



NUHS 2024 GREEN PLAN



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CHIEF EXECUTIVE'S MESSAGE



Professor Yeoh Khay Guan
Chief Executive, NUHS
October 2025

Dear Stakeholders,

As we present the NUHS FY2024 Green Plan, we do so with a clear understanding of our responsibilities – not only as a healthcare provider, but as a public institution entrusted with the well-being of people, communities, and the planet.

The global climate agenda has encountered considerable setbacks this year, amid a complex backdrop of geopolitical tensions, trade disruptions and conflict. In this uncertain environment, NUHS remains steadfast in our commitment to delivering healthcare that is both sustainable and value-driven. As Singapore's academic health system, we are not just a healthcare provider but a leader in care, education, and research. This triple mission empowers us to innovate, translate research into practice, and continue pushing the boundaries of what is possible in healthcare. We recognise that sustainability is not peripheral, but central to our mission – to advance health for today's population, and for generations to come.

FUTURE-READY, CLIMATE-RESILIENT HEALTHCARE

The World Economic Forum estimates the climate crisis could impose \$1.1 trillion in additional costs to healthcare systems globally by 2050. Climate change is a global phenomenon, and its effects will likewise be felt in Singapore, through rising climate-related health risks that add to the existing pressures of an ageing population and high chronic disease burden.

NUHS is responding by expanding and upgrading our infrastructure in a sustainable manner. In FY2024, as the redevelopment of the Alexandra Hospital (AH) and National University Hospital (NUH) continued, we initiated work on the new Tengah General and Community Hospital (TGCH). I am pleased to share that all three hospitals are being developed with environmental sustainability and climate resilience principles embedded end-to-end, from master planning and building design to daily operations.

We also recognise that digitalisation in healthcare, while a transformative solution to increasing healthcare workload, carries significant environmental impact. To manage the growing carbon footprint from AI and digital systems, we established a new Green IT Taskforce in FY2024. The Taskforce will drive efforts to mitigate the carbon footprint from digitalisation by embedding sustainability into IT procurement, operations and systems planning.

A HOLISTIC SUSTAINABILITY APPROACH

At the heart of our efforts is delivering incredible care to our patients and communities while taking good care of our staff, in a sustainable manner. The new Sustainable Clinical Care Taskforce will foster closer alignment between our Appropriate Care efforts in the NUHS Care Plan, and our 2030 environmental sustainability targets.

We are equally committed to supporting the wellbeing of our 17,000 strong workforce. Our people are at the heart of this mission to deliver Incredible Care and Health, Together! In FY2024 we continued investing in employee health and wellbeing, as well as their personal and professional development. Initiatives such as our flagship WeCare programme to promote a positive organisational culture focused on caring for yourself and others reflect our belief that a resilient and inclusive workforce is essential to delivering excellent care, now and in the future.

LOOKING FORWARD

In FY2024, we were honoured to be the first healthcare institution to receive the SGBC-BCA Business Leadership in Sustainability Award in the 'Transformation' sub-category – a testament to our holistic and forward-thinking approach in developing a sustainable healthcare built environment.

Complementing this achievement, NUH made history in June 2025 by becoming the first hospital globally to receive the Healthcare Sustainability Certification, a landmark recognition awarded by the Joint Commission International (JCI) in collaboration with the International Hospital Federation's Geneva Sustainability Centre.

Our path ahead is guided by a simple but powerful idea: healthcare must do good without doing harm. Sustainability is not a separate effort – it is robustly embedded in our care models, our leadership culture, our transformation agenda, and our partnerships.

To all our stakeholders – patients, colleagues, suppliers, and partners – thank you for your trust and collaboration. Together, we will continue building a healthier and sustainable future.

CHIEF SUSTAINABILITY OFFICER'S MESSAGE

Dear Stakeholders,

NUHS is committed to building a more sustainable healthcare system. Healthcare is highly complex: energy-intensive, operating 24/7, and deeply intertwined with critical services and population demographics. Our guiding principle remains unchanged: patient safety is and always will be our foremost priority. Sustainable care is safe care - it is about enabling safe, high-quality, and future-ready care while using our resources responsibly and effectively.

Last year, we took a significant step forward as the first public healthcare cluster in Singapore to measure and disclose our environmental impact.

PROGRESS TOWARDS 2030 SUSTAINABILITY TARGETS

As a public healthcare cluster, we continue to align our targets with Singapore's Green Plan 2030. We made progress towards key sustainability targets. Scope 1 emissions declined further as more clinicians transitioned to lower-carbon anaesthetic drugs. Scope 2 emissions saw a modest reduction despite increases in patient visits and workload, through the ongoing roll-out of energy efficiency initiatives across NUHS.

We are embedding and integrating recycling more deeply into daily healthcare operations. We made encouraging strides in waste reduction and recycling. A new initiative on optimising the use of couch paper in clinics led by our Service Operations, Nursing and Infection Prevention teams successfully reduced couch paper use without compromising patient safety. The team achieved a 0.5tCO₂e reduction over 6 months and an 19% reduction in monthly couch paper consumption. The "Sort at Source" initiative introduced small recycling bins on medication carts and IV preparation trolleys in the wards, enabling our nurses to recycle directly at the point of waste generation.

DECARBONISING HEALTHCARE

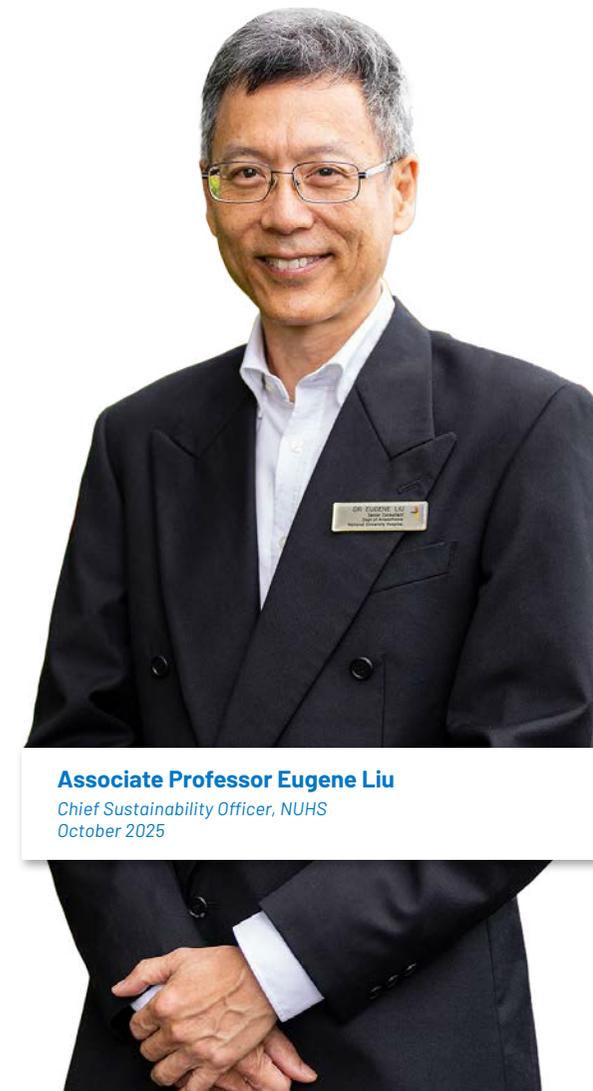
Many emission hotspots remain difficult to mitigate, such as from the pharmaceuticals and medical supplies that we use in caring for patients. Balancing emissions reduction with clinical safety, infection control, and technological advancement will continue to require careful, evidence-based decisions.

The new Sustainable Care Taskforce and Green IT Taskforce will bring together clinical, operational, and technical domain expertise to target our emission hotspots in a value-driven and collaborative manner. The environmental evaluation of value-based care will relate both financial cost and carbon footprint to the clinical outcomes' metrics.

ENCOURAGING COLLECTIVE ACTION ON SUSTAINABILITY

An informed and empowered workforce is essential to transforming the way healthcare is delivered and experienced, and to embedding sustainability in organisational mindsets and practices. We will expand our employee engagement and education initiatives to encourage more sustainable practices in healthcare. We will roll out climate literacy e-learning modules that all NUHS staff can access.

At NUHS, sustainability is a shared responsibility and a collective journey. While the road ahead is challenging, it also presents us with the opportunity to redefine what world-class, sustainable healthcare looks like for Singapore. I thank all our partners and stakeholders who continue to support this endeavor.



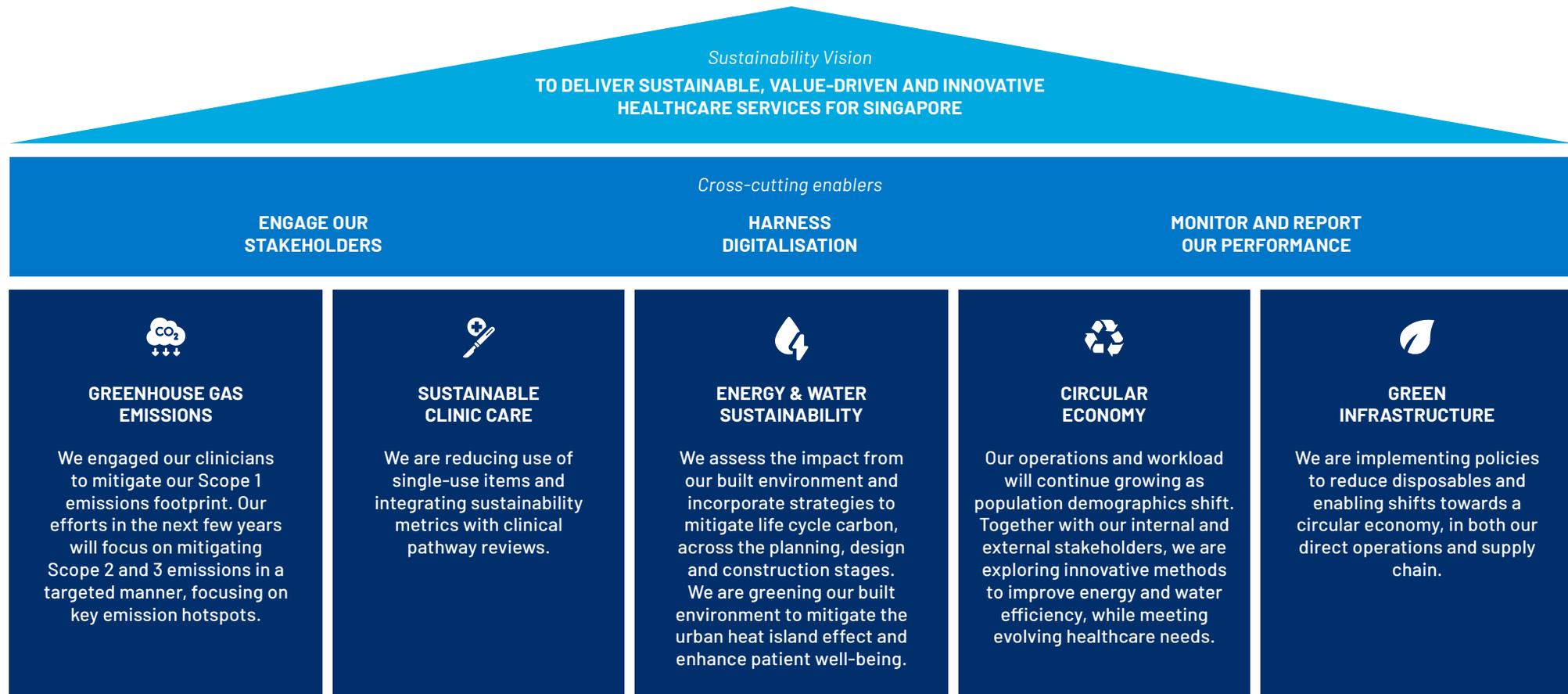
Associate Professor Eugene Liu

Chief Sustainability Officer, NUHS
October 2025

OUR SUSTAINABILITY COMMITMENT

At NUHS, we have begun the work to transform the traditional resource and energy intensive healthcare model. Our approach to sustainability places people at the centre of everything we do, recognising that the health of our patients, staff and communities is deeply connected to the health of our planet. Guided by our mission to deliver Incredible Care and Health, Together!, we care for each other and for those we serve.

We are embedding sustainability principles across our direct operations and value chain to deliver care in a manner that ensures the well-being of present and future generations. To effectively measure and report our progress, we have established short and long term targets under each focus area.



2024 SUSTAINABILITY HIGHLIGHTS

TENGAH GENERAL AND COMMUNITY HOSPITAL - Building Climate-Resilient Healthcare for the Future

“
Caring for Individuals, Cultivating Thriving Communities
”

To be completed in the early 2030s, the 1,500-bed Tengah General and Community Hospital (TGCH) will expand NUHS' regional hospitals network to better serve the healthcare needs of residents in western Singapore. In line with the Urban Redevelopment Authority's vision for a "Lush Evergreen Town" in Tengah, TGCH includes a variety of green spaces that blend harmoniously with the surrounding natural environment.

Climate Resilient Healthcare

TGCH incorporates a suite of passive climate-responsive strategies to future-proof the hospital against rising temperatures and the Urban Heat Island Effect. Optimised building orientation and façades maximise natural ventilation and daylighting. Hybrid cooling systems and high-efficiency mechanical and electrical systems lower energy consumption while maintaining indoor comfort for occupants. The hospital will be built on slightly undulating ground with enhanced drainage design and flood defences to mitigate extreme rainfall events. Where feasible, TGCH will harness on-site renewables such as rooftop solar panels.

Circularity and Low-Carbon Materials

Circular design principles and embodied carbon guide the selection of construction materials for TGCH. For example, mass engineered timber, recycled concrete aggregate, and green steel will be adopted where feasible. Consideration of modular design in the hospital ensures resource optimisation, flexibility and scalability to meet evolving healthcare needs in the future.

Sustainable Operations by Design

From the outset, TGCH integrates high-efficiency water fixtures, rainwater harvesting, pneumatic recycling chute systems and Internet of Things (IoT)-enabled general and recycling bins, to improve water efficiency and promote waste reduction. During operation, cutting-edge smart platform technology, supported by IoT sensors with advanced analytics, facilitates real-time monitoring and performance optimisation for improved operational efficiency.

With sustainability and patient wellbeing at its core, TGCH sets a new benchmark for integrating environmental responsibility and landscaping into healthcare infrastructure. By creating a healing environment that is energy and resource efficient, and climate resilient, TGCH advances NUHS' mission to deliver exceptional care for current and future generations.



Key Highlights

Optimised surgical instrument trays for Total Knee Replacement (TKR) surgeries

- ▼ 42.3% reduction in tCO₂e from autoclaving fewer instruments



Sustainability Certification Course for Healthcare Staff

NUHS staff were equipped with knowledge and skills to champion environmental stewardship and integrate sustainable practices into everyday operations across NUHS.

SGBC-BCA Business Leadership in Sustainability Award

NUHS was the first healthcare cluster to be recognised as an exemplary leader in transforming our healthcare operations and built environment through sustainable practices, reaffirming our efforts in building an environmentally sustainable healthcare system.

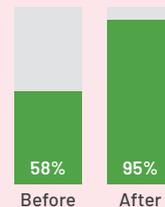


Circular Redesign of Recycling Bin Covers in NUH Supported by the Ministry of Sustainability and the Environment's SG Eco-Fund

Collaborated with a plastic recycling vendor to modify existing bin covers using upcycled existing plastics, making recycling of targeted items more intuitive for staff and visitors and improving recycling rate.



Recycling rate



Co-organised the Inaugural Healthcare Symposium on Energy & Water Efficiency with MOHH

Themed 'Heal Our Patients, Heal Our Planet', the symposium was graced by then Senior Minister of State for Sustainability and the Environment, Dr Amy Khor. Panellists from the three public healthcare clusters discussed best practices for integrating sustainability in healthcare facilities.

Alexandra Hospital's Go Green team organised a beach clean-up in partnership with Green Nudge. Approximately 149kg of waste was collected in an hour.



Celebrating Green Day across NUHS Institutions



MANAGING OUR CLIMATE RISKS

Planetary health is inextricably linked to long-term health of the communities we serve. NUHS recognises that our duty of patient care includes caring for the planet. We are committed to managing our climate impact and building a climate-resilient healthcare system. In view of the upcoming mandatory climate reporting requirements for large, non-listed companies, we have aligned our management approach with the TCFD's recommendations and embarked on our first climate scenario analysis to assess the impact of climate change on healthcare operations.

Looking ahead, we intend to qualitatively examine all relevant physical risks (e.g. wildfires, droughts, zoonotic diseases, heat-related illnesses) and transition risks within our value chain, using TCFD's recommended scenario analysis approach. As part of this continuous assessment, we are reassessing some climate risks considered in 2023 and will disclose additional climate risks, where material, in our next reports. In parallel, we are developing a methodology to model the financial impact of climate change on our assets and healthcare operations.

QUALITATIVE CLIMATE SCENARIO ANALYSIS

NUHS conducted our first qualitative climate scenario analysis in 2024. Our existing and planned healthcare institutions were assessed for vulnerability to climate hazards and the transition risk associated with carbon pricing policies. We considered three time horizons and used climate projections from two IPCC scenarios that reflect low and very high emissions pathways. Time horizons were aligned with financial planning and typical redevelopment cycles of our healthcare institutions. The long-term time horizon of 2100 enabled us to assess chronic climate impacts on healthcare infrastructure, which tend to materialise cumulatively over decades. For transition risks, time horizons correspond with our financial planning and Net Zero targets. Discussions were conducted with relevant stakeholders to deepen insights and 'sense-make' the climate risks and opportunities identified.

Our climate scenario analysis showed that the projected chronic increase in mean air temperatures, increased frequency of heatwaves and urban flooding events may significantly impact NUHS' healthcare operations. Under the Shared Socio-economic Pathway (SSP) 1-2.6 scenario, carbon pricing levied indirectly on NUHS through our Scope 2 emissions will lead to higher operational costs, further compounded by the energy-intensive nature of healthcare operations and growing healthcare workload.

OUR MANAGEMENT APPROACH

We adopt a differentiated approach to mitigating physical risks, depending on the time horizons identified. By year 2100, all NUHS healthcare institutions would have undergone Addition and Alteration (A&A) works at least once when nearing their 30th year of operation. This presents an opportunity to incorporate climate-resilient design during future A&A works to mitigate long-term climate risks and retrofit existing infrastructure to mitigate climate risks identified in the short and medium term. To reduce our financial exposure to Singapore's carbon pricing regulations, we have implemented a Scope 2 decarbonisation plan.

Climate scenario analysis parameters in accordance with the TCFD recommendations	
Coverage	Own operations within all NUHS healthcare institutions (hospitals, polyclinics, corporate office)
Time horizons	Short term (2030), Medium term (2045), Long term (2100 for physical risks and >2045 for transition risks)
Emission scenarios	For physical and transition risks: IPCC SSP1-2.6 and IPCC SSP5-8.5
Risks assessed	We assessed a subset of the physical and transition risk categories as described in the TCFD recommendations. These are: <ul style="list-style-type: none">• Acute and chronic physical risks related to mean air temperature, heatwaves, precipitation and sea levels• Transition risks related to carbon pricing

CLIMATE-RELATED RISKS

Risk Description	Potential implications	Ongoing mitigation measures
<p>Physical risk</p> <p> Chronic increase in mean air temperatures</p>	<ul style="list-style-type: none"> Increased demand for cooling leading to higher energy and water consumption and operational costs. Reduced performance and efficiency of mechanical and electrical (M&E) systems, leading to equipment failure or reduced operational lifespan, and higher operational costs. 	<p>Existing built infrastructure impacted over the short term (2030) and medium term (2045)</p> <ul style="list-style-type: none"> Energy efficiency measures such as hybrid cooling and raising the set point temperature of air-conditioning to 25°C, to lower cooling demand. Continuous monitoring chiller plant energy efficiency will ensure our air conditioning equipment are operating efficiently. NUHS is progressively retrofitting all air handling units (AHU) with air side optimisers that will help to operate air conditioning equipment more efficiently. NUHS is studying the feasibility of operating our facilities at lower air flow rates, while ensuring both infection control standards and indoor thermal comfort needs are still met. When successful, the initiative could further reduce cooling load leading to energy cost savings. <p>Future built infrastructure impacted in the long term (2100)</p> <ul style="list-style-type: none"> NUHS has implemented climate resilience design standards for all new buildings. For instance, designs must conform with low Envelope Thermal Transfer Value (ETTV) characteristics, promote natural ventilation flow, opt for assisted natural ventilation areas with ceiling fans where feasible, incorporate greenery to mitigate the urban heat island effect, etc. Procurement of critical M&E equipment will consider whether equipment is designed to operate in ambient conditions exceeding +4°C rise, with no significant decrease in operational capacity. Design assumptions (used to size our equipment in assets with lifespan beyond 2100) will be updated to ensure operational reliability and resilience in climate conditions projected for 2100.
<p> Heatwaves</p>	<ul style="list-style-type: none"> Increased demand for cooling leading to higher energy & water consumption and increased operational costs. Lower staff productivity and disruptions to healthcare service delivery. Staff working outdoors or in naturally ventilated areas (e.g., wards) may be exposed to heat-related injuries. 	<p>Existing built infrastructure impacted over the medium term (2045)</p> <p>In addition to mitigation measures for rising mean air temperatures:</p> <ul style="list-style-type: none"> NUHS is exploring load-shaving using Energy or Thermal Storage Systems, to mitigate the spike in electricity costs during heatwaves. <p>Future built infrastructure impacted in the long term (2100)</p> <p>In addition to mitigation measures for rising mean air temperatures:</p> <ul style="list-style-type: none"> Future building design will incorporate water-saving appliances and bio-swale ponds to reduce potable water usage during heatwaves. Explore the use of Energy Storage System or Thermal Storage System and whether these systems can be designed for extended periods of use during the day. We will regularly review and update our workplace safety and health policies based on the latest heat stress advisory.

CLIMATE-RELATED RISKS

Risk Description	Potential implications	Ongoing mitigation measures
 <p>Urban flooding</p>	<ul style="list-style-type: none"> Flood events may damage structural components of buildings necessitating repair and reinforcements, leading to higher operational costs. Flood events may damage M&E systems in basements or lower levels of buildings, leading to equipment failure or reduced operational lifespan, and higher operational costs. 	<p>Existing built infrastructure impacted over the short term (2030) and medium term (2045)</p> <ul style="list-style-type: none"> NUHS has implemented business continuity planning and conducted regular disaster response drills, including sandbag deployment at high flood risk building openings, portable pumps deployment and regular testing of emergency generators. Deployed smart Internet of Things (IoT) flood sensors in high flood risk areas for early detection of floods. <p>Future built infrastructure impacted in the long term (2100)</p> <ul style="list-style-type: none"> Future building design will incorporate increased basement pumped drainage, larger rainwater holding tanks, higher minimum platform level (i.e., 2-3m above projected flood levels under the SSP5-8.5 scenario), redesigned drainage system and floodgates at all building openings. Where feasible, we will limit basement structures in future assets, for e.g., by designing for above ground car parks. All critical M&E systems will be sited at ground level and above, with sufficient diesel capacity for backup generators to minimise disruptions to critical healthcare operations.
Transition risk		
 <p>Carbon pricing policies and regulations</p>	<ul style="list-style-type: none"> Increased operational costs associated with Scope 2 emissions. 	<ul style="list-style-type: none"> Developed and implemented a Scope 2 decarbonisation plan combining demand-side efficiency with supply-side decarbonisation to reduce Scope 2 emissions and minimise NUHS' financial exposure. All new buildings will be designed to achieve best in-class energy efficiency, minimally to be aligned with BCA's Green Mark Platinum Super Low Energy Standard. NUHS is working closely with our collaborators and partners to test and pilot innovative low-carbon technologies, such as passive displacement cooling units, to further minimise exposure from shifts in carbon pricing policies.

NUHS' efforts to mitigate and adapt to climate change also provide opportunities to strengthen operational resilience and reduce operating costs.

CLIMATE-RELATED OPPORTUNITIES		
Opportunities	Description	Potential implications
 <p>Resource efficiency</p>	<ul style="list-style-type: none"> Integrating energy efficient technologies in infrastructure design and operations. Waste management through behavioural change and circular economy approaches e.g., refurbishing large medical equipment, repurposing non-hazardous medical plastics. Design and develop healthcare facilities with adaptable spaces, efficient systems to enable the transition towards a circular economy and optimise resource use. 	<ul style="list-style-type: none"> Reduced exposure to volatility in electricity and water tariffs, waste management costs and evolving carbon pricing policies. Reduction in operating costs.
 <p>Energy source</p>	<ul style="list-style-type: none"> Expanded use of renewables such as on-site solar panels. 	<ul style="list-style-type: none"> Reduced exposure to carbon pricing regulations.
 <p>Resilience</p>	<ul style="list-style-type: none"> Incorporating climate-adaptive design and considerations in existing workflows, new buildings and A&A works for existing buildings. Selection criteria of new building equipment will include an assessment of its operational efficiency and capacity in higher ambient temperatures. Developing solutions to mitigate the urban heat island effect such that more spaces can be naturally ventilated. As a provider of critical public infrastructure, our future assets will be flood proof by design. 	<ul style="list-style-type: none"> Reduced vulnerability to extreme weather and climate-change induced operational disruptions, leading to increased operational resilience.

2030 ENVIRONMENT TARGETS

NUHS supports the national agenda on sustainable development in our capacity as a public healthcare cluster. The table outlines our progress on environment topics and targets, aligned with the Singapore Green Plan. The baseline year referenced is 2018-2020.

ENVIRONMENT TOPICS	2030 ENVIRONMENT TARGETS AND METRICS	2024 PROGRESS
Greenhouse Gas Emissions	<ul style="list-style-type: none"> 25% reduction in total operating GHG emissions (Scopes 1, 2 and 3, excluding Scope 3 CAPEX) 	<ul style="list-style-type: none"> 42% increase in total operating GHG emissions (Scopes 1, 2 and 3, excluding Scope 3 CAPEX) compared to baseline
Sustainable Clinical Care	<ul style="list-style-type: none"> 80% reduction in medical gas emissions 30% reduction in supply chain emissions 	<ul style="list-style-type: none"> 77% reduction in medical gas emissions 63% increase in supply chain emissions
Green Infrastructure	<ul style="list-style-type: none"> 50% of NUHS buildings meet BCA Green Mark Super Low Energy building standards In each healthcare institution: 5.0 green plot ratio In each healthcare institution: Reduced ambient temperature in 18 urban heat island (UHI) hotspots 	<ul style="list-style-type: none"> AH and JHC achieved their 5.0 green plot ratio target, while NUH's green plot ratio increased from 3.72 to 4.01 Overall, 12 UHI hotspots with reduced ambient temperature
Energy and Water Sustainability	<ul style="list-style-type: none"> 10% reduction in EUI¹ against baseline of 280.33 kWh/m² 10% reduction in WEI¹ against baseline of 148.03 litres/day.pax Install 100 EV charging stations 	<ul style="list-style-type: none"> 1.55% reduction in EUI 18.26% reduction in WEI As of FY24, 19 EV stations installed: 10 in NUH, 3 in AH and 6 in NTFGH
Circular Economy	<ul style="list-style-type: none"> 60% reduction in waste disposed compared to 2020 baseline 60% recycling rate 	<ul style="list-style-type: none"> 14.25% reduction in waste disposed 10% recycling rate achieved

¹ With reference to baseline stock of buildings.

GREENHOUSE GAS EMISSIONS

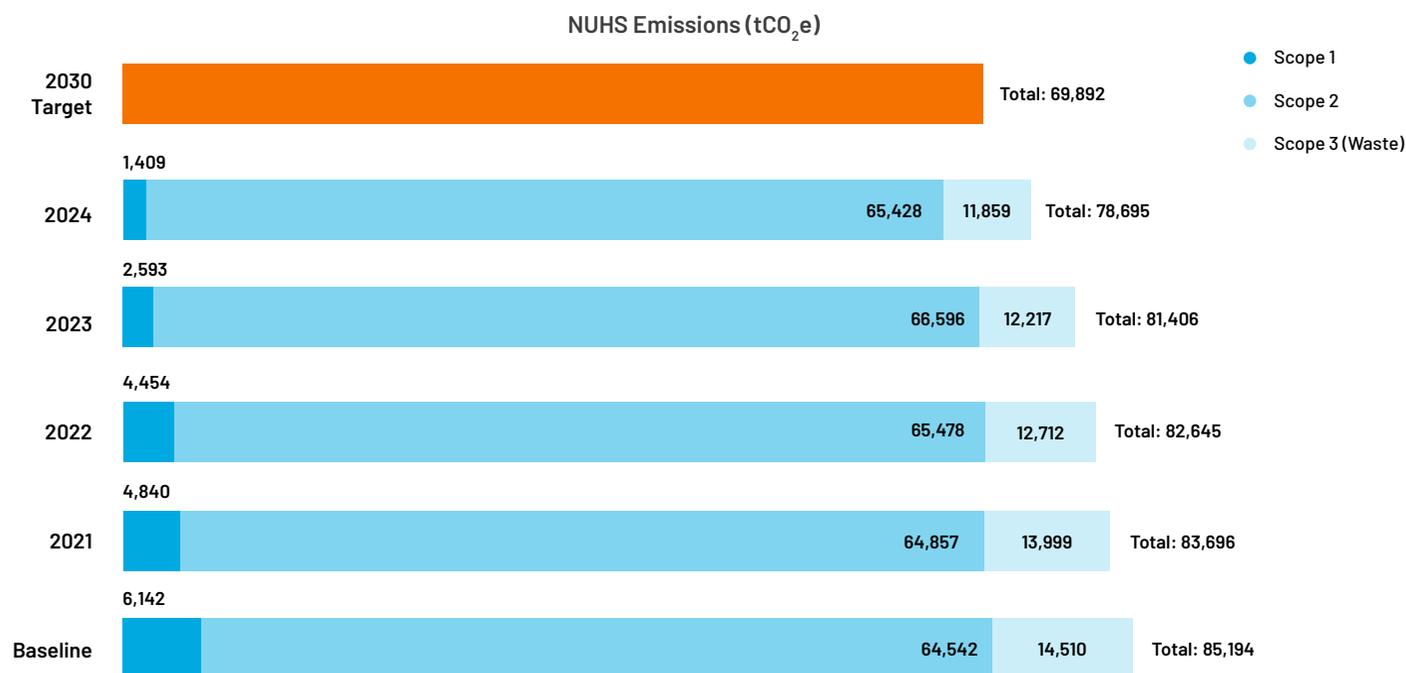
Reducing GHG emissions is integral to NUHS' mission of advancing health and delivering care for current and future generations. Healthcare is both impacted by climate change and a significant contributor to GHG emissions. Decarbonising healthcare enables NUHS to mitigate climate risks, promote patient wellbeing, and build a more resilient health system. We are committed to achieving 25% reduction in overall GHG emissions by 2030, against the baseline years of 2018-2020².

OUR MANAGEMENT APPROACH

NUHS measures and discloses our GHG emissions across Scopes 1, 2 and 3, in accordance with the GHG Protocol. Our decarbonisation efforts in the next few years will focus on mitigating Scope 2 and 3 waste-related emissions which account for the majority of NUHS' emissions footprint. Through continued engagement efforts with our clinicians, Scope 1 emissions have declined significantly by 77%, compared to the baseline year.

In 2024, the measured and reported emissions arising from NUHS' operations were 78,695 tCO₂e³, representing a 7.6% decrease from our 2018-2020 baseline and a 3.3% decrease compared to 2023. This comprises 1,409 tCO₂e in Scope 1 emissions, 65,428 tCO₂e in Scope 2 emissions and 11,859 tCO₂e in Scope 3 waste-related emissions.

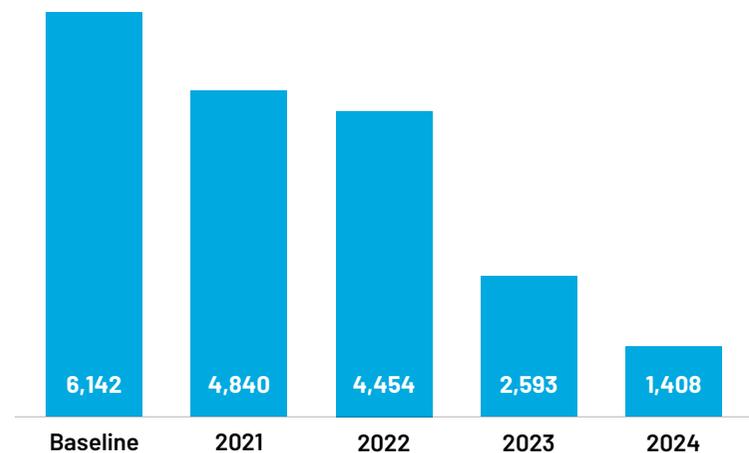
Progress towards our 2030 emissions target



² Baseline years were selected to align with GreenGov.SG.

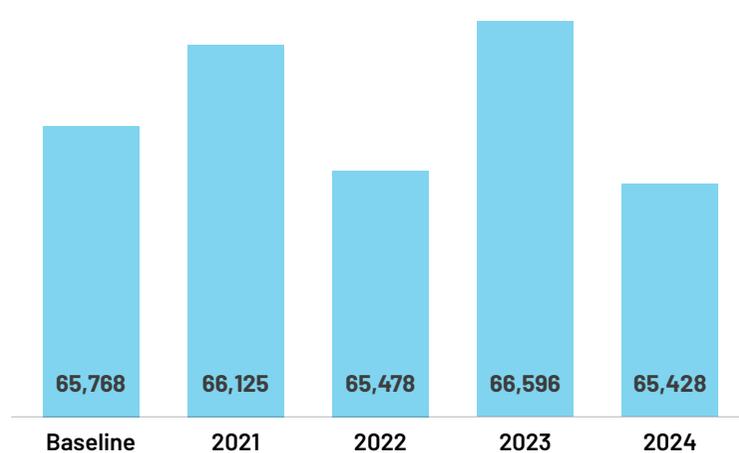
³ This number includes only Scope 1, 2 and Scope 3 waste-related emissions.

Scope 1 (tCO₂e)



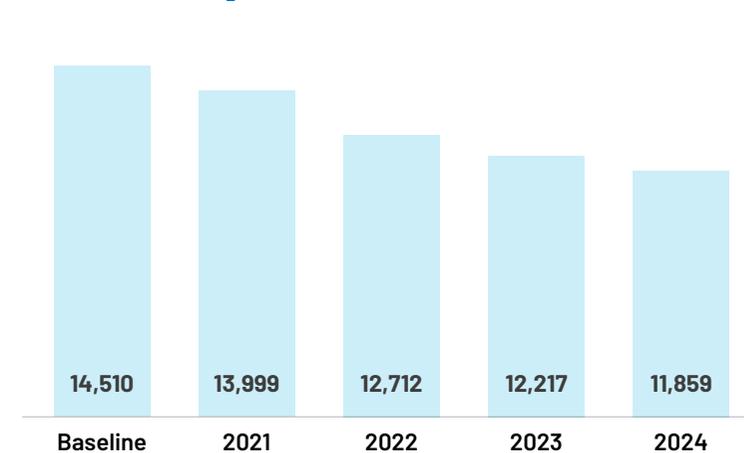
Scope 1 emissions arise from the use of anaesthetic gases, as well as town gas for preparation of patients' meals. Scope 1 emissions decreased from 2,593.0 tCO₂e in 2023 to 1,408 tCO₂e in 2024. Our Scope 1 mitigation approach is underpinned by continued efforts to engage clinicians on switching from desflurane to greener anaesthesia drugs and more efficient usage of nitrous oxide.

Scope 2: Electricity (tCO₂e)



Scope 2 emissions are a significant contributor to NUHS' GHG emissions. Healthcare services consume significant amounts of energy to operate round-the-clock and for infection prevention. Our approach to managing Scope 2 emissions is aligned with the mitigation hierarchy. We prioritise avoiding emissions through sustainable design at the onset, followed by optimising for energy efficiency. Remaining Scope 2 emissions will be mitigated through deployment of renewable energy.

Scope 3 Category 5: Waste Generated in Operations (tCO₂e)



Emissions from waste decreased from 12,217 tCO₂e to 11,859 tCO₂e. This decrease was due to a shift towards a circular approach in waste management. Our approach is to first reduce waste generated. Public and staff awareness, plus the provision of convenient recycling facilities boost participation. Additionally, exploring and introducing new recycling streams – such as electronic waste, textiles, and food waste – can divert more materials away from landfills. NUHS has achieved a 14% reduction in waste disposed compared to our baseline and increased our recycling rate from 4% to 10%.

SUSTAINABLE CLINICAL CARE

The global healthcare sector faces the dual challenge of delivering high-quality care while addressing resource constraints and mitigating climate change impacts. To meet this challenge, healthcare systems are increasingly adopting sustainable clinical approaches that redefine value through the delivery of appropriate, Value Based Care. This shift benefits patients while simultaneously safeguarding our planet for future generations.

OUR MANAGEMENT APPROACH

A key component of this sustainability drive is the growing movement to identify and reduce low-value care - interventions that offer limited or no benefit to patients and may even cause harm. At NUHS, we recognise that minimising such practices is essential for delivering more efficient, effective, and sustainable healthcare. By focusing on high-value interventions, we can optimise patient outcomes while reducing unnecessary resource consumption and environmental impact.

DRIVING VALUE-BASED AND LOW-CARBON CARE

NUHS 'Appropriate Care' aims to identify and eliminate unnecessary medical treatments and empower our clinicians to develop low-carbon care pathways.

Reducing Unnecessary Interventions

We conducted comprehensive, NUHS-wide reviews of prescribing patterns for end-of-life patients, the use of Point-of-Care Testing (POCT) for glucose, ESR, CRP, and procalcitonin tests, and the frequency of repeat HbA1c tests within three months.



Preventing Futile Care

Our nurse-led initiatives focus on stopping futile care, deprescribing unnecessary medications, and revising care protocols based on patient life expectancy (<6 months and <1 month). We have also implemented end-of-life care bundles and indicators to ensure compassionate and appropriate care.

INNOVATING FOR ENVIRONMENTAL AND OPERATIONAL EFFICIENCY

In FY2024 NUHS initiated several projects for sustainable clinical care.

A.R.I.S.E - TKR (Repacking of Instruments and Sterile Equipment in Total Knee Replacement Surgeries):

NUH's Department of Orthopaedic Surgery led an initiative to optimise instrument trays for total knee replacement surgeries. Collaborating with industry partners, the team developed streamlined configurations tailored to surgeon preferences and essential requirements. A three-month trial demonstrated significant improvements in operating room efficiency, surgical workflows, and reduction of unnecessary instruments. The ergonomic improvements, such as lighter trays and more intuitive instrument arrangements, have reduced physical strain on our surgical and TSSU teams. The project has resulted in decreased sterilisation requirements, leading to reduced energy and consumption, and consequently notable reduction in the carbon footprint of these procedures. The projected savings, for an annual caseload of 1,000 TKRs, are:

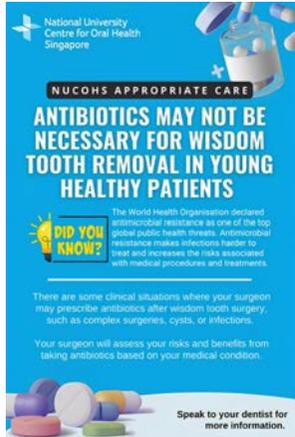
- 10 tCO₂e reduced from sterilising fewer instruments
- 1,006.5 annual man-hours saved
- 151,800 litres of water saved yearly
- S\$22,176 in annual cost savings from utilities and manpower



Achieving the triple bottom line: Optimising TKR instrument sets for resource and manpower efficiency, financial savings and a lower carbon footprint

PROTECTING PATIENTS AND THE ENVIRONMENT

Reducing antibiotic prescriptions



Clinicians from the National University Centre for Oral Health (NUCOHS) reduced the overprescription of antibiotics for wisdom tooth surgeries, a practice that previously affected 84.5% of patients. Through new guidelines, comprehensive educational materials for both clinicians and patients, and a robust compliance tracking system, we achieved a remarkable reduction in antibiotic prescription rates to 15.4% (a 69.1% decrease). Crucially, this was achieved while maintaining low infection rate of 0.83%. This initiative led to:

- Significant cost savings and reduced waste
- Lowered risk of antibiotic resistance
- 14.7 tCO₂e avoided from decreased antibiotic usage

Reducing Intravenous Medications



Intravenous (IV) paracetamol carries a larger environmental footprint compared to its oral counterpart due to complex production, packaging, transportation, administration, and disposal processes. Recognising this, NUH implemented the Reducing Intravenous Medication (R.I.M.) project to decrease IV paracetamol usage in operating theatres. Through a combination of staff education, workflow improvements, and increased access to oral medications, the clinical team successfully reduced IV paracetamol use by 14.3%. This is projected to save NUH over \$11,000 annually, reduce plastic waste by at least 46kg, and avoid ~500kg CO₂e emissions. Plans are underway to expand this initiative to other hospitals and specialties, potentially multiplying these benefits.

Breathing Green: Improving anaesthesia practices



The NUH Department of Anaesthesia initiated the “Breathing Green” project, aligning with international guidelines to reduce anaesthesia breathing circuit changes from daily to weekly. Rolled out across all three operating theatre complexes in the hospital, this initiative significantly reduced single-use plastic consumption and medical waste generation. The project demonstrates the potential for thoughtful clinical interventions that optimise resource use and decrease environmental impact while maintaining the highest standards of patient safety.

- 60% reduction in breathing circuit usage
- 5.4 tCO₂e avoided
- S\$38,880 saved annually

Breathing circuits are now changed weekly in NUH. The project team's findings have been published in the British Journal of Anaesthesia and shared with other hospitals across Singapore, showing how healthcare can contribute to sustainability efforts while maintaining the highest standards of patient care.

GREENING THE HEALTHCARE BUILT ENVIRONMENT

The healthcare built environment plays a critical role in NUHS' environmental footprint and promoting patient wellbeing. We recognise that how we plan, design, construct and operate our healthcare facilities, directly impacts our carbon emissions, the health outcomes of our patients, and wellbeing of our employees and communities we serve. From the outset, our planning and design for all major infrastructure developments embeds climate responsiveness, low-carbon and patient-centred design principles. NUHS aims to achieve best in class energy standards for all new hospital developments.

In our existing campuses, we strive to expand green spaces and improve access to greenery. Various research studies have highlighted a strong correlation between greenery and improved patient outcomes. Complementing climate resilient design, greenery is also employed to mitigate the Urban Heat Island (UHI) effect. NUHS has progressively intensified green spaces across our hospitals and polyclinics. As of 2024, we planted more than 280 trees and 1,200 shrubs across NUHS campuses. NUHS strives to provide more trees and greenery in our new hospital developments.

OUR MANAGEMENT APPROACH

To continue serving our population now and in the future, NUHS is committed to ensuring all future healthcare infrastructure is resilient to climate change.

Raising the Bar for Sustainable Healthcare Infrastructure Design

We have committed to ambitious sustainability targets for our new built projects – Alexandra Integrated General Hospital, Tengah General and Community Hospital (TGCH) and NUH Redevelopment, including compliance with BCA Green Mark Platinum Super Low Energy (SLE) building standards. We worked closely with our architects and engineers to prioritise passive design and incorporate energy-efficient systems. By lowering life cycle emissions and enhancing energy performance, these measures deliver measurable environmental impact reductions, reduce operating expenditure, and provide a more healing environment for better patient outcomes.



NUH Redevelopment – Vision for 2042

Designing with Climate Change in mind

To manage the physical impacts of climate change on our healthcare infrastructure while maintaining high standards of patient care, NUHS conducted our first climate risk assessment to guide the planning of New Build and Addition and Alteration (A&A) projects. Climate adaptation measures were developed for material climate risks and will be included in early-stage planning and design of New Build and A&A projects.

Harnessing Digitalisation and Innovation

In 2024, we piloted an Integrated Data Platform at Levels 18 and 19 of NUH Medical Centre. The centralised building platform integrates data from building management systems, space usage, and operations workflows in one interface. With data analytics and AI solutions, the insights will enable system optimisation, space utilisation and reduce resource consumption, leading to maintenance cost savings.

Applying Cool Paint to Improve Thermal Comfort

NUHS is taking additional steps to reduce heat stress as part of our UHI mitigation strategy. In 2024, the implementation of cool paint technology in Bukit Batok polyclinic and AH's Security Block as well as the installation of solar film at Block 19 in AH helped cool three hotspots in NUHS.

Rewilding Campuses

AH, NUH and JHC embarked on rewilding efforts to improve connectivity of green spaces and promote growth of native plants. These rewilding sites are situated away from areas with heavy human traffic to increase the restoration success of each site.

Community Gardens

To promote employee wellbeing and engagement, 16 community garden plots were set up in NUH. The community gardens in NUH were launched during NUH Green Day on 14 June 2024, where employees were encouraged to adopt plants as part of the hospital's greenery efforts. Across NUHS, more implementation sites are planned for 2025.



NUHS employees preparing their community garden plots at NUH Utility Block L5 on NUH Green Day 2024

OPTIMISING FOR ENERGY AND WATER SUSTAINABILITY

Energy and water play a crucial role in NUHS' direct operations. As our workload grows, we strive to continue balancing our energy use and water consumption with environmental stewardship.

OUR MANAGEMENT APPROACH

NUHS' energy and water efficiency strategies spans healthcare delivery, facility design and operational practices.

Harnessing Solar and Innovative Cooling Solutions

NUHS continues to enhance energy efficiency and reduces carbon emissions through clean energy and efficiency initiatives. Close to 1,000 solar panels have been installed, with another 1,000 scheduled by year's end.

Smart Technology

NTFGH has upgraded its Air Handling Units (AHUs) by installing a smart air handling unit controller that will optimise air side energy consumption during operation. This initiative improves energy efficiency and reduces operational carbon footprint. If successful, similar smart technology will be scaled up across NUHS institutions.

Green Mark (GM) Certification for Existing NUHS Buildings

Existing NUHS buildings are also undergoing GM 2021 feasibility studies and GM 2021 certification work. With the smart AHU controller, JHC is on track to achieve GM 2021 Platinum Super Low Energy certification by 2025.

Operating Theatre (OT) Setback

Across NUHS, 42 operating theatres have adopted energy-saving measures, with 9 more underway. NTFGH places idle OTs in eco-mode, while NUH and AH reduce air changes during non-operating hours while still meeting infection-control standards. In particular, the initiative to reduce the air change rates can cut OT energy use by up to 40%, contributing to about 1% projected annual energy savings against baseline.

LED Retrofitting

NTFGH completed its LED lighting upgrade, replacing 60,000 bulbs with energy-efficient LEDs. LED retrofitting works commenced in NUH, with Medical Centre as the first building to be retrofitted and planned for completion in 2027. Upon completion, the LED project will significantly reduce electricity consumption and would yield annual energy savings of 3.1% against our baseline.

Sub-metering

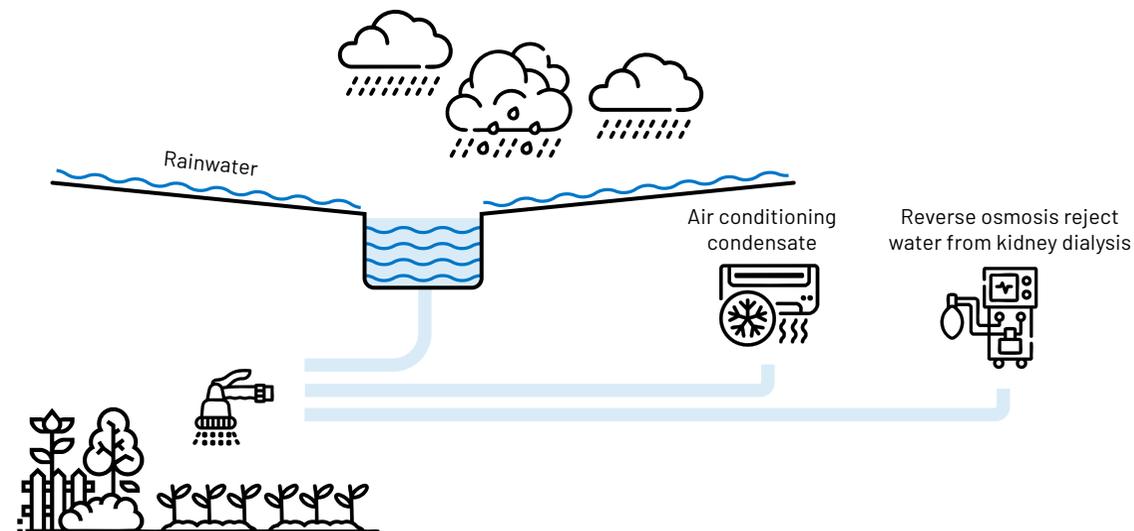
To drive accountability on energy usage, and ensure consistency and transparency in reporting our performance, NUHS has been progressively installing sub-metering devices in NUH and AH. This initiative will allow us to track and report the outcomes of our energy-efficiency projects at a more granular level and tackle issues at source.

Closing the Water Loop: Smarter Irrigation Systems

We recycle rainwater, new water, chiller condensate, and unused fresh dialysate to irrigate our hospital's trees and landscape. By tapping into these non-potable water sources, we conserve precious freshwater and reduce wastewater discharge.

Recycling Reject Water from Kidney Dialysis

At NTFGH, an initiative was carried out to recycle reject water from the reverse osmosis plant used in kidney dialysis. The reject water is introduced for non-potable water usage at the hospital. The initiative is reportedly able to save up to 9,400 m³ of water per year⁴.



⁴ Equivalent to water usage of 50 units of 4 room HDB flats

BUILDING A CIRCULAR ECONOMY FOR BETTER CARE

In 2024, we made significant strides in our waste management and recycling efforts, with a 14.25% reduction in waste disposed compared to our baseline, coupled with an increase in our recycling rate to 10% from the baseline figure.

These results stem from our concerted efforts to transition away from the traditional linear “take-make-dispose” model towards a more sustainable circular economy approach across our healthcare facilities. Our strategy involved integrating circularity principles not only into our waste management streams but also throughout our operational practices.

OUR MANAGEMENT APPROACH

We implemented a range of innovative initiatives designed to minimise waste and promote resource circularity. A key strategic focus was on the refurbishment of radiology equipment to extend operational lifespans, thereby reducing the need for new purchases.

Targeting Medical Plastics Recycling

A key focus was recycling previously unclassified medical plastics, such as syringes and packaging diverting them from incineration. We cultivated partnerships with local companies specialising in waste transformation.

Magorium: This collaboration enabled us to collect uncontaminated medical plastics and transform them into a sustainable bitumen substitute for road construction.

XingHe: A closed-loop recycling system was implemented, reprocessing plastic packaging for clean linen into new plastic bags, effectively maintaining these materials within a circular economy.

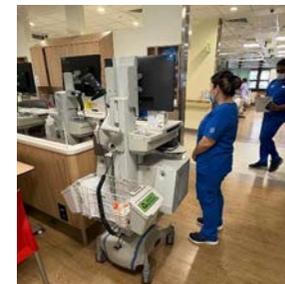
To date, NUHS has successfully diverted 4.6 tonnes of plastic waste from incineration through these programmes.

Fostering Sustainable Practices through Behavioural Change and Digital Transformation

Beyond material-specific initiatives, we actively promoted behavioural change and leverage digital transformation to embed sustainable practices into daily routines across our facilities.

Sort-at-Source in NUH

This initiative involved placing small recycling bins onto medication carts and IV prep trolleys in wards, making it easier for staff to recycle at the point of waste generation. During a pilot trial in three NUH wards, paper recycling increased by 47%, while plastic recycling surged by 231%. It is slated for rollout across NUHS by Q4 FY2025.



The Sort-at-Source initiative makes sustainable behaviour intuitive by integrating it into everyday work routines.

Reducing couch paper usage in NUH Specialist Outpatient Clinics (SOCs)

Teams from Service Operations, Nursing, and Infection Prevention collaborated to develop a comprehensive usage matrix to ensure the appropriate use of couch paper in clinics while maintaining stringent hygiene and patient safety standards, resulting in waste reduction and cost savings.

- \$23,509.20 in annual savings
- An 18.7% reduction in monthly couch paper consumption (137 rolls)

Electronic paperless workflow for medical report requests

Utilising NUHS' electronic medical record system and the NUHS App, we implemented a secure end-to-end digital workflow across NUH, NTFGH, and AH for insurance companies, law firms, and patients.

- Annual savings of 166,432 pieces of A4 paper
- \$66,664.90 in annual cost savings from reduced paper and office supplies usage

Along with other similar digitalised workflows contributed to our overall reduction of use of paper by 31% compared against our FY19 baseline.

A “Bin it Right!” playbook to guide users on proper waste segregation

This comprehensive guide tailors waste management strategies to different staff awareness levels, going beyond policy to actively shape behaviours and mindsets.

GREENING OUR IT INFRASTRUCTURE

Information Technology (IT) is an important cornerstone of healthcare. Its integration in healthcare has transformed the way healthcare professionals deliver care and manage patient information – playing an important role in improving efficiency, accuracy and access to healthcare. At NUHS, our IT infrastructure contributes significantly to the overall emissions footprint. With increasing digitalisation of the healthcare sector, improving the energy efficiency of our IT infrastructure can greatly reduce our environmental impact.

OUR MANAGEMENT APPROACH

NUHS adopts a lifecycle approach to greening our IT infrastructure, incorporating sustainability into procurement and system design, infrastructure management, operations and end-of-life equipment management.

IT Supplier Engagement

In partnership with Synapxe (the national health tech agency), we are mapping our IT value chain, with the intent to identify and engage our top IT suppliers (by spend). Subsequent engagement efforts will focus on better understanding of our suppliers' emission profiles and strengthening collaboration on emissions reduction opportunities. This enables us to address the most material IT emission sources within our Scope 3: Category 1 (Purchased Goods and Services) footprint and accelerate our decarbonisation efforts.

Migration to Cloud-based Solutions and Lower Emission Storage Methods

Reducing reliance on on-site data centres by moving applications to cloud-based solutions is a key decarbonisation strategy for NUHS. Consolidating computing resources in centralised off-site data centres can enhance energy efficiency. Additionally, utilising virtual machines allows for more efficient use of computing power with fewer hardware resources, thereby reducing embodied carbon emissions.

We will promote responsible data management by encouraging housekeeping practices, such as removing unnecessary data and emails stored on shared drives, discouraging digital clutter and reducing energy demand. We are exploring implementing tiered data storage, where data not requiring rapid access is migrated to lower-tier, lower-energy cloud platforms to further improve efficiency.

Green NUHS IT Policy and Guidelines

Looking ahead, we are developing green IT policies and guidelines to promote environmentally conscious use of IT equipment. Plans include reducing the deployment of LAN points and Voice over Internet Protocol (VoIP) phones in areas where they are unnecessary, reviewing the use of electronic queue management systems, and extending the useful life of monitors and peripherals to minimise waste.

ESTABLISHING SUSTAINABLE SUPPLY CHAINS

Effective supply chain management enables responsible procurement and strengthens NUHS' contribution to the broader public good, environmental protection and social responsibility. In addition, sustainable procurement is a key strategy to achieving our overall GHG emission reduction targets. NUHS aims to achieve 30% reduction in procurement-associated emissions by 2030. Currently, the supply chain accounts for over 80% of NUHS' total emissions.

OUR MANAGEMENT APPROACH

Price-Quality-Environment Supplier Evaluation

To target supply chain emissions, NUHS is transitioning its procurement framework to include evaluation of suppliers' sustainability performance. Suppliers taking part in NUHS' procurement will be evaluated with environmental criteria in a full Price-Quality-Environment (PQE) evaluation. In preparation for PQE evaluation, training sessions were held to educate staff on the updated environment criteria. As part of our capability-efforts, all procurement staff also attended courses to deepen their knowledge on assessing suppliers' sustainability performance.

Supplier Engagement

Our key suppliers were engaged to explore emissions reductions initiatives and informed about the upcoming changes to NUHS' procurement framework. We also continue encouraging our suppliers to participate in the CDP (formerly Carbon Disclosure Project) disclosure exercise. In 2024, disclosure participants increased from 120 to 185 suppliers.



Group Strategic Procurement organised a booth during the Group Ops & Info Tech Townhall on May 2024. The sustainability-themed booth showcased the new PQE-based evaluation process and digital name card initiative.

REFERENCES

TCFD DISCLOSURE TABLE

Our disclosures based on the TCFD framework are set out below.

Recommended disclosures	NUHS' Approach	Page
Governance		
<p>Describe the board's oversight of climate-related risks and opportunities</p>	<p>The Board provides corporate advisory on all sustainability matters, including climate-related risks and opportunities. Progress against goals and targets to manage climate-related risks and opportunities are reported at annual Board Meetings. The Board also approves climate disclosures in the annual sustainability report.</p> <p>At NUHS, specialised board committees are utilised to address climate risks before these risks are incorporated within the Group Enterprise Risk Management framework. For a start, the Board has delegated responsibility for oversight of climate risks to the Infrastructure Development Committee (IDC), given that climate risks are highly interconnected with environmental sustainability matters overseen by the IDC. The IDC meets quarterly and reports back to the Board as needed.</p>	-
<p>Describe management's role in assessing and managing climate-related risks and opportunities</p>	<p>NUHS is committed to ensuring strong governance of climate risks and opportunities is cascaded through the organisational structure.</p> <p>At management-level, the GPSC is responsible for steering NUHS' climate resilience strategy and monitoring progress against climate targets. The GPSC also provides guidance on climate-related matters to the Office of Sustainability. The GPSC meets thrice yearly and is chaired by NUHS CEO, with NUHS CSO, key senior management and institution leaders represented. This facilitates cross-department and institution collaboration during the implementation of climate resilience activities.</p> <p>Led by NUHS CSO, the Office of Sustainability is responsible for climate reporting and coordinates NUHS' decarbonisation strategy across the cluster. The Office of Sustainability works closely with key departments to review their climate risks and opportunities annually and update mitigation strategies, based on the latest climate projections.</p>	-

Recommended disclosures	NUHS' Approach	Page
Strategy		
Describe the climate-related risks and opportunities the organisation has identified over the short, medium and long term	NUHS recognises that climate change has wide-ranging implications on healthcare delivery. Climate-related extreme events may impact critical healthcare infrastructure, supplies and our employees, potentially leading to operational disruptions, compromised patient care and patient dissatisfaction. The IPCC's Sixth Assessment Report projects an increase in zoonotic disease prevalence and health conditions such as respiratory illnesses, cardiovascular outcomes and foodborne diseases. This growing healthcare workload will increase NUHS' operating costs, especially as a public healthcare institution.	Please refer to Managing our Climate Risks pages 8-11 for detailed disclosures on our scenario analysis parameters and climate risks and opportunities assessed.
Describe the impact of climate-related risks and opportunities on the organisation's businesses, strategy and financial planning	In 2024, we conducted our first qualitative climate scenario analysis, using a subset of physical and transition risk categories recommended by the TCFD. The analysis provided broad insight on potential climate risks and opportunities that would impact our healthcare operations and costs.	
Describe the resilience of the organisation's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario	Looking ahead, we will progressively expand the scope of our physical risks (e.g. wildfires, droughts, zoonotic diseases, heat-related illnesses) and transition risks (e.g. greenwashing) assessed. In parallel, we are developing semi-quantitative approaches to model the financial impact of climate risks and opportunities on NUHS.	
Risk Management		
Describe the organisation's processes for identifying and assessing climate-related risks	NUHS strives to identify and assess climate risks in a scientifically robust manner. We reviewed the latest policy and scientific literature on climate trends and incorporated the 'External Impact' and 'Internal Impact' perspectives to provide a holistic 360-degree view of various climate risks NUHS is exposed to. Our approach is summarised below:	Please refer to Managing our Climate Risks pages 8-11 for detailed disclosures on our scenario analysis parameters.
Describe the organisation's processes for managing climate-related risks	<p>1. Data collection We referenced the IPCC's Sixth Assessment Report, NEA's V3 Climate Change Study and conducted a peer benchmarking exercise, to shortlist climate risks and opportunities relevant to our operational context.</p> <p>To qualitatively assess exposure to physical risks, we extracted climate projections from authoritative data sources. Projections covered three time horizons: 2030, 2045, 2100 and two IPCC scenarios: SSP1-2.6 and SSP5-8.5. To qualitatively assess exposure to carbon pricing, we conducted a literature review of national carbon pricing policies and regulatory requirements.</p>	
Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organisation's overall risk management	<p>2. Stakeholder engagement Shortlisted climate risks and opportunities were confirmed with relevant department representatives and senior management, to ensure alignment with NUHS operational needs and strategic goals.</p> <p>3. Risk assessment Climate risks were scored using existing risk assessment criteria and confirmed with relevant stakeholders, to facilitate future integration into NUHS' overall risk management framework. Thresholds for each climate risk were established by assessing impact and likelihood of the risk occurring.</p>	

Recommended disclosures	NUHS' Approach	Page	
Risk Management			
Describe the organisation's processes for identifying and assessing climate-related risks	4. Risk Mitigation To holistically manage climate-related risks identified, NUHS leverages the current Group Enterprise Risk Management framework ('House of ERM').	Please refer to Managing our Climate Risks pages 8-11 for detailed disclosures on our scenario analysis parameters.	
Describe the organisation's processes for managing climate-related risks	<div data-bbox="904 385 1567 699" data-label="Diagram"> </div>		
Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organisation's overall risk management		<p>We anticipate completing our qualitative assessment of all climate-related risks by 2026 or earlier. Thereafter, material climate risks will be integrated into NUHS' overall risk management.</p>	
Metrics and Targets			
Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process	<p>NUHS utilises the following metrics to monitor our climate risks and opportunities.</p> <ol style="list-style-type: none"> 1. Scope 1, 2 and 3 greenhouse gas emissions 2. Energy use intensity 3. Water efficiency index 4. Waste and Recycling Rates <p>Scope 2 emission targets are integrated into the organisation-wide Balanced Scorecard, which informs NUHS management and staff remuneration.</p>		

Recommended disclosures	NUHS' Approach	Page
Metrics and Targets		
Disclose Scope 1 and 2, and if appropriate, Scope 3 GHG emissions and the related risks	<i>Please refer to Greenhouse Gas Emissions pages 13-14 for NUHS' 2024 Scope 1, Scope 2 and Scope 3 (waste) emissions.</i>	
Describe the targets used by the organisation to manage climate-related risks and opportunities and performance against targets	<i>Please refer to 2030 Environment Targets page 12 for quantitative targets and respective disclosure chapters for our 2024 performance against each target.</i>	