SINGAPORE'S FIRST BIENNIAL TRANSPARENCY REPORT *2024*

UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

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NOTES ON USING THIS DOCUMENT
As a developing country Party to the United Nations Framework Convention on Climate Change (UNFCCC), Singapore is obliged to submit our Biennial Transparency Report (BTR) every two years, with the first submission to the UNFCCC by 31 December 2024.

The BTR presents Singapore's Greenhouse Gas (GHG) Inventory from 2000 to 2022, projections of GHG emissions and removals up to 2030, and planned, adopted, and implemented mitigation actions till 2030.

This document was prepared in accordance with the UNFCCC modalities, procedures and guidelines (MPGs) for the Enhanced Transparency Framework (annex to decision 18/CMA.1).

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FOREWORD

Mr Teo Chee Hean
Senior Minister
Chairman of the Inter-Ministerial Committee on Climate Change (IMCCC)

We stand at a critical crossroads. The first Global Stocktake (GST) had made clear how far away the world is from achieving the Paris Agreement's goals. With the widespread and rapidly intensifying effects of climate change, Parties must take more decisive action to secure our collective future.

As a low-lying island city-state, climate change is an existential threat for Singapore. Even though we account for only 0.1% of global emissions, Singapore is deeply committed to the global effort to combat climate change and is continually working to overcome our constraints to raise our climate ambition.

In October 2022, Singapore pledged to achieve net zero emissions by 2050, contingent on technological maturity and effective international cooperation. We also announced that we will enhance our 2030 Nationally Determined Contribution (NDC) to reduce emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.

Since then, we have been focusing our efforts on implementation to ensure that our climate targets are backed by concrete policies and plans. At the start of this year, we raised our carbon tax level five-fold to S$25 per tonne of emissions. We will progressively raise it to S$50-80 per tonne by 2030[1], making our carbon tax one of the highest in Asia. We believe that economic growth should not come at the expense of additional emissions. We have mandated zero vehicle population growth since 2018 and for all vehicles to run on clean energy by 2040. We have also put in place regulations for all new and repowered natural gas power plants to be at least 10% more efficient and at least 30% hydrogen-compatible by volume. These are just a few examples of the wide gamut of measures Singapore has undertaken.

Beyond domestic climate action, Singapore is also committed to working with other Parties to deliver on our ambitions through regional partnerships. At COP-28, Singapore announced Financing Asia's Transition Partnerships (FAST-P), a blended finance initiative that aims to mobilise up to US$5 billion to finance transition and marginally bankable green projects in Asia. In 2022, Singapore launched the Sustainability Action Package to offer capacity-building support for fellow developing countries across a range of sustainability-related topics. We have also been funding the Singapore branch of the Intergovernmental Panel on Climate Change (IPCC) Working Group II Technical Support Unit (TSU) since February 2024.

Underpinning effective and credible climate action is transparency. The Enhanced Transparency Framework (ETF) represents a clear global commitment to keep every country on track to achieving their emissions reduction targets, and the inaugural Biennial Transparency Report (BTR) will demonstrate our resolve in advancing much needed global action.

Singapore's First BTR highlights the progress we have made and the efforts we have undertaken to meet our emissions reduction pledges. While we have come a long way, there is still much more that we must do. We will press ahead to ensure a greener world for our future generations.

[1] This is equivalent to US$37.29 to US$59.66. Conversion from S$ to US$ based on the monthly exchange rate as of Jan 2024.

EXECUTIVE SUMMARY

Singapore continues to build on a long-standing, comprehensive national approach that seeks to achieve sustainable growth alongside environmental protection. This approach has allowed us to limit our growth in emissions and stay on track to achieve our international commitments, notwithstanding our geographical constraints.

National Circumstances

Singapore is a small and low-lying island city-state vulnerable to the effects of climate change. With a total land area (including that of smaller surrounding islands) of about 735.6 km^2[2], Singapore's population density of over 8,000 persons per km^2 is one of the highest in the world.

Due to Singapore's small size and dense urban landscape, there are challenges to using alternative energy sources such as hydroelectricity, wind, solar and nuclear energy. These difficulties in transitioning to alternative energy sources are recognised by the UNFCCC. Solar remains the most viable source of renewable energy in Singapore, and we aim to accelerate the deployment of solar energy despite challenges arising from our national circumstances.

Institutional Arrangements

Climate change is an issue with many dimensions that cut across the responsibilities of several ministries. The IMCCC, chaired by Mr Teo Chee Hean, Senior Minister and Coordinating Minister for National Security, oversees the whole-of-government (WOG) coordination on climate change policies. The National Climate Change Secretariat (NCCS) is a dedicated unit under the Prime Minister's Office (PMO) Strategy Group that serves as the secretariat to the IMCCC.

Greenhouse Gas (GHG) Inventory

Singapore's GHG emissions for 2022 totalled 58,587 gigagram (Gg) CO_2 equivalent. Carbon dioxide (CO_2) accounted for 86% of total emissions. Non-CO_2 gases such as methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) accounted for the remaining 14% of total emissions. This includes HFC emissions from the refrigeration and air-conditioning (RAC) sector that are newly added to Singapore's GHG inventory.

Mitigation Measures

Singapore achieved our Copenhagen pledge to reduce our emissions by 16% below our BAU level in 2020. In October 2022, Singapore pledged to achieve net zero emissions by 2050, contingent on technological maturity and effective international cooperation. We also announced that we will enhance our 2030 NDC to reduce emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.

A key pillar of Singapore's strategy to mitigate GHG emissions is to improve energy efficiency across different sectors of the economy. Singapore does not subsidise energy costs, and has taken steps to use a cleaner fuel mix for electricity generation, switching from fuel oil to natural gas. Natural gas, the cleanest fossil fuel, currently constitutes about 95% of our fuel mix for electricity generation. To decarbonise the power sector, Singapore will tap on "Four Switches". Beyond natural gas, we will harness solar, regional power grids and emerging low-carbon technologies.

Singapore will continue to push ahead with mitigation efforts in the different sectors as part of the Green Plan, which is a whole-of-nation movement to advance Singapore's national agenda on sustainable development.

In addition, Singapore has implemented a carbon tax which currently covers 80% of our total GHG emissions. At the start of this year, we raised our carbon tax level five-fold to S$25 or US$18.65 per tonne of emissions. We will progressively raise it to S$50 to S$80 or US$37.29 to US$59.66 per tonne by 2030. The carbon tax will complement our existing mitigation efforts to meet our climate pledge under the Paris Agreement.

Vulnerability and Adaptation Measures

As a relatively low-lying, densely populated island in the tropics, Singapore is naturally vulnerable to the impacts of climate change. Singapore takes a proactive, long-term approach towards climate change adaptation. Climate change resilience goes beyond physical adaptation, and must include building resilient mindsets as well as collective action to safeguard our environment. Additionally, our trade-dependent economy increases our exposure and vulnerability to the volatilities induced by climate change. Climate resilience and adaptation plans will be continuously reviewed and adjusted as new knowledge and information on the effects of climate change become available.

Concluding Remarks

Singapore remains committed to doing our part in this global crisis. We will advance on this sustainability journey together as a nation, making a decisive move to achieve net zero by 2050 and at the same time building up our climate resilience and adaptation. As a responsible member of the global community, Singapore will continue to work at the international, regional and bilateral levels to support collective global efforts to address the challenges of climate change.

[2] Based on data from the Singapore Land Authority as of June 2024.

Chapter 1

NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

The mangroves and mudflats along the western shore of Pulau Semakau harbour rare and unusual plants and animals. The preservation of this biodiversity makes Semakau Landfill a unique location where Singaporeans can discover nature while learning about the need to preserve the environment by reducing and recycling their waste.

Chapter 1.

National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

The most significant GHG emitted in Singapore is CO_2, primarily produced by the burning of fossil fuels to generate energy used by the industry, building, household and transport sectors. Given Singapore's small land size and highly urbanised landscape, GHG emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector are negligible in comparison with other economic sectors and the size of carbon stocks.

A.

Overview of greenhouse gas emissions (2000–2022)

From 2000 to 2023, Singapore's economy grew at a compound annual growth rate (CAGR) of 4.6% in real terms, bringing real GDP levels (in chained (2015) dollars) from S$193 billion in 2000 to S$532 billion in 2023. In the same period, Singapore's GHG emissions grew at a slower rate with a CAGR of 1.8%, from 2000 to 2022.

As an open trade-oriented economy, Singapore's GDP is sensitive to changes in the global economy and its growth volatility is much higher than that of larger economies[3]. Since emissions attributable to economic activity make up a large proportion of Singapore's emissions, our emissions trajectory can be affected by external economic conditions and events. For example, the uptick in emissions in 2010 can be attributed to Singapore's strong recovery after the Global Financial Crisis in 2008 and 2009, when real GDP rebounded by 14.5% in 2010 after growing marginally at 0.1% in 2009.

Overall, both emissions intensity and energy intensity have improved by 45% from 2000 to 2022. Some of the key policy initiatives implemented during this period include a switch in fuel mix from fuel oil to natural gas, a cleaner fuel source, as well as various schemes promoting energy efficiency. These include the BCA Green Mark (GM) Scheme, a green building rating system, and co-funding and financing schemes that promote the development of environmentally friendly buildings.

Bishan-Ang Mo Kio Park, one of the largest urban parks in central Singapore, features a naturalised meandering river with lush banks of wildflowers ideal for picnics and gatherings.

[3] Is Smoother Always Better? Understanding Singapore's Volatility-Growth Relationship, Shruthi Jayaram, Titus Lee and Thia Jang Ping, Economic Survey of Singapore 2009

Figure 1: Time Series of GHG Emissions

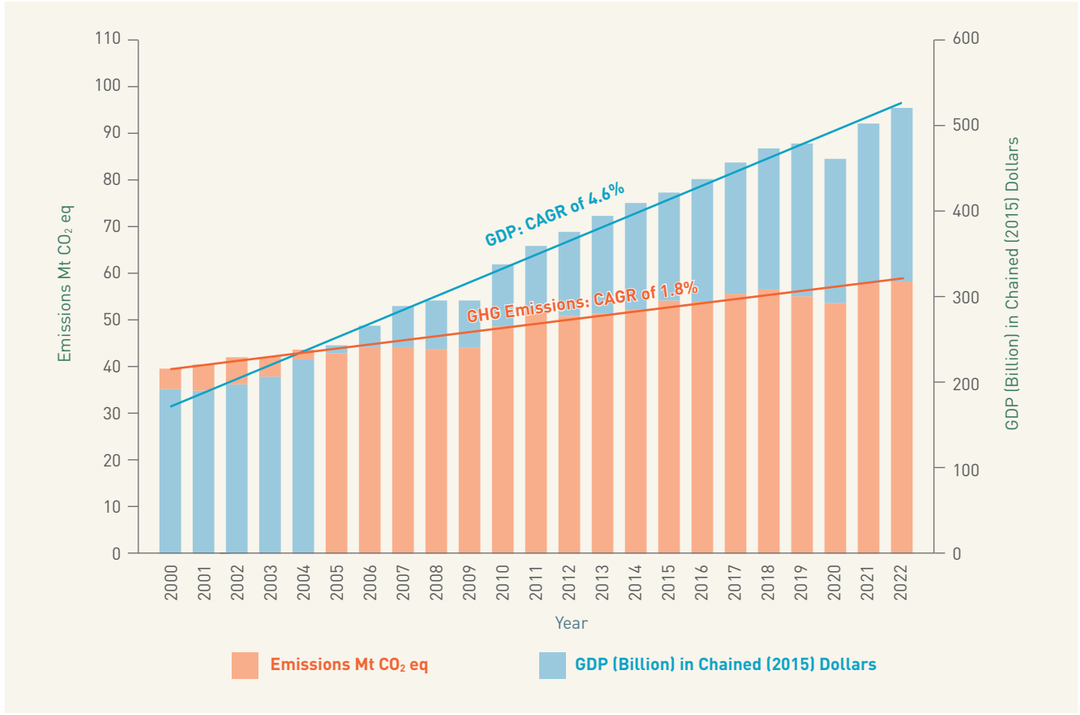
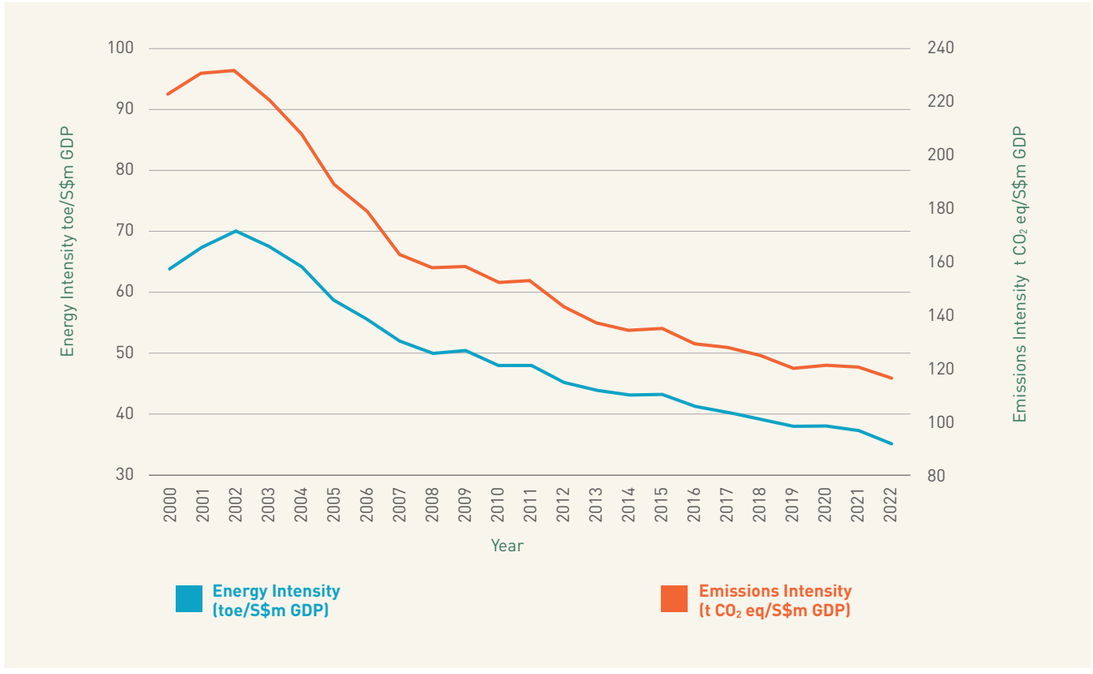


Figure 2: Time Series of Energy and Emissions Intensity



B.

GHG emissions and removal by GHG type and Intergovernmental Panel on Climate Change (IPCC) sectors

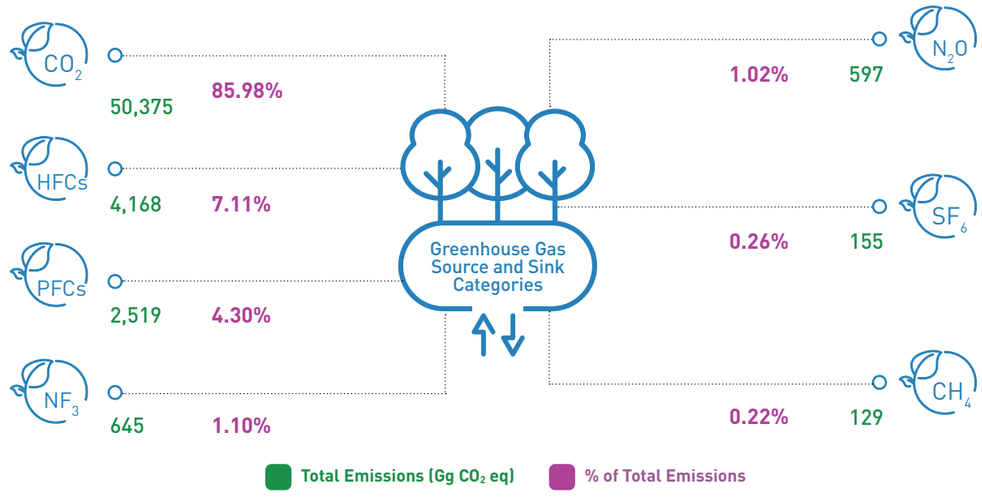
Singapore's emissions for CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 were estimated for the following five sectors, namely:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture
- Land Use, Land-Use Change and Forestry (LULUCF)
- Waste

The overview of emissions by type of gas and sector for 2022 is shown in Table 1 and Table 2.

Greenhouse Gas Source and Sink Categories

Table 1: Overview of emissions by gas type



IPCC Sectors

Table 2: Overview of emissions by IPCC sectors

Singapore's GHG emissions for 2022 totalled 58,587 Gg CO_2 eq. A breakdown of the total GHG emissions by IPCC sectors and GHG type in Gg CO_2 eq can be found in Table 3 below with a detailed report of each sector found in the National Inventory Document (NID) 2024.

Table 3: Singapore's 2022 GHG emissions by IPCC sector and GHG types

Greenhouse Gas Source and Sink Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Total (Net)
	CO_2 equivalents (Gg)							
Total (Net) National Emissions	**50,374.84**	**129.14**	**596.97**	**4,167.77**	**2,518.74**	**154.58**	**644.77**	**58,586.82**
1 Energy	**48,729.46**	**111.64**	**227.31**					**49,068.42**
1.A. Fuel combustion activities	48,164.53	63.67	226.31					48,454.51
1.A.1. Energy Industries	21,335.93	15.45	69.41					21,420.79
1.A.2. Manufacturing industries and construction	18,952.35	11.60	16.44					18,980.38
1.A.3. Transport	6,862.79	34.58	138.19					7,035.56
1.A.4. Other sectors	763.23	1.83	0.35					765.41
1.A.5. Others	250.23	0.21	1.92					252.36
1.B. Fugitive Emissions from Fuels	564.93	47.97	1.01					613.91
1.B.1. Solid fuels	IE	NO	NO					IE
1.B.2. Oil and Natural Gas and other emissions from energy production	564.93	47.97	1.01					613.91
1.C. CO_2 Transport and storage	NO	NO	NO					NO
2 Industrial Processes and Product Uses	**1,310.38**	**13.00**	**278.82**	**4,167.77**	**2,518.74**	**154.58**	**644.77**	**9,088.05**
2.A. Mineral Industry	NO							NO
2.B. Chemical industry	1,288.04	13.00	14.94	NO	NO	NO	NO	1,315.97
2.C. Metal industry	IE	NA	NO					IE
2.D. Non-energy products from fuels and solvent use	0.99	NO	NO					0.99
2.E. Electronics industry	IE	IE	263.88	117.45	2,518.74	128.84	644.77	3,673.67
2.F. Product uses as substitutes for ODS				4,050.33	NO	NO	NO	4,050.33
2.G. Other product manufacture and use	NO	NO	NO	NO	NO	25.74	NO	25.74
2.H. Other	21.35	IE	IE	NO	NO	NO	NO	21.35
3 Agriculture	**0.07**	**2.70**	**5.27**					**8.04**
4 Land Use, Land-Use Change and Forestry	**30.80**	**NO**	**7.31**					**38.12**
5 Waste	**304.14**	**1.80**	**78.26**					**384.19**
5.A. Solid Waste Disposal		1.80						1.80
5.B. Biological treatment of solid waste		IE, NE						IE, NE
5.C. Incineration and Open Burning of Waste	304.14	0.00	2.50					306.64
5.D. Wastewater Treatment and Discharge		NO	75.75					75.75
Information Item								
CO_2 from Biomass Combustion for Energy Production	2,700.64							2,700.64

Notation keys:
C= Confidential, IE = Included elsewhere, NE= Not estimated, NA = Not applicable and NO= Not occurring

Methodology used

2006 IPCC Guidelines

Singapore's emissions were estimated using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories. Emissions estimates were based on the sectoral approach. Most emissions estimates were derived using Tier 1 methodology provided in the 2006 IPCC Guidelines. Unless otherwise stated, all default conversion and emission factors used were taken from the 2006 IPCC Guidelines.

A higher tier methodology was used where data was available. Specifically, higher tiers and country/plant-specific emission factors were used for estimating fugitive emissions from oil and natural gas, petrochemical and chemical industries emissions from some categories of IPPU, CH_4 emissions from solid waste disposal and CO_2 emissions from the incineration of waste.

Emissions from the LULUCF sector were also obtained mainly from using Tier 2 and Tier 3 methodologies based on the 2006 IPCC Guidelines and the 2013 Supplement to the 2006 IPCC Guidelines: Wetlands (Wetlands Supplement), where applicable.

IPCC Good Practice Guidance

The CO_2 emissions from hazardous waste incineration were estimated using Tier 1 methodology from the 2006 IPCC Guidelines, with default emission factors from the IPCC Good Practice Guidance due to unavailable factors in the 2006 IPCC Guidelines. The use of 2006 IPCC Guidelines applied also improves the transparency, consistency, comparability, completeness and confidence in the national GHG inventory of emissions estimates. More information on the use of tiers and methodology can be found in the NID 2024.

Global Warming Potentials

The estimated CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 emissions were converted to CO_2 equivalent (CO_2 eq) using the 100-year time-horizon GWP values from the IPCC 5th Assessment Report (AR5), as presented in Table 4 below.

Table 4: 100-year time-horizon GWP values from the IPCC AR5

Greenhouse Gas	Chemical Formula	GWP
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265
Hydrofluorocarbons	HFCs	116 -12,400
Perfluorocarbons	PFCs	6,630 - 11,100
Sulphur Hexafluoride	SF_6	23,500
Nitrogen Trifluoride	NF_3	16,100

Precursors

Emissions of precursors such as carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs) and other gases such as sulphur dioxide (SO_2) are not included in the inventory. The levels of these gases in the air are currently monitored by a network of ambient air quality monitoring stations. CO, NOx and SO_2 are considered air pollutants and are regulated under the Environmental Protection and Management Act (EPMA), which stipulates emission standards for these pollutants. Strict enforcement programmes and air quality monitoring have helped to ensure that the emissions of all these precursors are minimised and that air quality remains good.

Breakdown of emissions by IPCC sector

1- Energy

The combustion of fossil fuels to generate energy is the major source of GHG emissions in Singapore. The amount of emissions emitted from the energy sector in 2022 was 49,068 Gg CO_2 eq and the breakdown can be found in Table 5.

According to the 2006 IPCC Guidelines, CO_2 emissions from waste incineration are estimated from the portion of the waste that is fossil-based, and the non-fossil-based fraction is excluded. As heat from the incineration of waste is recovered to produce electricity in Singapore, CO_2, CH_4 and N_2O emissions from waste incineration are reported in the energy sector. Heat from the incineration of sludge from wastewater processes is also recovered in Singapore, hence only CH_4 and N_2O emissions from sludge incineration are reported in the energy sector[4]. Biomass combusted for energy recovery has been reported in Table 3 as an information item and excluded from the national totals.

Jurong Island is supporting Singapore's sustainability efforts through increasing solar deployment and enabling carbon capture, utilisation and storage (CCUS)

Table 5: Total GHG emissions from Energy sector in 2022

Categories	Total GHG emissions (Gg CO_2 eq)	% of Total Emissions from Energy
1 - Energy	49,068	100.00%
1.A. - Fuel combustion activities	48,455	98.75%
1.A.1. Energy industries	21,421	43.65%
1.A.2. Manufacturing industries and construction	18,980	38.68%
1.A.3. Transport	7,036	14.34%
1.A.4. Other sectors	765	1.56%
1.A.5. Other	252	0.51%
1.B. - Fugitive emissions from fuels	614	1.25%
1.B.1. Solid fuels	IE	
1.B.2. Oil and natural gas and other emissions from energy production	614	1.26%
1.C. - CO_2 Transport and storage	NO	

Notation keys:
IE = Included elsewhere and NO = Not Occurring

[4] More details on the incineration of solid waste and incineration of sludge can be found in the NID 2024 under Chapter 7 Waste section.

2 - Industrial Processes and Product Use

The emissions from the IPPU sector are compiled from the GHG reports submitted by energy-intensive companies in the industrial sector as part of the regulatory requirements under the Energy Conservation Act (ECA) introduced in 2013 and Carbon Pricing Act (CPA) from 1 January 2019 onwards. The amount of emissions from the IPPU sector in 2022 was 9,088 Gg CO_2 eq.

Emissions from the IPPU sector are estimated using a mix of Tier 1, Tier 2 and Tier 3 estimation methods from the 2006 IPCC Guidelines, incorporating plant-specific methodology, activity data and emission factors where data is available. Where default factors were used, they were taken from the 2006 IPCC Guidelines. The report of methods and emission factors used for the emissions estimation for each IPPU source category can be found in NID 2024, Chapter 4.

The two main sources of emissions in the IPPU sector are from 2.F. Product Uses as Substitutes for Ozone Depleting Substances and 2.E. Electronics Industry, contributing to 44.57% and 40.42% of the IPPU emissions respectively.

Emissions from 2.F. Product Uses as Substitutes for Ozone Depleting Substances, is mainly attributed to emissions from the usage of HFCs in the stationary air-conditioning sub-application. In the electronics industry, CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 were used in the manufacturing processes, with emission control technologies installed in some processes.

2.H. Other includes estimated emissions where there is no methodological guidance provided in the 2006 IPCC Guidelines, such as the Food and Beverages industry, flare, vents and fugitive emissions from biomedical, electronic and shipbuilding industry. For such emissions, international guidelines or plant-specific methodology were used for emissions estimation. In addition, emissions from source categories that are considered confidential such as from metal industry are aggregated under 2.H. Other. The breakdown of emissions by type of gas in the IPPU sector is as shown in Table 6 below.

Table 6: Total GHG emissions from IPPU sector in 2022

Categories	Total GHG emissions (Gg CO_2 eq)	% of Total Emissions from IPPU
2 - Industrial Processes and Product Use	9,088.05	100.00%
2.A. - Mineral Industry	NO	
2.B. - Chemical Industry	1,315.97	14.48%
2.C. - Metal Industry	C	
2.D. - Non-Energy Products from fuels and Solvent Use	0.99	0.01%
2.E. - Electronics Industry[5]	3,673.67	40.42%
2.F. - Product Uses as Substitutes for Ozone Depleting Substances	4,050.33	44.57%
2.G. - Other Product Manufacture and Use	25.74	0.28%
2.H. - Other	21.35	0.23%

Notation keys:
C = Confidential and NO = Not Occurring

[5] 2.F.5 Solvents has been included in this category due to data confidentiality.

3 - Agriculture

Local production of leafy vegetables in Singapore

Agriculture

The GHG emissions from agriculture for the reporting year 2022 are negligible, contributing only 0.01% of Singapore's total GHG inventory. The small agriculture sector only occupies about 1% of land in Singapore and mainly produces eggs, food fish and leafy vegetables for local consumption to supplement our imports of these items. A small number of dairy cows and goats are also reared for milk for local consumption.

The emissions from the agriculture sector for the reporting year 2022 are estimated to be 8.04 Gg CO_2 eq as presented in Table 7. The emissions from agriculture sector were estimated using the Tier 1 approach, with default emission factors from the 2006 IPCC Guidelines. The activity data was derived from census data and customised surveys. Considerable amount of effort was spent to collect data required from farms for the BTR and emissions were insignificant.

Table 7: Total GHG emissions from Agriculture sector in 2022

Greenhouse gas source and sink categories	CO_2	CH_4	N_2O
	(kt)		
3 -Total agriculture	0.07	0.10	0.02
3.A. Enteric fermentation		0.02	
Option A:			
3.A.1.a. Dairy cattle		0.02	
3.A.1.b. Non-dairy cattle*		IE	
3.A.4. Other livestock (goat)*		IE	
3.B. Manure management		0.09	0.01
3.B.1. Cattle*		IE	IE
Option A:			
3.B.1.a. Dairy cattle*		IE	IE
3.B.1.b. Non-dairy cattle*		IE	IE
3.B.4. Other livestock (goat)*		IE	IE
3.B.4. Other livestock (poultry)		0.09	0.01
3.B.4. Other livestock (quail)*		IE	IE
3.B.5. Indirect N_2O emissions			NE
3.C. Rice cultivation		NO	
3.D. Agricultural soils			0.01
3.D.1. Direct N_2O emissions from managed soils			0.01
3.D.2. Indirect N_2O Emissions from managed soils			0.01
3.E. Prescribed burning of savannahs		NO	NO
3.F. Field burning of agricultural residues		NO	NO
3.G. Liming	0.07		
3.H. Urea application	0.00		
3.I. Other carbon-containing fertilizers	NE		

Notation keys:
NE = Not Estimated, IE = Included elsewhere and NO = Not Occurring

** For reporting, emissions for all livestock categories have been combined due to data confidentiality issues given the small number of livestock farms in Singapore*

4 - Land Use, Land-use Change and Forestry

Singapore maintains a system to capture emissions and removals from the LULUCF sector, ensuring compliance in accordance with the 2006 IPCC Guidelines on LULUCF. Estimation and reporting of the GHG emissions and removals were carried out for all land use and land-use change categories in Singapore and assessed for all five carbon pools (i.e. aboveground biomass, belowground biomass, dead wood, litter and soil organic matter), as well as non-CO_2 gases from such pools. The main land use categories (Forest Land, Cropland, Wetlands and Settlements) were further subdivided into subcategories (such as Stocked Forest Areas in Forest Land and Tree-covered Areas in Settlements, for example) for assessment of their respective contributions to emissions and removals. The category Grassland is not relevant for Singapore, as lawns and grassland patches are located in between infrastructure, in urban parks and stocked forests, and subsumed under the Forest Land or Settlements land-use categories using specific emission factors for such vegetation. The category Other Land does not occur in Singapore. However, a unique land category "Other (Sea)" is included to capture emissions/removals mainly from activities such as land reclamation projects.

For all land-use change categories, the IPCC approach of estimating emissions and removals in all pools for a transition period of 20 years was applied. Methods employed in the assessment follow higher tier approaches where possible, for example in Forest Land. The land use and land-use change matrix was assessed based on a wall-to-wall mapping using very high-resolution satellite images. Emission factors of any significant pools from subcategories were estimated with Tier 2 or 3 methodologies using modelling approaches and country-specific data derived from field measurements of tree biomass and soil carbon stock, together with ground-truthed land use maps. Carbon stock changes in biomass and soil for Mangroves, which is a subcategory under Forest Land, were taken from the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands and complemented by country-specific carbon stocks from published literature.

A restored freshwater swamp, the Rasau Walk in the Jurong Lake Gardens contains over 50 species of plants, which are found in naturally occurring freshwater swamp forests.

Due to Singapore's insignificant share of the total land area taken up by Cropland, Tier 1 methodology was applied and default figures from the 2006 IPCC Guidelines were used for carbon stocks for biomass and soil as well as management factors.

Singapore is a highly dynamic country with frequent land-use changes within a short period of time. As such, it is not uncommon for land to have been converted to other land-use categories or subcategories more than once within a 20-year transition period. To ensure that these land-use changes relate to a more realistic estimate of carbon stock changes, the latest land use maps are visually verified against historical land use maps. Furthermore, short-term land use changes were corrected using a smoothing procedure that addresses land-use changes and conversions of 10 years or less. We have also completed another round of ground truthing exercise resulting in updated emission factors for significant land-use categories and subcategories. The corresponding estimates of emissions and removals were derived from these updated emission factors.

The total annual net emissions for the reporting year 2022 for the LULUCF sector of Singapore amounted to 38.12 Gg CO_2 eq (including N_2O). A summary breakdown of the contributions from each land-use category is represented below.

Table 8: Total GHG emissions from the Land Use, Land-Use Change and Forestry sector in 2022

	Annual Change in Carbon Stocks, Gg					
Land-Use category	**Biomass**	**Dead Organic Matter**	**Soil**	**CO_2 (Gg CO_2 eq)**	**CH_4 (Gg CO_2 eq)**	**N_2O (Gg CO_2 eq)**
4.A. Forest Land	11.02	0.86	8.80	-75.84	NO	0.14
4.B. Cropland	0.05	0	0.11	-0.59	NO	0
4.C. Grassland	NO	NO	NO	NO	NO	NO
4.D. Wetlands	-0.21	-0.02	-0.27	1.81	NO	NO
4.E. Settlements	-17.43	-2.86	-8.46	105.42	NO	7.17
4.F. Other Land	NO	NO	NO	NO	NO	NO
4.H. Other (Sea)	0	0	0	0	NO	0
Total	-6.56	-2.02	0.18	30.80	NO	7.31

Note: Figures may not add up to the totals due to rounding.
Notation key: NO = Not Occurring

5 - Waste

The total emissions for the reporting year 2022 for the Waste sector of Singapore amounted to 384 Gg CO_2 eq, contributing 0.66% of Singapore's total GHG inventory. A summary breakdown of the contributions from each waste category is represented in Table 9.

5A - Solid Waste Disposal

Solid Waste Management

Growth in Singapore's population and economy have contributed to an increase in the amount of solid waste disposed of by about seven-fold, from 1,260 tonnes a day in 1970 to 8,760 tonnes a day in 2022.

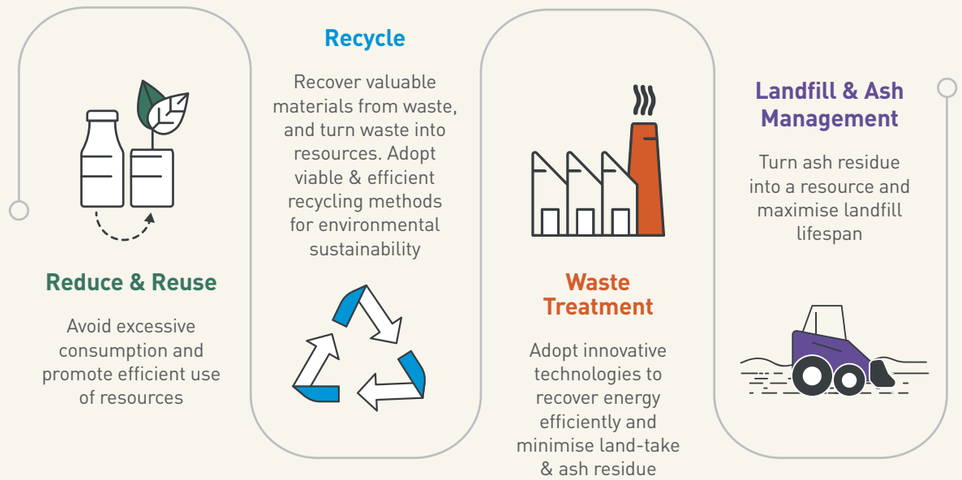
With waste quantities projected to continue increasing with growing affluence and population, Singapore's main challenge in solid waste management is ensuring sufficient land for waste disposal given our limited land stock.

Singapore has therefore adopted a suite of strategies encapsulated in the diagram below for a more sustainable solid waste management system. In the designing and implementation of these strategies, the Government works hand in hand with key stakeholders in the people and private sectors.

At source where the waste is generated, recyclables are sorted and retrieved for processing to conserve resources. The remaining waste is collected and sent to waste-to-energy plants for incineration. Incineration reduces the waste by up to 90 per cent, saving landfill space, and the heat is recovered to produce steam that propels turbine-generators to generate electricity, providing up to three per cent of the island's electricity needs.

The incineration ash and other non-incinerable wastes are then transported to the Tuas Marine Transfer Station (TMTS) from where they are barged to Semakau Landfill for final disposal.

Figure 3: Solid waste management system in Singapore



5B – Biological treatment of solid waste

Under biological treatment of solid waste, according to 2006 IPCC Guidelines, there are two types of possible sources of emissions, that is, (i) composting and (ii) anaerobic digestion at sludge digesters at water reclamation plants (WRPs). Both types of processes occur in Singapore. While composting does occur in Singapore, the emissions from animal manure is currently reported in category 3.B. Manure Management. For community composting, since emissions may be occurring and data for this activity is not collected, "NE" is applied from 2000 to 2022. As for anaerobic digestion, the biogas produced by the sludge digestor in Singapore's four WRPs is used to produce heat and electricity.

5C - Incineration and Open Burning of Waste[6]

Municipal Solid Waste (MSW) Incineration

The emissions from the waste sector are mainly from waste incineration. Similar to the energy sector, energy-intensive incineration companies submit their GHG reports as part of the regulatory requirements under ECA and CPA while facilities that engage in hazardous and clinical waste incineration report under the Environmental Public Health Act (EPHA) and its Regulations. To prevent double counting of emissions for hazardous and clinical waste incineration, information from EPHA was used from 2000 to 2022. For MSW incineration, information from national waste statistics was used from 2001 to 2018 while from 2019 onwards, CPA's MSW incineration data was used. The amount of emissions from the incineration of waste in the waste sector that is without energy recovery in 2022 was 384 Gg CO_2 eq. The breakdown of the GHG emissions under the waste sector can be referred to in Table 9.

Aerial view of Tuas South Incineration Plant, Singapore's 4th Waste-to-Energy Plant

Sludge Incineration[7]

From 1985 to 2008, treated sludge was applied on reclaimed land sites as a soil conditioner. Residual CH_4 emissions were due to the decay of the organic contents in the sludge from these sites. Since 2009, direct methane emissions from sewage sludge have been significantly reduced by incinerating the sludge.

As heat from the incineration of sludge is recovered to produce electricity, according to the 2006 IPCC Guidelines, CH_4 and N_2O emissions from the incineration of sludge are reported in the energy sector.

Clinical and Hazardous Waste Incineration

Facilities engaged in the incineration of clinical and hazardous waste in Singapore are regulated by the NEA under the EPHA and its Regulations. The activity data (such as the amount of clinical and hazardous waste collected) submitted by these facilities to NEA was used to estimate the emissions of CO_2, CH_4 and N_2O.

5D - Wastewater Treatment and Discharge

Used water from domestic and non-domestic sources is conveyed via sewers to four WRPs for treatment. Domestic used water comprises mainly sewage and sullage water generated from households and commercial premises such as hotels, restaurants and shops through activities such as cooking and washing. Industrial used water is trade effluent generated by factories from manufacturing processes.

[6] Emissions from the incineration of solid waste and the incineration of sludge are included under 1A1 Energy Industries.

[7] In accordance with the 2000 IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, emissions from the incineration of sewage sludge for the year 2010 were estimated by PUB based on the backward trend extrapolation of available data from September 2010 to December 2010. The emissions were from the sludge incineration plant operated by ECO-SWM which was registered as a Clean Development Mechanism (CDM) project on 13 September 2010. From 2012 onwards, emissions from the incineration of sewage sludge were estimated by PUB based on the forward trend extrapolation of available data from 2010 and 2011.

Table 9: Total GHG emissions from Waste sector in 2022

Categories	Total GHG emissions (Gg CO_2 eq)	% of Total Emissions from Waste
5 - Waste	384.19	100.00%
5.A. - Solid waste disposal	1.80	0.47%
5.B. - Biological treatment of solid waste	IE, NE	IE, NE
5.C. - Incineration and open burning of waste	306.64	79.81%
5.D. - Wastewater treatment and discharge	75.75	19.72%

Notation key:
NE = Not estimated, IE = Included elsewhere.

C. National Inventory Systems

The GHG inventory preparation process typically involves the following steps:

1. **Planning and Preparation**
   This stage involves establishing the institutional arrangements, developing a work plan and conducting training and capacity-building activities.

2. **Data Collection and Management**
   During this stage, data on GHG emissions and removals are collected through legislation and surveys conducted by the respective government agencies, which are the data owners for the energy, IPPU, agriculture, LULUCF and waste sector.

3. **Data Processing and Quality Control**
   The collected data is processed and compiled to estimate the GHG emissions and removals for the reporting year. Recalculation is conducted to ensure time series consistency. This involves applying specific methodologies and emission factors based on 2006 IPCC Guidelines, country-specific or plant-specific emission factors to the collected activity data. Quality control is also conducted to improve the quality of the inventory. For example, quality control helps in reducing human errors that may occur during inventory compilation.

4. **Reporting and Quality Assurance**
   The final stage includes the compilation of the national GHG inventory report, which undergoes a quality assurance process to ensure its accuracy and completeness before it is endorsed for submission.

These steps are crucial for tracking and reporting on the national GHG emissions and removals, and often involve collaboration among multiple government agencies and stakeholders. Further details on the inventory preparation process can be found in section 1.2.2 of the NID 2024.

Chapter 2.

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

Built across the mouth of Marina Channel, the Marina Barrage creates Singapore's 15th reservoir and the first in the heart of the city. It is a testament to sustainability and a great place for family outings such as picnics and kite flying.

A.

National circumstances and institutional arrangements

Country Profile

Singapore is a small island state in Southeast Asia and consists of one main island and more than 60 smaller ones. It is located between latitudes 1°09'N and 1°29'N and longitudes 103°36'E and 104°25'E, approximately 137 km north of the equator. It is separated from Peninsular Malaysia by the Straits of Johor, and the Indonesian islands by the Straits of Singapore.

Land Area

The main island of Singapore is about 49km from east to west and 28km from north to south, with a coastline of 215km. The total land area (including that of smaller islands) is about 735.6 km^2[8]. Among the smaller islands, the larger ones are Pulau Tekong (25.5 km^2), Pulau Ubin (10 km^2) and Sentosa (4.8km^2).

Singapore's surface reaches 163m at our highest point. Much of Singapore is generally flat and less than 15m above sea level, as defined by the Singapore Height Datum (SHD)[9].

[8] Based on data from the Singapore Land Authority as of June 2024.
[9] The SHD is defined as the mean sea level determined at Victoria Dock in Singapore between 1935 and 1937.

Chapter 2

INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT

Singapore has one of the world's largest floating solar panel farms, spanning about 45 hectares.

Climate

Singapore has a tropical climate, with relatively high and uniform temperatures, abundant rainfall and high humidity throughout the year. The 1991-2020 long-term annual mean temperature was about 27.8°C. The long-term average annual rainfall is around 2,534mm. The climate of Singapore is characterised by two monsoon seasons separated by inter-monsoonal periods. The Northeast Monsoon occurs from December to early March, and the comparatively drier Southwest Monsoon from June to September. The early part of the Northeast Monsoon (December to early January) is the wetter period of the year when monsoon surges occur, which sometimes result in prolonged heavy rain in Singapore. The later part of the Northeast Monsoon (late January to early March) is usually much drier, with February being the driest month during this period. Afternoon thunderstorms are common throughout the year, especially during the inter-monsoonal periods from late March to May and October to November. During the Southwest Monsoon and inter-monsoonal periods, widespread heavy rain and gusty winds associated with Sumatra squalls also occur occasionally.

Recent Trends

Observations by the Meteorological Service Singapore (MSS) showed that the warming trend experienced in Singapore over the past decades continued in 2023. The mean temperature for the last decade from 2014 to 2023 reached a new high of 28.06°C, 0.05°C above the previous record for the decade from 2013 to 2022. This is the third consecutive year that Singapore's decadal mean temperature record was broken, with 5 of the top 10 warmest years occurring in the last decade.

At the Changi climate station, the annual mean temperature in 2023 was 28.2°C, 0.4°C above the long-term average and the fourth warmest on record since 1929 (tied with 2015 and 1997). 2023 also saw the highest daily maximum temperature of 37.0°C measured on 13 May at Ang Mo Kio (tied with previous record at Tengah on 17 April 1983).

Other than high temperatures, 2023 also experienced drier than normal months in April, May, August and October. These months were also the top 10 driest for their respective months since 1980.

Population

As of June 2023, Singapore's total population, including foreigners working in Singapore, was estimated at 5.9 million. The resident population, comprising Singapore citizens and permanent residents, was estimated at 4.1 million, or 70% of the total population. Singapore's small land area also means that our population density of over 8,000 people per km^2 is one of the highest in the world.

Economy

Due to Singapore's small domestic market, Singapore is an export-oriented economy that is highly dependent on international trade. In 2023, in nominal terms, Singapore's external merchandise trade amounted to S$1,206 billion or US$915 billion, two times its GDP (S$508 billion or US$385 billion). Over several decades, Singapore has built up a strong economy where the manufacturing and wholesale & retail trade sectors comprised around 18.6% and 23.6% of nominal value added respectively, in 2023. Singapore's small domestic market has necessitated an export-oriented economy, with the bulk of our industries manufacturing products for export rather than local consumption. Singapore's strategic geographical location has also enabled it to develop into a major air and sea transportation hub. The economic structure in 2023 is as shown in Table 10.

Table 10: 2023 Economic Structure of Singapore

Economic Structure, 2023 (Nominal Value Added Share, %)	%
Manufacturing	18.6
Construction	3.5
Utilities & Other Goods Industries	1.5
Wholesale Trade	22.3
Retail Trade	1.3
Transportation & Storage	6.8
Accommodation	0.8
Food & Beverage Services	0.9
Information & Communications	5.7
Finance & Insurance	13.8
Professional Services	5.7
Administrative & Support Services	2.8
Real Estate	3.1
Other Services Industries	9.6
Ownership of Dwellings	3.6

Water

Located in the equatorial belt, Singapore receives abundant rainfall annually. However, Singapore is considered a water-scarce country due to having limited land to collect and store rainwater. To ensure a sustainable water supply and enhance water resilience for Singapore, PUB has developed a diversified and robust supply of water through the "Four National Taps", namely local catchment water, imported water, NEWater[10] and desalinated water.

[10] NEWater is high-grade reclaimed water, produced from treated used water that is further purified using advanced membrane technologies and ultraviolet disinfection, making it clean and safe to drink.

Energy-saving biomimetic membrane trialled at Kranji NEWater factory

Since 2011, the total water catchment area has increased from half to two-third of Singapore's land surface with the completion of three reservoirs in urbanised areas. Despite our best efforts to maximise water supply from our local catchments, Singapore is still physically limited by our small land area, while demand for water continues to increase in tandem with economic and population growth. Water demand is expected to almost double by 2065.

NEWater and desalinated water are independent of rainfall, thus greatly enhancing the resilience of our water sources against dry weather. However, the production of these two sources is more energy-intensive than treating raw water from the local catchment. PUB has been investing in research and development (R&D) to improve the energy efficiency of our water production. For instance, biomimetic membrane technology, which mimics and models desalination processes in nature, is being engineered and scaled up to reduce the energy needed for membrane-based water purification processes. Another research area is pressure-retarded osmosis, which recovers energy from the concentration difference between seawater desalination brine and another low salinity stream within the water loop. Combining these technologies will lower the energy demand for water production at a systems level. These low-energy solutions will take time to develop and mature before they can be fully deployed.

Managing demand is equally essential in ensuring a sustainable water supply. Singapore adopts a multi-pronged approach in managing its water demand: pricing water to reflect its scarcity value, mandating water efficiency standards and public education on water conservation practices. Through wide-ranging water conservation measures, Singapore's per capita domestic water consumption was reduced from 165 litres per day in 2003 to 141 litres per day in 2023.

Singapore's National Circumstances and Constraints

Singapore currently accounts for around 0.1% of global emissions. We will continue to build on a long-standing and comprehensive national approach that seeks to achieve sustainable growth alongside environmental protection. As we work towards a low-carbon future, the extent of emission reduction from our climate strategy will depend on our national circumstances, past mitigation efforts and geographical constraints, which limit our access to renewable energy at scale.

Historically, our strategic geographical position along the East-West trade routes made Singapore a natural location for regional trade. Today, building on our position as a key regional port, much international trade takes place here and we continue to supply critical products from oil refining and petrochemical plants to the world. While the sector is a large source of our carbon emissions, it also employs a sizeable workforce. As such we are carefully managing the sector's transition. We have started work on improving the energy efficiency across the sector and will continue to push for further reductions in the sector's emissions.

Singapore has taken early measures on sustainable development such as switching to natural gas for electricity generation instead of more pollutive fuel oil, and imposing a vehicle quota system to cap vehicle growth. Since 2018, we have capped the vehicle growth rate for cars and motorcycles at zero. In addition, we have optimised the use of our scarce land through integrated urban planning. Given Singapore's unique circumstances as both a city and a nation-state, our small land area has to accommodate not only housing and commercial hubs, but also power plants, reservoirs, air and seaports and industries, all within our boundaries. Singapore has also adopted a greening strategy to extend our natural capital and green cover. Our urban greenery and natural ecosystems help to mitigate the effects of and build resilience to climate change by storing and sequestering carbon. As trees grow, they build up biomass and become carbon stock. Our greenery also helps to keep urban areas cooler and improve air quality, thus mitigating the impact of climate change.

Climate Vulnerabilities

Fundamentally, climate change poses an asymmetrical and existential challenge to small island nations like Singapore. Although our impact on global emissions is small, the effect of climate change is disproportionately large on us as a low-lying island nation.

Singapore's vulnerability to climate change will require the Government to pursue a comprehensive adaptation programme to protect our coasts and low-lying areas. These adaptation actions will impose significant fiscal costs on the Government.

Alternative Energy Disadvantage

Singapore has limited land area, relatively flat land, a high urban density, low wind speeds (2-3m/s), and lacks near-surface geothermal resources and major river systems. Therefore, harnessing alternative energy sources such as hydroelectricity, marine, wind, geothermal or conventional nuclear power is a major challenge. Whilst solar energy is Singapore's most viable domestic renewable energy option, competing uses for land greatly limit our access to solar energy at scale. Such difficulties in transitioning to alternative energy are recognised by the UNFCCC, under Articles 4.8 and 4.10. Nonetheless, we will continue to pursue available opportunities.

Solar

Solar is Singapore's most viable source of renewable energy. However, our land constraints limit our ability for large scale deployment. In addition, high cloud cover and substantial urban shading across Singapore pose challenges such as intermittency. Despite these constraints, the Government continues to press ahead with solar energy deployment, leveraging innovative deployment technologies and designs where possible to harness its full potential.

Biomass

Biomass is not viable as a significant energy resource for Singapore. Unlike other countries that have been able to use biomass as an alternative to fossil fuels, Singapore is limited by land constraints and a lack of a significant domestic agricultural sector. We already convert much of our waste (including biogenic waste) to energy today, but that has only been able to contribute about 3.1% of total electricity generation as of 2022.

Marine (Tidal and Wave Power)

Singapore's tidal range (difference between high and low tide) is about 1.7m, well below the 4m tidal range that is typically required for commercial tidal power generation. The availability of wave power is determined by the height and frequency of waves, but the waters around Singapore are relatively calm as we are surrounded by land masses. In addition, wave, tidal and ocean thermal energy have limited application as much of our sea space is used for ports, anchorage and international shipping lanes. Nevertheless, in an effort to harness whatever little marine energy is available to us, Singapore is partnering industry to develop and pilot tidal turbines that can generate electricity from slower currents.

Geothermal

There are no adequate near-surface geothermal resources that would allow for conventional geothermal systems deployment in Singapore. Deep geothermal energy has emerged in recent years as a potential option, although technoeconomic feasibility remains challenging. Singapore is in the process of a nation-wide, non-invasive geophysical study to assess our deep geothermal resource potential.

Carbon Capture, Utilisation and Storage (CCUS) and Hydrogen

Whilst emerging low-carbon solutions such as CCUS and low-carbon hydrogen have been conceptually proven, their large-scale deployment globally has been limited by economic, institutional and technical constraints. Singapore's land constraints make these solutions particularly challenging. We have insufficient sites that can support large-scale CO_2 sequestration, and our limited land area makes it challenging to explore the different pathways for low-carbon hydrogen. Despite these constraints, Singapore is in the process of developing a low-carbon ammonia supply chain, to experiment with the use of ammonia in shipping and power generation.

On Carbon Capture and Storage (CCS), Singapore has appointed a lead consortium (S Hub, comprising Shell and ExxonMobil) to study the feasibility of developing an end-to-end CCS project from Singapore. As Singapore lacks suitable underground geological formations for cross-border CCS, the success of our CCS efforts will depend on bilateral cooperation as well as other factors such as technocommercial considerations. CCS also remains prohibitively expensive for low-CO_2 concentration streams (e.g. power plant point source emissions).

Nuclear

Singapore conducted a pre-feasibility study (Pre-FS) on nuclear energy, which concluded in 2012 that nuclear energy technologies available at the time were not suitable for deployment in Singapore. Conventional nuclear technologies require sizeable emergency planning zones, which poses significant challenges for small and densely populated countries like Singapore. Nonetheless, since Singapore is alternative energy disadvantaged, we need to keep our options open, and continue to study and assess developments in safer nuclear energy technologies.

Recognition of National Circumstances in the United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC Articles 4.8 and 4.10 calls for Parties to take into consideration developing countries' national circumstances – especially small island countries, countries with low-lying coastal areas, land-locked and transit countries, and countries disadvantaged in the use of alternative energy sources, amongst others.

Article 4.8: "Parties shall give full consideration to actions to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures." Three sub-clauses in the article are of specific relevance to Singapore, namely

4.8 (a) Small island countries

4.8 (b) Countries with low-lying coastal areas

4.8 (h) Countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products

Article 4.10: "The Parties shall, in accordance with Article 10, take into consideration in the implementation of the commitments of the Convention the situation of Parties, particularly developing country Parties, with economies that are vulnerable to the adverse effects of the implementation of measures to respond to climate change. This applies notably to Parties with economies that are **highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products and/or the use of fossil fuels for which such Parties have serious difficulties in switching to alternatives**."

Pursuit of Sustainable Development

Singapore has always prioritised environmental issues and has pursued the goals of growing the economy and protecting the environment concurrently.

Our pursuit of sustainability and environmental protection is reflected in our approach to urban development and resource management, including how we manage transportation, housing, waste, greenery, energy and water. For instance, since the early 2000s, we have been replacing fuel oil with natural gas – the cleanest form of fossil fuel – as the primary fuel for electricity generation. In the first half of 2023, natural gas accounted for around 94.3% of our electricity generation, with the remainder mainly from waste-to-energy plants and solar PVs. Solar deployment has also increased significantly over the years, with an installed solar capacity surpassing 1 GWp to date. We will continue to maximise the deployment of solar on all available spaces (e.g. rooftops) to meet our ambition of 1.5 GWp by 2025, and at least 2 GWp by 2030. We are also developing innovative clean energy solutions in partnership with academia, industry and other countries. We price energy at market cost, without any subsidy, to reflect resource scarcity and promote judicious usage. We also maintain stringent measures to discourage vehicle ownership and usage, and to encourage energy efficiency and conservation across all the sectors. To maximise the potential of emission reduction from sectoral measures, Singapore implemented a carbon tax, the first carbon pricing scheme in Southeast Asia, in 2019. In 2024, Singapore raised its carbon tax from S$5 per tonne of CO_2 eq emitted to S$25 per tonne of CO_2 eq emitted. The carbon tax is not standalone – it forms part of our comprehensive suite of mitigation measures to reduce emissions, create green growth opportunities, and transition to an energy-efficient and low-carbon economy. We safeguard more than 7,800 hectares of green spaces – nature reserves, gardens and parks – across Singapore, and integrate greenery throughout the city.

This approach has allowed Singapore's emissions intensity today to be one of the lowest in the world. We ranked among the 20 best-performing out of 141 countries in terms of emissions intensity in 2017[11]. We are recognised as Asia's most sustainable city and the fourth most sustainable city globally according to the 2018 Sustainability Cities Index. The Sustainability Cities Index recognises that Singapore is undertaking several sustainability initiatives that will create a high-quality living environment, which is resilient and in line with the broader climate change agenda. Singapore has also been ranked first in the Global Competitiveness Index in the World Economic Forum (WEF)'s Global Competitiveness Report 2019, underscoring how our sustainability efforts have helped Singapore maintain its competitiveness. Innovation will be key for Singapore to continue to develop sustainably. We aim to develop an ecosystem of green finance and active R&D that nurtures the development and adoption of low-carbon innovations. With such an ecosystem, we can seize green growth opportunities, grow our economy and create new jobs as we transition to a low-carbon economy.

Despite our constraints and unique circumstances, Singapore is committed to reducing our emissions across all sectors to support global climate action. Details of our mitigation actions are provided in the sections to follow.

[11]Source: International Energy Agency, CO_2 Highlights 2019

Government Structure and Institutional Arrangements for Climate Change

Climate change is an issue with many dimensions that cut across the responsibilities of several ministries. The Inter-Ministerial Committee on Climate Change (IMCCC) was therefore set up in 2007 to oversee the WOG coordination on Singapore's approach to climate change. The IMCCC is chaired by the Senior Minister and Coordinating Minister for National Security, and includes the Deputy Prime Minister and Minister for Trade and Industry, the Minister for Sustainability and the Environment, the Minister for Foreign Affairs, the Minister for National Development, and the Minister for Transport. The IMCCC is supported by an Executive Committee (Exco) comprising the Permanent Secretaries of the respective Ministries. The IMCCC Exco oversees the work of the Carbon & Energy Transition Working Group (CETWG), Economic Transition Working Group (ETWG), Resilience Working Group (RWG) and Sustainability & Engagement Working Group (SEWG). These working groups were newly organised following a review of our institutional arrangements in 2023.

The CETWG oversees the development, implementation and tracking of progress for carbon mitigation measures. A Measurement, Reporting and Verification (MRV) Task Force under the CETWG is tasked with coordinating inter-agency MRV efforts. This includes the preparation of Singapore's National Communications (NC) and BTR by an inter-agency working group for approval by the IMCCC. The ETWG coordinates and enables the growth of Singapore's green economy. ETWG will also develop plans and levers for economic transformation towards a sustainable and low-carbon economy. The RWG studies Singapore's vulnerability to the effects of climate change and develops long-term plans that ensure the nation's resilience to future environmental change. The SEWG develops the national sustainability agenda to strengthen Singapore's resource resilience. It addresses emerging and cross-cutting issues on sustainability, guide planning and implementation of both domestic and international communications, and engagement for climate change and sustainability. The SEWG also leads sustainability capability building in the government.

To ensure the effective coordination of Singapore's domestic and international policies, plans and actions on climate change, the NCCS was established as a dedicated unit in July 2010 under the PMO. NCCS is part of the Strategy Group which supports the Prime Minister and his Cabinet to establish priorities and strengthen strategic alignment across the Government. The positioning of NCCS underscores the importance that Singapore places on climate change.

Figure 4: Institutional Arrangements for Climate Change

Inter-Ministerial Committee on Climate Change (IMCCC)

Chair: Senior Minister and Coordinating Minister for National Security Teo Chee Hean

Inter-Ministerial Committee on Climate Change Executive Committee (IMCCC Exco)

Chair: Head Civil Service

Carbon & Energy Transition Working Group (CETWG)	Economic Transition Working Group (ETWG)	Resilience Working Group (RWG)	Sustainability & Engagement Working Group (SEWG)
Chair: Permanent Secretary (Trade and Industry)	Chair: Second Permanent Secretary (Trade and Industry)	Co-Chairs: Permanent Secretary (Sustainability and the Environment) and Permanent Secretary (National Development)	Chair: Permanent Secretary (Sustainability and the Environment)

B.

Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates

Singapore's NDC under Article 4 of the Paris Agreement is to reduce emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.

Our NDC is an economy-wide absolute GHG emissions limitation target. It is a single-year target, and the implementation period is from the beginning of 2021 to end 2030. Key sectors covered include Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land-Use Change and Forestry (LULUCF) and Waste. The greenhouse gases covered are CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3. All categories of anthropogenic emissions or removals are included and will continue to be included.

Policies implemented during the implementation period will contribute to the achievement of Singapore's NDC. Additionally, Singapore also intends to use internationally transferred mitigation outcomes (ITMOs) under Article 6 towards our NDC. We expect these ITMOs to make up the residual emissions reductions required to meet our target, after accounting for the abatement from all other policies and plans implemented within the 2030 timeframe.

Table 11: Singapore's nationally determined contribution under Article 4 of the Paris Agreement

Target(s) and description, including target type(s), as applicable	Singapore's NDC is an economy-wide absolute emissions limitation target to reduce its GHG emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	Singapore's NDC is a single-year target, with target year of 2030.
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	As Singapore's NDC is an economy-wide absolute GHG emissions limitation target, only the target of around 60 Mt CO_2 eq in 2030 will be used as a reference point. The NDC does not take reference from any baselines, base years or starting points.
Time frame(s) and/or periods for implementation, as applicable	Beginning 2021 to end 2030.
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	Singapore's NDC is an economy-wide absolute GHG emissions limitation target. Key sectors covered are Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land-Use Change and Forestry (LULUCF), and Waste. Greenhouse gases covered are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). All categories of anthropogenic emissions and removals are included and will continue to be included.
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	Singapore intends to use ITMOs under Article 6 towards its NDC. Singapore expects these ITMOs to make up the residual emissions reductions required to meet its NDC target, after accounting for the abatement from all other policies and plans implemented within the 2030 timeframe.
Any updates or clarifications of previously reported information, as applicable	Not applicable.

C.

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

NDC Definitions

Singapore's NDC, as defined in Chapter 2 Section B, is economy-wide and covers all sectors and categories. As the coverage is equivalent to what is reported in our NID, no further definitions are required to understand our NDC.

Table 12: Definitions needed to understand NDC

	Definitions needed to understand NDC
Sector or category defined differently than in the national inventory report	Not applicable.
Mitigation co-benefits of adaptation actions and/or economic diversification plans	Not applicable.
Other relevant definitions	Not applicable.

Indicator

Singapore uses net GHG emissions and removals as an indicator to track our progress towards and implementation and achievement of our NDC. This approach is in line with our NDC being an absolute GHG emissions limitation target. The most recent information, as well as historical information for this indicator can be found in the NID, which reports our net GHG emissions and removals.

Table 13: Description of selected indicator

Indicator	Description
Net GHG emissions and removals	
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s)	As Singapore's NDC is an economy-wide absolute GHG emissions limitation target, only the target of around 60 Mt CO_2 eq in 2030 will be used as a reference point to track progress towards the implementation and achievement of our NDC. Our NDC does not take reference from any baselines, base years, or starting points.
Updates in accordance with the GHG inventory, if any	Not applicable.
Definitions needed to understand indicator	Not applicable.
Relation to NDC	Singapore's NDC is a 2030 target for our net emissions and removals
Most recent information	Singapore's total GHG emissions in 2022 was 58.59 Mt CO_2 eq.

Methodologies and Accounting Approaches

As Singapore's NDC will be accounted for based on net GHG emissions and removals in 2030, our accounting approaches will be equivalent to those in our NID, which uses 2006 IPCC Guidelines for National GHG Inventories. Emissions estimates were based on the sectoral approach. Most emissions estimates were derived using Tier 1 methodology provided in the 2006 IPCC Guidelines. Where default conversion and emission factors were used, they were taken from the 2006 IPCC Guidelines as well, unless otherwise stated. Chapter 1 of our BTR as well as our NID provide further details on our accounting approaches and methodologies.

As such, Singapore's NDC accounting is consistent with Article 4, paragraphs 13 and 14. To the extent possible, in accounting for our emissions, we promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting. Singapore also takes into account, where appropriate, existing methods and guidance under the Convention.

As of 2022, Singapore has not participated in cooperative approaches that involve the use of ITMOs. We plan to do so and will report our methodologies accordingly when we do.

Refer to Chapter 2 Section D for the methodologies used to track progress arising from the implementation of policies and measures.

Table 14: Methodologies and accounting approaches – consistency with Article 4, paragraphs 13 and 14, of the Paris Agreement and with decision 4/CMA.1

For the first NDC under Article 4:	
Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement	For its first NDC, Singapore will account for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (collectively, the "2006 IPCC Guidelines"), specifically, by way of the Sectoral approach. Singapore's NDC accounting is consistent with Article 4, paragraphs 13 and 14. To the extent possible, in accounting for our emissions, we promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting. Singapore also takes into account, where appropriate, existing methods and guidance under the Convention.
For each NDC under Article 4:	
Accounting for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement:	
Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement	For its first NDC, Singapore will account for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (collectively, the "2006 IPCC Guidelines"), specifically, by way of the Sectoral approach. Singapore's NDC accounting is consistent with Article 4, paragraphs 13 and 14. To the extent possible, in accounting for our emissions, we promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting. Singapore also takes into account, where appropriate, existing methods and guidance under the Convention.
Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable	Singapore will assess the implementation and achievement of its NDC target by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines, specifically, by way of the Sectoral approach.
Each methodology and/or accounting approach used for the construction of any baseline, to the extent possible	Not applicable. Singapore's NDC target, which aims to peak and subsequently reduce emissions to an absolute emissions level, does not take reference from any baseline.
If the methodology or accounting approach used for the indicator(s) differ from those used to assess the implementation and achievement of the target, describe each methodology or accounting approach used to generate the information generated for each indicator	Not applicable. The accounting approach for the indicator does not differ from the accounting approach used to assess the implementation and achievement of Singapore's NDC target.
Any conditions and assumptions relevant to the achievement of the NDC under Article 4, as applicable and available	The achievement of Singapore's NDC is contingent on technological maturity and effective international cooperation. Singapore's ability to fulfil its pledge, like all Parties, will depend on the continued international commitment by Parties to the Paris Agreement and their climate pledges.
Key parameters, assumptions, definitions, data sources and models used, as applicable and available	As Singapore's NDC is based on net GHG emissions and removals in 2030, our accounting approach will be aligned with the methodologies in our NID. Any key parameters, assumptions, definitions, data sources and models used within our NID would also be used to account for our NDC target.
IPCC Guidelines used, as applicable and available	Singapore will account for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, specifically, by way of the Sectoral approach.

Report the metrics used, as applicable and available	Singapore's emissions for CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 will be derived using the 2006 IPCC Guidelines, via the Sectoral approach. The Tier 1 methodology will be used for most emissions estimates. Higher tier methodology will be used, where relevant and depending on availability of data. The aggregation of GHG emissions and removals will be reported using the 100-year time- horizon global warming potential (GWP) values from the IPCC Fifth Assessment Report.
For Parties whose NDC cannot be accounted for using methodologies covered by IPCC guidelines, provide information on their own methodology used, including for NDCs, pursuant to Article 4, paragraph 6, of the Paris Agreement, if applicable	Not applicable. Singapore's NDC will be accounted for using IPCC guidelines.
Provide information on methodologies used to track progress arising from the implementation of policies and measures, as appropriate	Singapore will track progress arising from the implementation of policies and measures by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines.
Where applicable to its NDC, any sector-, category or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, taking into account any relevant decision under the Convention, as applicable:	
For Parties that address emissions and subsequent removals from natural disturbances on managed lands, provide detailed information on the approach used and how it is consistent with relevant IPCC guidance, as appropriate, or indicate the relevant section of the national GHG inventory report containing that information	GHG emissions and removals from natural disturbances, if any, will be accounted for in accordance with the prescribed 2006 IPCC Guidelines, coupled with field inventory measurements where applicable.
For Parties that account for emissions and removals from harvested wood products, provide detailed information on which IPCC approach has been used to estimate emissions and removals	Not applicable. There is no timber industry in Singapore. Hence, Singapore at present has no GHG emissions and removals from harvested wood products.
For Parties that address the effects of age-class structure in forests, provide detailed information on the approach used and how this is consistent with relevant IPCC guidance, as appropriate	Singapore will estimate GHG emissions and removals in the LULUCF sector with up to Tier 3 approaches where feasible, and apply very high-resolution satellite images, coupled with collection of country-specific data resulting from field inventory measurements undertaken at regular intervals and estimated by modelling approaches. The field measurements will take into consideration tree growth information across the range of tree species and diameter classes.
How the Party has drawn on existing methods and guidance established under the Convention and its related legal instruments, as appropriate, if applicable	Singapore will assess the implementation and achievement of its NDC target by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines, specifically, by way of the Sectoral approach. Singapore also takes into account, where appropriate, existing methods and guidance under the Convention.
Any methodologies used to account for mitigation benefits of adaptation actions and/or economic diversification plans	Not applicable. Singapore will account for any mitigation co-benefits from adaptation actions and/or economic diversification as mitigation actions in accordance with the assumptions and methodological approaches indicated above.
Describe how double counting of net GHG emission reductions has been avoided, including in accordance with guidance developed related to Article 6 if relevant	As of 2022, Singapore has not participated in cooperative approaches that involve the use of internationally transferred mitigation outcomes (ITMOs) under Article 6. We plan to do so and will report the relevant information accordingly when we do.
Any other methodologies related to the NDC under Article 4	Not applicable.

Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs:	
Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs	Singapore's NDC is based on net GHG emissions and removals in 2030. The scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches used for communicating and implementing Singapore's NDC are equivalent, and therefore consistent.
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable	As Singapore's NDC is based on net GHG emissions and removals in 2030, the methodologies used for accounting will be equivalent to, and therefore consistent with, the methodologies in our NID.
For Parties that apply technical changes to update reference points, reference levels or projections:	
Explain how any methodological changes and technical updates made during the implementation of their NDC were transparently reported	To the extent possible, any methodological changes and technical updates will be reported in Singapore's NID.
Striving to include all categories of anthropogenic emissions or removals in the NDC and, once a source, sink or activity is included, continuing to include it:	
Explain how all categories of anthropogenic emissions and removals corresponding to their NDC were accounted for	All categories of anthropogenic GHG emissions and removals will be accounted for using the 2006 IPCC Guidelines, specifically, by way of the Sectoral approach.
Explain how Party is striving to include all categories of anthropogenic emissions and removals in its NDC, and, once a source, sink or activity is included, continue to include it	All categories of anthropogenic emissions and removals are included, and will continue to be included, in Singapore's NDC.
Provide an explanation of why any categories of anthropogenic emissions or removals are excluded	Not applicable.
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of its NDC	
Provide information on any methodologies associated with any cooperative approaches that involve the use of ITMOs towards an NDC under Article 4	As of 2022, Singapore has not participated in cooperative approaches that involve the use of internationally transferred mitigation outcomes (ITMOs) under Article 6. We plan to do so and will report the relevant information accordingly when we do.

Tracking Progress Towards NDC

Singapore is on track to meeting our 2030 NDC. Our indicator of net GHG emissions and removals was 53.87 Mt CO_2 eq, 58.29 Mt CO_2 eq and 58.59 Mt CO_2 eq in 2020, 2021 and 2022 respectively (inclusive of LULUCF). Singapore will peak our emissions before reducing to around 60 Mt CO_2 eq in 2030.

Table 15: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement

Indicator	Description
Net GHG emissions and removals	
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s)	As Singapore's NDC is an economy-wide absolute GHG emissions limitation target, only the target of around 60 Mt CO_2 eq in 2030 will be used as a reference point to track progress towards the implementation and achievement of our NDC. Our NDC does not take reference from any baselines, base years, or starting points.
Information for previous reporting years during the implementation period of its NDC under Article 4	2020 Total GHG Emissions: 53,872 kt CO_2 eq 2021 Total GHG Emissions: 58,285 kt CO_2 eq Includes contribution from LULUCF
The most recent information	2022 Total GHG Emissions: 58,587 kt CO_2 eq Includes contribution from LULUCF
Progress made towards the NDC, as determined by comparing the most recent information for each selected indicator, including for the end year or end of period, with the reference point(s), level(s), baseline(s), base year(s) or starting point(s)	The most recent information for the indicator of net GHG emissions and removals is 58,587 kt CO_2 eq in 2022. Singapore is on track to meeting our NDC of reducing emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.
Where applicable, information on GHG emissions and removals consistent with the coverage of its NDC under Article 4	As above. Our indicator's coverage is the same as our NDC.
Contribution from the LULUCF sector for each year of the target period or target year, if not included in the inventory time series of total net GHG emissions and removals, as applicable	Not applicable. Our inventory time series includes the contribution from the LULUCF sector.
Total net GHG emissions and removals, taking into account the contribution from the LULUCF sector	Information is as above. Our inventory time series includes the contribution from the LULUCF sector.
Information on cooperative approaches that involve the use of internationally transferred mitigation outcomes towards an NDC under Article 4	Not applicable. As of 2022, Singapore has not participated in cooperative approaches that involve the use of ITMOs. We plan to do so and will report the relevant information accordingly when we do.

D.

Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

Introduction

Singapore achieved our 2009 Copenhagen pledge of reducing emissions by 16% below 2020 business-as-usual (BAU) levels, with our 2020 emissions being equivalent to 32% below our BAU levels. Singapore has since committed, as our NDC, to reduce emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier. Singapore also raised our national climate target to achieve net zero emissions by 2050 as part of our Long-Term Low-Emissions Development Strategy (LEDS). While these are challenging targets given our limited potential for alternative energy sources that could reduce emissions on a significant scale, Singapore is on track to meet our 2030 NDC.

Singapore's Approach to Reducing Emissions

Energy is a strategic resource for Singapore as we are almost completely reliant on the import of oil and gas for our energy needs.

Recognising that energy is a scarce resource, we price fuel and electricity according to supply and demand, and do not subsidise energy costs. This policy of pricing energy correctly helps to incentivise firms and households to use energy wisely, minimise energy wastage and overconsumption, and thus helping to control emissions.

Since the early 2000s, Singapore has taken steps to use a cleaner fuel mix for electricity generation, switching from fuel oil to natural gas. The proportion of Singapore's electricity generated by natural gas has risen from 26% in 2001 to around 95% in 2023, with the grid emission factor of the power system improving in tandem. To further reduce emissions, we are pursuing cleaner energy sources where possible, such as solar and regional power grids, and exploring emerging low-carbon alternatives (e.g. CCUS and hydrogen).

The SolarNova programme is a Whole-of-Government effort to aggregate demand for solar photovoltaic (PV) systems across government agencies. This includes installing the systems on the rooftops of HDB flats and public sector buildings.

In March 2024, Singapore committed an initial $5 billion into the Future Energy Fund to develop infrastructure needed for the supply of low-carbon electricity to Singapore. The Fund will catalyse energy transition projects to secure low-carbon energy supplies in support of Singapore's decarbonisation ambitions.

Measures to Reduce Emissions

Measure #1- Shifting to Cleaner Energy Sources

Energy Efficiency

As Singapore is alternative energy disadvantaged, improving energy efficiency is one of our key mitigation strategies. This will require our households and businesses to be more energy-conscious and make adjustments to their daily activities, choices and processes. In addition to reducing emissions, greater energy efficiency also leads to cost savings. The Government will continue to raise awareness and build capabilities to improve energy efficiency across sectors. A major part of this effort involves addressing sector-specific barriers using incentives or regulatory measures where appropriate, such as the Resource Efficiency Grant for Emissions (REG(E)).

Solar

Solar energy remains the most viable renewable energy option for Singapore, and its deployment has been growing steadily. We have doubled our solar power deployment since 2021 to over 1.35 GWp. We are on track to reach at least 2 GWp by 2030, which can generate enough energy to meet the annual electricity needs of around 350,000 households. To encourage further adoption in Singapore, we are actively investing in R&D and test-bedding to improve the efficiency and lower the price of solar technologies and associated systems.

Regional Power Grids

Singapore has made steady progress in our plans to import low-carbon electricity to meet one-third of our energy needs by 2035. To date, we have awarded Conditional Approvals to 10 projects, to import 7.35 GW of low-carbon electricity from Cambodia, Indonesia, Vietnam, and Australia (some of these projects are expected to come online only after 2035). Of these 10 projects, five projects from Indonesia have progressed to being awarded Conditional Licences. MTI/EMA will also continue to grant conditional approvals to projects as long as they are credible and competitive to serve our future energy needs.

These projects, if realised, will become the building blocks of an inter-connected ASEAN Power Grid ("APG"). The APG is a win-win initiative that matches countries with demand for renewable energy, with neighbours who have significant renewable energy potential. It will improve project bankability and accelerate the development of new renewable energy capacity. Singapore will continue to work with our neighbours to establish the necessary regulatory and commercial frameworks and ecosystems needed for cross-border electricity trading and the deployment of grid infrastructure and subsea cables.

Singapore also recognises the importance of international collaboration to drive regional initiatives for energy transition like the APG. The International Energy Agency (IEA) has established its first regional cooperation centre in Singapore, which will serve as a hub for the IEA's activities and engagement in Southeast Asia, providing technical advice and policy support to Governments and regional bodies to accelerate the energy transition.

Emerging low-carbon alternatives

Singapore has ongoing efforts to study and pilot emerging low-carbon solutions that have the potential to help reduce Singapore's carbon footprint. For instance, the Government has launched a Request for Proposal (RFP) for low- or zero-carbon ammonia solution for power generation and bunkering. In July 2024, two consortia were shortlisted for the next phase of the RFP, where they will work with the Government to conduct feasibility studies. The Government intends to select the eventual winner next year, who will be the lead developer to conduct an operational pilot by the end of the decade.

Advances in deep drilling technology have also unlocked deep geothermal energy as a potential renewable energy source for Singapore. EMA is embarking on a non-invasive geophysical study to assess Singapore's deep geothermal resource potential. The study is scheduled to be completed by 2026. If results are positive, the heat resource could be utilised for a range of applications, such as power generation, cooling and direct heating.

Newer nuclear power plant designs also have the potential to be much safer than many of the plants in operation today, though many of these newer technologies are still being tested and have not been operationally proven. Singapore has not made a decision on whether to deploy nuclear energy. Any decision on deployment would require detailed studies of the safety, reliability, affordability and environmental sustainability of nuclear energy for Singapore. Singapore is thus building our capabilities in nuclear science and safety to better understand the implications and benefits of evolving nuclear energy technologies for Singapore.

R&D investments, such as those under the Low-Carbon Energy Research (LCER) programme, can expand the range of technological solutions available to and improve the technoeconomic viability of low-carbon alternatives for Singapore. As of March 2024, two LCER phases have been administered, with S$110 million awarded to 28 projects.

[12] Technical potential refers to the estimated achievable capacity (expressed in terms of megawatt) of a renewable energy technology that is available for development after accounting for topographic limitations, usable space, system performance etc.

Measure #2- Reducing Industrial Emissions through Energy Efficiency & Other Measures

As industry is the largest energy-consuming sector in Singapore, there are extensive efforts to improve industrial energy efficiency, to reduce our emissions and achieve better and sustained energy and emissions management.

The Government works closely with the industry to encourage the adoption of energy-efficient technologies through a mix of incentives, capability building and regulations.

Singapore has a range of financial incentives available to encourage emissions reduction, such as the Resource Efficiency Grant for Emissions (REG(E))[13], the Energy Efficiency Grant (EEG)[14], and the Investment Allowance for Emissions Reduction (IA(ER)). These help to offset part of the upfront capital investments in energy-efficient technologies for businesses in their industrial facilities. The Government regularly reviews and enhances these measures to encourage more businesses to become more energy efficient. Recent enhancements include the extension of support to other forms of emissions reduction technologies, such as efforts in switching from carbon-intensive energy sources or process gases with higher GWP. To further support and encourage more industrial facilities to be energy-efficient, REG(E) has been extended beyond 2024, and the minimum abatement criterion for REG(E) was lowered in April 2024 to extend the grant to more eligible businesses and projects. In 2024, the EEG was also further extended to other industry sectors with additional support for companies that pursue larger investments that drive greater energy efficiency.

To develop and build up expertise in energy efficiency, Singapore has also conducted energy efficiency studies and put in place national schemes for building energy efficiency capabilities within our workforce. The Energy Efficiency Opportunities (EEO) Assessor Certification Scheme jointly developed by the Government and the Institution of Engineers, Singapore (IES) in 2018 aims to certify qualified professionals to conduct energy efficiency opportunities assessments. The Energy Efficiency Technology Centre (EETC) has been set up to help companies, in particular Small and Medium-sized Enterprises (SMEs), uncover and implement energy efficiency opportunities, and train a pipeline of industrial energy efficiency engineers to support the future low-carbon economy. The centre is a collaboration between the Government and the Singapore Institute of Technology (SIT).

The Greenhouse at Dulwich College (Singapore) which opened in October 2023 is the first international school building in Singapore to be certified Green Mark Platinum Zero Energy under the BCA Green Mark 2021.

The ECA, introduced in 2013[15], mandates energy-intensive companies in the industry sector to appoint a qualified energy manager, monitor and report their energy use and GHG emissions, and submit energy efficiency improvement plans on an annual basis. This is aimed at ensuring energy-intensive companies in the industry sector put in place proper energy management practices.

The ECA has since been further enhanced in 2017 to stipulate more rigorous energy management practices. For the registered companies under the ECA, they are required to put in place a structured energy management system to strengthen their energy management practices, and periodically conduct energy efficiency opportunities assessments (EEOAs) at existing industrial facilities to identify technically and economically feasible energy efficiency improvement opportunities. Besides existing facilities, companies investing in new and major expansions of energy-intensive industrial facilities are required to review the facility design to identify technically and economically feasible energy efficiency improvement opportunities. These companies must also report measured energy performance of key energy-consuming systems in their facilities. In contrast, power generation companies ("gencos") regulated under ECA are required to implement Energy Performance Monitoring (EPM) under EEOA requirements. Through EPM, a thermodynamic model of the power plant is developed which allows performance benchmarks to be established under varying operating conditions, where areas of performance and thermal efficiency degradation are identified so that gencos can take targeted actions during scheduled maintenance.

[13] REG(E) had replaced the Grant for Energy Efficiency Technologies (GREET), the predecessor of the Productivity Grant for Energy Efficiency that was introduced in 2016.

[14] EEG was launched in 2022 to encourage businesses in the food services, food manufacturing and retail sectors to adopt energy-efficient equipment, by co-funding investments in them. From 2024 onwards, the former Energy Efficiency Fund (E2F) which supported manufacturing companies to invest in energy efficient technologies or equipment, has been consolidated under the EEG.

In addition, Minimum Energy Performance Standards (MEPS) has been introduced to phase out less efficient 3-phase induction motors which are commonly used in the industrial sector.

To help improve energy efficiency in the industry sector, Minimum Energy Efficiency Standards (MEES) for energy consuming industrial systems was developed. MEES for water-cooled chilled water systems (WC-CWS) was introduced in 2019. WC-CWS in new industrial facilities that require Planning Permission (PP) clearance or equivalent on or after 1 December 2020 are to conform to MEES. These industrial facilities have to incorporate energy-efficient chilled water systems from the outset and ensure that the systems are operating at optimal condition throughout their lifespan. In addition, WC-CWS installed in existing industrial facilities must conform to MEES by 1 December 2025 for facilities regulated under ECA and 1 December 2029 for all other industrial facilities.

Overall, we expect to achieve 2.24-3.36 Mt of CO_2 eq abatement from these energy efficiency measures by 2030. From 2019 to 2022, we achieved around an estimated 1 Mt of CO_2 eq abatement and will continue to undertake the ongoing measures.

Measure #3- Use of Carbon Capture, Utilisation and Storage (CCUS) for Hard-to-Abate Sectors

We are currently exploring the use of CCUS to abate emissions from hard-to-abate sectors such as Energy and Chemicals by 2030. The Government has recently announced the formation of S Hub (comprising ExxonMobil and Shell) to study the development of an end-to-end value chain from Singapore.

As part of the Sustainable Jurong Island plans, the Government has set a target of achieving at least 2 mtpa of CO_2 abatement through CCS by 2030 and at least 6 mtpa of CO_2 abatement from low-carbon solutions by 2050.

Measure #4- Greening Buildings

As a highly urbanised island state, the greening of buildings is an important part of Singapore's mitigation strategy. To encourage the adoption of energy-efficient technologies in buildings, the Government launched the BCA GM scheme in 2005. This is a green building rating system designed specifically for buildings in the tropics and sub-tropics. The scheme forms the backbone of the Singapore Green Building Masterplan (SGBMP), which was rolled out in 2006 to encourage, enable and engage industry stakeholders to adopt green building designs and practices.

Launched in Mar 2021, the latest edition of the SGBMP was co-created with over 5,000 individuals across the Built Environment sector as well as the wider community. It captures Singapore's commitment to pursue more ambitious sustainability standards for the sector. In addition to greening 80% of buildings by Gross Floor Area (GFA) by 2030, this latest edition of the SGBMP introduced two new goals: for 80% of new developments to meet Super Low Energy (SLE) standards from 2030, and for our best-in-class buildings to achieve 80% improvement in energy efficiency from 2005 levels by 2030.

To achieve these three "80-80-80 in 2030" targets, the Government has employed the use of both regulations and incentives. Our regulatory measures include:

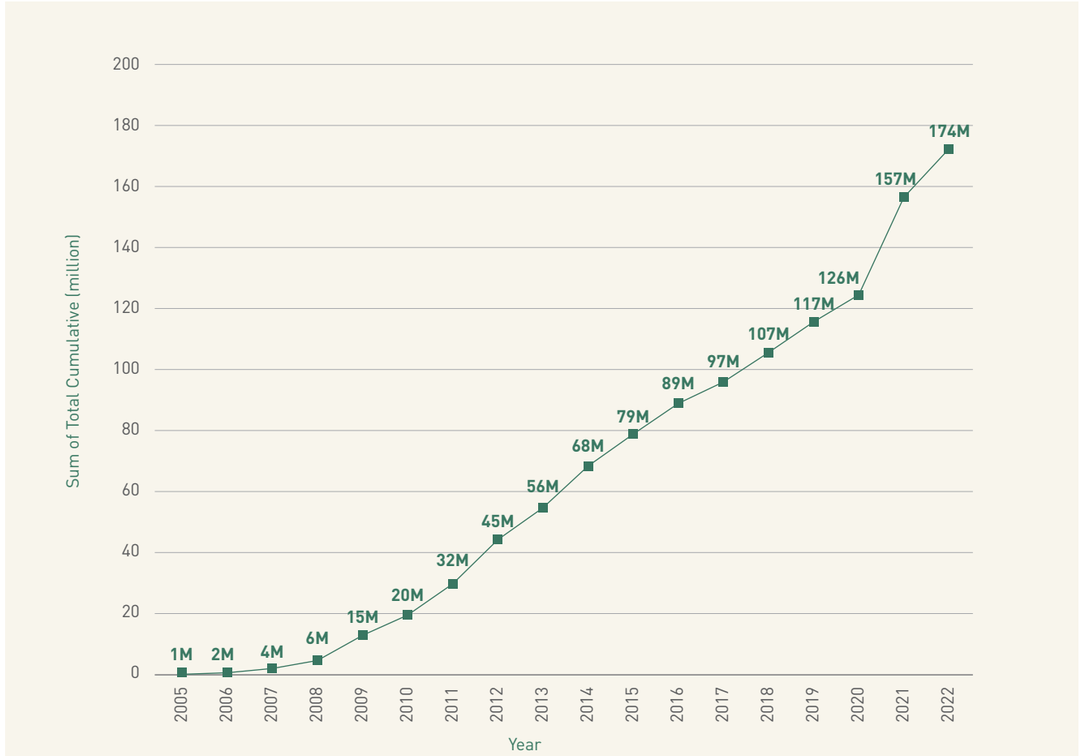
- Meeting Minimum Sustainability Standards. New buildings and existing buildings undergoing major retrofitting works or energy use change are required to meet minimum environmental sustainability standards.
- Mandatory Higher GM Standards for Government Land Sales (GLS) sites. Building projects on GLS sites are required to meet GM Platinum SLE standards and attain the Maintainability Badge[16]. Additionally, building projects in key strategic areas such as Marina South and Jurong Lake District are required to attain additional sustainability badges.
- Mandatory Submission of Periodic Energy Audits and Building Energy Performance Data. To ensure that building cooling systems continue to operate efficiently throughout the building's lifecycle, building owners are required to submit periodic energy audits. Additionally, building owners of prescribed buildings[17] are required to submit their building information and energy consumption data on an annual basis. This data is used to monitor building energy efficiency and establish a national energy benchmark for buildings. The collected information is also published to encourage building owners to proactively implement measures to improve the energy performance of their buildings.
- Mandatory Energy Improvement (MEI) Regime. The Government plans to introduce a new MEI regime for buildings by 2025. This will require owners of buildings with poor energy performance to undertake energy audits and energy efficiency improvement measures to improve their buildings' energy consumption.

Regulation is complemented with incentive schemes to encourage developers to achieve higher GM standards, and to help building owners co-fund the upfront retrofitting cost.

- Built Environment Transformation GFA Incentive Scheme. New private developments that achieve higher GM standards, in addition to other requirements, may be eligible for up to 3% additional GFA.
- GM Incentive Scheme for Existing Buildings (GMIS-EB) 2.0. This $63-million incentive scheme helps building owners lower the upfront capital costs of achieving higher energy efficiency standards by providing co-funding for retrofitting works.

Through these efforts, we have greened about 54% of our buildings by GFA as of Dec 2022 and are on track to meeting our target of 80% by 2030. The buildings sector has also achieved an estimated 0.21 Mt of CO_2 eq abatement in 2022, out of our projected abatement of 0.85 Mt CO_2 eq by 2030.

Figure 5: Green Gross Floor Area (GFA) of buildings in Singapore (Cumulative)



[15] From 1 January 2019, measurement and reporting requirements for GHG emissions are imposed under the Carbon Pricing Act.
[16] The Maintainability Badge is awarded under the GM framework to projects that have done very well in incorporating maintainability considerations upfront at the design stage.
[17] Building types include commercial buildings (offices, hotels, retail buildings and mixed developments), healthcare facilities, education institutions, civic and community institutions, places of worship, and sport and recreation buildings.

Measure #5- Shifting Travel Demand to Low-Emission Modes and Reducing Vehicular Emissions

Singapore aims to establish Walk-Cycle-Ride (WCR) transport modes, comprising active mobility, and public and shared transport modes, as the preferred way to travel. By 2040, all journeys to the nearest neighbourhood centre using WCR modes of transport will take no more than 20 minutes, while nine in 10 peak period WCR journeys will be completed in less than 45 minutes. Mass public transport is the most energy-efficient mode of powered transport. Singapore's target is for the mass public transport modal share during the morning and evening peak hours to reach 75% by 2030. To encourage the use of public transport, the length of the rail network will expand from about 270 km today to about 360 km in the early 2030s. Eight in 10 households will be within a 10-minute walk from a train station. We will also progressively implement Transit Priority Corridors, where roads are integrated with bus lanes, wider footpaths and dedicated cycling paths or shared paths to support more sustainable modes of transport. Additionally, we will maintain a vibrant point-to-point market that provides commuters better access to taxis and private hire cars, and encourage car sharing to give the populace more commuting choices without having to own a car.

Singapore will accelerate the building of cycling paths and active mobility infrastructure to make cycling and walking more convenient and attractive. By 2030, our cycling path network will be extended to 1,300 km, up from 600 km today. Beyond the 200 km of sheltered walkways from transport nodes to homes and public amenities that have been built, a further 150 km of these sheltered walkways will be added by 2040.

The ownership and usage of vehicles will continue to be managed through various upfront and recurrent taxes. Prospective vehicle owners are required to bid for a limited pool of Certificates of Entitlement, which allows a holder to purchase a vehicle and use it for 10 years. Since 2018, we have capped the vehicle growth rate for cars and motorcycles at zero. Having secured the rights to purchase a vehicle, owners are also required to pay taxes such as Additional Registration Fee upfront and road tax annually. To manage vehicle usage, Electronic Road Pricing (ERP) is in place to charge for the use of congested roads during peak hours throughout the year. Those who drive more also pay more in fuel duties.

To encourage the purchase of cars and taxis with lower emissions, the Carbon Emissions-Based Vehicle Scheme (CEVS) and the Fuel Economy Labelling Scheme (FELS) were introduced in 2013. FELS provides information on the fuel economy of vehicles for a more informed decision on vehicle purchase, while CEVS provides rebates for cars with low-carbon emissions and imposes surcharges on cars with high carbon emissions. CEVS was replaced by the Vehicular Emissions Scheme (VES), with a new Vehicular Emissions label, in January 2018. In addition to CO_2, VES includes four additional pollutants (i.e. hydrocarbons, CO, NOx and particulate matter) and the rebate or surcharge is based on the worst-performing pollutant. Given the promising results of VES, a similar scheme, the Commercial Vehicle Emissions Scheme, was introduced in April 2021 for light goods vehicles. Singapore is working on the large-scale adoption of green vehicles. By 2040, we aim to phase out pure internal combustion engine (ICE) vehicles and have all vehicles running on cleaner energy. The public sector itself will take the lead and progressively procure and use cleaner energy vehicles. Since 2020, all new public bus purchases have been cleaner energy buses, including electric and hybrid buses. We are introducing policies and initiatives to encourage the adoption of electric vehicles (EVs). We have introduced tax incentives such as the Electric Vehicle Early Adoption Incentive (EEAI) and the enhanced VES to lower the upfront purchase cost of an EV, as well as made revisions to the road tax structure to lower the running cost of owning an EV. We will also expand our public charging infrastructure to support the growth of the EV population, with a target of 60,000 charging points nationwide by 2030, in tandem with EV adoption. Singapore is systematically decarbonising our land transport by encouraging WCR as the preferred commuting modes, managing private car demand and usage, and greening our vehicle profiles.

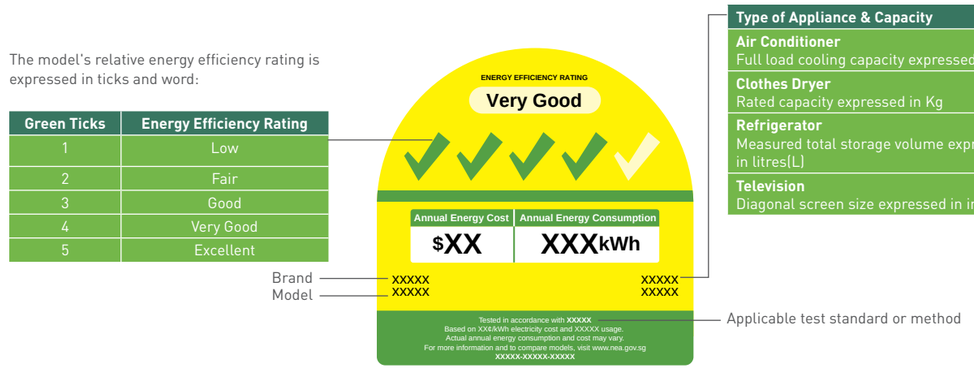
The mitigation measures in the transport sector are projected to achieve 2.07 Mt of CO_2 eq abatement in 2030, with an estimated 0.09 Mt of CO_2 eq abatement achieved in 2022.

The accessibility of charging infrastructure is vital for encouraging EV adoption, one of the key initiatives to achieve Singapore's net zero goal.

Measure #6- Improving Energy Performance Standards of Household Appliances and Promoting Energy Efficiency to Households

The household sector accounts for about 14.4% of the total electricity consumed in Singapore. If households reduce their electricity consumption by using energy-efficient appliances, they will help to reduce Singapore's GHG emissions and contribute towards actions to address climate change, and also enjoy reduction to their utility bills. To help consumers make more informed purchasing decisions, the Government introduced the Mandatory Energy Labelling Scheme (MELS) in 2008, which requires suppliers of key energy-consuming household appliances to affix their products with energy labels to identify energy-efficient models. To date, the MELS covers air conditioners, refrigerators, TVs, clothes dryers and lamps.

Regulations on MEPS were introduced for refrigerators and air conditioners in 2011 to raise the average energy efficiency of household appliances by removing energy-inefficient models from the market. Only appliance models that meet the MEPS are allowed for sale. This protects consumers from being locked into the high energy costs of operating energy-inefficient appliances. Since 2019, MEPS cover air conditioners, refrigerators, clothes dryers, lamps and fluorescent lamp ballasts. Since the introduction of the MELS and MEPS, the average energy efficiency of refrigerators as well as air conditioners have improved by 42% and 59% respectively. These improvements translate to annual household energy savings of about S$500 million or US$373 million[18].



Singapore's Mandatory Energy Labelling Scheme

Measure #7- Reducing Emissions from Waste and Wastewater Treatment

The Government is also looking to reduce emissions from waste and wastewater treatment. First, we incinerate our waste and wastewater sludge, which reduces CH_4 emissions from landfills. Second, we intend to increase our overall waste recycling rate to 70% by 2030 from 57% in 2022.

Other measures to reduce emissions are through maximising energy efficiency in operations and increasing energy production and recovery. One key initiative in progress is the co-location of a used water treatment plant (Tuas Water Reclamation Plant (TWRP)) and an Integrated Waste Management Facility (IWMF), which is expected to be completed in phases from 2026 onwards. The integration of these two facilities is collectively known as the Tuas Nexus and provides an opportunity to harness process synergies in treating used water and solid waste, reaping the benefits of a Water-Energy-Waste nexus. The co-digestion of used water sludge with food waste can produce 40% more biogas as compared to existing WRPs, due to the synergistic effect of co-digestion. The biogas produced will be combusted at IWMF to increase overall thermal efficiency and electricity production at the Tuas Nexus. The electricity generated will be sufficient for both TWRP and IWMF, with excess electricity exported back to the national grid.

Measure #8- Reducing GHG emissions from the use of refrigerants in RAC sector

Singapore has implemented a series of measures to reduce the emissions arising from the use of hydrofluorocarbons (HFCs) in the refrigeration and air-conditioning (RAC) sector. In 2022, Singapore put in place global warming potential (GWP) limits to phase out RAC equipment that use high-GWP refrigerants.

Singapore has also introduced training courses for household air-conditioner technicians and chiller technicians. The training and certification scheme aims to raise competencies within the industry on the proper handling of refrigerants during installation, maintenance and decommissioning of RAC equipment.

[18] Based on the total sales of air conditioners and refrigerators between 2009 and 2018

Spent refrigerants are sometimes vented into the atmosphere during equipment disposal, resulting in HFC emissions. Under the Resource Sustainability Act, e-waste recyclers, who take in household RAC equipment for recycling, are prohibited from venting spent refrigerants. The Environmental Public Health Act also mandates the collection and proper treatment of spent refrigerants from decommissioned RAC equipment. Operators of refrigerant treatment facilities and e-waste recyclers who handle the reclamation and destruction of spent refrigerants will have to obtain a Toxic Industrial Waste Collector (TIWC) licence.

Carbon Tax

Singapore introduced a carbon tax, the first carbon pricing scheme in Southeast Asia, on 1 January 2019. The carbon tax applies to all facilities emitting 25 kt CO_2 eq or more GHG emissions in a year without exemption, and covers around 80% of our national emissions. The carbon tax provides an economy-wide price signal to encourage GHG emission reduction where it makes the most economic sense.

At the start of this year, Singapore raised our carbon tax level five-fold to S$25 per tonne of emissions. We will progressively raise it to S$50-80 per tonne by 2030[19], making our carbon tax level one of the highest in Asia.

Internationally Transferred Mitigation Outcomes

Singapore intends to use internationally transferred mitigation outcomes (ITMOs) under Article 6 towards our NDC. We expect these ITMOs to make up the residual emissions reductions required to meet our target, after accounting for the abatement from all other policies and plans implemented within the 2030 timeframe.

To that end, Singapore has been cooperating with likeminded countries on ITMOs under Article 6.2 of the Paris Agreement. Bilateral cooperative approaches under Article 6.2 enable us to realise emissions reductions beyond what is possible within Singapore's borders, while also promoting sustainable development and environmental integrity. They will be underpinned by legally binding bilateral Implementation Agreements (IAs) which oblige corresponding adjustments be made on ITMOs transferred to Singapore. As of September 2024, Singapore has signed IAs with Ghana and Papua New Guinea.

In support of global climate ambition, Singapore's bilateral agreements will require carbon credit developers to make a monetary contribution equivalent to 5% of the share of proceeds (SOP) from Article 6.2-authorised ITMOs generated under our IAs towards the host countries' adaptation actions and/or UNFCCC Adaptation Fund.

Article 6 transactions through Singapore will also support an overall mitigation of global emissions (OMGE). 2% of Article 6.2-authorised ITMOs are required to be cancelled at issuance, thereby preventing these credits from entering the market and contributing to an overall mitigation of global emissions.

Domestic Measurement, Reporting and Verification

The domestic measurement, reporting and verification (dMRV) of Singapore's mitigation actions is a whole-of-government effort[20]. Each government agency is responsible for monitoring, measuring and documenting the progress of the mitigation actions under its purview.

Agencies usually utilise relevant data collected from official surveys, required under various Acts, for dMRV purposes. Data collected from companies and/or building owners is then verified by the lead agencies. For example, power generation companies are required under the Electricity Act to measure and report the quantity of fuel used for electricity generation monthly. The lead agency for the power sector, EMA, will verify the reported data through QA/QC procedures in accordance with the IEA, IPCC and United Nations Statistics Division's guidelines and requirements. EMA uses this data to monitor emissions from the electricity generation sector. The aggregated data is also available through EMA's annual "Singapore Energy Statistics" report.

Information collected by the lead agencies is consolidated by the Carbon and Energy Transition Working Group (CETWG) secretariat annually. CETWG will then assess the effect of the various mitigation measures and track Singapore's progress in meeting our mitigation pledge and objectives.

[19] This is equivalent to US$37.29 to US$59.66. Conversion from S$ to US$ based on the monthly exchange rate as of Jan 2024.

[20] The agencies involved include the Ministry of Sustainability and the Environment, the Ministry of Trade and Industry, the Ministry of Transport, the National Climate Change Secretariat, the Building and Construction Authority, the Economic Development Board, the Energy Market Authority, the Land Transport Authority, the Maritime and Port Authority of Singapore, the National Environment Agency, the National Parks Board and PUB, Singapore's National Water Agency

List of Mitigation Measures

Table 16 - Shifting to Cleaner Energy Sources

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Low-carbon electricity import	Encourage multilateral crossborder electricity trading and integration of power grids (i.e., ASEAN Power Grid).	To increase the amount of low-carbon electricity in Singapore's energy mix.	Infrastructure	**Adopted** Singapore's target is to import low-carbon electricity to meet one-third of our energy needs by 2035. To date, we have awarded Conditional Approvals to ten projects, to import 7.35 GW of low-carbon electricity from Cambodia, Indonesia, Vietnam and Australia (some of these projects are expected to come online only after 2035). Of these 10 projects, five projects from Indonesia have progressed to being awarded Conditional Licences.	Energy	CO_2	Progressively from 2028	EMA	Fuel mix	The carbon abatement achieved by this measure is based on the emission factor of the natural gas CCGTs that would have resulted from generating the amount of electricity displaced by the imported low-carbon electricity.	To date, we have awarded Conditional Approvals to 10 projects, to import 7.35 GW of low-carbon electricity from Cambodia, Indonesia, Vietnam and Australia (some of these projects are expected to come online only after 2035).	2,340

Table 17 - Reducing Industrial Emissions through Energy Efficiency & Other Measures

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Reducing industrial emissions through energy efficiency and other measures	To encourage energy efficiency improvements and other forms of emissions reduction from the Industry sector.	Encouraging energy efficiency retrofits & other emissions reduction efforts in the manufacturing sectors and data centres. This can involve switching away from carbon intensive fuels as well as process gases with higher Global Warming Potential.	Technology, regulation, incentive	**Adopted** Companies are being supported for their emissions reduction efforts through financial incentive schemes, such as the Resource Efficiency Grant for Emissions (REG(E)), the Energy Efficiency Grant (EEG), and the Investment Allowance for Emissions Reduction (IA(ER)).	Energy, IPPU	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	2019	EDB, NEA	Abatement committed and achieved calculated through data collection/ audits.	Abatement calculated based on carbon abatement from the implementation of projects supported under the schemes. Abatement arising from incentives will be audited by professionals with competencies in the technologies and measurement and verification process.	1,000	2,240-3,360

Table 18 – Use of Carbon Capture, Utilisation and Storage (CCUS) for Hard-to-Abate Sectors

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
CCUS	Reduce emissions from hard-to-abate sectors such as Energy and Chemicals industry.	To capture, transport and store emissions instead of releasing into atmosphere.	Technology, legislation, incentive	**Adopted** Announced the formation of S Hub (comprising ExxonMobil and Shell) to study the development of an end-to-end value chain from Singapore.	IPPU	CO_2	2030	EMA	NA	Abatement based on amount of CO2 exported to a storage country, based on metered volumes.	0	Up to 2,500

Table 19 - Greening Buildings

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Regulatory measures, incentives, and research and development to raise adoption of green buildings	<u>New Buildings</u> Requiring owners of new buildings to achieve minimum environmental sustainability standards, and encouraging them to achieve a GM standard beyond the legislated minimum standards through incentives. Developments in Government Land Sale (GLS) sites and key strategic areas are required to achieve a higher Green Mark (GM) standard beyond the legislated minimum standards.	To improve energy efficiency and sustainability standards of buildings.	Legislation, incentives	**Implemented** <u>New Buildings</u> *Legislation* In 2021, the minimum energy performance requirement for new buildings was raised from 30% to 50% improvement in energy efficiency over 2005 levels. In 2022, the sustainability requirements for GLS sites were enhanced to GM:2021 Platinum Super Low Energy (SLE) standards. *Incentives* In 2022, the Built Environment Transformation GFA incentive scheme was launched to encourage the adoption of higher sustainability standards for new buildings (e.g. GM Platinum SLE standard with Maintainability Badge). *Progress* As of Dec 2022, 19.6% of new developments by GFA are certified to be SLE.	Energy	CO_2	2021	BCA, URA	Through electricity consumption and building information data collected through the Building Energy Submission System	The abatement is calculated by the difference between the BAU emission values (i.e. no legislation/ incentives) projected for the new building stock in 2020, and the emission values after legislation and incentives have been implemented.	210	850

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
	Existing Buildings Requiring existing building owners to achieve minimum environmental sustainability standards when undergoing major retrofits, or installing or replacing the building cooling system. Building owners are also incentivised to achieve a GM standard beyond the legislated minimum standards through co-funding schemes.			Existing Buildings *Legislation* In 2021 and 2022 respectively, the minimum energy performance requirement for existing buildings undergoing major retrofit and major energy use change was raised from 25% to 40% improvement in energy efficiency, over 2005 levels. Owners of prescribed buildings are also required to submit building energy consumption data annually and conduct energy audits on building cooling systems every three years. The Government will be introducing a new Mandatory Energy Improvement (MEI) regime in 3Q 2025. The regime requires owners of energy-intensive buildings to undertake energy audits and energy efficiency improvement measures to improve their buildings' energy consumption *Incentives* In 2022, the Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0) was launched. This scheme co-funds the upfront cost of energy efficiency retrofits for existing buildings. *Progress* As of December 2022, 54% of buildings by GFA, have been greened.			2021	BCA				

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
	Innovation Supporting research, development and demonstration for technologies and innovations that lead to highly energy efficient buildings			Innovation Established in 2014, the Green Buildings Innovation Cluster (GBIC) programme serves as a one-stop research, development and demonstration platform for technologies and innovations that lead to highly energy efficient buildings. In 2022, the GBIC programme (GBIC 2.0) was enhanced to focus on three key areas with significant impact on energy and carbon emissions, i.e. alternative cooling technologies, data-driven smart building solutions and advanced ventilation technologies. To date, GBIC programme has supported the development of more than 60 innovative technologies from more than 50 firms. As of December 2022, our best-in-class green buildings have achieved 71% energy efficiency improvement over 2005 levels.			2022	BCA				

Table 20 - Shifting Travel Demand to Low-Emission Modes and Reducing Vehicular Emissions

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Increasing the public transport modal share	Expanding the rail and bus network, building integrated transport hubs, implementing more bus priority measures; and managing travel demand and planning better as detailed in the Land Transport Master Plan 2040.	To increase usage of public transport, the most energy-efficient mode of powered transport.	Infrastructure, regulations, incentives, technology, education	**Adopted** Singapore's target is for the public transport modal share during the morning and evening peak hours to reach 75% by 2030. The length of the rail network will increase further from about 270 km today to about 360 km in early 2030s.	Transport	CO_2	NA. Singapore has been continually seeking to increase the public transport modal share.	LTA	Peak period mass public transport modal share	Mitigation effect is calculated as the difference between the total energy consumed for (i) the projected BAU travel demand and the modal split; and (ii) the actual travel made and the modal split.	0	840
Cleaner energy public bus fleet	Replacing the current Internal Combustion Engine (ICE) public bus fleet with cleaner energy buses.	To switch public buses to cleaner energy buses.	Infrastructure, technology	**Adopted** Since 2020, all new public bus purchases will be cleaner energy buses, including electric and hybrid buses. 50 hybrid buses and 60 electric buses have been fully deployed on the roads, since 2019 and 2021 respectively. With the recent award of 2 new ebus contracts in 2023, 420 new ebuses will be progressively deployed for passenger service starting from Dec 2024, until the end of 2025.	Transport	CO_2	2013	LTA	Cleaner energy public bus take-up rate	Mitigation effect is calculated based on the number of cleaner energy public buses and the difference between the average carbon emissions of a normal ICE public bus and those of a cleaner energy public bus.	10	160
Electrification of light duty vehicles	Implementing schemes that limit the number of ICE light duty vehicles and rolling out various initiatives that encourage take up of electric vehicles (EVs).	To encourage take up of electric light duty vehicles which release less emissions than are more energy efficient over ICE vehicles	Infrastructure, incentives, education	**Adopted** By 2040, we aim to phase out pure ICE light duty vehicles. We have introduced tax incentives to lower the upfront and running cost of owning an EV such as the Electric Vehicle Early Adoption Incentive (EEAI), the enhanced VES, and revisions to the road tax structure for mass-market EVs. We will also expand our public charging infrastructure to support the growth of the EV population, with a target of 60,000 charging points nationwide by 2030, in tandem with EV adoption.	Transport	CO_2	2020	LTA	Electric light duty vehicle take-up rate	Mitigation effect is calculated based on the number of electric vehicles EVs and the difference between the average carbon emissions of a normal car and those of an electric vehicle EV.	30	900

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Car/taxi fuel efficiency	Implementing the mandatory Fuel Economy Labelling Scheme (FELS) and the Vehicular Emissions Scheme (VES).	To encourage the take-up of more energy efficient vehicles.	Legislation, incentives	**Adopted** The CEVS and the FELS were introduced in 2013. The CEVS was replaced by the VES with a new Vehicular Emissions label in January 2018. In addition to CO_2, the VES includes four additional pollutants (hydrocarbons, carbon monoxide, nitrogen oxides and particulate matter) in the assessment of new cars, taxis and newly imported used cars for rebate or surcharge based on the worst-performing pollutant.	Transport	CO_2	2020	NEA, LTA	Increase in registration of cars in lower carbon bands and reduction in registration of cars in the higher carbon bands	Mitigation effect is calculated based on the increased quantity of cars/taxis purchased in the CEVS/ VES lower carbon bands (i.e. the rebate bands or similar cleaner cars), compared to the historical rates, and the average carbon emission reduction for the CEVS/ VES bands. This is calculated against BAU projections, which are the emissions computed considering the quantity of cars/ taxis purchased in the absence of CEVS/ VES rebates/ surcharges.	50	170

Table 21- Improving Energy Performance Standards of Household Appliance and Promoting Energy Efficiency to Households

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Minimum Energy Performance Standards (MEPS) for household appliances – air conditioners, fridges, lighting, clothes dryers, water heaters	Disallowing the supply of inefficient appliances that fall short of specified minimum energy efficiency levels.	To improve the overall energy efficiency of appliances in the market.	Legislation	**Implemented** MEPS for air conditioners and fridges were implemented in September 2011 and have been raised progressively between 2013 to 2022. Both will be raised further in 2025. MEPS for clothes dryers were implemented in April 2014 and was raised in January 2022. MEPS for general lighting were implemented in July 2015. The MELS was extended to common CFLni and fluorescent tubes, and their LED direct replacements in November 2019. MEPS were raised to phase out incandescent lamps in November 2019. MEPS were introduced for fluorescent lamp ballasts in November 2019. In April 2024, MELS was extended to all T8 and T5 linear fluorescent and LED tubes in April 2024 and MEPS were raised.	Energy	CO_2	2011	NEA	Annual purchase pattern of appliance models by tick-rating	The carbon emissions arise from the energy use of home appliances. The emissions in two scenarios, the BAU and Policy scenarios, are calculated. In both scenarios, the annual hours of usage of home appliances are assumed to remain the same as that of the reference year, 2005. In the BAU scenario, since there are no policies affecting purchasing decisions, it is assumed that there is no change in the purchasing pattern of home appliances by energy efficiency rating over the forecast period 2006-2020. The emissions are calculated based on the predicted stock of appliances (initial stock plus purchases less displaced and retired stock), annual hours of usage and annual energy consumption based on energy efficiency rating.	170	500-520

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Promotion of energy efficiency to households	Promoting the purchase of energy efficient appliances through the Mandatory Energy Labelling Scheme (MELS) for household appliances and outreach efforts.	To promote energy efficiency to households.	Promotion	**Implemented** The MELS for air conditioners and fridges was introduced in 2008 and extended to clothes dryers in 2009, TVs in 2014 and general lighting in 2015. Household energy efficiency awareness programmes (e.g. media publicity, energy-saving contests, energy efficiency roadshows) have been rolled out since 2008.	Energy	CO_2	2008	NEA	Annual purchase pattern of appliance models by tick-rating	In the Policy scenario, purchasing decisions are modified by mandated standards and energy labelling. The purchasing pattern of home appliances by energy efficiency rating is obtained from market data on purchases of products of different efficiency levels. This together with estimated lifespans of the appliances are used to calculate the mix of appliances by energy efficiency rating in the stock. The carbon emissions of the stock are calculated based on energy consumption. The emissions abatement is the difference in carbon emissions between the BAU and Policy scenarios.		0-280

Table 22- Reducing Emissions from Waste and Wastewater Treatment

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Co-digestion of used water sludge and food waste	The co-digestion of used water sludge and food waste increases biogas production, which is processed in high efficiency superheaters to generate more renewable energy.	To increase the amount of biogas generated and used.	Infrastructure, development	**Adopted** Tuas Nexus is on track to be completed in phases from 2026.	Energy	CO_2	2026	PUB	Additional amount of biogas generated	Abatement is based on the increased generation of biogas from the co-digestion of used water sludge and food waste, compared to mono-digestion of used water sludge. The additional amount of biogas generated can be used to generate electricity, offsetting some of the fossil fuels needed to generate electricity.	0	20
Enhance plastic recycling	Implement beverage container return scheme to take back and recycle plastic beverage containers, to divert them from incineration.	To increase the plastic recycling rate.	Legislation	**Adopted**	Energy	CO_2, CH_4, N_2O	2026	NEA	Recycling rate	Abatement will be calculated using the amount of plastic beverage containers recycled.	0	Pending finalisation of scheme parameters
Increase overall recycling rate	Mandatory waste reporting and submission of waste reduction plan for large commercial premises, starting with large hotels and shopping malls, has been implemented in 2014.	To increase the overall recycling rate.	Legislation	**Implemented** Affected premises have submitted their waste report. The overall recycling rate in 2022 was 57%.	Energy	CO_2, CH_4, N_2O	2014	NEA	Recycling rate	Emissions and abatement will be calculated using the amount of waste incinerated and waste recycling rates, compared against the BAU projections.	0	50

Table 23- Cross-Sectoral Measures

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Carbon tax	Introduce a carbon tax to on facilities that directly emit at least 25,000 t CO2 eq of GHG emissions annually. The carbon tax currently covers 80% of our total GHG emissions.	To provide an economy-wide price signal to encourage GHG emission reduction, while giving companies the flexibility to take action where it makes the most economical sense.	Market-based instrument	**Adopted** The carbon tax came into force on 1 January 2019, at S$5 or US$3.73 per tonne of emissions. At the start of this year, we raised our carbon tax level five-fold to S$25 or US$18.65 per tonne of emissions. We will progressively raise it to S$50 to S$80 or US$37.29 to US$59.66 per tonne by 2030.	Economy-wide	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	2019	NEA	Carbon intensity and energy efficiency of the Singapore economy	The carbon tax covers around 80% of our national emissions, and applies to large direct industrial emitters from the manufacturing, power generation, water and waste management sectors. It is applied uniformly and without exemptions. Taxable facilities are required to submit a Monitoring Plan, as well as annual Emissions Reports. The Emissions Reports must be verified by an accredited external auditor.	Not applicable as the carbon tax is not a standalone measure. The results from having a carbon tax are demonstrated through the abatement from sector specific policies and measures.	Not applicable as the carbon tax is a cross sectoral measure to complement other policies and measures for meeting Singapore's NDC.

E.

Summary of greenhouse gas emissions and removals

Singapore's GHG emissions for 2022 totalled 58,587 Gg CO_2 eq. A breakdown of the total GHG emissions by IPCC sectors and GHG type in Gg CO_2 eq can be found in the table below with a detailed report of each sector found in the NID 2024.

Table 24: Singapore's GHG emissions in 2022

Greenhouse Gas Source and Sink Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Total (Net)
	CO_2 equivalents (Gg)							
Total (Net) National Emissions	**50,374.84**	**129.14**	**596.97**	**4,167.77**	**2,518.74**	**154.58**	**644.77**	**58,586.82**
1 Energy	**48,729.46**	**111.64**	**227.31**					**49,068.42**
1.A. Fuel combustion activities	48,164.53	63.67	226.31					48,454.51
1.A.1. Energy Industries	21,335.93	15.45	69.41					21,420.79
1.A.2. Manufacturing industries and construction	18,952.35	11.60	16.44					18,980.38
1.A.3. Transport	6,862.79	34.58	138.19					7,035.56
1.A.4. Other sectors	763.23	1.83	0.35					765.41
1.A.5. Others	250.23	0.21	1.92					252.36
1.B. Fugitive Emissions from Fuels	564.93	47.97	1.01					613.91
1.B.1. Solid fuels	IE	NO	NO					IE
1.B.2. Oil and Natural Gas and other emissions from energy production	564.93	47.97	1.01					613.91
1.C. CO_2 Transport and storage	NO	NO	NO					NO
2 Industrial Processes and Product Uses	**1,310.38**	**13.00**	**278.82**	**4,167.77**	**2,518.74**	**154.58**	**644.77**	**9,088.05**
2.A. Mineral Industry	NO							NO
2.B. Chemical industry	1,288.04	13.00	14.94	NO	NO	NO	NO	1,315.97
2.C. Metal industry	IE	NA	NO					IE
2.D. Non-energy products from fuels and solvent use	0.99	NO	NO					0.99
2.E. Electronics industry	IE	IE	263.88	117.45	2,518.74	128.84	644.77	3,673.67
2.F. Product uses as substitutes for ODS				4,050.33	NO	NO	NO	4,050.33
2.G. Other product manufacture and use	NO	NO	NO	NO	NO	25.74	NO	25.74
2.H. Other	21.35	IE	IE	NO	NO	NO	NO	21.35
3 Agriculture	**0.07**	**2.70**	**5.27**					**8.04**
4 Land Use, Land-Use Change and Forestry	**30.80**	**NO**	**7.31**					**38.12**

Greenhouse Gas Source and Sink Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Total (Net)
	CO_2 equivalents (Gg)							
5 Waste	**304.14**	**1.80**	**78.26**					**384.19**
5.A. Solid Waste Disposal		1.80						1.80
5.B. Biological treatment of solid waste		IE, NE						IE, NE
5.C. Incineration and Open Burning of Waste	304.14	0.00	2.50					306.64
5.D. Wastewater Treatment and Discharge		NO	75.75					75.75
Information Item								
CO_2 from Biomass Combustion for Energy Production	2,700.64							2,700.64

Notation keys:
C= Confidential, IE = Included elsewhere, NE= Not estimated, NA = Not applicable and NO= Not occurring

F.

Projections of greenhouse gas emissions and removals

Overview

Singapore projected our emissions under a 'with measures' scenario for 2025, 2028 and 2030, with 2028 being our expected peak emissions year. Our 2030 emissions are projected to be 60 Mt CO_2 eq, which is in line with Singapore's 2030 NDC to reduce emissions to around 60 Mt CO_2 eq in 2030 after peaking emissions earlier.

In accordance with the flexibility provision in paragraph 95 of decision 18/CMA.1, Singapore projected its emissions under a 'with measures' scenario to the end point of our NDC under Article 4 of the Paris Agreement. Singapore is currently developing capabilities to project and report emissions across a longer timeframe. These capabilities have to be developed both centrally as well as on a sectoral basis to ensure greater confidence in the projections reported. Singapore expects to report longer-horizon projections within the next two BTRs (i.e., by 2028).

Singapore's emissions projections are reported on a sectoral basis as well as by gas. The sectors projected – Energy, IPPU, Agriculture, LULUCF and Waste – are equivalent in definition, scope, coverage, etc. as the sectors in our NID 2024. Should there be changes to the sectors covered in future NIDs, our sectoral projections will be updated to align with those changes as well.

As Singapore's indicator to track our progress towards our NDC is net GHG emissions and removals, the projection of our total emissions can also be taken as a projection of our indicator.

Overall Projected Emissions

Singapore's overall emissions in 2022 were 58.59 Mt CO_2 eq with LULUCF, and 58.55 Mt CO_2 eq without LULUCF. While Singapore has not participated in cooperative approaches that involve the use of ITMOs under Article 6 as of 2022, Singapore estimates the use of 2.51 Mt CO_2 eq[21] per annum of ITMOs over the NDC implementation period (i.e., from 2021 to 2030). This would bring the total 2022 emissions to 56.07 Mt CO_2 eq. Under a 'with measures' scenario, including the projected use of ITMOs, Singapore's projected 2025 emissions are estimated to be 59.70 Mt CO_2 eq, which is 6.46% higher than 2022. Singapore projects that our emissions would peak around 2028, at around 61.92 Mt CO_2 eq, which is 3.73% higher than projected 2025 emissions, before reaching 60 Mt CO_2 eq in 2030.

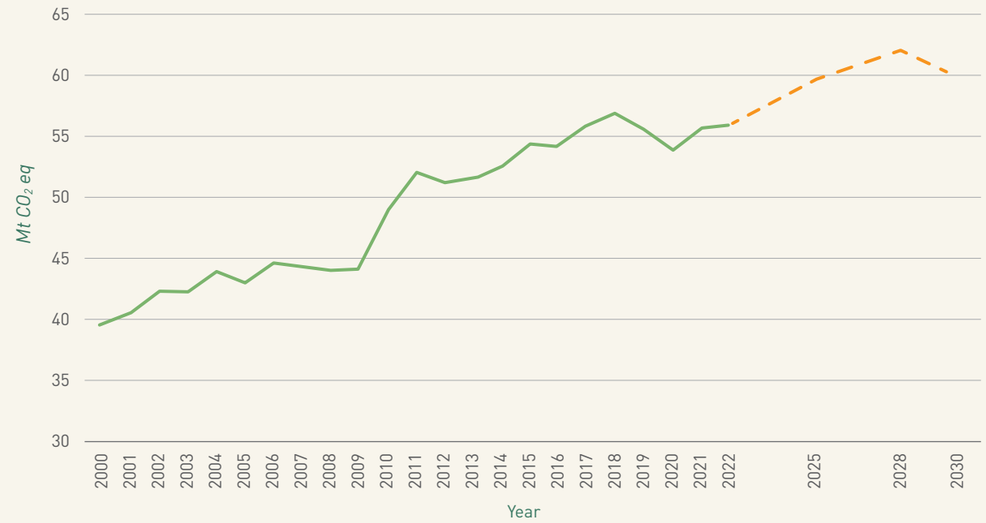
[21] The estimated use of ITMOs is expected to make up the residual emissions reductions required to meet Singapore's NDC under Article 4 of the Paris Agreement and may change as Singapore updates our emissions projections in future BTRs.

Table 25: Overall projected emissions (Mt CO_2 eq)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total with Projected Use of ITMOs	39.69	40.58	42.34	42.32	43.89	43.11	44.63	44.47	44.07	44.24	48.90	52.10	51.26
Total without ITMOs	39.69	40.58	42.34	42.32	43.89	43.11	44.63	44.47	44.07	44.24	48.90	52.10	51.26
Energy	38.27	39.37	40.86	40.39	41.81	40.63	41.80	42.39	41.73	41.78	45.64	48.36	47.51
IPPU	1.20	1.06	1.27	1.75	1.90	2.37	2.64	1.88	2.09	2.23	3.00	3.43	3.52
Agriculture	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LULUCF	0.00	-0.07	-0.03	-0.05	-0.06	-0.12	-0.08	-0.08	-0.04	-0.04	-0.06	-0.04	-0.06
Waste	0.21	0.23	0.23	0.23	0.24	0.22	0.26	0.27	0.28	0.26	0.31	0.33	0.28

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2028	2030
Total with Projected Use of ITMOs	51.59	52.61	54.41	54.14	56.06	56.84	55.58	53.87	55.77	56.07	59.70	61.92	60.00
Total without ITMOs	51.59	52.61	54.41	54.14	56.06	56.84	55.58	53.87	58.28	58.59	62.21	64.43	62.51
Energy	47.51	48.15	49.76	49.43	50.24	50.51	48.69	46.40	49.76	49.07	52.60	53.80	52.03
IPPU	3.80	4.15	4.28	4.39	5.44	6.01	6.57	7.14	8.15	9.09	9.09	10.09	9.94
Agriculture	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
LULUCF	0.00	0.02	0.09	-0.03	0.01	0.01	0.02	0.02	0.03	0.04	0.09	0.12	0.14
Waste	0.27	0.28	0.28	0.34	0.36	0.31	0.30	0.31	0.33	0.38	0.42	0.40	0.38

Figure 6: Projections of Singapore's overall emissions, inclusive of projected use of ITMOs



Projected Emissions by Sector

The projections in this section cover five sectors – Energy, IPPU, Agriculture, LULUCF and Waste – under a 'with measures' scenario, excluding the projected use of ITMOs.

Energy

Singapore's Energy sector emissions in 2022 were 49.07 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 Energy sector emissions are estimated to be 52.60 Mt CO_2 eq, 7.20% higher than 2022. Energy sector's estimated 2028 and 2030 emissions are 53.80 Mt CO_2 eq and 52.03 Mt CO_2 eq, respectively.

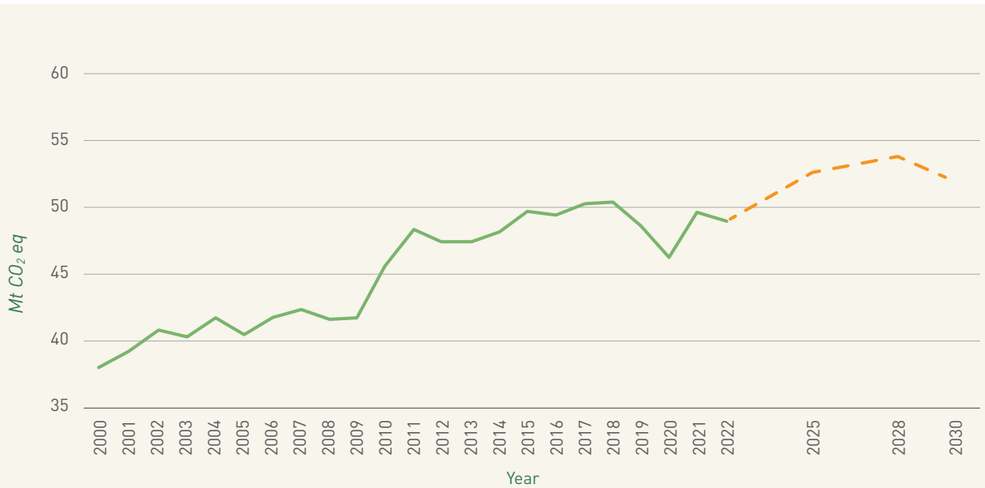
Table 26: Projected emissions from Energy sector (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy (Mt CO_2 eq)	38.27	39.37	40.86	40.39	41.81	40.63	41.80	42.39	41.73

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy (Mt CO_2 eq)	41.78	45.64	48.36	47.51	47.51	48.15	49.76	49.43	50.24

Year	2018	2019	2020	2021	2022	2025	2028	2030
Energy (Mt CO_2 eq)	50.51	48.69	46.40	49.76	49.07	52.60	53.80	52.03

Figure 7: Projected emissions from Energy sector (with measures)



IPPU

Singapore's IPPU sector emissions in 2022 were 9.09 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 IPPU sector emissions are estimated to be 9.09 Mt CO_2 eq, 0.02% lower than 2022. IPPU sector's estimated 2028 and 2030 emissions are 10.09 Mt CO_2 eq and 9.94 Mt CO_2 eq, respectively.

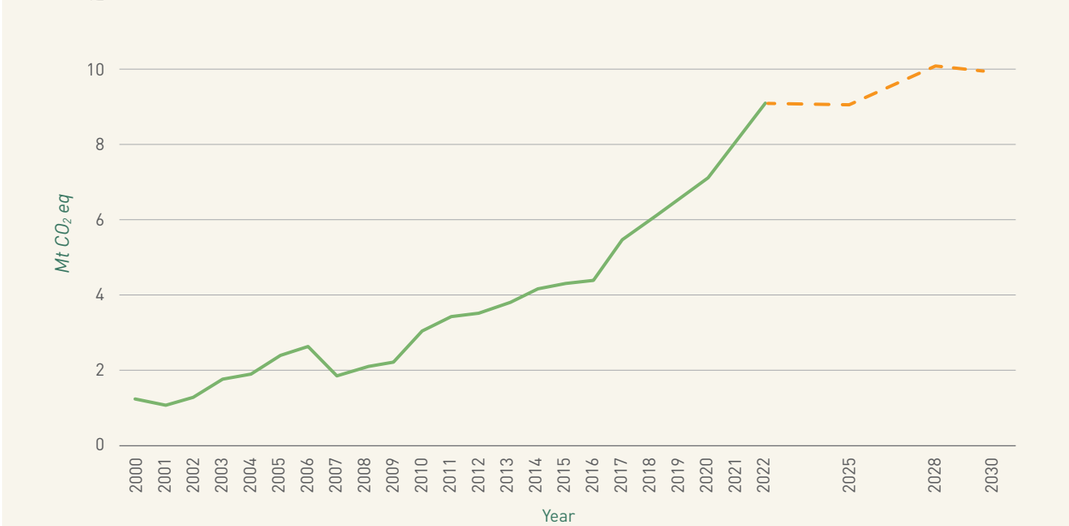
Table 27: Projected emissions from IPPU sector (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
IPPU (Mt CO_2 eq)	1.20	1.06	1.27	1.75	1.90	2.37	2.64	1.88	2.09

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
IPPU (Mt CO_2 eq)	2.23	3.00	3.43	3.52	3.80	4.15	4.28	4.39	5.44

Year	2018	2019	2020	2021	2022	2025	2028	2030
IPPU (Mt CO_2 eq)	6.01	6.57	7.14	8.15	9.09	9.09	10.09	9.94

Figure 8: Projected emissions from IPPU sector (with measures)



Agriculture

Singapore's Agriculture sector emissions in 2022 were 0.01 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 Agriculture sector emissions are estimated to be 0.02 Mt CO_2 eq, about twice that of 2022. Agriculture sector's estimated 2028 and 2030 emissions are both around 0.02 Mt CO_2 eq.

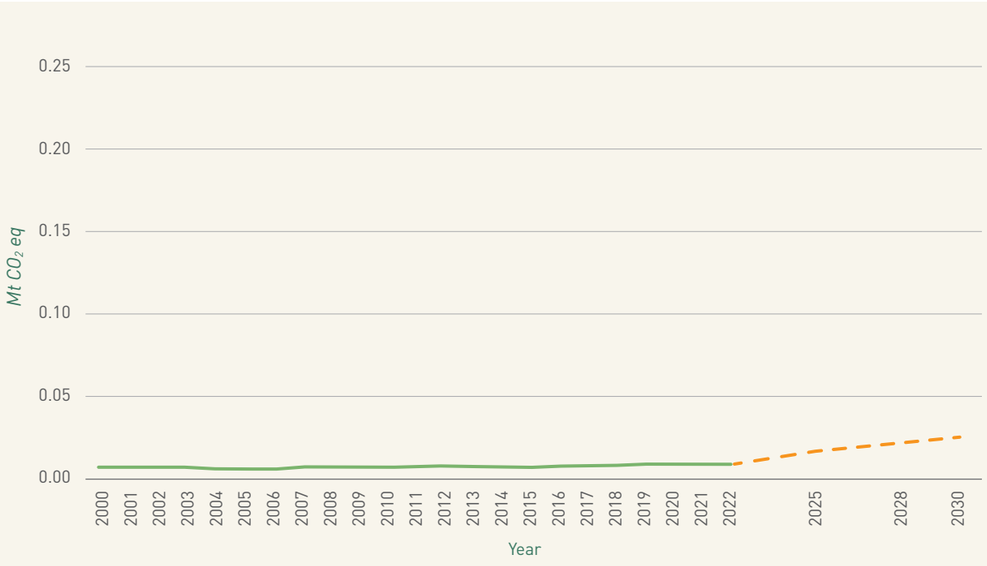
Table 28: Projected emissions from Agriculture sector (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agriculture (Mt CO_2 eq)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture (Mt CO_2 eq)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Year	2018	2019	2020	2021	2022	2025	2028	2030
Agriculture (Mt CO_2 eq)	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02

Figure 9: Projected emissions from Agriculture sector (with measures)



LULUCF

Singapore's LULUCF sector emissions in 2022 were 0.04 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 LULUCF sector emissions are estimated to be 0.09 Mt CO_2 eq, over twice that of 2022. LULUCF sector's estimated 2028 and 2030 emissions are 0.12 Mt CO_2 eq and 0.14 Mt CO_2 eq, respectively.

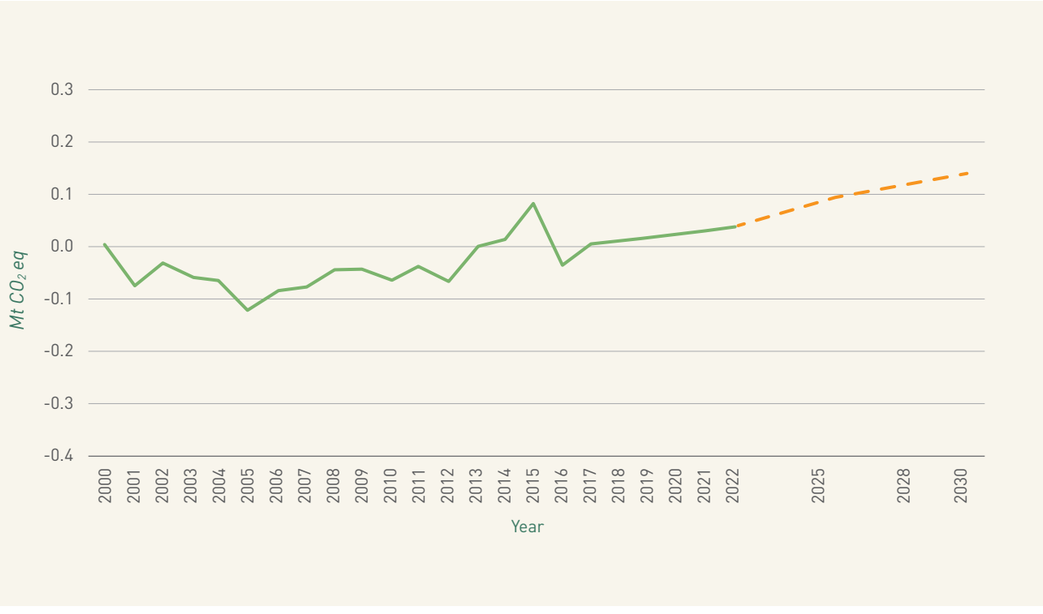
Table 29: Projected emissions from LULUCF sector (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
LULUCF (Mt CO_2 eq)	0.00	-0.07	-0.03	-0.05	-0.06	-0.12	-0.08	-0.08	-0.04

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
LULUCF (Mt CO_2 eq)	-0.04	-0.06	-0.04	-0.06	0.00	0.02	0.09	-0.03	0.01

Year	2018	2019	2020	2021	2022	2025	2028	2030
LULUCF (Mt CO_2 eq)	0.01	0.02	0.02	0.03	0.04	0.09	0.12	0.14

Figure 10: Projected emissions from LULUCF sector (with measures)



Waste

Singapore's Waste sector emissions in 2022 were 0.38 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 Waste sector emissions are estimated to be 0.42 Mt CO_2 eq, which is 8.54% higher than 2022. Waste sector's estimated 2028 and 2030 emissions are 0.4 Mt CO_2 eq and 0.38 Mt CO_2 eq, respectively.

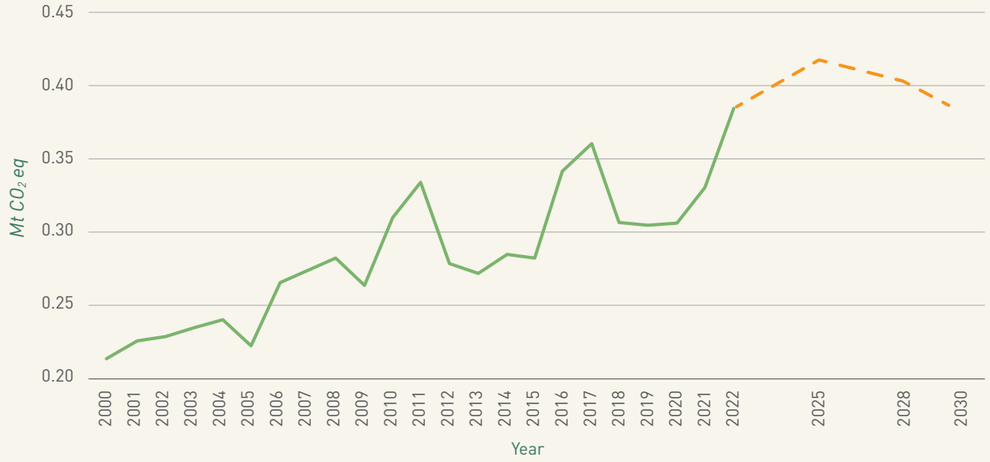
Table 30: Projected emissions from Waste sector (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Waste (Mt CO_2 eq)	0.21	0.23	0.23	0.23	0.24	0.22	0.26	0.27	0.28

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste (Mt CO_2 eq)	0.26	0.31	0.33	0.28	0.27	0.28	0.28	0.34	0.36

Year	2018	2019	2020	2021	2022	2025	2028	2030
Waste (Mt CO_2 eq)	0.31	0.30	0.31	0.33	0.38	0.42	0.40	0.38

Figure 11: Projected emissions from Waste sector (with measures)



Projected Emissions by Gas

The projections in this section cover the seven gases reported in our NID 2024 – CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 – under a 'with measures' scenario, excluding the projected use of ITMOs.

CO_2

Singapore's CO_2 emissions in 2022 were 50.37 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 CO_2 emissions are estimated to be 55.23 Mt CO_2 eq, 9.63% higher than 2022. CO_2 emissions in 2028 and 2030 are estimated to be 57.97 Mt CO_2 eq and 56.81 Mt CO_2 eq, respectively.

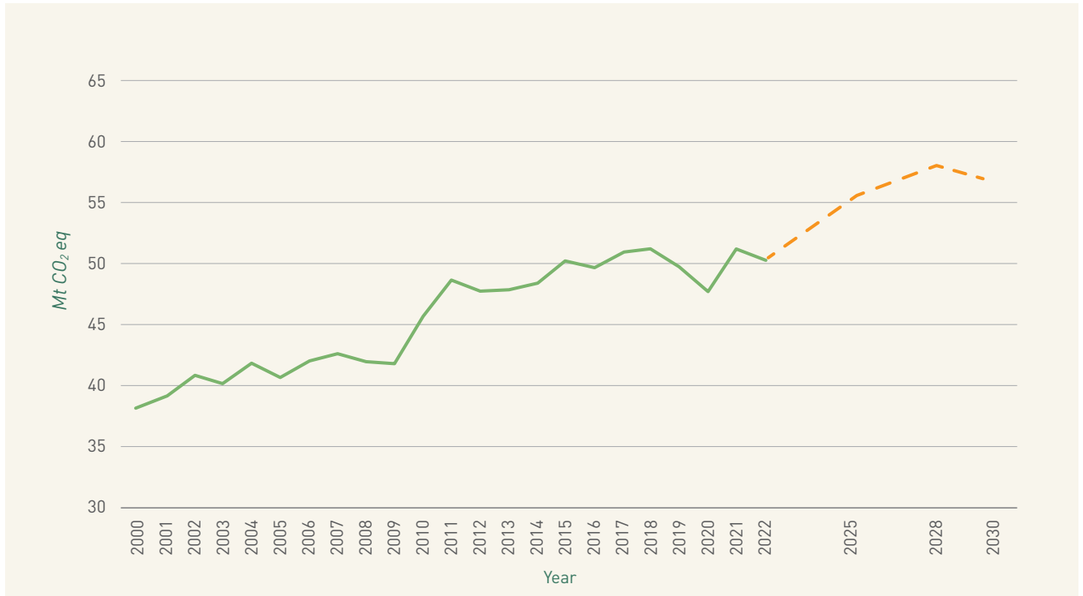
Table 31: Projected CO_2 emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
CO_2 (Mt CO_2 eq)	38.26	39.26	40.80	40.28	41.82	40.68	41.96	42.57	42.03

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
CO_2 (Mt CO_2 eq)	41.88	45.82	48.69	47.77	47.80	48.53	50.23	49.76	50.90

Year	2018	2019	2020	2021	2022	2025	2028	2030
CO_2 (Mt CO_2 eq)	51.17	49.70	47.73	51.20	50.37	55.23	57.97	56.81

Figure 12: Projected CO_2 emissions (with measures)



CH_4

Singapore's CH_4 emissions in 2022 were 0.13 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 CH_4 emissions are estimated to be around 0.11 Mt CO_2 eq, 11.39% lower than 2022. CH_4 emissions in 2028 and 2030 are estimated to be 0.11 Mt CO_2 eq and 0.10 Mt CO_2 eq, respectively.

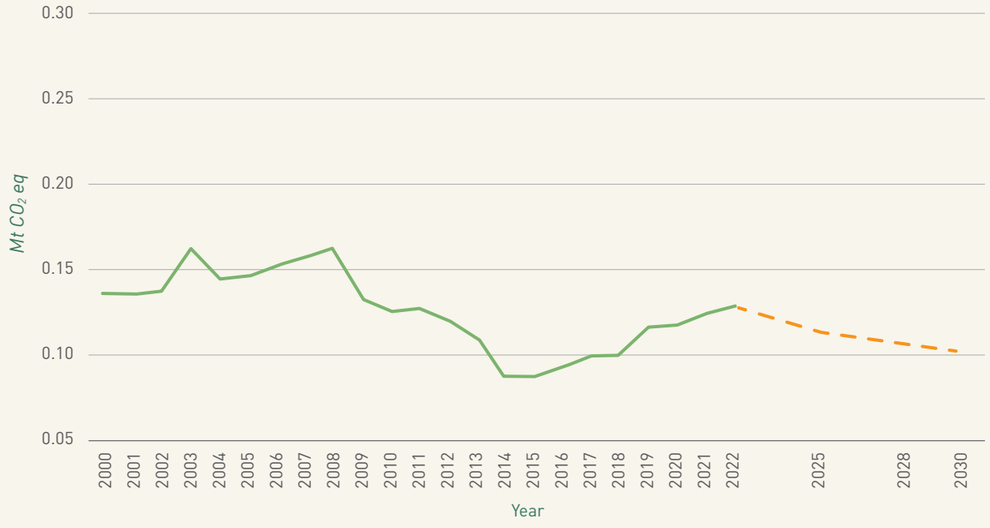
Table 32: Projected CH_4 emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
CH_4 (Mt CO_2 eq)	0.14	0.14	0.14	0.16	0.15	0.15	0.15	0.16	0.16

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
CH_4 (Mt CO_2 eq)	0.13	0.13	0.13	0.12	0.11	0.09	0.09	0.09	0.10

Year	2018	2019	2020	2021	2022	2025	2028	2030
CH_4 (Mt CO_2 eq)	0.10	0.12	0.12	0.12	0.13	0.11	0.11	0.10

Figure 13: Projected CH_4 emissions (with measures)



N_2O

Singapore's N_2O emissions in 2022 were 0.60 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 N_2O emissions are estimated to be 0.60 Mt CO_2 eq, 0.19% higher than 2022. N_2O emissions in 2028 and 2030 are estimated to be 0.61 Mt CO_2 eq and 0.57 Mt CO_2 eq, respectively.

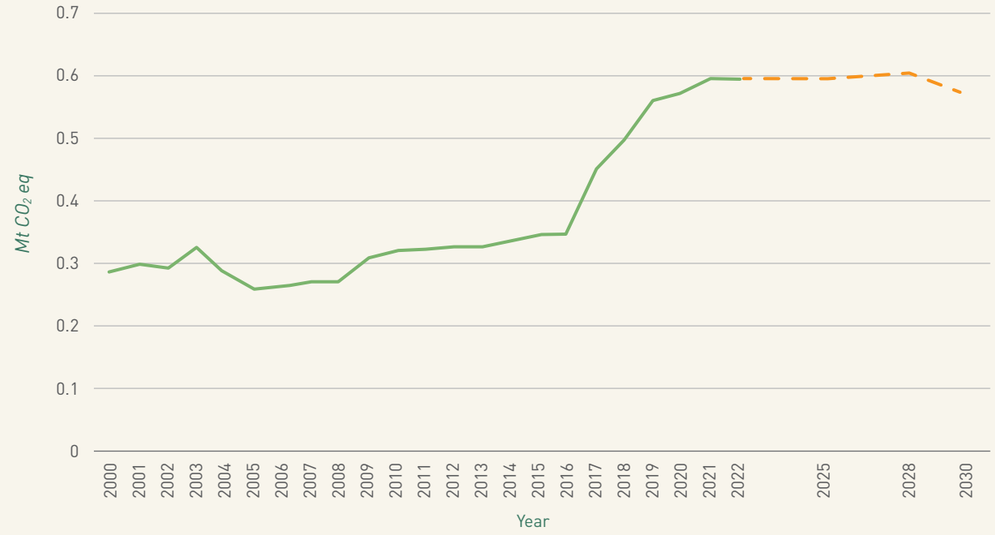
Table 33: Projected N_2O emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
N_2O (Mt CO_2 eq)	0.29	0.30	0.29	0.32	0.28	0.26	0.26	0.27	0.27

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
N_2O (Mt CO_2 eq)	0.30	0.32	0.32	0.32	0.32	0.33	0.34	0.35	0.45

Year	2018	2019	2020	2021	2022	2025	2028	2030
N_2O (Mt CO_2 eq)	0.50	0.56	0.57	0.60	0.60	0.60	0.61	0.57

Figure 14: Projected N_2O emissions (with measures)



HFCs

Singapore's HFCs emissions in 2022 were 4.17 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 HFCs emissions are estimated to be 4.00 Mt CO_2 eq, which is 3.95% lower than 2022. HFCs emissions in 2028 and 2030 are estimated to be 3.29 Mt CO_2 eq and 2.69 Mt CO_2 eq, respectively.

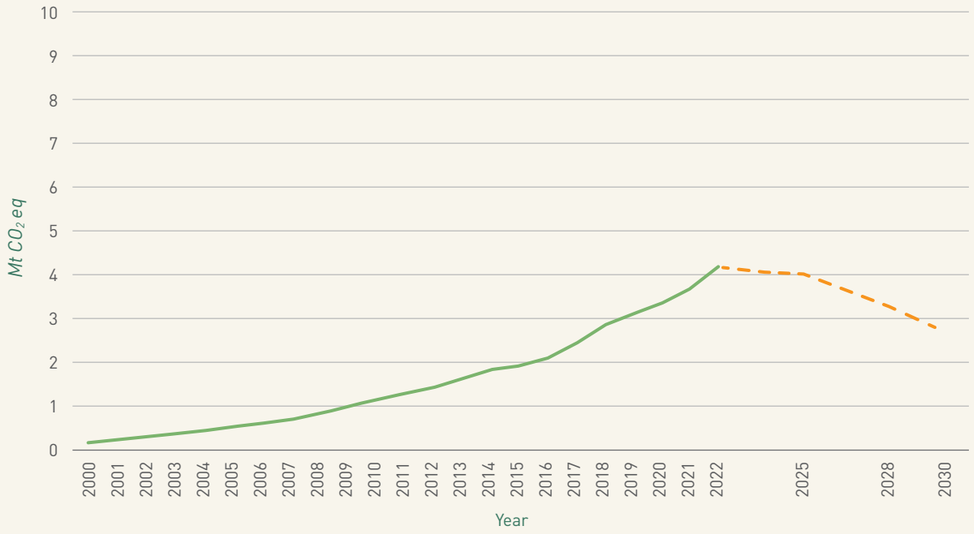
Table 34: Projected HFC emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFCs (Mt CO_2 eq)	0.15	0.20	0.29	0.35	0.40	0.49	0.56	0.68	0.81

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
HFCs (Mt CO_2 eq)	0.96	1.08	1.25	1.41	1.60	1.81	1.91	2.07	2.41

Year	2018	2019	2020	2021	2022	2025	2028	2030
HFCs (Mt CO_2 eq)	2.84	3.09	3.32	3.66	4.17	4.00	3.29	2.69

Figure 15: Projected HFC emissions (with measures)



PFCs

Singapore's PFCs emissions in 2022 were 2.52 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 PFCs emissions are estimated to be 1.71 Mt CO_2 eq, which is 32.03% lower than 2022. PFCs emissions in 2028 and 2030 are estimated to be 1.87 Mt CO_2 eq and 1.77 Mt CO_2 eq, respectively.

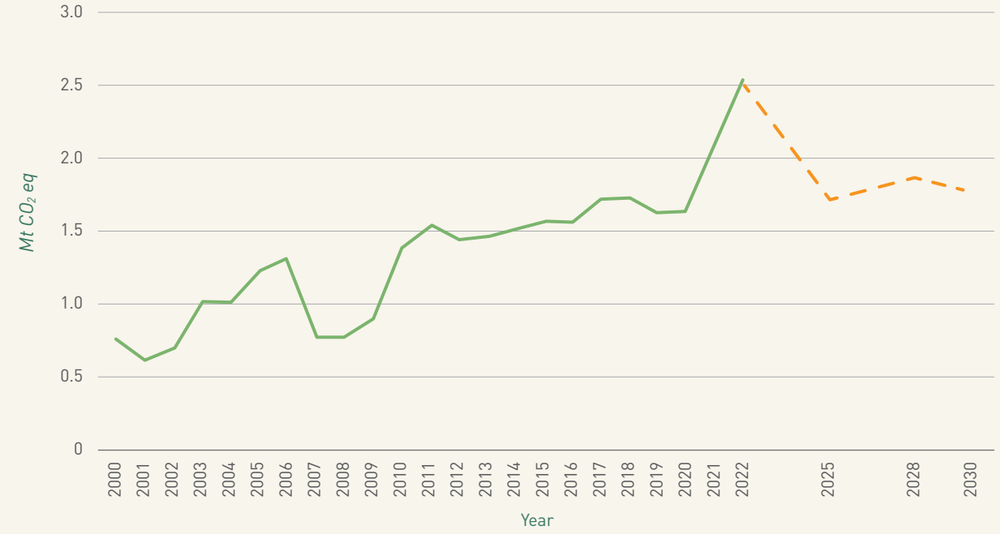
Table 35: Projected PFC emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
PFCs (Mt CO_2 eq)	0.76	0.62	0.70	1.01	1.02	1.23	1.31	0.77	0.78

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
PFCs (Mt CO_2 eq)	0.90	1.38	1.53	1.44	1.48	1.51	1.56	1.56	1.71

Year	2018	2019	2020	2021	2022	2025	2028	2030
PFCs (Mt CO_2 eq)	1.73	1.62	1.64	2.10	2.52	1.71	1.87	1.77

Figure 16: Projected PFC emissions (with measures)



SF_6

Singapore's SF_6 emissions in 2022 were 0.15 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 SF_6 emissions are estimated to be 0.11 Mt CO_2 eq, which is 27.91% lower than 2022. SF_6 emissions in 2028 and 2030 are both estimated to be 0.11 Mt CO_2 eq.

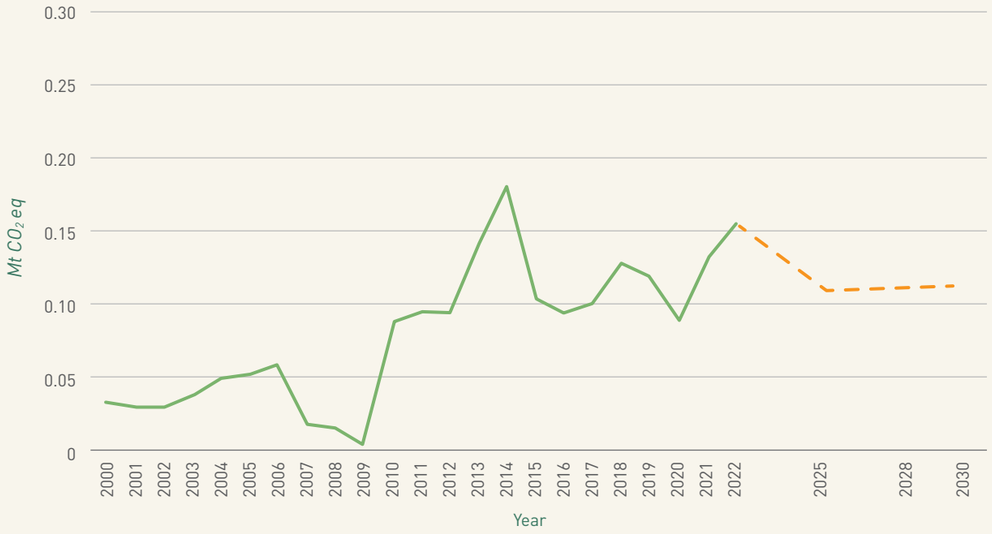
Table 36: Projected SF_6 emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
SF_6 (Mt CO_2 eq)	0.03	0.03	0.03	0.04	0.05	0.05	0.06	0.02	0.02

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
SF_6 (Mt CO_2 eq)	0.01	0.09	0.10	0.10	0.14	0.18	0.10	0.09	0.10

Year	2018	2019	2020	2021	2022	2025	2028	2030
SF_6 (Mt CO_2 eq)	0.13	0.12	0.09	0.13	0.15	0.11	0.11	0.11

Figure 17: Projected SF_6 emissions (with measures)



NF_3

Singapore's NF_3 emissions in 2022 were 0.64 Mt CO_2 eq. Under a 'with measures' scenario, Singapore's projected 2025 NF_3 emissions are estimated to be 0.45 Mt CO_2 eq, which is 30.87% lower than 2022. NF_3 emissions in 2028 and 2030 are estimated to be 0.48 Mt CO_2 eq and 0.46 Mt CO_2 eq, respectively.

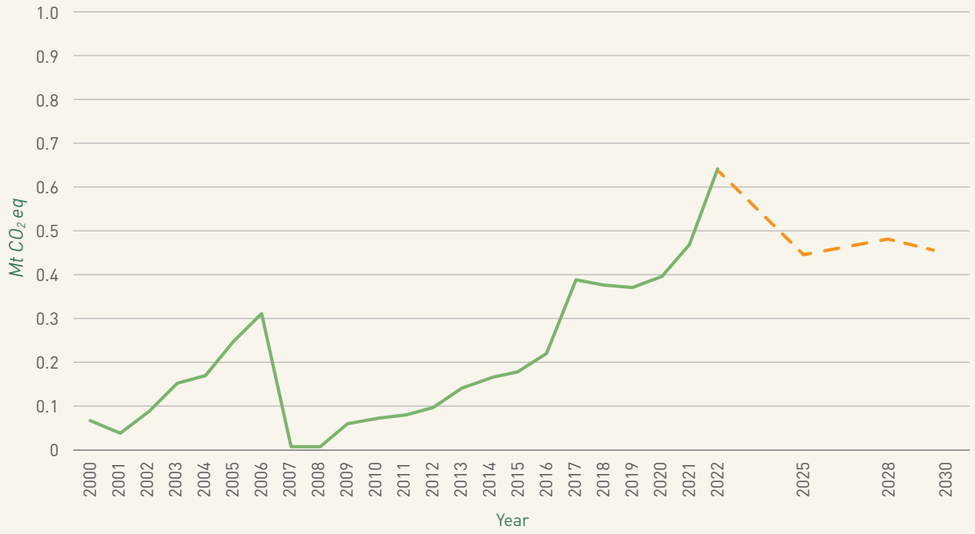
Table 37: Projected NF_3 emissions (with measures)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
NF_3 (Mt CO_2 eq)	0.07	0.04	0.09	0.15	0.17	0.25	0.32	0.01	0.01

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
NF_3 (Mt CO_2 eq)	0.06	0.07	0.08	0.10	0.14	0.16	0.18	0.22	0.39

Year	2018	2019	2020	2021	2022	2025	2028	2030
NF_3 (Mt CO_2 eq)	0.38	0.37	0.40	0.46	0.64	0.45	0.48	0.46

Figure 18: Projected NF_3 emissions (with measures)



Methodologies

Overview

Singapore's emissions projections were developed with sector-specific methodologies. Each of the sectors' projections included projections by gas. As such, the methodologies for Singapore's emissions projections by gas are covered within each sectors' individual projections methodologies detailed in this section.

Energy

The projected emissions trajectory for the Energy sector was developed through an aggregation of various sub-sector projections, and after accounting for abatement measures under the 'with measures' scenario. The methodologies detailed in the following sub-sections all apply to emissions sources under the Energy sector.

Buildings

The buildings sector computed its abatement under the 'with measures' scenario by calculating the difference between the BAU emissions values (i.e., no tightening of legislation or additional incentives) projected for the building stock in 2030, and the emission values after legislation and incentives have been implemented.

Growth of the building stock is based off the Urban Redevelopment Authority's planned new GFA to be added each year till 2030. The growth in electricity consumption due to the additional GFA added is based on estimates of the typical Energy Use Intensity (EUI) of different building types under BCA's GM 2021 standards. Assumptions were also made for the relative impact of different building types (e.g., commercial, hospitals, institutional) within the building stock to model the building sector emissions trajectory.

For existing buildings, the model estimates the proportion of the building stock that is likely to be retrofitted based on factors such as the age of the building, age and efficiency of the chiller and the overall performance of the building. The improvement in energy performance is pegged to the EUI requirements under the prevailing legislation or GM 2021. For buildings that are not projected to undergo retrofitting, a yearly degradation rate is applied to the model for a drop in energy performance due to aging equipment.

Household

The household sector uses the historical mix of town gas and/or liquified petroleum gas (LPG) in its projections of direct emissions. The sector observed that the compositional mix of the aforementioned gases are generally time invariant, and thus can be used as a meaningful point of extrapolation to estimate emissions within the Household sector. These estimates include the abatement accrued from mitigation measures under the 'with measures' scenario.

For indirect emissions, the Household sector's projections draw from projections of Singapore's Grid Emissions Factor, after accounting for abatement accrued under the 'with measures' scenario. These projections are based on projected growth trajectories for Singapore's domestic population and economic growth, as well as anticipated changes in Household sector electricity demand across the projection horizon.

Land Transport

Land transport sector emissions were projected based on anticipated changes in emissions associated with road vehicles and electricity consumption by road and public transport infrastructure and assets including bus and rail operations.

A multi-modal transport modelling approach is used to project vehicle mileage based on mode share, travel demand and its distribution, incorporating national-level economic planning parameters, land use plans and transport policies.

Baseline vehicular emissions are derived from total fuel consumption by road vehicles and apportioned to the vehicle types based on vehicle population, average mileage travelled and fuel efficiency data. The effects of key mitigation actions aimed at shifting travel demand to low emission modes and reducing vehicular emissions are projected based on assumed uptake of cleaner energy vehicles such as through electrification. The abatement quantity per measure was calculated against a baseline scenario which assumes no additional measures are in place, consistent with the 'with measures' scenario.

Maritime

Projections for Singapore's domestic maritime emissions take into account historical and projected trends in energy demand and growth of the Port of Singapore (e.g., cargo throughput).

Aviation

Singapore's domestic aviation emissions are projected based on historical emission data, projected growth in the aviation sector, and estimated savings in emissions associated with the implementation of cleaner energy vehicles and building energy efficiency mitigation measures.

Waste and Water

The projections of Energy sector's emissions trajectory include projected emissions from waste incineration as well as incineration of sludge. The water sub-sector's emissions, which include emissions from incineration of sludge, are primarily from emissions of N_2O arising from the discharge of treated UW effluent.

For indirect emissions, both sub-sectors draw from projections of Singapore's Grid Emissions Factor, after accounting for abatement accrued under the 'with measures' scenario. The projected indirect emissions also account for the Singapore's population growth trajectory, which would affect projected water demand.

Power

The projections of Energy sector's emissions trajectory are based on sectoral forecasts of electricity demand and accounts for abatement accrued by the Power sub-sector through mitigation measures under the 'with measures' scenario. This takes into account our committed plans to bring in at least 2GWp of solar by 2030 and 6GW of clean electricity imports by 2035. The abatement is calculated based on the difference in emission values in a Business-As-Usual Scenario (i.e., emissions from electricity generated by natural gas-fired combined cycle gas turbines, which makes up ~95% of our fuel mix) and the emission values after the sub-sector's mitigation measures have been implemented.

IPPU

The projected emissions trajectory of the IPPU sector factors Singapore's target to boost Singapore's manufacturing sector's value-add by 50% by 2030, as well as transformation in the industry sector's emissions profile across the projection horizon.

It takes reference from historical emissions trends and incorporates industry trends in market growth and adoption of decarbonisation measures under the 'with measures' scenario.

The projected emissions trajectory of the IPPU sector also includes emissions for Refrigeration and air-conditioning (RAC) HFCs. These emissions were projected using historical refrigerant demand data, expected lifespan of equipment and emission factors in accordance with the IPCC 2006 Guidelines for respective HFC sub-applications (e.g., domestic refrigeration, commercial refrigeration, mobile air-conditioning, unitary air-conditioning). These estimates include the abatement accrued from mitigation measures under the 'with measures' scenario.

Agriculture

For the projected emissions trajectory of the Agriculture sector, projected local production volumes were used to derive projected activity. This was in turn used with default parameters and emission factors in accordance with the IPCC 2006 Guidelines to obtain the emissions projections.

LULUCF

The development of the projected emissions of the LULUCF sector employed simple GHG projections using statistical trends based on past emissions from the land use categories in the sector. This involves extrapolating data from 2008-2017, which was assessed to be a relatively stable period for emissions based on land use (i.e., there were no major outliers in the data). Power functions were then applied to significant land-use changes to generate realistic projection trajectories that would slow the trend in later years. The 100-year time-horizon GWP from AR5 for N_2O of 265 is used to convert the projected N_2O emissions to CO_2 equivalent.

Singapore will explore developing more robust GHG projections for the LULUCF sector for subsequent BTRs.

Waste

The projected emissions trajectory of the Waste sector uses historical averages for waste disposal and generation rates, and accounts for abatement measures under the 'with measures' scenario.

The projections of Waste sector emissions also include projected emissions from wastewater handling which is managed by the water sub-sector. The water sub-sector's emissions are primarily from emissions of N_2O arising from the discharge of treated UW effluent. Projections were calculated based on IPCC 2006 Guidelines and utilise projections of Singapore's population growth trajectory.

Chapter 3

INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT UNDER ARTICLES 9-11 OF THE PARIS AGREEMENT

Participants at the Towards Climate Resilience & Urban Sustainability for the Pacific course (27 to 31 May 2024), conducted under the Singapore-Pacific Resilience and Knowledge Sharing (SPARKS) programme

Chapter 3.

Information on financial, technology development and transfer and capacity-building support under Articles 9-11 of the Paris Agreement

A.

National circumstances, institutional arrangements, and country-driven strategies

Notwithstanding our vulnerable circumstances as a low-lying Small Island Developing State (SIDS), Singapore seeks to achieve our climate targets using our own financial and technological resources. Singapore is also committed to collaborating internationally and working with partners to promote global climate action. Singapore has provided technical assistance and capacity-building support to officials from fellow developing countries on various climate-related issues through the Singapore Cooperation Programme (SCP), our flagship technical assistance programme.

Notably, Singapore launched a dedicated Climate Action Package (CAP) in 2018 to offer capacity-building support for fellow developing countries, in particular SIDS and Least Developed Countries (LDCs), on climate-related areas such as climate change adaptation and mitigation, green climate financing and stormwater management. Under the CAP, which concluded in March 2023, we have conducted over 60 courses for over 1,400 participants from over 130 countries, territories, and intergovernmental organisations. The courses were conducted in partnership with UN agencies and countries such as Japan, New Zealand and the US.

As part of Singapore's continued efforts towards the global Sustainability agenda, Singapore launched the Sustainability Action Package (SAP) in October 2022. The SAP, which is running from April 2023 to March 2026, builds on the CAP to support building up capacities in a wide variety of sustainability-related topics, including building resilience for water resources and food security, managing and financing green projects, developing sustainability infrastructure and managing carbon markets. The programmes bring together diverse knowledge partners from the public and private sectors, and aim to serve as a platform for government officials from all developing countries to share challenges and best practices on tackling sustainability and climate issues.

Singapore has also learned through our capacity-building initiatives. For example, the workshops on transitioning to the ETF, which Singapore co-organised with the US Environmental Protection Agency in March 2023 and March 2024 with support from the UNFCCC Secretariat, have strengthened our own transparency-related technical capacities.

Singapore contributes towards international climate science research, including the Intergovernmental Panel on Climate Change (IPCC), the UN's top climate science body. Singapore supports the IPCC Working Group II on Impacts, Adaptation and Vulnerability in the IPCC's Seventh Assessment Report Cycle (AR7), with Singaporean Professor Winston Chow as the elected Developing Country Co-Chair. Singapore has been funding the establishment and operations of the Singapore branch of the Technical Support Unit (TSU) since February 2024. Singapore also contributes to the IPCC through the nomination of local climate scientists as authors or review editors to IPCC reports. Through its active contributions to the IPCC, Singapore works closely with other countries to advance global climate science efforts, which are crucial in informing climate policies and plans across the world.

Smart Cities Green Buildings Programme, August-September 2022

Site visit to Sembcorp Tengeh Floating Solar Farm for the SCP Training Award course on Introduction of New Energy Trends: From Carbon Capture to Hydrogen Economy, October 2023

B.

Information on support for technology development and transfer under Article 10 of the Paris Agreement

Singapore does not foresee the need to access technology development and transfer under Article 10 of the Paris Agreement.

Information on capacity-building support provided under Article 11 of the Paris Agreement

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
1 Weather Prediction by Numerical Methods Module 3 (WPNM-M3)	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam	The workshop provided ASEAN National Meteorological and Hydrological Services training on the fundamentals of numerical weather prediction.	Adaptation	Completed	The workshop was organised by the ASEAN Specialised Meteorological Centre (ASMC; hosted by the MSS of NEA) from 6 to 10 February 2023 in Singapore.
2 Weather Prediction by Numerical Methods Module 4 (WPNM-M4)	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam	The workshop provided ASEAN National Meteorological and Hydrological Services (NMHSs) training on the fundamentals of numerical weather prediction.	Adaptation	Completed	The workshop took place from 7 to 11 October 2024 in Singapore.
3 ASEAN Specialised Meteorological Centre (ASMC) Attachment Programme 2024	Brunei Darussalam and the Philippines	The ASMC Attachment Programme strengthened cooperation among ASEAN Member States in the areas of weather, climate and related environmental research and operations. The attachment focused on enhancing the understanding of subseasonal-to-seasonal (S2S) predictability (i.e., on a timescale of weeks to months) and the use of different machine learning techniques in the development of S2S products.	Adaptation	Completed	
4 Fourth ASEAN Regional Climate Data, Analysis and Projections Workshop (ARCDAP-4)	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam	The workshop aims to train ASEAN National Meteorological and Hydrological Services in the use of regional climate projection scenarios.	Adaptation	Planned	ASMC is planning to organise the 4th ARCDAP workshop in 2Q2025 in Singapore.
5 Environmental Conservation and Sustainability	ASEAN Secretariat, Benin, Burkina Faso, Egypt, Gambia, Georgia, Ghana, Guyana, India, Maldives, Mauritius, Myanmar, Nigeria, North Macedonia Oman, Palestinian Authority, Philippines, Rwanda, Saudi Arabia, Serbia, Sierra Leone, Türkiye, Uganda and Uzbekistan	The course equipped participants with knowledge on addressing issues on environmental conservation, coastal population and urbanisation.	Adaptation	Completed	The course took place from 15 to 19 August 2022 (virtual).

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
6 Sustainable Integrated Water Resources and Stormwater Management (SIWRM)	September 2022: Bhutan, Cambodia, Hungary, Indonesia, Maldives, Mauritius, Morocco, Mozambique, Myanmar, Nauru, North Macedonia, Oman, Philippines, Samoa, Seychelles, Sudan, Thailand, Timor-Leste, United Nations, Vanuatu, Vietnam and Yemen	The course discussed Singapore's approach to integrated water resource management to manage the effects of extreme weather conditions brought on by climate change.	Adaptation	Completed	The course took place from 19 to 23 September 2022. Singapore-UNICEF JTP
7 Integrated Water Resources Management	May 2024: Bhutan, Botswana, Brunei Darussalam, Cambodia, India, Indonesia, Malawi, Mauritius, Mongolia, Morocco, Nepal, Pakistan, Philippines, Timor-Leste and Vietnam	This was a hybrid course which merged the topics of SIWRM and water, sanitation and hygiene (WASH). The course discussed Singapore's approach to integrated water resource management to manage the effects of extreme weather conditions brought on by climate change. It also included a practice workshop on Bottleneck Analysis for sustained WASH services.	Adaptation	Completed	The course took place from: 18 to 27 March 2024 (virtual component) 6 to 9 May 2024 (in-person component) Singapore-UNICEF JTP
8 Introduction to Disaster Risk Reduction (DRR)	July 2024: Cameroon, Eswatini, Gambia, India, Indonesia, Kenya, Laos, Madagascar, Malawi, Malaysia, Maldives, Marshall Islands, Mauritius, Montenegro, Namibia, Nigeria, Oman, Pakistan, Palestinian Authority, Philippines, Rwanda, Seychelles, South Africa, Tunisia, Ukraine and Zimbabwe	The course examined key principles of DRR and the hardcoding of resilience into policy, implementation action and human behaviour. It also covered Singapore's experiences in DRR and its WOG approach in formulating adaptation measures and building resilience in the community.	Adaptation	Completed	• 7 to 10 November 2022 (virtual) • 8 to 12 July 2024 Singapore-UNDRR JTP
9 Understanding Risk Management and Risk Financing for Disaster Resilience	Antigua and Barbuda, Bahamas, Barbados, Belize Grenada, Haiti, Jamaica, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Sint Maarten (Dutch Part) and Trinidad and Tobago	The course enhanced the Caribbean SIDS' risk-financing and resilience by better planning for future large-scale disasters, supported enhancement and implementation of National Disaster Risk Reduction Strategies, contributed to the achievement of the global targets of the Sendai Framework for Disaster Risk Reduction (2015 – 2030), and strengthened partnerships and the cadre of trained professionals for DRR in the Caribbean region.	Adaptation	Completed	The course took place from 2 to 15 May 2023 (virtual). Singapore-UNDRR JTP

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
10 Water Management and Sustainability	Southeast Asia and ASEAN Secretariat	The course covered Singapore's and Morocco's respective approaches and strategies in management of water resources, water sustainability and climate resilience.	Adaptation	Completed	The course took place from 31 July to 4 August 2023. Singapore-Morocco JTP
11 Assuring Food Safety and Security	August 2024: Bhutan, Brazil, Indonesia, Kuwait, Malawi, Malaysia, Malta, North Macedonia, Philippines, Samoa, Serbia and Thailand	The course provided an overview of Singapore's national food control system and strategies to improve food safety and security.	Adaptation	Completed	The course took place from: - 4 to 8 July 2022 (virtual) - 14 to 18 August 2023 - 19 to 23 August 2024
12 Used Water Management and Treatment	Palestinian Authority	The course discussed approaches to integrated water resources, water reuse management, water quality and process control as well as industrial reuse.	Adaptation	Completed	The course took place from 21 to 24 August 2023.
13 Sustainable Integrated Water Resources Management	March 2024: Azerbaijan, Bahrain, Benin, Bhutan, Burkina Faso, Cyprus, Fiji, Hungary, Indonesia, Iraq, Jordan, Kazakhstan, Malaysia, Maldives, Malta, Mauritius, Morocco, Poland, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Thailand and Vietnam November 2024: SCP-eligible countries, territories and inter-governmental organisations	The course discussed Singapore's approach to integrated water resource management to manage the effects of extreme weather conditions brought on by climate change.	Adaptation	March 2024 course completed. November 2024 course planned.	The course took place from 4 to 8 March 2024. The next iteration has been planned for 4 to 8 November 2024.
14 Food Innovation and Technology	IAI beneficiary countries (Cambodia, Laos, Myanmar, Vietnam) 1 to 5 August 2022: Laos 22 to 26 August 2022: Myanmar 12 to 16 September 2022: Cambodia 26 to 30 September 2022: Vietnam 15 to 19 January 2024: Combined for Cambodia, Laos, Myanmar and Vietnam	The course covered topics that would provide participants with an understanding of Singapore's strategies and policies on food and the framework for managing food security and safety; as well as for them to appreciate the technologies available for ensuring food security and food safety diagnosis.	Adaptation	Completed	The course took place from: • 1 to 5 August 2022 (virtual) • 22 to 26 August 2022 (virtual) • 12 to 16 September 2022 (virtual) • 26 to 30 September 2022 (virtual) • 15 to 19 January 2024 (virtual)
15 Water Management	Indonesia	The course shared insights and innovations in the management of clean water, as well as Singapore's approach to clean water governance and its public engagement campaigns.	Adaptation	Completed	The course took place from 15 to 19 May 2023.

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
16 Drone Aerial Mapping Project	Indonesia	Conducted by Temasek Polytechnic, the project worked with the Jambi municipal government, Jambi Polytechnic, and the University of Jambi to provide solutions for flood monitoring through drone aerial mapping, and to train drone operators in Jambi.	Adaptation	Completed	The project took place from: - 25 to 29 February 2024 - 5 to 9 May 2024 - 15 to 18 July 2024
17 Capacity Building Programmes under the MOU regarding Collaboration on Knowledge Sharing, Capacity Building and Research between Centre for Liveable Cities and the Nusantara Capital City Authority	Indonesia	The MOU covers cooperation in areas such as integrated transport and infrastructure development, smart city development, sustainable water and waste management, urban development and heat humidity management.	Adaptation	Ongoing	The programmes have been scheduled from July 2023 to June 2025.
18 Towards Climate Resilience & Urban Sustainability for the Pacific	Fiji, French Polynesia, Marshall Islands, Samoa, Tonga Tuvalu and Vanuatu	The course focused on capacity building in urban governance, planning and development to enhance climate resilience and sustainable development among the Pacific Islands Forum (PIF) members.	Adaptation	Completed	The course took place from 27 to 31 May 2024. Singapore-Pacific Resilience and Knowledge Sharing (SPARKS) Package
19 International Law, Climate Change and Sea Level Rise	PIF Members	The course provided participants with a basis on international law and international law-making, and to provide an understanding of how international law can provide a tool to help address the challenges posed by climate change, particularly sea level.	Adaptation	Completed	The course took place from 4 to 8 November 2024. SPARKS Package
20 Climate Change and Aviation Sustainability	October 2024: SCP-eligible countries, territories and inter-governmental organisations	The course provided participants with knowledge of the complexities of implementing sustainable environmental, social and economic strategies within the aviation industry.	Adaptation	Completed	The course took place from 14 to 18 October 2024.
21 Workshop on Disaster Risk Management	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Curaçao, Dominica, Grenada, Jamaica and Saint Kitts and Nevis	The course examined key principles of Disaster Risk Reduction (DRR), Urban Search and Rescue, and the hardcoding of resilience into policy, implementation action and human behaviour. Using Climate Change as an anchor, the course showcased the approaches and adaptations adopted by Colombia and Singapore to integrated risk management and multi-stakeholder approach to crisis recovery.	Adaptation	Completed	The course took place from 24 to 28 June 2024. Singapore-Colombia JTP

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
22 Initiative for ASEAN Integration	IAI beneficiary countries (Cambodia, Laos, Myanmar and Vietnam) 6 to 8 August 2024: Cambodia 19 to 22 August 2024: Myanmar 10 to 13 September 2024: Vietnam 10 to 12 December 2024: Laos	The course aims to share with participants the concept of sustainability in the food industry, including the use of food processing technologies, techniques, and tools to achieve sustainability in food manufacturing.	Adaptation	August and September 2024 course completed. Course planned for: · 10 to 12 December 2024	The course took place from: · 6 to 8 August 2024 · 19 to 22 August 2024 (virtual) · 10 to 13 September 2024 The course has been planned for December 2024.
23 Consultancy Study on Vietnam's Carbon Markets	Vietnam's Ministry of Natural Resources and Environment	This was a three-month consultancy study to help Vietnam's Ministry of Natural Resources and Environment establish its national policies to implement carbon credit projects aligned to Article 6 of the Paris Agreement.	Mitigation	Completed	
24 Asia Pacific Carbon Markets Roundtable (APCMR)	15 participants from Chile, China, Fiji, Indonesia, Mexico, Palau, Peru, PNG, Samoa, Sri Lanka, Thailand and Vietnam	This workshop provided a platform for mutual learning and sharing of experiences on regional developments on carbon pricing and markets, capabilities needed to support the introduction of a carbon price and development of a regional carbon market.	Mitigation	Completed	This workshop was co-organised with the New Zealand government from 13-14 April 2023 in Wellington, New Zealand.
25 Smart Cities Green Buildings Programme (GBP)	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam	The Smart Cities GBP discussed and built collective knowledge in strengthening climate resilience in the region, and helped train a new generation of ASEAN urban planners, architects and engineers in the latest techniques, materials and architectural designs to improve the air quality inside and outside of buildings, reduce the full lifecycle carbon footprint of the building and construction sector and improve building siting and resilience to better adapt to climate impacts.	Mitigation	Completed	The programme took place from 31 August to 6 September 2022 and 4 to 8 December 2023. Singapore-US TCTP

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
26 Study Visit to Singapore National Environment Agency (NEA) by Ministry of Natural Resources and Environment (MoNRE) of Vietnam and Japan International Cooperation Agency (JICA)	Ministry of Natural Resources and Environment (MoNRE) of Vietnam	Vietnam MoNRE was preparing for the implementation of facility-level GHG reporting through an electronic reporting system under the law on environmental protection 2020. The study visit aimed to: a) Understand Singapore's tracking of progress towards its NDC; b) Understand Singapore's MRV framework; and c) Understand the GHG emissions reporting template/system.	Mitigation	Completed	Following its study visit in Sep 2023, MoNRE invited NEA to join its UNFCCC COP-28 side event *"Translating commitment into concrete action: regional dialogue on facility GHG reporting to drive NDC/net zero implementation and business engagement"* in December 2023. NEA's representative shared Singapore's experiences and lessons learnt in developing and operating the GHG reporting system.
27 Workshop on Planning Southeast Asia's Decarbonisation Pathways	Brunei Darussalam, Cambodia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam	The course explored challenges and opportunities in the energy transition. Participants also learned from international climate and energy experts on issues cross-cutting the energy-climate nexus, including regional energy cooperation, technological innovations, transparency and energy equity.	Mitigation	Completed	The workshop took place from 26 to 28 September 2022.
28 Clean Energy and Emission Reduction	SCP Training Award (SCPTA): October 2022: Bhutan, Bosnia and Herzegovina, Burkina Faso, Cyprus, Egypt, Gambia, Indonesia, Mexico, Myanmar, Nigeria, Oman, Philippines, Rwanda, Sierra Leone, Tajikistan, Thailand, Togo, Trinidad and Tobago, Türkiye, Uzbekistan and Yemen June 2023: ASEAN Secretariat, Azerbaijan, Bhutan, Brunei Darussalam, Bulgaria, Dominican Republic, Ghana, Indonesia, Iran, Jordan, Malaysia, Mauritius, Nepal, North Macedonia, Palestinian Authority, Senegal, Tanzania, Trinidad and Tobago and Uzbekistan Initiative for ASEAN Integration (IAI) beneficiary countries (Cambodia, Laos, Myanmar and Vietnam) July 2023: Myanmar September 2023: Laos October 2023: Cambodia November 2023: Vietnam	The course focused on Singapore's multi-agency engagement in formulating clean and renewable energy solutions to achieve a balance between development and climate action obligations. It also touched on the importance of collective mitigative actions on a global scale.	Mitigation	Completed	The course took place from: Under SCPTA •17 to 21 October 2022 (virtual) •5 to 9 June 2023 Under IAI •24 to 28 July 2023 (virtual) •25 to 29 September 2023 (virtual) •16 to 20 October 2023 (virtual) •30 October to 3 November 2023 (virtual)

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
29 Workshop on Sustainable Trade	Angola, Antigua and Barbuda, Argentina, Bangladesh, Cambodia, Cameroon, Chile, China, Costa Rica, Eswatini, Fiji, Gambia, Georgia, Honduras, India, Jamaica, Laos, Madagascar, Maldives, Mauritius, Pakistan, Papua New Guinea, Paraguay, Philippines, Saint Kitts and Nevis, Samoa, Seychelles, Tajikistan and Thailand	The main objective of this workshop was to enhance knowledge and understanding of the on-going work and discussions at the WTO on how trade, trade policy and the multilateral trading system intersect with efforts to address the triple environmental challenges of climate change, pollution and biodiversity loss.	Mitigation	Completed	The workshop took place from 23 to 25 November 2022. Singapore-WTO TCTP
30 Regional Workshop on Stewarding the Low Carbon Transition	Southeast Asia	The course brought together regional policymakers to discuss the latest international developments, share insights on the key strategies and policy levers, intended effects and the implementation challenges to achieve national climate targets.	Mitigation	Completed	The course took place from 27 to 28 April 2023.
31 Carbon Accounting	Bahrain, Cambodia, Cote d'Ivoire, Ecuador, Egypt, Gambia, Indonesia, Iran, Lesotho, Lithuania, Morocco, Niger, Oman, Samoa, Serbia, Thailand, Tobago, Trinidad, Tunisia and Zambia	The course introduced carbon accounting and national GHG inventories.	Mitigation	Completed	The course took place from 10 to 14 July 2023.
32 Introduction to Carbon Market	July 2024: ASEAN Secretariat, Bhutan, Cambodia, Cuba, Dominican Republic, Ghana, India, Indonesia, Laos, Malaysia, Maldives, Mauritius, Mozambique, North Macedonia, Pakistan, Philippines, Serbia, Togo and Zambia	The course introduced participants to carbon markets as well as carbon offsetting projects.	Mitigation	Completed	The course took place from: - 25 to 29 September 2023 - 22 to 26 July 2024
33 Introduction of New Energy Trends: From Carbon Capture to Hydrogen Economy	October 2023: Angola, Bahrain, Bhutan, Brunei Darussalam, Cambodia, Ghana, Indonesia, Iran, Madagascar, Malawi, Malaysia, Mauritius, Namibia, Nigeria, Oman, Poland, Serbia, Tanzania and Togo 2024 programme: SCP-eligible countries, territories and inter-governmental organisations	The course provided an overview of renewable and low-carbon energy technologies, with a focus on the use of hydrogen as a green fuel.	Mitigation	October 2023 course completed. October 2024 course completed.	The course took place from 16 to 20 October 2023. The second iteration took place from 21 to 25 October 2024.
34 Blue Carbon Policy and Finance Capacity Building Workshop	25 participants from ASEAN and AOSIS Member States	The two-day capacity-building workshop took participants on a deep dive into blue carbon, equipping them with technical knowledge on the policy and finance tools available for conserving and restoring coastal blue carbon ecosystems; strengthening their knowledge on blue carbon implementation potential, as well as building capacity for ASEAN and AOSIS Member States' priority national mitigation and adaptation actions.	Cross-cutting	Completed	The workshop was co-organised with the United Kingdom, National University of Singapore Centre for Nature-based Climate Solutions and Conservation International, and took place from 17 to 18 October 2023. Singapore-UK Third Country Training Programme (TCTP)

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
35 Training Workshop on Transitioning to the ETF and Tracking of Progress in Implementing and Achieving NDCs	28 government officials from Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Maldives, Mongolia, Nepal, Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam	This three-day training workshop aimed to enhance the technical capacities of national experts who were involved in preparing NDCs and BTRs, including tracking progress of implementation and achievement of NDCs, as well as implementation of Article 6 of the Paris Agreement.	Cross-cutting	Completed	The workshop was co-organised with the US Environmental Protection Agency, with support from the UNFCCC Secretariat from 8 to 10 March 2023.
36 Hands-On Training Workshop on Transitioning to the ETF Including the Preparation of the BTR	36 government officials from Bangladesh, Bhutan, Brunei Darussalam. Cambodia, China, India, Indonesia, Kazakhstan, Lao PDR, Malaysia, Maldives, Mongolia, Nepal, Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam	This four-day training workshop aimed to • Raise awareness on the latest developments related to the implementation of the ETF; • Enhance the technical understanding of the MPGs and their application to different thematic areas covered by the BTR; • Promote peer-learning and exchange of experiences and lessons learned; and • Compile the outcomes of the interactive exercises for dissemination.	Cross-cutting	Completed	The workshop was co-organised with the US Environmental Protection Agency and the NDC Partnership, with support from the UNFCCC Secretariat from 12 to 15 March 2024.
37 Joint Singapore–New Zealand Article 6.2 Capacity Building Workshop for ASEAN Member States	19 participants from 10 ASEAN member states (with an additional 10 attending virtually)	This 1.5-day workshop helped to develop capability and capacity among ASEAN Member States to meet Article 6 participation requirements and to undertake Article 6 activities.	Cross-cutting	Completed	The workshop was co-organised with the New Zealand High Commission in Singapore and the New Zealand Ministry of Foreign Affairs and Trade, from 29 to 30 September 2022, as part of the Singapore – New Zealand Enhanced Partnership. South Pole was engaged to support the organisation of the workshop.
38 Climate Change Adaptation and Mitigation Strategies	August 2023: Bhutan, Botswana, Brunei Darussalam, Cambodia, Gambia, Indonesia, Malaysia, Nigeria, North Macedonia, Palestinian Authority, Panama, Poland, Saint Kitts and Nevis and Thailand	The course enabled participants to focus on ways to mitigate environmental challenges that arise from climate change, and gain insights into the various adaptation and mitigation strategies that could be adopted to tackle climate change.	Cross-cutting	Completed	The course took place from: • 14 to 18 March 2022 (virtual) • 27 June to 1 July 2022 (virtual) • 21 to 25 August 2023

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
39 Workshop on Renewable Energy	Southeast Asia and ASEAN Secretariat	Building on the long-standing ASEAN-US energy cooperation, the workshop sought to enhance the collaboration between the US and the region on the initiatives under the ASEAN Plan of Action for Energy Cooperation 2021 – 2025. The key programme areas included renewable energy, energy efficiency and regional energy policy and planning.	Cross-cutting	Completed	The workshop took place from 22 to 24 March 2022 (virtual). Singapore-US TCTP
40 Sustainable Financing of Cities	May 2023: ASEAN Secretariat, Azerbaijan, Bhutan, Bosnia and Herzegovina, Bulgaria, Cambodia, Georgia, Ghana, Hungary, India, Maldives, Mauritius, Myanmar, Nigeria, North Macedonia, Palestinian Authority, Philippines, Rwanda, Samoa, Thailand and Tunisia	The course touched on the sustainable financing of urban infrastructure through a holistic approach that considers interlinked issues such as environmental, social and governance.	Cross-cutting	Completed	The course took place from 9 to 13 May 2022 (virtual) and 15 to 19 May 2023.
41 Environmental Leadership Programme for Sustainable Infrastructure	ASEAN Secretariat, Bhutan, India, Malaysia, Myanmar, Nepal, Pakistan, Philippines and Sri Lanka	The course covered the links between infrastructure and the Sustainable Development Goals, with an emphasis on building resilience, including through integrated approaches and how planners can maximise SDG outcomes by incorporating sustainability concerns into the early strategic planning of infrastructure.	Cross-cutting	Completed	The course took place from 4 to 8 July 2022 (virtual). Singapore-UNEP Joint Training Programme (JTP)
42 Managing Coastal Biodiversity under Urbanisation Pressures	September 2023: Cambodia, Fiji, Gambia, Indonesia, Jordan, Malawi, Malaysia, Maldives, Mauritius, Myanmar, Nigeria, Palestinian Authority, Togo and Tunisia	The course shared Singapore's approach to the protection and management of coastal biodiversity in the face of intense urbanisation. It also discussed the impact of climate change on achieving the Sustainable Development Goals (SDGs) in the context of coastal ecosystem services.	Cross-cutting	Completed	The course took place from 18 to 22 July 2022 (virtual) and 4 to 8 September 2023.

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
43 Workshop on Sustainable and Resilient Infrastructure	Southeast Asia and ASEAN Secretariat	This course provided a comprehensive overview on how to incorporate sustainability and resilience throughout the full infrastructure lifecycle, and a holistic approach to developing sustainable infrastructure in Southeast Asia.	Cross-cutting	Completed	The workshop took place from 15 to 19 August 2022. Singapore-US TCTP
44 Smart Cities Professional Exchanges: Circular Waste Management in the Urban Context	Southeast Asia and ASEAN Secretariat	This course leveraged Singapore's and the US' experiences to promote knowledge sharing and encourage the application of guiding principles in smart, sustainable urban development with a focus on waste management in the context of resource circularity.	Cross-cutting	Completed	The course took place from 3 to 14 October 2022. Singapore-US TCTP
45 Green Climate Financing	ASEAN Secretariat, Azerbaijan, Bhutan, Bosnia and Herzegovina, Botswana, Cameroon, Gambia, Georgia, Indonesia, Kiribati, Mauritius, Myanmar, North Macedonia, Palestinian Authority, Panama, Philippines, Serbia, Sierra Leone, Sri Lanka, Trinidad and Tobago, Vietnam and Yemen	This course featured the financing mechanisms available to support climate change projects and sustainable infrastructure development.	Cross-cutting	Completed	The course took place from 14 to 18 November 2022 (virtual).
46 Workshop on Infrastructure Finance and Standards	Southeast Asia and ASEAN Secretariat	The workshop aimed to raise standards in infrastructure development in the Southeast Asian region to provide value for money on infrastructure investment, advance environmental and climate goals, and avoid unsustainable debt. It also advanced national and global climate goals by identifying ways to make infrastructure more resilient to climate change and limit contributions to GHG emissions.	Cross-cutting	Completed	The workshop took place from 9 to 13 January 2023.

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
47 Sustainable Waste Management and Smart Urbanisation	Under SCPTA 20 to 24 February 2023: ASEAN Secretariat, Armenia, Azerbaijan, Bahrain, Benin, Costa Rica, Egypt, Guyana, India, Iran, Jamaica, Kuwait, Malaysia, Malta, Mauritius, Mexico, Nepal, Nigeria, Oman, Palestinian Authority, Philippines, Sudan, Togo, Tunisia and Uzbekistan IAI beneficiary countries (Cambodia, Laos, Myanmar and Vietnam) 16 to 20 January 2023: Myanmar 30 January to 3 February 2023: Cambodia 6 to 10 March 2023: Vietnam 15 to 19 January 2024: Myanmar 29 January to 2 February 2024 (virtual): Cambodia 26 February to 1 March 2024 (virtual): Vietnam	The course provided insights to Singapore's multi-agency collaboration in formulating and implementing nature-based solutions and closing the waste loop to enhance urban resilience in the face of climate change challenges.	Cross-cutting	Completed	The course took place from: Under SCPTA • 20 to 24 February 2023 (virtual) • 29 January to 2 February 2024 Under IAI • 16 to 20 January 2023 (virtual) • 30 January to 3 February 2023 (virtual) • 6 to 10 March 2023 (virtual) • 15 to 19 January 2024 (virtual) • 29 January to 2 February 2024 (virtual) • 26 February to 1 March 2024 (virtual)
48 Law of the Sea and Climate Change	February 2024: Bangladesh, Brunei Darussalam, Cambodia, Indonesia, Maldives, Pakistan, Philippines, Samoa and Thailand	The course provided participants with a deeper understanding of how climate change is impacting the oceans and how the law of the sea reflected in UNCLOS can be used to address them. The course also equipped participants with knowledge on the interactions between the climate change regime and the law of the sea.	Cross-cutting	Completed	The course took place from 6 to 10 March 2023 (virtual) and 5 to 9 February 2024 (virtual). Japan-Singapore Partnership Programme for the 21st Century (JSPP21)
49 Sustainable Urban Transport Planning and Strategies	June 2024: Azerbaijan, Bhutan, Bulgaria, Cook Islands, Costa Rica, Fiji, Ghana, Hungary, India, Indonesia, Jordan, Kiribati, Lithuania, Malawi, Malta, Mauritius, Mongolia, Nauru, North Macedonia, Pakistan, Palestinian Authority, Rwanda, Serbia, Sri Lanka, Timor-Leste and Ukraine	The course provided an overview of Singapore's urban transport planning and strategies, as well as innovations to develop and manage a sustainable, integrated and effective urban transport system.	Cross-cutting	Completed	The course took place from: - 18 to 22 September 2023 - 24 to 28 June 2024.
50 Building Smart and Sustainable Cities	Azerbaijan, Bhutan, Bolivia, Bulgaria, Eswatini, Georgia, India, Indonesia, Iraq, Jordan, Kazakhstan, Kuwait, Kyrgyz Republic, Malaysia, Maldives, Mauritius, Nigeria, North Macedonia, Peru, Philippines, Saint Kitts and Nevis, Seychelles, Sierra Leone, Tanzania, Thailand, Togo, Tunisia, Uganda and Vietnam	Centred around the Singapore Liveability Framework, the course equipped participants with the knowledge and skills required to manage technologies against the backdrop of changing economics, ecological and social systems to build a smart and sustainable city.	Cross-cutting	Completed	The course took place from 18 to 22 March 2024.

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
51 Green Economy	September 2023: Bhutan, Indonesia, Marshall Islands, Myanmar, Philippines, Sri Lanka, Thailand and Vanuatu	The course allowed participants to draw from the experiences of both Japan and Singapore in understanding the efforts of both countries in greening the economy.	Cross-cutting	Completed	The course took place from 25 to 29 July 2022 (virtual) and 4 to 9 September 2023 (virtual). Japan Singapore Partnership Programme for the 21st Century (JSPP21)
52 Waste Segregation and Plastic Recycling	Comoros, France, India, Iran, Kenya, Malaysia, Maldives, Mauritius, South Africa and United Arab Emirates	The course supported the development needs of IORA Member States through capacity building, in line with the IORA Strategic Framework of Action to Combat Marine Debris in the Indian Ocean.	Cross-cutting	Completed	The course took place from 18 to 22 March 2024.
53 Workshop on Environmental Drivers of Health Security	Brunei Darussalam, Cambodia, Cook Islands, Fiji, Indonesia, Kiribati, Laos, Malaysia, Myanmar, Palau, Philippines, Thailand, Tonga, Vanuatu and Vietnam	The course saw valuable discussions on five of the key environmental drivers of health insecurity – all of them are relevant globally, and in the ASEAN/Mekong region. These drivers are among those that are key to national, regional and global health security, pandemic preparedness and environmental sustainability – but intersectoral coordination on these issues is limited.	Cross-cutting	Completed	The course took place from: - 6 to 10 March 2023 - 11 to 15 March 2024. Singapore-US TCTP
54 Greening Technical and Vocational Education and Training (TVET) for sustainable development	IAI beneficiary countries (Cambodia, Laos, Myanmar and Vietnam) 1 to 5 Aug 2022: Laos 22 to 26 Aug 2022: Myanmar 12 to 16 Sep 2022: Cambodia 26 to 30 Sep 2022: Vietnam Under SCPTA May 2024: Bhutan, Cambodia, Cook Islands, Dominican Republic, Fiji, Ghana, India, Malawi, Malaysia, Maldives, Marshall Islands, Mongolia, Montenegro, Morocco, Myanmar, Nepal, Pakistan, Palestinian Authority, Papua New Guinea, Philippines, Rwanda, Seychelles, Sri Lanka and Togo	The course enabled participants to: (i) understand the concept and principles of Green TVET and green skills development; (ii) apply the five pillars strategy of greening TVET; and (iii) develop action plan for the implementation of five pillars strategy of greening TVET.	Cross-cutting	Completed	The course took place from: Under IAI • 1 to 5 August 2022 (virtual) • 22 to 26 August 2022 (virtual) • 12 to 16 September 2022 (virtual) • 26 to 30 September 2022 (virtual) • 6 to 10 May 2024

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
55 Integrated Waste Management Strategies and Circular Economy for Sustainable Development	Azerbaijan, Cambodia, Fiji, India, Indonesia, Iraq, Jordan, Lithuania, Mauritius, Nepal, Nigeria, Pakistan, Palestinian Authority, Philippines, Saint Kitts and Nevis, Serbia, Seychelles, Sierra Leone, South Africa and Sri Lanka	The course addressed environmentally sustainable development with a focus on circular economy and the importance of promoting integrated solid waste management strategies for creating environmental sustainable local and regional solutions in the context of policy, planning, practice and innovation to advance a circular and sustainable materials management approach to optimise resource efficiency, recovery and reuse for socio-economic and ecological benefits.	Cross-cutting	Completed	The course took place from 15 to 19 July 2024.
56 Sustainable Infrastructure Project Development and Financing	Azerbaijan, Benin, Bhutan, Brunei Darussalam, Cambodia, Ghana, India, Indonesia, Jordan, Kiribati, Madagascar, Mauritius, Nigeria, North Macedonia, Pakistan, Seychelles, Sri Lanka, Uganda, Venezuela and Vietnam	The course pertained to the UN 2030 Sustainable Development Agenda, and Singapore Sustainable Development Blueprint in areas on Infrastructure and economy, infrastructure financing and developments.	Cross-cutting	Completed	The course took place from 12 to 16 August 2024.
57 Green Financing	SCP-eligible countries, territories and inter-governmental organisations	The course offered an opportunity to develop the knowledge base of corporate and government leaders and inspire them to become a resource for their clients and constituents for their sustainable finance needs.	Cross-cutting	Completed	The course took place from 9 to 13 September 2024.
58 Disaster Risk Reduction and Management	December 2024: SCP-eligible countries, territories and inter-governmental organisations	The course will share key principles of disaster risk reduction and Singapore's WOG approach to crisis response and recovery. Topics include: Integration of disaster risk reduction and climate change adaptation into development policies; Key principles of disaster risk reduction; Sendai Framework for Disaster Risk Reduction 2015 - 2030; and WOG and multi-stakeholder approach to integrated risk management, crisis response and recovery.	Cross-cutting	Planned	The course has been planned for 2 to 6 December 2024.

Title	Recipient entity	Description and objectives	Type of support (Adaptation / Mitigation / Cross-cutting)	Status of measure or activity (Planned / Ongoing / Completed)	Additional information
59 Macroeconomics of Climate Change	May 2024: SCP-eligible countries, territories and inter-governmental organisations	The course provided an overview of the science and economic costs of climate change, discussed policy options for adaptation and mitigation, and analysed challenges and opportunities related to transitioning to greener economic models.	Cross-cutting	Completed	The course took place from: · 12 to 23 September 2022 · 25 September to 6 October 2023 · 6 to 17 May 2024
60 Sustainability Made Easy for Micro, Small and Medium Enterprises (MSMEs)	IAI beneficiary countries (Cambodia, Laos, Myanmar and Vietnam) 12 to 15 August 2024: Myanmar 7 to 10 October 2024: Vietnam 8 to 10 October 2024: Cambodia 11 to 13 December 2024: Laos	The course aims to introduce participants to the different components of the Environment, Social and Governance (ESG) requirements and reporting standards and on how to develop an ESG system and policy that will help in assessing business practices and performance on various sustainability and ethical issues, as well as in measuring business risks and opportunities in those areas.	Cross-cutting	August and October 2024 course completed. Course planned for: · 11 to 13 December 2024	The course took place from: · 12 to 15 August 2024 (virtual) · 7 to 10 October 2024 (virtual) · 8 to 10 October 2024 The course has been planned for December 2024.
61 Understanding Sustainability: What and Why?	IAI beneficiary countries (Cambodia, Myanmar and Vietnam) 10 to 12 September 2024: Myanmar 16 to 19 September 2024: Vietnam 10 to 12 December 2024: Cambodia	The course aims to provide participants with a broad-based understanding of sustainable development and the importance for organisation to adopt sustainable practices, and the standards governing sustainable practices in the three key pillars of environment, social and governance (ESG).	Cross-cutting	Completed	The course took place from: · 10 to 12 September 2024 · 16 to 19 September 2024 The course has been planned for: · 10 to 12 December 2024

ANNEX TO FIRST BIENNIAL TRANSPARENCY REPORT

Annex I

Common reporting tables of the national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

As the common reporting tables will be reported electronically, please refer to the relevant reporting in the UNFCCC website.

Annex II

Common tabular formats

This section covers the two items:

- Information necessary to track progress in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement
- Information on financial, technology development and transfer and capacity-building support under Articles 9–11 of the Paris Agreement

Similar to the common reporting tables which will be reported electronically, please refer to the relevant reporting in the UNFCCC website.

Annex III

Information in relation to the Party's participation in cooperative approaches

As of 2022, Singapore has not participated in cooperative approaches that involve the use of ITMOs. We plan to do so and will report the relevant information accordingly when we do.

GLOSSARY

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AFOLU	Agriculture, Forestry and Other Land Use
APCMR	Asia Pacific Carbon Markets Roundtable
ARCDAP	ASEAN Regional Climate Data, Analysis and Projections
AR5	Fifth Assessment Report
ASMC	ASEAN Specialised Meteorological Centre
BAU	Business-As-Usual
BCA	Building and Construction Authority
BESS	Building Energy Submission System
BREEF	Building Retrofit Energy Efficiency Financing
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CAGR	Compounded Annual Growth Rate
CAP	Climate Action Package
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CERT	Clean Energy Research & Testbedding Programme
CETWG	Carbon & Energy Transition Working Group
CEVS	Carbon Emissions-Based Vehicle Scheme
CFLni	Compact Fluorescent Lamps with Non-Integrated Ballasts
CH_4	Methane
CO_2	Carbon Dioxide
CO_2 eq	Carbon Dioxide Equivalent
CO	Carbon Monoxide
dMRV	Domestic Measurement, Reporting and Verification
DTSS	Deep Tunnel Sewerage System
E_2F	Energy Efficiency Fund
EASe	Energy Efficiency Improvement Assistance Scheme
ECA	Energy Conservation Act

GLOSSARY

EDB	Economic Development Board
EEAI	Electric Vehicle Early Adoption Incentive
EEG	Energy Efficiency Grant
EEO	Energy Efficiency Opportunities
EEOAs	Energy Efficiency Opportunities Assessments
EETC	Energy Efficiency Technology Centre
EMA	Energy Market Authority
EMIS	Energy Management Information Systems
EPHA	Environmental Public Health Act
EPM	Energy Performance Monitoring
EPMA	Environmental Protection and Management Act
ERP	Electronic Road Pricing
ETF	Enhanced Transparency Framework
ETWG	Economic Transition Working Group
EUI	Energy Use Intensity
EVs	Electric Vehicles
Exco	Executive Committee
FELS	Fuel Economy Labelling Scheme
GBIC	Green Buildings Innovation Cluster
GBP	Green Buildings Programme
GBMP	Green Building Masterplan
Gg	Gigagram
GHG	Greenhouse Gas
GLS	Government Land Sales
GM	Green Mark
GMIS-EB	Green Mark Incentive Scheme for Existing Buildings
GREET	Grant for Energy Efficient Technologies
GST	Global Stocktake
GWh	Gigawatt-Hour
GWp	Gigawatt-Peak
GWP	Global Warming Potentials
HFCs	Hydrofluorocarbons
IA(ER)	Investment Allowance for Emissions Reduction
IAI	Initiative for ASEAN Integration
ICA	International Consultations and Analysis
ICE	Internal Combustion Engine
ICT	Information and Communications Technology
IEA	International Energy Agency
IES	Institution of Engineers, Singapore
IMCCC	Inter-Ministerial Committee on Climate Change
INWG	International Negotiations Working Group
IORA	Indian Ocean Rim Association
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITMOs	Internationally Transferred Mitigation Outcomes
IWMF	Integrated Waste Management Facility
JICA	Japan International Cooperation Agency
JTP	Joint Training Programme
kg	Kilogram
kt	Kilotonne
LCER	Low-Carbon Energy Research
LDCs	Least Developed Countries
LEDS	Long-Term Low-Emissions Development Strategy
LNG	Liquefied Natural Gas
LPG	Liquified Petroleum Gas
LTA	Land Transport Authority
LULUCF	Land Use, Land-Use Change and Forestry
LWG	Long-Term Emissions and Mitigation Working Group
MCF	Methane Correction Factor
MEES	Minimum Energy Efficiency Standards
MEI	Mandatory Energy Improvement
MELS	Mandatory Energy Labelling Scheme

MEPS	Minimum Energy Performance Standards
MGO/MDO	Marine Gas Oil/Marine Diesel Oil
MoNRE	Ministry of Natural Resources and Environment of Vietnam
MPGs	Modalities, Procedures, and Guidelines
MRV	Measurement, Reporting and Verification
MSS	Meteorological Service Singapore
MSW	Municipal Solid Waste
Mt	Million Tonnes
Mt CO_2 eq	Million Tonnes of Carbon Dioxide Equivalent
MWp	Megawatt-Peak
N_2O	Nitrous Oxide
NC	National Communication
NCCS	National Climate Change Secretariat
NDC	Nationally Determined Contribution
NEA	National Environment Agency
NF_3	Nitrogen Trifluoride
NID	National Inventory Document
NMHSs	National Meteorological and Hydrological Services
NMVOCs	Non-Methane Volatile Organic Compounds
NOx	Nitrogen Oxides
PFCs	Perfluorocarbons
Pre-FS	Pre-Feasibility Study
PMO	Prime Minister's Office
PP	Planning Permission
PUB	PUB, Singapore's National Water Agency
PUE	Power Usage Effectiveness
PV	Photovoltaic
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
RAC	Refrigeration and Air Conditioning

REG(E)	Resource Efficiency Grant for Energy
RFP	Request for Proposal
RWG	Resilience Working Group
S2S	Subseasonal-to-Seasonal
SAP	Sustainability Action Package
SCP	Singapore Cooperation Programme
SCPTA	SCP Training Award
SCS	Solar Capability Scheme
SDGs	Sustainable Development Goals
SEWG	Sustainability & Engagement Working Group
SF_6	Sulphur Hexafluoride
SGD	Singapore Dollar
SGBMP	Singapore Green Building Masterplan
SHD	Singapore Height Datum
SIDS	Small Island Developing States
SIT	Singapore Institute of Technology
SMEs	Small and Medium-sized Enterprises
SO_2	Sulphur Dioxide
tCO_2 eq	Tonne of Carbon Dioxide Equivalent
TCTP	Third Country Training Programme
TMTS	Tuas Marine Transfer Station
TWRP	Tuas Water Reclamation Plant
UNFCCC	United Nations Framework Convention on Climate Change
VES	Vehicular Emissions Scheme
WC-CWS	Water-Cooled Chilled Water Systems
WCR	Walk-Cycle-Ride
WEF	World Economic Forum
WOG	Whole-of-government
WPNM-M3	Weather Prediction by Numerical Methods Module 3
WPNM-M4	Weather Prediction by Numerical Methods Module 4
WRPs	Water Reclamation Plants

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