NUS SUSTAINABILITY REPORT 2024

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A 2013 photo taken from the same spot as the cover image, revealing significantly sparser greenery in front of University Hall. Since then, the University has intensified its campus greening efforts, committing to plant up to 100,000 new trees by 2030 — a target that is already 55 per cent met — and contributing to 10 per cent of the National Parks Board's OneMillionTrees movement.

This is an interactive report. Use the navigation bar and the page titles on the contents page to jump to specific sections. Clicking on in-text links will direct you to more information outside of the report."

OUR APPROACH TO SUSTAINABILITY

The National University of Singapore (NUS) recognises that the vision of a more sustainable future cannot be achieved by any one individual, organisation, or country. It requires a collected, committed, and concerted effort by all.

As a university, NUS plays a crucial role in this global mission as a centre for education, research, innovation, and leadership. It not only nurtures the next generation of leaders and pursues groundbreaking scientific breakthroughs, but also uses its sprawling grounds as a testbed to demonstrate the efficacy of novel technologies. NUS students, faculty, administrators, and alumni also influence thinking and action by spearheading initiatives both within and beyond the campus.

This is why sustainability is firmly integrated into all that is done at NUS, from the way it develops and structures its curricula, to the research it undertakes, to the design and operation of its campus infrastructure.

By leveraging cross-disciplinary learning, NUS provides students with a comprehensive understanding of sustainability issues to face an increasingly complex future. This will in turn instil in them a strong sense of responsibility for the environment.

On the research front, NUS has strengthened its research capabilities and built on existing collaborations with the industry, while seeking out new opportunities to co-create solutions for greater environmental and societal impact.

Within the campus, it has continued to challenge the status quo by placing sustainability at the core of its masterplanning, design and construction, renovation, operation, and maintenance of its buildings and grounds. It has taken a multi-pronged approach to reducing its carbon footprint, which includes minimising resources used; cutting down waste and carbon emissions; and conserving and augmenting its natural environment.

And through its students, faculty, and alumni, the university advances sustainability by encouraging and supporting them in their sustainability-related endeavours both in and beyond NUS.

All these efforts are guided by the University Sustainability and Climate Action Council, which was formed in 2021. Chaired by the NUS President and composed of faculty and staff, the council is committed to transforming NUS into a university that is a role model for sustainability.

REPORT SCOPE

As the second edition of the NUS Sustainability Report, this publication provides an update on the university's contributions to environmental and climate-related sustainability in 2024.

Similar to the inaugural report published last year, it does not claim to be a complete documentation of all that has been done. Rather, it takes a more qualitative approach with carefully selected features that showcase the range and depth of NUS' commitment to sustainability.

In preparation for a more comprehensive Environmental, Social, and Governance (ESG) report in the near future, this year's report slightly expands in scope, incorporating the social and human aspects of the university's sustainability efforts. But the focus remains on its contributions to the environment.

Many of the programmes and initiatives highlighted in the following pages support the United Nations Sustainable Development Goals (SDGs) – a global framework designed to accelerate sustainability and climate action by 2030. Broadly, its efforts contribute to the following SDGs:

Depending on the type of data, three different reporting time frames were used:

- AY: Academic Year – A one-year study period, comprising two semesters and a special term (every August to July of the following year)
- FY: Financial Year – A one-year fiscal year, typically used for financial accounting and budgeting (every April to March of the following year)
- CY: Calendar Year – A one-year period from January to December

Data highlighted in this report are from NUS unless otherwise stated.

PRESIDENT'S FOREWORD

At NUS, sustainability is a central mission – one that guides how we teach, research, operate our campus, and collaborate with partners. In this second edition of the NUS Sustainability Report, we reaffirm our commitment to create a more resilient, equitable, and sustainable future for Singapore and the world.

Our starting point is education. We believe that sustainability thinking and green competencies must be embedded across disciplines and learning pathways. In 2024, NUS delivered more than 550 undergraduate and postgraduate courses that focus on green skills and knowledge at every level.

The courses are not confined to environmental science; they span architecture, business, engineering, law, and the humanities. For example, "Cheeseburger in Paradise", a course offered by the Faculty of Arts and Social Sciences, explores the environmental, cultural, economic, and nutritional dimensions of food, helping students understand how personal choices affect global systems.

The expansion of graduate and professional offerings at NUS reflects both the urgency of sustainability challenges and the growing appetite for relevant expertise. New graduate courses such as the Master of Science in Climate Change and Sustainability and the Master of Science in Data Science for Sustainability, as well as the expansion of our lifelong learning and professional programmes support Singapore's transition to a green economy and meet evolving industry demands.

NUS is also at the forefront of impactful, interdisciplinary research that addresses pressing sustainability challenges. From decarbonisation and alternative energy technologies to sustainable protein and green manufacturing, many of these research efforts have led to innovative breakthroughs that challenge the status quo and help shape the future with purpose and impact.

For instance, an NUS PhD graduate and a multidisciplinary team comprising NUS researchers have co-founded tHEMEat Company and developed VEME®, a novel flavour catalyst which is derived from upcycled vegetable and food waste. VEME® replicates the sensory experience of meat while reducing reliance on traditional livestock farming. This discovery exemplifies how university research can be translated into real-world solutions that promote food security and circular economy principles.

Such successes remind us that collaboration with industry, government, and civil society is essential to amplifying our impact. In line with this, research collaborations on sustainability-related

projects increased by over 70 per cent between 2023 and 2024, fostering a growing number of joint ventures in areas ranging from decarbonising data centres to optimising global supply chains. Through these strategic partnerships, NUS ensures that our innovations are not only practical and scalable, but also firmly grounded in addressing the needs of society.

In the green transformation of our own campus, NUS continues to lead in sustainable campus development, with buildings such as SDE4 – Singapore's first purpose-built net-zero energy building, the rejuvenated SDE1 and SDE3 and most recently the Yusof Ishak House, setting new benchmarks for high energy performance As part of efforts to enhance the campus' thermal comfort, we have planted over 50,000 trees, expanding the campus tree canopy coverage to 60 per cent.

NUS is also implementing a three-year detailed plan from FY2025 to reduce our emissions towards baseline levels by FY2027 in doing our part for climate change. Our campus continues to serve as a living laboratory where researchers and industry partners can collaborate to translate cutting-edge technologies into impactful, scalable solutions to shape a sustainable future.

Our faculty and researchers are also influencing global discourse on sustainability – from shaping environmental policy to advancing climate law in the Global South. At COP29 in 2024, NUS experts contributed insights on conservation technology, urban resilience, and sustainable healthcare. On campus, student leaders and eco-conscious students continue to drive zero-waste initiatives and nature outreach, reminding us that leadership starts with everyday actions.

These efforts, among many others, have contributed to NUS being ranked among the top three universities in Asia for Sustainability in the 2026 QS World University Rankings.

Sustainability is a shared journey. We continue to persevere in our mission to educate, innovate, and lead for a more sustainable tomorrow.

Professor Tan Eng Chye
President
National University of Singapore

2024 IMPACT AT A GLANCE

Data as at December 2024 unless otherwise indicated.

Education

>550 sustainability-centric courses delivered across the undergraduate and postgraduate curriculum (AY2024)

26% of undergraduates have taken at least one sustainability-related course (AY2024)

61% of undergraduates found jobs in sustainability-related industries (CY 2024)

185 alumni founded sustainability-related companies

Research

17% of all research and academic papers published were sustainability-related (CY2024)

155 ongoing research collaborations with external partners on sustainability -related research projects

S$176M in competitive funding for sustainability research (FY2024)

28 sustainability-related spin-off companies set up based on NUS technology

Campus

9.2 megawatt-peak campus-wide solar photovoltaic system commissioned

70% drop in energy consumption projected for retrofitted Yusof Ishak House

50 campus-wide micro-climate sensors used to establish baseline campus outdoor thermal comfort map

55% of target to plant 100,000 trees on campus by 2030 achieved

Leadership

16% of senior NUS leaders engaged in advisory roles, consultation work, or held non-executive directorships in sustainability-related companies

EDUCATION

Cultivating Climate Consciousness

BUILDING KNOWLEDGE FOR IMPACT

Today's environmental and social challenges demand interdisciplinary solutions. At NUS, sustainability education is approached holistically, with principles embedded across core and elective courses in diverse disciplines.

This is delivered through a three-pronged strategy. First, researchers and educators incorporate sustainability into their core curricula, whether in engineering, science, law, or the humanities.

Second, the university offers specialised programmes, including two launched in 2024: the Master of Science in Climate Change and Sustainability and the Master of Science in Data Science for Sustainability.

Third, NUS fosters interdisciplinarity through platforms like the College of Humanities and Sciences – a partnership between the Faculty of Arts and Social Sciences and the Faculty of Science – where students from different fields collaborate on sustainability projects.

In 2024, NUS delivered 268 undergraduate and 287 postgraduate courses that build skills in critical thinking, sense-making, and values-based decision-making – essential for navigating trade-offs in the pursuit of sustainability and equity.

Overall, the university's curriculum centres on four key levels of green skills training:

1. General awareness and understanding of sustainability
2. Cross-sector and cross-function education
3. Sector-specific and function-specific skills training
4. Frontier green skills

At the foundational level, courses like "Cheeseburger in Paradise" explore sustainability through culture, economics, microbiology, and nutrition. In cross-sector education, the Business School offers green accounting and sustainable finance courses, while the Faculty of Arts and Social Sciences teaches subjects such as Resource and Energy Economics and Climate Justice.

Specialist training is delivered through its professional schools, with offerings like Climate Responsive Architecture; Hydrogen Energy and Technology; Marine Conservation; and new specialisations in Sustainable Green Buildings and Sustainable Chemistry – part of a portfolio now comprising 33 undergraduate specialisations.

NUS' continuing education arm also continues to expand, with Professional Certificates in Financing Sustainability and Sustainability for the Built Environment.

At the same time, it is boosting sustainability awareness among students and staff on what it means in practice, such as at Ridge View Residential College where students are engaged in sustainability-related initiatives. NUS staff are also encouraged to attend courses organised by the university to enhance their sustainability literacy and apply the knowledge gained at their workplace.

NUS' all-encompassing approach to sustainability education empowers students and staff to contribute to a more sustainable future.

HIGHLIGHTS IN NUMBERS

Undergraduate Education
(AY2024)

7 sustainability-themed majors

18 sustainability-themed second majors and minors

33 sustainability-themed specialisations

Postgraduate Education
(AY2024)

15 sustainability-related master's programmes

Graduate Employment
(CY2024)

61% of undergraduates found jobs in sustainability-related industries

Innovation and Enterprise
(As at Dec 2024)

185 alumni founded sustainability-related companies

153 sustainability-related startups founded by alumni

Professional and Executive Education
(CY2024)

3 graduate certificates

37 short courses*

8 professional certificates and advanced professional certificates

9 executive education programmes

**Short courses may be stacked towards professional certificates*

Informal Education
(As at Dec 2024)

>20 environmental student groups

Enrolment in Sustainability-Themed Programmes

3,232 students taking undergraduate majors, minors, and specialisations (AY2024)

1,444 students taking master's programmes (AY2024)

1,510 training places in Professional and Executive Education (CY2024)

SHORING UP TALENT FOR CLIMATE ACTION

As demand for expertise in climate solutions intensifies, NUS has launched two new specialised Master's programmes in sustainability to help build a strong pipeline of talent.

The graduate programme in Climate Change and Sustainability, offered by the Department of Geography, bridges the biological, physical, social, and engineering sciences to provide training in both the science of climate change and practical response strategies.

Its interdisciplinary approach reflects the complex nature of climate challenges, particularly in Asia where rapid development has contributed to increasing climate vulnerability.

Students will explore everything from atmospheric science to climate policy implementation. They also have the option to undertake research projects, allowing for deeper specialisation in climate-related issues.

What sets this degree apart from NUS' existing environmental offerings, such as the Master of Science in Environmental Management, is its heavy focus on climate science, mitigation approaches, and socio-economic impacts.

Alongside this offering, NUS launched a Master of Science in Data Science for Sustainability through a collaboration between the Department of Statistics and Data Science and the Centre for Nature-based Climate Solutions, in partnership with the Department of Biological Sciences.

Students will master advanced analytical techniques while developing a deep understanding of sustainability challenges.

The programme addresses the growing need for professionals who can analyse complex environmental data sets to inform decision-making. As organisations increasingly track sustainability metrics, the demand for data scientists with environmental expertise has grown steadily.

Both programmes target local and international students, reflecting the global nature of sustainability challenges. Graduates will be ready to enter a job market where sustainability knowledge is becoming a mainstream requirement across all sectors.

◀ *NUS continues to expand its master's programmes in sustainability, ensuring that Singapore builds up a pipeline of talent ready to take climate action.*

EMPOWERING FUTURE-READY PROFESSIONALS

In a world plagued by growing climate challenges, NUS' continuing education programmes ensure that professionals are equipped with critical skills in emerging sustainable domains.

The university has continued to expand its portfolio of specialised Professional Certificates to provide practical knowledge in specialised sustainability areas while building towards recognised professional credentials.

To accommodate the diverse schedules of working professionals, the programmes comprise industry-relevant component short courses that typically span from one to three days.

For example, the Professional Certificate in Financing Sustainability, offered by the Sustainable and Green Finance Institute, teaches participants to mobilise capital to support a sustainable future. It features courses addressing the growing intersection of finance and environmental concerns. Participants learn to integrate economic, social, and environmental considerations into financial evaluations, monetise environmental impacts, and identify investment opportunities that generate positive returns for both portfolios and the planet.

For those leading organisational sustainability transformation, the Professional Certificate in Managing Sustainability provides training in carbon accounting and sustainability governance. Beyond theoretical frameworks, the programme equips participants with actionable strategies to establish credible environmental targets and create sustainability reports that satisfy increasingly demanding stakeholders and regulatory requirements.

The Professional Certificate in Sustainability for the Built Environment focuses on a sector that is responsible for approximately 40 per cent of global carbon emissions. The programme explores nature-based climate solutions, low-carbon construction materials, and smart building technologies that can reduce environmental impacts. Participants emerge with the ability to integrate sustainability principles in both new construction projects and retrofitting existing buildings.

What sets these Professional Certificates apart is their immediate applicability. Participants don't just learn about sustainability – they develop tangible skills to implement sustainable solutions the very next day. By connecting academic expertise with industry realities, NUS' continuing education programmes are creating a growing network of sustainability practitioners across sectors.

Through its Professional Certificate programmes, NUS equips working adults with skills in emerging domains that allow them to implement sustainable solutions in their work. ▶

SUSTAINABILITY EDUCATION IN ACTION

▲ *RVRC students after they assisted to salvage fresh produce with Fridge Restock Community at Pasir Panjang Wholesale Centre.*

Situated adjacent to the ecological landscape of Kent Ridge Forest, Ridge View Residential College (RVRC) was established in 2014 as an innovative living-learning programme centered on the twin themes of sustainability and workplace readiness. The college employs a holistic pedagogical approach, emphasising experiential and outdoor learning, interdisciplinary collaboration, and meaningful engagement with industry and community partners.

A core feature of RVRC's curriculum is the integration of the United Nations Sustainable Development Goals (UN SDGs), which enables students to critically engage with the multifaceted dimensions of sustainability and envision pathways toward a more equitable and resilient future.

For example, the "RVN2000 Engaging Communities in Sustainability" course guides students to explore the pivotal role of communities in addressing challenges such as resource consumption and waste reduction. A notable experiential component for this course involves fieldwork at the Pasir Panjang Wholesale Centre, where students collaborate with grassroots initiatives to rescue cosmetically imperfect produce. These efforts directly support community distribution channels, contributing to food security and resource efficiency at the neighbourhood level.

RVRC encourages student agency beyond formal coursework, providing avenues for students to initiate and participate in impactful sustainability projects. Since 2019, the RV FoRestore student interest group at the college has led reforestation initiatives at Chestnut Nature Park, a vital ecological buffer for the Central Catchment Nature Reserve. Students propagate and nurture native species, with over 600 trees planted to date – a testament to RVRC's hands-on approach to realising Singapore's vision of a City in Nature.

Furthermore, RVRC staff and alumni strive to foster sustainability awareness beyond the NUS campus, to spark meaningful dialogue and citizen action. The RVRC x National Library Board specialised initiative, focused on public engagement, was launched in 2021 as a monthly series featuring "expert talks". It has gradually evolved into an interactive bi-monthly lecture series that aims to elucidate and simplify critical issues related to sustainability in Singapore, ranging from ecosystem conservation to urban sustainability.

By nurturing environmentally conscious leaders equipped with the knowledge and skills to address pressing global challenges, RVRC continues to play a pivotal role in shaping the future of sustainability-centric education at NUS.

Through initiatives such as orientation talks and leadership circulars, NUS aims to create an environmentally informed workforce.

BUILDING SUSTAINABILITY LITERACY FROM WITHIN

How much greenhouse gas emissions does the NUS community generate yearly just by going about their daily activities? Such carbon footprint questions were part of NUS' efforts to improve sustainability literacy for staff in 2024.

New executive, administrative and research employees at NUS are introduced to the Campus Sustainability Framework and Roadmap 2030 as part of their onboarding, which familiarises them with the university's environmental sustainability strategy.

The sessions go beyond standard presentations. Carbon footprint quizzes and open discussions on community building efforts encourage interactivity, aimed at instilling a sense of ownership and accountability towards NUS' carbon footprint. In 2024, 470 new staff attended the orientation sessions, where about 90 per cent said the sessions were relevant to their work.

New staff are also introduced to how sustainability principles are integrated into campus architecture and buildings such as NUS University Town and SDE4, with plans to include an experiential learning journey to the newly retrofitted net-zero energy Yusof Ishak House.

Beyond staff orientation sessions, environmental awareness is also promoted through NUS' internal staff circulars from the Deputy President of Administration, Mr Clarence Ti. About one-third of those issued in 2024 focused on environmental topics, such as campus decarbonisation and climate adaptation.

For mid-level managers, NUS launched a tailored version of "Sustainability: The Next Challenge", a popular Business School executive course. The two-day programme mainly covers the application of the Environmental, Social and Governance (ESG) framework in evaluating organisational sustainability, with an emphasis on the Governance pillar as a critical enabler for sustainability issues.

Two runs of this specialised training in 2024 have equipped 44 middle managers from various departments with comprehensive sustainability knowledge.

From orientation talks, leadership circulars, learning journeys to formal training, NUS aims to create a workforce fluent in sustainability literacy, equipped to translate the university's sustainability goals into meaningful action in the workplace.

RESEARCH

Challenging Conventions

DRIVING INNOVATION FOR A SUSTAINABLE TOMORROW

Research is the engine behind innovation – and a powerful catalyst for sustainability. As the world confronts climate change, resource scarcity, and rising demands for energy and food, research provides the critical foundation for long-term solutions. From deepening our understanding of complex global systems to developing breakthrough technologies, sustainability research paves the way for a more resilient future.

Universities play a special role in this journey. As centres of knowledge creation and talent development, they offer not just new discoveries but the ideas, people, and partnerships needed to bring these solutions into the real world. At NUS, sustainability research is grounded in rigour, collaboration, and impact – spanning disciplines and bridging science, engineering, policy, and behavioural studies.

In carbon capture and clean energy, researchers are creating novel materials to convert carbon dioxide into useful products and exploring ammonia as a zero-carbon fuel. In sustainable food systems, efforts are underway to reinvent meat production through cell culture and fermentation, supported by the Bezos Centre for Sustainable Protein.

Meanwhile, innovations in green chemistry are turning waste streams into valuable materials, such as the recovery of precious metals from e-waste using engineered microbes. In behavioural science, researchers are identifying public knowledge gaps around climate targets and helping individuals translate awareness into meaningful action.

Through research, NUS contributes to national and global sustainability goals, guided by the belief that innovation – when grounded in science and shared purpose – is key to shaping a liveable, low-carbon future for all.

HIGHLIGHTS IN NUMBERS

Research and Academic Publications
(CY2024)

17%
(or 2,308)
of research and academic papers published are sustainability-related

87%
of sustainability-related publications involve collaboration with other institutes

5%
of sustainability-related publications involve corporate collaborations

141
collaborating countries/ regions for NUS' sustainability-related publications

2.67
Field-Weighted Citation Impact for sustainability-related publications*

**Measures how well-cited a publication is compared to similar publications*

Research Collaborations
(As at Dec 2024)

155
ongoing research collaborations with external partners on sustainability-related research projects

70
with companies and industry associations

70
with research institutes and institutes of higher learning

15
with government agencies

Technology Transfer and Innovation
(As at Dec 2024)

28
sustainability-related spin-off companies set up based on NUS technology

Grants
(FY2024)

S$176M
in competitive funding for sustainability research

DECARBONISATION THROUGH CARBON CAPTURE AND ALTERNATIVE ENERGY TECHNOLOGIES

Carbon dioxide can now be turned into valuable materials through a process that requires no extreme heat or pressure, with a new technique created by researchers from NUS Chemical and Biomolecular Engineering.

Professor Liu Bin, NUS Deputy President (Research and Technology), and Professor Zhao Dan have developed a novel metal-organic framework-based material that catalyses the conversion of captured carbon dioxide into useful cyclic carbonates, which are used in the production of polymers, chemicals and pharmaceuticals. They attained a yield of over 99 per cent, and importantly, demonstrated high efficiency at room temperature.

In another sustainable energy solution, Professor Yan Ning is exploring ammonia as a clean energy alternative. His team is working on two strategies: decomposing ammonia to obtain hydrogen as a clean fuel source, and blending ammonia with natural gas to reduce the latter's carbon footprint. Since ammonia contains no carbon, it offers a promising path to meeting emission targets.

In a space-saving solution crucial for land-scarce Singapore, Prof Yan's team is integrating ammonia processing directly with gas turbines. This approach uses waste heat from the turbines to power the conversion process, reducing the land footprint compared to traditional methods that need large furnaces and separation units.

These technologies are part of Singapore's journey toward net-zero emissions by 2050. NUS is spearheading these efforts through specialised research centres including the Centre for Hydrogen Innovation, Centre for Energy Research and Technology, Solar Energy Research Institute of Singapore, the Energy Studies Institute, and the REC@NUS Corporate R&D Laboratory for Next Generation Photovoltaics.

The university's approach includes developing carbon capture, utilisation, and storage systems, improving renewable energy integration, and finding ways to convert greenhouse gases into valuable products. In parallel, Singapore is diversifying its energy mix through investments in hydrogen, energy storage, and solar technologies.

By focusing on efficient, scalable, and economically viable solutions, the work of NUS researchers demonstrates how innovative thinking can help lay a strong foundation for a sustainable, low-carbon economy, paving the way toward a cleaner, more resilient energy future.

▲ *Prof Yan Ning and his team are looking to develop more energy-efficient and greener methods of extracting hydrogen from ammonia.*

REINVENTING FOOD PRODUCTION FOR A SUSTAINABLE FUTURE

Picture a juicy piece of pork that was not raised on a farm but grown in a laboratory using animal cells. This is the future of food taking shape at NUS Food Science and Technology today.

Led by Professor Huang Dejian, researchers have created cultured pork using a scaffold made from kafirin, a protein found in red sorghum grain. Unlike traditional scaffolds made from wheat or soy that can trigger allergies, this gluten-free alternative could make lab-grown meat more accessible to consumers with dietary restrictions.

In 2020, Singapore made history as the first country where cultivated meat could be legally sold to consumers. This progressive regulatory environment has attracted numerous food technology companies, including Cellivate Technologies, a NUS spin-off that is developing fetal bovine serum (FBS)-free media for cultivated meat, leather, and cruelty-free cosmetics. Such FBS-free media relies on chemically defined formulations for cell growth and eliminates the need for animal-derived materials in production.

These innovations could not have come at a more critical time. With the global population expected to reach 10 billion by 2050, food production must increase by 60 per cent to feed everyone.

NUS researchers are experimenting with multiple sustainable approaches to meet this demand. The recently launched Bezos Centre for Sustainable Protein is exploring microalgae and biomass fermentation to produce high-quality, affordable microbial proteins. Researchers are enhancing these proteins' flavour, nutrition, and digestibility while developing methods to scale up production.

Another promising direction is the Centre's efforts to integrate plant proteins with fermentation-based ingredients to create more affordable alternative protein products.

Meanwhile, the WIL@NUS Corporate Laboratory is using synthetic biology to develop healthier food products and green production technologies for industrial enzymes and biochemicals.

By focusing on food innovation and alternative proteins, NUS researchers are driving research in sustainable food production to supplement traditional agricultural practices.

▲ *Scientists at the Bezos Centre for Sustainable Protein are looking at ways to produce microbial proteins from microalgae, which can be further developed into cultured meat and plant-based protein hybrids.*

PUSHING BOUNDARIES TO GREEN THE MANUFACTURING SECTOR

Over 60 million tonnes of electronic waste is discarded globally each year, according to the United Nations Global E-waste Monitor Report 2024. Hidden within these mountains of obsolete smartphones, laptops, and gadgets lie valuable precious metals worth billions. Now, Associate Professor Wen Shan Yew and his team have developed a solution: microbes that “mine” this urban ore.

By modifying natural enzymes, the researchers from NUS Biochemistry and Synthetic Biology for Clinical and Technological Innovation (SynCTI) have created specially engineered microbial enzymes that extract precious metals from electronic waste with remarkable efficiency: 15 times better for gold and 200 times better for silver than their natural counterparts.

This innovation could greatly reduce the environmental damage caused by traditional metal recovery methods which require harmful chemicals.

Through research centres like the NUS Environmental Research Institute and SynCTI, the university is also advancing sustainable materials development, resource recovery, and creating circular manufacturing systems that align with global sustainability goals.

In another pioneering effort, Associate Professor Koh Ming Joo from NUS Chemistry has created a more sustainable method to synthesise Z-alkenes, important chemical building blocks used in manufacturing, and found in, for example, the breast cancer therapeutic Tamoxifen, the dietary supplement beta-carotene, and the antibiotic fusidic acid. His iron-catalysed approach eliminates the need for precious metals typically used in these processes, making production both greener and more cost-effective.

These innovations exemplify NUS’ commitment to circularity and green chemistry, an approach that designs eco-friendly processes and products that reduce or eliminate hazardous substances, consume less energy, and create less waste.

NUS researchers have developed a method to recover precious metals like gold and silver from e-waste using specially engineered microbial enzymes. (Photo by Nathan Cima on Unsplash) ▶

BUILDING SINGAPORE'S RESILIENCE AGAINST CLIMATE CHANGE

As the effects of climate change intensify, it is increasingly important for NUS to expand its research focus to include climate resilience – strengthening the capacity of institutions and nations to withstand and adapt to both long-term stresses and sudden shocks. This strategic direction not only reinforces the university's leadership in sustainability, but also advances Singapore's national priorities.

To this end, a work group on risk and resilience chaired by Professor Low Teck Seng, Senior Vice President of Sustainability and Resilience under the Office of the President, was set up in January 2024. It maps out how the research capabilities within the university can plug the gaps in the national agenda for resilience.

Three subgroups, drawing from research capabilities across various disciplines, were formed: one to look into boosting our nation's food resilience, another to examine ways to mitigate the impact of climate change on public health, and a third to focus on the nexus of resources.

Food supply

The Food Resilience subgroup led by The Logistics Institute-Asia Pacific has developed a research initiative to address vulnerabilities in Singapore's food supply chain, and boost its resilience against external shocks.

It uses mathematical optimisation models that focus on three critical areas – improving food distribution, developing cost-effective stockpiling strategies, and modelling potential external shocks to the supply chain. The last includes developing a digital twin to evaluate alternative scenarios for shock testing. The Food Resilience subgroup is in the midst of engaging with industry partners to apply its initiative in the real world context.

Public health

The Climate, Environment and Health Programme at the Saw Swee Hock School of Public Health is leading research to understand and prevent the health impacts of environmental change across Asia, in particular on infectious disease risks. Within Singapore, the team is working to understand the role of microclimates and human-wildlife interfaces across green spaces in driving risks of dengue and other diseases.

Another research area, led by the Heat Resilience and Performance Centre (HRPC) at NUS Medicine, is to study the impact of rising heat on public health. HRPC has been designated the Global Heat Health Information Network Southeast Asia Hub. It will work with the region to shape strategies, research, and policies aimed at mitigating the impact of extreme heat on public health.

Nexus of resources

Meanwhile, the Centre for Water Research (CWR) at the Department of Civil and Environmental Engineering is tackling the escalating effects of climate change on water resources and treatment processes.

Their research focuses on developing advanced treatment technologies to combat cyanobacterial blooms caused by rising temperatures, which degrade water quality and strain conventional treatment methods. Energy-saving bioprocesses are also employed to remove nutrients causing such blooms from waterbodies. Additionally, CWR is investigating the challenges posed by the decay of chloramine, a disinfectant used in drinking water distribution systems, due to higher temperatures.

Through these concerted efforts, NUS is laying the groundwork for a more resilient Singapore – one that is better equipped to safeguard the well-being of future generations.

◄ *By focusing on research that strengthens food supply, public health, and the nexus of resources, the university aims to build up Singapore's resilience against climate change.*

CATALYSING TECHNOLOGY TRANSFER THROUGH INDUSTRY COLLABORATIONS

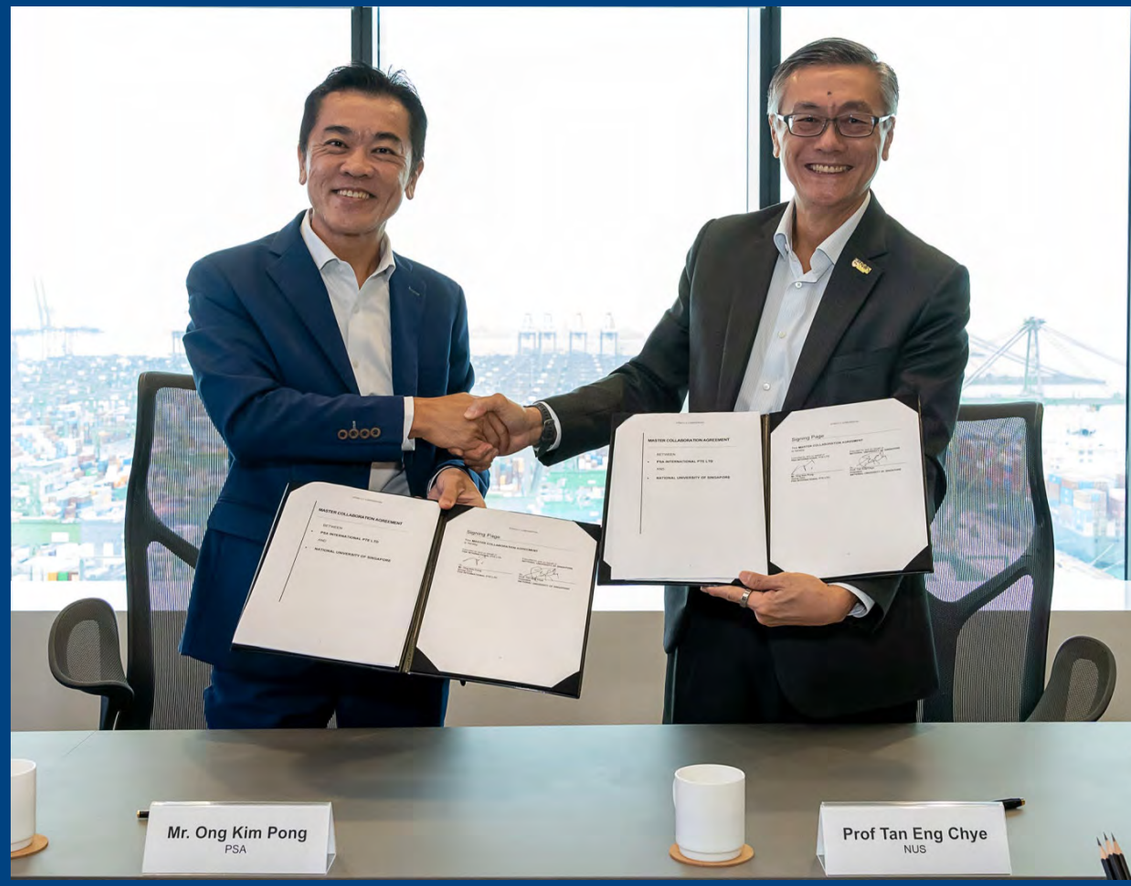
NUS has long been a catalyst for transformative research, tapping its strength in translating academic expertise into real-world solutions. Through strategic partnerships with industry leaders, NUS is addressing pressing sustainability challenges – from decarbonising data centres to optimising global supply chains.

One such collaboration is with Equinix, the world's leading digital infrastructure company. NUS' Centre for Energy Research and Technology, under the College of Design and Engineering, is working with Equinix to set up a Co-Innovation Facility. The facility, which opens in early 2027, will be an open research hub for global technology innovators, data centre technology partners, and academia to co-develop and trial core and edge technologies that deliver reliability, energy efficiency, and cost efficiency.

Similarly, NUS has joined forces with global port operator PSA International to establish the PSA-NUS Supply Chain Living Lab. This initiative will foster the development of supply chain optimisation solutions with industry stakeholders, providing a testbed for scalable innovations that enhance agility, resilience, and sustainability for supply chain operations both regionally and globally. PSA will be supporting the initiative with funds of up to S$10 million.

These partnerships reflect a broader commitment to co-creating with industry: NUS currently has some 155 active Research Collaboration Agreements on sustainability, spanning 70 companies, 15 government agencies, and 70 research institutes and institutions of higher learning. Such collaborations underscore NUS' belief in turning cutting-edge research into tangible impacts for a greener tomorrow.

As global sustainability challenges intensify, NUS continues to bridge the gap between academia and industry, proving that collaboration is key to building a sustainable future.



▲ *NUS President Prof Tan Eng Chye (right) and Group CEO of PSA International Mr Ong Kim Pong signed the agreement to launch the PSA-NUS Supply Chain Living Lab.*

BRIDGING KNOWLEDGE GAPS ABOUT CLIMATE CHANGE

While a large majority of Singaporeans are familiar with the concept of "Net Zero", only about 15 per cent know that there is a national target to achieve Net Zero carbon emissions by 2050.

This was revealed in a study conducted by the LRF Institute for the Public Understanding of Risk (IPUR) at NUS, which also highlighted several gaps between people's perceived and actual knowledge about Singapore's climate target and pathway to Net Zero.

The study was done in collaboration with the Singapore University of Technology and Design's Lee Kuan Yew Centre for Innovative Cities and the Ministry of Sustainability and the Environment.

When provided with information about the 2050 target, 65 per cent of respondents supported the current goal, while a further 17 per cent welcomed a more ambitious timeline for cuts in carbon emissions.

And while respondents generally agreed that everyone has a role to play in tackling the climate crisis and correctly identified using public transport instead of private vehicles as a way to reduce their carbon footprint, knowledge about which other actions are the most effective when it comes to reducing emissions was more limited.

This is because people tended to under-estimate the impact of changes like reducing air travel or switching away from meat consumption, and to over-estimate the impact of energy conservation in the home.

With these findings in mind, the study's authors, led by Dr Olivia Jensen, Deputy Director and Lead Scientist at IPUR, concluded that a good first step to move the needle is for individuals to calculate their own carbon footprint, which can be done through calculators tailored to the Singapore context available online.

This will help individuals know what the most effective actions are, and allow them to select actions which make a difference in emissions terms, while taking into account their other values and commitments.

To further support them in their Net Zero journey, IPUR developed a practical guide for individuals to reduce their carbon footprint across four key areas: food choices, consumption and waste management, transport and travel habits, and utility usage.

For instance, minimising food waste cuts emissions as discarded food not only wastes the resources and energy used in its production, but also produces additional greenhouse gases as it decomposes.

By focusing on personal carbon footprint, the study and guide provide information and tools for individuals to move from climate awareness to effective climate action, and allow decision-makers to identify opportunities to accelerate progress.

▲ *IPUR has developed a practical guide for individuals to reduce their carbon footprint across four key areas: food choices, consumption and waste management, transport and travel habits, and utility usage.*

At the core of research lies the drive to turn laboratory discoveries into practical solutions that address real-world challenges. Enabling this transformation is a strong support system that offers researchers mentorship, funding, industry connections, and other essential resources to bring their innovations to market.

One such initiative is the Technology Transfer and Innovation Programme, which provides a suite of services – from intellectual property advice to funding for research translation – aimed at helping researchers license their technologies or spin them off into start-ups.

Another key pillar is the Graduate Research Innovation Programme (GRIP), which delivers structured, step-by-step guidance for researchers and postgraduate students aspiring to launch deep technology start-ups. GRIP teams benefit from access to Master Engineers, NUS facilities such as labs and prototyping support, and investments of up to S$100,000.

Since its launch in 2018, GRIP has supported the creation of 119 start-ups, attracting S$67 million in external funding and grants as of December 2024.

CEMENTING A GREEN FUTURE FOR CONSTRUCTION

With buildings accounting for over 20 per cent of its carbon emissions, Singapore is working to decarbonise the building and construction sector – with help from startups like Circrete.

Founded in 2023, Circrete upcycles waste marine clay into durable cement. Its innovative solution tackles two sustainability problems at once. While cement is a key ingredient in construction, it accounts for about 8 per cent of global emissions. Circrete's production method, which uses waste marine clay, reduces carbon emissions associated with cement production by up to 70 per cent.

It also gives the more than 10 million tonnes of waste marine clay excavated annually during construction activities in Singapore a new purpose. Marine clay has poor mechanical properties, making it unusable for construction. It is also expensive to dispose of.

Circrete began its journey as a spinoff from GRIP, when Dr Tong Shanshan, now its Chief Executive Officer, Associate Professor Pang Sze Dai, its Chief Technology Officer, and Dr Du Hongjian, its Technical Advisor, came up with the marine clay idea.

GRIP provided the team structured mentorship to refine its business model and validate market viability, and strategies to navigate scaling challenges.

True to its name, Circrete promotes a circular economy by upcycling local construction waste. The company has since worked with partners like Singapore's Building and Construction Authority (BCA) and integrated property group Soilbuild Group Holdings Ltd. In February 2025, it completed the first structural use of its green cement in a pilot trial.

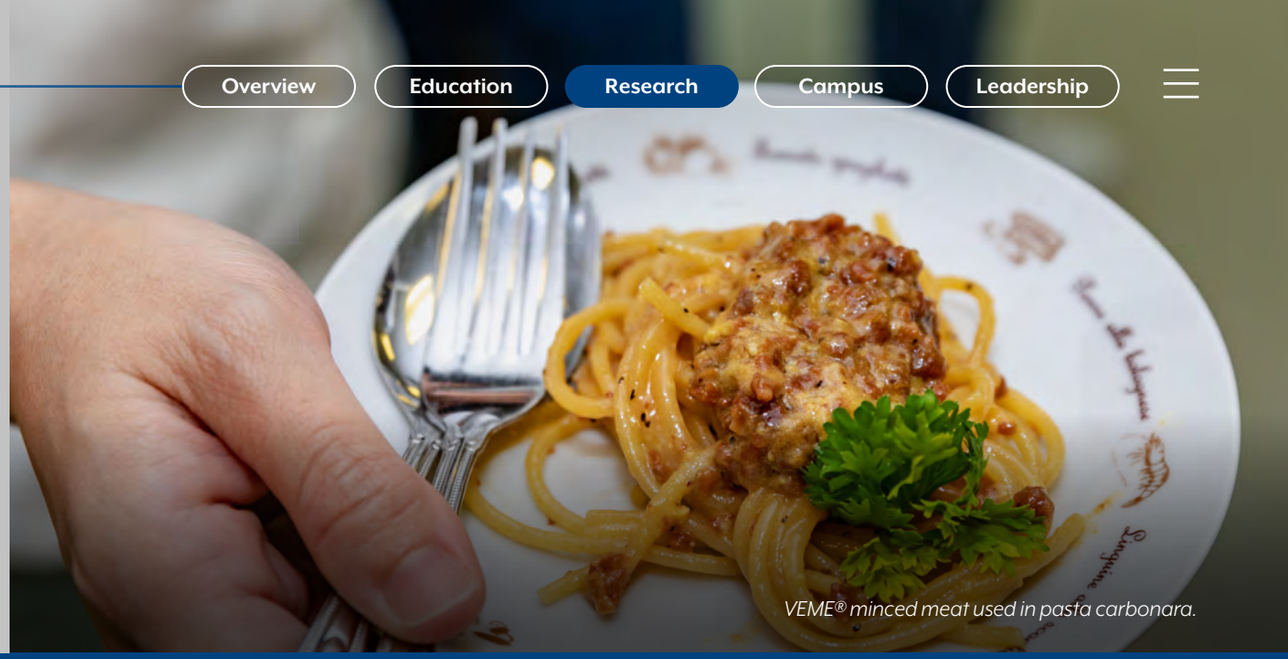
Circrete hopes to make green cement the norm in the building and construction industry, while innovating new sustainable building materials.

"Circrete's ultimate goal is to establish a circular economy for construction materials by upcycling 100 per cent of Singapore's excavated waste into durable, low-carbon alternatives," said Dr Tong.

"Success for us entails the widespread adoption of its green cement across the built environment sector, driving measurable reductions in carbon emissions and landfill dependency."

Dr Du Hongjian (left) and Assoc Prof Pang Sze Dai demonstrate the use of Circrete's green cement in a structural project at a construction site – a collaboration with Soilbuild Construction Group, Alliance Concrete, and BCA. ▶

BEEFING UP FOOD SUSTAINABILITY BY UPCYCLING WASTE INTO PLANT-BASED PROTEINS



VEME® minced meat used in pasta carbonara.

Plants can taste like meat, thanks to food tech companies like tHEMEat Company. However, the startup's novel flavour catalyst, called VEME®, is unique. Described as a "delicious, affordable, and domestically producible food source", VEME® is produced by upcycling vegetable and food waste, preventing them from ending up in landfills.

While reducing reliance on traditional livestock farming, which is a significant contributor to greenhouse gas emissions, VEME® also promotes a circular economy of sustainable food systems by creating value from discarded resources.

Co-founded in 2021 by now-Chief Executive Officer Max Tham, an integrative sciences and engineering programme PhD graduate from NUS, together with a multidisciplinary team from the university, the tHEMEat Company initially faced the challenge of translating lab-scale experiments into functioning and economically viable industrial processes.

But it has since started factory operations and obtained its food manufacturing license from the Singapore Food Agency in January 2025. Now, the startup offers a range of VEME® products, including plant-based minced meat in chicken, beef, fish, mutton, and unagi flavours.

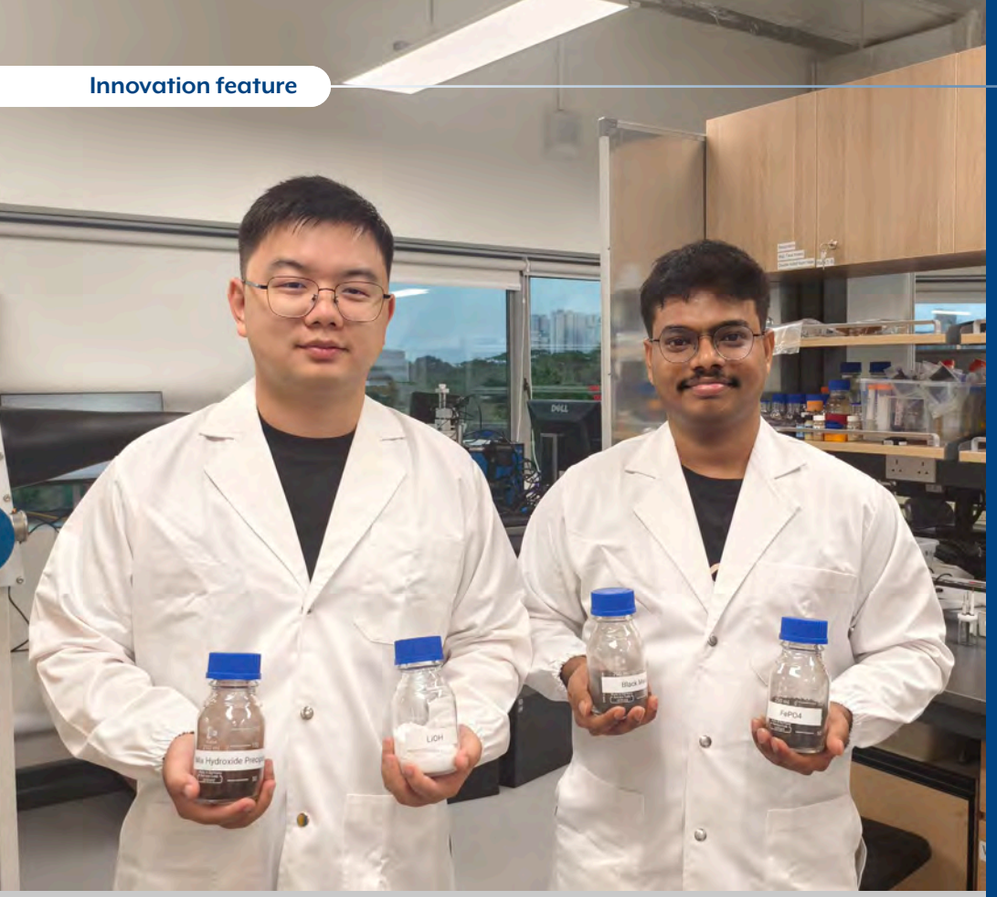
VEME®, a vegan heme molecule, replicates the look, cook, smell, and taste of animal meat for plant-based proteins by intensifying cooking reactions to produce the pre-requisite chemical compounds that give rise to flavour profiles identical to meat.

Going forward, the startup hopes to make its plant-based protein solutions a mainstay in the alternative protein market, both locally and globally, by expanding partnerships with food manufacturers to integrate its own solutions into mainstream production methods.

It also plans to continue innovating in sustainable food technologies to reduce the environmental impact of food production by upcycling vegetable and horticultural discards.

"Success for tHEMEat would be seeing Singaporeans become repeat customers of our VEME® alternative protein products and incorporating them into local dishes en masse," said Dr Tham.

"This would signal to us that our products are genuinely being enjoyed for their deliciousness and affordability, and that we are making a tangible impact in contributing to Singapore's food security and enhancing the quality of life for our fellow Singaporeans."



Co-founders of Lincore, Dr Wang Xun (left) and Mr Saikiran Reddy, are turning battery waste into a renewable resource.

HOW LINCORE IS FIXING THE DIRTY SECRET BEHIND CLEAN ENERGY

The electric revolution promises a greener future, but its foundation is built on an unsustainable truth. The critical materials powering batteries – lithium, nickel, and cobalt – come from some of the planet's most destructive practices, from toxic mining runoff to child labour in cobalt mines.

Enter Lincore, a Singapore-based innovator founded in 2024 and spun out of GRIP, with a radical solution: turning battery waste into a renewable resource with zero waste and emissions.

"Access to critical materials is essential for our energy transition journey. Recovering these materials from spent batteries can reduce our reliance on extractive mining, but existing recycling technologies are uneconomical, pollutive, and unable to handle all Lithium-ion battery chemistries," said Mr Saikiran Reddy, CEO and co-founder of Lincore. "We want to change that through a clean recycling method."

While traditional recycling relies on environmentally damaging methods which produce significant waste and greenhouse gases, Lincore's breakthrough electro-metallurgical technology regenerates the chemicals used in the process, creating a closed loop.

Its modular technology is also able to accommodate all Lithium-ion battery chemistries in a singular system, and recycle waste onsite at a smaller scale.

"Typically, companies build large recycling plants, one for each type of battery chemistry, which increases the capital expenditure and operational expenditure for such plants. Lincore's ability to process all types of battery waste within a single system is the first in the world," said Mr Saikiran.

The name "Lincore" is drawn from the words Lithium, Nickel, and Cobalt, and Recycling, Regeneration, and Reuse, reflecting the company's mission.

Besides producing no hazardous waste, Lincore's process also reduces reliance on unethical mining practices. And by locating recycling operations near manufacturers, it reduces transportation emissions and regulatory hurdles.

Lincore's technology is the product of years of research by co-founders Mr Saikiran and Dr Wang Xun, using lab facilities at Professor Wang Qing's lab in the Department of Materials Science and Engineering. Today, the company is working towards building its pilot system by end-2025, and deploying its first commercial plant by 2028.

And its work has not gone unnoticed – in 2024, Lincore was selected by Breakthrough Energy, the climate organisation founded by Bill Gates, as one of its inaugural Southeast Asian Fellows, and is set to receive funding and support from the organisation.

By 2030, as most batteries globally reach the end of their 10-year lifespan, Lincore's adaptable system will play a pivotal role in creating a circular battery economy, turning waste into high-purity precursors for new batteries and paving the way for a greener energy future.

CAMPUS

Greener Grounds

A COLLABORATIVE APPROACH TO CLIMATE ACTION AND SUSTAINABILITY

Managing sustainability on campus presents unique challenges. At NUS, this is threefold – rising greenhouse gas emissions, temperatures, and waste generation.

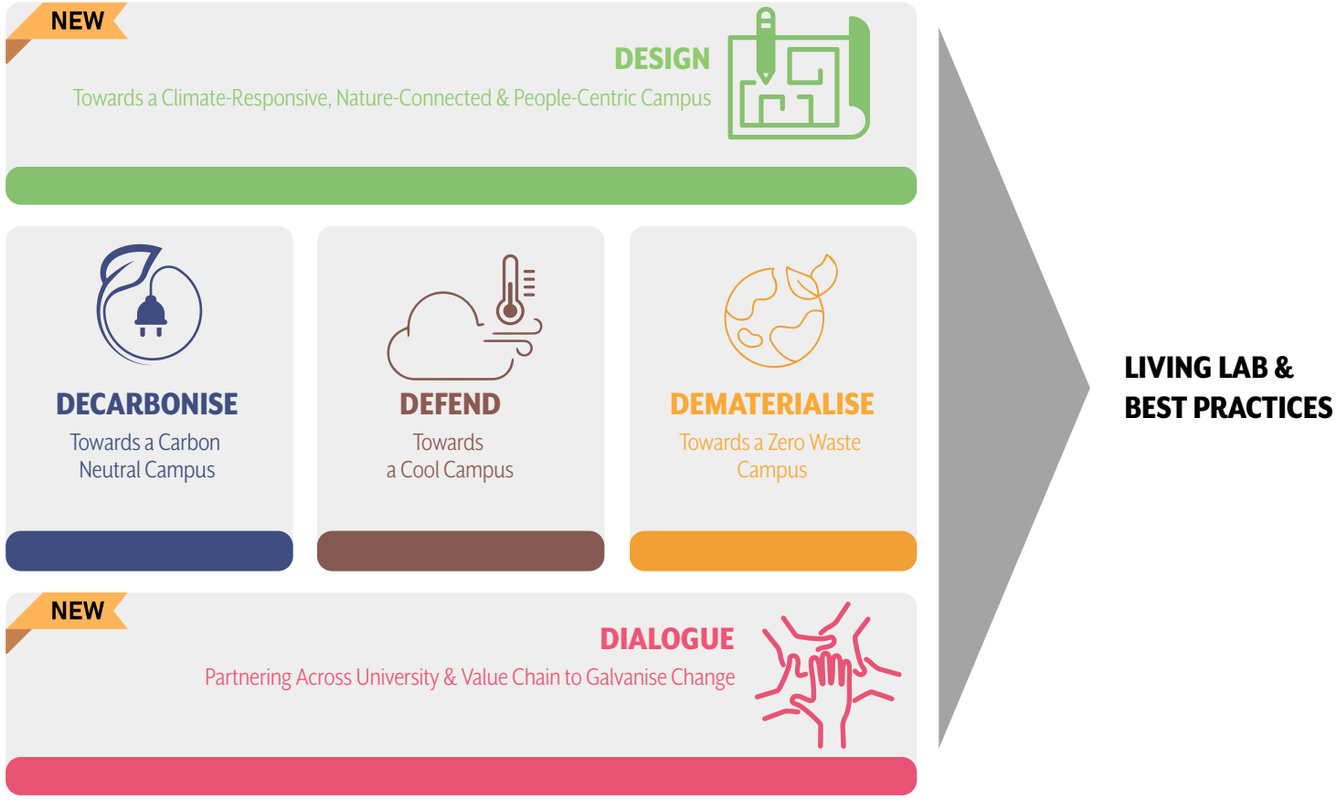
The Campus Sustainability Roadmap 2030 Framework tackles these challenges through five pillars – decarbonise, defend, dematerialise, design, and dialogue. The latter two are new additions, in response to the need for a whole-of-campus effort.

Decarbonise

In recent years, the university's gross floor area has expanded to accommodate more energy-intensive research laboratories and increases in computing power for generative artificial intelligence and hostel rooms. As a result, without intervention, emissions could rise to at least 149 kilotonnes carbon dioxide equivalent (CO_2e) by 2030. In FY2024, its Scope 1 and 2 emissions was 118 kilotonnes CO_2e against the baseline of 113 kilotonnes in FY2019.

A three-year decarbonisation plan is underway to reduce emissions towards baseline levels by FY2027. Efforts include reducing the energy consumption of NUS' 10 most energy-intensive laboratory buildings, such as by completing a campus-wide switch to energy-efficient ultra-low temperature freezers. Targeted energy plans are being co-developed with faculties based on building energy profiles, including testing real-time control of laboratory ventilation rates.

CAMPUS SUSTAINABILITY ROADMAP 2030 FRAMEWORK



Yusof Ishak House (YIH) has been retrofitted into a net-zero energy building, a first for a student-centric facility in Singapore. YIH targets to reduce its pre-renovation energy consumption by 70 per cent. The university has also commissioned 9.2 MWp of solar photovoltaic systems for over 60 campus buildings.

NUS is also working with the College of Design and Engineering's Department of Chemical and Biomolecular Engineering to explore opportunities to trail a Direct Air Capture solution to remove carbon dioxide from ambient air. The technology developed by Prof Zhao Dan and his research team is based on a new type of porous polymer material known as a covalent organic framework (COF) that has been treated with metal ions. This gives the treated COF the ability to capture and retain far higher levels of carbon dioxide compared to other materials currently used for carbon capture.

Defend

Meanwhile global warming continues to impact the campus environment, with NUS weather station data showing an average increase in daytime and nighttime temperatures of about 0.7 deg C from 2020 to 2024. To strengthen its climate resilience, NUS has installed a dense micro-climate sensor network – Singapore's first at an institute of higher learning – to assess the impact of heat mitigation measures such as cool paint and campus greenery. At the same time, it continues to intensify campus greening efforts, having planted over 50,000 trees since 2018 and expanding its tree canopy coverage from 36 per cent to 60 per cent in five years.

Dematerialise

A larger population and more catering events have also led to an increase in waste generated – the volumes generated in FY2024 increased to 0.22 kg/day/capita from the baseline of 0.14 kg/day/capita. NUS is managing this by promoting food waste reduction through sustainable procurement, increasing food waste being recycled with onsite systems, and closing plastic loops by processing PET bottles collected on campus into food grade recycled PET resins.

Design

The university is harnessing academic expertise to refresh the Kent Ridge masterplan to create a more climate-resilient and low-carbon campus. This includes maximising tree canopy coverage, incorporating biophilic spaces to combat higher temperatures, making the campus more pedestrian-friendly, and rejuvenating old buildings into highly energy-efficient ones while keeping embodied carbon.

Dialogue

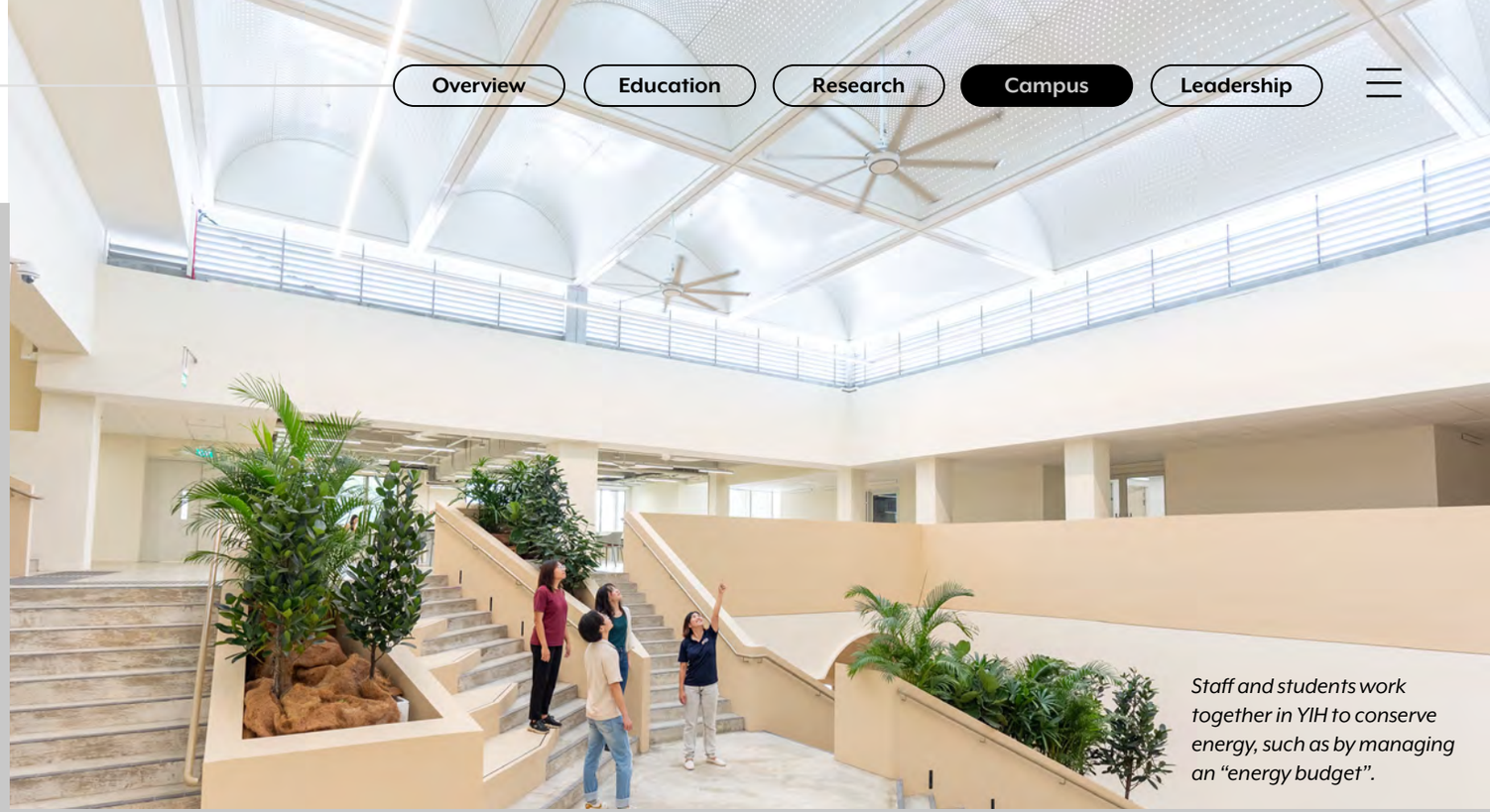
Equally vital is the role of behavioural change. NUS is working with staff and student groups in YIH to manage an energy budget. It is also co-developing dedicated energy reduction action plans with faculties and schools. Further, it plans to reduce waste by launching an annual campaign to encourage reusables, and strengthen the community's recycling sorting norm by engaging hostelites.

Further information on the university's environmental performance can be found in its Environmental Disclosures.

TARGETS AND PERFORMANCE

	DECARBONISE	DEFEND AGAINST CLIMATE CHANGE	DEMATERIALISE
2030 Targets (Unless otherwise indicated)	• 30% ↓ in Scope 1 & Scope 2 emissions from FY2019 baseline (113 $ktCO_2e$) • Reduce Scope 1 & Scope 2 emissions towards FY2019 baseline by FY2027 [new] • 20% ↓ in Energy Use Intensity (EUI) from FY2019 baseline (195 kWh/m^2)	• Establish a campus Outdoor Thermal Comfort Index by FY2024 • Develop a long-term mitigation plan to address outdoor thermal comfort using insights from the Cool NUS-BEAM project [new] • Plant 100,000 trees by 2030	• Establish waste sorting and reusing norms to achieve a 50% recycling rate • 30% ↓ in daily waste disposed per capita from baseline FY2021 level (0.14 kg/day/capita) • Close the plastic and food waste loops in NUS
FY2024 Performance	• Emissions were 118 $ktCO_2e$ compared to 122 $ktCO_2e$ in FY2023 • EUI was 193 kWh/m^2 compared to 198 kWh/m^2 in FY2023 The decreases were attributed to the exclusion of NSCC's i4.0 data centre that is not operated by NUS (2.7 $ktCO_2e$) and reduction in Singapore's average grid emission factor (1.3 $ktCO_2e$). Overall, the net effect is that emissions and EUI were comparable to FY2023.	• Established a campus outdoor thermal comfort baseline map and identified key hotspots for short- and long-term mitigation	• Campus recycling rate fell to 19% from 27% in FY2023 • Daily waste disposed per capita rose to 0.22 kg/day/capita from 0.18 kg/day/capita in FY2023 This was mainly due to growth in campus population, catering activities and closure of NEA's food waste recycling plant, that caused an increase in waste disposed and significant reduction in food waste recycling.
Achievements to date	• Commissioned 9.2 MWp of solar photovoltaic system • Implementing carbon reductions projects that deliver 2.8 $ktCO_2e$ of annual savings, including campus-wide switch out to energy-efficient deep freezers and LED relamping in selected buildings	• Implemented cool paint experiments on building and ground hardscapes and commenced campus Computational Fluid Dynamics analysis to study harnessing prevailing winds for campus ventilation • Planted 55,221 trees, contributing to campus tree canopy area growth from 36% in FY2019 to 60% in FY2024	• Introduced a hub-and-spoke system to increase food waste recycling with onsite systems • Closed plastic PET1 loop by processing into food grade rPET1 pellets

RETROFITTED NET ZERO ENERGY BUILDING YUSOF ISHAK HOUSE SETS NEW ENERGY CONSERVATION NORMS



Staff and students work together in YIH to conserve energy, such as by managing an "energy budget".

Come October 2025, the newly refurbished Yusof Ishak House (YIH) will officially reopen its doors. Retrofitted as a net-zero energy building, soon-to-be-commissioned solar photovoltaic (PV) panels on its roofs will eventually produce enough renewable energy to meet its annual consumption needs.

The design also features a highly efficient hybrid cooling system, along with more spaces that let in natural light and ventilation, to minimise energy use and carbon emissions. More importantly, the building hopes to encourage behaviour change through its energy conservation efforts.

For instance, staff and students will learn to adapt to feeling comfortable instead of feeling cold, as the air-conditioning in YIH is set at 26.5 deg C. Occupancy-activated ceiling fans will enhance the cooling effect while saving energy. Occupants will also enjoy better indoor air quality as the cooling system uses 100 per cent fresh air instead of recirculated air.

To raise user awareness, staff and students will help manage an "energy budget". This includes deciding the duration of air-conditioning for different spaces in the building, and switching off equipment that are not in use to save energy.

Prior to its revamp in 2022, YIH's annual electricity consumption was around 2.2 gigawatt-hour (GWh), enough to power over 470 HDB four-room flats for a year. With the retrofit, YIH strives to cut its energy use by 72 per cent to 0.6 GWh. This translates to an energy usage intensity (EUI) of 47 kilowatt-hours per square meter per year, about 48 per cent lower than the Building Construction Authority's EUI benchmark for institutes of higher learning buildings.

YIH is the latest addition to NUS' list of net-zero energy buildings, with the university's SDE buildings (SDE1, SDE3 and SDE4) set to become the first positive-energy building cluster on campus by end 2025.

It demonstrates how sustainability can be balanced with human needs, serving as a model for best practices in energy conservation.

CUTTING ENERGY USAGE IN NUS' TOP 10 ENERGY-INTENSIVE BUILDINGS

▲ *UCI and NUS Medicine are conducting an energy modelling study and an implementation trial on one floor in the MD6 building to dynamically vary the air change rates.*

Ventilation in laboratories is critical in ensuring a comfortable and safe environment where airborne chemicals and hazardous air pollutants can be removed or diluted promptly. But this comes at a high energy cost.

Running high air change rates – the number of times that the volume of air in a space is replaced with cool, dehumidified air per hour – can account for between 50 to 70 per cent of the total building energy consumption, an energy profiling study on the top 10 energy-intensive buildings on the NUS campus found.

The reason: many laboratories fix the air change rates for peak hours and off-peak periods at levels compliant with prevailing safety codes, regardless of laboratory activity levels. This means that energy consumption remains high despite little or no activity in the laboratories, resulting in energy wastage and overcooling of spaces.

To change this, NUS' University Campus Infrastructure (UCI) and NUS Medicine are conducting an energy modelling study and an implementation trial on one floor in the MD6 building to dynamically vary the air change rates. This is done with the help of Volatile Organic Compound (VOC) and people occupancy sensors.

During the trial, air change rates are dynamically reduced in real time if the measured VOCs go below the threshold specified or increased if the threshold is exceeded – while complying with safety requirements and ensuring the comfort of occupants. If successful, this system could reduce energy usage by up to 15 per cent.

The plan is to implement this system in all MD6 laboratories as part of the goal to achieve a 20% building-wide energy reduction by 2026, before rolling it out to more similar laboratories on campus.

Since completing a comprehensive energy audit of MD6 in 2022, UCI has also completed the manual optimisation of air change rates – where an individual tracks laboratory activity levels and adjusts the settings accordingly – and a campus-wide switch to energy-efficient ultra-low temperature freezers. To date, this has contributed to cutting MD6's energy consumption by 8.5 per cent.

Building on the successful energy reductions in MD6, NUS Medicine is now working closely with UCI to co-develop energy reduction action plans for its remaining building spaces, guided by detailed energy profiles.

CAMPUS OUTDOOR THERMAL COMFORT MAP PAVES WAY FOR A CLIMATE-RESILIENT CAMPUS

A member of the Cool NUS-BEAM research team discusses a heatmap showing how increased greenery has helped lower temperatures. ▶

Just as the world has been breaking temperature records, so has the NUS campus, with average temperatures rising by about 0.7 deg C from 2020 to 2024. But the challenge also opened up opportunities to enhance campus sustainability.

A micro-climate greenery study has found that intensifying campus greening efforts could mitigate rising temperatures. An analysis of 17 specific sites on campus found that those with denser greenery and more shade, such as larger tree canopies, had lower ambient temperatures.

A campus-wide analysis comparing data from 2024 and 2019 also showed that the increase in greenery density across the university's campus developments correlated with up to a 1 deg C decrease in localised temperatures.

The research was part of the Cool-NUS BEAM project, a living laboratory research-operations partnership between College of Design and Engineering (CDE) researchers and the University Campus Infrastructure, which established a baseline outdoor thermal comfort map of the Kent Ridge campus. This was done through the use of ambient temperature, solar radiation, and wind data collected through its campus-wide micro-climate sensor network.

Aside from its greening efforts, the university also evaluated the effectiveness of applying cool paint with higher solar reflectivity on building facades.

A trial at the CDE precinct found that cool paint was effective in reducing localised ambient air temperature by up to 1 deg C between 10am and 5pm. The building's energy cooling load for the west-facing facades was also observed to have been reduced by up to 14 per cent.

This suggests that replacing hard surfaces with green spaces and applying cool paint on sun-exposed facades are effective measures to improve outdoor thermal comfort.

The first campus-wide array of micro-climate sensors has allowed NUS to take an evidence-based approach to evaluate mitigation measures. Moving forward, the university will be using the trial insights to refresh the campus masterplan to better manage outdoor thermal comfort.

BUILDING THE GREENEST CAMPUS IN SINGAPORE

Every other month, staff and students armed with shovels can be seen working together near a secondary forest on campus dubbed “the Ridge” to plant a variety of tree saplings. Guided by NUS’ horticultural team and forest ecology experts, the volunteers are an integral part of the many community tree planting activities on campus.

Initiated by student environmental group NUS SAVE, the university’s greening efforts flourished after a visit from founding prime minister Mr Lee Kuan Yew in 2011. Since 2015, NUS has diligently planted new trees every November in conjunction with the national Tree Planting Day.

The university met the halfway mark of its target in November 2024, with over 50,000 new trees planted since late 2018, and is on track to hit 100,000 trees by 2030 as part of its commitment to the National Parks Board’s OneMillionTrees movement. This includes rare species such as *Margaritaria indica,* which was first discovered in Singapore during a construction project in NUS University Town.

Through these efforts, the university’s campus tree canopy area has grown from 36 per cent in 2019 to 60 per cent in 2024. This means that over half the campus grounds are now covered with trees, providing much-needed shade amid rising temperatures.

Through campus greening, NUS aims to create a biophilic and climate-resilient campus that enhances biodiversity, deepens connection with nature, and enriches the experiences of its community.

The only university in Singapore blessed with a secondary forest, NUS could also become the country’s greenest campus over the next decade. It is working on a campus greenery plan that explores ways to increase the tree canopy area.

To encourage its community to learn more about NUS’ trees and natural heritage, gamified campus trails are also set to launch in the coming year. This self-guided greenery trail aims to educate users about things in their environment such as the heritage and endangered tree species.

From planting roots to growing minds, NUS is shaping a greener campus for our community to be closer to nature.

Minister for Sustainability and the Environment, Ms Grace Fu (left), and NUS Deputy President (Administration), Mr Clarence Ti, planting a tree to commemorate the milestone of 50,000 trees planted — marking the halfway point.

SHAPING RESOURCE-CONSCIOUS CAMPUS COMMUNITIES

Where do recyclables placed in campus-wide recycling bins end up? With lower contamination rates of around 20 to 30 per cent, are these recyclables actually sent for recycling?

These were the questions that the NUS Zero Waste Taskforce sought to answer. It placed several trackers in PET1 (Polyethylene Terephthalate) bottles in NUS University Town recycling bins, revealing that recyclables ended up in Peninsular Malaysia – possibly at recycling facilities with only basic environmental controls that may negatively impact the local environment.

To ensure responsible end-of-life management of recyclables, the Taskforce visited and contracted an established recycling facility in Johor, Malaysia, where the PET1 bottles undergo rigorous processing. This includes a multi-step washing process before the bottles are crushed into flakes and pelletised into food grade recycled PET (rPET) resins. The facility also monitors its pollution impact, such as by doing regular tests on the water discharged from the facility.

Having closed the PET1 recycling loop, the university is now also reducing the amount of food waste disposed of by expanding a hub-and-spoke model that transports preparatory food waste to on-site facilities. There, food waste is turned into compost or a substrate for aquaculture feed.

The Taskforce also plans to build a culture of careful waste sorting to increase the amount of recyclables collected and push up the campus recycling rate. It will deploy more recycling bins and introduce a comprehensive campus sorting guide containing details about its segregated recycling system, what can and cannot be collected for recycling, and where these recyclables are sent to.

But with limits to what recycling alone can achieve, reducing waste at its source is essential. NUS is taking the lead with its Sustainable Procurement Framework, guiding staff to make more mindful purchasing decisions such as reducing wastage in food catering purchases.

As disposable takeaways make up 13 per cent of NUS' waste stream, NUS is also organising an annual campus-wide Bring-Your-Own campaign to reduce waste in other major plastic streams – such as Polypropylene 5, commonly used in disposable takeaways – which are not viable for recycling. At the same time, efforts to engage the hostelite community aim to embed mindful resource consumption into daily life – a crucial step towards a building more sustainable campus culture.

NUS is organising an annual campus-wide Bring-Your-Own campaign to reduce waste at source.

LEADERSHIP

Champions of Change

LEADING WITH PURPOSE

Sustainability at NUS is catalysed through institution-wide platforms. The university's flagship festival, NUS Sustainability CONNECT, returned in 2024 with over 30 events, strengthening partnerships, activating student involvement, and promoting public engagement. At COP29, NUS further amplified Southeast Asia's academic voice on the global stage, contributing insights on conservation technology, urban resilience, and sustainable healthcare.

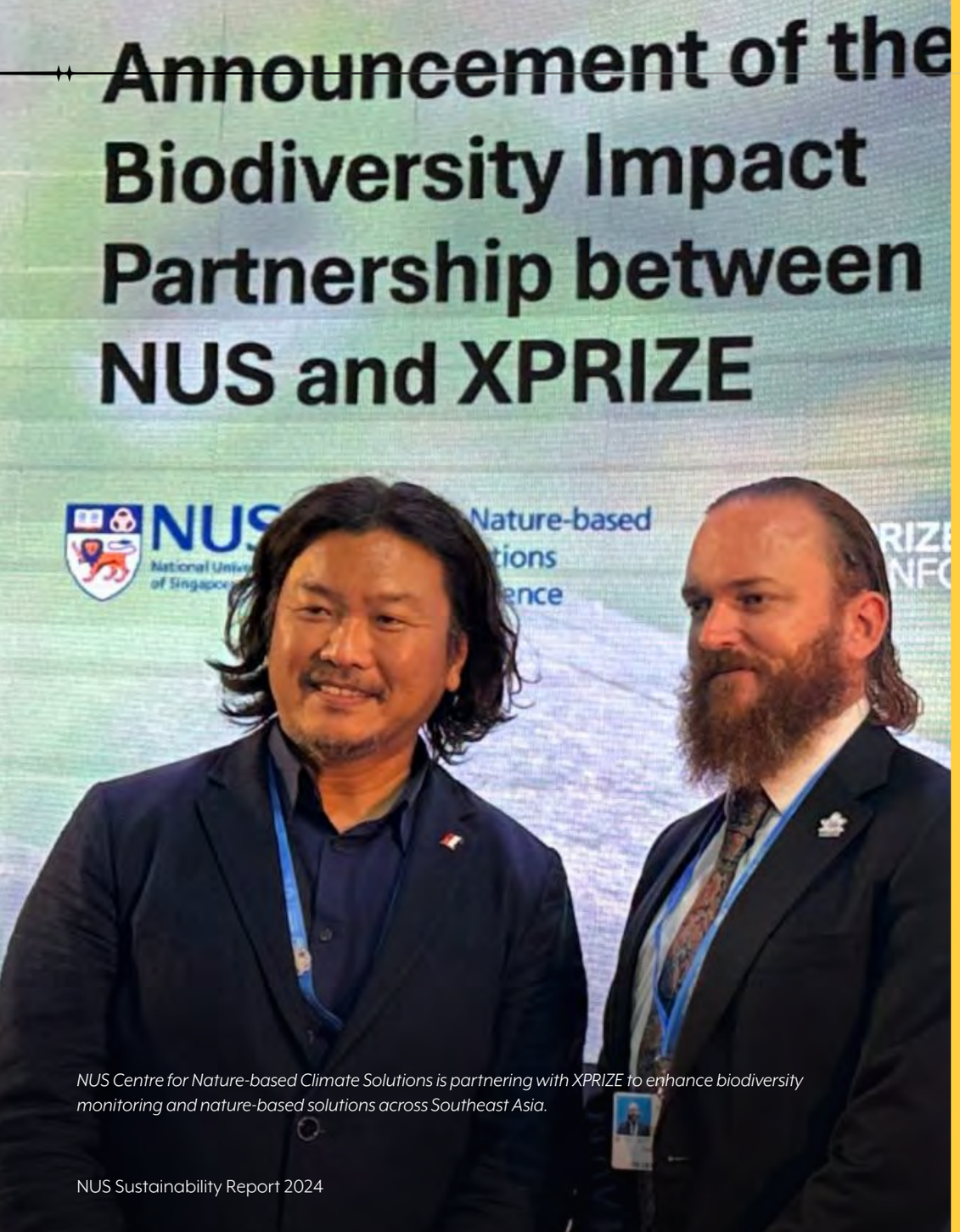
Within the campus, sustainability is brought to life through everyday action. Student-led efforts in residential halls – from zero-waste initiatives to nature outreach – are redefining what it means to live sustainably, underscoring that leadership starts with personal responsibility.

Meanwhile, faculty members are designing impactful solutions, mobilising communities for collective action, and informing global discourse. From nature conservation and coastal protection to green finance and climate justice, they are charting new directions for research and real-world impact.

Professor Koh Lian Pin, Vice President of Sustainability and Resilience, is transforming ecological science into tools for policy and business. Professor Adrian Law from the Department of Civil and Environmental Engineering is pioneering climate-adaptive water infrastructure through engineering innovation.

Professor Sumit Agarwal of NUS Business School is leveraging behavioural economics to enhance transparency in sustainable finance. Meanwhile, Associate Professor Jolene Lin from NUS Law is shaping the fast-evolving field of climate law, with a focus on the Global South.

These stories reflect the diversity and dynamism of NUS' approach to sustainability – grounded in knowledge and translated into action.



NUS Centre for Nature-based Climate Solutions is partnering with XPRIZE to enhance biodiversity monitoring and nature-based solutions across Southeast Asia.

FORGING GLOBAL PARTNERSHIPS AT COP29

As global climate negotiations unfolded in Baku, Azerbaijan, for the 29th Conference of the Parties (COP29) in November 2024, NUS once again took its place at the table.

Building on its longstanding observer status at the United Nations Framework Convention on Climate Change (UNFCCC), NUS showcased its research to the world through multiple presentations and panels at the two-week conference, which drew over 55,000 delegates from around the world.

Led by Associate Professor Adrian Loo from the NUS Centre for Nature-based Climate Solutions (CNCS), nine faculty members from the NUS delegation spoke at the Singapore pavilion. Among them was Professor Benjamin Cashore from the Lee Kuan Yew School of Public Policy, who moderated panel discussions on critical issues like sustaining access to drinking water amid climate change and accelerating alternative protein innovation in Asia.

On Urbanisation Day, NUS Cities signed a Memorandum of Understanding with global climate leadership group C40, establishing a partnership to equip city leaders with tools to tackle the climate emergency.

The Centre for Sustainable Medicine (CoSM) garnered global coverage when it launched the world's first postgraduate programmes in sustainable healthcare at the Singapore pavilion. Led by CoSM Director, Professor Nick Watts, the Centre also facilitated discussions on healthcare decarbonisation and climate strategies across the Health, UK, Canada, and Malaysia pavilions.

Students, too, played a vital role at COP29. Graduate student Tanya Talwar from the Department of Architecture contributed to the documentation of UNFCCC's Youth Constituency (YOUNGO) and hosted a session featuring rainforest conservation breakthroughs. Under the Climate Youth Development Programme, student delegates also spoke at panel discussions at the post-COP29 public roundup session organised by CNCS.

Ahead of COP30 in Brazil, NUS announced the Biodiversity Impact Partnership with American innovation platform XPRIZE Foundation to advance conservation technology in Southeast Asia.

These multifaceted engagements reinforced NUS' position as a world-class institution, amplifying Southeast Asia's academic voice on the global stage.

NUS SUSTAINABILITY CONNECT 2024 GAINS TRACTION IN SECOND YEAR

A bigger and better NUS Sustainability CONNECT returned in 2024 with more than 30 events packed into a week from 14 to 21 September.

As the university's flagship sustainability initiative, launched in 2023, the festival showcases NUS' efforts in research and innovation, education, campus operations, and thought leadership.

The second edition featured several firsts, including the inaugural NUS Environmental Management Leadership Lecture. Mr Ravi Menon, Singapore's first Ambassador for Climate Action and a member of the NUS Board of Trustees, kicked off the discussion by outlining Singapore's strategy for transitioning to a low-carbon future.

The festival partnered for the first time with the Lee Kuan Yew School of Public Policy on its Festival of Ideas. Other notable events in the festival included the NUS Cities Symposium on "Liveable Cities in Uncertain Times", and the NUS Environmental Research Institute's Symposium on "Innovative Environmental Solutions for Accelerating Low-Carbon Transition".

Participants also gained practical insights through behind-the-scenes tours at Solar Energy Research Institute of Singapore's laboratories, its Agri-PV testbed at Yuhua, and Ridge View Residential College (RVRC).

Hands-on workshops included RVRC's sessions on Biophilic Design and Nature Journaling, while an event called Carbon Crunch by Lloyd's Register Foundation Institute for the Public Understanding of Risk prompted discussions on how to cut one's carbon footprint.

Student groups injected vibrancy into the line-up, with activities such as film screenings and donation drives led by NUS Vision of Equality for a Greener Earth, NUS College EcoPlanet, NUS Bitscraps, and Student Energy NUS. The festival concluded with a reforestation initiative by NUS Toddycats, where participants planted 100 tree saplings at Kent Ridge Road to enhance the forest habitat and contribute to the National Parks Board's OneMillionTrees movement.

◀ *Mr Ravi Menon, Singapore's first Ambassador for Climate Action and a member of the NUS Board of Trustees, spoke at the inaugural NUS Environmental Management Leadership Lecture.*

GREEN LIVING IN NUS STUDENT RESIDENCES

NUS students are transforming residential halls into thriving hubs of sustainability through innovative ground-up initiatives. Across the campus, student-led committees are championing eco-conscious practices. Here are three examples of how halls are championing sustainability among residents.

Sheares Hall

At the heart of Sheares Hall's sustainability efforts is the ConSheares committee. Through the "Adopt a Plant" initiative, freshmen and their senior mentors engage in gardening – from decorating cement pots to planting saplings at the Sheares Garden.

ConSheares also has an EnviroKids programme, where it partners with the Sheares Hall Voluntary Corps and Tasek Academy and Social Services to educate disadvantaged students about environmental issues through hands-on activities. Initially organised as two standalone sessions, the committee is now looking to convert EnviroKids into a recurring engagement.

Prince George's Park Residence

What began as a residence-specific response to end-of-semester waste has expanded into a campus-wide sustainability movement at Prince George's Park Residences, which houses many short-term students.

The InfiniUse initiative collects and redistributes usable items from international and exchange students who are heading home, to their incoming peers. The team has further expanded their mission to include the collection of unclaimed parcels for repurposing.

InfiniUse has since benefited over 300 exchange students and helped to redistribute more than 20 boxes of second-hand items.

Pioneer House

Pioneer House's Frugality and Sustainable Living Subcommittee holds Fashion Swap every academic year, where residents exchange pre-loved clothing to combat textile waste. Some 50kg of clothing changed hands at the last Fashion Swap held in October 2024.

It also organises annual island-hopping excursions to St John's Island and Lazarus Island to raise awareness about Singapore's unique ecosystems and cultural heritage.

Through these diverse initiatives, NUS students are demonstrating that sustainable living is not merely an academic concept, but involves practical actions that can be adopted in daily life.

At NUS' residences, sustainability is not a concept but a way of life.

◀ *Sheares Hall's Adopt a Plant initiative pairs juniors and seniors to learn how to care for their chosen plant together.*

CALLED TO CONSERVATION BY A BIRD CALL

In an era defined by climate urgency and biodiversity loss, Professor Koh Lian Pin stands at the nexus of science, policy, and action. As NUS Vice President (Sustainability and Resilience), Chief Sustainability Scientist, and Director of the Centre for Nature-based Climate Solution he does not just study environmental crises – he designs systemic solutions to address them.

One of the most highly cited conservation scientists in the world, Prof Koh's work focuses on developing policy-relevant science and science-based decision support tools to reconcile humanity's needs with environmental protection.

His interest in conservation began in university when a lecturer played a recording of the last call of the Kaua'i 'O'o bird, recorded just before it went extinct in 1987. "The experience had a profound impact on me, and strongly influenced my decision to pursue a career in conservation science."

Today, Prof Koh is an ardent advocate for conservation, having taken on roles at a myriad of organisations such as ETH Zurich, the World Economic Forum, and as a former Nominated Member of Parliament in Singapore.

By transforming complex ecological research into tools for policymakers and businesses, he bridges the gap between knowledge and impact, proving that conservation is about both saving nature and securing humanity's future.

Professor Koh Lian Pin

"The biggest conservation challenge is the need to find the right balance between environmental protection and socio-economic development."

SINK OR SWIM: CUTTING-EDGE TECH KEY TO MITIGATING WATER-RELATED CLIMATE CRISES

Professor Adrian Law

"I follow the philosophy that research needs to be accompanied by field applications."

Against the backdrop of worsening water-related climate events like floods and rising sea level, Professor Adrian Law from the Civil and Environmental Engineering Department at the College of Design and Engineering is on a mission – to contrive adaptive urban water systems for a climate-disrupted future with high uncertainties.

As Executive Director of the Coastal Protection and Flood Resilience Institute Singapore, Prof Law studies water-related climate crises and designs preventive solutions, something that has become more difficult to do over the years.

"Previously, design guidelines could be established from extensive past observations. Climate change has made us rethink this paradigm completely. We now have to use our best scientific knowledge to predict future extremes under conditions that have not been seen so far," he said.

For Prof Law, solutions must not only be science-based – they must also have an implementation pathway. That is why he adopts the Research-Development-Translation-Application philosophy to transform concepts and insights from laboratory experiments and numerical simulations into cutting-edge solutions with real-world applications and benefits.

Among his past research, he has used close-range remote sensing to monitor coastal environments and tapped probabilistic machine learning to optimise process control for water systems and treatment facilities. Building on his work, he hopes to continue deriving innovative and cost-effective technology to better predict water-related climate events and inspect coastal defences.

DECODING THE HUMAN SIDE OF GREEN FINANCE

Money moves the world, but what moves money? Professor Sumit Agarwal specialises in answering that question, not just with spreadsheets and algorithms, but by studying human behaviour itself.

A distinguished professor of finance at the NUS Business School and Managing Director of the NUS Sustainable and Green Finance Institute, Prof Agarwal's work focuses on revealing how psychology and policy shape financial decisions, especially when it comes to green finance. Green finance refers to anything in the finance sector that is related to environmental issues, activities, and impacts, such as green funds or the problem of greenwashing.

Born in India and raised in Tanzania and Uganda, Prof Agarwal was exposed to the problems of over-fishing in lakes and rivers early on in his life.

After stints at the Federal Reserve Bank of Chicago and Bank of America, he transitioned to academia to advocate for credible and transparent practices in green finance. His experience with behavioural finance, however, has made him keenly aware that academic research must be practical.

"Collaborating with industry partners is important to ensure research and education align with real-world needs," he said. It is with this approach that he hopes to make real change.

Professor Sumit Agarwal

I hope to promote transparency and credibility in green finance to combat issues like greenwashing, and establish NUS as a hub for thought leadership in sustainable finance, influencing policy and practice across Asia and beyond."

PIONEERING CLIMATE JUSTICE IN THE GLOBAL SOUTH

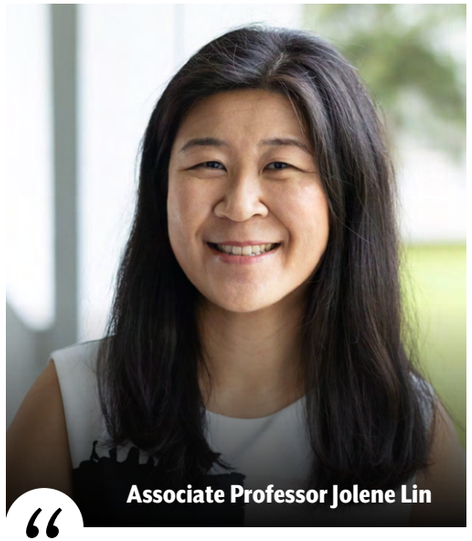
As the climate crisis reshapes our world, Associate Professor Jolene Lin at NUS Law is at the forefront of defining how the law can respond. A leading expert in climate change law, she is driven by one fundamental question: "What can lawyers do to contribute to the fight against climate change?"

For the Director of the Asia-Pacific Centre for Environmental Law, this emerging field is both urgent and exhilarating. "Its scope and boundaries are still forming," she said, making it an exciting area of law to be studying and teaching.

Her groundbreaking work includes co-authoring *Litigating Climate Change in the Global South,* one of the first systematic studies of climate lawsuits in developing nations. "The Global South experience, an under-explored and under-represented context, offers opportunities for knowledge-sharing and multi-directional learning," she explained. The book won the 2025 Australian and New Zealand Society of International Law Book Prize.

Beyond academia, Assoc Prof Lin ensures her work is also practical through roles like serving as a member of the Academic Circle supporting the United Nations Special Rapporteur on the right to development.

At NUS, she envisions the university as a global hub for climate justice, a place that draws the brightest minds to study and research the pathways for climate justice.



Associate Professor Jolene Lin

What makes the law come alive for students is learning about how it works in real life."

LOOKING AHEAD

This second edition of the NUS Sustainability Report reflects the university's ongoing commitment to environmental sustainability and its growing ambitions in this space. As detailed in the report, NUS continues to advance efforts across education, research, campus operations, and leadership. These efforts are underpinned by a shared sense of purpose and a desire to contribute meaningfully to national priorities and global goals.

Looking ahead, NUS aims to deepen its contributions by fostering stronger connections across its community – among academic staff, researchers, students, and administrators – as well as with external partners in government, industry, and civil society. The report offers not just a transparent snapshot of progress, but also a common framework to guide future initiatives and facilitate more purposeful collaborations.

A key area of focus going forward is climate resilience. As the impacts of climate change intensify, the university is expanding its efforts to help institutions, cities, and communities adapt and thrive in the face of growing uncertainty. This will involve drawing on NUS' wide-ranging expertise – from science and technology to the humanities and social sciences – to develop integrated solutions that address the interdependencies between climate, built environment, economy, and society.

To support this, NUS has launched NUS Sustainable Futures, a new initiative to foster interdisciplinary collaboration and shape the next phase of sustainability research and education. It seeks to bring together researchers across domains, strengthen alignment, and support more mission-driven, problem-solving approaches to sustainability. By doing so, NUS aims to unlock new synergies, build a more cohesive sustainability ecosystem, and contribute to the global transition towards a more equitable, low-carbon future.

With this report as a foundation, NUS will continue to track progress, strengthen partnerships, and invest in ideas and people that will shape a more resilient and sustainable tomorrow.

Online Sustainability Report
Scan the code, or visit
sustainability.nus.edu.sg/commitment/reports-and-plans/

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CELEBRATING THE PAST,
SHAPING THE FUTURE