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Technical analysis of the fourth biennial update report of Singapore submitted on 27 December 2020

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 fourth 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
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
EF	emission factor
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
HWP	harvested wood products
ICA	international consultation and analysis
IMCCC	Inter-Ministerial 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
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 third BUR on 27 December 2018, which was analysed by a TTE in the thirteenth round of technical analysis of BURs from non-Annex I Parties, conducted from 27 to 31 May 2019. After the publication of its summary report, Singapore participated in the ninth workshop for the facilitative sharing of views, convened virtually from 24 to 27 November 2020.

5. This summary report presents the results of the technical analysis of the fourth 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 fourth BUR on 27 December 2020 as a stand-alone update report. The submission was made within two years from the submission of the third BUR.

7. A desk analysis of Singapore's BUR was conducted remotely from 8 to 12 March 2021 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: Hoy Yen Chan (Malaysia), Thiago de Araújo Mendes (former member of the Consultative Group of Experts from Brazil), Excellent Hachileka (Zambia), Eduardas Kazakevicius (Lithuania), Rhianna Murphy (former member of the Consultative Group of Experts from the Bahamas), Asaye Ketema Sekie (Ethiopia), Valentyna Slivinska (Ukraine) and Sirinthornthep Towprayoon (Thailand). Mr. Kazakevicius and Mr. de Araújo Mendes were the co-leads. The technical analysis was coordinated by Jeonghyun Emily Park (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 fourth BUR, the TTE prepared and shared a draft summary report with Singapore on 25 May 2021 for its review and comment. Singapore, in turn, provided its feedback on the draft summary report on 2 July 2021.

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 19 October 2021.

[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 annex I.

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

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 fourth BUR, Singapore provided an update on its national circumstances, including a description of national development priorities, objectives and circumstances, including features of geography, demographics, climate and economy that might affect the Party's ability to deal with mitigating and adapting to climate change, as well as information regarding national circumstances and constraints on the 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, Article 4, paragraphs 9–10, of the Convention.

20. Singapore transparently reported in its fourth BUR information 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 the roles and responsibilities of the overall coordinating entity, the involvement and roles of other institutions, mechanisms for information and data exchange, and QA/QC procedures for the GHG inventory.

21. Singapore reported that the IMCCC was established in 2007 and oversees whole-of-government coordination in relation to climate change policies. The IMCCC is chaired by the Senior Minister and Coordinating Minister for National Security and includes the Minister for Sustainability and the Environment, the Minister for Finance, the Minister for Foreign Affairs, the Minister for National Development, the Minister for Trade and Industry and the Minister for Transport. The NCCS was established in 2010 under the Prime Minister's Office and serves as the secretariat to the IMCCC. The NCCS supports the Prime Minister and his Cabinet in establishing priorities and strengthening strategic alignment across the Government in relation to climate change. Singapore reported that the positioning of the NCCS under the Prime Minister's Office reflects the importance that the Party places on climate change.

22. In its fourth BUR, Singapore reported that it was conducting a review of its institutional arrangements. During the technical analysis, the Party provided an update on the review and explained that the scope of the IMCCC has been expanded to cover five working groups to address long-term emissions and mitigation, resilience, sustainability, green economy, and communications and engagement. The Party clarified that the expanded scope of the IMCCC reflects Singapore's holistic approach to addressing the global climate crisis and serves to enhance its whole-of-government response to climate change across multiple domains. The Party indicated that it will report information on the expanded IMCCC in its next BUR.

23. Singapore reported in its fourth BUR information on its domestic MRV arrangements. The MRV arrangements are designed at the national level and cover three main areas: preparing NCs and BURs; compiling the GHG inventory; and monitoring, measuring and documenting the progress of mitigation actions. The MRV Task Force under the Long-Term Emissions and Mitigation Working Group of the IMCCC coordinates inter-agency efforts related to MRV, such as preparing NCs and BURs, which is carried out by an inter-agency working group, and preparing relevant authorities for engaging in the ICA process. The NCs and BURs are subject to approval by the IMCCC. In its BUR, the Party reported that it participates in technical workshops and consults the UNFCCC secretariat, think tanks, academia and international organizations with a view to further enhancing its MRV processes.

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

24. 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.

25. Singapore submitted its fourth BUR in 2020 and the GHG inventory reported is for 2016. The GHG inventory is consistent with the requirements for the reporting time frame.

26. GHG emissions and removals for the BUR covering the 2016 inventory were estimated using methodologies from the 2006 IPCC Guidelines for all reported categories. Tier 1 methods were used for most categories, but higher-tier methods were used where data were available. In particular, tier 2 or 3 approaches 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. The TTE commends the Party for using the most recent IPCC guidelines.

27. Information on AD and EFs used and their sources was reported in the BUR. Singapore summarized its data sources for each sector in tabular format, including information on data owners, in the BUR (p.57). The Party reported that it used country- or plant-specific EFs for some categories for which tier 2 or 3 approaches were used, and clearly summarized the EFs used for each category in the BUR (pp.27–31).

28. Information on the Party's total GHG emissions by gas for 2016 is outlined in table 1 in Gg CO_2 eq. It shows an increase in emissions of 80.3 per cent including land, HWP and other emissions and 80.7 per cent excluding land, HWP and other emissions since 1994. The TTE commends the Party for providing emission estimates for NF_3 in the BUR.

Table 1
Greenhouse gas emissions by gas of Singapore for 2016

Gas	*GHG emissions (Gg CO_2 eq) including land, HWP and other emissions*[a]	*% change 1994–2016*	*GHG emissions (Gg CO_2 eq) excluding land, HWP and other emissions*[a]	*% change 1994–2016*
CO_2	48 263.33	74.5	48 251.38	74.9
CH_4	100.38	–22.2	100.38	–22.2
N_2O	320.01	63.1	314.83	69.9
HFCs	469.13	8 507.9	469.13	8 507.9
PFCs	1 235.41	937.0	1 235.41	937.0
SF_6	93.94	959.1	93.94	959.1
Other (NF_3)	220.51	40 735.2	220.51	40 735.2
Total	**50 702.71**	**80.3**	**50 685.58**	**80.7**

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

29. 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 provided clarification in its BUR, noting that CO, NO_X, NMVOCs and sulfur dioxide are considered air pollutants and emissions of those gases are currently monitored by a network of ambient air quality monitoring stations in Singapore. The Party reported that 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 and air quality monitoring ensure that the emission levels of these precursor gases are kept as low as possible in the country.

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

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, HWP and other emissions (categories 3.B and 3.D), as reported by the Party, in 2016 are reflected in table 2.

Table 2
Shares of greenhouse gas emissions by sector of Singapore for 2016

Sector	*GHG emissions (Gg CO_2 eq)*	*% share*[a]	*% change 1994–2016*
Energy	48 046.82	94.8	73.5
IPPU	2 291.98	4.5	1 402.5
AFOLU	17.12	0.0	–76.1
Livestock (category 3.A)	NE	NA	NA
Land (category 3.B)	15.77	NA	NA
Aggregate sources and non-CO_2 emissions sources on land (category 3.C)	NE	NA	NA
HWP and other emissions (category 3.D)	1.36	NA	NA
Waste	346.78	0.7	77.6

[a] Share of total without 2006 IPCC Guidelines AFOLU categories 3.B (land) and 3.D (HWP (3.D.1) and other emissions (3.D.2)).

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 tier 1 approach was used for all categories in the energy sector with the exception of category 1.B.2 (oil and natural gas), for which a combination of tier 2 and 3 approaches was used to estimate fugitive emissions. The key category analysis identified fuel combustion activities in the energy sector as the primary source of Singapore's GHG emissions in terms of both level and trend.

35. For the IPPU sector, information was clearly reported on GHG emissions for all source categories except category 2.A (mineral industry), which was reported as "NO". The Party used a combination of tier 1, 2 and 3 methodologies from the 2006 IPCC Guidelines to estimate emissions for this sector. It used the tier 1 approach and default EFs for category 2.D (non-energy products from fuels and solvent use), while higher-tier methods with plant-specific EFs were used for the other IPPU categories reported by the Party. Electronics industry was reported as the sector's largest source of GHG emissions (accounting for 71.7 per cent of total IPPU emissions), followed by product uses as substitutes for ozone-depleting substances (17.3 per cent of total IPPU emissions). Both were identified as key categories in the level assessment.

36. Singapore reported emissions for category 3.A (livestock) under the AFOLU sector from the 2006 IPCC Guidelines as "NE" and explained in the BUR that GHG emissions from agriculture in Singapore are considered negligible compared with those from with other sectors. In its BUR, the Party also clarified that it is conducting a study on GHG emissions from the agriculture sector using both tier 1 and tier 2 methodologies and plans to update the GHG inventory in the light of the results for its next BUR. For category 3.C (aggregate sources and non-CO_2 emissions sources on land), the Party reported net CO_2 and N_2O emissions as "NE" and CH_4 emissions as "NO".

37. Information on the notation keys used for category 3.A was not clearly reported for some subcategories. The Party reported emissions from dairy cows as "NE", whereas emissions from other cattle were reported as "NO". It was not clear to the TTE why the Party used "NO" for other cattle. During the technical analysis, the Party clarified that cattle in Singapore are reared exclusively for milk production and the population falling under the other categories of cattle (male cattle, calves pre-weaning, replacement dairy heifers and

growing cattle post-weaning) is small. The Party also clarified that it did not prioritize calculating emissions for these subcategories, which are not a major source of emissions compared with other sectors. Singapore indicated that it will consider providing updated information on the notation keys reported for category 3.A in its next BUR.

38. Information on methodologies, EFs and notation keys was not clearly reported in the BUR for some subcategories under category 3.C (aggregate sources and non-CO_2 emissions sources on land). Singapore reported in its BUR (p.30) that it used the tier 3 approach and country-specific EFs to estimate direct and indirect N_2O emissions from managed soils, but N_2O emissions were reported as "NE" for these subcategories in the BUR (p.121). During the technical analysis, the Party clarified that the information on page 121 of the BUR is more accurate and the methodologies and EFs reported on page 30 for these subcategories should be corrected to "NE".

39. Disaggregated information on the source categories in the AFOLU sector was not clearly reported in the BUR for 1994, 2000, 2010, 2012 or 2014. Although the Party used the 2006 IPCC Guidelines for all years reported, emissions from the AFOLU sector were reported separately for the agriculture and LULUCF categories for those years and comparable information on category 3.C (aggregate sources and non-CO_2 emissions sources on land) was not reported clearly. During the technical analysis, the Party clarified that it reported emissions for this category as "NO" and "NE" for 2016 and therefore considered that there was no need to report information on this category in summary tables for the preceding years. In addition, the Party reported net CO_2 emissions from the agriculture sector as "NE" for 1994–2014 but did not clearly explain the reason for this in the BUR. During the technical analysis, the Party clarified that agriculture in the country includes a limited amount of vegetable farming, which involves the application of lime and fertilizer, and the corresponding emissions were reported as "NE".

40. Singapore reported annual GHG emissions and removals for 2016 for categories 3.B (land) and 3.D (HWP and other emissions) under the AFOLU sector. Total net emissions for both categories were reported as 17.12 Gg CO_2 eq for 2016. The Party used a combination of tier 1 and 3 approaches to estimate emissions for category 3.B and used the tier 3 approach for category 3.D. The Party provided a detailed sectoral reporting table for these categories in the BUR (pp.118–125).

41. 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: the Party reported the total land area of Singapore (including smaller islands) as 728 km^2 (equivalent to 72,800 ha) (on p.10) but the total land area used in estimating emissions and removals for category 3.B (land) as 71,970 ha (on p.122). During the technical analysis, the Party clarified that the total reported land area of Singapore is based on updated data from 2020, whereas the information reported under category 3.B relates to data from 2016, which are based on satellite imagery acquired for the reporting year. The Party confirmed that there was no underestimation of emissions and that the entire land area was included to produce the estimates for the reporting year.

42. Information on methodologies, EFs and notation keys used for subcategory 3.B.4 (wetlands) was not clearly reported in the BUR: the Party reported using the tier 1 methodology with default EFs from the 2006 IPCC Guidelines to estimate N_2O emissions from wetlands (on p.30) but reported N_2O emissions as "NO" for this subcategory (on pp.44 and 120). During the technical analysis, the Party clarified that it used the tier 1 approach to calculate emissions and removals for subcategory 3.B.4.b (land converted to wetlands) on the basis of the original land use, but the result was nonetheless "NO". In addition, although net CO_2 emissions were reported as "NO" for subcategory 3.B.4.a (wetlands remaining wetlands), the total area of wetlands in Singapore was reported as 3,911 ha in the BUR (p.124). During the technical analysis, the Party clarified that, in the national context, wetlands refers to reservoirs and water catchment areas considered to be flooded land. It also clarified that the reported area of 3,911 ha is accounted for under subcategories 3.B.4.a.ii (flooded land remaining flooded land) and 3.B.4.b.ii (land converted to flooded land). The Party indicated that it will consider including the AFOLU background table under subcategory 3.B.4 (wetlands) in future BURs.

43. The Party included a country-specific subcategory (other (sea)) under categories 3.B (land) and 3.D (HWP and other emissions), but did not report in the BUR information on the sources and sinks covered by this subcategory. Moreover, it was not clear to the TTE why similar information on this subcategory was reported under categories 3.B and 3.D. During the technical analysis, the Party clarified that the subcategory refers to sea areas that are not reported under other subcategories under category 3.B and is used to report emissions and removals from activities related to land reclamation projects. The Party also clarified that under category 3.B emissions and removals were reported for land-use changes from other (sea) to forest land, cropland and settlements, whereas under category 3.D emissions and removals were reported for land-use changes from forest land, cropland and settlements to other (sea).

44. For the waste sector, information was reported on CO_2, CH_4 and N_2O emissions for categories 4.A (solid waste disposal), 4.C (incineration and open burning of waste) and 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". The tier 2 approach was used to estimate CH_4 emissions from solid waste disposal and CO_2 emissions from incineration of solid waste, while the tier 1 approach was used for the rest of category 4.C. CO_2, CH_4 and N_2O emissions from incineration of solid waste and sludge were reported under category 1.A.1 (energy industries) in accordance with the 2006 IPCC Guidelines. The waste sector accounts for less than 1 per cent of Singapore's national GHG emissions and is not a key category in terms of either level or trend. The Party reported in its BUR that CH_4 emissions from sewage sludge have been significantly reduced by incinerating the sludge.

45. Disaggregated information on the source categories for CH_4 emissions from solid waste disposal (category 4.A) was not clearly reported in Singapore's BUR. During the technical analysis, the Party clarified that CH_4 emissions from waste disposal on land are due to treated sludge being applied on reclaimed land sites as a soil conditioner in 1985–2008 (see BUR p.45), which resulted in residual CH_4 emissions due to the anaerobic decay of organic content in sludge at these sites. Since 2009, the incineration of sludge has led to a significant reduction in direct CH_4 emissions from sewage sludge. The Party indicated that it will consider including a detailed sectoral reporting table for the waste sector in future BURs.

46. Information on methodologies used to estimate N_2O emissions for category 4.D (wastewater treatment and discharge) was not clearly reported in the BUR: Singapore reported estimated N_2O emissions of 66.95 Gg CO_2 eq for category 4.D for 2016 (on p.48) but reported the methodology for estimating N_2O emissions for this category as "NA" (on p.31). During the technical analysis, the Party clarified that the 2006 IPCC Guidelines do not provide higher-tier methods and suggest estimating N_2O emissions from domestic wastewater effluent using the methodology provided in the Guidelines (vol. 5, chap. 6, p.24). Singapore clarified that it followed this guidance but reported the methodology as "NA" in the BUR (p.31) as no specific tier is assigned to this approach. In its BUR, the Party also reported that it estimated N_2O emissions from human sewage using annual per capita protein intake data from the Food and Agriculture Organization of the United Nations. The Party indicated that it will update the tier methodology, as noted by the TTE, for estimating N_2O emissions for this category in future BURs.

47. The BUR provides an update to all GHG inventories reported in the Party's previous NCs and BURs. The update was carried out for 1994–2014 using the methodologies contained in the 2006 IPCC Guidelines, thus generating a consistent 22-year time series for 1994–2016. The Party reported that it recalculated emissions from all sectors to reflect its transition to using the 2006 IPCC Guidelines, to move from using the GWP values from the AR2 to those from the AR5, and to include estimates of NF_3 emissions. The Party also reported that IPCC splicing methodologies were applied in making the recalculations for the earlier years of the time series. The Party reported that the recalculations reduced emission estimates by 1–2 per cent for recent years. For 2014, the Party reported a decrease of 1.9 per cent compared with the total net emissions reported in its NC4 and third BUR.

48. Singapore described in its BUR the institutional framework for the preparation of its 2016 GHG inventory. The Party reported that the National Environment Agency coordinates multi-agency efforts to prepare the GHG inventory. It also reported that its GHG inventory preparation process follows four steps: data collection and compilation by various

government agencies, QC checks by the National Environment Agency, QA checks by an independent team and finally review and endorsement by the MRV Task Force of the IMCCC. The Party further reported that it has developed an emission data monitoring and analysis system to facilitate data collection and archiving throughout the process of preparing the GHG inventory. The system serves various functions, including receiving input and AD from different data sources, generating emission estimates and storing and archiving all data used.

49. 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 13 key categories, 10 of which relate to fuel combustion activities (see the table on p.49 of the BUR). According to the assessment, CO_2 emissions from the combustion of natural gas for electricity and heat generation is the main contributor to total emissions for 2016 (34.2 per cent of total GHG emissions). The trend assessment identified 10 key categories (see the table on p.50 of the BUR). The strongest trend is the decrease in emissions from fuel oil combustion for electricity and heat generation (41.0 per cent), followed by the increase in emissions from natural gas combustion for electricity and heat generation (25.5 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.

50. The BUR provides information on QA/QC measures for all sectors, as described in paragraph 48 above, including a summary of QA/QC activities in the areas of data collection and compilation and emission calculations. The TTE commends Singapore for providing information in accordance with the IPCC good practice guidance.

51. Singapore reported information on CO_2 fuel combustion using only the sectoral approach. In its BUR, the Party clarified that its trade data show high volatility as it is a global trading hub with a high ratio of trade to gross domestic product, reflective of large and varying trade volumes coupled with the presence of a large refining and petrochemical sector. The Party recognizes that this data volatility results in large discrepancies between emission estimates calculated using the sectoral and the reference approach. The Party considers that the sectoral approach allows for greater accuracy in calculating emissions in its national context. The Party reported that it is conducting a study to gain a better understanding of the discrepancies between the two approaches and intends to include the results in future BURs.

52. Information was clearly reported on international aviation and marine bunker fuels. For 2016, emissions from international aviation and marine bunkers were estimated as 15,524.46 and 156,418.03 Gg CO_2 eq, respectively.

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

54. 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. However, in its BUR, the Party clarified that it is making efforts to quantitatively estimate the uncertainty of the GHG inventory and will include the results in future BURs when they are available.

55. The TTE noted that the transparency of the information reported on GHG inventories could be further enhanced by addressing the areas noted in paragraphs 37, 38, 39, 41, 42, 43, 45, 46 and 54 above, which could facilitate a better understanding of the information reported on GHG inventories.

56. In paragraphs 27, 31, 34 and 38 of the summary report on the technical analysis of Singapore's third BUR, the previous TTE noted areas where the transparency of the reporting on GHG inventories could be further enhanced by reporting information on sources of EFs for all source categories, disaggregated data on the source categories in the LULUCF sector

and methodological tiers and EFs used for the IPPU sector, in addition to providing a consistent time series for all source categories. The current TTE noted the improvements referred to in paragraphs 27, 35, 40 and 47 above and commends the Party for enhancing the transparency of its reporting.

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

57. 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.

58. The information reported provides a clear and comprehensive overview of the Party's mitigation actions and their effects. In its BUR, the Party reported information on its national context and framed its national mitigation planning and actions in the context of its mitigation targets for 2020 and 2030. For 2020, Singapore had pledged to reduce its GHG emissions by 16 per cent below the 'business as usual' level for that year. The Party also referenced its updated NDC, which was submitted on 31 March 2020 under the Paris Agreement and includes the aim for national GHG emissions to peak at 65 Mt CO_2 eq around 2030. Singapore reported that its estimated total annual emission reduction for 2018 is 8.20 Mt CO_2 eq below the 'business as usual' level for that year (see BUR table 1-6) and confirmed that it is on track to meet its 2020 target.

59. Most of the Party's mitigation actions are in the energy sector. Singapore reported that energy is a strategic resource for the Party as it relies on importing oil and gas to meet its energy needs. In its BUR, the Party reported that since the early 2000s it has taken steps to switch from fuel oil to natural gas for electricity generation. To further reduce emissions, Singapore will harness the "four switches": natural gas, solar energy, regional power grids and emerging low-carbon solutions. Singapore also reported that improving energy efficiency is one of its key mitigation strategies given the limited options for alternative energy sources in the light of its national circumstances.

60. The Party reported a summary of its mitigation actions in tabular format in accordance with decision 2/CP.17, annex III, paragraph 11. All 15 mitigation actions, including carbon tax, are summarized in the BUR (tables 1–7). The Party also reported information on its mitigation actions in narrative format.

61. Consistently with decision 2/CP.17, annex III, paragraph 12(a), Singapore reported the names and descriptions of its mitigation actions as well as on coverage (sector and gases) and progress indicators in the BUR (tables 1–7). For all mitigation actions, apart from the carbon tax, quantitative goals for 2020 were reported in Mt CO_2 eq.

62. Across all sectors, it was not clear to the TTE whether the quantitative goals reported in the BUR refer to the annual GHG emissions avoided in 2020 or to accumulative emission reductions over a certain period. During the technical analysis, the Party clarified that the targets refer to the annual GHG emission reduction to be achieved in 2020.

63. For all mitigation actions, Singapore reported information on methodologies and assumptions, the objectives of the actions, steps taken or envisaged to achieve those actions, progress of implementation (completed or ongoing) and the results achieved.

64. Across all sectors, it was not clear to the TTE whether the information reported on results achieved refers to annual GHG emissions avoided in 2018 or to accumulative emission reductions over a certain period. During the technical analysis, the Party clarified that the information reported refers to the annual GHG emission reduction achieved in 2018.

65. Singapore reported 12 mitigation actions for the energy sector, divided into five groups: shifting to cleaner energy sources; improving energy efficiency in industry and promoting use of cleaner fuels; greening buildings; shifting travel demand to low-emission modes and reducing vehicular emissions; and improving energy performance standards of household appliances and encouraging households to increase energy efficiency.

66. The first group of mitigation actions in the energy sector refers to energy transition and consists of two mitigation actions: switching the fuel mix from fuel oil towards natural

gas for power generation, and installing solar photovoltaics. The Party reported that the first mitigation action has already been completed and increased the share of natural gas in the power generation mix from 70 per cent in the 'business as usual' scenario to 95 per cent in 2016. The estimated annual GHG emission reduction resulting from this mitigation action was reported as 4 Mt CO_2 eq for 2018, which represents the largest emission reduction in the energy sector. The mitigation action for solar installation is ongoing and focuses on research and development and the 'test-bedding' and deployment of solar photovoltaics. The estimated annual GHG emission reduction resulting from this action was reported as 0.078 Mt CO_2 eq for 2018.

67. The second group of mitigation actions in the energy sector is related to industry and involves four mitigation actions (two completed and two ongoing), all of which involve some form of incentive for the private sector. The aim of the two completed actions was to improve energy efficiency in the manufacturing sector and encourage third-party utility providers to switch to cleaner fuels. The Party estimated that these actions led to annual emission reductions of 0.42 and 0.070 Mt CO_2 eq, respectively, in 2018. The two ongoing actions involve encouraging investments in cogeneration plants that can help to increase energy efficiency and improving the energy efficiency of data centres. Singapore reported that these actions led to estimated emission reductions of 0.59 and 0.00028 Mt CO_2 eq, respectively, in 2018.

68. Information on the assumptions used for establishing the baselines for the mitigation actions related to the manufacturing sector and cogeneration plants was not clearly reported in the BUR. During the technical analysis, the Party clarified that all entities involved must provide a measurement and verification plan, which must be in accordance with international guidelines and codes such as the International Performance Measurement and Verification Protocol, for quantifying the GHG emission reduction achieved by implementing a project supported by the incentives, with the aim of ensuring consistency in the reported goals and achievements.

69. One energy-related mitigation action focused on greening buildings was reported under the third group. The ongoing action, which is called the Green Mark Scheme, sets environmental standards with a view to improving the energy efficiency of new and existing buildings. This is supported by the use of regulations, co-funding and financing schemes to drive adoption of green buildings. This action resulted in an estimated emission reduction of 0.93 Mt CO_2 eq in 2018.

70. For the fourth group of mitigation actions in the energy sector, which relates to transport, the Party reported three ongoing actions focused on shifting travel demand to low-emission modes and reducing GHG emissions from vehicles. The three actions involve increasing the share of public transport in modal split, promoting off-peak use of cars and use of non-motorized transport, and implementing fuel-economy labelling schemes and a vehicular emissions scheme to encourage the take-up of more energy-efficient vehicles. The estimated emission reductions achieved as a result of these actions in 2018 amount to 0.76, 0.11 and 0.37 Mt CO_2 eq, respectively.

71. The final group of mitigation actions in the energy sector relates to energy efficiency of household appliances and consists of two ongoing actions for promoting the purchase of energy-efficient appliances through a mandatory energy labelling scheme launched in 2008 and the minimum energy performance standards introduced in 2011.

72. Information on the coverage of gases, progress indicators and results achieved for the mandatory energy labelling scheme was not clearly reported in the BUR. During the technical analysis, the Party clarified that the information provided on minimum energy performance standards in the BUR (table 5) also applies to the mandatory energy labelling scheme, and reported that the actions were estimated to have achieved a combined emission reduction of 0.73 Mt CO_2 eq in 2018.

73. For the waste sector, the Party reported two mitigation actions: incinerating wastewater sludge and increasing the overall recycling rate (see BUR table 6). The latter is divided into two parts: mandatory reporting and submission of waste reduction plans for large commercial premises, and the pricing of waste disposal. The Party reported that the actions on incinerating wastewater sludge and the mandatory reporting on waste reduction are

ongoing. Singapore also reported that incinerating wastewater sludge achieved an estimated emission reduction of 0.14 Mt CO_2 eq in 2018, which exceeds the action's quantitative goal of achieving an emission reduction of 0.10 Mt CO_2 eq in 2020.

74. The second part of the mitigation action related to the recycling rate was described as "right waste disposal pricing" in the BUR, the meaning of which was not clear to the TTE. In addition, information on progress of implementation for this part of the mitigation action was not clearly reported in the BUR. During the technical analysis, the Party clarified that this part of the action refers to setting the waste disposal fees charged to waste generators at an appropriate level, for example based on the amount of waste disposed of, such that it encourages them to reduce waste generation and disposal. The Party also clarified that this action is being considered for implementation in the future.

75. The results achieved for the mitigation action related to the recycling rate were reported as 0 Mt CO_2 eq in the BUR, and it was not clear to the TTE whether this actually meant zero or was a result of rounding. During the technical analysis, the Party clarified that the estimated result of this action is indeed zero as the overall recycling rate did not increase as expected.

76. In addition to the actions in the energy and waste sectors, Singapore reported information on its carbon tax as a cross-cutting measure. The carbon tax, which was introduced by the Party on 1 January 2019, applies to all facilities emitting 25 kt CO_2 eq or more in a year without exemption. It was reported that the carbon tax covers approximately 80 per cent of Singapore's national emissions. For the initial five years of implementation (2019–2023), the tax rate is set at 5 Singapore dollars (roughly equivalent to USD 3.64) per t CO_2 eq. The tax rate is subject to further review by 2023. The Party reported that, during the initial five-year period, the Government is prepared to spend more than the expected carbon tax revenue to help companies improve their energy and carbon efficiency through the adoption of greener and cleaner technologies and practices. The Party also reported that it is not able to report the specific results achieved from a cross-cutting carbon tax, but its impact is reflected in the emission reductions achieved from sector-specific actions.

77. Singapore provided information on its involvement in international market mechanisms as a Party to the Kyoto Protocol. The Party reported that it is eligible to participate in the clean development mechanism under the Kyoto Protocol as a non-Annex I Party and had six registered clean development mechanism projects as at December 2019. Singapore stated that information on these projects could be found in its NC3 and first BUR. The Party noted that it continues to monitor international developments in this area and is studying how it can leverage robust international market mechanisms to complement its domestic mitigation efforts and to position Singapore as a carbon services hub to harness new economic opportunities. The carbon services hub will include activities such as low-carbon project development, consulting and verification services for clean development mechanism, carbon footprinting, project financing and legal services.[2]

78. Singapore reported information on its domestic MRV arrangements in accordance with decision 2/CP.17, annex III, paragraph 13. The information reported indicates that the Party has a domestic MRV system in place for mitigation actions. Singapore reported that each government agency is responsible for monitoring, measuring and documenting progress in relation to the mitigation actions under its purview, while a whole-of-government approach is adopted for MRV of mitigation actions. The Party reported that government agencies usually use data collected via official surveys. Data collected from the private sector and building owners are verified by the lead agencies through QA/QC procedures in accordance with the guidelines and requirements of the IPCC, the International Energy Agency and the United Nations Statistics Division. The verified data are consolidated by the Long-Term Emissions and Mitigation Working Group under the IMCCC, which assesses the effects of the various mitigation measures and tracks Singapore's overall progress in terms of meeting its mitigation pledges and objectives.

[2] See https://www.nccs.gov.sg/singapores-climate-action/carbon-services-and-climate-finance/ for more information.

79. The TTE noted that the transparency of the information reported on mitigation actions could be further enhanced by addressing the areas noted in paragraphs 62, 64, 68, 72, 74 and 75 above, which could facilitate a better understanding of the information reported on mitigation actions.

80. In paragraph 49 of the summary report on the technical analysis of Singapore's third BUR, the previous TTE noted an area where the transparency of the reporting on mitigation actions could be further enhanced by including information on the carbon tax in tabular format. The current TTE noted the improvement referred to in paragraph 60 above and commends the Party for enhancing the transparency of its reporting.

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

81. 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.

82. Singapore reported information on constraints 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 use of alternative energy sources such as solar, nuclear and wind power.

83. Information on gaps and related financial, technical and capacity-building needs was not reported in Singapore's BUR. During the technical analysis, the Party clarified that it has no gaps related to the strategies and assessments for the country's transition to alternative energy. It also 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. Further, Singapore explained that its technical and capacity-building needs were implied in the BUR (chap. 2), where it reported on its ongoing efforts to further enhance the national capacity to improve its MRV processes.

84. Information on financial resources, technology transfer, capacity-building and technical support received was not reported in Singapore's BUR. However, the Party did report that it does not rely on external sources of support for addressing climate change. During the technical analysis, the Party further clarified its approach to addressing its climate change related needs by investing in innovation and technology; for example, by pursuing partnerships with actors in the private sector, civil society and academia for co-creating solutions that are appropriate to the national context, and by actively participating in various international capacity-building activities related to climate change with a view to learning from other countries' experience.

85. Information on nationally determined technology needs with regard to the development and transfer of technology was not reported in Singapore's BUR. During the technical analysis, the Party clarified that information on its technology needs and priorities was incorporated into the BUR (chap. 1), which contains information on its national circumstances and geographical constraints on expanding its use of alternative energy. Singapore explained that, although solar energy is the most viable alternative energy option in the country, accessing solar energy at scale is a major challenge owing to limited land. The Party clarified that, despite these challenges, it is taking steps to promote deployment of solar photovoltaics by investing in research and development and 'test-bedding' with the aim of improving the efficiency and lowering the cost of the technology. Singapore also clarified that it is investigating emerging low-carbon solutions, such as carbon dioxide capture, use and storage and using low-carbon hydrogen as an alternative fuel and industrial feedstock. The Party indicated that it will continue to evaluate such technologies and invest in relevant research and development initiatives.

86. The TTE noted that the transparency of the information reported on needs and support received could be further enhanced by addressing the areas noted in paragraphs 83 and 85 above, which could facilitate a better understanding of the information reported on needs and support received.

87. Singapore reported in its BUR that it provides technical assistance to fellow developing countries, primarily through the Singapore Cooperation Programme. Established in 1992, the aim of the Programme is to support capacity-building in developing countries in relation to implementing the Sustainable Development Goals and the Paris Agreement, covering areas such as climate action, sustainable cities and communities, and affordable and clean energy. In addition, the Party provides support to other developing countries, particularly the least developed countries and small island developing States, through its Sustainable Development and Climate Change Programme, which was established in 2012, and the Climate Action Package, which was launched in 2018. The Party reported that it works with international organizations and initiatives, including the United Nations Office for Disaster Risk Reduction, the UNFCCC secretariat and the NDC Partnership, to support climate change related capacity-building. The TTE commends Singapore for reporting on these activities, noting that the information facilitates understanding of the national circumstances with regard to support needed and provided.

D. Identification of capacity-building needs

88. 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.

89. The TTE noted that, although capacity-building needs were not identified during the technical analysis, Singapore reported in its BUR the following ongoing efforts to enhance its capacity:

(a) Enhancing data collection and analysis for the LULUCF sector;

(b) Developing an emissions inventory for HFCs using IPCC tier 2 methodology;

(c) Understanding the discrepancies between the emission estimates calculated using the reference and the sectoral approach.

III. Conclusions

90. The TTE conducted a technical analysis of the information reported in the fourth 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 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; and domestic MRV. During the technical analysis, additional information was provided by Singapore on institutional arrangements, the GHG inventory, mitigation actions and financial, technical and capacity-building needs. The TTE concluded that the information analysed is mostly transparent.

91. Singapore reported information on the institutional arrangements relevant to the preparation of its NCs and BURs. It established and has since maintained institutional arrangements that allow for the sustainable preparation of its BURs. The IMCCC, which was set up in 2007 to oversee whole-of-government coordination in the area of climate change policy, is responsible for approving the NCs and BURs, which are prepared by an inter-agency working group. The NCCS was established under the Prime Minister's Office and serves as the secretariat of the IMCCC. The Party is conducting a review of its institutional arrangements and indicated that it will provide an update thereon in its next BUR. Singapore reported information on its existing domestic MRV arrangements covering the preparation of national reports, GHG inventory compilation and monitoring of mitigation actions. The MRV Task Force under the IMCCC takes a leading role in coordinating inter-agency efforts, including for the preparation of NCs and BURs ahead of their submission to the IMCCC for approval.

92. In its fourth BUR, submitted in 2020, Singapore reported information on its national GHG inventory for 2016. 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 2016 were reported as 50,685.58 Gg CO_2 eq (excluding land, HWP and other emissions) and 50,702.71 Gg CO_2 eq (including land, HWP and other emissions). A total of 13 key categories were identified in the level assessment, the most significant being CO_2 emissions from combustion of natural gas for electricity and heat generation (34.2 per cent of total GHG emissions). The Party also identified 10 key categories in the trend assessment, with the strongest trends being the decrease in fuel oil combustion for electricity and heat generation (41.0 per cent) and the increase in natural gas combustion for electricity and heat generation (25.5 per cent). Estimates of precursor gases were not included in the BUR and CO_2 emissions from fuel combustion were reported only using the sectoral approach.

93. Singapore reported information on mitigation actions and their effects in both tabular and narrative format in the context of its mitigation targets for 2020 and 2030. The Party reported 11 ongoing and 3 completed mitigation actions in the energy and waste sectors. The 12 actions reported for the energy sector focus on the transition to cleaner energy sources; improving energy efficiency of industry, buildings and household appliances; and shifting travel demand to low-emission modes and reducing vehicular emissions. The two mitigation actions in the waste sector focus on incinerating wastewater sludge and increasing the recycling rate. Singapore also reported information on its carbon tax as a cross-cutting measure whose mitigation impact covers approximately 80 per cent of the national emissions. The Party further reported that the largest estimated emission reduction was due to switching the power generation fuel mix in favour of natural gas, with an estimated reduction of 4.0 Mt CO_2 eq in 2018. Singapore estimated that all 15 mitigation actions combined led to a total annual emission reduction of 8.20 Mt CO_2 eq in 2018, and confirmed that it is on track to meet its 2020 mitigation target.

94. Singapore reported information on key constraints with regard to its transition to using alternative energy sources but did not report on gaps and related needs. During the technical analysis, the Party clarified that it has no gaps in its associated strategies and assessments. The Party did not report information on financial resources, technology transfer, capacity-building or technical support received. During the technical analysis, Singapore clarified that it does not rely on external sources of funding for implementing its national climate change policies and programmes. Instead, it invests in innovation and technology, as clarified by the Party. Information on nationally determined technology needs was not reported in the BUR. During the technical analysis, the Party clarified its efforts to promote use of alternative energy sources and emerging low-carbon solutions. In addition, Singapore shared information on its provision of support to fellow developing countries through various programmes and initiatives.

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

96. The TTE, in consultation with Singapore, did not identify any needs for capacity-building 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 on its ongoing efforts to enhance its capacity.

(a)

Annex I

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

Table I.1
Identification of the extent to which the elements of information on greenhouse gases are included in the fourth 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 fourth BUR in December 2020; the GHG inventory reported is for 2016.
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.
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.118–125).
	(b) The sectoral report tables annexed to the Revised 1996 IPCC Guidelines.	Yes	Comparable information was reported in the BUR (pp.34–48).
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 and 2014.

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 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:		
	(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 annex to the BUR (pp.84–85).
	(b) Table 2 (National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF_6).	Yes	Comparable information was reported in the annex to the BUR (pp.86–89).
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 worksheets for 2016 and GHG inventory summary tables for 1994, 2000, 2010, 2012 and 2014 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;	Yes	
	(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:		
	(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	*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 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.	No	
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	Singapore 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	Singapore used the 2006 IPCC Guidelines. 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 other (sea) under categories 3.B and 3.D, but did not provide an explicit description of the sources and sinks covered by this subcategory.
	(i) Source and/or sink categories;		
	(ii) Methodologies;		
	(iii) EFs;		
	(iv) AD;		

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
	(e) Parties are encouraged to identify areas where data may be further improved in future communications through capacity-building.	Yes	
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.	Yes	Notation keys were used.
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 fourth 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	
	(b) Information on:		

Decision	*Provision of the reporting guidelines*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
	(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 fourth 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 2/CP.17, annex III, paragraph 14	Non-Annex I Parties should provide updated information on:		
	(a) Constraints and gaps;	Partly	The Party provided information on constraints but not on any gaps identified.
	(b) Related financial, technical and capacity-building needs.	No	
Decision 2/CP.17, annex III, paragraph 15	Non-Annex I Parties should provide:		
	(a) Information on financial resources received, technology transfer and capacity-building received;	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 climate change, including for the preparation of the current BUR.	No	

Decision	*Provision of the reporting requirements*	*Assessment of whether the information was reported*	*Comments on the extent of the information provided*
Decision 2/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.

B. UNFCCC documents

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

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

FCCC/SBI/ICA/2015/TASR.1/SGP. Summary report on the technical analysis of the first BUR of Singapore. Available at https://unfccc.int/ICA-cycle1.

FCCC/SBI/ICA/2017/TASR.2/SGP. Summary report on the technical analysis of the second BUR of Singapore. Available at https://unfccc.int/ICA-cycle2.

FCCC/SBI/ICA/2019/TASR.3/SGP. Summary report on the technical analysis of the third BUR of Singapore. Available at https://unfccc.int/ICA-cycle3.