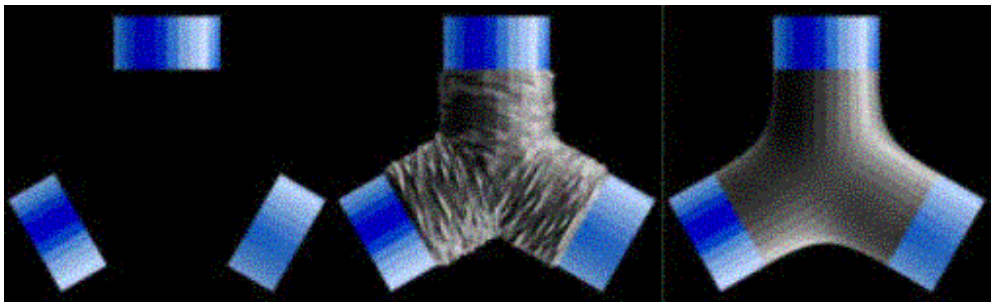
Gap-filling methodologies for the 2004 ETC-ACC CLRTAP and GHG (CRF) air emissions spreadsheet



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Contents

Introduction

This report presents the proposed gap-filling methodology that will allow the provision of a complete and transparent air emissions database that meets the modelling and analysis requirements of the EEA and ETC-ACC in 2004. This air emissions database will incorporate the agreed reported datasets from CLRTAP and UNFCCC, gap-filled to remove gaps and data inconsistencies, where this is necessary and appropriate, and which can therefore provide an accepted source of information for use in EEA reports and fact-sheets. This inventory gap-filling task falls within the scope of Task 1.1.16.1b of the 2004 ETC-ACC Implementation Plan.

The initial identification of data inconsistencies and gaps in reported inventory submissions that may require gap-filling will occur through a separate inventory review process to be performed by ETC-ACC and EMEP. Details of this review process are described in the Implementation Plan 2004 under Task 4.4.2.2. The review process will identify, by sector and pollutant, unexplainable and significant inconsistencies according to defined criteria which can then be addressed through the gap-filling procedure. A joint EMEP/EEA report will summarise the results of the work and will be published in July 2004.

It is clearly recognised that, ideally, there should be no need to gap-fill to reported inventory data, it being the responsibility of reporting Parties to submit full and accurate inventory datasets. Nevertheless, for a variety of reasons, EEA/ETC-ACC users of inventory information can have difficulty obtaining complete and consistent inventory data, due to for example, the presence of gaps within reported time series.

A complete and consistent set of inventory data is an obvious requirement for data users. The ETC-ACC requires a complete air emissions inventory to generate time series, trend and distance-to-target information for policy makers. This data also forms the basis for the EEA emissions-related indicators, fact-sheets and related supporting policy documents including:

- Energy and Environment Report
- TERM
- Agriculture and Environment Report
- State of the Environment Reports
- Other policy reports (e.g. Europe's Environment: the third assessment).

Similarly, EMEP/MSCW as another main user of inventory data requires complete and accurate information for modelling purposes. The presence of gaps or erroneous values in reported data can have significant impacts on the results of the deposition modelling calculations.

It is proposed that gap-filling will be performed at an appropriate aggregated sectoral level and for specified pollutants according to user requirements. For example, a description of the aggregated sectors and pollutants currently included in the ETC-ACC Air Emissions Database (where information is available) is shown in Table 1.

Table 1. Description of aggregated sectors and pollutants contained in the ETC-ACC Air Emissions Database.

EEA Code	Aggregated sector descriptions	Pollutants
1	Energy Industries	*Air pollutants:* CO, NH_3, NMVOCs, NO_x, primary PM_{10}, SO_2.
2	Fugitive Emissions	
3	Industry (Energy)	
4	Agriculture	
5	Waste	*Greenhouse gases:* CH_4, CO_2, N_2O HFC, PFC, SF_6.
6	Other (Energy)	
7	Road Transport	
8	Other Transport	
9	Industry (Processes)	*'Combined' air pollutant issues:* Acidifying potential, GWP, Particulate formation, Tropospheric ozone formation potential.
10	Other (Non Energy)	
11	Transport	
12	Energy Industries (Power Production 1A1a)	
13	Energy Industries (Other 1A1b&c)	

The scope and nature of the techniques to be used for inventory data gap-filling were originally discussed and agreed upon at a workshop held at IIASA last year (2003). Further details of this meeting are contained in the report ETC-ACC (2003)[1].

[1] ETC-ACC (2003). Gap-filling methodologies for the CLRTAP/NEC and GHG (CRF) air emissions inventory. EEA-ETC/ACC-Technical paper. Martin Adams & Justin Goodwin, AEA Technology 14-2-2003.

Procedure

Any process used to gap-fill inventory data is required to be simple and pragmatic. The methods described here will be performed by those institutions that are primarily responsible for the inventory review process, in order to avoid inconsistent approaches and ensure that links are retained to the relevant conventions (AEAT for CLRTAP air emissions data and UBA-V for GHG emissions data). It should also be noted that the methodologies used for gap-filling of reported greenhouse gas data are fully consistent with the gap-filling methods required under the EU Monitoring Mechanism and the UNFCCC gap-filling procedures.

As previously mentioned, it is proposed that gap-filling will be performed at an appropriate aggregated sectoral level and for specified pollutants according to user requirements. Where possible for non-GHG air pollutants, a common level of sector aggregation will be decided upon prior to the gap-filling process, which will avoid overlap of activity between different institutions applying the gap-filling methodology to differently aggregated data. Sectors can then be aggregated further according to the final requirements of users.

Generic gap-filling methodologies

- If the identified data gap or inconsistency in the sectoral data can also be identified in the national total trend, then gap-fill or interpolate as appropriate.
- If the identified data gap or inconsistency in the sectoral data is not evident in the national total trend, then sectoral totals should be reallocated to remove the inconsistency wherever possible.

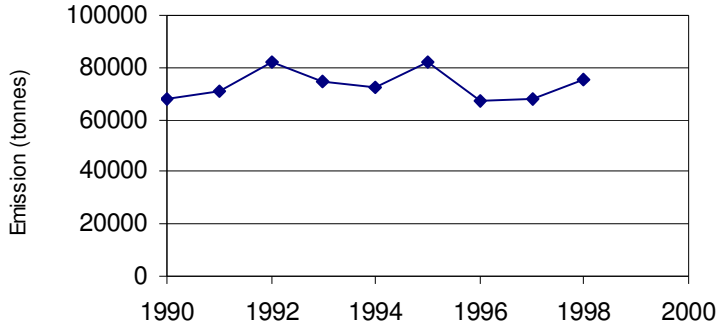
The following examples illustrate the type of inconsistencies that can occur in reported sectoral data (to be identified through the separate inventory review process), the potential causes of the inconsistency and the gap-filling method that would be used to correct the situation (with reference to the generic rules given above). Gap-filling need only occur for those situations where the identified data-gap or inconsistency has a significant effect on trends at an aggregated level.

a) Data Gaps

Issue:
Data gaps occur in reported data either at beginning or end of time series data, or for years within the time period itself.

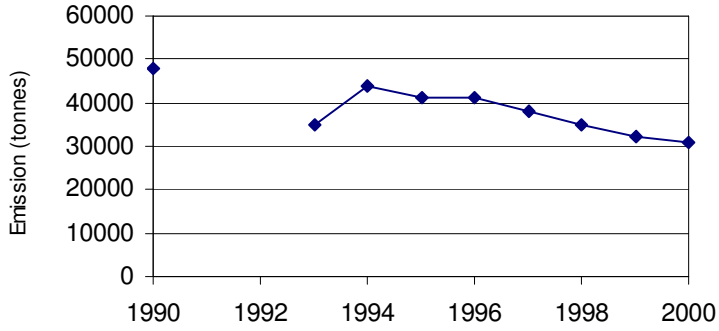
Examples:

Figure 1. Data-gaps in end-years: e.g. NO_x emissions from Energy Industries sector, Portugal.



Source: EMEP/CLRTAP (2003)

Figure 2. Data-gaps within time-series: e.g. CO emissions from Road Transport sector, Luxembourg.



Source: EMEP/CLRTAP (2003)

Potential cause of inconsistency:
Non-reporting, or reporting/reallocation of a previously reported sector under another reporting category.

Recommended gap-filling methodology:
If two or fewer years are missing from the outsides of the datasets i.e. beginning or end of time series information, copy the nearest reported emission value to the blank years.

If two or fewer years are missing from within a dataset, interpolate between the two reported values.

If three or more years are missing from the outsides of the datasets i.e. beginning or end of time series information, use an appropriate proxy trend (see **Table 2**) to interpolate values.

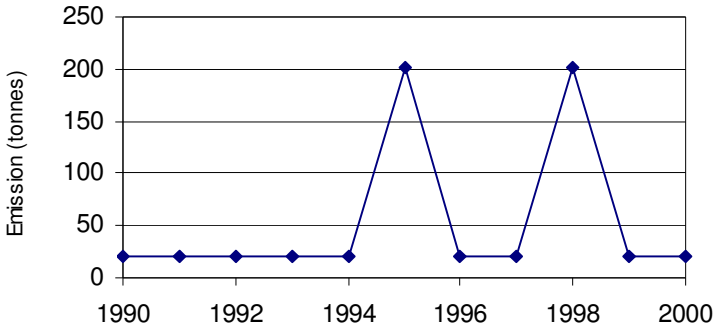
If three or more years are missing from within a dataset, an appropriate proxy trend (see Table 2) could be used to interpolate values.

b) Data spikes or dips

Issue:
Unusually high (or low) values within time series datasets indicate the value may be anomalous, and should therefore be gap-filled.

Example:

Figure 3. Data-gaps within time-series: e.g. NH_3 emissions from the Waste sector, Liechtenstein.



Source: EMEP/CLRTAP (2003)

Potential cause of inconsistency:
Incorrect emission data reported, or also in the case of a dip, non-reporting/reallocation of a previously reported sub-sector category under another reporting category.

Recommended gap-filling methodology:
Correction of anamolous value by interpolating between reported values either side.

Table 2. Potential drivers and proxy trend information for selected fuel combustion activities.

Source category	Possible drivers	International data sources
1.A.1 Energy industries	Gross domestic product (GDP)	Organisation for Economic Co-operation and Development (OECD), World Bank
1.A.1.a Public electricity and heat production	GDP Public electricity production/output	OECD, World Bank United Nations, IEA, EUROSTAT, UNIPEDE
1.A.1.b Petroleum refining	Crude oil throughput Other production data (if available) GDP(last resort)	United Nations, IEA, EUROSTAT OECD, World Bank
1.A.2 Manufacturing industries and construction	Production data (iron, steel, etc.) (highly recommended) Production index (Value added) GDP(last resort)	United Nations, OECD, EUROSTAT, CEMBUREAU (for cement) OECD, World Bank
1.A.3.a Civil aviation	Number of landings and take offs Transport performance (passenger km, tonnes km)	ICAO, EUROSTAT
1.A.3.b Road transportation	Transport performance (passenger km, tonnes km, vehicle km) Number of car registrations (last resort)	EUROSTAT
1.A.3.c Railways	Transport performance (passenger km, tonnes km)	EUROSTAT
1.A.3.d Navigation	Transport performance (passenger km, tonnes km)	EUROSTAT
1.A.4.a Commercial/institutional	Number of m^3 or m^2 of buildings [Employees] Degree days	
1.A.4.b Residential – CO_2	Population Number of households Income (in $) Consumption (in $) Degree days	United Nations, OECD, EUROSTAT
1.A.4.b Residential – CH_4, N_2O	Bio-energy (crop/fuel wood production data)	FAO, (IEA)
1.A.4.c Agriculture/forestry/fisheries	Value added	OECD, World Bank, EUROSTAT

Source: UNFCCC (2002). Methodological Issues. guidelines under Articles 5,7 and 8 of the Kyoto Protocol: Report of a workshop to alaborate draft technical guidance on adjustments under Article 5.2 of the Kyoto Protocol. FCCC/SBSTA/2002/INF.5.

Gap-filling procedures to be used in 2004

For the ETC-ACC emissions spreadsheet it is proposed the following methods will be used for gap-filling in 2004. A record of data that has been gap-filled will be kept as part of Task 1.1.16.1b and will be placed on Circa together with the final emissions spreadsheet later in 2004 as part of the planned QA/QC report on gap-filling progress and issues.

Gap-filling routine: main air pollutants (CO, NH_3, NMVOC, NO_x, PM_{10} and SO_2)

Where countries have not reported data for one, or several years, data will be interpolated to derive emissions values when data is missing between two different years. If the reported data is missing either at the beginning or at the end of the time series period, the emission value will be considered to equal the first (or last) reported emission value.

Missing data: Particulate matter (PM_{10})
As a general rule, is **not** proposed that gaps will be filled where no data has been reported for a given sector by Parties in any year. The primary exception to this is for emissions of primary PM_{10}, where the importance of these for air quality/policy issues requires the use of inventory data from other sources. In this situation, national primary PM_{10} emission totals and sector data will be obtained from the RAINS PM model developed by IIASA (the Clean Air For Europe (CAFE) baseline scenario will be used). Data from RAINS will be obtained for 5 of the EU25 countries where no PM_{10} emissions were reported to UNECE/LRTAP (despite the protocol requirements to do so). PM_{10} is an important issue with respect to human health, and so this is the only pollutant where external data will be obtained to allow a complete timeseries to be compiled for EU15 & EU10. RAINS is judged to be the best readily available source of European estimates of PM_{10} emissions. Base data that goes into the model has the advantage of having been bilaterally discussed by IIASA with countries under the CAFE process. Values are available from the model only for 1990, 95 and 2000, and so interpolation between these years will be unavoidable.

Missing data: Energy Industries (Power Production 1A1a)
Where data is missing from the Power Production 1A1a sector, an alternative gap-filling routine will be performed. This is a result of users experience in prior years, where inconsistencies in data analysis occurred using data to which the general gap-filling procedure had been performed. For this sector, missing values will be derived based on the ratio of the 'Power Production 1A1a' sector to the parent sector 'Energy Industries' in the most recent year for which both values for both sectors are available. This ratio can therefore subsequently be used to calculate emission values for the 1A1a sector if a value for the parent sector 'Energy Industries' is available.

Gap-filling routine: greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6)

Information in this section is reproduced from that contained in the report EEA (2004)[2], and describes the process used to fill gaps in greenhouse data for the EU-15 Member States which will be included in the ETC-ACC air emissions spreadsheet.

"The EC GHG inventory is compiled by using the inventory submissions of the 15 Member States. For data gaps in Member States' inventory submissions (CRF summary table 1.A or sectoral emission tables), the following procedure is applied by EEA ETC/ACC in accordance with the implementing provisions under Council Decision 280/2004/EC for missing emission data:

1. If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. If CO2 emissions from energy sector are concerned, extrapolation of emissions should be based on percentage change of Eurostat CO2 emission estimates if appropriate.

2. If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert re-view team as provided in the *Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol*[3] is used without application of the conservativeness factor.

3. If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the *Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol*[3] without application of the conservativeness factor."

For the gap-filling in 2004 this means that extrapolation and interpolation were used. In addition, where emission trends were available at more aggregate level (e.g. national total or sectors), but not at disaggregate level, the percentage change of the aggregate emission trends was applied to the disaggregate level.

Colour key

In 2004, the 'base' national total and sector datasets contained in the gap-filled air emissions spreadsheet will be colour coded to clearly show what data has been gap-filled and hence helping improve transparency. This will allow data that has been gap-filled to be easily identified, and will also provide information on the type of gap-filling that has been used. The following table shows the colour scheme that will be used to indicate gap-filled data.

[2] EEA (2004). "European Community Greenhouse Gas Inventory 1990-2002 and Inventory Report 2004", Technical Report No 2/2004. European Environment Agency, Copenhagen.
[3] As included in FCCC/SBSTA/2003/10/Add.2.

Table 3. Colour used to indicate gap-filled values in the 2004 air emissions spreadsheet.

Colour	Description
1	Emission value considered to equal the first (or last) reported emission value.
2	Emission value interpolated
3	Value for sector '1A1a power production' gap-filled using ratio of the '1A1a' sector to the parent sector 'Energy Industries' in the most recent year in which both values for both sectors were available.
4	Value for sector '1A1a power production' interpolated using ratio of the '1A1a' sector to the parent sector 'Energy Industries' in the most recent years in which both values for both sectors were available.
5	Value for sector '1A1a power production' gap-filled using ratio of the '1A1a' sector to the parent sector 'Energy Industries' using ratio from reported data in 2003.
6	Data from RAINS PM10 model
7	Indicates at least one component pollutant of an aggregated issue (acidifying potential, GWP, Particulate Formation, TOFP) has been gap-filled.

Unallocated emissions

In 2004, an additional sector will be included in the gap-filled air emissions dataset – 'Unallocated'. This sector is the difference between the reported national total and the sum of the reported sectors for a given pollutant (ie unallocated = [national total]-[sum of sectors]), and can hence be either negative or positive in value. Therefore if one adds up the (reported sectors and unallocated), the national total will be obtained.

The use of an 'unallocated' sector will be done in response to 2 specific user 'needs': 1) in previous years (i.e before 2003) ETC-ACC did not worry about differences if they existed, but subsequently received many comments from data users who found this problematic i.e. sectors adding to >100% of the national total which made little sense in terms of fact-sheet analysis; and

2) a second option would be to provide an 'estimated' national total based on the sum of the sectoral emissions reported by a country. However, this approach is not regarded as appropriate. National totals reported by countries are important numbers and are the basis of how progress is evaluated to NEC targets etc. Any new 'estimate' provided and used for official EEA analysis for such purposes would have to be extensively documented & approved by the country concerned.

Inclusion of this additional sector therefore means that it is no longer necessary to 'revise' the official national totals to ensure they are consistent with the sum of the individual sectors. This also means that the reported official national totals are reproduced in the air emissions spreadsheet, and not an ETC-ACC estimate for the national total. This is important for determining the progress that countries have made toward meeting their NEC target obligations etc, which should be based on the respective officially reported national totals. So to balance these 2 conflicting

requirements the 'unallocated' sector method has been used. Together with observations made in the separate ETC inventory review task[4], it also serves as another tool that helps illustrate the problems that still exist with national inventory reporting.

ETC-ACC gap-filled air emissions spreadsheet 2004

A copy of the 2004 gap-filled air emissions spreadsheets (1.2Mb zip) is available from the ETC/ACC web site at: http://air-climate.eionet.eu.int/docs/ETCACC_TechnPaper_2004_3_Emiss_Gapfilling_spreadsheet04_v1.zip

[4] Vestreng V., Adams M. and Goodwin J., Inventory Review (2004). Emission data reported to CLRTAP and under the NEC Directive. EMEP/EEA Joint Review Report. EMEP/MSC-W 1/2004. ISSN 0804-2446

Timetable 2004

The following table indicates the planned timetable table for gap-filling activity and the main institutions responsible for this.

Table 4. Timetable of inventory gap-filling process and main responsibilities [A].

Date	Activity	Institution(s) responsible/coordinating
1st March 2004	Air emissions data from EMEP/CLRTAP delivered to ETC-ACC.	Met.No
31st March 2004	Deadline for last corrections to GHG reports by MS	(UBA-V)
Mid April 2004	Update of databases on GHG emission trends and projections including gap-filling	UBA-V
Mid July 2004	Final draft of issues report to to EEA and CEC DG ENV	UBA-V
15th July 2004	Finalisation of joint EMEP/EEA report outlining issues surrounding data quality of submitted NEC/CLRTAP emissions data	AEAT/Met.No
Jul-Aug 2004	Compilation gap-filled AP and GHG emissions data.	AEAT lead. UBA-V
Aug 2004	ETC-ACC gap-filled air emissions dataset 2004	AEAT lead. UBA-V
Aug 2004	ETC-ACC QA/QC report for gap-filling	AEAT lead. UBA-V

[A] Times for tasks have been based on those in the ETC-ACC Implementation Plan 2004.