

A*STAR SUSTAINABILITY REPORT FY2023

APRIL 2023 - MARCH 2024



TABLE OF CONTENTS

About A*STAR	03
Our Mission	03
Our Vision	03
About This Report	04
Reporting Scope	04
Reporting Framework	05
Data and External Assurance	05
Feedback	05
Chairman & CEO Foreword	06
Chairman & CEO Foreword Corporate Governance	06 07
Chairman & CEO Foreword Corporate Governance A*STAR Board (as of 31 March 2024)	06 07 07
Chairman & CEO Foreword Corporate Governance A*STAR Board (as of 31 March 2024) Enterprise Risk Management	06 07 07 08
Chairman & CEO Foreword Corporate Governance A*STAR Board (as of 31 March 2024) Enterprise Risk Management Sustainability Governance	06 07 07 08 09
Chairman & CEO Foreword Corporate Governance A*STAR Board (as of 31 March 2024) Enterprise Risk Management Sustainability Governance Stakeholder Engagement	06 07 07 08 09 10
Chairman & CEO Foreword Corporate Governance A*STAR Board (as of 31 March 2024) Enterprise Risk Management Sustainability Governance Stakeholder Engagement Our Material Topics	06 07 07 08 09 10 11

Integrating Environmental Sustainability into Operations	15
Greenhouse Gas (GHG) Emissions	16
Energy Management	17
Water Management	19
Waste Management	21
Environmental Stewardship	24
Nurturing People and Community	25
Diversity and Inclusion	26
Workplace Safety and Health and Staff Wellbeing	29
Employment / Talent Management	36
Training and Education	37
Community Involvement	39
Building Trust for a Green Economy	41
Anti-corruption	42
Sustainable Procurement	43
Driving R&D for Singapore's Sustainability	44
Research and Development (R&D)	45
GRI Content Index	58

2

ABOUT A*STAR

OUR MISSION

We advance science and develop innovative technology to further economic growth and improve lives.

The Agency for Science, Technology and Research (A*STAR) drives mission-oriented research that advances scientific discovery and propels technological innovation. We are committed to nurturing and developing talent and leadership across our research entities, as well as within the wider research community and industry.

Our research initiatives create economic growth and jobs for Singapore. As a science and technology organisation, we play a pivotal role in bridging the gap between academia and industry in terms of research and development (R&D). In these endeavours, we seek to integrate the diverse capabilities of our research entities and collaborate with the wider research community as well as other public sector agencies towards meaningful and impactful outcomes.

Together with other public sector entities, we develop industry sectors by integrating our capabilities to create impact with multinational corporations and globally competitive companies, partnering with local enterprises for productivity and gearing them for growth and nurturing R&D-driven start-ups by seeding for surprises and shaping for success.

In addition, our research contributes to societal benefits such as improving outcomes in healthcare, urban living, and sustainability. These serve to enhance lives in Singapore and beyond.

OUR VISION

A global leader in science, technology and open innovation

A*STAR is a catalyst, an enabler and a convenor of significant research initiatives among the research community in Singapore and beyond. Through open innovation, we collaborate with our partners in both the public and private sectors and bring science and technology to benefit the economy and the society.



ABOUT THIS REPORT



REPORTING SCOPE

A*STAR's inaugural Sustainability Report (SR) covers all research entities, corporate functions and subsidiaries¹ in Singapore, for the financial year 2023 from 1 April 2023 to 31 March 2024.

Our operational footprint spans 12 locations in Singapore. Apart from our owned premises at Jurong Island and Science Park 2, A*STAR is a tenant in the other 10 premises.



- A*StartCentral A*STAR Co-innovation Space
- Biopolis 1 (BP 1): Centros, Proteos, Chromos, Helios, Genome, Nanos, Matrix
- Biopolis 2 (BP 2): Immunos, Neuros
- A*STAR ARTC & A*STAR SIMTech at Cleantech Park
- A*STAR IDL at Defu Lane
- Fusionopolis 1 (FP 1): Connexis

- Fusionopolis 2 (FP 2): Innovis, Kinesis, Synthesis
- A*STAR ISCE² at Jurong Island
- NUS Brenner Centre
- Lee Kong Chian School of Medicine HQ
- A*STAR IME Building at Science Park 2 (SP 2)
- Interlocal Centre

OUR RESEARCH ENTITIES, INSTITUTIONS AND NATIONAL PLATFORMS

A*STAR is involved in a broad range of research areas from biomedical sciences, physical sciences, and engineering. As of 31 March 2024, A*STAR comprised about 5,900 staff, consisting of scientists, researchers, technical and non-technical staff, industry development staff, commercialisation staff and corporate staff.

BIOMEDICAL RESEARCH ENTITIES

- A*STAR Infectious Disease Labs (A*STAR IDL)
- A*STAR Bioinformatics Institute (A*STAR BII)
- A*STAR Bioprocessing Technology Institute (A*STAR BTI)
- A*STAR Genome Institute of Singapore (A*STAR GIS)
- A*STAR Institute for Human Development and Potential (A*STAR IHDP)
- A*STAR Institute of Molecular and Cell Biology (A*STAR IMCB)
- A*STAR Singapore Institute of Food and Biotechnology Innovation (A*STAR SIFBI)
- A*STAR Singapore Immunology Network (A*STAR SIgN)
- A*STAR Skin Research Labs (A*SRL)

SCIENCE AND ENGINEERING RESEARCH ENTITIES

- A*STAR Institute for Infocomm Research (A*STAR I²R)
- A*STAR Institute of High Performance Computing (A*STAR IHPC)
- A*STAR Institute of Materials Research and Engineering (A*STAR IMRE)
- A*STAR Institute of Microelectronics (A*STAR IME)
- A*STAR Institute of Sustainability for Chemicals, Energy and Environment (A*STAR ISCE²)
- A*STAR Singapore Institute of Manufacturing Technology (A*STAR SIMTech)
- A*STAR National Metrology Centre (A*STAR NMC)

JOINT INSTITUTIONS

- A*STAR Advanced Remanufacturing and Technology Centre (A*STAR ARTC)
- Skin Research Institute of Singapore (SRIS)
- InVivos

1. For details on A*STAR's subsidiaries, please refer to our Annual Report.

NATIONAL PLATFORMS

Platforms managed by A*STAR on behalf of the ecosystem and funded nationally:

- Biomedical Sciences Industry Partnership Office (BMS IPO)
- Consortium Management Office (CMO)
- Diagnostics Development (DxD) Hub
- Experimental Drug Development Centre (EDDC)
- Low Carbon Energy Research Coordinating Office (LCER CO)
- National Additive Manufacturing Innovation Cluster (NAMIC)
- National Gallium Nitride Technology Centre (NGTC)
- Nucleic Acid Therapeutics Initiative (NATi)
- National Quantum Office (NQO)
- National Robotics Programme (NRP)
- National Semiconductor Translation and Innovation Centre (NSTiC)
- National Supercomputing Centre (NSCC)
- Singapore Biodesign (SB)
- Technology Centre for Offshore and Marine, Singapore (TCOMS)
- Urban Solutions and Sustainability Innovation & Enterprise Office (USS I&E Office)

02 **REPORTING FRAMEWORK**

This report has been prepared with reference to the Global Reporting Initiative (GRI) Standards. The GRI Standards were chosen as one of the most widely used standards and provide a comparable and credible way to disclose A*STAR's sustainability performance. The reporting principles of comparability, accuracy, timeliness, clarity and reliability, as set forth by the GRI Standards, were adhered to in the preparation of this report. The GRI Content Index is provided on pages 58 – 61.

This report also takes reference from the United Nations Sustainable Development Goals (UN SDGs) and highlights A*STAR's efforts in contributing to the UN SDGs that are most relevant to our operations.

Lastly, the scope of this SR is aligned with GreenGov.SG's reporting guidelines.

03 **DATA**

DATA AND EXTERNAL ASSURANCE

A*STAR has established an Office of Sustainability (AOS) to coordinate and track sustainability performance data across the agency's operations in a standardised manner. As this is our inaugural SR, the data presented has not been externally verified. We may consider seeking external assurance for future SRs.



A*STAR is committed to integrating sustainability in our operations and supporting Singapore's sustainability goals. We welcome feedback from all stakeholders on our inaugural SR. For any feedback or questions on this report, please contact our Chief Sustainability Officer, Prof Yeoh Lean Weng at <u>yeoh_lean_weng@hq.a-star.edu.sg</u> or the AOS at <u>a-star_os@hq.a-star.edu.sg</u>.

CHAIRMAN AND CEO FOREWORD

At A*STAR, sustainability is fundamental to how we conduct impactful research and innovate for the future. This means integrating sustainable practices into our own operations, in order to support our sustainability vision to be a global leader catalysing sustainability transformation through science, technology, and open innovation. To achieve this, we are guided by a framework that encompasses **Environmental, Social, Governance and Research & Development** pillars to drive meaningful change across our organisation.

Contributing towards Singapore's 2030 Green Plan and Beyond

As Singapore works towards its 2030 Green Plan, the public sector is leading the way to pursue sustainable development under the GreenGov.SG targets. We aim to contribute to GreenGov.SG's Net-Zero target by 2045, after peaking emissions around 2025. Our FY2030 goals include a 10% reduction in Energy Utilisation Index (EUI) and Water Efficiency Index (WEI) from FY2018 to FY2020 baseline levels and a 30% reduction in Waste Disposal Index (WDI) from FY2022 baseline level.

We are making good progress in our environmental efforts, achieving a 5.1% and 10% reduction in EUI and WEI respectively, as well as a 18.6% reduction in the WDI. Additionally, we have implemented measures to minimise the environmental impact of lab operations. Currently, 13 of our research institute laboratories are BCA Green Mark certified.

Advancing Sustainable Technologies and Community Wellbeing

One of the key sustainability R&D highlights of FY2023 was the establishment of the ExxonMobil-NTU-A*STAR Corporate Lab. This industry-academia partnership aims to advance sustainable technologies, especially low-carbon solutions, aimed at advancing Net Zero commitments globally.

In addition, findings from the Growing Up in Singapore Towards healthy Outcomes (GUSTO) birth cohort study by A*STAR, KK Women's and Children's Hospital (KKH), National University Health System (NUHS) and National University of Singapore (NUS), resulted in two new guidelines adopted for maternal mental health and screen use in children, as well as the development of a Primary School Readiness Assessment Tool. These initiatives contribute towards healthier and more resilient communities for future generations.

Fostering a Supportive Work Environment

Our staff are the main catalysts for innovation and scientific excellence. Hence, we consistently prioritise their safety, wellbeing, and professional growth within our organisation.

Our commitment to workplace safety is evident, with A*STAR consistently achieving a lower Workplace Injury Rate than the national average. A*STAR is ranked as the Most Attractive Employer among Engineering and Natural Sciences students surveyed by Universum for the third consecutive year, as well as top in the 100 Leading Graduate Employers survey by gradsingapore for the second year in a row. These achievements highlight our commitment to fostering a supportive work environment.

Strengthening Governance

A*STAR maintains a zero-tolerance policy for corruption, emphasising ethics, transparency, and accountability.

In procurement, we have revised our Tender Requisition Form to integrate sustainability as one of the evaluation criteria and included the GreenGov.SG requirements as part of the Requirement Specifications.

Looking ahead, we are committed to embedding sustainability at the heart of our work, ensuring that we not only contribute to but also catalyse transformative change through multidisciplinary innovation, creating impactful solutions that will benefit Singapore, Singaporeans and Science.



A*STAR SUSTAINABILITY REPORT FY2023

CORPORATE GOVERNANCE

01

A*STAR BOARD (AS OF 31 MARCH 2024)

The Board is chaired by Prof Tan Chorh Chuan and comprises the following members:



Professor Tan Chorh Chuan

Permanent Secretary (National Research and Development)

Permanent Secretary (Public Sector Science and Technology Policy and Plans Office), Prime Minister's Office

Chairman, A*STAR

Chairman, MOH Office for Healthcare Transformation (MOHT)

Chair, Healthier SG Implementation Office, MOH



Mr Frederick Chew

Chief Executive Officer, A*STAR Chief, Public Sector Science and Technology Policy and Plans Office Prime Minister's Office, Singapore

Mr Adrian Chua

Professor Sir John O'Reilly

Chairman, Science and

Engineering Advisory Council

(SEAC), A*STAR





Professor Barry Halliwell



Professor Isaac Ben-Israel

Director of The Blavatnik Interdisciplinary Cyber Research Center and the Yuval Ne'eman Workshop for Science Technology and Security, **Tel Aviv University**



Professor Stefan Catsicas

Managing Partner, Skyviews Lifescience SA





Mr Chia Song Hwee Deputy Chief Executive Officer, Temasek International Pte. Ltd.

Professor William Chin

Bertarelli Professor of Translational Medical Science and Medicine Emeritus. Harvard Medical School



Mr Arunjai Mittal Independent Director



Deputy Secretary (Development), **Ministry of Finance** (MOF)



Chairman, BMRC Advisory Council (BMAC), A*STAR Senior Advisor, Academic Appointments and Research Excellence. Office of the Senior Deputy President and Provost, Tan Chin Tuan Centennial Professor. National University of Singapore (NUS)

Ms lacqueline Poh

Managing Director,

Economic Development

Board





Mr Ouek Gim Pew

Senior R&D Consultant, **Ministry of Defence**



Mr Ravinder Singh Group Chief Operating Officer, Technology & Innovation, ST





Mr Soh Gim Teik

Partner, Finix

Corporate

Advisory LLP



Ms Yong Hwee Yee Senior Vice President, Head of

Operations APAC, Olam Food Ingredients (Olam Group Limited)

For more information on A*STAR's organisation structure, please visit https://www.a-star.edu.sg/about-astar/corporate-profile/organisation-structure or refer to our Annual Report.



Mr Sopnendu Mohanty





Professor Jackie Hunter

Chief Executive Officer. **OIPharma Partners Ltd** Chairman, Boards of **Biocortex Ltd. Brainomix**

Dr Benjamin Koh Deputy Secretary (Sustainability).

Ministry of Sustainability and the Environment

(MSE)



Ms Cindy Lim Chief Executive Officer. Infrastructure, Keppel Ltd

02

ENTERPRISE RISK MANAGEMENT

A*STAR recognises the importance of effectively managing risks to ensure the achievement of our mission and strategic objectives in a dynamic and ever-changing environment. The Enterprise Risk Management Office (ERMO) was formally set up in 2012 to drive and manage our Enterprise Risk Management (ERM) development and implementation. The primary goal of the ERMO is to enhance the ability of A*STAR to make informed and risk-aware decisions.

Our ERM framework takes practical reference from applicable international standards such as ISO 31000 and the Committee of Sponsoring Organisations (COSO) Framework, the Risk Governance Guidance for Listed Boards (issued on 10 May 2012), where practical. By drawing the key principles, frameworks, and processes for risk management outlined in these references, we established our Enterprise Risk Management (ERM) framework. This framework embodies a systematic and proactive approach to identify, assess, mitigate, and monitor risks (e.g. compliance with regulations, and workplace health and safety) that could impact our strategic goals and operations.

ERM Governance Structure

The current ERM governance is overseen by A*STAR's Chairman and Board. Our senior management is also involved in the risk management process and oversees risk management activities across the organisation, as well as the role of the ERMO.

An ERM manual has been developed to provide an overview of the key concepts of our ERM framework and governance structure. This manual will guide our staff at all levels to identify, assess, and manage risks effectively, fostering a culture of risk awareness, accountability, and continuous improvement. Structured training programmes are also in place to train our staff in risk management tools, methodology and templates.

ERMO's role is to facilitate our entities and departments to implement ERM and align their risk appetite and tolerance with A*STAR corporate governance. Key risks reported by departments and entities would be consolidated and evaluated on the effectiveness of their risk management control measures. The risks are reported to the Board annually. A*STAR currently has over 20 units that have implemented the ERM framework and we will continue to onboard more in the coming years.



^{2.} Research Entities' Risk Officers to work with ERM Office on all Research Entities' ERM matters. Research Entities ERM Committee comprises representatives from departments within research entities and partners from Corporate Group.

^{3.} HQ ERM Committee comprises Division Risk Officers from Corporate Group, BMRC, SERC, A*GA & I&E who work with ERM Office to drive ERM initiatives within their divisions.

03

SUSTAINABILITY GOVERNANCE

A*STAR has established a sustainability governance Structure, chaired by the Board. In addition, the Office of Sustainability (AOS) was established to oversee and coordinate sustainability efforts across the organisation in March 2023. Our sustainability governance structure comprises the Board, Senior Management, the Sustainability Working Committee (SWC), the Sustainability Working Group (SWG), the Executive Directors (EDs) of the research entities and corporate Head of Divisions (HODs).

Board and Senior Management

The Board provides strategic guidance and direction to our senior management in the development of our sustainability policies and strategies and is regularly updated on A*STAR's sustainability efforts. Our Senior Management oversees the management of A*STAR's sustainability matters and approves the annual SR.

Sustainability Working Committee (SWC)

The SWC guides the development of our sustainability policies and strategies and monitors the performance of targets and initiatives by engaging our divisions, research entities, and key external stakeholders as needed.

Sustainability Working Group (SWG)

The SWG is led by our Chief Sustainability Officer (CSO), Professor Yeoh Lean Weng, and consists of representatives from relevant research and corporate entities. In addition, eco-representatives (Eco-Reps), reporting to the EDs of research entities and corporate HODs, are responsible for developing and implementing sustainability mitigation plans aimed at achieving A*STAR's environmental targets.

A*STAR Office of Sustainability

AOS is headed by the CSO and provides regular updates on the sustainability initiatives, ensuring effective communication and collaboration among stakeholders. AOS is responsible for developing and reviewing the sustainability strategies, mandatory sustainability measures for infrastructure enhancements, as well as providing advice to entities on sustainability matters.



STAKEHOLDER ENGAGEMENT

At A*STAR, our key stakeholder groups include staff, public sector entities, local community, local and overseas Institutes of Higher Learning (IHLs) and industry collaborators, and suppliers/vendors/contractors. We believe engaging these stakeholders through meaningful interactions is crucial as it fosters collaboration, understanding and enhances the impact of our initiatives. We can hence ensure better alignment of our operations with their needs and expectations.

Key Stakeholder Groups	Purpose of the Stakeholder Engagement	Key Engagement Methods	Engagement Frequency
STAFF	Promote environmental sustainability	Meetings and dialoguesActivities and eventsTraining	Regularly, dependent on activities
	Promote mental health, wellbeing, safety, and health	Mental Health Week, Health and Safety Day	Annually
	awareness	Coaching sessionsRecreational events and social gatherings	Regularly, dependent on activities
	Provide updates on procurement process, grant calls and R&D workplan	Sharing sessions and seminars	Regularly, dependent on activities
PUBLIC SECTOR	Align with the GreenGov.SG requirements	Dialogue sessions	Regularly, dependent on activities
ENTITIES	Develop national standards and national initiatives	Meetings and knowledge exchange via emails	Regularly, dependent on activities
	Leverage different expertise to strengthen sustainability capabilities	Collaborative training courses	Regularly, dependent on activities
		Wellness Ambassadors programme	Quarterly
	Promote knowledge sharing on various topics	 ERM sharing sessions Collaborative research projects Meetings, demos, events, visits and conferences 	Regularly, dependent on activities
LOCAL COMMUNITY	Promote environmental sustainability	Activities such as Earth Hour, Go Green @ One-North, SG Clean Day	Annually
	Give back to the community	Donation drives and community service eventsVisits and showcases	Regularly, dependent on activities
LOCAL AND OVERSEAS IHLS & INDUSTRY COLLABORATORS	Strengthen R&D capabilities by promoting collaborations with both academia and industry	 Partnerships, joint labs, consortia, research centres and joint research collaborations Industry projects Workshops, seminars and conferences Secondment and joint appointment 	Regularly, dependent on projects and collaborations
SUPPLIERS/VENDORS/ CONTRACTORS	Ensure compliance with terms and conditions of purchasing policies	Emails and policy documents	Regularly, dependent on activities

OUR MATERIAL TOPICS

A*STAR employed a four-step materiality assessment approach in FY2023. Taking into consideration the emerging ESG and climate trends, disclosures from peers in the R&D sector, GreenGov.SG's recommended ESG metrics and our activities, we developed a list of preliminary material topics. This list was identified together with insights from staff.

These topics were identified and assessed through a stakeholder survey that was distributed to 1) internal stakeholders e.g. staff and management, and 2) external stakeholders e.g. suppliers and entities within the public sector, which A*STAR works closely with. We plan to engage more stakeholders in the future to gather their respective views on the identified material topics.

The final list of material topics crucial to A*STAR's organisational success and stakeholders was validated and endorsed by Senior Management at the materiality assessment workshop.



These material topics encompass a range of issues with significant impact on operations, the environment, the society, and the economy.

A*STAR addresses these material topics in the subsequent chapters of this SR. For each material topic, we have disclosed its strategies, initiatives, targets, and performance indicators (where relevant).

We plan to review the material topics every two years or whenever there are any significant changes in operations.



Importance to A*STAR's organisational success

A*STAR SUSTAINABILITY REPORT FY2023

A*STAR SUSTAINABILITY FRAMEWORK



MATERIAL TOPICS AND THEIR IMPORTANCE TO A*STAR

Sustainability Area	Material Topics	Importance to A*STAR
ENVIRONMENTAL	GREENHOUSE GAS (GHG) EMISSIONS	A*STAR aims to reduce our GHG emissions to support Singapore's commitment to achieving net-zero emissions.
	ENERGY MANAGEMENT	Energy consumption is linked to carbon emissions, a significant contributor to climate change.
	WATER MANAGEMENT	Singapore faces water scarcity and water treatment is an energy-intensive activity.
	WASTE MANAGEMENT	The Semakau Landfill is rapidly running out of space for incineration ashes. We produce hazardous waste, which needs to be managed properly.
SOCIAL	WORKPLACE SAFETY & HEALTH AND STAFF WELLBEING	It is fundamental to provide our staff with a healthy and safe work environment for conducive work.
	DIVERSITY AND INCLUSION	We are committed to encouraging diversity and inclusion within our organisation workforce to bring together different perspectives, ideas and representations to the work we do.
	COMMUNITY INVOLVEMENT	We aim to nurture and foster a spirit of volunteerism and make a positive impact on the lives of the less fortunate while promoting science and technology to the community.
	EMPLOYMENT/TALENT MANAGEMENT	Attracting and retaining talent are key for sustaining A*STAR's ability to drive cutting-edge research and innovation, ultimately enhancing our organisation's impact and mission.
	TRAINING AND EDUCATION	As we operate in fields where scientific knowledge and technology evolve constantly, we believe in lifelong skill development and learning for our staff to ensure they stay at the forefront of these advancements.
GOVERNANCE	ANTI-CORRUPTION	A*STAR aims to maintain the trust with our stakeholders.
	SUSTAINABLE PROCUREMENT	We recognise the need to embed sustainability principles into our procurement processes.
RESEARCH & DEVELOPMENT	RESEARCH AND DEVELOPMENT (R&D)	A*STAR's core mission is to advance science and develop innovative technology for economic growth and societal benefit, including improving sustainability outcomes.

13

FY2023 SUSTAINABILITY HIGHLIGHTS

ENVIRONMENTAL



SOCIAL

9 Infuse After 5 social Most Attractive Diversity Day 2023 with more gatherings to foster **Employer** amongst than 500 staff participating and staff cohesion engineering/natural 31 staff receiving the inaugural and a sense science students **Diversity Champions Awards** of belonging Average of Over **S\$16,000** raised A*STAR'S Workplace Injury **102** training for the beneficiaries of Rate in FY2023 remained Pathlight School and the hours consistently lower than Lions Befrienders Service per staff the National Statistics Association R&D Launched the The **GUSTO birth cohort study** by A*STAR, Contributing to 9 KKH, NUHS, and NUS led to new guidelines for ExxonMobil-Low Carbon & maternal mental health and children's screen **NTU-A*STAR Energy Research** use, and the development of a Primary School **Corporate Lab** (LCER) phase 2 Readiness Assessment Tool for low-carbon projects, to solutions advance low-carbon technologies and decarbonise power Launched an **Electric** Launched **2 joint food labs**: and industry sectors Fermentation Joint Lab with Vehicle (EV) ScaleUp Bio boosting local food battery testing and innovation and Food Processing disassembly line to Joint lab with Nurasa for support the circular commercial scale-up economy for batteries

Requisition Form

INTEGRATING ENVIRONMENTAL SUSTAINABILITY INTO OPERATIONS



01 GREENHOUSE GAS (GHG) EMISSIONS

In line with the GreenGov.SG target, A*STAR aims to achieve net zero emissions around 2045, after peaking emissions around 2025.

A*STAR's total carbon emissions are primarily contributed by Scope 2. In FY2023, total emissions, including both Scope 1 and 2, reached 70.63 ktCO₂e, with Scope 2 accounting for 93.4% of the total.

GHG emissions (ktCO,e)

	Scope 1	Scope 2	Total
FY2018	0.01	65.72	65.73
FY2019	0.01	63.47	63.48
FY2020	0.00	61.62	61.63
FY2021	0.01	62.81	62.82
FY2022	0.01	64.26	64.27
FY2023	4.66 ⁴	65.97	70.63

The primary sources of A*STAR's Scope 1 emissions⁵ are lab gas used for R&D operations, which contributes 77.4%, and refrigerant leakage, which accounts for 21.0%. A*STAR's Scope 2 emissions⁶ result from the purchased electricity and cooling to sustain our operations.

With relatively low Scope 1 emissions generated, the majority of our emissions arise from Scope 2 emissions, specifically from the electricity consumed in our tenanted facilities such as offices, laboratories (including cleanrooms), and data centres.

A*STAR has many energy-intensive facilities such as cleanrooms, Biosafety Level (BSL) 2 and 3 laboratories, data centres, and animal facilities. We would like to highlight that due to the nature of our R&D work that are enabled by these critical facilities, powering down certain equipment is not a viable option, as this may compromise our research equipment, potentially incur additional emissions from restarting them.

However, to meet our target of peaking emissions around 2025 and achieving net zero emissions around 2045, we will be adopting a holistic decarbonisation strategy to reduce our carbon footprint. We have implemented various energy-efficiency measures, which are highlighted in the subsequent section.

^{4.} In FY2023, A*STAR expanded Scope 1 boundary to include lab gas usage, refrigerants leakage and fuel used for stationary consumption, which were not accounted for in previous financial years.

^{5.} Scope 1 emissions refer to direct carbon emissions from sources that are owned or controlled by A*STAR, including lab gas usage, refrigerant leakage, combustion of fossil fuels in vehicles and fuel use for stationary consumption. 6. Scope 2 emissions refer to indirect carbon emissions resulting from the generation of electricity and purchased cooling consumed by A*STAR.

02 ENERGY MANAGEMENT

A*STAR's total electricity consumption covers both standard⁷ and non-standard⁸ infrastructure. The table below presents our total electricity consumption figures from FY2021 to FY2023.

For GreenGov.SG reporting, only standard infrastructure is considered in the calculation of electricity consumption for EUI.

We are committed to align with the GreenGov.SG targets. Our EUI⁹ target is to achieve 489.3 kWh/m² by FY2030, which is a 10% reduction from our baseline figure of 543.7 kWh/m², the average EUI from FY2018 to FY2020.

Total electricity consumption

	FY 2021	FY 2022	FY 2023
Total electricity consumption ¹⁰ (GWh)	153.8	154.2	158.3

Energy Utilisation Index (EUI)

In FY2023, we achieved about **5.1%** EUI reduction from the baseline figure of 543.7 kWh/m² to 515.8 kWh/m². Our electricity consumption for standard infrastructure also decreased compared to the baseline, enabled by the implementation of energy-efficient measures (see page 18).

We are currently implementing energy-efficient upgrades in Biopolis buildings, including replacing AHUs, fan coil units (FCUs) and other air-conditioning systems. Moving forward, we will continue to implement energy management strategies to further optimise and reduce our energy consumption. By continuously identifying opportunities for improvement and implementing targeted measures, we aim to achieve our 10% EUI reduction target by FY2030.



Electricity consumption and EUI

- 7. A*STAR's standard infrastructure includes 12 premises (mentioned on page 4) excluding the non-standard infrastructure. A*STAR's calculation of electricity consumption for EUI is only for standard infrastructure which has been approved by MSE for GreenGov.SG reporting.
- 8. A*STAR's non-standard infrastructure refers to 50% of A*STAR IME (due to production), as well as Invivos and NSCC. This exclusion has been approved by MSE for GreenGov.SG reporting.
- 9. The formula used to calculate the EUI is as follows: Agency EUI in Year N = (Total amount of electricity consumed for all Agency premises in Year N) / (Total GFA for all Agency premises in Year N). For the calculation of the FY2021, FY2022 & FY2023 EUI performances, the GFAs are taken to be 259,567, 262,709 and 262,914 m² respectively.
- 10. Our electricity consumption data are collated from the 12 premises mentioned in the reporting scope on page 4. For research entities where the exact consumption data was not available, we used a best estimate approach to calculate their consumption.
 - As a small number of research entities residing at Chromos and Helios buildings within Biopolis 1 have incomplete data from FY2018 to FY2012, we used the data gathered in FY2022 and applied it retrospectively to FY2018 to FY2022's missing data fields. This is a fair approach as the missing data fields constitutes less than 3% of the annual electricity consumption.
 - As a small number of research entities residing at FP 2 have incomplete data for FY2018, we applied data averaging from FY2019 to FY2022 and use it for FY2018 missing data field. This is a fair approach on the assumption that those research entities' operations did not differ significantly from FY2018 to FY2022.

A*STAR's main activity revolves around research and development in our laboratories. Laboratories have special needs, such as high receptacle load, stringent humidity management, rapid fresh air dilution due to safety requirements and long operation hours.

As laboratories tend to consume three to five times more energy than a typical office space, this highlights the significance of addressing energy efficiency and implementing sustainable practices within our laboratories facilities to reduce our environmental impact and achieve our sustainability goals.

BCA Green Mark for Laboratories and Offices

In 2017, A*STAR SIgN achieved the BCA Green Mark Gold award for Laboratories under the world's first green certification scheme for laboratory design and operation, launched by the BCA. Since then, we have continued our commitment to reducing the environmental impact of our laboratories, with 11 more research entities earning the Green Mark Gold award in 2020 and A*STAR NMC attaining the prestigious Green Mark Platinum award in 2023.

Moving forward, we aim to recertify our 11 labs and pursue at least a Green Mark Gold award for additional research institutes. We are also exploring Green Mark certification for our offices, with A*STAR NMC's offices recently awarded the BCA-HPB Green Mark Healthier Workplaces in October 2023.

Examples of Energy-efficient Initiatives Implemented within A*STAR

Since 2017, A*STAR has been actively implementing energy-efficient initiatives to reduce our overall energy consumption. We will continue to conduct energy audits at selected facilities to improve our energy performances and operate in an energy-efficient manner. Here are some notable examples with estimated annual savings¹¹:





348 MWh

Energy-efficient pumps purchase for A*STAR IME at FP 2 (Synthesis Building) and SP 2



LED lighting replacement at BP and ISCE² at Jurong Island

^{11.} These estimated energy savings figures are either provided by appointed consultant or derived based on system specifications calculations. For comparison, the typical annual electricity consumption of a 4-bedroom HDB unit is 4.2 MWh/year.

03 WATER MANAGEMENT

A*STAR's total water consumption covers both standard and non-standard infrastructure. The chart below presents the total water consumption including both portable water and NEWater from FY2021 to FY2023.

For GreenGov.SG reporting, only standard infrastructure is considered in the calculation of water consumption for WEI¹².

A*STAR aims to achieve 254.9 litres/pax/day by FY2030 for our water consumption, which is a 10% reduction in WEI from our baseline figure of 283.2 litres/pax/day, the average WEI from FY2018 to FY2020.

Water Efficiency Index (WEI)

In FY2023, we achieved a WEI reduction of approximately **10%**, decreasing from the baseline figure of 283.2 litres/pax/day to 254.9 litres/pax/day.

Moving forward, we will continue to implement water conservation strategies and conduct water audits to further reduce our water consumption. For example, we will collect wastewater from our water purification system and upcycle it for use, such as flushing the autoclave during monthly maintenance. Additionally, we will focus on cultivating a water conservation mindset among our staff by creating a dashboard to encourage desired behaviours.





12. A*STAR's WEI target is in line with GreenGov.SG target. The formula used to calculate WEI is as follows:

Agency WEI in Year N = [Total amount of water consumed for all Agency premises in Year N× 1000] / [Average number of operational days in Year N for the Agency] × (Total number of staff per day for the Agency + (0.25 × Total number of visitors per day for all Agency premises))]

- For the calculation of the WEI: Average number of operational days is taken to be 260 days.

- The number of staff per day for FY2021, FY2022 and FY2023 are taken to be 6,029, 6,056 and 5,863 respectively.

- Total number of visitors per day for all our premises is taken to be 253.

For information, the work-from-home arrangement for FY2023 was 2 days a week.

Breakdown of total water consumption

NEWater

NEWater consumption and WEI

Our NEWater consumption¹³ is heavily dependent on our research operations, whereby the primary utilisation of NEWater is for facility operations, as well as our application in semiconductor operations. The increase in NEWater consumption in FY2023, relative to FY2021 and FY2022, is primarily due to augmented research and production activities.

Since FY2020, we have enhanced the efficiency of our cooling tower systems, process cooling water (PCW) systems and the ultrapure water (UPW) plant. Furthermore, improvements in January 2023 were made to enhance UPW utilisation efficiency. These enhancements contributed towards the **6.7%** reduction in FY2023's NEWater WEI, compared to the baseline figure, which is the average from FY2018 to FY2021.

6.7% 360.000 230.2 214.7 210.1 204.7 340,000 332,805 330,869 325,744 324.284 320,000 300,000 FY 2021 FY 2022 FY 2023 Baseline NEWater consumption (standard infrastructure) (m³) WEI (litres/pax/day)

Potable Water

Potable water $^{\rm 14}$ consumption and WEI dropped in FY2023, compared to FY2021 and FY2022.

Over the years, we have implemented water conservation initiatives, which include the installation of water-efficient fittings for our taps and water conservation reminders pasted at our water sources. These efforts have contributed to the **24.3%** potable water WEI reduction in FY2023, compared to the baseline figure, which is the average from FY2018 to FY2020.

Potable water consumption and WEI



20

^{13.} The NEWater is consumed at two locations, namely SP 2 and FP 2. NEWater is supplied to cooling towers and labs, and essential for processes like UPW and PCW, which are critical for semiconductor operations. 14. The amount of potable water consumed is based on the 12 premises mentioned in the reporting scope on page 4.



As A*STAR's facilities include offices and laboratories, we generate both office waste and hazardous waste. A*STAR owns two buildings at Jurong Island and SP 2.

General Waste Management

A*STAR has set a target to achieve 0.38 kg/person/day by FY2030, which is a 30% reduction in WDI¹⁵ from the FY2022 baseline¹⁶ of 0.54 kg/person/day. In FY2023, our WDI was 0.44 kg/person/day, reflecting an **18.6%** reduction from the FY2022 baseline, achieved through various waste management efforts.

We currently have access¹⁷ to waste data for our facilities located at Jurong Island and SP 2, which are currently occupied by our staff from A*STAR ISCE² and A*STAR IME respectively. In FY2023, we generated 74,474 kg of non-hazardous waste and 1,058 m³ of hazardous waste.

Waste Management Efforts within Our Offices

Recycling bins have been placed in printing rooms at our offices. Furthermore, steps have been taken to minimise single-use waste. To further support sustainable practices, water jugs and reusable cups are provided for boardroom meetings, reducing the reliance on disposable items.





Laboratory Waste Management

Various R&D activities undertaken by A*STAR generate hazardous waste and general lab waste. A*STAR ISCE² has developed **proper segregation & disposal methods** and **waste disposal & label guidelines** for laboratory waste to ensure safe and compliant waste management practices.



Proper segregation & disposal methods guidelines

- 15. A*STAR's WDI target is in line with GreenGov.SG target. The formula used to calculate WDI is as follows: Agency WDI in Year N = [Total amount of general waste disposed of at Jurong Island and SP 2 in Year N] / [Average number of operational days in Year N for Jurong Island and SP 2 × (Total number of staff per day for Jurong Island and SP 2 + (0.25 × Total number of visitors per day for Jurong Island and SP 2))]
- For the calculation of the WDI: Average number of operational days is taken to be 260 days.
 Total number of staff per day is taken to be 649.
- 16. Based on GreenGov.SG's recommendation, the baseline year for the WDI is for FY2022. However, as there were no historical data for FY2022, we extrapolated the data from January to March 2023.
- 17. For premises owned by landlords such as JTC, they are in-charged of submitting the consolidated waste data of the premises directly to the Ministry of Sustainability and the Environment.

Hazardous Waste Management

Each hazardous waste requires specific handling and disposal processes to minimise environmental and health risks. The figure below provides a brief summary of the types of activities and their associated hazardous waste:

Activities and associated hazardous waste

Output	Hazards	Disposal Method			
Activity: Chemical Synthesis and Analysis					
Chemical residues, solvents, acids, bases, reactive compounds	Toxicity, flammability, corrosiveness	Requires neutralisation, special containers, and proper labeling for safe disposal			

Activity: Biological Research

Contaminated cultures. biological samples, sharps (needles)

Biohazardous materials, infectious agents

Incineration or autoclaving before disposal in biohazard bags or sharps containers

.

Activity: General Laboratory Operations

Mixed waste streams including broken glass, contaminated labware, spent solvents

Combination of chemical, biological, and physical hazards

Segregation and proper classification before disposal according to each waste type

A*STAR has established the **biohazard and chemical waste disposal workflow** to ensure the safe, efficient, and compliant handling of hazardous materials. These processes require careful management to protect lab personnel, the public, and the environment. Licensed Toxic Industrial Waste (TIW) service providers collect and transport the waste to the dedicated facility for incineration, providing proper documentation for the disposal process.

Most of our biohazard waste originates from our biomedical research labs. As biomedical research increases, the volume of biohazard waste rises. To mitigate this, we use reusable plastics and glassware where practicable. These items, such as beakers, conical flasks, measuring cylinders, and bottles, are washed and sterilised before reuse. All biohazard liquid waste is disinfected before discharged or collected by TIW for disposal.

Nevertheless, biological work often requires the use of single-use plasticware, which is challenging to replace due to the need for stringent sterilisation and contamination standards (such as RNase-free conditions).



Reduce, Reuse and Recycle Waste Generated from Our Laboratories

A*STAR prioritises sustainability through various waste management practices in its laboratories, promoting resource efficiency and reducing environmental impact.



Freecycle lane encourages researchers to adopt unused but functional laboratory consumables, providing a sustainable solution for items that are no longer needed due to personnel changes, lab relocations, or evolving research requirements. This minimises waste, surplus, and expenses, while promoting reuse and recycling.



A*STAR ISCE² freecycle lane initiative

A*STAR also promotes waste reduction by reusing **solvent containers** for storing incompatible chemicals and recycling High-Density Polyethylene (HDPE) Decon-90 detergent bottles. These efforts ensure proper chemical handling and minimise environmental impact.



Reuse and recycle of lab plastic containers



Equipment sharing of idle project equipment among A*STAR's teams or divisions, optimises resource allocation and minimises environmental impact. **Over S\$280,000** was reallocated more efficiently for other essential resources, due to the availability of the same or similar equipment within the institute.

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Chemical sharing programme reduces costs, environmental impact, and procurement lead times by allowing teams to share existing chemical inventory. Managed by A*STAR ISCE², this initiative enhances productivity and sustainability by minimising waste and avoiding unnecessary purchases. It has achieved a **33%** year-on-year reduction in new chemical product purchases, reduced stockpiling, and controlled unessential waste generation.



To reduce general waste generated at our premises, A*STAR ISCE² provides **plastic, metal, paper and e-waste recycling bins.** In FY2023, a total of **6,533 kg** of recyclable materials and **6,647 kg** of e-waste were collected for recycling at Jurong Island. In addition to consumer e-waste collected under the Extended Producer Responsibility (EPR) Scheme, A*STAR ISCE² arranged for other e-waste to be handled by NEA-licensed recyclers.

05

ENVIRONMENTAL STEWARDSHIP

In December 2022, A*STAR pledged to be a Green Nation Advocate and made it a priority to take action for a green, liveable and climate-resilient Singapore.

Contribution towards Environmental Events

A*STAR planted **six** trees at JTC Corporation's Go Green @ one-north campaign as a symbolic gesture contributing to NParks' OneMillionTrees by 2030 movement. The movement aims to restore nature back to our city and redouble our efforts to green our urban infrastructure. Organised by SpIA, we raised **over \$\$3,000**, which was donated to NParks in support of Singapore's vision of becoming a City in Nature.



A*STAR's participation contributed to NParks' OneMillionTrees by 2030 movement

Advancing Sustainability through Global Collaboration

A*STAR is committed to sustainability through collaborations with local and international stakeholders. Professor Yeoh Lean Weng, CSO of A*STAR, has presented at various global conferences, showcasing A*STAR's decarbonisation capabilities and seeking global collaboration.

At the Sweden Indo-Pacific Business Summit on 5 December 2023, Professor Yeoh emphasised the importance of R&D for low-carbon technologies. He highlighted the need for public sector, academia, and industry collaboration to advance technologies such as Carbon Capture, Utilisation and Storage (CCUS), Sustainable Aviation Fuel (SAF), and high-value chemicals and fuels for industrial decarbonisation.



A*STAR CSO (2nd from right) invited as a keynote panellist at the Sweden Info-Pacific Business Summit

515

NURTURING **PEOPLE AND** COMMUNITY



01 DIVERSITY AND INCLUSION

A*STAR places high importance in ensuring diversity and inclusion (D&I) within our organisation. We continuously adopt initiatives to enhance workplace gender equality, including the establishment of the Diversity Work Group (DWG) and A*STAR Diversity Day.



Staff number and ratio breakdown by gender

A*STAR Diversity Work Group (DWG)

The DWG ensures the principles of D&I through initiatives in Publicity and Communications, Data Science, Empowerment, and Support & Resources.

Supported by various divisions like Corporate Communications (CC), Leadership & Organisation Development (L&OD), Human Resources (HR), and Infuse, DWG activities in FY2023 included conducting D&I attitude surveys, and providing resources for working parents, especially women in science.

The DWG also launched a quarterly newsletter, "Diversity Matters", and promoted ground-up initiatives to build cultural understanding within research entities.



A*STAR's Diversity Work Group

The DWG also collaborated on other science, technology, engineering, and mathematics (STEM) D&I initiatives:

- On 25 March 2024, the DWG co-organised the International Women in STEM & Medicine Symposium 2024, which brought together women-focused organisations in the medical, healthcare and STEM spaces.
- On 26 July 2023, the DWG also partnered Singapore Women in Science (SGWiS) to host a session where a female scientist shared insights on her career and personal development.



Organisers from A*STAR, IHLs, and invited speakers at the International Women in Science and Medicine Symposium event held on 25 March 2024

A*STAR SUSTAINABILITY REPORT FY2023

A*STAR Diversity Day

A*STAR's biennial Diversity Day event, held on 8 November 2023, attracted over 500 staff and showcased A*STAR's commitment to D&I.



Organising committee of A*STAR Diversity Day 2023

The inaugural Diversity Champions Awards were presented, honouring **31** staff with D&I values. At the event, the DWG also shared findings from the first Diversity Survey, which gathered 1.640 responses to inform and strengthen D&I policies. The DWG intends to have a follow-up survey with senior management to gain insights on promoting D&I, leadership, and innovation.



The SUPER MUMS programme was established in August 2022 to address challenges faced by A*STAR mothers in working and advancing their careers while supporting their children.

The DWG organised coaching sessions, connecting professional coaches with A*STAR mothers and fathers to help them navigate parenthood. They also facilitated sharing sessions with over 141 staff to tackle the challenges of maintaining a positive parentchild relationship while instilling discipline, striking a balance between nurturing their children's development while fulfilling their own aspirations.

In FY2023, SUPER MUMS spun off to become the SUPER PARENTS interest group, recognising the importance of fathers in parenting.

Diversity & Inclusion Training

A*STAR recognises that D&I values should be embedded across organisational levels. To foster an inclusive environment where every talent is recognised and valued, the DWG and A*STAR's L&OD have partnered to curate LinkedIn Learning courses to combat unconscious bias at work.



I am committed to fostering a culture of diversity and inclusion at A*STAR. By

Driving diversity at A*STAR is about fostering a culture of belonging, empathy, and respect for everyone. I am proud to champion diversity by creating an inclusive environment where every voice, opinion, ambition, and point of view is heard, valued, and respected. By truly listening and understanding one another, we build a stronger, more innovative community.

embracing different perspectives and backgrounds, we can drive innovation and create a more dynamic and supportive work environment.

Dr Rabiatul Adawiah Binte Mohamed Yazid. A*SRL, Diversity Champion



Dr Ramon Jose Paniagua Dominguez, A*STAR IMRE, Diversity Champion



Ground-Up Initiatives

To empower the A*STAR community in driving change and fostering conversations around D&I, the DWG has provided funding support that research entities can leverage. This bottom-up approach aims to empower individuals and communities to collectively address their concerns.



A*STAR GIS runway

A*STAR ARTC and A*STAR SIMTech combined forces and organised a series of networking lunches to facilitate a supportive environment for female staff. These lunches offered a platform for women to connect with one another, share experiences and provide mentorship.



A*STAR SIMTech and A*STAR ARTC women's networking lunches

02 WORKPLACE SAFETY & HEALTH AND STAFF WELLBEING

Workplace safety and health (WSH) is a key risk identified within A*STAR's ERM framework. This ensures safety- and health-related incidents are reported, analysed, and managed.

- WSH statistics and incident case studies are reported in our monthly A*STAR Employee Meetings (ASM) and A*STAR Leadership Meetings (ALM).
- A*STAR established a **WSH committee at the research entity level** to promote and maintain WSH within the RI.
- We promote a **safety-conscious culture and prioritise mental wellbeing** through staff and stakeholder involvement, proactive safety measures and robust health programmes.
- We conduct **risk assessments and implement control measures** for all work activities.
- We conduct **regular WSH training and awareness programmes** for staff, including safety inductions and external training for specific hazards.
- We promote staff wellbeing and productivity through a **culture of health and wellness**, including pre-placement and regular medical examinations, as well as health promotion programmes.

Safety and Health Dashboard

There were no major incidents¹⁸ or fatalities¹⁹ in the last five years. The work-related injury rate in FY2023 was 0.23 based on 200,000 hours worked. The main types of workrelated injury recorded were cuts, contusion injuries, and needlestick injuries.

The number of near misses²⁰ consistently surpassed the number of incidents reported. The number of minor incidents²¹ rebounded in FY2023 after a decline in FY2022 and remained relatively stable over the past five years. Moderate incidents²² have consistently remained at the same level. Occurrence of occupational diseases²³ remains rare. However, there was 1 case of musculoskeletal disorder among staff reported in FY2023.



Reported numbers of 'Near-misses 'Minor incidents, 'Moderate incidents, and 'Occupational Diseases' within the past five years

^{18.} An incident that resulted in serious injury to person (i.e. high-consequence work-related injury); serious damage to plant, equipment or building.

^{19.} An incident that results in loss of life.

^{20.} An incident that does not involve any injury to person; an incident that resulted in minor injury to person but does not require medical treatment or medical leave and it is not classified as a dangerous occurrence.

^{21.} An incident that resulted in minor injury to person with < 3 days medical leave or light duties; and/or minor damage to plant, equipment or building.

^{22.} An incident that resulted in minor injury to person with > 3 days medical leave; and/or moderate damage to plant, equipment or building, where assistance from external agencies (e.g. the SCDF) is not required.

^{23.} Any disease specified in the Second Schedule of the Workplace Safety and Health Act (WSHA) and any other disease that is directly attributable to any exposure to any chemical or biological agent arising out of and in the course of any employment e.g. Musculoskeletal disorders of the upper limb.

In FY2023, A*STAR identified risks that may result in high-consequence injuries or ill health. Using the hierarchy of controls, we have implemented control measures to eliminate these hazards and minimise risks.

Work-related hazards identified in FY2023

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Inhalation of toxic gases used in cleanrooms e.g., Ammonia, Phosphine, Hydrogen Fluoride

Gas cabinet systems, life support systems, emergency response procedures and user training for staff handling toxic gases in cleanrooms



Misuse of manufacturing machines/equipment including high-power lasers and robotic arms

Machine guards, lockout/tagout procedures, user training, mandatory personal protective equipment when using machines/equipment



Exposure to Arsenic, Benzene, Cadmium, Manganese and Mercury

Handling of chemicals in fume hoods only, medical surveillance of staff, user training and mandatory personal protective equipment when handling these chemicals

The line chart compares A*STAR's workplace injury rate (WIR)²⁴ with the National Statistics for all industries and the Professional Scientific & Technical Activities (PSTA)²⁵ sector (the sector A*STAR falls under). Our WIR is based on the number of moderate incidents, as defined by the MOM, specifically injuries requiring medical leave of three days or more.

A*STAR's WIR consistently remained lower than the national statistics over the analysed period. Our WIR in FY2023 was at the same level as in FY2022. A similar trend can be observed in the national statistics for the WIR across all industries.



Comparison of WIR against national statistics

^{24.} Workplace Injury Rate is the number of injuries >3 days of MC per 100,000 workers

^{25.} Professional Scientific & Technical Activities sector includes industries such as Legal Services; Accounting, Tax Preparation, Bookkeeping, and Payroll Services; Architectural, Engineering, and Related Services; Specialised Design Services; Computer Systems Design and Related Services; Management, Scientific, and Technical Consulting Services; Scientific Research and Development Services; Advertising and Related Services; Other Professional, Scientific, and Technical Services; Scientific Research and Development Services; Advertising and Related Services; Other Professional, Scientific, and Technical Services

Health and Safety Training Conducted in FY2023

A*STAR Safety and Sustainability Day

On 13 October 2023, A*STAR held our annual Safety & Sustainability (S&S) Day, bringing together **over 400** participants at Biopolis. The event's theme "Safe Workplace, Healthy Employees, Sustainable Future" aimed to promote a safe and healthy work environment for everyone and foster a green corporate culture.



A*STAR CEO delivering the opening address for the S&S Day

Safety: Vendors showcased their latest safety and personal protective equipment at the event. The WSHC game console featured the 'Look. Think. Do.' game, allowing participants to gain safety awareness in an interactive manner. Additionally, World Courier conducted a workshop on proper packing solutions, demonstrating a triple packaging system for transporting infectious samples.



Vendors engaging with staff to introduce their latest safety products

Sustainability: Examples of our sustainable R&D projects were showcased. Additionally, two hands-on workshops were conducted to empower staff with practical skills for sustainable living. These workshops aimed to inspire staff to incorporate eco-friendly practices into their lives.



Crafting nature into art at the Natural Decor Workshop

A*STAR Community CPR and AED Certification Course

The SpIA, with the Singapore Heart Foundation (SHF), conducted comprehensive half-day training courses on Cardiopulmonary Resuscitation and Automated External Defibrillator (CPR and AED). The sessions aim to equip participants with life-saving skills, build confidence in cardiac emergency response, and provide up-to-date CPR and AED techniques. Successful participants receive a two-year certification. This initiative has trained **over 235** staff in FY2023, enhancing our community's pool of first responders.



CPR and AED training facilitated by our certified instructors and Singapore Heart Foundation

A*STAR SUSTAINABILITY REPORT FY2023

A*STAR Fire Warden Training Programme

At A*STAR, we emphasise emergency preparedness by equipping our staff with emergency response skills, through the annual fire drills and the A*STAR Fire Warden Training Programme launched in 2018.

In FY2023, over 100 fire wardens were trained across four sessions.



Staff appointed as fire wardens practiced putting out a fire with the portable fire extinguisher

Open Communication on Safety and Health Matters

We encourage all staff to use our intranet platform, A*Connect, for efficient organisational communication. The A*STAR Health & Safety Group page serves as a hub for sharing essential updates, including WSH matters and upcoming events, fostering active participation and engagement.

Safety and Health Talks and Care Time Activities

In FY2023, we organised a series of Care Time talks and activities on WSH and wellness. Collaborating with Infuse, our community wellness unit, these sessions addressed diverse aspects of personal and professional wellbeing.

Mental Wellness the TCM Way

Learn how to stay healthy by balancing emotions with simple acupressure massage and recipes.

Learn about unhealthy habits that

can lead to toxin accumulation

and how acupressure massage

Factors in preventing slip, trips

and fall incidents in the workplace.

can aid in detoxification.

Finding Your Feet

Detox Workshop

Legal Aspects of Workplace Safety and Health Act

The principles of the Workplace Safety and Health Act, the duties of the main stakeholders and sharing of cases.

Tulips of the Future

Nurture the creative mind and heart in learning to create your own enchanting lighted tulips.

Am I Working in a Healthy Place?

Importance of indoor air quality in the workplace and the impact on productivity and health.

Examples of Care Time talks and activities

A*STAR SUSTAINABILITY REPORT FY2023

Promoting Staff Wellbeing

A*STAR is committed to providing comprehensive support for staff wellbeing and fostering a culture of wellness. Below are some examples of the initiatives implemented:

Staff Benefits

A*STAR promotes work-life balance through family-friendly policies and Flexible Working Arrangements (FWAs), including part-time, staggered hours, and hybrid work.

A monthly fitness subsidy is provided to staff to encourage an active lifestyle. In addition, staff can apply for complimentary passes to Singapore attractions such as Gardens by the Bay, Singapore Zoo, River Wonders, Bird Paradise, and Science Centre Singapore.

A*STAR offers a comprehensive suite of leave benefits, acknowledging the diverse needs at different life stages. Leave options include marriage, maternity, paternity, childcare, infant care, parent-care, unpaid care, and birthday leave, as well as volunteer leave for charities or public agency programmes.

In FY2023, the return-to-work rate for staff on parental leave²⁶ was **100%**.



FY2023 number of staff who returned to work after parental leave

Prevention

Infuse sets up staff interest group programmes to create a vibrant staff community, comprising activities that promote camaraderie, information exchange, and emotional wellbeing.

As of FY2023, there were **12** interest groups. One of these, the mindfulness community, has been holding weekly mindfulness practices since 2018, offering practitioners opportunities to reorganise their thoughts, bringing calm and ownership to their actions.

Additionally, the Mental Health Reboot workshops were introduced in 2022 to promote mental wellbeing through various healing modalities, such as tension release exercises, muscle relaxation techniques, centring our intuition, sound baths, and journaling.



Weekly mindfulness practices





Mental health reboot workshops

26. Parental Leave refers to maternity, paternity leave and adoption leave.

In 2020, A*STAR launched the Wellness Ambassador initiative, training around **100** staff to offer peer support and promote mental wellbeing.

A*STAR also ensures a supportive environment with confidential grievance handling, HR counselling resources, helplines, and mental wellness insurance coverage.

In 2022, Safe Sapce @ A*STAR was set up for A*STAR staff and students can share personal issues or concerns about workplace discrimination, harassment, or other inappropriate behaviour. This was set up as an alternative and independent channel to whistleblowing for staff who might be unsure of reporting procedures or anxious about reporting through traditional channels. Staff are individually supported and guided through follow-up actions while maintaining confidentiality.



Wellness Ambassador workshops conducted regularly

Engagement

A*STAR organises regular lunchtime chats with our Deputy Chief Executive Officers to discuss topics ranging from WSH to research ethics.

To support staff wellbeing and foster stronger bonds among colleagues, various social activities and initiatives like the A*STAR Dinner and Dance and A*STAR Family Day, were organised.



A*STAR D&D in FY 2023

Infuse After 5

Monthly social gatherings are hosted to foster cohesion, inclusivity, and a sense of belonging amongst the A*Community. These events serve as a platform for recruitment and Whole-of-A*STAR launches. Each event features A*STAR senior management or RI leadership as guests-of-honour. A total of **nine** Infuse After 5 events were held in FY2023.



Wellbeing Education

morale and productivity.

Snapshots of Infuse After 5 events

Infuse team conducting in-person sessions at A*SRL, CC and A*STAR IMCB

Infuse partnered various A*STAR entities for customised wellbeing workshops. Tailored

to the unique needs of A*STAR entities and facilitated by in-house trainers, these inperson sessions covered topics such as Positive Psychology, Workplace Wellbeing, and Mindful Breathing. The workshops fostered a culture of wellbeing, and led to improved

03 EMPLOYMENT/TALENT MANAGEMENT

A*STAR recognises its staff as its greatest asset. With a strong Singapore core and a diverse global community from **over 60** countries, we attract, develop and retain top talent to drive innovation and scientific excellence.



FY2023 staff turnover

Compensation and Benefits

A*STAR is committed to maintaining a motivated and well-compensated workforce. We regularly review compensation, working with an independent consultant to ensure competitiveness. The last comprehensive review was completed in FY2023. These initiatives are integral to retaining top talent and supporting employee development.

Employer of Choice Awards

A*STAR has maintained the lead in **Universum's 2023 Singapore's Most Attractive Employers** among Engineering and Natural Sciences students (from NTU, NUS, SUTD and SIT) for three consecutive years since 2021.

In addition, A*STAR secured the top spot in the **2023 100 Leading Graduate Employers survey** by gradsingapore for the second consecutive year. A*STAR topped the rankings in both the Engineering, Design & Manufacturing and Scientific R&D sectors.

Awards and Recognition

A*STAR continues to recognise outstanding contributions and distinguished service to both the organisation and Singapore. Such recognitions reflect A*STAR's deep commitment to nurturing long-term careers and fostering a culture of excellence within the organisation.



Three A*STAR staff were awarded the prestigious **National Research Foundation Investigatorship (NRFI)**, and **five** others received the **NRF Fellowship (NRFF)**. These awards are central to our mission of driving Peaks of Excellence in research.



In recognition of the significant efforts made during the COVID-19 pandemic, **more than 300** A*STAR affiliates were honoured with the **National COVID-19 Resilience Medal (CRM)** and the **National COVID-19 Resilience Certificate (CRC)**. These special national awards pay tribute to those who played a direct role in Singapore's fight against the COVID-19 pandemic.



The commitment and excellence of A*STAR staff were further recognised through the **National Day Awards in 2023**, with **40** staff receiving honours for their merits and distinguished service to Singapore.



Additionally, A*STAR acknowledged the dedication of **662** staff with five or more years of service through the **Dedicated Service Awards**. This included 234 staff who devoted 15 years or more to the organisation.



COVID-19 recognition award ceremony 2023

A*STAR SUSTAINABILITY REPORT FY2023

04

TRAINING AND EDUCATION

Learning and development are key elements in strengthening our workforce to sustain present performance and meet future challenges. At A*STAR, we strive to develop every staff to be professionally competent and able to demonstrate personal mastery when performing their work.

We advocate a **three-pronged approach** in our learning and development efforts — Organisation-led, Supervisor-led, and Self-initiated. We encourage our staff to take charge and actively seek learning and development opportunities to operationalise their plans for personal and professional growth.

Guided by the Public Service Division's Instruction Manual 2 (IM2), our **Development Framework** encompasses three key competency areas—Leadership, Functional, and Core—that support recruitment, performance management, career planning, and overall learning and development.

Development Framework



A*STAR supports supervisors and staff with resources, infrastructure, and time for skill development. In March 2024, we launched **the A*STAR Learning Management System**, a centralised platform that streamlines learner engagement across the organisation. The platform hosts competency-based content, such as grant proposal writing and project management for research staff, and leadership programs for management. All staff also have access to LinkedIn Learning for flexible skill enhancement anytime, anywhere.

To further support skill development and career progression, A*STAR offers a range of structured training programmes aimed at upskilling staff:

- Mandatory Induction Programmes for New Hires: In FY2023, all of our new hires attendedtheseprogrammes, which offer a comprehensive on boarding initiative designed to familiarise new hires with A*STAR's policies, culture, and operational procedures.
- Mandatory Programmes for Headquarter (HQ) Staff New Hires: In FY2023, a total of **284** staff attended these programmes. These programmes ensure that HQ staff are equipped with the necessary skills for effective policy application and communication.
- Centrally Run Courses for Research Entities: In FY2023, a total of 441 staff participated in these courses, which were offered to research entities to enhance their skills in research and project management.
- **Centrally Run Courses for A*STAR Staff:** In FY2023, a total of **205** staff attended these programmes, including courses such as What is Design Thinking? and Design Thinking for A*STAR Digital Literacy and Innovation Programme (broad-based).
- Leadership Milestone Programmes (in-house): In FY2023, a total of **248** staff participated in these leadership development programmes, including the Advanced Managerial Development Programme (AMDP) and the Managerial Development Programme (MDP) to develop leadership and managerial skills.

A*STAR recommends that 70% of learning comes from experiential activities, 20% from developmental relationships, and 10% from formal structured training. Training budgets are allocated by headcount at the start of each financial year to ensure all staff have learning opportunities. We also support staff pursuing formal structured education and training through sponsorship schemes, with eligible staff granted up to 2 days of Examination Leave per module.

In FY2023, our staff clocked an average of **102** learning hours per staff, through various learning activities and interventions such as classroom training, conferences, and e-learning.





FY2023 training hours statistics

Career Development and Advancement Framework (CDAF)

To support personal, professional and career growth, the CDAF was introduced across A*STAR to all research and corporate staff in June 2022 and February 2023 respectively. The CDAF helps staff advance by building competencies across career stages, with the CDAF Guides outlining personal, functional, and leadership competencies and relevant development interventions.

Supervisors were trained to conduct career development conversations, and as of FY2023, **231** Reporting Officers (ROs) completed in-house Leadership Milestone Programs. The annual performance review, focused on performance, development, and career planning, aligns with this competency-based model, ensuring a transparent framework for staff and supervisors.



AVERAGE TRAINING HOURS BY GENDER

05 COMMUNITY INVOLVEMENT

At A*STAR, we are committed to developing Singapore as a world-class research hub and giving back to society, making a positive difference to the lives of the less fortunate.

A*STAR's CSR committee organises activities that are guided by three pillars: Science, Community and Environment.

COMMUNITY



A 1-day volunteer leave was introduced in February 2023 to promote volunteerism and allow staff to broaden their skillsets and network with key community partners. In FY2023, **81** A*STAR staff contributed a total of about **480** volunteer hours.

Our community involvement activities, outreach programmes and fundraising events strengthen relationships with youths and community partners. In recognition of our contributions to our philanthropic partner, Community Chest, we have been awarded the Community Chest Award (Charity Silver) for the past three years.

Giving Back to the Community

A total of **S\$16,237** was raised by A*STAR in FY2023 through the following events and donation drives:

- As part of A*STAR's National Day Observance Ceremony (NDOC) on 8 August 2023, we launched a fundraising campaign in support of Pathlight School, which is the first school to offer Singapore's national curriculum alongside life readiness skills for students with autism and related conditions. The campaign raised S\$15,698 and enabled Pathlight school to provide more holistic support for its students.
- On 30 November 2023, A*STAR held a donation drive for pre-loved items, raising S\$539. The proceeds were donated to the Lions Befrienders Service Association (LBSA), which supports seniors in aging healthily and living meaningful lives. The unsold items were distributed to less-privileged individuals and residents of oneroom flats in Geylang Bahru and Whampoa, with support from the Salvation Army Church.



Group photo of CEO A*STAR and LBSA at Infuse After 5 on 30 November 2023

A*STAR SUSTAINABILITY REPORT FY2023

STEP-UP Mentorship Programme

A*STAR partnered with the HCSA Community Services in its STEP-UP Mentoring Programme that seeks to provide a social network of support to HCSA beneficiaries during their reintegration phase back to the society. Over 6 months, the A*STAR volunteers helped the mentees to identify their strengths and goals while providing support to help them overcome existing challenges and enhance communication skills.

SG Clean Day 2023

A*STAR participated at SG Clean Day 2023, Singapore's largest clean-up movement organised by Public Hygiene Council. **More than 200** staff and family members participated and became part of the new Singapore Book of Records with the highest number of people involved in an island-wide clean-up.



A*STAR's participation, together with the Ministry of Trade and Industry (MTI) family at SG Clean Day 2023

Purple Parade 2023

On 4 November 2023, A*STAR participated in the Purple Parade 2023, Singapore's largest ground-up movement to support D&I and celebrate persons with disabilities.



A*STAR's participation at Purple Parade 2023



BUILDING TRUST FOR A GREEN ECONOMY

01 ANTI-CORRUPTION

A*STAR has zero tolerance for corruption. Ethics, transparency and accountability are of utmost importance to A*STAR. Therefore, we have policies and best practices in place, where we expect our staff to follow the highest ethical standards and act with integrity. We have made all policies and relevant information available on A*STAR's internal staff portal and communicated them to all staff to ensure these policies are understood and ingrained in our workforce.

Code of Conduct

Our Code of Conduct is built upon the values of Ethics and Integrity, Empathy and Respect and Excellence and Standards. It is intended as a compass for all staff and embodies the ethos of the whole of A*STAR. Our staff are expected to conduct themselves professionally and with integrity at all times.

Conflict of Interest

As part of A*STAR corporate governance framework, all staff must annually declare their investments, external appointments and non-indebtedness, ensuring that any conflicts of interest are appropriately managed. All Board members are to submit their annual Disclosure of Interest form and notify Board Secretariat of any changes outside the annual declaration period. Board's annual Disclosure of Interests are tabled at the first Board Meeting of the year.

Whistleblowing Policy

A*STAR has a whistleblowing policy for individuals to raise any concerns, in confidence and without fear of reprisal. We expect all staff to maintain high standards of integrity and professionalism by reporting any wrongdoing that falls short of our fundamental principles.



02

SUSTAINABLE PROCUREMENT

A*STAR recognises the need to embed sustainability principles into our procurement processes. This shift in approach aligns with our overarching goal to operate as a responsible entity while ensuring the efficiency and effectiveness of our operations. We are committed to fostering responsible consumption and have made significant strides in integrating sustainability into our procurement practices.

Sustainability Integration in Procurement Process

To embark on sustainable procurement, we revised our practices to include sustainability criteria in the Tender Requisition Form and incorporated GreenGov.SG requirements in our requirement specifications.

Requestors are encouraged to consider the life cycle costs and impacts of procured goods and services.

Tenderers are encouraged to offer eco-friendly alternatives and innovative solutions.



Enhanced Tracking of Green Purchases

We are refining our procurement system to track green purchases, enhancing our commitment to environmental sustainability, transparency, and accountability.

Future Plans

A*STAR remains committed to sustainable and responsible procurement, with an aim to drive positive environmental changes while achieving cutting-edge research and innovation. Moving forward, we will focus on the following:



Supplier Engagement: Supplier engagement will take place over multiple phases. We will start off with the development of a supplier code of conduct, which outlines our expectations for suppliers regarding sustainability practices, ethical behaviour, and legal compliance.



Scope 3 Emission Reporting: We will identify the key purchases, which are the primary Scope 3 carbon footprint contributors, and high-impact purchases that have the greatest potential for emissions reduction. This targeted approach will guide supplier engagement and purchasing decisions.



Internal Awareness and Staff Training: We recognise that internal awareness and education are critical to fostering a culture of environmental responsibility among our staff. With training programmes in place, our teams will be equipped with the necessary knowledge and skills to make informed decisions on sustainability.

In FY2023, **90%** of the total value of our purchase orders was issued to Singaporeregistered companies, highlighting our commitment to supporting local suppliers and the local economy. A*STAR's commitment to sustainability is a whole-of-A*STAR effort, ensuring we contribute positively to the environment while maintaining the highest standards of research and innovation.

DRIVING R&D FOR SINGAPORE'S SUSTAINABILITY



01

RESEARCH AND DEVELOPMENT (R&D)

Our R&D efforts supports A*STAR's mission to drive impactful research and innovation for Singapore's economy. We develop solutions for global challenges and promote efficiency across industries. Through collaborating with industry partners, public sector entities and research institutions, A*STAR develops its thought-leadership in R&D, and tackles national and global issues, reinforcing our commitment to environmental, societal and economic advancement.

Research Governance

A*STAR's research governance aligns with the national Research, Innovation and Enterprise (RIE) master plan, ensuring a **robust research strategy** through annual workplans and expert reviews for global competitiveness. The Research Office (RO) **oversees policies and operations, maintaining governance and compliance throughout the research lifecycle.** Key RO functions include:

- Tracking research output and conducting benchmarking
- · Maximising funding and overseeing strategic projects
- · Ensuring compliance with ethical standards
- Organising expert panels for feedback on research impact
- Maintaining research governance through conducting relevant checks and supporting whistleblowing policy

Addressing Sustainability Challenges with Our R&D Capabilities

A*STAR harnesses scientific discoveries and technological innovations to address complex challenges, contributing to a greener, healthier and more resilient Singapore. We are committed to conduct impactful research locally and globally.

Fostering Collaborations between Industry and Research Institutions in Low Carbon Energy Solutions

A*STAR advances low-carbon technologies through collaborations with industry, academia, and government to reduce carbon emissions and support Net-Zero goals. Re-established in 2022, A*STAR ISCE² focuses on decarbonising processes, developing future energy solutions, innovating sustainable materials, as well as enabling rapid and safe deployment of sustainable solutions.

In 2024, A*STAR ISCE² was awarded funding for several projects under LCER phase 2 to develop best practices and recommendations for ammonia/ hydrogen storage and handling as well as ammonia cracking catalysts for efficient low-carbon hydrogen production. A*STAR's contribution to **nine out of 16** LCER Phase 2 projects demonstrates its commitment to advancing low-carbon technologies and supporting the industry decarbonisation.

Additionally, in collaboration with IHI Corporation, $A^*STAR ISCE^2$ is working on converting CO₂ into SAF, with a test rig planned to be launched in Q1 2025.



ExxonMobil-NTU-A*STAR Corporate Lab

Recognising the importance of industry-research partnerships, Nanyang Technological University (NTU), A*STAR (ISCE², IMRE, IHPC), and ExxonMobil (EM) co-established the ExxonMobil-NTU-A*STAR Corporate Lab.

The new lab focuses on innovative areas like SAF, alternative construction materials, and low-carbon hydrogen, aimed at advancing Net Zero commitments globally. This S\$60 million Corporate Lab will develop solutions in the following areas:

- · Convert biomass into lower GHG emission fuels;
- · Carbon capture and utilisation using by-product industrial brines;
- Turn methane into low-carbon hydrogen and solid carbon materials;
- · Develop efficient carbon capture and carbonation technology for industry by-products;
- · Large-scale application of carbon in concrete



Deputy Prime Minister Heng Swee Keat tours an exhibit showcasing sustainable solutions at the launch of the Corporate Lab

Develop Alternative Sand Technology for CO, Capture

A*STAR ISCE², NUS and NTU have collaborated to develop technology that converts CO₂ and waste materials into sustainable construction sand substitutes, supporting Singapore's circular economy.

With Singapore producing about 50 million tonnes of CO_2 annually—40% from the power sector— and facing landfill saturation by 2035, this project aims to upcycle CO_2 and waste materials, like recycled concrete aggregates and incineration ash, into construction materials.



*CO*₂ mineralisation demonstration unit for the production of alternative sand

Green Compass[™]

Green Compass[™] is a tool that helps organisations assess their sustainability maturity level and develop actionable roadmaps through a four-step process of "Learn, Assess, Prioritise, and Plan". Since its launch in April 2022, Green Compass[™] has guided 250 participants from 35 organisations to enhance their environmental practices. For example, it helped Tru-Marine – a local SME – kick-off their sustainability journey with targeted initiatives like setting sustainability targets and improving energy efficiency.

Developed by A*STAR, JTC and TÜV SÜD, the program continues to expand through strong collaborations such as our training partnership with Singapore Polytechnic.

A Sustainable Solution for PET Plastic Degradation

Engineered enzymes from soil actinobacteria can efficiently break down PET plastic into simpler molecules at mild temperatures, providing a sustainable recycling solution that reduces energy use and carbon emissions compared to traditional methods.

In a collaboration between A*STAR IMCB and A*STAR ISCE², researchers focused on actinobacteria enzymes capable of depolymerising resilient plastic pollutants like PET. A*STAR BII contributed through enzyme analysis and sequence mining, while A*STAR SIFBI provided the actinobacteria strains. This innovation has the potential to transform waste management strategies, including the use of anaerobic digesters for mixed waste streams.

Life Cycle Assessment and Life Cycle Costing (LCA-LCC) Platform

A*STAR SIMTech's LCA-LCC platform helps organisations quantify their environmental and economic impacts, promoting sustainability efforts and GHG emissions reduction.

The LCA-LCC platform is a tool that provides customised reports with global and Singapore-specific emissions data for sustainability planning. It has been commercialised and licensed to Zevero, facilitating the quantification of GHG emissions for various organisations.

Notable use cases include assessments on vehicle types, agri-food sector emissions, and environmental and economic modelling for the Tuas Next-Generation Port.

helps and bility LCA-LCC platform

C





LCA - LCC Platform



EV Battery Testing and Disassembly Line

In collaboration with McKinsey & Company, A*STAR ARTC launched an electric vehicle (EV) battery testing and disassembly line in October 2023, which focused on supporting Circular Economy for batteries with efficient remanufacturing processes and employing Industry 4.0 technologies to enhance safety and productivity in battery handling.

To address the labour-intensive handling of retired batteries that also poses safety and health risks to workers, automated disassembly solutions and battery health assessments were developed for repurposing or recycling the batteries. These innovations reduce processing time and protect workers in managing the ncreasing volume of retired EV batteries.



Sharing of EV battery testing and disassembly line with industry companies

Improving Sustainability of Maintenance, Repair and Overhaul (MRO) Work for Singapore Airlines (SIA)

In 2019, A*STAR SIMTech partnered with SIA and SIA Engineering Company (SIAEC) to establish a lab for recoating and restoring methodologies.

The collaboration has enabled the repair of over 2,000 surface-damaged copper trims for SIA, reducing waste and lead time from six months to three weeks, while boosting increasing durability by 50%.

A technology transfer agreement with Applied Total Control Treatment Pte Ltd (ATC) in June 2023 aims to scale repairs for over 3,000 additional trims.



Copper trim in SIA business class seat

Digital Resource Management Systems for Manufacturing

The artificial intelligence (AI)-driven waste-to-resource advisory platform by A*STAR SIMTech and Circular Unite enhances resource circularity through waste upcycling and industrial ecology, reduces reliance on virgin materials, and lowers carbon emissions in Singapore.

Launched at the A*STAR ARTC Startup Challenge in November 2023, this platform creates a marketplace for intercompany collaborations to repurpose industrial waste as inputs for other companies' processes, increases transparency and helps companies track carbon footprints, supporting Singapore's Zero Waste vision.



A*STAR SIMTech's waste-to-resource intelligence platform and sharing of the circular marketplace at the A*STAR ARTC startup challenge 2023

Improving Recycling Efforts Using BINgo

The BINgo pilot collected 370 kg of clean recyclables, diverted waste from incineration and improved recycling in Singapore.

BINgo is a smart waste sorting bin developed by FairPrice Group (FPG) and A*STAR, BINgo utilising AI, Internet of Things (IoT), and smart sensors for smart waste sorting. Launched as a oneyear pilot, it features engaging tools to help shoppers identify recyclables. Following its success, KL Enviro (now KLERRA) has licensed the technology, with the first enhanced bin set to launch in Q4 2024.



BINgo, a smart waste sorting bin, during the pilot by FairPrice Group and A*STAR

Improving Energy and Water Efficiency

A*STAR's research drives innovations that enhance energy and water efficiency, helping industries optimise resource use and minimise environmental impact for a sustainable economy. By developing technologies and collaborating with partners, A*STAR promotes sustainable practices and accelerates improvements in energy and water efficiency nationwide.



Resource Efficiency Monitoring & Analytical Platform (REMAP) - A suite of modular platforms for energy and resource analytics, enabling streamlined monitoring and analysis across multiple resource domains

Water Efficiency Monitoring and Analytics System (WE2MAS)

A*STAR ARTC's software algorithm enhances water efficiency and treatment effectiveness, aiming to reduce water consumption in pilot projects with companies like Coca-Cola and Philips. Developed by A*STAR ARTC, this algorithm enhances water usage efficiency and treatment effectiveness and recommending strategies for water closed-loop system. Partnering with Calibre as the systems integrator, the technology is being piloted in collaboration with various companies to improve their water management practices.

Driving Social Impact

A*STAR drives positive social impact, particularly in prenatal and early childhood health. We strengthen Singapore's capacity to improve long-term health outcomes in Singapore, contributing to more resilient communities.

Growing Up in Singapore Towards healthy Outcomes (GUSTO)

A*STAR's Early Life Funding Initiative supports the S\$55 million Prenatal/Early Childhood Grant, enhancing capabilities in Singapore and improving maternal and child health.

The GUSTO study, a collaboration among A*STAR IHDP, KKH, NUHS and NUS, examines how prenatal and early childhood conditions affect health and development.

Key achievements include new maternal mental health guidelines with implementation of universal antenatal screening introduced at KKH in February 2023, and contributed to MOH's guidelines on screen time for children, advising no screen time for those under 18 months. Additionally, the Whole Child Panel, a tool developed by A*STAR IHDP and NUS, was introduced in 18 PCF preschools to assess children's development and provide early intervention for at-risk students. These initiatives collectively enhance wellbeing and foster resilient future generations.

Sustainable Food, Food Security, and Food Waste Reduction

Ensuring a stable food supply is vital for Singapore's population health and security, especially where more than 90% of our food supplies are imported (Singapore Food Agency (SFA) statistics, 2023). A*STAR supports sustainable food systems by developing innovative technologies to tackle challenges in food production, security, and food waste management. A*STAR aligns with Singapore's "30 by 30" food security agenda and circular economy principles to create sustainable food solutions and reduce food waste.

Food Tech Innovation Centre (FTIC) to Enable Sustainable Nutrition Solutions

In partnership with Nurasa, A*STAR SIFBI launched the Food Tech Innovation Centre (FTIC), which will boost Singapore's food security by developing high-value nutritional ingredients and supporting food innovation.

A*STAR SIFBI operates two joint labs within the FTIC, focusing on fermentation and food-processing solutions. The shared infrastructure enhances pilot-scale efforts for alternative proteins and facilitates the translation of research to market, leveraging public-private partnerships to enhance local food resilience.

Celebrating the official opening of FTIC

Bringing Cultivated Meat and Seafood to the General Population

The Centre of Innovation for Sustainable Banking and Production of Cultivated Meats (CRISP Meats) is a multi-institutional research programme launched by A*STAR, in collaboration with SIT and NUS, which plays a key role in advancing cultivated meat and seafood.

It develops integrated technologies designed to accelerate innovation in cultivated meat production, supporting Singapore's goal of meeting 30% of its nutritional needs with locally produced food by 2030.

Tamping Down on Food Waste

A*STAR SIFBI, in collaboration with industry partners, has developed innovative solutions to address Singapore's food waste challenges through a comprehensive white paper.

A*STAR SIFBI, with integrated research capabilities in food nutrition, public health, biotechnology, manufacturing and agri-food technology, collaborated with ID Capital Pte Ltd, Bühler Group & Dole Sunshine Company to uncover innovation opportunities across the food value chain.

Waste-to-value: a white paper on the future of food upcycling in Asia

Conversion of Food waste into Fertiliser

A*STAR ISCE² collaborated with Westcom Bio-Tech, and commercialised a microbial technology that enables the conversion of food waste into fertiliser within 24 hours.

Since 2019, Westcom has installed food digesters capable of processing over 10,000 tonnes of waste annually, and have been installed in over 40 schools and key locations. In 2020, Westcom expanded its reach by securing a contract for additional digesters at various JTC industrial sites.

Developing Sustainable Food Systems with Microalgae-based Proteins

A*STAR SIFBI and industry partners are developing microalgae-based protein and innovative food concepts to enhance food security in agri-food systems.

In collaboration with NUS, the Singapore-Eidgenössische Technische Hochschule (ETH) Centre, Bühler Group, Givaudan, Nestlé, Planted Foods, Sophie's BioNutrients, and the SFA, A*STAR SIFBI has launched a research project focused on sustainably producing microalgae-based protein. The intent is to develop innovative food concepts that better align with consumer preferences.

A*STAR SIFBI team working on developing sustainable food with microalgae-based proteins

A Microbial Bioconversion Platform: Valorisation of Waste Biomass into Microbial and Insect Ingredients for Use in Aquafeeds

The A*STAR SIFBI project has attracted significant industry interest, resulting in two Research Collaboration Agreements (RCAs) for producing sustainable aquafeeds from food waste.

Sustainable aquafeeds can be produced by converting food waste into high-quality proteins like single-cell protein (SCP) and black soldier fly larvae (BSFL). Life cycle analysis shows that BSFL production creates a low carbon footprint, supporting sustainable aquaculture.

Technology microbial conversion

Sustainable Transport and Green Buildings

Sustainable transport and green buildings foster resilient infrastructure, minimising environmental impact and enhancing economic benefits. A*STAR's research supports the transition to cleaner energy, improving urban sustainability while aligning with decarbonisation goals.

Singapore Integrated Transport Energy Model (SITEM)

The SITEM model informs Singapore's transition to EVs and supports decarbonisation commitments by analysing charging patterns and energy demand.

A*STAR IHPC collaborated with TUMCREATE Ltd to develop a high-fidelity, city-wide simulation model of Singapore's transport system. Working with government agencies, the SITEM model helps plan for EV charging infrastructure, aligning with Singapore's 2040 vision for cleaner energy vehicles. In FY2023, SITEM also spun off new projects covering electrification of maritime harbour craft and airport support vehicles.

SITEM's integrated modelling and simulation framework

Centre for Emissions and Energy Modelling (CE2M)

The CE2M initiative demonstrated that small shifts in EV charging behaviour could significantly reduce Singapore's future power plant investment costs.

In the first phase of the CE2M, A*STAR SIMTech and A*STAR IHPC integrated high-fidelity EV charging demand data from the SITEM model with macroscopic decarbonisation models. This capability allowed planners to understand overall system impact of pricing strategies strategies to influence drivers' charging behaviour. Following the completion of CE2M 1.0 in October 2023, the initiative will expand in CE2M 2.0 to include power and industry sector models, aiding local agencies in Singapore's decarbonisation planning.

Optimising Urban Space Design with Integrated Environmental Modeller (IEM)

The IEM optimises urban design by visualising environmental impacts, enhancing the sustainability of development projects like Tengah and Queenstown.

A*STAR IHPC, A*STAR I²R, and HDB developed the IEM, an urban-planning tool that creates 3D models to assess how solar irradiance, air temperature, wind, and noise affect urban environments. Adopted in projects like the Queenstown District, IEM's phase 2 enhancements, including Wind-Driven Rain analysis and Building Energy Modelling, support a more comprehensive and efficient urban planning.

A*STAR and HDB used the IEM tool to conduct simulation studies including wind flow (top) to improve the overall thermal comfort by up to 10% (bottom)

Overall R&D Performance and Targets

We monitor our overall R&D performance²⁷ annually using the RIE2025 KPIs. As of FY2023, we were on track to achieve most of the RIE2025 KPI targets.

RIE2025 KPIs	RIE2025 Target	A*STAR's Achievements
		FY2023
Number of Industry Projects	6,500	1,348
Industry R&D Spending (S\$ mil)	1,200	354.6
Licensing Revenue (S\$ mil)	24	11.7
Number of Successful Spinoffs	40	15

As of 31 March 2024, A*STAR had 12 sustainability-related spinoff companies. Example of one spinoff company's sustainability contributions is featured below.

A Sustainable Bean-Free Coffee Option

Prefer, a bio-flavours spinoff from A*STAR SIFBI, developed a sustainable coffee alternative made from upcycled food waste. This addresses the challenges of diminishing coffee farmland and the significant carbon footprint from coffee bean production.

By utilising surplus bread, spent barley grains, and okara (soy pulp waste), Prefer offers a bean-free environmentally friendly alternative to traditional coffee. Compared with coffee beans, Prefer's coffee grounds require approximately 5 times less CO₂ to produce.

This innovation contributes to a sustainable future while supporting local businesses and reducing food waste.

Production of bean-free coffee

27. For detailed information on our R&D performance, please refer to our annual report.

GRI CONTENT INDEX

Statement of use: A*STAR has reported the information cited in this GRI content index for the period 1 April 2023 and 31 March 2024 with reference to the GRI Standards. **GRI 1 used:** GRI 1: Foundation 2021

GRI Standards	Disclosure Number	Disclosure Title	Page Reference	
General Disclosures				
GRI 2 (2021): General	2-1	Organisational details	03	
Disclosures	2-2	Entities included in the organisation's sustainability reporting	04	
	2-3	Reporting period, frequency, and contact point	04 - 05	
	2-5	External assurance	05	
	2-6	Activities, value chain and other business relationships	03 - 05	
	2-7	Employees	26	
	2-9	Governance structure and composition		
	2-10	Nomination and selection of the highest governance body: The nomination and selection process for board members will adhere to the MTI's guidelines for Statutory Boards. The Board Secretariat will consult internally with A*STAR's senior management before seeking inputs from the MTI. After endorsement by our Chairman, approval will be sought from the Cabinet. Key considerations for nominating and selecting board members include aligning with our strategic areas of focus, ensuring board diversity in line with MTI's guidelines, and maintaining independence among board members.	07 - 09	
	2-11	Chair of the highest governance body		
	2-12	Role of the highest governance body in overseeing the management of impacts		
	2-13	Delegation of responsibility for managing impacts		
	2-14	Role of the highest governance body in sustainability reporting		
	2-15	Conflicts of interest	42	
	2-16	Communication of critical concerns	34	
	2-20	Process to determine remuneration	36	
	2-22	Statement on sustainability strategy	06	
	2-23	Policy commitments	12 24 42 42	
	2-24	Embedding policy commitments	12, 34, 42 - 43	
	2-26	Mechanisms for seeking advice and raising concerns	34, 42	
	2-29	Approach to stakeholder engagement	10	

GRI Standards	Disclosure Number	Disclosure Title	Page Reference
Material Topics			
GRI 3 (2021): Material	3-1	Process to determine material topics	11
Topics	3-2	List of material topics	12 - 13
Integrating environme	ental sustainability into	our core operations	
Material topic: Greenh	ouse Gas (GHG) Emissio	ons	
GRI 3 (2021): Material Topics	3-3	Management of material topics	
GRI 305 (2016):	305-1	Direct (Scope 1) GHG emissions	16
Emissions	305-2	Energy indirect (Scope 2) GHG emissions	
	305-5	Reduction of GHG emissions	18
Material topic: Energy	Management		
GRI 3 (2021): Material Topics	3-3	Management of material topics	
GRI 302 (2016): Energy	302-1	Energy consumption within the organisation	
	302-2	Energy intensity	17 - 18
	302-3	Reduction of energy consumption	
	302-4	Reduction in energy requirements of products and services	
Material topic: Water l	Management		
GRI 3 (2021): Material Topics	3-3	Management of material topics	
GRI 303 (2018): Water	303-1	Interactions with water as a shared resource	19 - 20
and Effluents	303-2	Management of water discharge-related impacts	
	303-5	Water consumption	
Material topic: Waste	Management		
GRI 3 (2021): Material Topics	3-3	Management of material topics	21
GRI 306 (2020): Waste	306-1	Waste generation and significant waste-related impacts	
	306-2	Management of significant waste-related impacts	21 22
	306-3	Waste generated	21-23
	306-4	Waste diverted from disposal	

A*STAR SUSTAINABILITY REPORT FY2023

Disclosure Number Disclosure Title **GRI Standards**

GRI Standards	Disclosure Number	Disclosure Title	Page Reference			
Caring for our people a	and community					
Material topic: Diversi	ty and Inclusion					
GRI 3 (2021): Material Topics	3-3	Management of material topics	26 - 28			
GRI 405 (2016): Diversity and Equal Opportunity	405-1	Diversity of governance bodies and employees: Referencing A*STAR's Board, women make up approximately 20%	7, 26			
Material topic: Workplace Safety & Health and Staff Wellbeing						
GRI 3 (2021): Material Topics GRI 403 (2018): Occupational Health and Safety	3-3	Management of material topics	29 - 35			
	403-1	Work-related injuries				
	403-2	Hazard identification, risk assessment, and incident investigation				
	403-3	Occupational health services				
	403-4	Worker participation, consultation, and communication on occupational health and safety				
	403-5	Worker training on occupational health and safety				
	403-6	Promotion of worker health				
	403-7	Prevention and mitigation of occupational health and safety impacts directly linked by business relationships				
	403-9	Work-related injuries				
	403-10	Work-related ill health				
Material topic: Employment/Talent Management						
GRI 3 (2021): Material Topics	3-3	Management of material topics	36			
GRI 401 (2016): Employment	401-2	Benefits provided to full-time employees that are not provided to temporary or part-time employees				
	401-3	Parental leave				
Material topic: Trainin	Material topic: Training and Education					
GRI 3 (2021): Material Topics	3-3	Management of material topics	37 - 38			
GRI 404 (2016): Training and Education	404-1	Average hours of training per year per employee				
	404-2	Programmes for upgrading employee skills and transition assistance programmes				
	404-3	Percentage of employees receiving regular performance and career development reviews				
Material topic: Community Involvement						
GRI 3 (2021): Material Topics	3-3	Management of material topics	- 39 - 40			
GRI 413 (2016): Local Communities	413-1	Operations with local community engagement, impact assessments, and development programmes				

60

GRI Standards Disclosure Number Disclosure Title

Upholding trust and enabling a green economy						
Material topic: Anti-corruption						
GRI 3 (2021): Material Topics	3-3	Management of material topics	42			
GRI 205 (2016): Anti- corruption	205-2	Communication and training about anti-corruption policies and procedures				
Material topic: Sustainable Procurement						
GRI 3 (2021): Material Topics	3-3	Management of material topics	42			
GRI 204 (2016): Procurement Practices	204-1	Proportion of spending on local suppliers	43			
Advancing R&D capabilities to support Singapore's sustainability agenda						
Material topic: Research and Development (R&D)						
GRI 3 (2021): Material Topics	3-3	Management of material topics	45			
GRI 203 (2016): Indirect Economic Impacts	203-2	Significant indirect economic impacts	45 - 57			

Page Reference

