The International Conference on Innovative Engineering Education 2025

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Engineering Education and Sustainable Development

- Aligning Competencies, Impact, and Global Collaboration

Keynote Address by

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Engineering Education - the Context

A world of volatility, uncertainty, complexity and ambiguity

Changing global economy leveraged on technology and sustainable development

Rapid disruptive technological innovations, short shelf life of specialized knowledge

Interdisciplinary collaboration

Common destiny – climate change & sustainability

What Kind of Engineer for 2030?

NOT JUST TECHNICAL EXPERTS

BUT GLOBAL CHANGE-MAKERS
FOR SUSTAINABILITY AND EQUITY

The Challenge Ahead

“The SDGs are, at their heart, an engineering challenge.”

Are we preparing engineers to meet this responsibility?

SUSTAINABLE DEVELOPMENT GOALS

Challenge statements can fall under one or more of the 17 UN SDGs

Engineering & the SDGs

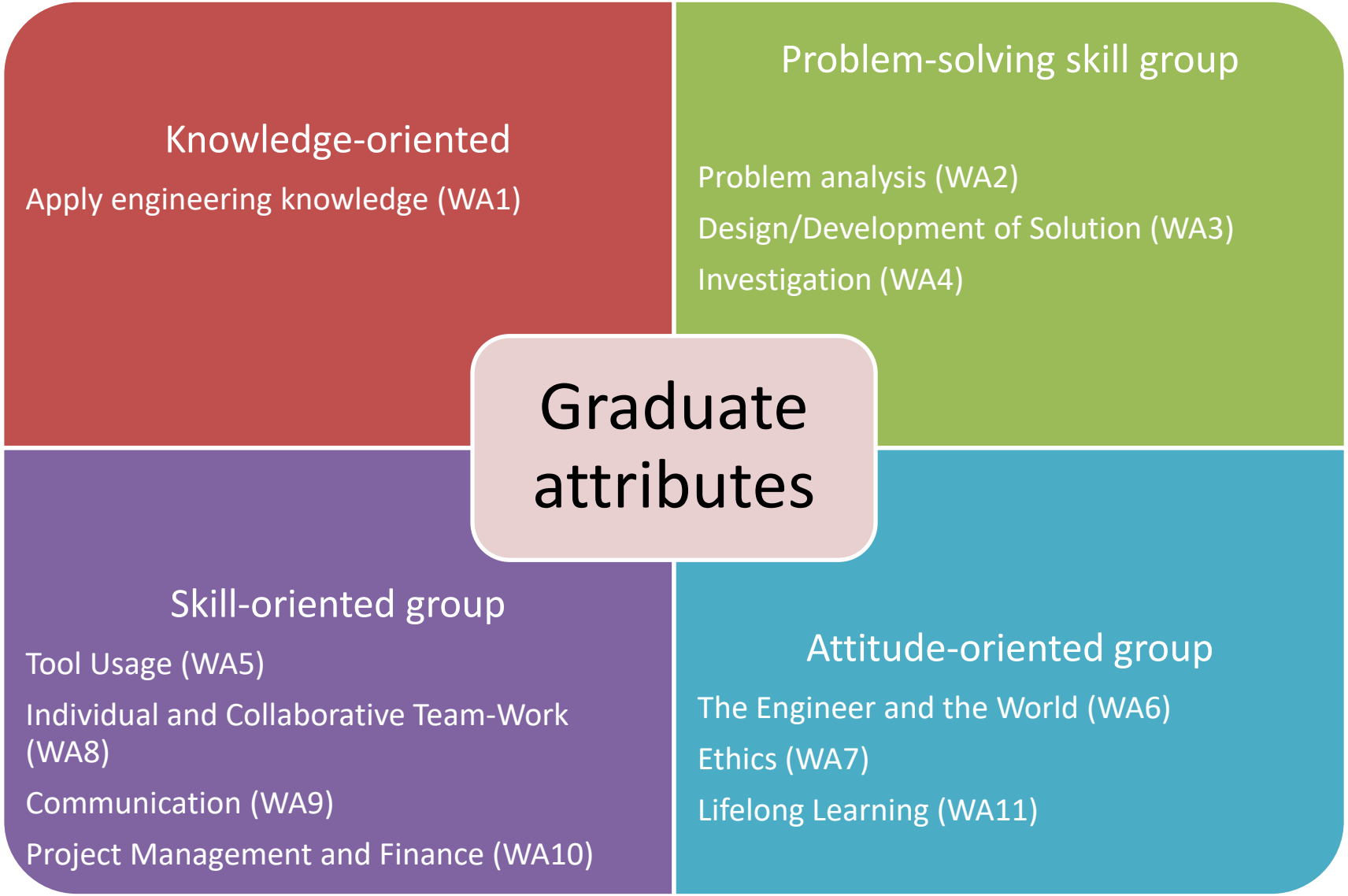
Engineering underpins nearly every SDG

Critical areas: energy, water, cities, climate, digital inclusion

The Education Gap

Technical fundamentals are strong ✅

Alignment with SDG priorities often weak ❌



Competencies

Washington Accord

Engineering Education – Washington Accord Perspective

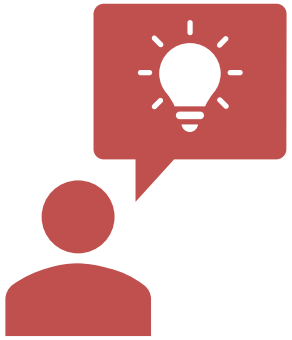
Engineering education to develop competent, innovative, and socially responsible engineers who possess the knowledge, skills and ethical grounding necessary to address the complex challenges of the contemporary world.

Engineering education prepares students to apply engineering principles to design, analyze and improve systems, products and processes in a way that advances technology and benefits society.

Globally Aware, Locally Contextualized

- Student-centered learning & passion-driven education
- Competencies for the 21st century
- Continuous transformation of skills
- Digital & data literacy as core capabilities
- Critical thinking, collaboration & communication
- Global awareness with local relevance

Graduate Attributes & Competencies



Problem analysis, design, sustainability, ethics

Teamwork, communication, lifelong learning

From GAPCs to SDGs

Ethics → Responsible AI, Just Transitions

Design → Sustainable Infrastructure

Teamwork → Cross-disciplinary SDG projects

Competence → Impact

Case: Student project co-developing clean water with communities

Purpose-driven projects deliver real-world SDG impact

Curriculum Innovation

01

Infuse sustainability into all core subjects

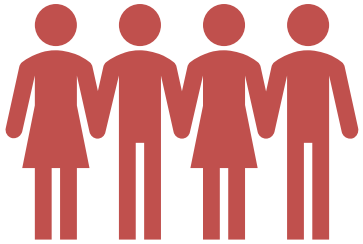
02

Link projects to real community needs

03

Embed ethics, equity, inclusivity in problem framing

Experiential Learning



Service learning with communities

Industry collaboration on decarbonization and smart cities

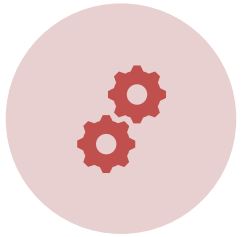
Sharing of Singapore's Experience

Green Skills for the Green Economy

Green Skills for the Green Economy

DRIVING FORCE OF SUSTAINABLE GROWTH

SKILLS FOR EMERGING GREEN SECTORS



INTEGRATION ACROSS INDUSTRIES

LIFELONG LEARNING & ADAPTABILITY

ROLE OF ENGINEERING EDUCATION

Green Ecosystem – Singapore Example

- People is key
- Green programs to involve all stakeholders
- Performance standards
- Laws and legislations on energy efficiency
- Recognition and awards
- Financial incentives
- Competent energy professionals
- Green professional networks

Sustainability Education in SIT

Sustainability Education Committee

Sustainability Education Via Learner's Perspective

SUSTAINABILITY EDUCATION ROAD MAP FOR SITIZENS

LEVEL 0: GENERAL AWARENESS FOR PUBLIC

LEVEL 1: BASELINE EDUCATION - MICROMODULE

Compulsory for all students. provides fundamental knowledge for learners to better transit into deeper, discipline-specific, and multi-disciplinary sustainability subjects and projects

LEVEL 2: SUSTAINABILITY IN CURRICULUM

Sharpen and enhance sustainability content in SIT and joint undergraduate programmes

LEVEL 3: OPPORTUNITY TO DEEPEN THROUGH MINOR

Student will read discipline-specific modules, embedded with sustainability content, read sustainability core modules which cover a variety of topics, such as life cycle assessment, sustainability report, green financing

LEARNING LOOPS

Applications of sustainability concepts and addressing problem statement from 17 UN SDGs through opportunities such as Communication Studies, Integrated Work Study Programme, Social Innovation Project and Capstone etc.

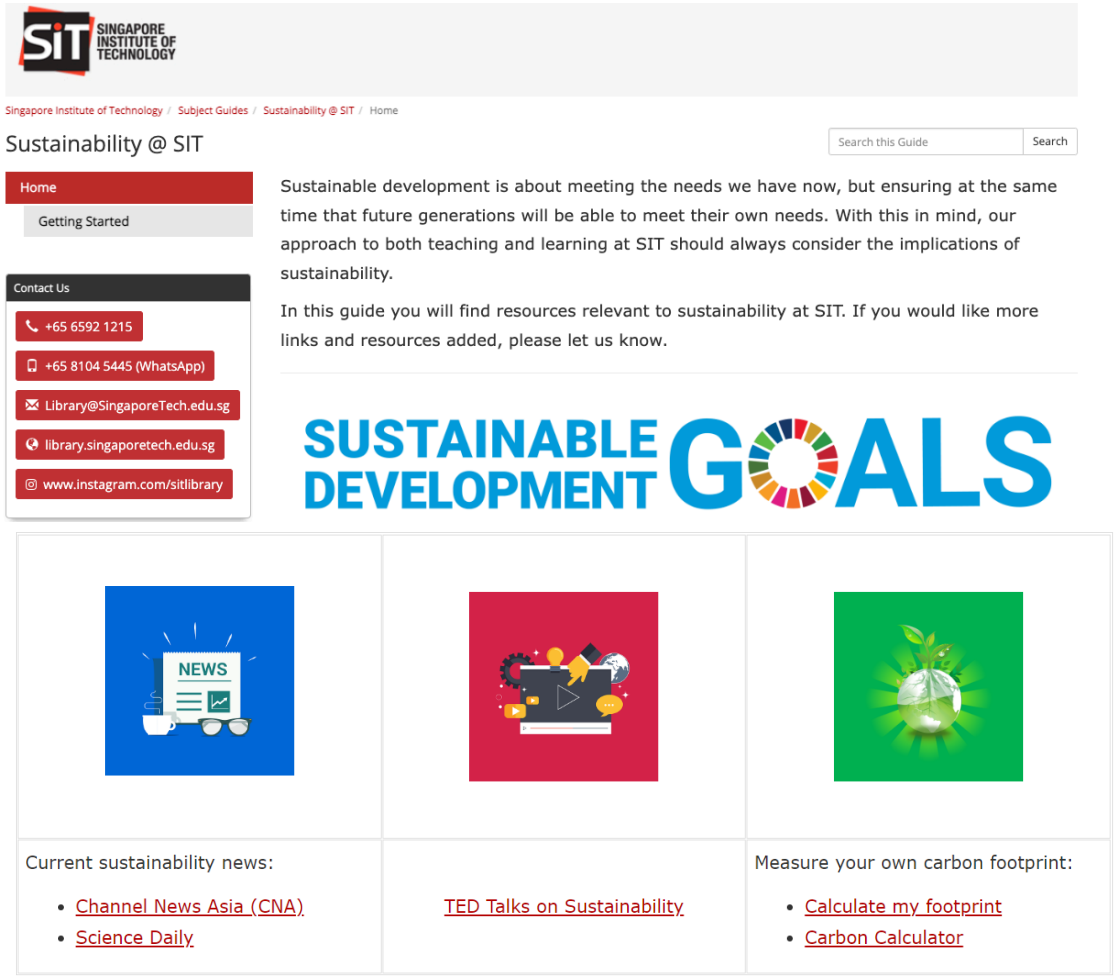
LEVEL4:EMPOWERING PROFESSIONALS

Supercharge sustainability knowledge through CET courses & workshops, with stackable pathways to certificates and degrees

Level X: Student participation in Sustainability-related activities are encouraged throughout their stint in SIT

Level 1 – Incorporate baseline sustainability education for SIT and joint degree UG students (Started for AY22/23):

- Embedded sustainability element in university-wide modules such as:
  - Sustainability 101 Micro-module – Introduction to Sustainability,
  - UCS1001 Critical Thinking & Communication,
  - USI2001 Social Innovation Project
- Made available library resources to support sustainability education



Level 1 – Incorporate baseline sustainability education for SIT and joint degree UG students (Started for AY22/23):

Sustainability 101 Micro-module:

- Two hours of e-learning
- Launched on 29 Aug 2022
- Compulsory starting from AY22 Cohort
- Four topics:
  1. Why is sustainable development important?
  2. What is sustainable development?
  3. What are the key challenges in Singapore?
  4. How can individuals, organisations and Singapore contribute to sustainable development?

Supports the learning of sustainability–related modules (e.g., SIP) & projects (e.g., capstones)

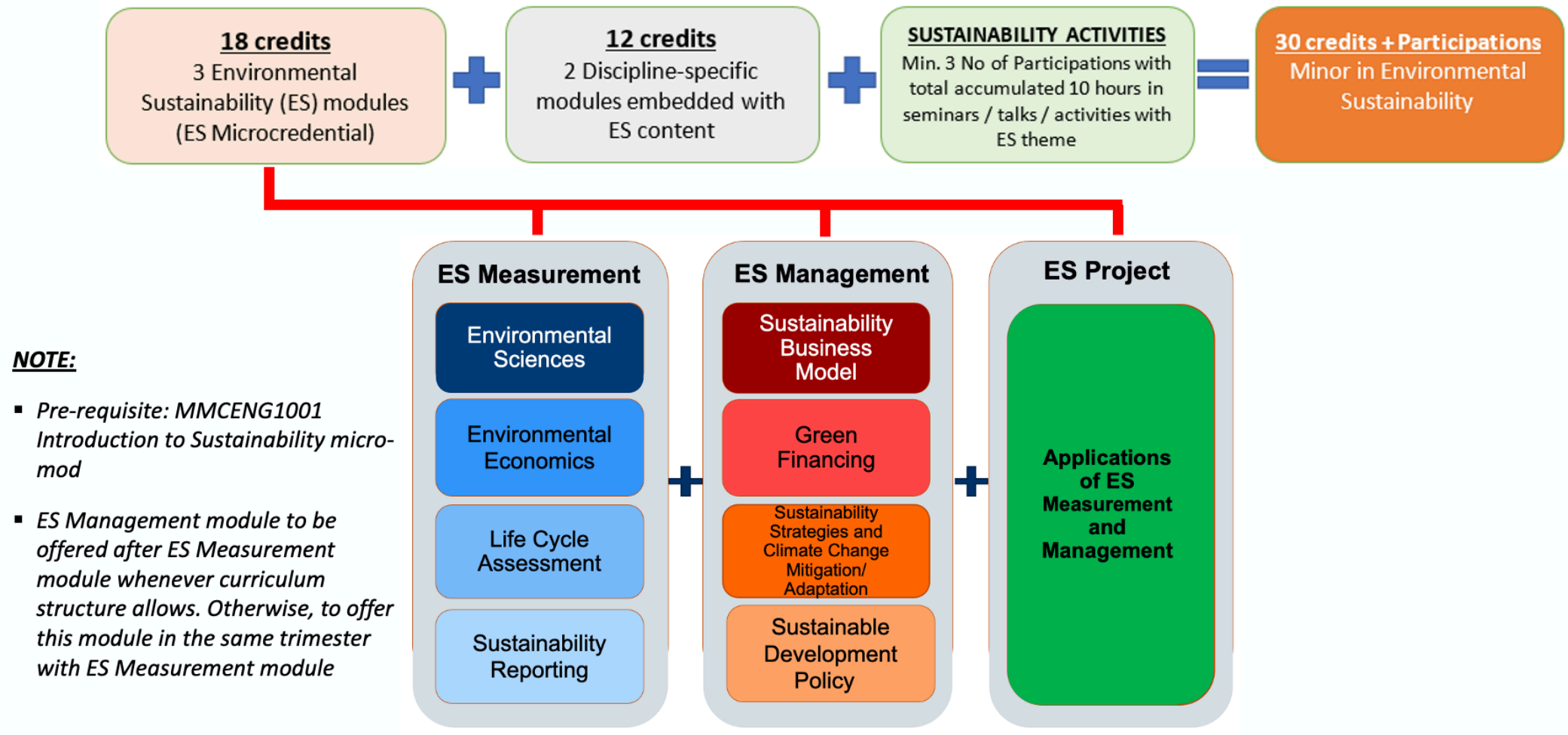
Level 2 – Sharpen and enhance sustainability content in SIT and joint undergraduate programmes:

- Working with all Programmes to make recommendations to incorporate sustainability elements (Contents, Module Descriptions, Module Learning Outcomes, Programme Education Objectives)

- Reference frameworks: ESG, MOE/SSG's Green Skills and United Nations General Assembly's Sustainable Development Goals, etc.

Level 3 – Opportunity to Deepen Through Minor

Minor in Environmental Sustainability (Launched in AY23/24)



To enable SIT graduates of various disciplines to contribute towards environmental sustainability targets of organizations, industry, and nation.

Level 3 – Opportunity to Deepen Through Minor

Sci. Dpl. Glenn S. Banaguas, renowned scientist, diplomat, and one of the of the leading experts on environment, climate change, and disaster risks in Asia, sharing his experience on Sustainability with students reading the Minor in Environmental Sustainability

- Appreciation to IAC for giving input on the Minor in Environmental Sustainability (MES) during the first IAC Meeting.
- Offering of Minor in Environmental Sustainability (MES) in AY2023
  - In AY2023, students from Electrical Power Engineering & Engineering Systems programmes are eligible to sign up for MES. They will start Environmental Sustainability modules in their year 2 (i.e., AY2024).
  - From AY2024, students from the Mechanical Engineering and Digital Supply Chain will be eligible to sign up for the Minor.
  - Key feedback from students: Appreciated the sharing from industry and case studies – *Invitation to IAC members to contribute on this if available*
- At the overall programme level, learning loop created with application/reflection via the Integrated Work Study Programme, Social Innovation Project and Capstone

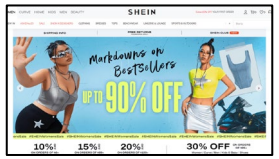
Level 3 – Opportunity to Deepen Through Minor

- Students apply their learning by using real-life examples of companies listed on the SGX.
- In their group report and presentation, they make comparison of key environmental indicators, discuss carbon accounting, LCA and sustainability reporting, and analyze the improvement strategies to reach their carbon reduction emission goals

Level 3 – Opportunity to Deepen Through Minor

SHEIN

ZALORA



KEY ENVIRONMENTAL INDICATORS

KEY FACTORS	SHEIN	ZALORA
Carbon Footprint	SHEIN's 2022 production spike led to a **52% emissions rise**, over **99% 9.17 million tonnes CO2e are scope 3 activities.** Efforts to reduce carbon footprint - Usage of **Renewable Energy for Operations** - Source for **environmentally friendly products** - **decarbonising** their **supply chain**	ZALORA emitted **211,886 tons of CO2, manufacturing** taking up **62%** Efforts to reduce carbon footprint - **Reduction** in **Electricity Consumption** - **Replacing packaging material** to one that has **lower environmental impacts** - **increase recycling rates**
Fair Labour Practices	Efforts to ensure fair labour practices - Human Rights Policy: **SHEIN's Human Rights Responsibilities** - Ensure fair wages, working hours etc - SHEIN **audits suppliers** (SHEIN's **Code of Conduct**) to ensure **fair labour standards**	Efforts to ensure fair labour practices - Code Of Conduct and Ethical Trade Manual social **audits** to **evaluate working environments** - **training sessions** to proper ethical trade, wage, and working hour management.
Ensuring Sustainable Consumption and Production Patterns	GHG emissions **increased** by **112,486 CO2** in **2022** Efforts to increase sustainable consumption and production patterns - **material traceability** - **educate suppliers** to cater new production models - set plans for **circular economy** for SHEIN's products	Efforts to increase sustainable consumption and production patterns - **switch fabrics** with **lower environmental impacts** to ensure sustainable consumption - promote **conscious shopping** and **circular fashion** to consumers - **minimise** use of **plastic** for packaging

SDE3001 Environmental Sustainability Measurement:

- Students compare Shein and Zalora and shared the disastrous impact of fast fashion on the environment and in terms of unfair labor practice.

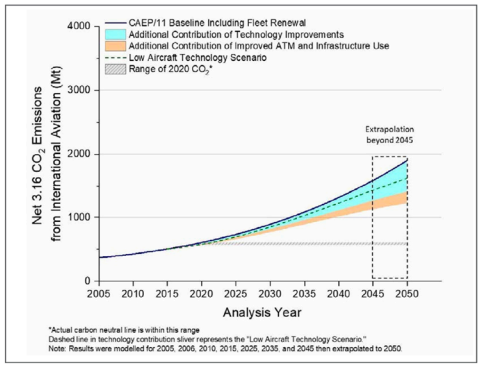


Fig 3: Global aviation CO_2 emissions through 2050 (Fleming et al., n.d.)

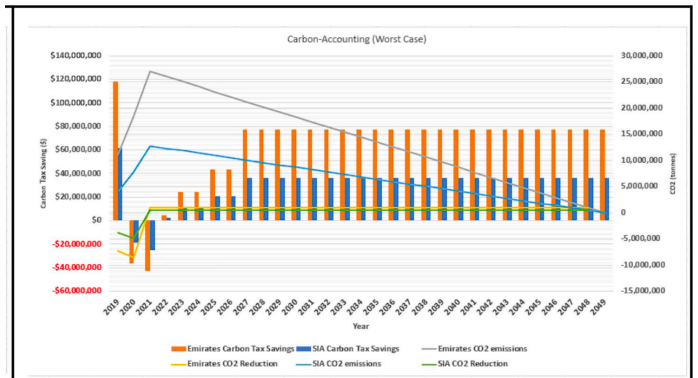


Fig. 12: Worst case scenario for carbon tax

- Students compare Singapore and Emirates Airlines CO_2 footprints and the insufficient commitments they intend to take. They model the cost of operations as the value of carbon credits increases over time, underlying the urgency to transform the sector.

Level X – Facilitate student activities as a learning platform

- Support and promote student participation in sustainable related events and student life activities
  - For example: the AECOM City Hack, student participation in international competition – “Make the Case” – East Asia

Draft media kit information [tbc]

The Energy Efficiency Technology Centre @SIT

https://www.singaporetech.edu.sg/energy-efficiency-technology-centre

EETC@ SIT

To promote and develop energy efficiency capability and new technologies in the local energy efficiency ecosystem for industrial sectors

Build Capability for SMEs

- Offer low-cost high quality energy assessments to SMEs
- Help SMEs to achieve energy savings
- Advise grants available for SMEs

Upskill Energy Professionals

- Offer Energy Efficiency Upskilling Programme Upskill industry professionals in industrial energy efficiency
- Training deep dives into industrial systems for e.g. Compressed Air Systems, Pump Systems and Electrical Power Systems
- 3-day theory + 2-day practical course
- Fulfill part of requirements to be in-house EEOA (Energy Efficiency Opportunities Assessor)

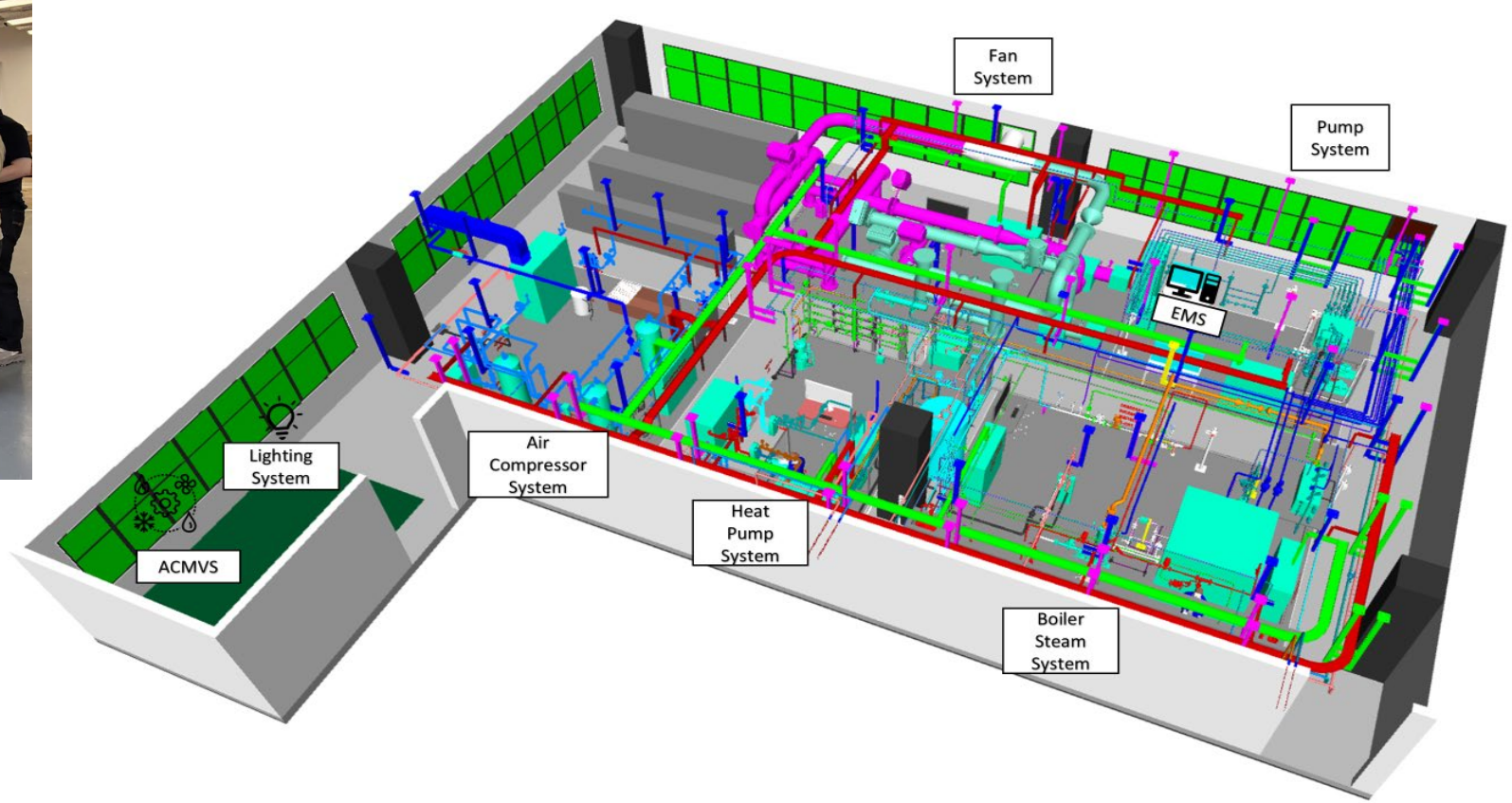
Training of Talent Pipeline

- Attach SIT students to industry through Integrated Work Study Programme (IWSP) to work on energy assessment/ energy efficiency projects
- Opportunity to continue projects to capstone / MEng Tech projects

Hands-on real-world experience

Integrated Work Study Programme – Students work at EETC from 8 to 12 months will acquire competencies through actual industrial energy audits.

EETC Lab In SIT Punggol Campus



Call for International Collaboration

Sustainability is Global

Climate, water, digital access cross borders

Education must prepare engineers to collaborate globally

Modes of Collaboration

Joint modules between universities

Credit mobility & exchange programs

Shared international design challenges

Global recognition frameworks (e.g. Washington Accord)

Amplifying Impact Through Collaboration

International teams co-create SDG solutions

Collaboration multiplies local and global impact

Collaboration for sustainability

- Sustainable development is a global challenge that requires collective action and collaboration across sectors and regions.
- Organic Integration of Sustainable Development Goals (SDGs) in Engineering Education can be facilitated through immersion in
  - National commitments to global climate change/ net-zero targes & UN SDGs
  - National ecosystem for green economy
  - National education framework (incorporation of critical core skills)
  - University's requirements for critical core skills
  - Engineering school's requirements for interdisciplinary sustainability education
  - Disciplinary in-depth sustainability requirements
- Engineering education must reshape curriculum and practice to develop green skills which encompass the knowledge, abilities, and competencies required to operate in a green economy, and to deliver UN SDGs.

Call to Action

1

Align competencies with SDGs

2

Ensure education delivers real-world impact

3

Collaborate globally to amplify outcomes

Closing Vision

Engineers as enablers of sustainable, inclusive progress

Imagine every graduate contributing to a sustainable future

That is our responsibility and opportunity