ARC NiCE Hub Newsletter

September 2025

Nutrients in a Circular Economy

Content

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Message from our Hub Director

Dear colleagues,

It is with great pride and enthusiasm that I reflect on the remarkable progress and achievements of the ARC NiCE Hub over the past several months. Since March 2025, our community has grown in impact, innovation, and collaboration, pushing the boundaries of what is possible in nutrient recovery and circular-economy solutions.

One of our most exciting milestones was the launch of the NiCE Loo Lab in March, proudly showcased at UTS and at The Royal Botanic Garden in Sydney. This public display demonstrated the potential of urine-diversion technologies and sparked important conversations about sustainable sanitation and resource recovery across our communities.

Our collaboration with CityForest to apply Urval, our urine-derived fertiliser, on green walls marks another step toward real-world application. In parallel, we successfully retrofitted the urine-diversion and treatment station in UTS Building 11, enhancing our capacity for onsite trials and public engagement.

We have also made significant strides in regulatory engagement, working closely with the NSW EPA on requirements for orders and exemptions. With our preliminary trials now concluded, we are well positioned for broader implementation.

We celebrate a major policy breakthrough: the Plumbing and Drainage Amendment Regulation (No. 2) 2025 is now in force in Queensland, officially incorporating provisions for urine-diverting toilets into the state's plumbing regulations. Congratulations to our Brisbane node on this landmark achievement.

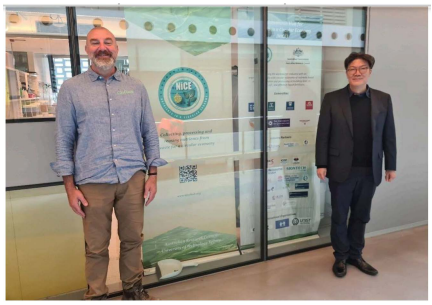
In another proud moment, our Urval work through the ARC NiCE Hub received Second Prize in the UTS Research Translation Competition, recognising the real-world value and impact of our research. The Hub was also proud to participate in the 2025 NSW Commercialisation Showcase, hosted by the Office of the NSW Chief Scientist & Engineer at UTS, where we shared our commercialisation journey among leading research and industry partners.

We extend our warmest congratulations to our outstanding students, whose dedication and excellence have been recognised through prestigious awards and publications in leading scientific journals. Your work is the foundation of our future.

We are also proud to organise the Circular Economy for Climate and Environment Conference 2025 in Melbourne, further reinforcing our commitment to national leadership in sustainable innovation.

Thank you to all our researchers, partners, and supporters for your continued dedication. Together, we are not only advancing science but also shaping a more sustainable and circular future.

I look forward to meeting you in Melbourne soon.



Warm regards

Prof Ho Kyong Shon

Director ARC Research Hub for

Nutrients in a Circular Economy (NiCE)

Featured Story

Highlight on Melbourne Node Activities

Our Melbourne Node Team has been making particularly exciting progress in the recent months. With the CECE25 conference soon to be held in Melbourne, let's have a look at some other thrilling updates from our Melbourne partners.

The University of Melbourne researchers successfully lead efforts to allow urine-diverting toilets in Queensland

In a major win for the NiCE Hub, The University of Melbourne researchers, supported by industry partner Urban Utilities and university partners from the Brisbane node, successfully engaged with the Queensland Government to amend the state's Plumbing and Drainage Regulation. The Plumbing and Drainage Amendment Regulation (No. 2) 2025 came into effect in late June 2025 and now allows the installation of urine-diverting toilets within the state. This is an important outcome in dismantling regulatory barriers that too often hold back innovative research and pilot projects.

The details of the amended regulation are available on the Queensland Government webpage.

Ugold pilot trials ready to kick off in Melbourne

The University of Melbourne researchers are soon ready to start pilot-scale trials for the technological optimisation of the Ugold technology in Melbourne. The Ugold pilot system, capable of treating up to 100 litres of hydrolysed urine per day, was constructed by industry partner AJJA Technologies and shipped to Melbourne in June 2025. With the help of new collaborator Composting Toilet Systems, the Ugold pilot will be operating on urine collected from music festivals and other public events across Victoria. Spring is here, which means the festival season will soon be in full swing - and so will the Ugold trials!

Figure caption: The University of Melbourne researchers Dr Veera Koskue (left), MPhil candidate Vania Mendez and A/Prof Stefano Freguia are getting the Ugold pilot system ready for upcoming trials.

The University of Melbourne welcomes two new students to the NiCE Hub

The University of Melbourne Team has grown with two new students, PhD candidate Fateme Hassanli and MPhil candidate Vania Mendez, who joined the group in July 2025. Let's get to know our newest group members!

Fateme Hassanli joined the NiCE Hub as a PhD candidate in July 2025. She is working under the supervision of A/Prof Stefano Freguia in the Department of Chemical Engineering at The University of Melbourne.

Her research focuses on nutrient recovery from source-separated urine through electrolysis, with a dual aim: producing liquid fertilisers rich in ammonium, phosphorus, and potassium, while simultaneously generating hydrogen as a clean alternative energy carrier. A key challenge in this field is the high water content of stabilised urine, which limits the commercial viability of urine-derived fertilisers. Fateme's work aims to address this by developing electrochemical strategies to concentrate nutrients and improve recovery efficiency.

Fateme completed both her undergraduate and master's degrees in Materials Science and Engineering, with a specialisation in corrosion, at Shiraz University of Technology, Iran. Her master's research focused on electrochemistry and batteries, and she further expanded her expertise through research assistant experience in fuel cells. Bringing this background into the wastewater field, she is now applying her electrochemistry knowledge to develop sustainable solutions using electrolysis for nutrient recovery and renewable energy production.

PhD candidate Fateme Hassanli

MPhil candidate Vania Mendez

Vania Mendez is originally from Mexico and holds a Bachelor's degree in Renewable Energy Engineering from the National Autonomous University of Mexico (UNAM). During her undergraduate studies, she developed a focus on bioenergy. Throughout her studies, she built a strong foundation in sustainable technologies with a particular focus on bioenergies. During this period, she collaborated with the Environmental Processes and Alternative Technologies Laboratory (LIPATA) and the GEMMA research group, where she worked on projects related to wastewater treatment for the production of biofuels through anaerobic processes. These experiences sparked her interest in integrating renewable energy with biological processes to address environmental challenges.

Currently, Vania is pursuing a Master's degree at The University of Melbourne, where her research has shifted toward bioelectrochemical systems (BES). Her project focuses on the scale-up of these systems for the recovery of fertilisers from hydrolyzed urine. By combining her background in renewable energy with experimental work in bioelectrochemistry, Vania aims to bridge the fields of energy, resource recovery, and environmental engineering.

First NiCE Hub PhD candidate approaching graduation at The University of Melbourne

While we're excited to welcome our new students Fateme and Vania to our group, we're also getting ready to bid farewell to Chee Xiang Chen, who was the first PhD candidate to join the NiCE Hub Melbourne Node in June 2022. Chen successfully delivered his PhD completion seminar at the Department of Chemical Engineering, The University of Melbourne a couple of weeks ago and is currently busy finalising his thesis for submission in the upcoming weeks. We are incredibly proud of Chen's impressive work at The University of Melbourne and know he will achieve great things after graduation - but we will certainly greatly miss him!

Figure caption: PhD candidate Chee Xiang Chen (left) delivered his PhD completion seminar on August 26, 2025. He was introduced by his primary supervisor, A/Prof Stefano Freguia.

Alongside his PhD thesis, Chen has also been busy finalising article manuscripts from his PhD work. Here are some latest updates from his research work:

Source-separated urine can serve as a suitable alternative to synthetic fertiliser due to its high nitrogen (N), phosphorus (P), and potassium (K) content. Cities are the primary sources of urine because of their dense populations, whereas demand for fertiliser, such as for broadacre agriculture and national parks, often lies in rural areas. Long-distance transport of urine to these areas is necessary but incurs high distribution costs, which could affect the affordability of urine fertiliser. Over the years, researchers have suggested concentrating urine prior to long-distance distribution to reduce these costs. Reverse osmosis (RO) is a viable option, as it has relatively low energy requirements and efficiently recovers N, P, and K from urine. However, the economic viability of urine concentration using RO remains unclear.

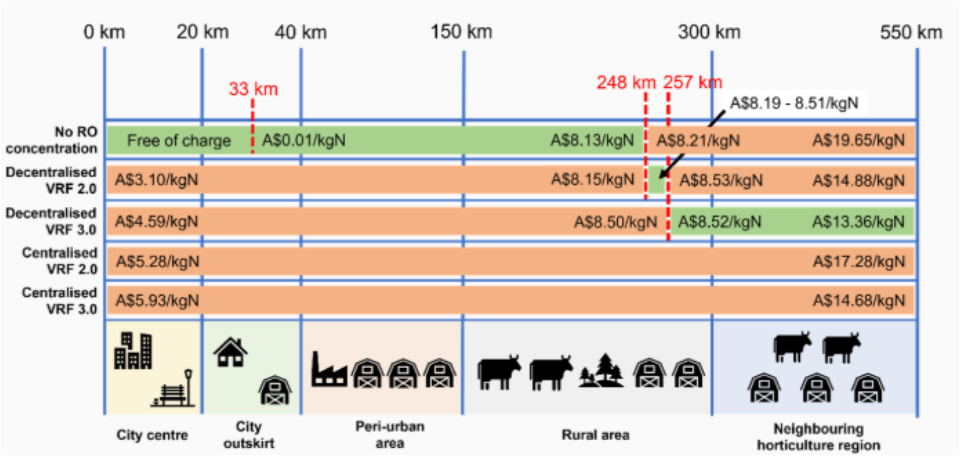


Figure caption: Graphical illustration of the minimum selling price of urine fertiliser with subsidies from water utilities ($2.601/kgN) and a 7% discount rate, at various distribution distances from the city centre. The row at the bottom of the figure represents the corresponding demand at each distance.

A study comparing centralised and decentralised RO concentration scenarios showed that, with a 7% discounted cash flow rate, urine fertiliser could be supplied for free within a 33 km radius in the baseline scenario without RO concentration, relying solely on water utility subsidies of A$2.069/kgN. For distances between 34 and 247 km, additional charges to customers are required, though the baseline scenario still yields the lowest minimum selling price. Beyond 247 km, the decentralised RO scenario offers the lowest price at A$8.19/kgN. Since a 248 km radius encompasses Greater Melbourne and surrounding peri-urban areas, adopting RO concentration depends not only on distribution distance but also on the availability of surplus urine, customer acceptance of the selling price, and the proportion of customers located beyond 248 km.

Upcoming NiCE Hub events

Circular Economy for Climate and Environment Conference CECE 2025

Date: 22 to 24 September 2025

Venue: Melbourne Connect, Melbourne, Australia

Organised by: University of Technology Sydney, University of Melbourne and Victoria University

For further information, visit www.nicecece.org or contact the organising committee on info@nicecece.org

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Recent Grant Success

NiCE Hub researchers have been successful in securing prestigious ARC funding in recent months - here are some highlights!

Dr. Zhiyao Wang from The University of Queensland awarded ARC Early Career Industry Fellowship

Zhiyao Wang has been awarded the prestigious ARC Early Career Industry Fellowship. This highly competitive program supports outstanding early-career researchers in building strong collaborations with industry to deliver translational impact. Zhiyao's fellowship will focus on advancing biosolids management that simultaneously reduce greenhouse gas emissions and enable resource recovery. Working closely with water utilities and industry partners, her research aims to develop scalable solutions that bridge fundamental microbiology with engineering practice.

Griffith University partners in successful "Training Centre for Climate-Resilient Water" bid

The "Training Centre for Climate-Resilient Water"-with Griffith University's participation through Prof Cara Beal, A/Prof Sayed Iftekhar, and Prof Anne Roiko-has just been awarded funding under the Australian Research Council's Industrial Transformation Training Centres scheme for 2025. The Centre aims to skill people, and organisations to make water supply more climate-resilient to new drought, flood and quality challenges. It uses advanced monitoring, adaptive management, and multi-functional precinct design. Creating new collaborative governance approaches, and wide stakeholder and community support, is key to success. Improved economic and energy security, strengthened decision-making, and greater use of recycling and stormwater are key expected outcomes supported by an industry-engaged process and a legacy Knowledge and Training Bank. A national Design Challenge series for water and energy infrastructure seeks to drive collaborative innovation. Multiple sciences come together to impact strategies, policy and thought.

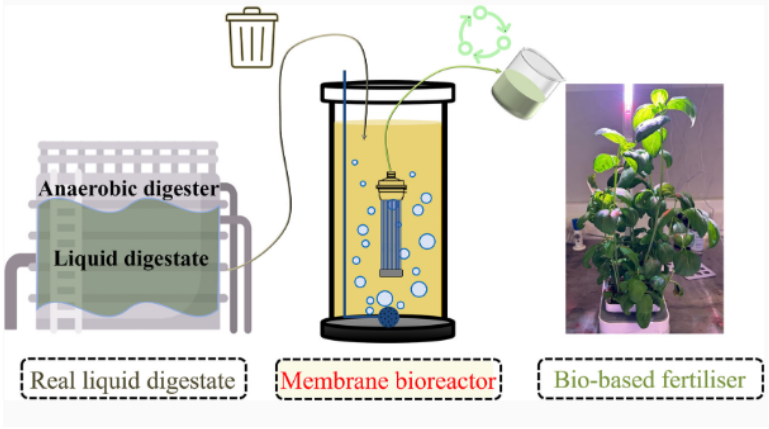
Recent Research Activities at Partner Universities

Sydney node

University of Technology Sydney (UTS).

Valorisation of liquid anaerobic digestate into liquid fertilisers via membrane bioreactors: a proof-of-concept study *Merenda et al. (2025), DOI: 10.1016/j.watres.2025.124026*

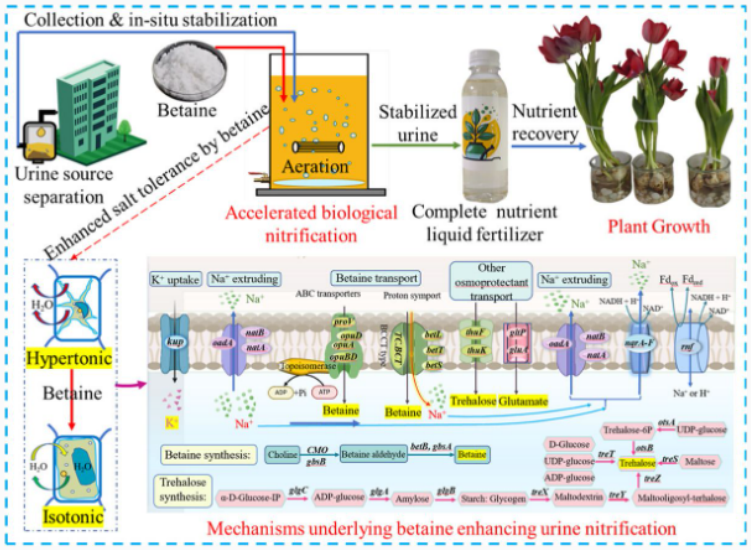
Nutrient-rich liquid anaerobic digestate holds great potential as renewable feedstock of micro- and macro-nutrients and value-added organic compounds in a circular bioeconomy. Membrane bioreactors offer a compact and efficient strategy to recover nutrients from wastewater, nonetheless no applications on liquid anaerobic digestate have been explored to date. In this proof-of-concept study, real liquid anaerobic digestate was valorised into liquid N-P-K fertilisers by biological nitrification, using a laboratory-scale membrane bioreactor fitted with submerged ultrafiltration membranes. The membrane bioreactor was operated for seven months, achieving a high nitrification rate of 446 ± 48 $mgN \cdot L^{-1} \cdot d^{-1}$ while removing ~80 % of total organic carbon. Nitrosococcus and Nitrospira genera were responsible for the conversion of ammonia into nitrate. The nitrite oxidising bacteria (NOB) to ammonia oxidising bacteria (AOB) ratio was linked to the hydraulic retention time, revealing that NOB:AOB ratio greater than 5 was correlated with an accelerated nitrification process, achieving a 58 % reduction in hydraulic retention time while maintaining a stable NH_4^+ conversion rate of 54 %. The obtained liquid fertiliser, rich in micro- and macro-nutrients and humic compounds, outperformed a commercial fertiliser in the hydroponic growth of basil (Ocimum Basilicum), affording a 100 % increase in fresh biomass compared to the commercial fertiliser presenting a similar nutrient formulation. This study will lay the foundation of a circular bioeconomy of nutrients whereby inexpensive and abundant waste, such as liquid anaerobic digestate, is valorised into value-added renewable fertilisers.



Ultra-rapid start-up biological nitrification for nutrient recovery from source-separated urine
Wang et al. (2025), DOI: 10.1016/j.watres.2025.124343

Biological nitrification presents a sustainable approach for urine resource recovery. However, high salinity and ammonium concentrations in urine inhibit or even damage microorganisms, causing delayed start-up and unstable. This study first introduces betaine (150 $mg \cdot L^{-1}$) to enhance urine nitrification by improving microbial salt tolerance and metabolic. Compared with the conventional typical process without betaine addition, introducing betaine shortened start-up time from 98 to 36 days, increased nitrification rate from 313.9 to 563.7 mg $N \cdot L^{-1} \cdot d^{-1}$, reduced nitrite accumulation, and improved resilience to water quality fluctuations. It also upregulated expression of nitrifying bacteria and related functional genes. Mechanistically, betaine stimulated extracellular polymeric substances production and regulated tryptophan and tyrosine metabolism genes, improving sludge aggregation and microbial stability. Betaine modulated genes for K^+ uptake and Na^+ extrusion to maintain initial osmotic balance. Subsequently, betaine promoted the uptake/synthesis of osmoprotectants (e.g., betaine and trehalose), upregulated electron transport chain genes and optimized energy metabolism. Notably, Betaine-induced multiple salt-tolerance mechanisms showed synergistic effects, with Rubrivivax sp., Paracoccus aminovorans, and Nitrobacter sp. identified as core salt-tolerant species. Even after betaine discontinuation (at day 40), high nitrification activity and salt tolerance persisted, though reduced amoABC gene abundance may

constrain long-term performance. Furthermore, betaine-enhanced urine fertilizers demonstrated high nutrient recovery efficiency and reduced phytotoxicity, indicating strong potential for agricultural reuse. Overall, this study provides novel theoretical and practical insights, establishing betaine as an effective strategy for accelerating and stabilizing biological nitrification in high-salinity wastewater systems such as urine, with broad implications for sustainable treatment and resource recovery.

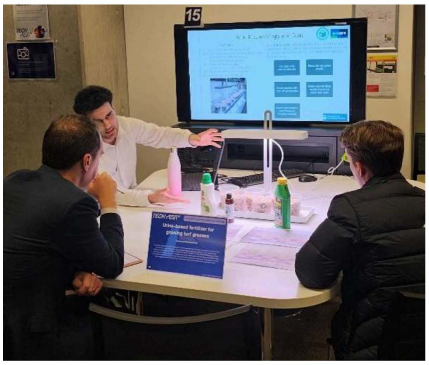


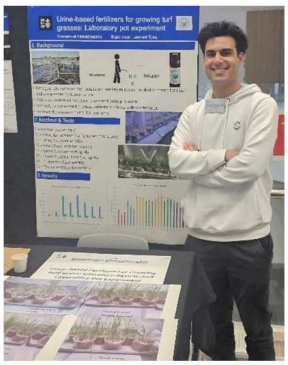
Growing potential: Urine-based fertilisers in action

As part of the ARC Nutrients in a Circular Economy (NiCE) Hub, our team at UTS, in collaboration with the City of Sydney Council, has been conducting research to compare the potential of urine-based fertilisers as a sustainable alternative to commercial fertilisers for growing turf grass. This study builds on our earlier work, which compared a urine-based fertiliser only against a granular commercial fertiliser. In the current experiment, we expanded the scope to include two additional liquid commercial fertilisers, applied at different frequencies, to provide a broader comparison with our urine-based liquid fertiliser.

Over a five-week period, Annual Rye Grass was grown under seven treatment groups, including urine-based fertilisers applied weekly and fortnightly, commercial liquid and granular fertilisers, a slow-release granular fertiliser, and a control with no fertiliser. Growth was monitored through germination rates, shoot counts, grass height, biomass yield, and visual health assessments. The results showed that while some commercial fertilisers supported faster initial germination, the urine-based treatments consistently outperformed most other groups over the course of the study. Weekly applications produced the highest shoot counts and germination yields, while fortnightly applications achieved the tallest grasses by Week 5. Biomass results reinforced these findings, with urine-based treatments generating greater wet and dry biomass compared to commercial fertilisers. Visual observations further highlighted denser, healthier, and more vibrant grasses in the urine-treated groups than in the control or some commercial treatments.

These encouraging results were shared at the 2025 FEIT Capstone Showcase and the FEIT Tech Festival, generating strong interest among both academic and industry audiences. Together, this project highlights the promising role of urine-derived fertilisers in advancing resource recovery research and demonstrates practical applications of sustainable nutrient recycling within the NiCE Hub.





Western Sydney University

We completed our second polytunnel experiment to see how urine-based fertilizer (UrVAL) performs under different application methods. In this study, we compared giving the fertilizer all at once versus spreading it into two or three smaller doses, and we adjusted the amount of nitrogen supplied to lucerne (a legume) and phalaris (a grass). Each crop was grown in pots of sandy soil

inside the polytunnel.

When lucerne received a single high dose beyond 80 kg N/ha, growth slowed, and the soil became more acidic. Phalaris showed an early growth boost but then declined under the same treatment. In contrast, splitting the fertilizer into two or three smaller doses produced steadier growth, kept the soil pH closer to neutral, and supported a healthier microbial community. Lucerne needed very little extra nitrogen because it can fix its own; phalaris benefited from moderate split doses.

Overall, our results show that, with split application of fertilizer and dose optimization, urine-based fertilizers can match synthetic commercial fertilizers for pasture growth, also protecting soil health and supporting a more sustainable nutrient cycle.

Figure caption: UrVAL®-treated lucerne and phalaris showing strong, healthy growth, with vibrant green leaves and robust plants-a clear sign of the positive impact of well-managed fertiliser application.

We've got two exciting projects on the way!

In the lab:

Our next study dives into the lab incubation to understand how our urine-derived fertilizers, UrVAL and UGold, behave with phosphorus and support soil life. We'll compare these two products with each other and a no-fertilizer control, using soil collected from Western Sydney University's research farm. By combining each fertilizer with different organic materials- different source of natural straw (Lucerne and Phalaris) we'll see how "fueling" soil microbes changes the way they release and recycle phosphorus. We'll also test what happens when we boost the soil's own organic matter and when we add a natural iron mineral (goethite) that helps lock nutrients in the soil.

This experiment will track a range of responses: how much phosphorus stays available, how soil microbes grow and what enzymes they produce, and even which microbial families thrive. We expect to see that mixing urine fertilizers with organic matter sparks more microbial activity and better phosphorus availability than synthetic fertilizers alone. The results will help us understand how to get the most value from recycled fertilizers while keeping soils healthy.

In the polytunnel - boosting overall fertilizer performance

Our next study is a soil incubation to understand how urine-derived fertilizers interact with phosphorus and support soil life. We will compare UrVAL and UGold against a no-fertilizer control using soil from Western Sydney University's research farm. We will also test how outcomes change when we add organic matter (e.g., plant residues/composted materials) and when we add a natural iron mineral (goethite) that can help retain nutrients in soil.
Together, these projects will help us design fertilizers that are both sustainable and effective - cutting nutrient losses, improving soil life, and producing healthy crops. That's a win for farmers, and for the planet.

Brisbane node

The University of Queensland

Key findings in our recent publications include:

- Long-term monitoring results revealed that upstream carbon capture, while recovering significant energy for carbon offset (40 %of total emission), stimulated downstream nitrous oxide (N_2O) emissions, a major contributor to Scope 1 emissions. In response, integrated mitigation strategies were developed using mechanistic modelling, incorporating process optimizations

- We developed a systematic decision-making framework that considers the impact of key factors, including plant covering, aeration type, configurations, monitoring duration, cost and technical difficulties etc. The framework incorporates a comprehensive multi-criteria evaluation to balance five essential criteria, including equipment cost, consumable cost, commissioning, maintenance and complexity in data analysis. (Wang et al., 2025)

University of Southern Queensland

Loganholme Biosolids Gasification Project

Field trial: Year 3. Determine the fertiliser replacement value in a winter wheat crop (yield) of biosolids derived biochar.

The third year of a field trial using a wheat crop conducted from May to November 2025 at the irrigated Ag plot field at the University of Southern Queensland as per the agreement. This Trial has been established to determine the fertiliser replacement value of Loganholme biochar derived from biosolids against commercial fertiliser using grain yield, total biomass and groundcover as indicators (Figure 1).

Glasshouse experiment. Experiment evaluated Loganholme biosolids derived biochar (BB) for P-fertilising capacity against superphosphate (SP) by growing ryegrass over 5 months on two different sandy soils: one from QLD and the other from NSW. A total of 27 pots (170 mm diameter, 2.0 L volume) for each soil were prepared, each containing 3.0 kg of soil. Pots were performed using the following treatments: 1. Control, 2. Superphosphate - 3 rates (20, 40 and 80 kg of P per ha), 3. BB - 5 rates (20, 40, 80, 120 and 250 kg of P per ha). Urea was applied for each pot with standard rates of 100 kg of N per ha. In this scenario all variation in yield should be related to change in P applied as superphosphate (SP) or BB. Ryegrass was harvested monthly and shoots dry weight recorded in order to evaluate long term fertilising effect of BB (Figure 2). The results demonstrate that BB provides similar phosphorus fertiliser values to industrial fertilisers (SP), demonstrating its potential as a sustainable alternative for agricultural use with the optimal rates of BB application as a P fertiliser are 1.0 - 3.0 t/ha depending on soil. Overall, the study concludes that BB is an effective and environmentally friendly alternative to traditional biosolids and industrial fertilisers, offering a sustainable solution for phosphorus recovery and heavy metal management in agricultural soils.

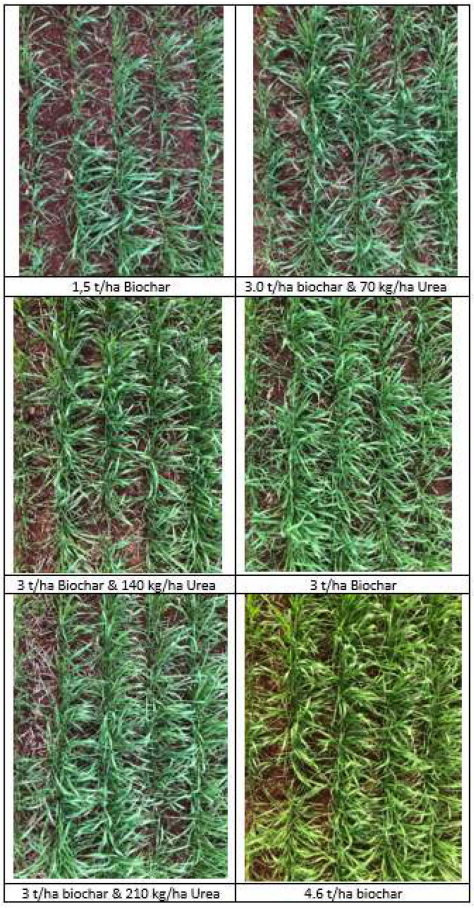
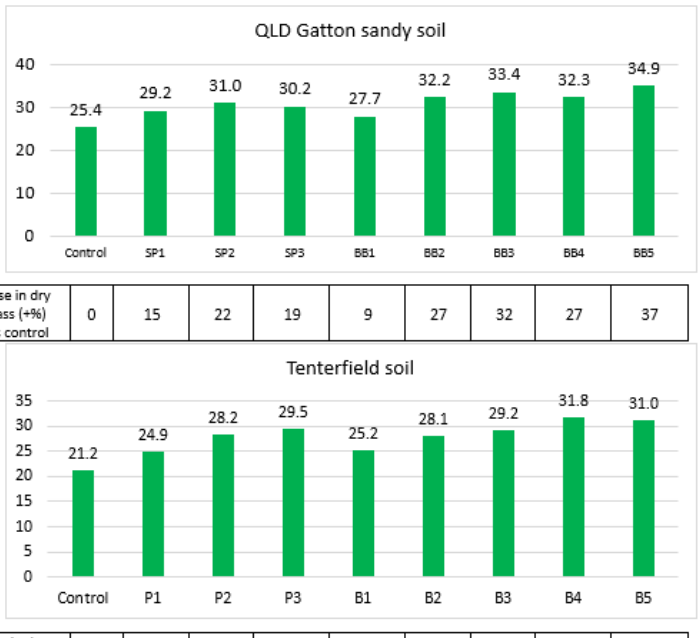


Figure 1. Field trial. Wheat after 2 months of growing



Increase in dry biomass (+%) versus control	0	15	22	19	9	27	32	27	37

Increase in dry biomass (+%) versus control	0	18	33	39	19	33	38	50	47

Figure 2. Dry mass of ryegrass after 5 harvesting events, g/treatment

Evaluation and demonstration of Ugold efficacy in field trials

A pot experiment was established in glasshouse using two soil types from Queensland, Australia, namely: clayey Ferrosol (Rhodoxeralf, US Taxonomy Classification) and acidic sandy Yellow Chromosol (Alfisol, US Taxonomy Classification). The efficiency of urine as a fertilizer was compared with the corresponding amount of mineral fertilizer (urea). The experimental design consisted of one control (zero-amendment), and two treatments: mineral fertiliser as urea and source-separated human urine, which were applied at two (100 and 150 kg/ha of N) and three (100, 150 and 200 kg/ha of N) rates, respectively. Results revealed that after five cuts, dry matter yield for urine treated pots were higher: 53% increase for Yellow Chromosol sandy loam and 46% increase for Ferrosol clayey soil compared to urea treated (Figure 3). Dry weight increased with increasing application rates in both soils. Split application of urine derived N sources resulted in higher cumulative dry matter. For sandy loam: 15.4 - 20.0 g/treatment for split application and 14.2 -16.0 g/treatment for once-off application. In summary, this study provides strong evidence that recovering nutrients from source-separated human urine offers a promising and sustainable approach for fertilizer replacement in agriculture, potentially leading to enhanced plant growth without detrimental effects on soil properties. Further research could explore the long-term impacts of urine application on soil health and nutrient cycling, as well as optimize application rates and methods for various crop types and soil conditions.

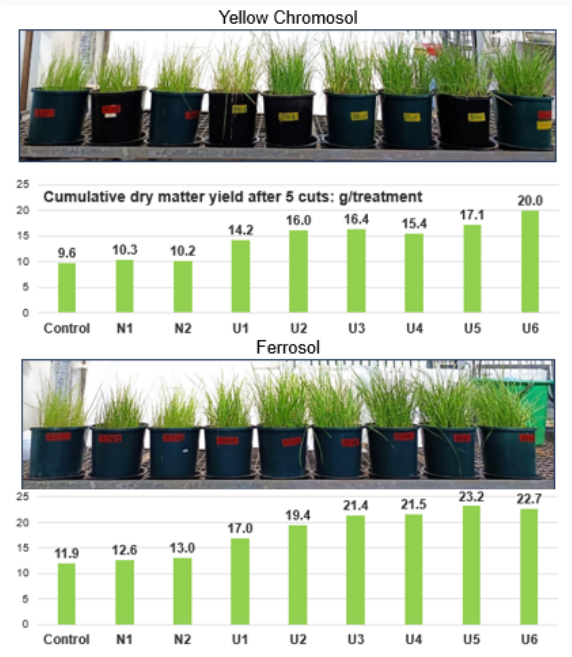


Figure 3. Dry mass of ryegrass after 5 harvesting events, g/treatment

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Griffith University

Incorporating non-market benefits into the economic evaluation of urine-diverting technologies: Evidence from Queensland, Australia

Introduction:

Australia's wastewater sector is undergoing a significant transformation in response to growing urban populations, aging infrastructure, and increasing expectations for effluent water quality. At the centre of this shift is a growing emphasis on turning waste into valuable resources to support a circular economy, with a particular focus on developing, testing, and scaling up urine-diverting technologies (UDTs). The program seeks not only to enhance the resilience of the wastewater industry but also to strengthen Australia's fertiliser market with sustainable, locally tailored products.

This study quantifies the non-market benefits of UDTs using a discrete choice experiment and integrates these intangible benefits into a detailed benefit-cost analysis to provide the most up-to-date estimates of the overall value of UDT systems. We also present a stylised benefit-cost analysis of an upscaled UDT system, incorporating subsidised benefits provided by water utilities as compensation for reduced downstream nutrient loads.

Proposed methodology:

An online DCE survey, designed using an S-efficiency criterion and implemented via Qualtrics, is conducted with 1,610 respondents across Queensland, New South Wales, and Victoria. A willingness-to-pay space model is applied to directly estimate the non-market benefits of UDTs, which are then integrated into a detailed benefit-cost analysis based on a case study in Victoria Park, Queensland.

Expected outcomes:

(1) add to the existing literature by quantifying non-market benefits of UDTs through a DCE, focusing on five desgin features of UDTs: (i) types of toilets and/or urinals targeted; (ii) location targeted; (iii) capacity of water savings; (iv) use of recovered nutrients as fertilisers; (v) scale of environmental benefits. (2) underscore the importance of incorporating non-market benefits into the economic evaluation of sanitation initiatives. (3) present a stylised benefit-cost analysis of an up-scaled UDT system.

Other News from Partner Universities

Sydney node

University of Technology Sydney (UTS)

2025 NSW Commercialisation Showcase

The 2025 NSW Commercialisation Showcase, hosted by Office of the NSW Chief Scientist & Engineer at the University of Technology Sydney Aerial Function Centre, brought together some of the state's most dynamic research and industry leaders to celebrate cutting-edge commercialisation success stories.

It was a great opportunity for the Nutrients in a Circular Economy research hub, represented by Director Professor HK Shon and Hub Manager Ibrahim El Saliby to share and promote groundbreaking nutrient recovery and reuse technologies. The event served as a powerful platform to forge new partnerships and engage with key figures shaping the future of clean technology.

Second Prize in the UTS 2025 Research Translation Competition

Excited to share that the ARC Research Hub for Nutrients in a Circular Economy (ARC NiCE Hub) has won Second Prize in the UTS 2025 Research Translation Competition!

Our pitch, "Transforming Human Waste into Value-Added Fertilizer Biostimulant - StimGro," demonstrates how a critical waste stream can be transformed into a sustainable, circular solution for agriculture.

A big congratulations to all the students, research fellows, professional staff, and chief/partner investigators who are advancing nutrient circularity and driving innovation through the ARC NiCE Hub!




The NiCE Loo Lab launch

The NiCE Loo Lab, a mobile public toilet that transforms human urine into safe and valuable fertiliser, was officially launched on 14 March at the University of Technology Sydney (UTS).

This innovative unit features waterless urinals, urine-diverting toilets, a urine separation system, and a compact membrane bioreactor. Developed over two years of collaborative research, the project was led by researchers from the ARC Nutrients in a Circular Economy (NiCE) Hub at UTS, in partnership with The University of Melbourne and supported by South East Water.

The NiCE Loo Lab recently made its public debut in Sydney's Domain as part of the exhibition "NiCE Loo Lab in The Domain". The event gave the public a first-hand look at the technology and sparked strong interest and engagement.

During the exhibition, researchers explained how recovering nutrients from urine can:

- Close the nutrient loop to support sustainable agriculture
- Reduce environmental pollution from wastewater
- Promote water conservation in urban sanitation systems

This project highlights how innovative design and science can work together to create practical solutions for a more sustainable future.



Visit to the Local Land Services Demonstration Farm

NiCE Hub Chief Operating Officer Ibrahim El-Saliby recently had the opportunity to spend a day at the Local Land Services Demonstration Farm in Richmond, NSW, where he joined a diverse group of industry experts, researchers, and growers to explore some exciting developments in horticulture and sustainable agriculture.

The event featured a series of insightful presentations and field demonstrations. We received valuable updates on crop biosecurity from representatives of the NSW Department of Primary Industries and Regional Development, as well as AUSVEG, highlighting current challenges and strategies to safeguard our agricultural systems. Applied Horticultural Research shared their latest findings on soil health and fertility through the Soil Wealth program, emphasizing practical approaches to improving productivity and sustainability. We also got a firsthand look at the "Level Up Hort" project led by RMCG, which showcased innovative tools and techniques aimed at enhancing horticultural practices and decision-making.

It was a great opportunity to engage with regulators, growers, and fellow researchers, and to discuss how circular nutrient strategies –such as nutrient recovery from waste streams–can contribute to resilient and productive agriculture.

The day was a fantastic blend of knowledge sharing, collaboration, and hands-on learning. It was inspiring to see so many passionate individuals working together to drive innovation and sustainability in the sector.

Western Sydney University

Our PhD candidate Niraj Yadav has been collecting accolades at both local and national levels. Locally, he won both Judge panel runner up award and People's Choice Award at the Hawkesbury Institute for the Environment's Three Minute Thesis heat and another People's Choice Award at the School of Science Research Symposium-proof that our work resonates with diverse audiences. These achievements showcase the widespread interest in nutrient recycling and our team's ability to communicate its benefits effectively. Beyond competitions, we continue to engage with schools, community groups and professional audiences through seminars and guest lectures, spreading the message of sustainable fertilisers.

Brisbane node

University of Queensland

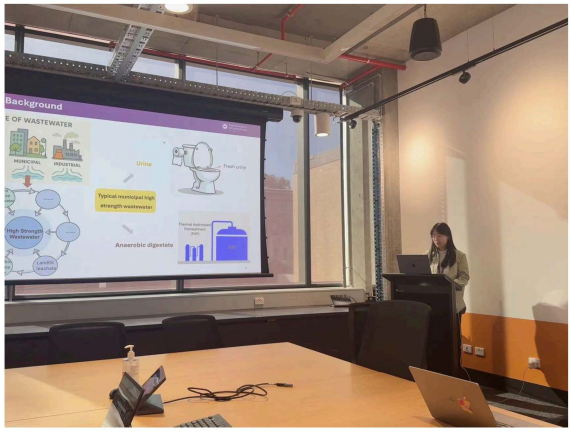
PhD Confirmations: Celebrating Lu and Shirley's Milestones

We are delighted to share that two of our PhD students, Lu and Shirley, have successfully completed their first confirmations

Lu's research, Mechanistic Insights and Mitigation Strategies for N_2O Emissions in Municipal High-Strength Wastewater Treatment, addresses one of the most pressing challenges in sustainable wastewater management: reducing nitrous oxide (N_2O), a potent greenhouse gas. Her work aims to unravel the biological and chemical pathways that drive emissions and to design practical strategies for mitigation in real-world treatment systems.

Shirley's project, Capture and Treatment of Gaseous N_2O Emission from Wastewater Treatment Plants, complements this focus by tackling off-gas emissions. She is investigating innovative approaches to capture and treat N_2O at the source, contributing to the global push toward net-zero emissions in the water sector.

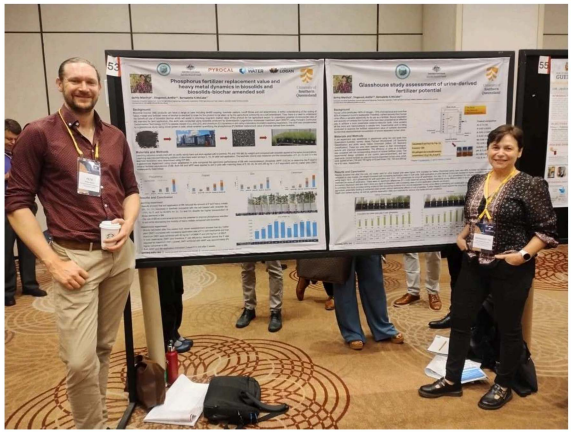
Their confirmations mark a strong beginning to two highly impactful projects. Congratulations to both Lu and Shirley!



University of Southern Queensland

Professor Bernadette McCabe attended National Biosolids Conference 2025 in Hobart, Tasmania and presented UniSQ research "Agronomic assessment of biosolids biochar produced by Pyrocal's CCT at Loganholme WWTP".

Dr Peter Harris and Professor Bernadette McCabe attended 2025 American Society of Agricultural and Biological Engineers (ASABE) Annual International Meeting in Toronto, Canada and presented two posters: "Nitrogen fertilising potential of source-separated human urine" and "Phosphorus fertilizer replacement value and heavy metal dynamics in biosolids and biosolids-biochar amended soil".



UniSQ PhD candidate Seonmi Lee successfully completed her "Confirmation of Candidature" stage of her PhD project "A challenge of nutrient recovery from human urine loaded biochar for sustainable application in agriculture as a fertiliser".

Griffith University

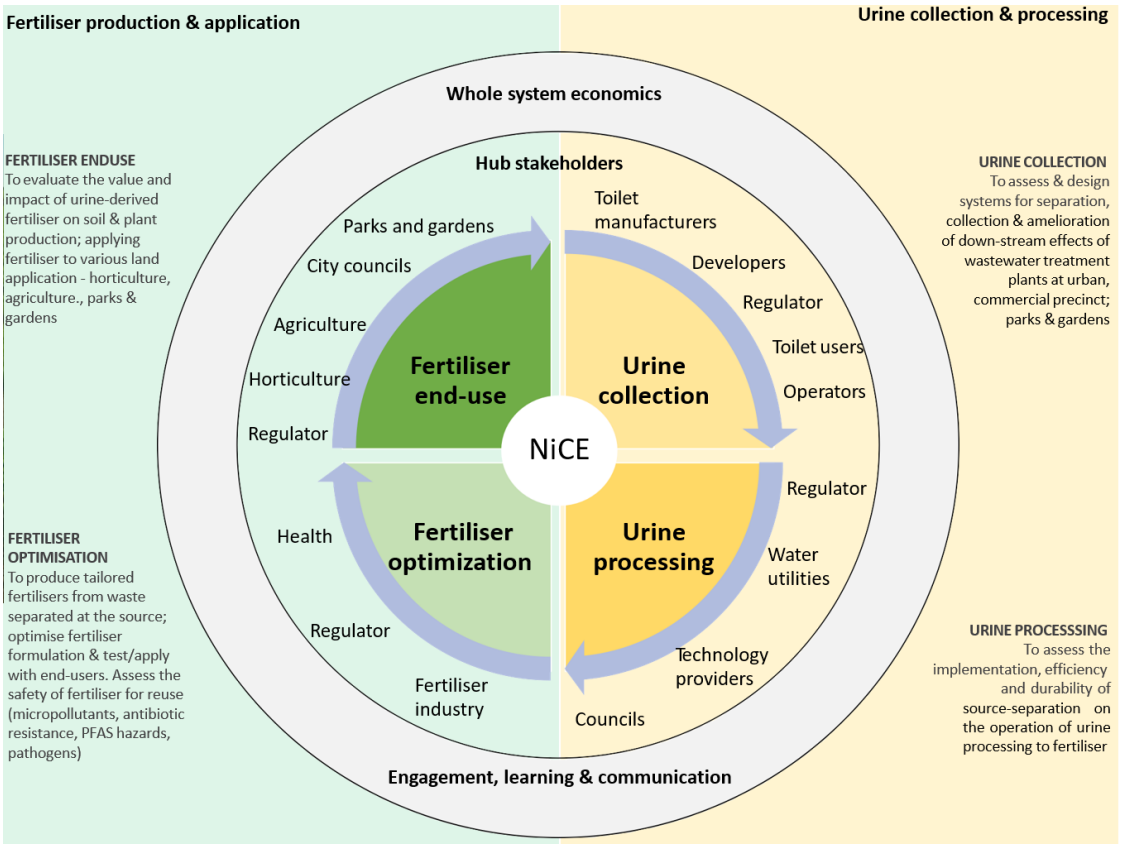
PhD candidate Johanna Engels recently returned to the Netherlands to present her research on modelling the microbial health risks of urine-derived fertiliser at the 22nd Health-Related Water Microbiology Conference in Amersfoort (16-20 June). In the QMRA & Modelling session, she presented a study titled "Urine diversion - at the crossroads between a circular economy and microbial health risks," detailing the development of a health risk model to evaluate treated urine reuse in urban green spaces. Preliminary results indicate that microbial risks from urine-derived fertilisers are negligible following membrane treatment. Johanna was grateful for the opportunity to showcase and discuss her research with other health experts, and is now finalising her paper on *Modelling the Health Risk of Urine-Derived Fertiliser Application in Urban Green Areas.*

About Us

The ARC Research Hub for Nutrients in a Circular Economy (NiCE) will make Australia the world leader in a new circular economy, based on nutrient recycling through the separation, collection and processing of human urine into safe and effective fertilisers. It will use an integrated and multidisciplinary approach to create the technical and social know-how, the business models and the regulatory frameworks needed for the uptake of this circular economy concept.

The Hub's outcomes will directly benefit Australia's water utilities, agriculture, and manufacturing sectors. Urine recycling can save up to 50% of sewage treatment operating costs and avoid costly capital upgrades. New technology (toilet designs, sensors and membrane processes for urine) will create new opportunities for Australia's manufacturing sector.

The ARC Nice hub has successfully developed two technologies to convert human urine to safe and nutrient-rich compound fertilisers. Within the NiCE Hub's scope, two groundbreaking fertilizer products have been successfully developed: UrVAL and UGOLD. These products utilize cutting-edge technologies to transform urine into valuable resources for horticulture. In addition, many of our industry partners are also working on the recovery of valuable nutrients from different type of waste material.



ARC NiCE Hub Plan diagram

Our Partners

Universities

Industry Partners

International Organisations

2025 Publications

1. Ometto, A.R., Koskue, V., Cerdan, J.M.A., de Melo Duarte Borges, T., Roiko, A., Iftekhar, S., Cordell, D., Roods, J., Shon, H.K., Freguia, S., Oliveira, M.G., de Vasconcelos Gomes, L.A., Evans, S., Beal, C. (2025). Pathways to circular nutrient ecosystems: Strategic roadmaps addressing sustainability drivers and barriers in Australia. Sustainable Production and Consumption 56, pp. 593-617. DOI: 10.1016/j.spc.2025.04.017

2. Merenda, A., Shafaghat, A. H., Sohn, W., Seccombe, D., Phuntsho, S., Shon, H.K. (2025). Valorisation of liquid anaerobic digestate into liquid fertilisers via membrane bioreactors: a proof-of-concept study. Water Research 285: 124026. DOI: 10.1016/j.watres.2025.124026

3. Soo, A., Gao, L., Shon, H. K. (2025). Roadmap for Australian Wastewater Nutrient Recovery-Towards a Sustainable Circular Economy. Desalination and Water Treatment 323: 101273. DOI: 10.1016/j.dwt.2025.101273

4. Wang, F., Yang, Y., Gao, J., Li, X., Lu, Z., Fan, X., Cao, S., Liu, Y., Tijing, L.D., Shon, H.K., Ren, J. (2025). Ultra-rapid start-up biological nitrification for nutrient recovery from source-separated urine. Water Research 287: 124343. DOI: 10.1016/j.watres.2025.124343

5. Li, K., Duan, H., Wang, S., Wu, Z., Wardrop, P., Lloyd, J., Christy, N., De Jong, P.,Ye, L. (2025). Balancing energy recovery and direct greenhouse gas emissions in wastewater treatment. Water Research X 28: 100328. DOI: 10.1016/j.wroa.2025.100350

6. Wang, S., Li, K., Ahmmed, M.S., Duan, H., Ye, L. (2025). A systematic decision-making framework for selecting nitrous oxide quantification methods in water utilities. Water Research X 28:100350. DOI: 10.1016/j.wroa.2025.100350

7. Yu, H., Reynolds, J., Koskue, V., Marchuk, S., Antilla, D., McCabe, B., Beal, C., Freguia, S., Yadav, N., Powell, J. (2025). Recovering nutrients from urine - a golden opportunity for sustainable fertiliser production. Plants, People, Planet *(accepted, in print).*

8. Marchuk S., Antilla, D.L., Hammond D, Croker, B., McCabe, B.K. (2025). Heavy metal dynamics and evaluation of phosphorus fertiliser value for biosolids derived biochar. Conference: Australian Water Association's National Biosolids Conference 2025, 17-18 March 2025, Hobart, Australia

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Hub Manager
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