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# Report of the individual review of the greenhouse gas inventory of the Russian Federation submitted in 2006*

* In the symbol for this document, 2006 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

# I. Overview

## A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of the Russian Federation, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 16 to 22 July 2007 in Moscow, Russia, and was conducted by the following team of nominated experts from the roster of experts: generalist – Ms. Anke Herold (Germany); energy – Ms. Branca Americano (Brazil); industrial processes –Mr. Marius Țăranu (Republic of Moldova); agriculture – Mr. Rob Sturgiss (Australia); land use, land-use change and forestry (LULUCF) – Mr. Zoltán Somogyi (Hungary); waste – Ms. Irina Yesserkepova (Kazakhstan). Ms. Anke Herold and Ms. Branca Americano were the lead reviewers. The review was coordinated by Ms. Katia Simeonova and Mr. Javier Hanna (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 the Russian Federation for comment prior to its publication.

## B. Inventory submission and other sources of information

3. In its 2006 submission, the Russian Federation submitted a complete set of common reporting format (CRF) tables for the years 1990 to 2004 and a national inventory report (NIR). The 2006 submission was submitted in two stages: the NIR on 8 January 2007 and the CRF tables on 16 February 2007. The Russian Federation submitted revised estimates on 4 September 2007, including revised estimates for perfluorocarbons (PFCs) for 1995 and additional specific notes in response to questions raised by the ERT during and after the in-country review. The revised estimates are considered in this review report. Final revised estimates for 1990 and 2004 were submitted on 14 January 2008. The full list of materials used during the review is provided in the annex to this report.

## C. Emission profiles and trends

4. In 2004, the most important GHG in the Russian Federation was carbon dioxide ($CO_2$), which contributed 71.9 per cent to total[1] national GHG emissions expressed in $CO_2$ eq.,[2] followed by methane ($CH_4$), 22.0 per cent, and nitrous oxide ($N_2O$), 4.9 per cent. Hydroflurocarbons (HFCs), PFCs and sulphur hexafluoride ($SF_6$) taken together contributed 1.2 per cent of the overall GHG emissions in 2004. The energy sector accounted for 81.3 per cent of the total GHG emissions in 2004 followed by industrial process, 8.9 per cent, agriculture, 6.6 per cent, waste, 3.2 per cent, and solvents and other product use, 0.02 per cent. Total GHG emissions amounted to 2,125,958.94 Gg $CO_2$ eq. in 2004 and decreased by 36.0 per cent from the base year to 2004. The emission trends by sector and by gas are comparable with those of other Parties with economies in transition.

5. Tables 1 and 2 show the greenhouse gas emissions by gas and by sector, respectively.

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[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of $CO_2$ eq. excluding LULUCF, unless otherwise specified.

[2] In this report, the values for total and sectoral emissions for 1990 and 2004 reflect the revised estimates submitted by the Russian Federation in the course of the review. These estimates differ from the Russian Federation's GHG inventory submitted in 2006.

## Table 1. Greenhouse gas emissions by gas, 1990–2004[a]

| GHG emissions | Gg $CO_2$ equivalent | | | | | | | | Change BY–2004 (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Base year Convention[b] | 1990 | 1995 | 2000 | 2001 | 2002 | 2003 | 2004[b] | |
| $CO_2$ (with LULUCF) | 2 686 622.29 | 2 686 622.29 | 1 522 889.94 | 1 896 923.82 | 1 833 692.21 | 1 403 014.51 | 1 271 613.87 | 1 329 055.90 | –50.5 |
| $CO_2$ (without LULUCF) | 2 500 352.09 | 2 500 352.09 | 1 663 621.74 | 1 535 269.11 | 1 586 570.18 | 1 583 041.55 | 1 639 680.19 | 1 529 128.84 | –38.8 |
| $CH_4$ | 581 873.92 | 581 873.92 | 380 604.32 | 339 764.26 | 338 342.97 | 342 566.65 | 354 373.12 | 468 007.91 | –19.6 |
| $N_2O$ | 221 751.82 | 221 751.82 | 136 432.31 | 104 986.07 | 105 477.29 | 106 133.53 | 103 325.88 | 104 755.82 | –52.8 |
| HFCs | 7 970.34 | 7 970.34 | 7 594.62 | 12 101.88 | 13 424.73 | 9 964.93 | 9 870.57 | 9 775.82 | 22.7 |
| PFCs | 15 308.68 | 15 308.68 | 15 753.84 | 18 547.43 | 18 441.78 | 14 512.14 | 15 050.67 | 15 705.61 | 2.6 |
| $SF_6$ | 98.54 | 98.54 | 94.25 | 116.53 | 106.63 | 107.78 | 118.21 | 138.10 | 40.2 |

*Note*: BY = Base year; LULUCF = Land use, land-use change and forestry.

[a] In this table the data for the industrial processes and waste sectors reflect the revised estimates for the complete time series submitted on 4 September 2007, while data for the solvents and other product use, agriculture and LULUCF sectors reflect the original estimates. Data for the energy sector reflect the revised estimates for 1990 and 2004 submitted on 14 January 2008, while data for the remaining years reflect the original estimates.

[b] The Russian Federation submitted revised estimates for 1990 and 2004 in the course of the initial review on 14 January 2008, and for PFCs for 1995 on 4 September 2007. These estimates differ from the Russian Federation's GHG inventory submitted in 2006.

## Table 2. Greenhouse gas emissions by sector, 1990–2004[a]

| Sectors | Gg $CO_2$ equivalent | | | | | | | | Change BY–2004 (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Base year Convention[b] | 1990 | 1995 | 2000 | 2001 | 2002 | 2003 | 2004[b] | |
| Energy | 2 707 695.94 | 2 707 695.94 | 1 783 415.19 | 1 625 015.52 | 1 673 005.21 | 1 668 944.90 | 1 723 877.23 | 1 728 466.20 | –36.2 |
| Industrial processes | 241 012.77 | 241 012.77 | 157 601.43 | 172 831.26 | 175 511.54 | 170 578.42 | 181 857.36 | 188 169.92 | –21.9 |
| Solvent and other product use | 556.44 | 556.44 | 506.97 | 518.07 | 527.96 | 526.63 | 527.72 | 529.83 | –4.8 |
| Agriculture | 309 368.59 | 309 368.59 | 204 477.60 | 146 268.29 | 147 338.90 | 147 309.23 | 143 108.45 | 139 822.01 | –54.8 |
| LULUCF | 190 271.69 | 190 271.69 | –139 790.93 | 365 293.23 | 249 221.66 | –176 460.87 | –362 147.03 | –198 519.78 | –204.3 |
| Waste | 64 720.16 | 64 720.16 | 57 159.03 | 62 513.63 | 63 880.32 | 65 401.23 | 67 128.59 | 68 970.98 | 6.6 |
| Other | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total (with LULUCF)** | **3 513 625.59** | **3 513 625.59** | **2 063 369.28** | **2 372 440.00** | **2 309 485.61** | **1 876 299.55** | **1 754 352.32** | **1 927 439.17** | **–45.1** |
| **Total (without LULUCF)** | **3 323 353.90** | **3 323 353.90** | **2 203 160.22** | **2 007 146.77** | **2 060 263.95** | **2 052 760.41** | **2 116 499.35** | **2 125 958.94** | **–36.0** |

*Note*: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable.

[a] In this table the data for the industrial processes and waste sectors reflect the revised estimates for the complete time series submitted on 4 September 2007, while data for the solvents and other product use, agriculture and LULUCF sectors reflect the original estimates. Data for the energy sector reflect the revised estimates for 1990 and 2004 submitted on 14 January 2008, while data for the remaining years reflect the original estimates.

[b] The Russian Federation submitted revised estimates for 1990 and 2004 in the course of the initial review on 14 January 2008, and for PFCs for 1995 on 4 September 2007. These estimates differ from the Russian Federation's GHG inventory submitted in 2006.

## D. Key categories

6. The Russian Federation has not reported a key category analysis as part of its 2006 GHG inventory submission. A tier 1 key category analysis (level and trend) was performed in 2007 for the years 1990, 2004 and 2005 and was provided to the ERT during the in-country review. The Russian Federation has included the LULUCF sector in this key category analysis. As the key category analysis was performed fairly recently, it has not yet been used in a systematic way for the prioritization of inventory improvements and quality assurance/quality control (QA/QC) activities. The secretariat[3] performed a key category analysis for the 2006 submission and this is used in the following sections.

## E. Main findings

7. The Russian Federation's GHG inventory is generally accurate, as defined in the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines), and is mostly consistent 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). However, the NIR is incomplete and not comprehensive enough, which results in an insufficient level of transparency. Further improvements required in the NIR relate to detailed descriptions of methodology, emission factors (EFs), activity data (AD) and the detailed description of individual sectors (e.g. energy).

8. Information provided in the NIR and the CRF tables does not always comply with the principles of completeness, consistency, accuracy and transparency. Some AD, EFs and estimation methods are not fully in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. Many revisions and improvements were implemented during the course of the review in response to the potential problems and further questions raised by the ERT. These are identified in the sectoral sections of this report. The ERT acknowledges that all these problems were resolved during the review where they related to 1990 emissions, but that further problems need to be resolved for the complete time series and in particular for the more recent years. The ERT recommends the Russian Federation to reflect these improvements and changes in its next inventory submission. In the inventory preparation, the QA/QC plan and procedures have not yet been implemented in a systematic way. The ERT recommends the Russian Federation to fully implement the QA/QC plan and to document its implementation in its next inventory submission. The Russian Federation is encouraged to use correct notation keys in the CRF tables and estimate all relevant emissions at an appropriate level of disaggregation. The data archiving system should be developed further.

[3] The secretariat identified, for each Party, those source 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* (hereinafter referred to as the IPCC good practice guidance for LULUCF) for the base year or base year period as well as the latest inventory year. Key categories according to the tier 1 trend assessment were also identified. 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.

## F. Cross-cutting topics

### 1. Completeness

9. The 2006 GHG inventory of the Russian Federation contains a complete set of CRF tables for the years 1990–2004 and an NIR. However, the inventory submission coverage of gases and categories is incomplete. Many categories are reported as not estimated ("NE") in the CRF tables and many categories are estimated at an aggregated level, in particular in the energy sector. An assessment of the completeness of the 2006 submission is difficult because of the incorrect use of notation keys. The use of notation keys should be improved, indicating clearly the type of gaps, such as a non-existing source, not occurring ("NO") or not applicable ("NA"), the inclusion of a source in another category, included elsewhere ("IE"), the omission of a source due to a lack of data ("NE") or an evaluation showing that the source is negligible ("NE"). The completeness of the inventory was improved considerably by the provision of additional information and data during and after the in-country review. However, the revised CRF tables still do not contain emissions from solid fuel transformation, emissions from closed mines, $CO_2$ emissions from coal mining and handling, $CO_2$ emissions from asphalt roofing and road paving with asphalt, emissions and removals from grasslands and emissions from land conversions. An improved disaggregation of emission estimates should be provided in the CRF tables of the next inventory submission, including those missing categories that are likely to be relevant to the Russian Federation. Detailed recommendations are provided in the sectoral sections of this report.

10. The NIR is not complete because the sections on the key category assessment and the assessment of completeness (also with regard to geographic coverage) are missing. For the energy sector, no detailed documentation on methodologies and data is provided. The ERT recommends the Russian Federation to include in the NIR of its next submission all the elements and sections outlined in the structure specified in the UNFCCC reporting guidelines.

### 2. Transparency

11. The NIR submitted in 2006 did not provide the information necessary to replicate the emissions and removals estimates. In particular, the description of the methodologies and data in the energy sector was not sufficiently detailed. Some parts of the emission estimations were not documented at all, and descriptions were not sufficiently detailed for many categories with regard to methods, AD, EFs and data sources. Large parts of the information needed to understand the inventory estimates were only provided orally during the in-country review. These explanations should be documented in future NIRs. A considerable effort is required to improve the transparency of the information in the NIR, explaining the methods, data, data sources and assumptions, and the rationale for the choice of methods and EFs. How the data were collected and compiled by the external data providers should be explained. Improved transparency in the NIR is essential for future reviews. Specific recommendations are provided in the sectoral sections of this report.

12. With regard to confidential information, the ERT was informed that there is a differentiation in Russian legislation between statistics that are not publicly available and only "for internal use of governmental institutions" (e.g. disaggregated energy balances) and "state secret" information (e.g. data on aluminium production). Access was completely denied to the ERT to the second category of data, but calculations and assumptions were explained in detail. The ERT recommends that for confidential AD, the Russian Federation provide indices relative to 1990 instead of total amounts in its next NIRs. This avoids the disclosure of data, but enables a better evaluation of the information and the emission trends during the review. It also recommends that the Russian Federation clarify within the national system that the inventory review is a form of "internal use" so that ERTs can at least be provided with access to the data under this classification. The status of confidentiality should be indicated clearly in the NIR as well as the legal basis for the confidentiality.

13. The disaggregated energy balance, the basis for more than 80 per cent of the Russian emissions, was classified "for internal use only". However, during the in-country review the ERT was able to examine the energy balance for 1990 and cross-check that the data were used correctly and that the data were consistent with the data used in the emissions calculations. The Russian Federation is the only country where the disaggregated energy balance is classified as "for internal use only" for the entire time series. Some parts of the national balance were sent to the IEA and made available in international statistics. It is important that the ERT is provided with national information to enable it to check consistency between national energy data and international sources. The national system should address this issue urgently and disaggregated energy balances should be made available to ERTs in the future.

### 3. Recalculations and time-series consistency

14. The Russian Federation did not submit GHG inventories under the UNFCCC in the years prior to 2006 so no recalculations are reported in the 2006 submission. Many recalculations were made in 2007, leading the ERT to believe that the national system can ensure that recalculations of previously submitted estimates of GHG emissions by sources and removals by sinks are prepared in accordance with the IPCC good practice guidance.

15. Revised emission estimates for the 2006 submission were submitted and discussed during the in-country review and additional revisions were made available to the ERT. These resulted in major changes in the energy sector and smaller revisions in the other sectors. The revisions led to many improvements in the inventory estimates for all sectors. In the next inventory submission it is important that the Russian Federation transparently document and describe all changes and improvements in the NIR and in the CRF tables, including explanations of the revised methodologies and the rationales for their use.

16. The inventory is broadly consistent and the same methods and data sources have generally been used across the entire time series. During the in-country review, the ERT was informed that there were some inconsistencies in the energy balances across the time series due to changes in data compilation methods and sectoral structures. These inconsistencies could not be assessed during the in-country review and it is unclear whether they create minor or major problems because the detailed energy balances were not available for all years and because of the time constraints created by the large number of revisions of data during the review. The ERT recommends that future reviews continue thoroughly to assess time-series consistency, in particular in the energy sector, because this task could only be performed partially during this review.

### 4. Uncertainties

17. The Russian Federation has not provided an uncertainty analysis for each category and for the inventory in total, as specified in the IPCC good practice guidance. Uncertainly analyses were only performed for the agriculture (tier 1 and tier 2) and LULUCF sectors (tier 1). During the in-country review, Rosstat presented detailed information on the statistical uncertainties of AD. The ERT recommends that uncertainty estimates for AD within the inventory be elaborated in cooperation with Rosstat. The ERT recommends that the Russian Federation provide in its next NIR a complete uncertainty analysis for all inventory sectors based on the revised estimates discussed during the in-country review.

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

18. The Russian Federation has elaborated a QA/QC plan in accordance with the IPCC good practice guidance. The QA/QC plan is part of an internal Institute of Global Climate and Ecology (IGCE) order on the "Practice of Quality Assurance and Quality Control for the National GHG Inventory" of 7 March 2007, which, among other issues, includes a description of specific QA/QC procedures, the plan for the

preparation of the national GHG inventory and the templates of the QC checklists. However, the QA/QC plan and procedures have not yet been implemented in a systematic way. Some individual QC procedures were used for the preparation of the 2006 inventory submission. A more complete implementation is envisaged for 2008. The ERT recommends the Russian Federation to fully implement the QA/QC plan and to document the implemented checks and activities in a transparent way in its next inventory submission.

19. The QA/QC plan includes general QC procedures (tier 1) as well as general source/sink category-specific procedures (tier 2). These have not yet been applied systematically for key categories and for those individual categories in which significant methodological and/or data revisions have occurred. Tier 2 QC procedures are more advanced in the agriculture and forest sectors but have not been specified in detail in the energy sector, where many revisions, which were not driven by the procedures of the QA/QC plan, occurred prior to and during the in-country review.

20. During the in-country review, Rosstat informed the ERT that for national statistics a unified system of classification and coding technical, economic and social information has been created in the Russian Federation. An integrated programme for the development and practical implementation of a system of standard indicators and registries has been in place since 2001. Since 2005, the development of statistical parameters has been implemented in accordance with a new All-Russian Registry of Economic Activities, which has been harmonized with the European statistical classification of economic activities (NACE). From 2008, it is planned to introduce a new All-Russian Registry of Economic Activities, which has been harmonized with the classification of products by activity (CPA). QC checks on data are performed at its regional branches and Rosstat uses software checks to detect errors and problems in regional information. Rosstat has the right to make adjustments on the basis of information received indirectly and sends requests back to its regional branches if problems are detected. Rosstat is the most important data provider in the compilation of the inventory. For other data providers, no information was available on QA/QC procedures and the type of activities estimated in the data sources used was sometimes unclear. The ERT recommends the Russian Federation to include in its next NIR a description of the QA/QC activities conducted by Rosstat on the specific statistics used for the GHG inventory and to add information on the QA/QC activities of other data providers.

21. Currently, no systematic evaluation of necessary improvement activities exists. The ERT recommends that in future years essential improvements should be clearly identified by the IGCE and Roshydromet and that Roshydromet support the IGCE in the collection of data and parameters for these improvement activities. The ERT recommends the Russian Federation to include such information in its future NIRs.

## G. Areas for further improvement

### 1. Identified by the Party

22. The NIR identifies the following areas for further improvement:

(a) Collection of additional data to fill gaps in the estimated categories and gases;

(b) Further development of country-specific EFs;

(c) The application of higher tier methods for key categories;

(d) Further implementation of the IPCC good practice guidance for LULUCF;

(e) Inclusion of dead organic matter and soil pools in the LULUCF estimates;

(f) Estimation of emissions/removals from the category grazing land management.

23. During and after the in-country review, the ERT received evidence that the IGCE has recently improved the inventory in many areas, in particular through:

(a) Revision of many emission estimates, in particular in the energy sector but also in the industrial processes and waste sectors, based on additional and improved data received;

(b) Development of key category assessment;

(c) Adoption of higher quality (higher tier) methods for some key categories, and development of own models for sophisticated parts of the inventory estimation such as in the agriculture sector;

(d) More use of country-specific information;

(e) Implementation of the activities of the QA/QC plan;

(f) Implementation of a database for storing and archiving data incorporated into the inventory and inventory estimations;

(g) Implementation of the detailed LULUCF recommendations from the third national communication review.

24. These elements are not yet included in any official inventory documents submitted to the UNFCCC and the ERT recommends that the Russian Federation address all these elements in its next inventory submission.

2. Identified by the ERT

25. The Russian Federation has only established the necessary formal procedures for inventory preparation very recently, and it is not yet clear whether the formal procedures will work effectively, that all necessary data and information will be provided to the inventory agency and that all formal procedures will be implemented on a regular basis. The ERT considers that the quality of the national system has to be measured on the basis of its output, which is the quality and timeliness of the annual inventory submission. This implies:

(a) Timely annual submission of the NIR and the CRF;

(b) Complete CRF tables with correct use of notation keys where all relevant source/sink categories are estimated at an appropriate level of disaggregation;

(c) A transparent NIR describing and reporting all calculation methodologies, the AD used, EFs and other parameters for all sectors of the inventory, in particular for the energy sector;

(d) Full implementation of the IPCC good practice guidance and the use of higher tier methods for key categories, in particular in the energy and industrial processes sectors;

(e) Speed-up preparation of the system of additional statistical indicators/parameters that are needed for inventory preparation.

26. The follow-up process to the issues identified during the review and how the recommendations of this review are implemented in the future will show whether the procedures for inventory planning, preparation and management are working efficiently (e.g. whether relevant data for the estimation of emissions from international bunker fuels will be provided by the corresponding agency).

27. The ERT identifies the following cross-cutting issues for improvement. The ERT recommends that the Russian Federation:

(a) Increase the resources and improve the QA/QC procedures for the national energy balance and ensure access to the national balance for ERTs;

(b) Improve the data on fuel consumption in the different categories;

(c) Provide quantified uncertainty estimates for all sectors;

(d) Provide a key category assessment and prioritize resources for further inventory improvements based on this assessment;

(e) Fully implement the QA/QC procedures and the QA/QC plan for the inventory preparation.

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

# II. Energy

## A. Sector overview

29. The energy sector contributed 81.3 per cent of the GHG emissions of the Russian Federation in 2004. $CO_2$ was the major contributor with 79.3 per cent of the sector's emissions, while $CH_4$ contributed 20.5 per cent and $N_2O$ contributed 0.2 per cent. Emissions from the energy sector decreased by 36.2 per cent between 1990 and 2004, from 2,707,695.94 Gg $CO_2$ eq. to 1,728,466.20 Gg $CO_2$ eq., mainly due to the steep economic decline in the 1990s. In 2004, emissions from fuel combustion were responsible for 78.0 per cent of energy sector emissions. The remaining 22.0 per cent were fugitive emissions. Energy industries were the largest contributor to emissions from fuel combustion, contributing 64.1 per cent, followed by transport, 13.0 per cent, other sectors, 12.0 per cent, manufacturing industries and construction, 8.6 per cent, and other, 2.2 per cent. The structure of emissions from the energy sector has changed since 1990. The contribution of fugitive emissions to the energy sector has increased from 15.7 per cent in 1990 to 22.0 per cent in 2004. The reduction in the contribution of emissions from fuel combustion to the energy sector came mainly from transport (15.8 per cent to 13.0 percent), manufacturing industries (9.5 per cent to 8.6 percent) and other (11.6 per cent to 2.2 per cent).

30. The original 2006 inventory submission contained many gaps in the energy sector. Only aggregate $CO_2$ emissions for fuel combustion (1.A) were reported. There was no sectoral breakdown into major categories and subcategories and no $CH_4$ and $N_2O$ emission estimates were reported. For fugitive emissions, $CO_2$ emissions from solid fuels and from oil, natural gas and venting were not estimated. $CH_4$ emissions were not estimated for some subcategories of oil and natural gas, and no estimates were provided for venting. Emissions of $N_2O$ were provided only for flaring. Emissions from solid fuel transformation and from international bunker fuels were not estimated.

31. The energy sector is covered very briefly and is incomplete in the 2006 NIR. No descriptions of AD, EFs, methodologies, completeness, transparency, consistency of the time series, uncertainties, QA/QC, recalculations and planned improvements are included. During the in-country review, additional oral and written explanations were provided to the ERT in the areas requested, adding transparency in key areas. However, the lack of an appropriate NIR considerably hampered the review. Considerable efforts have to be made by the Russian Federation to provide a transparent NIR as part of its next inventory submission. This should follow the guidance and structure outlined in the UNFCCC reporting guidelines. It should, in particular, include individual trend explanations for all key categories

and a description of the methods and their choice, as well as presentation of AD, EFs and other estimation parameters and of their sources and the choice of these sources. The energy section of the NIR should include a description and explanations of the differences between the reference approach and the sectoral approach, and a description of the estimation of feedstocks and non-energy use of fuels, uncertainties and time-series consistency, source-specific QA/QC activities, recalculations, planned improvements and responses to the review process.

32. As is mentioned above, detailed Russian energy balances are classified as "for internal use only" and considered confidential. After some discussions, the ERT was able to look at the balance for 1990 during the in-country review in the presence of Russian inventory experts. However, the ERT was not provided with a copy of this balance or with the detailed energy balances for any other year. Only highly aggregated energy information from the energy balance is publicly available. This situation considerably hampered the work of the ERT in a sector that covers more than 80 per cent of the Russian Federation's emissions. No other Annex I Party considers its disaggregated energy balance to be confidential. During the in-country review, the consistency of the 1990 energy balance with AD presented in the preliminary estimations of sectoral and reference approaches was checked, but this task could not be performed for any other year in the inventory time series (e.g. 2004). Therefore, the time-series consistency of the inventory data could not be assessed. It is important that the Russian Federation provides future ERTs with access to the underlying energy data to enable a complete assessment of time-series consistency and of the accuracy of the inventory data, in particular for the latest reported years.

33. During the in-country review, the Russian Federation announced that the estimates for the entire energy sector had been completely revised because the IGCE had only been provided with access to the 1990 energy balance shortly before the review visit. The ERT requested the Russian Federation to complete this work and provide these estimates together with substantive supporting information. After the in-country review, the Russian Federation provided a completely revised estimate for the energy sector for 1990 and 2004, including the sectoral approach formally submitted for the first time, a revised reference approach and $CH_4$ and $N_2O$ emission estimates from fuel combustion in accordance with the recommendations of the ERT. Additional explanations of the methods and data used and the underlying sources were also provided. Revised estimates covered the following categories for 2004: $CO_2$ emissions from energy industries (1.A.1); manufacturing industries and construction (1.A.2), including all subcategories; transport (1.A.3), including all subcategories; other sectors (1.A.4), including all subcategories; and other – stationary (1.A.5.a).

34. The revised CRF tables provided after the in-country review did not contain a separate estimate for petroleum refining (1.A.1.b) or for manufacture of solid fuels and other energy industries (1.A.1.c). Apparent consumption of lubricants was not estimated using the reference approach. $CH_4$ and $N_2O$ emission estimates were frequently included in other categories. The revised estimates also included recalculations for fugitive emissions, but no emissions from solid fuel transformation (1.B.1.b) were estimated, and generally there were no estimates of $CO_2$ emissions from solid fuels. The ERT strongly recommends that the Russian Federation provide separate estimates for petroleum refining and manufacturing of solid fuels and other energy industries in its next submission. The NIR and CRF tables should clearly explain all the remaining gaps and cases where emissions are reported as included elsewhere ("IE"). In the course of the review, some of these revised estimates were further corrected at the request of the ERT and a second revised set of CRF tables for 1990 and 2004 was provided, including the additional corrections. After the in-country review, following the recommendations of the ERT, the Russian Federation revised downwards the GHG emissions for 2004 from fuel combustion by 9.7 per cent (from 1,492,072.52 Gg $CO_2$ eq. to 1,347,740.68 Gg $CO_2$ eq.) and revised upwards the fugitive emissions by 44.6 per cent (from 263,317.22 Gg $CO_2$ eq. to 380,725.52 Gg $CO_2$ eq.), mainly due to the addition of previously missing subcategories. Estimates for international bunker fuels in the aviation and marine categories were also provided for the years 1990 and 2004.

35. Due to the lateness of the provision of this additional and improved information and the lack of a complete time series, time series checks and cross-comparisons of implied emission factors (IEFs) or other specific parameters with other Parties could not be performed. This is an important outstanding task for the review of the next inventory submission.

36. The estimates for the energy sector were recalculated very shortly before the review visit so no time was available for QA/QC procedures. During the review, the ERT discovered a number of mistakes in the calculations which demonstrated gaps in QC procedures. The ERT strongly recommends that the QA/QC activities outlined in the QA/QC plan are fully implemented for the energy sector as soon as possible.

37. No uncertainty assessment was provided for the energy sector. The Russian Federation should prepare a complete uncertainty assessment for its next inventory submission as recommended in the general section.

38. No key category analysis was available for the energy sector. The key category analysis carried out by the UNFCCC secretariat, which was performed on a largely different set of data than the revised CRF tables provided to the ERT, identified the following key categories for 2004: $CO_2$ from stationary combustion – gaseous, liquid, solid and other fuels, $CO_2$ from road transportation, $CO_2$ from other transportation, $CH_4$ and $CO_2$ from oil and natural gas, and $CH_4$ from coal mining and handling. The Russian Federation is strongly urged to provide a complete key category analysis as part of its next inventory submission and to use the key category analysis to further improve its estimation.

39. The Russian energy balance is compiled at the federal level by Rosstat. It is available within 11 months for the previous year. A short version of the energy balance is published annually in the Russian Statistical Yearbook and also presented to the IEA. Some methodological revisions have occurred in the past, but the time series was not revised to make it consistent. Therefore, the Russian energy balance includes some time-series inconsistencies, although the quantitative extent of these is unknown.

40. During the review it was explained that there is a high uncertainty in the energy balance in the allocation of fuel consumption to individual sectors such as transport, industry, households, services or agriculture for fuels that are consumed in many sectors. Whereas energy production and total consumption are monitored accurately, the Russian statistical system has no accurate statistics on sectoral consumption levels and total consumption is broadly split between the different sectors based on general assumptions that were not explained in detail to the ERT.

41. The Russian energy balances provide data in tonnes of coal equivalent, a unit not widely used in other countries. Conversion factors from coal equivalents were provided for the ERT during the review. The Russian Federation should report these conversion factors in its future NIRs.

## B. Reference and sectoral approaches

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

42. In the original 2006 submission, $CO_2$ emissions were estimated using the reference approach and the sectoral approach for 2004. The CRF tables included AD for production, imports, exports and stock change, but no estimations for international bunker fuels. Emissions were calculated using the IPCC default EFs and the fraction of carbon oxidized. Carbon stored was reported in CRF table 1.A.d. The total of emissions originally estimated for the energy sector in 2004 was 1,457,284.08 Gg $CO_2$. After the in-country review, revised CRF tables were provided in which total emissions estimated using the reference approach for 2004 were revised downwards to 1,412,729.68 Gg $CO_2$, which is 3.1 per cent lower than the original data in the 2006 submission. The difference is because of changes in apparent

consumption data for most fuels, in particular crude oil, natural gas liquids, jet kerosene, diesel, LPG, coking coal, other bituminous coal and coke oven/gas coke as well as the inclusion of coke used for iron and steel production as other solid fuel. EFs were not changed and remain the IPCC default EFs. The revised CRF tables include information on international bunker fuels.

43. During the in-country review, a revised set of CRF tables containing the sectoral approach was provided to the ERT, but efforts were concentrated on 1990. The ERT requested the Russian Federation to provide these revised estimates in line with the discussions with the ERT during the in-country review, including transparent documentation of the method chosen, the assumptions, the AD and the EFs used in the revised calculations and the data sources. After the in-country review, within the six-week period, the Russian Federation provided a complete revised estimation for the energy sector using the sectoral approach, in accordance with the recommendations of the ERT and correcting the problems identified during the in-country review. Some of these revised estimates were further corrected later at the request of the ERT and second sets of revised CRF tables for 1990 and 2004 were provided that included the additional corrections. These tables contain AD, IEFs and $CO_2$, $CH_4$ and $N_2O$ emission estimates for most categories. Estimations for petroleum refining (1.A.1.b) and manufacture of solid fuels and other energy industries (1.A.1.c) were still included under public electricity and heat production (1.A.1.a) and not reported separately. EFs (except for the energy industries category (1.A.1), where country-specific EFs are used), carbon content values, the fraction of carbon oxidized and the other parameters used were taken from the Revised 1996 IPCC Guidelines. IPCC tier 1 methods were applied to all emissions estimations. The ERT strongly recommends the Russian Federation to at least estimate emissions from key categories using higher tiers and country-specific EFs. The ERT focused its review on the 1990 data, and the 2004 CRF tables were not revised in detail. Some important differences from the original set of CRF tables were identified.

44. The AD reported in CRF table 1.A(a) were extracted from the energy balance. The sectoral structure of the energy balance is slightly different from the common international structure and this difference affects primarily transport emissions estimates. Transport in the Russian Federation's energy balance is taken into account as an economic sector and includes more than just data on fuel consumption for transportation. Similarly, consumption for transportation is also included in other sectors (e.g. gasoline consumption for private transportation is included in the residential sector). The reallocation of these emissions was treated properly by the Russian Federation.

45. $CH_4$ and $N_2O$ emissions from all the subcategories of manufacturing industries and construction (1.A.2) were calculated for this category as a whole and reported under iron and steel (1.A.2.a). This allocation introduces a distortion to the iron and steel IEFs and hampers an assessment of emissions estimates for all the subcategories. In accordance with the IPCC good practice guidance, emissions related to energy use of blast furnace gas were considered under category 2.C.1 in the industrial processes sector. The ERT strongly recommends the Russian Federation to estimate and report separately $CH_4$ and $N_2O$ emissions from all the subcategories of manufacturing industries and construction.

46. In the original 2006 submission the reported difference for 2004 between the reference and sectoral approaches was –2.3 per cent, which implies higher emissions in the sectoral approach. This is unlikely to be correct. In the revised CRF tables, the difference in $CO_2$ emissions between the two approaches is 5.3 per cent. The differences in $CO_2$ emissions for all types of fuels are significant and need to be explained in the NIR of the next inventory submission of the Russian Federation.

### 2. International bunker fuels

47. Russian Federation national statistics report total jet kerosene consumption but not the split of consumption between domestic and international air traffic. The Russian Federation provided

estimations for international bunker fuels after the in-country review, following the request of the ERT. The method used to estimate the split between domestic and international aviation is not based on aggregate or individual aircraft movements as recommended by the IPCC good practice guidance. The transport ministry of the Russian Federation only provided fuel consumption data for international (return) flights operated by Russian carriers for the period 1996 to 2004. It is unclear how these data were collected. Total fuel consumption for all international flights is derived using a number of additional general assumptions, for example, that fuel consumption by international air carriers constitutes 50 per cent of the fuel consumption of Russian carriers in the period 1990 to 2004. In addition, the resulting fuel consumption by international carriers was divided by three and that by Russian carriers by 1.5. These assumptions are not justified by additional supporting information and they do not seem to be realistic. For example, reports from the major international airports show that the number of international carriers operating in the Russian Federation has been constantly increasing, as has the number of flights operated by international carriers. Many international carriers have launched or expanded long-distance flight operations in the Russian Federation, which potentially consume more fuel per flight than the average international distance flown by Russian carriers. The constant relationship of 50 per cent for fuel consumption by international carriers in relation to Russian airlines outlined above does not capture the dynamic development of international air traffic in the Russian Federation.

48. Thus, the ERT considers that the method used to calculate the split between domestic and international fuel consumption is not in line with the IPCC good practice guidance. According to the IPCC good practice guidance, aircraft movement data may be obtained from passenger kilometres and cargo tonnage data, but these sources are not considered very reliable and inventory agencies are requested to ensure completeness. The Russian Federation only used passenger-kms and neglected cargo data, and the data are incomplete as they only cover Russian carriers and not international carriers. The assumptions used to complete the estimate are not based on the IPCC good practice guidance and have not been justified sufficiently. The Russian Federation is strongly recommended to revise its method for splitting jet fuel consumption between international and domestic air traffic and to base it on LTO data per aircraft type and distance travelled as recommended by the IPCC good practice guidance. Such data are available from air traffic control authorities and are collected in the Russian Federation as in other countries. The institutional arrangements for inventory preparation should ensure access to such data for the inventory agency.

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

49. The Russian Federation estimates and reports in the CRF only part of its fuel use for non-energy purposes. The reason is that the IPCC default fractions of carbon stored are not available for all fuels for which non-energy use is reported in the energy balances. The ERT encourages the Russian Federation to estimate the fractions of carbon stored for these fuels and to complete the reporting of non-energy fuel use. The ERT recommends the Russian Federation to provide a more transparent description of the non-energy use of fuel in its next NIR explaining how the AD are collected and reported throughout the entire time series.

### C. Key categories

#### 1. Stationary combustion: liquid, solid and gaseous fuels – $CO_2$

Energy industries (1.A.1)

50. $CO_2$ emissions from petroleum refining (1.A.1.b) are reported together with public electricity and heat production (1.A.1.a). This is an important category and should be reported separately. $CH_4$ and $N_2O$ emissions from petroleum refining are not estimated. The ERT recommends the Russian Federation to report these emissions separately in its next inventory submission.

51. $CO_2$ emissions from manufacture of solid fuels and other energy industries (1.A.1.c) are reported together with public electricity and heat production (1.A.1.a). This category should be reported separately. The ERT recommends the Russian Federation to report these emissions separately in its next inventory submission.

52. $CO_2$ emissions from public electricity and heat production (1.A.1.a), which include emissions from other categories (1.A.1.b) and (1.A.1.c), represent 49.9 per cent of the emissions from the energy sector. After the in-country review, the Russian Federation revised downwards the $CO_2$ emissions from this category by 10.8 per cent (from 966,109.22 Gg to 862,088.15 Gg) for 2004. The underlying data could not be assessed. It is important that the Russian Federation provides future ERTs with access to the underlying energy data and assumptions to enable a complete assessment of this category.

Manufacturing industries and construction (1.A.2)

53. $CO_2$ emissions from manufacturing industries and construction contributed 6.7 per cent of the emissions from the energy sector of the Russian Federation in 2004 and have decreased by 46.4 per cent since 1990. The revised CRF tables provided after the in-country review contain separate estimates for all subcategories of manufacturing industries and construction. The revised estimate for $CO_2$ emissions (137,705.59 Gg) is 15.8 per cent lower than the original estimate (115,891.01 Gg). It is important that the Russian Federation provides future ERTs with access to the underlying energy data and assumptions to enable a complete assessment of this category.

### 2. Road transportation – $CO_2$

54. $CO_2$ emissions from road transport contributed 4.8 per cent of the emissions from the energy sector in 2004 and have decreased by 53.0 per cent since 1990. The ERT identified many inconsistencies in the CRF tables of other categories in the 2006 submission and the subsequent revisions after the in-country review, which have implications for the road transportation category. The Russian Federation explained that the differences and inconsistencies identified by the ERT in commercial/institutional (1.A.4.a) and agriculture/forestry/fisheries (1.A.4.c) were due to the reallocation of emissions that had been initially allocated to the road transportation category and were subsequently subtracted from this category. The reallocation of these emissions was treated properly by the Russian Federation for 1990 but could not be checked for 2004. The revised estimate for $CO_2$ emissions (82,902.90 Gg) is 26.7 per cent lower than the original estimate (113,129.91 Gg). The ERT recommends the Russian Federation to provide detailed explanations in its next NIR of the allocation of fuel consumption to the road transportation, commercial/institutional and agriculture/forestry/fisheries categories in order to improve the clarity of the estimation and reporting of these categories.

### 3. Coal mining and handling – $CH_4$

55. $CH_4$ emissions from the coal mining and handling category contributed 2.0 per cent of the total national emissions and 2.5 per cent of the sectoral emissions in 2004. These emissions decreased by 36.4 per cent in the period 1990–2004, mainly because of a decrease of 44.5 per cent in $CH_4$ emissions from underground mines – mining activities, which is the main subcategory. The NIR reports the use of IPCC tier 1 and tier 2 methods for these estimates combined with IPCC default EFs for surface mines and post-mining activities. A country-specific EF was used for $CH_4$ estimates for underground mines. Data on coal production from underground and surface mines are provided by Rosstat.

56. The NIR lacks transparency as the information provided is very limited and does not cover AD, country-specific EFs and the parameters used in calculations, or information on QA/QC activities, uncertainties, time-series consistency and planned improvements or any detailed category-specific information. The NIR provides a short description and interpretation of emission trends, indicating that the period 1990–2004 was characterized by an overall emission decrease during the whole of the 1990s

followed by an increase since 2000. In addition to reductions in the amounts of coal produced, coal mining was also affected by structural changes in production during these years, with an increase in the share of surface mining. The ERT noted fluctuations in the $CH_4$ emissions trend since 1998 in the order of +/–7.5 per cent, which the Russian Federation explained were due to economic reasons and to the growing share of less $CH_4$-emitting open mining in coal production. The ERT recommends the Russian Federation to include in its next NIR more detailed category-specific information on the AD, EFs and parameters used in the calculations, as well as cross-cutting information related to the category, including trends, following closely the outline provided in the UNFCCC reporting guidelines.

57. During the in-country review, the Russian Federation informed the ERT that it had revised its emissions estimation of the 2006 GHG submission for coal mining and handling to incorporate revised AD and, where available, country-specific EFs for individual coal basins. The ERT requested the Russian Federation to provide these revised estimates in line with the preliminary estimates already provided to the ERT during the in-country review, including an overview of the share of emissions calculated based on basin-specific data, information on the coal basin-specific EFs and parameters used for the calculations and transparent documentation of the chosen method, assumptions and activities included in the revised calculations and the data sources.

58. After the in-country review, following the recommendations of the ERT, the Russian Federation provided revised estimates of $CH_4$ emissions, including recovery, for 1990 and 2004. The overall impact of the revisions in this category for 2004 was an increase in the $CH_4$ emissions by 60.3 per cent from 1,269.91 Gg to 2,035.81 Gg and a reduction in the $CH_4$ recovered of 15.1 per cent from 52.46 Gg to 44.55 Gg.

59. For the revised estimates, the Russian Federation used a tier 2 method in accordance with the IPCC good practice guidance. The coal production data were obtained from a published state statistical report (Russian Statistical Yearbook, 2006) and grouped in territorial-geographic regions based on the major coal basins, type of mining activities and types of coal in the country. The country-specific EFs were developed for each region on the basis of the coal-bed methane content (gas-bearing capacity) and methane abundance in underground mines. The coal-bed methane content data for the major coal basins were taken from published literature. $CH_4$ abundance data were obtained from measuring equipment installed in operational underground mines.[4]

60. Methane recovery is performed at the mines in the Pechora coal basin and data were derived based on coal-bed methane content (or gas-bearing capacity) and methane abundance in the underground mines. Actual measurement data for recovered $CH_4$ were available for the years 1990–2000 and 2005 and the years 2001 to 2004 were interpolated. For post-mining activities EFs, the fraction of $CH_4$ released was accounted for in addition to the actual coal bed $CH_4$ content and the existence of preliminary drainage in relevant territorial-geographic regions. The $CH_4$ fraction released from post-mining activities was taken as 10 per cent for the Pechora basin and the relevant territorial-geographic region. For other basins, it was assumed that 30 per cent of methane is released during post-mining activities.[5]

61. The country-specific EFs for underground mining used in the northern (38.9 $m^3\ t^{-1}$) and southern regions (26.4 $m^3\ t^{-1}$) are higher than the IPCC default range for underground mining for the Soviet Union (USSR) (17.8 – 22.2 $m^3\ t^{-1}$) while the country-specific EFs for western Siberia (the main producer), the central and the Ural regions and the average Russian EFs across all regions are within the IPCC default range. The Russian Federation explained that the data for the northern and southern regions are obtained from direct measurements in coal mines and that coal from these regions has higher than average $CH_4$

[4] The Gas-Bearing Capacity of the USSR Coal Basins and Deposits, 1979; Malyshev and Ayruni, 1999.
[5] The Gas-Bearing Capacity of the USSR Coal Basins and Deposits, 1979; Malyshev and Ayruni, 1999; IPCC, 2000.

contents. The Russian Federation also announced plans to further improve the estimation of $CH_4$ emissions from coal mining by implementing a tier 3 approach.

62. The country-specific EFs for surface mining in the northern region, western and eastern Siberia, the far east region as well as Primorye and Sakhalin (6.0, 6.9, 5.0, 8.4 and 3.4 $m^3 t^{-1}$, respectively) are about three times higher than the IPCC default range of 0.3 – 2.0 $m^3 t^{-1}$ (the global average). Western Siberia is the main producer. The resulting IEF for $CH_4$ (4.29 kg/t) for the Russian Federation is much higher than the IEFs of all other reporting Annex I Parties. The Russian Federation explained that the higher country-specific EFs are based on measurements that take into account gas bearing strata adjacent to the coal strata from which $CH_4$ is released when the mine is opened. It was also explained that the major Russian surface mines are in the same region (western Siberia) as the underground mines and that the same coal seams are operated as underground mines in some regions, but are close to the surface in other regions and operated as surface mines. $CH_4$ EFs are based on direct measurements by Russian coal experts from Russian Academy of Science, published in national literature.

63. $CH_4$ emissions from post-mining activities for surface mining were not estimated because the IPCC good practice guidance assumes that the post-mining emissions associated with surface mining operations are already accounted for under open mining emissions.

64. Methane recovery measurement data for 1990–2000 and 2005 are available from published national sources. For the years 2001–2004, methane recovery was interpolated on the basis of these data. The general process of $CH_4$ formation and $CH_4$ emission control in the estimation is based on Malyshev and Ayruni (1999).

65. The ERT encourages the Russian Federation to make further efforts to improve its estimates using a tier 3 method for underground mining operations in its subsequent submissions, as announced during the review. In order to increase transparency, it also recommends the Russian Federation to provide more detailed information on AD, characteristics of coal basins and their geographic distribution, the types of mining and coals, country-specific EFs (in particular for surface mining) and the parameters used for calculations as well as transparent documentation of the method, assumptions and data sources in its next NIR. The ERT also encourages the Russian Federation to include estimations of emissions from closed underground mines in its future submissions by, for example, using methods contained in recently published recognized international literature, or in the GHG inventory reports of other Parties such as the United Kingdom.

### 4. Oil and natural gas – $CH_4$ and $CO_2$

66. GHG emissions from the oil and natural gas category contributed 15.9 per cent to the total national emissions and 19.6 per cent to the sectoral emissions in 2004. Emissions from this category decreased by 5.6 per cent in the period 1990–2004, mainly because of a 7.7 per cent decrease in $CH_4$ emissions from natural gas (the main source of emissions in this category). As is reported in the NIR, estimates of $CH_4$ emissions from oil- and natural gas-related activities are based on the IPCC tier 1 methodology. IPCC default EFs and country-specific EFs were used for the calculations. Data on oil- and natural gas-related activities were provided by Rosstat.

67. As is mentioned above for other categories, the NIR lacks transparency because the information provided is very limited and does not contain any detailed category-specific information. The NIR provides a brief interpretation of emission trends, indicating that the period 1990–2004 was characterized by downward trends that lasted for the whole of the 1990s and subsequent growth. During the in-country review, the Russian Federation explained that these changes in emissions reflect changes in production activities in the sector which decreased as a result of the economic recession in the country and later increased in the years of economic recovery. The ERT noted fluctuations in the trend and abrupt

inter-annual changes in $CH_4$ and $CO_2$ emissions from flaring – combined at the beginning and the end of the time series (reaching –21.2 per cent in 1992–1993 and +49.8 per cent in 2001–2002). The Russian Federation explained that these changes reflect the actual changes in the amount of associated gas flared within a specific year and that oil production, which decreased during the economic recession in the 1990s and increased in the years 2001–2002, is the main driver of the amount of associated gas flared in the country.

68. During the in-country review, the ERT identified a number of subcategories under the oil and natural gas category for which emissions were not estimated in the 2006 inventory submission for the entire time series (e.g. $CO_2$ emissions from all categories, with the exception of flaring – combined; $CH_4$ emissions for oil – exploration, oil – distribution of oil products, oil – other, natural gas – exploration, venting – oil, venting – combined, flaring – oil (including $N_2O$) and flaring – gas (including $N_2O$)). In addition, $CH_4$ emissions for venting – gas are reported as "IE" in the CRF tables and included under the natural gas category. The ERT also noted that, because this is a key category, estimation based entirely on IPCC default EFs is not in accordance with the IPCC good practice guidance for key categories.

69. During the in-country review, the ERT requested the Russian Federation to provide revised estimates for emissions from oil and natural gas operations, representing all relevant emission sources as discussed during the in-country review. The ERT also requested the Russian Federation to ensure and demonstrate that the inclusion of additional sources did not lead to double counting of emissions and that activities that do not emit fugitive emissions are excluded; and to provide transparent documentation of the chosen method and any assumptions made in the calculations, explaining in detail the activities included in the revised estimates, data sources, EFs and other parameters used.

70. After the in-country review, following the recommendations of the ERT, the Russian Federation provided revised estimates for $CH_4$ and $CO_2$ emissions, including previously missing sources and $N_2O$ emissions from flaring, for 1990 and 2004. The impact of the revisions in this category for 2004 was an increase in $CO_2$ emissions of 21.3 per cent from 24,020.15 Gg to 29,145.25 Gg, an increase in $CH_4$ emissions of 45.2 per cent from 10,124.46 Gg to 14,701.19 Gg and an increase in $N_2O$ emissions of 575.2 per cent from 0.05 Gg to 0.33 Gg. The overall impact of the revisions in this category was an increase in GHG emissions of 42.8 per cent in 2004 from 236,649.16 Gg $CO_2$ eq. to 337,973.51 Gg $CO_2$ eq.

71. For the revised estimates, the Russian Federation used a combination of the tier 1 method from the Revised 1996 IPCC Guidelines and the refined tier 1 method from the IPCC good practice guidance and their corresponding EFs. The AD used to calculate emissions from the oil and natural gas activities were obtained from a published state statistical report (Russian Statistical Yearbook, 2006). The EFs are partly country-specific, taken from published scientific literature, and partly IPCC default EFs. In the paragraphs below a detailed discussion of oil, natural gas and venting and flaring emissions estimates is provided separately.

Oil (1.B.2.a)

72. Emissions were calculated for the following operations: servicing of producing oil wells ($CO_2$ and $CH_4$ emissions reported under exploration); production of oil and natural gas liquids (NGL) ($CO_2$ and $CH_4$); oil transport ($CO_2$ and $CH_4$); refining and storage ($CH_4$, nitrogen oxide ($NO_X$), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and sulphur dioxide ($SO_2$)); and venting ($CO_2$ and $CH_4$) and flaring of associated gas ($CO_2$, $CH_4$ and $N_2O$). Emissions from the servicing of producing oil wells, and from venting and flaring as well as precursors from refining and storage and emissions from NGL production were calculated for the first time and new data were made available for these calculations.

73. $CO_2$ and $CH_4$ emissions from oil exploration were not estimated in the 2006 inventory submission, but were provided after the in-country review. The emissions were calculated using the IPCC default EFs for servicing wells. The number of producing wells was estimated based on the daily average debit of one well and total annual oil production. The assumption was made that oil wells operate continuously for the entire year.

74. The Russian Federation reports a separate estimate for $CH_4$ emissions from NGL production under other (1.B.2.a.vi). NGL is considered to be a resource that is extracted separately and for which production data are provided in the Russian Statistical Yearbooks. The IEA defines NGL as all liquid products separated from natural gas in gas processing or recycling plants. NGL production is not included as a separate category in the Revised 1996 IPCC Guidelines. Russian experts and additional materials provided to the ERT confirmed that in Russia NGL extraction is a separate production process. The $CH_4$ EF used by the Russian Federation is 2,650 kg/PJ, calculated using the default IPCC net calorific value (NCV) for Norway and Canada of 45.22 TJ/kt. While oil production decreased between 1990 and 2004 by 12.4 per cent (from 589,861.3 $km^3$ to 516,570.3 $km^3$), NGL production increased by 58.9 per cent (from 10,200 kt to 16,204 kt).

75. For oil production, the $CH_4$ EF used is 1.45 t/$km^3$ of oil produced, and the $CO_2$ EF is 0.27 t/$km^3$ of oil produced, which represent the average value from the range provided by IPCC for oil production in the former USSR. For oil transport, the default IPCC EFs for $CO_2$ and $CH_4$ are used. $CO_2$ emissions from oil production and transport were not estimated for the 2006 inventory, but were provided to the ERT during the in-country review.

Natural gas (1.B.2.b)

76. Apart from associated gas flaring, no $CO_2$ emission estimates were provided for this category in the 2006 inventory submission. However, $CO_2$ emissions from natural gas were submitted to the ERT after the in-country review. Nor were $CH_4$ emission estimates from venting of oil and flaring in gas production estimated in the 2006 inventory, but these were also made available after the in-country review.

77. An average $CH_4$ content in natural gas of 98 per cent was assumed for the emission estimates from gas production, transmission, storage and distribution. This is higher than the IPCC good practice guidance default content, which is 91.9 per cent, used for EFs for transmission and distribution. The ERT requested the Russian Federation to further substantiate this figure for $CH_4$ content. It was explained that the $CH_4$ content in natural gas extracted in western Siberia (Yamburg) is 97 per cent (Wuppertal Institute, 2005). The share of western Siberian gas in the total natural gas production of Russia in 1990–2004 was 91–92 per cent. On this basis, a revised, more conservative, estimate for the $CH_4$ content (96.5 per cent) in Russian natural gas was calculated, using 97 per cent $CH_4$ for western Siberian gas and the IPCC good practice guidance default $CH_4$ content of 91.9 per cent for the remaining gas produced.

78. The subcategory production/processing (1.B.2.b.ii) includes $CO_2$ and $CH_4$ emissions from natural and associated gas production and processing. The content of $CH_4$ in natural and associated gas was assumed to be the same and production and processing technologies for natural and associated gas were assumed to be relatively similar. A country-specific $CH_4$ EF for production of natural and associated gas of $3.149 \times 10^{-3}$ Gg/$Mm^3$ was used originally for gas production, which was derived by the IGCE from Russian sources from the early 1990s (Nazarov et al., 1992; Vekilov et al., 1992). As this EF is higher than the range of default EFs contained in the IPCC good practice guidance ($2.6 – 2.9 \times 10^{-3}$ Gg/$Mm^3$), the ERT requested further evidence for this EF. In response to the ERT request, additional sources of measurement data for fugitive emissions from gas production were identified, which report much lower EFs: $4.02 \times 10^{-4}$ Gg/$Mm^3$ for measurements taken in 1997 and $7.37 \times 10^{-4}$ Gg/$Mm^3$ (based on same

measurements, but corrected in 2003). The measurements included two production plants – one built in 1986 and one built in 1994. Due to the age of the plants, the low EF derived in these measurements is unlikely to be representative for the complete time series for the entire country. Due to the high variation in $CH_4$ EFs in the national literature, the Russian Federation decided to use the average IPCC default value EF of 2.75 x 10-3 $Gg/Mm^3$, which was accepted by the ERT. It was announced that further work will be conducted to elaborate a country-specific EFs for fugitive $CH_4$ emissions from gas production and processing in future inventories. The ERT recommends that the Russian Federation base this improved country-specific EF on a sufficient number of production and processing facilities with an adequate representation of ages and technologies for the Russian gas sector.

79. The subcategory transmission (1.B.2.b.iii) includes $CO_2$ and $CH_4$ emissions from leakage during gas transmission through high pressure pipelines and leakage during gas storage. $CO_2$ emissions were originally not included in the 2006 submission but were provided after the in-country review. The amounts calculated in 2004 are 4,821.0 Gg $CH_4$ for transmission and 130.238 Gg $CH_4$ for storage.

80. The country-specific EFs used for gas transmission were calculated at Gazprom JSC in cooperation with Ruhrgas AG in 1996–1997 on the basis of case studies on gas leakage (Dedikov et al., 1999). Separate EFs for gas compressor stations and transmission pipelines were derived as a result of these studies, which were used for elaboration of country-specific EFs for gas transmission. The resulting country-specific EF is 0.9 per cent of gas transmitted through high pressure pipelines.

81. The estimated emissions from storage are within the range for emissions if calculated using the IPCC good practice guidance EFs range, albeit closer to the upper end, but higher than if calculated using an average IPCC default EF. The major leakages from gas storage facilities are associated with gas injection into and extraction from storage facilities. In the Russian Federation, the technology for gas storage is based on pumping it into suitable underground geological structures in the warm season and its extraction during the cold season (abandoned gas deposits are suitable and also used for this purpose if located near regions with high gas consumption). Storage facilities generally consist of a compressor station for gas injection, which is similar to compressor stations used at the high-pressure gas pipelines of the Russian gas transmission system, and a set of equipment for gas extraction similar to the equipment used at the natural gas production sites. The EF for a single compressor station was calculated from the data on gas transmission based on the EF by Dedikov et al. (1999) and used as the EF for gas injection into storage facilities. In the cold season, gas is extracted from storage facilities using the same technologies as those used for extraction at the gas deposits. For this reason, the EF for the extraction from storage is the same as that for gas production.

82. For gas distribution, the EF was calculated from the IEA analysis of gas distribution in the Russian Federation (IEA, 2006), which reports an average loss rate of 3.2 per cent of distributed gas. In its 2004 annual report, Gazprom JSC announced the completion of a comprehensive inventory of its gas distribution facilities to determine the current state of equipment and its reconstruction and maintenance requirements. This work should be taken into account in any future improvement of the country-specific EF for gas distribution.

83. $CH_4$ emissions from leakage during gas use were calculated separately for large industrial plants and power stations, which use the gas coming through high-pressure pipelines, and residential and commercial consumers, which obtain the gas through the medium- or low-pressure gas distribution network. The emissions from leakage during gas consumption were estimated based on the apparent natural gas consumption in the country and natural gas use by industrial plants and power stations, which were obtained from the CRF tables on fuel combustion (1.A).

Venting and flaring (1.B.2.c)

84. During the review, the Russian Federation provided new estimates for $CO_2$ and $CH_4$ emissions from venting of high pressure pipelines as well as new estimates for $CO_2$, $CH_4$ and $N_2O$ emissions from flaring during gas production and processing, which were not estimated before. The EFs for venting and flaring are the mean values from the range provided by the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

85. The estimates for flaring are separated between flaring of natural gas during gas production and flaring of associated gas from oil production. The state statistics represent only the data on the utilized fraction of associated gas produced within the specific year. It was assumed that all other associated gas that is produced but not utilized is flared. The ERT identified some double counting for flaring, and the estimates provided were revised. In the estimations, the gas flared during gas production was subtracted from the gas consumption by the end-users as well as from the amount of gas processed.

86. In order to increase transparency, the ERT encourages the Russian Federation to make further efforts to improve its estimates in its subsequent submissions using detailed infrastructure data for natural gas operations, and to provide more detailed information on AD, the characteristics of the oil and gas industry in the country, the available infrastructure data, and the country-specific EFs and parameters used for calculations as well as transparent documentation of the methods, assumptions and data sources in its next NIR. The ERT also encourages the Russian Federation to make efforts to include estimates for categories currently reported as "NE".

## D. Non-key categories

### 1. Civil aviation – $CO_2$

87. In the 2006 inventory submission, the Russian Federation did not estimate emissions from civil aviation or provide data on fuel consumption for civil aviation, with the exception of a small amount of aviation gasoline in 2004. During the in-country review, the ERT requested the Russian Federation to provide such estimates as data became available. In response to the ERT's request, after the in-country review, $CO_2$ emissions and jet kerosene consumption data for civil aviation were provided for the years 1990 and 2004. According to these data, jet kerosene consumption for civil aviation fell by 91 per cent from 508,308.21 TJ in 1990 to 46,681.08 TJ in 2004. This is the largest decrease in fuel consumption for civil aviation reported by any Annex I Party. In response to the further questions of the ERT, the decrease was explained by reduced demand for passenger and freight air transport and an increase in the fuel efficiency of aircraft. However, in the ERT's opinion the decrease still seems very large taking into account the fact that, according to the Russian response, the domestic passenger volumes of Russian air carriers decreased by 73 per cent between 1990 and 2004 and freight volumes decrease by 66 per cent between 1991 and 2004. If an average decrease of 70 per cent in passenger or freight volumes is assumed between 1991 and 2003, a reduction in specific fuel consumption per ton-km of about 70 per cent would be necessary to achieve a total reduction of fuel consumption of more than 90 per cent in this period. Such a tremendous increase in the efficiency of aircraft in Russia does not seem to be realistic. It is also important to note that the aircraft fleet for international flights was modernized in the 1990s, while older planes continued to operate on domestic flights – so the efficiency increase for domestic flights would be lower compared to international flights.

88. Jet kerosene is the major fuel used for aviation, along with small amounts of aviation gasoline which are not reported separately in Russian energy statistics but included under jet kerosene consumption. The totals for jet kerosene consumption for domestic and international aviation reported in the revised CRF tables were 573 PJ in 1990 and 151 PJ in 2004. IEA energy statistics report 788 PJ of jet kerosene consumption in 1990 and 416 PJ in 2004. Thus, the total jet kerosene consumption included

in the GHG inventory is 73 per cent of the IEA total in 1990 and only 36 per cent of the IEA total in 2004. During the review, Rosstat experts explained that IEA data for total jet kerosene consumption is consistent with national statistics, but that the small quantity of aviation gasoline reported by the IEA does not exist in Russian data. Thus, the estimation of total fuel consumption for aviation seems to be incomplete, and total $CO_2$ emissions from aviation are underestimated, especially for the most recent years. In particular, the reported $CO_2$ emissions of 3,389.05 Gg from civil aviation for 2004 seems to be far too low.

89. The method used to split fuel consumption between international and domestic flights is not considered to be in line with IPCC good practice guidance (see paragraphs 47 and 48 above) and the latest years will need to be revised in the future if the method is not changed because $CO_2$ emissions for recent years seem to have been considerably underestimated. The Russian Federation is strongly recommended to revise its method for splitting jet kerosene consumption between international and domestic air traffic, and to base any new method on LTO data per aircraft type and distance travelled as recommended by the IPCC good practice guidance. The large discrepancy in total jet kerosene consumption between the CRF data and the IEA data needs further consideration and explanation, and subsequent correction for future inventory submissions.

#### 2. Navigation – $CO_2$

90. For 2004 the residual oil and gas/diesel consumption for domestic navigation included in the CRF contains considerable discrepancies compared to IEA data for these fuels: the CRF reports 11,020 TJ residual fuel oil consumption, whereas the IEA reports 16,921 TJ, and for gas/diesel oil use the CRF reports 11,042 TJ and the IEA 29,987 TJ. Fuel consumption for domestic navigation decreased by 90 per cent between 1990 and 2004. Some fuels included in the 1990 estimate, such as gasoline and other motor fuels, seem to disappear between 1990 and 2004. This strong decrease is not explained and is unrealistic. Together with the discrepancy with IEA data, this points to an underestimation of $CO_2$ emissions from domestic navigation in recent years. Further justification of the fuel consumption data trends has to be provided. A complete time series of fuel consumption and the resulting emissions is essential to any further assessment of the consistency of the time series. The ERT recommends the Russian Federation to revise its estimation of domestic navigation in order to ensure better consistency with international data. The estimation methods for emissions from domestic navigation should be described separately in the NIR, the data sources for the fuel consumption data should be clearly explained and data for international and domestic fuel use should be provided.

# III. Industrial processes and solvent and other product use

## A. Sector overview

91. In 2004, total GHG emissions from the industrial processes sector amounted to 188,169.92 Gg $CO_2$ eq., contributing 8.9 per cent to total national GHG emissions. Emissions from this sector have declined by 21.9 per cent between 1990 and 2004, mainly driven by decreases in emissions from limestone and dolomite use (55.6 per cent), cement production (39.6 per cent), lime production (38.6 per cent), iron and steel production (15.2 per cent), nitric acid production (14.0 per cent) and ammonia production (4.9 per cent). In 2004, $CO_2$ was the dominant GHG, accounting for 84.2 per cent of sector emissions, followed by PFCs (8.3 per cent), HFCs (5.2 per cent), $N_2O$ (1.8 per cent), $CH_4$ (0.4 per cent) and $SF_6$ emissions (0.1 per cent). Iron and steel production was the largest category in 2004, contributing 46.1 per cent to total sector emissions, while the other major categories were aluminium production (11.7 per cent), cement production (10.9 per cent), ammonia production (9.5 per cent), limestone and dolomite use (8.5 per cent), production of HCFC-22 (5.1 per cent) and lime production (4.0 per cent).

92. The key category analysis performed by the secretariat for 2004 revealed four key categories in the Russian Federation's industrial processes sector: iron and steel production – $CO_2$, cement production – $CO_2$, aluminium production – PFCs and ammonia production – $CO_2$.

93. The industrial processes sector reporting is generally complete. However, during the in-country review the ERT noted that estimates of emissions from asphalt roofing and road paving with asphalt were reported by the Russian Federation as "NE", while fugitive emissions of HFCs, PFCs and $SF_6$ were reported as "NA". Emissions from the solvent and other product use sector were estimated only for $N_2O$, while $CO_2$ and NMVOC emissions were reported as "NE" and "NA". The ERT also noted from Statistical Yearbooks that industrial operations exist for the production of bricks, ceramics, polyethylene, synthetic resins and plastic, and sulphuric acid, which suggests that these emission categories are missing. The Russian Federation is encouraged to report emissions from these categories in its next submission in order to improve the completeness of the inventory.

94. The Russian Federation reported $CO_2$ emission estimates from glass production as "NE" in its original submission. However, the NIR reports that the categories limestone and dolomite use and soda ash use take into account the amount of limestone ($CaCO_3$), dolomite ($CaMg(CO_3)_2$) and soda ash ($Na_2CO_3$) used as raw materials in the glass manufacturing process. During the in-country review the ERT recommended the Russian Federation to report $CO_2$ emissions arising from the use of these raw materials in the glass manufacturing process as "IE" and this recommendation was followed in the revised CRF data provided to the ERT after the in-country review.

95. The Russian Federation has estimated actual emissions of HFC-23 from production of HCFC-22 using the IPCC default methodology. The notation key "NE" was used for subcategories within the consumption of halocarbons and $SF_6$ (except for refrigeration and air conditioning equipment and electrical equipment). Actual HFCs emissions from the use of HFCs in refrigeration and air conditioning equipment have been reported for stationary refrigeration but not for mobile refrigeration. The Russian Federation is encouraged to report HFCs emissions from mobile refrigeration in its next submission to improve the completeness of the inventory. $SF_6$ emissions from electrical equipment were reported based on information received from RAO UES using a country-specific approach. However, in the CRF table Summary 3 for this source category the use of other methodology ("OTH") was reported. The Russian Federation is encouraged to use the correct notation key for this category in the respective CRF tables. $SF_6$ is used in the magnesium industry on a restricted scale as a cover gas in foundries to prevent oxidation of molten magnesium. The default IPCC methodology is used for estimations of these emissions. PFC emissions from aluminium production were reported using the IPCC tier 1b methodology and default EFs.

96. The Russian Federation provides justifications in the NIR for the assumptions made and the choice of data and of methods used. Most categories are reported with the required detail in the CRF tables, with a few exceptions where AD from some categories (e.g. $CO_2$ and PFCs emissions from aluminium production) have been reported as confidential ("C") to protect commercially sensitive information. The CRF tables and the NIR provide sufficient transparency to enable the assessment of the data used and methodologies applied, except for the categories production of halocarbons and $SF_6$ and consumption of halocarbons and $SF_6$. The Russian Federation is recommended to improve the transparency of the estimates for these categories by including in its next NIR all relevant AD and information on the rationale for the choice of methodology, country-specific EFs and AD as well as any assumptions used.

97. After the in-country review, revised estimates for the complete time series (1990–2004) based on improved methods and updated AD were submitted by the Russian Federation in response to questions raised by the ERT during the in-country review on cement production – $CO_2$, iron and steel production –

$CO_2$, aluminium production – PFCs, lime production – $CO_2$, limestone and dolomite use – $CO_2$ and nitric acid production – $N_2O$.

## B. Key categories

### 1. Cement production – $CO_2$

98. The Russian Federation used the IPCC tier 2 methodology and a rounded value of 65 per cent of the default IPCC value for lime (calcium oxide, (CaO)) content by weight in clinker (64.6 per cent). The use of the rounded value for the lime content in clinker leads to an overestimation of the 2004 emissions. During the in-country review, the Russian Federation was recommended to provide revised estimates for this category. After the in-country review, following the recommendation of the ERT, the Russian Federation revised the default value for lime content in clinker. The $CO_2$ emissions from cement production were revised downwards by 0.6 per cent for 2004 (from 20,705.21 to 20,577.79 Gg).

### 2. Iron and steel production – $CO_2$

99. The Russian Federation estimated $CO_2$ emissions from iron and steel production using the IPCC tier 2 methodology. Production data for iron and steel compiled at the national level by Rosstat were used. The ERT noted that the export and import of "conversion pig iron" was not taken into account in the current inventory submission, and that it was assumed that all "conversion pig iron" produced is used for steel production. During the in-country review, additional data obtained from the Federal Service on State Statistics and the Federal Customs Service were made available to the ERT, which document exports and imports of "conversion pig iron". The Russian Federation was recommended to provide revised calculations for this category, and to document the coverage of categories and the methods used for the estimation, as well as the AD and EFs used and the sources from which these data were derived. Following the recommendations of the ERT, after the in-country review, the Russian Federation provided the ERT with revised $CO_2$ emission estimates arising from steel production. The ERT agreed with the approach used by the Russian Federation. $CO_2$ emissions from steel production decreased by 11.2 per cent for 2004 (from 5,004.86 to 4,446.43 Gg $CO_2$). The revised estimation method should be reported transparently in the Russian Federation's next NIR.

### 3. Aluminium production – PFCs

100. The Russian Federation used the IPCC tier 1 methodology and default EFs for the estimation of PFC emissions ($CF_4$ and $C_2F_6$) from aluminium production. Only the EFs used for the Soderberg process are in accordance with the IPCC good practice guidance. The shares of Vertical Stud Soderberg (VSS) and Horizontal Stud Soderberg (HSS) technologies were not provided to the ERT during the in-country review. Nor could the assumptions made on the shares of Centre Worked Prebaked (CWPB) and Side Worked Prebaked (SWPB) technologies in the estimation of PFC emissions from aluminium produced through the use of the Prebaked Anode Process be substantiated during the in-country review. As this can lead to overestimations or underestimations of 2004 emissions for this category, the Russian Federation was encouraged to collect plant-specific information on the shares of VSS, HSS, CWPB and SWPB technologies used in aluminium production and to develop EFs consistent with the technology used in the country. Following the recommendation of the ERT, after the in-country review, the Russian Federation collected plant-specific information on the shares of VSS, HSS, CWPB and SWPB technologies used in aluminium production. Based on this information, the Russian Federation revised the PFC emissions arising from this category using default IPCC EFs that were consistent with the technology used. The ERT agreed with the approach used by the Russian Federation. The estimate for PFC emissions from aluminium production decreased by 15.7 per cent for 2004 (from 18,637.20 to 15,705.61 Gg $CO_2$ eq.). The revised estimation method should be reported transparently in the Russian Federation's next NIR.

### 4. Ammonia production – $CO_2$

101. The Russian Federation has estimated $CO_2$ emissions from ammonia production using the IPCC tier 1b approach. For the next inventory submission the Russian Federation is encouraged to estimate these emissions using the most accurate methodology (tier 1a), based on natural gas input and applying plant-specific EFs based on the carbon content of natural gas.

## C. Non-key categories

### 1. Lime production – $CO_2$

102. The Russian Federation did not disaggregate lime production AD by lime types. This is required by the IPCC good practice guidance, which provides default values for high calcium/dolomitic lime with a default breakdown of lime types of 85/15. During the in-country review, the ERT recommended the Russian Federation to use the default IPCC value of the breakdown into lime types and to provide revised calculations for this category for the entire time series. After the in-country review, following the recommendation of the ERT, the Russian Federation revised its estimates for $CO_2$ emissions arising from lime production for the entire time series. The ERT agreed with the approach used by the Russian Federation because it follows the IPCC good practice guidance. Due to the revision, $CO_2$ emissions from lime production increased by 2.2 per cent for 2004 (from 7,288.97 to 7,449.33 Gg $CO_2$). The revised estimation method should be reported transparently in the Russian Federation's next NIR.

### 2. Limestone and dolomite use – $CO_2$

103. The default EFs used by the Russian Federation for the limestone and dolomite use category are based on the stochiometric equation of the chemical reaction, assuming pure limestone/dolomite. This assumption results in higher emissions estimates than an estimation that takes into account the specific purity of limestone/dolomite. During the in-country review, the Russian Federation was recommended to use specific purity factors for limestone and dolomite in its emissions estimation, provide revised calculations for this category and document the assumptions and/or data used on the specific purity of limestone/dolomite. After the in-country review, following the recommendations of the ERT, the Russian Federation provided the ERT with average specific purity factors for limestone flux in metallurgy, limestone for glass production, dolomite for metallurgy and refractory material production, and dolomite for glass production (Shishkin, 1984; Sementovskiy et al., 1997, 1998; Biryulev et al., 1999; Sementovskiy, 1999). Based on these factors, the Russian Federation revised the $CO_2$ emissions from limestone and dolomite use. The ERT agreed with the approach used by the Russian Federation. The $CO_2$ emissions from limestone and dolomite use decreased by 4.7 per cent in 2004 (from 16,830.05 to 16,040.86 Gg $CO_2$). The revised estimation method should be reported transparently in the Russian Federation's next NIR.

### 3. Nitric acid production – $N_2O$

104. During the in-country review, the ERT identified a mistake in the conversion factor used to estimate the amount of non-concentrated nitric acid processed into ammonium nitrate. A conversion coefficient of 0.786 tonnes of $NHO_3$/tonne of $NH_4NO_3$ should be used, based on the stochiometric equation of the chemical reaction, but the value used by the Russian Federation was 0.780 tonnes of $NHO_3$/tonne of $NH_4NO_3$. The Russian Federation was encouraged to revise this conversion factor and provide revised estimates for this category for the entire time series. Following the recommendation of the ERT, after the in-country review, the Russian Federation revised its estimates for $N_2O$ emissions arising from nitric acid production. The ERT agreed with the approach. Due to the revision, the $N_2O$ emissions from this category increased by 0.7 per cent for 2004 (from 3,416.57 to 3,441.43 Gg $CO_2$ eq.).

# IV. Agriculture

## A. Sector overview

105. The agriculture sector contributed 6.6 per cent of the Russian Federation's total emissions in 2004. Emissions were 139,822.01 Gg $CO_2$ eq. in 2004 and are estimated to have declined by 54.8 per cent between 1990 and 2004. Emissions of $CH_4$ fell by 55.9 per cent and emissions of $N_2O$ fell by 54.3 per cent. Estimated uncertainties are high for this sector, particularly for $N_2O$ emissions. Enteric fermentation – $CH_4$, manure management – $N_2O$ and both direct and indirect $N_2O$ emissions from agricultural soils have were identified as key categories in the Russian Federation's inventory according to the secretariat's analysis for 2004.

106. The coverage for the sector is complete. Estimates have been prepared for all categories and for all years where emissions occur: enteric fermentation, manure management, agricultural soils and rice cultivation. Burning of savannas and burning of agricultural residues are reported as "NO".

107. There are no significant fluctuations in the tier 2 or country-specific EFs. The significant decline in the Russian Federation's emissions from the agriculture sector since 1990 is largely attributable to the significant decline in the agricultural output of the Russian Federation and related changes in AD.

108. In general, the Russian Federation's AD collection and reporting systems appear to be of high quality. Comprehensive agricultural data have been collected for independent policy purposes for a long time and these are published by Rosstat. Data from government agricultural organizations are collected by census each year and sampling techniques are used for information from small and medium-sized farms. Instructions to respondents for completing questionnaires and methodology descriptions were provided to the ERT during the in-country review. Results from a full census of the industry, undertaken in 2007, should be published in late 2008.

109. Overall, the methodological choices made by the Russian Federation for its estimations are consistent with the IPCC good practice guidance. The Russian Federation used country-specific methods equivalent to tier 2 methods for important livestock subcategories (dairy cattle, non-dairy cattle and swine) and tier 1 methods were used for the remaining livestock categories. A country-specific method was adopted for the direct soil emissions – crop residues subcategory.

110. Not all the estimation methodologies are fully documented in the NIR, although additional data were provided to the ERT during the course of the in-country review. Transparency in the inventory through the NIR could be improved. The Russian Federation should provide additional information in the NIR with more explanations of the reasons for the trends in emissions and it is recommended to implement, and report on, the full set of tier 2 QC measures set out in the IPCC good practice guidance. Reporting on these measures is especially important given the significant declines in emissions since 1990. Such reporting would provide a degree of confidence to users of the inventory that the estimates are soundly based.

## B. Key categories

### 1. Enteric fermentation – $CH_4$

111. The Russian Federation's country-specific methodology for estimations in this category makes use of data published by Rosstat on direct feed intake by livestock. Unusually, this allows the Russian Federation to estimate emissions independently of livestock performance characteristics and livestock herd sizes. The ERT views this method as a significant methodological enhancement over the default methods set out in the IPCC good practice guidance in which direct feed intake is estimated indirectly from livestock performance characteristics.

112. While a number of QC checks were performed, the ERT encourages the Russian Federation to perform and document in its next NIR the full range of QC checks set out in the IPCC good practice guidance. In particular, the country-specific EFs applied for both dairy and non-dairy cattle are similar to those applied in Western Europe, but higher than those indicated by the IPCC good practice guidance tier 2 method that utilizes livestock performance characteristics. Given this outcome, the ERT also encourages the Russian Federation to estimate emissions using the IPCC good practice guidance tier 2 methods as a QC check and to undertake annual reconciliations between the country-specific and the IPCC good practice guidance emission estimates, if necessary.

113. $CH_4$ emissions decreased significantly for most livestock species between 1990 and 2004. In the case of non-dairy cattle, herd size has fallen by over 50 per cent since 1992, largely as a result of a 43 per cent reduction in the consumption of beef in the Russian Federation since 1992. Given the substantial declines in the AD since 1990, the ERT encourages the Russian Federation to report data on the underlying causes of the changes in emission trends in its next NIR. In particular, livestock commodity market balances (consumption, production, exports, imports and stock changes) should be compiled and reported in the NIR to provide both an explanation for the causes of the trends in emissions and a QC check for the AD used in the emission calculations.

### 2. Manure management – $N_2O$

114. The emission trends observed for emissions from manure management reflect the trends in livestock AD. Emissions of $CH_4$ declined by 53.3 per cent between 1990 and 2004 while emissions of $N_2O$ declined by 57.9 per cent over the same period. The Russian Federation has implemented IPCC good practice guidance methodologies for this sector. As is described above, the quality of the AD is high.

### 3. Direct soil emissions – $N_2O$

115. Emissions in this category have declined by 48.0 per cent since the base year, largely reflecting reductions published by Rosstat in the application rates of nitrogen fertilizers by the agricultural sector in the Russian Federation. Given the significant decline in emissions, during the in-country review the ERT encouraged the Russian Federation to implement QC checks to reconcile application rates of fertilizers with market balances (production, consumption, exports, imports and stock changes) to ensure accurate and consistent estimates for the entire time series. Reconciliations were also recommended for the data reported by the Russian Federation to the United Nations Food and Agriculture Organization (FAO). After the in-country review, the Russian Federation provided the ERT with the additional QC checks and substantiated the sharply declining trend in $N_2O$ emissions from agricultural soils. The Russian Federation is recommended to include these additional checks and the additional information in its next NIR.

116. The Russian Federation has implemented a tier 1 methodology consistent with the IPCC good practice guidance for the synthetic fertilizers subcategory, but with the adoption of country-specific EFs that depend on three soil types. However, emissions have been estimated using highly aggregated AD. Improved emission estimates for this key category, especially given the significant decline in application rates, could be obtained by a spatial disaggregation of AD that reflects variations in soil type. The ERT encourages the Russian Federation to develop more disaggregated methods for this sector over time, while also linking with any developments in soil carbon modelling developed for the LULUCF sector.

117. Like all other categories in the agriculture sector, there was a significant decline in emissions between 1990 and 2004 (26.2 per cent) from the crop residue category, reflecting significant declines in crop production particularly for maize and other livestock feeds. The Russian Federation has implemented a country-specific methodology that is consistent with the approach of recently published

recognized international literature while utilizing country-specific parameters. The resulting emission estimates are higher than those which would have been estimated using the IPCC good practice guidance default parameters, although the effects on the trend in emissions are minor. Given the significance of the decline in emissions, the ERT encourages the Russian Federation to undertake QC checks for this sector and to report them in its next inventory submission.

# V. Land use, land-use change and forestry

## A. Sector overview

118. The Russian Federation reported a net removal of 198,519.78 Gg $CO_2$ eq. for 2004. This figure is the result of net emissions of 329,152.71 Gg $CO_2$ eq. from the cropland category and net removals of 527,672.49 Gg $CO_2$ eq. from the forest land category. Based on these figures the secretariat identified both forest land remaining forest land and cropland remaining cropland as key categories for the level and trend assessments in 2004.

119. The Russian Federation has not separately reported any emissions or removals in any mandatory land conversion categories (i.e. forest land converted to cropland, grassland, wetlands, settlements or other land). This is partly due to the differences in definitions of land-use categories between the national level and the IPCC good practice guidance for LULUCF. The ERT recommends the Russian Federation to reconcile its national level definitions with those of the IPCC good practice guidance for LULUCF, to re-aggregate data from regional or lower level statistics, to revise land statistics to develop a consistent land representation, and to report on all the mandatory land conversion categories. The ERT also suggests that the Russian Federation consider the type of spatial assessment unit that will be used for the determination of forest area and address the issue of how land will be identified (e.g. by using remote sensing).

120. The Russian Federation applied approach 1 of the IPCC good practice guidance for LULUCF for land identification. The application of IPCC approach 2, probably in combination with approach 3, seems necessary because of the high diversity of the forests, the large area of the country and the existence of large tracts of unmanaged forests. The ERT learned that a detailed land data collection system exists in the country. The ERT recommends the development of the inventory using disaggregated data and compilation using either Reporting Method 1 or 2 of the IPCC good practice guidance for LULUCF.

121. A partial quantitative uncertainty estimation was made for the LULUCF sector in the 2006 GHG inventory submission. The ERT recommends the Russian Federation to estimate overall uncertainty for the sector in its next inventory submission in order to prioritize the allocation of resources for the further development of the inventory. The uncertainty estimation should be extended by including non-quantifiable elements, for example missing categories such as land-use changes.

122. Partial and not formalized sector-specific QA/QC activities were conducted during the preparation of the 2006 GHG inventory submission. At its request, during the in-country review the ERT was provided with a detailed description of the data flow and the QA/QC activities for the inventory of the forest land categories. A detailed written description of the QA/QC activities in the NIR and their full implementation are recommended for the next inventory submission.

## B. Key categories

### 1. Forest land remaining forest land – $CO_2$

123. The Russian Federation did not report definitions for the various forest land and land-use change categories as required by the IPCC good practice guidance for LULUCF. Therefore, it was not possible

to assess the accuracy of the identification of those forests for which the emission and removal data were reported. The definitions should include information on predefined thresholds (e.g. crown closure) and on ecosystem type (as specified in the IPCC good practice guidance for LULUCF), species and age. The Russian Federation is encouraged to develop, consistently apply and report such definitions in its next GHG inventory submission.

124. The ERT notes that while the Russian Federation considered all its forests as managed in its third National Communication, it reported much less area of managed forest in the NIR and in the fourth National Communication, without describing in detail how data for "managed" land are developed. There are also either inconsistent data in the time series, or large changes in the area of both the "forest fund" national land-use category and the managed forests in many years (at an annual rate of one million ha or more), or both. The ERT encourages the Russian Federation to revise the forest land statistics.

125. The volume stock data that were used to develop emission and removal estimates were taken from aggregated forestry statistics, and are reported only by main species and age classes. No regional or site disaggregation was undertaken. Such disaggregation is strongly recommended considering the very large variation in the forest types in the highly significant forest area of the country. In addition, the reported combined conversion and expansion factors that are applied for the estimation of carbon stock changes are not transparently derived from a national database of case studies, and there is no information on their representativeness and thus on their accuracy for application to the national GHG inventory of the sector. Further disaggregation of these factors is suggested by ecological regions, site and management types. In addition, the ERT recommends the Russian Federation to consider, in a timely manner, the development of new factors (or biomass functions) or the verification of the existing ones using data from a representative forest inventory.

126. The Russian Federation did not estimate emissions and removals in soils, dead wood and litter. Some of these pools, at least in some places, may be subject to significant changes due to human activities (e.g. erosion due to forest operations) or climate change, and thus they may be significant sources or sinks. Therefore, the ERT recommends the Russian Federation to estimate and report these emissions and removals in its next submission.

#### 2. Cropland remaining cropland – $CO_2$

127. For cropland remaining cropland, the trend in the reported net carbon (C) stock changes in the biomass is unstable and fluctuates. The net C stock changes in soils per unit area have been identified as outliers and are generally the lowest of the reporting Parties. These inconsistencies may be at least partly explained by the fact that Russia applied a tier 3, that is, country-specific, model to estimate net C stock changes for cropland. The model applies many country-specific assumptions and average values. Although the description of the model is rather detailed in the NIR, there are many gaps in the description and a number of methodological elements that are not justified. Moreover, the nature and the description of the model do not allow a proper assessment of its accuracy. Although it is claimed that the model has been peer-reviewed in Russia and publication of this review is currently in press in a Russian scientific journal, the ERT suggests that it has yet to be confirmed that the model is robust and is able to provide an unbiased estimate for the entire country. Further verification, development and review of the model by the international scientific community are needed before this model is applied for estimating emissions and removals in this key category.

### C. Non-key categories

#### Forest land – $CH_4$ and $N_2O$

128. The Russian Federation reports non-$CO_2$ emissions from forest fires. The ERT acknowledges this effort because significant emissions can occur from forest fires especially in certain years of high

frequency of fires. The methodology for the estimation conforms with the IPCC good practice guidance for LULUCF methodology using country-specific values. However, the ERT suggests that, in its next submission, the Russian Federation further verify the AD (area of forest fires) and the EFs, and develop uncertainty estimates to assess the accuracy of the reported emissions.

# VI. Waste

## A. Sector overview

129. In 2004 total GHG emissions from the waste sector amounted to 68,970.98 Gg $CO_2$ eq., contributing 3.2 per cent to the total national emissions. Emissions from solid waste disposal on land contributed 53.6 per cent of sectoral emissions and emissions from wastewater handling 46.4 per cent. Between 1990 and 2004 emissions from the waste sector increased by 6.6 per cent. Total emissions from the sector declined by 12.6 per cent between 1990 and 1994 but then, after a slight fluctuation in 1995, started to increase. This last change is mainly due to enhanced municipal solid waste streams. The ERT recommends the Russian Federation to report emissions from missing sources in its next inventory submission.

130. The key category analysis performed by the secretariat for 2004 revealed two key categories in the Russian Federation's waste sector: $CH_4$ emissions from solid waste disposal on land and $CH_4$ emissions from wastewater handling.

131. The reporting in the waste sector is generally complete. The Russian Federation has estimated $CH_4$ and $N_2O$ emissions from solid waste disposal on land and wastewater handling. Emissions from waste incineration are not reported because all incineration plants are with energy recovery and related $CO_2$ emissions are included in the energy sector, although AD for waste incineration are reported in the NIR. However, the Russian Federation uses the notation key "NE" in the sectoral CRF tables whereas "IE" would be more appropriate in this case.

132. An uncertainty assessment was not carried out in the original 2006 submission, but was provided to the ERT as part of the revised information.

133. After the in-country review, revised estimates for the complete time series (1990–2004) were submitted by the Russian Federation in response to questions raised by the ERT relating to $CH_4$ recovery from domestic and commercial wastewater.

## B. Key categories

### 1. Solid waste disposal on land – $CH_4$

134. A tier 2 methodology (FOD model) for emissions calculations is applied for this category, which is appropriate and in line with the IPCC good practice guidance. The Russian Federation uses a country-specific degradable organic carbon (DOC) value and default IPCC factors. The category only includes municipal household waste and does not take into account industrial waste or sludge disposal. AD on disposal of solid waste to landfills for 1999–2004 were taken from Rosstat statistics and for 1960–1990 from communal services.[6] Data for 1991–1998 were interpolated. It is assumed that all the municipal solid waste (MSW) collected and landfilled is treated in managed landfills. For the share of the rural population for which waste is not collected, it is assumed that the waste is disposed of in unmanaged open sites. Waste generation in rural areas was extrapolated from urban areas and the waste generation rate of the urban population was applied. The NIR states that the high waste generation rate for the rural population could cause an overestimation of emissions. During the in-country review, the ERT

[6] K. D. Pamfilov. Academy of municipal economy.

recommended the Russian Federation to replace the waste generation rate for urban areas applied to rural areas in this calculation by a specific waste generation rate for rural areas and to revise the emissions estimation accordingly. After the in-country review, the Russian Federation informed the ERT that no specific waste generation rate for the rural population could be found. For 2004 the Russian Federation reports 51,597 tonnes of waste landfilled. With a total population of 144.2 million and 98 per cent disposal to landfills, this results in an average waste generation rate of 0.36 tonnes per capita per year for 2004. The Revised 1996 IPCC guidelines provide a default of 0.32 tonnes per capita per year for the Russian Federation and in recently published recognized international literature the default is 0.34. Thus, the average waste generation rate used for 2004 seems appropriate compared to the IPCC default. In 1990 the average waste generation rate was 0.24 tonnes per capita per year, and this is the reason that $CH_4$ emissions increased by 44.3 per cent from 1990 to 2004, even considering that a slightly higher population and a similar percentage of disposal of waste to landfills existed in the country in 1990 in comparison with 2004.

135. The NIR indicates that methane generation potential ($L_o(x)$) has the same value for the entire time series from 1990 to 2004. This means that waste composition has not changed during this time. In other Parties with economies in transition the waste composition has changed substantially since the beginning of the 1990s. The ERT recommends the Russian Federation to revise the $L_o(x)$ depending on available information on waste composition for its next submission.

136. The value of the $CH_4$ generation rate *k* is averaged for the whole country and a single *k* value of 0.05 for dry temperate/boreal climate is used. However, the Russian Federation is a big country with diverse climatic conditions so the $CH_4$ generation rate should vary between different regions. The ERT recommends using a national weighted average DOC value based on regional DOC values (wet and dry temperate) for regions with different climate conditions in the next submission, because even a small change in emissions coefficients can cause substantial changes in $CH_4$ emissions.

137. The NIR includes AD on compost production for the period 1971 to 2004. However, emissions from this activity are not calculated. The ERT encourages the Russian Federation to estimate emissions from compost production using the methodology provided in recently published recognized international literature and to report them under the subcategory other in CRF table 6.A.

### 2. Wastewater handling – $CH_4$

138. Under the industrial wastewater category, $CH_4$ emissions are reported for wastewater handling in petroleum refining, chemical and petrochemical production, pulp and paper production, and food industries. The methodology and EFs used are the IPCC default ones. The methane correction factor (MCF) used is a national weighted average factor. However, emissions from wastewater and sludge are estimated together, which is not in line with the IPCC methodology. The ERT recommends the Russian Federation to provide separate emission estimates for these subcategories in its future submissions.

139. Default methodology and EFs are used for estimations of domestic and commercial wastewater emissions. However, emissions from wastewater and sludge have been estimated together, which is not in line with the IPCC methodology. Between 1990 and 2004 $CH_4$ emissions from domestic and commercial wastewater decreased by 12.4 per cent while recovery of emissions related to energy use or flaring increased by 5.1 per cent, but no explanation is provided in the NIR. The ERT recommends the Russian Federation to include more information about and explanation of these trends in its next NIR.

140. The NIR states that some quantity of biogas is generated when wastewater sewage is treated in methane tanks. This $CH_4$ is partly flared and partly used for energy recovery. The CRF tables 6.B do not contain data on recovery, which should be subtracted from the $CH_4$ emissions in this subcategory. During the in-country review, the ERT recommended the Russian Federation to provide revised data for

the base year on emissions from commercial and domestic wastewater handling excluding energy recovery. Following the recommendations of the ERT, after the in-country review, the Russian Federation revised its estimates for this category on the basis of the IPCC good practice guidance methodology. The $CH_4$ emissions from domestic and commercial wastewater have been revised upwards by 77.1 per cent for the base year (from 440.27 to 779.77 Gg $CH_4$) and by 48.2 per cent for 2004 (from 460.90 to 683.13 Gg $CH_4$). The revised estimates of $CH_4$ emissions from wastewater handling take into account two different systems of domestic wastewater treatment which were not differentiated in the original 2006 inventory submission. As a result, $CH_4$ emissions from domestic and commercial wastewater treatment were defined as a sum of emissions from the two types of systems. For the urban population it is assumed that systems with aerobic biological water treatment followed by anaerobic sludge treatment in methane tanks with biogas recovery (first type) are used. For wastewater in rural areas methane tanks without recovery are used, resulting in higher $CH_4$ emissions (second type). In the information provided after the in-country review, the Russian Federation stated that this recalculation allowed it to improve the completeness of its estimates in this category.

### C. Non-key categories

Wastewater handling - $N_2O$

141. For the estimations of emissions in this category, data on protein consumption were taken from FAO reports until 2003. The FAO did not provide this information after 2003 so the Russian Federation used data from a national institute, reporting a protein consumption value lower than FAO data. The ERT recommends the Russian Federation to use FAO data or national AD for the entire time series in order to make emissions estimation consistent. This could require the recalculation of emissions for the entire time series.

## VII. Conclusions and recommendations

142. The Russian Federation has provided its GHG inventory data for the years 1990 to 2004, including a full set of the CRF tables required with data on all relevant gases and an NIR. The Russian Federation's GHG inventory is generally accurate, as defined in the UNFCCC reporting guidelines, and is consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. During the in-country review, the ERT identified a number of categories where the methods, AD or EFs used were not fully in accordance with the IPCC good practice guidance and might lead to overestimation of emissions in 1990 or underestimation of emissions in the most recent years. The ERT recommended the Russian Federation to revise its estimates for these categories. After the in-country review, the Russian Federation provided revised estimates and additional information for these categories for 1990 and 2004 in accordance with the recommendations of the ERT and in line with the IPCC good practice guidance. For the industrial processes and waste sectors, a complete time series of revised CRF tables from 1990 to 2004 was submitted. The focus of the review was 1990. Review of the most recent inventory years and time-series consistency, particularly for the energy sector, need to be further prioritized in the next review cycle.

143. In the course of the review, the ERT formulated a number of recommendations relating to the completeness, consistency, accuracy and transparency of the information presented by the Russian Federation. Most of the recommendations were implemented during the review process. The key remaining recommendations[7] are that the Russian Federation should:

(a) Maintain and enhance the operational functions of its institutional arrangements for inventory preparation, such as flows of necessary data and information to the inventory

[7] For a complete list of recommendations, the relevant sections of this report should be consulted.

agency and implementation of the mandatory QA/QC procedures, as outlined in the information provided in the NIR and during and after the in-country review, and ensure that all formal procedures are implemented on a regular basis;

(b) Provide a timely annual submission of the NIR and the CRF;

(c) Fully implement the IPCC good practice guidance;

(d) Include private and semi-private entities in its institutional arrangements for data collection where plant-specific data increases the accuracy of the inventory estimates;

(e) Include in its next submission updated information on institutional arrangements covering the information that was provided to the ERT during the review and reflecting the improvements made and planned, for example, with respect to QA/QC activities, archiving procedures, key category analyses, and the completeness, consistency and transparency of the inventory.

144. The ERT identified the following recommendations relating to the Russian Federation's GHG inventory submission that it believes should be considered in the course of future reviews. The key recommendations[8] are that the Russian Federation should:

(a) Make the necessary efforts to provide data and emissions estimates for all sectors, categories and gases that have not been estimated, in particular the missing estimates for the energy sector and emissions from all stages of the use of ozone depleting substances (ODS) substitutes;

(b) Provide a transparent and comprehensive NIR describing and reporting all calculation methodologies, AD used, EFs and other parameters for all sectors of the inventory, in particular for the energy sector;

(c) Provide complete CRF tables with correct use of notation keys where all relevant categories are estimated at an appropriate level of disaggregation;

(d) Fully implement the QA/QC management system and develop an inventory improvement plan as part of the QA/QC procedures;

(e) Improve the resources and QA/QC procedures for the national energy balance and ensure access to the national balance for the ERTs;

(f) Provide quantified uncertainty estimates for all sectors taking into account national circumstances and existing data gaps and use these to prioritize inventory improvements;

(g) Improve the data on fuel consumption in the different categories, in particular with regard to the method for splitting jet kerosene consumption between international and domestic air traffic, and base its estimations on the recommendations of the IPCC good practice guidance;

(h) Reconcile its national level definitions with those of the IPCC good practice guidance for LULUCF, develop a consistent land representation, report separately on all the mandatory land conversion categories and apply the IPCC approach 2 (probably in combination with approach 3) for land identification;

[8] For a complete list of recommendations, the relevant sections of this report should be consulted.

(i) Complete the archiving system with relevant data and link it with the emissions estimations;

(j) Report, document and describe transparently the information on recalculations in the CRF tables and in the NIR.

Annex

# Documents and information used during the review

## A. Reference documents

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## B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Alexander Nakhutin (Institute of Global Climate and Ecology) including additional material on the methodology and assumptions used as included in the sectoral parts of this overview.

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