleksandar Nikosolki** (Murdoch University) Evolution and Challenges in Battery Recycling Technology in Australia	Keynote: **Lena Jungbluth** (Monash Behaviour Works) Designing behaviour change interventions for a circular economy
11:10-11:30	Keynote: **Gavin Collis** (CSIRO) LIB recycling in Australia, the Indo-Pacific and the US: Opportunities for a Circular Economy	Keynotes conversation chaired by **Franz Wohlgezogen**
11:30-11:45	Keynotes conversation chaired by **Helena Wang**	**Mayuri Wijayasundara**, Anvarta Unlocking Scope 3 Emissions Reductions through Circular Business Models: A Supply Chain and Governance Perspective
11:45-12:00	**Damien Giurco**, University of Technology Sydney Battery minerals for a circular economy: Australia's role in responsible sourcing	**Amelia Leavesley**, University of Melbourne Circular economy governance in three Australian cities
12:00-12:15	**Jianfeng Mao**, University of Adelaide Selective Extraction of Critical Metal Resources from Spent Li-ion Batteries	**Chanuthi Rajapaksa**, Yokohama City University Rethinking Transparency in Fashion Supply Chains: Between Visibility and justice
13:15-12:30	**Will Ng (presenting for George Franks)**, University of Melbourne	**Paul Solomon VinothKumar**, V3 Eco Solutions

	Recovering graphite and cathode oxides from black mass	Unintended Consequences of Climate Change Mitigation and Adaptation Measures in the Circular Economy Framework
12:30-12:45	**Linda Zou**, Victoria University Recovery of lithium by pseudocapacitive electrodes in capacitive deionization	**Yuqing Lu**, University of Melbourne Surgical device companies' commitments towards net zero
12:45-13:00	**Parama Chakraborty Banerjee**, Monash University Lithium-ion battery recycling-Challenges and opportunities	**Urvi Thanekar**, University of Melbourne Stakeholder Driven Insights to Embed Circularity in Healthcare Procurement
13:00-14:00	Lunch break + **Poster Pitches** chaired by **Li Gao** (South East Water) in Forum 1-2	
	Forum 1-2-3 – Unintended Consequences	
	Chair: **Stefano Freguia** (University of Melbourne)	
14:00-14:20	Keynote: **Minna Saaristo** (Environment Protection Authority Victoria) Emerging contaminants in the environment: Where should research and management efforts be directed for optimal environmental outcomes?	
14:20-14:40	Keynote: **Matthew Askeland** (ADE Consulting Group) Emerging contaminants: unintended versus unforeseen	
14:40-15:00	Keynotes conversation chaired by **Stefano Freguia**	
15:00-15:15	Invited talk: **Prashant Srivastava**, CSIRO A novel method to assess leaching of contaminants of concern from recycled tyre products	
15:15-15:30	**Daiane Scaraboto**, University of Melbourne How Consumer Informal Production Can Support Market-Autonomous Circular Economies	
15:30-15:45	**Saeromi Lee**, Korean Institute of Civil Engineering and Building Technology Monitoring Greenhouse Gases Emissions During the Secondary Composting Process of Food Waste Compost Products	
15:45-16:00	**Forbes McGain**, Western Health Healthcare & the circular economy	
16:00-16:30	Afternoon tea break	
16:30-17:00	Closing Remarks and Awards	

Day 4: Thursday 25 September 2025

Technical tours 8:00 AM – 1:00 PM

Tour 1	Cleanaway site
Tour 2	South East Water site

List of posters

P1	**Meenaakshi Balakrishnan**, V3 Eco Solutions	The Circular Shift - Circular Model To Eliminate Future Emissions And Heal The Past

P2	**Yi Zhang**, University of Melbourne	Nutrient recovery from hydrolysed urine by high-rate electrodialysis: A proof-of-concept study
P3	**Ibrahim El Saliby**, University of Technology Sydney	Anthroponics in a Circular Economy: Effect of urine fertiliser on the flowering and longevity of Gerbera cut-flower plants (*Gerbera jamesonii*)
P4	**Jaishree Yadav**, RMIT	Selective recovery of rare earth elements from NdFeB magnet using a deep eutectic solvent
P5	**Linitho Suu**, Korea Institute of Civil Engineering and Building Technology	Study on an electrocrystallization method for selective recovery of valuable resources from high-concentration wastewater
P6	**Xichao Zhang**, University of Melbourne	Electrocapillary-Driven Metal Separation: A Low-Energy Pathway for Sustainable Alloy Recycling
P7	**Haiwei Zhou**, University of Melbourne	Environmental Effectiveness of Circular Economy Strategies for Lithium-ion Batteries
P8	**Joowan Lim**, Korea Institute of Civil Engineering and Building Technology	Development of Bipolar Membrane Electrodialysis for Selective Recovery of Valuable Resources from Brine and Wastewater

Plenary Session 1:

Plenary session Chair: **Sandra Kentish, University of Melbourne**

Circularity in Coles

Sean O'Malley

Circular Economy Manager, Coles Group

sean.o'malley@coles.com.au

Brief bio of plenary speaker

Dr Sean O'Malley is a behavioural ecologist by training but has spent most of his early working life as a research and development manager in a range of fast-moving consumer goods companies in local and international roles. Following these roles Sean joined Planet Ark working across many areas of sustainability including waste, packaging, forestry, carbon and the Circular Economy with a focus on its measurement. Achievements whilst at Planet Ark include the creation of the Australasian Recycling Label (ARL), working on a critical paper on PFAS presence in packaging and participating in the creation of a range of certification standards.

After a short period of consulting and working in the plant-based protein industry Sean joined Coles in 2023 as the Circular Economy Manager within the group sustainability team. The role encompasses a range of activities linked to the Circular Economy and Product Stewardship including working on food waste, in store used battery collection, the various container deposit schemes and working to resolve the challenge of soft plastic collection and recycling. Sean is a graduate of the CIRCO Circular Economy training programme.

Abstract

Coles operates across all states but is not just supermarkets. Operations also include Liquorland, online sales, distribution centres, home delivery and manufacturing. There is a high degree of complexity and many potential areas for circular thinking, this is complicated by the fact that what we sell is largely consumed. Sustainability in Coles is focussed across three pillars of nature, climate and the circular economy but also has to ensure what we sell is ethically and sustainably sourced. Activities are focussed through a core group sustainability team, but expertise and project activities are spread across the diverse range of business units.

The presentation will discuss a range of circular economy activities many of which are customer focussed elements of Coles' operations and linked to how we can assist with resolving challenges in recycling. Much of what we do requires not only Coles to facilitate an activity but also often requires regulatory changes and the interaction of actors across the value chain. In this presentation I will focus on the importance of relationships and collaboration and often that it requires many organisations to establish systems that work. Examples will be included across the topics of food waste, packaging strategy and soft plastics, batteries and container deposits schemes. Circularity works well with a regulatory push but succeeds when collaboration between actors can deliver value.

Industry-driven research collaborations to solve Australia's plastic waste problem

Ian Dagley

CEO, Solving Plastic Waste Co-operative Research Centre

ian.dagley@solvingplasticwastecrc.com

Brief bio of plenary speaker

Dr Ian Dagley is the Chief Executive Officer of the recently funded Solving Plastic Waste Cooperative Research Centre (SPW CRC). Prior to this appointment he was Chief of the Science Partnerships and Engagement Division of the Defence Science and Technology Group (DST) and had been the CEO of the CRC for Polymers for 21 years.

Ian has a PhD from the University of Melbourne, an MBA from RMIT, and is a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE).

Abstract

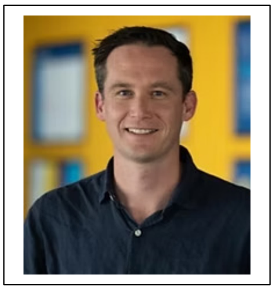
The Solving Plastic Waste Cooperative Research Centre (SPW CRC) was established in July 2024 with a grant of $40 million from the CRC Program over 10 years. Over this period it will expend more that $120 million in cash and in-kind resources on industry-driven collaborative research projects between the research sector and its end-user partners that target major outcomes and impacts.

The Solving Plastic Waste CRC will ensure that focused, industry-driven collaboration between the research sector, governments and the entire plastics value chain is effectively enabled to transform the way plastic products are designed, manufactured, used, recovered, and recycled, and how microplastic soil pollution is remediated. This will be achieved by developing improved product designs, new materials, technologies, and processes, and by exploring new business models and economic systems. It will accelerate Australia's progress towards its targets of eliminating plastic pollution, establishing a circular and climate neutral economy for plastics, and growing a competitive, sustainable advanced manufacturing sector.

This presentation will provide an overview of the planned activities of the SPW CRC including its four research programs on: 1) Materials and designs - to reduce products' environmental impact; 2) Maximising the recovery and value of end-of-life plastics; 3) Implementing a circular economy for plastics in Australia; and 4) Mitigating the risk of microplastics in agricultural soils. It will also cover the SPW CRC's Education and Training Program which will provide scholarship funding support for 40 PhD students providing them with core skills training and industry placement opportunities designed to enhance their careers.

Plenary Session 2:

Plenary session Chair: **Stefano Freguia, University of Melbourne**



Matthew Snell

Group Manager, Circular Economy, South East Water

Matthew.Snell@sew.com.au

Brief bio of plenary speaker

Matt leads South East Water's Circular Economy group, driving the organisation's strategy to create a more sustainable and resilient water future. He is responsible for future-focused planning and delivery of assets across South East Water's Water Recycling Plants, with a clear mandate to embed circular economy principles into infrastructure and operations. His work focuses on reducing carbon emissions, maximising alternative water use, advancing resource recovery, and developing viable long-term solutions that close the loop on waste.

Since joining South East Water in 2017, Matt has held a number of leadership roles. As part of the senior leadership team, he oversees a significant portfolio of treatment and resource recovery projects, accelerating the transition toward net zero emissions while ensuring reliable water services for a growing population in a changing climate.

Before South East Water, Matt worked as an engineer on some of Melbourne's most significant infrastructure projects, including the Regional Rail Link and the $400 million upgrade of the Eastern Treatment Plant. This experience shaped his expertise in delivering large-scale, complex infrastructure with long-term community and environmental benefits.

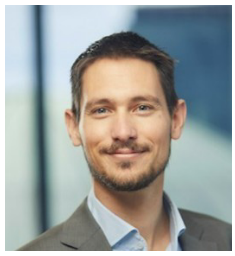
Passionate about the future of the water sector, Matt is committed to mentoring the next generation of engineers and building meaningful career pathways in circular economy and water innovation. He is also a strong advocate for creating safe, diverse and inclusive workplaces where people are supported to thrive and contribute to sustainable outcomes.

Abstract

Panel discussion 1: Plastic Recycling

Moderator: Sandra Kentish, University of Melbourne

Developing circular solutions for rigid and flexible plastic packaging



K1 - Jeroen Wassenaar
Cleanaway Waste Management

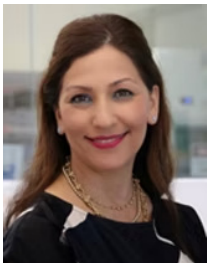
Brief bio of keynote speaker

Jeroen Wassenaar is the Head of Innovation at Cleanaway since January 2024. He is leading Cleanaway's efforts to create circular and low carbon solutions for plastics and other recovered resources.
He has more than 15 years of experience in the petrochemical and plastics industries across Europe and Australia with TotalEnergies and Qenos working in research and development, technical service, marketing, and project management. He holds a PhD in chemistry from the University of Amsterdam and his areas of expertise include catalysis, polymer chemistry, strategic planning, plastics sustainability, and the circular economy.
Jeroen is also the Treasurer and Vice President of the Society of Plastics Engineers: Australia – New Zealand Section and a member of the rigid plastics material stewardship committee at the Australian Packaging Covenant Organisation (APCO).

Abstract

The National Sword policy launched by China in 2018 to no longer accept unsorted plastic waste has become a global catalyst for the development of local plastics circular economies. In response, the Australian government implemented the waste export ban that meant that only single polymer recycled plastic pellets were allowed to be exported without specific licenses or exemptions. This has sparked a wave of investments and resulted in an almost circular self-sufficiency for Australia for several key plastic packaging materials including clear PET and natural HDPE.
Cleanaway's growth in plastics recycling has been closely aligned with the national and global momentum for investment in plastic recycling. Firstly, Cleanaway invested in growing its footprint in material recovery facilities with advanced optical sorting capabilities to produce single polymer plastic bales. Secondly, through a series of joint ventures with the Pact Group, Asahi Beverages, and Coca-Cola Europacific Partners, Cleanaway established three state-of-the-art mechanical recycling facilities to produce food grade rPET and rHDPE as well as non-food grade coloured rHDPE and rPP.
The next frontier in plastics recycling is flexible plastic packaging that has historically been plagued with low recycling rates despite its high efficiency when it comes to material use, barrier properties and packing line speeds. Whilst recent years have seen progress in terms of recycling of clear LDPE business-to-business packaging, circular solutions for post-consumer soft plastic packaging have so far been limited to downcycling into infrastructure applications like fenceposts, bollards or asphalt fillers.
Advanced chemical recycling through pyrolysis and subsequent cracking to produce monomers followed by polymerisation is a pathway that could provide a fully circular solution for polyolefin-based soft plastics. Cleanaway has partnered with Viva Energy in 2024 to commence a pre-feasibility study for an industrial facility that will convert soft plastics into pyrolysis oil. The oil can then be injected into the fluidized catalytic cracker at the Geelong refinery to produce propylene and then polypropylene in the polymerisation reactor on the same site. The project has now entered full feasibility, and the presentation will provide a latest update on this development.
The keynote presentation will provide key insights into Cleanaway's plastics circularity journey, addressing the key challenges and learnings. It will also give an outlook on what the next decade could deliver for plastics recycling in Australia.

Plastics at the End of Life: Challenges and Opportunities for Recycling



K2 - Minoo Nabae
Deakin University

minoo.naebe@deakin.edu.au

Brief bio of keynote speaker

Professor Minoo Naebe is the Deputy Director of the Centre for Sustainable Bioproducts (CSB) at Deakin University and the Founding Group Leader at Carbon Nexus within the Institute for Frontier Materials (IFM). She specializes in polymers and composites, with a strong focus on developing sustainable materials and processes to support transformative applications for a low-carbon economy. Professor Naebe has successfully led numerous collaborative projects with local and international industry partners across the transport, energy, and construction sectors. She is the Program Leader of the recently funded Solving Plastic Waste Cooperative Research Centre (SPW CRC) and her research has resulted in several commercial outcomes, including the establishment of a spin-off company at Deakin ManuFuture. Recognized globally for her contributions, Professor Naebe has been listed among the world's top 2% most-cited scientists in Materials (Stanford Career Rankings) for five consecutive years (2020–2024).

Abstract

Plastics are essential to modern life, yet their end-of-life management poses significant environmental and economic challenges. Globally, millions of tonnes of plastics are produced annually, but only a small fraction is recycled into products of comparable quality. Achieving a closed-loop system is hindered by multiple factors, including material degradation during repeated recycling cycles, limitations of existing recycling technologies, and inefficiencies in collection, sorting, and processing. Many plastics never reach recycling streams or are contaminated, reducing their potential for high-value reuse.

Mixed and contaminated waste streams further complicate recovery. Plastics from consumer, industrial, and packaging applications are often multi-layered, blended, or combined with additives, making separation and quality retention difficult. Consequently, much recovered material is downcycled into lower-value products or discarded entirely, resulting in a substantial loss of material and embodied energy.

This presentation provides an overview of the current state of plastics recycling, with a focus on thermoplastics at the end of their life. It highlights challenges associated with mechanical recycling and the limitations of emerging approaches, and examines technological advances that improve recovery, including enhanced sorting, and process/formulations optimization strategies that preserve polymer quality.

Practical pathways to maximize the value of end-of-life plastics will be discussed, showing how improved recovery and processing can enable recycled polymers to be reintegrated into a wide range of applications. By connecting scientific understanding with industrial practice, the talk illustrates opportunities for higher-quality recycling, more efficient use of polymer resources, and measurable reductions in environmental impact. The discussion emphasizes that advancing a circular plastics economy requires optimizing the entire lifecycle from collection to reuse, transforming plastic waste from an environmental challenge into a valuable resource.

Session 1: Plastics Recycling

Chair: Sandra Kentish

Waste Tyre Permeable Kerbs

O1 - Abbas Rezamand

Abbas Rezamand[1], Christopher Szota[2], Meenakshi Arora[1], Mahdi M. Disfani[1]
1 Department of Infrastructure Engineering, The University of Melbourne
2 School of Agriculture, Food and Ecosystem Sciences, The University of Melbourne

a.rezamand@unimelb.edu.au

Brief bio of speaker

Abbas commenced his Ph.D. in Geotechnical Engineering at the University of Melbourne in 2023, with a focus on waste tyre permeable pavements. His research aims to evaluate the mechanical, hydrological, and environmental performance of permeable pavements using aggregates sourced from recycled end-of-life tyres. He holds a bachelor's degree in Civil Engineering from Amirkabir University of Technology and a master's degree in Geotechnical Engineering from the University of Tehran, Iran. He also has seven years of professional experience as a geotechnical engineer.

Abstract

The growing demand for sustainable and environmentally friendly infrastructure has led to increased interest in reusing waste materials such as end-of-life tyres. Waste tyre permeable pavement, previously developed at the University of Melbourne, is emerging not only as a potential solution for reusing the waste tyres but also as an effective system for mitigating stormwater surges. However, due to challenges such as limited performance under heavy traffic load, its application has so far been restricted to light volume traffic applications. Initial market analysis, assessments and consultations indicate that an innovative waste tyre permeable kerb and channel system can resolve some of the current issues on uptake of waste tyre permeable pavements. However, to achieve this, its behaviour under real field conditions and varied environmental conditions is necessary to be fully understood to assure industry and end-user confidence in this technology. This research aims to evaluate the performance of a permeable kerb and channel system, made of recycled materials, under actual field conditions through constructing a trial and monitoring performance over time. The evaluation includes mechanical, hydrological, and environmental assessments. The trial consists of two sections: one with a waste tyre permeable kerb and channel system (as test section), and the other one with a concrete kerb and channel system (as control section). The waste tyre permeable kerb is made of recycled tyre-derived aggregate (TDA), along with rock-derived aggregates (RDA) and polyurethane (PU) binder. The trial was conducted in the carpark of a railway station in Pakenham, VIC 3810, Australia. The performance of the constructed permeable kerb and channel system was evaluated by conducting a wide range of laboratory tests and several rounds of field measurements. In summary, the results from both laboratory tests and field experiments indicate that the mechanical performance of the waste tyre permeable kerbs is satisfactory from a performance perspective. Additionally, the outcomes of field measurements and observations show that the permeable kerb and channel system can effectively capture rainfall. Initial stormwater quality analyses and microplastics testing also indicate promising results in terms of reducing contaminant levels in stormwater eventually entering receiving waterways. In addition, each meter of waste tyre permeable kerb uses approximately 26.5 kg of recycled tyre-derived aggregates, which is equivalent to about 3 passenger car tyres.

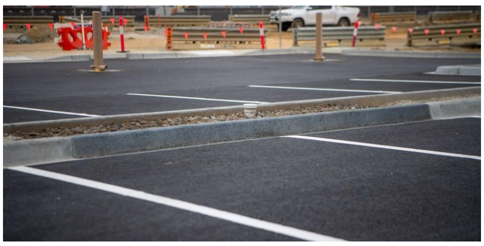


Figure 1. Waste tyre permeable kerb and channel system

PTFE Conversion to Value-Added Products Using Low Emission Liquid Metal Systems

O2 - Sina Mehdifar
University of Melbourne

smehdifar@student.unimelb.edu.au

Brief Bio of Speaker

Sina is a final year Master of Chemical Engineering student at University of Melbourne. This project has been completed as his Research Project, supervised by Dr. Zavabeti (co-author). Sina has been the recipient of the Discipline Award in University of Melbourne Endeavor Exhibition which is awarded to the best project in the Chemical Engineering Discipline. Sina has also demonstrated excellence in various other projects and subjects during his degree. Specifically, his Design Project on Alkaline Water Electrolyser Simulation was awarded the first place in Australia in the Aspen Academic Innovators Challenge. Sina has completed his undergraduate at University of Melbourne where he obtained Bachelor of Science and Diploma in Music.

Abstract

Polytetrafluoroethylene (PTFE) is a widely utilised high-performance fluoropolymer known for its chemical inertness. However, its resistance to degradation, combined with its extensive use, poses significant challenges for recycling and environmental sustainability. Conventional disposal methods for PTFE waste can potentially result in environmental hazards, underscoring the importance of developing innovative PTFE recycling strategies. This project investigates a novel, waste-free, and low-emission approach to recycling PTFE into a value-added product (supercapacitors) by employing a lithium-gallium (LiGa) alloy system. The LiGa alloy offers a safe and on-demand means of utilising lithium metal to efficiently reduce PTFE under mild temperatures and atmospheric pressure in a nitrogen-filled environment. During the reaction, the lithium alloyed in gallium diffuses to the PTFE surface and reduces PTFE.

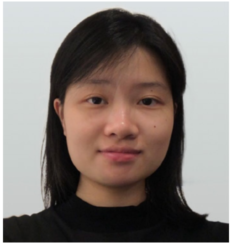
Comprehensive material characterization confirmed that the primary reaction products are amorphous carbon and lithium fluoride. Additionally, it was demonstrated that elevated temperatures enhance the kinetics of the reaction.

The resulting reacted alloy, comprising a gallium core with a surface crust of reaction products, was directly utilised as a binder-free electrode for supercapacitors. Electrochemical tests revealed that the fabricated supercapacitor exhibited a high areal specific capacitance of 240.58 $\mu F/cm^2$ along with excellent cyclic stability.

In this work, we are approaching the problem from a new perspective—not merely recycling plastic within the same cycle, but breaking the vicious cycle altogether by transforming the plastic into entirely different, value-added materials rather than reintroducing it as plastic. Previously, a similar liquid metal approach was also used to convert CO2 to supercapacitors. While many other researchers have converted CO_2 into fuels or transient materials that can ultimately revert back to CO_2 or greenhouse gases, this approach creates useful products that neither reappear in their original form nor re-enter the environmental cycle as greenhouse gases or persistent pollutants.

Overall, our findings demonstrate that LiGa liquid metal enables the effective reduction of PTFE under mild conditions, yielding materials suitable for integration into energy storage devices. This approach contributes meaningfully to the circular economy and advances environmental sustainability.

Characterisation and Upcycling Strategies for Decommissioned Subsea Flexible Flowline Polymers



O3 - Yeong Ni H’ng

Yeong Ni H’ng[1,2], Alex Duan[1], Pooria Pasbakhsh[2], Massoud Sofi[2]
1 School of Chemistry, The University of Melbourne
2 Department of Infrastructure Engineering, Faculty of Engineering and Information Technology, The
University of Melbourne

hngy@student.unimelb.edu.au

Brief bio of speaker

Yeong Ni H’ng obtained her master’s degree in science (chemistry) from The University of Melbourne. She is currently pursuing a PhD focused on upcycling plastic waste from decommissioning subsea flexible flowline into valuable products, as part of a CRC-P project.

Abstract

Subsea flexible flowlines composed of steel, composites and polymers/plastics serve to transport hydrocarbons from offshore wells to the global market. Globally, decommissioning subsea flowlines is happening as offshore oil and gas infrastructure aims to transition toward more sustainable practices. Presently, there are no established recycling/upcycling solutions for materials from decommissioned subsea flexible flowlines, posing a growing environmental threat as potential sources of large-scale plastic waste. To offer a new sustainable pathway for the oil and gas industry by contributing to environmental protection and circular economy goals, this research focuses on a comprehensive characterisation of polymers recovered from decommissioned subsea flowlines, followed by converting the polymers into valuable products (chemical feedstocks and energy fuels) via thermal valorisation technology.

Insights from Sustainable Healthcare Research Priority Setting Workshop: Materials Efficiency and Circularity

O4 - Rebecca Patrick (presented by Urvi Thanekar)

Melbourne School of Population and Global Health, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne.

urvi.thanekar@unimelb.edu.au ; rebecca.patrick@unimelb.edu.au

Brief bio of speaker

Dr Rebecca Patrick is a teaching and research academic who is recognised for her expertise in nature, environment, and health research and scholarship. She leads multi-institution mixed methods research in climate-related mental wellbeing and health co-benefit intervention measurement and evaluation.

Urvi Thanekar is a PhD candidate within the Institute of Health Transformation at Deakin University partnering with Barwon Health focusing on reducing their environmental footprint using systems dynamics and economic analysis. She also works with the Climate Catch Lab at the University of Melbourne on projects that intersect climate change and healthcare systems.

Abstract

Background

Healthcare is responsible for approximately 4–5 % of global greenhouse gas emissions, with more than 60 % originating from Scope 3 sources predominantly the production, transport, use, and disposal of goods and services. Single-use plastic consumables and extensive plastic packaging exacerbate environmental impact while driving up operational costs. Applying circular economy principles—where materials are designed for reuse, refurbishment, and recycling—can both reduce emissions and improve system resilience. In October 2024, the University of Melbourne's Climate CATCH Lab convened a Priority Setting Workshop to co‑design a research and implementation agenda for improving sustainability in healthcare.

Objectives

The workshop pursued three interrelated objectives. First, it aimed to identify and rank research themes that align circular economy principles with healthcare decarbonisation goals. Second, it sought to engage a diverse cohort—including clinicians, procurement specialists, engineers, policy makers, and non-governmental organizations—in co-creating actionable research questions. Third, it intended to develop a systems-based model mapping the barriers, enablers, and leverage points across three thematic domains: Digital Innovation & Data Science; Materials Efficiency & Circularity; and Workforce & Quality Improvement.

Methods

Over a three-hour online session, thirty-five participants were allocated to one of three breakout rooms corresponding to the thematic domains. In the first half of the workshop, each group articulated its domain's primary challenges. In the second phase, participants generated potential opportunities and enabling conditions, highlighted evidence gaps, and drafted priority research questions. A "star" voting exercise then established preliminary rankings. Throughout, real-time collaborative documents captured verbatim insights. These notes underwent thematic analysis and were synthesised into a Causal Loop Diagram, which revealed systemic feedback loops and pinpointed high-leverage intervention points.

Findings:

Materials and Circularity was one of the workshop's focal domains offering the most immediate opportunity for emissions reduction and cost savings. Stakeholders observed that many hospitals lack robust Central Sterile Supply Departments, leading to misconceptions that sterilising reusable items is more polluting than disposables. Procurement contracts typically emphasize upfront cost minimisation, and standardized circularity metrics are notably absent, hindering benchmarking and evidence-based decision-making. To address these barriers, the workshop proposed reframing educational campaigns to promote reuse and waste-as-resource mindsets, forging multidisciplinary collaborations with product designers and engineers to develop reusable consumables, and leveraging procurement policies by embedding circularity criteria and mandatory environmental reporting into contract renewals. Defining and piloting indicators such as reuse rates, resource recovery percentages, and extended product lifespans was identified as a critical research priority to guide procurement scorecards and policy frameworks.

Conclusions

The Priority Setting Workshop yielded a co-designed, systems-oriented research agenda that positions Materials Efficiency & Circularity at the heart of healthcare decarbonisation efforts alongside digital innovation and workforce and quality improvement. The identified materials efficiency and circularity priorities will inform projects and catalyse university wide collaborations, policy action items, and high-impact research toward a resilient, circular healthcare future.

Machine Learning-Guided Catalyst Discovery with LCA Integration for Hydrogen Production from Plastic Waste: A Sustainable Circular Economy Approach

O5 - Ayesha Obaid
RMIT University

S4186545@student.rmit.edu.au

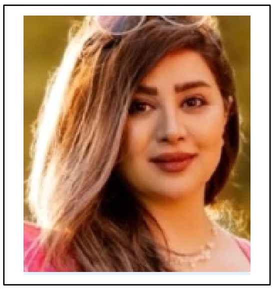
Brief bio of speaker

PhD Researcher at RMIT University working on AI-integrated electrocatalyst optimization for hydrogen production from plastic waste. Research Assistant at UTS with published work on life cycle assessment of hydrogen pathways. Former HSE & Sustainability professional with 5+ years of industry experience in ISO standards, energy audits, and environmental compliance. Passionate about clean energy, sustainability, and bridging research with real-world impact.

Abstract

The twin global crises of plastic waste accumulation and fossil fuel dependency call for innovative, cross-disciplinary solutions. Hydrogen production from plastic waste through catalytic conversion offers a promising avenue to address both, yet the design of efficient catalysts remains a major bottleneck due to the complexity of feedstock and reaction pathways. This study presents a novel framework combining machine learning (ML) and life cycle assessment (LCA) to accelerate catalyst discovery while ensuring environmental sustainability. Using computational descriptors and open-access catalyst datasets, we train predictive ML models such as Random Forests and Support Vector Regression to identify key features governing hydrogen yield and catalyst selectivity. These models streamline the search for high-performance, non-toxic, and cost-effective catalyst systems. Beyond performance optimization, we integrate LCA methodologies to evaluate the environmental impacts of various catalyst pathways throughout their lifecycle from raw material extraction and synthesis to deployment and disposal. Key impact categories include global warming potential, energy consumption, and resource depletion. This dual approach ensures that the ML-recommended catalysts are not only effective but also environmentally responsible. Our findings indicate that integrating LCA into the catalyst design pipeline can guide more sustainable decision-making and reduce the risk of shifting burdens across the value chain. This fusion of AI, green chemistry, and environmental assessment supports the development of closed-loop, circular economy systems, where plastic waste becomes a resource rather than a pollutant. By combining the predictive power of ML with the holistic insights of LCA, this study contributes to the evolution of intelligent, sustainable materials discovery for hydrogen energy and offers a replicable roadmap for environmentally conscious innovation in chemical engineering.

Solving Two Problems, One Solution: Transforming Food Waste into Active Biodegradable Plastics with Carbon Dots



O6 - Shima Jafarzadeh
Shima Jafarzadeh, Colin J. Barrow, Minoo Naebe, Wendy Timms
Centre for Sustainable Bioproducts, Deakin University, Geelong, Victoria 3216, Australia

s.jafarzadeh@deakin.edu.au

Abstract

The world faces two pressing global challenges, plastic pollution and food waste. To address these, this project aims to create a sustainable and cost-effective active bioplastic from food waste that aligns with circular economy principles for food packaging applications. This study employs hydrothermal synthesis to produce carbon quantum dots (CDs) derived from avocado waste, serving as a functional filler for enhancing the properties of food packaging films derived from bread waste. The CDs were blended into the matrix at different concentrations to produce active packaging films using a solution casting method. The impact of CDs on the film's structure, thermal characteristics, optical and physical-chemical attributes was examined. The findings revealed that the uniform distribution of CD nanofillers within the matrix notably improved the film's crystallinity, optical and thermal resilience. Therefore, CD-added films offer substantial potential as a safe, value-added, low-cost, and functional nanofiller for developing packaging materials. By optimizing the blend ratio and production methods, this approach could lead to a viable bioplastic solution that reduces both plastic and food waste, supporting world's sustainability goals and reducing plastic's environmental footprint.

Keywords: *Active packaging, biodegradable plastic, carbon dots, food waste, Plastic pollution*

Panel discussion 2: Circular Water

Moderator: Mikel Duke, Victoria University

The water sector circular economy imperative

K3 - Jason Cotton
Program Director, Intelligent Water Networks

jason.cotton@iwn.org.au

Brief bio of keynote speaker

Jason Cotton is a seasoned innovation professional with over two decades of global experience in fostering innovative practices across the utility, small and medium enterprise, and education sectors. He holds a Bachelor of Science (Honours) from Flinders University, a Certificate of Management from Mt Eliza Business School, and has studied under renowned business strategist Gary Hamel at the Innovation Academy in the United States Jason joined Intelligent Water Networks (IWN) as Program Director in 2023 where he has been instrumental in leading projects that leverage real-time data and advanced technologies to enhance water management practices. Jason's work at IWN reflects his deep-seated belief in the power of innovation to transform essential services, ensuring they meet contemporary challenges and serve communities effectively.

Prior to joining IWN, Jason was Manager of Innovation and Continuous Improvement at Greater Western Water (GWW) where he also played a key role in the formation of GWW by leading the Operations Stream Integration.

Abstract

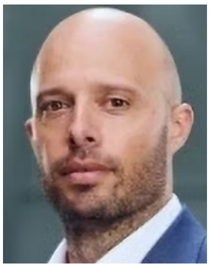
As climate pressures intensify, urban populations grow, resources become increasingly scarce and environmental systems become more stressed, the water sector faces an urgent challenge—and opportunity—to embrace the principles of a circular economy. This presentation will explore the critical role the water industry must play in shifting from a linear "take-make-use-dispose" model to a circular approach that regenerates resources, reduces waste, and maximizes value across the entire water cycle.

The presentation will consider the required shifts and the systems-level thinking to realise the immediate and future circular economy opportunity and the impact of doing so at a planetary level. The presentation will conclude that embedding circular economy principles is not just environmentally responsible—it is economically prudent, builds operational resilience and contributes to the water sector's long-term sustainability.

H2O 360°: Rethinking water projects

K4 - Michael Thomas and Kerryn Lester-Smith
Barwon Water, Program Manager and Deputy Program Manager of Intelligent Water Network's (IWN) Circular Economy Program

Michael.thomas@barwonwater.vic.gov.au
Kerryn.lester-smith@barwonwater.vic.gov.au



Brief bio of keynote speakers

Michael Thomas is the R&D Lead at Barwon Water. In this capacity he collaborates with research institutions and industry partners to advance projects that align with Barwon Water's Strategy 2030, focusing on areas such as the circular economy, emerging contaminants, smart networks, and climate change. Michael is also the Program Lead for the Intelligent Water Network's (IWN) Circular Economy initiative and co-chairs the Water Services Association of Australia's (WSAA) Research and Development Network. Prior to joining the water sector Michael spent 20 years as an officer in the Australian Defence Force, and was a climate change adviser to the Department of Defence. Michael has completed two Masters degrees and a Ph.D. in Political Science from UNSW.

Kerryn Lester-Smith is the Research and Development Specialist at Barwon Water. In this capacity, she has supported innovative projects aimed at enhancing water management practices and circular economy initiatives. She focusses on advancing research translation and fostering strategic collaborations that address critical water-related challenges. She is also the Deputy Program Manager for the Circular Economy Program at Intelligent Water Networks (IWN), where she is co-hosting "The Ripple Effect," a podcast series exploring sustainable practices and innovations in water management. She has a Masters in Health and Human Services Management and has also held senior roles in the social insurance sector across public sector agencies with experience in managing complex and evolving projects in fast paced environments.

Abstract

IWN is a catalyst for the transformation of the Victorian water industry, delivering operationally ready innovative solutions to water sector challenges by bridging the gap between research outcomes and industry application. This presentation will explore IWN's Circular Economy program, highlighting key trials across the sector's resource streams of biosolids, biogas, and recycled water. Biosolids are a product leftover from wastewater treatment. IWN are leading a number of innovative projects exploring novel pyrolysis technologies with RMIT and Earth Systems, its application as a soil enhancer for farmers, and high-value cutting-edge uses in energy storage with Deakin's Battery Research and Innovation Hub. In the area of biogas, IWN are investigating how Victorian water authorities can integrate gas produced from wastewater treatment plants and digestion processes into the grid to displace the use of natural gas—a cleaner energy source. Another project ("GreenO2") involves capturing 'waste' oxygen from hydrogen fuel production involving electrolysis; exploring the beneficial use of the oxygen to reduce emissions and improve wastewater treatment processes. Recycled water projects will also be highlighted, including testing ways to tap latent energy in sewer networks—heating municipal swimming pools and reducing greenhouse gas emissions. An innovative advanced grey-water recycling trial will also be showcased, demonstrating a novel European technology that can help save water via a decentralised water treatment setup.

Session 2: Circular Water

Chair: Mikel Duke, Victoria University

Removal of pharmaceutical compounds by catalytic chitosan nanocomposite membranes from wastewater

O7 - Linda Zou
Institute for Sustainable Industries & Liveable Cities, Victoria University

Linda.Zou1@vu.edu.au

Brief bio of speaker

Professor Linda Zou has worked at Khalifa University during 2014-2024. Before that, she was a Research Professor at University of South Australia since 2010. Her research interests include developing more efficient novel water purification and desalination technologies, such as nanocomposite membranes, capacitive deionization electrodes, and membrane fouling minimization, where nanostructured materials are incorporated, the technology can be used to remove micropollutants such as pharmaceutical compounds, forever chemicals, heavy metals and fine oil droplets from wastewater to safeguard public health and recover the valuable resources and to support today's circular economy. Dr. Zou led the invention of novel cloud seeding materials during the awarded research project by the 1st Cycle UAE Research Program on Rain Enhancement Science. This research direction aligns with mitigation of climate change. Dr. Zou has published numerous journal articles as senior author (Google Scholar h-index 59, total citations 15000+). She is in the 2020-2023 Stanford University's List of World's Top 2% of Scientists in single year ranking, as well of Career-long Scientists with the greatest citation impact in the environmental engineering and desalination field.

Abstract

Pharmaceutical contaminants, such as paracetamol (PC) and ibuprofen (IB), are among the most persistent pollutants in wastewater, raising significant environmental and health concerns due to their resistance to conventional treatment methods. This study introduces four novel chitosan-based nanocomposite membranes: neat chitosan (CH), MXene/chitosan (TC), laccase-coated MXene/chitosan (LTC), and MnO_2/MXene/chitosan (MTC), developed for effective pharmaceutical contaminant removal. These membranes were thoroughly characterized using SEM to examine surface morphology, EDX for elemental composition, FTIR for chemical bonding analysis, and XRD for crystallographic structure determination. Among the membranes, LTC achieved the highest removal efficiencies, eliminating up to 99% of IB and 93% of PC, facilitated by the combined enzymatic degradation by laccase and catalytic properties of MXene. MTC followed closely with removal efficiencies of 98.5% for IB and 91% for PC, driven by a synergistic mechanism of MnO_2 and MXene, generating reactive oxygen species (ROS) to oxidize contaminants. The TC membrane exhibited moderate removal capabilities, while CH showed limited removal of less than 32%. Antifouling performance was also evaluated under accelerated fouling conditions, where LTC and MTC demonstrated superior antifouling behavior with minimal flux decline and high flux recovery rates of 93% and 95%, respectively. These results highlight the membranes' ability to combine separation, catalytic degradation, and fouling resistance. The findings provide a sustainable, robust, and efficient solution for addressing real-world wastewater treatment challenges, particularly the removal of pharmaceutical contaminants, advancing the field of nanocomposite membrane technology [1].

1. P Mahato, F Arshad, M Shiraz Ali, C S Perera, L Zou*, Removal of pharmaceutical compounds by chitosan nanocomposite membranes with catalytic additives from wastewater, Desalination, Volume 602, 2025, 118635.

Sustainable Sulfate Removal from Wastewater Using Tannin-Iron Functionalized NF-270 Membrane

O8- Bhavya Karumanchi

*Bhavya Karumanchi [a,b], Shuronjit Kumar Sarker [a], Gangagni Rao Anupoju[a,b], Biplob Kumar Pramanik [a]**

[a]School of Engineering, RMIT University
[b]Bioengineering and Environmental Sciences (BEES) Group, Department of Energy & Environmental Engineering, CSIR-Indian Institute of Chemical Technology, Hyderabad, India
Corresponding author*

*Speaker's email s4077407@student.rmit.edu.au

Brief bio of speaker

Bhavya Karumanchi is a cotutelle Ph.D. candidate at Royal Melbourne Institute of Technology (RMIT) and CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad, India. Her research focuses on biological and membrane-based sulfur removal from gaseous and liquid wastes. She is working on the isolation of sulfur-oxidizing bacteria (SOB) for H_2S removal from biogas and sulfate reduction from wastewater. Her current work involves the use of NF-270 nanofiltration membranes functionalized with tannic acid and ferric chloride to enhance sulfate rejection and promote circular water treatment. She is also studying high-solids anaerobic digestion for improved biogas production and sulfur mitigation. With a background in Environmental Science and Biotechnology, Bhavya integrates microbial processes with environmental engineering to develop sustainable, resource-recovery-based treatment systems. She has actively participated in academic workshops and conferences and is passionate about advancing eco-friendly technologies for water reuse and clean energy.

Abstract

Sulfate pollution in industrial wastewater is a growing concern, contributing to aquatic toxicity, infrastructure corrosion, and microbial imbalance. In this study, we developed an eco-friendly nanofiltration approach using a **tannin-iron functionalized NF-270 membrane** to tackle this challenge. Tannic acid, a plant-based polyphenol, offers natural metal-binding properties, while ferric chloride forms stable iron-tannate complexes on the membrane surface through a simple dip-coating method. The resulting bio-functionalized membrane achieved up to **92% sulfate rejection** at low operating pressures (4-6 bar), with stable flux and minimal fouling. Tests with synthetic sulfate wastewater (100-300 mg/L Na_2SO_4) confirmed consistent performance. Surface analysis (FTIR, SEM-EDX, contact angle) revealed increased hydrophilicity and surface roughness, contributing to enhanced separation efficiency. Notably, the process generated an **iron-tannate sulfate sludge,** which shows promise for reuse in construction materials and pigment production-supporting circular economy principles. This sustainable membrane modification strategy is low-cost, scalable, and free from toxic reagents, making it suitable for treating sulfate-laden effluents from textile, tannery, and mining industries. Ongoing work focuses on treating real wastewater and evaluating long-term membrane regeneration.

Keywords: Sulfate removal; Tannic acid; NF-270; Wastewater

The Soil Energy Network: Can Canberra's Underground Sponge Create Cooler Cities?

O9 - Walter Jehne & Benjamin Fox
Regenerate Earth

Brief Bio of Speakers

Walter Jehne is an internationally recognised soil microbiologist and innovation strategist. He has immense field and research experience in soils, grasslands, agriculture and forests at local, national (CSIRO and Science Adviser to Australia's National Soil Advocate), and international (UN) level. Walter's specialisation is the role of soil microbes' symbiotic processes in the ecology of diseases, plant health, nutrient and waste cycling, soil pedogenesis and the regeneration of bio-systems.
Decades of research have made him expert in plant root ecology, mycorrhizal fungi, glomalin, and soil carbon formation. He also has worked on biology's enormous influences in hydrological cycles, weather patterns, regional and global cooling, and cloud formation and rain precipitation. Recent work has focused on commercializing leading bio-innovations which will urgently help restore agro-ecosystems and urban agriculture and ecologies. Walter is determined to advance the practical verification, application and extension of these innovations, including for cities and their supply chains, to sustain the current 8 billion and projected 10 billion people by mid-century.
Ben Fox makes things happen by wrangling ecologies, influencing complex systems and tuning networks. He has a background in agro-ecology, soil science, engineering design & cultural development;
Ben has led organisations and projects in Australia and Asia, including regional and remote Australia. Ben also loves riding bicycles, style, and the scent of fresh rain on the soil.

Abstract

Canberra, Australia's national capital, is increasingly experiencing the intensifying effects of climate change, including frequent and severe urban heatwaves. In response, *Rewetting Our Urban Soil Sponge to Cool Canberra* demonstrates a pragmatic, nature-based solution to urban heat by enhancing the moisture-holding capacity of soils in grassland open spaces. This initiative integrates field experimentation, community education, and applied ecological design to advance circular economy principles and climate resilience in the urban environment.
Building on successful European trials in Lahti, Finland—which demonstrated the potential of soil-focused lawn management to regenerate carbon-rich, moisture-retaining substrates—the Rewetting project adapts those techniques to Canberra's hotter, drier conditions. By optimising the small water cycle in urban landscapes through improved soil hydration, latent heat flux, and reduced heat re-radiation, the project aims to demonstrate enhancement of local microclimates while reducing energy demand and improving public wellbeing.
Trial sites are located in Harrison, one of Canberra's hottest suburbs with low tree canopy coverage. Led by a multidisciplinary team—Professor Leah Moore (geoscience and water systems), Walter Jehne (soil microbiology and regenerative systems), and Ben Fox (urban ecology and systems design)—the project is a transdisciplinary collaboration. It involves testing and demonstration of soil energy dynamics, monitoring surface temperature, soil moisture infiltration, and vegetation responses. Outcomes will be viewed through the dual lenses of quantitative environmental data and aesthetic design evaluation methods.
Key objectives include demonstrating practical interventions for urban heat mitigation, evaluating their seasonal performance, and producing actionable guidelines for land managers and local governments. Co-benefits include improved ecosystem services, increased plant survival in green infrastructure projects, and enhanced biodiversity in degraded suburban landscapes.
To ensure long-term impact, the project is embedded within local institutions. Partnerships with the Canberra Environment Centre and Community Housing Canberra support public workshops, citizen monitoring, and integration of trial outcomes into residential land management practices. These collaborations help position soil rehydration as a civic priority and a core strategy in circular urban water systems.
This research aligns with CECE's themes, linking climate mitigation, resource circularity, and community-led regeneration. By treating soil not as inert infrastructure but as a living, sponge-like ecology central to energy and water cycling, the project reconceives open space management as a regenerative, climate-adaptive practice. The trial evaluates how management practices—such as mowing regimes, soil amendments, vegetation structure, and water-sensitive design—affect soil moisture, temperature regulation, and urban energy dynamics.
By integrating adaptive vegetation strategies and smart climate monitoring, this project offers a scalable, evidence-based framework for energy-conscious urban landscape management. In doing so, it positions Canberra as a national and global exemplar of circular, climate-smart design for microclimate energy control, soil health, and low-carbon urban development. Join us for a truly, ahem, grassroots approach to urban cooling.

Advanced Interfacial Solar Evaporation for Sustainable Water Production and Mineral Recovery

O10 - Qiang Fu
Centre for Technology in Water and Wastewater (CTWW), School of Civil and Environmental Engineering, University of Technology Sydney.

Qiang.fu@uts.edu.au

Brief bio of speaker

Dr. Qiang Fu is an Associate Professor in the School of Civil and Environmental Engineering at the University of Technology Sydney (UTS), where he leads a research group within the Centre for Technology in Water and Wastewater (CTWW). His research focuses on the design and development of advanced functional materials, including two-dimensional (2D) materials, metal-organic frameworks (MOFs), polymer composites, 3D-printed architectures, membrane nanotechnologies, and advanced hydrogels, for applications in the energy and environmental sectors.

Dr. Fu earned his Bachelor of Engineering in Chemical Engineering from Shanghai Jiao Tong University in 2004 and completed his Ph.D. in Polymer Chemistry at Fudan University in 2009. He then undertook postdoctoral research at the University of Melbourne before joining UTS. He has published over 140 peer-reviewed journal articles and holds four patents. His work has received more than 8,300 citations, with an h-index of 53, and includes five highly cited papers. Dr. Fu has been awarded over AUD $4 million in competitive research funding, including grants from the Australian Research Council (ARC), Cooperative Research Centre (CRC), and the New South Wales Government.

He currently serves as Vice-President of the Australasian Practical Zero Emissions Society (APZES), is a Chartered Member of the Royal Australian Chemical Institute (MRACI CChem), and is actively involved in professional organizations including the American Chemical Society (ACS) and the Membrane Society of Australasia (MSA).

Abstract

Water is the basis for the existence and continuation of all life on Earth. The water resources on Earth are extremely huge (ca. 1.46 × 1016 cubic meters). However, 99.97% of the water exists in the form of seawater or deep groundwater that is difficult to collect, and only less than 0.03% can be easily used by humans. Due to geographical and climate constraints, the shortage of freshwater is of concern to 2.8 billion people in 48 countries all over the world especially in Africa, the Middle East, and Oceania, and the affected population may rise to 4.0 billion based on reasonable predictions. Consequently, the discovery of the next-generation freshwater production technologies with low-cost, high-water production rate and ease of installation and use is considered a promising solution to this global challenge and has attracted increasing attention all over the world.
The Interfacial Solar Evaporation (ISE) system is a floating device mounted on the surface of the sea in which a hydrogel with customized features is integrated. By incorporating a photothermal additive into the hydrogel matrix, SDIE can greatly increase the evaporation rate of seawater. Our team has developed a series of new hydrogel materials that enable higher freshwater production efficiency by tuning the hydrogel structure on the nanometer,

Development of resource recovery technology from high-concentration wastewater using F-SMDC with anti-solvent and electro-crystallization

O11- Linitho Suu (presenting for Youngkwon Choi)

Youngkwon Choi[a,b,*], Joowan Lim[b], Linitho Suu[a] , June-Seok Choi[a,b],

[a] Department of Civil and Environmental Engineering, University of Science and Technology (UST)

[b] Department of Environment Research, Korea Institute of Civil Engineering and Building Technology (KICT),

Speaker & Corresponding author's email
[*] YoungKwon Choi, E-mail: youngkwon813@kict.re.kr

Brief bio of speaker

Youngkwon Choi is a senior researcher and professor at the Korea Institute of Civil Engineering and Building Technology (KICT), affiliated with the University of Science and Technology (UST), specializing in advanced membrane technologies, water treatment, and resource recovery. He holds a Ph.D from the University of Technology, Sydney, and a Master's from Kookmin University, South Korea. His research spans membrane distillation, crystallization, zero liquid discharge, brine mining, and wastewater treatment in field of secondary battery/semiconductor industry. He has published in top-tier journals including, Desalination, Journal of Membrane Science, Environmental Science: Water Research & Technology, and the Journal of Cleaner Production. His work has focused on recovering high-value resources such as lithium carbonate and sodium sulfate from high-salinity waste streams and evaluating advanced pre-treatment strategies for microfiltration. He also holds patents related to energy resource recovery in extreme environments and arctic energy plant feasibility assessment. Professor Choi's interdisciplinary expertise bridges membrane science, energy systems, resourxe recovery and sustainable water management.

Abstract

High-salinity brine and wastewater generated in seawater desalination and secondary battery recycling processes cause environmental and economic problems, and new power is needed to solve these problems. This study proposes a hybrid process combining anti-solvent crystallization, electro-crystallization, and fractionated submerged membrane distillation crystallization (F-SMDC) for the treatment and resource recovery from brine generated in seawater desalination and wastewater from secondary battery recycling processes. The anti-solvent crystallization method is applied to recover inorganic salts (such as NaCl and Na_2SO_4) from high-salinity brine, offering the advantages of low energy consumption and reduced environmental impact through solvent recycling. Electro-crystallization is utilized to recover valuable metal ions (e.g., Ni, Co, Mn) from battery wastewater, which can be transformed into NiCoMn hydroxide catalysts while simultaneously enabling hydrogen production through electrolysis. The F-SMDC process integrates membrane distillation and crystallization within a single reactor, facilitating the recovery of high-purity water from the upper section (high temperature, low salinity) and the growth of high-purity salt crystals from the lower section (low temperature, high salinity), achieving a high water recovery rate (volume concentration factor >3.5). By combining these processes, the proposed hybrid system demonstrates significant reductions in energy consumption, enhanced resource circularity, and the achievement of zero liquid discharge (ZLD). This research is expected to contribute to the development of sustainable resource recovery technologies for complex wastewater streams, with future potential for integration with renewable energy sources such as solar power.

Keywords: Anti-solvent crystallization, Brine, Electro-crystallization, Membrane distillation crystallizer, Secondary battery wastewater, Resource Recovery

Acknowledgement

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Process Simulation of Circular Carbon Capture and Conversion

O12 - Marzieh Namdari
Department of Chemistry, The University of British Columbia

mhs.namdari@gmail.com

Brief bio of speaker

Dr. Marzieh Namdari is a postdoctoral fellow in the Department of Chemistry, at the University of British Columbia. She completed her PhD in Environmental Engineering at Concordia University in 2023. Her research focuses on electrochemical CO_2 capture and conversion pathways, and process simulation.

Abstract

To address the global impact of rising atmospheric CO_2 concentrations, significant research efforts have focused on capturing CO_2 directly from air and industrial exhaust streams. Captured CO_2 can either be sequestered or converted into valuable carbon-based products, such as carbon monoxide (CO). Further reduction of CO to methane (CH_4), a main component of natural gas, enables a closed-loop system that recycles carbon from fuel to CO_2 and back to fuel; an essential step toward a circular carbon economy.

Traditional CO_2 capture and conversion pathways, however, require a thermally intensive step to regenerate pure CO_2 from the capture solution, which is substantially energy and cost intensive. An alternative electrochemical pathway can bypass this regeneration step. In this approach, CO_2 is first absorbed from ambient air or flue gas into an aqueous alkaline solution enriched in hydroxide (OH^-) and carbonate (CO_3^{2-}) ions—referred to as the CO_2 capture solution. This solution enters the capture unit where it reacts with CO_2 to form (bi)carbonate-rich solution—referred to as the reactive carbon solution.

Rather than releasing CO_2 through conventional heating, this reactive carbon solution is fed into an electrolyzer, where electrochemical activation occurs. The electrochemically provided protons (H^+) react with (bi)carbonate ions within the catholyte, forming CO_2 *in-situ*. This internally generated CO_2 is available for electrochemical reduction at the cathode, where it is converted into value-added products such as CO, formate, CH_4, and C_2H_4. The hydroxide ions (OH^-) produced during the CO_2 reduction reaction are recycled back into the capture unit, closing the loop by regenerating the CO_2 capture solution. This electrochemically integrated approach eliminates the need for high-temperature CO_2 desorption, significantly improving energy efficiency.

In this work, we present a process simulation of a direct air capture (DAC) system using Aspen Plus® to evaluate the feasibility and optimization of the CO_2 capture unit. The simulated process uses a potassium carbonate-based solvent and is designed to operate under atmospheric CO_2 concentrations, targeting a capture rate of 646 tCO_2/year. The absorber column design was optimized by fixing the column diameter and adjusting the height to achieve a balance between performance and capital cost. To further enhance mass transfer kinetics, the addition of 0.1 M piperazine as a CO_2 capture promoter was evaluated. Simulation results indicate that piperazine significantly improves CO_2 capture efficiency, enabling a 50% reduction in the column height—from 10.3 m to 5.25 m—without compromising capture performance. This translates into a meaningful reduction in equipment size and associated capital investment.

Building on this process model, we estimate the techno-economic feasibility of integrating the capture system with a (bi)carbonate-fed electrolyzer for on-site CO production. Our analysis suggests that this configuration can achieve a CO breakeven price as low as $0.86 per kg, underscoring the promise of air-derived carbon valorization. This work illustrates the role of process innovation in accelerating the design of economically viable, modular carbon capture and utilization pathways, paving the way toward scalable, energy-efficient carbon circularity.

Panel Discussion 3: Circular Construction

Moderators: Ehsan Yaghoubi and Malindu Sandanayake, Victoria University

Sustainability in Pavement Design and Construction

K5 - Andrew Kiesel
Tonkin Taylor

akiesel@tonkintaylor.com.au

Brief bio of keynote speaker

Andrew Kiesel is an Associate Geotechnical and Pavement Engineer at Tonkin + Taylor and has over 13 years' experience in a wide range of projects including roads, port facilities, sport centres, landfills, landslides, retaining structures, foundations, earthworks, and deep fill projects.

Throughout his career, Andrew has focused on pavement design and analysis and has worked on a broad range of infrastructure projects including major freeway and arterial road upgrades, local government project and private client projects. More recently Andrew has been leading pavement design packages on the Eastern Fwy Upgrade between Burke Road and Tram Road, which has a major focus on sustainability across all stages of the works

Abstract

Sustainability has emerged as a critical consideration in pavement design and construction, with major infrastructure projects increasingly required to reduce carbon emissions while maintaining long-term performance and cost-effectiveness.

This presentation explores how pavement design and construction align with circular economy principles, highlighting best practices and innovations across each project phase to achieve whole-of-life sustainability. Victoria has been incorporating recycled materials such as, demolition waste, crushed glass, tyres, and reclaimed asphalt since the early to mid-1990s. Over the past decade, government policy has accelerated their widespread adoption, reinforcing circular economy goals.

Rethinking warm mix asphalt (WMA) this is another important innovation pavement projects need to consider in a circular economy due to its ability to lower energy requirements and thus reduce greenhouse gas emissions. WMA technologies enable asphalt production and compaction of asphalt at lower temperatures than conventional hot mix asphalt, reducing fuel consumption and lowering emissions.

Emerging technologies such as bio-bitumen are reshaping the pavement sustainability landscape. Derived from renewable organic sources like lignin and waste bio-oils, bio-bitumen offers a promising alternative to fossil-based binders. Research institutions and contractors are actively trialling bio-bitumen on low-volume roads, with potential for broader implementation.

Through real-world project examples, Andrew will demonstrate how sustainable materials and construction methods are being applied, highlighting the long-term benefits contractors can realise by adopting these practices. In parallel, he will address potential unforeseen risks, such as variability in recycled material quality, performance uncertainties of emerging technologies, and supply chain limitations that must be carefully managed to ensure successful implementation and whole-of-life outcomes.

In conclusion, Victoria's approach to sustainable pavement design integrates recycled materials, energy-efficient technologies, and innovative binders. As the industry moves toward carbon neutrality, addressing practical and financial barriers will be essential to scaling these solutions and ensuring resilient, low-impact road networks.

Australian Reduction Roadmap

K6 - Dan Hill
Melbourne School of Design, University of Melbourne

dan.hill@unimelb.edu.au

Brief bio of keynote speaker

Professor Dan Hill is Director of Melbourne School of Design, the graduate school in the Faculty of Architecture, Building and Planning at the University of Melbourne. A designer and urbanist, Dan's previous design leadership roles include the Swedish government's innovation agency Vinnova in Stockholm, Arup in London and Sydney, Fabrica in Treviso, the Finnish Innovation Fund SITRA in Helsinki, and the UK's Future Cities Catapult and BBC in London. Dan is also a Visiting Professor of Practice at UCL's Institute for Innovation and Public Practice (IIPP) and a founder member of the Council on Urban Initiatives, a joint venture between UN HABITAT, LSE and UCL. He has also held roles of Professor at the Oslo School of Architecture and Design (AHO) and Visiting Professor at Design Academy Eindhoven. Dan was one of the inaugural Design Advocates for the Mayor of London and a Trustee of Participatory City Foundation and is now part of the Advisory Group of Open Systems Lab, advisory board of IIPP, and Scientific Committee for UrbanAI. He is on the editorial boards of Future Observatory Journal and She Ji: The Journal of Design, Economics, and Innovation. Dan is the author of the books 'Dark Matter & Trojan Horses' (Strelka Press, 2012) and 'Designing missions' (Vinnova, 2022), amongst others.

Abstract

The **Australian Reduction Roadmap** is an initiative aimed at driving change in our construction codes, such that they align with climate science by working within 'planetary boundaries' and thus contribute meaningfully to Australia's commitment to the Paris Agreement's goals. The analysis in the Roadmap suggests that, taking housing as an example, if we continue build 'business-as-usual', we require **a 98% drop in emissions per square metre of typical new housing in Australia within a handful of years**. Indeed, if we were to build the current Australian government housing targets of approximately 200,000 new homes per year, that new building activity would consume approximately 200% of the nation's total emissions budget (as suggested by the Paris Agreement). The primary role of the Reduction Roadmap is to make clear the scale and speed of change required, and suggest how we might create the broader conditions required to produce such change in Australia.

Following the 'theory of change' of its Danish Reduction Roadmap precursor, it attempts to build a groundswell of support and advocacy for significant changes within industry and government, ensuring that whole lifecycle emissions, crucially including embodied emissions limits, are meaningfully represented in Australian building regulations. Close collaboration with Danish colleagues helped frame the research method, and communications strategies, including the subsequent development 'Beyond the Roadmap', assessing linked challenges of biodiversity regeneration. Next steps for the project will include a **materials roadmap**, describing how transformation of design, strategy and building practices would allow the sector to work within planetary boundaries, and a **housing roadmap**, indicating how broad societal goals (linking health and social equity outcomes to environmental outcomes) for housing Australia might be achieved by using both reduction and materials as strategies.

The Roadmap has been produced by a multidisciplinary, multi-university team comprising colleagues at University of Melbourne, UTS, and QUT, as well as Terroir, an architectural practice. Over time, it aims to build an open movement for advocacy and action. This talk will unpack the thinking behind the Roadmap, including international comparisons, contextualised for Australia. The first version of the Roadmap also hints at the range of likely intervention points required, from shifts in fiscal policy to fabrication, renewable energy and regenerative materials, or inventive approaches to downsizing, retrofit and smaller-but-higher-quality housing, design and planning practise alongside new forms of governance and industry practise, and these will be described in the talk. Finally, the talk will openly describe the method, and its flaws and avenues for improvement, as well as outlining the next steps, from research and education through to policy design and practise engagement.

Session 3: Circular Construction

Chair: Ehsan Yaghoubi

Construction Waste generation hotspots detection using image processing assisted by BIM-VR toward greener construction projects

O13- Yaser Mohammed Rageh Gamil
School of Engineering, Monash University Malaysia

Yaser.g@monash.edu

Brief bio of speaker

Dr. Yaser is a dedicated researcher and academic with a Ph.D. in Civil Engineering, specializing in formwork pressure, a critical aspect of concrete construction technology. With a strong foundation in construction practices, Dr. Yaser's work bridges the gap between theoretical research and practical application in the field. Beyond his academic pursuits, Dr. Yaser is committed to mentoring the next generation of engineers and fostering a deeper understanding of sustainable and resilient infrastructure.

Abstract

Construction waste generation is a pressing environmental issue globally, with significant implications for sustainability, resource conservation, and public health (UN SDG3,911,13). The amount of waste generated annually is very significant and inevitable, which requires an in-depth study. The waste is generated by all the construction activities, starting from material transport, construction, maintenance, demolition, and deconstruction of any type of built structure. This research focuses on the waste generated during the construction phase. The potential application of building information modelling (BIM) with virtual reality (VR), assisted by real-time monitoring of construction activities (IoT), toward digitalizing the process. Images will be collected from the construction site either using real-time capturing or time-lapse recordings during the construction. The data will then be analysed using image processing for pattern recognition to detect waste materials, and machine learning will then be used to train the system to recognise waste materials in patterns. This information is then used to be integrated with the BIM embedded with VR and as-built model to enable decision making, avoiding or minimizing the waste generation. By consolidating existing knowledge, the outcome serves as a valuable resource for policymakers, researchers, and practitioners seeking to address the challenges associated with construction waste generation.

Reimagining Waste: House Deconstruction and Timber Reuse as Part of a Circular Economy Strategy

O14 - Angelique Milojevic
School of Design,University of Technology Sydney (UTS)

Angelique.Milojevic@uts.edu.au

Brief bio of speaker

Angelique is a multidisciplinary designer with over 20 years of experience in diverse design modalities such as web design, architecture, business design and consulting, and currently works at UTS School of Design as lead researcher on The Circular Timber project - Co-designing Materials Reuse. Her career includes working on multimillion-dollar projects for government initiatives, property developers, and renowned architects, collaborating with diverse teams and stakeholders. Additionally, she is a published author, featuring interviews with prominent Australian entrepreneurs.

Angelique holds a Master of Design, a Graduate Diploma in Design Science, a Bachelor of Design (Product Design) and a Diploma of Innovation.

Abstract

Australia's construction and demolition (C&D) sector is a major contributor to national waste and is projected to generate 42 million tonnes annually by 2030 (DCCEEW, 2023). Despite growing policy support for circular economy principles, material recovery, particularly in deconstruction, remains limited. Between 2016 and 2021, over 102,000 residential demolitions were approved nationwide, with 27,000 in New South Wales alone (ABS, 2021), exacerbating pressure on landfills. Greater Sydney is expected to reach landfill capacity by 2030 (NSW EPA, 2025).

This review critically explores the global shift from conventional demolition to deconstruction, with a particular emphasis on timber recovery and reuse. It draws on the Circular Timber project—a multi- stakeholder initiative involving academic institutions, government agencies, and local communities—as a practical demonstration of circular material reuse. The project serves as a tangible proof of concept, integrating a design-led approach within a circular economy framework.

Through a comparative analysis, the review evaluates the environmental, economic, and social trade-offs between demolition and deconstruction, while identifying systemic barriers to the sustainable implementation of these practices. A key contribution is the design-led methodology piloted in the Northern Rivers region, where timber salvaged from two flood-affected homes in Lismore was repurposed into prototypes by local designers, architects, and timber makers. This participatory process validated the technical feasibility of timber reuse and illuminated its socio- cultural value, linking material recovery to community resilience and identity.

The findings highlight the potential of deconstruction to drive circular transformation. While economic and logistical challenges remain, the Circular Timber project demonstrated the desirability, feasibility, and sustainability of reclaimed timber applications. It also exposed critical gaps in policy, infrastructure, and market development, underscoring the need for targeted investment and cross-sector collaboration.

This review contributes to the expanding field of circular economy research by advocating for scalable deconstruction and a waste material recovery system. It calls for further investigation into enabling conditions—regulatory, economic, and social—that can support a systemic transition toward circular deconstruction practices.

Enhancing Mechanical and Environmental Performance of Pervious Concrete Pavements for Sustainable Urban Infrastructure

O15- Zohreh (Venus)Shakeri

Zohreh (Venus)Shakeri, Rackel San Nicholas and Mahdi M. Disfani
Department of Infrastructure Engineering, The University of Melbourne

zfakharshake@student.unimelb.edu.au

Brief bio of speaker

Zohre (Venus) Shakeri is a civil engineer and PhD candidate at the University of Melbourne, specialising in sustainable materials and urban infrastructure. Her current research focuses on developing pervious concrete pavements (PCP) with improved mechanical performance and reduced environmental impacts, contributing to enhanced stormwater management and mitigation of urban heat island effects. She is particularly interested in optimising concrete mix designs through the use of supplementary cementitious materials, life-cycle assessment, and advanced concrete technologies to promote sustainable construction practices.

Zohre holds a Master of Science in Civil Engineering, specialising in Water and Hydraulic Structures, from the University of Tehran, one of the top-ranked universities in her home country, where she graduated with distinction. Her master's thesis investigated seepage monitoring in embankment dams using thermal measurements and numerical simulations with Abaqus Finite Element software.

Abstract

In recent decades, climate change and global warming have increased the frequency of extreme weather events such as torrential rainfall. In addition, rapid population growth and urbanisation have significantly expanded sealed surfaces like roofs and roads, intensifying challenges related to stormwater management and urban heat islands (UHI).

Pervious concrete pavement (PCP) is increasingly used as a sustainable solution in urban infrastructure, owing to its interconnected pore structure that enables water infiltration and helps mitigate surface temperatures. Additionally, PCP generally requires a lower total amount of cementitious materials than conventional concrete, contributing to reduced environmental impacts. However, the inherently porous nature of PCP results in lower mechanical strength, making it a solution for certain applications such as areas with light traffic loads and hence limiting its broader use in urban infrastructure.

This study aims to enhance the mechanical performance and reduce the environmental footprint of PCP, to enable its broader application in urban infrastructure while contributing to sustainable development goals.

Laboratory experiments were conducted to investigate the effects of varying water-to-cement ratios (0.26, 0.32, 0.38) and aggregate-to-cementitious material ratios (2.5, 3.0, 3.5, 4.0). Additionally, the influence of partially replacing cement with supplementary cementitious materials (SCMs), including fly ash (15%, 30%) and silica fume (1.0%, 3.0%), was thoroughly studied.

The results indicate that an optimised mix design can significantly improve both the mechanical strength and durability of PCP without compromising its permeability. The optimal mixture design developed in this study comprises 85% cement, 15% fly ash, and 1% silica fume, achieving compressive strengths of approximately 12 MPa after 7 days of curing and 17 MPa after 28 days of curing. Compared with conventional concrete, life-cycle assessment analyses highlight the environmental benefits of PCP, including substantial reductions in embodied carbon and energy consumption. These advantages are largely attributed to PCP's inherently high aggregate to binder ratio, resulting in porous structure, which reduces the total cementitious material required. Furthermore, partial replacement of cement with SCMs, such as fly ash, further decreases the overall cement demand.

Overall, this research supports the development of stronger and more sustainable PCP, contributing to environmentally responsible urban construction and enhancing cities' resilience to climate-related challenges.

Fire-Resilient Asphalt Pavements Using Recycled Aggregates: A Comparative Study of Fire Performance, Mechanical Properties, and Environmental Impacts

O16- Zahra Kamali

Zahra Kamali, A/Prof Ehsan Yaghoubi, Prof Maurice Guerrieri, Prof Khalid Moinuddin
Institute for Sustainable Industries & Liveable Cities (ISILC), Victoria University

*zahra.kamali@live.vu.edu.au

Brief bio of speaker

Zahra Kamali is a PhD candidate at the Institute for Sustainable Industries and Liveable Cities (ISILC), Victoria University, specialising in pavement engineering with a focus on asphalt and recycled materials. Her research investigates the multifaceted impacts of fire on asphalt pavements, integrating recycled materials, fire dynamics, and pavement performance. She has strong expertise in laboratory testing, material characterisation, and performance evaluation of asphalt mixtures. Holding a Master's degree in pavement engineering, Zahra has authored peer-reviewed journal papers and is passionate about advancing sustainable, fire-resilient pavement solutions that contribute to safer, longer-lasting, and more environmentally road infrastructures.

Abstract

This research investigates the development of fire-resilient asphalt pavements by maximising the use of recycled materials such as Reclaimed Asphalt Pavement (RAP) and Recycled Concrete Aggregate (RCA). In addition to their sustainability benefits, RAP and RCA may improve the fire resistance of asphalt due to their higher thermal stability. Given the growing concerns around bushfires and tunnel fires, the flammability of binder in asphalt pavements has become a critical issue. To evaluate fire performance, Cone Calorimeter testing is conducted, and mechanical properties are assessed using Indirect Tensile Strength (IDT), Tensile Strength Ratio (TSR), and Indirect Tensile Fatigue Test (ITFT). The objective is to develop a balanced mix that provides both fire and mechanical performance for safer and more sustainable road infrastructure.

Unveiling Asphalt Surface Temperature Under Climate Extremes: A Comparative Study of Linear and Evolutionary Models

O17- Foad Ghasemi

Foad Ghasemi, A/Prof Ehsan Yaghoubi, Dr. Rudi van Staden
[1]Institute for Sustainable Industries & Liveable Cities (ISILC), Victoria University

foad.ghasemi@live.vu.edu.au

Brief bio of speaker

Foad Ghasemi is a PhD candidate in Civil Engineering at Victoria University, where his research explores the aging behavior of bituminous binders and asphalt mixtures under Australian climatic conditions. He holds academic degrees in both civil and chemical engineering and has authored over twenty peer-reviewed publications and several technical books on topics including bitumen modification, unsaturated soils, and numerical methods. His background includes doctoral research in Canada and extensive industry experience, integrating computational modeling and experimental materials science for sustainable infrastructure. He has received numerous academic honors, including the Waterloo Dean's Discretionary Fund, the STAQ Program Bursary, and recognition as a Distinguished University Scholar in consecutive years.

Abstract

Accurate estimation of asphalt surface temperature is critical for assessing pavement performance and material longevity, especially under intensifying climate extremes. This study presents a comparative modelling framework utilizing Multiple Linear Regression (MLR) and Genetic Programming (GP) to predict asphalt surface temperatures based on key meteorological variables, including air temperature, solar exposure, humidity, and wind speed. While MLR offers interpretability and simplicity, GP demonstrates superior performance by capturing complex, nonlinear interactions inherent in climatic data. Models were trained and evaluated using data from various Australian regions, encompassing a broad spectrum of environmental conditions. The GP model consistently outperformed its linear counterpart, particularly in regions with high solar loads and extreme temperature fluctuations. The proposed framework enables efficient, scalable temperature prediction to support climate-responsive pavement design and performance analysis. It also provides a foundation for future work in aging simulation, digital twins, and sustainable infrastructure planning.

Construction and Demolition Waste Management Practices in Australia: A Systematic Literature Review

O18 - Noushin Islam

College of Sport, Health and Engineering, Victoria University

noushin.islam@live.vu.edu.au

Brief bio of speaker

I am Noushin Islam, a PhD researcher at the Institute for Sustainable Industries and Liveable Cities (ISILC), Victoria University, Melbourne. My research focuses on "Developing a Framework for Sustainable Management of Construction and Demolition (C&D) Waste." I am currently pursuing this PhD under the supervision of A/Prof. Malindu Sandanayake, A/Prof. Shobha Muthukumaran, and Dr. Dimuth Navaratna. My PhD research is supported by a Research Training Program Stipend (RTPS) Scholarship from Victoria University.

Abstract

The construction and demolition (C&D) sector generate a significant portion of Australia's total waste, with over 29.2 million tonnes produced during 2022-2023. The Australian government has introduced several initiatives to advance sustainable C&D waste management (C&DWM) practices. These initiatives includes 'Circular Procurement', 'Carbon Pricing', Recycled Product Certification Scheme', 'Green Rating', 'Product Stewardship' (involving stakeholders, like retailers, consumers and recyclers), 'Extended Producer Responsibility' schemes (specifically for manufacturers, importers, or brand owners) aim to share responsibilities throughout product's lifecycle and promote materials reuse and recycling. Incentive mechanisms can significantly impact waste reduction and material circularity. Some Australian states imposed higher landfill levies (e.g., New South Wales (NSW) and Victoria (VIC)) to discourage waste disposal and offer government grants and rebates (e.g., Western Australia's Roads to Reuse (RtR) program) for using recycled materials from certified recyclers. Furthermore, circular procurement initiatives in Australia emphasise contracting out for sourcing and purchasing materials with recycled content, low-carbon materials, and selecting designs that facilitate deconstruction over demolition. Examples include mandates for a minimum percentages of recycled materials in NSW construction projects and prioritising recycled and reused materials in VIC transport projects. Despite these initiatives, the adoption of sustainable C&D waste management practices remains low due to a lack of uniformity in C&D management regulations and reduction targets, limited standardisation of recycled products' specifications, negative perceptions about the cost and performance, and insufficient technical guidelines for recycled products, which have led to a weak market demand. In Australia, only 4.5% of materials are repurposed, which is below the global average of 7.2% and less than half the European Union's achievement of 11.5%. Furthermore, circular procurement strategies and grants are primarily used in major public construction projects under public-private partnership agreements.

Thus, this paper explores how current incentive mechanisms and circular procurement strategies are implemented in the Australian C&DWM sector and compares them with global best C&DWM practices. For instance, the Netherlands' Mandatory Material Passports and Circular Trading, 'The Secondary Material Market and Green Procurement practices in Germany, etc., on how they have improved C&DWM practices from linear to sustainable adoption. This study employed a systematic literature review focusing on the impact of circular procurement and incentive mechanisms on the sustainable C&DWM context. Three databases- Web of Science, Scopus and Google Scholar were used for document collection, and a total of 496 were listed initially. Duplicate, non-English and grey literature were excluded, and finally, 77 documents were thoroughly reviewed and analysed using thematic analysis.

The research findings reveal, 'Material Passports' as 'Data Bank' to support material traceability, and data transparency and validation, 'Standardise specifications of secondary materials' makes circular procurement scalable which will enhance the demand for recycled C&D products, and 'Mandatory on-site C&D waste separation' ensures a stable and high quality supply of materials for reuse and recycling. These strategies need harmonisation at the micro, meso and macro levels across the Australian C&DWM sector. Future research is needed to develop comprehensive strategies for facilitating environmental, economic, and social benefits throughout the C&D waste management supply chain.

Panel Discussion 4: Nutrient recycling

Moderator: Ho Kyong Shon, University Technology Sydney

Closing the Loop: Advancing Circular Agriculture through Enhanced Efficiency Fertilisers

K7 - Roya Khalil
Research and Development, Melbourne, Incitec Pivot Fertilisers

roya.khalil@incitecpivot.com.au

Brief bio of keynote speaker

Roya is the Director of Research and Development and Stewardship at Incitec Pivot Fertilisers, where she leads a multidisciplinary team delivering innovation at the intersection of sustainable agriculture, circular economy, and climate resilience. Her current work spans enhanced efficiency fertilisers, nutrient recovery from animal and food waste, soil health, and greenhouse gas mitigation technologies —core pillars supporting the decarbonisation and sustainable agricultural systems.

With over two decades of experience in R&D and innovation leadership, Roya has held senior roles at organisations including Incitec Pivot Limited, Orora Packaging, Bega Cheese, Coca-Cola Amatil, SPC Ardmona, and Plantic Technologies. She has successfully led the development and commercialisation of several patented technologies, including bio-based and compostable packaging, nitrogen inhibitors, and organo-mineral fertilisers.

Roya is also a strong advocate for industry–academia collaboration. She serves as a Partner Investigator at the ARC Research Hub for Smart Fertilisers and Industry Advisor at the ARC Research Hub for Nutrients in the Circular Economy, both based at the University of Melbourne. Additionally, she is an Advisory Board Member at the Australian Graduate School of Engineering at UNSW and a former Chairwoman, Board Member, and Fellow of the Australasian Institute of Packaging (AIP).

Roya holds a PhD and a bachelor's degree in chemical engineering, as well as an MBA with a specialisation in strategic marketing.

Abstract

Australia is embarking on its first national circular economy transition, aiming to double its circularity by 2035. With only 3.7% of the economy currently circular, most resources are used once and discarded, leading to environmental degradation and lost economic value. In agriculture, a circular approach focuses on regenerating soils, closing nutrient loops, and improving nutrient use efficiency (NUE) using tools like Enhanced Efficiency Fertilisers (EEFs) and the 4R nutrient stewardship principles, Right source, Right rate, Right time, and Right place. This shift offers opportunities to reduce waste, recycle nutrients, cut emissions, and build local input systems while enhancing farm resilience, productivity, and profitability. EEFs play a pivotal role in this model by reducing nitrogen losses and greenhouse gas emissions while improving nitrogen retention and crop uptake. Innovations in fertiliser technologies, when aligned with regenerative practices and policy frameworks, can drive Australia's sustainable agriculture agenda and support national circular economy and climate goals.

Globally, nitrogen inhibitors have seen a 250–300% rise in adoption between 2013 and 2023, increasing from less than 3% to 7–10% of total nitrogen fertiliser use—equivalent to 2.0–3.5 million tonnes of treated nitrogen. Looking ahead to 2030, the market is projected to grow at a compound annual growth rate (CAGR) of 8–12%, potentially accounting for 15–20% of all nitrogen fertiliser. This growth is being driven by policy efforts to reduce nitrogen losses, increased demand for nutrient efficiency, and integration into carbon farming and climate-smart programs. Emerging markets, such as Southeast Asia, Latin America, and Sub-Saharan Africa, are expected to accelerate adoption as part of sustainable intensification strategies.

The agriculture sector is a significant contributor to greenhouse gas (GHG) emissions, accounting for 85% of Australia's nitrous oxide (N_2O) emissions. N_2O has 300 times the warming potential of carbon dioxide and persists in the atmosphere for over a century. Ammonia (NH_3) emissions also contribute to indirect N_2O formation, acid rain, and environmental degradation. Nitrogen-based fertilisers are the primary source of these emissions, responsible for approximately 80% of N_2O and NH_3 emissions in Australia. In response, Incitec Pivot Fertilisers (IPF) developed innovative products, Green Urea NV® and eNpower®-coated urea—to inhibit nitrogen loss and enhance fertiliser efficiency.

In 2024, IPF launched a large-scale nationwide field trial across 19 sites in South Australia, Victoria, New South Wales (including the long-term Glenelg phosphorus trial near Grenfell), Queensland, and Tasmania. These trials evaluated the performance of Green Urea and eNpower under real-world farming conditions. Results demonstrated that eNpower reduced N_2O emissions by 68–96.5%, and Green Urea lowered NH_3 losses by 48–91%, significantly improving nitrogen retention in the soil and boosting productivity.

Rethinking Nutrient Management in Water Utilities—From Linear Removal to Circular Recovery

K8 - Django Seccombe
Sydney Water

Django.seccombe@sydneywater.com.au

Brief bio of keynote speaker
Django is an environmental engineer and change broker, committed to unlocking new enterprise and creating a more circular and sustainable economy.

Django's experience spans operations, planning, project development, strategy and policy development in the water and bioenergy sector. His current role focuses on establishing and embedding circular economy practice in Sydney Water and building collaborations across industry sectors in the rapidly growing Greater Sydney. Django's current projects focus on the integration of our water, energy, food and waste systems.

Abstract
Water utilities manage substantial nutrient flows—primarily nitrogen and phosphorus—through wastewater treatment systems designed to safeguard environmental and public health. Conventional nutrient management relies on chemical and biological processes that convert nitrogen to atmospheric emissions and bind phosphorus into sludge. While effective at meeting discharge regulations, this approach is increasingly inefficient and costly. Internal recycles can return up to 10% of the nutrient load for re-treatment, compounding energy use and operational complexity.

This linear model presents several systemic challenges:

- It depletes nutrient resources from agricultural soils, undermining long-term food security.
- It demands high chemical and energy inputs, contributing to elevated life cycle costs and cost-of-living pressures.
- It carries a significant carbon footprint, driven by energy consumption and fugitive nitrous oxide (N_2O) emissions.

Sydney Water illustrates the scale of this issue, managing 31,500 tonnes of nitrogen and 6,600 tonnes of phosphorus annually. Of these, 66% and 38% respectively are discharged to the ocean, 5% of nitrogen is emitted to the atmosphere, and the remainder is captured in biosolids and returned to land. While biosolids application has been a successful nutrient and carbon recycling strategy, it now faces growing scrutiny due to contaminants and tightening regulations.

Meanwhile, global demand for sustainable fertilizers is rising, driven by agricultural intensification, policy incentives, and the environmental costs of fossil-based fertilizer production. Nutrient recovery from wastewater offers a compelling opportunity to meet this demand while reducing environmental impacts and operational costs. However, scaling recovery faces risks including contamination with heavy metals and emerging pollutants, regulatory uncertainty, and public acceptance challenges.

This paper explores the scale and fate of nutrient flows in water utilities, evaluates the economic and environmental trade-offs of current practices, and highlights opportunities for nutrient recovery to support sustainable agriculture. It also examines market dynamics, policy frameworks, and risk mitigation strategies essential for transitioning toward a circular nutrient economy.

K9 - Deli Chen
Food and Ecosystem Sciences, Faculty of Science,
The University of Melbourne

delichen@unimelb.edu.au

Brief bio of speaker

Deli Chen is a Distinguished Professor and discipline leader of Soil and Environment Research in the School of Agriculture, Food and Ecosystem Sciences at the University of Melbourne and Director of the ARC Research Hub for Smart Fertilisers.

Deli gained his B.Sc. from Nanjing Agricultural University, M.Soil Sci from the Institute of Soil Science, Chinese Academy of Sciences, and PhD from the University of Melbourne.

Deli's research focuses on the nitrogen dynamics of plant-soil systems, efficiency of nitrogen fertiliser, animal waste management, mitigation of greenhouse gas emissions and remediation of environmental pollution. He leads a multidisciplinary program involving plant science, soil science, chemistry, chemical engineering, and industries to produce a new generation of nitrogen fertilisers for transformational improvements in nitrogen use efficiency.

He has more than 350 peer-reviewed journal publications (including Nature, Science, Nature Geoscience, Nature Water, Nature Food, Nature Communications, PNAS, citations > 24,000 with H index of 80). He is a Highly Cited Researcher by Clarivate™, ranked in the top 1% by citations for his research field.

His research achievement has been recognised by Fellow of Australian Academy of Science (2025), IFA Norman Borlaug Plant Nutrition Award (2024), lifetime Honorary Member of the International Union of Soil Sciences (2024). Frontiers Planet Prize (2023), Kingenta Agricultural Science Award (2019) and Soil Science Australia JA Prescott Medal (2010). He is a Fellow of the Soil Science Society of America, Soil Science Australia, American Society of Agronomy and Australian Academy of Science. He was honoured as an Officer of the Order of Australia (AO) for distinguished service to sustainable agriculture.

Abstract

Nitrogen (N) present in livestock excreta is around 100 million tonnes N/year globally (representing ~75% of synthetic N fertilisers used), but only 30% of this is recovered and re-used in agriculture. Moreover, more than half of the nitrogen in livestock waste is lost to the atmosphere as ammonia (NH3) and nitrous oxide (N2O), posing significant risks to human and environmental health, biodiversity and economic sustainability. At the same time, half of global food production relies on using synthetic N fertilisers. Livestock excreta therefore represents a relatively untapped N resource. Its effective harvesting can be reused in agriculture, while concurrently reducing its adverse effects when lost to the environment.

We have developed lignite-based technologies to recover and reuse nutrients and organic material from livestock waste. Our work demonstrated that lignite applied to the bedding of animal pens decreased NH3 emissions by over 60% in intensive cattle feedlots and 36-44% in poultry farms. This N retention ability is largely due to Australian lignite's inherent chemical and physical properties, abundant acidic surface functional groups, high adsorption capacity, rich microporosity as well as biological immobilization. The binding and retention capacity of lignite products also reduced odour emission rates by 44-53%.

Recently, by integrating advanced material design, additives, industry manufacturing, microbiology, soil science, agricultural nitrogen management, and cost-benefit analyses, we focused on improving lignite performance. We developed novel lignite pellets to capture ammonia, mitigate odour and biomass loss, to transform lignite-fortified waste streams into organo-mineral fertilisers and soil amendments.

Session 4: Nutrient Recycling

Chair: Ho Kyong Shon, University Technology Sydney

Maximizing Single-Cell Protein Yield from Agricultural Waste: Strain Selection, Pretreatment Optimization, and Scalable Bioreactor Production

O19 - Kashif Rasool

Kashif Rasool[1,*,] Zukhruf Asim[1,2], Hafiz Muhammad Aamir Shahzad[1], Fares Almomani[2,]
[1]Qatar Environment and Energy Research Institute (QEERI), Hamad Bin Khalifa University, Qatar Foundation
[2]Department of Chemical Engineering, Qatar University, Doha, Qatar

*krasool@hbku.edu.qa

Brief bio of speaker

Dr. Kashif Rasool is a Senior Scientist in Sustainability and Environment at the Qatar Environment and Energy Research Institute (QEERI), Hamad Bin Khalifa University (HBKU). He holds a Ph.D. in Environmental and Energy Engineering from Kyungpook National University, South Korea, and specializes in sustainable bioprocesses, waste valorisation, and microbial biotechnology. With a strong publication record of over 75 peer-reviewed articles in high-impact journals, his research focuses on innovative solutions for resource recovery, circular bioeconomy, and energy-efficient systems. As the corresponding author of this study, Dr. Rasool leads interdisciplinary efforts to advance single-cell protein production from agricultural waste, bridging the gap between environmental sustainability and food security.

Abstract

The growing global demand for sustainable protein sources, coupled with the urgent need to manage agricultural waste, has driven research into innovative bioconversion methods. Single-cell protein (SCP) production through liquid-state fermentation (LSF) presents a promising solution by valorising agro-industrial residues into high-value microbial biomass. However, the efficiency of SCP production largely depends on pretreatment strategies and microbial strain optimization. This study investigates the pretreatment of agricultural waste to enhance SCP yield using optimized yeast strains.

In the first phase, both single and co-culture yeast strains were evaluated for SCP production on YPD broth and agricultural waste. Fermentation over five days yielded maximum biomass with *Saccharomyces cerevisiae* (1.8 g/L) and its co-culture with *Candida krusei* (4.58 g/L). Protein content relative to biomass was 45% for *S. cerevisiae* and 44.5% for the co-culture. The second phase focused on optimizing pretreatment parameters for SCP production using Response Surface Methodology (RSM) with a three-level factorial model. Temperature, residence time, and hydrochloric acid concentration were selected as independent variables. The optimal conditions 87.5°C, 3% HCl, and 90 minutes, resulted in maximum biomass (4.6 g/L), protein (2.67 g/L), nitrogen (7.24 g/L), and non-purgeable organic carbon (0.72 g/L).

In the final phase, a continuous 30-day bioreactor run under optimized conditions demonstrated scalable SCP production, achieving peak biomass (16.9 g/L) and microbial protein yield (63.3%) on Day 7. These findings highlight the potential of strain-substrate synergies in maximizing SCP production, offering a sustainable approach to protein generation while mitigating agricultural waste.

This study underscores the feasibility of high-yield SCP production through optimized pretreatment and fermentation strategies, contributing to circular bioeconomy advancements.

Achieving Circularity in Dairy Processing

O20 - Sandra Kentish
Sandra E. Kentish, George Q. Chen, Sally L. Gras, Dairy Innovation Hub, University of Melbourne

*sandraek@unimelb.edu.au

Brief bio of speaker

Sandra Kentish is a Redmond Barry Distinguished Professor at the University of Melbourne and a Fellow of the Australian Academy of Technological Sciences and Engineering. She is an Editor of the Journal of Membrane Science and was awarded the Membrane Society of Australasia Anita Hill Leadership Award in 2022. Professor Kentish is well known for her work on carbon dioxide capture. Her team has worked to establish the best membranes for this approach and then importantly, tested these systems at pilot plant scale. Her more recent work has focused on the use of polymeric membranes with an electrical driving force for dairy processing applications, water treatment, hydrogen production, CO2 reduction and mineral extraction. This work moves from the very fundamentals of ion sorption to pilot plant trials of electrodialysis technology.
LinkedIn: https://www.linkedin.com/in/sandra-kentish-29729013/
Google Scholar: https://scholar.google.com.au/citations?user=ynaaV9YAAAAJ&hl=en

Abstract

A significant volume of dairy ingredients is currently lost within the wastewater streams exiting a dairy factory. Recovery of these ingredients can both add value as product streams and significantly reduce the cost of effluent treatment. This presentation will give an overview of our work in this field. We have investigated the use of both nanofiltration and electrodialysis to recover valuable protein and lactose from acid whey, a stream that is currently only utilized as low value animal fodder. We have also considered the use of countercurrent dialysis to replace the use of diafiltration to purify lactoferrin after chromatographic purification. This approach can achieve a saving of up to 77% in fresh water and 46% in sodium chloride consumption. Finally, we have shown that the high salt concentrations in salty whey can be converted into acid and base, replacing the chemicals currently used in cleaning-in-place applications.

Source-separated urine in pilot-scale membrane bioreactor and production of urine fertiliser: Impact of hydraulic retention time

O21- Weonjung Sohn

Weonjung Sohn[1], Andrea Merenda[1], Amirhossein Shafaghat[1], Sherub Phuntsho[1], Li Gao[2,3], Ho Kyong Shon[1*]
[1]ARC Industry Hub for Nutrients in a Circular Economy (ARC NiCE Hub), Centre for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney; [2]South East Water; [3]RMIT University

*Speaker's email : Weonjung.Sohn@student.uts.edu.au

Brief bio of speaker

Weonjung Sohn is currently a PhD candidate at University of Technology Sydney under Prof. Hokyong Shon's supervision. Her main research interests include biological nitrification process in membrane bioreactors for nutrients recovery in a circular economy from source separated urine. She is a Website and Social Media Manager of the ARC NiCE hub.

Abstract

Prolonged hydraulic retention time (HRT) in urine-treating membrane bioreactors (MBR) remains a challenge as it increases system footprint and costs. This study investigated the effects of fixed HRT conditions in a pilot-scale compact MBR system on urine nitrification performance, aiming to determine the optimal HRT threshold ensuring the effectiveness of the produced liquid fertiliser on hydroponic plant growth. The start-up phase of the MBR successfully achieved stable nitrification at a 7-day HRT under pH-based feeding, with a high enrichment of *Nitrospira* as the predominant nitrite-oxidising bacteria (NOB) and *Nitrosococcus* as the dominant ammonia-oxidising bacteria (AOB). However, the transition to continuous urine feeding at systematically reducing HRTs of 5 days, 3 days, and 1 day resulted in a decreasing ammonia-to-nitrate conversion rate, dropping from 40% to 10% along with a significant nitrite accumulation caused by the high enrichment of AOB over NOB. The urine fertiliser produced under each HRT condition presented distinctive formulations, with a fixed total nitrogen concentration and varying nitrogen species proportions. The fertilisers were applied to hydroponic growth of basil and orchard grass. Both basil and orchard grass showed optimal growth, in terms of roots-to-shoots ratio, at HRTs of up to 5 days. However, orchard grass showed more resilience to the variations in HRT, displaying similar fresh biomass yields across the different conditions. This study offers valuable insights into optimising HRT in urine MBR systems to enhance nutrient recovery as a liquid fertiliser, paving the way for more compact and cost-efficient on-site nutrient recovery and fertiliser application at scale.

Nitrogen fertilising potential of source-separated human urine

O22 - Serhiy Marchuk

Serhiy Marchuk[1], Diogenes L. Antille[1,2], , Stefano Freguia[3], Veera Koskue[3] Bernadette K. McCabe[1]

[1]University of Southern Queensland, Centre for Agricultural Engineering; [2]CSIRO, Agriculture and Food, [3]University of Melbourne, Department of Chemical Engineering

*Serhiy.Marchuk@unisq.edu.au

Brief bio of speaker

Dr. Serhiy Marchuk currently works at the Centre for Agricultural Engineering (CAE), University of Southern Queensland as a Research Fellow. Serhiy has completed his PhD degree in soil chemistry from the University of Adelaide. His research focuses on the analysis and characterization of soil, plants, and organic materials, and resource recovery for agricultural use. Serhiy currently works on several projects related to use of organic amendments as nutrients supply in crop production.

Abstract

The majority of nutrients ingested by humans are excreted through urine making it a suitable raw material for its use as a fertiliser. Source separation and recovery of human urine have been proposed as an effective way to improve nutrient circularity and close the waste-to-resource cycle. Urine contains all the micro- and macro-nutrients in soluble form. The aim of this study was to examine the suitability of liquid fertiliser produced from source separated human urine as a nitrogen (N) source for ryegrass (*Lolium perenne* L.) production. A pot experiment was established in a glasshouse facility using two Queensland soils; namely: a clayey Ferrosol (Rhodoxeralf, US Taxonomy) and acidic sandy Yellow Chromosol (Alfisol, US Taxonomy). The selection of these soils was based on their differences in mineralogy, texture, pH, and water-holding capacity. The effectiveness of urine as a N fertiliser was compared with a synthetic fertiliser of known performance (urea, 46% N). The experimental pot design consisted of one control (zero-amendment) and 2 treatments with 2 rates of urea (100 and 150 kg ha^{-1} N) and 3 rates of source separated human urine, applied either once-off or split (100, 150 and 200 kg ha^{-1} N). Results revealed that after five consecutive cuts, dry matter yield (DMY) of ryegrass in urine-treated pots was 53% and 46% higher than with urea in the Yellow Chromosol and Ferrosol, respectively. Regardless of the amendment applied, DMY increased with an increase in the N application rate in both soils. The split application of source-separated urine resulted in higher cumulative dry matter compared with one-off application. Soil pH and EC were not significantly affected by either fertiliser treatment or application rate ($P>0.05$). The Emmerson dispersion test did not show any signs of dispersion with increasing rates of urine application. In summary, this study provided evidence suggesting that the recovery of nutrients from source-separated human urine offers a promising and sustainable approach for its use as a fertiliser in crop production. Further research should focus on exploring the long-term effects of source-separated human urine application on soil physico-chemical properties and nutrient cycling, as well as optimising application rates, timing of application and fertiliser placement for different crops and soils.

Bioelectroconcentration for nutrient recovery from human urine: Up-scaling from laboratory to pilot scale

O23- Veera Koskue

Veera Koskue, Stefano Freguia
Department of Chemical Engineering, The University of Melbourne

*veera.koskue@unimelb.edu.au

Brief bio of speaker

Dr Veera Koskue obtained her doctorate in Environmental Engineering in Finland in 2022. She currently works as a Postdoctoral Research Fellow at the Department of Chemical Engineering at the University of Melbourne, Australia. She is involved in the ARC-funded Nutrients in a Circular Economy (NiCE) Industrial Transformation Research Hub that aims to find innovative ways to recycle nutrients from human urine into fertiliser products. Veera is experienced in resource recovery from various wastewater streams and the design and operation of different (bio)electrochemical systems.

Abstract

Human urine is a concentrated stream that contains key nutrients nitrogen, phosphorus and potassium at concentrations up to 8.6 g_N L^{-1}, 0.5 g_P L^{-1}, and 2.4 g_K L^{-1}, respectively [1], while only contributing to ca. 1% of municipal wastewater volume [2]. Therefore, diverting urine from other wastewater at the source using waterless urinals and/or urine-diverting toilets and treating it separately opens interesting opportunities for nutrient recovery. An emerging technology for converting urine into value-added liquid fertiliser is bioelectroconcentration (BEC). BEC is a technique where electric energy is used to drive the migration of ionic target nutrients, such as ammonium nitrogen, through ion-exchange membranes into a liquid fertiliser. Part of the required electric energy is generated *in situ* by electroactive microbes that are capable of converting chemical energy in organic matter to electrical energy at the anode of the system [3]. This keeps the energy consumption of the recovery system low at 2–4 kWh per kilogram nitrogen recovered [1,4].

BEC has been demonstrated to be highly suitable for nutrient recovery from human urine in laboratory scale, capturing up to 70% of nitrogen into liquid fertiliser under optimised operational conditions [1,4]. However, mass transfer in the BECs has not been ideal due to imperfect flow distribution and accumulation of gaseous oxidation and reduction products in the system. This study addressed these issues by introducing two technical changes: the number of feed channels was increased from one to four to improve flow distribution; and simple gas-liquid separation columns were inserted into the anode and cathode mixing loops to remove gases produced at the electrodes.

In preparation for pilot-scale BEC trials, these changes were first tested in laboratory-scale experiments operating four parallel 0.8-litre BEC reactors continuously with either synthetic or real human urine. Flow distribution was successfully improved with the new feed channel configuration, while all gases were effectively removed from the system in the separation columns. Each reactor treated up to 2 L of urine per day, producing on average 172 mL d^{-1} of liquid fertiliser with an ammonium nitrogen concentration of 20 ± 0.8 g_N L^{-1}. This was 3.4 times higher compared to the feed urine, which contained 6 g_N L^{-1}.

These technical advances were then implemented in the design of a pilot-scale 18-litre BEC, which is ready to start treating 40–100 L of hydrolysed urine per day in Melbourne, Australia. Real human urine will be sourced from public events around Victoria using portable urine-diverting toilets and waterless urinals (Composting Toilet Systems Pty Ltd, Australia). In the pilot trials, special focus will be paid to the overall energy consumption of the system, including auxiliary equipment; the longevity of the membranes; and the effect of environmental factors, such as seasonal changes, on microbial activity at the anode.

References

[1] Monetti et al. (2021), Separ. Purif. Technol. 279: 119793
[2] Kuntke et al. (2012), Water Res. 46, pp. 2627–2636
[3] Rabaey et al. (2007), ISME Journal 1, pp. 9–18
[4] Ledezma et al. (2017), Environ. Sci. Technol. Lett. 4(3), pp. 119–124

Panel Discussion 5: Battery Recycling

Moderator: Helena Wang, University of Melbourne

Flash Joule Heating – A Scalable Technology for Critical Metal Recovery from Black Mass and E-Waste

K10 - Simon Adams
Chief Financial Officer and Company Secretary

simon.adams@MetalliumInc.com

Brief bio of keynote speaker

Simon Adams is Chief Financial Officer and Company Secretary of Metallium Ltd. He brings more than 25 years of financial, corporate governance, and capital markets experience across ASX-listed companies in the resources and technology sectors. At Metallium, Simon oversees financial strategy, compliance, and stakeholder engagement, supporting the company's transformation from an exploration business into a U.S.-centric industrial technology leader. He has played a key role in structuring Metallium's capital base, advancing strategic partnerships, and positioning the company's U.S. subsidiary, Flash Metals USA Inc., to scale its proprietary Flash Joule Heating (FJH) technology.

Abstract

Battery recycling remains a global challenge, with low recovery rates and reliance on complex, high-cost processes. Metallium Ltd is advancing the commercialisation of Flash Joule Heating (FJH), a breakthrough technology developed at Rice University that applies ultra-rapid electrical heating with proprietary chemistry to waste streams. In very short timeframes, FJH achieves elevated temperature change that enable selective volatilisation and conversion of metals into high-purity, water-soluble products.

The technology has shown strong promise not only in recovering nickel, cobalt, manganese, and lithium from battery black mass, but also in processing complex electronic waste such as printed circuit boards (PCBs), where high-value metals including gold, silver, tin, copper and PGEs can be efficiently recovered.

Metallium is now scaling this innovation with its first commercial demonstration plant in Houston, Texas. By coupling high recovery rates with a modular, low-emission design, FJH provides a commercially viable pathway to U.S. onshore refining of black mass and e-waste, strengthening supply-chain resilience and supporting the development of a sustainable domestic battery materials industry.

Evolution and Challenges in Battery Recycling Technology in Australia

K11 - Aleksandar Nikoloski

Extractive Metallurgy Hub, Harry Buttler Institute (Centre for Water Energy and Waste), Murdoch University

a.nikoloski@murdoch.edu.au

Brief bio of keynote speaker

Professor Aleksandar N. Nikoloski is an esteemed research leader and Head of Extractive Metallurgy Hub at Murdoch University. Renowned for his contributions to applied electrochemistry and hydrometallurgical processes, he holds a PhD in Metallurgical Engineering and has over 28 years of teaching and research experience. His achievements include the prestigious 2023 Vice Chancellor's Excellence in Research Distinguished and Sustained Achievement Award. Professor Nikoloski has pioneered research in processing lithium, vanadium, uranium, rare earths, and base metals. His work integrates fundamental science with practical applications, including energy storage systems and environmentally sustainable technologies. He has authored over 100 high-impact journal publications, produced three patents, and contributed extensively to industry and government reports. His research group, internationally recognized for its excellence, has positioned Murdoch University at the forefront of hydrometallurgical innovation in Australia. His collaborations with industry continue to enhance resource recovery and recycling efforts, cementing his legacy as a leader in sustainable process development for the minerals industry.

Abstract

Australia's journey in battery recycling technology has evolved rapidly in response to environmental risks, industry needs, and global trends. This talk will outline the progression of battery waste management beginning in 2017, when pioneering research led to advanced methods for recovering valuable elements from mixed metal dust (now known as black mass). Initial efforts revealed significant fire and contamination risks, highlighting the need for expertise and safe collection logistics. With less than 4% of battery waste being recovered and over 95% sent to landfills, regulatory and market incentives have made battery recycling a national priority. Our research focused on physical separation and hydrometallurgical processes to efficiently recover metals such as nickel, manganese, cobalt, lithium, and graphite, addressing technical challenges including binder removal and safe discharging. Innovations included the use of benign domestic chemicals like vinegar and sugar to extract valuable elements, and the development of patented technologies enabling complete resource recovery. The journey has demonstrated that recycling alone is insufficient. Effective reuse, repair, and repurposing strategies, coupled with optimised battery collection and discharging technologies, are essential for truly sustainable battery management. The talk will highlight Australia's unique position in minerals processing, the advancements achieved by my team, and the key logistical and technological challenges that must be overcome to accelerate the clean energy transition.

LIB recycling in Australia, the Indo-Pacific and the US: Opportunities for a Circular Economy

K12 - Gavin Collis

Principal Research Scientist, CSIRO

gavin.collis@csiro.au

Brief bio of keynote speaker

Gavin was appointed to CSIRO (Clayton, VIC) in 2006 as a Chemist and has worked across a variety of multi-disciplinary projects involving materials design for specific end-use applications. He has expertise in energy generation and storage applications. His has a broad interest in developing and using sustainable chemicals and green processes that allow the reuse, recycling and upcycling of materials. In recent years, he has focused on the challenges and opportunities around circular economies towards recycling lithium-ion batteries.

Gavin completed his undergraduate and PhD degrees at the University of Western Australia. He held positions at Worsley Alumina (Collie, WA), AGC-Woodwood Clyde Consultants (Perth, WA), Massey University (New Zealand) as a Post-doctoral Fellow, Lecturer and Assistant Director of the Nanomaterials Centre, and Los Alamos National Laboratory (New Mexico, USA). He has received prestigious awards (e.g. CSIRO OCE Julius Career and 2020 Churchill Fellowship (LIB Recycling)) and active member of the Royal Australian Chemical Institute (RACI), American Chemical Society (ACS) and the Minerals, Metal and Materials (TMS) Recycling & Environmental Technologies Committee (USA).

Abstract

Lithium-ion Batteries (LIBs) are ubiquitous in our everyday usage from portable electronics, electric vehicles (EVs) and battery energy storage systems (BESS).

Over the years, to increase efficiency and reduce waste lead acid batteries have achieved > 95% recycling rates. However, whilst some LIB technologies have yet to reach end-of-life (EoL), minimal effort has been developed to address the growing waste of these batteries. To date, the use of LIBs has been based on a linear economy, especially where these devices have not been designed for recycling, with large amounts going to landfill.
However, as we transition to Net Zero Emissions (i.e. reducing waste solid, liquid and gas) and with the growing drive behind the implementation of Environment, Social, Governance (ESG) framework and regulations a change is occurring globally. We are seeing a shift to circular economies where reuse, recycling, and upcycling are becoming more important, and sustainable and green technologies are becoming critical drivers in LIB recycling and many sectors of the chemical industry.

The presentation will highlight what is happening in Australia, the US and Indo-Pacific regions from supply chains, to barriers and opportunities for Australia in terms of sovereign capability, energy security, new industries and skilled workforce to address the transition to renewable energy.

Panel Discussion 5: Battery Recycling

Moderator: Helena Wang, University of Melbourne

Battery minerals for a circular economy: Australia's role in responsible sourcing

O24 – Damien Giurco
University of Technology Sydney, Institute for Sustainable Futures

Damien.Giurco@uts.edu.au

Brief bio of speaker

Damien Giurco is Distinguished Professor at the Institute for Sustainable Futures, University of Technology Sydney. His work builds evidence, strategies and practices on the material requirements for a net-zero circular economy. He was a foundation director of the Product Stewardship Centre of Excellence and currently coordinates UTS involvement in the NSW Decarbonisation Innovation Hub, leads research in the Future Battery Industries Cooperative Research Centre on responsible sourcing of battery minerals and is the circular economy program lead in the Solving Plastics Waste Cooperative Research Centre. He served as Editor-in-Chief for the journal Resources and is a member of the Scientific Committee of the World Resources Forum.

Abstract

Batteries are a central technology in transitioning society's energy and mobility sectors away from fossil fuels and towards net zero. Yet their expanding use relies on mining increasing quantities of minerals containing lithium, copper, nickel and in the years ahead, increasing the amounts of these and other metals sourced also from recycling. Balancing the responsible sourcing of metals from primary and secondary resources in support of a circular economy is a formidable challenge – for policy and investment in industrial capacity, as well as stakeholder expectations and standards of environmental performance.

This paper presents insights from multi-year research undertaken with government and industry partners by several Australian universities in the Future Battery Industries Cooperative Research Centre which explored this challenge.

The research approach included site-visits to industry, stakeholder workshops and interviews, modelling and analysis informed by primary and secondary data.

Findings identified drivers, barriers and reporting requirements for a comprehensive range of international responsible sourcing initiatives (including the Initiative for Responsible Mining Assurance – IRMA and Towards Sustainable Mining – TSM); assessed mechanisms and maturity of supply chain traceability (including geochemical verification of battery mineral ores) and projected improvements in environmental performance over the coming decade arising from the greater uptake of voluntary sustainability initiatives aligned with responsible sourcing.

Future directions regarding Australia's role in the responsible sourcing of battery materials for a globally circular economy are discussed in light of the Australian Government's Circular Economy Framework (with its goal to double the circularity rate in the Australian Economy by 2035) and the Future Made in Australia plan, together with an evolving global geopolitical and trade landscape that intersects with the ambitions of a range of international countries to pursue the circular economy.

Selective Extraction of Critical Metal Resources from Spent Li-ion Batteries

O25 - Jianfeng Mao
School of Chemical Engineering, The University of Adelaide,

jianfeng.mao@adelaide.edu.au

Brief bio of speaker

Associate Professor Jianfeng Mao is an ARC Future Fellow, Clarivate Highly Cited Researcher and the Discipline and Program Lead in Materials Engineering at the School of Chemical Engineering, the University of Adelaide. His current research interests are in developing advanced electrolytes and materials for next-generation batteries, as well as the green battery recycling methods for promoting the sustainability of battery supply chain. He has filed six patents and published over 130 papers (70+ as the first or corresponding author) in the leading discipline journals, including J. Am. Chem. Soc., Angew. Chem., Adv. Mater., Energy Environ. Sci., Nat. Commun., Sci. Adv., and so on. His publications have attracted more than 15,000 citations with a H-index of 60 (Google Scholar).

Abstract

The age of the electric car is all but upon us. Lithium-ion batteries (LIBs) are among the costliest components of electric vehicles (EVs). Along with the boom of global EV market, billions of LIBs are reaching their expected lifetime. Additional to problems of environmental care and safety, the metals and materials used in LIBs will be lost if not properly handled. Environmental pollution and critical materials loss from spent LIBs are thus a major global concern. Recycling of spent LIBs is urgently needed to address the raised significantly economic and environmental concerns, but traditional recycling pyrometallurgy and hydrometallurgy technologies are not efficient and sustainable. Another challenge in the practical LIB recycling is the selective separation and recovery of multiple metallic elements in the cathode materials. In this talk, I will introduce our recent work on the design of a leaching and separation process system based on the “green solvents” to enable the high selective recovery of transition metals and Li from spent LIB cathode. Compared to the traditional hydrometallurgy technologies using strong acid and pyrometallurgy using high temperature, the process is low cost and recyclable, and avoids using extreme heat or corrosive acids.

Recovering graphite and cathode oxides from black mass

O26 - Will Ng (Presenting for George Franks)
John Lu, Will Ng, and **George V. Franks**
Chemical Engineering, The University of Melbourne

gvfranks@unimelb.edu.au

Brief bio of speaker

George Franks is Professor in Chemical Engineering at the University of Melbourne. His degrees are in Materials Science and Engineering (Bachelor MIT, 1985 and PhD UCSB, 1997). His research includes suspension rheology, ceramic powder processing and minerals processing. His work in materials processing is primarily related to processing of complex shaped ceramics and composites with unique microstructures such as 3D printed multi-scale porous ceramics. His work in minerals processing relates to development and application of novel polymeric reagents in solid/liquid separation and froth flotation. This work is pivoting to recovering value from secondary resources. He is a co-Deputy Director of the ARC COE for Enabling Eco-Efficient Beneficiation of Minerals. He has 148 papers in international peer reviewed journals, 7 book chapters and four patents with 6100 citations and h-index = 45. He is Associate Editor of the Journal of the American Ceramic Society and on the Advisory Board of Advanced Powder Technology. http://www.chemical.eng.unimelb.edu.au/ceramics/.

Abstract

Black mass is the fine residue remaining after copper, aluminium, steel and plastic have been recovered from shredded Li-ion batteries. The black mass is primarily the anode and cathodes containing valuable materials including graphite (from anodes) and cathode oxides of metals such as lithium, cobalt, nickel, and manganese. We demonstrate recovery of graphite and cathode oxides from black mass using froth flotation for the separation. The approach is to recover the hydrophobic graphite in the froth phase, leaving the hydrophilic cathode materials in the pulp suspension phase. When the flotation is conducted using the as received material, only 40% of the graphite is recovered and the purity (grade) is only 40%. The problem is that a hydrophobic binder is used in the battery manufacturing which coats both the anode and cathode materials, making them difficult to separate. When the binder is removed by chemical pretreatment, the recovery of graphite increases to 83% yet the grade remains at 60%. The recovery of fine cathode materials by entrainment is responsible for the low grade. Further purification in sulphuric acid increases the grade to 90% graphite. 53% of the cathode oxides remain in the pulp suspension with a purity (grade) of 85%. After thermal treatment in air at 800 ˚C, the purity of the metal oxides increases to 99.9% (mixed metal oxides). Studies are ongoing to determine the performance of the recycled graphite and cathode materials.

Recovery of lithium by pseudocapacitive electrodes in capacitive deionization

O27 - Linda Zou

Institute for Sustainable Industries & Liveable Cities, Victoria University

Linda.Zou1@vu.edu.au

Brief bio of speaker

Professor Linda Zou has worked at Khalifa University during 2014-2024. Before that, she was a Research Professor at University of South Australia since 2010. Her research interests include developing more efficient novel water purification and desalination technologies, such as nanocomposite membranes, capacitive deionization electrodes, and membrane fouling minimization, where nanostructured materials are incorporated, the technology can be used to remove micropollutants such as pharmaceutical compounds, forever chemicals, heavy metals and fine oil droplets from wastewater to safeguard public health and recover the valuable resources and to support today's circular economy. Dr. Zou led the invention of novel cloud seeding materials during the awarded research project by the 1st Cycle UAE Research Program on Rain Enhancement Science. This research direction aligns with mitigation of climate change. Dr. Zou has published numerous journal articles as senior author (Google Scholar h-index 59, total citations 15000+). She is in the 2020-2023 Stanford University's List of World's Top 2% of Scientists in single year ranking, as well of Career-long Scientists with the greatest citation impact in the environmental engineering and desalination field.

Abstract

Lithium is a crucial component in rechargeable lithium-ion batteries for many applications, including the powering of electric vehicles and stationary energy storage systems. This investigation focused on two hybrid pseudocapacitive materials, the polystyrene sulfonate-MXene composite (PM) and the sodium titanate/graphene oxide composite (NG), for lithium ions recovery from aqueous Li^+ resources. This was achieved by selectively removing unwanted divalent Ca^{2+} and Mg^{2+} ions, as well as monovalent K^+ ions, through capacitive deionization (CDI) using a single-cell system, resulting in a final solution enriched with Li^+ ions. Based on the ion selectivity order observed previously as $Mg^{2+} \approx Ca^{2+} > K^+ > Li^+$, a series of CDI experiments were conducted with sequential steps to remove more selective ions first and to obtain a lithium-enriched solution with higher purity and maximum extracted fraction. Both PM and NG electrodes demonstrated promising performance when tested in binary, ternary, and quaternary ionic solutions with the recovered lithium solution purity in the range of 59.09%-95.94% and 59.75%-77.17%, respectively. Further, the highest enrichment factor values observed were $S_{Li+,Mg2+}$; 268.1 for PM and $S_{Li+,Ca2+}$; 44.25, for NG electrodes. The PSS-modified MXene composite electrode in obtaining the Li^+ solution with the highest purity when separated Ca^{2+} from a binary solution. These findings offer valuable insights into the selective electrosorption of divalent ions over lithium ions through the utilization of ion intercalation pseudocapacitive nanocomposite electrodes. The obtained results hold significance in advancing novel non-precipitation techniques for the recovery of lithium ions from aqueous lithium resources [1].

1. M Faheem, R Alam, A Alhajaj, L Zou*, Recovery of lithium by pseudocapacitive electrodes in capacitive deionization, Electrochimica Acta, 2024, 489, 144267.

Lithium-ion battery recycling-Challenges and opportunities

O28 - Parama Chakraborty Banerjee

Department of Chemical and Biological Engineering, Monash University,
Clayton, Victoria, Australia

parama.banerjee@monash.edu

Brief bio of speaker

Parama is a Senior Lecturer in the Department of Chemical and Biological Engineering at Monash University. Parama's research focus includes recovery of critical metals and minerals from wastes, recycling of ewastes, electrocatalysis, energy storage (batteries and supercapacitors), multifunctional electrocatalytic material development and corrosion. Parama has supervised a number postdocs and PhD students, who are now employed in academia and industry. Parama has received several awards including an Early career researcher award from CRC Australia.

Abstract

Lithium-ion batteries (LIBs) are widely used as a critical energy storage system for internet of things (IoT), electric vehicles (EV) and various renewable energy sources. However, the widespread use of LIBs has resulted in the significant accumulation of batteries with different chemistries in landfills. Existing methods for LIB recycling are unsustainable, non-environmentally friendly and ineffective at recycling spent LIBs with mixed chemistry. These methods are inadequate to achieve recovery and repurposing of the valuable and sometimes toxic components. This mandates an inherent need to improve the existing processes or develop a novel, sustainable, environmentally friendly and effective alternative process. In this talk, we present a comprehensive review of the current recovery technologies; demonstrating the gaps in understanding, the challenges and opportunities available in the recycling processes. I shall also present the recent research from our labs in this area with an aim to facilitate the LIB recycling industry to shift towards a circular economy.

Panel Discussion 6: Supply Chain and Governance

Moderator: Franz Wohlgezogen, University of Melbourne

Overcoming barriers and challenges for a circular economy

K13 - George Panas

george.panas@unimelb.edu.au

Brief bio of keynote speaker

After 25 years of senior management experience, George recently transitioned to academia, completing a PhD on sustainable grocery eCommerce supply chains. He is now Enterprise Fellow, and Director of Engagement in the Department of Management & Marketing at the University of Melbourne. He lectures in both undergraduate and postgraduate supply chain management subjects. In his teaching and research, George draws extensively on his own personal work experience, where he held functional leadership roles at BHP, GlaxoSmithKline, Coles Group, Australia Post, and Australia's national broadband network (nbn). George is passionate about ensuring academic programs and research engage closely with industry, ensuring both graduates and research output can best meet the needs of organisations and society. His current research interests include sustainable supply chains, investigating whether greater disclosure of packaging to be used by retailers in the eCommerce last mile can impact consumer purchasing decisions and subsequent waste generation; and ethical supply chain sourcing, where he has published in leading operations management academic journals on the topic of managerial decision-making and modern slavery in global supply chains.

Abstract

The keynote explores the intersection between circularity and greenhouse gas (GHG) emissions, particularly challenges and opportunities for retailers to reduce scope 3 emissions. It highlights the overemphasis on consumer-oriented communication strategies versus substantive action, a reliance on policy over supplier engagement, and a tendency to prioritize measurement over implementation. The keynote will discuss how circularity and GHG reduction activities must extend well beyond influencing consumer behaviour, but in driving change across extended, complex and global supply chains.

Designing behaviour change interventions for a circular economy

K14 - Lena Jungbluth

Lena.Jungbluth@monash.edu

Brief bio of keynote speaker

Lena is an applied behaviour change researcher with over ten years' experience working at BehaviourWorks Australia at Monash University. She mainly works on environmental topics and has been involved in many projects aiming to improve pro-environmental behaviours, attitudes and knowledge. Lena's key research interest is hospital sustainability, with a particular focus on waste management. Lena is about to complete a PhD at the Monash Sustainable Development Institute looking at ways to improve recycling at hospitals by drawing on behavioural science.

Other examples of Lena's work include mapping the connections between responsible consumption behaviours, exploring facilitators and barriers to responsible household chemicals and e-waste disposal, improving biosecurity risk preparedness among aquaculture farmers, and understanding farmers' opinions on energy efficiency and riparian land management.

Abstract

The keynote explores the critical role of behavioural science in designing promising behaviour change interventions for a circular economy. It demonstrates that awareness raising and education alone do not necessarily lead to a change in human behaviour and introduces the BehaviourWorks Method as a structured approach for developing behavioural interventions. It illustrates this method's three phases – Exploration, Deep Dive, and Application – using examples from circular economy projects and provides an overview of intervention options beyond education.

Session 6: Supply Chain and Governance

Chair: Franz Wohlgezogen, University of Melbourne

Unlocking Scope 3 Emissions Reductions through Circular Business Models: A Supply Chain and Governance Perspective

O29 - Mayuri Wijayasundara
Anvarta Pty Ltd

Mayuri@anvarta.com

Brief bio of speaker

Mayuri is a leading international expert in designing transition strategies and pathways, specialising in transition towards a low-carbon and circular economy.
She has over 20 years' experience as a senior industry practitioner, researcher and an advisor delivering programs internationally. Mayuri has led industry transformation programs in the Asia Pacific and served as a tenured University academic leading a research group in enablers of a circular economy. She was recently engaged as Circular Economy Expert at UN Habitat and currently is a practising advisor through the company she founded – Anvarta. Mayuri serves as a ministerial advisory committee member of Recycling Victoria and in boards of several other industry/professional associations. She holds a PhD from the University of Melbourne and is a chartered management accountant of CIMA, UK.

Abstract

Scope 3 emissions which include indirect greenhouse gas emissions arising across a company's value chain, including suppliers, logistics, product use, and disposal, often make up the largest share of a business's total carbon footprint. Yet, among Scope 1,2 and 3 emissions, Scope 3 emissions get the attention last mainly due to the complexity in understanding and reliably estimating it.

As regulatory, investor, and stakeholder pressures intensify, businesses are being called to account for their full value chain emissions. In this context, circular business models present a transformative pathway, not only to reduce Scope 3 emissions but to promote effective carbon and resource management in the supply chain. It aims to support organisations in taking realistic steps towards decarbonisation while improving how they manage resources, relationships, and risk across the supply chain.

This presentation explores how circular economy strategies such as reuse, product-as-a-service, reverse logistics, and material recirculation can be leveraged to mitigate Scope 3 emissions. By shifting away from linear consumption and introducing new models of ownership, access, and distribution, businesses can keep products and materials in use longer through reusing, repairing, remanufacturing and service-based approaches.
Practical insights will be shared on how circular models can be embedded within supply chain operations, supported by a real-world case study illustrating strategies and outcomes achieved through this transition.

Circular economy governance in three Australian cities

O30 - Amelia Leavesley
University of Melbourne

*amelia.leavelsey@unimelb.edu.au

Brief bio of speaker

Amelia is an urban sustainability scholar, teacher and former consultant who is passionate about healthy cities and good governance. She is currently completing her PhD on multilevel waste governance in Australian cities at the Faculty of Architecture, Building and Planning, University of Melbourne. Her PhD research explores the multilevel governance aspects of Australia's circular economy transition, focussing on the role of local governments in advancing sustainable municipal waste outcomes.

Amelia also works as a Research Fellow in Urban Climate Leadership at the Melbourne Centre for Cities, where she is co-developing and delivering a regional training programme for city-level climate action in the Asia Pacific. Her work builds on over 5 years of research experience working on urban climate policy, multilevel governance, city networking and climate action with local governments across the world.

Amelia also brings 10 years of industry experience as a strategic engagement consultant and water scientist, working with multiple levels of government to help deliver major projects in water, planning, transport and waste. She holds a Master of Environment (Education and Social Change) from the University of Melbourne and the University of Copenhagen (postgraduate exchange), and a Bachelor of Science (Engineering and Environmental Science) from the University of Western Australia.

Abstract

Sustainable municipal waste management (MWM), which encompasses waste reduction, reuse, and resource recovery practices, remains a persistent challenge for local governments in Australia. Faced with growing waste production and landfill capacity limits, local authorities are under increasing pressure to reduce waste to landfill, increase recycling rates, and keep materials in circulation: activities which are often outside of their direct control. There is concurrent and growing academic debate academic debate regarding the governing complexities involved in achieving more circular and sustainable MWM outcomes in cities. A key consideration of this work is the dynamic and overlapping nature of the governance of waste, where divergent 'modes of governing' (here, classified as waste management objectives) lead to conflicting priorities and unsustainable outcomes – including more disposal of waste. Navigating these governance complexities is critical to overcoming existing MWM constraints and advancing more circular outcomes in Australian cities.

This presentation adapts Bulkeley et al.'s 'modes of waste governing' framework to analyse circular economy governance in three cities from New South Wales, Australia. This research draws on waste policies and interviews with key stakeholders to investigate how localised governing processes influence circularity outcomes in each site. The framework identifies five different governing 'modes' and analyses the tools, actors and processes involved in each. These modes loosely align with principles of the waste hierarchy and include disposal, energy recovery, resource recovery, reuse, and circularity. The analysis considers the arrangement of waste governance around these objectives, the degree of entrenchment for each governance arrangement, and how these arrangements interact and compete.

Thematic analysis reveals that interactions between governance arrangements influence how circularity outcomes are achieved within each locality. Disposal and resource recovery are the most dominant modes, while circularity and reuse are outcompeted and remain emergent across all sites. Tensions emerge between waste policy ambitions which pursue circularity outcomes and the dominant regulatory, financial, and infrastructure systems supporting more conventional MWM practices, such as disposal. These tensions create perceived and real 'stuckedness,' preventing local governments from pursuing more circular outcomes. While collective local action aids with 'unsticking,' overcoming these systemic challenges requires engagement between all levels of government.

As Australian regulatory authorities and different levels of government grapple with the transition toward a more circular economy, useful knowledge has been gained about how local governments can overcome governance complexities to accelerate the transition toward circular outcomes in cities. This research highlights the need for strengthened regulations, access to infrastructure, and dedicated financial support to overcome local MWM challenges, and underlines the significance of multilevel coordination for progressing circular economy outcomes.

Rethinking Transparency in Fashion Supply Chains: Between Visibility and justice

O31 - Chanuthi Rajapaksha
Yokohama City University

chanuthir@gmail.com, u235063d@yokohama-cu.ac.jp

Brief bio of speaker

I am a PhD candidate at Yokohama City University, Japan. I bring over 17 years of professional experience in business development across Sri Lanka and Japan, including five years in the fashion industry where I managed supply chain operations and strategic growth in Tokyo. My doctoral research examines transparency and governance in global fashion supply chains, with a focus on ethics, digital traceability, and justice-oriented transparency and traceability practices.

Abstract

This paper rethinks transparency as a central mechanism of governance in global fashion supply chains. While transparency initiatives such as audits, traceability platforms, and dashboards have contributed meaningfully to making supply chains more visible and have elevated accountability on issues like labour standards and environmental impact, they are increasingly shaped by technocratic and managerial logics that prioritize measurable outputs over deeper structural reforms. These mechanisms, while valuable in promoting oversight, often function as symbolic performances that obscure inequities, silence upstream voices, and exclude context specific knowledge.

Drawing on critical literature in supply chain ethics, epistemic injustice, and the politics of visibility, the paper argues that prevailing transparency practices frequently deliver informational visibility without substantive accountability. Standardized data systems tend to Favor large brands and formal suppliers, marginalizing informal, subcontracted, or culturally distinct actors in the Global South. The emphasis on quantifiable indicators such as compliance scores or material traceability produces epistemic exclusions that treat those most affected by governance regimes as data subjects rather than knowledge holders or decision makers.

To move beyond these limitations, the paper proposes a justice-oriented transparency framework grounded in three interlinked pillars: **Inclusivity, Contextuality**, and **Reflexivity.** Inclusivity demands recognition of diverse actors as legitimate co-creators of transparency processes. Contextuality resists one size-fits all metrics, advocating for locally embedded approaches that reflect plural ethical worlds. Reflexivity encourages brands and certifiers to examine the power structures underpinning transparency systems, asking whose interests are served and what remains unseen. Rather than rejecting existing tools, the framework seeks to **complement and strengthen them** by embedding ethical, participatory, and justice centred values. It responds to the growing recognition that visibility alone cannot deliver equitable outcomes in global production networks. By shifting from top down surveillance to co-produced accountability, the framework is expected to offer a pathway for more inclusive and transformative approaches to supply chain governance.

Unintended Consequences of Climate Change Mitigation and Adaptation Measures in the Circular Economy Framework

O32 - Paul Solomon VinothKumar
V3 Eco Solutions Pvt. Ltd

re@v3ecosolutions.com

Brief bio of speaker

Paul Solomon is the Co-Founder and Managing Director of V3 Eco Solutions Pvt. Ltd., a climate innovation enterprise focused on regenerative infrastructure, circular economy models, and large-scale carbon drawdown systems. With a background in Technical Training, IT Services, sustainable development and systems thinking, Paul leads pioneering initiatives that integrate ecological design, community well-being, and policy transformation. He is currently spearheading the Global Carbon Realignment Initiative, a 100-billion-metric-ton emissions reversal framework aligned with the SDGs and Paris Agreement targets. Paul is passionate about designing future-proof climate strategies that minimize unintended consequences while maximizing social equity and planetary health.

Abstract

As global warming intensifies, the circular economy has emerged as a defining model for addressing the double crises of planetary destruction and unsustainability. Designed to recover natural systems, eliminate waste, and recover lifecycles of materials, circular solutions are today's foundational global climate adaptation and mitigation strategy. But lurking behind their promise lies a stark blind spot: most such solutions produce unintended consequences—unforeseen environment, economic, and social impacts that can actually oppose sustainability objectives.

This paper investigates these systemic failings through five international case studies covering sectors and jurisdictions. Drawing on the fields of systems thinking and life-cycle visioning, the study reveals how such measures as electric vehicles, renewable energy, biofuels, waste recycling programs, and carbon trading inevitably have collateral consequences—ranging from environmental disruption and distributional inequity through rebound effects and late decarbonization. First is India's EV transition, where pressure towards e-mobility has inadvertently fuelled lithium mining from fragile ecosystems, furthered urban-rural inequities, and delivered new waste challenges through spent-battery disposal. The second example from the EU is how large-scale biofuel use aimed at lowering transport-related emissions has caused deforestation, carbon leakage, and food insecurity through indirect land use. In the third case, we examine global fashion brands' recycling programs of fast fashion. Heralded as green initiatives, these programs have enabled continuing overproduction, largely relied on downcycling, and resulted in waste dumping in Global South nations and concerns about waste colonialism. The fourth case explores solar power deployment within India's Rajasthan state, in which promotion of clean energy conflicted with local community rights to grazing and local biodiversity—shedding light on conflict between renewable targets and socio-ecological resilience. The final case gives a critical examination of carbon offsetting projects, common amongst firms and net-zero states. These projects have also come under widespread criticism for enabling "phantom credits," displacing indigenous cultures, and allowing emitters to postpone direct reduction—unveiling gaps in implementation, governance and justice in the voluntary carbon market. Collectively, these cases illuminate key system-level problems: rebound effects, temporally or spatially shifting burdens, equity errors, and governance mismatches. For these, the paper recommends multi-layered solutions founded on anticipatory policy-making, life-cycle assessment (LCA), just transition processes, and adaptive governance. Rather than giving up on circular methods, the paper calls for their recalibration. Climate action must shift from single-issue corrections toward entire-system considerations. When we put unintended consequences on the table not as setbacks but as signals for refinement, we can improve our designs for circular economies and their resilience—so that our models don't only reduce emissions but also catalyze justice, equity, and ecological rejuvenation. This writing is ultimately a warning and a direction: that toward a race for cyclical climate solutions, what we neglect can be as vital as what we aim for. Only by designing with anticipation can we build a genuinely regenerative future.

Surgical device companies' commitments towards net zero

O33 – Yuqing Lu
Yuqing Lu, Yusuf Wardak
Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Parkville, VIC 3010, Australia

yulu5@student.unimelb.edu.au

Brief bio of speaker

Sunny Yuqing Lu is a final-year medical student at the University of Melbourne with a strong interest in sustainability in healthcare. She has led and contributed to multiple projects evaluating the carbon footprint and environmental impact of healthcare practices across various specialties. Her work includes assessing the use of fluorinated gases in vitreoretinal surgery at the Royal Victorian Eye and Ear Hospital, exploring sustainability in coronary artery bypass grafting for patients with coronary artery disease, and examining the environmental impact of surgical device companies. Beyond her academic and clinical pursuits, Sunny is an avid adventurer who enjoys skiing, playing golf, and practicing classical dance—passions that reflect her commitment to a well-rounded and vibrant life.

Abstract

Background: Climate change increasingly demands substantial actions across all sectors globally to ensure a sustainable future. Frameworks like the Science Based Targets initiative (SBTi) guide companies, including surgical device providers, in reducing greenhouse gas emissions (GHGE). This study focuses on the net-zero commitments of surgical device companies operating in Australia, evaluating their alignment with global sustainability targets.

Methods: 29 major surgical device companies operating in Australia were selected based on a large tertiary hospital's expenditure in Victoria and an expert panel from the Royal Australasian College of Surgeons. A content analysis of their carbon emission commitments was conducted using a modified framework from the PricewaterhouseCoopers (PwC) Building blocks for net zero transformation framework, with three domains: accountability, ambition, and action; the Carbon Disclosure Project (CDP) grading; the SBTi approval system. Environmental, Social, and Governance (ESG) reports were reviewed to assess companies' monitoring and disclosure of GHGE, their GHGE targets for scope 1, 2, and 3, and their specific strategies in business activities for GHGE reduction. We developed a scorecard for the 29 companies selected based on their accountability, ambition, and action towards carbon net zero.

Results: Companies were classified into three groups: industry leaders with SBTi-approved targets across all three scopes (Abbott Laboratories, Bard Australia, Boston Scientific, Edwards Lifesciences, Johnson & Johnson, Olympus, Teleflex, Terumo, and Zimmer Biomet); intermediate companies with SBTi-approved targets missing scope 3, or with specific carbon reduction targets without SBTi approval (3M, B Braun, Baxter Healthcare, Cardinal Health, Livanova, Medtronic, Molnlycke Health Care, Smith & Nephew, and W L Gore & Associates); and companies without adequate targets (Applied Industrial Technologies, Bausch & Lomb, Conmed Corporation, Cook Medical, Da Vinci Intuitive Surgical, Defries industries, Integra Neurosciences, Karl Storz Endoscopy, Medline Industries, Multigate Medical Products, and Stryker). Common gaps included suboptimal scope 3 commitments, limited disclosure of specific decarbonisation business activities and environmental and sustainability corporate governance, and most importantly, an effort to move away from a linear business model toward a circular business model. The latter was lacking in all companies reviewed.

Conclusion: Surgical device companies in Australia show growing commitments towards net zero, with gaps remaining in carbon reporting and reduction strategies. Surgical device manufacturers should aim to address these important gaps in their decarbonisation journey and move towards a circular business model.

Stakeholder Driven Insights to Embed Circularity in Healthcare Procurement

O34 - Urvi Thanekar

Urvi Thanekar, Rebecca Patrick

Melbourne School of Population and Global Health, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne

Brief bio of speaker

Urvi Thanekar is a PhD candidate within the Institute of Health Transformation at Deakin University partnering with Barwon Health focusing on reducing their environmental footprint using systems dynamics and economic analysis. She also works with the Climate Catch Lab at the University of Melbourne on projects that intersect climate change and healthcare systems.

Dr Rebecca Patrick is a teaching and research academic who is recognised for her expertise in nature, environment, and health research and scholarship. She leads multi-institution mixed methods research in climate-related mental wellbeing and health co-benefit intervention measurement and evaluation.

Abstract

Background

Healthcare systems contribute 4–5 % of global greenhouse gas emissions, with over 60 % arising from Scope 3 sources—predominantly the lifecycle impacts of plastic consumables. Single-use medical instruments and packaging dominate these emissions, yet entrenched procurement practices and supplier monopolies constrain uptake of reusable alternatives. This PhD research combined semi-structured interviews (Phase I) and Group Model Building workshops (Phase III) in a large regional Australian health service to co-design strategies that embed circular economy principles—such as Environmental Product Declarations (EPDs), product stewardship, and lifecycle-based procurement—into purchasing for high-impact consumables.

Methods

Twenty clinicians, procurement officers, sterilisation managers and sustainability leads participated in interviews exploring perceptions of reusable versus disposable consumables. Subsequent GMB workshops with thirty-five stakeholders generated a Causal Loop Diagram, revealing feedback loops, systemic barriers and leverage points for embedding circularity. Outputs were thematically analysed to prioritise interventions around procurement reform, supplier engagement, EPD adoption and metrics development.

Findings

Supplier Monopolies and Proprietary Consumables. Long-term contracts—many negotiated during the COVID-19 pandemic—lock hospitals into high-volume purchasing of branded, single-use consumables, obscuring total lifecycle costs and limiting trial of reusable alternatives. Proprietary designs further discourage reprocessing by complicating sterilisation or excluding take-back schemes, reinforcing disposable-heavy norms .

Environmental Product Declarations and Lifecycle Transparency. Stakeholders advocated mandating EPDs in tenders to disclose cradle-to-grave impacts and make comparative carbon and cost data visible at procurement. Embedding EPD requirements would shift decision-making from initial purchase price to total lifecycle value—including reuse rates, resource recovery percentages and product longevity .

Procurement Innovation for Priority Consumables. Participants emphasised establishing a dedicated sustainability procurement role to oversee transparent purchasing, champion circular criteria, and negotiate flexible contracts permitting pilot trials of reusable alternatives. Servitisation models—where manufacturers retain responsibility for maintenance and end-of-life management—were proposed to realign supplier incentives with reuse goals and reduce hospitals' operational risk .

Materials Efficiency & Circularity as a Leverage Point. Circularity of critical consumables (e.g., surgical trays, drapes, gowns) emerged as the most actionable pathway to rapid Scope 3 reductions. Key enablers included reframing education campaigns to promote reuse and waste-as-resource mindsets, and forging multidisciplinary partnerships with engineers and product designers to co-develop reusable products and circular packaging solutions.

Conclusions

Materials efficiency and circularity—anchored by mandatory EPDs, product stewardship and procurement reform—offer a clear, actionable steps for decarbonising healthcare. By leveraging purchasing power to demand full-lifecycle transparency and hold suppliers accountable, health services can dismantle institutional lock-ins and supplier monopolies that perpetuate single-use dependency.

Panel Discussion 7: Unintended Consequences

Moderator: Stefano Freguia, University of Melbourne

Emerging contaminants in the environment: Where should research and management efforts be directed for optimal environmental outcomes?

K15 - Minna Saaristo
Environment Protection Authority (EPA VIC)

minna.saaristo@epa.vic.gov.au

Brief bio of keynote speaker

Dr. Minna Saaristo is an ecotoxicologist with over 20 years of international experience in applying science-based approaches to assess the impacts and risks of contaminants of concern on the environment. She is a Principal Scientist in Ecological Risk and Emerging Contaminants at EPA Victoria and leads the Emerging Contaminants Program there. Since joining EPA in 2019, Dr. Saaristo has led projects assessing background concentrations of emerging contaminants in soil, freshwater, sediment, and biota across the state, uncovering their presence in influent and effluent waters, and investigating the uptake of contaminants of concern into edible crops. Prior to her work at EPA, Dr. Saaristo spent 10 years as a Research Fellow at Monash University. She is an internationally recognized behavioural ecotoxicologist whose multidisciplinary research has provided pivotal insights into how chemical pollutants affect sexual selection across multiple generations of wildlife.

Abstract

Emerging contaminants are a wicked problem. There is limited information on their presence in the environment, their persistence and bioaccumulative characteristics, and whether exposure to sublethal levels causes adverse effects on non-target organisms. When circular economy and climate change are added to the equation, it feels like a mission impossible. Despite this, regulatory and management actions are essential. Regulators are constantly seeking the best available science and knowledge to support their decision-making.

In my talk, I will provide an overview of the work my Emerging Contaminants team has undertaken over the past six years at EPA Victoria. It offers a snapshot of findings from studies conducted during major floods, to catching fish upstream and downstream of wastewater treatment plants, to collecting water samples following significant rain events. I will share some unexpected findings and lessons learned along the way.

To explore how research should be directed for optimal environmental outcomes, I will touch on principles from green chemistry. The tenth principle of green chemistry is "Design for Degradation"—meaning that chemical products should be designed to break down into harmless substances after their useful life, preventing persistence in the environment. This approach aligns directly with circular economy principles by minimizing waste and promoting resource recovery. In essence, design for degradation is a key element in building a circular economy that prioritizes resource efficiency, waste reduction, and environmental regeneration.

Climate change has—and will continue to—play a role in shaping the environmental distribution and toxicity of emerging contaminants. For example, elevated water temperatures may alter the biotransformation of contaminants into more bioactive metabolites and impair homeostasis. The complex interactions between climate change and contaminants may be especially problematic for species living at the edge of their physiological tolerance, where acclimation capacity is limited. Regions experiencing decreased precipitation may see increased volatilization of persistent organic pollutants and pesticides into the atmosphere. I will provide insights from our flood studies and offer suggestions regarding the type of research regulators are seeking to address this multifaceted issue.

As stated in UNEP's statement on pollution and the circular economy: “A key part of the solution to the three planetary crises is to transition to a more resource-efficient and circular economy, where waste and pollution are eliminated, products and materials are kept in use at their highest value, and natural systems are regenerated.” We must address the risks of pollution, but more importantly, we should embrace the opportunities that arise from circular solutions. In my presentation, I will share insights from the work we have done at EPA to collaboratively tackle pollution through partnerships.

Emerging Contaminants - Unintended versus Unforeseen

K16 - Matthew Askeland
ADE Consulting Group

matthew.askeland@ade.group

Brief bio of speaker

Matthew Askeland is an environmental professional engaged in the contaminated land, resource recovery, and circular economy sectors specialising in the management of emerging contaminants.
Matt previously led ADE Consulting Group's Victorian Environment Practice which included a specialist Business Unit, focused on emerging contaminants.
Matt enjoys solving problems, challenging conventional approaches, and being generally disruptive.

Abstract

The transition to a circular economy has been widely championed as an environmental and economic imperative. However, as resource recovery and reuse expand into new territories, unintended consequences have emerged in the form of contaminant risks that threaten human health, environmental objectives, and the viability of circular business models.

At Waste Expo 2023, I delivered a talk titled *"Circular Economy: The False Start"*, in which I warned that our headlong rush into circularity, driven by investment enthusiasm rather than technical readiness, was likely to be derailed by inadequate attention to contaminants. Since then, many circular initiatives have encountered precisely the challenges predicted: contaminated input material streams (feedstocks), regulatory uncertainty, reputational damage, and even complete failure.

This presentation builds upon that foundation, offering both a warning and a roadmap. It examines the consequences of integrating emerging contaminants into new material loops in situations where source materials were never designed for reuse. This doesn't mean innovation should be avoided, but that the potential impacts of emerging contaminants need to be strongly considered.

Emerging contaminants must be defined more broadly than the usual suspects like PFAS, Flame retardants, or UV stabilisers like 6PPD-quinone. In this context, they also include re-emerging substances such as asbestos, lithium, and heavy metals, which are resurfacing through poorly characterised waste streams as they get reused in numerous new processes and end markets.

Unlike true circularity, which is ideally built on intentional design principles (e.g., eliminating hazards at the source), much of today's resource recovery operates under the constraints of legacy systems. We are recovering materials that were never designed for even a second life, and doing so without a full understanding of their contaminant profiles or transformation potential. This presents profound challenges not only for industry but also for regulators, who must adjudicate risks under high uncertainty.

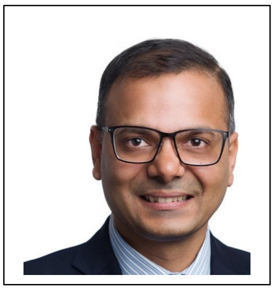
Drawing on field experience, industry data, and regulatory frameworks, this session offers a system-thinking approach to understanding contamination risks in circular material flows. It explores:

- Why knowledge gaps and uncertain toxicology profiles hinder investment and innovation.
- How linear risk models fail to capture circular complexity.
- Where risk is being displaced: into biosolids, secondary fuels, composts, construction products, and what we can do to address it.
- Practical recommendations for reducing uncertainty, including traceability, precautionary screening, and collaborative R&D.

This presentation will speak directly to those in policy, regulation, industry, and waste management who seek to build a resilient circular economy that does not compromise safety or public trust. Through foresight and systems integration, we can better anticipate, manage, and ultimately prevent the next wave of unintended consequences.

Session 7: Unintended Consequences

Chair: Stefano Freguia



A novel method to assess leaching of contaminants of concern from recycled tyre products

O35 - Prashant Srivastava

Brief Bio of Invited Speaker

I am a researcher with three decades of diverse experience in environmental and agricultural science. My research focuses on environmental contaminants, waste management, recycling, and circular economy and has taken place in Asia, Australia, and North America.

I have led multidisciplinary research teams to deliver high-quality, high-impact research projects focussing on environmental contaminants assessment, remediation and management. I have worked collaboratively with diverse stakeholders to achieve outcomes that have brought about a step-change in the assessment of contaminated sites in Australia.

My current research interests include assessment, remediation and management of chemicals of emerging concern, including but not limited to per- and poly-fluoroalkyl substances (PFAS), microplastics, tyre rubber chemicals, e-wastes, personal care products etc in soil, surface and ground water, wastes and biosolids.

One of my current projects is developing beneficial reuse options for highly saline brine generated from coal seam gas production. Simultaneously I am also assessing and mitigating risks from environmental contaminants in construction and road waste to enable their reuse and circular economy.

Abstract

Recycling old tyres into pavement products is environmentally appealing but raises concerns about certain chemicals of concern (COCs) being leached into the environment. Traditional leaching tests often overestimate environmental risks because they do not mimic real-world rainfall and runoff. This study presents a novel method to assess chemical leaching, called the static surface leaching procedure (SSLP), which better simulates how rain interacts with rubberised pavement surfaces. Two types of pavements containing different amounts of recycled tyres were tested. While the traditional batch method suggested a relatively higher release of some chemicals, SSLP results showed that most COCs were within safe limits, except for a few that exceeded thresholds reported in some published studies. SSLP helps identify realistic environmental risks and can guide safer recycling practices for tyres and other materials in construction.

How Consumer Informal Production Can Support Market-Autonomous Circular Economies

O36 - Daiane Scaraboto

Dr Marcia Christina Ferreira (University of Essex, UK), Prof Daiane Scaraboto (University of Melbourne, Australia)*, Prof Bernardo Figueiredo (RMIT University, Australia), Prof Eliane Britto (Fundacao Getulio Vargas, Brazil), Dr Adriana Schneider Dallolio (Universidade de Sao Paulo, Brazil).

dscaraboto@unimelb.edu.au

Brief bio of speaker

Daiane Scaraboto is Professor of Marketing at the Faculty of Business and Economics, at the University of Melbourne. Her research challenges taken-for-granted market notions such as value, exchange, and access, by examining how consumers collaborate, instigate market change, and engage with sustainability challenges. Her projects employ large qualitative datasets combining interviews, ethnographic fieldwork, media and social media data. She has published influential research in the fields of Consumer Culture and Marketing.

Abstract

People often modify and make their own consumer goods. This phenomenon, termed here as consumer informal production, encompasses practices such as craftwork, do-it-yourself (DIY), repair, and makeshifting. Consumer informal production is not regulated by governmental institutions, does not follow formal economic principles, and does not produce goods intended for sale (Campbell, 2005). Moreover, some of its practices thrive without relying on market resource provisions and, as such, may support the establishment of informal circular economies.

In this study, we adopt a practice-theoretical lens to map existing one such market-autonomous practice of consumer informal production: makeshifting. Makeshifting involves consumers' (re)use of materials, objects, and their parts to adjust, improve, or invent their own consumption goods. Terms such as *jugaad* in India (Agarwal et al., 2020), *bodge* in the United Kingdom (Roe and Scott-Bottoms, 2020); and *urawaza* in Japan (Katayama, 2008), demonstrate the global presence of this practice.

Our netnographic study (Kozinets, 2020) investigates *gambiarra*, the Brazilian term for makeshifting. Whereas it is common in resource-scarce environments, makeshifting emerges not only from scarcity but also from an abundance of idle objects that invite reuse, often in ingenious ways (Boufleur, 2013). Whether driven by scarcity or abundance, makeshifting is resource-oriented, and therefore can inform understandings of how resources can be kept in circulation, a goal that is at the core of the circular economy (Blomsma and Tennant, 2020).

We find that ingenuity and resourcefulness are at the core of makeshifting. Rather than seeing only the materiality as it exists, consumers envision what it can become and reconfigure materials to afford new product designs. For example, consumers create automatic pet feeders using whichever materials, objects, and their parts they have readily available, including waste (e.g., disposable plastic bottles and PVC pipe offcuts). Makeshift solutions are open-ended, varied, and allow for a multiplicity of applications for objects and materials. Just in our dataset, we identified 16 different makeshifts of pet feeders, evidencing how multiple practitioners arrive at different solutions for the same need.

Our findings indicate that makeshifting not only extends the life of material resources, but also democratizes access to consumption. This is seen in the varied makeshift solutions developed by Brazilian consumers for pool bathing—some temporary and improvised, others more permanently incorporated into backyards and home designs. Consumers endow pickup trucks, skip bins, cisterns, tarpaulins, and other materials and objects with new affordances, combining these objects into new material arrangements to create makeshift bathing pools.

Whereas some consumer information production (e.g., craftwork) largely depends on tools, materials, and components purchased through formal markets, practices such as makeshifting rely on alternative resources such as repurposed waste, found objects, or spare materials. Our findings demonstrate how consumers use these resources to perform everyday activities such as cooking, organizing, and pet care without purchasing new products. By transgressing market norms and relying on alternative resources, makeshifting supports the development of a market-autonomous circular economy. As such, our study extends understandings of the core role consumers play in advancing circular economies (Hobson, 2020).

Monitoring Greenhouse Gases Emissions During the Secondary Composting Process of Food Waste Compost Products

O37 - Saeromi Lee

Saeromi Lee, Chang hyuk Ahn, Jonghun Lee, Joowan Lim, Linitho Suu, June-Seok Choi, Youngkwon Choi*
Department of Environmental Research, Korea Institute of Civil Engineering and Building Technology (KICT),

Speaker's email: saeromi@kict.re.kr

Brief bio of speaker

Saeromi Lee is a research specialist with a background in limnology, with particular expertise in aquatic ecosystems. Building on ecological research, I have recently expanded my focus to include carbon neutrality, exploring biogeochemical processes and greenhouse gas emissions in the context of organic waste treatment.

Abstract

The recycling rate of food waste in Korea is close to 100%, with methods such as feed production, composting, and biogas production. Approximately 30% of the total is produced as compost (food waste compost, FWcom) and then recycled(Lee et al., 2020). However, due to its immature state or the presence of foreign substances, farmers are reluctant to use it as compost. As a result, unused compost is often left outside, leading to leachate formation and causing direct environmental issues such as soil contamination and water pollution(Lee et al., 2017). Additionally, with the increasing focus on climate change, there is growing attention on the occurrence of greenhouse gases. Therefore, this study monitored CO_2 emissions to confirm those from compost produced at national facilities. The equipment used was an integrated data logger system (CR1000X, Campbell Scientific, USA) for continuous CO_2 measurement and basic item measurements. CO_2 was measured with sensors in chamber (eosFDCO_2, Eosense Inc., Canada) and probe (eosGPCO_2, Eosense Inc., Canada) forms, in conjunction with temperature, pH, oxidation-reduction potential (ORP), moisture, and electrical conductivity (EC; CS650, Campbell Scientific, USA). These readings were managed in real-time using the LoggerNet 4 program. The eosFDCO_2 used is a forced diffusion chamber (FDC) system that continuously measures CO_2 from the atmosphere diffusing into the chamber (FDatm), CO_2 directly produced from the soil (FDsoil), and CO_2 flux (FDflux) from biological and chemical processes within the soil. Samples were obtained from an environmental management center operated by a local government, then spread out in stainless steel trays (W550×D450×H70mm) in the lab for measurements. Experimental setups included: 1) Indoor air, 2) FWcom, 3) FWcom+water, 4) Coffee grounds (CG), and 5) CG+water, with a certain amount of water added for efficient pretreatment and ease of measuring pH and EC. The results showed higher CO_2 values in FWcom+water, with FDC measurements being higher than GP sensors (FDsoil 920.4±24.0 ppm). This suggests that the FDC system, being a closed dynamic system, has better detection capabilities compared to exposed probe forms. Additionally, flux values were identified in FWcom and FWcom+water, indicating some microbial respiration in the final product. pH was slightly acidic in FW and CG, with accuracy decreasing as moisture levels dropped. ORP values increased with moisture, suggesting active oxidation reactions, and were higher in coffee grounds compared to food waste compost. This study confirms the potential for continuous CO_2 emissions from food waste compost, suggesting that compost left on croplands for further maturation can become a new CO_2 source. Future research will focus on creating materials capable of removing non-point source pollutants from urban streams by further refining food waste compost.

References

Lee, S, Park J. R. & Ahn, C. H. 2020 Development of Sustainable Food Waste Management for Reducing Greenhouse Gases Emissions in Korea. Ecology and Resilient Infrastructure, 7, 248–255.
Lee, Y. D., Yoo, J. H., & Joo, J. H. 2017 The effect of food waste compost and livestock manure on Chinese cabbage (Brassica rapa var. glabra) growth. Kor. J. Soil Science and Fertilizer, 50, 547-553.

Acknowledgement

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Healthcare & the Circular Economy

O38 - Forbes McGain

Forbes McGain, Associate Dean, Healthcare Sustainability, Scott McAllister, Research Fellow, Catherine O'Shea, Healthcare Carbon Lab, University of Melbourne

Forbes.mcgain@wh.org.au

Scott.mcallister@unimelb.edu.au

Catherine.oshea@unimelb.edu.au

Brief bio of speaker

Forbes McGain is an anaesthetist and intensive care physician at Western Health, Melbourne, Australia, and the inaugural Associate Dean Healthcare Sustainability in the Faculty of Medicine, Dentistry and Health Sciences at The University of Melbourne.Forbes is a founder of the study of healthcare environmental sustainability, including life cycle assessment (LCA). Forbes has pioneered international collaboration on research projects, editorials, and sustainability statements with individual colleagues, medical colleges, and high impact journals. Such sustainable healthcare research has led to: environmental and financial savings, and social benefits at the hospital workplace in Australia and internationally. Further, via such research and Forbes' engagement, this has led to medical colleges and government policy changes to align with more environmentally sustainable practices.

Scott McAllister has been undertaking environmental life cycle assessments (LCA) for the last 15 years. Since 2009, he became involved in performing assessments in healthcare, and subsequently has authored and co-authored papers on the environmental impacts of a range of medical devices and interventions. He recently completed a PhD on decarbonising healthcare.

Catherine O'Shea is Program Manager of the Healthcare Carbon Lab. She has worked within the field of healthcare sustainability for 20 years developing extensive experience in delivering programs that improve social and environmental performance within the healthcare environment. She maintains a strong passion for healthcare sustainability, collaboration in research and policy development.

Abstract

Many sustainability issues within hospitals can be attributed to the current design of the hospital supply chain as a linear system—with procurement, use and prompt discard of mainly single-use consumables. The adoption of circular economy principles within healthcare is thus seen as a matter of urgency.

Medical (single use) consumables and their packaging require substantial amounts of energy and (raw) materials for their production, and their disposal leads to substantial waste generation. Effective waste management can provide opportunities to reduce operational costs, environmental impacts and potential health risks to staff and patients, however while research on circular economy adoption in healthcare has grown, a critical gap exists in understanding how the field evolves and the primary themes driving its transformation.

The Healthcare Carbon Lab's recently launched Life Cycle Inventory (LCI) project is exploring this knowledge deficit by revealing the material makeup of medical consumables using FTIR-ATR analysis. In the absence of labelling requirements for medical items, we will thus specify their carbon footprint. We are compiling an inventory of medical consumables for healthcare staff, researchers, academics and policy makers to improve transparency and assist the currently incomplete regulatory rigour in the design of a circular economy for healthcare. Early findings of the LCI suggest that the linear nature and recyclability of these medical products is more complex and challenging than suspected.

Australian hospitals continue their commitment to 'single use' or 'single patient use' (disposable) items despite evidence supporting the use and fiscal responsibility for reusables. When reusable medical devices are compared with disposable alternatives, reusables often show financial and environmental benefits, especially when the disinfection and re-sterilisation processes are powered by increasingly prevalent renewable energy sources3.

Reusable alternatives exist for items such as gowns, drapes and barrier linens, PPE, plastic and metalware, surgical instruments, a growing number of medical devices and occupational supports, however given that the regulatory landscape for Medical Devices is much more stringent, progress is slow. Combined with clinicians prevailing uncertainty about authorisation of new reusable products, there are several barriers to the adoption of new and reusable technologies.

Poster Session

Moderator of Poster Pitches: Li Gao, South East Water

The Circular Shift - Circular Model To Eliminate Future Emissions And Heal The Past

P1 - Meenaakshi Balakrishnan
V3 EcoSolutions Pvt. Ltd. (*Founder, Director*)

meenuma@v3ecosolutions.com

Brief Bio Of Speaker

Meenaakshi Karthikeya is a regenerative systems designer, climate policy strategist, and founder of V3 EcoSolutions Pvt. Ltd., a company leading India's transformation toward climate-positive living systems. Her work spans policy, infrastructure, nature-led solutions, and circular carbon economies.
She is the creator of the Global Carbon Realignment Initiative (GCRI)—a planetary framework designed to complement the Paris Agreement by actively drawing down legacy emissions while halting future emissions through regenerative design. GCRI is being prepared for submission to the United Nations as a bold global alternative to net-zero frameworks. At the national level, she is also spearheading the Climate Policy Framework for India, a comprehensive legal structure of climate acts to guide the country's transition into a regenerative and inclusive future. To prove the feasibility of large-scale models, she has developed working prototypes—including a 5-acre rainwater-harvesting lake, food forests, and zero-emission infrastructure—demonstrating circularity at a micro-scale before scaling up.
V3 EcoSolutions is currently in the advanced design and planning stage of a 2,000-acre climate-positive community in Tamil Nadu. The project will move into implementation once formal collaboration with the government is secured.

Abstract
Background & Rationale

- The climate crisis demands a dual response: removing legacy emissions and preventing future emissions.
- While the Paris Agreement targets future reductions, it leaves a major gap in addressing existing atmospheric carbon.
- There is an urgent need for scalable, ground-up models that embed circularity, regeneration, and community-led governance, turning emission-heavy living into net-negative ecosystems.

What V3 Is Doing

- V3 EcoSolutions is developing a 2,000-acre circular carbon community in Tamil Nadu, India, serving as an on-the-ground prototype of the Global Carbon Realignment Initiative (GCRI).
- GCRI is a planetary framework designed by V3 to complement the Paris Agreement. It introduces a two-pronged strategy:
  - Large-scale drawdown of legacy emissions, and
  - Complete elimination of future emissions through regenerative, circular systems.
- This initiative is being prepared for presentation to the United Nations as a complementary framework to guide global efforts to reverse carbon emissions.
- In parallel, V3 is also developing a national Climate Policy Framework for India, which will serve as a legally structured roadmap for building climate-positive governance across all sectors.

Design & Structure

- The 2000-acre community is structured into nine circular, functional layers:
  - 100-acre central lake for rainwater harvesting, floodwater capture, fish farming, and microclimate cooling.
  - 50-acre recreational zone for community well-being, health, and access to nature.
  - 250-acre commercial and business zone, eco-constructed and entirely powered by renewables.
  - 500-acre zero-emission residential zone using carbon-neutral materials (no cement, no steel).
  - 500-acre farming zone regenerating soil while recycling biomass, food waste, and livestock manure.
  - 100-acre livestock zone with closed-loop waste-to-energy integration.
  - 500-acre food forest and bamboo perimeter serving as a living carbon sink and ecological defense layer.

Nutrient recovery from hydrolysed urine by high-rate electrodialysis: A proof-of-concept study

P2 - Yi Zhang

Yi Zhang, Veera Koskue, George Q. Chen, Sandra Kentish, Stefano Freguia
Department of Chemical Engineering, The University of Melbourne

yi.zhang48@unimelb.student.edu.au

Brief bio of speaker

Yi Zhang is currently in the second year of his Ph.D. program, under the supervision of A/Prof. Stefano Freguia in the Department of Chemical Engineering at the University of Melbourne. His research focuses on the recovery of nutrients from source-separated urine through electrodialysis as part of the Nutrients in a Circular Economy (NiCE) Industrial Transformation Research Hub, partly funded by the Australian Research Council.

Abstract

With global population growth and increasing food demand, the need for nitrogen (N), phosphorus (P), and potassium (K) fertilisers continues to rise [1,2]. Human urine accounts for approximately 80% of the N, 50% of P, and 70% of K in municipal wastewater [3], making it a sustainable source for liquid fertiliser production [4]. Electrodialysis (ED) is an emerging technology for nutrients recovery, which can concentrate these ions through ion exchange membranes when an electric current is applied [5]. It can achieve a high concentration factor with relatively low energy consumption (4.9–8.5 kWh/kg NH_4-N) [6,7], reducing transport and operational costs while minimising the transfer of micropollutants and pathogens to the final product, ensuring the safety of the liquid fertiliser produced [5,8]. Operating at high current densities can accelerate ion transport, reducing membrane area requirements, which helps to lower capital costs. However, if the current density is raised too high, it may approach the limiting current density (LCD), which varies dynamically during opeartion due to changes in the solution concentrations on both sides of the membranes. Beyond the LCD, further increases in current no longer improve selective ion transport but instead intensify the transport of other ions such as hydroxide ions and protons generated by water splitting. This leads to increased system resistance, higher energy consumption, and can induce membrane fouling due to local pH shifts [9,10]. To avoid these issues, most ED studies have adopted a conservative strategy, using relatively low current densities (2-10 mA/cm^2) [6,11,12]. These approaches are excessively conservative and further research is required to find strategies for increasing current densities in urine-fed ED stacks while still operating below the LCD.

This study investigated the feasibility of high-rate ED for nutrient recovery from hydrolysed urine at high current densities of 10-30 mA/cm^2 in batch mode. The objective was to maximise ion transport without exceeding the LCD, thereby achieving a balance between energy consumption and nutrient recovery. At 30 mA/cm^2, the system approached the LCD when total ammonia nitrogen removal reached ca. 64%, with a stable specific energy consumption of 9.0 ± 0.2 kWh/kgN and an average nitrogen migration rate of 104.2 gN/m^2/h. Compared to 10 mA/cm^2, the ion transport rates of N, P, and K increased by 4.1-, 3.4-, and 3.2-fold. The fertiliser product obtained at 30 mA/cm^2 contained 20.0 ± 0.3 g NH_4-N/L, 9.9 ± 0.2 g K^+/L, and 1.6 ± 0.0 g PO_4-P/L, corresponding to concentration factors of 3.5, 4.1 and 3.4 for N, P, and K, respectively.

These findings provide a practical reference for continuous ED system design, where membrane area and feed rate can be optimised to ensure efficient nutrient recovery while operating below LCD to minimise energy losses and capital costs. High-rate ED thus shows promise for decentralised fertiliser production from source-separated urine, supporting nutrient circularity and reducing the environmental impact of human waste.

References

[1] Gorazda et al. 2023. Arch. Environ. Prot. 49, 3, 38-49; [2] Li et al. 2023. China Agr. Econ. Rev. 15:134–158; [3] Larsen et al. 2013. IWA Publishing, 241–257; [4] Sohn et al. 2023. Desalination. 560, 116663; [5] Pronk et al. 2006. Environ. Sci. Technol. 40, 2414–2420; [6] Ward et al. 2018. Water Res. 135, 57–65; [7] Tarpeh et al. 2018. Environ. Sci. Technol. 52, 1453–1460; [8] Xu et al. 2019. J. Environ. Eng. 145, 04018144; [9] Luo et al. 2018. J. Membr. Sci. 555, 429–454; [10] Yu et al. 2023. Chem. Eng. J. 451, 138908; [11] Silva et al. 2022. Chem. Eng. J. 450, 137975; [12] Ferrari et al. 2022. Water Res. 218, 118504.

Anthroponics in a Circular Economy: Effect of urine fertiliser on the flowering and longevity of Gerbera cut-flower plants (*Gerbera jamesonii*)

P3 - Ibrahim El Saliby

Juan Lucas[1], Ibrahim El Saliby[2], Ho Kyong Shon[2]

[1]The Royal Botanic Garden Sydney

[2] School of Civil and Environmental Engineering, Faculty of Engineering and Information Technology

*Speaker's email: Ibrahim.elsaliby@uts.edu.au

Brief bio

Dr. Ibrahim El Saliby is a research manager with a wealth of experience in managing and maintaining research projects in nutrient recycling, wastewater treatment and reuse, and plant propagation and production for plant science and conservation. Dr. El Saliby holds a Doctor of Philosophy in Environmental Engineering from the University of Technology Sydney, a Master of Science in Plant Sciences from the American University of Beirut and a Diploma of Agricultural Engineering from the Lebanese University.

Abstract

Human urine is considered a sustainable resource for fertiliser production because it contains essential nutrients critical for plant growth and biomass production. There is an increasing focus on technological processes to convert urine into fertilisers, supporting nutrient recovery and fostering circular economy principles. This approach enables the development of sustainable nutrient loops through applications in ornamental horticulture or urban agriculture, thereby reducing waste and environmental pollution. UTS has demonstrated success in converting human urine into plant fertiliser via the UrVal technology, resulting in the commercial product UrVal fertiliser. The current experimental study aims to evaluate the impact of UrVal fertiliser on Gerbera growth, compared to a conventional commercial fertiliser, to assess its efficacy and potential for practical application.

Urine fertiliser (UrVal) performance was compared with a commercial fertiliser solution (Cal-Mg Finisher, Peters Excel, ICL) as nutrient solutions tailored for Gerbera (*Gerbera jamesonii*). Plants were grown in 200 mm plastic pots, on raised benches, outdoor and using Peat/Perlite P500 (1:1) as a growing media. Fertiliser treatments were applied weekly and were as follows: i) Control (The plants only received water), ii) U100 (Urval fertiliser at 100 ppm Nitrogen), iii) U200 (Urval Fertiliser at 200 ppm Nitrogen), and iv) CMPP (Commercial fertiliser, Peters Excel Cal-Mag finisher at 200 ppm Nitrogen).The experiment layout was a completely randomised design with 5 replications per treatment. The experiment was carried out at the Royal Botanic Garden Sydney – Nursery to test our hypotheses on plant performance and growth.

On fortnightly basis, data was collected on the number of flowers. At the end of the experiment, the total number of flowers was recorded. Roots and shoots of each plant were separated to assess fresh biomass. To measure the dry biomass, leaves and roots samples were placed in paper bags in a Memmert GmbH oven (Model 400, Germany) at 100 ℃ for 24 hours and then weighted again. Roots to shoots ratio (RSR) was also calculated as the ratio between roots dry weight and shoots dry weight. The ANOVA analysis showed a statistically significant difference between treatments in the total number of flowers produced ($p < 0.05$). No significant differences were found between CMPP and U 200.This suggests that the CMPP treatment resulted in significantly more flowers compared to Control and U 100 treatments. In conclusion, the use of U200 in cut-flower Gerberas is promising in comparison to CMPP.

Selective recovery of rare earth elements from NdFeB magnet using a deep eutectic solvent

P4 - Jaishree Yadav

Jaishree Yadav[1*], Warren Bruckard[2], Nawshad Haque[2], Biplob Kumar Pramanik[1]
[1]School of Engineering, RMIT University, VIC 3001, Australia
[2]CSIRO Mineral Resources, Clayton South, Melbourne, VIC 3169, Australia

s3986831@student.rmit.edu.au

Brief bio of speaker

Jaishree Yadav is currently pursuing her Ph.D. at RMIT University in collaboration with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, having commenced her candidature in 2024. Her research is primarily focused on the optimization of sustainable hydrometallurgical processes for the efficient recovery of rare earth elements from end-of-life NdFeB permanent magnet. By employing innovative selective leaching and separation techniques, her work aims to achieve high recovery rates while minimising the co-extraction of impurities, thereby enhancing process sustainability and economic viability. Ultimately, her research contributes to advancing circular economy practices and securing a stable supply of these critical materials for emerging clean energy and high-tech applications.

Abstract

Recycling electronic waste, particularly NdFeB permanent magnets, offers a sustainable approach to mitigating supply chain risks associated with rare earth elements (REEs). This study aimed to (i) develop and optimise a non-corrosive and efficient deep eutectic solvent (DES)-based leaching process for the treatment of NdFeB magnet waste and (ii) achieve the selective extraction of neodymium (Nd) to produce a high-purity Nd oxide suitable for magnet manufacturing. The influence of pretreatment methods on leaching efficiency was systematically investigated. Selective REE leaching was successfully achieved using roasted magnet material in a DES system composed of choline chloride and malonic acid at a 1:1 molar ratio. Under optimised conditions (80 °C, solid-to-liquid ratio of 1:20, 6 h leaching time), this DES exhibited excellent selectivity, achieving leaching efficiencies of 95% for Nd and 92% for praseodymium, while limiting iron dissolution to only 1%. The leached Nd was recovered by stripping with oxalic acid, followed by oxidative roasting, yielding Nd_2O_3 with a purity exceeding 99.5%, meeting the specifications required for new NdFeB magnet production. Furthermore, Density Functional Theory calculations indicated that the interaction between choline chloride and malonic acid results in an energy decrease of 35.37 eV, confirming the formation of strong hydrogen bonding and the stable synthesis of the DES. Overall, this work demonstrates a highly efficient and environmentally benign approach for the recovery of critical REEs from magnet waste, highlighting its potential for future industrial-scale application within a circular economy framework.

Study on an electrocrystallization method for selective recovery of valuable resources from high-concentration wastewater

P5 - Linitho Suu

Linitho Suu[a], Joowan Lim[b], June-Seok Choi[a,b], Youngkwon Choi[a,b,*]
[a] Department of Civil and Environmental Engineering,
University of Science and Technology
[b] Department of Environment Research, Korea Institute of Civil Engineering and Building Technology

suulinitho@kict.re.kr

Brief bio of the speaker

Linitho Suu is an integrated Master's/PhD student in the Department of Environmental Research at the Korea Institute of Civil Engineering and Building Technology (KICT), affiliated with the University of Science and Technology (UST), South Korea. She holds a Bachelor's in Civil Engineering from Karunya University, India, and attended the University of British Columbia as a visiting research student during her final year. Currently in the third semester of the program, her research focuses on resource recovery from aqueous waste streams using membrane-based and electrochemical technologies, including electrodialysis, electrocrystallization, and bipolar membrane systems. She actively participates in international conferences and is committed to developing sustainable, energy-efficient solutions for material extraction from wastewater.

Abstract

The recycling of secondary batteries generates wastewater containing valuable metals such as copper, nickel, manganese, and cobalt, which are crucial for resource recovery and environmental protection. Currently, the solvent extraction method is used to recover such resources, but it requires the use of large amounts of chemicals and generates high concentrations of wastewater, necessitating the search for new, environmentally friendly methods. Electrocrystallization is a good alternative that solves the problems of solvent extraction. It enables the direct reduction of metal ions to metal crystals at low temperatures, minimizing the use of chemical reagents and reducing energy consumption compared to the conventional solvent extraction method. In this study, we investigate the application of electrocrystallization as a sustainable and efficient method for the selective recovery of these metals in their metallic crystalline form. We evaluate the effects of process parameters, including applied potential, pH, and electrolyte composition, on the purity, morphology, and yield of recovered metal crystals. Our results demonstrate that electrocrystallization offers a promising approach for the environmentally friendly recovery of high-purity metals from battery recycling wastewater, contributing to the advancement of circular economy strategies in the battery industry.

Electrocapillary-Driven Metal Separation: A Low-Energy Pathway for Sustainable Alloy Recycling

P6 - Xichao Zhang

Department of Chemical Engineering, Faculty of Engineering and Information Technology, The University of Melbourne

xichaoz@student.unimelb.edu.au

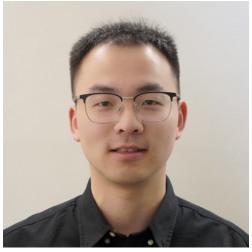
Brief bio of speaker

Ms. Zhang is an electrochemist specializing in sustainable metal refining and critical materials recovery. Her research develops novel electrochemical separation techniques to efficiently extract rare and post-transition metals from industrial waste and complex alloys. Focusing on electrocapillary-driven processes and low-energy extraction methods, this work advances environmentally responsible metallurgy by transforming waste streams into valuable resources through fundamental electrochemical innovations.

Abstract

Alloying is a spontaneous process governed by the intrinsic miscibility of metal atoms. The reverse process of dealloying miscible metals through direct physical means has been challenging to achieve. Here we report a novel physical process for the direct separation of solute metals from liquid alloys. Our findings show that electrocapillary in Ga-Sn-Bi-Pb liquid alloy can lead to the selective expulsion of Bi, Sn or Pb from the alloy surface as pure metals. The metals are expelled sequentially from the alloy with Bi first, followed by Sn, and then Pb. Theoretical calculations suggest that the sequence of expulsion is primarily determined by the surface energy of solute metals. A metallurgical process based on this phenomenon has been proposed and evaluated as a viable approach for refining post-transition metals. This study presents innovative insights that lay the foundation for developing reliable low-energy metallurgical techniques to separate metals based on differences in their surface energy.

Environmental Effectiveness of Circular Economy Strategies for Lithium-ion Batteries



P7 - Haiwei Zhou
Faculty of Engineering and Information Technology, University of Melbourne

haiwei.zhou@student.unimelb.edu.au

Brief bio of speaker

Haiwei Zhou is a fourth-year PhD candidate at the University of Melbourne. His PhD research focuses on evaluating the resource and environmental benefits of applying circular economy strategies to the lithium-ion battery value chain. Haiwei has a strong background in quantitative modelling, particularly in dynamic material flow analysis (MFA) and life cycle assessment (LCA), and a broad research interest in the intersection of sustainable energy transitions and circular economy. He has published three first-author papers and co-authored two other papers in leading journals, including One Earth, Resource, Conservation and Recycling, and Applied Energy. His research has gained recognition in the field, and he has been invited to deliver oral presentations at five international conferences during his candidature, where he received the Best Student Presentation Award. Beyond academic achievements, Haiwei is passionate about science communication and enjoys sharing research with both expert and general audiences.

Abstract

The lithium-ion battery (LIB) supply chain is indispensable for the clean energy transition but faces pressing resource and environmental challenges. This thesis systematically quantifies how, and to what extent, different circular economy (CE) strategies could mitigate these challenges. By integrating dynamic material flow analysis (MFA) and life cycle assessment (LCA), the research provides a consistent framework for evaluating the environmental effectiveness of diverse CE strategies, such as yield improvement, downsizing, material substitution, lifetime extension, repurposing, and recycling.
The findings confirm that CE strategies are a valuable lever to reduce primary material consumption and mitigate greenhouse gas emissions across the battery supply chain, but their effectiveness varies considerably across time, regions, and applications. Realising the full potential of CE requires recognising interactions, synergies, and trade-offs among them, and adopting a truly systematic perspective. Overall, our research deepens understanding of battery circularity and delivers evidence-based insights to advance the circular economy and power a more sustainable energy future.

Development of Bipolar Membrane Electrodialysis for Selective Recovery of Valuable Resources from Brine and Wastewater

P8 - Joowan Lim
Joowan Lim, Jonghun Lee, Saeromi Lee, Linitho Suu, June-Seok Choi* and Youngkwon Choi*
Department of Environmental Research,
Korea Institute of Civil Engineering and Building Technology (KICT)

Speaker's email : jwlim@kict.re.kr

Brief bio of speaker

Dr. Joowan Lim is a postdoctoral researcher at the Korea Institute of Civil Engineering and Building Technology (KICT). He received his Ph.D. in Environmental Engineering in 2023, with a focus on membrane distillation processes. His current research focuses on the recovery of valuable resources from seawater brine and wastewater using membrane distillation crystallization and electrochemical technologies, including electrodialysis, electrocrystallization, and bipolar membrane systems.

Abstract

With the growing demand for critical minerals such as lithium (Li), cobalt (Co), and manganese (Mn), driven by the rapid expansion of energy storage systems, electric vehicles, and electronics, there are increasing concerns about the limited availability and environmental impact of conventional extraction methods. Current resource extraction and refining practices often lead to significant ecological disturbances, substantial energy consumption, and high operational costs, highlighting the need for sustainable and efficient recovery technologies. Seawater brine and industrial wastewater represent significant yet underutilized sources of these valuable resources, containing notable concentrations of strategic materials. This study focuses on the fabrication of bipolar membranes (BPM) and the development of a bipolar membrane electrodialysis (BMED) process designed to effectively recover valuable resources from seawater brine and wastewater. The primary objectives are two-fold: firstly, optimized fabrication methods for BPMs to enhance the selective separation of target ions are developed; secondly, a BMED system utilizing these fabricated BPMs is constructed and validated. In this research, resource recovery efficiency is initially evaluated using electrodialysis systems and commercial BPMs. Key performance metrics, including ion selectivity, recovery rate, membrane durability, and energy efficiency, are systematically compared between commercial and fabricated membranes. The outcomes of this research substantially contribute to sustainable resource recovery practices and advance the circular economy by efficiently extracting valuable materials from seawater brine and wastewater.

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