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DENMARK

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN THE YEAR 2004¹

I. OVERVIEW

A. Introduction

1. This report covers the centralized review of the 2004 greenhouse gas (GHG) inventory submission of Denmark, 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. The review took place from 18 to 22 October 2004 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. Newton Paciornik (Brazil) and Mr. Bernd Gugele (European Community), Energy – Ms. Maria Lidén (Sweden), Ms. Tetyana Gordiyenko (Ukraine) and Ms. Karen Treanton (International Energy Agency, IEA), Industrial Processes – Ms. Ionela Draghici (Romania) and Mr. Teemu Oinonen (Finland), Agriculture – Ms. Lilian Portillo (Paraguay) and Mr. Len Brown (New Zealand), Land-use Change and Forestry (LUCF) – Ms. Kathryn Bickel (United States) and Mr. Michael Gytarsky (Russian Federation), Waste – Mr. Oscar Paz Rada (Bolivia) and Mr. Faouzi Ahmed Senhaji (Morocco). Mr. Newton Paciornik and Mr. Michael Gytarsky were the lead reviewers. The review was coordinated by Mr. Javier Hanna (UNFCCC secretariat).

2. In accordance with the “UNFCCC guidelines for the technical review of greenhouse gas inventories from Annex I Parties”, 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.

B. Inventory submission and other sources of information

3. In its 2004 submission, Denmark has submitted a complete set of common reporting format (CRF) tables for the years 1990–2002 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years’ submissions, additional information provided by Denmark in response to the ERT’s questions sent during the review and other information. The full list of materials used during the review is provided in annex 1 to this report.

C. Emission profiles and trends

4. In the year 2002, the most important GHG in Denmark was carbon dioxide (CO₂), contributing 79.1 per cent to total² national GHG emissions expressed in CO₂ equivalent, followed by nitrous oxide (N₂O) – 11.7 per cent, and methane (CH₄) – 8.2 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆) taken together contributed 1.0 per cent of the overall GHG emissions in the country. The Energy sector accounted for 78.9 per cent of total national GHG emissions, followed by

¹ In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year of publication.

² In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO₂ equivalent excluding LUCF, unless otherwise specified.

Agriculture (14.8 per cent), Industrial Processes and Solvent and Other Product Use (4.7 per cent) and Waste (1.6 per cent). Total GHG emissions amounted to 68,491 Gg CO₂ equivalent and were almost at the same level in 2002 as in 1990 (0.4 per cent lower). Total net GHG emissions amounted to 64,678 Gg CO₂ equivalent and had decreased by 1.9 per cent from 1990 to 2002.

D. Key sources

5. As part of its 2004 submission, Denmark has reported a tier 1 level and trend key source assessment. The analysis performed by the Party and the UNFCCC secretariat³ produced slightly different results. The reason for the differences was the more disaggregated categories used by Denmark in the Energy sector (e.g., Mobile Combustion). Although several planned improvements are listed in the NIR, no overall inventory improvement plan using the key source analysis as a basis is described in the NIR.

E. Main findings

6. The NIR submitted by Denmark is broadly in conformity with the UNFCCC reporting guidelines. The methodologies for estimating GHG emissions are generally consistent with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 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 LUCF chapter of the NIR does not follow the outline of the UNFCCC reporting guidelines. A number of improvements have been undertaken since the previous (2003) submission. A strategy for implementing the quality assurance/quality control (QA/QC) plan is now included in the NIR. Nevertheless, some categories are still not reported, as stated in paragraph 7 below.

F. Cross-cutting topics

Institutional arrangements

7. According to the NIR, the National Environmental Research Institute (NERI) under the Danish Ministry of Environment prepares and submits the inventory in cooperation with other ministries, research institutes, organizations and companies, which provide data on a voluntary basis. More formal agreements with these institutions are being worked out.

Completeness

8. In general the ERT found the Danish inventory to be complete. It covers all years from 1990 to 2002 and all six mandatory GHGs. Some sources are not included, as identified in the CRF (e.g., Waste-water Handling, Limestone and Dolomite Use, Soda Ash Use). In addition, in the LUCF category, emissions from abandonment of managed lands and forest and grassland conversion, and CO₂ emissions and removals from soils are not reported. However, the completeness of the reporting has improved with the inclusion of categories that were previously missing (e.g., Nitric Acid Production). Notation keys are used in the CRF tables, but are still missing from some (e.g., tables 5.C, 5.D and 7). In annex 6 to the NIR Denmark reports GHG emissions data for the Faroe Islands (up to 2001) and Greenland (only CO₂ emissions), but these data are not included in the CRF tables.

³ The secretariat had identified, for each individual Party, those source categories which 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. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has performed a key source analysis, the key sources presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key source assessment conducted by the secretariat.

Transparency

9. In general the inventory is transparent. The NIR includes more detail in relation to methods and underlying assumptions than the previous 2003 submission. Better use of the notation keys has contributed to improve transparency.

Recalculations and time-series consistency

10. The ERT noted that the Party has undertaken recalculations of all time series from 1990 to 2001. The largest change resulting from the recalculations in absolute terms is in the estimates for N₂O emissions from agricultural soils (decreases of 15.3 per cent in the figure for 1990 and 19.7 per cent in the figures for 2001) owing to improvements in the estimation of emissions from nitrogen leaching and crop residues. The next-largest change is in the estimates for N₂O emissions from chemical industry as a result of the inclusion of N₂O emissions from nitric acid production, which were previously not reported (1,043 Gg in 1990 and 885 Gg in 2001).

Uncertainties

11. Denmark has applied a tier 1 approach for the estimation of uncertainties for the Energy and Agriculture sectors (although these cover 93 per cent of total national emissions). Uncertainties for the Industrial Processes and Waste sectors are missing, as already highlighted in the 2003 centralized review report. Denmark uses basically default uncertainty estimates from the IPCC good practice guidance. The values for N₂O, although mostly in accordance with the IPCC good practice guidance, are considerably higher than those adopted by other Annex I Parties (e.g., 1,000 per cent for Energy and 500 per cent for Agriculture). If such high levels of uncertainty are assumed, asymmetric and probability density functions should be applied because the variables in question can take on only non-negative values. It should be noted that, in consequence, the use of a tier 2 method is recommended for uncertainty propagation instead of the tier 1 approach. Denmark is also recommended to make efforts to develop country-specific uncertainty values.

Verification and quality assurance/quality control approaches

12. In the NIR, Denmark reports on several QC procedures carried out, such as the checking of results with those obtained using the Selected Nomenclature for Sources of Air Pollution (SNAP) categories and with previous submissions. QA with independent reviewers has not been carried out. A strategy for implementing a QA/QC plan is presented in the NIR, which represents a clear improvement from the last submission, but this plan is yet to be implemented. The ERT noted that the use of the word "verification" in section 1.6.8 of the NIR is not in accordance with the definition established in the IPCC good practice guidance and may be a source of misunderstanding.

Follow-up to previous reviews

13. As recommended in the 2003 centralized review report, information on institutional arrangements is included in the NIR. The use of the notation keys has also improved, although some are still missing. The strategy for implementing the QA/QC plan is now included in the NIR. No improvement has been made regarding the incorporation of GHG inventories for Greenland and the Faroe Islands. Also no improvement has been made on uncertainty analysis, as missing sectors have not been incorporated and no further country-specific estimates have been included.

G. Areas for further improvementIdentified by the Party

14. The NIR identifies several areas for improvement. Among the most important, the Party notes: for the Energy sector, the disaggregation of fuel consumption in the Manufacturing Industries and Construction source category and the updating of energy statistics; for the Industrial Processes sector, the improvement of statistics for lime production and glass production, the investigation of CO₂ emissions from products of

expanded clay, and the improvement of the emission factor (EF) for N₂O from nitric acid production; for the Agriculture sector, the estimation of CO₂ emissions from agricultural soils; and for the Waste sector, the estimation of CH₄ and N₂O emissions from the source category Waste-water Handling.

Identified by the ERT

15. In addition to the issues identified by the Party, the ERT noted the following cross-cutting issues for further improvement: implementation of a QA/QC system in accordance with the IPCC good practice guidance as a follow-up to the strategy presented in the NIR; improvement and extension of the uncertainty analysis by referring to country-specific uncertainty estimates, as far as possible, and by providing uncertainty estimates for all sectors; and the development and documentation of an overall inventory improvement plan on the basis of key source analysis.

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

II. ENERGY

A. Sector overview

17. In 2002, the Energy sector accounted for 78.9 per cent of total national GHG emissions. Fuel combustion emissions contributed 77.9 per cent of total national GHG emissions, and CO₂ emissions from the sector contributed 95.9 per cent of the total CO₂ emissions of Denmark. Total GHG emissions from fuel combustion increased by 2.6 per cent between 1990 and 2002, mainly caused by an increase in the Transport sector. Transport contributed 23.6 per cent of total GHG emissions in the Energy sector. CO₂ emissions from fuel combustion increased by 1.3 per cent between 1990 and 2002, CH₄ emissions increased by 230.3 per cent over the same period, and N₂O emissions increased by 41.0 per cent.

18. The level of disaggregation for the Manufacturing Industries and Construction source category is not in line with the IPCC Guidelines. The ERT noted that Denmark is planning to provide the correct split in its next submission.

19. The Party's reporting in the Energy sector is transparent. Since Denmark carries out a very detailed tier 3 calculation, not all the numbers were available to allow the ERT to replicate the estimates. However, the methodologies are well documented in the NIR. Combustion of waste is reported as biomass for non-CO₂ emissions, and split into biomass and other fuels for CO₂ emissions. To improve the transparency of its reporting, the ERT encourages Denmark to use the same biomass/other fuels split for all gases. Recalculations in the Energy sector are minor and well documented in the NIR.

B. Reference and sectoral approaches

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

20. The differences between the sectoral and reference approaches are compared and explanations are given in the NIR. They are minimal and vary between -1.96 and +1.50 per cent.

International bunker fuels

21. For aviation, flights from Denmark to Greenland and the Faroe Islands are classified as domestic and the emissions estimates are based on fuels sold and flights by origin and destination. For navigation all marine fuel sales in Greenland are treated as domestic. In the reference approach (table 1.A(b)) consumption of jet kerosene is considered international. In its response to the 2004 previous review stages, Denmark indicated that in future inventories an explanation will be given in the documentation box for the reference approach, or alternatively the jet kerosene consumption applied for aviation between Denmark and Greenland/the Faroe Islands will be considered domestic consumption in the reference approach as well. The ERT recommends that the latter solution be adopted.

22. The ERT noted that the EFs for jet kerosene and aviation gasoline are different for tables 1.A(b) and 1.C of the CRF. In the interest of transparency, the ERT encourages Denmark to explain this difference in the NIR.

Country-specific issues

23. In the reference approach, white spirit is included under naphtha. To improve the transparency of its reporting, the ERT encourages Denmark to report it under Other Oil. To make the reference approach consistent with table 1.A(d) it is proposed that Denmark enter the appropriate value for carbon stored in the row for Other Oil.

C. Key sources

24. In accordance with the IPCC good practice guidance, Denmark has disaggregated its key source analysis for the Energy sector so that emissions from a single category are estimated using the same method and the same EF. The resulting list of 12 individual sources is more detailed than that provided by the secretariat and does not always correspond to the CRF categories.

Stationary combustion: coal – CO₂

25. The same EF has been applied to brown coal briquettes and coke oven coke as for coal from 1990 to 2001. For 2002, however, different EFs are used for the three types of fuel. Denmark indicated in its response to the 2004 previous review stages that it will be revising the time series. This will not significantly change the Danish inventory.

Stationary combustion: oil – CO₂

26. For those liquid fuels that are included in the key source category, Denmark may wish to evaluate whether the CORINAIR default factors are appropriate and, if they are not, to consider developing country-specific EFs. The ERT noted that Denmark is planning to improve its documentation of the CO₂ EFs.

Navigation: oil – CO₂

27. The fuel consumption for gas/diesel oil used in navigation reported for 2002 in the CRF is 19.8 per cent higher than that reported to IEA. The ERT felt that the information provided by Denmark in its response to the 2004 previous review stages did not clarify the differences.

D. Non-key sources

Fugitive emissions: oil and natural gas – CH₄

28. CH₄ emissions fluctuate substantially over the period 1990–1996. Denmark indicated in its response to the 2004 previous review stages that the emissions inventory for fugitive emissions from oil and natural gas activities will be revised before its next submission.

Navigation: other fuels – CH₄

29. The emissions included in Other Fuels for navigation affect the CH₄ emissions trend significantly. The ERT encourages Denmark to improve the documentation of Other Fuels for navigation in the NIR.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

30. According to the 2004 inventory, in 2002 the Industrial Processes and Solvent and Other Product Use sector accounted for 4.7 per cent of the total GHG emissions of Denmark. From 1990 to 2002, total GHG emissions from the sector increased by 44.2 per cent owing to the substantial contribution of HFCs and PFCs. Emissions from Solvent and Other Product Use have decreased by approximately 10 per cent since

1990. In response to the previous review, the inventory has been improved to cover especially nitric acid production and iron and steel production.

31. Systematic quantitative uncertainty analysis has not been performed for the sector. Some qualitative uncertainty estimates are provided in CRF table 7. The Party in its response to the draft review report informed that systematic quantitative analysis of the uncertainty on estimates of GHG emissions will be included in the next submission.

B. Key sources

Cement production – CO₂

32. Denmark applies a country-specific method for estimating CO₂ emissions from cement production. This method is not consistent with the IPCC good practice guidance, since it uses activity data (AD) measured in total cement equivalents. The approach is outlined in the NIR, however. Since the source is a key source for Denmark, clinker production data should be used instead. Denmark explained that it will try to obtain clinker production data. The ERT encourages Denmark to make the calculations consistent with the IPCC good practice guidance as soon as possible. The Party in its response to the draft review report informed that it is still working on improving the emission estimates for cement industry by obtaining more detailed production data.

33. Denmark reports recalculations due to changes in cement production AD (a change from cement to total cement equivalents). It is not clear from the NIR why the recalculations were applied for the years 1998–2001 only. In response to the ERT's questions, Denmark explained that data were available only for the years recalculated, and that it would continue its efforts to obtain the full time series of AD. The ERT encourages Denmark to enhance consistent time series representation in line with methodological advice provided in the IPCC good practice guidance, in spite of the fact that cement industry informed that information on clinker sale for the years 1990–1997 is not available.

Consumption of halocarbons and SF₆ – HFCs and PFCs

34. The ERT took note of the extensive efforts Denmark has made in estimating both potential and actual emissions of HFCs, PFCs and SF₆. The actual emissions have been estimated using a tier 2a bottom-up approach. The methods of data collection described in the NIR and the EFs (product manufacturing and product life factors) are in line with the IPCC good practice guidance.

35. The ERT noticed the very low ratio of potential to actual emissions in the case of HFC-152a. Denmark explained that this is due to its use in soft foam blowing, which results in a high proportion of gas being emitted. On the basis of calculations and analysis performed by the ERT, Denmark's explanation was found to be plausible.

Nitric acid production – N₂O

36. Denmark has reported N₂O emissions from nitric acid production for the first time in its 2004 inventory. Because this is a key source for Denmark, this addition marks an improvement in the accuracy and completeness of the inventory.

C. Non-key sources

Lime production – CO₂

37. The CO₂ emissions reported under this category are a combination of emissions from lime and brick production, resulting in a very low implied emission factor (IEF). The ERT believes that the inventory would be more transparent if these emissions were reported separately, as they are in annex 3.C of the NIR. However, Denmark indicated that it is not clear where emissions from brick production should be reported in the CRF. The ERT recommends that Denmark report these emissions under subcategory 2.A.7 Other and specify where the emissions come from. The Party in its response to the draft review report informed that the

separation will not be done for the 2005 submission, but will be considered along with the implementation of the new CRF reporting system.

Iron and steel production – CO₂

38. This is the first time Denmark has reported CO₂ emissions from steel production under Industrial Processes for the period 1990–2001. Denmark reports that production stopped in early 2002. These emissions are estimated based on coke consumption of metallurgy using default EFs. The ERT noted that Denmark indicates in the NIR that energy consumption associated with industrial processes and the resulting emissions are included in the Energy sector of the inventory due to the overall use of energy balance statistics for the inventory. In response to draft review report, Denmark indicated that no double counting takes place, as consumption of coke used in the manufacturing industry for other purposes is not included in the general energy statistics. The ERT encourages Denmark to include this information in its next inventory submission.

IV. AGRICULTURE

A. Sector overview

39. In 2002, the Agriculture sector contributed 14.8 per cent of total GHG emissions and was the second-largest emission source in Denmark. Agricultural soils contributed 56.9 per cent to sectoral emissions, followed by enteric fermentation and manure management (27.6 and 15.5 per cent, respectively). From 1990 to 2002, emissions from the sector fell by 21 per cent due to a decrease in N₂O emissions from agricultural soils as a result of a national environment policy.

40. The submission is almost complete in terms of gases, sources and time series. The category Goats has been included for the first time. CRF tables 4.E and 4.F have not been completed because the relevant activities do not occur in Denmark. The ERT encourages Denmark to complete these tables with the appropriate notation keys.

41. GHG emissions from the Agriculture sector are estimated according to a comprehensive agricultural model (DIEMA), using AD from national statistics (Statistics Denmark) and country-specific research. The ERT encourages Denmark to include more detailed information in the NIR on the methodologies and equations used in the DIEMA model to enable comparison with the IPCC guidelines and the IPCC good practice guidance. The Party in its response to the draft review report informed that more detailed description of DIEMA will be given in the 2005 submission.

42. The ERT noted that, in response to previous reviews, some QC procedures have been implemented in the inventory preparation, but the overall QA/QC and verification procedures still need to be implemented. The ERT further noted that Denmark has a plan for involving individual experts in QA procedures and encourages the Party to report on this plan in its next submission. The Party in its response to the draft review report informed that implementation of a general QA/QC procedure is under development, including a more specific QA/QC plan for the Agriculture sector, and the results of this work will be presented in the next submissions.

43. Denmark includes a detailed list of plans for improvements in response to previous reviews. Particularly important are the use of national EFs for N₂O, the estimation of N₂O reductions caused by biogas-treated slurry, the reporting of average feed intake per year for each animal category, to enable comparison with the IPCC default values, and better uncertainty estimates.

B. Key sources

Enteric fermentation – CH₄

44. Denmark uses a tier 2 method for all animal categories, which is consistent with the IPCC good practice guidance. The feed intake is based on a country-specific rate with units that are compatible with the IPCC defaults. Denmark noted that it intends to improve these in its future submissions. To improve the

transparency of the estimates, the ERT recommends Denmark to include more information in the NIR on livestock characterization.

45. According to the NIR, national milk production data are provided annually; however, the data on fodder consumption, based on the efficiency of feeding controls and feeding plans, are updated only every three to four years. The ERT encourages Denmark to include additional information in the NIR on how the DIEMA model calculates emissions from milk production and fodder intake.

46. The ERT noted that Denmark has reported CH₄ IEFs for Non-dairy Cattle that are the lowest of the reporting Parties for many years of the period 1990–2002 (33.72–35.80 kg CH₄/head/year). Denmark explained that this category is a weighted average for different livestock categories including young cattle. The Party provided additional clarification of the calculations to the ERT and stated that additional information would be included in a subsequent NIR. For comparability with other Parties' inventories and consistency with the livestock categories in the IPCC good practice guidance, the ERT recommends Denmark, if possible, to report emissions from both dairy cows and heifers under the category Dairy Cattle. The Party in its response to the draft review report informed that more detailed description of the subcategories and the EF for each of these subcategories will be given in the next NIR.

Manure management – CH₄

47. For this category, Denmark has applied a tier 2 method and country-specific EFs, which are consistent with the IPCC good practice guidance. The CH₄ IEFs increased from 1990 to 2002 as a result of changes in milk yield and stable type. The ERT noted large inter-annual variations in CH₄ emissions, as a consequence of changes in stable type, and encourages Denmark to document allocation to different stable types in its next inventory submission. The Party in its response to the draft review report informed that a table that shows the changes in stable type will be included in the next NIR.

Manure management – N₂O

48. Denmark uses IPCC default EFs with country-specific nitrogen excretion rate (Nex) values updated yearly. It has included additional information in the NIR as recommended by the previous reviews. The uncertainties for the N₂O EFs is reported as 500 per cent, five times larger than the IPCC default. The ERT noted that Denmark is planning to improve the estimation of the uncertainty of its EFs and encourages Denmark to develop country-specific EFs for this category.

49. Denmark includes goats in the sheep population for this source category. The ERT encourages Denmark to include information to support why Goats are treated together with Sheep for Manure Management.

50. There is an inconsistency in the information provided in the NIR. The text states that Nex for Swine is increasing, whereas table 6.8 shows a decrease in Swine Nex from 1990 to 2002. The ERT encourages Denmark to clarify this inconsistency in its future submissions.

Direct soil emissions – N₂O

51. Denmark has applied a tier 1a method to estimate N₂O emissions. The EFs for all sources are based on the IPCC default values and national data from the ammonia inventory.

52. Frac_{GASF} and Frac_{GASM} are calculated from national data; specifically, the amount of volatilized nitrogen (N) is determined from Denmark's ammonia inventory. In response to the ERT's questions, Denmark provided a web link to additional documentation on the inventory. The ERT encourages Denmark to provide more supporting information on its ammonia emissions inventory in its next NIR.

53. Denmark includes emissions from grass and clover fields in the emissions from N-fixing crops. There is no IPCC good practice guidance method or IPCC default EF for this category. Denmark provided additional information during the review and the ERT encourages Denmark to include this supporting information in its NIR.

Indirect emissions – N₂O

54. The 1990–2002 values of $\text{Frac}_{\text{LEACH}}$ are the highest for reporting Parties. Denmark uses model predictions to obtain $\text{Frac}_{\text{LEACH}}$, but there is no information on how well the models predict measured leaching. The ERT encourages Denmark to provide additional supporting information on how the model outputs correspond with field measurements.

C. Non-key sourcesAnimal production – N₂O

55. The amount of N deposited on pasture is estimated from Denmark's ammonia inventory. The ERT has already recommended in this review (paragraph 52 above) that Denmark provide additional information to support its ammonia inventory calculations. The NIR states that a country-specific EF is applied (7 per cent) whereas table 4.D shows that the IPCC default N₂O EF (2 per cent) is used. The ERT recommends that Denmark clarify this apparent inconsistency between the CRF and the NIR. The NIR states that it is assumed that 15 per cent of the nitrogen from dairy cattle is excreted on grass. The ERT encourages Denmark to document the basis for this assumption.

V. LAND-USE CHANGE AND FORESTRY**A. Sector overview**

56. In 2002, the LUCF sector represented removals of 5.6 per cent of total national GHG emissions. It was a sink of 3,725 Gg CO₂, comprising uptake from forest growth of 6,083 Gg CO₂ and emissions from harvesting of 2,358 Gg CO₂. The sink increased by 893 Gg CO₂ (32 per cent) from 1990 to 2002. The LUCF sink generally increased from 1990 to 2002; however, a severe storm in December 1999 led to unusually high removals of damaged wood from forests, causing a decline in annual removals in 2000.

57. Denmark only estimates emissions and removals for the category Changes in Forest and Other Woody Biomass Stocks. According to the CRF tables, forest and grassland conversion and abandonment of managed lands do not occur in Denmark. During the review, Denmark noted that there is very little abandonment of agricultural land in Denmark. The ERT encourages Denmark to assess whether these categories occur and to include this information in the NIR. If they occur, the ERT recommends that Denmark calculate emissions and removals from them, following the IPCC Guidelines with the use of default values and expert opinion, if necessary. The NIR notes that including the category CO₂ Emissions and Removals from Soils is a high priority for future methodological improvements. The ERT encourages Denmark to include this category. During the review Denmark noted that liming occurs on agricultural lands. The ERT recommends Denmark to include CO₂ emissions from liming following the IPCC Guidelines, using default values. The ERT noted that the LUCF chapter of the NIR does not follow the outline of the UNFCCC reporting guidelines and recommends Denmark to follow it in its future inventory submissions to enhance the transparency of its reporting.

58. Denmark plans a new National Forest Inventory. The sample-based system, anticipated to begin in 2006, will replace the Forestry Census that is currently the primary data source for this sector. The data from the new inventory system will be reported in Denmark's future NIRs.

59. The ERT noted that the CRF tables are more complete than those in Denmark's previous submission. However, it is difficult to reconstruct the emissions and removals estimates with the information provided in the NIR. Denmark is encouraged to provide more information on the AD, the methodologies used, and the results of the estimates. The ERT further noted that CRF table 5.A does not include all the sources covered in the NIR.

60. Recalculations are discussed in the NIR and reported in the CRF tables. However, it is unclear how the recalculations reported in CRF table 8(a) correspond to the recalculations described in the NIR. Including explanations for recalculations in CRF table 8(b) would enhance the transparency of the inventory. Uncertainties are discussed in general terms, citing potential sources of error and variation in the estimates.

B. Sink and source categories

Changes in forest and other woody biomass stocks – CO₂

61. This category is further divided into “Forests Planted before 1990” and “Afforestation since 1990”. Estimates for both types are based largely on AD from the 1990 and 2000 Forestry Census. The ERT noted that the Forestry Census is mainly based on questionnaires sent out to the owners of forest land every 10 years and is subject to change as more respondents become involved. The ERT further noted that, in response to previous reviews, the NIR includes separate estimates for CO₂ emissions and removals.
62. The estimates of emissions and removals from “Forests Planted before 1990” are generally consistent with the IPCC Guidelines. The ERT recommends that Denmark include a detailed explanation of the method in its future submissions to improve the transparency of its reporting. Denmark used species-specific wood densities that are likely to improve the quality of its emissions and removals estimates compared to the IPCC default values. The NIR states that expansion factors of 1.8 and 1.2 were taken from the published literature because there were no expansion factors available for Danish conditions. In response to the draft review report, Denmark noted that small-scale studies have been initiated on *Norway Spruce* to improve the choice of expansion factors. The ERT encourages Denmark to include information on these studies in future inventory submissions.
63. Ten-year averages have been used to estimate annual increments from the Forestry Census. Emissions from harvesting are estimated using annual harvest statistics from Statistics Denmark. The ERT noted that forest inventories often measure growth and harvest; increment data derived from the Forestry Census may therefore already account for harvesting. In response to the draft review report, Denmark clarified that the Forestry Census does not record standing volume and therefore harvesting is not included in the growth models. During the review, Denmark noted that models for estimating gross increment had been improved with updated site indices. These revisions have increased the estimated net forestry sink by roughly 230 per cent (from 916 to 3,000 Gg CO₂) compared to the estimates in previous submissions. References for the models are cited in the NIR. In the future, Denmark plans to include in the NIR additional information on the models used to derive increments. The ERT encourages Denmark to include information on how model refinements affect uncertainties.
64. The forestry sink is slightly higher in the years 2000–2002 than in 1990–1999. The NIR attributes this to increased response rates in the 2000 Forestry Census, resulting in larger forest area estimates due to the use of new information from forest owners. The ERT recommends that the complete time series be revised to reflect the more accurate land area estimate derived from the 2000 Forestry Census. This is necessary in order to correct the artificial increase in the estimates of sinks after 2000 and the inconsistent representation of forest land area over the time series. In response to the draft review report, Denmark noted that it will try to quantify the contribution of area change to the change in net carbon removals between 1990–1999 and 2000–2003. However, the recalculation of the time series will be implemented as soon as new National Forest Inventory system becomes fully operative.
65. A formal analysis of uncertainty is not applied; however, the NIR indicates that the estimates should be treated with caution. As noted in the NIR, the new National Forest Inventory will enable an assessment of uncertainty in the inventory data themselves. The ERT notes that the new National Inventory System may also provide data on additional carbon pools, such as understorey vegetation, dead organic matter and forest soils, and recommends Denmark to include these pools in its future estimates.
66. A separate method is used to estimate emissions and removals from “Afforestation since 1990”. The method is consistent with the IPCC Guidelines. Danish yield tables for Norway spruce and oak are used to calculate annual rates of carbon uptake using a simple carbon uptake model. However, the ERT recommends that, to improve transparency, Denmark include in its NIR more details on the method used. The area of afforested land is taken from the Forestry Census and data from the Danish Forest and Nature Agency. Wood volumes are converted to carbon storage using the same approach as for “Forests Planted before 1990” except that a larger expansion factor is used to account for the age-dependency of expansion factors. In response to the draft review report, Denmark explained that removals have not occurred because

the stands are too young to be harvested. The NIR notes that the method can estimate carbon storage in wood products if desired. It is unclear why this category requires a different estimation method from “Forests Planted before 1990”. The ERT recommends that Denmark explain why a separate method is used.

67. Net annual rates of CO₂ uptake have increased steadily since 2000 due to increasing areas of land being converted to forest. Emissions and removals are not reported separately. Net removals from “Afforestation since 1990” are not reported in CRF table 5.A. The ERT recommends Denmark to include the estimates in the CRF.

VI. WASTE

A. Sector overview

68. In 2002, the Waste sector accounted for 1.7 per cent of the total GHG emissions of Denmark. Total CH₄ emissions from the sector (which amounted to 20.1 per cent of total national CH₄ emissions in 2002) decreased by 13.6 per cent from 1990 to 2002 and by 4.8 per cent from 2001 to 2002 as a result of the implementation of waste management plans. Solid waste disposal on land is reported to be the only source of emissions in the Waste sector. Methane recovered represented 17.2 per cent of total CH₄ emissions in 2002. Emissions from waste incineration are reported in the Energy sector.

69. The structure of the Waste chapter in the NIR does not follow the structure outlined in the UNFCCC reporting guidelines. The ERT encourages Denmark to follow this structure in its next submission.

70. The NIR and the CRF tables report estimates only for CH₄ emissions from the source category Solid Waste Disposal on Land, not including estimates for other source categories as required by the UNFCCC reporting guidelines. The ERT encourages Denmark to provide complete information in its future submissions.

71. The information presented in both the NIR and the CRF tables is transparent but not sufficient to allow for the replication of the emissions estimates. The CRF background data tables have not been completely filled in, and the information reported is incomplete. The ERT encourages the Party to provide enough information and data in its future submissions to allow the ERT to replicate the emission estimates. In response to the draft review report, Denmark noted that this is to be considered, and more efforts will be put into improvement of the description in the NIR of the decay model used to estimate emissions.

72. Recalculations for the source category Solid Waste Disposal on Land have been performed due to a change in the AD for the years 1996–2001, and resulted in an increase of 1.7 per cent in the figures for CH₄ emissions in 2001. The same recalculations were done due to a change in the EFs for the years 1990–1995, and resulted in a decrease of 0.05 per cent in the figures for CH₄ emissions in 1990. The CRF tables provide all the recalculated estimates and summarize the changes made for the period 1990–2002.

B. Key sources

Solid waste disposal on land – CH₄

73. Denmark has used the IPCC tier 2 method (first-order decay) for the estimation. The amount of waste was obtained from the Danish Environmental Protection Agency. The composition of the solid waste is given for all years. However, the per capita waste production is not reported in the additional information table of the CRF.

74. The main parameters for calculating CH₄ emissions (degradable organic carbon (DOC), degradable organic carbon assimilated (DOC_f), methane oxidation factor, fraction of municipal solid waste (MSW) disposed at solid waste disposal sites (SWDS), and methane fraction in landfill gas) are not reported in the additional information table. The NIR does not explain whether the values given for the CH₄ EFs of different components of the MSW are country-specific or default values. The relationship between the “half-life of the carbon in the waste” and the “time lag” remains unclear. The ERT recommends the use of consistent terminology in order to avoid confusion.

75. The methane emissions trend tables from the source category Solid Waste Disposal on Land and the corresponding sectoral background data tables are provided for the period 1990–2002 in the CRF. The ERT encourages Denmark to complete the additional information tables in the CRF.

C. Non-key sources

Waste-water handling – CH₄

76. The NIR and the CRF tables do not report estimation of CH₄ and N₂O emissions from waste-water handling for the period 1990–2002 as required by the UNFCCC reporting guidelines. Denmark states that the source category Waste-water Handling will be analysed and CH₄ and N₂O emissions estimates will be reported and documented in future; however, CH₄ from this source is believed to be of only minor importance. The ERT recommends Denmark to make the necessary efforts to estimate these emissions and provide additional information both in the CRF and in the NIR. In response to the draft review report, Denmark noted that a project carried out has resulted in methodologies and emission estimates of CH₄ and N₂O which will be included in the 2005 submission.

Waste incineration – CO₂

77. The “Waste 21” plan establishes the goal of incinerating 24 per cent of waste generated. A municipal obligation to assign combustible waste to incineration facilities was introduced in 1996. Even if emissions from waste incineration are reported in the Energy sector, the actual amounts of waste incinerated should be provided so as to give a clear picture of the waste fluxes. The share of the biogenic part in the waste incinerated should also be reported.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

- 2003 and 2004 Inventory submissions of Denmark. 2004 submission including a set of CRF tables for 1990–2002 and an NIR.
- UNFCCC secretariat (2004). “Report of the individual review of the greenhouse gas inventory of Denmark submitted in the year 2003 (Centralized review)”. FCCC/WEB/IRI(3)/2003/ DNK (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/denrep03.pdf>).
- UNFCCC secretariat. “2004 Status report for Denmark” (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/den04.pdf>).
- UNFCCC secretariat. “Synthesis and assessment report of the greenhouse gas inventories submitted in 2004. Part I”: FCCC/WEB/SAI/2004 (available on the secretariat web site <<http://unfccc.int/resource/webdocs/sai/2004.pdf>>) and Part II – the section on *Denmark* (unpublished).
- UNFCCC secretariat. Review findings for Denmark (unpublished).
- Denmark’s comments on the draft “Synthesis and assessment report of the greenhouse gas inventories submitted in 2004” (unpublished).
- UNFCCC secretariat. “Handbook for review of national GHG inventories”. Draft 2004 (unpublished).
- UNFCCC secretariat. “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories”, “Part II: UNFCCC reporting guidelines on national communications” and “Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention.” FCCC/CP/1999/7 (available on the secretariat web site <<http://www.unfccc.int/resource/docs/cop5/07.pdf>>).
- UNFCCC secretariat. “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting guidelines on annual inventories” and “Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention.” FCCC/CP/2002/8 (available on the secretariat web site <<http://unfccc.int/resource/docs/cop8/08.pdf>>).
- UNFCCC secretariat. Database search tool – *Locator* (unpublished).
- IPCC. *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000* (available on the following web site: <<http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm>>).
- IPCC/OECD/IEA. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, volumes 1–3, 1997* (available on the following web site: <<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>>).

B. Additional materials

Responses of Denmark to the questions of the ERT provided by Mr. Erik Lyck, National Environmental Research Institute.

Damgaard Poulsen, Hanne and Verner Friis Kristensen (eds) (1997). Standard values for farm manure: A revaluation of the Danish standard values concerning the nitrogen, phosphorus and potassium content of manure. Danish Institute of Agricultural Sciences, Ministry of Food, Agriculture and Fisheries.

Sander Poulsen, Thomas (2004). Ozone depleting substances and the greenhouse gases HFCs, PFCs and SF₆ - Danish consumption and emissions 2002. Environmental Project No. 890 2004. Danish Environmental Protection Agency, Copenhagen. The report is available electronically at <<http://www.mst.dk/udgiv/Publications/2004/87-7614-123-3/pdf/87-7614-124-1.PDF>>.

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