DECARBONISATION PLAYBOOK FOR TOURISM BUSINESSES

This playbook serves as a guide for tourism businesses, including attractions, cruise terminal operators, hotels, integrated resorts, MICE (Meetings, Incentives, Conferences and Exhibitions) and travel agents. It equips businesses with essential knowledge on carbon emissions, helping them to start their decarbonisation journey or build on their existing efforts. This playbook aims to support the tourism sector in a collective effort towards achieving Singapore's ambitious goal of net-zero carbon emissions by 2050. Together, we can achieve our vision of becoming a City in Nature, where Large Experiences come with Small Footprints.

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WHY DECARBONISE?

Contribute to the Singapore Green Plan 2030

The Singapore Green Plan 2030 is a nationwide movement to advance Singapore's sustainability goals. The Green Plan positions Singapore to achieve its long-term aspiration of **net-zero emissions by 2050**.

What is Net Zero and Carbon Neutrality?

- Net-zero commitment requires a company to reduce its greenhouse gas emissions across all areas of business by making operational changes.
- Carbon neutrality imposes fewer constraints. A company can achieve this by offsetting its carbon dioxide emissions, often through purchasing carbon credits. This does not necessarily require changing business practices.
- In essence, achieving net zero requires companies to change or adapt their practices, while carbon neutrality allows for more flexibility in achieving emission reductions.

BUILDING OWNERS

Support the Singapore Green Building Masterplan (SGBMP) managed by the Building and Construction Authority (BCA). The SGBMP unites our ambitions for a sustainable built environment, driving us towards a greener, more resilient Singapore targets:

- By 2030, to green 80% of Singapore's buildings (by Gross Floor Area).
- From 2030, to have 80% of new buildings (by Gross Floor Area) to be Super Low Energy buildings.
- By 2030, to see best-in-class green buildings achieve an 80% improvement in energy efficiency.

VEHICLE OWNERS

Contribute to the Electric Vehicle (EV) Roadmap by transitioning fleets to EVs, installing EV charging points at premises, and encouraging staff and visitors to use cleaner transportation options. Targets:

- By 2025, new registrations of diesel cars and taxis to cease, and all HDB towns to be EV-ready with chargers at all HDB carparks.
- By 2030, all new car and taxi registrations are to be of cleaner-energy models, with 60,000 EV charging points deployed nationwide.
- By 2040, for 100% of vehicles to run on cleaner energy.

Sustainability for Every Business

Not a building or vehicle owner? This playbook is packed with practical guides for all tourism businesses to reduce their carbon footprint in other ways. Every business has a role to play in Singapore's journey towards net-zero emissions.

Reap Long-Term Cost Savings

Decarbonisation efforts often yield substantial long-term cost savings for companies. While upfront investments may be required, they typically result in reduced operational costs through lower energy consumption and decreased reliance on fossil fuels.

Mandai Wildlife Group

To enhance energy efficiency, the Mandai Wildlife Group implemented a range of initiatives, including passive design strategies that maximise shade and harness prevailing wind directions to reduce the need for active cooling loads. Mandai Wildlife Group also adopted innovative technologies such as high-efficiency magnetic bearing chillers at the Ocean Network Express Penguin Cove and Airbitat units from ST Engineering, which significantly lowered energy consumption and refrigerant use. These collective efforts for energy efficiency across the parks contributed to a reduction in energy intensity from 10.6 kilowatt-hours (kWh) per guest in 2021 to 8.2 kWh per guest in 2023, resulting in an estimated cost savings of $3 million in 2023.

Meet Growing Expectations for Sustainable Businesses

There are growing expectations from consumers and business travellers for tourism businesses to be sustainable. The Booking.com Sustainable Travel 2024 Report revealed that 75% of leisure travellers desire more sustainable travel options, while the Global Business Travel Association Foundation's The State of Climate Action in Business Travel 2023 Report indicated over 60% of companies are selecting or planning to select suppliers based on sustainability criteria.

Address Regulatory Risks

The Mandatory Climate-Related Disclosures have a direct effect on tourism businesses from 2025, where all listed firms will be required to make climate-related disclosures from financial year 2025, followed by large non-listed firms two years after that.

These changes will impact tourism companies that are either listed on the stock exchange or have an annual revenue exceeding S$1 billion and total assets of at least S$500 million.

Key considerations for businesses as new regulations come into effect:

The new mandatory disclosure process will be rolled out in phases, giving companies time to adjust and prepare.

Singapore is aligning its local reporting standards with the International Sustainability Standards Board. This means that disclosures by companies will be globally comparable.

From 2027, listed companies and large non-listed companies will need to obtain external limited assurance, or independent verification, on their Scope 1 and 2 emissions.

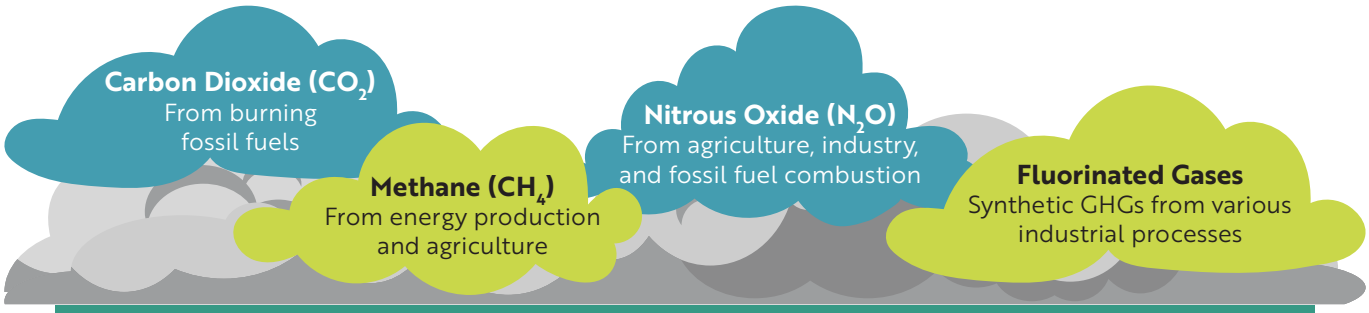
Companies that have already begun sustainability reporting using other internationally recognised standards and frameworks will be granted a three-year transitional period, where they will be exempt from the new requirements.

Companies with clients subject to the above regulations may also need to provide related carbon emissions data.

REDUCING GREENHOUSE GAS EMISSIONS

101 on Carbon Emissions

Greenhouse gases (GHGs) trap heat in the Earth's atmosphere. This heats up the atmosphere and raises the average temperature of the planet. The four main types are:



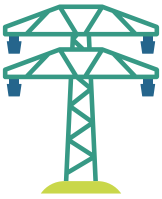
Each gas has a Global Warming Potential (GWP), measuring its heat-trapping ability compared to CO_2 over 100 years. Higher GWP means a greater warming impact per ton emitted.

SCOPE 1:

Direct emissions from sources owned or controlled by reporting entity:

- Stationary combustion (e.g. generator set and cooking equipment)
- Fugitive emissions (e.g. refrigerants leaked from air conditioners and chillers, fire extinguishing agents and direct emissions from fertilisers)
- Mobile combustion (e.g., owned transport fleet)

For tourism businesses that own or operate buildings, Scope 1 largely comes from **supplied town gas**. In Singapore, town gas is mainly used by residential and commercial customers for cooking and heating purposes.



SCOPE 2:

Indirect emissions from purchased energy by reporting entity:

- Purchased electricity
- Steam
- Heat
- Cooling

For tourism businesses, this largely comes from **purchased electricity** from the national grid. Emissions from steam, heat and cooling are generally considered more negligible for the tourism sector, as they are typically small.

SCOPE 3:

All other indirect emissions in the value chain[1], including but not limited to:

- Purchased goods and services
- Upstream and downstream transportation and distribution
- Waste generated
- Business travel
- Employee commuting
- Processing of sold products
- End-of-life treatment of sold products

The material elements of Scope 3 emissions that impact tourism businesses are **waste generated in operations, purchased goods and services, employee commuting and business travel**.[2]

[1] The value chain is the sequence of activities a company undertakes to create and deliver a product or service. It includes everything from design and production to distribution and customer support.

[2] This is based on the World Travel and Tourism Council's Net Zero Roadmap for Travel & Tourism.

Measuring Carbon Emissions

a. **Establishing a Boundary**
Focusing on Scope 1 and 2 emissions provides a practical starting point, as they are directly measurable (e.g., direct emissions from supplied town gas and indirect emissions from purchased electricity). After addressing your Scope 1 and 2 emissions, it is crucial to tackle the more complex but equally significant Scope 3 emissions.

b. **Recommended Baseline Year**
Establishing a baseline year is crucial for effective carbon emissions tracking and reduction. Companies should generally select the earliest year with reliable data that aligns with their business goals and context. Calendar year 2023 serves as an appropriate baseline, as it reflects post-pandemic business activity. The Singapore Hotel Association and Singapore Association of Convention and Exhibition Organisers and Suppliers have both adopted 2023 as their baseline year.

c. **Formula for Calculating Carbon Emissions**
The Annex provides a step-by-step methodology.

d. **Contextualising Carbon Emissions**
After calculating carbon emissions, contextualise this data by selecting an appropriate operational metric to derive the emissions intensity to understand the impact of your carbon footprint.

Knowing your emissions intensity is crucial for relating emissions to organisational scale, setting realistic targets, tracking efficiency improvements over time, as well as comparability to local and international standards.

Formula: Emissions Intensity = Total Emissions ÷ Operational Metric

Important: Choose an operational metric that is most relevant and meaningful to your specific business context. This ensures emissions intensity calculations accurately reflect your company's performance and facilitate more effective decision-making.

Operational metrics to consider using[3]:

 Attractions	Total Visitors per Year Venue Area in Square Feet
 Cruise	Total Number of Passengers (Per Journey)
 Hotels	Total Building Area (Annual) Occupied Rooms (Daily)
 MICE	Total Attendees per Year Venue Area in Square Feet
 All Businesses	Company Revenue (Per Million)

[3] For MICE, this is aligned with the calculation standards in the MICE Venue Sustainability Playbook. For Attractions, it is aligned to the calculation metric with MICE. For Hotels, this is aligned with the Hotel Carbon Measurement Initiative (HCMI). For Cruises, it is aligned with the World Travel & Tourism Council's Net Zero Roadmap for Travel and Tourism (Page 15).

Setting Targets

It is important to set reduction targets that can guide and track your decarbonisation process.

a. If you are just starting out in your decarbonisation journey, begin by setting yearly carbon reduction targets. You can also focus on specific areas of your business operations first. This approach helps to encourage progress towards the main goal, with the aim of developing more rigorous targets in the future.
   i. Estimate your projected carbon footprint and identify solutions that could support the decarbonisation.
   ii. You can set an aspirational target that is aligned with the vision of your organisation or industry. For example, the SME Climate Hub recommends halving your GHG emissions by 2030 and achieving net-zero emissions before 2050, which is aligned with the Green Plan's ambition of net zero by 2050.

b. If you are more advanced in your journey, we recommend that you consider setting targets that are aligned with global initiatives such as the Science Based Targets Initiative for Buildings.

Recommended Interventions

a. **Get Sustainability Certification**
Sustainability certification is a good opportunity to optimise your resource use, while demonstrating your sustainability commitment in a credible way.

FOR BUSINESS OPERATIONS

1. **The GSTC Criteria** serve as the global standards for sustainability in travel and tourism. The Criteria are used for education and awareness-raising, policy-making, measurement and evaluation, and as a basis for certification by businesses, government agencies, and other organisation types. The standards are centred around four pillars:

Sustainable Management

Cultural Impacts

Socioeconomic Impacts

Environmental Impacts

Depending on your industry, you may choose the appropriate Criteria accordingly:

- GSTC Attraction Criteria
- GSTC Industry Criteria for Hotels
- GSTC Industry Criteria for Tour Operators
- GSTC MICE Criteria for Events & Exhibitions

2. **The Singapore MICE Sustainability Certification (MSC) Framework** equips and certifies businesses for adopting sustainable practices in events and raises sustainability standards across Singapore's MICE industry. The standards for MICE event organisers and venues within the framework are GSTC-Recognized.

FOR BUILDING OWNERS

BCA Green Mark 2021 (GM: 2021) is an internationally recognised green building certification scheme tailored for the tropical climate. It aims to raise Singapore's standards in energy performance, while emphasising on maintainability in building design. It also focuses on enhancing a building's resilience to climate change and creating healthier environments for building users.

b. **Planning Your Sustainability Journey**
It is important to understand your businesses' sustainability profile so energy efficiency issues and energy-saving opportunities can be identified and pursued.

Based on feedback from industry on the lack of knowledge of solution providers in the market, STB has compiled a Compendium of Sustainability Solution Providers who can support your decarbonisation journey in the areas of carbon measurement, reduction and reporting.

c. **Adopt Energy-Efficient Solutions**
BCA's Super Low Energy Building Technology Roadmap proposes prioritising passive strategies, active strategies and smart energy management, followed by renewable energy, to reduce energy consumption in buildings.

We have curated energy-efficiency solutions most relevant to tourism businesses from various guides.[4] These solutions can be implemented gradually, allowing businesses to spread costs and adapt operations over time, while reaping immediate benefits in energy savings.

PASSIVE STRATEGIES

Passive strategies are essential for designing energy-efficient buildings. They integrate energy efficiency and project-specific parameters into the building's foundation.

When retrofitting an existing building, implementing passive solutions might be limited and complicated, and must therefore be assessed on a case-by-case basis.

1 Advanced Building Materials

- Energy harvesting materials to capture and utilise ambient energy
- Phase change materials (PCM) for improved insulation and energy efficiency in walls, ceilings or roofs

2 Greenery on the Building's Façade

To allow for temperature regulation

ACTIVE STRATEGIES

In the commercial office building, the majority of the building's electrical consumption is attributed to active mechanical systems used for cooling (60%), mechanical ventilation (10%) and lighting (15%). Another active source of energy consumption is plug loads (25%) due to an extensive use of computers, monitors and servers in commercial buildings, as well as mini refrigerators, televisions and other appliances in guest rooms of hotels.

1 Smart Lighting Systems

- DALI smart lighting control system (50–80% potential savings)
- LED lighting (more energy-efficient and longer-lasting than traditional bulbs)
- Automatic lighting control based on occupancy, reducing energy waste in unoccupied spaces
- Daylight harvesting using light sensors to adjust artificial lighting based on natural light availability

[4] With reference from Powering a Sustainable Future: A Playbook on Scope 2 Emissions Reduction for Singapore Businesses by the Energy Market Authority of Singapore, the MICE Venue Sustainability Playbook by the Singapore Tourism Board and the Super Low Energy Building Technology Roadmap by the Building and Construction Authority.

ACTIVE STRATEGIES

2 Heating, Ventilation, and Air-Conditioning (HVAC) Optimisation

- Internet of Things (IoT)-enabled HVAC systems with automatic adjustments based on occupancy and weather conditions
- Demand-controlled ventilation to adjust ventilation equipment according to occupant needs

Marina Bay Sands

From 2022, room control units (RCU) were installed in newly renovated rooms to optimise a wide array of guest room devices, including air-conditioning, room lighting, curtain control and power sockets. The RCUs adopt a control methodology which uses a range of inputs — such as check-in/check-out status and real-time occupancy — to automate air-conditioning automatically, delivering optimised guest comfort while minimising energy consumption.

3 Energy Auditing and Monitoring

- Detailed energy audits to identify efficiency issues and opportunities
- Installation of energy monitoring systems (energy meters, temperature/light sensors, data loggers)

SMART ENERGY MANAGEMENT

The building management system (BMS) is a control system that can be used to monitor and manage the mechanical, electrical and electromechanical services in a facility. Smart building technologies have shown potential in saving an estimated 8–18% of total building energy consumption and providing a host of non-energy benefits.

1 Smart Building Management Systems (BMS)

- Incorporates IoT, advanced sensors, and big data analytics
- Monitors and manages mechanical, electrical, and electromechanical services
- Includes occupancy-based and scheduled strategies for HVAC and lighting control
- Enables data-driven optimisation and model predictive control of multiple systems

POWERING CHANGE: EXPLORING ALTERNATIVE ENERGY SOURCES

What is Renewable Energy?

Renewable energy comes from natural sources that replenish faster than we use them. These abundant resources are all around us and include solar energy from the sun, wind energy from air currents, geothermal energy from the Earth's heat, hydropower from flowing water, ocean energy from tides and waves, and bioenergy from organic matter. By harnessing these sustainable sources, we can power our world while reducing our reliance on finite fossil fuels.

What is Singapore's Renewable Energy Potential?

With year-round sunshine, solar energy is Singapore's most promising renewable energy source. It is clean, generates no emissions and can boost our energy security.

Being in the tropical sun belt, Singapore enjoys an average annual solar irradiance of 1,580 kWh/m^2/year which can be utilised through photovoltaic (PV), by converting sunlight into electricity and solar thermal, producing hot water.

- The Energy Market Authority's aim is to potentially achieve 1.5 GWp of solar deployment by 2025, and at least 2 GWp by 2030. This is equivalent to meeting the annual electricity needs of around 260,000 households in Singapore, or around 2% of our total projected electricity demand in 2025.
- The Solar Energy Research Institute of Singapore has estimated that Singapore has the technical potential to deploy up to 8.6 GWp by 2050, which would constitute around 10% of the projected electricity demand then.

PV Solutions

Types of Solar PV

Technology	Description
High efficiency PV	Higher performance PV for better yield per m^2.

Technology	Efficiency (%)	Manufacturers (examples)
High-efficiency Si	19 - 22	Panasonic, SunPower
Mono-Si	17 - 19	Jinko Solar, Trina Solar, Kyocera, Hanwha-SolarOne, Canadian Solar, Hanwha-Q-Cells, LG
Multi-Si	16 - 18	REC Solar, Jinko Solar, Trina Solar, Soltech, Mitsubishi, Sunrise Solartec, Motech, Mission Solar, MegaCell, JA Solar, Yingli, Gintech, Suniva, Hyundai, Suntech, LG
Thin Film	14 - 16	Solar Frontier (CIGS), First Solar (CdTe)

Technology	Description
Perovskite PV technologies	• Perovskite solar cells are flexible. • They can be painted or sprayed on a surface from an ink solution or churned out of a printer like a newspaper, allowing them to be attached to virtually anywhere.
Co-location of solar PV and greenery	• Use of both greenery and solar PV on the same roof space, allowing PV output increase of 3% due to the extra cooling from the green roof.
Anti-degradation system	• Degradation mechanism to slow down degradation of PV panel over time and make it more durable and efficient.

Case Study

PARKROYAL COLLECTION Marina Bay, Singapore

The hotel has installed 210 solar panels on its rooftop, generating around 350 kWh daily. This renewable energy powers the hotel's operations, reducing overall electricity consumption by around 1.4%, resulting in cost savings of close to SGD 33,500 per year.

OFFSETTING FOR IMPACT: THE CARBON OFFSET STRATEGY

Companies should prioritise direct decarbonisation measures, before considering using offsets on the remaining emissions to meet voluntary climate commitments.

Carbon Credits

Represent measurable carbon emission reductions or removals (in tonnes of CO_2 equivalent). They are generated by projects that absorb carbon (e.g., reforestation) or reduce emissions (e.g., renewable energy). Carbon markets enable the trading of these credits, allowing businesses to buy, sell and exchange them as part of their emissions management strategies.

Since 2024, under Singapore's International Carbon Credit (ICC) framework, carbon tax-liable companies in Singapore can use eligible ICCs to offset up to 5% of their taxable emissions. These ICCs must comply with Article 6 of the Paris Agreement and meet seven principles to demonstrate environmental integrity. For more information, refer to Singapore's Carbon Markets Cooperation website.

- Companies should use high-quality carbon credits for greater confidence that the claimed emissions reductions or removals are realised. Singapore's International Carbon Credit (ICC) Framework lists seven principles that ICCs must meet to demonstrate environmental integrity. These principles are: Not double counted, Additional, Real, Quantified and verified, Permanent, No net harm and No leakage. To learn more about these principles, companies can refer to Singapore's Eligibility Criteria.
- Companies should make informed decisions when purchasing carbon credits, such as by referencing third-party standard-setting bodies and ratings agencies, conducting due diligence and managing the risk of credits as a portfolio.

Renewable Energy Certificates (RECs)

RECs (also known as Energy Attribute Certificates) target Scope 2 emissions from purchased electricity. These are tradable instruments representing one unit of renewable energy generation, typically one megawatt-hour (MWh). They track and aggregate energy attributes, allowing businesses to claim the use of renewable energy. RECs can be purchased bundled with or separate from the actual flow of electricity, depending on the issuing system and market.

- The Singapore Standards Code of Practice for Renewable Energy Certificates (SS 673) outlines the framework for RECs in Singapore.

Do Carbon Offsets Count Towards Being Net Zero?

Companies that wish to make specific claims about their sustainability performance (e.g., 'carbon neutral' or 'net-zero' claims) should make clear which standard they are referencing for such claims and adhere to the specifications of the standard accordingly.

SMALL CHANGE, LARGE IMPACT: YOUR QUICK-START GUIDE TO EMISSION REDUCTION

Carbon emissions reduction begins with small steps. Every level of your tourism organisation can contribute to meaningful change, creating a collective impact that drives significant emissions reductions.

AT THE INDIVIDUAL LEVEL

- Encourage energy efficiency. Do switch off computers at power sockets and remind your colleagues to do so as well. Consider using smart Wi-Fi timer plugs with remote control, which eliminate standby power and allow remote management via apps.
- Embrace greener transport options by choosing 'Walk, Cycle, Ride' options. Walk short distances, cycle on dedicated paths, or take MRTs and buses for longer journeys. When taking private transport, consider EVs to support the transition to cleaner energy.
- Sustainable Food Choices. Local Produce or plant-based options for packed lunches is fresher and has a lower carbon footprint due to shorter transport distances.
- Organise a 'Green Week' at your company, featuring challenges like a zero-waste lunch day or a 'Bike to Work' event. Create an eco-tips bulletin board in a common area, with practical office-specific sustainability ideas.

AT THE CORPORATE LEVEL

- Communicate the company's decarbonisation goals, emphasising the importance of everyone's individual contribution.
- Consider switching to EVs for your existing company fleet and gradually increase EV adoption as charging infrastructure expands. Leverage the Heavy Vehicle Zero Emissions Scheme announced at Budget 2025 to defray adoption and implementation costs.
- Consider carbon offsets for business travel such as the Changi Carbon Offsets Programme.
- Companies can also engage in corporate programmes such as the Energy Efficiency National Partnership (EENP) which helps corporations enhance competitiveness and reduce their carbon footprint. Under this voluntary partnership programme, companies work towards implementing an in-house energy management system (EnMS) to monitor and optimise energy use, appointing an energy manager, developing policies, setting targets and executing efficiency improvement plans.

YOUR DECARBONISATION TOOLKIT: ESSENTIAL RESOURCES

GRANTS AND PROGRAMMES

Sustainability Reporting Grant (SRG) by Enterprise Singapore and the Economic Development Board

The SRG supports companies in developing their first sustainability report that incorporates climate-related disclosures consistent with the International Sustainability Standards Board (ISSB) standards.

Business Improvement Fund (BIF) by Singapore Tourism Board

BIF promotes innovation while driving productivity and competitiveness through technology adoption and business redesign. For example, projects that improve resource efficiency and competitiveness or pursue sustainability certification may qualify.

Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0) by Building and Construction Authority

GMIS-EB 2.0 helps building owners improve energy performance. It reduces upfront capital costs for energy efficiency retrofits. The scheme also improves returns on investment for buildings aiming to meet super low energy or zero energy standards.

Catalysing Sustainability in Singapore's SMEs Programme by Carbon Disclosure Project

The programme provides local firms with a structured framework for environmental data disclosure, offering sector-specific benchmarking to guide strategic improvements.

SME Sustainability Reporting Programme by Enterprise Singapore

The SME Sustainability Reporting Programme (SME SRP) supports local non-listed SMEs to develop their first sustainability reports.

CALCULATORS

Tourism businesses can self-calculate your carbon emissions using the formula provided in the Annex or the following calculators.

Hotels

Hotel Carbon Measurement Initiative (HCMI) by Sustainable Hospitality Alliance

HCMI is a methodology for hotels to calculate the carbon footprint of hotel stays and meetings in their properties.

MICE

NZCE Measurement Methodology by Net Zero Carbon Events

The NZCE Measurement Methodology serves as an essential source for understanding and quantifying event-level emissions. It provides guidance on measurement for the main identified event emission source categories.

All Businesses

Gprnt by the Monetary Authority of Singapore

Gprnt (pronounced "greenprint") tackles the global ESG data gap by equipping businesses of all sizes with tools to collect, report, and take action on their sustainability data.

COURSES

These programmes are designed to equip your company with the knowledge and tools needed to embark on your sustainability journey effectively. Explore our full range of courses here!

Carbon Management

1. **Carbon Accounting & GHG Management – Key to a Low-Carbon Future** by UN Global Compact Network Singapore (GCNS), supported by Enterprise Singapore

   This programme builds skills in carbon accounting and greenhouse gas management by teaching how to use GCNS' in-house resources such as the Carbon & Emissions Recording Tool (CERT) to track and manage your emissions easily. In addition, learn about practical solutions to reduce emissions.

2. **Climate Change and Sustainability: Leveraging Carbon Market Initiatives for Business** by National University of Singapore

   This programme covers pathways to climate-neutrality, approaches for reducing emissions and the strategic use of carbon credits.

Sustainability Reporting and Disclosures

1. **Net Zero and Corporate Climate Disclosures** by National University of Singapore

   This introductory course delves into the science, principles and fundamentals of corporate climate disclosures.

2. **Sustainability Reporting And Strategic Communication** by Singapore Management University

   This course provides a comprehensive guide to creating and leveraging sustainability reports, covering frameworks, metrics, stakeholder communication and practical implementation strategies.

OTHER RESOURCES

Super Low Energy Building Technology Roadmap by Building and Construction Authority

The roadmap provides strategic guidance to design and develop cost-effective super low energy (SLE) buildings through technology forecasting and trend analysis.

MICE Venue Sustainability Playbook by Singapore Tourism Board

This playbook offers actionable strategies for MICE venues to boost energy efficiency, optimise waste management and conserve water.

Decarbonisation for Singapore Enterprises Playbook by UN Global Compact Network Singapore, with support from Enterprise Singapore and National Environment Agency

This playbook shares the benefits of reducing emissions and how businesses can kickstart their journey towards low-carbon operations.

Powering a Sustainable Future: A Playbook on Scope 2 Emissions Reduction for Singapore Businesses by Enterprise Singapore, Energy Market Authority of Singapore, and Energy Research Institute @ Nanyang Technological University (ERI@N)

This playbook provides SMEs with practical strategies to reduce Scope 2 emissions from electricity use. It offers actionable solutions for energy efficiency, supporting individual carbon footprint reduction and broader power sector decarbonisation goals.

Singapore Hotel Sustainability Playbook by Singapore Hotel Association

The playbook is designed to cater to hotels at different stages of their journey, providing best practices and case studies to help hotels make informed decisions on sustainable practices which they can implement in their operations.

ANNEX: HOW TO CALCULATE YOUR SCOPE 1 AND 2 EMISSIONS

SOURCES OF DATA

Two main sources of data for your company to track across your utility bills:

1. Annual town gas sales in kilowatt-hours (kWh)
2. Annual electricity sales in kilowatt-hours (kWh)

EXAMPLE OF COMPANY ABC IN CALENDAR YEAR 2023

1. Annual town gas consumption of 22,905 kWh
2. Annual electricity consumption of 79,705 kWh

CONVERT TOWN GAS CONSUMPTION DATA TO SCOPE 1 EMISSIONS

Town gas produces three GHGs: CO_2, CH_4, and N_2O. Calculate each separately, then aggregate to get total carbon emissions.

Step 1: CO_2 Emissions

1. Convert sales data from kilowatt-hours (kWh) to gigawatt-hours (GWh). (To get GWh, divide your kWh figure by 1,000,000. For example, 5,000,000 kWh = 5 GWh.)
2. Convert to energy consumption (TJ) by applying the appropriate conversion factor: 3.6 TJ/unit
3. Calculate carbon content: Energy consumption (TJ) × 15.2 tC/TJ
4. Convert to carbon content (Gg C): Divide result by 1,000
5. Calculate CO_2 emissions: Gg C × 44/12

EXAMPLE

1. 22,905 / 1,000,000 = 0.0229 GWh
2. Energy consumption = 0.0229 x 3.6 = 0.08244 TJ
3. Carbon content = 0.08244 x 15.2 = 1.253 t C
4. Carbon content = 1.253 / 1,000 = 0.00125 Gg C
5. CO_2 emissions = 0.00125 x (44/12) = 0.00458 $kgCO_2$

Step 2: CH_4 Emissions

1. Use energy consumption (TJ) from Step 1b.
2. Multiply by CH_4 Global Warming Potential (GWP) of 27. For up-to-date GWP of CH_4, tourism businesses can check it here.

(A reminder: The Global Warming Potential (GWP) compares how much heat a gas traps compared to carbon dioxide. A higher GWP means the gas warms the Earth more. For example, if a gas has a GWP of 27, it traps 27 times more heat than CO_2 over a set time period.)

EXAMPLE

1. Energy consumption = 0.08244 TJ
2. CH_4 Emissions = 0.08244 x 27 = 2.226 $kgCO_2$

CONVERT TOWN GAS CONSUMPTION DATA TO SCOPE 1 EMISSIONS

Step 3: N_2O Emissions

1. Use energy consumption (TJ) from Step 1b.
2. Multiply by N_2O Global Warming Potential (GWP) of 273.
   For up-to-date GWP of N_2O, tourism businesses can refer to GHG Protocol's Intergovernmental Panel on Climate Change (IPCC) Global Warming Potential Values.

EXAMPLE

1. Energy consumption = 0.08244 TJ
2. N_2O Emissions = 0.08244 x 273 = 22.51 $kgCO_2$

Step 4: Total CO_2 Equivalent Emissions

1. Add results from Steps 1, 2, and 3

(Finally, we need to aggregate our calculations for each type of emission to get the total carbon emissions for Scope 1.)

EXAMPLE

1. Total CO_2 Equivalent Emissions = 0.00458 + 2.226 + 22.51 = **24.74 $kgCO_2$**

CONVERT ELECTRICITY CONSUMPTION DATA TO SCOPE 2 EMISSIONS

Formula: Carbon Emissions ($kgCO_2$) = Sectoral Electricity Consumption (kWh) × Average Operating Margin (OM) GEF Figures ($kgCO_2$/kWh)

For up-to-date annual OM figures, refer to the 'Grid Emission Factor' on the Energy Market Authority's website. The Grid Emission Factor (GEF) measures the average CO_2 emissions emitted per unit of net electricity generation in the system by all grid-connected power units. The GEF includes generation technologies from main power producers (e.g., combined cycle power plants and waste-to-energy) and autoproducers (e.g., embedded co-generation plants and solar)[5].

EXAMPLE

1. Carbon Emissions = 79,705 kWh x 0.412 $kgCO_2$/kWh = **32,838.46 $kgCO_2$**

[5] Autoproducers refers to enterprises that produce electricity but for whom the production is not their principal activity.

REFERENCES

Why Decarbonise?

1. https://www.greenplan.gov.sg/
2. https://www1.bca.gov.sg/buildsg/sustainability/green-building-masterplans
3. https://www.channelnewsasia.com/singapore/singapore-mandatory-climate-disclosures-listed-companies-2025-4155586
4. https://www.businesstimes.com.sg/esg/large-non-listed-companies-required-to-make-climate-disclosures-from-fy2027

Reducing Greenhouse Gas Emissions

1. https://www.epa.gov/ghgemissions/overview-greenhouse-gases
2. https://ghgprotocol.org/corporate-standard
3. https://action.wttc.org/climate-environment
4. https://carbonbetter.com/story/carbon-emissions-intensity/
5. https://www.nationalgrid.com/stories/energy-explained/carbon-neutral-vs-net-zero-understanding-difference

Powering Change

1. https://www.un.org/en/climatechange/what-is-renewable-energy

Small Change, Large Impact

1. https://carbonoffsets.changiairport.com/
2. https://www.nea.gov.sg/programmes-grants/programmes/for-corporate