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Report on data comparisons

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I. INTRODUCTION

A. Mandate

1. The Subsidiary Body for Implementation (SBI), at its seventh session, requested the secretariat to evaluate the feasibility of compiling and maintaining available supplementary data from authoritative sources on greenhouse gas (GHG) emissions for the purpose of comparison with the national submissions and to present a report on this comparison to its ninth session (FCCC/SBI/1997/21, para. 11 (d)). The SBI, at its ninth session, took note of the document prepared by the secretariat on an approach to comparison of data on greenhouse gas emissions (FCCC/CP/1998/5) and requested the secretariat to prepare a report on data comparisons to enable Parties to reach a conclusion on the feasibility of data comparisons at the tenth session of the SBI (FCCC/SBI/1998/7, para. 21(e)).

2. The SBI requested the secretariat to evaluate, in that report, the feasibility of data comparisons, including the availability of information on gases, sectors and sources, and the level of disaggregation. The SBI also requested that the report include specific suggestions on further work related to data comparisons, including comparisons of activity data, emission estimates and emission factors. Further, the SBI requested identification and analysis of the utility of sources other than national communications or inventories and methods of their compilation. The secretariat was requested as well to estimate the related resource implications of data comparisons (FCCC/SBI/1998/7, para. 21(e)).

B. Scope of the paper

3. This paper responds to the request by the SBI mentioned above by elaborating on approaches for comparisons of GHG inventory data. The paper provides information on the availability of sources of data for possible comparisons and the utility of such comparisons in the context of the UNFCCC. In preparing this paper, the secretariat examined a number of GHG inventories submitted by Annex I Parties in 1998, chosen primarily because they provided the most complete and representative data of the inventories submitted in 1998. The secretariat as well consulted with organizations and institutes maintaining related information and/or involved in aspects of data comparison.

4. The main focus of this technical paper is to provide background information for the subsidiary bodies. Although, as requested, it provides specific suggestions for further work in its conclusions, it does not provide an outline for work in this area. Parties may wish to read this paper in conjunction with the paper on elements of a review process related to greenhouse gas inventories (FCCC/SBSTA/1999/3), as the two issues are related.¹

¹ The ongoing revision to the GHG inventories component of the guidelines for preparation of national communications from Annex I Parties are also referred to at several points in this paper (FCCC/SB/1999/1 and Add.1). For the purposes of this paper the GHG component of the guidelines is referred to as the UNFCCC reporting guidelines on inventories.

5. A number of GHG inventories submitted by Annex I Parties were used to conduct some sample comparisons to assist the secretariat in preparing this report on data comparisons. The GHG inventory submissions due in 1998 which had been received by October 1998 were used for the sample comparisons. Of the 21 GHG inventories submitted at that point, only 10 contained some activity data and/or emission factors and therefore only these inventories were used for the purposes of this paper.² With respect to comparison with earlier submissions, although information may have been available from various earlier submissions, only those Parties that met the above criteria with respect to their 1998 submissions were considered. Although these selection criteria allowed for the consideration of the most recent information, due to the limited number of inventories used, the results should not be considered definitive but only illustrative.

6. In addition to sample comparisons conducted by the secretariat, the International Energy Agency (IEA) provided the results of comparisons it had conducted with respect to activity data and emission estimates from the energy sector. Also some other organizations³ provided information on the relevant data which they maintain.

II. BACKGROUND

7. In the course of its activities, including analysis of methodological issues, in-depth reviews of national communications, and compilations of information submitted by Parties, the secretariat over the last few years has identified several areas where national GHG inventories may need to be improved (see for example, FCCC/SBI/5/1999). They include:

(a) Transparency: not all national inventories contain adequate data to allow for comparison and identification of differences in inventory construction, and often do not even contain information at an initial level of disaggregation with respect to activity data and emission factors;

(b) Comparability: both methods and reporting vary among Parties. This creates added complexity for data analysis. While the Intergovernmental Panel on Climate Change (IPCC) Guidelines allow flexibility of methods, there is a reporting framework which is not

² The 1998 GHG inventory submissions of the following Parties were considered: Australia, France, Germany, Greece, Monaco, New Zealand, Norway, Slovakia, the United Kingdom of Great Britain and Northern Ireland and the United States of America. For the purposes of this paper earlier submissions of national GHG inventories or inventories included in national communications were not considered, except with respect to aspects related to comparisons of information reported in inventories over time. None of the 10 inventories selected contained activity data and emission factors for all sectors, nor did they always contain the necessary levels of disaggregation for purposes of comparison.

³ Carbon Dioxide Information Analysis Centre (CDIAC), Netherlands National Institute for Public Health and the Environment (RIVM), Statistical Office of the European Communities (EUROSTAT).

always respected. The UNFCCC guidelines also request information which is not always submitted by Parties (e.g. the reference approach for carbon dioxide (CO₂) from fuel combustion);

(c) Completeness: some sources are not included in some national inventories and it is sometimes unclear from the documentation provided, why the Party has chosen to exclude the source. Also, information on the uncertainties in the inventories is not always provided;

(d) Consistency: emission estimates may be recalculated from one publication to another because of changes in estimation methodologies or the underlying data used to make the calculations, or the identification of new sources. These changes sometimes remain unexplained in Parties' submissions and hence affect the transparency of reporting under the Convention. Likewise, understanding the reasons for the recalculations is important for the comparability between Parties.

8. It is recognized that some of these issues or areas in need of improvement are due to the nature of GHG inventories, and the constant aim of Parties to improve their inventories. Parties may choose to revise an emission factor to improve the accuracy of their estimate; they may likewise update activity data for similar reasons. Although these revisions are encouraged, the reasons behind them may not be published in the national communication or GHG inventory since, typically, very little information on emission factors and activity data is provided.

III. FEASIBILITY AND UTILITY OF DATA COMPARISONS

9. Various types of comparisons for the data contained in GHG inventories can be conducted. Emission estimates, activity data and emission factors can all be the subject of comparisons, and can be compared with alternative sources of information, with earlier submissions of information from the same Party, or in some cases with submissions from other Parties. Such comparisons of data can be useful in determining possible inconsistencies and errors in the GHG inventories and may assist in assessing the reliability of GHG emission estimates.

10. The paragraphs below examine several possible comparisons of emission estimates, activity data and emission factors. The results of sample comparisons conducted by the secretariat and information from other organizations are referred to in the paper. However, the results of the comparisons are not included here, but are available at the secretariat. Information on the sources of data other than national inventories and the degree to which data reported in GHG inventories can be compared with these alternative sources of data are also available at the secretariat.

A. Comparisons of emission estimates

11. Comparisons of emission estimates can be performed in several ways. Estimates can be compared with respect to emission estimates of other data sets (e.g. global databases), emissions from earlier submissions (recalculations), estimates obtained using different methodologies,⁴ and indicators.⁵ In this section only the first two types are discussed.

12. For the purpose of this note, the secretariat examined the results of comparisons from two sources, the IEA⁶ and the Emission Database for Global Atmospheric Research (EDGAR) of the Netherlands National Institute for Public Health and the Environment (RIVM).⁷ Many, and substantial, differences were found in the study comparing EDGAR and the GHG inventories from national communications, the differences being the largest for CH₄ and N₂O. These differences were greatest in the fugitive methane from oil and natural gas production, transmission and distribution sector. The main reason for these differences is the use of different emission factors and activity data.

13. In comparing estimates of CO₂ emissions from fuel combustion with estimates calculated using the IEA energy statistics, there were also a number of differences. Although for a few Parties the total emissions actually corresponded rather well, there were recognizable differences at the level of fuel type (coal, gas, oil). Four of the seven Parties considered had substantial differences in emissions from coal, and there were large differences in gas and oil for some Parties; there was, however, no recognizable pattern in the differences for the various fuel types.

14. Since all estimates in the national inventories are typically arrived at using national sources for emission factors and activity data, it is not possible to tell simply from a comparison of two estimates which is the more accurate. Experiments are under way to test methods to allow comparisons of inventory estimates with data from atmospheric measurements. At present, such comparisons are not useful as atmospheric measurements themselves vary in accuracy depending on the specific gas, emission source, and spatial and temporal resolution,

⁴ For example, see document FCCC/SBSTA/1999/INF.2 on comparison of greenhouse gas inventories submitted by Parties using own national methodologies with those obtained using the IPCC default methodologies.

⁵ Some examples of indicators would be CO₂ emissions per total primary energy supply, CO₂ emissions per gross domestic product and CO₂ emissions per capita. In this paper comparisons of indicators are not considered. Although comparison of indicators across Parties is feasible, the appropriate indicators, and data sources, would need to be determined, for which views may differ substantially among Parties due to the varied national circumstances.

⁶ "Summary energy and CO₂ comparisons" (tables), (provided by the IEA to the secretariat, 2 February 1999).

⁷ van Amstel, A.R., C. Kroeze, L.H.J.M. Janssen, J.G.J. Olivier, and J.T. van der Wal, "Greenhouse gas emission accounting: preliminary study as input to a joint International IPCC Expert Meeting/CKO-CCB Workshop on Comparison of Top-down versus Bottom-up Emission Estimates", WIMEK/RIVM report # 728001 002, September, 1997.

and could be more uncertain than the estimates to which they are compared. However, it may be possible in the future to use such data for comparisons.

15. The results of the comparisons suggest that comparisons of national emission estimates with emission estimates from other sources may not be so useful, and if so, only perhaps with respect to the energy sector, where methods are comparable (e.g. reference approach). In this sector comparisons could be useful in identifying where differences in assumptions may lie and where there may be possible inconsistencies or errors, but they do not give any indication of the accuracy of the estimates. In any case, for meaningful comparisons complete access to and a thorough understanding of the nature and structure of the data from alternative sources would be necessary.

16. As indicated above, the comparison of emission estimates with estimates previously submitted is another form of comparison. This has been done to a limited extent by the secretariat in the past.⁸ Such comparisons are a useful tool in the review and assessment of inventories, as they help to identify areas where methodological changes have taken place, new sources included and/or activity data updated. In addition, they may help to identify possible inconsistencies and errors in the inventories. If adequate information is provided in a consistent manner, comparisons of this sort are feasible. The present revision to the UNFCCC reporting guidelines on inventories tries to take these issues into account (FCCC/SB/1999/1 and Add.1).

B. Comparisons of activity data

17. Another type of comparison is that of the activity data underlying the emission estimates. Comparison of these data, as with emission estimates, can be made with alternative sources and with earlier submitted information.

18. The secretariat has done some preliminary analysis of the possibility of comparing activity data provided by Parties in their GHG inventories with the corresponding data sets from United Nations organizations were conducted. These organizations included the Statistics Division of the Department of Economic and Social Affairs, and the Food and Agriculture Organization of the United Nations (FAO). Comparisons were also conducted with data from the IEA for the energy (fuel combustion) sector.⁹

⁸ The secretariat has identified the problems of changes in estimates in inventories over time and reported the range of changes in its GHG inventory reports (FCCC/CP/1998/INF.9 and FCCC/SBI/1999/5), and its compilation and synthesis reports (see FCCC/CP/1998/11). The secretariat has also provided information with respect to the recalculation of GHG inventories in several of its documents on methodological issues (FCCC/SBSTA/1998/7, FCCC/SBSTA/1998/8 and FCCC/SBSTA/1999/INF.3). Also, for the purpose of this note, the secretariat reviewed several of the GHG inventories submitted in 1998 and noted the results of such comparisons, for most Parties did not differ significantly from comparisons previously reported in secretariat documents.

⁹ United Nations Statistics Division publishes the Energy Statistics Database and the Industrial Commodity Statistics Yearbook, FAO publishes the FAO Production Yearbook, and the IEA produces the Energy Statistics and Balances publications.

19. With respect to comparison of activity data submitted previously, as with emission estimates, it may help to identify errors and inconsistencies, indicate changes which have been made, and show the effect of these changes on recalculated inventories. Such comparisons could possibly serve as a useful component of review and assessment of GHG inventories, as they would, at a minimum, indicate areas which may need more thorough analysis and give an indication of the effect of changes on inventories (e.g. sectoral, national levels) (see FCCC/SBSTA/1999/3).

20. For such comparisons to be possible, an agreed format for reporting activity data (which sectors, categories, level of aggregation, etc.) would have to be adopted; for example the common reporting format for GHG inventories (FCCC/SB/1999/1/Add.1) which is under discussion by Parties would serve as a useful format for reporting comparable information. This information would have to be submitted electronically in the predetermined format in order to facilitate the large amount of data processing required and the actual comparisons which would need to be done by electronic means.

21. Comparisons of activity data with statistics from alternative sources have been performed before.¹⁰ These comparisons have had difficulty in establishing the reasons for differences in the estimates. This is primarily because there was a limited understanding of the underlying data used to make the estimates. For national inventories, there sometimes may not be enough detail provided on the construction of the estimates to make concrete conclusions about the underlying data or methodology. Moreover, Parties may not cite the data sources for some of their estimates nor provide enough detail on how they were used. All of these factors contribute to the difficulty of making comparisons of activity data.

22. In principle, activity data can be easily compared since the types of data on economic activities across Parties are similar. For example, procedures for producing energy balances in countries are well established and most Parties use their national energy balance to calculate their CO₂ estimates from fuel combustion. In addition, there are reliable sources of activity data available internationally and these provide ready-made data sets which can be used for comparisons. However, to date there has only been limited reporting of activity data in national inventories. This is in part due to lack of clear guidance as to the exact reporting requirements and format. With the revision of the UNFCCC reporting guidelines on inventories under way, this will hopefully lead to improved reporting of the required information.

23. The objective of the analysis was to provide observations on the usefulness of activity data comparisons to, as stated earlier, assist in the review and assessment of the GHG inventories. These observations are provided by sector in the text that follows. Parties may wish to note the possible extension of exercises such as these to the national scale, as they could serve as an important part of Parties' national GHG inventory procedures.

¹⁰ For example, Marland, G., Brenkert, A. and J. Olivier, "CO₂ from Fossil Fuel Burning: A Comparison of ORNL and EDGAR Estimates of National Emissions", *Environmental Science and Policy*, in press, 1999; see also van Amstel, A.R. et al., op. cit.

Energy

24. The energy sector is by far the most important source of emissions. For this exercise it was decided that a comparison should be made between the national GHG inventory data supplied by Parties using the reference approach and data obtained from the United Nations energy statistics and the IEA. It was anticipated that this type of comparison would (at a minimum) allow formats to be compared and would be a simple approach.

25. One of the difficulties encountered from the outset of the exercise was that many national inventories do not contain fuel-use data at all, or for the years for which data were available from international sources.¹¹ Therefore it is important to consider the availability of international statistics, in particular for comparisons of the most recent data provided by Parties.

26. As long as a reference approach for CO₂ emissions from fuel combustion calculation is available in the Parties' national inventory or national communication, these types of comparisons can be performed. They are also easy to perform from the perspective of identifying the correct data to compare. Only production, imports, exports, international bunkers, and stock changes need to be considered in the calculations. Transformation from primary energy products to secondary products are not considered, which is why the reference approach is so useful.

27. The International Energy Agency also conducted a comparison of activity data of the same inventories with their energy statistics.¹² The analysis of national inventory data with United Nations and IEA data identified some potential difficulties in undertaking comparisons.¹³ Specifically, there are a number of elements of reporting which need to be given close attention.

¹¹ Of the 10 inventories reviewed, only the those of Germany, Greece, New Zealand, Slovakia and the United Kingdom of Great Britain and Northern Ireland contained a detailed reference approach calculation which could be used. Energy data from Monaco could not be obtained from the United Nations energy statistics. It is possible that such data are available in other supplemental material, but these data were not available during the exercise. In any case, it is not likely that data for Monaco will be available in the international statistics, as typically energy statistics from Monaco are aggregated with those of France, which would no doubt influence the comparison with the French energy statistics as well. It is important to recognize that, at the time of the comparisons, the United Nations statistics only contained data up to 1995. Both the United States of America and Australia provided reference approach calculations for 1996, but these could not be compared with the United Nations data. However, data for 1996 were available from the IEA at that time, and the comparisons they conducted did include Australia and the United States of America.

¹² "Comparison of activity data submitted in national communications with data from the IEA", International Energy Agency, Paris, January 1999 (provided by the IEA to the secretariat, 2 February 1999).

¹³ The United Nations and the IEA share the same questionnaire for energy data and exchange their data in order to minimize duplication, therefore the data are not completely independent of each other. However, each statistical office conducts its own quality control procedures on the data and has slightly different means of presentation. In these respects each data set is unique.

These are the units in which data are reported (physical or energy units), whether data are reported on a gross or net calorific value basis, how stock changes are reported, and allocation of data related to non-energy processes.

28. For the comparisons with United Nations data, the overall differences in the energy balances were small or in some cases negligible. However, there were some large differences for certain fuel types. Generally, there was a better correspondence with the IEA data for the inventories considered. As the IEA comparisons converted their energy data into the units of the data presented in the national inventory, for the energy sector as a whole they were able to present an aggregate difference between the national data and the IEA data. These differences ranged from 0.4 to 4.2 per cent with, although they masked some significant differences at the level of fuel type.

Fugitive emissions

29. Difficulties were encountered when trying to compare national activity data for calculating fugitive emissions with data from the United Nations energy statistics. While it was possible in many cases to locate the production of oil or natural gas in the international statistics, it did not often compare well with the national activity data; at most, comparisons of national totals would have been possible. This may be because the recommended data, in the IPCC Guidelines, for calculating these emissions corresponds to the marketable production number rather than the total production number. The marketable production number is usually smaller than the total production number because it includes shrinkage and losses. However, for the comparisons this was not always the case. Moreover, none of the national inventories provided an indication as to whether the activity data referred to marketable or total production figures. Because of this confusion, comparisons of activity data for this sector do not appear in this report and may not be particularly useful.

Industrial processes

30. Industrial production statistics from Annex I Parties are considered fairly accurate. These statistics are used to estimate the emissions from the various industrial processes which produce GHG emissions. These statistics, as provided in the national inventories, were compared with the data from the United Nations Industrial Commodity Statistics Yearbook (1997) to evaluate their comparability with international data. A few difficulties in this sector were identified, but some comparisons are possible and may serve as a useful tool in assessing the activity data included in GHG inventories.

31. The first approach chosen for analysing this data was to look at a time series to determine if there is a consistent difference. For example, in the case of the United States of America, statistics are consistently lower than the United Nations statistics. In this case it is because the United Nations statistics report cement production while the United States used clinker production to calculate its emission estimate. The IPCC Guidelines recommend the use of clinker production as a more representative data set for the calculation of CO₂ emissions, but

these statistical data are not available in the United Nations statistics. Furthermore, not all Parties provide a clear indication as to whether or not clinker production was used as a basis of their calculations. For these reasons, the use of the United Nations statistics to evaluate activity data related to cement production is limited.

32. The second approach involved comparing activity data from various sectors with the corresponding data from the United Nations statistics. The comparisons indicated that iron and steel production statistics from the United Nations are comparable with data reported in inventories. Also the aluminium statistics from the United Nations industrial statistics yearbook may be useful for comparison with national activity data in a broad sense. For aluminium the sample comparison indicated that the figures differed somewhat, but could be considered comparable from a qualitative standpoint, that is to say the differences are not large in absolute terms. The differences between the national and international statistics of this process are in part due to the timing of reporting at the national compared to the international level. However, the differences may also be due to procedures for reporting confidential information. Depending on the concentration of an industry in a limited number of countries or the number of producers in a single country, production statistics may be considered confidential. In this case data may need to be aggregated and submitted through different channels.

33. From the comparisons, it would seem that some industrial production statistics could be useful for comparisons, such as iron and steel production and aluminium production. However, such comparisons would not seem to be as useful for emission estimates from soda ash use or glass production. These are categories where national statistics on end-use are needed since the emissions occur when soda ash is used for glass or chemicals production. Moreover, cement production statistics will not be useful since many countries use clinker production for producing their CO₂ estimate.

34. The lack of International Standard Industrial Classification (ISIC) codes in the reporting tables from the inventories needs to be noted. Without these codes, matching up the correct statistics is much more difficult. The provision of the ISIC codes in data which are to be compared would be an essential element for such comparisons. At present the IPCC Guidelines request, where possible, that emissions be reported according to the ISIC group or class in which they occur.

Agriculture

35. Agricultural statistics are often viewed as less accurate than industrial or energy statistics as these data are gathered from a large number of individual sources and hence have a larger possibility for error. Agricultural statistics also cover a wide range of products, from livestock production, to crops, to land areas harvested, each having its own range of uncertainty. Moreover, collection of agricultural statistics is not uniform throughout the globe. In some countries, for example, estimates are derived from indicators such as per capita consumption.

36. FAO is the United Nations body which collects and publishes data on global food production. It also publishes some statistics on management of forests and forest products. The secretariat compared the FAO data set with selected national inventory data. It appears from these comparisons that one of the main areas requiring clarification is the FAO definition of many of the agricultural products for which statistics are maintained.

37. Poor correlation was found between the FAO data on crop production and the crop production data in the national inventories. This does not appear to be an area where comparisons are feasible. Also, there was little success in comparing the FAO fertilizer statistics with those in the national inventories. The statistics available from the FAO on area of land harvested could not be compared with the activity data in the national inventories. It was not possible to establish a correlation between the FAO land classifications and those used at national level. More information is required in this area before comparisons can be performed.

38. Very small differences were observed between FAO and national statistics on animal populations. One general problem observed for most of the inventory data was the split between dairy and non-dairy cattle. In some instances there was correspondence for one category, but not the other. In other instances, the total numbers of cattle corresponded well but the subcategories differed significantly. As these differences were not uniform across all the inventories, if such comparisons are undertaken it may be necessary to deal with them on a case-by-case basis.

39. Another set of activity data are those reported for sheep population. For example, analysis of the data on sheep population in the United Kingdom's inventory with FAO statistics identified substantial differences. The reasons for this were clear, as the United Kingdom's report clearly explained that the population data were modified so as not to account for emissions from sheep after they have been slaughtered. This is not considered in the FAO population statistics, which record the total sheep population for a given year rather than the average, thus the differences in the data. Such details are useful when performing comparisons and for a full understanding of how the inventory was constructed.

40. An area where there is often poor correspondence between national and international statistics is in poultry statistics. Poultry populations are often difficult to match because chickens have an average lifespan of 20 weeks. This means that statistics must be kept on the average population of chickens and this varies depending on the number of laying hens, poultry for slaughter (fryers) and roosters. Methodologies to estimate emissions may or may not take this into account, but since poultry are not ruminants, even large errors in the populations will not affect the total methane emissions significantly.

41. It should be noted that the data set from the FAO is very user friendly and can be easily imported into a spreadsheet for manipulation. This made the comparisons quite easy to do. Most national inventories also provide statistics on animal populations, so comparisons are possible. Comparisons of such data could possibly increase the confidence in one of the larger sources of methane emissions.

Other sectors

42. Comparisons of data from the land-use change and forestry and waste sectors were not possible because of the lack of available international sources to compare with the information reported in inventories.

C. Comparisons of emission factors

43. Different emission factors, or changes to them, can affect emission estimates. Understanding the reason for the choice of an emission factor or changes in emission factors is important from the standpoint of transparency and consistency of reporting.¹⁴

44. As with emission estimates and activity data, a similar analysis was done of the comparisons of emission factors.¹⁵ Firstly, those emission factors which were available in the national inventories were compared with emission factors from earlier submissions from the same country. Secondly, those emission factors were compared with the IPCC default emission factors from the IPCC Guidelines. The usefulness of such comparisons was then evaluated.

Comparisons between emission factors in different submissions

45. Information on emission factors is often not included in national GHG inventory reports. Even if these emission factors are provided, it is sometimes unclear as to how they are used in the national estimation methodology. As well, reporting is sometimes not uniform between publications and may require some interpretation.

46. The emission factors used in the methodology are technology- or fuel-dependent, while the aggregate emission factors are simply the ratio of emissions to activity data. For the purpose of comparisons, it is important to maintain consistency as to the level of aggregation of the emission factors being compared. If the information provided in inventories is to be subject to comparisons, it is important that the reporting guidelines clearly state what is to be reported, and that adequate explanation and documentation are provided.

47. Though the information on the actual emission factors is useful and important, it may be presented in an ad-hoc manner, at varying degrees of aggregation, and not presented in all inventories over time, all of which complicate any comparison. Thus comparisons between aggregate emission factors are much easier to perform than comparisons with actual emission

¹⁴ For a discussion of the differences in emission factors and example comparisons of different emission factors see Lammers, P.E.M., A.A Olsthoorn and J.F. Feenstra, "Country/Region-Specific Emission Factors in National Greenhouse Gas Inventories", United Nations Environment Programme/Global Environment Facility, Nairobi, 1997.

¹⁵ Emission factors were available, to some extent and for some sectors, in the inventories of Australia, France, Germany, Norway and the United Kingdom.

factors. This is primarily because there is the possibility to have a standardized reporting format for these data and therefore to have them presented in a comparable way in each inventory. However, aggregate emission factors are not true emission factors, but rather simple back-calculations from activity data and emission estimates.

48. Since the aggregate emission factors are a type of indicator, they can be used for comparisons among one Party's submissions or for comparisons between Parties. Such cross-Party comparisons may be useful in identifying possible errors and inconsistencies, or for understanding the effects of different emission factors on emissions in comparison to other Parties. In some cases, comparisons of aggregate emission factors over several years can provide an indication of progress in areas such as energy efficiency, livestock efficiency or industrial production efficiency. Such information may be useful to the UNFCCC process. However, any comparison of emission factors among Parties would be influenced by specific underlying technologies and/or national circumstances, which, depending on the specific source in question, could limit the usefulness of comparisons.

Comparisons between national and default emission factors

49. The second type of comparison evaluated was that of the national emission factors with the default emission factors in the Revised 1996 IPCC Guidelines. Since the emission factors in the IPCC Guidelines are not aggregate emission factors that result from a ratio of emissions to activity data, it is not feasible to compare them with aggregate emission factors provided in inventories. The only meaningful comparison is with actual national emission factors used in national methodologies.

50. A review of the available inventories showed that emission factors of this type were often not readily available. The national inventory from Australia was chosen for this comparison because, of the 10 inventories considered, it contained the most detailed information on emission factors

51. This type of comparison was found to be of limited usefulness. For some methodologies, the IPCC Guidelines do not contain emission factors. For others they only offer a range of emission factors which may not be applicable to the Party being compared. Finally, if the Party has chosen to estimate its emissions using the IPCC default methodology, a comparison of the emission factors will indicate this, but only partially. With such comparisons, more detailed investigation would be needed into the actual methodology chosen before a clear conclusion could be made.

52. Despite the above observations, it is still possible to use the comparisons of emission factors with the IPCC defaults as a tool for performing "reality checks". The Revised 1996 IPCC Guidelines were compiled through research and consultation with the broader scientific community. Because of this, they are a good 'snapshot' of inventory science as it existed in 1996, though it continues to evolve. If a comparison of national emission factors with IPCC defaults reveals that the national emission factor is within the range quoted by the IPCC, this is a

good indication that it is consistent with the thinking of the broader scientific community. This does not give information on the accuracy of the resulting emission estimate, but it does increase the overall confidence in the process for obtaining this estimate.

53. Though it was possible to perform the emission factor comparisons with the IPCC defaults, the national emission factors used were only presented in a limited number of the inventories used for this paper. Moreover, some of the emission factors which were presented were being used in national methodologies which were different than that of the IPCC, and therefore comparisons of the emission factors may not be relevant. Furthermore, should Parties decide to require the reporting for all, or even for some sectors, of disaggregated emission factors, this would represent a significant amount of additional detail in the inventories, resulting in a sizable increase in the reporting requirements for Parties. In view of these concerns, overall, it would seem that the utility and feasibility of this type of comparison is rather limited.

IV. CONCLUSIONS

A. Overall conclusions

54. If a data source has been thoroughly checked and reviewed it can be used to build confidence among Parties. In the context of the UNFCCC process, the objective of data comparisons would not be to try to determine the accuracy of emission estimates or underlying data, but rather to detect errors or inconsistencies with the inventories submitted by Parties. Such comparisons could also be undertaken by Parties as part of national procedures, hence increasing the transparency of inventories and decreasing the likelihood of errors and inconsistencies. In this regard, data comparisons could be a valuable tool within the reporting and assessment framework of the UNFCCC.

55. The conclusions of this paper should be considered preliminary, as the number of inventories, actual data used and years considered were quite limited. If extensive comparisons are deemed necessary, some additional work into the available sources of data and the ways of compiling international statistics would be required before the use of data comparisons could be fully validated. This would need to consider a larger, more representative share of Annex I Parties, a series of years, and more thorough comparisons with the alternative sources of information.

56. However, an analysis of possible comparisons of emission estimates, activity data and emission factors, and their respective utility and feasibility, has been provided in this paper. The results of this analysis give some indication as to what areas might be worth further consideration in the context of activities related to the review and assessment of the GHG inventories.

B. Feasibility

57. The feasibility of doing data comparisons in part depends on the type of comparison to be performed. The following are some aspects which are common to any type of data comparison:

- (a) A prerequisite for comparisons is the use of a common reporting format for GHG inventories data to ensure complete and consistent submissions;
- (b) Analysis of data depends on full access to sources of information;
- (c) Resources must be adequate for maintaining/accessing relevant data and performing the required analysis.

58. As Parties are most knowledgeable about their data sources, have extensive expertise in the use of the data and a sound understanding of the nature of the data, ideally the data should be reviewed and compared at the national level prior to submission to international organizations, and then, as necessary, compared at the international level.

C. Utility

59. Despite the various limits to conducting data comparisons, there are some comparisons or aspects of them which may be of use to the UNFCCC process. For example, comparison of activity data and emission estimates, for some sectors/sources. International data sets from well respected institutions also have utility for the comparisons with national data. When data from both sources are comparable, a greater level of confidence could be given to the original national data. It is important to note, however, that comparisons must be combined with other tools in order to properly assess emission estimates, as comparisons do not provide enough information to fulfil this role.

60. Comparisons of emission factors are limited. The emission factors of Parties will differ from the IPCC emission factors and from each other. However, for some sectors cross-Party comparisons of aggregate emission factors may provide some insight into the inventories, taking into account that differences may be due to specific technologies or national circumstances.

D. Specific suggestions on further work

61. The original mandate for this paper requested the secretariat to provide some specific suggestions for further work. The suggestions provided here assume that a common reporting format will be adopted that will provide some level of activity data and aggregate emission factors, and that the secretariat will be asked to produce synthesis and assessment reports of GHG inventories. These suggestions also take into account the points above concerning feasibility and utility of comparisons, as well as relevance to the UNFCCC process, in particular

the review and assessment of annual GHG inventories. The suggestions are categorized as activities provided for, or not, in the proposed programme budget of the secretariat in its next biennium.

Activities provided for in the proposed budget for 2000-2001

62. In the synthesis and assessment reports and/or on the secretariat Web site, activity data, emission factors and emission estimates submitted by Parties could be presented alongside data from their previous submissions, submissions from other Parties and data sets from other sources (to some extent). This approach would facilitate the assessment of the Party's inventory by in-depth review teams or other interested Parties. The secretariat could undertake the preparation of lists containing such information with the resources identified in the programme budget of the secretariat for the next biennium.

63. On a limited basis (e.g. sectoral), a narrowly defined comparison of activity data, emission factors or emission estimates could be conducted. This could either be included in synthesis and assessment reports, as technical papers or as special reports. Of course the ability to do the comparisons would be subject to their feasibility in terms of availability of the required information, a common level of aggregation in reporting, and budget resources.

Activities not provided for in the proposed budget for 2000-2001

64. In addition to listing activity data, emission factors and emission estimates submitted by Parties, an assessment of the actual comparisons of various aspects of this information could be provided. This information could be provided as part of the synthesis and assessment reports or as separate documents. Such comparisons would probably have budgetary implications and would need to be planned for in the context of the secretariat's activities related to this issue. The actual budgetary implications of any or all possible comparisons would depend on their scale, in terms of types of comparisons, numbers of Parties and years for which data are to be considered. Any such comparisons would require resources additional to those that are presently provided for in the proposed programme budget for the next biennium.
