

## **Air emission inventory data in Europe: new perspectives**

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### **ABSTRACT**

Within Europe, a significant resource of publicly available officially-reported air emissions data is available. This information ranges from national emission inventory data reported by the European Union Member States, through to emissions reported by operators of industrial point source facilities.

This paper looks at the base of existing information with respect to officially-reported emissions data from countries, and describes several recent international initiatives which are designed to further improve the quality of the reported data and to modernise and simplify the collection, exchange and use of such data. Examples of such initiatives have included, for example, the introduction of an international inventory review process for national air emission inventories reported by countries, and the substantial revision of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (the European reference document providing experts with guidance concerning inventory methodologies and emission factors).

Finally, several illustrations of how reported emissions data are used in the international and European policy context to inform on air emission and air quality policy issues are presented. This includes examples showing how inventory data is used for tracking progress of national emission reduction commitments and the assessment of the effectiveness of sectoral policies in terms of their impacts on air quality at the European scale.

### **INTRODUCTION**

As in many global areas, European countries over the last decades have experienced rising demand for energy, industrial outputs and transport. The growth of these environmental pressures has in turn led to increases in, for example, the amount of fossil fuels burnt and agricultural intensity, all of which contributes to air pollution.

In Europe, various measures such as energy efficiency improvements, fuel switching from coal to natural gas, and the introduction of legislation requiring abatement of transport and industry emissions has helped to significantly reduce emissions of many air pollutants since 1990, resulting in improved air quality over the region. However, ambient concentrations of particulate matter and ozone in the air have not shown any clear improvement since 1997, despite the decrease in emissions since this time. A significant proportion of the European urban population therefore still lives in cities where EU air quality limit values (set for the protection of human health) are exceeded. The European Commission has estimated that air pollution in the European

Union, notably from fine particulate matter and ground-level ozone, presently causes the premature death of almost 370,000 citizens every year and reduces average life expectancy by an average of 9 months. In the most polluted areas, the loss of life expectancy may be up to two years.

Requiring the annual reporting of air emissions inventory data is one of the methods used in Europe to monitor the progress of countries in implementing policies designed to reduce emissions of air pollutants. At the national level, annual submission of air emissions inventory data has been required for a number of years under both the EU National Emission Ceilings Directive and the UNECE Convention on Long-range Transboundary Air Pollution and its protocols. Such data is always made publicly available. In a similar vein, while many environmental regulators within European countries have made industrial facility emissions data available at the country level, it is only in the last few years that such data has been made publicly available in a coordinated fashion at the European level. From 2009, facility-level emissions data from all 27 Member States of the European Union will be available annually from one website.

The objective of this paper is to present a snapshot of various aspects concerned with the reporting of air emissions data in Europe. The sections of this paper briefly describe the mechanisms underpinning the official-reporting of air emissions data, describe some of the recent initiatives aiming at improving the quality of the available data and finally illustrate some of the applications in which European emissions data are used.

## **BODY**

### **Existing information: the reporting of air emissions-related data in Europe**

#### National level

As identified in the preceding Introduction, within Europe there are two main legislative drivers that require the reporting of national air emissions data:

- the EU National Emission Ceilings Directive (NECD);
- the UNECE Convention on Long-range Transboundary Air Pollution and its protocols.

#### *The National Emission Ceilings Directive (NECD)*

The National Emission Ceilings Directive<sup>1</sup> was adopted in 2001, and covers 4 key pollutants that contribute to acidification, eutrophication and formation of ground-level ozone: sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), non-methane volatile organic compounds (NMVOCs), and ammonia (NH<sub>3</sub>). The Directive sets pollutant-specific and legally-binding emission ceilings (limits) for each country to be met by 2010. The ceilings within the NECD are in general somewhat stricter than those of the Gothenburg Protocol and were designed with the aim of broadly meeting various specific interim environmental objectives in order to improve the protection of the environment and human health against risks of adverse effects from acidification, health related ground-level ozone exposure and vegetation-related ground-level ozone exposure.

The emissions reporting requirements of the NECD were established to ensure it is possible to monitor the progress that the Member States are making towards meeting

their 2010 ceilings and to inform other EU policy. In practical terms, Member States must at the end of each year annually report their latest air emission data ('preliminary' data for the year X-1 and 'final' data for the year X-2) and their projected emission estimates for the year 2010. Member States are encouraged to use the same Nomenclature for Reporting (NFR) reporting format (national totals and sector data) as used for reporting to the UNECE LRTAP Convention described below. The European Commission, assisted by the EEA, is tasked with ensuring the reported emissions inventories and projections are made publicly available. The NECD data reported by Member States each year is freely available through the website of the EEA (<http://dataservice.eea.europa.eu/>), together with an annual status report describing the data received each year<sup>2</sup>.

The Directive also contains provisions to ensure the regular reporting of 'progress and plans' – reports from the Member States that describe the programmes they have (and plan), to implement to ensure the requirements of the national ceilings are reached. A detailed evaluation of the reported NECD programmes was performed last year (2007) for the European Commission. It analysed the projections and programmes submitted by the Member States and the measures they planned to implement<sup>3</sup>.

The NECD is presently undergoing a formal revision process. In early July 2008, the European Commission is expected to publish a proposal for a revised NECD, which will contain new emission ceilings for Member States for the year 2020 and also, for the first time, national emission targets for fine particulate matter (PM<sub>2.5</sub>).

#### *UNECE Convention on Long-range Transboundary Air Pollution*

The 1979 Convention on Long-range Transboundary Air Pollution (LRTAP Convention) (and its subsequent protocols) was one of the first legislative mechanisms under which countries were obliged to report data on air emissions. The Convention itself has now been signed by 51 Parties committed to addressing the issue of transboundary air pollution in the UNECE region. The Parties that have signed the Convention range from countries that are also Member States of the European Union, West Balkan countries, Russia and a number of countries in the EECCA region, and Canada and the USA.

In practical terms the reporting requirements of air emissions data and associated information under the Convention is defined in the UNECE Reporting Guidelines<sup>4</sup>. These Guidelines define the pollutants for which reporting is required (for those Parties which have ratified respective protocols), and define a number of other practical aspects such as submission dates, reporting years, and the reporting format Parties should use to submit emissions data in (the Nomenclature for Reporting (NFR) nomenclature closely resembles the IPCC source nomenclature developed for the reporting of greenhouse gases under the UN Framework Convention on Climate Change).

Presently, the reporting guidelines request Parties to submit time-series information on a number of air pollutants, including main pollutants (SO<sub>x</sub>, NO<sub>x</sub>, NH<sub>3</sub>, NMVOC, CO), particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>, TSP), heavy metals (Pb, Cd, Hg and the additional heavy metals As, Cr, Cu, Ni, Se, Zn) and POPs (aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex, toxaphene, hexachlorocyclohexane (HCH), hexabromobiphenyl, polychlorinated biphenyls (PCBs), dioxins/furans (PCDD/F), polycyclic aromatic hydrocarbons

(PAHs), and as additional information: short-chain chlorinated paraffins (SCCP) and pentachlorophenol (PCP)).

A proposal for a revision of the Reporting Guidelines under the Convention has been made in 2007. It is anticipated that the proposed revised Guidelines will be adopted by the Executive Body of the LRTAP Convention at the end of 2008.

Technical information concerning reporting under the LRTAP Convention is available from the website of the EMEP Centre on Emissions Inventories and Projections (CEIP). This new organisation started work in 2008 and aims to provide expert support to the work of the Convention in the field of air emissions. A database of all emissions reported by Parties under the Convention is available from the CEIP website ([www.emep-emissions.at](http://www.emep-emissions.at)), together with, for example, details of reporting requirements and emission inventory review activities (see also below).

### Current and future industrial/facility emissions reporting

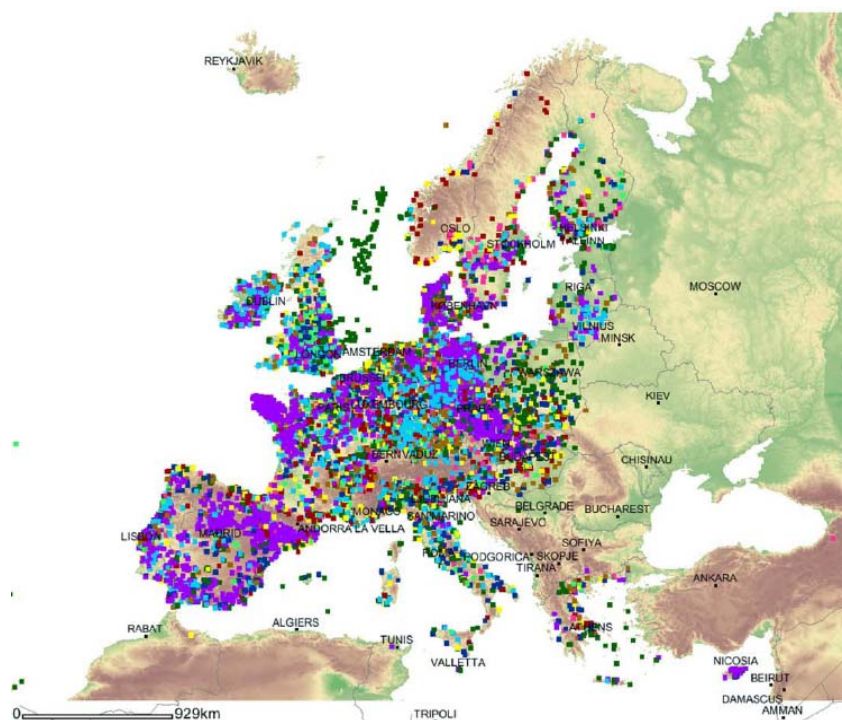
#### *EPER*

The European Pollutant and Emission Register (EPER)<sup>5</sup> was the first comprehensive reporting of the facility-level emissions within the European Union. The EPER Decision included 50 pollutants, 37 of which concerned emission to air, and 26 concerning emissions to water. Under EPER, countries were required to report emissions from facilities encompassing a range of activities, where the emissions of any of the pollutants in EPER exceeded pollutant-specific threshold values. The threshold values were set so as to ensure that approximately round 90% of emissions occurring from each activity were included in the EPER. Emissions were reported three-yearly, the first reporting under EPER occurred in 2003 (for emissions in the year 2001), the second reporting round was in 2006 (for emissions in the year 2004). The 2004 EPER dataset includes data from around 12,000 industrial facilities across the 27 European Union Member States and Norway.

A fundamental element of the EPER Decision was that the reported information within the EPER dataset would be publicly available. All reported EPER information is available on-line ([www.eper.ec.europa.eu](http://www.eper.ec.europa.eu)) (Figure 1), and may be searched by geographic location, pollutant, facility, activity etc. For each EPER reporting year, a review report was produced, documenting the status of the received data, and for example, comparing reported EPER emissions with the national emissions reported by countries to the LRTAP Convention and the NEC Directive. These review reports are also available at the EPER website address.

The EPER decision was repealed in 2007, as future reporting of industrial emissions within the European Union will be occur from 2009 onwards under the E-PRTR Regulation (see below).

**Figure 1. Map showing the European locations of facilities reporting 2004 emissions under the EPER Decision.**



*The European Pollutant Release and Transfer Register (E-PRTR)*

E-PRTR is the European Community's European Pollutant Release and Transfer Register<sup>6</sup>. The E-PRTR succeeds EPER and implements the obligations of the UNECE PRTR Kiev Protocol.

Within the UNECE region (a wider grouping of countries than is encompassed by the European Union), the UNECE Aarhus Convention's Kiev Protocol on Pollutant Release and Transfer Registers (PRTR) has established a PRTR requirement for Parties.

The Kiev Protocol has the objective "to enhance public access to information through the establishment of coherent, nationwide pollutant release and transfer registers (PRTRs)". The Protocol does not directly regulate pollution from emitting sources, rather it ensures that there is public access to information concerning the amount of pollution released from such sources. Having such information publicly available is expected to exert a significant downward pressure on levels of pollution. Under the Protocol, PRTRs developed by Parties should be based on a reporting scheme that is mandatory, annual and covers multimedia releases (air, water, land) as well as transfers of waste and wastewater. PRTRs should:

- be publicly accessible and searchable through the Internet;
- cover releases and transfers of at least 86 substances covered by the Protocol;
- cover releases and transfers from certain types of major point source (e.g. thermal power stations, mining and metallurgical industries, chemical plants, waste and waste- water treatment plants, paper and timber industries);
- accommodate available data on releases from diffuse sources (e.g. transport and agriculture); and
- allow for public participation in its development and modification.

E-PRTR is therefore the European Community's Pollutant Release and Transfer Register which has been designed to fully implement the obligations of the UNECE PRTR Protocol. The E-PRTR has a wider and more comprehensive scope than its predecessor EPER, and it goes beyond the requirements of the protocol, covering more pollutants with stricter thresholds. It covers more than 91 substances released to air and water from industrial installations in 65 different sectors of activity, and will also include transfers of waste and waste water from industrial facilities to other locations as well as data on emissions caused by accidents on the site of the facilities. One important further difference is that data on releases from diffuse sources (such as road traffic, agriculture, domestic heating, shipping etc) is included. The first reporting year under the E-PRTR will be for the year 2007, this data will be reported by Parties in June 2009, with the reported data being made publicly available by the European Commission and EEA in October 2009. To assist countries in preparing for the implementation of the E-PRTR the Commission, in cooperation with the Parties and other stakeholders, has published a guidance document for implementation of the E-PRTR in a number of languages:

<http://ec.europa.eu/environment/air/pollutants/stationary/eper/index.htm>.

### **Initiatives to improve the quality of European reporting**

In recent years, several initiatives have been undertaken in order to improve the quality of the reported data and to modernise and simplify the collection, exchange and use of such data. The following sections provide a snapshot description of three such initiatives:

- the introduction of an international inventory review process for national air emission inventories reported by countries;
- the substantial update and revision of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (the European reference document providing experts with guidance concerning inventory methodologies and emission factors);
- the provision of web-tools designed to facilitate reporting and ensure easier dissemination and user-access to emissions data.

#### Establishment of a national inventory review process

In 2004, the first formal expert review of national emission inventory data submitted by European countries under the LRTAP Convention and the NEC Directive was undertaken. The review process was initially established to check and assess Parties' data submissions with a view to improving the quality of emission data and associated information reported to the Convention and to the European Commission (in the case of the NEC Directive).

Since that first trial review, the review process has been formalised into a 3 Stage process under the LRTAP Convention and is performed in accordance with the methods and procedures endorsed by the Executive Body under the LRTAP Convention in 2007<sup>7</sup>. The document provides a full description of the review process, including the different stages of the review, the different reports provided to countries, and the responsibilities and activities of the various institutions involved with the inventory review process.



The three stages of the annual review, are:

- Stage 1: An initial check of submissions for compliance aspects such as timeliness, format of data and completeness;
- Stage 2: A synthesis and assessment of all national submissions with respect to additional aspects of inventory 'quality', such as consistency and comparability of data. It also evaluates the extent and scope of recalculations and compares inventory data submitted under different reportings e.g. LRTAP, NECD and UNFCCC;
- Stage 3: In-depth reviews of selected national inventories performed by a centralised team of emission experts.

The review is jointly carried out by the Cooperative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (EMEP) and the European Environment Agency (EEA). The first two stages of the technical review of air pollutant emission inventories reported under the Convention and its protocols allow for identification of potential problems in reported emissions. However, they do not enable detailed assessments or provision of feedback, for example, on methodological aspects or the appropriateness of the emission factors used, nor do they allow making recommendations for improvements. These issues are covered by the stage 3 review, where a team of experts meets to review in detail the emission inventory data and associated material submitted by countries. A voluntary Stage 3 review was performed for the first time in 2006, and will be performed again in 2008, before becoming mandatory for Parties (on a rolling basis) from 2009 onward. At each stage, national experts have the opportunity to clarify issues or provide additional information.

The review process itself was deliberately designed so as to allow a common approach to prioritizing and monitoring inventory improvements under the Convention with those of other organizations with similar interests such as the greenhouse gas reviews performed by the United Nations Framework Convention on Climate Change (UNFCCC). However, there are important differences between the two review processes established under the LRTAP Convention and the UNFCCC. In particular, differences occur in terms of the availability of the information and the quantity of pollutants to be covered, which are much greater under the LRTAP Convention. In addition, the review under the LRTAP Convention tends to go further than UNFCCC, which aims primarily at just checking the compliance against the Intergovernmental Panel on Climate Change (IPCC) guidelines (through a procedurally complex and resource intensive review process). In order to fulfil its objective to improve the quality of the emission data, the review under the Convention, for its part, has required development of a more scientifically oriented approach that targets policy needs and is sufficiently flexible to focus on different issues in different years.

The review process over the past years has facilitated the identification of a number of inventory-related issues where improvements have subsequently been addressed i.e. through the update, improvement and strengthening of emission reporting guidelines and guidance for countries.

The findings from the annual Stage 1 and 2 review are published each year in a summary report. The latest of these review reports is Vestreng et al (2007), which covers the emission inventory data submissions received from countries in 2007<sup>8</sup>.

## EMEP/ EEA Air Pollutant Emission Inventory Guidebook

In the mid 1980's a project was established to gather and organise information on emissions into the air relevant to acid deposition in Europe – the CORINAIR project. Under the CORINAIR work, basic emission inventories for European countries were established and an EMEP/CORINAIR Guidebook of emission inventory guidance material was compiled.

Since then, the joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook<sup>9</sup> (and now called the EMEP/EEA Air Pollutant Emission Inventory Guidebook) has been developed substantially and today provides a concise description of how to compile an atmospheric emissions inventory. It is prepared under the supervision of the expert panels of the UNECE/EMEP Task Force on Emission Inventories and Projections (TFEIP) and is published by the EEA (<http://reports.eea.europa.eu/EMEP-CORINAIR5/en>)

The Guidebook is intended to assist Parties to the LRTAP Convention report their emissions to the UNECE and the countries of the European Union to fulfil their emissions reporting requirements under the NEC Directive. For example, to help ensure harmonised and consistent emission information is reported, the NEC Directive requires Member States to establish emission inventories using the methodologies agreed upon by the LRTAP Convention and requests them to use the Guidebook in preparing their national emission inventories and projections. As such it is the most influential set of emission estimation methods used in air pollution studies in Europe.

In addition the Guidebook may be used to report some pollutants of relevance to the reporting to the UNFCCC (indirect GHGs) and to other international bodies. The Guidebook does not however provide guidance on the estimation and reporting of emissions of the gases responsible for global warming and climate change included in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, nor on estimation and reporting of emissions of gases responsible for stratospheric ozone depletion.

The Guidebook is intended to be used by Parties as a reference book on good emission estimation practice and as a checklist to ensure that all relevant activities are considered and their emissions quantified. In doing so, it has two key objectives:

- As noted above, the first objective is to deliver support to national experts compiling emission inventories in order to comply with the requirements of specific legal obligations (e.g. the LRTAP Convention and its protocols and EU NEC Directive). It aims to provide a complete set of methods that allow any country to provide an inventory with the quality required by the reporting obligations.
- The second key objective is to drive inventory improvement, which is important to reflect key new scientific and methodological insights and to support knowledge-based and effective policy making. For this the Guidebook attempts to reflect the latest available science and methods needed for high-quality emission inventories.

In 2006, the European Commission established a project to substantially update and revise the Guidebook. The updated Guidebook is due for completion in late 2008; draft versions of the Guidebook have been prepared and have been subject to a peer-review process in early 2008.



The revised Guidebook's structure is now fully consistent with the Nomenclature for Reporting (NFR) as defined in the reporting Guidelines of the LRTAP Convention. In addition, the revised Guidebook has been closely harmonised with the IPCC Guidelines for Greenhouse Gas Inventories by introducing the "Tiers" approach and by providing decision trees to support the selection of appropriate methodologies. The Guidebook is thus compatible with, and complementary to, the 2006 IPCC Guidelines.

The revised Guidebook will be more clearly structured to provide the user with both general information on the basic principles of constructing an emissions inventory and on the specific estimation methods and emission factors. The sector-specific guidance is ordered according to the Nomenclature For Reporting (NFR) source categories; the textual information provides a source description (including a general description about technologies and abatement technologies in use), guidance on methodological choice (including decision trees) and tier-based emission determination methods.

It is planned, that subject to content-approval from the technical bodies established under the LRTAP Convention, that the updated Guidebook will be published in late 2008.

## **Use of European air emissions data in policy assessment**

### Assessment of policy targets

A key function of the reporting of air emissions inventory data within the European Union is to allow its use for the monitoring and tracking of progress by Member States in meeting various policy objectives.

A clear example of the use of emissions data in this context is provided in the case of the National Emission Ceilings Directive (NECD). As has been noted above, the NECD of the European Union sets pollutant-specific and legally-binding emission ceilings (limits) for each country to be met by 2010. Each year, Member States must report emissions data and also emission projections for the four NEC pollutants (NO<sub>x</sub>, SO<sub>2</sub>, NMVOC and NH<sub>3</sub>) for the year 2010. Subsequently, an annual assessment of the progress being made by the Member States in meeting their respective obligations is made by the European Environment Agency.

As an example of this, a preliminary analysis of the most recent data reported under the NECD by Member States at the end of 2007 has been performed. This indicates that the number of countries which now anticipate missing one or more of their legally-binding 2010 emission ceilings has risen compared to the same analysis performed last year<sup>2</sup>. For this analysis, emission ceilings are compared against reported 'with measures' (WM) projections. WM projections take into account currently implemented and adopted policies and measures. Where countries have instead reported only 'business as usual' (BAU) projections, it is assumed for comparison against the ceilings that these are equivalent to a WM projection. A full analysis of the data reported in the 2007 reporting round will be published later in 2008 following country-consultation.

As was noted in the 2007 report, the emission ceiling for NO<sub>x</sub> remains the most difficult for many Member States to meet. An additional three Member States (Hungary, the Netherlands and the United Kingdom) now indicate that they will not reach their NO<sub>x</sub> ceilings by 2010 on the basis of policy measures they have put in place to date. This brings to 13 (of 27 Member States) the number of countries that anticipate missing their NO<sub>x</sub> ceilings unless they take further measures to reduce emissions (Table 1).

Five Member States (Denmark, France, Portugal, Spain and now also Poland) indicate they will miss their respective NMVOC ceilings; two countries their NH<sub>3</sub> ceilings (Germany and Spain) and one country (the Netherlands) its SO<sub>2</sub> ceiling.

Overall, 15 MS have now indicated they will miss at least one of their four respective emission ceilings. It is however noted that several MS (Belgium, France, Germany and the Netherlands) reported data indicating that, by implementing additional measures, they could still reach their 2010 emissions ceilings. In addition, by 2010 a number of MS will have successfully reduced emissions of certain pollutants significantly beyond the levels required by the NEC Directive ceilings i.e. they will have over-achieved compared to their original commitments for these pollutants.

The data which was reported in 2007 also includes for the first time data for the two new Member States (Bulgaria and Romania) which joined the European Union on 1 January 2007. Both anticipate meeting their emission ceilings for all four pollutants.

**Table 1. Overview of ‘With Measures’ projections as reported by the EU-27 Member States in 2007. (A ‘√’ indicates that the Member State anticipates meeting or exceeding its respective emission ceiling, while ‘x’ indicates that a ceiling will not be met without introduction of future measures to reduce emissions).**

Member State	NO <sub>x</sub>	NMVOG	SO <sub>2</sub>	NH <sub>3</sub>
Austria	x	√	√	√
Belgium	x	√	√	√
Bulgaria	√	√	√	√
Cyprus	√	√	√	√
Czech Republic	√	√	√	√
Denmark	x	x	√	√
Estonia	√	√	√	√
Finland	√	√	√	√
France	x	x	√	√
Germany	x	√	√	x
Greece	√	√	√	√
Hungary	x	√	√	√
Ireland	x	√	√	√
Italy	x	√	√	√
Latvia	√	√	√	√
Lithuania	√	√	√	√
Luxembourg	-	-	-	-
Malta	√	√	√	√
Netherlands	x	√	x	√
Poland	√	x	√	√
Portugal	√	x	√	√
Romania	√	√	√	√
Slovakia	√	√	√	√
Slovenia	x	√	√	√
Spain	x	x	√	x
Sweden	x	√	√	√
United Kingdom	x	√	√	√

Note: Luxembourg has not reported NECD projections. As no projections data were submitted by Hungary in the 2007 reporting round, use was made of NECD projections reported in earlier years. The data behind this analysis is available on the EEA’s website.

Emissions and projections data in this example link directly through to the assessment of policy targets. In a similar manner, distance-to-target type of assessments and indicators provide mechanisms for tracking of progress being made by countries/regions in meeting their respective policy objectives.

#### Use of inventory data in assessing European air emission trends

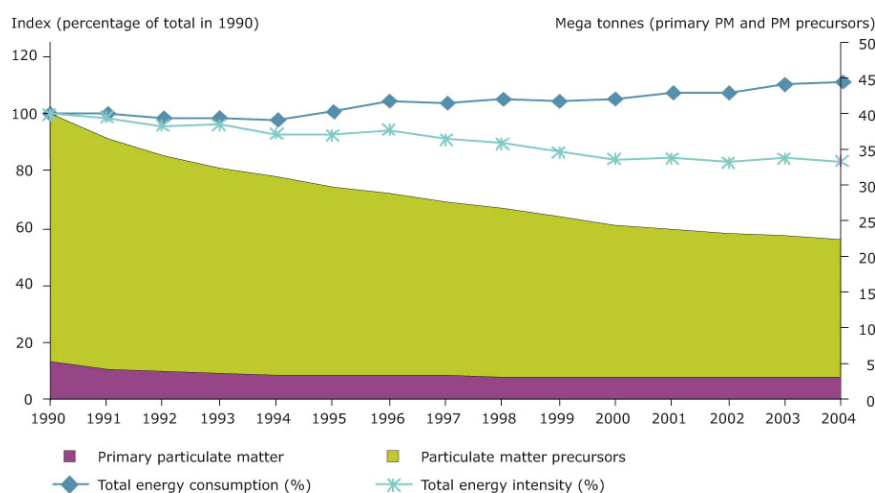
In addition to the use of reported emissions and projections data in assessing progress toward policy objectives, a second illustration of the types of applications for air emissions data are used in the European context is provided in this section.

Officially-reported emissions data is extensively used at the European level in the monitoring of trends of emissions and the subsequent impacts of air pollution on human health and the environment.

The results shown in this section are drawn from a comprehensive assessment of pan-European air quality which was published in 2007<sup>10</sup> – readers are therefore referred to this report for further details concerning for example the underlying methodological approaches and assessment details. The report 'Air pollution in Europe 1990–2004' analysed changes in air pollutant emissions and their possible health or ecosystem impacts in Europe.

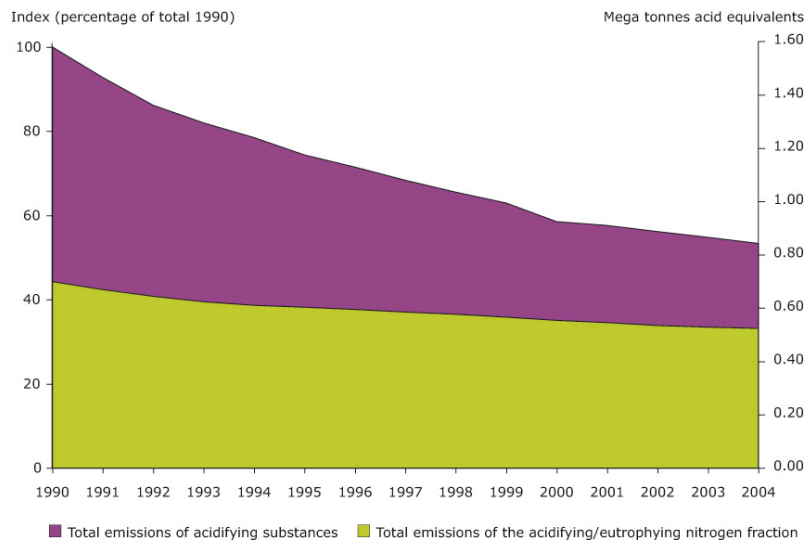
From the emission inventories reported by countries, it is clear that anthropogenic (man-made) emissions of a range of air pollutants have fallen substantially during this period. For example, emissions of primary and secondary particulate matter (PM<sub>10</sub>) have declined by around 45% during this period (Figure 2). SO<sub>2</sub> and NO<sub>x</sub> remain important contributors to secondary PM<sub>10</sub> formation, while primary PM<sub>10</sub> emission sources increasingly are dominated by emissions from diffuse sources such as the residential sector (heating) and transport.

**Figure 2. Trends in primary and secondary particulate matter emissions in 32 European countries.**



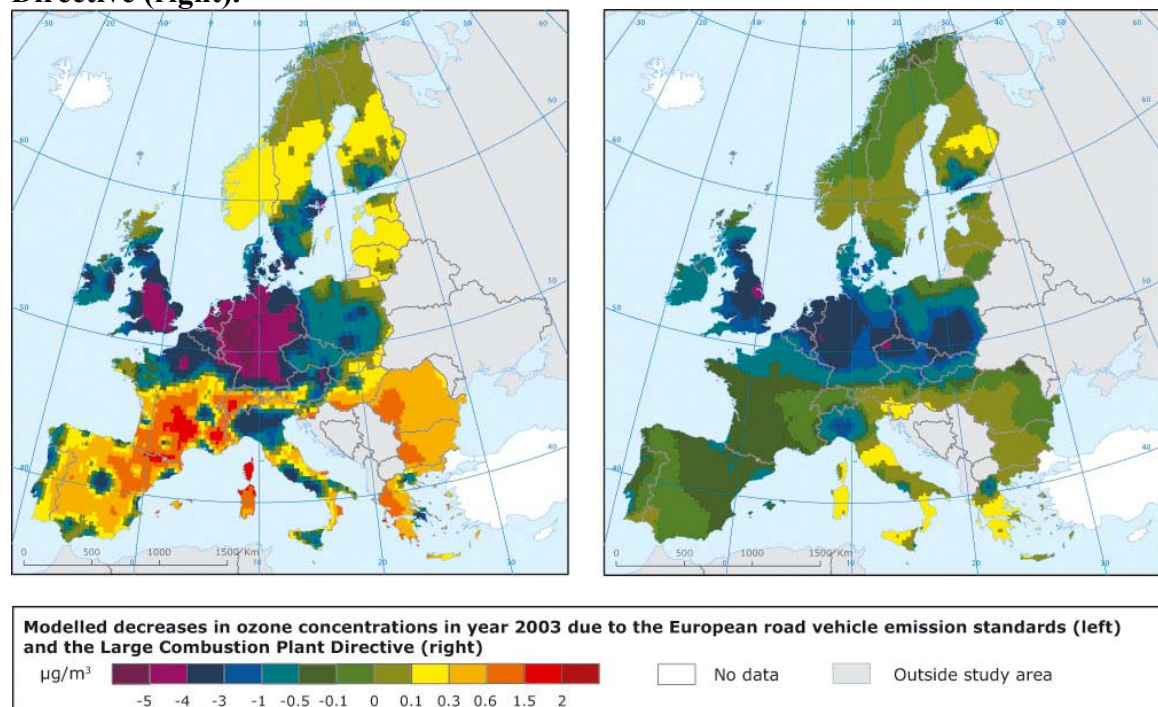
Similarly, over these 15 years, emissions of potentially acidifying substances have also declined substantially, by around 50% in the aggregate (Figure 3). As can be seen, this was mainly due to falling SO<sub>2</sub> emissions which since 1990 have fallen by more than 80% in some European countries. Importantly however, it is observed that over the same period, the acidifying and eutrophying nitrogen fraction (NH<sub>3</sub> plus NO<sub>x</sub>) has stayed broadly unchanged. As sulphur emissions have fallen, ammonia emitted from agricultural activity and nitrogen oxides from combustion processes have become the predominant acidifying and eutrophying agents affecting ecosystems.

**Figure 3. Trends in total acidification (S plus N) and of eutrophying nitrogen in 32 European countries.**



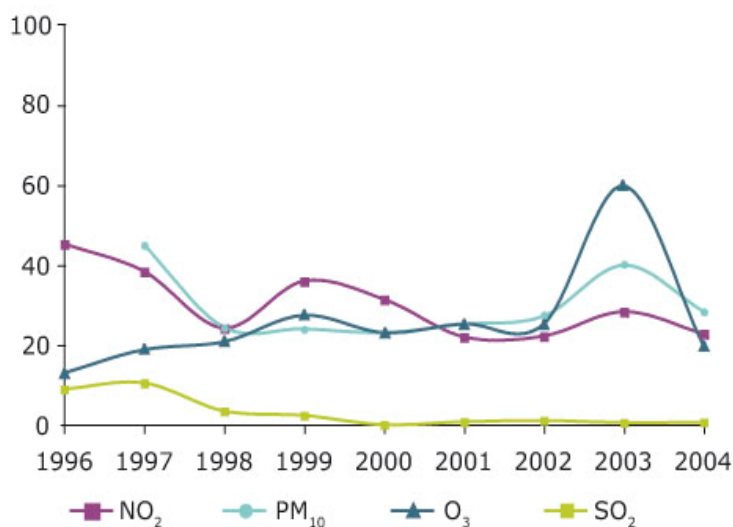
The European Union acts at many levels to reduce exposure to air pollution: through legislation, through co-operation with sectors responsible for air pollution, through national, regional authorities and NGOs, and through research. The observed emission decreases are in part, at least, due to the successful implementation of policies designed to decrease emissions. Some success stories are evident. Modelling work performed to assess the results of introducing vehicle emission standards in Europe and industrial pollution legislation (the Large Combustion plants Directive) has shown that in both instances quantifiable changes in the ambient levels of ozone have occurred across Europe as a result of these policies (Figure 4).

**Figure 4. Modelled decreases in ozone concentrations due to the introduction of European road vehicle standards (left) and the Large Combustion Plant Directive (right).**



However, despite the emissions reductions evidenced in the emissions inventories reported by European countries, in the 32 countries of the report, the potential exposure of the European urban population to high concentrations of particulate matter and ozone in the air has not shown any real improvement since 1997, despite the decrease in emissions during this time (Figure 5).

**Figure 5. Percentage of Europe's urban population exposed to pollution levels over European air quality limits/targets.**



It is estimated that up to 43% of Europe's urban population was exposed to PM<sub>10</sub> particle levels in excess of EU air limit values from 1990 to 2004, with the worst affected areas being Belgium, the Netherlands, Luxembourg, Poland, the Czech Republic and Hungary, as well as the Po Valley in Italy and southern Spain. During the same period, up to 60% of the urban population experienced ozone levels in excess of limit values. The reasons why air quality is not improving at the same rate as air emission reductions are complex, and is likely to be due to several factors. High levels of some pollutants like ozone and PM<sub>10</sub> can be partially explained by meteorological conditions – a combination of high temperatures, reduced precipitation and stable weather can impact pollution conditions, for example, the 2003 'heat wave' summer in Europe is linked to the high number of ozone exceedances as shown in Figure 5. There is hence an increasing awareness of the links between climate change and air pollution, as higher temperatures can lead to exposure to higher levels of air pollution. As emissions are reduced in Europe, there is also an increasing awareness of the importance of emissions from both natural sources and transboundary hemispheric transport as contributors to background levels of air pollution.

## CONCLUSIONS

The objective of this paper was to provide a snapshot of some of the existing information sources and uses of air pollutant emissions data in Europe. With respect to officially reported data submitted by European countries, the main reporting mechanisms for national emission inventory data are briefly described (i.e. the National Emission Ceilings Directive of the European Union and the UNECE LRTAP Convention and its protocols), together with the current and future reporting mechanisms for point source emissions in Europe (the European Pollutant emission



register (EPER) and the future European Pollutant Release and Transfer Register (E-PRTR)).

In addition, mention is made of several recent international initiatives which have been intended to improve the quality of the reported data. This includes the joint EMEP/EEA emission inventory review process, established under the LRTAP Convention and a discussion of various aspects concerned with the substantial revision and update of the EMEP/EEA Air Pollutant Emission Inventory Guidebook, the main source of emission inventory guidance for inventory compilers in Europe.

Finally, various examples were provided illustrating the uses of officially-reported emissions data in Europe. These include assessing the progress made by individual countries in meeting their legal commitments with respect to emission ceilings, and how European emission data is used to inform on emission trends and air quality impacts at the European scale.

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**KEY WORDS**

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