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Report of the individual review of the greenhouse gas inventory of Ukraine submitted in 2005*

* In the symbol for this document, 2005 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Executive summary

1. This report covers the in-country review of the 2005 greenhouse gas (GHG) inventory submission of Ukraine, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8 of the Conference of the Parties (COP). The review took place from 19 to 23 September 2005 in Kiev, Ukraine, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Ms. Penny Reyenga (Australia); Energy – Ms. Kristin Rypdal (Norway); Industrial Processes – Mr. Teemu Oinonen (Finland); Agriculture – Ms. Anna Romanovskaya (Russian Federation); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Rizaldi Boer (Indonesia); Waste – Ms. Tatiana Tugui (Republic of Moldova). Mr. Rizaldi Boer and Ms. Penny Reyenga were the lead reviewers. The review was coordinated by 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 Ukraine, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

3. In 2003 the most important GHG in Ukraine was carbon dioxide (CO_2), which contributed 59.4 per cent to total[1] national GHG emissions, followed by methane (CH_4), 37.2 per cent, and nitrous oxide (N_2O), 3.4 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are not reported. The Energy sector accounted for 81.4 per cent of the total GHG emissions, followed by Industrial Processes, 8.6 per cent, Agriculture, 5.7 per cent, and Waste, 4.3 per cent. The Solvent and Other Product Use sector was not estimated. Total national GHG emissions amounted to 527,064.98 Gg CO_2 equivalent and decreased by 46.2 per cent from 1990 to 2003. Tables 1 and 2 provide data on emissions by gas and by sector from 1990 to 2003.

4. Ukraine's 2005 submission is a substantial improvement over the previous year's submission, as common reporting format (CRF) tables for the complete time series and estimates of emissions/removals for the Land-use Change and Forestry (LUCF) sector were submitted for the first time. The expert review team (ERT) commends the Ukrainian experts for having prepared the inventory in such a short time.

5. The national inventory submitted by the Ukraine is broadly 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) and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). However, the Ukraine is yet to implement the *IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) and report using the LULUCF reporting tables required by decision 13/CP.9.

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LULUCF, unless otherwise specified. Ukraine has not provided the tables of the common reporting format for LULUCF as required by decision 13/CP.9 using the land use categories of the Intergovernmental Panel on Climate Change *Good Practice Guidance for Land Use, Land-use Change and Forestry*. Instead it has used the common reporting format tables for Land-use Change and Forestry as contained in the common reporting format adopted by decision 18/CP.8, which are based on the categories of the Intergovernmental Panel on Climate Change *Revised 1996 Guidelines for National Greenhouse Gas Inventories*.

Table 1. Greenhouse gas emissions by gas, 1990–2003

GHG emissions	Gg CO_2 equivalent														Change 1990–2003 (%)
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
CO_2 (with LULUCF)[a]	699 641	696 080	586 898	508 874	379 311	359 606	318 205	285 006	237 192	232 453	232 424	233 738	235 786	257 378	–63.2
CO_2 (without LULUCF)	738 579	727 524	641 420	555 982	428 308	408 542	379 830	350 449	300 829	295 737	293 918	293 433	293 094	313 139	–57.6
CH_4	194 374	186 528	183 883	175 254	170 895	161 482	161 534	158 429	149 706	144 962	147 668	169 638	172 121	196 302	1.0
N_2O	45 255	43 072	39 939	46 143	34 613	30 759	31 563	30 255	26 584	24 125	22 526	24 322	24 031	17 629	–61.0
HFCs	NE[b]	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
PFCs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
SF_6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
Total (with CO_2 from LULUCF)	**939 269**	**925 681**	**810 720**	**730 271**	**584 818**	**551 847**	**511 301**	**473 690**	**413 481**	**401 541**	**402 618**	**427 699**	**431 938**	**471 309**	–49.8
Total (without CO_2 from LULUCF)	**978 207**	**957 124**	**865 242**	**777 380**	**633 816**	**600 783**	**572 927**	**539 133**	**477 118**	**464 825**	**464 112**	**487 393**	**489 246**	**527 070**	–46.1

[a] LULUCF = Land Use, Land-use Change and Forestry.
[b] NE = not estimated.

Table 2. Greenhouse gas emissions by sector, 1990–2003

Sectors	Gg CO_2 equivalent														Change 1990–2003 (%)
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Energy	812 168	802 840	717 216	637 168	515 608	493 481	470 041	438 465	378 198	371 060	370 045	390 508	395 007	429 096	–47.2
Industrial Processes	71 125	61 979	58 439	44 187	34 872	30 603	29 080	33 455	38 796	40 472	42 877	45 240	44 454	45 450	–36.1
Solvent and Other Product Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Agriculture	78 788	75 282	73 250	79 127	66 528	60 118	57 546	51 690	44 233	40 893	37 318	34 945	34 830	29 819	–62.2
LULUCF[a]	–38 932	–31 440	–54 511	–47 095	–48 959	–48 925	–61 600	–65 440	–63 631	–63 271	–61 491	14 449	14 004	–55 756	43.2
Waste	16 119	17 021	16 326	16 884	16 770	16 570	16 234	15 521	15 884	12 386	13 869	5 702	5 767	22 699	40.8
Other	0	0	0	0	0	0	0	0	0	0	0	146	121	0	

[a] LULUCF = Land Use, Land-use Change and Forestry.

6. The review report identifies areas in which the completeness, consistency and transparency of the inventory should be improved for the next submission. Notably the Ukraine should include emission estimates for missing sources, address apparent inconsistencies in the time series, and improve the descriptions in the national inventory report (NIR) of methodologies and activity data (AD), and provide explanations of unusual trends and reasons for recalculations.

7. The institutional arrangements for preparation of the inventory are still being put in place in Ukraine. To ensure that Ukraine is able to provide the best available data and methodologies for estimating emissions, these arrangements need to ensure the close collaboration of the related ministries, governmental agencies and research institutions. Ukraine should also put in place quality assurance/quality control (QA/QC) and inventory improvement plans.

II. Overview

A. Inventory submission and other sources of information

8. Ukraine submitted an NIR on 19 May 2005 and an improved version of the NIR on 27 May 2005. In its 2005 submission, Ukraine included a complete set of CRF tables for the years 1990–2003, but did not include the LULUCF reporting tables required by decision 13/CP.9.

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

B. Key categories

10. Ukraine reported a key-category tier 1 analysis - level assessment as part of its 2005 submission. The key category analysis performed by the Party and the secretariat[2] produced different results. The Ukraine identified 25 key categories and the secretariat 14. The main reason for the differences is that CO_2 emissions from fuel combustion in the Party analysis were disaggregated by source category rather than fuel type. The ERT recommends that for the next submission Ukraine conduct both level and trend assessments including LULUCF as described in the IPCC good practice guidance for LULUCF. As there are a large number of missing categories, the ERT recommends that the Party also undertake a qualitative key-category analysis and give priority to filling possible key categories. For example, although data are not reported, the ERT would expect that consumption of HFCs, PFCs and SF_6 would be a key category given the increased use of these gases since 1990.

C. Cross-cutting topics

1. Completeness

11. Ukraine provided inventory data for the years 1990 to 2003. However, a number of source categories, particularly in the Industrial Processes and the Solvent and Other Product Use sectors, were not reported. In addition, a number of the CRF tables were not completed (e.g. tables 2(II), 8 and 9) and the LULUCF reporting tables required by decision 13/CP.9 were not submitted. Notation keys ("NE" - not estimated, "NO" - not occurring and "IE" - included elsewhere) should be carefully applied in all tables and explanations provided in table 9.

[2] The secretariat had identified, for each Party, those source categories which 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. Key categories according to the tier 1 trend assessment were also identified for those Parties providing a complete CRF submission for the year 1990. Where the Party has 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.

2. Transparency

12. The NIR provides some general information on the methodologies used and the sources covered. However, not all information required to enable reviewers to understand or replicate the calculations was provided. Future NIR submissions should include precise descriptions of methodologies, AD, explanations of unusual trends in emissions and reasons for recalculations. The Party should closely follow the table of contents provided 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 revised UNFCCC reporting guidelines) in preparing its next NIR.

3. Recalculations and time-series consistency

13. The ERT noted that recalculations for the years 2000 and 2001 had been undertaken. The rationale for these recalculations was not provided in the NIR and table 8 of the CRF was not completed. The ERT recommends that for future recalculations the explanations should be provided in the NIR and CRF table 8.

14. In a number of cases, Ukraine reported time series that show unexpected fluctuations and changes signalling possible inconsistencies in the time series (e.g. N_2O emission from Agricultural Soils and emissions from gasoline from Road Transportation). The Party explained that these inconsistencies were due to the changes in the collection of statistics since the country's independence in 1991. To ensure time-series consistency, the ERT recommends that Ukraine review the time series, explain in the NIR the changes which are considered to be real, and, for unexplained fluctuations and gaps, apply interpolation and other methods as presented in the IPCC good practice guidance. The methods used should be explained in the NIR.

4. Uncertainties

15. Ukraine did not report quantitative uncertainty estimates but did complete the qualitative assessment in CRF table 7. One quantitative estimate for Cement Production (1.67 per cent) was provided in the NIR. With the exception of LUCF, all estimates were of "medium" quality across the time series. The ERT concluded that this assessment may not be correct, as the accuracy of the IPCC tier 1 methods and default emission factors (EFs) for different sources varies. In addition, the Party indicated that the quality of the data over the period 1991–1997 was not as good as for the rest of the time series, and, as such, we would expect that the uncertainty would be higher in this period. The ERT recommends that the Party review its estimates and develop quantitative uncertainty assessments.

5. Verification and quality assurance/quality control approaches

16. The NIR describes the tier 1 quality control steps undertaken by the Party in estimating emissions. A draft of the inventory and NIR was placed on the web site of the Ministry for Environmental Protection of Ukraine <www.menr.gov.ua> for review and comment by independent experts and stakeholders following a national workshop. There is no indication of emissions verification activities other than the inclusion of the reference approach. During the review, the ERT was provided with information on the QA/QC procedures used by the State Statistics Committee of Ukraine. Ukraine is currently developing a QA/QC plan which, once it is agreed, will form part of the country's formal institutional arrangements for preparation of the annual inventory. The ERT would like to encourage the development of this plan and recommends that information on the standard QA/QC procedures of both the inventory agency and data collection agencies be included in the QA/QC plan with a brief summary included in the NIR.

6. Institutional arrangements

17. During the in-country visit, Ukraine explained that the institutional arrangements for preparation of the inventory are still being developed. The Ministry for Environmental Protection has overall responsibility for the national inventory, and instructed the Ukrainian Hydrometeorological Scientific Research Institute to prepare the current submission. The Institute prepared the submission with assistance from the European Commission project for technical assistance to Ukraine and Belarus with respect to their global climate change commitments (TACIS), and support from ICF Consulting and ARENA-ECO (Agency for Rational Energy Use and Ecology).

18. The ERT recommends that formal institutional arrangements be put in place as quickly as possible and that these arrangements ensure the close cooperation and collaboration of the various ministries, governmental agencies and research institutions in the development of appropriate methods and the collection of AD, EFs and other necessary data. It is also important to ensure clear communication between the Ministry for Environmental Protection and the inventory agency to ensure COP decisions and other documents relating to inventory elaboration are passed on to the experts.

19. To ensure there is a stable system for inventory compilation, the ERT would like to stress the need for continuity of staff in the compilation of the inventories due to the complex nature of inventory methodologies and the need to understand what has been done in previous years and the important steps required to improve the inventories.

7. Record keeping and archiving

20. Ukraine has a centralized record keeping and archiving system. The Institute keeps copies of the inventory data, EFs and emission estimates on experts' computers and has compiled a set of information and CRF tables on a central computer. All information is archived to CD-ROM. Copies of the papers referred to in the NIR were provided to the ERT upon request.

8. Follow-up to previous reviews

21. The most important improvements made by the Party were the preparation and submission of a complete set of CRF tables for 1990 to 2003 and the estimation of emissions/removals for the LUCF sector. However, these emissions/removals were not reported for the LULUCF sector using the tables required by decision 13/CP.9.

D. Areas for further improvement

1. Identified by the Party

22. In its response to the issues raised during the review, Ukraine indicated that it is working to improve estimates in all sectors, focusing on key categories, and will develop country-specific methodologies and EFs. Ukraine indicated that it is working to submit the LULUCF emissions/removals using the tables required by decision 13/CP.9 for the next submission.

2. Identified by the ERT

23. The ERT identified the following cross-cutting issues for improvement:

(a) Improve transparency of the NIR by providing more precise descriptions of methodologies, AD, explanations of unusual trends and reasons for recalculations

(b) Address time-series consistency issues

(c) Formalize the institutional arrangements and put in place QA/QC and inventory improvement plans

(d) Include missing source categories, giving priority to those likely to be key categories

(e) Consider use of higher tier methods for key categories

(f) Reassess qualitative uncertainty estimates and work towards development of quantitative uncertainty estimates.

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

III. Energy

A. Sector overview

25. In 2003, the Energy sector contributed 81.4 per cent of Ukraine's total GHG emissions. Fuel combustion accounted for 51.0 per cent of this total, and CO_2 emissions from this category accounted for 85.5 per cent of the country's total CO_2 emissions. Fugitive emissions play an important role in Ukraine due to the importance of coal mining and the existence of a wide network of transit gas and oil pipelines and gas distribution pipelines. Fugitive emissions made up 30.4 per cent of total national emissions in 2003. The contributions from single subsectors to the total national emissions are as follows: Energy Industries, 19.5 per cent, Manufacturing Industries and Construction, 17.9 per cent, Transport, 2.6 per cent, and Other sectors, 11.0 per cent. Total emissions from the sector have been almost halved compared to 1990 (47.2 per cent reduction). On the other hand, emissions increased by 8.6 per cent from 2002 to 2003 and have been at a stable level since 1998.

1. Completeness

26. All of the main IPCC source categories are estimated for the Energy sector for all years of the time series, and all GHGs are covered. The level of disaggregation is in line with the Revised 1996 IPCC Guidelines. Estimates of emissions of the precursor gases resulting from combustion are reported in the CRF. All the CRF tables, including the sectoral background tables, are provided. The ERT recognizes the large effort Ukraine made in completing data for the full time series in the 2005 submission. No information or comments are reported in the documentation boxes, and additional information is not provided in the relevant tables.

2. Transparency

27. Reporting of the Energy sector is not sufficiently transparent. Although the basis of the methodologies is explained in the NIR, details on EFs, energy statistics and country-specific methodologies needed to fully understand the inventory are missing. During the in-country review, the Party provided additional explanations to the ERT and shared background information (e.g. detailed energy statistical forms) which helped increase the transparency.

3. Recalculations and time-series consistency

28. Table8(a) (recalculations) was not filled in. However, the total emissions from Energy for 2001 and 2002 were increased by 3.7 and 3.5 per cent, respectively, between the 2004 and 2005 submissions. Recalculations were made for both fuel combustion and fugitive emissions. Ukraine is encouraged to complete the recalculations table in future submissions and document the reasons for recalculations.

29. Due to the combining of three different sources of statistical information as a basis for the energy data, time series generally appear inconsistent, with large fluctuations between inventory years. According to the Party, data after 1997 are more reliable compared to the period 1991–1997. The Party is strongly encouraged to perform a QA/QC of its time series and apply the methods for approximating time-series consistency, as outlined in the IPCC good practice guidance for LULUCF, where needed,

bearing in mind that total fuel consumption can be better known than consumption in individual sectors. In particular, it is recommended that the Party verify and document in its NIR the comparability of the base year 1990 data and data for recent years for key categories, by using independent data or appropriate indicators (e.g. production data or vehicle fleet) combined with a description of changes in technologies and processes. Bearing in mind that this is a particular challenge for Ukraine, the ERT would recommend that Ukraine give priority to this for the next submission.

4. Verification and quality assurance/quality control approaches

30. The Party has implemented QC procedures to check that numbers entered in the CRF are correct compared to the statistical forms. The Party is encouraged to also implement QA procedures to check these data for completeness/double-counting and time-series consistency (see the previous paragraph), and, where possible, implement QA/QC procedures using independent information, other than data from the statistical forms.

31. The energy data reported in the CRF (for the sectoral and reference approaches) partly deviated appreciably from the data reported to the International Energy Agency (IEA). Ukraine is recommended to cooperate with the State Statistics Committee of Ukraine to identify reasons for such differences, with the aim of harmonizing the two datasets.

B. Reference and sectoral approaches

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

32. Ukraine reported the reference approach for the years 1990 and 1999–2003. The differences between the CO_2 emissions derived from the sectoral and reference approaches, presented in CRF table 1.A(c), were 8.5 per cent for 2003 and –5.6 per cent for 1990. During the review, the Party presented revised calculations for 1990 showing a smaller difference between the approaches (1.2 per cent for CO_2) and the ERT was informed that the Party plans to recalculate other years of the time series. Ukraine has subtracted fuel for non-energy use in industrial processes, even though the carbon of this fuel is immediately released as CO_2. Ukraine is encouraged to increase transparency with respect to the data subtracted as "carbon stored in non-energy use of fuels" in Table 1.A(d), provide an explanation of the assumptions behind carbon subtracted for permanent storage and clearly distinguish between carbon subtracted for permanent storage and for immediate release in the Industrial Processes sector.

33. Total apparent consumption in the reference approach for 2003 presented in CRF table 1.A(b) is about 10 per cent below data reported by IEA. The largest differences are in solid fuels, where the value in the CRF is 30 per cent below the data reported by IEA. The Party explained that the production data for contaminants in coal that are not combustible were corrected and that the heating value was consistent with "clean coal". Gas import is 20–40 per cent higher in the IEA data, which the Party explained was due to a correction for gas used as feedstock in the Industrial Processes sector. The ERT recommends that in future submissions gas as feedstock be reported in line with the IPCC good practice guidance.

2. International bunker fuels

34. Ukraine did not estimate AD and emissions for marine and aviation bunkers for the years 1990–2003 and reported in 2003 all emissions as domestic. Civil aviation and navigation contribute only small shares (less than 0.1 per cent) of total emissions. Nevertheless, Ukraine is encouraged to collect data to enable reporting in line with the Revised 1996 IPCC Guidelines and the revised UNFCCC reporting guidelines.

3. Feedstock and non-energy use of fuels

35. Ukraine reported in Table 2(I)A-G consumption of 9,694 kt of coke for 2003, resulting in CO_2 emissions reported in subcategory 2.C.1 Iron and Steel Production. During the review, the Party provided additional information about its methodology for subtracting the corresponding amount from the Energy sector in order to avoid double counting. In a similar way, the Party subtracted from the Energy sector feedstock for ammonia production. Due to confidential data, emissions from reducing agents used for aluminium and ferroalloys production are not reported under Industrial Processes but under Energy. Ukraine is encouraged to increase transparency by using appropriate notation keys and providing explanations in the NIR and CRF.

C. Key categories

1. Stationary combustion: solid, liquid, gas – CO_2

36. Ukraine is using a tier 1 method for stationary combustion categories. During the review, the ERT was informed that Ukraine is developing a system for using country-specific EFs through direct reporting of emission data from enterprises. The ERT encourages the Party to develop suitable routines for QA/QC (including time-series and completeness checks) when applying these data in the inventory. In an intermediate phase, for verification, and possibly for use in combination with these data, the Party is recommended to derive country-specific EFs for coal and gas based on information from key enterprises delivering fuels.

37. Systems for collection of AD have been changed twice since 1990. In 1990 the data were based on the regional energy balance of the former Soviet Union. A system for reporting energy statistics was developed between 1991 and 1997. The Party informed the ERT that because of difficulties in developing this system, the data for this period fluctuate. From 1998, a new system was established and all major problems were solved. The Party believes the energy balance of 1990 was of high quality and that the fuel consumption data are comparable to energy statistics collected for recent years.

38. Many fluctuations in implied emission factors (IEFs) and emissions were identified in the previous review stage. The Party explained that fluctuations in IEFs were due to a mistake (not influencing total emissions), which will be corrected in the next submission. Regarding the fluctuations in trends, the Party is recommended to give highest priority to performing a QA/QC of emissions from the Residential category (solid fuels), where CO_2 emissions were reduced from 46,475 Gg in 1990 to 4,305 Gg in 2003, and the Public Electricity and Heat Production category (gaseous fuels), where CO_2 emissions were reduced from 136,747 Gg in 1990 to 39,706 Gg in 2003. The Party explained that the trend from 1990 to 2003 was due to restructuring of the economy and changes in fuel prices.

2. Mobile Combustion – Road Vehicles: liquid – CO_2

39. Several fluctuations in emissions were identified in the previous review stage, and these can be explained by changes in data collection systems, as described for stationary combustion. When working to reduce these inconsistencies, the Party is strongly recommended to give highest priority to Road Transportation (gasoline), where emissions were reduced from 21,181 Gg in 1990 to 378 Gg in 2003. For verifying emissions from road transport, the Party may wish to calculate emissions based on the size of its car fleet and annual mileage (e.g. using a model).

3. Fugitive Emissions: Coal Mining and Handling – CH_4

40. The Party has implemented a country-specific methodology for coal mining based on reported emissions data from underground coal mines (70 per cent of total number of underground coal mines) and calculations for remaining underground mines and for surface mines. The method has been applied to all years since 1990. During the review, the ERT was provided additional documents about the methodology. Emissions from gas recovered and closed mines have not been estimated due to lack of

data. The Party is encouraged to obtain data for these emission sources for inclusion in future submissions.

4. Fugitive Emissions: Oil and Gas Operations – CH_4

41. Ukraine reported emissions from gas processing, transmission and distribution using a country-specific methodology. The losses were estimated based on mass balances as estimated by the relevant enterprises. The ERT welcomed the improvement of using a country-specific methodology. The IEFs reported are among the highest of the reporting Parties (e.g. from Transmission 477 kg/TJ in 1990 and 801 kg/TJ in 2003 and from Distribution 172 kg/TJ in 1990 and 574 kg/TJ in 2003). The Party explained that the high IEFs are due to old technologies with several leakage points, and that the increases in IEFs in recent years are due to increased pressure in the system of pipelines. The Party is recommended to verify these high losses in close cooperation with the relevant national institutions, and, if possible, make a comparison using independent sources of data. In particular, the Party is encouraged to explain reasons for higher losses from gas transmission through Ukraine, compared to losses from the gas distribution network.

D. Non-key categories

1. Mobile Combustion – Road Vehicles: liquid – N_2O

42. N_2O emissions from Road Transportation (gasoline) are estimated using a tier 1 methodology. As Ukraine is expected to have in recent years a large number of vehicles equipped with catalytic converters, the ERT encourages Ukraine to apply a higher tier method to account for changes in emissions due to the renewal and change in composition of its vehicle fleet.

2. Mobile Combustion – Aircraft and Water-borne Navigation: liquid – CO_2

43. Emissions from Civil Aviation were reported as "NE" for 1990. The ERT encourages Ukraine to provide an estimate, for example by using appropriate extrapolation techniques as described in the IPCC good practice guidance.

44. Large reductions in CO_2 emissions were reported for navigation in 2003 compared to 1990 (residual and diesel oil). Ukraine is encouraged to check these data and verify the reductions, for example by using port statistics.

E. Areas for further improvement

1. Identified by the Party

45. Ukraine is considering using higher tier estimates for fuel combustion based on reporting from enterprises.

2. Identified by the ERT

46. The ERT encourages Ukraine to derive country-specific EFs for coal and gas based on information from key enterprises delivering fuels and to estimate emissions from Road Transportation using a higher tier.

47. The ERT recommends that the Party explain in its NIR large changes in emissions since 1990 and apply additional QA/QC to those changes. In particular, Ukraine is recommended to check potential inconsistencies in time series and apply splicing techniques in line with good practice where appropriate.

48. The ERT encourages Ukraine to cooperate with the State Statistics Committee to identify reasons for differences between energy data of the inventory and data reported to IEA.

49. The ERT encourages Ukraine to verify the high losses from gas transmission through Ukraine and the increase in losses in recent years (CH_4 IEF: 477 kg/TJ in 1990 and 801 kg/TJ in 2003).

50. The ERT recommends that Ukraine estimate emissions from bunker fuels and check and verify the time series of emissions from civil aviation and navigation.

IV. Industrial Processes and Solvent and Other Product Use

A. Sector overview

51. In 2003, emissions from the Industrial Processes sector contributed 8.6 per cent of Ukraine's total GHG emissions, excluding LULUCF. Virtually all of these emissions (99.4 per cent) consisted of CO_2 emitted from Mineral Products, Chemical Industry and Metal Production. Most of the CO_2 (66.5 per cent) originated from Iron and Steel Production, while processing of Mineral Products and in the Chemical Industry contributed the remainder (17.6 and 15.9 per cent, respectively). Some N_2O (0.5 per cent of total industrial processes emissions) and CH_4 (0.1 per cent of total) were emitted from the Chemical Industry.

52. Emissions of CO_2, N_2O and CH_4 showed similar trends over time. All emissions decreased over the first half of the 1990s, reaching minima in 1995–1996. These minima are 20–40 per cent of 1990 emission levels. From 1996 onwards, emissions began to rise again to levels which are 40–90 per cent of 1990 level. During the review, Ukrainian experts explained that the trends are due to the Ukrainian independence in 1991 and subsequent economic recession in the country.

1. Completeness

53. Ukraine has made remarkable progress in providing a full time series of emissions for many categories of the Industrial Processes sector. Not included, however, were emissions from categories 2.A.3 Limestone and Dolomite Use, 2.A.6 Road Paving with Asphalt, 2.A.7 Glass Production, 2.B.2 Nitric Acid Production, 2.B.4 Silicon Carbide Production, 2.C.2 Ferroalloys Production (reported as confidential), 2.C.3 Aluminium Production (reported as confidential), 2.D.1 Pulp and Paper Production, and 2.F Consumption of Halocarbons and SF_6. The Solvent and Other Product Use sector also was not estimated.

54. The ERT recommends that Ukraine include information on the sources not estimated in CRF table 9. The ERT also recommends that Ukraine summarize the coverage of the inventory in the NIR and provide explanatory information.

55. During the review, Ukrainian experts explained that data for some of the missing categories are available, but that further work is needed on ensuring the quality of data. Such categories include CO_2 from Ferroalloys Production, N_2O Emissions from Nitric Acid Production and non-methane volatile organic compounds (NMVOC) emissions from Solvent and Other Product Use. The ERT encourages Ukraine to finalize this process and provide estimates in the next inventory submission.

2. Transparency

56. The NIR did not facilitate understanding of all calculations made. Considerable improvement is possible by including more information on assumptions made for each category. The ERT recommends that Ukraine increase the level of detail of methodological descriptions in its NIR.

3. Recalculations and time-series consistency

57. During the review, Ukraine explained that considerable changes were made to its inventory. Changes included addition of years not previously estimated to the time series, revision of previous

estimates, and removal of previously submitted estimates. Previous 2001 and 2002 estimates of N_2O emissions from Nitric Acid Production, PFC emissions from Aluminium production, and CO_2 emissions from Ferroalloys Production were removed from the inventory due to problems with data quality. Revisions were made to estimates of N_2O emissions from Adipic Acid Production, CO_2 emissions from Carbide Production, CO_2 from Lime Production, CO_2 from Cement Production, and CO_2 from Soda Ash Production and Use. The full time series of NMVOC emissions from Asphalt Roofing was added to the inventory.

4. Uncertainties

58. Quantitative uncertainty analysis was not done for the Industrial Processes sector. However, the general uncertainty section of the NIR does provide a quantitative estimate for Cement Production (1.67 per cent).

5. Verification and quality assurance/quality control approaches

59. No formal quality control procedures were applied during preparation of the inventory. Quality assurance was not considered. Some quality control appears to have taken place, because estimates for some categories were not submitted due to identified data quality problems. The ERT recommends that Ukraine implement QA/QC procedures as described in the IPCC good practice guidance.

B. Key categories

1. Iron and steel production – CO_2

60. Ukraine estimates emissions from crude iron production by multiplying coke consumption data by the IPCC default EF 3.1 t CO_2/t coke consumed. However, good practice calls for the accounting of the quantity of carbon stored in crude iron. The IPCC good practice guidance equation 3.6A (p. 3.25) produces a smaller estimate of CO_2 emissions. During the review, Ukrainian experts were well aware of the need to provide revised estimates in accordance with the IPCC good practice guidance. The ERT therefore recommends that Ukraine provide recalculated estimates for this source in its next submission.

61. The ERT notes that CO_2 emissions from steel production were not included in the inventory. To improve completeness and accuracy, the ERT recommends that Ukraine estimate these emissions and report them in its next submission.

62. The inventory submission of 2005 was a remarkable improvement from the previous submission, in that AD and emission estimates for crude iron production were provided for all years of the time series from 1990 to 2003.

2. Cement Production – CO_2

63. Ukraine uses clinker production statistics and a national EF (0.547 t CO_2/t clinker) based on research to calculate CO_2 emissions from Cement Production. The approach taken for this key category is as recommended in the IPCC good practice guidance. The ERT recognizes the improvements made by Ukraine since the previous year's submission.

3. Lime Production – CO_2

64. Emissions from Lime Production are estimated using data on two types of lime produced in Ukraine based on standard known CaO contents. The default EFs are used for the two types of lime, resulting in an IEF for total lime production of 0.82 t CO_2/t lime produced. This factor is within the range of IPCC default factors (0.79–0.91 t CO_2/t lime produced), as should be the case. Given the information presented to the ERT during review, estimates prepared by Ukraine are consistent with the IPCC good practice guidance.

4. Ammonia Production – CO_2

65. Estimates for CO_2 from Ammonia Production were based on production data in combination with the default EF. This is consistent with the Revised 1996 IPCC Guidelines. However, the Revised 1996 IPCC Guidelines give a more accurate method based on consumption of methane. The result might be further improved by application of a national EF. Therefore, since this is a key category, the ERT encourages Ukraine to further develop its sources of data in order to obtain more accurate results.

C. Non-key categories

1. Coke – CH_4

66. Emissions of CH_4 from production of coke were not included in the inventory. The ERT notes that although CH_4 emissions from production of coke may not be significant in terms of total emissions from the Industrial Processes sector, completeness would be improved by including them. The ERT therefore encourages Ukraine to use the default EF given for Coke in the Revised 1996 IPCC Guidelines (table 2–10, p. 2.23) and include estimates of CH_4 emissions from production of coke in its next submission.

2. Adipic Acid Production – N_2O

67. The ERT found a mistake in calculations that substantially affected the level of emissions from this source. During the review, Ukrainian experts were able to provide new estimates that agreed with the calculations of the ERT. The reported emissions were 5.4–5.6 per cent of revised estimates. The ERT recommends that Ukraine include these recalculated estimates in its next submission.

3. Soda Ash Production and Use – CO_2

68. Ukraine did not provide emission estimates for Soda Ash Production. The Ukrainian experts explained that this was due to the fact that limestone, lime and chalk are used as raw materials, and that there are no EFs available for these materials. The Revised 1996 IPCC Guidelines give a default emission factor for trona (hydrated sodium bicarbonate carbonate) only, which is not used as a raw material in Ukraine. The ERT encourages Ukraine to develop a national EF, and to report these emissions in future submissions. Discussions with national industry experts and review of other Parties' inventories may help in developing an EF.

69. Ukraine did report a complete time series of activity and emissions data for soda ash use. This is a considerable improvement from the previous submission. Imports and exports of soda ash were considered and the IPCC default EF was used. The estimates are thus consistent with the Revised 1996 IPCC Guidelines.

D. Areas for further improvement

1. Identified by the Party

70. Ukraine intends to prepare emission estimates for categories not estimated. To this end, the Ukrainian experts indicated that they will continue discussions with the Ministry of Industrial Policy and the Ministry for Environmental Protection to obtain the required data.

2. Identified by the ERT

71. The ERT recommends that Ukraine increase the level of detail of methodological descriptions in its NIR. For instance, addition of AD for lime production, together with assumptions regarding EFs and abatement technology, would make the reporting fully transparent in that emissions calculations could be replicated.

72. The ERT also encourages Ukraine to explain the large variations in time series of emissions in its NIR. These descriptions would ideally include explanations of the general trends, as well as the large inter-annual variations.

73. The ERT also recommends that Ukraine quantify uncertainties for the sources in the Industrial Processes sector to help pinpoint the categories that should be prioritized for further inventory development and improvement.

V. Agriculture

A. Sector overview

74. In 2003 the Agriculture sector accounted for 5.7 per cent of total national GHG emissions, reaching 29,819.48 Gg CO_2 equivalent. Over the period 1990–2003, emissions from the sector decreased by 62.2 per cent. In 2003 N_2O emissions accounted for 53.1 per cent of the total Agriculture sector emissions. Methane emissions accounted for the remaining 46.9 per cent. Agricultural Soils, Enteric Fermentation, and Manure Management were the major agricultural source categories, contributing 42.0, 40.4, and 16.6 per cent, respectively, to total Agriculture sector emissions. The contributions from Rice Cultivation and Field Burning of Agricultural Residues were 0.3 and 0.7 per cent, respectively. The category Prescribed Burning of Savannas is not occurring, as there are no savannas in Ukraine.

75. From 1990 to 2003, emissions from Enteric Fermentation and Manure Management decreased by 67.0 and 64.3 per cent, respectively, because of a reduction in livestock populations - most importantly, decreased populations of non-dairy cattle (by 79.4 per cent) and swine (by 63.3 per cent). The decline in dairy cattle was less pronounced (49.5 per cent), because these animals were mostly on private sector farms. The emissions from agricultural soils declined by 54.5 per cent in the period 1990–2003, due to a constant decline in nitrogen supplied by mineral fertilizers (72.7 per cent since 1993) and animal waste nitrogen returned to soils (64.8 per cent). The ERT encourages Ukraine to provide in its NIR relevant explanations on trends of GHG emissions.

76. Based on its key-category analysis, the Party identified Enteric Fermentation in dairy and non-dairy cattle, Direct and Indirect N_2O Emissions from Agricultural Soils and N_2O emissions from solid manure management systems as key categories. In the secretariat's analysis, only Enteric Fermentation and Direct and Indirect N_2O Emissions from Agricultural Soils were identified as key categories. The results are in good agreement and the use of disaggregated sub-sources of Enteric Fermentation and Manure Management is in line with IPCC good practice guidance.

1. Completeness

77. The CRF includes estimates of all gases and sources of emissions from the Agriculture sector, as recommended by the Revised 1996 IPCC Guidelines. Ukraine completed all relevant Agriculture tables of the CRF for the period 1990–2003. Compared with the previous year's submission, the current CRF tables were completed much better and all relevant sources were this time estimated in the inventory. However, the CRF tables were not filled in completely. Notation keys were inconsistently used in the CRF tables for all time series. Little information was presented in footnotes or boxes. The Party may wish to check the use of notation keys in the CRF tables and correct its reporting in the next submission. The information in the NIR is complete.

78. Nitrous oxide emissions from the Cultivation of Histosols subcategory were not reported. The Party explained that AD on the area of cultivated organic soils were not available. However, in the LUCF sector, data on agricultural organic soils are reported. The ERT recommends that the Party report all data in the inventory consistently across sectors and provide estimates from Cultivation of Histosols in its next submission.

79. As there is a small population of mules and asses, the emissions from these animals should be reported as "NE" rather than "NO". Explanatory information should be included in table 9 of the CRF. CO_2 emissions were reported as "0" in CRF table 10, although estimations were not conducted in the Agriculture sector. The ERT suggests reporting using notation key "IE". It also recommends filling in CRF table 4.E (Prescribed Burning of Savannas) with notation key "NO".

2. Transparency

80. The NIR provided overall information on methodology, AD, EFs and references for every category. However, it is unclear from the NIR how actual calculations of nitrogen in crop residues were performed. In the documentation box of CRF table 4.D it is noted that specific fractions of nitrogen were used for each crop, while the NIR states that the default methodology was used. During the review, the national experts provided a comprehensive explanation of the methods and national data used in the calculations of the amount of nitrogen in crop residues. The ERT recommends that the Party expand the explanations of calculations in the NIR and CRF tables in the 2006 submission.

81. AD for the Agriculture sector inventory are obtained from the agrarian census every fifth year. Population enterprises and facilities are the statistical basis for the census. For all years in between, agricultural data are supplied by the State Statistics Committee based on extrapolation of data from representative enterprises/facilities of the rural population. The ERT encourages the Party to provide information on collection of AD in a transparent manner in its NIR.

82. IPCC tier 1 methods and default EFs are used to estimate emissions from the Agriculture sector. The ERT would like to encourage the Party to examine the possibility of using tier 2 methods and developing country-specific parameters and conversion factors for key categories in the future.

3. Recalculations and time-series consistency

83. The estimates of 2002 emissions of CH_4 and N_2O for the Agriculture sector were recalculated for the 2003 submission – reduced 13 per cent and increased 49 per cent, respectively, compared to previous submission. There is no explanatory information on recalculations made reported in CRF table 8. During the review, the Party explained that CH_4 emissions from Agriculture were recalculated due to inclusion of estimations from the Field Burning of Agricultural Residues category, use of IPCC good practice guidance data for Rice Cultivation, and correction of a few noted mistakes in the calculations of CH_4 emissions from Enteric Fermentation. Recalculations of N_2O emissions were due to corrected estimation in the Manure Management category and inclusion of indirect N_2O emissions from Agricultural Soils and Field Burning of Agricultural Residues. All recalculations were performed throughout the time series. Ukraine is encouraged to provide in table 8 of the CRF relevant information on all recalculations made.

84. The trend of N_2O emissions was inconsistent in the period 1990–1997. The peak of N_2O emissions from Agriculture in 1993 was explained by the Party as being due to the inclusion of emissions from synthetic fertilizers. Ukraine did not report N_2O emissions from synthetic fertilizers for 1990–1992 and 1994–1996 due to the lack of AD. The ERT recommends that Ukraine obtain data on the input of nitrogen fertilizers in these years or use interpolation between data for known years.

85. The populations of swine and poultry increased between 2001 and 2002 by 20.3 and 19.2 per cent, respectively. The population of swine decreased by 20.4 per cent between 2002 and 2003. These changes were due to a non completely successful attempt to develop meat-producing farms in 2002. The Party may wish to provide explanations for rapid changes in animal populations in its next NIR submission.

4. Uncertainties

86. No quantitative estimates of uncertainty were made for the sector. The State Statistics Committee estimated that the uncertainty of AD for Agriculture is not more than 8 per cent. Ukraine has expressed its intention to develop quantitative uncertainty estimates for its next submission. The ERT encourages this work.

B. Key categories

1. Enteric Fermentation – CH_4

87. In the previous review stage it was noted that AD reported for populations of cattle, sheep and swine were lower compared to the data provided by the Food and Agriculture Organization of the United Nations (FAO), by 18.1, 6.3 and 25.7 per cent, respectively. According to the State Statistics Committee of Ukraine, FAO annual statistical review of Ukraine contains preliminary data. These preliminary data are later made more accurate, and used in the GHG inventory. The ERT encourages Ukraine to provide clear explanations of differences between the country's data and FAO data in the Party's next NIR submission.

2. Direct N_2O Emissions from Agricultural Soils – N_2O

88. Animal wastes applied to soils were calculated by the Party using the default $Frac_{GRAZ}$, which is 2 per cent. The 1996–1999 value reported for this fraction is 7 per cent. However, data on allocation of nitrogen in animal waste management systems (AWMS) reported in the table 4.B(b) show that the fraction of nitrogen left on pastures is about 15 per cent. All of this nitrogen was accounted for in the Animal Production subcategory. Therefore, there was double counting of part of the manure nitrogen left on pastures by grazing animals and overestimation of N_2O emissions. During the review, Ukraine provided revised estimates of the amount of animal wastes applied to agricultural soils, in accordance with data on the split of AWMS in the country, and the resulting N_2O emissions for the whole time series. The ERT recommends that Ukraine provide recalculated estimates for this source in its next submission.

89. The default calculations made by the ERT for estimation of the amount of nitrogen in crop residues and corresponding N_2O emissions resulted in a value that was an order of magnitude higher than that reported in table 4.D. The Party explained that only part of the above-ground biomass was included in its calculations. The Party expressed its intention to review all flows of crop residues and report in its next submission correct values for residues left on fields. The ERT encourages the Party in this effort.

C. Non-key categories

1. Manure Management – N_2O

90. The default data on the use of AWMS for Eastern Europe were used. However, in the former Soviet Union the "daily spread" system was prohibited due to the requirement to disinfect manure before application. The ERT recommends that Ukraine investigate the types of AWMS used in the country in the period 1990–2003 and consider the possibility of developing country-specific data on the split of AWMS.

2. Rice Cultivation – CH_4

91. The 1990 value of CH_4 IEF for rice fields (70 g/m^2) is one of the highest of reporting Parties. The Party may wish to examine more closely the correctness of AD used for 1990.

3. Field Burning of Agricultural Residues

92. In its 2004 submission, Ukraine did not provide estimations of GHG emissions from Field Burning of Agricultural Residues, placing notation key "NO" in CRF table 4.F. However, in its 2005 submission, Ukraine reported GHG emissions from this category. The Party may wish to check if this agricultural activity is occurring in the country. The ERT recommends that Ukraine check whether the annual crop production data reported by the State Statistics Committee are in dry or wet matter, and the appropriateness of applying the fraction of dry matter in calculations.

D. Areas for further improvement

1. Identified by the Party

93. The national inventory team is in the process of obtaining enhanced characterization data for dairy and non-dairy cattle. These data will be used for tier 2 estimations of CH_4 emissions from Enteric Fermentation and Manure Management in the next submission. Ukraine intends to use country-specific data on the split of AWMS, nitrogen excretion rates, fractions of nitrogen in the different crops, and residue/crop ratios.

2. Identified by the ERT

94. The ERT acknowledges and encourages the further work of the inventory team on issues identified by the Party. Ukraine may wish to include all relevant explanations of the issues identified in this review in its next NIR and CRF submission.

VI. Land Use, Land-use Change and Forestry

A. Sector overview

95. In the inventory submitted in 2005, Ukraine provided estimates of removals and emissions from Changes in Forest and other Woody Biomass Stocks, CO_2 Emissions and Removals from Soil, and Other (forest wildfires). The Party did not use the LULUCF CRF reporting tables required by decision 13/CP.9 due to financial and time limitations. Ukraine used the IPCC tier 1 methods and default EFs for its estimations.

96. The rate of CO_2 removals from Changes in Forest and other Woody Biomass Stocks was relatively constant in the period 1990–1992 at about –49,755 Gg per year. In 1993 it suddenly increased to –59,094 Gg, then remained constant until 1999, and then decreased slightly. The rate of removals decreased by about 743 Gg per year in the period 1999–2003. CO_2 emissions or uptake by soil varied considerably from year to year. This was mainly due to dynamic changes in land management systems for mineral soils from year to year. After 1995, carbon stored in the soil and litter of mineral soils increased by about 3,672 Gg CO_2 annually due to changes in land-use practices. CO_2 emissions from wildfires in managed forests also varied considerably between years. On average, CO_2 emissions from fires amounted to about 119 Gg annually. A small amount of non-CO_2 emissions was also emitted from fires. The total net removals in the sector increased at a rate of about 7.7 per cent annually between 1990 and 1996, and decreased at a rate of 2.7 per cent annually between 1997 and 2003.

1. Completeness

97. The Party's CRF submission includes estimates of CO_2 removals and emissions from the LUCF sector, and also covers CH_4, N_2O, NO_X and CO. In the CRF, the Party reported a number of source and sink categories and subcategories as "NE" and "NO": Forest and Grassland Conversion, Abandonment of Managed Lands, and Forest Soils. In the NIR, it was reported that the estimation of GHG emissions from Forest and Grassland Conversion could not be estimated due to lack of data, but for Abandonment of Managed Lands no explanation was provided. As Ukraine must use the LULUCF CRF reporting tables

in its next submission, the Party should adopt land-use categories defined in the IPCC good practice guidance for LULUCF, i.e. Forest Lands, Croplands, Grasslands, Wetlands, Settlements and Other Land, and use the methods recommended in the IPCC good practice guidance for LULUCF for the estimations.

2. Transparency

98. Ukraine provided enough information as well as the sources of data used in developing the inventory. The approach used in the estimation of carbon emissions from wildfires was also provided to the team, and it was consistent with the Revised 1996 IPCC Guidelines. The definition of wildfires followed the definition given in the Encyclopaedia of Agriculture (Matckevich and Lobanov, 1972). The data on the area of agricultural land by land-use/management system were only available for 1996. The Party explained that the area of agricultural land by land-uses/management systems for other years was estimated based on the proportion of each land-use/management system to the total agriculture in 1996.

3. Recalculations and time-series consistency

99. The Party did not report any recalculation, as it was the first time the Party reported estimations for the LUCF sector.

100. There was a sudden increase in net carbon removals from Changes in Forest and Other Woody Biomass Stocks between 1992 and 1993. Following analysis of the inventory spreadsheet provided by the Ukrainian experts, it was clear that the increase was due to a large increase in carbon sequestration by forests under the Other category. Total area of forests under the Other category was about 42 per cent of the total forest area for 1990–1992, and about 50 per cent for 1993–2003. The Party was unable to explain the change, although it was suggested that it might be due to a change in methodology in defining forests under the Other category. Possibly the types of forests under the Other category were expanded in 1993. The Party explained that the forests under the Other category included parks, greenbelts, gardens, urban forests, etc. The ERT recommends that the Party treat these forests under separate categories and apply different growth rates for each type.

4. Uncertainties

101. In the CRF was provided qualitative uncertainty of the estimates. Because the Party mostly used IPCC default values in developing its inventory, and some of the AD were estimated from other available data, all estimates were considered of low quality. The NIR did not include explanation regarding the certainty of estimates.

102. Ukraine plans to improve the certainty of estimates by developing local carbon removal factors and EFs or using existing data available through collaboration with research agencies in the country. According to a representative from the Ukrainian Research Institute of Forestry, a map of spatial distribution of forest compartments, which contains information on tree species, stand ages and site conditions, is available. According to the representative, the map only covers a number of sites, and there is plan to expand the coverage area to include the whole country. Considering progress on data availability, Ukraine may be able to perform quantitative uncertainty analysis, rather than qualitative analysis, following the IPCC good practice guidance for LULUCF.

5. Verification and quality assurance/quality control approaches

103. No specific QA/QC procedures were undertaken in this sector, other than the general tier 1 QC steps outlined in the NIR.

B. Sink and source categories

1. Changes in Forest and Other Woody Biomass Stocks

104. Ukraine has provided a list of AD sources in the references of the NIR. The mean biomass annual increment (MAI) for each tree species was taken from a publication of the State Committee of Forestry Management of Ukraine (2004). The Party divided the category into six species, namely *Pinus spp*, *Fir spp*, Quercus, Fagus, Betula and Others. The MAIs used for the species were 3.0, 5.4, 3.0, 3.5, 3.4 and 4.4 t dm/ha/year, respectively, for all inventory years. The first two values are slightly lower than the IPCC defaults.

105. The MAI for the forest under the Other category is quite high at 4.4 t dm/ha/year, the second highest after *Fir spp*. The Party explained that forests under the Other category include parks, greenbelts, gardens, etc. The MAI of these forests should be lower than that of the plantation forests. By reducing the MAI of the Other category, to make it similar to the MAI of the *Pinus spp*, the CO_2 removal would decrease by about 17 per cent from the current estimates. The ERT encourages the Party to disaggregate this Other category into a number of forest categories and use appropriate MAIs.

106. Conversion of harvested wood volume to total biomass was performed using biomass expansion factors (BEF), wood dry density (WD) and carbon content of biomass (CC). Ukraine used a BEF of 1.9, WD of 0.5 t/m^3 and CC of 50 per cent. These values are in the range of the IPCC default values. However, in Ukraine, the harvested wood data consist of industrial wood, fuelwood and wood used for other technological needs. These three types of harvested wood come from the same plantations. Thus, the estimation of the total biomass based on the harvested wood data should account for the three types of wood. In its analysis, Ukraine only applied the BEF to the industrial wood. The ERT encourages the Party to improve its estimations by accounting for the three types of harvested wood.

2. Forest and Grassland Conversion

107. No estimates of GHG emissions were reported from Forest and Grassland Conversion. However, based on the area data of grassland provided in CO_2 Emissions and Removals from Soil, it was shown that the area of grassland decreased in the period 1990–2003. This may suggest that there was conversion of grassland to other uses. The ERT encourages Ukraine to estimate the emissions from such activities.

3. Abandonment of Managed Lands

108. No estimates of carbon removals from the Abandonment of Managed Lands were reported. Considering the conditions in neighbouring countries, the ERT believes that such abandoned land also exists in the Ukraine. CRF table 4.F for 1990–2003 showed that biomass production (estimated from crop production and ratio of residue/crop production data) decreased consistently, while total area of agricultural land was relatively constant. This may indicate that some agricultural land may have been abandoned.

4. CO_2 Emissions and Removals from Soil

109. In the NIR, Ukraine notes that CO_2 Emissions and Removals from Soil occur in the three activities defined in the Revised 1996 IPCC Guidelines. All EFs used in the inventory were IPCC default values.

110. The NIR identified eight categories of land-use/management systems. During the review, the ERT found that the categories of the land-use/management systems described in the English version of the NIR were incorrectly translated. However, the land-use/management systems considered in the analysis were cropland, perennial crops, grazing/pasture, forest, wetland/swamp land and other land with trees. Ukraine divided the country into three soil groups, namely high activity soils, soils that contain

low or high clay, sandy soils and aquic. The ERT found that the default values for estimating soil carbon content under native vegetation were taken from a region with a warm temperate-moist climate type. In fact, the country falls under two climate types, namely warm temperate dry and warm temperate-moist. Ukraine was unable to select the appropriate default values as a map showing the distribution of the area according to land-use/management system and climate type was unavailable when the inventory was developed. In addition, during the review it was stated that most of the country's wetland/swamp land was unmanaged. For this reason, this land-use should not be included in the analysis.

111. The forest area data used in this analysis are not consistent with the forest area data used in Changes in Forest and other Woody Biomass Stocks. The forest area data of the inventory year (t) in Changes in Forest and other Woody Biomass Stocks are the same as those of t-20 in CO_2 Emissions and Removals from Soil.

112. The Party considered that cropland was the only ecosystem agriculturally impacted. Therefore, the Party applied base factor, tillage factor and input factor to estimate soil carbon content of this land. Other land use such as grazing land/pasture and perennial crops may also fall under agriculturally impacted ecosystems, and thus the same method should be applied to these land-use categories.

113. The default IPCC EFs were used to estimate CO_2 emissions from organic soils and from lime application. Because data on the organic carbon content of soils (0–30 cm depth) and the emission rates from organic and other soils are available (e.g. Buksha and Pasternak, 2005), the ERT encourages Ukraine's inventory team to use local data in future submissions.

5. Other (Forest Wildfires)

114. Ukraine estimated the emissions from wildfires in managed forests. The Party classified the fires into three types: low fires, up fires and below-ground fires (Matckevich and Lobanov, 1972). The data for low and below-ground fires were reported in the form of burnt area. Based on a State Committee of Forestry Management of Ukraine (2004) study, it was found that the average carbon loss due to low fires was between 8 and 10 t/ha, and below-ground fires about 100 t/ha. The below-ground fires occur in peat land. Ukraine used values of 8 t/ha and 100 t/ha for all inventory years for low and below-ground fires, respectively. For up fires, the data were reported in two forms, namely burned area and volume of wood burned from the standing trees and the harvested wood left on the forest floor. It was assumed that in up fires about 70 per cent of the wood was burnt completely. To convert the wood volume into dry matter, biomass density of 0.4 t/m^3 was used. This is not consistent with the biomass/wood density used in changes in forest and other woody biomass stocks, i.e. 0.5 t/m^3. As the up fires occur in the plantation forest, the same biomass density should be applied.

115. Ukraine did not estimate the delayed emissions due to the decomposition of dead organic matter after fires. To increase the completeness, the ERT encourages Ukraine to include these emissions in its next submission. The IPCC good practice guidance for LULUCF provides method for estimating these emissions.

C. Areas for further improvement

1. Identified by the Party

116. Ukraine is aware of limitation in EFs and AD used in the inventory. Ukraine is aware of the availability of local EF data and plans to use them in its next submission. During the review, a representative from the Ukrainian Research Institute of Forestry explained that the Institute has prepared a manual for the development of inventories and monitoring of GHGs in forestry (Buksha and Pasternak, 2005). The manual contains methods for sampling which are in harmony with international standards relating to carbon dynamics in forest ecosystems, and also contains GHG EFs developed in the country. It also describes methodological improvements required for Ukraine to fulfil its commitments under the

Kyoto Protocol. Ukraine's inventory team informed the ERT that it will use the manual as one of the main references in developing its next inventory.

2. Identified by the ERT

117. For its next inventory, the Party should be able to use the LULUCF reporting tables required by decision 13/CP.9 and apply the IPCC good practice guidance for LULUCF.

118. As the Party has to apply the IPCC good practice guidance for LULUCF in its next submission, it may need to group its land-uses/management systems according to the categories defined in the IPCC good practice guidance for LULUCF, i.e. Forest Lands, Croplands, Grasslands, Wetlands, Settlements and Other Land. GHG emissions or removals occurring in these lands due to changes in management or due to conversion to other land uses should be estimated.

119. Some of the estimates may be overestimates due to inappropriate selection of EFs, particularly the mean biomass increment of forests under the Other category.

120. Considering the progress on availability of EFs and AD, the Party may be able to perform quantitative uncertainty analysis, rather than qualitative analysis.

121. The electronic data archiving system of the sectoral inventory should be developed and improved, as this would allow Ukraine and the next review team to access data easily and facilitate the QA/QC process.

VII. Waste

A. Sector overview

122. Emissions from the Waste sector contributed 4.3 per cent of total national GHG emissions in 2003, compared with 2.3 per cent in 1990. The trend of CH_4 emissions is unstable and emission levels fluctuated from 1998 onwards. The inter-annual changes during 1998–2003 were in the range of –23.8 per cent and 23.1 per cent.

123. CH_4 emissions from Solid Waste Disposal on Land contributed 2.9 per cent of total national emissions in 2003. Emissions from Waste-water Handling and Waste Incineration contributed 1.3 per cent and 0.1 per cent to total national emissions, respectively.

124. Ukraine's key-category analysis identified only CH_4 emissions from Solid Waste Disposal on Land, whereas the key-category analysis by the secretariat also identified CH_4 emissions from Waste-water Handling in both the level and trend assessments.

1. Completeness

125. The NIR covers emissions from all source categories. The IPCC default method was used for estimating GHG emissions from all sources in the Waste sector. The assumptions and methodologies used for estimating emissions are described in the NIR. Some AD and EFs are reported in additional information boxes of CRF.

126. The CRF tables include estimates of most gases and sources of emissions from the Waste sector, excluding emissions of CH_4 from Sludge, which were not estimated due to lack of documentary information on amount of decomposed organic matter removed with sludge.

2. Transparency

127. The 2005 inventory submission is more transparent than the previous one, mainly because descriptions of the methodology used, including assumptions and background data and studies, have been

included. Some improvements for estimating emissions from the Waste sector are summarized in a relatively accessible format and described in the NIR. The ERT believes that more detailed references on the AD used should be included in the next submission.

3. Recalculations and time-series consistency

128. In its 2005 submission, Ukraine recalculated estimates for CH_4 emissions from Solid Waste Disposal on Land. For the year 2002, the recalculations resulted in a decrease in emissions, from 1,187.53 Gg CH_4 in the 2004 submission to 626.23 Gg CH_4 in the 2005 submission. The change was due to the revision of data on landfilled waste. The estimates for the period 1990–1998 were based on an average daily rate of waste generation per person (1999–2003) of 0.681 kg/per/day multiplied by the urban population, whereas for the period 1999–2003, estimates were based on statistical reports.

129. The methods and EFs used for estimating CH_4 emissions from Solid Waste Disposal on Land were taken from the Revised 1996 IPCC Guidelines and were consistently applied over the entire time series.

4. Uncertainties

130. Qualitative estimates provided in the CRF submission report a "medium" level of uncertainty for the Waste sector. The Party is planning to develop prior to its next submission a quantitative uncertainty analysis of Ukraine's emissions inventory. The ERT welcomes this effort and encourages Ukraine to report the results in its next submission.

5. Verification and quality assurance/quality control approaches

131. There is no formal QA/QC plan for the Waste sector. The ERT recommends that Ukraine implement QA/QC procedures for the sector as described in the IPCC good practice guidance.

B. Key categories

1. Solid Waste Disposal on Land – CH_4

132. The IPCC tier 1 method was used to estimate CH_4 from Solid Waste Disposal on Land. Emission factors for estimating CH_4 were also taken from the Revised 1996 IPCC Guidelines (DOC_F=0.77, OX=0 for all solid waste disposal sites (SWDS), MCF=1 for managed sites and MCF=0.4 and 0.8 for unmanaged shallow and unmanaged deep sites, respectively).

133. The 1990–2003 values of the CH_4 IEF for Solid Waste Disposal on Land - Managed SWDS (0.09 t/t waste) have been identified as outliers. They are in the high end of the range of reporting Parties. In the opinion of the ERT, this is explained by an underestimation of CH_4 emissions from SWDS, due to the incorrect allocation of waste disposal between managed and unmanaged landfills.

134. According the NIR (based on an ARENA-ECO study (2004)), 56.1 per cent of landfills in Ukraine are unmanaged and 43.9 per cent are managed. Ukraine used this assumption for all time series. However, in the NIR it is also stated that most landfills (2,520 of 3,194) are illegal and 559 do not meet environmental standards/requirements. A short reference document provided during the review (JI - Projects Landfills screening and preliminary estimation of methane emissions potential from the landfills of large Ukraine's cites) contained insufficient information to allow the ERT to clearly distinguish the number of managed and unmanaged landfills. This led the ERT to conclude that SWDS may still not comply with environmental requirements, and hence the assumption that 43.9 per cent of landfills are managed may not be appropriate for all times series, especially for the base year 1990. During the review, the Party provided a revised breakdown of managed and unmanaged SWDS for the complete time series (10.3 per cent unmanaged shallow, 89.7 per cent unmanaged deep for 1990). The ERT recommends that Ukraine provide recalculated estimates for this source in its next submission.

135. CRF table 6.A is incomplete with regard to additional information. Only some AD are reported in the additional information table, and references in the NIR are insufficiently documented.

136. The notation key "NE" was used for the data on waste recycling in the additional information table. Information on fraction of MSW disposed to SWDS is not indicated; however the NIR provided this information in table 6.3. The ERT recommends that the Party fill in, as much as possible, the additional information table in the CRF.

137. Due to lack of official information about CH_4 recovery from landfills, the amount of CH_4 recovered was not excluded from the emission totals. The ERT recommends that the Party exclude recovered CH_4 from emission totals in its next submission.

138. Since 1999, Ukraine has collected data on solid waste disposal at SWDS. In that year, a statistical form was introduced to aid in the collection of AD from waste management utilities. Data on waste disposal for the period 1999–2003 were used to estimate an average daily rate of waste generation per person (0.681 kg/per/day). This rate was then used to estimate waste production for 1990–1998. Use of this rate to calculate generated waste for 1999 resulted in a reported decrease of 23 per cent for that year compared to 1998. In the opinion of the ERT, the reported decrease in generated waste for 1999 was the result of introduction of the new statistical form, as not all SWDS were reported in the first year of introduction of the form.

139. The ERT recommends that Ukraine take into consideration economic growth and product consumption during the period 1990–1998, and make a new estimation of the waste generation rate (other Parties assume a 1.5–3 per cent annual increase in waste generation). The ERT recommends that Ukraine calculate data for the total amount of waste disposed at landfills in 1999, based on average generation rate.

140. The composition of landfilled waste is held constant over time series (DOC=0.17). The ERT recommends that the Party develop further studies on composition of landfilled waste and take into account the experience of other countries (e.g. Austria changed DOC from 0.15 to 0.12 during the period from 1980–2002).

141. To increase the accuracy of CH_4 emission estimates, and based on changes of the amount of waste generated during the period 1990–2003, the ERT recommends that Ukraine conduct further studies on historical data on solid municipal waste disposal at SWDS. The ERT also recommends that the Party conduct further research to facilitate the use of tier 2 (first order decay - FOD) estimation method, and that it undertake further studies and surveys on solid waste management systems and composition and characterization of waste in the country.

2. Waste-water Handling – CH_4

142. Emissions from Waste-water Handling accounted for 31.1 per cent of total GHG emissions from the Waste sector in 2003. This is high compared to what other Parties report for this subsector. The default IPCC EFs and tier 1 method were used to estimate emissions. The ERT found that the fraction of biochemical oxygen demand (BOD) that will ultimately degrade anaerobically, was omitted from the calculations. Therefore, the resulting 304.85 Gg of CH_4 reported for 1990 is the result of a calculation that assumes all domestic and commercial waste water was treated anaerobically. The ERT is of the opinion that omission of this fraction BOD could have resulted in an overestimation of CH_4 emissions from Waste-water Handling for all years of the time series. During the review, Ukraine provided revised estimates for the complete time series, using a value of 0.15 for the fraction of BOD that will degrade anaerobically. The ERT recommends that the fraction be used to estimate emissions in future submissions and the source used to determine this fraction be well documented. Also, the ERT recommends that the Party provide recalculated estimates for this source in its next submission.

143. Due to lack of information on CH_4 recovery, recovered CH_4 emissions are not excluded from the estimation of total emissions. Ukraine has four methane recovery tanks, but only one is still in operation. The ERT recommends that data on CH_4 recovery be obtained for future submissions. Emissions and AD for sludge are reported as "NE", as no AD on amounts of sludge are available in the Ukraine. The Ukrainian experts informed the ERT that sludge would be considered in the next inventory submission.

144. The 1990–2003 values of the CH_4 IEF (4.30 and 8.04 kg/kg DC (degradable organic component) for 1990 and 2003, respectively) for Waste-water Handling (Domestic and Commercial Wastewater) were identified as outliers. They were the highest of reporting Parties, except in 1992, when they were the second highest. The Party explained that the amount of "total organic product" was reported incorrectly, but the value for CH_4 emissions is correct, and when the data are corrected, the CH_4 IEFs will be equal to 0.20 and 0.48 kg/kg DC, respectively. According to the ERT's estimations, these values should be 0.480 and 0.483 kg/kg DC, respectively, which are still higher than other Parties' reported values. The ERT recommends that the Party revise its assumptions and estimates for the next submission.

145. N_2O emissions from human sewage were estimated based on population. The population decreased between 1990 and 2003 by 8.8 per cent, and protein consumption decreased from 105.3 g/per/day in 1990 to 77.7 g/per/day in 2003. As a result, N_2O emissions decreased by 1.5 times during this period.

C. Non-key categories

Waste Incineration – CO_2

146. CO_2 and N_2O emissions from Waste Incineration were estimated using the IPCC default methodology. All waste was incinerated without energy recovery. The NIR contains a detailed description of the data used for estimating emissions from incineration of municipal solid waste. The Party is planning further studies with the aim of disaggregating waste into municipal, hazardous and clinical waste.

147. The trend in CO_2 emissions from Waste Incineration during the period 1990–1998 was relatively stable. It was estimated that in this period 6 per cent of total generated waste was incinerated. Since 1999, when actual incineration data began to be used for emissions estimation, large fluctuations in CO_2 emissions have been observed. The reported inter-annual changes between 1998 and 2003 were in the range of –23.8 per cent and 23.1 per cent.

148. In the CRF table 6.C, AD and emissions for biogenic and plastic and other non-biogenic waste are reported as "NO" for 1990–2003. The biogenic and plastic and other non-biogenic components should be reported separately in the table using the 40 per cent fraction, reported by the Party, for biogenic or non-biogenic carbon in waste to split the all wastes category (the Russian version and the English version of the NIR are not consistent and differ in the reported information).

D. Areas for further improvement

1. Identified by the Party

149. The Party informed the ERT that it intends to obtain data for estimating CH_4 and N_2O from sludge and to disaggregate AD into different types (municipal waste, clinical waste and hazardous waste).

2. Identified by the ERT

150. The ERT encourages Ukraine to do the following in its future inventories:

(a) Revise its approach to landfill characterization in order to produce a more accurate breakdown of managed and unmanaged SWDS;

(b) Carry out surveys to obtain data on waste management and solid waste composition;

(c) Provide more detailed additional information in CRF table 6.A – Solid Waste Disposal on Land;

(d) Conduct further research with a view to switching from tier 1 method to tier 2 (FOD) method for estimation of CH_4 emissions from SWDS;

(e) Conduct surveys to develop estimates of fraction of the BOD, that is degraded anaerobically;

(f) Document all relevant background data and assumptions.

Annex

Documents and information used during the review

A. Reference documents

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for national greenhouse gas inventories, volumes 1–3, 1997. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

UNFCCC. Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories. FCCC/SBSTA/2004/8. Available at: http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

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

UNFCCC secretariat. Status report for Ukraine. 2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2005_status_report_ukraine.pdf>.

UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2005. FCCC/WEB/SAI/2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/sa_2005_part_i_final.pdf>.

UNFCCC secretariat. Ukraine: Report of the individual review of the greenhouse gas inventory submitted in the year 2004. FCCC/WEB/IRI/2004/UKR. Available at <http://unfccc.int/resource/webdocs/iri/2004/ukr.pdf>.

B. Additional information provided by the Party

Agency for Rational Energy Use and Ecology (PNNL). Greenhouse gas emissions inventory of Ukraine's cement sector. Kiev, July 2003.
(Prepared by ARENA-ECO Ukraine for the U.S. Environmental Protection Agency, Project of the Pacific Northwest National Laboratory.)

Agency for Rational Energy Use and Ecology (PNNL). Inventory of Methane Emissions in the Solid Waste Sector of Ukraine. Kiev, 2004. 24 pp. (in Ukrainian).

Agency for Rational Energy Use and Ecology (PNNL). (JI - Landfills screening and preliminary estimation of methane emissions potential from the landfills of large Ukraine's cites. Kiev, 2003. 205 p. (in Ukrainian).

Buksha I.F. and V.P. Pasternak. Inventory and monitoring of greenhouse gases in forestry. Kharkov, 2005. 125 p. (in Ukrainian).

Soviet Encyclopaedia, Vol. 3: Encyclopaedia of Agriculture. Edited by Matckevich V.V. and P.P. Lobanov. p. 677–678. (in Russian).

State Committee of Forestry Management of the Ukraine. Legal base and methodological manuals for Ukraine to meet Kyoto Protocol commitments; report on research work. Kharkov, 2004. 145 p. (in Ukrainian).

Национальный отчет Украины. Инвентаризация выбросов парниковых газов в 2001–2002 гг. (National Report of Ukraine. Inventory of greenhouse gas emissions in 2001–2002 years). 42 p.

Responses to questions during the review were received from Ms. Galina Galenko (Ukrainian Hydrometeorological Scientific Research Institute) and Mr. Georgy Panchenko (Agency for Rational Energy Use and Ecology), and included additional material on the methodology and assumptions used.

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