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

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

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# I. Overview

## A. Introduction

1. This report covers the centralized review of the 2005 greenhouse gas (GHG) inventory submission of Belgium 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 3 October to 8 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Ms. Mirja Kosonen (Finland) and Mr. Jim Penman (United Kingdom); Energy – Ms. Sumana Bhattacharya (India), Mr. Christov Christo (Bulgaria) and Mr. Hugh Saddler (Australia); Industrial Processes – Mr. Jochen Harnisch (Germany) and Mr. Stanford Mwakasonda (Republic of South Africa); Agriculture – Mr. Samuel Adejuwon (Nigeria) and Mr. Leonard Brown (New Zealand); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Hector Ginzo (Argentina) and Mr. Zoltan Somogyi (Hungary); Waste – Mr. Carlos Lopez (Cuba) and Mr. Takashi Morimoto (Japan). Mr. Carlos Lopez and Mr. Jim Penman were the lead reviewers. The review was coordinated by Mr. Matthew Dudley (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", a draft version of this report was communicated to the Government of Belgium, 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 2005, Belgium submitted a largely complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years' submission, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

## C. Emission profiles and trends

4. In 2003, the most important GHG in Belgium was carbon dioxide ($CO_2$), contributing 85.5 per cent to total[1] national GHG emissions expressed in $CO_2$ equivalent, followed by nitrous oxide ($N_2O$), 7.6 per cent, and methane ($CH_4$), 5.8 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride ($SF_6$) taken together contributed 1.1 per cent of overall emissions. The Energy sector accounted for 81 per cent of the total GHG emissions, followed by Industrial Processes (9.6 per cent), Agriculture (7.8 per cent) and Waste (1.4 per cent). Total GHG emissions amounted to 147,550 Gg $CO_2$ equivalent and increased by 1.26 per cent from 1990 to 2003.

## D. Key categories

5. Belgium undertook tier 1 level and trend key category assessments for its 2005 submission. The results were similar to the secretariat's[2] assessment, although Belgium used more detailed categories, leading in the level assessment to 27 key categories, where the secretariat found 18, and in the trend assessment to 28 and 16, respectively. The development of the inventory from three regional

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

[2] The secretariat identified, for each individual Party, those source categories which are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the Intergovernmental Panel on Climate Change *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Key categories 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 category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

components (for Brussels, Flanders and Wallonia) has led to some complications for the key category analysis as a basis for choice of methodologies.

## E. Main findings

6. The Belgian submission contains an NIR structured in accordance with the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the revised UNFCCC reporting guidelines) and CRF tables. The NIR discusses quality assurance/quality control (QA/QC) but as yet the Party has no QA/QC plan; this will be a very useful development given the significant challenges in integrating the different methodological approaches as between Flanders, Wallonia and Brussels. Major methodological developments have taken place since the 2004 submission in the estimation of emissions from the petrochemicals industry and from natural gas processing and distribution, and Belgium is building a national inventory system.

## F. Cross-cutting topics

### 1. Completeness

7. Data are provided for all gases, sectors and years. CRF tables 7 (Overview), 8(b) (Recalculation – Explanatory Information) and 9 (Completeness) have not been provided, and table 10 (Trends) is provided only in the CRF tables for 2003. The notation keys are used in some sectoral and background tables in a limited way. Belgium has provided the new LULUCF reporting tables as required by decision 13/CP.9 of the Conference of the Parties for the years 1990–2003, although estimates are only provided for Forest Land Remaining Forest Land. Source category coverage sometimes varies between regions. The ERT understands that Belgium intends to provide the missing information in the next submission.

### 2. Transparency

8. Greater use of the methodological annexes could increase transparency, which is limited by space in the present NIR, and which sometimes varies between regions. The consistency of the data as between the NIR and the CRF tables needs improvement, notably in the Industrial Processes sector. Belgium has made progress with this by establishing a working group to promote data consistency, and by the certification of inventory agencies (e.g. using the ISO 9001:2000 and Eco-Management and Audit Scheme (EMAS) certifications). The ERT notes that Belgium intends to improve transparency in future submissions.

### 3. Recalculations and time-series consistency

9. The overall effect of the recalculations performed is that, whereas previously total national emissions were estimated to have risen by 2.9 per cent between 1990 and 2002, they are now estimated to have fallen by 0.2 per cent over that period. The recalculations have led to decreases in the estimates of emissions for 1990 and for 2002 by 0.04 per cent and 3.1 per cent, respectively. This follows an extensive study of energy use and feedstocks in the petrochemicals industry in Flanders, leading to a significant increase in the amount of carbon estimated to have been stored in products, particularly in more recent years. The revised estimates are in principle an improvement, although they are not fully transparent; the demarcation between Other industrial emissions recorded in the Industrial Processes sector; and the treatment of carbon stored in products, need more clarification, and CRF table 8(b) should be completed. Transparency is particularly important given the magnitude of the recalculations. The same study has also led to a reallocation of energy use to the different fuel types, with some implications for the estimation of emissions because of differences in emission factors (EFs). The ERT noted with approval that Belgium is considering providing a methodological annex on these recalculations in the next NIR. Other recalculations reflect among others the accounting of biomass fuels in cement kilns since 1995 and some corrections because of double counting in the iron and steel sector.

### 4. Uncertainties

10. An Intergovernmental Panel on Climate Change (IPCC) tier 1 uncertainty analysis has been performed for the first time on the basis of expert evaluation. The results of this analysis are presented at a summary level and at the individual source category level. Uncertainty evaluation is not in general used to determine priorities for the improvement of the inventory.

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

11. Independent audits for regional inventories have been introduced, and national coordination takes place in a working group of the Coordination Committee for International Environmental Policy, which also conducts internal QA/QC activities. The Interregional Environment Unit compiles the national inventory of regional inventories. The National Climate Commission is formally responsible for the verification of the inventory. A report describing the national inventory system is planned by the end of 2005. The ERT encourages Belgium to develop a formal QA/QC plan based on the advice in the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance).

### 6. Follow-up to previous reviews

12. A major recalculation has been carried out as the result of a study by the petrochemical industry, which was foreshadowed in Belgium's 2004 submission, and a new and detailed bottom-up methodology has been applied to the estimation of emissions from the storage and transport of natural gas. Estimates of carbon sequestration have been made for the whole country for the first time, and some basic parameters are now better harmonized. A working group has been established to improve consistency in the reporting.

## G. Areas for further improvement

### 1. Identified by the Party

13. The NIR identifies possible improvements in carbon EFs as a result of data becoming available in connection with the European Union Emissions Trading Scheme (ETS); better estimation of emissions of non-methane volatile organic compounds (NMVOCs); work on emissions from agricultural soils and manure management; the establishment of the geographical location of LULUCF activities and an evaluation of forest soil carbon; the inclusion of recovery of $CH_4$ from waste-water handling; and regional improvements in the estimation of emissions from waste, as identified below. Independent reviews by region and an external review involving experts from the Netherlands are planned.

### 2. Identified by the ERT

14. The overriding priority for Belgium is to continue working to present activity data (AD), EFs and methodologies in a transparent and consistent manner for the country as a whole. This does not mean that regional variations should be neglected, but that the relationship between the regions and the whole should be presented in an obviously clear and logical manner. This is linked to the priority of developing current QA/QC practices into a coherent quality management system. Progress in recalculations requires adequate transparency, and Belgium should provide the CRF table 8(b) (Recalculations). The ERT understands that Belgium will submit this CRF table in its next submission. Recommended improvements relating to specific source/sink categories are presented in the relevant sector sections of this report.

# II. Energy

## A. Sector overview

15. In 2003, energy consumption accounted for 81 per cent of total GHG emissions in Belgium. Virtually all fossil fuel is imported, and amounted in 2003 to 44.81 Mtoe in total, comprising 6.21 Mtoe of coal, 24.15 Mtoe of oil, and 14.44 Mtoe of gas. Use of nuclear fuel is equivalent to 13.07 Mtoe in primary energy terms.

16. Emissions from the Energy sector amounted to about 119 512 Gg of $CO_2$ equivalent in 2003. The largest key category is Road Transportation, which accounted for 21 per cent of total sectoral emissions, followed by Public Electricity and Heat Production (20 per cent), Residential (19 per cent), Iron and Steel (10 per cent) and Chemicals (6 per cent).

17. Total GHG emissions from the Energy sector increased by a little under 7 per cent between 1990 and 2003. The main drivers of this increase were Road Transport and the Commercial/Institutional sectors. $N_2O$ emissions from transport more than doubled between 1990 and 2003. This is partly due to the introduction of catalytic converters in 1993. $CO_2$ emissions from manufacturing industry and construction decreased by 9.6 per cent over the period 1990–2003.

18. A major recalculation has been made as the result of a study, foreshadowed in the 2004 submissions, of the petrochemical industry in Flanders, where almost all of the industry is located. This has led to recalculation of quantities of fuel used in 1.A.2.c Chemicals and related $CO_2$ emissions, with a consequent significant reduction in the estimates of total $CO_2$ emissions from the Chemicals subsector. For the inventory year 2002, for example, the estimates of emissions from this subsector are reduced from 8,591 Gg $CO_2$ equivalent in the 2004 submission to 7,980 Gg in the 2005 submission.

19. The change is caused by the fact that the study has shown that a greater proportion of carbon atoms in the fossil fuel feedstocks are partitioned into long-lived chemical products and a smaller proportion into $CO_2$ following combustion. This was confirmed by Belgium in response to questions raised by the ERT during the course of the review. The change has a much larger effect in the most recent years than in the base year (1990) (see the NIR page 45), because of a large expansion in petrochemical industry capacity in the early 1990s. It would be helpful if an English language version of the full study, currently only available in Dutch, could be included in Belgium's 2006 submission.

20. A recalculation has been made of $CO_2$ emissions from the use of coal, coke oven gas and blast furnace gas in 1.A.1a Public Electricity and Heat Production in Wallonia, using industry-specific rather than default EFs. This has resulted in an increase in reported emissions. The same EF for blast furnace gas has been applied to the recalculated emissions from the use of this fuel in 1.A.2a Iron and Steel in Flanders. The overall effect is to decrease national emissions from this industry sector.

21. A new and very detailed bottom–up methodology has been applied to the estimation of emissions from the storage and transport of natural gas, and a recalculation has been made for all years. As part of the recalculation, $CO_2$ emissions associated with energy use in pipeline transport have been moved from 1.A.3e Other Transportation to 1.B.2.bii Natural Gas Transmission and Distribution in order to avoid double counting (see the NIR page 41). However, while this has been done for all previous years, it has not been done for 2003. Moreover, it is not good practice to move combustion emissions in this way. It means that some energy consumption is not properly reported and accounted for and will contribute to the discrepancy between the sectoral and reference approaches. The ERT recommends that Belgium provide a better way of identifying and avoiding double counting of $CO_2$ emissions between the two subsectors, while continuing to use the new method which in principle represents a substantial improvement.

## B. Reference and sectoral approaches

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

22. Table 1.A(c) shows a large discrepancy between the sectoral and reference approaches. The NIR (pages 46–53) discusses possible reasons for the discrepancy. Much of it is due to inconsistencies between the fuel consumption data used for the sectoral approach, which are aggregated from detailed data for the three regions of Belgium, and the data used for the reference approach, which are taken from the federal energy balance. A study in 2002 found large discrepancies between the two data sets. The NIR reports that in 2003 a working group under the National Climate Commission was set up to promote the work of harmonizing the different energy balances. The work is still ongoing.

23. A large consumption of Other fuels is reported in 1.A.2.c Chemicals. The NIR (page 45) explains that these are recovered fuels from petroleum-crackers and other chemical process units. This means that they are derived mainly from petroleum products (liquid fuels) and some from gas. Allocating these fuels to liquid and gaseous fuels, rather than to Other, is technically more correct, but entail some loss of transparency. An important consequence of reporting these fuels as Other is that they are not included under Liquid Fuels in table 1.A(c) and therefore contribute to the apparent discrepancy (for liquid fuels) between the sectoral and reference approaches. Reallocation would reduce the apparent discrepancy between for liquid fuels although the total discrepancy would be unaffected.

24. Consumption of liquefied petroleum gas (LPG) is reported under Other Fuels in 1.A.3b Road Transportation. As a result it is added to the total for Other Fuels, rather than Liquid Fuels, in table 1.A(a)s1, and is not included in Liquid Fuels in the sectoral approach total in table 1.A(c). This is caused by a problem with the CRF format and it contributes to the discrepancy for liquid fuels between the sectoral approach and the reference approach.

25. The solid fuel consumption data in the reference approach (260.25 PJ) do not include coking coal. Belgium should clarify whether consumption of coking coal is included with consumption of other types of coal.

### 2. Country-specific issues

26. The $N_2O$ and $CH_4$ EFs reported in the NIR are selected from different sources for the three regions and differ significantly. They need further reconciliation. There are many other differences and minor inconsistencies in the approaches taken by the three regions as described in the NIR. Continuing work will be required to ensure that these do not affect the quality of the inventory.

## C. Key categories

### 1. Manufacture of solid fuels and other energy industries – $CO_2$

27. The 2003 $CO_2$ EF for solid fuels is low (46.81 t/GJ), while for the base year (1990) it is significantly higher (84.1 t/GJ). It decreases over the first years of the inventory and shows a variable trend around the level of 45 t/GJ. The Party has explained that this is caused by cessation of direct use of coal in this source category, as a result of coal mine closure and other types of industry restructuring. It would be helpful if the NIR included more transparent information about the trend and variations.

### 2. Iron and steel and chemicals

28. The transparency of the inventory would be improved if the quantities of blast furnace gas and coke oven gas consumed were reported in the NIR, and if the NIR included more information about the nature and quantities of Other fuels and about the estimates of carbon stored in products.

# III. Industrial Processes and Solvent and Other Product Use

## A. Sector overview

*29.* In 2003, emissions from the Industrial Processes sector in Belgium amounted to 14 231 Gg $CO_2$ equivalent, or 9.6 per cent of total national emissions. Overall sector emissions decreased by 11.0 per cent between 1990 and 2003. This was mainly due to decreases in emissions of PFCs and to $SF_6$ in the production of fluorochemicals. Respective emissions had peaked in 1995 and have since dropped by over 90 per cent.

30. Emissions from the Solvent and Other Product Use sector are reported in the CRF tables as amounting to 253 Gg $CO_2$ equivalent, or 0.18 per cent of total national emissions in 2003.

31. Recalculations have been carried out for ammonia production, other (chemical industry) and other (industrial processes). Recalculations are also reported for lime production, glass production and HFC/PFC emissions. The Party is encouraged to carry out QA/QC and uncertainty analysis for specific emission sources and activities in relation to the data and the methodologies used.

## B. Key categories

### 1. Cement production – $CO_2$

32. Elements of the IPCC good practice guidance can be seen in the method used, but information is lacking on how the country-specific EFs have been developed and updated and how data for clinker production have been obtained. Belgium should provide this information in its future submissions and indicate how the IPCC good practice guidance is followed.

### 2. Lime production – $CO_2$

33. Plant-specific EFs are given, although without relevant details on type of lime and the source of the lime production data. In its future NIRs the Party is encouraged to provide more information on how the IPCC good practice guidance is followed for this key category. To avoid confusion arising from the terminology, it is suggested that the Party use “dolomite lime” instead of “dolomite”, since the latter gives the impression that emissions were from dolomite production within the Lime Production emission source.

### 3. Ammonia production – $CO_2$

34. Ammonia production data are confidential, but emissions are reported. The NIR mentions use of the IPCC good practice guidance on emissions from ammonia production, but there is currently no IPCC good practice guidance on ammonia production emissions. The Party did report emissions of $CO_2$ from two other plants in the Walloon region; these two plants also use ammonia production process $CO_2$ emission, which is reported by the Party. Belgium has stated that it will improve documentation in its next NIR to improve the transparency of this activity, and to address the double counting issue.

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

35. There is a brief account of emissions from nitric acid production. The NIR mentions that plant-specific production data are available, indicating that the IPCC good practice guidance can be followed in estimating emissions from this key category. An EF of 5.189 kg/t has been used, but no justification provided on the use of this factor with reference to plant age, technology type and so on, and whether this factor is considered as country industry average throughout the time series. The $N_2O$ emissions show a general decreasing trend, but there is no mention of introduction of abatement technology. Belgium is encouraged to provide clear details of the methodological approach used, in line with the IPCC good practice guidance, and understands that plant specific data are available.

5. Other chemical industry– $CO_2$ and $N_2O$

36. Belgium does not provide information on how the one plant which produces caprolactam monitors $N_2O$. Belgium has stated that this information will be provided in its next submission.

6. Other (industrial processes) – $CO_2$

37. The NIR should clarify how the calculation was done for the non-energy use of fuels and the Party should specify what the $CO_2$ emission sources reported under 2.G are. Given the recent recalculations of this source and the fact that it is a key category, Belgium is encouraged to provide further information on the methods applied to estimate emissions from this source and on how it is separated from stored carbon as determined in the Energy sector.

7. Other (industrial processes) – HFCs

38. Destruction of HFCs is reported as negative emissions, for example, in 2002 and 2003. The methodology used is not mentioned in the NIR and appears to be a deviation from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the IPCC good practice guidance, which count mitigation action as the effect on the national emissions, not negative emissions.

8. Iron and steel production – $CO_2$

39. The NIR indicates that EMEP/CORIAIR and IPCC methods have been used, and that the calculation of emissions is based on the production of iron and steel rather than the use of reducing agents, and this is not quite clear. The AD reported for iron and steel production, for example for 1990 and 1995, do not match the International Iron and Steel Institute (IISI) reports for Belgium. Possibly, only part of the total Belgian production has been reported. Belgium is encouraged to use industry-representative data for this key category. The distribution of $CO_2$ emissions across different reporting categories is confusing. Belgium is also encouraged to use the IPCC good practice guidance for this key category.

9. Production of halocarbons and $SF_6$ – PFCs. $SF_6$

40. The discussion in the NIR on the production of halocarbons and $SF_6$ does not make it clear whether the emissions are from their direct production or from the manufacturing of other products such as semiconductors. Belgium is encouraged to provide more details on this and to separate the discussion on production of halocarbons and $SF_6$ from the discussion on their consumption.

41. Belgium is commended for considering additional sources of halocarbon emissions from an electrochemical synthesis plant. However, it does not provide information in its NIR on the methods applied for the determination of the emissions from this plant currently and in the past. Following a request by the ERT, the Party provided comprehensive supporting material describing the methods applied to estimate emissions from this source. Belgium is encouraged to provide excerpts from this material in its next NIR.

42. The NIR reports that the electro-fluorination plant emitted $SF_6$ along with PFCs. Belgium is encouraged to report other GHGs – for example trifluoromethyl sulphur pentafluoride ($SF_5CF_3$), which have been reported in the literature (see Hites et al., 2000) for this type of plant – even if those gases are not covered by the Kyoto Protocol.

10. Consumption of halocarbons – HFCs and PFCs

43. The NIR does not discuss methodological issues for this source, but gives a statistical account of the emissions instead. Belgium is encouraged to provide methodological information in its future submissions, in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice

guidance. The ERT noted that important progress has been made in respect of the estimation of emissions from the consumption of halocarbons and $SF_6$. Belgium is also encouraged to apply the IPCC good practice guidance for this source.

### C. Non-key categories

1. Soda ash production and use – $CO_2$

44. Belgium is encouraged to consider historical emissions from the production of soda ash in Solvay's plant in Couille, which was discontinued in 1998. Part of this information may already be captured in the CORINAIR default factors applied to the glass industry. Belgium is encouraged to take a consistent approach to this source within the framework of the CRF, and to analyse and report soda ash consumption across all relevant industries. Belgium has stated that it will improve the reporting of this activity in future submissions.

2. Limestone and dolomite use – $CO_2$

45. No information is reported under this category. The ERT understands that these emission are reported in table 2(I).A-G, under A. Mineral products, 7 'Other'. Belgium is encouraged to take a consistent approach on this source within the framework of the CRF, and to analyse and report limestone and dolomite consumption across the relevant industries. Belgium is also encouraged to survey and report this source in its future inventories, for example, on the basis of data collected from the ETS.

3. Consumption of $SF_6$ in magnesium production and casting – $SF_6$

46. The CRF tables for the years 1990–1993 indicate the notation key "not estimated" ("NE"), and no entries can be found for subsequent years until inventory year 2003, for which a value of 0 is given. Belgium is encouraged to check for consistency, to check that its reporting and use of the notation keys are correct for this source, and to provide information as applicable.

## IV. Agriculture

### A. Sector overview

47. In 2003, the Agriculture sector in Belgium was responsible for emissions amounting to 11.6 Gg $CO_2$ equivalent, or 7.8 per cent of total national emissions. This represents a reduction by 1.2 Gg (9.6 per cent) from the 12.8 Gg $CO_2$ reported for 1990. The NIR attributes this decline to crises in agriculture in Belgium, including the occurrence of bovine spongiform encephalitis (BSE). Belgium identified key categories in the Agriculture sector at a more disaggregated level than the secretariat. Animal Production was identified as a key category by Belgium.

48. Belgium has recalculated the entire time series based on updated or improved information on the allocation of animals to animal waste management systems (AWMS), nitrogen (N) content of crops and crop residue remaining on the field, and correction of errors. Belgium has also included $CH_4$ emissions from agricultural soils and reallocated emissions from human sewage to the Waste sector. The NIR identifies a number of planned improvements including a country-specific study on $CO_2$ emissions from agricultural soils (which should be reported in the LULUCF sector).

49. The reporting of emissions is generally complete. Rice cultivation, prescribed burning of savannahs and field burning of agricultural residues do not occur in Belgium and the notation key "not occurring" ("NO") is used. Additional information on the allocation of animals to AWMS and on climate zones is not included either in the CRF or in the NIR. Uncertainties have been quantified from expert judgment and the use of IPCC defaults.

50. The ERT noted a number of inconsistencies in the livestock population data for sheep, swine and poultry reported in tables 4.A, 4.B(a) and 4.B(b). There is also a 21 per cent difference between the

sheep population reported in the CRF and that reported to the Food and Agriculture Organization of the United Nations (FAO), and a 36 per cent difference between the two in the figures for swine population. Belgium should ensure consistency between the CRF tables as well as between its GHG inventory and the national reporting to international organizations. The AD are taken from an agricultural survey dated 1 May 2002 and reported in a publication of the National Institute of Statistics (NIS). The ERT noted that interpolation with subsequent census data would better represent livestock numbers over the year 2003. Interpolation of this kind would, however, need to be done consistently throughout the time series, and might require subsequent revision of provisional estimates.

51. A considerable amount of information on the AD on animal populations and crops for the 2003 inventory is presented, but similar detail is lacking for the other years of the time series. This information does, however, appear to be available through the NIS. There is also a general lack of information on the derivation of the country-specific EFs and the methodologies used. As in the 2004 review, Belgium is encouraged to include supporting documentation for all country-specific EFs and methodologies, and to include additional statistical information from the NIS in its inventory submission. The ERT encourages Belgium to focus its efforts for this sector in Flanders and Wallonia, since the territory of Brussels only accounts for 0.02 per cent of the agricultural area in Belgium.

## B. Key categories

### 1. Enteric fermentation – $CH_4$

52. Cattle are the significant subcategory in Enteric Fermentation, accounting for 95 per cent of emissions in this subcategory. The NIR notes that emissions are estimated using the IPCC tier 1 methodology with default EFs unless country-specific data are available. Country-specific values appear to be used for cattle and sheep but there is no information in the NIR supporting these values. To be consistent with the IPCC good practice guidance, Belgium should report emissions from cattle using a tier 2 methodology. The ERT noted that much of the data required for a tier 2 methodology are already collected by the National Institute of Statistics and recommends that Belgium implement a tier 2 methodology for this source.

53. An 8 per cent increase in emissions from dairy cattle in 1998 was followed by a 5 per cent decrease in 1999. This fluctuation appears to be not consistent with the 0–2 per cent annual decreases observed from 1990. In response to questions from the ERT, Belgium stated that the increase is related to the number of cattle and that it will investigate it. A similar apparent inconsistency applies to the inter-annual changes in the figures for emissions from sheep in 1994–95 and 1999–2000. The ERT encourages Belgium to provide additional explanation for the changes in livestock number.

### 2. Manure management – $CH_4$

54. An IPCC tier 2 methodology has been used for Flanders and is described in the NIR. Information on the animal populations and animal weights is included; however, manure production, volatile solid excretion (VS), methane-producing capacity (Bo) and the methane conversion factor are not reported in the CRF or the NIR, and a complete bibliographical reference is not provided in the NIR. Emissions from Wallonia are estimated using a regional model that is not described in the NIR. The ERT encourages Belgium to improve the transparency of its reporting in this category. The IEF for sheep is the highest of all reporting Parties, seven times the IPCC default for a cool climate and 80 per cent higher than the highest of other Parties. More transparency would help to explain the reasons for this, or indicate whether any revision is needed.

### 3. Manure management – $N_2O$

55. $N_2O$ emissions are calculated using an IPCC tier 1 methodology and annual country-specific nitrogen excretion (Nex) values for dairy and non-dairy cattle, sheep and swine. The 2003 Nex for sheep and swine are 55–65 per cent of the IPCC default. The NIR contains no information on how the annual

Nex are derived or how the allocation to AWMS is determined. Belgium is encouraged to include this information in its future NIRs. $N_2O$ from manure management is discussed under Agricultural Soils in the NIR rather than under Manure Management.

56. The ERT noted that the amount of manure allocated to the pasture range and paddock AWMS in table 4.B(b) is 50 per cent of the amount shown in table 4.D for animal production. $Frac_{GASM}$ has not been reported. The ERT encourages Belgium to check the allocation between categories and report the values of fractional parameters used.

4. Direct emissions from agricultural soils – $N_2O$

57. Most AD have been obtained from an annual publication of the NIS. The Centre for Agricultural Economics produced data for nitrogen fertilizer while data on nitrogen leaching have been obtained from the System for the Evaluation of Nutrient Transport to Water (SENTWA).

58. In estimating direct $N_2O$ emissions from synthetic fertilizers and animal waste applied to soil, the IPCC default EF of 0.0125 kg N-$N_2O$/kg N has been used. The NIR states that the same EF was also used for crop residue applied to soil; however, the CRF reports an IEF from crop residues of 0.0002 kg N-$N_2O$/kg N. The CRF also reports an IEF of 0.001 kg N-$N_2O$/kg N for N-fixing crops, but the NIR gives no information about this source. It is recommended that these apparent inconsistencies be checked. For emissions from the cultivation of histosols, Belgium uses the default factor of 5 kg $N_2O$-N/kg N from the Revised 1996 IPCC Guidelines. This has been updated to 8 kg $N_2O$-N/kg N in the IPCC good practice guidance, but the NIR does not discuss the reason for retaining the 1996 default.

5. Indirect emissions from nitrogen used in agriculture – $N_2O$

59. The NIR states that 1 per cent of the 10.9 kg of nitrogen deposited per hectare of land is volatilized. The IPCC default is also 1 per cent; however, the EF back-calculated in the CRF is slightly different, and the estimate should be checked. Indirect $N_2O$ emissions from leaching and run-off are estimated using a country-specific value for $Frac_{LEACH}$ of 17 per cent in combination with the IPCC default EF. The IPCC default for $Frac_{LEACH}$ is 30 per cent and there is no explanation in the NIR supporting the use of the country-specific value.

### C. Non-key categories

Direct emissions from agricultural soils – $CH_4$

60. Belgium uses a national methodology to estimate $CH_4$ removals and emissions. The ERT requests that transparent information on the methodologies used in Flanders and Wallonia, the comparability of the approaches and the uncertainties be included the NIR. $CH_4$ emissions from wetlands and removals in forest soils and grassland should be reported in the LULUCF sector. Emissions from unmanaged surface waters (rivers and lakes) should not be reported in the national inventory. Removals on agricultural soils do occur but the NIR does not present sufficient information for the $CH_4$ sources and sinks mentioned to be reviewed.

## V. Land Use, Land-use Change and Forestry

### A. Sector overview

61. In 2003, the net removals reported for the LULUCF sector in Belgium amounted to around 2.4 per cent of total national GHG emissions. However, Belgium only provides $CO_2$ emission/removal estimates for 5.A.1 Forest Land Remaining Forest Land. No estimates of emissions are provided for other categories and the notation key "NE" is used for all other mandatory source categories (5.A.2, 5.B.1, 5.B.2, 5.C.1, 5.C.2, 5.D.2, 5.E.2, and 5.F.2). Belgium has stated that all categories will be covered in the next NIR.

62. It is encouraging that, in contrast to Belgium's previous submissions, the estimates of carbon (C) sequestration have been made for the whole country, and some basic parameters are now country-specific. Belgium intends to determine the geographical location of LULUCF activities. However, the NIR lacks any uncertainty estimation. Belgium will provide an uncertainty estimation– Monte Carlo analysis for biomass and error propagation for other categories in the next NIR.

### B. Sink and source categories

Forest land remaining forest land – $CO_2$

63. The forest area is reported in the CRF tables to have decreased from 641 kha in 1990 to 621 kha in 2003. It is not clear from the description of the methodology used for estimating emissions and removals whether emissions from this decrease of forest land area (presumably a deforestation, unless there is some other explanation, such as a change in the methodology used for area estimation) are included in the calculations or not. The ERT noted that emissions and removals in forest land converted to any other land use should be reported in the appropriate categories. Belgium has stated to the ERT that the category forest land remaining forest land includes only areas with annual growth increment, and believes the apparent deforestation mentioned by the ERT was mainly due conversion of productive stands to non (commercially) productive forest. Belgium has undertaken to check this.

64. Page 72 of the NIR describes the trend in forest area as linear for both coniferous and deciduous species. However, according to the CRF tables the rate of change is decreasing in both cases. The area data for 1990 in the CRF table for both species groups, and the value for 1994 for conifers, seem to be inconsistent with the rest of the data, and should be checked. Additionally, there is a small discrepancy between the value of the forest area in Flanders given in the Overview, which is 1,463.81 $km^2$, and the corresponding value in table 7.1, which is 1,447 $km^2$. Similarly, according to table 7.2, the forest area in Wallonia is only 4,587 $km^2$, and not 5,448 as given in table 7.1. Belgium has expressed that these area discrepancies are also due to a confusion between the productive and non productive areas, and that this misunderstanding will be clarified in the next NIR.

65. According to page 69 of the NIR, the forest inventory sample plot centres which were formerly at the edges or borders of plantations have been moved towards the inside of the plantations. This could lead to a bias in stock estimates. This is because given the highly fragmented nature of the plantation/ forest areas in Belgium, a high proportion of the total area will reflect patterns of forest cover and growth near the edge, and so samples taken from the heart of the plantation/forest areas may not be representative. A more detailed description of the forest inventory methodology in general, and of the methodology used for the sampling strategy in particular, could clarify this and other issues concerning the forest inventory data, which form the basis for the estimates included in the GHG inventory. Belgium has stated that it will provide a more complete methodological description of the regional forest inventories.

66. It seems from the methodological description that biomass C stock changes have been estimated using the stock change method, and that C stock changes due to harvests have been calculated from the total C stock changes and the C stock changes due to wood growth. Belgium is encouraged to validate the accuracy of the calculations, for example, by cross-checking with the harvest data if statistics are available. Belgium has stated that it will compare harvest data statistics with the model results in the next NIR.

67. The method used for obtaining biomass C stock estimates between 1990 and 2000 is not described in detail. This description should include, among other things, information on how data from the partial forest inventories have been used, and assumptions made concerning the trend, linear or otherwise. Belgium has stated that it will improve the methodology description in order to avoid any kind of misunderstandings in the future.

68. The trend of the biomass C stock changes show fairly steady values from 1990 up to and including 2000, but a new model is applied to model the dynamics of biomass for 2001 and thereafter, thus producing an inconsistency in the time series. Belgium is encouraged to ensure time-series consistency by using one of the methods suggested by the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (the IPCC good practice guidance for LULUCF). Belgium has stated that the consistency of time-series will be discussed in the next NIR.

69. The conversion factors displayed in table 7.3 seem in general to be reasonable. However, the values of wood growth for most of the conifers seem rather high. Also, no justification is provided as to why age-independent growth data have been used in the model *Evolutions de la forêt belge* (EFOBEL) instead of forest yield tables widely applied for forest growth modelling. Using mean annual increment data may result in major underestimation or overestimation of current growth. Belgium has stated that it prefers to use data measured in the field (i.e. annual wood growth) instead of data obtained from yield tables taking into account the uncertainties involved.

# VI. Waste

## A. Sector Overview

70. In 2003, the Waste sector contributed 1.4 per cent of total GHG emissions in Belgium. Between 1990 and 2003 sectoral emissions declined by an estimated 44.27 per cent, mainly due to decreasing emissions of $CH_4$ from landfills, which fell by 65.1 per cent. $CH_4$ emissions from composting increased by 479.4 per cent over the period. The reporting is complete except for 6.B.1 Industrial Wastewater Handling and $CH_4$ recovery in the waste-water treatment plants. All the CRF tables are filled in from 1990 to 2003, although with some blank cells and only limited use of the notation keys. CRF table 8(b) provides all the recalculated estimates performed in the Waste sector and brief explanations are provided in the NIR but not in the CRF. Belgium is encouraged to fill in the CRF tables by using the appropriate notation keys where emissions estimates are not reported, and providing fuller information on recalculations performed.

71. The ERT noted that Belgium plans to improve the partitioning of the organic/inorganic waste fraction in Flanders; estimate the amount of $CH_4$ recovered in waste-water treatment plants; and improve the estimates of $CH_4$ from production of compost. It encourages Belgium to continue working to present the information in the NIR and the CRF so that AD, EFs, parameters and methodologies are provided in a nationally integrated fashion, and generally to improve the transparency, completeness and comparability of the inventory.

## B. Key categories

### 1. Solid waste disposal sites – $CH_4$

72. Belgium uses a country-specific model which is based on the first-order decay (FOD) method and considers emissions of industrial and municipal waste separately. The NIR includes references to most of the reports and data sources used. According to the NIR the same value for the biodegradation rate constant – k = 10 per cent – has been used for both municipal and industrial waste. However, arguments that justify the selection of that value and the use of the same value of k for both waste types are not provided. The degradable organic carbon (DOC) values reported in the NIR for different periods are country-specific and reflect the changing composition of waste in the country. However, the survey data, subsequent sampling results, and the composition of wastes are not included in the NIR, and no additional information is provided in CRF table 6.A. The fraction of degradable organic carbon ($DOC_f$) used in the estimation is 0.77, which is the default value indicated in the Revised 1996 IPCC Guidelines if lignin C is excluded from the DOC value. If lignin C is included in DOC, it is good practice to use a value of 0.5–0.6. Belgium has stated that it will check $DOC_f$, and the ERT encourages Belgium to continue to work on the estimation and determination of solid waste composition and also to perform an

analysis of the values used for the parameters in the estimation model and to adjust them, if possible, to the IPCC good practice guidance recommendations.

73. Sludge from waste-water handling is often disposed to solid waste disposal sites (SWDS). Emissions from this sludge should therefore be included under this category. Neither the NIR nor the CRF provides information on the destination of the sludge or gives any indication as to whether part of this is deposited in SWDS in Belgium. The ERT recommends Belgium to improve the information provided on the destinations of this sludge, and notes the intention to do this in the next NIR.

74. In CRF table 6.A, $CH_4$ recovery is not reported for the years 1990–1992 inclusive, and the value in 1994 and 1995 is reported as "0". No information on the trend of $CH_4$ recovery is indicated in the NIR. The ERT recommends Belgium to provide this information with a view to achieving greater transparency and understands that Belgium will provide this information in its next submission.

2. Other (composting) – $CH_4$

75. $CH_4$ emissions from compost production in Flanders have been estimated using regional AD combined with EFs taken from CITEPA (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) (20 kg $CH_4$/t compost). The $CH_4$ emissions from this source category show a increasing trend from 1990 to 2003 (+ 479.4 per cent) due to a mandatory moratorium on landfilling of organic waste in favour of composting. Neither the NIR nor the CRF provides transparent information on this source category, for example, on the characteristics of the compost production in the country, the form in which the AD were obtained, and the disaggregation of AD by waste type. The ERT considers that $CH_4$ emissions from compost production may be underestimated. It is apparent that compost production has only been considered for Flanders, whereas the NIR (page 77) would indicate that compost production also occurs in Wallonia. Belgium has stated that $CH_4$ emissions from composting in Wallonia will be included in its next submission. The ERT recommends Belgium to report the emissions and make the information on this source transparent in both the NIR and the CRF.

### C. Non-key categories

1. Waste-water handling – $CH_4$

76. $CH_4$ emissions from domestic and commercial waste water amounted to 3.7 Gg (5.8 per cent of $CH_4$ emissions in the Waste sector) in 2003. Two sources of $CH_4$ emissions have been considered: municipal waste-water treatment plants, and septic tanks. In municipal waste-water treatment plants, $CH_4$ emissions have been estimated using the methodology described in the EMEP/CORINAIR guidebook. $CH_4$ recovery has not been estimated because of lack of data. No information has been submitted on the fate of the sludge, for example, if some part of it is deposited in SWDS, nor is it possible to determine whether any industrial waste water is released into the domestic sewer system. The methodology used for the individual waste-water treatment plant (or septic tank) is based on a journal article (Vasel, 1992). The $CH_4$ EF used for estimating emissions from the source is 0.25 kg $CH_4$/kg biochemical oxygen demand (BOD), which is the EF recommended in the EMEP/CORINAIR handbook. According to the IPCC good practice guidance, it is good practice to use the default value of 0.25 kg $CH_4$/kg chemical oxygen demand (COD) or 0.6 kg $CH_4$/kg BOD. The ERT recommends Belgium as far as possible to use the values for Bo recommended in the IPCC good practice guidance for this source category.

77. The information submitted is very limited, thus reducing the transparency of the emissions estimates reported. The NIR contains no information on the AD, for example, on percentage of domestic waste water and sludge treated. Industrial waste water has not been considered because of lack of data. The ERT recommends that information submitted on this source category in the NIR and the CRF should be improved, completeness checked and alternative ways of estimating the emissions from industrial waste-water treatment explored. Belgium has stated that it will provide this information in future submissions.

### 2. Waste-water handling – $N_2O$

78. $N_2O$ emissions from waste-water handling amounted to 0.99 Gg in 2003. Emissions from domestic and commercial waste water have been estimated by using the methodology described in the EMEP/CORINAIR guidebook. $N_2O$ emissions from human sewage have been estimated following the method in the Revised 1996 IPCC Guidelines. According to the NIR, data on protein consumption per capita from the FAO statistics were used. However, the CRF specifies that data were available only for Wallonia and Flanders. The ERT recommends Belgium to clarify the origin and representativeness (regional or national) of the data used as this influences the emissions estimate made for this source category. The ERT notes that Belgium intends to clarify this in its next submission.

79. To avoid double counting, the amount of N that is applied to soils in the form of sewage sludge should be subtracted from the amount of N from sewage discharged to waste water. This cannot be analysed because the NIR does not give information on the destination of the sludge, and in particular does not specify whether some part of this was applied to soils in 2003. The ERT encourages Belgium to further improve the information provided for the $N_2O$ emissions estimates in this source category and understands that the 2006 inventory will be revised and the issue further investigated.

### 3. Waste incineration – $CO_2$ and $N_2O$

80. Emissions from this source amounted to 335.1 Gg $CO_2$ in 2003 (93.1 Gg $CO_2$ from flaring in the chemical industry and 242.1 Gg $CO_2$ from municipal waste incineration). The NIR discusses cremation in Wallonia and Brussels, and the incineration of industrial waste in Flanders, as additional categories, but from the information provided it is not clear whether emissions from these sources are included in the CRF or not. The amount of municipal waste incinerated in 2003 decreased by 73.4 per cent compared to 2002, but the amount in 2001 and the values for flaring in the chemical industry between 1994 and 2001, and in 2003, are not provided in CRF table 6.C. Belgium has stated that it would attempt to provide the missing amounts of municipal waste incinerated (2001), and the values for flaring in the chemical industry between 1994 and 2001 and in 2003, in its next submission. The ERT encourages Belgium to make the revisions.

81. $N_2O$ emissions from domestic waste incineration amounted to 0.08 Gg in 2003 and have been calculated using AD from the individual companies involved combined with a single EF taken from CITEPA. From the information provided it was impossible for the ERT to determine whether the EF used takes into account the characteristics of incinerators, as recommended in the IPCC good practice guidance. Belgium has stated that the EF was the value from CITEPA and that is does not take into account the characteristics of incinerators. The ERT recommends that the explanation be provided in the next NIR.

Annex

# Documents and information used during the review

## A. Reference documents

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

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

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UNFCCC. Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories, *and* Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention. FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

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

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

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

## B. Additional information provided by the Party

Responses to questions during the review were received from Ms. Miet D'heer (Flemish Environment Agency), including the following additional material on the methodology and assumptions used:

Hites, R. A., Santoro, M. A., Sturges, W. T., Oram, D. E., Penkett, S. A., Wallington, T. J., Shine, K. P., Brenninkmeijer, A. M.. Science 3, November 2000: pp 935-936.

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