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SPAIN

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN 2003[1]

(In-country review)

EXECUTIVE SUMMARY

1. This report describes the findings of the review of the 2003 inventory submission of Spain, 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. Spain submitted its annual inventory on 29 April 2003, consisting of common reporting format tables for the years 1990–2001 and the national inventory report.

2. The review took place from 29 September to 3 October 2003 in Madrid, Spain, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Mr. Carlos Lopez (Cuba); Energy – Ms. Anke Herold (Germany); Industrial Processes – Mr. Riccardo de Lauretis (Italy); Agriculture – Mr. Luis Gerardo Suarez (Mexico); Land-use Change and Forestry – Ms. Thelma Krug (Brazil); Waste – Mr. Oscar Paz (Bolivia). Ms. Anke Herold and Mr. Oscar Paz were the lead reviewers of this review. The review was coordinated by Ms. Rocio Lichte and Ms. Clemencia Licona-Manzur (UNFCCC secretariat).

3. In accordance with the UNFCCC "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 Spain, which provided comments that were considered and incorporated, as appropriate, in this final version of the report. Spain responded to a large number of issues identified by the expert review team by indicating that they are currently being considered in the preparation of its subsequent inventory.

4. In the year 2001, the most important greenhouse gas in Spain was carbon dioxide (CO_2), contributing 80.3 per cent to total[2] national greenhouse gas emissions expressed in CO_2 equivalent, followed by methane (CH_4) – 10.5 per cent – and nitrous oxide (N_2O) – 7.7 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 1.5 per cent of the overall greenhouse gas emissions in the country, with HFCs being the major contributor to this group of gases (with 1.4 per cent of the national total). The Energy sector accounted for 77.1 per cent of total greenhouse gas emissions, followed by Agriculture (11.2 per cent), Industrial Processes (7.3 per cent) and Waste (4.0 per cent).

5. Total greenhouse gas emissions (excluding Land-use Change and Forestry (LUCF)) amounted to 382,789 Gg CO_2 equivalent and increased by 33.1 per cent from 1990 to 2001. Tables 1 and 2 provide

[1] In the symbol for this document, 2003 refers to the year in which the inventory was submitted, and not to the year of publication. The number (2) indicates that this is an in-country review report.

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

data on emissions by gas and by sector from 1990 to 2001. Over this period, CO_2 emissions increased by 35.1 per cent, CH_4 emissions by 33.2 per cent and N_2O emissions by 10.7 per cent. Emissions from HFCs and SF_6 increased by 120 and 281 per cent, respectively, while those from PFCs decreased by 72.4 per cent. Emissions from fluorinated gases as a group increased by 74.3 per cent. Although emissions increased over this period as a whole, decreases occurred in 1993, 1996 and 2001. Spain explained these as being mainly the result of beneficial hydrological conditions in those years and their impact on electricity generation.

6. In its 2003 submission, Spain provided a complete set of common reporting format tables for 1990–2001 as well as a national inventory report. The national inventory report contains information on general methodology, the inventory principles followed, recalculations, results and key sources analysis, trends and comparison of the current inventory submission to the 2002 submission. For the review, Spain provided a methodological supplement structured according to CORINAIR SNAP[3] codes with detailed information on activity data, emission factors and methodologies used for the period 1990–2001. Only in this document is the key methodological information that is needed for the assessment of the inventory provided. This information represents a notable improvement compared with previous years. However, the review highlighted that certain areas need additional, more detailed explanations. Spanish experts were usually able to provide such explanations easily during the visit, so that the discussions on these areas should indicate where Spain can further improve its methodological descriptions. The expert review team expects that the information included in the methodological supplement will be incorporated in future into the national inventory report, in accordance with the guidance on the structure of the national inventory report provided in the UNFCCC reporting guidelines adopted by decision 18/CP.8 of the Conference of the Parties.

7. The Directorate-General for Environmental Quality and Assessment of the Ministry of the Environment has the overall responsibility for the national inventory and plays the role of inventory agency. It is assisted by a consulting firm (Analisis Estadisticos de Datos, S.A (AED)), which undertakes, among other things, the actual inventory preparation. Other ministries and institutions, such as business associations, are also involved in the preparation of the inventory, mainly in the provision of activity data. However, frequently no information on methodologies, quality assurance/quality control (QA/QC) procedures or the exact data sources used by these institutions exists within the inventory agency, and further work is needed on transparency and quality assurance/quality control for these parts of the inventory.

8. Improved institutional arrangements and possibly a legal basis for the supply of data to the national inventory agency should be considered in the future in order to guarantee a stable supply of information for the preparation of the inventory, as well as complete and consistent time series.

9. The methodologies used and reporting are largely consistent with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines), the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the UNFCCC reporting guidelines for national greenhouse gas inventories. Important parts of the IPCC good practice guidance have not yet been fully implemented, for example, uncertainty assessment and the establishment of a quality assurance/quality control system, but work has already started and the expert review team encourages Spain to complete the implementation of the IPCC good practice guidance as soon as possible.

10. Regarding the organization of the national inventory database and data flow, the expert review team was already able to check that the database is consistent and that it has appropriate quality control. The system for documenting inventory information has also been implemented to a great extent, and the

[3] SNAP: Selected Nomenclature for Air Pollution.

expert review team was able to check its operation by making searches. Further improvements are planned by Spain which are likely to produce a reliable and operational system.

11. Spain has a centralized archiving system for its inventory preparation, maintained by the Sub-Directorate-General of Environmental Quality of the Ministry of the Environment. During its visit the expert review team received detailed information on the contents and functioning of the archiving system, which is sufficiently developed to be functioning. Although not yet completely developed, it represents an important part of the quality assurance/quality control activities that are currently being introduced.

12. The Party itself has already identified major areas for improvement at the more general and sectoral level of the inventory and achieved by its own analysis an overview of problems and weaknesses that is fairly complete. The expert review team fully supports these findings and the ongoing efforts in the major areas for improvement identified, which should be reflected in Spain's forthcoming inventory submissions in 2004 and 2005. In addition, the expert review team recommends that Spain elaborate an inventory improvement plan as part of the quality assurance/quality control system where all areas for improvement are clearly documented, as well as responsibilities, ways of resolving the issues identified and timelines for implementing the planned improvements.

13. The most relevant improvements are those related to the verification and completion of the available data and information, as well as examination of the possibilities of using more advanced tiers and more specific methods where recommended by the IPCC good practice guidance, in particular for the Spanish key source categories, for example, some sources within the Industrial Processes sector (aluminium production and iron and steel production). The Industrial Processes sector would also benefit from further investigations of the country-specific emission factors in some areas and from improved collection of data on consumption of fluorinated gases (e.g., for refrigeration). Although detailed methodologies and models are applied in the Agriculture sector, the inventory would also gain in accuracy and quality if more country-specific agricultural practices and parameters were used in estimating the emissions.

14. In the Energy sector, the expert review team considers that the national process by which the Ministry of Economy compiles the country's energy statistics is not sufficiently transparent and that the transparency of the methodologies used for collecting and compiling the underlying energy data, as well as for completing the International Energy Agency (IEA)/Eurostat questionnaires, needs to be further improved. The expert review team supports all the sector-specific planned improvements identified by Spain, which cover the major sectoral weaknesses.

15. The sector where the greatest additional efforts from Spain are needed, and are currently ongoing, is the LUCF sector. For 5.A Changes in Forest and Other Woody Biomass Stocks, data collected by a different method will be available soon, which will allow significant improvements to these estimates. However, it is unlikely that these improvements will also facilitate reporting of the other LUCF categories because conversion data and information on management practices that affect soil carbon will still be lacking and because of the current land classification system. The expert review team recommends that Spain undertake efforts to improve its land classification in order to allow a clear distinction to be made between forest land, grassland, crop land and other categories, and to meet the IPCC reporting requirements. The expert review team also recommends that Spain make additional efforts to estimate CO_2 emissions and removals from soils because, even with the ongoing efforts to create a soil carbon stock database, it is not anticipated that the emissions/removals from soils will be provided in the next upcoming inventories.

16. In the Waste sector, the quality of the inventory would benefit from improvements to the emission factors for solid waste disposal and waste-water handling and more transparent documentation of the choice of parameters in the national inventory report. Spain should also review its system for estimating CH_4 recovery from landfills, which currently leads to an underestimation of CH_4 emissions from landfills.

Table 1. Greenhouse gas emissions by gas, 1990–2001

GHG emissions	(Gg CO_2 equivalent)												Change from 1990–2001 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
CO_2 emissions (with LUCF)[(a)]	198 147	204 970	212 936	203 22	213 457	225 133	212 631	232 447	241 351	266 259	278 948	277 995	40.3
CO_2 emissions (without LUCF)[(a)]	227 400	234 222	242 189	232 474	242 710	254 485	241 883	261 699	270 603	295 512	308 200	307 247	35.1
CH_4	30 285	30 562	31 609	32 003	33 080	33 758	35 425	36 452	37 698	38 089	39 316	40 329	33.2
N_2O	26 636	26 389	25 644	23 732	25 959	25 690	28 006	27 361	28 080	29 410	30 799	29 483	10.7
HFCs	2 403	2 179	2 762	2 258	3 458	4 645	5 196	6 125	5 809	7 163	8 171	5 287	120.0
PFCs	828	787	781	793	785	790	758	784	749	695	404	228	–72.4
SF_6	55	61	63	67	75	93	101	121	140	185	211	212	280.8
Total (with CO_2 from LUCF)	**258 356**	**264 950**	**273 798**	**262 077**	**276 816**	**290 110**	**282 120**	**303 293**	**313 829**	**341 804**	**357 851**	**353 536**	**36.8**
Total (without CO_2 from LUCF)	**287 608**	**294 202**	**303 050**	**291 330**	**306 069**	**319 363**	**311 372**	**332 545**	**343 081**	**371 056**	**387 104**	**382 789**	**33.1**

[a] LUCF = Land-use Change and Forestry

Table 2. Greenhouse gas emissions by sector, 1990–2001

GHG source and sink categories	(Gg CO_2 equivalent)												Change from 1990–2001 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
1 Energy	216 943	224 356	234 037	224 575	233 166	244 815	232 346	251 636	259 501	283 914	296 516	295 177	36.1
2 Industrial Processes	22 560	21 405	20 123	18 580	22 320	24 743	24 952	26 686	27 420	29 585	30 698	27 849	12.3
3 Solvent Use	1 329	1 349	1 347	1.273	1 310	1 355	1 442	1 523	1 635	1 673	1 706	1 627	22.4
4 Agriculture	37 373	37 181	36 904	35 600	37 537	36 776	40 262	39 589	40 943	41 923	43 642	42 987	15.0
5 LUCF[a]	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	–29 252	0.00
6 Waste	9 401	9 910	10 637	11 299	11 734	11 672	12 369	13 109	13 580	13 959	14 540	15 146	61.1
7 Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

[a] LUCF = Land-use Change and Forestry

I. OVERVIEW

A. Inventory submission and other sources of information

17. Spain submitted a national inventory report (NIR) on 29 April 2003. The NIR contains information on general methodology, the inventory principles followed, recalculations, a key source analysis and an annex on carbon dioxide (CO_2) removals. Spain also submitted a complete set of common reporting format (CRF) tables for the years 1990–2001. Where needed, the expert review team (ERT) used information from the 2002 inventory submission.

18. In addition, for the review Spain provided a methodological supplement structured according to CORINAIR Selected Nomenclature for Air Pollution (SNAP) codes with additional information on activity data (AD), emission factors (EFs) and methodologies used for the period 1990–2001. This document contains the key methodological information for the assessment of the inventory.

19. During the review Spain provided the expert review team (ERT) with additional sources of information and explanations. This information is not part of the inventory submission but is in many cases referenced in the NIR. The full list of materials used during the review is provided in annex 1 to this report.

B. Key sources

20. Spain has reported a key source tier 1 analysis, both level and trend assessment, as part of its 2003 submission. The key source analyses performed by the Party and the secretariat[4] produced different results, mainly in the Energy sector. The main reason for the differences is that Spain chose a higher level of disaggregation of source categories while the secretariat applied the aggregation level provided in IPCC good practice guidance for tier 1. Although the level of disaggregation in the key source analysis has been chosen in such a way that important changes in individual sources can be discerned (e.g., the introduction of diesel in the transportation sector), the key source analysis is not yet clearly linked with the priority-setting for inventory improvement. Spain is already developing actions to improve this.

21. The ERT recommends that Spain perform a tier 2 key source analysis after completion of the uncertainty assessment and further enhance the use of qualitative criteria in the identification of key sources.

C. Cross-cutting topics

22. Methodologies used and reporting are largely consistent with the IPCC Guidelines, the IPCC good practice guidance and the UNFCCC reporting guidelines for national greenhouse gas (GHG) inventories. CORINAIR methodologies and EFs are also used. Important parts of the IPCC good practice guidance have not yet been fully implemented, for example, uncertainty assessment and the establishment of a quality assurance/quality control (QA/QC) system. The ERT encourages Spain to complete the implementation of the IPCC good practice guidance as soon as possible.[5]

Completeness

23. In general, the inventory covers all years, gases and sectors, and most of the source categories, and is complete with regard to geographical coverage. However, the estimation of emissions and

[4] 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.

[5] According to the conclusions of the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its twelfth session, Annex I Parties should use the IPCC good practice guidance for inventories due in 2003 and beyond (FCCC/SBSTA/2000/5, para. 48(c)).

removals in the LUCF sector is incomplete, and categories 5.B Forest and Grassland Conversion, 5.C Abandonment of Managed Lands, and 5.D CO_2 Emissions and Removals from Soil have not been estimated. The inclusion of categories 5.B and 5.D in particular could have a significant impact on the inventory total (including LUCF). Non-CO_2 emissions from anthropogenic forest fires are also not reported. In the Energy sector, emissions from military energy use are not estimated and it is unclear if military fuel consumption is included in the AD used. In the Industrial Processes sector, potential emissions for fluorinated gases (F-gases) are not estimated (because the required data are lacking), nor are emissions from limestone and dolomite use (only partial information is available), asphalt roofing and road paving (no CO_2 EF is available), or methane (CH_4) emissions from ethylene and styrene production. In addition, some minor subcategories are not estimated ("NE"), as explained in the sectoral sections of this report. The ERT recommends Spain to estimate emissions from the source categories that are not yet estimated as soon as possible, in particular those categories that contribute to the total emissions and that may not be negligible.

24. The use of notation keys has improved compared to previous submissions, although in the CRF a number of cells are still left blank. Limited additional information and a few explanations in the documentation boxes are provided in some tables of the CRF (e.g., incineration and waste-water handling in the Waste sector). The ERT encourages Spain to further improve the use of the notation keys and the presentation of additional information in the CRF.

Transparency

25. The information received for this review, especially that contained in the methodological supplement, represents a notable improvement compared with previous years. Assumptions, methodologies, data sources, AD and EFs are mostly explained clearly in the methodological supplement.

26. The structure of the methodological supplement is based on SNAP codes. Although all underlying information has generally been provided with a great level of detail, together with relevant information on the SNAP nomenclature, this structure affects the transparency of the submission for the purposes of the UNFCCC review. The transparency and comprehensiveness of the NIR would be significantly improved if part of the information currently included in the methodological supplement were included in the actual NIR. It is expected that this problem will be overcome once Spain follows the structure for the NIR that is outlined in the revised UNFCCC reporting guidelines and once the NIR incorporates the methodological information that is currently in the supplement.[6]

27. Although in general the information submitted facilitates replication and assessment of the inventory, in some categories more detailed explanations or additional information are necessary, for example, in relation to the sources of factors used in country-specific methods in the LUCF sector, or livestock characterization in the Agriculture sector. The ERT encourages Spain to further improve the transparency of its inventory.

28. Regarding the institutional arrangements, the information on the activities of and data compilation performed by other government institutions (e.g., other ministries) is sometimes not transparent or they are not documented, for example, the process by which the Ministry of Economy compiles the national energy statistics.

29. For some source categories and for uncertainties, expert judgement is used. However, no protocols for eliciting the opinion of experts are available and the documents provided do not explain how the IPCC good practice guidance is followed. The ERT recommends Spain to implement the methodological recommendations for expert judgement included in the IPCC good practice guidance.

[6] In accordance with decision 18/CP.8, the revised UNFCCC reporting guidelines on annual inventories (adopted by the same decision) should be used by Annex I Parties as of their inventory submissions due by April 2004.

30. During the presentations of the inventory, Spain provided additional explanations which are not included in the NIR. The ERT recommends Spain to incorporate some of those explanations in the NIR and its annexes for the benefit of future reviews, as indicated in the sectoral sections of this report.

31. During the review Spain clarified issues related to confidentiality. Data in some categories of the Industrial Processes sector are confidential when the source category involves data from fewer than three plants. In these cases, industry provides confidential data (AD and basic parameters) to the Ministry of the Environment (MoE) for the estimation of GHG emissions. To avoid disclosure of this information, the data and corresponding emissions estimates are presented at a higher level of aggregation. This does not, however, affect the completeness of the inventory. The ERT recommends Spain to work to reduce the amount of confidential data, for example, to make estimates available at a disaggregated level for historic years when production data have become less sensitive.

Recalculations and time-series consistency

32. The ERT noted that the recalculations reported for the years 1990–2000 were undertaken to take into account the revision of statistics, which in this submission was the main reason for recalculations, as well as methodological changes (factors and algorithms) and the elimination of errors. The major changes include the following. For large point sources, errors detected in the questionnaires for the years 1990–2000 have been corrected. Revised AD have been incorporated in the figures for road transport (1990–1996), natural gas transport and distribution (1990–2000), agricultural production and crop surfaces (1990–2000), and cattle (1990–2000). The preliminary figures of the energy balance for 2000 have been replaced by final energy data. The energy balance published by the IEA, on which AD in the Energy sector are usually based (see paragraph 55), is not yet available by the time the inventory is compiled. Energy data for the most recent years are therefore always preliminary and will be recalculated in the next inventory submission.

33. Both the CRF and the NIR provide explanations for all recalculations performed. The recalculations improved the consistency of the time series and the reliability of emissions estimates and trends. They have resulted in an upward revision of the total emissions for 1990 by 0.41 per cent (0.46 per cent including LUCF), while total emissions for the year 2000 have been revised upwards by 0.3 per cent, compared to the 2002 submission.

34. The information provided seems mostly consistent. The same methodologies and data sets are used for the base year and all subsequent years. However, because little information is available on the AD compiled by other ministries, it is possible that differences in the time series of data sets are not appropriately reflected.

Uncertainties

35. No quantitative uncertainty assessment, as required by the IPCC good practice guidance, has been conducted so far. In CRF table 7, qualitative uncertainty estimates using the indicators high (H), medium (M) and low (L) are provided. This qualitative analysis is based on the system of qualitative levels used in EMEP–CORINAIR which takes into account the classification of AD and EF quality levels.

36. Spain is working on a quantitative uncertainty assessment and the detailed process was explained to the team during the visit. The ERT encourages Spain to finalize the uncertainty analysis as soon as possible.

Verification and quality assurance/quality control approaches

37. Spain does not report on QA/QC procedures applied. The review showed that QA/QC activities are in fact performed, for example, checks for input errors and comparisons of time-series data for updated information, as well as source-specific QA/QC activities. Some QA/QC checks are incorporated in the database, and questionnaires include additional information that is used for checking the reliability

of the data provided. However, Spain has not yet systematically implemented QA/QC procedures as recommended by the IPCC good practice guidance. It is currently working on their implementation and a manual of QC procedures is being prepared. The ERT recommends Spain to finalize this work and to implement all QC procedures recommended by the IPCC good practice guidance. Spain should also improve the documentation and reporting of QA/QC procedures performed at the general as well as at the sectoral level in its future NIRs.

38. As part of the verification activities carried out, Spain presented a project conducted by the Polytechnical University of Madrid (the Spanish Emissions Projection (SEP) project) which reconstructed the GHG emissions time series of the inventory independently for the purpose of developing projections until the year 2020. The results obtained made it possible to check the quality of the emissions estimates. The SEP project concluded that the inventory is of high quality, that coordination between the inventory agency and the ministry is excellent, and that the inventory team was able to answer all questions raised. However, the project also found a lack of transparency in some areas, inconsistencies in data on national maritime transport as a result of transcription errors, omissions in some subcategories (e.g., the omission of military use of fuel in the Energy sector), and misallocations, and requested more extensive documentation of the model used in the Agriculture sector.

39. Spain explained that several regions (Comunidades Autónomas) are also developing inventories, some of which (e.g., Galicia, Pais Vasco) are already advanced. It is planned to use these activities at regional level for verification purposes in the future.

Institutional arrangements

40. The Directorate-General for Environmental Quality and Assessment (Sub-Directorate-General of Environmental Quality) of the MoE has overall responsibility for the national inventory, including responsibility for disseminating the inventory results to domestic and international organizations. This Sub-Directorate carries out the role of inventory agency. The actual calculation of emissions, inventory preparation, database maintenance and documentation, among other tasks, are carried out by a consulting firm (Analisis Estadisticos de Datos, S.A (AED)) which provides technical assistance to the MoE. Close and efficient cooperation occurs between the two institutions, and the ministry is fully aware of the technicalities, methodological issues and problems related to the inventory data.

41. Other ministries and institutions also involved in the preparation of the inventory, mainly in the provision of AD, are the following: the Ministry of Agriculture, Fisheries and Food (agriculture and cattle), the Ministry of Economy (energy and general statistics), the ministries of Infrastructure and Interior (transport), the Ministry of Science and Technology (industrial processes), and other directorates of the MoE, namely the Directorate-General of Hydraulic Works and Water Quality (waste water) and the Directorate-General for Conservation of Nature (category 5.A of LUCF). Business associations contribute data for different sectors of the inventory, in particular in the industry sector.

42. Besides official statistics, the main domestic sources of information and data for the preparation of the inventory are the following: questionnaires to plants (especially to the large point sources), information from other regional or sectoral inventories, interviews with representatives of different sectors, and information from studies, published reports and the scientific literature.

43. The role of the above-mentioned organizations, associations etc. in the inventory preparation process is to supply basic AD as well as emission parameters and information on emissions measurements (for the sources with this type of data). However, frequently no information on methodologies, QA/QC procedures or the exact sources used by these institutions for data compilation exists within the inventory agency (a case in point is the Ministry of Economy which compiles the national energy statistics). The ERT recommends Spain to intensify the cooperation with the other organizations that contribute AD in order to implement the IPCC good practice guidance by confirming that all organizations involved in the inventory preparation are following the required QA/QC procedures.

44. Spain considers that the current institutional arrangements meet the needs of inventory preparation. However, at present no legal basis or mandatory obligation exists for the supply of data for the inventory. The collection of AD needed for the inventory is partly included in the annual National Statistical Plan, and thus has official status. In the Energy sector, the inventory agency explained that the availability of data is diminishing as a result of liberalization of the energy market. Under these circumstances, a legal basis may be considered necessary in order to guarantee data availability, completeness and consistent time series in future. The ERT recommends that Spain further improve the institutional arrangements and the legal basis for its data collection in order to guarantee a stable supply of information for the preparation of the inventory and that it increase the institutional support that the inventory team receives in order to carry out this task.

Record keeping and archiving

45. Spain has a centralized archiving system for its inventory preparation. This is maintained by the Sub-Directorate-General of Environmental Quality. During its visit the ERT received detailed information on the contents and functioning of the archiving system. The documentation and archiving system are developed far enough to be functioning and, although their development is not yet complete, it represents an important part of the QA/QC activities that are currently being introduced.

46. All information is documented, partly in electronic form, partly in hard copy. All sources are classified and listed in order to be retrievable. The documentation system will be further improved, for instance, as regards the resolution of some internal issues relating to centralization of the system, the retrieval of information, and the operation of the documentation system within the MoE. The ERT made some searches in the documentation system to check its operation and in most instances was able to retrieve the documents requested.

47. The ERT was also given information on the organization of the national inventory database and on the data flow from the point at which the data are received until they are filed. The checks made by the ERT to this system indicated that the database is consistent and that it has an appropriate control of quality.

Follow-up to previous reviews

48. The ERT noted major improvements in this inventory submission compared to the 2002 submission with regard to the transparency and quantity of information, which was largely due to the submission of the methodological supplement, as well as with regard to completeness and the use of notation keys.

49. The team also noted, however, that major issues identified in previous inventory reviews, such as the lack of documented QA/QC procedures and quantitative uncertainty assessment, have not yet been addressed in the 2003 submission.

D. Areas for further improvement

Identified by the Party

50. Spain identified several areas for improvement, as follows:

(a) Implementation of QA/QC procedures and uncertainty assessment;

(b) Verification and completion of the available information (for examples see issues addressed in the sectoral sections under “Areas for further improvement identified by the Party”);

(c) Examination of the possibilities of using more advanced tiers and more specific methods, for example, to take into account country-specific agricultural practices and parameters in the estimation of emissions from the Agriculture sector;

(d) Improvement of the completeness and transparency of the NIR;

(e) Continued development of and improvements to the documentation and archiving system (cataloguing, search and retrieval);

(f) Completion of the correct use of notation keys in the CRF.

51. Further areas are identified in the sectoral sections of this report. The ERT supports the ongoing efforts by Spain in these areas. These improvements are expected to be implemented for forthcoming submissions (2004/2005). However, the ERT recommends that Spain elaborate an inventory improvement plan as part of the QA/QC system where all areas for improvement are clearly documented as well as responsibilities, ways of resolving the issues and timelines for implementing the planned improvements.

Identified by the ERT

52. The ERT also considers that the following additional improvements are necessary. Spain should:

(a) Estimate emissions of source categories that are not reported in the inventory in order to improve the degree of completeness – for example, for emissions from military fuel use; emissions of halocarbons and SF_6 from semiconductor manufacture; potential emissions of HFCs, PFCs and SF_6; CO_2 emissions from soils and non-CO_2 gases in the LUCF sector – and reallocate emissions to the appropriate source categories where allocation errors were detected. It is also recommended that additional data/information be provided in the NIR to improve transparency, as indicated in the sector sections of this report;

(b) Provide more detail about and precise descriptions of those of its methodologies that differ from the IPCC Guidelines. References should be provided in the NIR to all methodologies, parameters and AD used;

(c) Improve cooperation between the institutions involved in the preparation of the inventory in order to improve background information on sources, methods, uncertainties and so on (e.g., the national energy data);

(d) Continue working on the establishment of the institutional and legal arrangements that guarantee a stable supply of information for the inventory preparation, and increase the institutional support the inventory team receives to carry out this task;

(e) Continue working to improve the transparency of the inventory;

(f) Conduct periodic studies to update nationally developed EFs, for example, in the Agriculture and Waste sectors;

(g) Reduce the amount of data that are treated as confidential in the Industrial Processes sector.

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

II. ENERGY

A. Sector overview

54. The Energy sector is the major contributor to total emissions in Spain. It represented 75 per cent and 77 per cent of Spain's total emissions in 1990 and 2001, respectively. Energy emissions increased by 36 per cent over the period 1990–2001.

55. The central responsibility for the collection of energy data lies with the Ministry of Economy, which provides the responses to annual questionnaires sent out by IEA and Eurostat. They in turn send their energy balances to Spain, and these are basis for Spain's emission estimates in the Energy sector. No national energy balance is produced by the Ministry of Economy itself. There is no specific legislation that requires the preparation of an energy balance. However, energy statistics are part of the annual national statistical plan. The submission of data to the national government therefore has an official character. For the purpose of the inventory, the national inventory team of the MoE produces a more disaggregated energy balance on the basis of IEA/Eurostat data and plant-specific information received directly from industry by the MoE Directorate-General for Environmental Quality and Assessment.

56. The responsibilities within the inventory agency for the Energy sector are clear, methods and data are well documented, and QA/QC activities are performed. However, little information is available related to the activities conducted by other national authorities, especially the Ministry of Economy, which compiles the national energy statistics. Frequently no information is available on methodologies, QA/QC procedures or exact data sources used by this ministry. The transparency of the energy information compiled from the Ministry of Economy should be improved for future NIRs, and QA/QC procedures should be applied and reported. This will require improved cooperation from the ministry.

57. The effects of this situation on the reliability of the energy estimates are limited as the inventory agency gathers additional energy data independently and this is later cross-checked with other sources. Regular meetings with industry and other national authorities are intended to address and overcome any problems identified by such verification procedures.

Completeness

58. The CRF includes estimates of most gases and sources of emissions from the Energy sector, as recommended by the IPCC Guidelines. Spain does not estimate emissions from military energy use. The inventory agency does not know if military fuel consumption is included in the national energy balance. Further information should be obtained. Spain reports all emissions from municipal waste incineration in the Energy sector, including those incinerators where the resulting energy is not used. It is not clear if the volume of combustion of waste fuels included in the Energy sector is complete as waste fuels are not included in the energy balance and emissions from industrial waste were not included in the Waste sector. The inventory does not estimate emissions from some source categories, for example, CO_2 emissions from 1.B.1.a Coal Mining and Handling, and in category 1.B.2 Emissions from Venting and Exploration, and part of Gas Flaring (exploration and production), because of a lack of data for some sub-sources and because emissions are considered as minor. Future NIRs and CRFs should provide justifications as to why certain emissions are considered negligible, along with the appropriate notation key ("NE").

59. The inventory agency receives responses to questionnaires with plant-specific energy and emissions data from large point sources. This plant-specific information is used for the estimation of energy consumption and emissions in the different source categories under Manufacturing Industries and Construction (bottom–up approach). Coverage of plant-specific information is complete for public power production and refineries. Coverage is not, however, complete for some industrial sectors, including the chemical and iron and steel industries (only integrated steel plants are covered). The inventory agency should try to achieve more complete coverage also in those sectors where it is incomplete.

60. The liberalization of the energy market has had a negative effect on the completeness of data collection in the Energy sector. The number of companies in the energy market is increasing considerably, and the authorities may not always be aware of the existence of new companies which have to be included in the reporting system. This situation should be further examined, especially for

liberalization of the gas market, and additional legislative action in relation to reporting may be necessary if problems remain or increase.

Transparency

61. The information provided in the NIR and the methodological supplement is not sufficiently transparent to enable the ERT to reconstruct all estimates. However, the presentations made by Spain during the visit provided clearer, more focused and more detailed information than the methodological supplement, for example, on the data sources used, methodological descriptions, source-specific QA/QC processes and planned improvements. This information provided to the ERT should be integrated in Spain's future NIRs.

62. The national process of compiling energy statistics is not very transparent and there is little information available as to how the Ministry of Economy compiles the questionnaires that are sent to IEA and Eurostat. The transparency of the methodologies used for compilation of the underlying energy data should be improved.

63. The inventory agency explained that the CO_2 EFs for fuels for different sectors and plant types reported in the methodological supplement are of an indicative character and represent CORINAIR default EFs for the respective source categories. These EFs are not related to the CO_2 EF used for the estimation of emissions in the Energy sector. The carbon EFs reported in the reference approach table represent the country-specific EF at aggregated level based on the plant-specific information received on carbon contents. The way in which EFs are currently reported is confusing, and in the future the NIR should clearly identify which data correspond to default emission factors used in the estimation and which ones correspond to average implied emission factors reported for other purposes.

Recalculations and time-series consistency

64. The AD provided in the methodological supplement in some cases show significant fluctuations or data gaps which may indicate inconsistent time series. However, the inventory agency was able to explain the fluctuations and gaps highlighted by the review team as being due to the development of activities. Because of the high level of disaggregation of the data provided, the temporary operation of individual plants has a strong impact and explains time-series fluctuations.

65. The IEA energy balance, which is the source for Spain's AD in the Energy sector, is not yet available for the most recent year when the inventory is compiled. Energy data for the most recent year are always preliminary and will be recalculated in the next inventory submission.

Verification and quality assurance/quality control approaches

66. The NIR and the methodological supplement do not include information on source-specific QA/QC procedures. However, such procedures are conducted. On the basis of plant-specific data from responses to questionnaires, the inventory agency compares consumption and emissions data as well as EFs with other data sources (e.g., energy data from the Ministry of Economy). In addition, questionnaires used by the inventory agency include several consistency checks that enable verification of AD and EFs reported by individual plants. These source-specific QA/QC procedures in the Energy sector should be mentioned in the NIR.

67. In the future it will be possible to use EPER (the European Pollution Emissions Register) data for additional verification exercises and consistency checks. Spain indicated that the possibilities of doing so are currently being studied. Plant-specific data from questionnaires can be compared with data reported by the same plants to EPER. However, the coverage of EPER only includes plants with more than 100,000 t of CO_2 emissions per year. Data were recently submitted to the European Commission for the year 2001. Descriptions of any results from comparisons of information provided in the questionnaires and information obtained through EPER would enhance the quality of the estimates in the Energy sector.

B. Reference and sectoral approaches

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

68. Although the deviations reported for CO_2 emissions for the comparison of the reference approach with the sectoral approach for 2001 are small, the inventory agency reported that the differences between the two approaches are currently under investigation and no final explanations could be provided. Further information on the reasons for the differences and the fluctuations in those differences for different years should be provided in the NIR once this investigation is finalized. During the review a transcription error for the natural gas stock was discovered which should be corrected in the next submission.

International bunker fuels

69. The inventory agency uses the data provided by IEA for international aviation bunkers and domestic aviation. The split between domestic and international aviation is reported by the Ministry of Economy to IEA. No information is available on the methods and data used by the ministry to distinguish between domestic and international. Further clarification should be obtained in future and reported in the NIR. Spain started to elaborate a method for aviation based on the landing/take off (LTO) cycles of each aircraft, but this method currently only covers the airport of Madrid and does not include information on the origin and destination of flights. The information on fuel consumption used in this more detailed approach is again based on information reported by the Ministry of Economy. An improved estimate for international aviation could be obtained in future using a higher-tier method for aviation based on consumption and distances for individual flights. The inventory agency should explore further possibilities of cooperation at the European level in order to implement a higher-tier approach.

70. A national method is used to distinguish domestic navigation from international marine bunkers. For fuel oil and gas oil, consumption data from the energy balances provided by IEA and/or Eurostat, as well as additional information from ANAVE, the mercantile association, are used (the source that reports the larger consumption is chosen). The association collects data on fuel consumption for each national-registered vessel in domestic navigation. Some distances travelled by international vessels which visit two Spanish ports in succession are not included in these data, nor are international operators of domestic naval transport. However, these cases are considered to be unusual and not very relevant. The national port authority indicated that it intends to investigate the improvement of data collection in ports in relation to the origin and destination of vessels for the purposes of the inventory, which should make it possible to improve the estimation method for domestic navigation and international marine bunkers in future.

Feedstocks and non-energy use of fuels

71. The estimates for feedstocks reported in reference approach table 1.A.(d) of the CRF are the values reported by the Ministry of Economy to IEA/Eurostat, and no detailed information exists about how these values are compiled. Emissions estimation for petroleum refining and iron and steel production is based on plant-specific data obtained from questionnaires. For some feedstocks, especially petroleum coke, natural gas and blast furnace gas, the disaggregated energy balance produced by the inventory agency constantly reports considerable statistical differences that indicate higher final consumption than fuel input. This seems to indicate double counting of feedstocks in the estimation system. Further analysis should be conducted on the non-energy use of fuels. Further information should be provided by the Ministry of Economy as to how the data on non-energy use reported to IEA/Eurostat are compiled.

72. The IPCC Guidelines indicate that the IEA data generally cover only deliveries to the industry sector for the manufacture of non-energy products, but that some of the fuels delivered will be oxidized by the user. If the reporting by the Ministry of Economy is based on this assumption, the inventory agency should collect additional national data on the use of non-energy products, as the data reported to IEA would not distinguish between fuels combusted and fuels incorporated in products.

C. Key sources

Stationary fuel combustion

1.A.1 Energy industries: oil, coal, gas, biomass – CO_2

73. Spain uses country-specific carbon EFs for most fuels (except feedstocks) which are based on detailed plant-specific data. The plant-specific data come from measurements of carbon contents. In most cases the complete fuel composition and data for calorific values are available to the inventory agency. This is consistent with the requirements of the decision tree in figure 2.2 of the IPCC good practice guidance.

74. Updated data should be gathered for biomass use as the current AD are extrapolated from estimates for 1991 and 1995. This task is already included in the planned improvements (see also paragraph 99, where all the improvements being considered by Spain that are relevant for stationary fuel combustion are addressed).

Public electricity and heat production: coal – CO_2

75. The range for the EF for refinery gas provided in the methodological supplement is wrong and should be corrected in future submissions.

76. This category includes energy use from waste incineration. With regard to the methodology used to separate fossil and biogenic waste fractions, a national source is used which estimates that 36 per cent of CO_2 from waste is of fossil and 64 per cent of biogenic origin. The methodological supplement does not provide a clear reference for these fractions or explain which method was used to derive these fractions or whether the underlying study is representative for all types of waste, regions and plants. Nor does it mention when this study was conducted. Spain should provide improved evidence for the selection of fossil and biogenic fractions.

Petroleum refining – CO_2

77. For fuel consumption in refineries, plant-specific data from questionnaires are used.

Manufacture of solid fuels and other energy industries – CO_2

78. Spain reports that the time series of carbon content for coke is not consistent and is based on two different, independent sources. The IPCC good practice guidance should be followed in order to achieve time-series consistency between different data sets for different years. Spain indicated that it has already taken steps to verify and amalgamate the information on the characteristics of coke.

1.A.2 Manufacturing industries and construction: oil, coal, gas – CO_2

79. For iron and steel, non-ferrous metals and chemicals, the SNAP structure divides the methodology according to different codes to reflect different processes. This type of documentation is not sufficiently transparent to allow analysis of the methodology for estimating this source in the short time provided during the review.

80. For non-ferrous metals the implied emission factors (IEFs) for all fuels are very high. This is the result of EFs per unit of manufactured product being used instead of an EF per unit of fuel used. The units of manufactured product are then converted to energy use by specific ratios and a fixed allocation to fuel types. The ERT recommends Spain to review the assumptions of this approach. For chemicals an error was detected, and CO_2 emissions from solid fuels were not included in the estimation. This should be corrected in future submissions.

1.A.1 Energy industries and 1.A.2 Manufacturing industries and construction – N_2O

81. The methodological supplement explains for nitrous oxide (N_2O) that default EFs (mainly CORINAIR) were used based on the fuel used and the fuel consumption. Some technology

disaggregation occurs with regard to boiler size or turbine use. For key source categories, the IPCC good practice guidance requires fuel consumption data by technology type to be gathered for non-CO_2 emissions (decision tree figure 2.3) and specifies that country-specific EFs should be used. Although it is acknowledged that there is a general lack of detailed information on N_2O EFs from these industrial sources in the IPCC Guidelines, Spain should further clarify in the methodological description in future years to what extent the IPCC good practice guidance is followed.

82. For liquid fuels the N_2O IEF is comparatively high at 10.1 kg/TJ: the average across the Parties for 2001 is 3.7 kg/TJ. However, Ireland, Greece and Belgium have IEFs of similar range. The information provided on the choice of N_2O EF in the methodological supplement is not sufficient to allow the ERT to analyse this issue further. Further explanation on the method and the choice of EF should be provided.

1.A.3 Road transport – CO_2 and N_2O

83. Spain uses the COPERT III model for the estimation of emissions from road transport. The model uses EFs based on vehicle categories, fuel types, driving modes, temperature and other parameters. Data on the disaggregated vehicle fleet are provided by the Directorate-General on Traffic (Ministry of Internal Affairs), data for fuel combustion are taken from the IEA/Eurostat energy balances, data on transport modes are provided by the Directorate-General of Roads (Ministry of Infrastructure), EF and data on fuel use come from COPERT III model parameters, and data on temperatures are taken from the MoE. The use of COPERT (tier 3) is consistent with the recommendations of the IPCC good practice guidance for N_2O as a key source in road transportation.

84. The problems identified by Spain with the input parameters to COPERT III are the lack of consistency of time series, different geographical disaggregation of data sets and the disaggregation of vehicle categories. In addition to the input parameters, Spain should also consider using some country-specific EFs besides the COPERT default EF.

85. A number of input parameters to the COPERT model for estimating N_2O emissions from gasoline used in road transportation have been revised since the last inventory submission. This has resulted in a change in the corresponding N_2O IEF for gasoline (6.1 kg/TJ), which in 2001 is no longer the lowest reported by countries within the European Union (EU) but is still at the lower end of the range. Compared to earlier submissions, the resulting N_2O IEF for gasoline is lower for the years 1990–1995 and higher for 1996–2000. The N_2O EF used is the default EF from COPERT for all European norms and has not been changed. The reasons for the recalculations are thus the updated and new data incorporated in the COPERT model as a result of improvements in the underlying data set on the fleet structure, mileage and speeds. More detailed explanations of such recalculations should be provided in the NIR as the explanation in the CRF tables is only a very short summary.

1.A.3 Domestic aviation and navigation – CO_2

86. See the previous section on international bunker fuels.

Fugitive emissions

1.B.1.a Coal mining and handling – CH_4

87. Spain uses a tier 2 method with specific EFs for each carbon type from each mining area. The estimation is based on the average CH_4 contents of coal extracted that are gathered from a sectoral study from the coal industry association (AITEMIN – Association for Research and Industrial Development of Natural Resources). According to the IPCC good practice guidance, mine-specific measurement data (tier 3) should be used if this source category is a key source. As mining activity will decline further in the future, this source will probably not be a key source in the level assessment in the future. In addition, measurement approaches would be very resource-intensive and would lead to inconsistent time series.

Taking this into account, the current method is considered to provide sufficiently accurate and consistent estimates.

88. An error has been detected in the AD reported for coal production in the CRF for the estimation of fugitive emissions from coal mines. AD should be divided by 1,000. This should be corrected in the CRF for all years, with the effect that the IEF for CH_4 from coal mines will be in a range comparable to those reported by other Parties. This error does not, however, affect the final emission estimate.

1.B.1.b Solid fuel transformation – CO_2

89. The explanations in the methodological supplement are not entirely clear as to whether only integrated steel plants are covered by the estimation method or whether other coke-producing plants are included. Spain clarified during the review that the coverage is complete. The exact source of information (plant-specific data for integrated steel plants and additional statistics from Ministry of Economics) should be included in future NIRs.

1.B.2.a Oil operations – CH_4

90. Emissions from oil and gas exploration are not estimated. Spain considers that such emissions are presumably minor taking into account the low activity levels of national oil and gas production activities.

1.B.2.a Oil operations, refining – CO_2

91. CO_2 emissions for crude oil refining from fluid catalytic cracking processes are estimated using a carbon balance approach based on coke retained in the catalyst.

1.B.2.b Natural gas operations – CH_4

92. Emissions from gas exploration have not been estimated as they are considered as insignificant. No data are provided for "Other leakage" from natural gas, nor have notation keys been used. Emissions from venting and flaring from gas production are currently not included in the inventory as no data are available. Emissions from flaring are not from gas production but from a gasification plant. As the volume of gas production is low, no additional efforts have so far been made to obtain estimates. For flaring the methodological supplement does not provide a methodological description or underlying data. Spain should make efforts to include emissions from venting or flaring.

93. Figures on emissions from gas are based on data from questionnaires. Information from questionnaires is validated by regression analysis (consistent time series), analysis of fluctuations in emissions and expert judgement.

94. The IPCC good practice guidance recommends the use of a tier 3 approach, which is equivalent to a rigorous emission source model, when this is a key source. The IPCC Guidelines explain that for tier 3 the amount of emissions is assessed by detailed infrastructure information and applying appropriate EFs, empirical correlations, process simulation results, and field measurements to these data. Spain indicated that it has used a tier 3 method. The methodological supplement explains that EFs were applied to statistical data, but the detail of reporting does not make it possible to assess the tier approach used. It also remains unclear how detailed data on numbers and volumes of gas losses were estimated or measured. Spain explained that it did not provide more detailed information and data sources for confidentiality reasons. A subsequent future in-country review should assess this information as this could not be done during this review.

95. The CH_4 IEF for gas distribution (36,023 kg/PJ in 2001) is among the lowest of all reporting Parties. In 2001 it was less than half the IEF in 1990, but for reasons of confidentiality no explanation is provided for the considerable reduction in fugitive emissions from the gas distribution system. Further explanations should be provided in the NIR insofar as confidentiality concerns allow.

96. The IEF for CH_4 from gas transmission (27,414 kg/PJ in 2001) is low compared to those reported by other countries. The IEF also fluctuates considerably throughout the time series, but for reasons of confidentiality no explanations were provided. Further explanations should be provided in the NIR, insofar as confidentiality concerns allow.

D. Non-key sources

Fugitive emissions: 1.B.1.b Solid fuel transformation – CH_4

97. The IEF (0.00035 kg/t) for CH_4 is lower by a factor of 100 than those of other countries. This is due to an error, as explained in paragraph 88. This should be corrected in future submissions.

Fugitive emissions: 1.B.2.c Flaring – CO_2

98. For the amounts flared in refining, plant-specific data from questionnaires are used. EFs for flaring from refineries have been derived from information declared in the questionnaires from some oil refineries, which was completed by expert judgement from experts of the Task Force on Emission Inventories and Projections.

E. Areas for further improvement

Identified by the Party

99. Spain described the following areas for improvement in the Energy sector:

(a) Verification and completion of available information on fuel characteristics for combustion in public power plants, especially for liquid fuels and gases used in the iron and steel industry;

(b) Improvement of estimation of international marine and aviation bunkers. Clarification of methods used for the reporting to IEA/Eurostat;

(c) Revision of fuel consumption (types and characteristics) in specific sectors;

(d) Disaggregation of fuel consumption for some subcategories in the CRF format, especially for pulp and paper and other categories (cement, glass production);

(e) Extension of data collection by plant-specific questionnaires to more sectors;

(f) Revision of consumption and characteristics of biomass fuels, including the EF for agricultural waste fuels;

(g) Improvement of the carbon balance used for coking plants and iron and steel works, in relation to the separation of energy emissions from process emissions;

(h) Identification of non-energy fuel use in order to avoid double counting, and analysis of the relationship to the energy balance;

(i) Revision of outliers in the time series for EFs, consumption data and characteristics in order to identify errors or problems;

(j) Improvement of estimation methods for mobile machinery;

(k) Improvement of allocation of autoproduction and co-generation plants;

(l) Revision of the EFs for CH_4 and N_2O in certain sectors;

(m) Revision of estimates for non-key source categories.

100. For most of the planned improvements identified by Spain, no detailed time schedule or information about how the improvements will be achieved was presented.

Identified by the ERT

101. The ERT supports all the sector-specific planned improvements, which cover the major sectoral weaknesses. Additional improvements are necessary in relation to the national inventory system, especially regarding the transparency, QA/QC procedures and background information of energy data collected and compiled by the Ministry of Economy.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

102. The Industrial Processes and Solvent Use sectors contributed 8.3 per cent (7.8 per cent and 0.5 per cent, respectively) in 1990 and 7.7 per cent (7.3 per cent and 0.4 per cent) in 2001 to Spain's total emissions. Emissions increased by 23.4 per cent in 2001 compared with 1990. However, between 2000 and 2001 emissions from these two sectors taken together decreased by 9 per cent. The trend of total emissions of the sectors is strongly related to the emission trend of the largest contributor of emissions in the Industrial Processes sector – cement production.

103. Basic statistical data are published by the Ministry of Science and Technology or by industrial associations, or are supplied directly by plants by means of questionnaires. In some cases more detailed information on production processes and technologies is provided by the industrial associations, as well as information on EFs, which sometime differ significantly from the IPCC default EFs.

Completeness

104. The CRF includes estimates of most gases and emission sources from the Industrial Processes sector, as recommended by the IPCC Guidelines. Minor sources have not been estimated because AD and/or EFs were not available or were only partially available for the following gases and source categories: CO_2 emissions from limestone and dolomite use, CH_4 emissions from ethylene and styrene production, and emissions of halocarbons and SF_6 from semiconductor manufacture. Estimates of F-gas emissions and time series from refrigeration are calculated on the basis of poor AD. Potential emissions of F-gases have not been supplied, mainly because of the current lack of information on imports and exports per gas. In some cases notation keys have not been used. Moreover, CRF table 9 has not been filled in with information on sources not estimated. Spain is encouraged to provide emissions for the sources not estimated, to complete table 9, and to make use of notation keys, as appropriate. In particular, Spain is encouraged to develop a country-specific approach to collecting AD for the estimation of potential emissions of HFCs, PFCs and SF_6, to estimate emissions from semiconductor manufacture, and to improve the estimation of HFCs, PFCs and SF_6 from refrigeration.

Transparency

105. The information provided in the NIR was not completely transparent. Nevertheless before and during the visit additional information was provided which made the information more transparent and complete, and detailed enough. In its future submissions, Spain is encouraged to report more information on assumptions, methodologies, EFs, data sources, AD and detailed emission trends in the NIR in accordance with the revised UNFCCC reporting guidelines (see footnote 6).

Recalculations and time-series consistency

106. Recalculations are reported for the whole time series 1990–2000. For all years the recalculated emissions for CO_2, CH_4 and N_2O are less than 2 per cent lower than those reported in the previous submission. If the recalculation of all gases taken together is considered, the differences are greater for the years 1997–2000. This is due to the updating of AD on mobile air conditioning and for aerosols to

estimate HFC emissions. In general the main reasons for the recalculations were improvements to AD, the elimination of double counting, and quality control activities. The recalculations have improved the accuracy and consistency of estimates.

Verification and quality assurance/quality control approaches

107. Some QA/QC procedures are implemented, for instance, sectoral emission reports are produced and discussed with the industrial associations and other ministries involved. Quality control procedures are applied in the calculation of emissions and some specific QC activities are implemented for the AD collected from industry by means of questionnaires. However, Spain does not yet report on these QA/QC procedures, and this should be included in the NIR.

B. Key sources

Cement production – CO_2

108. The country-specific EF for CO_2 is higher than the IPCC default (0.54 t/t compared to 0.507 t/t). This factor was recommended by the Spanish Cement Producers Association and supported by recent measurements which produced an average EF equal to 0.536 t/t. However, the lime (CaO) content and cement kiln dust correction factor used are close to the IPCC defaults. The possible difference between the EFs could be due to the content of magnesium carbonate (MgO) in the clinker, but no specific data are available. Spain is encouraged to continue its investigation into this issue with the aim of explaining the difference.

Nitric acid production – N_2O

109. Production data have been supplied to the national inventory team by the Chemical Industry Association, and for some years by the production plants, divided into low-, medium- and high-pressure nitric acid, but this level of information has to be kept confidential. The Chemical Industry Association also supplied the average EF, equal to 7 kg per tonne of production. The ERT recommends that Spain establish direct contact with the production plants in order to verify this EF.

HCFC production – HFC-23

110. Production data are provided by the production plants. Emissions have also been provided by the plants, but not always for the whole of the period covered by the inventory. The most detailed information is available for recent years. For earlier years emissions data are not provided; they have been calculated applying the IPCC default EF. Production data disaggregated at the plant level are confidential. The ERT recommends that Spain collect more detailed information from the plants about the production processes as well as information as to whether any destruction of HFC-23 takes place or not.

Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6

111. In the methodological supplement detailed information is included for each type of consumption. The use of these gases as substitutes for hydrochlorofluorocarbons (HCFCs) started in 1995 and increased considerably in the following years. The consumption in refrigeration and air conditioning equipment, in fire extinguishers, in aerosols and in electrical equipment is estimated. No consumption occurs in foam blowing, because HCFC-141b is used as a substitute for chlorofluorocarbons (CFCs). Nor is there any consumption with solvents or in magnesium foundries. Consumption in semiconductor manufacture has not been estimated because data are not available, and also because Spain needs to verify whether this source category should be reported as "NE" or "not occurring" ("NO"). Spain is introducing a new questionnaire for industrial associations to collect additional information. Other uses of HFCs and SF_6 were identified, such as the use of HFCs in hospitals with sterilization agents or of SF_6 in ophthalmic surgery; however, the quantities involved are negligible. Potential emissions have not been estimated because production, import and export data are available only for some subsectors and are

not complete by gas. Generally AD are collected from industrial associations by means of specific questionnaires; where there are gaps in the time series, the missing data are interpolated. The IPCC default EFs have been used. The major problems in estimation concern the use of HFCs and PFCs in refrigeration. For this activity only a few plants answered the questionnaire collecting information, and data refer only to 1996 and 1997. The whole time series was calculated starting from this incomplete information, and completeness should be improved regarding coverage of the sector and years. A specific register for refrigeration appliances could be implemented involving local authorities and relevant ministries. This work will improve the quality of the inventory considerably. Spain is encouraged to develop a register of refrigeration appliances.

C. Non-key sources

Ammonia production – CO_2

112. The IEF calculated (0.9 t/t) is lower than the IPCC default (1.5–1.6 t/t) and is the lowest reported by any Party. The value is an average of EFs provided by some ammonia-producing plants. Spain is encouraged to further investigate the possible causes of the difference and to provide supplementary referenced documentation.

Aluminium production – PFCs

113. Emissions of PFCs from aluminium production decreased by 78.8 per cent from 1990 to 2001; however, aluminium production increased slightly over that period. The IEFs for perfluoromethane (CF_4) and perfluoroethane (C_2F_6) during the period 1990–2001 decreased by 79.6 per cent and 83.1 per cent, respectively. Emission estimates are based on data supplied by industry and by measurement. The reductions in emissions are mainly due to a reduction of anode effect frequency and overvoltage, but specific information was not provided by the industry. Questionnaires have already been sent out to the industry with the aim of supplying more detailed information explaining the reductions. Spain should provide better evidence for this considerable decrease in the EFs in its future NIRs.

Metal production – CO_2

114. Concerning iron and steel production, sinter and coke emissions have not been reported, nor have notation keys been used. Spain indicated that emissions from sinter plants are estimated in the related category of the Energy sector, and emissions from coke production are reported in both the fuel combustion- and fugitive emissions-related categories. A more advanced tier for iron and steel production emissions could improve the estimates, in particular with regard to the correct allocation of emissions to the Energy and Industrial Processes sectors.

Solvent and other product use – CO_2

115. The IEF for CO_2 in degreasing and dry cleaning activities is the highest of the reporting Parties. It decreased by 61 per cent from 1990 to 2001. During the review Spain specified that an error had occurred in the reporting of AD: only part of solvent consumption was reported. However, the error does not affect the emissions estimate. Spain has supplied the correct time series of AD and EFs.

D. Areas for further improvement

Identified by the Party

116. The Party described the following areas for improvement in the Industrial Processes sector:

(a) Periodic studies to update nationally developed EFs, for example, for nitric acid and ammonia production;

(b) Further investigation of EFs that are significantly different from the IPCC default and of other possible sources of emissions;

(c) Improvements to the existing register of refrigeration appliances in cooperation with local and central authorities in order to collect more precise information on F-gas consumption;

(d) The introduction of advanced-tier methods to estimate emissions in aluminium production and iron and steel production;

(e) A reduction in the number of confidential sources by means of agreement with the industry.

Identified by the ERT

117. The ERT identified the following additional areas for improvement. The Party should:

(a) Consider a bottom–up approach for key sources instead of weighted-average-based EFs, applying more advanced tiers for aluminium and steel production estimates;

(b) Estimate the potential emissions of HFCs, PFCs and SF_6, and emissions not yet estimated in the sector;

(c) Improve data and information about the HCFC production process.

IV. AGRICULTURE

A. Sector overview

118. Emissions from the Agriculture sector increased by 15 per cent between 1990 and 2001. The contribution of the sector to the national total decreased from 13 per cent in 1990 to 11 per cent in 2001, mainly because of larger increases in other sectors.

119. For this sector, the main sources of information are the *Anuario Estadístico Agrario* produced by the Ministry of Agriculture, Fisheries and Food (MAPA), the Production Bulletins published by the MAPA, and direct communications from the MAPA, in that order of hierarchy and definitiveness. Other sources of information were industrial associations as fertilizer producers. There are no formal institutional arrangements for information flow.

Completeness

120. The CRF includes estimates of most of the gases and sources of emissions from the Agriculture sector, as recommended by the IPCC Guidelines.

Transparency

121. The highly detailed and spatially resolved data used in the Agriculture sector are processed in a complex data management system, which makes review of the submission for this sector difficult. Although detailed information on methods and data is provided in the methodological supplement, not all the processes are fully transparent. During the visit, the ERT was given access to the data management system and the inbuilt calculation and consistency checks of data input were explained. For some data categories (i.e., production statistics), flow charts for data collecting input to the system were provided during the review. The inclusion of these materials in future NIRs would contribute to enhanced transparency.

122. For some short-lived sources, the MAPA releases statistics three times a year, disaggregated to province level, and adjustments are made to produce yearly “occupancy” population data. These data are averaged at province level to produce the province livestock characterization, which is consistently used for all emission sources that depend on livestock characterization. Emissions are then calculated for the province and added up to produce the national emissions estimates. These procedures are built into the data management system and applied across the entire time series. This national livestock characterization protocol produces systematic differences when the results are compared with the Food

and Agriculture Organization (FAO) livestock data. Representatives of the MAPA indicated that they intended to track the path of information from the country to FAO in order to clarify these differences in future. In its response to the draft of this report, Spain explained these differences as being largely due to the provisional character of the data for the most recent year(s) as well as the different intervals at which data are released. When the MAPA releases production statistics several times a year, averages are used for the purposes of the inventory, while FAO obtains the data as released in December of a given year. The ERT encourages Spain to provide these explanations and to describe its procedures for livestock characterization more comprehensively in future NIRs as these apparent differences may attract the attention of other ERTs in future reviews.

123. Information on animal waste management systems (AWMS) was gathered from expert judgement; however, this process is not supported by proper documentation according to the IPCC good practice guidance.

Recalculations and time-series consistency

124. If information is not yet available for a recent inventory year, then statistics from the nearest, or in some cases (determined by weather conditions) the most similar year are used. Once information is made available from higher up the hierarchy order, it is included in the centralized data management system which ensures consistent recalculations and updated protocols. Spain indicated that this recalculation procedure may be another source of differences between its national inventory and the FAO data, given that it is not known whether FAO also updates those data.

Verification and quality assurance/quality control approaches

125. Input data protocols are in place to reduce the amount of data handling by individuals, thus reducing the probability of mistakes being introduced by human error. Consistency checks are built in for some data inputs (i.e., checks for magnitude, and checks to see if the sums of parts equal the totals). However, no formal QA/QC protocol is yet in place, nor is there any external peer review process, apart from the work referred to in paragraph 38.

B. Key sources

Enteric fermentation – CH_4

126. As described above, livestock characterization is carried out in a way that is consistent with good practice for the entire time series. EFs for cattle and sheep are derived using the IPCC good practice guidance. However, without the methodological supplement and other background materials provided during the review (see the list of references in annex 1), the information provided in the NIR regarding the average animal mass and milk production data used in the estimation is not fully transparent. Such information as well as a detailed description of the calculation process should be provided in future NIRs. Starting from very detailed analysis by different breeds of cattle at province level, their mass and milk production rates are normalized relative to a dominant cattle variety called “frisonas”. In this way, data for a “typical” normalized breed of cattle are generated and these are used in the IPCC model-based procedure to obtain the gross energy intake. This procedure needs to be better clarified in future NIRs to facilitate review. Nevertheless, the entire procedure is consistently applied across all breeds of cattle at province level and built into the data management system. Spain is also recommended to conduct further research in order to use more country-specific parameters in the estimation where currently IPCC defaults are used.

Manure management – CH_4

127. The tier 2 method used to estimate the gross energy intake has also been used to estimate the volatile solid excretion (VS) for cattle. The same comments as above apply to this source, as it shares the same livestock characterization as recommended by the IPCC good practice guidance. The calculation procedures are built into the data management system for the disaggregated livestock characterization.

128. Spain calculates a methane correction factor (MCF) that is temperature-dependent. The reason is that some Spanish provinces have annual mean temperatures that oscillate around 15°C, which is the dividing line between cool and temperate climates in the IPCC guidelines. These provinces will jump from one MFC to the other when only small annual variations in temperatures occur. A function has therefore been developed that smooths out the temperature dependence of the MCF for the different AWMS.

129. The ERT recommends that the methodological description in the annexes to the NIR describe these procedures and their impact on the IEF in more detail.

Manure management – N_2O

130. In spite of an increase of the livestock population, in particular of non-dairy cattle, emissions reported from this source category remained constant between 1990 and 2001, mainly as a result of changes in the structure of the population and the shares of dairy and non-dairy cattle in total livestock population, as Spain explained in response to the draft of this report. Actually, emissions did increase, but not in this source category, as most non-dairy cattle are fed by grazing, and the resulting emissions are reported in another source category as direct and indirect emissions from direct application of excreted animal nitrogen in agricultural soils. Another reason that explains the constant emissions is the change of the livestock populations from AWMS with high EFs to systems with lower EFs (i.e., liquid systems).

Agricultural soils – N_2O

131. Spain has used a nitrogen balance for the joint estimation of ammonia (NH_3) and N_2O emissions, although NH_3 emissions are reported under a different convention. NH_3 and N_2O are both included in the data management system. This methodological approach is in line with good practice as it avoids either omissions or double counting of nitrogen emissions.

132. Strong fluctuations occur in disaggregated agricultural AD and in the IEFs for some crops. The changes in AD were explained by strong fluctuations in the production statistics reported by the MAPA. The changes in EFs were explained in terms of strong fluctuations in yield, as yields of some crops, particularly rain-feed crops, vary a great deal with the weather.

C. Non-key sources

Manure management – CH_4

133. Data on CH_4 emissions from manure management of horses, mules and goats are based on statistical data from the MAPA disaggregated to different ages. Spain has adapted the IPCC default EF to lower values for the young categories. If the default EF already accounts for the fact that there is a significant share of young animals, then this adjustment is redundant and the emissions are underestimated. Spain should start an investigation of its country-specific EFs, which could resolve this problem.

134. Field burning of agricultural residues is reported in the Waste sector of the methodological supplement and should be reported under the Agriculture sector.

D. Areas for further improvement

Identified by the Party

135. Spain explained that independent scientists in the country are currently reviewing methods used for livestock emissions and this review will define any improvements to be undertaken.

Identified by the ERT

136. The ERT identified the following areas for improvement:

(a) Emissions from field burning of agricultural waste should be reported in the Agriculture sector and not in the Waste sector, as stated in the IPCC Guidelines;

(b) Differences with FAO data (livestock, fertilizers[7]) should be explained in future NIRs by describing how data are generated, aggregated and reported (see also paragraph 122). The inclusion of examples could be useful;

(c) More transparent information on the livestock characterization used should be provided in the NIR and the additional information provided during the review should be incorporated in the NIR;

(d) The documentation of the data management system should be developed and the documentation system generally improved. The more disaggregated calculations are, and the more model-dependant they are, the greater the need for an efficient documentation management system.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

137. The Spanish territory covers an area of 50,595,505 hectares (ha), of which approximately 52 per cent (26,273,232 ha) is considered to be forest area. Of this total, only 14,732,247 ha are covered by trees (*bosque; arbolado abierto* (crown cover between 5 and 35 per cent)). The remaining area (11,540,988 ha) includes no trees or presents a crown cover density of less than 5 per cent (*arbolado disperso* – scattered tree formation).

138. The main source of data used by Spain to report emissions and removals from the LUCF sector is the Second National Forest Inventory (NFI2). NFI2 covered the period 1986–1996. Its design, development and control were the responsibility of the Servicio de Inventario Forestal del Instituto Nacional para la Conservación de la Naturaleza (ICONA) which comes under the Ministry of Agriculture, Fisheries and Food. The estimation of carbon sinks under category 5.A has been undertaken by the Servicio de Proteccion contra Agentes Nocivos under the Directorate-General for Conservation of Nature of the MoE, while the estimation of CO_2 emissions under this category is the responsibility of the inventory team from the Directorate-General for Environmental Quality and Assessment in the MoE.

139. Over the period 1990–2001, CO_2 emissions/removals from the LUCF sector have been reported as a constant value that represents an annual net removal of 29,252.46 Gg CO_2 (annual growth increment of 40,275 Gg CO_2 and total biomass consumption from stocks of 11,022 Gg CO_2). This represents 7.6 per cent of the total GHG emissions reported by Spain. Hence there is no change reported from 1990–2001, despite the fact that data from the Spanish forest inventories indicate a significant increase in the forest area, in particular forest areas covered by trees (*forestal arbolada*). In addition, other related variables, such as volume, number of trees and annual mean growth, also increased. These increases are related to a number of reforestation programmes over the period 1940–1980 which were responsible for the reforestation of over 3 million ha, mainly with Pinus and Eucalyptus. An additional 450,000 ha were afforested (84 per cent slow-growing species) during the period 1994–1999, as a result of incentives offered by the European Community to afforest areas previously used for agriculture and/or cattle raising.

Completeness

140. Spain reports estimates only under category 5.A Changes in Forest and Other Woody Biomass Stocks, but does not report under categories 5.B Forest and Grassland Conversion, 5.C Abandonment of Managed Lands and 5.D CO_2 Emissions and Removals from Soils.[8] Spain indicated that the non-reporting under 5.B and 5.C is due to the fact that the relevant estimates are included in category

[7] Differences between data on fertilizers provided in the NIR and the FAO data were also addressed in Spain's response to the draft of this report. The ERT, however, is of the opinion that more explanation of the data collection processes could improve future NIRs and facilitate future reviews.

[8] CO_2 emissions from soils are not reported in the Agriculture sector either.

5.A Changes in Forest and Other Woody Biomass Stocks. In this case, Spain should use the notation key "included elsewhere" ("IE") rather than the "NE" indicated in the CRF tables. Since the data used in the inventory are derived from NFI2, and given that the definition of "forest" is a very broad one in Spain (it includes land vegetated by arboreal species and woody formations in grassland and herbaceous vegetation grown spontaneously or by seeding or planting, and that is not or has not been cultivated), the data do not allow disaggregation to the different IPCC LUCF categories. As regards category 5.D CO_2 Emissions and Removals from Soils, no estimates are provided because of the lack of data in NFI2 and lack of data on agricultural soils. The ERT strongly recommends that Spain estimate emissions and removals from forest and agricultural soils in a concerted effort between the relevant ministries and institutions. Spain has initiated a soil database that might be useful in future inventories. Spain does not report emissions of non-CO_2 greenhouse gases, except nitrogen oxide (NO_X) emissions from soils.

Transparency

141. Spain acknowledged that the LUCF sector has received little attention in the inventory, since the estimates merely repeat those provided in previous years. Nor did the earlier inventory submissions contain additional information. The replication of even the few data that are presented was hindered by the lack of data and additional information which could have been provided in the NIR.

Recalculations and time-series consistency

142. See paragraphs 139 and 144.

B. Sink and source categories

143. Spain estimates CO_2 emissions from two LUCF-related activities, (1) wood harvesting and (2) fires, both of which are included under category 5.A Changes in Forest and Other Woody Biomass Stocks. The data for wood harvesting (commercial wood) are provided by the Ministry of Agriculture, Fisheries and Food (*Anuario Estadístico Agrário*, 1990). A country-specific methodology is applied to estimate emissions from harvested wood.[9] In its equation for estimating emissions from harvested wood, Spain introduces a factor of ½ which is used to avoid possible double counting that could arise from the gap between the base year reporting (1990) and the data collected for NFI2 (1986–1996). According to the national experts, the units sampled after 1990 could have been affected by harvesting and fires occurring after 1990. Hence, the estimates of the biomass stocks would be smaller than they would have been if they had been estimated in 1990, and the increases in carbon stocks due to CO_2 removal would therefore be underestimated. Given that CO_2 emissions from harvesting are fully accounted for, Spain would most likely overestimate total CO_2 release from LUCF as a result of reporting full emissions from harvesting and reporting less removals from land affected by harvesting after 1990. The ERT recommends that Spain review the use of this factor in this equation, since it reflects an (implied) carbon emission factor (0.23 tC/t dm) that is half of that recommended by the IPCC Guidelines. Specific recommendations are provided in annex 2 to this report.

144. Regarding emissions from fires, only data on CO_2 emissions from fires in forest areas covered by trees (*monte arbolado*) are provided. They are derived from an average of the estimates for the amount of carbon burnt per hectare and the area of commercial timber affected by fires during the period 1990–1996. Since Spain is using a constant value for emissions and removals from LUCF for the entire period 1990–2001, a consistent methodological approach would require emissions from forest fires to be averaged in the same way. Non-CO_2 gases from forest fires are not reported. However, they have been estimated and included in the methodological supplement. They are derived using the methodology and

[9] This method comprises the steps recommended by the IPCC: (1) conversion of volume of biomass (m^3) to mass of dry matter using the default conversion rate of 0.5 t dm/m^3; and (2) use of a country-specific expansion factor to account for the non-commercial biomass harvested with the commercial roundwood and left to decay. This country-specific biomass expansion factor based on scientific studies (1.6) seems to be consistent with similar factors adopted by other European countries with similar forest cover.

EFs indicated in the EMEP/CORINAIR Guidebook. The ERT recommends that these values be included under category 5.E Other.

145. Estimates of CO_2 removals have been derived using country-specific methodologies which differentiate between removals by adult and young trees. The source of data (standing volume of commercial timber with bark and number of young trees) is NFI2. The same biomass expansion factor as is used to estimate emissions from harvested wood has been applied to adult trees (1.6) and a factor of 1.4 has been applied for young trees. Both seem appropriate for temperate forests and are based on national studies. Spain carried out a detailed analysis of the data in NFI2, allocating the data to the IPCC categories Plantations (Pinus radiate and Eucalyptus) and Commercial (Evergreen and Deciduous). The average annual growth rates provided for commercial forests are smaller than the values indicated in the IPCC Guidelines (2 tonnes dm/ha). The values presented for plantations – around 8 t dm/ha – seem appropriate. However, the data included in the NIR are not sufficient to allow the figures presented in table 5.A of the CRF to be replicated. Additional information was provided during the review from General Directorate for Nature Conservation. More detailed information should therefore be provided in future NIRs. Finally, the equation used to estimate removals from adult trees incorporates the annual growth rate, based on the commercial volume of the harvested wood. From the data in table 1 of the methodological supplement, this corresponds to 0.0506 t dm/ha. The same annex provides the annual trunk volume growth rate for young trees, equal to 0.02 t dm/ha. However, young trees are normally expected to grow faster than adult trees. The values provided here do not correspond to this expectation, and should be re-evaluated by the Party.

C. Areas for further improvement

Identified by the Party

146. Spain is in the process of finalizing its Third National Forest Inventory (NFI3), which will cover the period 1996–2005. The data from this new inventory, collected so as to be comparable with those from NFI2, will allow the changes in carbon stocks that are due to changes in the biomass content of the forest area (per species) to be estimated. Data for NFI3 are being collected over the same parcels and trees as used in NFI2, thus providing a unique opportunity to monitor the changes that have occurred in 10 years, which was not possible using NFI1 and NFI2. It is expected that annual estimates will be provided for CO_2 emissions/removals under 5.A Changes in Forest and Other Woody Biomass Stocks based on the data collected for NFI3. This will result in a recalculation of the entire time series, which is expected for the 2004 inventory submission.

147. For future inventories, Spain will also make use of the *Inventario Ecológico y Forestal de Cataluña* (Catalunia Ecological and Forest Inventory) which provides biomass expansion factors for more than 20 forest species. These data, when applied to the data from NFI3, will make it possible to generate more precise estimates of the carbon stocks in the forest biomass, as well as their evolution.

Identified by the ERT

148. Even after completion of NFI3, it is unlikely that the reporting under the categories 5.B Forest and Grassland Conversion, 5.C Abandonment of Managed Lands and 5.D CO_2 Emissions and Removals from Soils will be facilitated because conversion data (e.g., conversion of forests to other categories and vice versa, management practices that affect soil carbon) will be lacking and because the data collected in the NFI include a broad range of land uses (anything that is not crop land). The ERT recommends that Spain undertake efforts to improve its land classification in order to allow a clear distinction between forest land, grassland, crop land and other categories. Otherwise it will be difficult, if not impossible, to meet the IPCC reporting requirements.

149. The ERT recommends that Spain make additional efforts to estimate CO_2 emissions and removals from soils because, even with the ongoing efforts to create a soil carbon stock database, it is not anticipated that the emissions/removals from soils will be provided in the next few inventories.

150. Spain should also reconsider the adjustment factor used in the estimation of harvested wood and the growth factors used for young and adult trees for plantations.

VI. WASTE

A. Sector overview

151. The Waste sector in 2001 contributed 4.0 per cent of Spain's total emissions. During the period 1990–2001, total waste emissions increased by 61 per cent, which represents the largest growth among all sectors. CH_4 emissions from the Waste sector accounted for 34 per cent of total CH_4 emissions in Spain in 2001, and solid waste disposal sites (SWDS) in 2001 accounted for 76.7 per cent of emissions from this sector. During the period 1990–2001, CH_4 emissions from SWDS increased by 95 per cent as a result of a reduction in the number of unmanaged waste disposal sites. The percentage of managed SWDS was near 90 per cent in 2001, and the number of sites with gas recovery was five. Emissions from waste-water handling increased by 53 per cent over the period 1990–2001.

152. The Directorate-General for Quality and Environmental Assessment of the MoE is in charge of databases for SWDS and waste incineration. The responsibility for the collection of data for waste-water handling lies with the Directorate-General of Hydraulic Works and Water Quality.

Completeness

153. The NIR and the CRF include emission estimates for all gases and sources from the Waste sector, as required by the UNFCCC reporting guidelines. However, estimates for N_2O from waste-water handling only include emissions from human sewage; emissions from industrial and commercial waste water are not included because IPCC methodologies for these sources are not available. All the CRF tables for Waste were completed from 1990 to 2001, with minor omissions and/or inconsistencies. The information provided in the additional information and documentation boxes is limited, especially for waste incineration and waste-water handling. Spain should complete this information. Emissions from incineration of industrial waste are not estimated; however, such emissions are partly included in the Energy sector. Emissions from waste incineration with and without energy use are reported in the Energy sector. Spain should clearly separate emissions from waste incineration plants with and without energy use and allocate emissions correspondingly to the Energy and Waste sectors. Spain should also provide complete estimates for any parts of incineration of industrial waste that are not covered in the Energy sector.

Transparency

154. The information presented in both the CRF and the NIR, and especially in the methodological supplement, is transparent. However, more information on the methodology used and underlying assumptions should be provided in the NIR and in the CRF in order to allow replication of the inventory calculation. The expert judgements related to AD and values for the different algorithms used should be supported by including the relevant protocols.

Recalculations and time-series consistency

155. The CRF provides all the recalculated estimates made in the Waste sector and summarizes the changes made for the period 1990–2001. The NIR gives the use of updated AD for all Waste subsectors as the reason for the recalculations.

Verification and quality assurance/quality control approaches

156. A QA/QC system is in the process of being implemented. Spain provided an oral description of the general QA/QC system during the visit. This system was not presented in detail in the documents received by the ERT. An important database for the Waste sector is under development. Further information should be included in future NIRs.

B. Key sources

Solid waste disposal sites – CH_4

157. The CORINAIR /tier 2 (first order decay (FOD)) method used is consistent with the IPCC good practice guidance. The amount of municipal waste production was obtained from different sources, including surveys in local municipalities and Autonomous Communities, and the composition of municipal solid waste (MSW) was derived from a study entitled "El Medio Ambiente en España" ("The environment in Spain") which provides data back to 1994. Earlier years have been extrapolated based on population data, and missing years in the period 1984–2001 have been interpolated. Neither the NIR nor the methodological supplement mentions how disaggregated AD for solid waste disposal (1970–1984) are extrapolated. Further information should be provided in future NIRs.

158. The main parameters for calculating CH_4 generation are the degradable organic carbon (DOC) content, the DOC_f, the methane oxidation factor and the methane fraction for landfill gas, the values for which were obtained from the IPCC Guidelines. The CH_4 generation rate constant k is based on the average from the IPCC Guidelines.

159. The amount of CH_4 recovery is estimated on the basis of the share of controlled landfills. The shares of CH_4 recovery provided in the methodological supplement seem unreasonably high. For Asturias y Cantabria, it is assumed that 100 per cent of CH_4 generated has been captured and used in recent years; for earlier years the assumption is 80–90 per cent. However, 100 per cent gas capture is technically not possible, even with modern gas capture systems.[10] Thus, CH_4 emissions from landfills are currently underestimated for recent years. The IPCC good practice guidance recommends basing CH_4 recovery on measurement data. Spain should make efforts to include measurement data for this parameter in its future inventories.

160. For the CH_4 generation rate constant k, a value of 0.1 was assumed. The IPCC default is 0.05. A more rapid degradation than that expressed using the default value is not unlikely, taking into account climate conditions. However, further information should be provided in the NIR on the assumptions used for k, as this value also depends on the fractions of easily and less easily degradable waste.

161. Spain is using an oxidation factor of 0.05, but no further documentation is provided in the methodological supplement. The IPCC default is 0; however, for well managed sites 0.1 can be assumed. Spain explained that the intermediate value 0.05 was chosen as not all managed sites are considered as well managed.

Waste-water handling – CH_4

162. The CORINAIR methodology has been used. The equivalent population served by a waste-water treatment system has been used to estimate the level of charge of chemical oxygen demand (COD) produced by the industry, and other AD are based on information and data from the Directorate of Hydraulic Works and Water Quality of the MoE and expert judgement. These sources are not consistent and complete; further information should be provided in the NIR in relation to this data set.

163. Emissions have been estimated on the basis of total waste-water and sludge treatment, with no differentiation of treatment types. The ERT strongly recommends that Spain collect data on the shares of aerobic and anaerobic waste-water treatment. The revision of the value of per capita production of biochemical oxygen demand (BOD) is also recommended because the calculated value of 81 g/h-day is very high in comparison with those reported by other countries (see table 6–5, reference manual of the IPCC Guidelines). Further justification should be provided in Spain's next NIR.

[10] The United Kingdom reports 85 per cent recovery for modern complete gas capture systems, and 40 per cent for limited gas capture. Other countries report much lower CH_4 recovery: Austria 20 per cent (1999), the Netherlands 18 per cent, the United States 33 per cent and Germany 44 per cent.

164. The methodology applied for emissions from industrial waste water is derived from the IPCC Guidelines for area sources (= Industrial Waste Water in the CRF) and the EMEP/CORINAIR for point sources (= Other Industrial Waste Water in the CRF). The estimation used AD from questionnaires to industry for the years 1994 and 1996. Other years are extrapolated based on the industrial production index developed by the National Institute of Statistics. Further information on the methodology and the parameters used should be provided in Spain's future NIRs for both parts of the estimation.

165. The EFs used have been calculated following the IPCC Guidelines, experts' recommendations and the IPCC good practice guidance. The equations 5.8 to 5.10 of the IPCC Guidelines were used to determine the EFs, the default value of maximum methane-producing capacity (Bo) from the IPCC good practice guidance was used, and the other elements needed to determine the EFs (fraction of waste-water type (WS) and MCF) were estimated by expert judgement. This expert judgement was not supported by review carried out by other experts.

166. The information contained in the CRF (table 6.B) is not complete in terms of additional information, and the analysis of waste-water handling provided in the NIR could be improved. Further information should be provided in the NIR related to total waste water, treated waste water, industrial waste water treated, domestic waste water treated, and the relation between aerobic and anaerobic handling systems. N_2O emissions from human sewage were estimated correctly.

C. Non-key sources

Waste incineration – CO_2

167. Emissions from waste incineration are reported in the Energy sector even when the resulting energy is not used. This allocation is not in accordance with the IPCC Guidelines, and emissions from waste incineration without energy use should be included in the Waste sector.

168. The CORINAIR methodology has been used, which is not equivalent to an IPCC tier approach. AD were obtained from the Directorate-General of Quality Control and Environmental Assessment using reports and data from questionnaires.

169. The emissions factors used are from the EMEP/CORINAIR Guidebook. These EFs have not been compared with the IPCC default values. In some sectors, energy use from industrial waste is included in the Energy sector (e.g., for cement production), but it remains unclear if the coverage of these emissions is complete. As waste fuels are not included in the energy balance, the estimates cannot be compared with this source. Spain should provide information regarding the amounts of waste incinerated (both municipal waste and industrial waste) with and without energy use.

170. In the methodological supplement, the methodologies used for calculating emissions from burning of agricultural residues and from venting and flaring are described in the Waste sector instead of the Agriculture and Energy sectors. The descriptions are not sufficiently transparent for the ERT to be able to analyse the calculations. The methodological descriptions should be presented under the correct IPCC categories.

171. Neither the NIR nor the methodological supplement provides information about how the fossil and biogenic fractions are derived. This information should be provided in future NIRs, especially as the fossil fraction used for municipal waste is lower than the IPCC default.

D. Areas for further improvement

Identified by the Party

172. Spain is planning the following improvements: to compare the EFs from solid waste disposal (SWD) and waste-water handling with the IPCC Guidelines and good practice guidance; and to strengthen its institutional arrangements in order to establish a data system and improve the archiving system for the Waste sector.

Identified by the ERT

173. In addition, the ERT recommends the following:

(a) The estimation of the CH_4 recovery from landfills should be revised;

(b) The choice of parameters (e.g., for the CH_4 generation rate constant k) and methods should be more transparent in the NIR and more explanations should be provided;

(c) The choice of EFs and parameters for waste-water handling should be reconsidered;

(d) Spain should clearly separate emissions from waste incineration plants with and without energy use and allocate emissions correspondingly to the Energy and Waste sectors;

(e) Spain should estimate emissions from sources currently not entirely covered in the inventory (e.g., emissions from incineration of industrial waste);

(f) Small reporting problems were identified, which should be addressed in future submissions:

(i) All methodologies, parameters and AD used should be clearly referenced;

(ii) The ERT encourages Spain to fill in the CRF background tables including additional information boxes as far as possible, analysing in each case the information available in the databases and specialized studies.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2003 submission including CRF for 1990–2000 and an NIR, and a methodological supplement entitled: "Ministerio de Medio Ambiente. *Inventario Nacional de Emisiones a la Atmosfera 1990–2001: Acidificadores, precursores de ozono y gases de efecto invernadero; Análisis por Actividades Emisoras de la Nomenclatura SNAP-97 y Correspondencia con Categorías CRF-IPCC,* Julio 2003".

2002 submission including CRF for years 1990–2001 and an NIR.

UNFCCC secretariat (2003). "Report of the individual review of the greenhouse gas inventory of Spain submitted in the year 2002 (Desk review)." FCCC/WEB/IRI(1)/2002/ESP (available at http://unfccc.int/program/mis/ghg/countrep/spadeskrev02.pdf).

UNFCCC secretariat. "2003 Status report for Spain" (available at http://unfccc.int/program/mis/ghg/statrep03/spa03.pdf).

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2003. Part I": *F*CCC/WEB/SAI/2003 (available at http://unfccc.int/program/mis/ghg/s_a2003.html) and Part II – section on Spain (unpublished).

Spain 's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2003" (unpublished).

UNFCCC secretariat. Review findings for Spain (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories." Draft 2003 (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." FCCC/CP/1999/7 (available at http://www.unfccc.int/resource/docs/cop5/07.pdf).

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

UNFCCC secretariat. Database search tool – *Locator* (unpublished).

IPCC. *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000* (available at 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 at http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm).

B. Additional materials

Responses to questions during the review were received from Ms. Angeles Cristobal (MoE) including additional material on the methodology and assumptions used.

Ministerio de Medio Ambiente. 2003. *Inventario de Emisiones 1990–2001: Acidificadores, precursores de ozono y gases de efecto invernadero*. Madrid, September.

Ministerio de Medio Ambiente. 2002. Tercera Comunicación Nacional de España.

Ministerio de Medio Ambiente. *El Medio Ambiente en España.* Annual editions 1994–2001.

Ministerio de Medio Ambiente. 2000. "Plan Nacional de Residuos Sólidos Urbanos (2000–2006)".

Ministerio de Medio Ambiente. 2003. "Inventario Nacional de Emisiones de Contaminantes a la Atmósfera. Normas para la cumplimentación del cuestionario Grandes Focos Puntuales en procesos de combustión. Sector: Centrales termoeléctricas convencionales." April.

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ANNEX 2: SUPPLEMENTARY INFORMATION

Land-use change and forestry: changes in forest and other woody biomass stocks

1. This annex analyses further the equation used by Spain to estimate emissions and removals under 5.A Changes in Forest and Other Woody Biomass Stocks. It has been developed to provide Spain with an alternative method of estimating CO_2 removals and emissions from the LUCF sector. Since some information was not available to develop an alternative method based on concrete elements, some assumptions were needed. It is expected that Spain will view this annex as an input to motivate the revision of the methods currently used by the Spanish team that is responsible for this part of the inventory.

2. The methodological approach introduced here is based on forest area changes and their associated carbon stocks. Other methods could have been proposed, but would possibly require data that are not presently available from the Second National Forest Inventory (NFI2). Although it is understood that the actual forest area does not change as a result of harvesting and/or fire, the methodological approach suggested here implies a "virtual" change in the area from which the carbon losses and gains are then estimated. It takes account of the concerns expressed by Spain regarding double counting. Additionally, it avoids the confusion that arises from the analysis of the CRF tables, in particular with respect to the implied carbon emission factor (presently it appears as half the value indicated by the IPCC), as a result of the factor being introduced in the equation to estimate emissions from harvested wood.

3. With regard to fires, data regarding burning efficiency do not seem to exist. If they were provided, better estimates of emissions from fires could be generated. The methodology proposed here is based solely on the data and information made available by Spain during the in-country review. On this basis, Spain may be in a better position to review the proposal in the light of possible other data that may be available.

4. Spain introduced a factor of ½ in its equation to estimate emissions from harvested wood. In the opinion of the ERT, this factor should be reviewed by the Party. Two recommendations are made: (1) that the factor should be eliminated from the present equation in order to avoid misunderstandings (presently, this factor is responsible for an implied carbon emission factor of 0.23 in the CRF tables, which is half the default value provided by the IPCC); and (2) that the issues of concern (double counting) should be incorporated elsewhere, in a more transparent manner.

5. The data used by Spain to report under the LUCF sector originate from the NFI2, which started in 1986 and ended in 1995. Estimates of CO_2 removals under the category Changes in Forest and Other Woody Biomass for 1990 have been estimated using data from this inventory and the following assumptions:

(a) The areas measured in the samples observed after 1990 would be less than they would have been in 1990, since they would have been affected by harvesting and by fire;

(b) The average growth would be underestimated for those units sampled before 1990, and overestimated for those units sampled after 1990. An assumption is made here that these biases balance out.

6. Since the forest areas observed after 1990 are underestimated as a result of harvesting and fire (implying that less CO_2 removals are reported), Spain compensates for this assumption in the equation adopted to estimate CO_2 emissions from harvested wood. A factor of ½ is introduced in the equation since, supposedly, half of the sample units in NFI2 would have been observed before 1990, and the other half after 1990. The concern about possible double counting arises from: (1) reporting less removals due to the impact of harvesting and fire in the forest area; and (2) reporting emissions from harvested wood.

Hence, Spain would be in the following unfavourable situation: (1) of reporting the full emissions from harvesting (if the factor of ½ was not introduced), and (2) of NOT reporting more removals, since harvesting would have had an impact on the forest area observed after 1990. What is questionable is the appropriateness of the value chosen for the given factor.

7. An alternative methodological approach is suggested, and is based on the following argument: (1) emissions from harvested wood can be estimated from the data provided for 1990 (in m^3) and the equation adopted by Spain, without the factor of ½; hence, it is the actual emissions from harvesting which are estimated; (2) emissions from fire can be estimated since the area burnt (in hectares) in that year is known, as well as the amount of carbon emitted per hectare; hence, the actual emissions from fire can be estimated; the equation adopted by Spain would have to be reviewed; and finally (3) removals from the forest area can be recalculated, estimating how much additional area (and hence, removals) would have been reported IF all samples had been observed until 1990. The proposed approach would first estimate the additional area, and then convert this additional area into CO_2 removals.

The approach can be summarized by the following equation:

8. Total CO_2 removals would be estimated as:

(a) CO_2 removals reported in the NIR + amount of CO_2 that would be removed IF *monte arbolado* had not been harvested in the period 1991–1995 + amount of CO_2 that would be removed IF *monte arbolado* had not been affected by fires in the period 1991–1995.

(b) These amounts should be estimated from the estimate of the additional area that would have been observed if all samples were observed in 1990. The approach is subdivided into two considerations: (1) areas affected by fires; and (2) areas affected by harvesting.

(c) Regarding the area affected by fires: Based on the data provided in the *Procedimiento de Cálculo de los Stocks de Carbono en los Montes (hasta 2002)*, the following areas have been affected by fire, from 1991 to 1995.

Year	**1991**	**1992**	**1993**	**1994**	**1995**	**Total**
Area (ha)	105 963	39 834	33 266	250 407	42 137	471 607

(d) Hence, an additional area of forest, equal to 471,607 ha, would be contributing to CO_2 removal from 1991 to 1995.

9. Regarding area affected by harvesting, it is assumed here that the same volume reported in 1990 (15,458,903 m^3) was cut every year. Hence, from the period 1991–1995, a volume equivalent to 77,294,515 m^3 would have been removed. To convert the volume of biomass expressed as m^3 into mass of dry matter expressed as tonnes (t dm), the default conversion ratio recommended by the IPCC is 0.5 t dm/m^3. Hence, 77,295,515 m^3 * 0.5 t dm/m^3 = 38,647,257 t dm. The IPCC gives a range of dry matter in above-ground biomass in temperate forests (tonnes dry matter/ha). The range provided is 220–295. Let us assume the lowest limit of 220 t dm/ha. Hence, 38,647,257 t dm / 220 t dm ha^{-1} = 175,669 ha is an estimate of the area affected by harvesting from 1991 to 1995.

10. The sum of area affected by fire and the area harvested from 1990 to 1995 is then 471,607 ha + 175,669 ha = 647,276 ha.

The next step is to convert this additional area into CO_2 removals:

11. Spain indicates, for commercial evergreen and deciduous forests, values of 1.56 and 1.16 respectively, as average annual growth rate, expressed as tonnes dry matter/ha. Using the value of 1.36 (the mean of 1.16 and 1.56), gives an estimate of 880,295 tonnes of dry matter in the additional area. Converting into living biomass (by using a factor of 1.6) gives 1,408,472 t living biomass which,

converted into carbon (by using the IPCC default value of 0.5) gives 704,236 t C. This corresponds to 704,236*44/12 = 2,582,199 t CO_2 = 2,582 Gg CO_2.

12. Using these values in the equation proposed above leads to: 40,274.67 Gg CO_2 + 2,582 Gg CO_2 = 42,856.67 Gg CO_2 which represents total CO_2 removals.

13. In the next step CO_2 emissions have to be estimated:

(a) From fires: it is suggested that only the amount emitted in 1990 be considered, for consistency. An area of 72,117 ha was affected, and the mean carbon EF indicated in the *Procedimiento de Cálculo de los Stocks de Carbono en los Montes (hasta 2002)* is 5,725 t C/ha, leading to 1,514 Gg CO_2 emissions.

(b) From harvesting: the volume of wood harvested in 1990 reported in the NIR is 15,458,903 m^3. Converting this into dry matter gives 15,458,903 m^3 * 0.45 t dm/m^3 = 6,956,506 t dm. This, if multiplied by 1.6, gives a total of 11,130,410 t living biomass. The conversion of this into carbon gives 11,130,410 * 0.5 = 5,565,205 t C and to CO_2 gives an amount of 20,405 Gg CO_2.

The estimated CO_2 emissions and removals are presented in the table below:

Emissions/Removals	**Amount in Gg CO_2 (rounded)**
Removals	–42 857
Emissions by harvesting	+20 405
Emissions by fire	+1 514
Net CO_2 removal	–20 937

14. The proposed methodology can then be summarized as follows:

ASSUMPTIONS:

(a) The same amount of commercial wood harvested in 1990 occurs in every year of the period 1991–1995;

(b) The underestimate of the annual growth in the samples collected prior to 1990 is balanced by the overestimation of the annual growth in the samples collected post-1990;

(c) The harvesting and the fires are mutually exclusive events, in the sense that they cannot occur in the same area;

(d) There is no CO_2 removal from the regeneration of areas affected by harvesting or fire.

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