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Technical analysis of the second biennial update report of India submitted on 31 December 2018

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 second biennial update report of India, conducted by a team of technical experts in accordance with the modalities and procedures contained in the annex to decision 20/CP.19.

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Abbreviations and acronyms

AD	activity data
BUR	biennial update report
CDM	clean development mechanism
CH ₄	methane
CO	carbon monoxide
COP	Conference of the Parties
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
EF	emission factor
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
ICA	international consultation and analysis
IPCC	Intergovernmental Panel on Climate Change
IPCC good practice guidance	<i>Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories</i>
IPCC good practice guidance for LULUCF	<i>Good Practice Guidance for Land Use, Land-Use Change and Forestry</i>
IPPU	industrial processes and product use
LED	light-emitting diode
LULUCF	land use, land-use change and forestry
MRV	measurement, reporting and verification
NA	not applicable
NAPCC	national action plan on climate change
NC	national communication
NMVOC	non-methane volatile organic compound
non-Annex I Party	Party not included in Annex I to the Convention
NO _x	nitrogen oxides
N ₂ O	nitrous oxide
PFC	perfluorocarbon
QA/QC	quality assurance/quality control
REDD+	reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
Revised 1996 IPCC Guidelines	<i>Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories</i>
SF ₆	sulfur hexafluoride
SO _x	sulfur oxides
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”
2006 IPCC Guidelines	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>

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 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. India submitted its first BUR on 22 January 2016, which was analysed by a TTE in the fifth round of technical analysis of BURs from non-Annex I Parties, conducted from 13 to 17 June 2016. After the publication of its summary report, India participated in the third workshop for the facilitative sharing of views, convened in Bonn on 15 May 2017.
5. This summary report presents the results of the technical analysis of the second BUR of India, 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, India submitted its second BUR on 31 December 2018 as a stand-alone update report. The submission was made within two years after the submission of the first BUR.
7. The technical analysis of the BUR took place from 27 to 31 May 2019 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: Sorin Deaconu (Romania), Sanjay Dorji (Bhutan), Takeshi Enoki (Japan), Sandra Boitumelo Motshwanedi (South Africa), Stanford Mwakasonda (United Republic of Tanzania), Sekai Ngarize (Zimbabwe), Helen Joan Plume (New Zealand), Atsushi Sato (Japan), Ioannis Sempos (Greece), Samir Tantawi (Egypt) and Hartley Walimwipi (Zambia). Ms. Ngarize and Mr. Sempos were the co-leads. The technical analysis was coordinated by Alma Jean and Dirk Nemitz (secretariat).
8. During the technical analysis, in addition to the written exchange, through the secretariat, to provide technical clarifications on the information reported in the BUR, the TTE and India engaged in consultation¹ on the identification of capacity-building needs for the preparation of BURs and participation in the ICA process. Following the technical analysis of India's second BUR, the TTE prepared and shared a draft summary report with India on 28 August 2019, for its review and comment. India, in turn, provided its feedback on the draft summary report on 15 September 2019.
9. The TTE responded to and incorporated India's comments referred to in paragraph 8 above and finalized the summary report in consultation with the Party on 30 September 2019.

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 chapter 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 chapter 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 chapter II.D below).

11. The remainder of this chapter presents the results of each of the three parts of the technical analysis of India'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 the progress made 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 reporting in the Party's second BUR compared with that in the first BUR. Information on GHG inventories, mitigation actions and their effects, and needs and support reported in the second BUR demonstrates that the Party has taken into consideration the areas for enhancing transparency noted by the previous TTE in the summary report on the technical analysis of the Party's first 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 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 second BUR, India provided an update on its national circumstances, including information on the features of geography, climate and economy that may affect its ability to mitigate and adapt to climate change, and a description of national-level development circumstances, priorities and actions. Information has been updated since the first BUR on the energy, water, agriculture, forestry, building and transport sectors.

20. India transparently described in its BUR the existing institutional arrangements relevant to the preparation of its NCs and BURs on a continuous basis. The institutional arrangements to facilitate responses to climate change incorporate a clear definition of the roles and responsibilities of various government ministries. The arrangements include the National Steering Committee and Technical Advisory Committee, both of which comprise relevant institutions and experts. Members of the Technical Advisory Committee are drawn from the Government, academia and civil society. The Committee's purpose is to coordinate and guide the preparation of the BUR. The information reported indicates that India has taken steps towards creating sustainable institutional arrangements and strengthening the existing system of reporting by including additional institutions.

21. India reported that dedicated domestic MRV arrangements at the national level have yet to evolve and would be developed on the basis of in-depth scientific and technical research, although several national programmes and schemes have developed their own MRV systems for measuring financial and intended physical achievements. Some of these programmes and schemes relate to mitigation (e.g. the Perform Achieve Trade scheme) but are not directly used for the MRV of GHG emissions. In addition, MRV arrangements specific to a scheme or programme have been developed in some key sectors, namely power, renewable energy, buildings, industry, transportation, forestry, agriculture and waste. However, these arrangements do not necessarily address GHG emissions. During the technical analysis, India stated its intention to establish an integrated domestic MRV system based on availability of finance and capacity development.

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

22. As indicated in table 1 in annex I, India reported information on its GHG inventory in its BUR 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. India submitted its second BUR in 2018, and the GHG inventory reported is for 2014, which is consistent with the requirements for the reporting time frame. In the second BUR, the Party also included the national inventories for 1994, 2000, 2007 and 2010, disaggregated by sector (i.e. energy, IPPU, agriculture, LULUCF and waste), as reported in its NC1, NC2 and first BUR. India reported a consistent time series of the national inventory in graphic format for the period 2000–2014. The TTE commends the Party for enhancing the transparency of the information reported in its BUR by including summary information tables of inventories for previous submission years.

24. GHG emissions and removals reported in the BUR covering 2014 were estimated using a combination of methods from the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines. Significant shares of emissions for key categories were estimated by applying a higher-tier method (e.g. tier 2) or by using country- or plant-specific EFs and other parameters. Methodologies, EFs and sources of AD remained largely the same as those used for the estimation of emissions in the first BUR. Programmes and studies for developing new EFs and improving the coverage and accuracy of the inventory are ongoing; for example, a

study to develop country- and sector-specific EFs and other parameters for fuel combustion. The TTE commends India for improving the national GHG inventory, applying higher-tier methodologies and country-specific EFs, and making continuous efforts to further improve the quality of the inventory for the relevant sectors.

25. Information on the Party's total GHG emissions by gas for 2014 is outlined in table 1 in units of mass. Emissions of the following sources of fluorinated gases were reported: PFCs (tetrafluoromethane and hexafluoroethane) from aluminium production; HFCs (HFC-23) from halocarbon production; and SF₆ from magnesium production. The TTE noted that some sources of HFCs, PFCs and SF₆ were not included in the inventory as information for the sources was not available (e.g. HFC emissions from air conditioning and refrigeration, HFC and PFC emissions from the electronics industry and SF₆ emissions from electrical equipment). During the technical analysis, the Party clarified that this reporting provision is not mandatory and its capacity to report on such non-mandatory matters depends on the support received, data availability and available institutional capacity. Working on non-mandatory items is not considered by the Party to be an efficient use of the resources provided. The TTE noted that including such clarification in the BUR could facilitate a better understanding of the information reported.

Table 1
India's Greenhouse gas emissions by gas for 2014

<i>Gas</i>	<i>GHG emissions (Gg) including LULUCF</i>	<i>GHG emissions (Gg) excluding LULUCF</i>
CO ₂	2 015 107.88	1 997 891.85
CO ₂ (removals)	-3 19 860.23	0
CH ₄	20 053.54	20 005.35
N ₂ O	476.71	475.29
HFCs (HFC-23)	1.59	1.59
PFCs (tetrafluoromethane)	2.61	2.61
PFCs (hexafluoroethane)	0.71	0.71
SF ₆	0.004	0.00
Other		
Total (in CO₂ eq)	2 306 295.43	2 607 488.12

26. In tables 1 and 2 of the BUR, India did not apply notation keys where numerical data were not provided owing to the source aggregation in some parts of those tables. The Party made limited use of notation keys in the detailed inventory table in an appendix to chapter 2 of its BUR. During the technical analysis, India clarified that notation keys were used where applicable in that table. The TTE noted that the use of notation keys consistently with the UNFCCC guidelines for the preparation of NCs from non-Annex I Parties could facilitate a better understanding of the information reported.

27. India reported partially 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. The Party reported an aggregated land area and the associated emissions or removals for the main LULUCF subsectors, without including information on AD, EFs or parameters, such as annual change in carbon stock by carbon pool, that were used for estimating the emissions or removals. India included a sectoral table in the second BUR for 2014 (appendix to chapter 2). The level of disaggregation by sector and subsector of table 2.22 is largely comparable with the information in the sectoral report tables annexed to the Revised 1996 IPCC Guidelines. During the technical analysis, India clarified that the relevant data were not available. The Party noted that this reporting provision is not mandatory and its capacity to report on such non-mandatory matters depends on the support received, data availability and available institutional capacity. Working on non-mandatory items is not considered by the Party to be an efficient use of the resources provided. The TTE noted that improving the comparability of the reported information in tables 2.13, 2.14 and 2.22 of the BUR with 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 could facilitate a better understanding of the information reported.

28. The share of emissions that different sectors contributed to the total GHG emissions excluding LULUCF as reported by the Party in 2014 are reflected in table 2.

Table 2

Share of greenhouse gas emissions by sector for India for 2014

<i>Sector</i>	<i>GHG emissions (Gg CO₂ eq)</i>	<i>Share^a (%)</i>
Agriculture	417 217.54	16.0
Energy	1 909 765.74	73.2
LULUCF	-301 192.69	NA
IPPU	202 277.69	7.8
Waste	78 227.15	3.0

^a Share of total without LULUCF.

29. India reported information on its use of GWP values consistent with those provided by the IPCC in its Second Assessment Report based on the effects over a 100-year time-horizon of GHGs.

30. The Party reported information on the energy sector, which contributed 73 per cent of the total national GHG emissions (excluding LULUCF). Fossil fuel combustion activities, comprising energy industries, manufacturing industries, transport and other subsectors, were the predominant source of energy sector emissions, accounting for 98 per cent. Fugitive emissions contributed 2 per cent to the total GHG emissions from the energy sector. India has developed country-specific EFs and net calorific values to estimate CO₂ emissions from fuel combustion activities associated with the different types of coal used in the country. Information on the CO₂ EFs of liquid and gaseous fuels was not clearly reported in the BUR. During the technical analysis, the Party clarified that IPCC default values from the 2006 IPCC Guidelines were used for these fuels. The TTE noted that reporting the source of EFs applied to estimate emissions in the BUR could facilitate a better understanding of the information reported.

31. India has developed and applied country-specific EFs for fugitive CH₄ emissions from underground and above-ground coal mining. The CH₄ EF for degree-I mines reported in table 2.5 of the BUR (2.91 m³/t) is lower than the lower limit of the range proposed in the 2006 IPCC Guidelines (10–25 m³/t). During the technical analysis, India clarified that an underground mine is categorized as a degree-I mine if the rate of CH₄ emissions per t coal produced is less than 1 m³. Degree-I mines operate at shallower depths than the underground mines in Australia, China, Europe and the United States of America and therefore are less gassy. The TTE noted that including this clarification in the BUR could facilitate a better understanding of the information reported.

32. Information on CO₂ emissions associated with flaring activities and purification of natural gas in the oil and natural gas category, and on CH₄ emissions associated with abandoned coal mines, is not reported in table 2.22 (1) or in the table in the appendix to chapter 2 of the BUR. During the technical analysis, India clarified that CO₂ emissions from flaring are not included in the oil and natural gas category owing to the unavailability of reliable data sets, and that, according to estimates, gas flared in India accounts for only 2–3 per cent of oil and natural gas gross production. Further, the Party clarified that the number of abandoned mines and their status are not known, though a study has been initiated by the Central Institute of Mining and Fuel Research to determine this information. The TTE noted that including these clarifications on flaring activities in the oil and natural gas sector and abandoned coal mines in the BUR could facilitate a better understanding of the information reported.

33. The 2006 IPCC Guidelines were used for estimating GHG emissions from the IPPU sector. India reported information on the methods and sources of data used to estimate the

emissions. The Party has developed and used plant- and country-specific CO₂ and N₂O EFs for the dominant categories of the sector, that is mineral industries, chemical industries and metal industries. The information reported in the BUR does not include the AD associated with the reported emissions. During the technical analysis, India clarified that the challenge of reporting the AD lies in the enormity of the data sets for those sectors, and further that it does not consider the AD to be a mandatory reporting requirement. The TTE noted that the Party reporting summary tables of AD in the BUR could facilitate a better understanding of the information reported.

34. For the agriculture sector, of the five subsectors, enteric fermentation is the highest GHG-emitting source (54.45 per cent), followed by agricultural soils (19.30 per cent) and rice cultivation (17.46 per cent). Tier 2 methods combined with country-specific EFs were applied for the estimation of emissions from enteric fermentation of cattle, buffaloes and goats, rice cultivation and agricultural soils. For the remaining categories, a combination of tier 1 methods and default EFs from the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines was used. Further, some AD were reported, such as dry matter intake and dung production (for the livestock population) and rice area per water regime, but not AD related to agricultural soils. The TTE noted that the Party reporting AD for the amount of synthetic and organic fertilizers used, manure deposited and crop residues in the BUR could facilitate a better understanding of the information reported.

35. The LULUCF sector was a net sink in 2014, with an increase in removals of about 19 per cent as compared with removals in 2010, which were reported in the first BUR. GHG emissions for the sector are estimated using the tier 2 approach from the IPCC good practice guidance for LULUCF and the 2006 IPCC Guidelines with country-specific EFs for the five land categories (excluding wetlands and other lands). Wetlands and other lands are not included in the GHG inventory because changes in carbon stocks are not expected for other lands; AD in line with the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* are not available for wetlands. The information reported indicates that the sink capacity of cropland is 3.6 times higher than that of forest land for 2014. During the technical analysis, India clarified that the area of cropland is approximately 2.3 times greater than the area of forest land and that the carbon sequestration in cropland mainly results from the increase in soil organic carbon stock, while in forest land soil organic carbon changes very slowly. The TTE noted that clarifying soil organic carbon differences between land categories in the BUR could facilitate a better understanding of the information reported.

36. For the waste sector, CH₄ emissions from solid waste disposal sites (19 per cent of the total GHG emissions for the sector) and from wastewater handling (81 per cent) are the key categories. India applied the tier 2 (first-order decay) method from the Revised 1996 IPCC Guidelines for estimating emissions from solid waste disposal sites, and tier 1 and tier 2 approaches from the Revised 1996 IPCC Guidelines, incorporating country-specific EFs and data, for the estimation of domestic, commercial and industrial wastewater. Information was not reported on the country-specific EFs and other parameters for domestic and commercial wastewater. Information on the incineration of municipal waste and the biological treatment of waste was also not reported. During the technical analysis, India clarified that the incineration of waste does not occur on a significant scale in the country and that composting on a large scale can be successful with adequate and significant segregation at the source. India is making significant efforts towards achieving this through several programmes and activities, which include but are not limited to the Swachh Bharat Mission, as mentioned in section 3.10.2 of the BUR. The TTE noted that clarifying this information in the BUR could facilitate a better understanding of the information reported.

37. India reported its national GHG inventory as a chapter of the BUR and it includes the national GHG inventories for 1994, 2000, 2007 and 2010, disaggregated by sector (i.e. energy, IPPU, agriculture, LULUCF and waste). An update to the GHG inventories, using the same methodologies as those used in the first BUR, was reported for the period 2000–2014 (BUR, figure 2.24). A consistent time series back to 1994 (reported in the NC1) was not reported as the years 1994 to 1999 were missing. During the technical analysis, India clarified that preparing a consistent time series would be a resource-intensive exercise and that the 1994 inventory is not comparable with the inventories for later years owing to the incompatibility

of data, methodologies and categorization. Particularly for the LULUCF sector, calculating a consistent time series would be a huge challenge because high-resolution data are not available for before 2000. The TTE noted that clarifying this information regarding the consistent time series in the BUR could facilitate a better understanding of the information reported.

38. India described in its BUR the institutional framework for the preparation of its national GHG inventories on a continuous basis. The Ministry of Environment, Forest and Climate Change is the focal point of the Government of India for coordination and management of climate change related programmes and actions and reporting of information pursuant to Article 4, paragraph 1, of the Convention. Studies for the preparation of the GHG inventory were carried out by 11 national institutions in their respective sectors of expertise. India is currently developing a national inventory management system that will coordinate the supporting institutions and provide adequate capacity for the preparation of NCs and BURs on a continuous basis. In the BUR, the Party highlighted the fact that formalizing institutional arrangements would require financial, technological and capacity-building support from international institutions and Parties included in Annex I to the Convention on a continuous basis. Activities, including the GHG inventory, for the preparation of India's second BUR were launched under the project "Preparation of Third National Communication and other New Information to the UNFCCC", supported by the GEF, the United Nations Development Programme and the Government of India.

39. India reported a key category analysis for 2014, which was based on a level assessment and trend assessment for the years 2011 to 2014. Neither assessment included LULUCF emissions. During the technical analysis, India clarified that LULUCF is a priority sector because of its importance to the national inventory, mitigation and adaptation, and because forests are a source of ecosystem services and important to livelihoods. The key category analysis was executed excluding LULUCF to avoid the effects of removals on the level assessment and the influence of different trends in carbon fluxes on other emission trends, in accordance with the logic outlined in the 2006 IPCC Guidelines.

40. The BUR provides information on QA/QC measures for all sectors, which were developed by taking into consideration the quality of the data, time constraints and capacity. The QC procedures include checking the reliability and proper documentation of the different sources of AD; for transcription errors in the AD; for consistency of the data across sectors and the time series; and for the completeness and integrity of the database. Sector-specific QC approaches have been integrated into the databases of the various ministries, government departments, industry associations and the remote sensing agency from which the AD are sourced. QA was conducted for the sectoral inventory estimates by experts and institutions that had not participated in the inventory estimation process, while independent studies validated the data. India reported in the BUR that an independent study (Ganesan et al., 2017) had investigated the Party's CH₄ emissions using a top-down approach, based on satellite data and measurements of air samples at various observational sites, and concluded that the magnitude of the emissions was consistent with that reported in the first BUR. The TTE commends India for providing information on QA/QC measures in accordance with the IPCC good practice guidance.

41. India reported information on CO₂ fuel combustion using both the sectoral and the reference approach. The difference in CO₂ emissions between the two approaches for 2014 was 3.83 per cent. The Party reported in the BUR that, owing to the minimal difference in the estimates of CO₂ emissions between the two approaches, information explaining the difference was not reported.

42. Information was duly reported on international aviation and marine bunker fuels. This information is included in the summary table as memo items, in line with the IPCC guidelines. The TTE commends India for reporting this information.

43. India reported information on the uncertainty assessment (level) of its national GHG inventory. Information on AD, EFs and combined uncertainty, separately for the key categories, is reported. The other categories were not included, nor was the total uncertainty and the trend uncertainty of the inventory reported. During the technical analysis, India clarified that the estimations for key categories were prioritized and reported in the BUR, and

indicated its need for the training and capacity-building of sectoral experts in carrying out uncertainty assessments in accordance with the IPCC guidelines.

44. The TTE commends India for providing a robust GHG inventory and noted that the transparency of the information reported on GHG inventories could be further enhanced by addressing the areas noted in paragraphs 25–27 and 30–37 above.

45. In paragraph 46 of the summary report on the technical analysis of India's first BUR, the previous TTE noted that the transparency of information reported in paragraphs 35–44 could be further enhanced. The current TTE noted that India took into consideration these areas for improvement in the second BUR and commends the Party for enhancing the transparency of the information reported.

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

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

47. The information reported provides a clear and comprehensive overview of the Party's mitigation actions and their effects. In its BUR, India frames its national mitigation planning and actions in the context of the NAPCC, which was launched in 2008 and includes eight national missions representing multi-pronged, long-term and integrated strategies for achieving key goals in the context of climate change. The Plan is an overarching framework for addressing climate change and promoting sustainable development. India reported information on the objectives, targets and key achievements for each of the eight missions of the Plan (BUR, table 3.1). The Party reported that states are actively contributing to the NAPCC by preparing state action plans on climate change, which prioritize the forest, biodiversity, agriculture, water, energy, urban development and transport sectors. Thirty-three of these plans have been completed and endorsed by the National Steering Committee on Climate Change. The Party envisions that extensions of the NAPCC at various levels of government will be aligned with the eight national missions.

48. India's contribution to reducing global GHG emissions is outlined in its 2010 voluntary pledge to reduce the emission intensity of its GDP by 20–25 per cent from the 2005 level by 2020 (excluding emissions from agriculture). In 2015, in its nationally determined contribution under the Paris Agreement, India voluntarily increased its target for reducing the emission intensity of its GDP by 33–35 per cent from the 2005 level by 2030. The Party also stated a target of achieving about 40 per cent of its cumulative electric power installed capacity from non-fossil-fuel-based energy resources by 2030. Most of the mitigation actions reported in the BUR are in the energy, industry, forestry, agriculture, buildings, transport and waste sectors. The Party reported that because of its proactive and sustained actions on climate change mitigation, the emission intensity of its GDP was reduced by 21 per cent during the period 2005–2014.

49. The Party reported a summary of its mitigation actions in tabular format in accordance with decision 2/CP.17, annex III, paragraph 11, for three groups of mitigation actions: sectoral (tables 3.24–3.27), major policies and programmes (table 3.28) and initiatives with indirect mitigation benefits (chapter 6, appendix). The Party reported that these tables are indicative and non-exhaustive. Information was also reported in textual format for these groups of actions, which also included the waste sector.

50. Consistently with decision 2/CP.17, annex III, paragraph 12(a), India clearly reported the names of mitigation actions for the three groups of actions identified in paragraph 49 above. Information on description, coverage, the nature of the action, progress indicators and quantitative goals are reported for all actions. The sectoral mitigation actions cover energy, forestry, agriculture and transport, with most actions in the energy sector. The Party reported that these mitigation actions reflect cumulative mitigation estimation. The Party reported a second group of mitigation actions as major policies and programmes, which reflect annual estimates of GHG emission reductions for the years 2011 to 2014. Most of the actions for this group focus on energy efficiency. The third group of mitigation actions is reported as other policies and programmes in chapter 6 of the BUR on additional information. The Party

identified these actions as having indirect mitigation benefits; however, GHG emission reductions were not estimated for these actions owing to lack of capacity. This group of actions was reported as additional information; see paragraph 73 below for further details.

51. India reported 11 mitigation actions for the energy sector (BUR, table 3.24). The mitigation actions in the energy sector are mainly in the areas of renewable energy and energy efficiency in the power sector, as the power sector contributes 43 per cent of India's total GHG emissions. The Party reported information on the methodologies and underlying assumptions for most of the mitigation actions in this sector. However, the assumptions for subcritical units (existing conventional technology) for clean coal were not reported. During the technical analysis, the Party clarified that the efficiency of the subcritical units is 38 per cent, as mentioned in section 5.3.2 of BUR. The objectives of the mitigation actions and the steps taken to implement them were also reported. India reported that its mitigation measures are derived from programmes and projects that are adopted, implemented or under implementation. The Party also reported information on the results achieved from the implementation of its mitigation actions in the energy sector as both estimated outcomes and estimated emission reductions, as well as co-benefits, such as the employment generated. Of the mitigation actions that were quantified, the highest GHG emission reductions came from the national programme for LED-based home and street lighting: the replacement of 312 million incandescent lamps for street lighting achieved reductions of 33 Mt CO₂ eq per year.

52. For the transport sector, including roads, railways, aviation and shipping, the Party reports that it is one of the fastest-growing sectors. The mitigation actions are mostly achieved through policy and legal instruments, technology development, standards to reduce vehicular emissions and the strategy to increase the share of alternative fuels in the overall fuel mix. India reported information on four mitigation actions, including their methodologies, underlying assumptions, objectives and steps taken to implement them (BUR, table 3.27 and pp.117–121). The TTE commends the Party for reporting information on the results achieved from the implementation of its mitigation actions in the transport sector, as both estimated outcomes and estimated emission reductions (table 3.28), such as, for 2011 and 2014 respectively, for the metro rail (0.6 Mt CO₂ eq and 0.72 Mt CO₂ eq), the bus rapid transit system (0.039 Mt CO₂ eq and 0.044 Mt CO₂ eq) and the Efficiency Gains in Railways scheme (0.31 Mt CO₂ eq and –0.56 Mt CO₂ eq). The results show a declining emission trend for these subsectors.

53. Information was reported for nine mitigation actions in the forestry sector, most of which relate to plantations, afforestation, reforestation and programmes to conserve and enhance the carbon sink, all of which are driven by various legal instruments (BUR, table 3.25). Under this sector, India also reported 19 CDM projects that are registered under afforestation or reforestation and have been approved by the Party's designated national authority and under the UNFCCC CDM process. Information on methodologies, assumptions, objectives, steps taken to implement the action, and the results achieved was reported for most of the actions. Estimated outcomes and estimated emission reductions, as well as co-benefits, such as the employment generated, were also reported for most of the mitigation actions. The Party reported that the National Horticulture Mission had a major impact and led to the sequestration of 137 Mt CO₂ from 2010 to 2016. The TTE commends India for its efforts.

54. Regarding the 19 afforestation or reforestation CDM projects, India reported that the annual emission reduction potential was 429,614 t CO₂ eq (BUR, table 3.22). Information on the results achieved by the national afforestation programme, the Compensatory Afforestation Fund Management and Planning Authority bill, and the Nagar Van Udyan Yojana initiative was not provided. During the technical analysis, the Party clarified that these three measures are new and data on tree species and soil types were not available to facilitate an assessment of their results. India plans, subject to the availability of data, resources and capacity, to estimate the results achieved. The TTE noted that including this clarification in the BUR could facilitate a better understanding of the information reported. The Party noted that no domestic market exists for the forestry sector. The statistics include information on all the projects, the sectors covered and the quantity of certified emission reductions issued for India (see para. 56 below).

55. Further, information on the results achieved included the outcomes of REDD+. In 2018, India developed a national REDD+ strategy with the overarching objective of facilitating the implementation of REDD+ under the Convention. The REDD+ strategy is aligned with the national forest policy and provides a national legislative and policy framework for the conservation and improvement of forests and the environment. In January 2018, India voluntarily submitted a national forest reference level to the UNFCCC, which includes the sustainable management of forests and covers four IPCC carbon pools (above-ground biomass, below-ground biomass, deadwood and litter, and soil organic carbon) and CO₂. The proposed reference level is -49.70 Mt CO₂ eq and is based on the historical time series (1994–2008). The Party reported a number of pilot projects for REDD+ that aim to reduce emissions and sequester carbon and to ensure participation and benefit-sharing in communities. LULUCF sequestered 319,860.23 Gg CO₂ emissions in 2014, which is about 16 per cent of India's total CO₂ emissions. The total carbon stock in forests for 2017 has been estimated at 7,083 Mt. The annual increase of carbon stock is 19.50 Mt carbon, that is 71.5 Mt CO₂ eq. The TTE commends India for its efforts.

56. For the agriculture sector, information on 10 mitigation actions was reported in the BUR. These actions include 290 registered CDM projects. Agriculture contributes 16.2 per cent of the total GHG emissions in India and 14.82 per cent to the country's gross value added (at constant 2011–2012 prices). Agriculture is not included in India's voluntary pledge under the nationally appropriate mitigation actions to be implemented by non-Annex I Parties.² Several initiatives in the sector promote sustainable development, mitigation and adaptation. Information is reported on the methodologies, underlying assumptions, objectives and steps taken to implement the actions (table 3.26 and pp.121–127). India reported information on the results achieved from the implementation of its mitigation actions in the agriculture sector as both estimated outcomes and estimated emission reductions, as well as co-benefits, such as the employment generated. During the technical analysis, the Party underscored its flagship project, the Pradhan Mantri Krishi Sinchayee Yojana (a micro-irrigation scheme). It aims to increase investments in irrigation at the field level, expand the cultivable area under assured irrigation, improve on-farm water use efficiency to reduce water wastage, and enhance the adoption of precision irrigation and other water saving technologies (to gain 'more crop per drop'). Micro-irrigation resulted in emission reductions of 22.82 Mt CO₂ eq during the period 2010–2016. The TTE commends India for providing information on mitigation actions in the agriculture sector.

57. India reported information on mitigation actions in the waste sector (BUR, pp.139–141), which contributes 3 per cent of India's total GHG emissions. The Government recognizes the co-benefits to the environment of efficient waste disposal and the conversion of waste to energy. The information reported indicates that, in 2016, India enacted and amended policy and regulatory instruments for the efficient management of various types of waste. In its BUR, the Party highlighted that the Ministry of Urban Development launched the Swachh Bharat Mission in October 2014, aimed at making the country clean by October 2019. The Mission includes, among other measures, projects for solid waste management and the establishment of waste-to-energy plants, and provides central financial assistance of up to 35 per cent of project costs. The information reported for this sector includes the name and description of the action, objectives, progress made in the implementation of the action and the underlying steps taken or envisaged. Information on results achieved in terms of GHG emission reductions was not reported in the BUR. During the technical analysis, India clarified that this was due to major challenges in the collection of data in terms of their quality and quantity, waste characterization, the quantity of different waste streams and regional variations in data collected. The Party indicated that it has identified technology needs and capacity-building gaps in relation to the transfer of waste management technologies, such as those for waste-to-energy and thermal technologies (incineration, pyrolysis, gasification and plasma technology).

58. The information reported on the mitigation actions as major policies and programmes relates to the agriculture, power, renewable energy and transport sectors. Information on status of implementation and objectives was reported, including the year the actions were implemented and the responsible entities. India reported results achieved as estimated

² See document FCCC/AWGLCA/2011/INF.1.

emission reductions from 2011 to 2014. During that period, renewable energy accounted for the highest emission reductions each year (19.85 Mt CO₂ eq, 21.19 Mt CO₂ eq, 20.8 Mt CO₂ eq and 20.93 Mt CO₂ eq, respectively), with the highest emission reduction achieved in 2012. Information on methodologies and assumptions and steps taken was not reported for this group of actions. During the review, India clarified that the methodological approach is similar to that reported in the earlier table (table 3.24 of BUR-2). The TTE noted that including clarification of the methodology in the BUR could facilitate a better understanding of the information reported.

59. India provided information on its involvement in international market mechanisms as a Party to the Kyoto Protocol. The Party reported this information as part of its mitigation actions in the forestry and agriculture sectors, including the number of actions and the results achieved as estimated emission reductions (see paras. 53 and 56 above).

60. India reported information on its domestic MRV arrangements in accordance with decision 2/CP.17, annex III, paragraph 13. The information reported indicates that India has established a domestic MRV system for mitigation actions that includes many sectors, schemes, and measurement and evaluation systems at the national and state level. Although most of the MRV systems do not directly track GHG emissions and mitigation impacts, the existing reporting is useful in arriving at reasonable estimates of the impacts of the policies. The Party noted that establishing an integrated domestic MRV system for the assessment of GHG mitigation actions is a capacity-building need, and that the system would require streamlined data management, technical capacity, improved analytical capability, and, most importantly, active coordination between all stakeholders and various government agencies. To develop a specific (consolidated) monitoring and verification process for the GHG inventory and mitigation actions, India requires additional finance and capacity-building.

61. The TTE noted that the transparency of the information reported on mitigation actions and their effects could be further enhanced by addressing the areas noted in paragraphs 51, 53–54 and 57–58 above.

62. In paragraphs 50 and 51 of the summary report on the technical analysis of India's first BUR, the previous TTE noted where the transparency of reporting of information on gases, quantitative goals, progress indicators, methodologies, assumptions, objectives and steps taken or envisaged for some mitigation actions could be further enhanced. The current TTE noted that India took into consideration these improvements and made significant efforts to report the methodologies and assumptions for most mitigation actions, and the impacts for groups of mitigation actions by sector in tabular format (for the energy, agriculture, forestry and transport sectors), including annual quantification of impacts for major policies and programmes. This information is provided in section 3.3 of the BUR for the energy sector, section 3.7 for the transport sector, section 3.8 for the agriculture sector and section 3.9 for the forestry sector. The TTE commends the Party for enhancing the transparency of the information reported.

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

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

64. India reported information on constraints and gaps, and related financial, technical and capacity-building needs, in accordance with decision 2/CP.17, annex III, paragraph 14. In its BUR India identified limited financial resources, inadequate modelling capacity to adopt tier 3 methods and approach 3 for land-use measurements, and insufficient analysis capacity as constraints. India reported capacity gaps related to estimating and reporting GHG inventories, and establishing and implementing an integrated domestic MRV system, among other gaps. The Party reported that its financial, technical and capacity-building needs primarily consist of upgrading the EFs for some core sectors to tier 3 and closing the gaps in AD for the GHG inventory preparation for the energy, IPPU, agriculture, LULUCF and waste sectors. In addition, India reported its need to improve the quality, transparency and consistency of the GHG inventory in line with the requirements of the 2006 IPCC Guidelines.

65. India reported information on financial resources, capacity-building and technical support received in accordance with decision 2/CP.17, annex III, paragraph 15. In its BUR India reported that it received financial support from various sources, including (1) the GEF: USD 87.87 million under the climate change focal area, of which USD 59.08 million was approved; (2) the GEF in conjunction with the Adaptation Fund: USD 9.88 million; (3) the Green Climate Fund: USD 178.1 million; (4) the Climate Investment Fund: USD 774.37 million since the Fund's inception in 2008; (5) bilateral funding and support (through the Department for International Development of the United Kingdom of Great Britain and Northern Ireland): 12 million pounds sterling; and (6) India's National Adaptation Fund for Climate Change. The information reported in the BUR indicates that India received capacity-building and technical support from the GEF to facilitate the preparation of the NC3. Information on technology transfer received was not reported. During the technical analysis, India clarified that it did not receive technology transfer in line with the current provisions under the UNFCCC, hence it was not reported. The TTE noted that the Party clarifying that it received no technology transfer in the BUR could facilitate a better understanding of the information reported.

66. India reported 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. In its BUR India reported that the technology needs assessment was nationally determined. The technology needs assessment was the basis for the technology needs reported in the BUR.

67. 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 paragraph 65 above.

68. The TTE noted and commends India for improving the transparency of the information reported on constraints and gaps, and related technology, financial, technical and capacity-building needs, including a description of support needed and received, in response to the summary report on the technical analysis of its first BUR.

69. India reported that it carries out various international technical cooperation programmes with both developed and developing countries. The Party also reported that it participates in an annual workshop on GHG inventories in Asia, an initiative of the Government of Japan, to improve the quality of its inventory. The Party also reported its success in establishing memorandums of understanding with a number of countries to exchange and strengthen expertise in climate change mitigation and adaptation. Further, India reported that it has jointly launched, with the United States, the United States-India Climate Fellowship Program to build long-term capacity for addressing climate change related issues in both countries. Under this programme, the Fulbright-Kalam Climate Fellowship for Doctoral Research and the Fulbright-Kalam Climate Fellowship for Postdoctoral Research were established. The TTE commends India for its activities. The TTE noted that this information could be useful for understanding the circumstances of India with regard to support needs and support provided.

D. Any other information

70. India reported in its BUR, in the chapter on additional information, information on adaptation actions, research and systematic observation, gender considerations and awareness-raising. It provided information on solar energy, adaptation, international cooperation, civil society participation, knowledge management, and communications and outreach, all of which have potential implications for GHG emission reduction. The TTE commends India for reporting this information in the BUR. Regarding its rapidly evolving solar energy landscape, India shared success stories, including the 400 kW grid interactive rooftop solar power plant that was installed at M. Chinnaswamy Stadium in Bengaluru. Regarding adaptation measures, India reported on measures being undertaken to strengthen disaster preparedness and to manage the impacts of climate change, including the Disaster Management Act of 2005, which provided the basis for a holistic approach to disaster management and established the National Institute of Disaster Management, a government

think tank that works on all aspects of disaster management capacity-building, including policy planning and research.

71. In the area of research and systematic observation, India reported that it has developed the indigenous capability to launch satellites for remote sensing, meteorological, communication and navigational applications (BUR, section 1.14). Furthermore, various ocean and weather forecasting systems that use satellite data assimilation are in place in the country. The TTE commends India for reporting this information. Ocean forecasting systems cover storm surge prediction, advanced ocean state prediction (both wave component and circulation component) and seasonal prediction of El Niño using an ocean–atmosphere coupled model.

72. India reported that it has been implementing gender-related activities as part of its work to build adaptive capacities in, among other areas, community livelihoods and ecological security. Under the national REDD+ strategy of 2018 a road map was developed for addressing drivers of deforestation and forest degradation and issues of gender equality. Further, the Party reported information on major initiatives for raising awareness of the need for climate action among different stakeholders. These initiatives include the Science Express Climate Action Special (a train with a mobile exhibition to raise public awareness), the Environment Education, Awareness and Training scheme, the Green Good Deeds movement, a media fellowship, and the Energy Conservation Day and Award.

73. The Party reported additional information on areas related to the mitigation actions documented in chapter II.C.3 above. According to the Party, in its first BUR, a non-exhaustive list of policies and measures was reported and these were revisited and updated in appendix 1 to the second BUR. The appendix included two tables that provided information at the national and state level, respectively, on the sector, target and type of instrument. The information in the first table outlined the programmes, policies, measures and projects at the national level in areas related to agriculture, education, finance, forestry, health, renewable energy, transport, urban and water. In the second table, India reported climate change mitigation and related initiatives at the state level. In addition to the sectors identified in the first table, the Party reported information on biodiversity, fisheries and industry.

E. Identification of capacity-building needs

74. In consultation with India, the TTE identified the following needs for capacity-building that could facilitate the preparation of subsequent BURs and participation in ICA:

- (a) GHG inventory preparation:
 - (i) Estimating and reporting HFC, PFC and SF₆ emissions from, for example, air conditioning and refrigeration and the electronics industry and electrical equipment;
 - (ii) Estimating and reporting CO, NO_x, NMVOC and SO_x emissions;
 - (iii) Training on verification techniques for the reported emissions of key source categories;
 - (iv) Establishing a long-term institutional and operational system for periodic, continuous and enhanced GHG emission estimation for national reporting under various UNFCCC reporting requirements (i.e. a national inventory management system);
 - (v) Enhancing the GHG inventory by migrating to higher-tier levels in all sectors;
 - (vi) Modelling for tier 3 estimation of emissions and removals in the LULUCF sector;
- (b) Mitigation actions and their effects:
 - (i) Enhancing capacity for assessing and quantifying the impacts of mitigation actions at the state level;

- (ii) Enhancing capacity for developing mitigation actions in the waste sector and assessing and quantifying their impacts;
- (iii) Enhancing capacity for collecting data that would enable the calculation of the results achieved in terms of benefits of mitigation actions under the national afforestation programme, the Compensatory Afforestation Fund Management and Planning Authority bill, and the Nagar Van Udyan Yojana initiative;
- (iv) Establishing an integrated domestic MRV system with associated data management system for tracking emissions, mitigation actions and support (climate finance, technology transfer and capacity-building). In addition, enhancing technical capacity for developing the requisite tools (e.g. procedures, guidelines, rules) for MRV, where applicable.

75. The TTE noted that, in addition to those identified during the technical analysis, India reported a detailed list of capacity-building needs in its BUR (section 5.5) covering the following areas:

- (a) GHG inventory preparation: establishing a sustainable GHG management system, collecting and improving AD, and improving and moving to higher tiers of EFs;
- (b) Mitigation: designing and implementing afforestation and reforestation projects;
- (c) Adaptation: conducting impact and vulnerability assessments and implementing them at the sectoral, subregional and integrated level, and sensitizing the Indian population vulnerable to the adverse impacts of climate change;
- (d) Technology transfer: providing training and upgrading skills for personnel across sectors for improving technology and tracking technology transfer received.

III. Conclusions

76. The TTE conducted a technical analysis of the information reported in the second BUR of India in accordance with the UNFCCC reporting guidelines on BURs. The TTE concludes that the reported information is mostly consistent with the UNFCCC reporting guidelines on BURs and 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 removal by sinks of all GHGs not controlled by the Montreal Protocol, including a national inventory report; mitigation actions and their effects, including associated methodologies and assumptions; constraints and gaps and related financial, technical and capacity-building needs, including a description of support needed and received; the level of support received to enable the preparation and submission of BURs; domestic MRV; and any other information relevant to the achievement of the objective of the Convention. The TTE concluded that the information analysed is mostly transparent.

77. India has taken steps and made efforts towards creating sustainable institutional arrangements by expanding the institutional network and establishing administrative arrangements to facilitate reporting. With the aim of strengthening its reporting, since the preparation of the first BUR, additional institutions have been involved in the reporting process. Studies for the preparation of the GHG inventory were carried out by 11 institutions in their respective sectors of expertise. Regarding the institutional arrangements relevant to the preparation of its BURs, the Ministry of Environment, Forest and Climate Change is the focal point for the Government of India. It coordinates and manages climate change related programmes and actions and reporting of information pursuant to Article 4, paragraph 1, of the Convention. Since it serves a dual role as the implementing and executing entity, in order to facilitate the preparation of the second BUR the Ministry conducted relevant activities, including workshops and national consultations. Mitigation actions were reported by four institutions with expertise in different sectors relevant to the BUR. Two institutions were engaged to carry out studies pertaining to MRV arrangements and to constraints, gaps and related finance, technology and capacity-building needs. India has taken significant steps to

create institutional arrangements that allow for the sustainable preparation of its BURs. These include organizational improvements and knowledge-sharing procedures to facilitate sectoral information transfer. India reported that dedicated domestic MRV arrangements at the national level have yet to be established.

78. In its second BUR, submitted in 2018, India reported information on its national GHG inventory for 2014. The Party reported a consistent time series of the national inventory in graphic format for the period 2000–2014. This included GHG emissions and removals of CO₂, CH₄ and N₂O for all relevant sources and sinks. India did not report an inventory for the precursor gases. Estimates of fluorinated gases were provided for only some source categories owing to difficulties in obtaining the necessary data, as clarified by the Party during the technical analysis. The inventory was developed on the basis of the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines. For the LULUCF sector, the IPCC good practice guidance and the 2006 IPCC Guidelines were applied. The total GHG emissions for 2014 were reported as 2,607,488.12 kt CO₂ eq (excluding LULUCF) and 2,306,295.43 kt CO₂ eq (including LULUCF). Thirty key categories were identified, most of them within the energy sector and associated with CO₂.

79. India reported information on mitigation actions and their effects. In 2015, in its nationally determined contribution under the Paris Agreement, India voluntarily increased its target of reducing the emission intensity of its GDP by 33–35 per cent from the 2005 level by 2030 and stated a target of achieving about 40 per cent of its cumulative electric power installed capacity from non-fossil-fuel-based energy resources by 2030. The Party reported on three groups of mitigation actions: sectoral, major policies and programmes, and initiatives with indirect mitigation benefits. The methodologies and assumptions for the mitigation actions and their objectives were clearly reported. Information on steps envisaged or achieved was reported for most of the mitigation measures reported. The results achieved include co-benefits (such as the generation of employment), estimated outcomes and estimated emission reductions. Mitigation actions were reported in the energy, industry, building, forestry, agriculture and transport sectors, as well as under policies and programmes related to the waste sector. Of the measures that were quantified, the measure with the greatest impact was the national programme for LED-based home and street lighting: the replacement of 312 million incandescent lamps achieved an emission reduction of 33 Mt CO₂ eq per year, and a reduction of 3.29 Mt CO₂ eq was achieved from the street lighting programme. In the forestry sector, the National Horticulture Mission had a major impact and led to the sequestration of 137 Mt CO₂ from 2010 to 2016.

80. India reported information on constraints and gaps, and the related financial, technical and capacity-building needs, clearly identifying limited financial resources and inadequate modelling capacity as constraints. India reported information on financial resources, capacity-building and technical support received. Financial support was received from various sources, including the GEF, the Green Climate Fund and the Climate Investment Fund, and through bilateral funding.

81. The TTE, in consultation with India, identified capacity-building needs listed in chapter II.E above 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. India prioritized all the capacity-building needs set out in paragraphs 74 and 75 above.

Annex I

Extent of the information reported by India in its second biennial update report

Table 1

Identification of the extent to which the elements of information on greenhouse gases are included in the second biennial update report of India

<i>Decision</i>	<i>Provision of the reporting guidelines</i>	<i>Yes/partly/no/NA</i>	<i>Comments on the extent of the information provided</i>
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	India submitted its second BUR in December 2018; the GHG inventories reported are for 1994 and 2000–2014.
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 COP or those determined by any future decision of the COP on this matter.	Yes	India used a combination of the Revised 1996 IPCC Guidelines and 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	The updated data used for the estimation of emissions and removals for 2014 have been reported in the BUR.
Decision 2/CP.17, annex III, paragraph 6	Non-Annex I Parties are encouraged ^a 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;	Partly	India reported aggregately the land area and the associated emissions and removals for the main LULUCF subsectors, without including information on AD, EFs or parameters such as annual change in carbon stock by carbon pool that were used for the estimation of emissions and removals. In table 2.14, the information reported includes a summary of LULUCF emission estimates, and in table 2.13 information on land-use change for 2005–2014 has been reported. Information on carbon stock changes was not reported as the estimates are mostly based on the 2006 IPCC Guidelines.
	(b) The sectoral report tables annexed to the Revised 1996 IPCC Guidelines.	Partly	India included a sectoral table for 2014 (table 2.22). Sectoral information has been provided as

Decision	Provision of the reporting guidelines	Yes/partly/no/NA	Comments on the extent of the information provided
			per the tables annexed to the Revised 1996 Guidelines. For the agriculture, LULUCF and waste sectors, the level of disaggregation by sector or subsector of emission estimates provided in the table is less detailed as compared with the sectoral report tables annexed to the Revised 1996 IPCC Guidelines. For example, emissions associated with the source category enteric fermentation were reported in aggregate and not separately for each animal type.
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.	Partly	India included the national inventory for 1994, 2000, 2007 and 2010, disaggregated by sector. The Party also reported a consistent time series for the national inventory in graph format for 2000–2014. However, a consistent time series back to the years reported in the NC1 was not reported owing to comparability issues.
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	India provided a summary information table of the national inventories for 1994, 2000 and 2010 reproduced from its previous submissions.
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	
	(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 table 2.22.
	(b) Table 2 (National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF ₆).	Yes	Comparable information was reported in table 2.22.
Decision 2/CP.17, annex III, paragraph 10	Additional or supporting information, including sector-specific information, may be supplied in a technical annex.	NA	
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	Yes	

<i>Decision</i>	<i>Provision of the reporting guidelines</i>	<i>Comments on the extent of the Yes/partly/no/NA information provided</i>	
	continuous process, including information on the role of the institutions involved.		
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 ₂ O.	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;	Partly	HFCs (HFC-23) from halocarbon production were reported.
	(b) PFCs;	Partly	PFCs (tetrafluoromethane and hexafluoroethane) from aluminium production were reported.
	(c) SF ₆ .	Partly	SF ₆ from magnesium production was reported.
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 SO _x , and included in the Revised 1996 IPCC Guidelines may be included at the discretion of Parties.	No	The Party did not report on other gases, such as SO _x .
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.	Yes	
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 Second Assessment Report based on the effects of GHGs over a 100-year time-horizon.	Yes	
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		

Decision	Provision of the reporting guidelines	Yes/partly/no/NA	Comments on the extent of the information provided
	<p>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:</p> <p>(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;</p> <p>(b) Explanation of the sources of EFs;</p> <p>(c) Explanation of the sources of AD;</p> <p>(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:</p> <p>(i) Source and/or sink categories;</p> <p>(ii) Methodologies;</p> <p>(iii) EFs;</p> <p>(iv) AD;</p> <p>(e) Parties are encouraged to identify areas where data may be further improved in future communications through capacity-building.</p>	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>NA</p> <p>Yes</p>	<p>India used a combination of the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines. Tier 1, 2 and 3 methodologies were used for the sectors reported in table 2.1.</p> <p>India used both default EFs from the Revised 1996 IPCC Guidelines and the 2006 IPCC Guidelines and country-specific EFs, as reported in table 2.1.</p> <p>India used the 2006 IPCC Guidelines and a national methodology.</p>
Decision 17/CP.8, annex, paragraph 22	Each non-Annex I Party is encouraged to use tables 1 and 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	Notation keys were not used in tables 1 and 2. Limited use of notation keys was made in the table in the appendix to chapter 2.
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;	Partly	The uncertainty assessment was carried out only for key categories. The total uncertainty and the trend uncertainty of the inventory were not reported.
	(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, paragraphs 3–10 and 41(g). Further, as per paragraph 3 of those guidelines, non-Annex I Parties are to submit updates of their national GHG inventories in accordance with 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. 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.

^a The Party clarified that all the reporting provisions that are encouraged are non-mandatory and its capacity to report such information is determined by the support received, data availability and available institutional capacity. Further, the Party clarified that it does not consider working on non-mandatory items to be an efficient use of the resources provided.

Table 2

Identification of the extent to which the elements of information on mitigation actions are included in the second biennial update report of India

<i>Decision</i>	<i>Provision of the reporting guidelines</i>	<i>Yes/partly/no</i>	<i>Comments on the extent of the information provided</i>
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:		
	(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	The Party reported quantified emission reductions for the energy, forestry, agriculture and transport sectors as part of the information on mitigation actions to the extent possible.
	(e) Information on international market mechanisms.	Yes	Information was included as part of the mitigation actions reported.

<i>Decision</i>	<i>Provision of the reporting guidelines</i>	<i>Yes/partly/no</i>	<i>Comments on the extent of the information provided</i>
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, paragraphs 11–13.

Table 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 second biennial update report of India

<i>Decision</i>	<i>Provision of the reporting requirements</i>	<i>Yes/partly/no</i>	<i>Comments on the extent of the information provided</i>
Decision 2/CP.17, annex III, paragraph 14	Non-Annex I Parties should provide updated information on:		
	Constraints and gaps;	Yes	
Decision 2/CP.17, annex III, paragraph 15	Related financial, technical and capacity-building needs.	Yes	
	Non-Annex I Parties should provide:		
	(a) Information on financial resources received, technology transfer and capacity-building received;	Partly	Information on technology transfer received was not reported.
Decision 2/CP.17, annex III, paragraph 16	(b) Information on technical support received from the GEF, 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.	Yes	
	With regard to the development and transfer of technology, non-Annex I Parties should provide information on:		
	Nationally determined technology needs;	Yes	
	Technology support received.	Partly	Information on technology support received was not reported.

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, paragraphs 14–16.

Annex II

Documents and information used during the technical analysis

Reference documents

First BUR of India. Available at <http://unfccc.int/8722.php>.

Ganesan AL, Rigby M, Lunt MF, et al. 2017. Atmospheric observations show accurate reporting and little growth in India's methane emissions. *Nature Communications*. 8(1): pp.1–7. Available at <https://doi.org/10.1038/s41467-017-00994-7>.

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NC1 and NC2 of India.

Available at http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php.

Summary report on the technical analysis of the first BUR of India. Available at http://unfccc.int/national_reports/non-annex_i_parties/ica/technical_analysis_of_burs/items/10054.php.