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REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY OF DENMARK SUBMITTED IN THE YEAR 2001[1]

(Desk review)

I. OVERVIEW

A. Introduction

1. The Conference of the Parties (COP), at its fifth session, by its decision 6/CP.5, requested the secretariat to conduct, during the trial period, individual reviews of greenhouse gas (GHG) inventories for a limited number of Parties included in Annex I to the Convention (Annex I Parties), according to the UNFCCC guidelines for the technical review of GHG inventories from Annex I Parties, hereinafter referred to as the review guidelines.[2] The secretariat was requested to coordinate the technical reviews and to use different approaches to individual reviews, including desk reviews, centralized reviews and in-country reviews.

2. The review of Denmark's 2001 inventory submission took place from 8 October to 27 October 2001. The desk review was carried out by a team of nominated experts from the roster of experts, working in their own countries. Experts participating in the review were Mr. Klaus Radunsky (Generalist, Austria), Mr. Michael McGettigan (Energy, Ireland), Mr. John Sarafidis (Energy, Greece), Mr. Mauro Meirelles de Oliveira Santos (Industrial processes, Brazil), Mr. Alexander Nakhutin (Industrial processes, Russian Federation), Mr. Ayite-Lo Ajavon (Agriculture, Togo), Mr. Pascal Boeckx (Agriculture, Belgium), Mr. Tomás Hernández-Tejeda (Land-use change and forestry, Mexico), Mr. James Barton (Land-use change and forestry, New Zealand), Ms. Sirintornthep Towprayoon (Waste, Thailand) and Mr. Heinrich Widmer (Waste, Switzerland). The review was coordinated by Ms. Rocio Lichte (UNFCCC secretariat). Mr. Klaus Radunsky and Mr. Ayite-Lo Ajavon were lead-authors of this report.

3. In accordance with the UNFCCC review guidelines, a draft version of this report was communicated to the Government of Denmark, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

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[1] In the symbol for this document, 2001 refers to the year in which the inventory was submitted, and not to the year of publication. The number (1) indicates that for Denmark this is a desk review report.

[2] For the UNFCCC review guidelines and decision 6/CP.5, see document FCCC/CP/1999/7, pages 109 to 114 and 121 to 122, respectively.

B. Inventory submission and other sources of information

4. The expert review team (ERT) reviewed the 2001 inventory submission of Denmark, which consists of the national GHG emissions inventory report (NIR) and the common reporting format (CRF) tables for all years from 1990 to 1999, submitted on 11 April 2001. Inventory reports from previous years were not considered during this desk review. In its 2001 NIR, Denmark referred to its 2000 NIR (Illerup et al. 2000) where, according to the Party, a thorough description of the CORINAIR inventory programme used for Danish emission estimations is given. In its response to the draft of this report, Denmark explained further that the NIR 2001 focuses mainly on major changes in methodologies since the previous year's submission.[3] The 2000 NIR was, however, not part of this desk review and therefore the observations made in this report are based exclusively on the information provided in the 2001 NIR and the submitted CRF tables.

5. The ERT also used for the review the status report 2001, the draft synthesis and assessment (S&A) report of the 2001 inventory submissions and the preliminary key source analysis[4] prepared by the UNFCCC secretariat. A response to the preliminary findings raised in the draft S&A report 2001 was not provided by Denmark. Since Denmark's 2000 inventory submission was not prepared according to the UNFCCC reporting guidelines using the CRF, Denmark was not included in the final S&A report of the year 2000 (FCCC/WEB/SAI/2000). For this reason, the inventory section from the in-depth review (IDR) of Denmark's second national communication (NC2) was also used, as a supporting source of information.

6. Other sources of information used during the review include: the preliminary guidance for experts participating in the individual review of GHG inventories, the UNFCCC reporting guidelines[5] and the review guidelines (FCCC/CP/1999/7).

7. During the review the Party was not contacted to request additional information.

C. Emission profile, trends, key sources

8. Denmark has a typical emission profile of an Annex I Party. The most important GHG is carbon dioxide (CO_2), which in 1999 accounts for 78% of total emissions,[6] followed by nitrous oxide (N_2O), 13% and methane (CH_4), 8%. By source, energy account for 79% of the total emissions, agriculture 17%, industrial processes 3% and waste contribute 1.5%.

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[3] According to the UNFCCC reporting guidelines, the national inventory report shall be submitted annually in its entirety to the COP, through the secretariat, and should be updated annually to reflect changes (FCCC/CP/1999/7, para. 33). The ERT takes note of the information provided by Denmark that the 2001 NIR focuses mainly on changes since the previous submission and that therefore, according to the communication from Denmark, some of the information identified as lacking in this review report might have been found in the 2000 NIR.

[4] The UNFCCC secretariat had identified, for each individual Party, those source categories that are *key sources* in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (hereinafter referred to as the IPCC good practice guidance). Key sources according to the tier 1 trend assessment were also identified for those Parties which provided a full CRF for the year 1990. The key sources presented in this report are based on the secretariat's preliminary key source assessment. These might differ from the key sources identified by the Party itself.

[5] 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 (FCCC/CP/1999/7), are referred to in this report as the UNFCCC reporting guidelines.

[6] In this report the term total emissions refers to the aggregate national GHG emissions expressed in terms of CO_2 equivalents excluding LUCF, unless specified otherwise.

Table 1. GHG emissions by gas, 1990 - 1999 (Gg CO_2 equivalent)

GHGs	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
Net CO_2 emissions/removals	52,129	62,750	57,394	59,061	62,933	59,755	73,094	63,589	59,239	56,000
CO_2 emissions (without LUCF)[(a)]	53,045	63,668	58,315	59,985	63,861	60,686	74,035	64,540	60,203	56,976
CH_4	5,852	5,900	5,901	5,998	5,893	5,869	5,858	5,711	6,017	5,644
N_2O	11,013	10,913	10,256	10,381	10,168	10,102	9,971	9,582	9,670	9,614
HFCs	0	0	3	30	58	126	278	344	503	621
PFCs	0	0	0	0	0	0	0	4	14	30
SF_6	43	61	89	135	122	107	61	73	59	65
Total (with net CO_2 emissions/removals)	69,037	79,624	73,643	75,605	79,174	75,960	89,262	79,302	75,502	71,975
Total (without CO_2 from LUCF)[(a)]	69,953	80,542	74,564	76,529	80,102	76,891	90,203	80,253	76,466	72,951

[(a)] In the CRF, the information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from LUCF.

Table 2. GHG emissions by sector, 1990-1999 (Gg CO_2 equivalent)

GHG SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
1. Energy	53,161	63,789	58,292	59,999	63,985	60,852	74,302	64,626	60,760	57,571
2. Industrial processes	1,049	1,239	1,393	1,476	1,497	1,544	1,727	1,959	2,013	2,118
3. Solvent and other product use	124	122	121	125	119	118	116	115	114	113
4. Agriculture	14,309	14,054	13,397	13,570	13,125	13,061	12,753	12,311	12,417	12,040
5. LUCF (net emissions)	-916	-918	-921	-924	-928	-931	-941	-951	-964	-976
6. Waste	1,310	1,338	1,361	1,359	1,376	1,317	1,304	1,241	1,163	1,110
7. Other	0	0	0	0	0	0	0	0	0	0

9. Tables 1 and 2 provide data on emission trends (related to unadjusted emission data), by gas and by sector. Emissions of CO_2, excluding land-use change and forestry (LUCF), grew by 7% between 1990 and 1999 driven mainly by the growth of emissions from transport. N_2O emissions decreased by 13% for the same period due to some decrease in emissions from agricultural soils. CH_4 emissions show almost the same level in 1999 as in 1990 although CH_4 emissions from energy had increased. However, this increase is compensated by a decrease from enteric fermentation in agriculture. Hydrofluorocarbons (HFCs) experienced significant growth from 1992 onwards, as did perfluorocarbons (PFCs) from 1997. Total GHG emissions (without CO_2 from LUCF) increased by 4.3% between 1990 and 1999.

10. Denmark did not provide a key source assessment. According to the preliminary level and trend assessment undertaken by the secretariat, the key sources shown in table 3 below have been identified for Denmark.

Table 3. Key sources Denmark: Level and trend assessment (UNFCCC secretariat)[(a)]

Key source	Gas	Level assessment for 1999 %	Cumulative total %	Contribution to trend %
Stationary combustion - coal	CO_2	25.8	26	32.2
Stationary combustion - oil	CO_2	18.0	44	
Mobile combustion - road vehicles	CO_2	15.5	59	8.6
Stationary combustion - gas	CO_2	14.3	74	31.3
Direct N_2O emissions from agricultural soils	N_2O	6.8	80	7.3
Indirect N_2O from nitrogen used in agriculture	N_2O	3.8	84	2.8
Enteric fermentation in domestic livestock	CH_4	3.7	88	2.9
Cement production	CO_2	1.8	90	2.0
Solid waste disposal sites	CH_4	1.5	91	
Fugitive emissions: oil & gas operations	CO_2	1.2	92	3.4
Manure management	CH_4	1.2	94	
Ozone depleting substances (ODS) substitutes	All HFCs and PFCs	0.9	95	
Mobile combustion - road vehicles	N_2O			1.6
Stationary combustion - gas	CH_4			2.2

(a) See footnote 4 to this report.

D. General assessment of the inventory[7]

1. Completeness and transparency of reporting

Completeness

11. Denmark submitted inventory data for the years 1990 to 1999 using the CRF of the UNFCCC reporting guidelines. The ERT identified a few omissions in the national inventory relating to waste water handling and waste incineration. Information on feedstocks is also missing. With these exceptions the inventory covered all major sources and sinks, as well as all direct and indirect gases, included in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, hereinafter referred to as the IPCC Guidelines.

12. It is noted that the CRF contains information for Denmark only but the additional emissions emanating from other Danish territories (Greenland and the Faroe Islands) are reported only in the totals given in the NIR.

Transparency

13. The ERT noted that the NIR includes information on:

(a) Methodologies regarding energy (feedstocks, bunkers and road traffic), LUCF and HFCs, PFCs and sulphur hexafluoride (SF_6); however, table Summary 3 on methods and emission factors used was not completed;

[7] The assessment and conclusions resulting from this desk review are based on the information available in the CRFs for 1990 – 1999 and the 2001 NIR (see also paragraph 4 and footnote 3).

(b) References to detailed methodology and supporting information for LUCF, HFCs, PFCs and SF_6 as well as to methodologies to calculate adjustments for electricity exchange and inter-annual temperature variations;

(c) Geographic coverage,[8] data management and software, the general methodology (CORINAIR);

(d) Uncertainties.

14. The ERT noted, however, that the NIR lacks:

(a) Calculation tables;[9]

(b) Indication of the rationale behind the choice of emission factors used;

(c) Clear indication of the methods used[10] (e.g. agriculture, waste);

(d) Clear indication of the rationale and complexity of the methodologies used (IPCC default, tier 1, tier 2, etc.);

(e) Indication of sectors (subsectors) and GHGs with emission data coming directly from measurements;

(f) Uncertainty data relating to individual sectors (subsectors).

15. The ERT also noted, however, that the CRF lacks:

(a) Information on the reference approach;

(b) Summary tables, for example on methods and emission factors (Summary 3), table 7 (overview), table 8(b) (recalculation – explanatory information), table 9 (completeness);

(c) Use of notation keys;

(d) Some sectoral background data (e.g. table 1.A(d), table 2(II).F).

16. The NIR provides only a very general description of the inventory process and the underlying data and methodologies. Some emission factors presented in the NIR are not consistent with those used to compute the emissions, as indicated in the corresponding individual

[8] In its response to the draft of this report, Denmark confirmed that all information given in the CRF tables and the NIR covers Denmark only, with the exception of appendix 1.2 and appendix 3 of the NIR, in which information concerning Greenland and the Faroe Islands is provided. According to information in appendix 3 of the NIR, the inventory for Greenland and the Faroe Islands only covers CO_2 emissions from fuel combustion.

[9] According to the UNFCCC reporting guidelines, the NIR should include calculation sheets or equivalent database information on detailed inventory calculations in each sector for all years from the base year to the year of the current annual inventory submission, containing, *inter alia*, disaggregated national emission factors and activity data underlying the estimates (FCCC/CP/1999/7, para. 33(b)). This reporting requirement was, however, dropped from the revised UNFCCC reporting guidelines, which were agreed by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its sixteenth session. The ERT would, however, encourage Denmark to include in the NIR some sample calculation sheets to improve transparency further and to help understanding the methodologies applied. The ERT notes that Denmark provides a general reference to CORINAIR and would have been prepared to supply calculation sheets upon request. However, the ERT did not ask for additional information during this desk review.

[10] In its response to the draft of this report, Denmark informed the ERT that a description of methods used in the agriculture sector can be found in the 2000 NIR, appendix 11 (see paragraph 4 and footnote 3).

sector discussions of this report. Thus a number of factors contribute to a lack of transparency in the Danish inventories and the content of the NIR falls significantly short of that specified in the UNFCCC reporting guidelines. In its response to the draft of this report, Denmark explained that the emission factors reported in the NIR are those from the CORINAR system. These might not be in agreement with the implied emission factors calculated in the CRF tables.

2. Cross-cutting issues

Institutional arrangements

17. Institutional arrangements were not addressed by the desk review. Some information is included in the section on LUCF.

Record keeping

18. No assessment of record keeping was made during this desk review.

Verification and quality assurance/quality control (QA/QC) approaches

19. Denmark has no formal QA/QC procedures for the inventory. Some QC is performed, however, although QA with independent review of the inventories has not yet been carried out and the NIR does not elaborate on activities carried out or on the methods used.

Recalculations

20. Some recalculations are reported for the years 1990 to 1998. For the base year 1990, CO_2 emissions were increased by 0.29%, CH_4 emissions were increased by 0.07% and N_2O emissions were increased by 1.73%. For the year 1995, recalculated emission data for HFCs, PFCs and SF_6 are significantly lower (48%, 100% and 23%) compared to previously reported ones. Explanatory tables on recalculations (table 8(b)) have not been completed but the NIR provides some explanation.

Uncertainties

21. Uncertainties are provided for total GHG emissions only (23%) and are calculated according to the methodology provided in Annex I of the IPCC Guidelines. Sensitivity analysis reveals the huge uncertainty relating to N_2O emissions from agricultural soils. Uncertainties are not provided for individual sectors, subsectors or GHGs.

3. Areas for further improvement

Planned or ongoing work by the Party

22. The following is planned by Denmark with respect to future inventories:

(a) Allocation of bunker fuels relating to transport between Denmark, Greenland and Faroe Islands;

(b) Independent review of the inventories.

23. The ERT encourages Denmark to implement and report on both of these.

Issues identified by the ERT

24. The ERT found that the inventory from Denmark needs some further improvement in addition to the improvements relating to transparency already indicated in paragraphs 14 to 16 above.

25. The ERT recommends that Denmark addresses the elements mentioned in paragraphs 14 and 15 in future NIRs, makes more use of explanatory notes and provides in the future more comprehensive information as specified in the CRF.

26. The ERT encourages Denmark to implement fully the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (hereinafter referred to as the IPCC good practice guidance) which Annex I Parties should apply as far as possible for their inventory submissions of 2001.[11]

27. *Verification*: The ERT encourages Denmark to consider implementing and reporting a formal system of verification for the whole national inventory, consistent with the IPCC Guidelines and the good practice guidance. This will help to overcome some existing inconsistencies and gaps in the current inventory.

28. *Methodologies*: Denmark is encouraged to consider developing, where appropriate, tier 2 approaches for key source categories.

29. *Emission factors*: A number of key source emission factors were derived some years ago. Denmark may wish to consider a review of some emission factors, particularly those obtained from the *Joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook* to reflect recent research or technological developments as well as national circumstances, for example in the case of emission factors for HFCs, PFCs and SF_6 (see paragraph 98) and for manure management (see paragraph 120).

30. *Reporting:* Denmark may wish to consider including in its NIR (i) an executive summary summarizing emissions profiles for Denmark, emissions trends and any major developments since the last report and (ii) a summary at the beginning of each section describing emissions profiles and trends. This is not a requirement of the IPCC or UNFCCC guidelines but would aid understanding of national circumstances. In addition, the ERT noted that the information reported in both the CRF and the NIR should be consistent, and that notation keys should be used according to the guidelines' requirements.

31. *Completeness:* Denmark may wish to consider in its future inventories some minor sources missing in the current inventory. These sources include feedstocks, and field burning of agricultural residues. Denmark explained in its response to the draft of this report that field burning was forbidden by law in 1989 and that this source is, therefore, considered to be negligible.

32. *Consistency*: Denmark may wish to eliminate some inconsistencies relating to the reporting of emissions of HFCs, PFCs and SF_6 in table 2(I) and table 2(II) and Summary 1.A as well as with respect to livestock numbers.

[11] According to the conclusions of the SBSTA at its twelfth session, the IPCC good practice guidance should be applied by Annex I Parties as far as possible for inventories due in 2001 and 2002 and should be used for inventories due in 2003 and beyond.

4. Consistency with the UNFCCC reporting guidelines and the IPCC Guidelines

33. The 2001 NIR and CRF were only partly consistent with the IPCC Guidelines and UNFCCC guidelines for estimating and reporting emissions. The IPCC Guidelines, CORINAIR methodologies and country-specific methodologies were used to estimate emissions. Most inconsistencies relate to poor reporting in the 2001 NIR which reduces transparency significantly.[12] Apparently the IPCC good practice guidance had not yet been implemented. In its response to the draft of this report, Denmark informed the ERT that some elements of the IPCC good practice guidance had already been applied for the 2002 inventory submission.

5. Conclusion

34. The ERT considers that in its 2001 inventory submission (NIR 2001 and the CRF tables 1990-1999), Denmark has provided to the COP only partially adequate information on its GHG inventory and GHG emission trends.[13]

II. ENERGY

A. Sector overview

35. The energy sector is by far the most important source of GHGs in Denmark. This sector accounts for 79% of total GHG emissions in 1999 and it gives rise to 97% of all CO_2 emissions in the country (without CO_2 from LUCF). Approximately 94% of all CO_2 emissions and 74% of total GHG emanate from four key source categories in this sector (stationary combustion of coal, oil and gas, and energy use in road transport).

36. For policy purposes, Danish emissions of GHG are adjusted to account for electricity exchange and annual temperature variations. The amount of electricity exchange is highly variable from year to year and this masks the underlying trend in emissions associated with energy industries. The 1990–1999 time series shows unadjusted CO_2 emissions in 1999 to be 4% higher than in 1990, but adjusted emissions decreased by 8% over the same period. While CH_4 and N_2O together account for a very small proportion of GHG emissions from the energy sector, CH_4 emissions doubled between 1990 and 1999 and N_2O emissions increased by almost 50%. The review described here relates to unadjusted emissions as reported in accordance with the UNFCCC reporting guidelines. In its response to the draft of this report, Denmark explained the increase in CH_4 emissions as owing to an increased use of natural gas for energy production; the increase in N_2O emissions is explained as due to an increase in the use of catalysts in cars.

1. Completeness

37. The energy sector of the Danish inventory is well covered with respect to IPCC source categories and all gases relevant to this sector. Fugitive emissions are adequately covered and the required reporting is performed in relation to international bunkers. The review noted that there is no breakdown for individual industries in subcategory 1.A.2. Manufacturing industries and construction. The CRF contains information for Denmark only but the additional emissions

[12] The ERT acknowledges, however, that a more comprehensive NIR was submitted in 2000; that NIR has not been subject to this review, as described in paragraph 4 and footnote 3 above.

[13] The ERT takes note of the communication from Denmark in which the Party explains that the 2000 NIR (Illerup et al. 2000), contains information relating to methodological issues that was not provided in the 2001 NIR. As explained in paragraph 4 above, the 2000 NIR has not been reviewed during this desk review.

emanating from other Danish territories (Greenland and the Faroe Islands) are reported in the totals given in the NIR. With regard to data for subcategory 1.A.2, Denmark explained in its response to the draft of this report that the Danish energy statistics do not include data according to the required breakdown into individual industries; improvements in this regard are, however, being considered.

2. Methodologies, activity data and emission factors

38. The CORINAIR methodology and associated software products, developed by the European Environment Agency, are used to compile, report and archive all emissions inventories in Denmark. The CRF tables for UNFCCC reporting are obtained by importing the activity data and the computed emissions data from the CORINAIR database. The energy statistics are official data (on a net calorific value (NCV) basis) supplied by Statistics Denmark. The NIR provides a list of emission factors used in Denmark for all gases covered by the CRF tables on energy. Country-specific values are mainly used for CO_2, SO_2 and NO_X in categories 1.A.1 and 1.A.2 while factors for the other gases are based largely on the CORINAIR defaults.

3. Recalculations

39. Danish inventories have been recalculated for the years 1990 to 1998. The NIR gives an outline of the work done and recalculated data are provided in table 8(a) of the CRF tables for these years. However, the explanatory tables on recalculations (table 8(b)) have not been completed. The NIR describes recalculations in the energy sector applying mainly to the various transport emission sources, including the use of bunker fuels. These recalculations take account of updated energy consumption in road transport and air traffic where a detailed application of CORINAIR emission factors is undertaken. From table 8(a) it can be seen that recalculations for the energy sector have had the most notable effect on N_2O where emissions from the sector have increased by 20 to 25% of previous estimates. The greatest changes occurred in sectors 1.A.2 and 1.A.4.

4. Uncertainties

40. The Danish NIR states that the overall uncertainty in GHG emissions has been estimated at 23%, based on the methodology provided in the IPCC Guidelines. No information is provided on the individual component uncertainties, relating to activity data and emission factors in the principal relevant sectors, which are combined to give this estimate. There is therefore no quantitative estimate available regarding uncertainty in emissions from the energy sector. In its response to the draft of this report, Denmark informed the ERT that its work on improving the uncertainty estimates is ongoing, using the IPCC good practice guidance.

5. Adjustments

41. Also, CO_2 emissions data adjusted for electricity exchange and temperature variations are reported in the CRF. However, the NIR does not describe the methods used to determine the amounts of adjustment.[14]

[14] Denmark informed the ERT that this information was provided in the 2000 NIR, appendices 9 and 10. See also paragraph 4 and footnote 3.

6. Conformity with the UNFCCC reporting guidelines and the IPCC Guidelines

42. The CORINAIR methodology for emissions inventories is widely accepted as being fully compatible with the IPCC Guidelines for estimating GHG emissions, and the results are readily converted to CRF format. In this context, emissions from energy sources in Denmark are considered to be compiled and reported in substantial compliance with the UNFCCC reporting guidelines. The omission of indicators and explanatory notes in the sectoral background data tables contributes to a lack of transparency in the inventories. For this sector, there appears to be relatively little specific application to date of the IPCC good practice guidance.

43. The NIR refers to CORINAIR and the associated CORINAIR/EMEP Atmospheric Emission Inventory Guidebook as the principal reference regarding methodology and emission factors. However, such reference in itself does not ensure transparency and comparability in the absence of information on important assumptions or the particular national circumstances relating to fuel types, activity data and emission factors for individual subsectors. Other key items of information missing from the NIR include calculation sheets, CO_2 emissions estimated according to the reference approach, uncertainty estimates and a description of QC activities.

B. Reference and sectoral approach

1. Comparison between reference and sectoral approach

44. Emissions of CO_2 according to the reference approach (table 1.A(b)) are not included in the CRF. Comparison with the results from the sectoral approach is not possible and national energy data cannot be compared with International Energy Agency (IEA) energy data. The NIR gives no reason for the omission of table 1.A(b). Emissions from military aviation are included in the 1990-1999 series, according to the NIR, but it is not clear where the values occur in the CRF. In its comment on the draft of this report, Denmark informed the ERT that the reference approach had not been provided due to software problems in transferring data from CORINAIR into the CRF. Denmark also explained that military aviation is included under 1.A.5 “Other”.

2. Treatment of feedstocks and non-energy use of fuels

45. No information is provided on feedstocks or the non-energy use of fuels. The NIR states that national energy statistics do not contain this information.

3. International bunker fuels

46. The emissions form international bunker fuels are fully covered and they are reported in accordance with the UNFCCC reporting guidelines. Air traffic was treated in detail under this heading in the recalculated time series for 1990-1998, resulting in improved accounting for domestic and international cruise traffic.

47. The amount of jet kerosene used in international aviation, reported by IEA for 1999, is 2.6% greater than that reported in the CRF. The deviations observed in international marine transport are slightly greater, reaching 8.2% for residual oil and –7.2% for diesel.

C. Key sources

1. Stationary combustion: oil, gas and coal – CO_2

48. Stationary combustion sources using coal, oil and gaseous fuels accounted for 74% of total Danish CO_2 emissions in 1999 and for 58% of total aggregate GHG emissions. This represents only a marginal change from the situation in 1990 but there has been a notable increase in the contribution from gas while those from coal and oils have decreased. The CORINAIR methodology is used to estimate emissions from these key sources using official energy data from Statistics Denmark. Country-specific emission factors appear to be used for CO_2 while CORINAIR default values are used in the case of CH_4 and N_2O.

Stationary combustion: coal

49. The combustion of coal was a major source of CO_2 in 1999, accounting for 34% of the total from fuel combustion and for approximately one quarter of the total GHG. However, this was a significant reduction on the contribution of coal to emissions in 1990, when 35% of total GHG emanated from coal combustion. The bulk of coal consumption occurs in electricity generation but some coal is used in all stationary combustion sources. The S&A report showed that the same CO_2 emission factor of 95 kg/TJ was used for all years in the 1990-1998 series. This present review found that this value also applies across all sectors, which is unusual.

Stationary combustion: liquid fuels

50. Liquid fuels remain an important source of emissions in all stationary combustion sources but their contribution is decreasing. The review notes the rather low implied emission factors (IEFs) for CO_2 for liquid fuels in energy industries, subsectors 1.A.1(a) and 1.A.1(b), which generally lie in the range 45-60 kg/TJ throughout the 1990-1998 time series. These are substantially lower than the IEF for liquid fuels in other stationary combustion sources where the values are close to defaults and which are similar to those of other Annex I Parties. The low values are not consistent with the CO_2 emission factors listed in the NIR. Denmark explained in its response to the draft of this report that plastic in waste used for energy production is included in this category (see NIR 2000, appendix 12), which results in a reduction of the "combined" (implied) emission factor compared to the fuel emission factor reported in the CORINAIR database.

51. There is considerable variation in some of the IEFs for a number of sector/fuel combinations in later years of the time series and they point to inconsistencies between the values given in the CRF and those listed in the NIR. The value for CO_2 for liquid fuels under subsector 1.A.4(a) reduced from 74.58 t/TJ in 1994 to 68.15 t/TJ in 1995 with further decreases to around 65 t/TJ in 1996 and 1997. The IEF increased again to an expected value of 74.3 t/TJ in 1998 but it decreased once more to 64.06 t/TJ in 1999. Denmark explained, in its response to the draft of this report, that emission factors for 1999 only were given in the NIR. Further, an implied emission factor originates from several activities included in the database, which show variations in activity rates and in the use of fuel types during the time series 1990-1999. Denmark also informed the ERT that documentation on this matter will be part of future reporting.

Stationary combustion: gaseous fuels

52. In common with many Annex I Parties, the contribution by gas to GHG emissions is increasing in Denmark. Emissions of CO_2 from the combustion of gas in energy industries increased almost three-fold from 1990 to 1999 and by 100% in manufacturing industries. Apart from a few exceptions noted below, there is good consistency in the use of emission factors for gaseous fuels across the subsectors and they conform to the values presented in the NIR. These values also compare well with those used in other Annex I Parties.

53. The IEF for CO_2 from gaseous fuels in 1.A.4(a) is the second lowest estimated among all reporting Parties, while the respective IEF in 1.A.4(c) is the lowest. In both cases, the IEF is less than 50 t/TJ.

2. Fuel consumption by road traffic

54. There has been a steady increase in the emissions of GHG from this source category since 1990. The emissions of CO_2 increased by 21% from 9,337 kt in 1990 to 11,323 kt in 1999. Over the same period, N_2O emissions increased from 400 tonnes to 1,410 tonnes. Road transport accounted for 16% of total GHG in Denmark in 1999. The emission factors for gasoline and diesel use in road transport are consistent over the time series and the CO_2 emission factors are similar to IPCC default values.

D. Non-key sources

1. Stationary combustion

55. The IEF for CH_4 for gaseous fuels under subsector 1.A4(a) increased from 5 kg/TJ in 1997 to 30.57 kg/TJ in 1998 and further to 80.49 kg/TJ in 1999. Similarly in this subsector, the IEF for CH_4 from biomass increased from 74.21 kg/TJ in 1997 to 177.32 kg/TJ in 1998. In subsector 1.A.4(c), the IEF for CH_4 for gaseous fuels increased from 5 kg/TJ in 1997 to 157 kg/TJ in 1998 and to 281.68 kg/TJ in 1999. Conversely, the IEF for CO_2 was reduced from the typical value of 56.84 t/TJ used up to 1997 to 42.3 t/TJ in 1998 and further to 30.42 t/TJ in 1999, which is the lowest value estimated among all reporting Parties.

56. The review notes that emissions from the combustion of liquid fuels appear in the CRF under sector 1.A.5 for all years 1990-1999 but there are no associated activity data and hence no IEFs. The ERT assumes that this may be due to incomplete transfer of information from the CORINAIR database to the CRF, which was confirmed by Denmark in its response to the draft of this report. This problem has been solved in the 2002 submission. Furthermore, it is unclear whether the emissions included here relate to military use of fuel, which the NIR states has been separated from other aviation as part of the recalculations for Denmark; these emissions reported under 1.A.5 were, however, confirmed by Denmark as being from military use of fuels (see also paragraph 44 above). A similar problem (no activity data or IEF) occurs for gaseous fuels for subsector 1.A.1(c) in 1994. The activity data and IEF do exist under this entry in 1995 but the IEFs are clearly anomalous.

57. Emissions relating to solid, gaseous or biomass fuels appear under subsector 1.A.4(c) in all years except 1994. There is no indication as to the share of emissions among individual subsectors under manufacturing industry and construction because only aggregated emissions are

provided in the CRF. With regard to missing data for 1994, Denmark informed the ERT in its response to the draft of this report that this mistake had been corrected in the 2002 submission.

E. Areas for further improvement

1. Planned or ongoing work by the Party

58. The Danish NIR provides little information on planned improvements on inventories. It does state that further work will be undertaken to quantify marine and aviation emissions due to traffic between Denmark and other Danish territories (Greenland and the Faroe Islands) so that they can be separated from international bunkers and instead assigned to national emissions. Future work will also detail how formal QA/QC procedures will be implemented.

2. Issues identified by the ERT

59. This ERT has identified the need for improvements in several areas. The key issue is obviously the achievement of a much more complete CRF time series by providing those tables currently left unfilled. The import procedure used to obtain the basic CRF tables from the CORINAIR database should be investigated in order to ensure that all data are successfully converted. A reappraisal of the CO_2 emission factors is needed for liquid fuels in energy industries in all years of the available time series and also for both CO_2 and CH_4 emission factors for gaseous fuels under 1.A.4 Other sectors in later years. The reasons for the significant year-to-year variations in these later years need to be explained. Information on activity data and emissions specific to the various subsectors under 1.A.2 Manufacturing industries and construction could benefit both the inventory process and the review process. See also paragraph 51 for comments provided by Denmark on this matter.

III. INDUSTRIAL PROCESSES

A. Sector overview

60. In 1999, industrial processes emissions account for 2.9% of the total CO_2 equivalent, greater than in 1990, 1.5%. Emissions of CO_2 are 66.2% of the CO_2 equivalent emissions in industrial processes in 1999, with cement production being responsible for 92.4% of this CO_2.

61. In the period 1990 to 1999, the increase of industrial processes CO_2 equivalent emissions was 102%, due mainly to fluorinated gases (emissions due to cement production increased by 39% in the same period). It is worth noting that the whole CO_2 equivalent emissions increase in Denmark was 4.3%.

1. Completeness

62. Based on international data (UN data) made available to the ERT, Denmark's CRF covers all important sources, although no CRF is presented for Greenland and the Faroe Islands.

2. Consistency

63. The CRF was provided from 1990 to 1999, using the same methodology.

3. Recalculations

64. No recalculations were made for industrial processes.

4. Transparency

65. It is not clear for all subsectors when CORINAIR or IPCC methodology is used.

5. Comparability

66. Due to lack of detailed information on the methodology used (i.e. it is not clear for all subsectors when CORINAIR or IPCC methodology is used), the comparability of emissions from industrial processes among Parties could not be adequately assessed for all subsectors.

6. Methodology, emission factors and activity data

67. CORINAIR methodology is generally used. In some cases, parts are taken from the IPCC Guidelines. For HFCs, PFCs and SF_6 the methodology is country-specific.

68. The NIR says that the most consistent emission factors have been used, either as measured values or default factors proposed by the CORINAIR methodology.

69. Activity data is based mainly on official statistics.

B. Specific findings

1. 2.A Mineral products

70. From 1990 to 1992 and from 1996 to 1997 there are great variations in CO_2 emissions originating from the cement industry. In its response to the draft of this report, Denmark explained that the data are based on reports from industry.

71. 2.A.2 Lime production: The IEFs for CO_2 reported for most years (7 years) are the second lowest compared to other Parties (0.20 - 0.29 t/t); the IPCC default ranges from 0.79 to 0.91t/t. The values reported for the years 1994, 1995 and 1996 are around 0.56 t/t. In its response to the draft of this report, Denmark explained that there are two activities in the CORINAIR database which contribute to this IPCC activity, the production of lime and the production of brigs. The activity rate is therefore a sum of burnt lime and brigs produced, and the implied emission factor is a "mixture" reflecting different trends in these productions. The emission factors used for lime and brigs are consistent through the time series and refer to the IPPC Guidelines and national circumstances.

2. 2.B Chemical industry

72. 2.B.1 Ammonia production: The Party did not report any CO_2 emissions associated with ammonia production although according to UN data there is ammonia production in Denmark.

73. 2.B.2 Nitric acid production: There are activity data only in 1990 and from 1994 to 1996, almost always the same figure of 400kt.

74. 2.B.5 Others (not specified): There are activity data only in 1990 and from 1994 to 1996, almost always the same figure of 100kt.

75. In both cases (Nitric acid production and Others), no emissions are assessed.

3. 2.C Metal production

76. 2.C.1 Steel production: There are activity data only in 1994 and 1995, with no related emissions.

77. 2.C.5 Others (not specified): There are activity data only in 1990 and from 1997 to 1998, with no related emissions.

C. Key sources

1. 2.A.1 Cement production – CO_2 (1.8% level assessment; 2.0% trend assessment)

78. CO_2 IEF was the second highest amongst Parties (from 0.54t/t from 1990 to 0.533t/t in 1999). It was not reported whether data were for cement or clinker, although the value is still higher than the IPCC default for clinker (0.507t/t) and that of the IPCC good practice guidance (0.526 t/t). In its response to the draft of this report, Denmark explained that data are based on reports from industry.

79. There is a high relative change in CO_2 emissions from 1990 to 1991 (23.2%) as compared to other years, and in 1999 emissions are 46.7% higher than in 1990. In its response to the draft of this report, Denmark explained that data are based on reports from industry.

D. HFCs, PFCs and SF_6

1. Overview

Completeness

80. Emissions of HFCs, PFCs and SF_6 are presented in the CRF tables and commented on in the NIR.

81. Some (probably less significant) HFCs/PFCs sub-sources are omitted without explanation.

82. As appears from the country's NIR (main text and Appendix 1.2), geographic coverage is not quite complete; HFCs, PFCs and SF_6 emissions remain not estimated for Greenland and the Faroe Islands. (Denmark apparently omitted to indicate the lack of full geographic coverage regarding HFCs, PFCs and SF_6 in table 11 of the CRF.)[15]

83. The CRF table Summary 3 (Summary report for methods and emission factors used), table 7 (Overview table for national GHG inventories) and table 9 (Completeness) have not been completed.

84. The emission trends of individual HFC species are presented for the 1992-1999 period (CRF table 10). Zero emission values are included for the years 1990 and 1991.

[15] See footnote 8 for information provided by Denmark in its comments to the draft review report with respect to geographical coverage.

85. Zero emission values for individual PFC species are presented in the CRF table 10 for the 1997-1999 period. Zero emission values are shown for the years 1990-1996.

86. With regard to the observations in paragraphs 84 and 85 above, Denmark informed the ERT, in its response to the draft of this review report, that in future submissions it would elaborate further on the reporting of these estimates.

87. The NIR does not suggest plans for improving completeness of HFCs, PFCs and SF_6 in the future.

Consistency

88. Tables provided are consistent with the UNFCCC reporting guidelines and the CRF.

89. CRF table 10 (Emission trends) and comments in the country's NIR indicate time-consistency of HFC, PFC and SF_6 estimates; description of methodologies and background data is, however, necessary to confirm it.[16]

90. Some data presented in the individual CRF tables are not reflected in the sectoral report and summary report tables.

Recalculations

91. Recalculations are provided for the years 1990-1998. The difference from the results of previous HFCs, PFCs and SF_6 estimates is well within 20%.

92. The NIR mentions the use of the updated emission factors for recalculations based on the CORINAIR guidebook. According to comments made by Denmark on the draft review report, this is not the case for emissions of HFCs, PFCs and SF_6.

93. No detailed explanations regarding recalculations of HFCs, PFCs and SF_6 estimates (methodology, etc.) are included in the NIR (see also footnote 16).

Transparency

94. Transparency is ensured, mainly, by referring in the country's NIR to the CORINAIR methodologies, databases and emission factors. It should be improved by provision of more detailed explanations and completion of the appropriate CRF tables.

95. No indicators are used in the CRF tables to explain gaps.

Comparability

96. A lack of activity data and emission factors, in the NIR, and limited information on methodologies decreases the level of general comparability.

Methodology

97. The country's NIR provides a general description of the approach and the steps taken to estimate HFCs, PFCs and SF_6 emissions. Methodologies from the IPCC Guidelines (IPCC tier 1 and tier 2) were used to estimate emissions of HFCs, PFCs and SF_6. Neither the CRF nor the NIR provides further details (see also footnote 16).

[16] In its comments to the draft of this report, Denmark informed the ERT that a report describing methodologies and background data (albeit in Danish) could be made available upon request.

Emission factors

98. No information on the emission factors of HFCs, PFCs and SF_6 is presented in the CRF tables. The country's NIR indicates that detailed information on the emission factors can be made available in electronic copy on request. As is mentioned in the NIR, "the most consistent emission factors have been used, either as measured values or default factors proposed by the CORINAIR methodology". There is no evidence of the use of country-specific emission factors in the NIR (see also footnote 16).

99. IEFs are not calculated.

Activity data

100. No information on the HFCs, PFCs and SF_6 emission-related activities is included in the CRF tables. It is indicated in the country's NIR that detailed information on activity data can be made available in electronic copy on request.

101. Results of the special study carried out by the Danish company COWIconsult were used in the HFCs, PFCs and SF_6 data collecting process.

Verification and QA/QC approaches

102. No special information on the HFCs, PFCs and SF_6 verification procedures is provided. The country's NIR presents no specific comments concerning QA/QC aspects of the HFC, PFC and SF_6 inventory or other cross-cutting issues.

Good practices

103. No special information on the application of good practices to the HFCs, PFCs and SF_6 emission estimates is provided; however, ways of data collecting described in the country's NIR (using the results of a special study, personal communication with the author) are in line with the IPCC good practice guidance.

Uncertainty

104. Uncertainties in HFCs, PFCs and SF_6 estimates are not addressed in the country's inventory.

Improvements

105. The country's NIR does not suggest future improvements to the HFCs, PFCs and SF_6 inventory.

2. Specific findings

Production and consumption of HFCs, PFCs and SF_6

106. In general, good work has been done in estimating HFC, PFC and SF_6 emissions, although, some problems were detected in reporting emissions and providing background information**.**

107. Emissions reporting problems are:

(a) There are uncompleted blank cells in the CRF 2(I) and 2(II) sectoral report tables;

(b) No potential emissions of HFCs, PFCs and SF_6 reported in CRF table 2(I) are mentioned in table 2 (II) Sectoral report for industrial processes – emissions of HFCs, PFCs and SF_6. Vice versa, actual SF_6 emissions from metal production (2C), and consumption of halocarbons and SF_6 (2Fa) presented in the table 2(II) are lacking in table 2(I) and Summary 1.A;

(c) Ratios of potential/actual emissions in CRF table 2(II) are inconsistent with data in table 2(I) and Summary 1.A;

(d) Reporting of HFC, PFC and SF_6 emissions can be improved by filling in CRF tables 7 and 9;

(e) Reporting of background information on HFCs, PFCs and SF_6 can be improved by filling in CRF tables 2(II).F and Summary 3, and including more detailed explanations in the NIR.

3. Key sources

108. ODS substitutes are responsible for 0.9% of the total 1999 GHG emissions. This source category is identified as a key source on the basis of the level assessment.

4. Questions and issues from previous review stages

109. Improvements in geographic coverage (a problem which was mentioned in the IDR of the country's NC2) do not affect HFC, PFC and SF_6 emissions.

IV. AGRICULTURE

A. Sector overview

110. Denmark's inventory submission conforms to the UNFCCC reporting guidelines and with the IPCC Guidelines. Denmark has provided the following information required by the COP:

(a) A NIR and a set of CRF tables;

(b) Disaggregated estimates of all GHGs and sources not controlled by the Montreal Protocol, using methods that are consistent with the IPCC Guidelines;

(c) Complete time series for all sources and all years (1990-1999);

(d) A description of the methodologies used to calculate emissions and removals;

(e) References for sources of information relating to emission factors and activity data and the rationale for their selection;

(f) A status report with inventory data for the 1990 to 1999 period, covering the sector and the following direct GHGs: CH_4 and N_2O;

(g) General information on estimates of uncertainties for most source categories.

111. The submission to the UNFCCC secretariat by Denmark covered all subsectors and the following direct GHGs: CH_4 and N_2O. The submission contains total emissions for Denmark, Greenland and the Faroe Islands for 1990 to 1999. However, it has not been possible to present a

complete inventory in the CRF. Information on Greenland and the Faroe Islands inventories are given separately.

112. CH_4 from enteric fermentation in domestic livestock, direct N_2O emissions from agricultural soils, and indirect N_2O from nitrogen used in agriculture were estimated.

113. Emissions from the agricultural sector were estimated using IPCC Guidelines, CORINAIR methodologies and country-specific methodologies. Most inconsistencies relate to poor reporting in the 2001 NIR which significantly reduces transparency. In its response to the draft of this report, Denmark referred to its 2000 NIR, where information on methodologies had been provided (see also paragraph 4 and footnote 3).

114. In the preparation of Denmark's annual emission inventories some QC is performed. QA with independent review of the inventories has not yet been carried out. Good practice guidance on QA/QC was not completely achieved.

Trends

115. The submission by Denmark shows a decrease in CH_4 emissions from 192.86 to 168.31 Gg and N_2O emissions from 33.09 to 27.44 Gg over the 1990-1999 period.

B. Key sources

1. 4.A Enteric fermentation – CH_4

116. Denmark reported emission estimates of CH_4 from enteric fermentation for dairy and non-dairy cattle, sheep, horses and swine. The overall picture shows a slight decrease in emissions for the agriculture sector.

2. 4.B Manure management – CH_4 and N_2O

117. Emission estimates of CH_4 and N_2O from manure management were reported for dairy and non-dairy cattle, sheep, horses poultry and swine.

Methodology

118. There is a lack of information as to which methodology was applied to estimate CH_4 emissions from enteric fermentation and manure management. In its response to the draft of this report, Denmark referred to its 2000 NIR, where information on methodologies had been provided (see also paragraph 4 and footnote 3).

Recalculations

119. CH_4 and N_2O emissions were recalculated for 1990 to 1999.

Activity data and emission factors

120. Activity data were provided by official statistics. Most consistent emission factors came from default emission factors proposed by the CORINAIR methodology or experiments.

Completeness

121. CH_4 from enteric fermentation and manure management from livestock classes other than cattle, sheep, swine, horses and poultry was not estimated. The livestock classes recorded covers the most significant emissions. Only population size and IEFs were reported.

Uncertainty

122. The factors controlling CH_4 emissions are not well understood. Uncertainties are not estimated.

3. 4.D Agricultural soils – N_2O

123. N_2O emissions from agricultural soils are estimated for:

(a) non-organic soils (synthetic fertilizer use, spreading animal waste as fertilizer, nitrogen fixing in soils and crop residues left on fields);

(b) direct N_2O emissions from organic matter;

(c) manure deposited by grazing livestock on pasture ranges and paddocks;

(d) N_2O emitted indirectly through fertilizer and animal waste spread on agricultural soils, and;

(e) N_2O emitted indirectly from atmospheric deposition, and agricultural soils through leaching and run-off. N_2O estimates are the totals of all these source categories.

Methodology

124. There is a lack of information as to which methodology was applied to estimate N_2O emissions from agricultural soils. In its response to the draft of this report, Denmark referred to its 2000 NIR, where information on methodologies had been provided (see also paragraph 4 and footnote 3).

Recalculations

125. Denmark has recalculated its estimates of CH_4 and N_2O for the years 1990 to 1999 but the effect of the recalculations was not clearly identified. Table 8b on explanatory information was not provided.

Activity data and emission factor

126. The assumptions used to perform the GHG inventory in the agricultural sector were documented and reported in the CRF. Assumptions underlying the emission and removal estimates were related to the activity data and emission factor used.

Completeness

127. Estimates of emissions on field burning of agricultural residue are not included in Denmark's submission. In its response to the draft of this report, Denmark explained that no estimates for burning of agricultural residue were included in the inventory because field burning was forbidden by law in 1989 and that the source is therefore considered to be negligible.

Uncertainty

128. In the agriculture sector, uncertainties on N_2O emissions from agricultural soils were addressed through sensibility analysis, and the values were huge.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

129. The LUCF sector constitutes a net sink, which in absolute terms, is equivalent to 1.3% of Denmark's total 1999 GHG emissions. Changes in forest and other woody biomass stocks constitute in 1999 a reported sink of CO_2 of 976 Gg. Denmark used a country-specific methodology for estimating the changes in forest and other woody biomass stocks.

1. Institutional arrangements

130. The GHG inventory in the LUCF sector is a part of the NIR and CRF tables have been prepared by Denmark's National Environmental Research Institute within the Ministry of Environment and Energy. Other governmental authorities providing data for the LUCF sector were Statistics Denmark and the National Forest and Nature Agency.

2. National self-verification and QA/QC

131. The NIR includes generalised information on QA/QC. This, however, was not sufficiently specific to determine whether it was applied to the LUCF sector. The NIR also notes that the IPCC has developed guidance on good practice. This does not as yet, however, extend to the LUCF sector.

3. Completeness

132. In terms of geographical coverage it is noted (based on information provided in appendix 3 of the NIR and comments by Denmark on the draft of this report) that the LUCF sector estimates nominally do not include Greenland and the Faroe Islands (see also footnote 8). The ERT proposes to state this clearly in appendix 3 which deals specifically with these external territories. However, LUCF activities, if any, in both these external territories are likely to be minimal.

133. Within the LUCF sector, estimates of emissions for Changes in Forest and Other Woody Biomass Stocks (for temperate forests) are only reported as in CRF table 5: Sectoral report for LUCF. Tables 5.A, 5.B, 5.C and 5.D were not utilized. Table 5.A could have been completed for Denmark even though a country-specific method was used. It is noted that Denmark was able to supply similar information to what is required in this table to the UNECE/FAO Temperate and Boreal Forest Resources Assessment 2000 in 1998.

134. It is noted that no notation keys were used for the following source and sink categories for which no numerical data has been provided in table 5 (because it was either too small or not estimated): Forest and grassland conversion, Abandonment of managed lands, CO_2 emissions and removals from soil and Other. In its response to the draft of this report, Denmark informed the ERT that notation keys had been used in the 2002 submission.

4. Transparency and use of indicators

135. The NIR appendix 5: *Methodology regarding removals by sinks* describes how the reference values used in the calculations for the LUCF sector were derived. It explains the use of a Danish-specific expansion factor of 2.0 as being slightly higher than the IPCC default factor of 1.9 and that this results in slightly lower C stores than when using the IPPC expansion and conversion factors. The rationale for this choice appears reasonable.

136. The annual CO_2 sequestration figure of 916 Gg due to net increment in forests existing prior to 1990 has been carried unchanged through the period 1990–1999 and the NIR remarks that the basis for calculating this was unsatisfactory. If more recent forest inventories had been conducted than the reference one (1990) this assumption of the net increments remaining constant could have been verified. Denmark recognized that this was a problem with the estimates.

137. The annual CO_2 sequestration by afforestation of former arable land has been estimated based on government and private afforestation rates and assumptions which are explained in the appendix.

138. Indicators have not been used in the CRF tables for the LUCF sector.

5. Recalculations

139. Recalculations of emissions and removals for the LUCF sector were reported for the years 1991-1998; these were due to minor updates in the LUCF data.

6. Uncertainties

140. The NIR does not specifically discuss uncertainties in the estimates for the LUCF sector.

7. Consistency with the UNFCCC reporting guidelines and the IPCC Guidelines

141. The LUCF sector for Denmark can be regarded as broadly consistent with the IPCC Guidelines and UNFCCC reporting guidelines (see also paragraph 152 below).

B. Specific sources and sinks

1. 5.A Changes in forests and other woody biomass

142. Changes in forests and other woody biomass constitute a sink of CO_2 equivalent to 1.3% of Denmark's total 1999 GHG emissions. The estimates for LUCF are consistent throughout the 1990 to 1999 period, with minor fluctuations in the proportion they contribute to total GHG emissions as other sectors (particularly energy) have changed in magnitude.

Methodology

143. Appendix 5 to the NIR describes the methodology used by Denmark in estimating removals by sinks. It is noted that a new sample-based forest inventory was being planned to replace the questionnaire-based approach to forest owners but this will not become available until 2001.

Activity data

144. The main source of activity data for afforestation is provided by the National Forest and Nature Agency based on government records. Table 5.A was not used in the CRF.

Conversion factors and IEFs

145. Conversion factors and IEFs are not reported for the LUCF sector in the CRF format. CO_2 emissions are not reported as gross emissions. The CO_2 removals are thus assumed to be net emissions in table 5.

2. 5.B Forest and grassland conversion

146. Net emissions from forest and grassland conversion are not reported.

3. 5.C Abandonment of managed lands

147. Net emissions from abandonment of managed lands are not reported.

4. 5.D CO_2 emissions and removals from soil

148. Net CO_2 emissions and removals from soil are not reported.

C. Areas for further improvement

149. Denmark is encouraged to supply a more complete NIR specifically describing how the QA/QC and uncertainty estimates are undertaken for the LUCF sector.

150. Denmark is encouraged to attempt to supply, as a minimum, table 5.A for the LUCF sector even though it uses a country-specific methodology.

151. Denmark should endeavour to develop estimates for the other specific sources within the LUCF sector.

152. With regard to the observations made in paragraphs 149-151 above, Denmark noted in its response to the draft of this review report that explanations as to how the estimates in the LUCF sector (changes in forest and other woody biomass stocks) had been derived were provided in appendix 5 of the NIR. The sources that had not been reported are currently considered to be very uncertain and of minor importance; however, these sources would be considered in the future.

VI. WASTE

A. Sector overview

153. The review is based on the CRF and the NIR. Agreement with the draft S&A report was found.

Completeness

154. The CRF contains only data for managed waste disposal on land. No further information and activity data were provided in the CRF tables.

Trends

155. CH_4 emissions from managed landfill disposal was reduced by 15%, from 62.4 Gg in 1990 to 52.84 Gg in 1999, whereas the reduction in disposed waste was by 54%, from 3,175 Gg to 1,467 Gg within that period. No comment was made on this fact in the NIR. Explanation would need comments on activity data. In its response to the draft of this report, Denmark explained that the emissions were not reduced to the same extent as the amount of waste because the model operated with a time lag in emissions (see also paragraph 156 below).

B. Key sources

1. 6.A Waste disposal on land – CH_4

156. No additional information concerning activity data and characterization of waste are available. In its response to the draft of this report, Denmark informed the ERT that references to the data and model used for waste disposal on land had been provided in the 2002 submission. Denmark also explained that the model was based on data for amounts of waste disposed of on land, which were produced by the Danish Environmental Protection Agency, and that the model used a tier 2 approach with an assumption of a half life of 10 years for the carbon deposited.

C. Non-key sources

1. 6.B Waste-water handling and 6.C Waste incineration

157. No data regarding waste-water handling and waste incineration is found in the CRF. Data reported from “Interessengemeinschaft der Betreiber thermischer Abfallbehandlungsanlagen (ITAD)" show that in 1997, 75% of waste was incinerated in Denmark. Activity data should be provided (see below). In its response to the draft of this report, Denmark informed the ERT that the 2002 submission provided explanations with regard to these matters, indicating that all waste incinerated was used for energy and heat production (this production is included in energy statistics, and hence emissions are included in the energy tables of the CRF under source category 1.A.1.a Public electricity and heat production), and that the Danish waste-water handling systems were considered to produce emissions of only negligible importance.

Methodology

158. There is a lack of numerical data in the CRF and in the NIR. There is no indication of methods and sources. The air emission factors inventory is based on CORINAIR.

D. Areas for further improvement

159. Activity data need to be completed, specifically concerning the description of municipal solid waste disposal, waste composition and efficiency of gas recovery. Data concerning waste-water handling and waste incineration need to be completed.

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