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Technical analysis of the fifth biennial update report of Singapore submitted on 1 November 2022

Summary report by the team of technical experts

Summary

According to decision 2/CP.17, paragraph 41(a), Parties not included in Annex I to the Convention, consistently with their capabilities and the level of support provided for reporting, were to submit their first biennial update report by December 2014. Further, paragraph 41(f) of that decision states that Parties not included in Annex I to the Convention shall submit a biennial update report every two years, either as a summary of parts of their national communication in the year in which the national communication is submitted or as a stand-alone update report. As mandated, the least developed country Parties and small island developing States may submit biennial update reports at their discretion. This summary report presents the results of the technical analysis of the fifth biennial update report of Singapore, conducted by a team of technical experts in accordance with the modalities and procedures contained in the annex to decision 20/CP.19.

Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
AFOLU	agriculture, forestry and other land use
AR	Assessment Report of the Intergovernmental Panel on Climate Change
BUR	biennial update report
CDM	clean development mechanism
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
EF	emission factor
ETF	enhanced transparency framework under the Paris Agreement
FAO	Food and Agriculture Organization of the United Nations
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
HWP	harvested wood products
ICA	international consultation and analysis
IMCCC	Interministerial Committee on Climate Change
IPCC	Intergovernmental Panel on Climate Change
IPCC good practice guidance	*Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*
IPCC good practice guidance for LULUCF	*Good Practice Guidance for Land Use, Land-Use Change and Forestry*
IPPU	industrial processes and product use
LULUCF	land use, land-use change and forestry
MRV	measurement, reporting and verification
N_2O	nitrous oxide
NA	not applicable
NC	national communication
NCCS	National Climate Change Secretariat
NDC	nationally determined contribution
NE	not estimated
NEA	National Environment Agency
NF_3	nitrogen trifluoride
NMVOC	non-methane volatile organic compound
NO	not occurring
non-Annex I Party	Party not included in Annex I to the Convention
NO_X	nitrogen oxides
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
Revised 1996 IPCC Guidelines	*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*
SF_6	sulfur hexafluoride
TTE	team of technical experts
UNFCCC guidelines for the preparation of NCs from non-Annex I Parties	"Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention"

UNFCCC reporting guidelines on BURs	"UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention"

I. Introduction and process overview

A. Introduction

1. The process of ICA consists of two steps: a technical analysis of the submitted BUR and a facilitative sharing of views under the Subsidiary Body for Implementation, resulting in a summary report and a record respectively.

2. According to decision 2/CP.17, paragraph 41(a), non-Annex I Parties, consistently with their capabilities and the level of support provided for reporting, were to submit their first BUR by December 2014. In addition, paragraph 41(f) of that decision states that non-Annex I Parties shall submit a BUR every two years, either as a summary of parts of their NC in the year in which the NC is submitted or as a stand-alone update report.

3. Further, according to paragraph 58(a) of the same decision, the first round of ICA is to commence for non-Annex I Parties within six months of the submission of the Parties' first BUR. The frequency of developing country Parties' participation in subsequent rounds of ICA, depending on their respective capabilities and national circumstances, and the special flexibility for small island developing States and the least developed country Parties, will be determined by the frequency of the submission of BURs.

4. Singapore submitted its fourth BUR on 27 December 2020, which was analysed by a TTE in the eighteenth round of technical analysis of BURs from non-Annex I Parties, conducted from 8 to 12 March 2021. After the publication of its summary report, Singapore participated in the twelfth workshop for the facilitative sharing of views, convened in Bonn on 7 June 2022.

5. This summary report presents the results of the technical analysis of the fifth BUR of Singapore, undertaken by a TTE in accordance with the provisions on the composition, modalities and procedures of the TTE under ICA contained in the annex to decision 20/CP.19.

B. Process overview

6. In accordance with the mandate referred to in paragraph 2 above, Singapore submitted its fifth BUR on 1 November 2022 as a summary of parts of its NC5. The submission was made within two years from the submission of the fourth BUR.

7. The technical analysis of Singapore's BUR was conducted from 17 to 22 February 2023 in Bonn and was undertaken by the following TTE, drawn from the UNFCCC roster of experts on the basis of the criteria defined in decision 20/CP.19, annex, paragraphs 2–6: Buket Akay (Türkiye), Irina Atamuradova (former member of the Consultative Group of Experts from Turkmenistan), Bernard Ayittah (Ghana), Hoy Yen Chan (Malaysia), Sangay Dorji (Bhutan), Baasansuren Jamsranjav (Mongolia), Nato Lomidze (Georgia), Anwar Sidahmed Mohamed Abdalla (Sudan), Gherghita Nicodim (Romania), Marcela Itzel Olguin-Alvarez (Mexico) and David Glen Thistlethwaite (United Kingdom of Great Britain and Northern Ireland). Irina Atamuradova and Gherghita Nicodim were the co-leads. The technical analysis was coordinated by Jeeyoon Jung and Sohel Pasha (secretariat).

8. During the technical analysis, in addition to the written exchange, in the virtual team room, to provide technical clarifications on the information reported in the BUR, the TTE and Singapore engaged in consultation[1] on the identification of capacity-building needs for the preparation of BURs and participation in the ICA process. Following the technical analysis of Singapore's fifth BUR, the TTE prepared and shared a draft summary report with Singapore on 15 May 2023 for its review and comment. Singapore, in turn, provided its feedback on the draft summary report on 19 June 2023.

9. The TTE responded to and incorporated Singapore's comments referred to in paragraph 8 above and finalized the summary report in consultation with the Party on 20 July 2023.

[1] The consultation was conducted via videoconferencing.

II. Technical analysis of the biennial update report

A. Scope of the technical analysis

10. The scope of the technical analysis is outlined in decision 20/CP.19, annex, paragraph 15, according to which the technical analysis aims to, without engaging in a discussion on the appropriateness of the actions, increase the transparency of mitigation actions and their effects and shall entail the following:

(a) The identification of the extent to which the elements of information listed in paragraph 3(a) of the ICA modalities and guidelines (decision 2/CP.17, annex IV) have been included in the BUR of the Party concerned (see chap. II.B below);

(b) A technical analysis of the information reported in the BUR, specified in the UNFCCC reporting guidelines on BURs (decision 2/CP.17, annex III), and any additional technical information provided by the Party concerned (see chap. II.C below);

(c) The identification, in consultation with the Party concerned, of capacity-building needs related to the facilitation of reporting in accordance with the UNFCCC reporting guidelines on BURs and to participation in ICA in accordance with the ICA modalities and guidelines, taking into account Article 4, paragraph 3, of the Convention (see chap. II.D below).

11. The remainder of this chapter presents the results of each of the three parts of the technical analysis of Singapore's BUR outlined in paragraph 10 above.

B. Extent of the information reported

12. The elements of information referred to in paragraph 10(a) above include the national GHG inventory report; information on mitigation actions, including a description of such actions, an analysis of their impacts and the associated methodologies and assumptions, and information on progress in their implementation; information on domestic MRV; and information on support needed and received.

13. According to decision 20/CP.19, annex, paragraph 15(a), in undertaking the technical analysis of the submitted BUR, the TTE is to identify the extent to which the elements of information listed in paragraph 12 above have been included in the BUR of the Party concerned. The TTE considers that the reported information is mostly consistent with the UNFCCC reporting guidelines on BURs. Specific details on the extent of the information reported for each of the required elements are provided in the tables included in annex I.

14. The current TTE noted improvements in the reporting in Singapore's fifth BUR compared with that in its fourth BUR. Information on the GHG inventory reported in the Party's fifth BUR demonstrates that it has taken into consideration the areas for enhancing the transparency of the extent of the information reported noted by the previous TTE in the summary report on the technical analysis of the Party's previous BURs.

C. Technical analysis of the information reported

15. The technical analysis referred to in paragraph 10(b) above aims to increase the transparency of information reported by the Parties on mitigation actions and their effects, without engaging in a discussion on the appropriateness of those actions. Accordingly, the focus of the technical analysis was on the transparency of the information reported in the BUR.

16. For information reported on national GHG inventories, the technical analysis also focused on the consistency of the methods used for preparing those inventories with the appropriate methods developed by the IPCC and referred to in the UNFCCC reporting guidelines on BURs.

17. The results of the technical analysis are presented in the remainder of this chapter.

1. Information on national circumstances and institutional arrangements relevant to the preparation of national communications on a continuous basis

18. As per the scope defined in paragraph 2 of the UNFCCC reporting guidelines on BURs, the BUR should provide an update to the information contained in the most recently submitted NC, including information on national circumstances and institutional arrangements relevant to the preparation of NCs on a continuous basis. In their NCs, non-Annex I Parties report on their national circumstances following the reporting guidance contained in decision 17/CP.8, annex, paragraphs 3–5, and they could report similar information in their BUR, which is an update of their most recently submitted NC.

19. In its fifth BUR, Singapore provided an update on its national circumstances, including a description of national development priorities, objectives and circumstances, including features of geography, climate and economy that might affect the Party's ability to deal with mitigating and adapting to climate change, as well as information on national circumstances and constraints in relation to specific needs and concerns arising from the adverse effects of climate change and/or the impact of the implementation of response measures, as referred to in Article 4, paragraph 8, and, as appropriate, paragraphs 9–10, of the Convention.

20. Singapore transparently reported in its fifth BUR an update on its existing institutional arrangements relevant to the preparation of its NCs and BURs on a continuous basis. The description covers key aspects of the institutional arrangements, including IMCCC, which was established in 2007 as the overall coordinating body for climate change policies. It is chaired by the Senior Minister and Coordinating Minister for National Security and composed of the Ministers of Sustainability and the Environment; Finance; Foreign Affairs; National Development; Trade and Industry; and Transport. IMCCC is supported by an Executive Committee, comprising senior officials from relevant government agencies, which oversees five working groups covering long-term emissions and mitigation; resilience; sustainability; green economy; and communications and engagement. The scope of IMCCC has been expanded to reflect Singapore's holistic approach to addressing the global climate crisis and to enhance its 'whole of government' response to climate change across multiple domains. In 2010, Singapore established NCCS under the Prime Minister's Office to ensure the effective coordination of domestic and international policies, plans and actions on climate change. NCCS serves as the secretariat to IMCCC and the Executive Committee.

21. Singapore reported in its fifth BUR an update on its domestic MRV arrangements. The MRV arrangements are designed at the national level and cover three main areas: the BUR and NC preparation process; the GHG inventory system; and monitoring, measuring and documenting the progress of mitigation actions. During the technical analysis, the Party clarified that IMCCC coordinates MRV issues and has established an MRV task force, co-chaired by NCCS and the Ministry of Sustainability and the Environment, to conduct work on this matter and report back to it. The MRV task force conceptualizes and oversees the domestic verification system, studies other countries' verification systems and reviews the adequacy of Singapore's regulatory policies on climate change. In its BUR, the Party reported that it participates in technical workshops and consults the secretariat, think tanks, members of academia and international organizations on MRV with a view to further enhancing its processes.

2. National greenhouse gas emissions by sources and removals by sinks

22. As indicated in table I.1, Singapore reported information on its GHG inventory in its BUR mostly in accordance with paragraphs 3–10 of the UNFCCC reporting guidelines on BURs and paragraphs 8–24 of the UNFCCC guidelines for the preparation of NCs from non-Annex I Parties, contained in the annex to decision 17/CP.8.

23. Singapore submitted its fifth BUR in 2022 and the GHG inventory reported is for 2018. The GHG inventory is consistent with the requirements for the reporting time frame.

24. GHG emissions and removals for the BUR covering the 2018 inventory were estimated using methodologies from the 2006 IPCC Guidelines, as well as from the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*, for all categories. Tier 1 methodology was used for most categories, but higher-

tier methodologies were used where data were available. In particular, tier 2 or 3 methodologies were used to estimate fugitive emissions from oil and natural gas, emissions for some IPPU categories, CH_4 emissions from solid waste disposal, CO_2 emissions from incineration of solid waste and CO_2 emissions and removals for the forest land and settlements categories under the AFOLU sector.

25. Information on AD and EFs used and their sources was reported in the BUR, including a summary of the data sources for each sector in tabular format and information on data owners (BUR p.101). The Party reported that it used country- or plant-specific EFs for some categories for which tier 2 or 3 methodologies were used and clearly summarized the type of EFs used (i.e. default, country-specific or plant-specific) for each category. Further details of the AD and EFs applied per category were reported for 2018 within supplementary tables in the annex to the BUR, including for stationary and mobile combustion, AFOLU and waste management.

26. Information on AD and EFs used to derive estimates for energy sector source category 1.B (fugitive emissions from fuels), all source categories in the IPPU sector, and AFOLU source category 3.D (other) was not clearly reported in Singapore's BUR. The TTE noted that for category 3.D the Party applied a country-specific methodology that is not part of the 2006 IPCC Guidelines. During the technical analysis, the Party clarified that the emission estimates for category 1.B and IPPU (category 2) were derived from aggregated emission reports of plant operators submitted to the NEA. The Party's clarification on category 3.D is further elaborated in paragraph 44 below.

27. Information on the Party's total GHG emissions by gas for 2018 is outlined in table 1 in Gg CO_2 eq. It shows an increase in emissions of 89.4 per cent with land and HWP and other emissions since 1994 (25,160.74 Gg CO_2 eq). The TTE commends the Party for providing NF_3 emission estimates in the BUR.

Table 1
Greenhouse gas emissions by gas of Singapore for 2018

Gas	*GHG emissions (Gg CO_2 eq) including land and HWP[a]*	*% change 1994–2018*	*GHG emissions (Gg CO_2 eq) excluding land and HWP[a]*	*% change 1994–2018*
CO_2	50 260.88	81.5	50 154.51	81.7
CH_4	113.41	–12.1	113.39	–12.1
N_2O	484.85	147.2	479.65	144.5
HFCs	507.29	9 208.1	507.29	9 208.1
PFCs	1 437.92	1 107.0	1 437.92	1 107.0
SF_6	127.06	1 332.5	127.06	1 332.5
Other (NF_3)	381.25	70 501.9	381.25	70 501.9
Total	**53 312.68**	**89.4**	**53 201.07**	**89.6**

[a] 2006 IPCC Guidelines AFOLU categories 3.B (land) and, if reported, 3.D (HWP (3.D.1) and other emissions (3.D.2)).

28. Information on emissions of CO, NO_X, NMVOCs and other gases not controlled by the Montreal Protocol, such as sulfur oxides, was not reported in Singapore's BUR. However, the Party clarified in its BUR that, as CO, NO_X, NMVOCs and sulfur dioxide are considered air pollutants, emissions of those gases are monitored by ambient air quality monitoring stations in Singapore. Further, CO, NO_X and sulfur dioxide emissions are regulated under Singapore's Environmental Protection and Management Act, which stipulates emission standards for these pollutants. In its BUR, Singapore stated that strict enforcement programmes on air pollutants and air quality monitoring ensure that the emission levels of these precursor gases are kept as low as possible in the country.

29. Singapore applied notation keys in tables where numerical data were not provided for all sectors except the AFOLU sector. The use of those notation keys was consistent with the UNFCCC guidelines for the preparation of NCs from non-Annex I Parties.

30. For the AFOLU sector, the cells for CO, NO_X and NMVOC emissions were not shaded and did not contain numerical data or a notation key. During the technical analysis, the Party clarified that these gases are typically generated from biomass burning; however, anthropogenic biomass burning under the AFOLU sector does not occur in Singapore. The Party stated that it will include the appropriate notation keys in a future submission.

31. Singapore reported comparable information addressing the tables included in annex 3A.2 to the IPCC good practice guidance for LULUCF and the sectoral reporting tables annexed to the Revised 1996 IPCC Guidelines.

32. The shares of emissions that different sectors contributed to the Party's total GHG emissions excluding land (category 3.B) and HWP and other emissions (category 3.D), as calculated by the TTE using information from the BUR, in 2018 are reflected in table 2.

Table 2
Shares of greenhouse gas emissions by sector of Singapore for 2018

Sector	*GHG emissions (Gg CO_2 eq)*	*% share*[a]	*% change 1994–2018*
Energy	49 867.74	93.7	80.1
IPPU	3 013.09	5.7	1 877.5
AFOLU	120.23	NA	11.1
Livestock (category 3.A)	4.91	0.0[b]	NA
Land (category 3.B)	110.53	NA	8.4
Aggregate sources and non-CO_2 emissions sources on land (category 3.C)	3.13	0.0[b]	NA
HWP and other emissions (category 3.D)	1.66	NA	NA
Waste	311.63	0.6	59.6

[a] Share of total without 2006 IPCC Guidelines AFOLU category 3.B (land) and, if reported, category 3.D (HWP (3.D.1) and other emissions (3.D.2)).
[b] Figures are quite small and presented as "0.0" owing to rounding.

33. Singapore reported information on its use of GWP values consistent with those provided by the IPCC in its AR5 based on the effects over a 100-year time-horizon of GHGs.

34. For the energy sector, information was clearly reported on GHG emissions for categories 1.A (fuel combustion activities) and 1.B (fugitive emissions from fuels). The Party reported emissions for category 1.C (CO_2 transport and storage) as "NO". The energy sector is responsible for the largest share of emissions in Singapore, with the majority of emissions originating from fuel combustion activities primarily producing CO_2 emissions. In particular, the CO_2 emissions from the combustion of natural gas, solid waste and coal for subcategory 1.A.1 (energy industry) and the combustion of refinery gas, natural gas and fuel oil for subcategory 1.A.2 (manufacturing industries and construction) are the key categories in terms of both level and trend. Furthermore, subcategory 1.B.2 (oil and natural gas) was highlighted as a key category in terms of both level and trend. The Party provided information in its BUR (p.83) on the use of tier 2 and 3 methodologies to estimate fugitive emissions from fuels (subcategory 1.B.2 (oil and natural gas)), outlining that energy-intensive companies are required under the Energy Conservation Act to calculate their emissions on the basis of the 2006 IPCC Guidelines and report them annually. These data are then aggregated to generate total national emissions.

35. Information on the emission estimation methods for fugitive emissions from fuels (subcategory 1.B.2) used by plant operators under the Energy Conservation Act, which are then aggregated by the Party, was not clearly reported in Singapore's BUR; the Party stated, however, that they are consistent with the 2006 IPCC Guidelines. During the technical analysis, the Party described in greater detail the data supply and QA/QC provisions in its inventory system that provide assurance of inventory data quality, which include certification of energy managers in companies; annual emissions report endorsement by the companies' senior management; NEA verification checks, including for AD, EFs and assumptions applied; site verifications for larger emitters; and quality checks of Energy Conservation Act submissions for time-series consistency and completeness. Singapore clarified that the new

data-gathering and MRV systems under the Carbon Pricing Act will improve the quality of data reported by operators to the NEA in the future, for example through the requirement that operator data are to be subject to third-party verification by NEA-accredited verifiers. The Party indicated that it may explore ways to describe operator estimation methods by source category in future submissions.

36. Information on emissions from biomass use (e.g. solid biofuels, liquid biofuels) within Singapore's economy was not reported in the BUR; according to the Party's detailed energy background tables, no biomass fuels were used in any sector within the national economy in 2018, despite Singapore being a significant producer of liquid biofuels and the Maritime and Port Authority of Singapore having established national biofuel standards for maritime transport. During the technical analysis, the Party clarified that there is currently no reported use of biofuels or fossil–biofuel blends within the national economy and that all liquid biofuels are understood to be sold to the international shipping sector (i.e. marine bunkers); the Energy Market Authority only collects data on biomass consumption for the power generation sector, which are combined with data on other renewable energy sources (e.g. solar) in the national energy balance. The Party also clarified that surveys of industry are planned; hence, national data reporting systems are now being developed to gather AD for biofuel use within the marine transport and other sectors with a view to informing future inventory reporting.

37. For the IPPU sector, information was clearly reported on GHG emissions for all source categories. Many source categories were reported as "NO", including all subcategories under category 2.A (mineral industry) and subcategories 2.B.1 to 2.B.7, 2.B.9 and 2.B.10 (under category 2.B (chemical industry)), 2.C.2 to 2.C.7 (under category 2.C (metal industry)), 2.D.3 and 2.D.4 (under category 2.D (non-energy products from fuels and solvent use)), 2.E.3 to 2.E.5 (under category 2.E (electronics industry)), 2.F.2, 2.F.4 and 2.F.6 (under category 2.F (product uses as substitutes for ozone-depleting substances)), 2.G.2 to 2.G.4 (under category 2.G (other product manufacture and use)) and 2.H.1 (under category 2.H (other industries)). The Party mainly used a combination of tier 2 and 3 methodologies from the 2006 IPCC Guidelines with country- and plant-specific EFs and assumptions applied to estimate emissions for this sector, with tier 1 methodologies used only for subcategories 2.D.1 (lubricant use) and 2.D.2 (paraffin wax use). Category 2.E was reported as the sector's largest source of GHG emissions, accounting for 74.4 per cent of total IPPU emissions, followed by category 2.F (product uses as substitutes for ozone-depleting substances) accounting for 12.5 per cent of total IPPU emissions; both were identified as key categories in both the level and the trend assessment.

38. Information on the methods and assumptions applied for several source categories was not clearly reported in Singapore's BUR, including for category 2.E, where the Party reported emissions of CO_2, CH_4 and N_2O, with the methodology described in the BUR (p.69) as "NA", applying plant-specific EFs. The TTE noted that reporting emissions of these gases from this source category is not consistent with the 2006 IPCC Guidelines and that the methods used by operators to estimate emissions and report under the Energy Conservation Act to the NEA for aggregation of emissions and reporting in the national inventory are not described, other than to state that they are consistent with the 2006 IPCC Guidelines. During the technical analysis, the Party clarified that category 2.E emissions of CO_2, CH_4 and N_2O were derived using a country-specific method on the basis of data reported under the Energy Conservation Act, such that emissions estimates are calculated with the consumption of GHG with the use rates, EFs and an assumed fraction of gas destroyed by emission control technologies. Similarly to the operator-reported data for category 1.B (fugitive emissions from fuels) referred to in paragraph 34 above, the operator data provided to the NEA are expected to improve in quality as a result of the Carbon Pricing Act, and Singapore will consider how to improve the clarity of its reporting of the estimation methods used by operators in their annual reports to the NEA for future submissions.

39. For subcategory 2.F.1 (refrigeration and air conditioning), Singapore reported in its BUR (p.61) that the inventory currently excludes an interim tier 1b estimate of HFC emissions from the refrigeration and air-conditioning sector (6,398.15 Gg CO_2 eq in 2018); that new licensing controls on HFCs that enable further data collection were introduced in 2019; and that it has been working to develop a new tier 2 estimates of HFC emissions for

2019 onward. The reason for excluding the interim estimate and the status of the new estimate was not clear to the TTE. During the technical analysis, the Party clarified that it has been gathering data and reviewing end-of-life HFC emissions, time-series data and quantitative uncertainties for the new model estimates. Source data are obtained from, inter alia, the Energy Conservation Act, the Environmental Protection Management Act and the Statistics Act. Singapore indicated that these new HFC emission estimates are likely to be ready for inclusion in the next submission.

40. Singapore reported under the 2006 IPCC Guidelines emissions for AFOLU categories 3.A (livestock) and 3.C (aggregate sources and non-CO_2 emissions sources on land), including notation keys. The Party reported in its BUR (p.85) that the GHG emissions for the AFOLU sector are considered negligible, accounting for only 0.02 per cent of the total national GHG emissions. The TTE noted improvements compared with the previous BUR, such as the inclusion of new estimates of CH_4 emissions for category 3.A (pp.164–165) and net CO_2 and N_2O emissions for category 3.C, and the provision of disaggregated information by source category.

41. For land and HWP (categories 3.B (land) and 3.D (HWP and other emissions), Singapore reported GHG emissions and removals for 2018 in the amount of 112.17 Gg CO_2 eq. The Party used a combination of tier 1 and 3 methodologies to estimate emissions for category 3.B and a tier 3 methodologies for category 3.D. It provided a detailed sectoral background table for category 3.B in the BUR (pp.170–176), in which the TTE noted an improvement in the information reported for subcategory 3.B.4 (wetlands) compared with the previous BUR.

42. Information on the total land area used in estimating GHG emissions and removals for category 3.B (land) was not clearly reported in the BUR. In its BUR, the Party reported its total land area as 733.1 km^2 (equivalent to 73,310 ha) on page 11, but the total land area used in estimating emissions and removals for category 3.B as 72,420 ha on page 17. During the technical analysis, the Party clarified that the total land area reported on page 11 is based on updated data from 2022, whereas the information reported on page 17 relates to data from 2018 based on satellite imagery. The Party confirmed that this did not result in any underestimation of related emissions and that the estimates for the reporting year cover the entire land area.

43. Emissions for subcategory 3.C.4 (direct N_2O emissions from managed soils) were reported in the BUR (p.178) by land category, where all emissions were from cropland. The Party, however, reported as "NE" N_2O emissions for forest and settlements and the reason was not clear to the TTE. During the technical analysis, the Party clarified that these data are not available and that it does not expect such emissions to contribute significantly to the emissions for this category.

44. Singapore reported a country-specific subcategory 3.D.2 (other) under category 3.D (HWP and other emissions) but did not provide detailed sectoral reporting for this subcategory. During the technical analysis, the Party clarified that the only source of emissions under category 3.D is subcategory 3.D.2 (other – reclamation of land from the sea) and that it will consider including detailed reporting on this subcategory in future submissions.

45. For the waste sector, information was reported on CO_2, CH_4 and N_2O emissions for categories 4.A (solid waste disposal) and 4.C (incineration and open burning of waste), and on N_2O emissions for category 4.D (wastewater treatment and discharge). The Party reported emissions for categories 4.B (biological treatment of solid waste) and 4.E (other) as "NO". CO_2, CH_4 and N_2O emissions from incineration of solid waste and sludge were reported under subcategory 1.A.1 (energy industry) in accordance with the 2006 IPCC Guidelines. The waste sector accounts for less than 1 per cent of Singapore's total national GHG emissions and it does not include a key category in terms of either level or trend. A detailed sectoral reporting table for the waste sector was provided in the BUR and the methodology for N_2O emissions for category 4.D (wastewater treatment and discharge) was reported as tier 1 methodology, which the TTE noted as an improvement on the previous BUR, in which the Party reported "NA".

46. Information on the methods and assumptions used to derive EF applied for category 4.C (hazardous waste incineration) was not clearly reported in Singapore's BUR. During the

technical analysis, the Party clarified that for estimating emissions for this category it applied a default factor for carbon content in wet waste derived from the IPCC good practice guidance, as national AD are only available on a wet waste basis and the 2006 IPCC Guidelines have no such factor.

47. The Party reported in its BUR (p.74) CH_4 emissions for category 4.D (wastewater treatment and discharge) as "NE". During the technical analysis, the Party clarified that CH_4 emissions from sewage sludge treatment have been significantly reduced by incinerating sludge and that fugitive CH_4 emissions from wastewater treatment and discharge are negligible as all unused biogas is flared.

48. The BUR provides an update to all GHG inventories reported in the Party's previous NCs and BURs. The update was carried out for 1994–2016 using the methodologies contained in the 2006 IPCC Guidelines, thus generating a consistent 24-year time series. The Party reported in its BUR (p.96) that it recalculated emissions for source categories with new or updated AD, including emissions for subcategories 1.A.2 (manufacturing industries and construction) and 1.A.3 (transport); emissions for all subcategories under the AFOLU sector; and emissions for category 4.D (wastewater treatment and discharge) owing to an update to the FAO annual per capita protein intake figure. The Party also reported that IPCC splicing methodologies were applied in making the recalculations for the earlier years where historical data were unavailable. The recalculations increased emission estimates by 0.1 per cent for 1994–2014, while the large increase of 1.6 per cent in 2016 was due to revision of AD.

49. Singapore reported a time series for its net national emissions in its BUR (p.97) and updates to summary information tables of inventories for previous submission years (1994, 2000, 2010, 2012, 2014 and 2016), but did not report a detailed time series for its emissions at the sectoral level. The TTE noted that, where estimates were recalculated across the time series, the updated AD and emissions (such as revised fuel use data for categories 1.A.2 and 1.A.3; revised FAO protein consumption data for category 4.D; and revised livestock numbers and other AFOLU data) were not clearly reported in the BUR for years other than 2018, for which a detailed sectoral table was provided. The TTE noted that this limits the clarity of the recalculations by source category across the time series. During the technical analysis, Singapore clarified that it will consider including in future submissions detailed sectoral tables for earlier years of the time series to improve the clarity of its recalculations.

50. Singapore described in its BUR the institutional framework for the preparation of its 2018 GHG inventory. The Party reported that the NEA coordinates multi-agency efforts to prepare the inventory. The data and information management system used to prepare the inventory are outlined in the BUR, which includes a description of the design and functions of the Emissions Data Monitoring and Analysis system, including its receipt of data inputs from different data sources; performance of emission calculations; QC checks; data archiving and storage security; and documentation of data sources, methodology descriptions and reference materials.

51. Singapore clearly reported that a key category analysis was performed for both the level of and the trend in emissions. The Party used approach 1 from the 2006 IPCC Guidelines for the level assessment, which identified 15 key categories, 11 of which relate to fuel combustion activities. According to the assessment, CO_2 emissions from the combustion of natural gas for electricity and heat generation were the main contributor to total emissions for 2018 (32.2 per cent of total GHG emissions). The trend assessment identified 13 key categories. The strongest trend was a decrease in emissions from fuel oil combustion for electricity and heat generation (40.2 per cent), followed by an increase in emissions from natural gas combustion for electricity and heat generation (23.2 per cent). The Party reported that including and excluding LULUCF did not change the key categories identified in either the level or the trend assessment.

52. The BUR provides an overview of the QA/QC system, including a summary of QA/QC activities across the process of inventory compilation and reporting, data collection, emission calculation, documentation and verification, and final endorsement of the national inventory by the MRV task force. The quality controls described include checks on input data and their appropriateness; checks on reported trends, units, conversion factors applied and consistency of data between sectors; other checks, such as on database integrity, data

transcription, completeness, recalculations and internal consistency (e.g. ensuring that subtotals add up to totals); and updates of periodic data and reviews of methods applied that are then documented in the Emissions Data Monitoring and Analysis system. During the technical analysis, the Party provided additional details on the QA/QC provisions in place, such as the requirements under the Energy Conservation Act that only certified energy managers may submit GHG reports to the NEA and that larger emitters shall be subject to site-level verification checks by the NEA. Furthermore, operators are required to implement and document QA/QC procedures and provide evidence to the NEA that these procedures have been implemented so as to ensure the quality of the emission data reported. As part of the implementation of the country's carbon tax (see para. 73 below), emission reports submitted will be subject to third-part verification by NEA-accredited verifiers to ensure their accuracy. The TTE commends the Party for reporting on its progress to develop a rigorous QA/QC system to ensure inventory data quality.

53. Singapore reported information on CO_2 fuel combustion emissions using the sectoral approach only; information on such emissions under the reference approach was not reported in the BUR. The Party reported that it experiences high volatility in data owing to its status as a global trading hub with large and variable trade volumes, coupled with the presence of a large refining and petrochemical sector. The Party also reported that it has been building capacity to understand the discrepancies between emissions calculated using the sectoral and the reference approach, through an ongoing study, since its fourth BUR, but the status of the study was not clear to the TTE. During the technical analysis, the Party clarified that its energy import and export trade far exceeds its domestic energy consumption and that small variations (in terms of percentage) in the trade data typically result in large discrepancies between emissions calculated using the sectoral and the reference approach. Singapore considers the sectoral approach to be more accurate and better at ensuring time-series consistency. It clarified that it considered reference approach emission estimates but did not include them in the BUR because of the large differences between the sectoral and reference approaches across the time series. Singapore will consider including the reference approach estimates in future submissions and will continue to explain the reasons for large and variable differences in values calculated using the sectoral and the reference approach across the time series.

54. Information was reported on international aviation and marine bunker fuels. For 2018, emissions from international aviation and marine bunkers were estimated at 15,684.96 and 157,319.27 Gg CO_2 eq respectively.

55. Singapore reported information on the uncertainty assessment (level) of its national GHG inventory. The uncertainty analysis covers all source categories, and the uncertainty of its estimates was qualitatively assessed on the basis of three confidence levels: high, medium and low. The Party reported that 99.8 per cent of its GHG emission data, most of which relate to fuel combustion activities, have a confidence level of medium or high according to its analysis, with the remaining 0.2 per cent attributed a low confidence level owing to methodological issues in the waste and AFOLU sectors.

56. Information on the underlying assumptions and methodologies used to define the confidence levels (high, medium or low) was not clearly reported in Singapore's BUR. It was not clear to the TTE why estimates in the LULUCF sector were described as having a relatively high uncertainty level (even when higher-tier methodologies are applied) on page 94 of the BUR but with a medium confidence level on page 95. During the technical analysis, the Party clarified that data collected through surveys were assessed to be of a medium confidence level and proxy data used for estimating emissions were assessed to be of a low confidence level, while the data collected under legislation regulated by, for example, the Energy Market Authority and the NEA have strengthened confidence in those data and form the basis for the high confidence in the GHG emission estimates. The Party will update the definition of confidence levels in its next submission. For the LULUCF sector, the Party clarified that additional data collected from the national forest inventory and refinements have enhanced the robustness of the data-collection process and thus elevated the confidence level to medium. As for the uncertainty, the Party reported that GHG estimates from the LULUCF sector are based on subtractions between emissions and removals in pools, in subcategories and across subcategories, leading to a relatively high uncertainty even when

higher-tier approaches are applied. Additionally, Singapore is making efforts to quantitatively estimate the uncertainty of the GHG inventory and will include the results when they become available.

57. The TTE noted that the transparency of the information reported on GHG inventories could be further enhanced by addressing the areas noted in paragraphs 26, 28, 30, 35, 36, 38, 39, 42, 43, 44, 46, 47, 49, 53 and 56 above, which could facilitate a better understanding of the information reported on GHG inventories.

58. In paragraph 55 of the summary report on the technical analysis of Singapore's fourth BUR, the previous TTE noted areas where the transparency of the reporting on GHG inventories, including the AFOLU and waste sectors, could be further enhanced. The current TTE noted the improvements referred to in paragraphs 40, 41 and 45 above and commends the Party for enhancing the transparency of its reporting.

3. Mitigation actions and their effects, including associated methodologies and assumptions

59. As indicated in table I.2, Singapore reported in its BUR, fully in accordance with paragraphs 11–13 of the UNFCCC reporting guidelines on BURs, information on mitigation actions and their effects, to the extent possible.

60. The information reported provides a comprehensive overview of the Party's mitigation actions and their effects. In its BUR, Singapore reported information on its national context and framed its national mitigation planning and actions in the context of the national emission reduction targets for 2020 and 2030. In 2021, Singapore launched its Green Plan 2030, which is a road map and 'whole of nation' effort towards sustainable development and net zero emissions. The Plan also sets out Singapore's approach to adapting to the impact of climate change and reducing emissions. In its BUR, Singapore reported that it has met its 2020 target of reducing emissions by 16 per cent below the 'business as usual' level for that year. The Party submitted its enhanced NDC on 31 March 2020 (first update) and a second update on 4 November 2022, under which it intends to reduce its annual emissions to around 60 Mt CO_2 eq by 2030 following a peak in its emissions. Most of the mitigation actions are in the energy sector. The implemented mitigation actions contributed to an estimated emission reduction of 9.15 Mt CO_2 eq in 2020, with the energy sector (power generation) being the main source of the emission reduction.

61. The Party reported a summary of its mitigation actions in tabular format in accordance with decision 2/CP.17, annex III, paragraph 11. The Party also reported information on its mitigation actions in narrative format.

62. Consistently with decision 2/CP.17, annex III, paragraph 12(a), Singapore reported the names of mitigation actions or groups of actions, coverage (sector and gases) and progress indicators in the BUR (tables 1–7). A clear description of mitigation actions, as well as information on quantitative goals, was provided in the BUR. Singapore reported 12 mitigation actions for the energy sector, divided into five groups (tables 1–5); 2 mitigation actions for the waste sector (table 6); and 1 cross-sectoral measure (table 7).

63. Information on the progress indicators for two mitigation actions related to household energy efficiency was not clearly reported in Singapore's BUR. The Party reported that the annual purchase pattern for appliance models by tick rating was used as a progress indicator for both of these mitigation actions (see para. 69 below), but it was not clear to the TTE whether tick rating referred to an energy rating system (e.g. rating by level of energy consumption or categorization using other energy-related indicators) or something else. During the technical analysis, the Party clarified that different energy performance metrics are used to measure the energy efficiency of appliances (e.g. coefficient of performance for air-conditioning units, annual energy consumption for refrigerators, energy consumption per wash for clothes dryers). The greater the number of ticks, the better the appliance's relative energy efficiency.[2]

[2] See also https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/energy-efficiency/household-sector/tick-rating.

64. For most of the mitigation actions, the Party clearly reported information on methodologies and assumptions, the objectives of the actions and steps taken or envisaged to achieve them, progress of the implementation of such actions and steps and results achieved, such as estimated emission reductions.

65. Singapore reported on five groups of mitigation actions within the energy sector. The first group focuses on shifting to cleaner energy sources (power generation) and comprises two actions, which have been completed. Singapore reported that the mitigation actions resulted in an estimated emission reduction of 4.55 Mt CO_2 eq in 2020, which is the largest emission reduction resulting from an action in the energy sector. One of the mitigation actions, on switching away from fuel oil for power generation, resulted in the share of natural gas increasing to 95.8 per cent, resulting in an estimated emission reduction of 4.38 Mt CO_2 eq in 2020. The estimated emission reduction from the other action, photovoltaic installations, was 0.17 Mt CO_2 eq in 2020. During the technical analysis, the Party also reported that the proportion of its electricity generated by natural gas rose from 60.8 per cent in 2003 to 95.8 per cent in 2020. As at 2020, Singapore had installed 431.4 MWp photovoltaics capacity; this was 15.7 MWp in 2013. The Party has also set targets to achieve 1,500 MWp capacity by 2025 and at least 2,000 MWp by 2030.

66. The second group of mitigation actions in the energy sector focuses on improving energy efficiency and promoting the use of cleaner fuels in industry and comprises four actions aimed at (1) encouraging investments in cogeneration plants, (2) improving energy efficiency in the manufacturing sector, (3) encouraging fuel switching by third-party utility providers and (4) improving the energy efficiency of data centres. Singapore reported that all mitigation actions in this group have been completed and resulted in estimated emission reductions of 0.59, 0.42, 0.07 and 0.00028 Mt CO_2 eq respectively in 2020.

67. The third group of mitigation actions in the energy sector focuses on 'greening' buildings, which refers to an ongoing action to improve energy efficiency and raise environmental sustainability standards for both new and existing buildings through implementation of the Green Mark scheme (a green building rating system launched in 2005), regulatory measures, and incentives. The Party reported that this action resulted in an estimated emission reduction of 0.99 Mt CO_2 eq in 2020. As at the end of 2021, 49 per cent of Singapore's buildings had been 'greened' by gross floor area and the Party is on track to meet its target of 80 per cent by 2030, as set out in the fourth edition of Singapore's Green Building Masterplan.

68. The fourth group of mitigation actions in the energy sector focuses on shifting to low-emission modes of transport and reducing vehicular emissions. Singapore reported three ongoing actions aimed at (1) increasing the use of public transport, (2) reducing the use of cars as a means of transport and (3) encouraging the take-up of more energy-efficient vehicles. The estimated emission reductions achieved in 2020 as a result of these actions amounted to 1.02, 0.15 and 0.50 Mt CO_2 eq respectively.

69. The fifth and final group of mitigation actions in the energy sector focuses on improving the energy performance standards of household appliances and promoting energy efficiency in households and includes two ongoing actions aimed at (1) improving the energy performance of household appliances in the market through minimum energy performance standards and (2) promoting energy efficiency in households through a mandatory energy labelling scheme. Singapore reported that, in 2021, the minimum energy performance standards were raised again for air conditioners, refrigerators and clothes dryers, and the mandatory energy labelling scheme was expanded to cover variable refrigerant flow air conditioners. The minimum energy performance standards were introduced in 2011 to improve the energy efficiency of household appliances, with only appliance models that meet those standards allowed to be put on sale, while the mandatory energy labelling scheme was introduced in 2008 to help consumers make more informed purchasing decisions and promote the purchase of energy-efficient appliances. The scheme requires suppliers of household appliances to affix energy labels to their products so that energy-efficient models are easily identifiable. The estimated emission abatement achieved in 2020 from these two actions amounted to 0.72 Mt CO_2 eq.

70. In the waste sector, Singapore reported two ongoing mitigation actions: incinerating wastewater sludge and increasing the overall recycling rate. The Party reported that the estimated emission abatement achieved from these two actions in 2020 amounted to 0.14 Mt CO_2 eq.

71. For the mitigation action on incinerating wastewater sludge, Singapore reported in its BUR that it derived its underlying assumptions from an IPCC methodological tool entitled "Tool to determine the methane emissions avoided from disposal of waste at a solid waste disposal site". However, it was not clear to the TTE whether the Party instead meant to refer to the CDM methodological tool. During the technical analysis, the Party clarified that the CDM methodological tool was being referred to and confirmed that the methodology and assumptions under this tool were used for the baseline scenario, with the abatement achieved estimated as the difference between the baseline scenario and the incineration emissions.

72. For the mitigation action on increasing the overall recycling rate, Singapore reported that emission reductions would be calculated using the amount of waste incinerated and the waste recycling rates compared with 'business as usual' projections. However, information on the assumptions (e.g. about trends in per capita waste generation, recycling rates and unrecycled waste treatment options) used for developing the 'business as usual' projections was not provided in the BUR. During the technical analysis, the Party clarified that the 'business as usual' projections assumed that there was no change in the waste generation and recycling rates and that waste-to-energy is the primary treatment method for waste that is not recycled.

73. Singapore reported on the introduction of a carbon tax as a cross-sectoral measure. The carbon tax was introduced in 2019 and applies, without exemption, to all operators emitting GHG emissions in excess of 25 kt CO_2 eq/year across all sectors, thus covering around 80 per cent of Singapore's national emissions. The Party reported that the carbon tax level was set at 5 Singapore dollars per t CO_2 eq for 2019–2023 and will be raised progressively from 2024 to reach around 50–80 Singapore dollars per t CO_2 eq by 2030 to support its transition to a low-carbon future. A transition framework will also be introduced to give existing emissions-intensive trade-exposed companies (e.g. in the energy, chemicals and electronics sectors) more time to transition to a low-carbon economy.

74. Singapore provided information on its involvement in international market mechanisms as a Party to the Kyoto Protocol. As at December 2020, Singapore had six registered CDM projects. As reported in the Party's NC3 and first BUR, estimated emission reductions from these six projects amount to about 473 kt CO_2 eq annually. In its BUR, Singapore stated that domestic emission abatement remains its priority and carbon credits are only one part of its long-term low-emission development strategy.

75. Singapore reported information on its domestic MRV arrangements in accordance with decision 2/CP.17, annex III, paragraph 13. The information reported indicates that Singapore has in place a domestic MRV system for mitigation actions. Singapore reported that each government agency is responsible for monitoring, measuring and documenting the progress of implementation of the mitigation actions under its purview. The government agencies usually use relevant data collected from official surveys, while data collected from companies or building owners are verified by the relevant lead government agencies. The long-term emissions and mitigation working group referred to in paragraph 20 above consolidates the information collected by the lead agencies annually and assesses the effect of the mitigation actions so as to track Singapore's progress in meeting its mitigation targets and objectives.

76. The TTE noted that the transparency of the information reported on mitigation actions could be further enhanced by addressing the areas noted in paragraphs 63, 71 and 72 above, which could facilitate a better understanding of the information reported on mitigation actions.

4. Constraints and gaps, and related technology, financial, technical and capacity-building needs, including a description of support needed and received

77. As indicated in table I.3, Singapore reported in its BUR, partially in accordance with paragraphs 14–16 of the UNFCCC reporting guidelines on BURs, information on finance, technology and capacity-building needs and support received.

78. Singapore reported information on constraints and gaps in accordance with decision 2/CP.17, annex III, paragraph 14. In its BUR, Singapore identified its small land area, relatively flat land, high urban density, low wind speeds and lack of geothermal resources as factors that limit its potential to expand the use of alternative energy sources such as solar, nuclear and wind. Solar energy is the most viable alternative energy option, but expanding solar energy on a large scale is a major challenge owing to the limited land available. Singapore reported in its BUR on its efforts to further enhance its MRV processes and climate policies to address any gaps.

79. Information on financial, technical and capacity-building needs was not reported in Singapore's BUR and the reason was not clear to the TTE. During the technical analysis, Singapore clarified that it did not report any financial needs because it does not rely on external sources of funding for implementing national climate change policies and programmes. Singapore also clarified that it invests in innovation and technology to address its climate change adaptation and mitigation needs. Further, Singapore pursues national and international partnerships to address its technical and capacity-building needs.

80. Information on financial resources, technology transfer, capacity-building and technical support received was not reported in Singapore's BUR in accordance with decision 2/CP.17, annex III, paragraph 15. However, the Party reported in its BUR that it does not exclusively rely on external support for addressing climate change. During the technical analysis, Singapore further clarified that it does not rely on external sources of funding to implement its climate change policies and programmes. It also clarified that it pursues partnerships at the national, regional and broader international levels to leverage innovative technologies and solutions, and actively participates in various international capacity-building activities related to climate change to learn from other countries' experience.

81. Singapore did not report in its BUR information on nationally determined technology needs with regard to the development and transfer of technology in accordance with decision 2/CP.17, annex III, paragraph 16, and the reason was not clear to the TTE. However, Singapore provided information on technologies in general as part of the national circumstances section in its BUR, including an assessment of different types of renewable energy sources and their viability and some details of research and development activities on low-carbon solutions. During the technical analysis, the Party clarified that it is investing in innovation and technology to address its climate change needs, and has partnerships with a number of countries on activities aimed at implementing low-carbon solutions and technologies, including the development of standards and certification for low-carbon hydrogen systems and joint research, development and deployment activities to improve the techno-economic viability of low-carbon technologies (energy-efficient water production, hydrogen, and carbon capture, utilization and storage technologies).

82. Singapore reported in its BUR that it provides technical assistance to fellow developing countries, primarily through the Singapore Cooperation Programme, the aim of which is to support capacity-building in developing countries in relation to achieving the Sustainable Development Goals and the goals of the Paris Agreement. Since its establishment in 1992, more than 137,000 officials from over 180 countries and territories have participated. Since 2012, Singapore has been offering courses related to sustainable development and climate change, most recently the Climate Action Package launched in 2018. These courses aim to support all developing countries, in particular small island developing States and the least developed countries, in building resilience while achieving their Paris Agreement pledges. Following positive feedback, the Programme was extended until 2023. Singapore also reported in its BUR that it works with other countries and international organizations to synergize expertise and pool resources to implement capacity-building programmes in the areas of disaster resilience and enhanced NDCs. The TTE commends Singapore for reporting on these activities, which facilitated its understanding of the circumstances of Singapore with regard to support needed and provided.

83. The TTE noted that the transparency of the information reported on needs and support received could be enhanced by addressing the areas noted in paragraphs 79–81 above, which could facilitate a better understanding of the information reported on needs and support received.

84. During the technical analysis, Singapore informed the TTE of its current initiatives for enhancing its existing MRV system for compliance with requirements under the ETF, for example its plan to organize a training workshop on the transition to the ETF and the tracking of progress in implementing and achieving NDCs, in collaboration with the secretariat and the United States Environmental Protection Agency. The workshop is aimed at enhancing the capacity of the Party and fellow developing countries in the Asia-Pacific region. The outcomes of its capacity-building efforts will be reported in future submissions.

D. Identification of capacity-building needs

85. No capacity-building needs that could facilitate the preparation of subsequent BURs and participation in ICA were identified by the TTE in consultation with Singapore.

86. The TTE noted that, although no capacity-building needs were identified during the technical analysis, Singapore reported the following efforts to enhance capacity in its BUR:

(a) Enhancing capacity in relation to MRV, including by participating in training programmes organized by the secretariat, the IPCC and other expert organizations;

(b) Enhancing capacity in relation to data collection and analysis for the LULUCF sector through training for technical staff and participation in capacity-building workshops;

(c) Enhancing capacity to develop a tier 2 methodology for estimating HFC emissions;

(d) Enhancing capacity to understand discrepancies between emission estimates calculated using the reference and the sectoral approach.

III. Conclusions

87. The TTE conducted a technical analysis of the information reported in the fifth BUR of Singapore in accordance with the UNFCCC reporting guidelines on BURs and concludes that the information reported is mostly consistent. It provides an overview of national circumstances and institutional arrangements relevant to the preparation of NCs and BURs on a continuous basis; the national inventory of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol; mitigation actions and their effects, including associated methodologies and assumptions; national constraints; domestic MRV; and support provided to fellow developing countries. During the technical analysis, additional information was provided by Singapore on its institutional arrangements, GHG inventory, and mitigation actions and their effects. The TTE concluded that the information analysed is mostly transparent.

88. Singapore reported an update on the institutional arrangements relevant to the preparation of its BURs. It has established and since maintained institutional arrangements that enable sustainable preparation of its BURs. IMCCC, which was set up in 2007 and oversees 'whole of government' coordination in the area of climate change policies, is responsible for approving NCs and BURs. NCCS was established in 2010 under the Prime Minister's Office and serves as the secretariat to IMCCC, coordinating Singapore's domestic and international policies, plans and actions on climate change. The Party also reported information on its existing domestic MRV arrangements covering the preparation of reports, GHG inventory compilation and monitoring of mitigation actions.

89. In its fifth BUR, submitted in 2022, Singapore reported information on its national GHG inventory for 2018. This included GHG emissions and removals of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3 for all relevant sources and sinks. The inventory was developed on the basis of the 2006 IPCC Guidelines. The total GHG emissions for 2018 were reported as 53,201.07 Gg CO_2 eq (excluding land, HWP and other emissions) and 53,312.68 Gg CO_2 eq (including land, HWP and other emissions). A total of 15 key categories were identified in the level assessment, the most significant being the combustion of natural gas for electricity and heat generation (CO_2), accounting for 32.2 per cent of the total national GHG emissions. The Party also identified 13 key categories in the trend assessment, with the

strongest trends being a decrease in emissions from fuel oil combustion for electricity and heat generation (40.2 per cent) and an increase in emissions from natural gas combustion for electricity and heat generation (23.2 per cent). Estimates of precursor gases were not included in the BUR and CO_2 emissions from fuel combustion were reported using only the sectoral approach.

90. Singapore reported information on mitigation actions and their effects in both tabular and narrative format in the context of its national emission reduction targets for 2020 and 2030. Singapore reported nine ongoing and six completed mitigation actions in the energy and waste sectors, including one cross-sectoral measure. The mitigation actions in the energy sector focus on shifting to cleaner energy sources, promoting energy efficiency in industry, 'greening' buildings, reducing transport emissions and improving the energy efficiency of households, while the mitigation actions in the waste sector focus on incinerating wastewater sludge and increasing the recycling rate. Singapore reported on its carbon tax as a cross-sectoral measure. The Party reported the progress of implementation of its mitigation actions and the results achieved, including estimated emission abatement. The highest emission reduction, 4.38 Mt CO_2 eq in 2020, was reported for a mitigation action in the energy sector (power generation) on switching away from fuel oil. The Party also reported information on its involvement in international market mechanisms and on MRV arrangements.

91. Singapore reported information on key constraints with regard to harnessing alternative energy sources such as hydroelectric, wind and geothermal power. Competing uses of land greatly limit Singapore's potential to expand the use of solar energy, its most viable alternative energy option, on a large scale. Singapore reported its efforts to further enhance its MRV processes and climate policies to address any gaps, but did not report on any financial, technical or technology transfer needs or capacity-building support received. The Party reported in its BUR that it does not rely exclusively on external sources for financial, technical, technological or capacity-building support to address climate change. Information on nationally determined technology needs was not reported in the BUR. Instead, Singapore reported on its ongoing efforts to promote the use of alternative energy sources and emerging low-carbon solutions and move towards a low-carbon, climate-resilient future through international partnerships and cooperation. In addition, it reported information on its provision of support to fellow developing countries through various programmes and initiatives.

92. The current TTE noted improvements in the reporting in the Party's fifth BUR compared with that in its fourth BUR. The information reported demonstrates that the Party has taken into consideration the areas for enhancing the transparency of the information reported noted by the TTE in the summary report on the technical analysis of the fourth BUR. However, improvements are ongoing, and the Party has taken note of outstanding areas for future improvements.

93. The TTE, in consultation with Singapore, did not identify any capacity-building needs that aim to facilitate reporting in accordance with the UNFCCC reporting guidelines on BURs and participation in ICA in accordance with the ICA modalities and guidelines, taking into account Article 4, paragraph 3, of the Convention. The TTE noted that, although no capacity-building needs were identified during the technical analysis, Singapore reported in its BUR on its ongoing efforts to enhance its capacity, as noted in paragraph 86 above.

Annex I

Extent of the information reported by Singapore in its fifth biennial update report

Table I.1
Identification of the extent to which the elements of information on greenhouse gases are included in the fifth biennial update report of Singapore

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
Decision 2/CP.17, paragraph 41(g)	The first BUR shall cover, at a minimum, the inventory for the calendar year no more than four years prior to the date of the submission, or more recent years if information is available, and subsequent BURs shall cover a calendar year that does not precede the submission date by more than four years.	Yes	Singapore submitted its fifth BUR in November 2022; the GHG inventory reported is for 2018.
Decision 2/CP.17, annex III, paragraph 4	Non-Annex I Parties should use the methodologies established in the latest UNFCCC guidelines for the preparation of NCs from non-Annex I Parties approved by the Conference of the Parties or those determined by any future decision of the Conference of the Parties on this matter.	Yes	Singapore used the 2006 IPCC Guidelines for all categories, including the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*.
Decision 2/CP.17, annex III, paragraph 5	The updates of the section on national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol should contain updated data on activity levels based on the best information available using the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF; any change to the EF may be made in the subsequent full NC.	Yes	
Decision 2/CP.17, annex III, paragraph 6	Non-Annex I Parties are encouraged to include, as appropriate and to the extent that capacities permit, in the inventory section of the BUR:		
	(a) The tables included in annex 3A.2 to the IPCC good practice guidance for LULUCF;	Yes	Comparable information was reported in the BUR (pp.164–179).
	(b) The sectoral report tables annexed to the Revised 1996 IPCC Guidelines.	Yes	Comparable information was reported in the BUR (pp.74–91).
Decision 2/CP.17, annex III, paragraph 7	Each non-Annex I Party is encouraged to provide a consistent time series back to the years reported in its previous NCs.	Yes	
Decision 2/CP.17, annex III, paragraph 8	Non-Annex I Parties that have previously reported on their national GHG inventories contained in their NCs are encouraged to submit summary information tables of inventories for previous submission years (e.g. for 1994 and 2000).	Yes	This information was reported for 1994, 2000, 2010, 2012, 2014 and 2016.
Decision 2/CP.17, annex III, paragraph 9	The inventory section of the BUR should consist of a national inventory report as a summary or as an update of the information contained in decision 17/CP.8, annex, chapter III (National greenhouse gas inventories), including:	Yes	

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
	(a) Table 1 (National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors);	Yes	Comparable information was reported in the BUR (pp.128–129).
	(b) Table 2 (National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF_6).	Yes	Comparable information was reported in the BUR (pp.130–131).
Decision 2/CP.17, annex III, paragraph 10	Additional or supporting information, including sector-specific information, may be supplied in a technical annex.	Yes	The Party provided GHG inventory tables for 2018 and GHG inventory summary tables for 1994, 2000, 2010, 2012, 2014 and 2016 in the annex to its BUR.
Decision 17/CP.8, annex, paragraph 12	Non-Annex I Parties are also encouraged, to the extent possible, to undertake any key source analysis as indicated in the IPCC good practice guidance to assist in developing inventories that better reflect their national circumstances.	Yes	
Decision 17/CP.8, annex, paragraph 13	Non-Annex I Parties are encouraged to describe procedures and arrangements undertaken to collect and archive data for the preparation of national GHG inventories, as well as efforts to make this a continuous process, including information on the role of the institutions involved.	Yes	
Decision 17/CP.8, annex, paragraph 14	Each non-Annex I Party shall, as appropriate and to the extent possible, provide in its national inventory, on a gas-by-gas basis and in units of mass, estimates of anthropogenic emissions of:		
	(a) CO_2;	Yes	
	(b) CH_4;	Partly	The Party reported CH_4 emissions for category 4.D (wastewater treatment and discharge) as “NE”.
	(c) N_2O.	Yes	
Decision 17/CP.8, annex, paragraph 15	Non-Annex I Parties are encouraged, as appropriate, to provide information on anthropogenic emissions by sources of:	Yes	
	(a) HFCs;	Yes	
	(b) PFCs;	Yes	
	(c) SF_6.	Yes	
Decision 17/CP.8, annex, paragraph 16	Non-Annex I Parties are encouraged, as appropriate, to report on anthropogenic emissions by sources of other GHGs, such as:		
	(a) CO;	No	
	(b) NO_X;	No	
	(c) NMVOCs.	No	
Decision 17/CP.8, annex, paragraph 17	Other gases not controlled by the Montreal Protocol, such as sulfur oxides, and included in the Revised 1996 IPCC Guidelines may be included at the discretion of Parties.	Yes	The Party reported NF_3 emissions.

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
Decision 17/CP.8, annex, paragraph 18	Non-Annex I Parties are encouraged, to the extent possible, and if disaggregated data are available, to estimate and report CO_2 fuel combustion emissions using both the sectoral and the reference approach and to explain any large differences between the two approaches.	No	The information was reported only for the sectoral approach.
Decision 17/CP.8, annex, paragraph 19	Non-Annex I Parties should, to the extent possible, and if disaggregated data are available, report emissions from international aviation and marine bunker fuels separately in their inventories:		
	(a) International aviation;	Yes	
	(b) Marine bunker fuels.	Yes	
Decision 17/CP.8, annex, paragraph 20	Non-Annex I Parties wishing to report on aggregated GHG emissions and removals expressed in CO_2 eq should use the GWP provided by the IPCC in its AR2 based on the effects of GHGs over a 100-year time-horizon.	NA	The Party used the GWP values provided in the AR5.
Decision 17/CP.8, annex, paragraph 21	Non-Annex I Parties are encouraged to provide information on methodologies used in the estimation of anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol, including a brief explanation of the sources of EFs and AD. If non-Annex I Parties estimate anthropogenic emissions and removals from country-specific sources and/or sinks that are not part of the Revised 1996 IPCC Guidelines, they should explicitly describe the source and/or sink categories, methodologies, EFs and AD used in their estimation of emissions, as appropriate. Parties are encouraged to identify areas where data may be further improved in future communications through capacity-building:		
	(a) Information on methodologies used in the estimation of anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol;	Yes	A combination of tier 1, 2 and 3 methodologies was used.
	(b) Explanation of the sources of EFs;	Yes	
	(c) Explanation of the sources of AD;	Yes	
	(d) If non-Annex I Parties estimate anthropogenic emissions and removals from country-specific sources and/or sinks that are not part of the Revised 1996 IPCC Guidelines, they should explicitly describe:	No	The Party reported information on category 3.D (other – reclamation of land from the sea) but did not explicitly describe the sources and sinks covered by this category, or any information on methodologies, AD and EFs.
	(i) Source and/or sink categories;		
	(ii) Methodologies;		
	(iii) EFs;		
	(iv) AD;		
	(e) Parties are encouraged to identify areas where data may be further improved in future communications through capacity-building.	Yes	The Party reported that it is continuously improving its LULUCF data collection and analysis processes, developing a

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
			tier 2 fluorinated gas model and conducting an ongoing study to build capacity to use the reference approach (BUR p.61).
Decision 17/CP.8, annex, paragraph 22	Each non-Annex I Party is encouraged to use tables 1–2 of the guidelines annexed to decision 17/CP.8 in reporting its national GHG inventory, taking into account the provisions established in paragraphs 14–17. In preparing those tables, Parties should strive to present information that is as complete as possible. Where numerical data are not provided, Parties should use the notation keys as indicated.	Partly	The cells for CO, NO_X and NMVOC emissions in the AFOLU sectoral table were not shaded and did not include numerical data or a notation key.
Decision 17/CP.8, annex, paragraph 24	Non-Annex I Parties are encouraged to provide information on the level of uncertainty associated with inventory data and their underlying assumptions, and to describe the methodologies used, if any, for estimating these uncertainties:		
	(a) Level of uncertainty associated with inventory data;	Yes	
	(b) Underlying assumptions;	Yes	
	(c) Methodologies used, if any, for estimating these uncertainties.	Yes	

Note: The parts of the UNFCCC reporting guidelines on BURs on reporting information on GHG emissions by sources and removals by sinks in BURs are contained in decision 2/CP.17, paras. 3–10 and 41(g). Further, as per para. 3 of those guidelines, non-Annex I Parties are to submit updates of their national GHG inventories in accordance with paras. 8–24 of the UNFCCC guidelines for the preparation of NCs from non-Annex I Parties, contained in the annex to decision 17/CP.8. The scope of such updates should be consistent with the non-Annex I Party's capacity and time constraints and the availability of its data, as well as the level of support provided by developed country Parties for biennial update reporting.

Table I.2
Identification of the extent to which the elements of information on mitigation actions are included in the fifth biennial update report of Singapore

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
Decision 2/CP.17, annex III, paragraph 11	Non-Annex I Parties should provide information, in tabular format, on actions to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol.	Yes	
Decision 2/CP.17, annex III, paragraph 12	For each mitigation action or group of mitigation actions, including, as appropriate, those listed in document FCCC/AWGLCA/2011/INF.1, developing country Parties shall provide the following information, to the extent possible:		
	(a) Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators;	Yes	

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
	(b) Information on:		
	(i) Methodologies;	Yes	
	(ii) Assumptions;	Yes	
	(c) Information on:		
	(i) Objectives of the action;	Yes	
	(ii) Steps taken or envisaged to achieve that action;	Yes	
	(d) Information on:		
	(i) Progress of implementation of the mitigation actions;	Yes	
	(ii) Progress of implementation of the underlying steps taken or envisaged;	Yes	
	(iii) Results achieved, such as estimated outcomes (metrics depending on type of action) and estimated emission reductions, to the extent possible;	Yes	
	(e) Information on international market mechanisms.	Yes	
Decision 2/CP.17, annex III, paragraph 13	Parties should provide information on domestic MRV arrangements.	Yes	

Note: The parts of the UNFCCC reporting guidelines on BURs on the reporting of information on mitigation actions in BURs are contained in decision 2/CP.17, annex III, paras. 11–13.

Table I.3
Identification of the extent to which the elements of information on finance, technology and capacity-building needs and support received are included in the fifth biennial update report of Singapore

Decision	*Provision of the reporting requirements*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
Decision /CP.17, annex III, paragraph 14	Non-Annex I Parties should provide updated information on:		
	(a) Constraints and gaps;	Yes	
	(b) Related financial, technical and capacity-building needs.	No	Information on financial, technical and capacity-building needs was not reported.
Decision /CP.17, annex III, paragraph 15	Non-Annex I Parties should provide:		
	(a) Information on financial resources, technology transfer and capacity-building received from the Global Environment Facility, Parties included in Annex II to the Convention and other developed country Parties, the Green Climate Fund and multilateral institutions for activities relating to climate change, including for the preparation of the current BUR;	No	
	(b) Information on technical support received from the Global Environment Facility, Parties included in Annex II to the Convention and other developed country Parties, the Green Climate Fund and multilateral institutions for activities relating to	No	

Decision	*Provision of the reporting requirements*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
	climate change, including for the preparation of the current BUR.		
Decision /CP.17, annex III, paragraph 16	With regard to the development and transfer of technology, non-Annex I Parties should provide information on:		
	(a) Nationally determined technology needs;	No	
	(b) Technology support received.	No	

Note: The parts of the UNFCCC reporting guidelines on BURs on the reporting of information on finance, technology and capacity-building needs and support received in BURs are contained in decision 2/CP.17, annex III, paras. 14–16.

Annex II

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. JL Houghton, LG Meira Filho, B Lim, et al. (eds.). Paris: IPCC/Organisation for Economic Co-operation and Development/International Energy Agency. Available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

IPCC. 2000. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. J Penman, D Kruger, I Galbally, et al. (eds.). Hayama, Japan: IPCC/Organisation for Economic Co-operation and Development/International Energy Agency/Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/gp/english/.

IPCC. 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. J Penman, M Gytarsky, T Hiraishi, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html.

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl.

IPCC. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc-nggip.iges.or.jp/public/wetlands/.

B. UNFCCC documents

First, second, third, fourth and fifth BURs of Singapore. Available at https://unfccc.int/BURs.

NC1, NC2, NC3, NC4 and NC5 of Singapore. Available at https://unfccc.int/non-annex-I-NCs.

Summary reports on the technical analysis of the first, second, third and fourth BURs of Singapore, contained in documents FCCC/SBI/ICA/2015/TASR.1/SGP, FCCC/SBI/ICA/2017/TASR.2/SGP, FCCC/SBI/ICA/2019/TASR.3/SGP and FCCC/SBI/ICA/2021/TASR.4/SGP respectively. Available at https://unfccc.int/ICA-reports.