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**Report of the individual review of the greenhouse gas inventories of Turkey  
submitted in 2007 and 2008<sup>\*</sup>**

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<sup>\*</sup> In the symbol for this document, 2008 refers to the year in which the inventory was submitted, and not to the year of publication.

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## I. Executive summary

1. This report covers the in-country review of the 2007 and 2008 greenhouse gas (GHG) inventory submissions of Turkey, coordinated by the UNFCCC secretariat, in accordance with decision 19/CP.8. The review took place from 13 to 18 October 2008 in Ankara, Turkey, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Klaus Radunsky (Austria); energy – Mr. Leif Hockstad (United States of America); industrial processes – Mr. Mauro Meirelles de Oliveira Santos (Brazil); agriculture – Ms. Britta Hoem (Norway); land use, land-use change and forestry (LULUCF) – Mr. Daniel Martino (Uruguay); and waste – Mr. Amr Osama Abdel-Aziz (Egypt). Mr. Hockstad and Mr. Martino were the lead reviewers. The review was coordinated by Mr. Harald Diaz-Bone and Mr. Vitor Gois Ferreira (UNFCCC secretariat).
2. In accordance with the “Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention” (hereinafter referred to as UNFCCC review guidelines), a draft version of this report was communicated to the Government of Turkey, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.
3. In 2006 (as reported in the 2008 inventory submission), the main GHG in Turkey was carbon dioxide (CO<sub>2</sub>), accounting for 82.5 per cent of total GHG emissions<sup>1</sup> expressed in CO<sub>2</sub> eq, followed by methane (CH<sub>4</sub>) (15.2 per cent), and nitrous oxide (N<sub>2</sub>O) (1.4 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>) collectively accounted for 0.9 per cent of the overall GHG emissions in the country. The energy sector accounted for 77.8 per cent of the total GHG emissions, followed by waste (9.1 per cent), industrial processes (8.2 per cent) and agriculture (4.9 per cent). Total GHG emissions amounted to 331,763.40 Gg CO<sub>2</sub> eq and increased by 95.1 per cent between the base year<sup>2</sup> and 2006. In 2005 (as reported in the 2007 inventory submission), total GHG emissions amounted to 312,420.27 Gg CO<sub>2</sub> eq. The shares of gases and sectors in 2006 (2008 inventory submission) were similar to those of 2005 (2007 inventory submission).
4. Tables 1 and 2 show GHG emissions by gas and by sector, respectively.
5. The inventory of Turkey is partially in line with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). The expert review team (ERT) noted that there are deficiencies of varying degrees with respect to all the inventory reporting principles (i.e. transparency, completeness, comparability, consistency, accuracy), the majority of these deficiencies are evidently due to the lack of proper institutional and organizational arrangements and an adequate allocation of resources for preparing and reporting the emission inventories.

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<sup>1</sup> In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO<sub>2</sub> eq excluding LULUCF, unless otherwise specified.

<sup>2</sup> Base year refers to 1990 for all gases.

**Table 1. Greenhouse gas emissions by gas, 1990–2006**

| Greenhouse gas emissions | Gg CO <sub>2</sub> eq |           |           |           |           |           |           |           | Change<br>base year 2006<br>(%) |
|--------------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------------------|
|                          | Base<br>year          | 1990      | 1995      | 2000      | 2003      | 2004      | 2005      | 2006      |                                 |
| CO <sub>2</sub>          | 139 594.1             | 139 594.1 | 171 853.8 | 223 806.0 | 230 987.3 | 241 884.4 | 256 433.7 | 273 704.7 | 96.1                            |
| CH <sub>4</sub>          | 29 207.2              | 29 207.2  | 42 538.8  | 49 268.9  | 47 756.9  | 46 289.7  | 49 316.9  | 50 330.1  | 72.3                            |
| N <sub>2</sub> O         | 1 257.5               | 1 257.5   | 6 326.7   | 5 739.7   | 5 252.2   | 5 494.5   | 3 431.9   | 4 594.3   | 265.4                           |
| HFCs                     | NA                    | NA        | NA        | 818.4     | 1 806.7   | 2 228.7   | 2 379.0   | 2 729.7   | NA                              |
| PFCs                     | NA                    | NA        | NA        | NA        | NA        | NA        | NA, NE    | 404.6     | NA                              |
| SF <sub>6</sub>          | NA, NE                | NA, NE    | NA, NE    | 322.9     | 479.4     | 704.6     | 858.7     | NA, NE    | NA                              |

Abbreviations: NA = not applicable; NE = not estimated.

**Table 2. Greenhouse gas emissions by sector, 1990–2006**

| Sectors                       | Gg CO <sub>2</sub> eq |           |           |           |           |           |           |           | Change<br>base year 2006<br>(%) |
|-------------------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------------------|
|                               | Base<br>year          | 1990      | 1995      | 2000      | 2003      | 2004      | 2005      | 2006      |                                 |
| Energy                        | 132 128.4             | 132 128.4 | 160 787.6 | 212 546.3 | 218 004.5 | 227 429.7 | 241 449.7 | 258 206.6 | 95.4                            |
| Industrial processes          | 13 070.5              | 13 070.5  | 21 644.1  | 22 232.4  | 24 125.0  | 26 448.3  | 25 394.8  | 27 125.3  | 107.5                           |
| Solvent and other product use | NA, NE                | NA, NE    | NA, NE    | NA, NE    | NA, NE    | NA, NE    | NA, NE    | NA, NE    | NA                              |
| Agriculture                   | 18 473.4              | 18 473.4  | 17 973.8  | 16 134.7  | 14 795.7  | 15 177.8  | 15 823.4  | 16 366.6  | –11.4                           |
| LULUCF                        | –44 086.9             | –44 086.9 | –60 736.8 | –65 609.0 | –65 753.4 | –73 244.4 | –69 493.8 | –76 104.3 | 72.6                            |
| Waste                         | 6 386.5               | 6 386.5   | 20 313.8  | 29 042.6  | 29 357.4  | 27 546.1  | 29 752.3  | 30 064.9  | 370.8                           |
| Other                         | NA                    | NA        | NA        | NA        | NA        | NA        | NA        | NA        | NA                              |
| <b>Total (with LULUCF)</b>    | 125 971.8             | 125 971.8 | 159 982.4 | 214 346.9 | 220 529.1 | 223 357.5 | 242 926.4 | 255 659.1 | 102.9                           |
| <b>Total (without LULUCF)</b> | 170 058.7             | 170 058.7 | 220 719.3 | 279 956.0 | 286 282.5 | 296 601.9 | 312 420.3 | 331 763.4 | 95.1                            |

Abbreviations: LULUCF = land use, land-use change and forestry; NA = not applicable; NE = not estimated.

6. The 2008 inventory submission covers most sectors and categories; however, the ERT identified a need for further improvements in the following areas: timeliness of the submission, completeness and transparency. To this end, the ERT recommends that Turkey identify, within the next year, a single national entity with responsibility for the inventory submission, strengthen the institutional system and, in particular, its decision-making capacity, develop an improvement plan for the inventory with the aim of preparing an inventory submission that is fully consistent with UNFCCC and IPCC guidelines, and provide the necessary human and financial resources to implement the improvement plan described above.

7. The ERT also recommends that the Party establish a formal quality assurance/quality control (QA/QC) system in order to guarantee the long-term robustness of the institutional system.

## II. Overview

### A. Inventory submission and other sources of information

8. The 2008 inventory was submitted on 21 August 2008; it contains a complete set of common reporting format (CRF) tables for the period 1990–2006. A preliminary national inventory report (NIR) was submitted on 9 October 2008. In its 2007 submission, Turkey included a complete set of CRF tables for the period 1990–2005 and an NIR. Where necessary, the ERT also used the 2006 submission during the review.

9. During the review, Turkey provided the ERT with additional information. The documents concerned are not part of the inventory submission but are, in many cases, referenced in the NIR. The full list of materials used during the review is provided in the annex to this report.

### B. Key categories

10. Turkey has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2008 submission. The key category analysis performed by the Party and that performed by the secretariat<sup>3</sup> produced different results owing to different sector splits and the fact that Turkey has not included the LULUCF sector in its key category analysis, as recommended by the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. Turkey identified the same key categories in the 2007 submission. Turkey did not identify additional key categories using a qualitative approach and, so far, does not use the results of the key category analysis as a driving factor for the preparation of the inventory.

11. The ERT recommends that Turkey include the LULUCF sector in its key category analysis in its next submission and use the results of the key category analysis as a driving force for the preparation of its inventory. The ERT also suggests that the Party improve the transparency of the approach used by ranking categories according to their contribution to the emissions trend in a separate table in the annex to the NIR and provide information about additional key categories that were identified by the trend assessment.

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<sup>3</sup> The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC *good practice guidance for Land Use, Land-Use Change and Forestry*. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

## **C. Cross-cutting issues**

### **1. Completeness**

12. The 2008 inventory submission shows full coverage for all years 1990–2006, but some source categories are missing in the reporting for every sector. Therefore, the ERT noted that the inventory submission is incomplete. The omissions also relate to potential key categories, for example N<sub>2</sub>O emissions from manure management. The ERT believes that many of the gaps in emission data can be addressed by even a modest effort to improve reporting. The ERT noted with interest the ongoing efforts made by Turkey to improve completeness, for example in the European Union (EU) project, upgrading the Statistical System of Turkey. The ERT encourages Turkey to intensify these efforts and recommends that the Party estimate emissions for all categories not yet addressed in its next inventory submission and use simplified country-specific methods, depending on the availability of data.

### **2. Transparency**

13. The information in the NIR is still incomplete and partly unclear and inconsistent with the CRF tables. The ERT acknowledges that Turkey has provided additional information, for example, explanations of trends, during the in-country review. The ERT encourages Turkey to further improve transparency of its national inventory submission by including the following: more detailed information on the choice of all methodologies, assumptions and activity data (AD); all references to the external sources used for inventory preparation; more detailed information on the national energy balances; and further explanation of emission trends and AD for sectors and key categories, especially in the case of fluctuations. The ERT also encourages Turkey to use notation keys in CRF tables consistent with the UNFCCC reporting guidelines and provide explanations for the use of each notation key in the CRF tables (in particular table 9(a)). The ERT recommends that Turkey reconsider the internal schedule, in particular with regard to the finalization of the NIR, which needs to be submitted by 15 April each year.

### **3. Recalculations and time-series consistency**

14. Information on recalculations was not provided in the CRF or NIR. In CRF table 8 (a), for 1990–2006, the same values have been reported in both the previous submission and the latest submission. The ERT noted that recalculations have been prepared by Turkey, following recommendations made during the review process, but have not been reported. The ERT recommends that Turkey prepare recalculations for the entire time series every year, in order to fully reflect the progress made in improving the GHG emission inventory, and strictly follow the reporting requirements of the UNFCCC reporting guidelines, in order to allow for the necessary transparency and consistency. The ERT noted that, in future inventory submissions, time-series consistency might become a problem owing to changes in data collecting methods (e.g. in the agriculture and waste sectors).

### **4. Uncertainties**

15. Uncertainty analysis is mainly based on expert judgment. However, there is a lack of transparency as there is no documentation on how the expert judgment was obtained. No update on the uncertainty estimate has been reported in the 2008 submission. The ERT welcomes the intention of Turkey to improve transparency with regard to the estimation of uncertainty and encourages the Party to update the uncertainty estimate every year. The ERT also recommends that the uncertainty analysis is used to inform the inventory improvement plan.

### **5. Verification and quality assurance/quality control approaches**

16. During the in-country review, the ERT was informed that QA is mainly carried out by the Turkish Statistical Institute (TurkStat) and that verification of emission data for transport and public electricity production occurred. QC is carried out by individual organizations within their responsibility for each respective sector. However, there has been no documentation of QC and there is a lack of a

formal QA/QC plan as requested by the IPCC Good Practice Guidance. The ERT recommends that Turkey: establish a formal QA/QC plan in accordance with the IPCC good practice guidance; clearly define and document all responsibilities of institutions/experts with regard to their contribution to the national GHG inventory, including QA/QC, and document this in the next NIR; and introduce better documentation of QC at all stages of inventory preparation.

#### 6. Institutional arrangements

17. During the in-country visit, Turkey explained the institutional arrangements for the preparation of the inventory. Until now the responsibility for the national inventory has been mainly shared between the Ministry of Environment and Forestry (MoEF) and TurkStat. Other ministries, organizations and institutions, as well as universities, are also involved in the preparation of the inventory.

18. In general, climate change activities are coordinated by the undersecretary of the MoEF under the inter-ministerial Coordination Board on Climate Change (CBCC). The CBCC was established in 2001 in accordance with a circular issued by the Prime Minister. The CBCC currently comprises eight working groups, and the Working Group on Emission Inventory of Greenhouse Gases, coordinated by TurkStat, is responsible for preparing the CRF tables and the NIRs.

19. The ERT was informed during the in-country review that the institutional arrangements are being further developed, with the aim of strengthening them. This process includes establishing two additional working groups, as well as climate change focal points in all institutions represented in the CBCC and identifying a single national entity with responsibility for the inventory submission. The ERT welcomes these plans by Turkey to further strengthen its institutional arrangements and recommends that the Party identify the single national entity with responsibility for the inventory submission, establish an improvement plan for the inventory with ambitious but workable timelines, and provide the necessary financial and human resources for its implementation.

#### 7. Inventory management

20. Turkey does not yet have an archiving system that is consistent with UNFCCC reporting guidelines and the IPCC Good Practice Guidance. The ERT recommends that Turkey establish an archiving system that includes the archiving of disaggregated emission factors (EFs) and AD, and document how these EFs and AD have been generated and aggregated for the preparation of the inventory. The archived information should also include internal documentation on QA/QC procedures, external and internal reviews, and documentation for each year on annual key categories, key category identification and planned inventory improvements. The archiving system should be held by the single national entity with responsibility for the inventory submission.

#### 8. Follow-up to previous reviews

21. The ERT noted that recommendations from previous reviews have been taken into account in inventory development; however, the follow-up on recommendations from the previous review was limited and not well documented. The ERT recommends that Turkey install a transparent and well-documented regular procedure that allows managing the improvement of the national GHG inventory according to well-prescribed priorities, in order to make best use of the resources available. The ERT also recommends that the Party develop an improvement plan for the inventory with the aim of preparing an inventory submission that is fully consistent with UNFCCC and IPCC guidelines, in particular with regard to timeliness, completeness and transparency.



## **D. Areas for further improvement**

### **1. Identified by the Party**

22. The 2008 NIR addresses plans for improvement relating to energy use in transport and the LULUCF sector. During the review Turkey indicated its plans to also improve transparency, completeness and the institutional system.

### **2. Identified by the expert review team**

23. Based on the findings of the in-country review, the ERT identified the following cross-cutting issues as priority items for improvement. Turkey should:

- (a) Identify a single national entity with responsibility for the inventory submission;
- (b) Strengthen the institutional arrangements as described during the in-country review;
- (c) Develop an improvement plan for the inventory with the aim of preparing an inventory submission that is fully consistent with UNFCCC and IPCC guidelines, in particular with regard to timeliness, completeness and transparency;
- (d) Establish a formal QA/QC system in accordance with best practice;<sup>4</sup>
- (e) Provide the necessary human and financial resources to implement the activities described above.

24. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

## **III. Energy**

### **A. Sector overview**

25. In 2006, the energy sector was the largest source of GHG emissions in Turkey, accounting for 258,206.6 Gg CO<sub>2</sub> eq. Emissions from the sector increased by 95.4 per cent between 1990 and 2006. The key driver for the rise in emissions, as described in the NIR, was the growing economy in Turkey, which has led to a large growth in energy demand in the country. The energy sector represented 77.8 per cent of total GHG emissions in 2006 (excluding LULUCF); this is equivalent to the percentage contribution seen in 1990. Within the energy sector, energy industries accounted for 35.2 per cent of the total sectoral emissions, followed by manufacturing industries and construction (29.9 per cent), transport (17.2 per cent), energy use in other sectors (1.A.4) (17.0 per cent) and fugitive emissions, reported for solid fuels (0.6 per cent). There were no major changes or differences in the energy sector between the 2007 and 2008 submissions. Methodological choices in the energy sector were the same and Turkey did not implement recalculations in the 2008 submission for any source category estimates presented in the 2007 submission.

### **1. Completeness**

26. The CRF tables include estimates of most gases and most categories of emissions from the energy sector, as recommended by the Revised 1996 IPCC Guidelines. The reporting of the energy sector in the 2008 submission (as well as the 2007 submission) is mostly complete for the fuel combustion source categories. However, the reporting of fugitive emissions from fuels was incomplete,

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<sup>4</sup> Best practice with regard to QA/QC can be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1 - General Guidance and Reporting.

as only fugitive emissions from mining were reported in the inventory submission. Fugitive emissions from oil and natural gas were reported as not estimated (“NE”). Emissions from subsector Other (1.A.5) were reported as not applicable (“NA”) and not occurring (“NO”). As fugitive emissions from oil and natural gas are not estimated, despite such activity in Turkey, the ERT recommends that Turkey report all categories of fugitive emissions. Further clarification should be provided that the reporting in the Other (1.A.5) fuel combustion category is complete. In the case of the category Other (1.A.5), normally used to report military fuel consumption and emissions, the ERT recommends that Turkey investigate whether end-use fuel consumption is currently included in other fuel consumption statistics, or whether this is an issue of incomplete reporting.

## 2. Transparency

27. With regard to transparency, the ERT noted that efforts are required by Turkey in future submissions to improve this cross-cutting issue in the energy sector. Currently, the NIR and CRF tables do not contain the proper documentation and level of detail necessary to review the calculations of the energy sector. The ERT recommends that Turkey improve its documentation of the fuel consumption AD used in the calculations (including the sources of those data) and further explain and document any methodological assumptions. These recommendations apply to all source categories in the energy sector. However, the ERT noted that added transparency is needed especially in certain energy sector categories, such as energy industries and energy use in transport, because of shared data and multiple calculation responsibilities in the national system.

## 3. Recalculations and time-series consistency

28. Recalculations were not performed for the energy sector in either the 2007 or the 2008 inventory submissions. The inventory submissions exhibit general time-series consistency in terms of methodological approaches. However, there are some time-series consistency issues regarding the reporting of fuel consumption in the CRF tables. This is especially the case for biomass consumption, which is reported under solid fuels (normally reserved for solid fossil fuel AD) for the 1990 to 2004 CRF tables, before being correctly reported in the biomass AD section of the tables in 2005 and 2006. The ERT recommends that Turkey correct this inconsistency in biomass AD reporting in the CRF tables in its future submissions.

## 4. Uncertainties

29. Uncertainties have been estimated based on varying procedures. For some categories, expert judgment is cited (though not transparently documented), while in other categories, the uncertainty analysis depends upon the differences seen in fuel consumption data that are reported in different publications. This approach is not consistent with the IPCC good practice guidance, and the ERT encourages Turkey to refer to this guidance when developing its uncertainty analysis for the energy sector.

## 5. Verification and quality assurance/quality control approaches

30. Turkey has implemented some QA/QC approaches in the energy sector, but they are not well documented in the NIR. The ERT encourages additional QA/QC steps beyond those already detailed during the in-country review in order to ensure accurate reporting, given the interactions of data in the energy sector. In addition, the ERT recommends that Turkey integrate QA/QC procedures to confirm the comparability of fuel consumption reported in the CRF tables with the values prepared by source category leads and reported in the national energy statistics.

## **B. Reference and sectoral approaches**

### **1. Comparison of the reference approach with the sectoral approach and international statistics**

31. Turkey has calculated CO<sub>2</sub> emissions from fuel combustion using the IPCC reference approach and the sectoral approach, and has provided data in CRF table 1.A(c) for the entire time series. In 2006, there was a difference of 9.65 per cent in the CO<sub>2</sub> emission estimates and of 13.33 per cent in the fuel consumption estimates between the reference and sectoral approaches. These differences resulted in an apparent underestimation of the CO<sub>2</sub> emissions reported for 2006 in the inventory submission using the sectoral approach. Turkey noted in the CRF documentation boxes that the differences are due to the availability of heat content data for liquid fuels in the inventory's sectoral approach in recent reported years. It was determined during the in-country review that end-use sector consumption of liquid fuels is uncertain in some sectors (namely, energy use in transport and other sectors). The ERT recommends that Turkey further investigate these differences, and the apparent lack of full sectoral fuel consumption data collection in the country, for future inventory submissions. Differences with comparable international data were not discussed during the in-country review owing to the late compilation of data by international agencies.

### **2. International bunker fuels**

32. Turkey does not report international bunker fuels in the 2007 and 2008 inventory submissions, explaining in the NIR that this was not possible owing to a lack of fuel registration data for both aviation and marine fuels. During the in-country review, the ERT learned that data from airports in Turkey on fuels sold for domestic aviation and international aviation are reported to the Ministry of Transport (MOT). The amount of fuel sold for domestic aviation, as reported by the airports, was then used to calculate emissions from civil aviation as reported in the inventory submission. The ERT encourages Turkey to clarify this data collection effort, and to explore possible coordination in the use of these data for the reporting of international bunker fuels in future inventory submissions. If the data are deemed appropriate, the ERT then encourages Turkey to report international aviation bunker fuels using the airport data on fuel sold for international aviation. The ERT also encourages further coordination between ministries in order to determine if a similar set of data is collected for marine fuels at ports.

### **3. Feedstocks and non-energy use of fuels**

33. Turkey reported the carbon stored in gas/diesel oil in CRF table 1.A(d); the documentation box does not provide details on feedstocks and non-energy use of gas/diesel oil. Details on the AD and storage factors were not provided in the NIR. No other feedstocks and possible non-energy uses of fuels were reported. During the in-country review, the ERT was informed that very limited data are currently collected on feedstocks and non-energy uses of fuels by the Ministry of Energy and Natural Resources (MENR). The ERT recommends that Turkey explore future data collection efforts for quantifying the amount of feedstocks and non-energy uses of fuels, and that the Party use the documentation box in CRF table 1.A(d) to explain future reporting.

## **C. Key categories**

### **1. Fuel combustion, stationary sources – CO<sub>2</sub>**

34. In the 2007 and 2008 inventory submissions, Turkey calculates CO<sub>2</sub> emissions using the IPCC tier 1 methodology, with default EFs from the Revised 1996 IPCC Guidelines. The use of tier 1 methodologies for key categories is not in line with IPCC good practice guidance.

35. The quality of data varies among the stationary fuel combustion sources. In the case of public electricity and heat production, data on fuel consumption are collected directly from each plant, and the Electricity Generation Company General Management (EÜAŞ) calculates CO<sub>2</sub> emissions using default EFs. However, plants are also providing information to EÜAŞ with data on plant-specific fuel

characteristics used in combustion, and more robust calculations are then performed with this detailed information. Since this higher tier calculation is already provided, in accordance with the IPCC good practice guidance, the ERT recommends that Turkey stop using default EFs, and instead use the plant-specific calculations already provided by EÜAŞ.

36. For energy use in the industrial sectors, including petroleum refining and manufacturing industries and construction, the MENR collects fuel consumption data directly from plants in the respective industries. In this case, the AD is of good quality, but the tier 1 methodology is still applied. The ERT recommends that Turkey develop data collection on fuel characteristics from this sector, especially for any fuels with variable heat and carbon contents. As the data become available, this will enable Turkey to follow the IPCC good practice guidance and calculate emissions from these sectors using a higher tier method for its future inventory submissions.

37. The remaining fuel consumption data collection efforts are less robust at this time; MENR makes assumptions on fuel consumption for the remaining end-users, which are currently reported under the other sectors category (1.A.4), consisting of residential, and agriculture/forestry/fisheries. Emissions from the commercial/institutional category were reported as included elsewhere ("IE") in the 2008 inventory submission. During the in-country review, it was determined that this category is likely to be included in the residential category. Also during the review, Turkey explained that assumptions are used to distribute fuel consumption to the other sectors (1.A.4) category, but that the person from whom these assumptions originated has since retired from MENR. Given the current difficulties in collecting data on fuel consumption and the use of assumptions, the ERT recommends that Turkey increase the transparency of its calculations by documenting assumptions made on AD. The ERT encourages Turkey to increase transparency of the difficulties of the other sector category (1.A.4) in order to facilitate future improvements and data collection efforts.

## 2. Fuel combustion, mobile sources: liquid and biomass fuels – CO<sub>2</sub>

38. In the 2008 and 2007 inventory submissions, Turkey calculates CO<sub>2</sub> emissions using the IPCC tier 1 methodology, with default EFs from the Revised 1996 IPCC Guidelines. The use of tier 1 methodologies for key categories is not in line with the IPCC good practice guidance. Turkey has reported the major categories in transport: civil aviation, road transportation, railways, and navigation in the CRF tables and the NIR.

39. While the MENR is responsible for the overall energy balance and statistics for Turkey, the MOT has developed fuel consumption AD for the transport categories. During the in-country review, it was determined that the different fuel consumption estimates are not necessarily reconciled and referenced against each other. While some fuels are almost exclusively consumed in the transport sector (e.g. jet kerosene), other fuels have multiple end-uses across the stationary combustion and mobile combustion subsectors (e.g. gas/diesel oil and liquefied petroleum gas (LPG)). The ERT noted that this possible correction of the sectoral fuel consumption is important, not only because of the effects on consumption in other sectors, but also because the subsequent calculations for CH<sub>4</sub> and N<sub>2</sub>O from road transportation depend upon the CO<sub>2</sub> calculation for estimating the number of kilometres travelled per vehicle type and mode. Given the issues with liquid fuels in the comparison of the reference and sectoral approaches, the ERT recommends that Turkey develop arrangements to better share data between ministries and to coordinate and communicate calculations. The documentation of methods and data sources used in the energy sector would improve transparency and facilitate this sharing of data. The ERT also recommends, concurrent with efforts in other sectors, that Turkey determine country-specific EFs in order to implement higher tier methods in the transport sector.

40. As discussed with regard to international bunker fuels, the MOT collects AD from airports in Turkey and uses these data for calculating emissions from domestic civil aviation. Turkey has improved

the discussion of trends in the NIR for the transport categories in the 2008 submission beyond that given in the energy chapter of the 2007 NIR.

### 3. Fugitive emissions: solid fuels – CH<sub>4</sub>

41. In the 2007 and 2008 inventory submissions, Turkey calculates CH<sub>4</sub> emissions using the IPCC tier 1 methodology, with default EFs from the Revised 1996 IPCC Guidelines. The use of tier 1 methodologies for key categories is not in line with IPCC good practice guidance. AD from the MENR appears to be accurate and the ERT therefore recommends that future data collection efforts focus on EFs that will allow higher tier calculation methods.

## **D. Non-key categories**

### Fuel combustion, road transportation: liquid – CH<sub>4</sub> and N<sub>2</sub>O

42. In the 2007 and 2008 inventory submissions, Turkey calculates CH<sub>4</sub> and N<sub>2</sub>O emissions using an IPCC tier 2 and 3 methodology, utilizing the CORINAIR model for road transportation. As discussed with regard to CO<sub>2</sub> emissions, the CH<sub>4</sub> and N<sub>2</sub>O emission calculations are linked to the fuel consumption developed by the MOT in order to match vehicle kilometres travelled with total fuel use. The MOT also collects information on vehicle registration numbers and kilometres travelled as inputs to this calculation. The ERT recommends that Turkey improve the transparency of these calculations, and further discuss the data collection efforts for the input data for this model. In particular, better documentation should be provided in the NIR on the assumptions used to integrate the CORINAIR model with vehicles and driving conditions in Turkey.

## **E. Areas for further improvement**

### 1. Identified by the Party

43. Turkey identified few planned improvements in the NIR of the 2008 submission for the energy sector. The main improvement identified was a project to study and gather data on driving cycles, vehicle conditions, and EFs, which would be used to improve the higher tier calculation methodology currently used to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation.

### 2. Identified by the expert review team

44. Given the importance of the energy sector, there are additional areas for further improvement, beyond the cross-cutting and source-specific recommendations described previously. In addition to those recommendations, the ERT recommends that Turkey:

- (a) Begin efforts to calculate emissions from key categories in the energy sector using country-specific tier 2 methods;
- (b) Enhance collaboration between agencies in order to improve the coordination of fuel consumption statistics and calculation estimates, owing to the linkages of fuel statistics in the energy sector. Specifically, continuous updates and corrections should be made to the primary dataset used for the calculations in order to eliminate any inconsistencies, chiefly in the sectoral use of liquid fuels, such as diesel oil and LPG;
- (c) Develop an improvement plan to gather studies on country-specific fuel characteristics, either through existing data collection efforts or through new studies.

45. In addition, the ERT encourages Turkey to prioritize its future data collection improvements in sectors and fuels with low data confidence in order to begin implementing higher tier calculation methods in future inventory submissions.

## **IV. Industrial processes and solvent and other product use**

### **A. Sector overview**

46. In 2006, the industrial processes sector accounted for 27,125.3 Gg CO<sub>2</sub> eq, or 8.2 per cent, of total GHG emissions. Emissions from the solvent and other product use sector were reported as “NA” or “NE”. Emissions from the industrial processes sector increased by 107.5 per cent between 1990 and 2006. The key driver for the rise in emissions is the increase of CO<sub>2</sub> (88.5 per cent) from cement production. Other sources were also significant in the rise of industrial processes emissions: N<sub>2</sub>O from nitric acid production increased by 2,263.9 per cent in the period, and the consumption of halocarbons and SF<sub>6</sub> also increased.

47. Within the industrial processes sector, 74.7 per cent of GHG emissions were from mineral products (i.e. CO<sub>2</sub> from cement production), followed by 12.0 per cent from chemical industries (i.e. N<sub>2</sub>O from nitric acid production) and 10.1 per cent from consumption of halocarbons and SF<sub>6</sub>. The remaining 3.2 per cent were from metal production.

#### 1. Completeness

48. The CRF tables include estimates for most gases and categories of emissions from the industrial processes sector, as recommended by the Revised 1996 IPCC Guidelines. Categories reported as “NE” are: potential emissions for fluorinated gases; consumption of halocarbons and SF<sub>6</sub> (actual emissions), except for HFC134a; and emissions from solvent and product use. The ERT recommends that Turkey improve data collection for these categories.

#### 2. Transparency

49. The ERT noted that technology processes are not sufficiently described in the NIR. Such descriptions would be needed in order to justify some EFs, as well as some considerable variations in the emissions time series, which are not fully explained. The ERT recommends that Turkey complete the basic information for these categories. As good practice, the Party should comment on trends for these time series.

#### 3. Recalculations and time-series consistency

50. No recalculations have been reported. Some of the recommendations of the previous review have been applied to the most recent years but not to the whole time series. The ERT recommends that the Party recalculate AD and EFs for the whole time series as soon as they become available in order to make accurate estimates.

#### 4. Uncertainties

51. Uncertainties have been assessed only once, in 2006, and the same results were presented in the 2006, 2007 and 2008 NIRs. The assessment was based on differences between supply and demand, with expert judgment from TurkStat, but without documentation on the rationale. The ERT recommends that Turkey follow the IPCC good practice guidance for eliciting expert judgment on uncertainties and fully document the conclusions.

#### 5. Verification and quality assurance/quality control approaches

52. During the review, host-country experts clarified that, except for cement production, there are no regular cross-checks of data applied to estimates from this sector. The ERT recommends the use of secondary sources of data, as long as they can be found, in order to improve the robustness of the data collection process.

## **B. Key categories**

### **1. Cement production – CO<sub>2</sub>**

53. TurkStat receives monthly reports from industries on clinker production and compares the data collected with the report from the Turkish Cement Manufacturers' Association, available annually, in order to note minor differences. However, there is no information on lime content of clinker; tier 1 methodology has been applied, but one value has been used from 1990 to 2004 and another for the remaining years. The ERT recommends that Turkey develop country-specific EFs, and use cement kiln dust (CKD) correction in accordance with the IPCC good practice guidance. While data on lime content of clinker are not available, the Party should use the same default value for the whole time series, with a minimum CKD correction.

### **2. Nitric acid production – N<sub>2</sub>O**

54. The ERT noted that the highest default value from the Revised 1996 IPCC Guidelines was used for the EF. There is no information in the NIR on the type of technology used or the age of the plants to justify the EF used. The NIR states that the plants in Turkey have been equipped with non-selective catalytic reduction (NSCR) technology, but there is no precise information on when this occurred. The ERT recommends that Turkey clarify the technology used in these plants and its age in its next submission, in order to justify the high EF for the earlier years, as well as to be precise on the date of instalment of NSCR abatement technology, for which another, smaller EF should be used.

55. Large variations along the time series were explained as consequences of changes in agricultural demand for fertilizers on the domestic market. The ERT recommends that, in its next submission, the Party clarify the trends in this source and provide a cross-check of AD with the national demand for fertilizers.

### **3. Consumption of halocarbons and SF<sub>6</sub>**

56. Emissions from consumption of halocarbons and SF<sub>6</sub> accounted for 10.1 per cent of sectoral emissions in 2006. According to the NIR, potential emissions have not been reported for fluorinated gases, due to a lack of information. For consumption of HFCs, only HFC134a was reported, as it is the only gas in this group that has a special import code. Tier 1 methodology has been used, taking into consideration full emissions in the year of importation with no stocks or exportation. On the other hand, SF<sub>6</sub> consumption data were obtained from direct communications between the MoEF and equipment importation industries until 2005; this flow of information has been lost due to the confidentiality principle implemented by the Turkish Undersecretariat of Customs, and no data have been reported for this year.

57. The ERT recommends that Turkey improve as soon as possible this lack of information on other gases and complete the gaps in the time series, as these are very potent greenhouse gases and their consumption is rapidly increasing.

### **4. Iron and steel production – CO<sub>2</sub>**

58. This category has been reported as key by trend owing to a decrease of 62.0 per cent between 1990 and 2006. However emissions were found to have been double counted, as all fuel consumption, including the amount used as feedstock, has been reported in the energy sector. The ERT recommends that Turkey estimate CO<sub>2</sub> emissions only for fuel used as feedstock, or consider all emissions in the energy sector, and explain large variations in AD across the time series, linking this with sectoral information, in its next submission.

### **C. Non-key categories**

#### **1. Lime production – CO<sub>2</sub>**

59. The EF used in the tier 1 approach is the highest one used and is incompatible with the high uncertainty estimates for calcium oxide and magnesium oxide content of produced lime, leading to an overestimation of emissions from this source. The ERT recommends that the Party revise this EF according to uncertainty in the composition of lime produced and revise the EF uncertainty estimate.

60. The review process has detected a change in the methodology used for data collection during the last two years, leading to an inconsistency for these years and an underestimation of emissions. Also, large variations in production were not well explained. The ERT recommends that Turkey revise its estimates for 2005 and 2006 in its next submission, in order to assure consistency across the time series, and provide explanations for large variations in the time series.

#### **2. Aluminium production – PFCs**

61. Emissions were reported only for 2006, although there has been aluminium production since 1990. The ratio CF<sub>4</sub>:C<sub>2</sub>F<sub>6</sub> was reported as 22.7 based on a tier 2 approach and is the highest among reporting Parties. The ERT recommends that Turkey complete the time series.

#### **3. Ammonia production – CO<sub>2</sub>**

62. A default EF was chosen, but information in the NIR on feedstock used is not clear. The ERT recommends that the Party clarify whether the by-product hydrogen is used as feedstock; if so, then the EF must be reduced accordingly.

63. Large variations across the time series were explained as the consequence of changes in agricultural demand for fertilizers in the domestic market, as this chemical is basic to their production but different trends from the correlated nitric acid production were not well-understood. The ERT recommends that Turkey clarify the trends in this source and provide a cross-check of AD for this source with national demand for fertilizers, which should be included in its next submission.

### **D. Areas for further improvement**

#### **1. Identified by the Party**

64. The Party has plans to improve data collection on fluorinated gases, with new import codes that will allow individualization on imports.

#### **2. Identified by the expert review team**

65. The ERT recommends that Turkey:

- (a) Prepare a legal basis for data collection on consumption of fluorinated gases in order to facilitate estimates in this category;
- (b) Fully describe in its next NIR the technology processes and methodologies used in the industrial sector in order to justify the EF used for the estimates;
- (c) Explain large variations in AD by cross-checking these data with secondary sources;
- (d) Undertake the task of estimating emissions for the whole solvent and other product uses sector.



## V. Agriculture

### A. Sector overview

66. In 2006, the agriculture sector accounted for 16,366.6 Gg CO<sub>2</sub> eq, or 4.9 per cent, of total GHG emissions. Emissions from the sector decreased by 11.4 per cent between 1990 and 2006. The key driver for the fall in emissions is the fall in CH<sub>4</sub> emissions from enteric fermentation due to a decreasing number of farms. Within the sector, 88.0 per cent of emissions were from enteric fermentation, followed by 5.5 per cent from manure management, and 4.0 per cent from field burning of agricultural residues. The remaining 2.5 per cent were from rice cultivation. The following categories are reported as “NE”: N<sub>2</sub>O from manure management and N<sub>2</sub>O from agricultural soils.

#### 1. Completeness

67. The CRF tables include estimates for most gases and categories of emissions from the agriculture sector, as recommended by the Revised 1996 IPCC Guidelines. However, the CRF tables do not include N<sub>2</sub>O emissions from manure management or N<sub>2</sub>O emissions from agricultural soils. Calculations made by United States Environmental Protection Agency for Turkey using Tier 1 methods and AD from the Food and Agricultural Organization of the United Nations (FAO) and other sources indicate that the total emissions from the agricultural sector might be almost four times as high as those reported in the 2008 submission. This may be an indication of very incomplete reporting of agriculture emissions by Turkey.

68. N<sub>2</sub>O emissions from manure management are reported as “NE” and the notation keys “NO”, “NE” and “NA” are applied to the usage of different manure management systems. Estimations exist for animal population and IPCC default values can be used for nitrogen excretion rates, the distribution between manure management systems and for the EFs. The ERT noted that this source is a potential key category. The ERT recommends that Turkey estimate and report emissions from this source in its next submission.

69. The ERT recommends that the Party use consumption statistics for synthetic fertilizers published by TurkStat in order to estimate and report emissions of N<sub>2</sub>O from this source in its next submission. The ERT noted that this source is a potential key category for Turkey.

70. The ERT recommends that Turkey estimate and report emissions of N<sub>2</sub>O from manure applied to soils by using IPCC default fractions if there is no national information available on the percentage of the manure produced that is droppings on pasture or burned or volatilized as NH<sub>3</sub> for the different animal categories. If there are no national values, the IPCC default values given in table 4.7 of the Revised 1996 IPCC Guideline Workbook (Volume 2) can be used to estimate the amount of nitrogen spread on fields. The ERT also recommends that the Party estimate emissions from crop residues by using IPCC default values.

71. The ERT recommends that Turkey use statistics from TurkStat for the production of N-fixing crops in order to estimate and report emissions of N<sub>2</sub>O from this source in its next submission. Data are given in the FAO database (FAOSTAT)<sup>5</sup> and could be used if no other data are available. The Ministry of Agriculture and Rural Affairs (MARA) is responsible for soil data. MARA is currently running a land consolidation project that will be finished in 2013. The results will include soil maps. The ERT recommends that the Party collect an expert estimate for the area of organic agricultural soil in Turkey that can be used until the results from the land consolidation project become available.

72. The ERT recommends that Turkey estimate and report emissions of N<sub>2</sub>O from droppings on pasture using the IPCC default fraction and EF if there are no national pasture data for the different

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<sup>5</sup> The United Nations Food and Agricultural Organization (FAO) database is available online at <<http://faostat.fao.org/>>.

animal groups. The ERT also recommends that the Party estimate and report emissions of N<sub>2</sub>O from volatilization and leaching using IPCC default fractions and EFs if there are no national data available.

## 2. Transparency

73. The ERT recommends that Turkey include plans for improvements for reporting of emissions from the agricultural sector in its next NIR. The notation key “NA” should only be used in cases when no emission is possible from this source. The ERT recommends that the Party evaluate their use of “NA” and change it to “NO” or “NE” where appropriate. The population of dairy cattle increased considerably between 1990 and 2006; for the other animal categories the number of animals is decreasing since the number of farms is decreasing. The ERT recommends that the Party include an explanation of the increase in dairy cattle farming in its next NIR to improve transparency.

## 3. Recalculations and time-series consistency

74. There have been no methodological changes and no recalculations between the 2007 and 2008 submissions. The source for the collection of data on the animal population may change from MARA to TurkStat (under the new EU project); recalculations for the whole time series must then be made. The ERT recommends that Turkey use the methodologies provided in chapter 7 of the IPCC good practice guidance for recalculating the time series.

## 4. Uncertainties

75. Uncertainty estimates in this sector are based on expert judgments from TurkStat. More information in the NIR and documentation from these experts about basis for the judgment is needed.

## 5. Livestock population characterization

76. The Party informed the ERT that TurkStat has begun a new statistics project (EU project) on the animal population with sample surveys for agricultural holdings and slaughterhouses in order to improve the animal population statistics. The ERT recommends that Turkey collect animal data at the disaggregated level that is needed for tier 2 emission estimates from enteric fermentation and manure management. The animal categories needed for enhanced livestock categorization are shown in chapter 4.1 of the IPCC good practice guidance.

## **B. Key categories**

### Enteric fermentation – CH<sub>4</sub>

77. Tier 1 methodology and IPCC default EFs are used for all animal groups to calculate emissions from enteric fermentation. The ERT recommends that the Party use a tier 2 methodology for cattle and sheep, in accordance with the IPCC good practice guidance.

78. For better transparency, the ERT recommends that Turkey provide more information in the NIR about how the EFs for the different animal categories have been chosen. For cattle, the default EFs from Asian countries have been chosen. The ERT recommends that Turkey verify this choice by comparing data for milk production per cow in Turkey with data from other countries. For other animal categories, EFs from developing countries have been chosen for the whole of Turkey. The ERT recommends that the Party consider regional differentiation of EFs.

79. The animal population needs to be further disaggregated for cattle and sheep, in order to use the tier 2 methodology, since this is a key category. The ERT suggests ensuring that categories in the sample survey from the TurkStat/EU project are sufficiently detailed. Information from agricultural experts on feed intake, weight gain and milk production, for example, is needed in order to develop country-specific EFs for cattle and sheep.

### **C. Non-key categories**

#### **1. Manure management – CH<sub>4</sub>**

80. Tier 1 methodology is used and default EFs are selected at a regional level according to climate. The ERT recommends that Turkey include more information in its next NIR on the selection of IPCC default EFs for the animal categories and consider the regional differentiation of EFs.

#### **2. Rice cultivation – CH<sub>4</sub>**

81. The ERT recommends that Turkey re-evaluate its choice of EF for rice cultivation. In the NIR, Turkey states that the water management regime is a continuous flood type and is irrigated, but in the CRF table, the emissions are reported under the category single aeration, which has a lower default EF. The ERT recommends that Turkey consult with agricultural experts on the agricultural practice that is used in the country and ensure consistency between the NIR and the CRF tables of its next submission.

#### **3. Field burning of agricultural residues – CH<sub>4</sub> and N<sub>2</sub>O**

82. Turkey estimates that 25.0 per cent of the harvest is burned. Field burning is prohibited by law in Turkey and the ERT therefore recommends that the Party examine this high percentage of harvest burned with agricultural experts.

83. In the CRF tables, the crop production for Turkey is given in kilotonnes instead of tonnes. The ERT encourages the Party to correct this in its next submission.

### **D. Areas for further improvement**

#### **1. Identified by the Party**

84. MARA is now responsible for collecting data on the animal population. The source of data collection for the animal population may change from MARA to TurkStat in order to improve the data quality (under the new EU project).

#### **2. Identified by the expert review team**

85. The ERT recommends that Turkey:

- (a) Prioritize completeness by filling the gaps in data in the inventory, particularly for N<sub>2</sub>O from manure management and N<sub>2</sub>O from agricultural soils;
- (b) Involve more agricultural experts from agencies and research institutions in the inventory preparation, in order to fill the gaps in data, and use more country-specific EFs for key categories;
- (c) Establish QC for this sector, including recalculations for the whole time series, and increase transparency through better documentation in the next NIR.

## **VI. Land use, land-use change and forestry**

### **A. Sector overview**

86. In 2005 and 2006, the LULUCF sector in Turkey accounted for net removals of 69,439.9 and 76,104.3 Gg CO<sub>2</sub> eq, respectively. The removals from this sector increased by 72.6 per cent between 1990 and 2006. Forest land remaining forest land was responsible for most of this increase. Within the LULUCF sector in 2006, 68.0 per cent of the GHG removals (excluding emissions) were from forest land

remaining forest land, followed by 22.8 per cent from cropland remaining cropland, 6.4 per cent from grassland remaining grassland and 2.8 per cent from land converted to forest land. Biomass burning in wildfires was the only source of emissions reported, and had very little significance (0.1 and 0.3 Gg CO<sub>2</sub> eq in 2005 and 2006, respectively, with extreme values of 0.1 and 1.5 Gg CO<sub>2</sub>-eq in 2005 and 1994, respectively).

87. The ERT noted the improvements achieved by Turkey in the 2007 and 2008 reports with respect to the previous submission. These include the implementation of LULUCF category reporting, in line with decision 13/CP.9, and the use of higher tier methods for estimating carbon stock changes in forest land. However, several deficiencies were detected with regard to accuracy, completeness, transparency, consistency and QA/QC. The Party is encouraged to continue with its efforts for solving these problems.

### 1. Completeness

88. The report for the LULUCF sector is incomplete. Several CRF tables are blank, and the use of notation keys is very limited and inaccurate. Estimates have been made only for State-owned forests, permanent crops (representing approximately only 10 per cent of cropland area), grassland areas under a land rehabilitation programme (covering approximately only 0.5 per cent of grassland area), some water reservoirs and urban trees. The ERT assessed that more than half of the land area of Turkey was not considered in the inventory estimates. The Party is encouraged to implement in its future submissions a complete representation of the use of land that is consistent with the IPCC good practice guidance on LULUCF and covers several points across the time series.

89. Turkey did not provide any estimates, nor did it report notation keys for other land, direct N<sub>2</sub>O emissions from nitrogen fertilization, N<sub>2</sub>O emissions from drainage of soils, N<sub>2</sub>O emissions from disturbance associated with land-use conversion to cropland and carbon emissions from agricultural lime application. For some of these categories, the Party explained during the review that the activities do not occur in Turkey (e.g. drainage of soils and lime application). For other categories, lack of data was the reason for not producing estimates. The ERT encourages the Party to improve the completeness of the inventory by collecting suitable data and/or providing suitable notation keys in its future submissions.

90. The information on land-use change reported by Turkey did not include the categories forest land converted to other land and grassland converted to other land, as mandated by the UNFCCC reporting guidance. The Party is encouraged to estimate these categories and to report estimates in the corresponding documentation boxes in CRF table 5.

### 2. Transparency

91. With the exception of the categories forest land and biomass burning, Turkey failed to provide in the NIR the descriptions, references and sources of information on the specific methodologies, assumptions, EFs and AD, or on the rationale for their selection. The ERT recommends that Turkey take into consideration the UNFCCC reporting guidelines when preparing its next submission.

### 3. Recalculations and time-series consistency

92. In 2007 and 2008 Turkey reported the LULUCF sector for the first time, using the format established by decision 13/CP.9. Therefore it was not possible to perform any recalculations. Several inconsistencies were identified by the ERT in the time series for various categories:

- (a) The time series for CO<sub>2</sub> removals by permanent crops shows two outlier values (an apparent overestimation for 2001 and an apparent underestimation for 2003);
- (b) The estimate for CO<sub>2</sub> removal in land converted to grassland in 2005 was twice as large as the values of all previous years, and for 2006 this category was reported as "NA";

- (c) Wetland estimates were only provided for the periods 1992–1997 and 1999–2002; and
- (d) CO<sub>2</sub> removals by urban trees were reported only for the period 1991–2000.

No explanations for these inconsistencies were provided in the NIR or during the review. The ERT recommends that Turkey provide consistent time series in its next submission.

#### 4. Verification and quality assurance/quality control approaches

93. No specific QA/QC plan for the LULUCF sector has been provided by the Party. The ERT noted that some QC practices, such as electronic processing of data on forest land, have not been documented. The Party is encouraged to comply with UNFCCC reporting guidelines by reporting in the NIR on its QA/QC plan and providing information on QA/QC procedures that have already been implemented or are to be implemented in the future.

### **B. Key categories**

#### 1. Forest land – CO<sub>2</sub>

94. Turkey reported net removals of 49.0 and 51.8 Mt CO<sub>2</sub> by forest land remaining forest land in 2005 and 2006, respectively. It also reported removals by conversion of land to forest land of 2.3 and 2.1 Mt CO<sub>2</sub>, respectively. These estimates corresponded to state-owned forest land only. While the ERT noted that the vast majority of forests in Turkey are in those public lands, there is a significant area of plantation in private lands that was not accounted for. In order to improve the accuracy and completeness of the inventory, the ERT recommends that Turkey collect information on forests on private land.

95. The conversion of land to forest land was assumed to occur in the proportions of 0.6 from grassland and 0.4 from cropland across the whole time series. The rationale for this assumption and the sources of information were not documented in the NIR, and it is recommended that Turkey do so in future reports.

96. The forest definition used by Turkey (minimum crown cover of 1 per cent) is not consistent with that used for reporting to FAO (minimum crown cover of 40 per cent) or with the parameters defined in relevant COP decisions (minimum crown cover between 10 and 30 per cent). The ERT suggests that the Party consider including land currently considered as degraded forest (with a crown cover of less than 10 per cent) under grassland in order to comply with the UNFCCC definition.

97. The ERT welcomes the development of country-specific values for biomass expansion factors, basic density of wood and the fraction of biomass left in forests after harvesting, which enabled tier 2 methods to be applied for some estimates. The ERT encourages Turkey to continue with further improvements that would increase the accuracy of estimates of carbon stock changes in forest land.

#### 2. Cropland – CO<sub>2</sub>

98. The cropland category accounted for a net sink of 16.3 and 17.4 Mt CO<sub>2</sub> in 2005 and 2006, respectively, as reported by the Party. These estimates, according to information provided in the NIR and during the in-country visit, covered only the area of permanent crops. Turkey provided in its NIR data on the area of permanent crops and on the carbon pools selected, but failed to include information on the methods and carbon stock factors used and the assumptions made. It also did not provide proper justification for the exclusion of the other carbon pools.

99. The area under permanent crops (approximately 2.3 Mha, as reported in the NIR) is much less than the total cropland area (26.5 Mha, as reported by FAO for 2005), meaning that more than 90 per cent of the cropland area was not covered in the 2005 and 2006 submissions. During the review, Turkey expressed that several changes are occurring in Turkey in the croplands, including the irrigation

of nearly 5.1 Mha. This may also bring about important changes in the carbon stocks. The Party is encouraged to collect information in order to achieve completeness in the reporting of this land-use category.

### 3. Grassland – CO<sub>2</sub>

100. Turkey reported that grassland area accounted for a removal of 2.0 and 4.9 Mt CO<sub>2</sub> in 2005 and 2006, respectively. While all the removals in 2006 were reported as occurring in grassland remaining grassland, 69.2 per cent of the removals occurred on lands being converted to grassland in 2005. According to information provided to the ERT during the review, the estimates for this category cover only lands being rehabilitated under a government programme, with a maximum extension of 81,600 ha, as compared to a total grassland area in Turkey of 14.6 Mha (FAOSTAT, 2005). The ERT suggests that the Party improve the completeness of the inventory for the grassland category.

101. Similarly to the cropland category, no information was given in the NIR about methods, assumptions and choice of EFs. The ERT encourages Turkey to provide this information in its future submissions.

## C. Non-key categories

### 1. Wetland – CO<sub>2</sub>

102. It was explained in the NIR that the inventory only covered areas flooded for creating reservoirs linked to the production of hydropower. However, the CRF tables contain estimates for wetland remaining wetland and not for lands converted to wetland. Estimates were only provided for the periods 1992–1997 and 1999–2002. The areas of reservoirs are not provided in the CRF tables, and procedures for the estimations were not included in the NIR. This category is reported as a sink; however, if the activity involved is a conversion of land to reservoirs, then a net emission (i.e. decrease in biomass and other carbon stocks) should be expected. The ERT recommends that Turkey provide a clear description of the AD and choice of method in the NIR and a complete time series in its future reports.

### 2. Settlements – CO<sub>2</sub>

103. The area of land under settlement was not reported. However, CO<sub>2</sub> removals by urban trees were reported for the period 1991–2000. It was explained in the NIR that the crown area of urban trees was determined in 2000, and this was presumably the reason for the lack of reporting for years after 2000. No description of methods and assumptions was provided in the NIR or in the CRF tables. The Party is encouraged to comply with UNFCCC reporting guidelines by providing the required information in the NIR and a complete time series in its future submissions.

### 3. Biomass burning – CH<sub>4</sub> and N<sub>2</sub>O

104. Emissions from burning of biomass in forest wild fires were reported as 0.06 and 0.30 Gg CO<sub>2</sub> eq in 2005 and 2006, respectively. A few errors were detected in the application of the IPCC methods for estimating CH<sub>4</sub> and N<sub>2</sub>O emissions. The values reported for CH<sub>4</sub> are actually expressed in units of C instead of CH<sub>4</sub> (i.e. they were underestimated by a factor of 12/16). The values for N<sub>2</sub>O were overestimated, since Turkey failed to use the N/C ratio and to multiply by 44/28 in order to convert units of N into units of N<sub>2</sub>O. During the review the Party expressed that it will correct the procedure in its future submissions.

105. CO<sub>2</sub> emissions from biomass burning do not have to be included in table 5(V) if they are already included in land use tables 5A–5F. The NIR states that these emissions were accounted for in category 5A; however, this was not indicated in the documentation box of table 5(V) as required. The Party is encouraged to provide all the required information in the corresponding documentation boxes in the CRF tables.

## **D. Areas for further improvement**

### **1. Identified by the Party**

106. The Party identified the following areas for future improvements: revision of climate maps; construction of yield tables for productive and non-productive coppice forests, respectively; preparation of yield tables for poplar and other woody species, including permanent crops; collection of data on soil organic carbon and litter for forests under different climate regions; and implementation of a new forest inventory system, including remote sensing, aero-photogrammetry and ground survey procedures.

### **2. Identified by the expert review team**

107. The ERT recommends that Turkey:

- (a) Implement a centralized geographic information system with full coverage of the Turkish territory including information on land-use categories and subcategories consistent with the IPCC good practice guidance for LULUCF for different points in time, and on climate and soil maps, based on IPCC classes;
- (b) Strengthen efforts to collect AD by implementing the third phase of the National Forest Inventory and by paying more attention to grassland and cropland areas, given their significance (54 per cent of Turkish territory);
- (c) Allocate the necessary resources, improve the inter- and intra-institutional coordination and implement capacity-building activities, particularly training of experts for the proper use of IPCC guidelines and good practice guidance, in order to achieve compliance with UNFCCC reporting standards in the future.

## **VII. Waste**

### **A. Sector overview**

108. In 2006, the waste sector accounted for 30,064.9 Gg CO<sub>2</sub> eq (9.1 per cent) of total GHG emissions. Emissions from the sector increased by 370.8 per cent between 1990 and 2006. The ERT commends Turkey's current and future efforts to estimate emissions from this sector. Due to the importance of emissions from this sector, the ERT encourages the Party to include external experts when estimating emissions from waste in future submissions.

#### **1. Completeness**

109. The CRF tables only contain estimates of CH<sub>4</sub> from the solid waste disposal site (SWDS) source category. Emissions from wastewater handling and incineration were not estimated.

#### **2. Transparency**

110. The justification for the selection of different parameters used to estimate emissions from this source category has not been explained in the NIR. The ERT encourages Turkey to provide the justification for the choice of such parameters in its next submission.

#### **3. Uncertainties**

111. Procedures to define uncertainty in AD and EFs were not explained in the NIR. The ERT recommends that the Party provide an explanation in its next submission.

#### 4. Verification and quality assurance/quality control approaches

112. An explanation of data collection and the QA/QC procedures that are applied to waste AD collection is lacking. During the in-country review, Turkey explained the QA/QC procedures that are applied during data collection. The Party is encouraged to provide further explanation for such procedures in its future submissions and to formalize a QA/QC plan for such activities.

#### **B. Key categories**

##### Solid waste disposal on land – CH<sub>4</sub>

113. During the previous review, the Party was encouraged to use tier 2 methodology for estimating waste from this source category; however, this was not done in either the 2007 or the 2008 submissions. The ERT would like to reiterate the recommendation made during the previous review and would also like to emphasize that, in accordance with the IPCC good practice guidance, tier 2 methodology should be used for key categories. Moreover, this guidance states that “the use of the default method will give a reasonable annual estimate of actual emissions if the amount and composition of deposited waste have been constant or slowly varying over a period of several decades. If the amount or composition of waste disposed of at SWDS is changing more rapidly over time, however, the IPCC default method will not provide an accurate trend” (IPCC good practice guidance, chapter 5, page 5.5). The ERT noted from the AD provided by Turkey that the amount of waste disposed of at SWDS rapidly changed during the reported period. During the in-country review, the Party agreed to apply a tier 2 approach in its future submissions. The ERT encourages the Party to continue with these efforts.

114. Turkey did not provide justification for the selection of the degradable organic carbon (DOC) value in the NIR. During the in-country review, the Party explained that the DOC value used to estimate emissions was based on the IPCC default value for food waste. The ERT recommends that Turkey use a weighted average DOC value based on waste composition data in its next submission.

115. The selected cubic or quadratic model for AD may not adequately represent the normal growth in the rate of waste generation (although the R<sup>2</sup> value for these models is the highest among the models that were evaluated). The model assumes that waste generation decreases after 2000 and will continue to decrease thereafter, which may not be realistic. During the in-country review, Turkey agreed with this conclusion. The ERT recommends that the Party revise this model in its next submission.

116. Emissions from unmanaged SWDS are reported in CRF table 6.A under unmanaged SWDS (Deep >5 m) while a methane correction factor (MCF) value of 0.6 was reported (which is associated with uncategorized SWDS). The NIR does not explain the rationale for such assumptions and does not clarify whether or not data are available on management practices in SWDS. The ERT encourages the Party to provide further explanation in its next submission.

117. It is not clear in the NIR whether Turkey used one or two models to estimate AD. During the in-country review, the Party clarified that the model is used only to estimate AD from uncategorized SWDS while actual AD and some data based on interpolation were used for managed SWDS. The ERT recommends that Turkey provide further explanation for this in its next submission.

118. During the in-country review, it was noted that the municipal solid waste (MSW) data are based on waste collected by managed landfill operators and waste collected by municipalities. Emissions from waste that is not collected are not estimated. The ERT recommends that the Party estimate emissions from uncollected waste in its next submission.

119. It is not clear in the NIR whether or not AD from industrial waste, sludge and organic fraction that might be present in construction and demolition waste are included in the estimates. Turkey is encouraged to clarify this in its next submission.



120. During the in-country review, it was noted that Turkey uses the classification for SWDS according to EU classification. The ERT recommends that the Party classify SWDS according to IPCC classification in order to avoid any possible confusion.

121. The emission trend from this sector has not been adequately explained. It is stated in the NIR that methane emissions from SWDS were almost constant compared with other sectors. This statement does not adequately explain the trend; in fact, emissions increased almost fivefold between 1990 and 2006. The Party is encouraged to provide a better explanation for the trend in its next submission.

122. In CRF table 6, Turkey did not explain the rationale for the reported values for the fraction of solid waste disposed of in SWDS. The Party clarified that the reported values for the fraction of waste disposed of in SWDS represent the fraction of waste disposed of in uncategorized SWDS. Moreover, this value was reported as a percentage rather than a fraction. The ERT recommends that Turkey correctly report the fraction of waste disposed of in all SWDS in its next submission.

123. In CRF table 6 A, CO<sub>2</sub> emissions from managed SWDS are reported as “IE”. It is not explained in the NIR where these emissions have been included. During the in-country review, Turkey clarified that this was a mistake in the CRF tables. The ERT recommends that the Party correct this in its next submission. Turkey has reported a value of 1.0 for methane generation rate constant (*k*), although it is not using tier 2 methodology. The ERT encourages the Party to select an appropriate value for *k* and use tier 2 methodology in its next submission.

124. During the in-country review, it was noted from a 2006 press release published by TurkStat that a percentage of solid waste is disposed of by open burning in open areas. The Party is encouraged to estimate such emissions in its next submission under category 6.A.3 (others).

### **C. Non-key categories**

#### **1. Wastewater handling – CH<sub>4</sub> and N<sub>2</sub>O**

125. During the previous review, the ERT recommended that Turkey estimate CH<sub>4</sub> emissions using the IPCC default parameters and N<sub>2</sub>O emissions using the FAOSTAT data on protein consumption. The ERT reiterates this recommendation.

126. In CRF table 6.B, the notation key “NA” is used for CH<sub>4</sub> and N<sub>2</sub>O emissions from domestic sludge and for N<sub>2</sub>O emissions from domestic and commercial wastewater. It is not explained in the NIR the reason for using this notation key for these sources. The ERT encourages the Party to provide an explanation of the rationale for using this notation key in its future submissions.

127. In CRF table 6.B, the notation key “NA” is used for CH<sub>4</sub> recovery from industrial and domestic and commercial wastewater. The reason for using this notation key is not explained in the NIR. The Party is encouraged to use the correct notation keys for this parameter in its future submissions.

#### **2. Waste incineration – CO<sub>2</sub> and N<sub>2</sub>O**

128. During the previous review, the ERT recommended that Turkey use the IPCC default methodology and parameters and report these emissions in its next submission. The ERT reiterates this recommendation.

129. In CRF table 6.C, the notation key “NA” is used for all emission sources under this source category, although it is reported in the NIR that one hazardous waste and two medical waste incineration plants exist. The notation key “NE” should be used if emissions are not estimated from a source category that does exist in a country. The ERT encourages the Party to estimate emissions from this source category in its next submission and to use the correct notation keys.

130. It was noted during the in-country review that hazardous and clinical waste data are reported to the MoEF. Turkey is encouraged to utilize this valuable data when estimating emissions from this source category in its next submission.

131. It was noted during the in-country review that 31 cement kilns are licensed to incinerate hazardous waste as an alternative fuel. The ERT recommends that Turkey report emissions from such fuels under the energy sector in its next submission.

132. It was noted during the in-country review that a proportion of the hazardous and clinical waste is incinerated and the produced heat is used in power generation. The ERT recommends that the Party estimate emissions from this source and report it under the energy sector in its next submission.

#### **D. Areas for further improvement**

##### **1. Identified by the Party**

133. It was noted during the in-country review that there are planned future improvements for this sector (e.g. for the solid waste disposal and wastewater handling source categories), but such plans have not been discussed in the NIR. Future improvements that are planned for the waste sector should be included in the NIR.

##### **2. Identified by the expert review team**

134. The ERT identified the main areas for improvement for the Party. Turkey should:

- (a) Improve completeness by estimating emissions from wastewater handling and incineration;
- (b) Improve transparency by providing more detailed information in the NIR on all parameters, AD and EFs used;
- (c) Provide information on uncertainty assessment, data collection and QA/QC procedures;
- (d) Use a higher tier method for estimating CH<sub>4</sub> emissions from solid waste disposal on land as this category is a key category.

### **VIII. Conclusions and recommendations**

135. The 2008 inventory submission covers most sectors and categories; however, the ERT identified a need for further improvements in the following areas: timeliness of the submission, completeness and transparency. The inventory of Turkey is partially in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT noted that there are deficiencies to varying degrees with respect to all the inventory reporting principles (i.e. transparency, completeness, comparability, consistency, accuracy), the majority of which are evidently due to the lack of proper institutional and organizational arrangements, as well as an inadequate allocation of resources for preparing and reporting the emission inventories.

136. During the in-country visit, Turkey explained the institutional arrangements for the preparation of the inventory. Until now, the responsibility for the national inventory has been mainly shared between the MoEF and TurkStat. Other ministries, organizations and institutions, as well as universities, are also involved in the preparation of the inventory.

137. The ERT was informed during the in-country review that the institutional arrangements are being further developed, with the aim of strengthening them. This process includes establishing two additional

working groups, as well as climate change focal points in all institutions represented in the CBCC, integrating TurkStat and CBCC and identifying a single national entity with responsibility for the inventory submission.

138. The ERT welcomes these plans by Turkey to further strengthen its institutional arrangements and recommends that the Party<sup>6</sup>:

- (a) Identify, within the next year, a single national entity with responsibility for the inventory submission;
- (b) Strengthen the institutional system and, in particular, its decision-making capacity, as a basis for developing an improvement plan for the inventory;
- (c) Develop an improvement plan for the inventory with ambitious but workable timelines with the aim of preparing an inventory submission that is fully consistent with UNFCCC and IPCC guidelines, in particular with regard to timeliness, completeness and transparency;
- (d) Establish a formal QA/QC system in accordance with good practice guidance;
- (e) Reconsider the internal schedule, in particular with regard to the finalization of the NIR, which needs to be submitted by 15 April each year;
- (f) Include the LULUCF sector in the key category analysis, and use the results as a driving factor for the preparation of the inventory;
- (g) Calculate emissions from key categories using a higher tier method;
- (h) Estimate emissions for all categories not yet addressed in its next inventory submission and use simplified country-specific methods, depending on the availability of data;
- (i) Prepare recalculations for the entire time series every year, in order to fully reflect the progress made in improving the GHG emission inventory, and strictly follow the reporting requirements of the UNFCCC reporting guidelines, in order to allow for the necessary transparency and consistency;
- (j) Establish an archiving system that includes the archiving of disaggregated EFs and AD, and document how these EFs and AD have been generated and aggregated for the preparation of the inventory;
- (k) Provide the necessary human and financial resources to implement the activities described above.

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<sup>6</sup> For a full list of the recommendations made by the ERT, see the main body of the text.

Annex**Documents and information used during the review****A. Reference documents**

Intergovernmental Panel on Climate Change. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Available at <<http://www.ipcc-nggip.iges.or.jp/public/gp/english/>>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Available at <<http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>>.

“Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories”. FCCC/SBSTA/2006/9. Available at <<http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>>.

“Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention”. FCCC/CP/2002/8. Available at <<http://unfccc.int/resource/docs/cop8/08.pdf>>.

Status report for Turkey 2007. Available at <<http://unfccc.int/resource/docs/2007/asr/tur.pdf>>.

Status report for Turkey 2008. Available at <<http://unfccc.int/resource/docs/2008/asr/tur.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2007. Available at <<http://unfccc.int/resource/webdocs/sai/2007.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2008. Available at <<http://unfccc.int/resource/webdocs/sai/2008.pdf>>.

FCCC/ARR/2006/TUR. Report of the individual review of the greenhouse gas inventory of Turkey submitted in 2006. Available at <<http://unfccc.int/resource/docs/2007/arr/tur.pdf>>.

**B. Additional information provided by the Party**

Responses to questions during the review were received from Mr. Evren Turkmenoglu (MoEF) and Mr. Ali Can (TurkStat), including additional material on the methodology and assumptions used.

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