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REVISION 1 OF THE RESOURCE COMPENDIUM OF PRTR RELEASE ESTIMATION TECHNIQUES
Part 1: Summary of Point Source Techniques

Series on Pollutant Release and Transfer Registers No. 5

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IOMC

INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

A cooperative agreement among FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank and OECD

Environment Directorate

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Publications on Pollutant Release and Transfer Registers

Pollutant Release and Transfer Registers (PRTRs): A Tool for Environmental Policy and Sustainable Development. Guidance Manual for Governments (OECD/GD(96)32) (1996).

PRTR Series
No. 1: Proceedings of the OECD International Conference on Pollutant Release and Transfer Registers (PRTRs). PRTRs: National and Global Responsibility.Tokyo, 9-11 September 1998. Part 1 (1999).

No. 2: Proceedings of the OECD International Conference on Pollutant Release and Transfer Registers (PRTRs). PRTRs: National and Global Responsibility. Tokyo, 9-11 September 1998. Part 2 (1999).

No. 3: Presentation and Dissemination of PRTR Data: Practices and Experiences, Getting the Word and Numbers Out (2000).

No. 4: How Pollutant Release and Transfer Registers Differ: A Review of National Programmes (2001).

No. 5: Resource Compendium of PRTR Release Estimation Techniques, Part 1: Summary of Point Source Techniques (2002).

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or contact:

OECD Environment Directorate,
Environment, Health and Safety Division

2 rue André-Pascal
75775 Paris Cedex 16
France

Fax: (33-1) 44 30 61 80

E-mail: ehscont@oecd.org

FOREWORD

OECD began work on the Pollutant Release and Transfer Register (PRTR) Release Estimation Techniques project in 1999. That same year, an expert workshop was held in Australia to: (1) identify what information is readily available on release estimation techniques for point and diffuse sources; and (2) recommend what can be done to improve the use and availability of such techniques. One of the recommendations from the workshop was to establish a Task Force to manage OECD work in this area. The Task Force on PRTRs was established in February 2000 under the auspices of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology.

The work programme of the Task Force calls for the development of several technical documents to provide governments and industry - as well as others who are interested in this issue - with information and practical guidance for identifying, selecting and applying different techniques for estimating pollutant releases from point and diffuse sources and from transfers. The *Resource Compendium of PRTR Release Estimation Techniques* – which includes a number of Parts - is the first in a series of documents created to help accomplish this goal. The intent of this *Resource Compendium* is to provide OECD countries with a basic information resource on estimation techniques typically used to quantify releases from point and diffuse sources and from transfers for a PRTR.

The principal objective in the development of the Resource Compendium was to collect information from OECD governments and selected industries on estimation techniques that are used (or are expected to be used) in calculating pollutant releases from point and diffuse sources, transfers and products. It consists of four separate Parts: Part 1 summarises techniques used for *point sources*; Part 2 provides information about techniques used to quantify releases from *diffuse sources*; Part 3 summarises information about techniques used to calculate the amounts of chemicals found in *transfers*; and Part 4 summarises information about techniques used to calculate the release amounts of chemicals contained in *products*. **This document is Part 1.** It was originally published in 2002, and has been updated in this current document to reflect new and additional information.

The purpose of this effort was not to yield specific recommendations on preferred estimation techniques; rather, it was to provide a catalogue of release and transfer estimation techniques available and summarise the pertinent information needed to apply them. Another aim of this project was to provide a listing of reports and other documentation describing the various methods being used in OECD countries to estimate releases of pollutants to air, water, and land. To the extent possible, the names and contact information for individuals who can provide these reports and documents were included.

The full *Compendium* was prepared under the auspices of the Task Force on PRTRs. Research for this document, Part 1, was carried out by Mark Saegar of Pacific Engineering Services. This document was revised under the leadership of the Ministry of the Environment, Japan in 2012.

This document is published under the responsibility of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology, which has agreed that it be unclassified and made available to the public.

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EXECUTIVE SUMMARY

A key aspect of any Pollutant Release and Transfer Register (PRTR) programme is the estimation techniques used to generate data on facility-specific releases and transfers. Companies that report data to a national PRTR generally estimate releases with, for example, emission factors or mass balance calculations, rather than submitting specific continuous monitoring data. As different industrial processes and activities involve different throughputs, equipment and operating conditions, different methods for estimating pollutant releases and transfers are required.

The development of new release estimation techniques can be extremely resource intensive, as can the identification and collection of techniques from other countries. To help reduce costs for Member countries, the OECD was asked to identify and review techniques used in Member countries to quantify releases and transfers, collate information on techniques used, and to make the information widely available.

Context

Historically, pollutant emission inventories were developed as tools to assist governments in tackling environmental problems, particularly air pollution, climate change, pollution of inland and marine waters and contaminated soils. The scope of many inventories covers primarily point sources, however, some information about diffuse sources is often included. Point sources are considered to be industrial facilities or stationary sources of pollutants. Diffuse sources can be defined as small or medium-sized facilities or particular activities whose releases do not qualify them as point sources (*e.g.* transportation).

A primary difference between *traditional* emission inventories and a PRTR is that PRTRs are intended to cover all environmental media (air, water and land as well as transfers), whereas the more *traditional* emissions inventories are media-specific (e.g. air or water). In addition, the scope of *traditional* emission inventories tends to cover a more limited set of chemicals than those covered by a PRTR programme. While PRTRs are national systems, emission inventories vary and can be national or limited in scope to a defined geographic region or to a specific catchment or airshed. However, an important point is that the techniques used to quantify releases under a traditional inventory can also be used for estimating releases for a PRTR programme. Therefore, this document contains some release estimation techniques used under a particular PRTR and some that are used in other inventory programmes.

Estimating releases

Several approaches exist for estimating pollutant releases to the environment from point (industrial) sources. These range from simple intuitive assessments to sophisticated empirical models. There are a number of estimation techniques available. The five most widely recognised categories of release estimation techniques are:

(i) direct monitoring;
(ii) mass balance;
(iii) chemical specific emission factors;
(iv) engineering calculations
  - indirect monitoring
  - models
  - other calculations
  - non-chemical specific emission factors; and
(v) engineering judgement (best guess with available data), techniques based on physical-chemical properties, combinations of techniques (engineering judgement and monitoring), the application of other techniques like default emission factors, *etc*.

Not all estimation methods are equally applicable to all pollutants, source types, or spatial and temporal scales of data collection. For some specific releases from particular source types, there may not be any well-documented techniques. For common pollutants from different source types, several estimation methods are available. When selecting an appropriate method for estimating (or calculating) a release, the types of releases (or transfers) targeted in a PRTR programme must be well characterised in the following terms:

- pollutant type;
- release medium;
- source type;
- spatial scale for reporting; and
- the temporal scale for reporting data.

Description of the Compendium

The Resource Compendium of PRTR Release Estimation Techniques is made up of 4 parts. **This document, which is Part 1**, **covers techniques used to quantify releases from point sources**. (Part 2 describes techniques used for diffuse sources, Part 3 summarises techniques used to estimate the amount of chemicals found in transfers and Part 4 summarises information about techniques used to calculate the release amounts of chemicals contained in products.) The overall purpose of the Resource Compendium is to provide information about the types of estimation techniques used in different Member countries and where they can be found. Such information has not previously been available in one place. It is not comprehensive guide of all techniques available, nor does it contain the actual estimation techniques; rather it provides a range of information about techniques currently used in many OECD countries.

CHAPTER 1: BACKGROUND AND CONTEXT

1.1 Introduction

Release estimation techniques for point and diffuse sources are a key aspect of any Pollutant Release and Transfer Register programme. Companies required to report under a PRTR usually estimate releases by, for example, calculating the mass balance of a process. Release estimation techniques (RETs) for PRTR reporting include methods used for calculating releases of specific chemicals to air, water and soil from different industrial processes and from transfers off-site.

Different industrial processes (*e.g.* steel versus chemical manufacturing) involve different kinds of throughput, equipment and operating conditions, and therefore require different techniques for estimating releases. It would be time consuming for one country to search for techniques already established in other countries and resource intensive to develop new techniques for all pollutant sources. The development of estimation techniques can be considered a significant task for countries trying to establish a PRTR. To facilitate PRTR implementation and to help countries save resources, OECD initiated a project to identify and review techniques in use and make such information widely available.

The Resource Compendium provides information about release estimation techniques available in specific OECD countries. Development of the document entailed the collection and collation of information on release estimation techniques (RETs) currently accepted in OECD countries for use in a PRTR programme. This document is Part 1 of the Resource Compendium, focusing primarily on techniques used to quantify pollutants released from point sources. (This document was first published in 2002, and has now been updated to include new and additional information.)

Information for this document was collected through two surveys sent to OECD countries, selected industries and trade associations: first in 2001 and then again in 2011. (The results of the surveys can be found in Annex 1.) Additional information was obtained through literature and Internet searches.

The 2011 complementary survey for updating this document was conducted by the Task Force of PRTRs.

1.2 Project scope

The original scope of this project was to collect and collate *actual* techniques to increase transparency and access of RETs across OECD. However, in the collection phase of the project, it was recognised that this would not be possible, as some techniques may have hundreds of pages of background documentation that are an integral part of the technique. Therefore, the project focus was shifted to collating and summarising information on the techniques available in OECD countries, and indicating where particular types of RETs could be found.

The OECD Task Force on PRTRs maintains an Internet-based Resource Centre of RETs (http://www.oecd.org/env_prtr_rc/), which contains actual information about techniques along with hyper-

links to available documentation about the technique (e.g. monitoring data use, process descriptions). The Compendium is incorporated into the database as a key reference guide.

1.3 Structure of the document

Chapter 1 provides background and contextual information on release estimation techniques for point sources. Chapter 2 focuses on the application of estimation techniques and fundamental approaches used to estimate releases from point sources. Chapter 3 summarises RETs by source and by country. The Annexes contain specific information about the type of techniques available in OECD countries and from international organisations and where further information can be found.

1.4 Planning phase

When planning a PRTR, the selection of the types of industries that must report, and the chemicals to be reported, will affect the types of techniques needed to estimate releases. It is also at this stage when the types of guidance or instructions to be provided to reporters should be determined.

The data quality objectives for the PRTR are directly related to the techniques that could be used to estimate releases. (The same holds true for estimating chemicals in transfers, however, transfers are addressed in Part 3 of the Compendium.) The data quality level required by the PRTR would necessitate different types of techniques. For instance, if the PRTR aims at providing data to the public, it might not have the same requirements as a PRTR that provides data as an indicator of policy performance. Figure 1 depicts the PRTR planning and preparation process and the role of data quality objectives in this process.

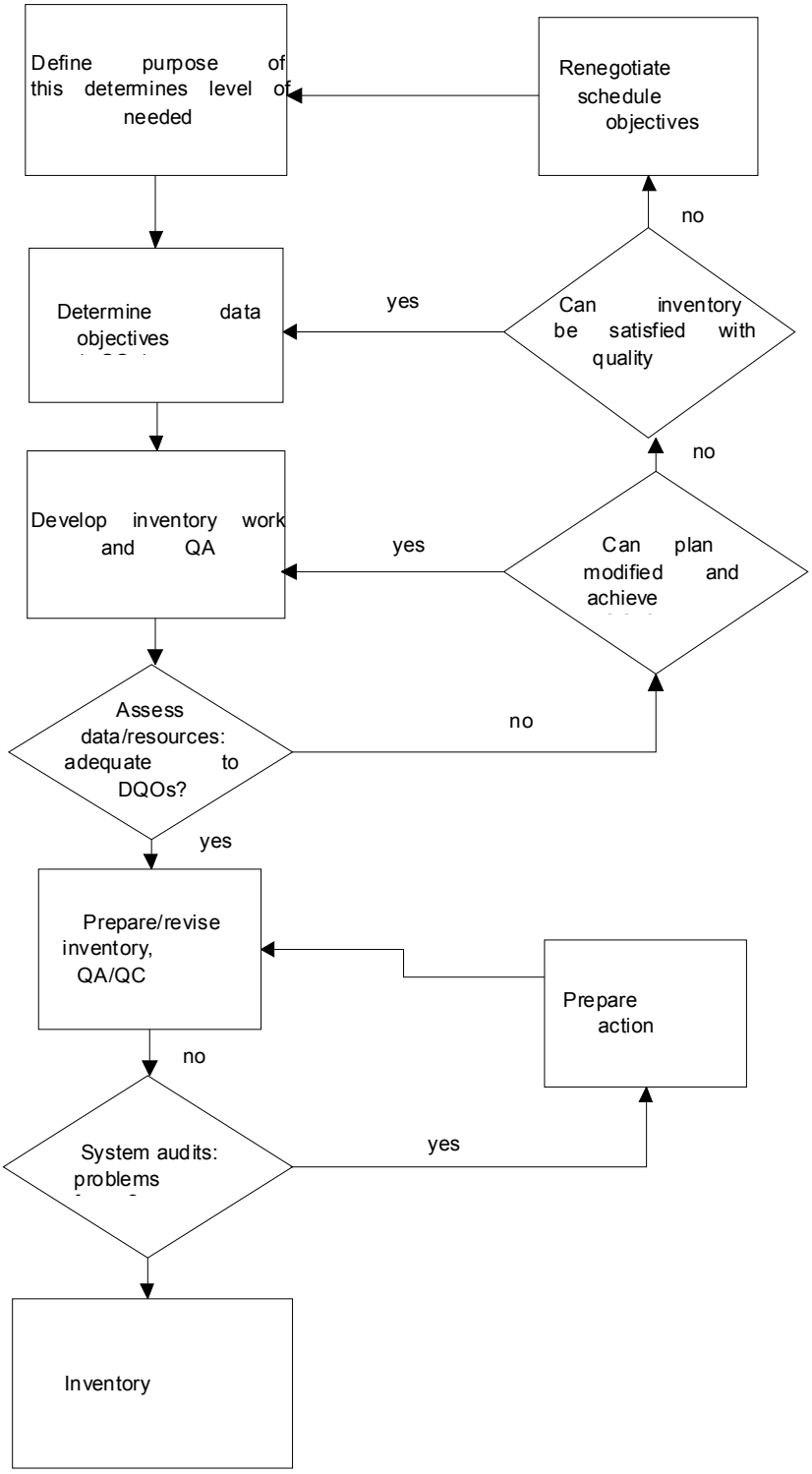
A budget and schedule need to be determined before the data collection and analysis phases of the PRTR process begin. Resource planning will involve staffing, computer hardware and software, and potential data collection costs. The amount of time needed to gather data should be factored into the schedule. The overall planning of the PRTR is an iterative process and integrated with resource planning. Decisions on source categories and the techniques to be used are usually affected by:

- data quality objectives according to inventory purposes;
- availability and difficulty of gathering data of acceptable quality;
- available resources, including timing, staff and budget; and
- relative significance of a source.

Another point to consider during the planning phase is the thresholds set for point source reporting. These thresholds will determine how much of the small and medium-sized industrial sector would be captured. For example, some countries may include dry cleaners as a point source while other countries may include this industry as a diffuse source. The planning stage can be a critical step for ensuring that a significant group of emitters is not missed, while also verifying that double counting does not occur. It is worth mentioning that the number of pollutants included in a PRTR would not affect the data collection and release estimation function, as long as there are available emission factors and speciation profiles.

Figure 1: Overview of PRTR Planning and Preparation

Role of data quality objectives



Source: EIIP, Volume 1, USEPA, 1997

CHAPTER 2: APPLICATION OF ESTIMATION TECHNIQUES FOR RELEASES

2.1 Identifying the types of releases to be estimated

Several approaches have been developed for calculating pollutant releases to the environment from point sources. These range from simple intuitive assessments, to sophisticated empirical models. Before considering the application of any of these methods, whether by a government or by an industrial facility, it is important to have a clear understanding of the types of pollutant releases that are of concern and the overall objectives of the estimation effort. Without such an understanding, there is a high risk of selecting an estimation technique that is not appropriate for the intended purpose, or one that yields results that are less accurate or less complete than desired.

When selecting an appropriate method for estimating a release, the types of releases (or transfers) targeted in a PRTR programme must be well characterised in the following terms:

- pollutant type;
- release medium;
- source type;
- spatial scale for reporting; and
- the temporal scale for reporting data.

Each of these points is addressed further in the following sub-sections.

2.1.1 Pollutant type

A first step when selecting an appropriate method for estimating a release is to determine if the pollutant is a discrete chemical (*e.g.* toluene), a class of chemical substances defined by chemical structure or constituents (*e.g.* polycyclic aromatic hydrocarbons – PAHs, or heavy metals), or a member of a category of pollutants defined by a particular environmental effect (*e.g.* substances that deplete stratospheric ozone, precursors of acid precipitation). Some RETs only apply to particular chemicals, while others produce an estimate of total emissions within a class; in the latter instance it is difficult, if not impossible, to identify which individual members (*i.e.* substances) of that class were emitted. There are other RETs that will estimate or measure the *effect* of an emission, such as chemical oxygen demand (COD), rather than the emission *per se*. As a general rule, the number and variety of available release estimation methods are greater for an aggregate type of pollutant indicator than for specific chemical compounds.

2.1.2 Release medium

Most estimation methods for *direct* releases are specific to a particular medium (*i.e.* air, surface water, underground or ground water, land) although some methods are less specific and may require the user to provide additional information about partitioning in the receiving environment. Methods that address *indirect* releases, for example those resulting from transfers to a water treatment facility, may require a great deal of additional data to partition accurately releases among receiving media.

2.1.3 Source type

While large point sources are generally treated individually, PRTRs may differ in how they address smaller point sources. Some PRTRs may address them by using the same techniques that are applied to larger point sources, while others will treat a collection of small point sources as a diffuse source category. Mobile sources produce diffuse patterns of pollutant releases and are generally modelled using approaches that depend on traffic patterns and characteristics of the fleet of vehicles in a given area.

2.1.4 Spatial scale for reporting

When small point sources are treated as an aggregate, it is necessary to define the scale of aggregation that will satisfy the programme objectives. RETs that are applicable at a global or national scale may neither be useful, nor very accurate, if the intent is to collect and disseminate data on a provincial or local scale.

2.1.5 Temporal scale for reporting

As in the case for spatial data aggregation, the desired averaging time can affect applicable RETs. Methods well suited for producing estimates of annual averages may introduce significant uncertainty when they are applied over shorter intervals.

2.2 Common sources of releases covered by PRTRs

Pollutants covered in PRTRs generally arise from one of two origins: first, those pollutants that are integral components of a process; and secondly, those that are formed as by-products of the process. In the first case, the amount of the pollutant associated with a particular process can be calculated. In the case of by-products, however, the amount of the substance generated can only be estimated as a range. Although release estimation methods attempt to consider the variables associated with releases, it is not always possible to prepare an RET that predicts pollutant release rates exactly. The following sub-sections address the origin of pollutants from point sources.

2.2.1 Origin of air pollutants

The activity that results in the largest emissions of air pollutants is combustion, related to energy and heat production, residential space heating, transportation, waste management, agricultural management practises and land clearing practices. In most cases, emissions of the principal combustion air pollutants are estimated using emission factors. These emission factors are generally of high quality and can be reliably applied and adapted to similar types of combustion equipment and fuel combinations in other countries.

Examples of point sources that contribute air pollutants include: metallurgical processes, wood pulp and paper manufacturing, chemical manufacturing, pharmaceuticals production, manufacturing of equipment and appliances, and textile production. (Some examples of diffuse sources of air pollution include small and medium-sized facilities in printing and graphic arts, surface coating, grinding operations, and waste incineration, or in transportation, construction, agricultural activities and open burning.)

For reference, the EMEP/EEA air pollutant emission inventory guidebook (formerly referred to as the EMEP CORINAIR emission inventory guidebook) provides guidance on estimating emissions from both anthropogenic and natural emission sources. This document can be accessed through the following link: http://www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep .

2.2.3 Origin of water pollutants

Water pollutants can be released from a variety of sources, including point sources - such as effluent pipes from manufacturing facilities or wastewater treatment plants. Water is used for a variety of reasons in industrial production processes and, in many cases, it is one of the main expenses incurred in manufacturing. Consequently, the use of water is often controlled and regulated within industrial processing facilities. Some of the uses of water in manufacturing and production processes include, but are not limited to, the following:

- as a solvent or a carrier;
- as a reactant;
- as a method to clean surfaces;
- as a liquid barrier to reduce or prevent air emissions;
- to produce steam for heating; and
- to cool a product that is subject to high heat during the process.

Wastewater streams absorb and carry away many different types of contaminants during any of these uses. In most industrial applications, that water is directed through a pipe or some other conveyance system to a sewer, or a treatment facility. The nature of industrial wastewater effluent, therefore, makes it relatively easy to measure the pollutant load directly. The amount of contaminant in many industrial wastewater streams is sometimes related to characteristics of the process, e.g. flow, temperature and pressure. Indirect monitoring based on volume proportional sampling schedules can be an effective method to estimate releases.

2.2.4 Origins of wastes destined for land disposal

There are many classifications of wastes that can be subject to land disposal, among which include: hazardous or non-hazardous and solid or liquid form. Non-hazardous solid wastes are typical municipal wastes frequently sent to a landfill or to a municipal waste incinerator. Hazardous wastes are generated in both solid and liquid forms in industrial manufacturing processes and as a result of commercial operations. Solid wastes are generated in the form of slag, ash, sediments, and wastes cut from formed products to make them conform to size and shape requirements. Liquid wastes include, but are not limited to, material from scrubbers used as air pollutant control devices; concentrated baths from metal finishing, etching or degreasing; contaminated oils, and conveyance slurries. These wastes are frequently termed hazardous if they contain metals, pesticides, fertilisers, dioxins, PAHs, or other chemicals that can be transferred to biological receptors, or ground water supplies.

In most cases, PRTR programmes are concerned with wastes considered to be of a *hazardous* nature. Often, industrial facilities will have disposal programmes linked to a permit system, or otherwise controlled through a handling fee or a disposal transaction. Therefore, the type and quantity of these chemicals is frequently determined through a direct monitoring and a permanent accounting system.

2.3 Fundamental approaches for estimating releases and transfers

The techniques most commonly used to estimate (or to actually measure) releases to the environment are:

- direct monitoring;
- mass balance;

- chemical specific emission factors;

- engineering calculations
  - indirect monitoring
  - models
  - other calculations
  - non-chemical specific emission factors; and

- engineering judgement (best guess with available data), techniques based on physical-chemical properties, combinations of techniques (engineering judgement and direct monitoring), the application of other techniques like default emission factors, *etc*.

In practice, two or more RETs are used in combination to develop estimates of a particular release. As a simple example, emission factors are usually based on monitoring data from of a subset of sources. Therefore, direct monitoring is used to provide the data needed to develop an emission factor that can be used to estimate releases. Similarly, mass balance approaches are sometimes used to develop an estimate of the total annual emissions of a chemical for a country. The estimate can then be used to develop a per capita emission factor, that can then be applied in future years (assuming there are no major changes in technology or use patterns) without expending additional effort to collect the data needed to complete a mass balance assessment.

The following sections briefly describe each type of technique, as well as its history of application and relevance to particular pollutants, sources, and spatial and temporal reporting frameworks.

2.3.1 Techniques based on monitoring

a) Characteristics of monitoring methods

Direct monitoring addresses a broad range of pollutants, or effects-based surrogates such as pH, if it is not possible to monitor for a specific chemical. In one sense, monitoring, which can be continuous or periodic, can be distinguished from all other methodologies. It is listed along with other techniques because, in many cases, a limited set of monitoring data is used to represent – or model – a broader range of emissions. A distinction should be drawn in the case of continuous monitoring, for which (at least for the particular monitored pollutant and source) no modelling is needed.

Continuous monitoring techniques are available for specific pollutants such as sulphur dioxide, lead, or hexavalent chromium. Generally costs and difficulty increase for methods used to monitor specific pollutants. These factors often combine to make continuous monitoring an impractical option.

In contrast to continuous monitoring is periodic monitoring, which is conducted less frequently than continuous monitoring. The frequency of periodic monitoring may range from daily to once or twice a year. In some cases, periodic monitoring of certain pollutants can be used to represent other pollutants by applying average ratios, or by using some other known condition related to the source.

There are also two types of monitoring: direct monitoring and indirect monitoring (an engineering calculation). Direct monitoring techniques are more commonly employed for point sources rather than diffuse sources. Monitoring of ambient conditions can be used to make valid inferences about both discrete point sources and diffuse sources. It is also possible to monitor many mobile sources, although this poses significant issues of data consolidation unless (as in a government mandated automobile emissions testing programme), the mobile source is brought to a particular location for testing and that there is an understanding of the percentage of all sources that will be actually tested.

b) Common applications of direct monitoring

Air releases

Direct monitoring provides a good option for determining releases from a limited number of regulated air pollutants, which may represent pollutant classes in some national programmes. It is also effective for some specific pollutants, if the emissions of that pollutant are associated with a small number of well-defined sources. For example, SO_2 emissions from large electric generation plants, and other large industrial boilers using fossil fuels, can be monitored efficiently and accurately using existing, well established monitoring methods. In many cases, the number of such facilities will be relatively low, the locations will be well known, and those sources will contribute the majority of total SO_2 emissions.

In selected applications, emissions are determined from these types of sources using continuous emission monitoring (CEM). CEM refers to the collection of release data using a monitor that is a permanently mounted collection system. Sample streams of air are then directed to a device that records the data electronically.

Many of the sources that lend themselves to direct monitoring are also the type of sources that are operated in a regular and consistent way. Emissions from such sources do not vary much with time; therefore, direct monitoring at periodic intervals (statistical sampling) can be used to determine average emissions over specified periods of time between the monitoring cycles. Sources of this type include large steam boilers at industrial facilities, smelters, blast furnaces and ovens at steel production facilities, and catalytic crackers at petroleum refineries.

Water releases

Pollutant releases into wastewater are generally confined to a pipe or some other conveyance system. Frequently, flow meters are placed at critical locations in the conveyance system in order to monitor conditions that would indicate a breech, a constriction, or a process upset. Releases can be easily estimated by measuring the concentrations of target pollutants in wastewater flows. The concentration of the pollutant in wastewater can be expressed in units of mass/volume multiplied by the flow rate in units of volume/time, yielding a direct release rate expressed in units of mass/time.

An approximation of continuous monitoring of water pollutants is often accomplished by collecting composite samples of wastewater. Composite samples, collected over a set period of time, are then analysed for a variety of different parameters. One approach based on volume proportional sampling has been shown to be nearly as accurate as continuous monitoring. When a process has instabilities, or otherwise varies over time, composite samples may obscure temporal patterns.

For those processes that have wastewater releases that are consistent over time, periodic monitoring of the pollutant concentration, along with the standard and continuous monitoring of flow, will provide accurate and representative estimates of the releases. Sample acquisition, stabilisation, and handling are all relatively straightforward procedures. Furthermore, the analytical methods for many common water pollutants are automated and the analysis costs are typically lower relative to the operating costs of modern industrial facilities. For these reasons, periodic direct monitoring approaches are a primary method for making estimates of pollutant releases from confined industrial wastewater flows.

Land releases

Land disposal techniques are used for both solid and liquid wastes that contain chemicals for a number of activities. Land disposal includes storage or treatment of chemicals in wastes on the land surface, under the land surface in landfills, or below the surface in deep injection wells. Each of these disposal methods is

affected by the physical size of the area used for the disposal and by specific chemical or biological capacities of the disposal site. Therefore, in almost all cases, records of the amount of chemicals deposited to these sites are collected and maintained on a routine and continuous schedule. The maintenance of detailed records, such as the data on the concentrations of chemicals of concern in the waste, sent to an outside disposal location is a common requirement of the waste management regulations in most OECD countries.

Such recordkeeping (or manifesting) systems are used by the receiving facility to estimate the concentrations of chemicals in waste. This is important because it helps the receiving facility to manage the chemicals in waste effectively.

For example, waste wood generated by milling and sizing various forms of pressure treated wood products is likely to contain significant amounts of creosote and perhaps other pressure treating compounds. In most cases, the waste manifest would contain information on both the concentration of the creosote in the waste wood and on the entire weight of the waste including the wood scraps, sawdust, and other non-hazardous components of the process. In this case, the creosote is the constituent of concern, and by using the information provided by the waste manifest it would be possible to separate the fraction of the creosote from the total amount of waste wood.

2.3.2 Emission factors

a) Characteristics of emission factors

An empirical model is one in which the modeller develops a mathematical relationship between one or more process related characteristics (*input variables*) and a set of release estimates (*output variables*). An example would be air emissions of sulphur dioxide from the recovery of air-dried unbleached pulp using multicyclone and venturi scrubbers and magnesium oxide as base. In this situation the *input variable*, expressed as 1,000 kilograms of air-dried unbleached pulp recovered, is known and is directly related to the *output variable*, expressed as the kilograms of sulphur dioxide emissions released. The model itself would simply consist of a ratio: the kilograms of sulphur dioxide emitted per 1,000 kilograms of air-dried unbleach recovered. Such a ratio is often referred to as an *emission factor*. The emission factor in this scenario is 4.5 kilograms of sulphur dioxide released per 1,000 kilograms of air-dried unbleached pulp recovered. Such emission factors probably represent the most widely used method of estimating air emissions.

Some emissions sources cannot be easily represented by a linear function between one operating parameter and the resulting emission rate. Emission factors for these types of processes may require more than one input variable, and as such become slightly more complex than the simple linear model. The great majority of emission factors are based on the results of a series of source tests conducted on a sample of sources chosen to represent the typical source in the defined source category. The assumption used in applying emission factors is that the untested sources, within a defined source category, have release characteristics that are similar to those of the tested sources. The great advantage associated with using emission factors is that emissions from many individual sources can be estimated by testing only a small fraction of those sources. Another advantage of emission factors is that they can sometimes be used to generate default emission factors for non-measurable substances, by applying specific knowledge of the process characteristics.

Emission factors can be expressed in almost any units, allowing a great deal of flexibility in deciding on the most appropriate measure to use as the basis for the emission factor. Typically, emission factors can be based on a reactant or process input (for instance, tonnes of coal or tonnes of ore processed) litres of solvent, a product or process output (*e.g.* m^2 of paper produced) kilowatts of energy produced, number of

vehicles produced, or on a land use activity, such as km^2 tilled land or km^2 of forest. (They may also be based on populations, *e.g.* number of people, number of cattle, number of households, a feature that makes emission factors particularly useful for estimating certain types of diffuse sources).

The primary limitation associated with the use of emission factors is that not all sources are designed or operated the same way. For a large number of sources, however, some of the error in the techniques would be associated with different operating conditions, and will very likely, *average out*. Another, more serious limitation of emission factors is that they are developed for a particular source type, and are at times are applied to sources that are inherently different. (This often happens when a better method cannot be found.) These limitations should be considered in all analyses that rely on emission factors, as it can be a source of great concern in trans-national comparisons, where facilities in a particular sector in one country may have significantly different features than those of the same sector in a different country.

Emission factors can be applied to most sources or pollutants that can be measured by some another technique so as to obtain the information needed to develop the factor. That factor is then applied to all other similar sources whether or not they were included in the set of sources that were tested to develop the factor. Most emission factors are developed by taking the average measured emission rate during a representative time interval and relating that to some other measure of the operating rate of the activity.

b) Chemical-specific emission factors

Air releases

An emission factor, as noted above, is a constant that relates the amount of emissions that are produced per unit of some measure of the activity that produces the emissions. Emission factors can be used to estimate releases from nearly any source type having emissions with a strong linear dependence on the amount of a particular activity. For example, the amount of NO_x generated during coal combustion can be predicted by applying an emissions factor expressed in kilograms of NO_x emitted per tonne of coal burned. Emission factors are widely used to estimate air emissions in environmental management programmes of all kinds. Several compilations of air emission factors are available and references to these documents are provided later in this report. Most of the emission factors listed in these compilations, however, were developed to support broad environmental planning activities and may not include all of the detail with respect to specific pollutants that might be desired in some PRTR programmes.

While there is considerable information available on air emission factors, a large portion of these documented emission factors address criteria pollutants such as VOCs or particulate matter, or very common compounds such as SO_2, lead or NH_3, and there are few emission factor compilations for other specific pollutants, such as benzene, mercury and specific dioxins.

Water releases

When monitoring data are not available, emission factors can be used to quantify pollutant releases to water from point sources. Emission factors are most useful for well-defined and regulated processes, such as chemical processing activities in continuous operation. As is the case for emission factors used to predict releases of air pollutants, emission factors for water pollutants will provide greater accuracy for aggregate estimates that represent large numbers of similar sources and for long averaging times. Individual source variability, and variability in the effluent characteristics over time, are generally not well represented by average emission factors. Many emission factors for water pollutants address classes of pollutants, such as total nitrates, soluble organic matter, or silt in water, as opposed to specific compounds such as mercury or chlorine.

Frequently, complex emission factors, relying on more than one parameter, are used to predict releases to water. As an example, the emissions of a chemical in fertiliser to surface waters from agriculture can be quantified using an emission factor with the following equation:

Quantity of pollutants directly entering surface waters = a x b x c / 100, where:

a = quantity of fertilisers used

b = emission factor for particular chemical in fertiliser in certain type of soil conditions directly entering surface waters, in kilogram of chemical entering surface water per kilogram of fertiliser used.

c = pollution load in the fertiliser (distinguished between farm manure and mineral fertiliser).

The above example indicates that the dividing line between a purely empirical model and a process-specific model becomes somewhat blurred when additional assumptions are required regarding the properties of the environment in which the potentially polluting substance is applied.

Land releases

Emission factors are not commonly used to estimate releases to land. Direct monitoring, mass balance, engineering calculations or surveys are used more frequently to quantify releases to land. Whenever emission factors are considered for land disposal releases, the same weaknesses that have been discussed for air and water pollutants are evident, that is estimates based on a large number of similar operations over a long averaging time will provide better accuracy than estimates made for any specific facility.

2.3.3 Mass balance

(a) Characteristics of mass balance methods

The simplest conceptual form of such models, although in practice often the most complex to develop, is a mass balance model. These models rely on the fundamental fact that what goes in must either come out in the form of a product or as a release, or be chemically changed to some other compound. Thus, one can model an emission from any system by knowing the amount of substance going into the system and the amount that is created or destroyed within the system. Any positive difference between inputs and net destruction (destruction – creation) in the system must therefore represent a release.

The general form of these models is as follows:

$$\Sigma(\text{Output}) = \Sigma(\text{Input}) - \Sigma(\text{Consumption}) + \Sigma(\text{Generation})$$

In practice, because most systems have multiple emissions, one generally deals with a set of known outputs (*e.g.* the amount of the substance incorporated into the product and the amount in known wastes) in order to model an unknown output (*e.g.* air emissions). For more complex systems, the conceptual simplicity of this approach is offset by intensive data requirements that will usually require direct monitoring of the other processes. Care should be taken to apply the mass balance approach to the media and pollutant combinations that have the lowest uncertainty or the most benign potential effects. Moreover, the margin of error resulting from mass balance applications should be taken into account when considering this technique.

It is also possible to apply an overall mass balance estimate to check the validity of the individual estimates of releases to the various media. A mass balance check may be particularly useful for source and

pollutant combinations that have relied on differing estimation techniques and that have uncertainties that are either unknown or cannot be easily calculated. It is a relatively simple procedure to add up all of the release estimates for the individual media and compare the results to the known amounts of the pollutant that is input to the process. The results will help to establish a measure or degree of reasonableness for the individual estimates.

b) Common applications of mass balance methods

Air releases

Mass balance methods for estimating air releases are often used to estimate solvent emissions from diffuse sources. Estimating releases from diffuse sources can be difficult because the activity that results in the emissions is generally variable on both spatial and temporal scales. As an example, consider the releases of a solvent from paint, or other surface coating material, used in commercial and residential settings. Collecting data on where and when these materials are used would be expensive, time-consuming and invasive. In these cases, however, the mass balance approach is straightforward. If it is assumed that all of the solvent contained in the surface coating is emitted, then knowing the amount of the coating that was used and the solvent content of the coating, would make it possible to estimate the total emissions. For sources that can be assumed to emit 100% of the solvent content, the mass balance method essentially becomes an emission factor of 100% of the input data used to quantify the activity.

Frequently, the amount of a solvent used can be approximated by the amount of the solvent sold in any given time. This assumption has increasing validity with longer time periods of estimation, and adds relatively little uncertainty to estimates that are made on an annual basis. In the above example, any solvent purchased in the target year, but used in the next year, can be assumed to be approximately equivalent to that amount purchased the year before but used in the target year.

Other forms of mass balance can also be used to estimate emissions from industrial applications. The amount of a solvent used as a raw material in any defined time period is almost always known. If the process adds a specific amount of the solvent to the product, and the amount released as a water pollutant and/or if the chemicals in the waste are known, the air release can be inferred by subtraction. These approaches can be used in complex operations for diffuse or fugitive releases that result from many potential release points

such as pumps, valves, flanges or monitoring ports. The basic equation used to estimate these releases by mass balance is:

$$S_{air} = S_{input} - (S_{react} - S_{gener.} + S_{prod} + S_{water} + S_{waste})$$

Where:

S_{air} = the amount of solvent released to air

S_{input} = the amount of solvent input to the process

S_{react} = the amount of solvent that is reacted away in the process

$S_{gener.}$ = the amount of solvent (if any) generated by the process

S_{prod} = the amount of solvent incorporated into the product

S_{water} = the amount of solvent released in wastewater

S_{waste} = the amount of solvent released in solid or liquid waste, including quantities recycled or treated

Water releases

Releases to water are often estimated by a mass balance approach. This technique is well suited to situations where releases to water are very complex and difficult to quantify with other approaches. The approach is similar to that used to quantify releases of solvents to air using mass balances. The mass balance equation for air releases can be rewritten for usage in quantifying releases to water:

$$R_{water} = R_{input} - (R_{react} - R_{gener.} + R_{air} + R_{waste})$$

Where:

R_{water} = the amount of chemical released to water

R_{input} = the amount of chemical input to the process

R_{react} = the amount of chemical that is reacted away in the process

$R_{gener.}$ = the amount of chemical that is created by the process

R_{air} = the amount of chemical releases to air

R_{waste} = the amount of chemical released in solid or liquid waste, including quantities recycled or treated

This technique may be especially well suited for facilities involved in chemical synthesis that wish to quantify their solvent releases to water, but do not have any direct monitoring or emission factors. For example, releases to water from a chemical facility may come from numerous discharge points that are not easily sampled or identified. In this case, performing a mass balance calculation for a specific solvent, or pollutant, can be the most efficient means of estimating representative releases to water.

Land releases

Mass balance equations offer an efficient method for estimating releases to land from industries when used in conjunction with direct monitoring. As with the application of mass balance for other media, this approach is most effective when good estimates are available for the fate of other chemicals used in a given process.

The basic equation used to estimate releases to land by mass balance is essentially the same as for air and water. As an example, chemical processes often produce sludge as a by-product of a chemical reaction or distillation. If the amount of chemical in the product is known, and the amount of waste released in the form of water and air emissions is known, the remainder can be assumed to be included in the sludge. As the total mass of sludge is likely to be tracked, the results of such a calculation can be verified using appropriate sampling of the concentration of the contaminant in sludge.

2.3.4 Engineering calculations

a) Characteristics of engineering calculations based on non-chemical specific emission factors

An alternative approach to modelling that can be somewhat less data intensive than mass balance models is to consider the detailed relationships that exist within an identified system. Such a process specific model, in effect, replaces knowledge of what the inputs and outputs of a system are with knowledge of what is likely to happen to an input or result, or an output, *inside* the modelled system. For example, while a mass balance model of a storage tank is likely to consider inflow and outflow to estimate breathing losses, a process specific model might focus on pressures inside the tank, vapour pressure of the liquid in the tank, and the operating parameters of relief valves. There is an infinite range of possible models between (what is commonly referred to as) the pure *black box* model and the *completely transparent* process model. The more information is known about inputs and outputs, the less knowledge is needed about internal processes, and *vice versa*.

b) Common applications of process-specific models

Air releases

Calculations using models can be applied to sources that have emissions related to an activity, and that are also influenced by some other external factor that is not related to the activity. For example, some sources of volatile organic pollutants are affected by temperature in addition to the amount of activity. In circumstances where it is easier to measure the operating parameters of a process than to directly assess emissions, the calculation model can be described as *indirect monitoring.* Indirect monitoring methods can be used to develop release estimates that are nearly as accurate as direct monitoring for selected sources at a fraction of the cost.

Calculations using models (with lesser degrees of measurement) are also widely used for mobile sources, because the influence from conditions of operation is essentially constant from one vehicle to another. Some examples of sources where emissions reflect both a primary measure of activity and an additional process condition are listed in Table 1. This Table contains sources for which calculation models are used.

The development of these calculation models can be very expensive and, as a result, they are frequently developed by government agencies or large associations representing specific industrial entities that contribute to emissions from a particular activity. Once these methods have been developed, they can usually be applied with limited effort to provide reasonable estimates of emissions from certain types of sources.

Table 1. Examples of source/activity for which calculation models are used

Source	Factors	Dependent parameters
Passenger Vehicles	Kilometres driven, litres of fuel consumed	Temperature, altitude
Heavy Equipment	Hours in operation, litres of fuel consumed	Load on engine, temperature
Fertiliser Use	Kilograms applied	Soil moisture, soil temperature
Tank (vapour evaporation)	Quantity of liquid stored	Temperature, turnover rate
Surface Impoundment (evaporation)	Mass loading rate	Temperature, wind speed, pH

A key weakness associated with calculation models is similar to the weakness associated with emission factors. These methods are sometimes inappropriately applied to sources that are operated differently from the sources that were used to develop the model. In other cases, these methods may require some specific types of information that may not be readily available to the inventory developer. References for calculation models for several sources are provided later in this document.

Water releases

There are calculation models for point source releases to water. For example, a number of models have been developed to predict and evaluate the effects of landfill leachate on groundwater. Other sources for which groundwater pollution has been modelled include industrial effluent, deep-well injection and underground storage tanks.

Indirect monitoring (calculation models with some parameters monitored in real time) can be applied in many cases for estimating water contaminants from industrial point source releases. The amount and nature of water pollutants released from industrial facilities are often directly related to one or more process related parameters, and estimates of releases to water can often be determined to a high degree of accuracy from measurements of these parameters

Calculation models are widely used to estimate pollutant releases to surface water and ground water from diffuse sources. For example, models have been developed in the Netherlands that predict nitrogen and phosphorous loads on surface and groundwater due to land use activities. The International Commission for the Protection of the Rhine has developed models to inventory diffuse contributions of pollution to the Rhine from sources such as agriculture and soil. Several models are available to predict concentrations of contaminants in storm water runoff from parking lots and urban environments.

Air and water releases

US EPA has developed the WATER9 model to estimate air and water releases of individual pollutants in wastewater collection, storage, treatment and disposal facilities. WATER9 is able to evaluate a full facility that contains multiple wastewater inlet streams, multiple collection systems, and complex treatment configurations. Also, WATER9 has the ability to use site-specific chemical property information, and the ability to estimate the missing chemical property values. This model can be accessed through the following link: http://www.epa.gov/ttn/chief/software/water/index.html.

Land releases

As previously stated, calculation models differ from emission factors particularly in respect to the number, complexity, and type of user defined input parameters required. The example provided for estimating releases to land using emission factors can be expanded to models.

Calculation models, based on user inputs, can provide information about the quantities of releases to the environment from numerous sources, including mine tailings, households and industries. For example, the amount of sewage sludge produced from publicly owned treatment works (POTWs) can be modelled, as can the amount of biodegradable and non-biodegradable wastes in household refuse, to obtain estimates of releases to land. Models can also be used to predict the amount of solid waste produced by the livestock industry.

c) Indirect monitoring

In most cases, it is possible to infer information about releases by monitoring other process parameters. This is known as indirect monitoring and can be very useful for sources that have release signatures that are dependent on standard operational conditions, such as temperature, pressure or moisture/water content. Indirect monitoring can sometimes be used to characterise diffuse sources that are not well suited to direct monitoring approaches. In most situations, however, indirect monitoring is used to obtain enough data to adequately represent average conditions related to the desired spatial and temporal scales. In some cases, periodic monitoring of certain pollutants can be used to represent other pollutants by applying average ratios, or by using some other known conditions related to the source.

Consider a process for which the release depends directly on the temperature and pressure within a reactor. In many cases, the product yield and/or product quality may also depend on those parameters, and therefore those parameters may be routinely monitored as a part of the production process. Those same parameters can then be used to estimate releases. For a process that has been very well characterised, indirect monitoring methods can be used to develop release estimates that are nearly as accurate as direct monitoring for selected sources at a fraction of the cost.

Water releases

Often, wastewater streams are not analysed for target pollutants but for more general parameters such as biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen concentrations or total organic carbon (TOC). These measurements provide a relatively inexpensive and easy test of the pollutant load in wastewater, but not of the specific pollutants. Knowledge of the potential pollutants in the wastewater may make these general tests more cost effective than analysing water for specific levels of individual pollutants. Use of this technique will depend upon the degree of inaccuracy acceptable to the planner with regard to identifying specific pollutants.

2.3.5 Engineering judgement

a) Characteristics of engineering judgement methods

All of the approaches discussed above are typically described as explicit models. That is, the parameters and assumptions used to make the prediction of a release can be stated unambiguously. Frequently, however, releases are estimated using methods that are more intuitive. Such implicit models take advantage of the experience and professional knowledge of the estimator. Over time these approaches have been discussed collectively as methods based on engineering judgement. While it has been recognised that the use of engineering judgement methods has the potential for errors and inconsistencies, the practical advantages of their role in developing release estimates quickly and inexpensively should not be unduly minimised. Often, engineering judgement methods are used initially to provide estimates in the first year or two of a programme. The analysis and interpretation of these results then frequently lead to the use or development of more sophisticated methods that can improve the accuracy, specificity and uses of the data.

b) Application of engineering judgement methods

Air, water, or land releases

Engineering judgement refers to approaches that are based on informed assessments and direct experience. These approaches are primarily used in cases where none of the more explicit estimation methods is judged to be applicable for a particular source or category of sources. Frequently, engineering judgement is applied to make estimates of one pollutant component by assuming that the emission rate is proportional to another component for which a more accurate method was used. For example, emissions of a particular type of reactive organic solvent used in a process may be routinely estimated as part of another specific environmental media programme. The reagent used in the process may include an additive that acts as a preservative. The additive, which would be present in a small concentration and not be involved in the process, would not be of as much interest as the reactive organic compound. The emissions of the additive could be estimated in proportion to the emissions estimate for the reactive organic compound. This type of estimate would be considered engineering judgement.

There are many possible engineering judgement methods that could be developed depending on the particulars of specific processes and sources. It is not possible to mention all of them in this discussion, but similar engineering judgement methods are likely to be obvious in particular circumstances as they arise. There is no ready way of characterising the application of engineering judgements to different release media.

2.3.6 The role of surveys

Surveys can be used in a variety of ways. They can be used to collect information from a subset of activities that represent a population of that activity and the results can then be used to make estimates about the whole range of activity. In some cases, a survey can be designed to collect information from all of the specific sources of a particular activity. In other cases, the survey may only reach a subset of the sources within an activity. When the survey addresses only a subset of the total activity, survey participants can be selected using statistical sampling methods or simply by sending the survey to a randomly selected subset.

For example, a survey could be developed to collect information from all commercial dry cleaners in an urban area or region. Each might be asked to provide information on the amount of each specific dry cleaning solvent that is used, and how much is recovered for reuse or recycling, and how much is disposed. One could then assume that the remainder is released as an air pollutant. That estimate would represent the total air release of the solvent for the surveyed area. The same survey could be sent to a subset of the dry

cleaner establishments that might also collect data on another measure of the activity, such as kilograms of material cleaned, number of employees and total sales. Such information could be used to derive an emission factor to scale up the total air emissions for that activity by simply assuming that the ratio of air emissions to the activity is the same for all dry cleaners.

Surveys are useful for collecting information from sub-threshold sources in a PRTR or diffuse sources. This is particularly true for large-scale type operations, such as fertiliser application, manure handling and treatment from agricultural activities, or the amount of motor oil removed from automobiles during routine maintenance at professional repair shops. As reporting programmes develop, surveys can be useful, particularly to set priorities and define more detailed and accurate data collection methods.

Surveys are also useful tools to quantify generation and disposal of chemicals in waste, and to estimate land disposal releases. Many similar operations may generate wastes in approximately the same proportions. The use of surveys allows a central agency to get an estimate based on actual operating conditions without having to burden each generating facility to collect and maintain that particular data. Often surveys can be set up to collect particular critical information that can be used to estimate more than one type of release or at least more than one target pollutant of any of the media.

2.3.7 Estimating accidental releases

Estimating accidental releases, or releases from other unusual events, presents a different set of circumstances for PRTR programmes. Most accidental or otherwise unplanned releases usually represent an acute exposure to risk over a short time period. Examples of these types of releases include severe process upsets, major breaches from storage vessels or containment structures, explosions, or accidents during the transport of chemicals. Time is the critical factor for responding to such releases which, in turn, affects how they can be addressed in PRTR systems.

Most of the release estimation techniques previously described cannot be implemented in situations that require an immediate response. Even in situations where they can be implemented, the data necessary to develop accurate estimates of the release may not be available. In most cases, accident response authorities will rely on some kind of simple transport model to quickly estimate the area that will be affected by such a release. These models are based on assumptions that will allow a quick assessment of the likely areas to be affected. Some of these assumptions are:

- the dispersion of the releases will follow a normal distribution pattern in response to wind or flows associated with a water body;
- the dilution of the releases in response to assumed dispersion is the only active process to counter the risk associated with exposure (no chemical reaction will occur to decrease the toxicity); and
- the risk will remain until the source is controlled or the leak or spill is contained.

The critical input variable needed is the source strength. Frequently, the best option available is to determine a maximum release strength, which can be calculated based on engineering judgement. For instance, in the situation in which a breach in a major storage vessel containing a highly flammable chemical that is also a respiratory irritant occurs, the worst case scenario would be that the tank was filled and all the chemicals leaked out and volatilised in, say, 20 minutes. The average source strength over the 20-minute period could be calculated quickly with a model.

2.4 PRTR data objectives and the application of estimation techniques

2.4.1 General applicability across media

As noted in the beginning of this chapter, not all estimation methods are equally applicable to all pollutants, source types, or spatial and temporal scales of data collection. For some specific releases from specific source types, there may not be any well-documented methods. As concerns common pollutants from different source types, several estimation methods are available. The following sub-sections address each of the three key release media, and examine the applicability of selected methods to different types of pollutants, sources, and scales in space and time. Some of the key characteristics of each type of technique are summarised in Table 2.

a) Air emissions

Direct monitoring techniques can be expensive to use on a routine basis since they require staff to operate and maintain the instruments, complete QA/QC checks, and manage the data. For those reasons, direct monitoring techniques, while providing the highest quality and reliability of emissions estimates, are not commonly used to develop emissions estimates for point sources. However, calculation models based on indirect monitoring methods, that make use of other types of data routinely collected for other purposes, may be applied for point sources.

Direct monitoring techniques are not well suited for any diffuse sources of air pollutants. Some examples include: all forms of mobile sources, architectural surface coatings, open burning (planned fires for land clearing, wildfires, *etc*.) and consumer product use. For this reason, direct and indirect monitoring methods are not widely applied as a tool to estimate releases from diffuse sources for routine, regularly compiled databases.

b) Water releases

For water, there is a notable difference in the methods available for estimating releases from point than from diffuse sources (releases from mobile sources directly to water are generally of lesser concern). For point sources, there is a heavy reliance on the monitoring of effects-based parameters for making pollutant release estimates, and on the use of indirect monitoring calculation models for specific chemicals. For diffuse sources, modelling seems to be at a relatively primitive state of development, with heavy reliance on measuring the environmental state, rather than evaluating emissions. This has changed somewhat in the past five years, reflecting a trend to evaluation of total loading within watersheds.

c) Land releases

Estimation methods for land releases appear to be the crudest of all. This may reflect a regulatory focus on total mass of managed in addition to a focus on hazardous constituents, and also that much land disposal can be identified as an independent process, with its (secondary) emissions being evaluated separately, rather than as part of the processes that led to the disposal.

Table 2. Application of Release Estimation Techniques

Estimation Method	Pollutants	Source Types	Spatial Scale	Temporal Scale
Monitoring –continuous or parametric	Existing techniques tend to focus on pollutant classes with an increasing trend to cover more specific pollutants.	Generally limited to point sources.	Generally applied at a process level or for a specific release point.	Applicable at all scales. Shorter temporal intervals translate into increased cost.
Chemical-specific emission factors	Generally developed for classes of pollutants from limited measurement data. Trend is to develop more chemical-specific emission factors as programmes advance and data become available.	Wide range of point and diffuse sources within air and water media have been addressed. Efforts continue to expand current databases.	Applicable at all scales. Activity data needs and costs to collect data rise with increasing spatial resolution.	Depends on the time interval of process specific activity data.
Mass balance	Well-suited to individual chemicals if process chemistry known.	Widely used for diffuse sources. Can easily be applied to point sources.	For diffuse sources, not well-suited to fine spatial resolution.	More accurate for longer time intervals.
Engineering calculations	Well suited for specific pollutants if process characteristics are well known.	Generally applicable to point sources.	Generally applied at a process level or for a specific release point.	Applicable to shorter time intervals or can be applied at longer time intervals.
Engineering judgement	Can always be applied.	Can always be applied.	Can always be applied.	Can always be applied.

Note : The time scale discussion here applies only to “routine” emissions.

CHAPTER 3: RELEASE ESTIMATION TECHNIQUES FOR POINT SOURCES

3.1 Estimation methods for point sources

Most of the PRTR programmes upon which Part 1 of the PRTR Resource Compendium is based are designed to collect release estimates of the target pollutants from large-sized industrial and energy production facilities. OECD collects and makes available information on RETs from OECD countries at the Resource Centre for PRTR RETs (http://www.oecd.org/env_prtr_rc/). The Resource Centre is a clearinghouse of guidance manuals and RET documents, and has links to PRTR documents and national PRTR websites, and includes summaries of the document contents. Documents can be accessed using the search engine or links at the Resource Centre. OECD also provides a global portal to PRTR information and activities from countries and organisations around the world at PRTR.net (http://www.prtr.net/) and PRTR Data on a national or regional level at the Centre for PRTR Data (http://www.oecd.org/env_prtr_data/).

This chapter describes the OECD survey and information collection process and provides a table (see Table 3) that summarises information collected from OECD countries.

3.2 Overview of survey responses

As noted in Chapter 1, information on RETs used in OECD countries had been collected via surveys. The table has been updated by the 2011 survey. Table 3 presents a summary of the results of the survey responses from government agencies. It is organised by country and type of RET used and environmental media. This table lists only the methods noted in the survey responses.

Some responses from governments provided general information about the national PRTR programmes rather than specific information about the methods used to estimate releases. Other survey responses stated that many different methods are used depending on the specific aspects of an industrial category, targeted pollutant lists or availability of information. One country, Israel, responded that information was not available because it was developing its PRTR system at the time of the 2011 survey.

The guidance materials provided by responding countries suggest that monitoring of releases at the source is the preferred estimation method. Emission factors, calculation models, and mass balance approaches are discussed frequently in these guidance documents, and are considered preferred RETs when it is difficult or too costly to apply direct monitoring methods. It is worthwhile to mention that RETs based on engineering judgement were noted less often in the survey responses, and were not generally recommended as preferred approaches.

Table 3: Release Estimation Techniques Available in OECD Countries

(A=Air, L=Land, W=Water)

Source Category	Australia			Belgium			Canada			Denmark			France			Japan			Netherlands		
	A	W	L	A	W	L	A	W	L	A	W	L	A	W	L	A	W	L	A	W	L
Agriculture				✔						✔	✔					✔	✔	✔		✔	
Energy	✔	✔	✔	✔			✔	✔	✔	✔	✔		✔			✔	✔	✔		✔	
Metallurgy Engineering	✔	✔	✔	✔			✔	✔	✔	✔	✔		✔			✔	✔	✔		✔	
Non-metallic minerals	✔	✔	✔	✔			✔	✔	✔	✔	✔		✔			✔	✔	✔		✔	
Primary chemical industry	✔	✔	✔	✔			✔	✔	✔	✔	✔		✔			✔	✔	✔		✔	
Products based on primary chemicals	✔	✔	✔							✔	✔		✔			✔	✔	✔		✔	
Textiles and leathers	✔	✔	✔	✔						✔	✔		✔			✔	✔	✔		✔	
Paper/cardboard	✔	✔	✔	✔			✔	✔	✔	✔	✔					✔	✔	✔		✔	
Commercial services	✔	✔	✔	✔						✔	✔					✔	✔	✔		✔	
Transportation	✔	✔	✔	✔						✔						✔	✔	✔		✔	
General services																✔	✔	✔		✔	
Households	✔	✔	✔	✔							✔					✔	✔	✔			
Pollution control Waste disposal	✔			✔									✔			✔	✔	✔		✔	
Regeneration Recovery	✔	✔	✔	✔											✔	✔	✔	✔		✔	
Manufacturing industries	✔	✔	✔	✔			✔	✔	✔		✔		✔		✔	✔	✔	✔		✔	

* This chart contains information that was reported to OECD via a survey.

Table 3: Release Estimation Techniques Available in OECD Countries (continued)
(A=Air, L=Land, W=Water)

Source Category	Norway			Spain			Sweden			Switzerland			United Kingdom			United States		
	A	W	L	A	W	L	A	W	L	A	W	L	A	W	L	A	W	L
Agriculture	✔	✔	✔	✔			✔	✔		✔	✔	✔				✔	✔	✔
Energy	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
Metallurgy Engineering	✔	✔	✔				✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
Non metallic minerals	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔			
Primary chemical industry	✔	✔	✔	✔	✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
Products based on Primary Chemicals	✔	✔	✔	✔	✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
Textiles and Leathers	✔	✔	✔	✔	✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
Paper/Cardboard	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔				✔	✔	✔
Commercial Services	✔	✔	✔				✔	✔		✔	✔	✔				✔	✔	✔
Transportation	✔	✔	✔				✔			✔	✔	✔						
General Services	✔	✔	✔				✔	✔		✔	✔	✔						
Households	✔	✔	✔				✔	✔		✔	✔	✔						
Pollution Control Waste Disposal	✔	✔	✔				✔	✔		✔	✔	✔	✔	✔	✔	✔		
Regeneration Recovery	✔	✔	✔				✔	✔		✔	✔	✔	✔	✔	✔		✔	✔
Manufacturing Industries	✔	✔	✔	✔	✔		✔	✔		✔	✔	✔				✔	✔	✔

* This chart contains information that was reported to OECD via a survey.

3.3 Estimating releases from small and medium-sized industrial facilities

The "common" method described below can be used to quantify releases from small- and medium-sized enterprises (SME) or those industrial facilities that fall below the reporting threshold for point sources. This method is basically a national mass balance approach. One drawback of this method is that the accuracy is not as high as that for most of the point source methods discussed in this Compendium. Nevertheless, it can provide a reasonable estimate of the relationship between the amount of the pollutants released from these small individual sources relative to the amount released by the large point sources.

While the method described below is generally applicable to all industrial categories and for all media, its characteristics will depend on the nature of the sources and the other methods that are being applied to estimate point source releases. This method requires that information on some common measure of the overall activity be reported for the point sources in addition to the release estimates. For example, consider the releases of organic solvents to air from metal finishing activities (solvents used as degreasers, in plating or etching operations, and in finishing operations such as paint or lacquer, *etc*.). The national agency or ministry would need to collect information on the total amount of activity conducted in the metal finishing sector including both the large point sources and any smaller sources that are below the point source reporting threshold. The average pollutant release per unit of activity can be calculated from the totals reported by all of the point sources. The amount of activity represented by the large point sources can then be subtracted from the national total. The remainder would represent the amount of the activity that is being completed by the SMEs. The average release rate can then be applied to that remaining activity to provide an estimate of the amount of emissions from the SMEs and other diffuse sources.

a) Method example

In this example we will assume that in a particular country 10,000 litres of acrylic primer paint is used for undercoating in the repair of automobiles during a year. Measures of total production can frequently be determined from national sales figures. Assume there are 50 large repair shops that meet the point source reporting criteria. Those 50 large shops consume 8,500 litres of the primer paint and release 400 kg of toluene. The remainder released by small shops is not required to be reported: their releases can be estimated by assuming that they consume the remaining 1,500 litres of paint, and that they release a proportional amount of toluene from that activity.

Point source release rate =	400kg / 8,500 litres or 47grams per litre
Diffuse sources release =	1,500 litres used x 47 grams per litre or 70.5 kg

This simple mass balance approach can be applied to essentially any activity and for any pollutants released to any environmental media. The essential assumption is that the release amount remains the same in all sizes of operations. That assumption does not always hold because of differences in technology, process efficiency and the amount of attention that is given to operational details. Nonetheless, this method will provide a reasonable estimate of the unreported amounts for general comparison and planning purposes in most cases.

3.4 Summary of release estimation techniques

A large amount of information on release estimation techniques was gathered through the OECD survey. Most countries have compiled some guidance and technical assistance documents on preferred and

alternate estimation techniques that can be used. Several countries have posted their guidance documents on the Internet to facilitate the dissemination of such materials.

This section provides a summary list of all Internet locations included in survey responses, along with contact information for the PRTR representative in each country. Table 4 lists all of the references to RET descriptions and PRTR estimation guidance manuals identified. While many available documents are listed in Table 4 and in the accompanying Annexes, it is not a comprehensive list of all such materials available, and it is anticipated that the list will evolve.

Table 4 also includes URL addresses for Internet pages where the specific techniques, guidance manuals and other general information about a country's PRTR can be found. Access to these documents is possible when using an electronic version by selecting the URL reference listed in the Table. Some documents listed in Table 4 can be also accessed as PDF files by selecting the particular file name. Further details about identified release estimation methods and OECD country PRTR programmes can be found in Annexes 2 through 14 of this report. Annex 15 describes RETs from specific industry sectors and Annex 16 describes some of the international resources available.

Whenever possible, a contact name with E-mail address, telephone number and fax number are provided in Table 4 and in the Annexes. Table 4 and the Annexes have been updated in 2012 as possible. While contact names listed in Table and the Annexes will change over time, the co-ordinates for the Ministry, or other government body, should remain the same and can be used accordingly. Therefore, it is to be noted that some countries/organisations listed in the Annexes may have not been updated since the first edition of this document was published in 2002. Before contacting a country/organisation, readers should check the information carefully. PRTR.net (http://www.prtr.net/) as well as the Resource Centre for PRTR RETs (http://www.oecd.org/env_prtr_rc/) mentioned in section 3.1 can also be used to search for a country/organisation's PRTR information and activities.

Table 4. Summary of Release Estimation Methods

Country/Organisation	Contact Information	Comments
Australia www.npi.ea.gov.au	Panna Patel NPI Section Environment Australia GPO Box 787 Canberra ACT 2601 Tel: +61 2 6250 0767 Fax: +61 2 6250 0365 E-mail: panna.patel@ea.gov.au	The Internet site listed in the first column is the home page for the Australian National Pollutant Inventory (NPI). The site contains over 78 industry manuals and 20 diffuse source estimation manuals. The site also contains data from the reports provided to date for both point and diffuse sources. Details of the industry and source categories are provided in Annex 2.
Belgium www.aarhus.be	Helga Pien Flemish Environment Agency Department of Air, Environment and Communication Team Air Emission Inventory Office: Dr. De Moorstraat 24-26, 9300 Aalst - Belgium Mail: A. Van de Maelestraat 96, 9320 Erembodegem - Belgium Tel: +32 53 72 67 19 E-mail: h.pien@vmm.be	At this moment no PRTR data are published yet on the website. The 3 regions are preparing their website with PRTR data for release in 2012.
Canada 1. www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F6300E68-1 2. www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=65A75CDF-1 3. www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=2DAFE231-1	François Lavallée National Pollutant Release Inventory Environment Canada 200 Sacré-Coeur, 10th Floor Gatineau (QC) Canada K1A 0H3 Tel: +1-819-994-4073 Fax: +1-819-953-2347 E-mail: francois.lavallee@ec.gc.ca	1. General information on guidance and legal requirements for NPRI reporters 2. Estimation tools for 25 sectors, including base metal smelting, mining, upstream oil and gas, and wastewater treatment plants 3. Air pollutant emission summaries for 17 key pollutants, including criteria air contaminants, heavy metals and persistent organic pollutants

Country/Organisation	Contact Information	Comments
Denmark www.mst.dk/English/	Mette Skovgaard Strandgade 29 1401 Copenhagen K Denmark Tel: +45 32 66 01 00 E-mail: msk@mst.dk	The survey response indicates that releases to air and water are estimated for several categories of point and diffuse sources in only the Danish inventory systems. Contact the Danish Ministry of Environment for more information.
Japan www.env.go.jp/en/chemi/prtr/prtr.html	Takehiko Fukushima Ministry of the Environment 1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100-8975 Tel: +81-3-5521-8260 Fax: +81-3-3580-3596 E-mail: ehs@env.go.jp	The Manual for PRTR release estimation methods is available at www.env.go.jp/en/chemi/prtr/manual/index.html .
The Netherlands www.emissieregistratie.nl/ERPUBLIEK/bumper.en.aspx	D.J. de Vries RIZA Afdeling EMN PO Box 17 8200 AA Tel: +31-(0)320-298536 Fax: +31-(0)320-298514 E-mail: h.dvries@riza.rws. minvenw.nl or Pieter.VanDerMost@ imh-hi.dgm.minvrom.nl or Jan.vanderPlas@imh-hi.dgm.minvrom.nl	Contact D.J. de Vries for information on estimating releases to water. Contact Pieter van der Most at the E-mail address in column 2 for information and help on methods for diffuse sources, and for estimating releases to all other media (air and land).
Norway	Lars Petter Bingh Øyvind Hetland Climate and Pollution Agency PO Box 8100 Dep. 0032 Oslo, Norway Tel: +47 22 57 34 00 Fax: + 47 22 67 67 06 E-mail: lpb@klif.no oyh@klif.no	Guidance Documents on Environmental Related Standards. Techniques are available in guidance documents and other published government reports.

Country/Organisation	Contact Information	Comments
Spain www.en.prtr-es.es/fondo-documental/metodos-de-medicion-y-calculo,15500,10,2007.html www.en.prtr-es.es/fondo-documental/documentos-de-mejores-tecnicas-disponibles,15498,10,2007.html	Iñigo de Vicente-Mingarro PRTR-España, Spanish Register of Emissions and Pollutant Sources. Ministry of Agriculture Food and Environmental Affairs of Spain Tel: +34 902 54 53 50 +34 7499121 Fax: +34 7499140 E-mail: info@prtr-es.es	In these two links useful documents/information are provided on how to estimate releases to the air/water/land. Sectorial/General guidance documents published by the Government. Also guidance elaborated by industrial organizations can be consulted/downloaded
Sweden www.swedishepa.se/ http://utslappisiffror.naturvardsverket.se/en/	Niklas Ricklund Swedish EPA 106 48 Stockholm Tel: +46 10 698 10 56 E-mail: niklas.ricklund@swedishepa.se	Links are provided to the Swedish EPA website and the national PRTR website (English versions).
Switzerland	Hans-Peter Saxer Swiss Agency for the Environment, Forests and Landscape CH-3003 Bern Switzerland Tel: +41 31 32 32 293 84 Fax: +41 31 32 479 78 E-mail: hanspeter.saxer@buwal.admin.ch	
United Kingdom www.defra.gov.uk http://prtr.defra.gov.uk/	Nicholas Obe 5f, Industrial Pollution Defra Ergon House Horseferry Road London SW1P 2AL Tel: +44 2072385304 E-mail: Nicholas.obe@defra.gsi.gov.uk	The UK's survey response indicates that releases are estimated for both point and diffuse sources. Additional information is provided in Annex 13.

Country/Organisation	Contact Information	Comments
United States 1. www.epa.gov/tri/ 2. www.epa.gov/ttn/chief/ 3. www.epa.gov/ttn/chief/efpac/index.html 4. http://water.epa.gov/scitech/wastetech/guide/index.cfm	Stephen C. DeVito TRI Program (2844T) U.S. Environmental Protection Agency 1200 Pennsylvania Ave, N.W. Washington, DC 20460 Tel: +1 202 566-0755 Fax: E-mail: devito.steve@epa.gov	1. The first Internet address provides comprehensive information regarding the US EPA's TRI programme and guidance to industries on estimation methods that can be applied to point and diffuse industrial sources. See Annex 14. 2. The second Internet address provides access to emission factors, emission estimation models, *etc*.; some techniques are used to estimate releases from diffuse sources; additional guidance for diffuse sources is in preparation. See Annex 14. 3. The third Internet site contains chemical-specific guidance manuals that provide information on estimating releases from industries that emit chemicals. See Annex 14. 4. The fourth internet site contains many guideline documents that provide information useful to estimate releases to water. Most of these sources are specific for point sources. The surveys received from the US EPA indicate that releases are only estimated for point sources. Some information will be available soon related to air emissions estimation from diffuse sources. Details can be found in Annex 14. US EPA has also made several documents available on specific releases or pollutants from some specific sources under its Pre-Manufacture Notice (PMN) requirements. To find pdf formatted versions of these documents, refer to Annex 14.

International Organisations		
European Environment Agency 1.http://vergina.eng.auth.gr/mech/lat/copert/copert.htm 2. www.inrets.fr/infos/cost319 3. http://org.eea.eu.int/news/ann980509317	Andre Jol Project Manager Air Emission Inventories European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen K, Denmark Tel: +45 33367144 Fax : +45 33367199	The first Internet address includes a software programme called Computer Programme to Calculate Emissions from Road Transport (COPERT), funded by the European Environment Agency. It calculates major air pollutants and other important compounds like N_2O, NH_3, SO_2 and Pb. The second Internet address is the home page for COST 319 which provides background documents on the emission factors and calculation methodologies used for estimating releases from transport sources. The third Internet address provides updates and news on their activities. Topic centres are: Air and Climate Change, Water, Nature and Biodiversity, Waste and Material Flow and Terrestrial Environment.
Intergovernmental Panel on Climate Change (IPCC) www.ipcc.ch /	The IPCC Secretariat World Meteorological Organisation Building 7bis Avenue de la Paix, C.P. 2300 CH- 211 Geneva 2, Switzerland Phone : +41-22-730-8208 Fax : +41-22-730-8025 E-mail : ipcc_sec@gateway.wmo.ch	The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories can be found at the Internet address in column 1, including release estimation methodologies for industrial processes. Specific gases addressed in this document are greenhouse gases. Information regarding the IPCC is located in Annex 16.
Organisation for Economic Co-operation and Development (OECD) 1. www.oecd.org/document/47/0,3746,en_2649_37465_47637167_1_1_1_37465,00.html 2. http://www.oecd.org/officialdocuments/displaydocumentpdf?cote=ocde/gd(96)32&doclanguage=en 3. www.oecd.org/env_prtr_rc/ 4. www.prtr.net/ 5. www.oecd.org/env_prtr_data/	2, rue André-Pascal 75775 Paris Cedex 16 France Tel: +33 1 45 24 17 63 Fax: +33 4 75 27 61 35 E-mail: ehscontact@oecd.org	1. This first Internet site provides access to a wide array of PRTR related information which has been generated by the OECD. The site also includes a series of documents on PRTRs. 2. The second Internet address listed in column 1 can be used to obtain the OECD PRTR Guidance Manual for Governments. 3. The third Internet address can be accessed guidance manuals and RET documents from OECD countries. 4. The fourth Internet address is a global portal to PRTR information and activities from countries and organisations around the world. 5. The fifth Internet address provides PRTR Data on a national or regional level.

International Organisations		
United Nations Institute for Training and Research (UNITAR) www.unitar.org/cwm/prtr	Palais des Nations CH-1211 Geneva 10 Switzerland Tel: +41 22 917 8525 Fax: +41 22 917 8047 E-mail: cwm@unitar.org	This Internet site is the UNITAR PRTR training and capacity building programmes home page. It includes links to training materials, workshop proceedings and other information sources that can be used to facilitate the Design and implementation of national pollutant release and Transfer registers (PRTRs).
UNECE **EMEP/CORINAIR** 1. www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep 2. http://tfeip-secretariat.org/ 3. http://acm.eionet.europa.eu/	Jessica Sully or Nikolas Hill AEA Technology Environment E6 Culham AEA Technology Abingdon, Oxon OX14 3ED United Kingdom Tel: +44 1235 46 3251/3158 Jessica.sully@aeat.co.uk	The first Internet address links to the EMEP/EEA air pollutant emission inventory guidebook — 2009, which has been prepared by the expert panels of the UNECE/EMEP Task Force on Emission Inventories and Projections. The Guidebook is published by the European Environment Agency and it is intended for general reference and for use by parties to the Convention on Long Range Transboundary Air Pollution when reporting to the UNECE Secretariat in Geneva. The second Internet address links to the working website of the Task Force on Emission Inventories and Projections. This gives further information about the work of the Task Force and contains Guidebook chapters which are currently under development. Details can be found in Annex 16. The third Internet address includes several downloadable computer tools developed by the European Environment Agency and its European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) to support European countries in compiling annual air emission inventories within the framework of the Corinair (CORe INventory AIR emissions) programme. These tools include: **CollectER:** used to collect and store information necessary to build an air emission inventory, and then calculate the emissions using emission factors, calculation models and other estimation methods recommended by EMEP/CORINAIR; **ReportER**: used to create reports of the air emissions data developed using CollectER in several formats that conform to international reporting guidelines; and **TrainER**: a training tool for how to use both CollectER and ReportER.
World Bank www.worldbank.org/nipr/	For information on contacting the World Bank, please go to: http://www.worldbank.org/html/extdr/gen.htm	This Internet site provides PRTR related information and links to other organisations involved in PRTR development.

International Organisations		
World Health Organisation www.who.int/en/	Headquarters Office in Geneva (HQ) Avenue Appia 20 1211 Geneva 27 Switzerland Tel: +41 22 791 21 11 Fax: +41 22 791 0746	This Internet site provides details on a wide range of chemicals.

ANNEX 1:
PRTR ESTIMATION METHODS SURVEY: DESIGN AND FORMAT

To survey the appropriate agencies and industries within OECD countries, two surveys were developed with which estimating techniques could be described: one for government agencies and one for industrial facilities. The surveys were developed as computer applications and posted on an OECD maintained Internet site, along with instructions on using the surveys. In most cases, users were able to access the survey files and the written instructions directly from this site.

Both the government and industry surveys had similar designs and questions. The registration page requested information pertaining to the government agency or industry facility submitting the survey. Information such as the contact name, phone number and E-mail was requested, along with information pertaining to PRTR reporting responsibilities. For the industry survey, information was also requested regarding the countries in which facilities were operating and reporting releases to the environment.

The registration page was followed by the actual pollutant release estimation techniques questionnaire. This page was split to show both a data tree containing a comprehensive source category list and the questions. Identical questions were provided for releases to air, water, and land. Additionally, a set of questions was provided for a category named *All Releases*. This was provided to facilitate data entry for source categories that used the same pollutant release estimation techniques for air, water, and land.

Boxes 1 and 2 of this Annex contain all survey questions.

Annexes 2 to 14 contain information about release estimation techniques for ten OECD countries; information for three countries (Belgium, Spain and Sweden) has been added in this 2012 revision, and information on five countries (Canada, Japan, Norway, the United Kingdom and the United States) has been modified in this 2012 revision.

Box 1
Registration Page Information

Country
Name of Contact Person
Agency or Ministry
Address
Telephone, Fax, E-mail Address

Source Types Reported by Government Agency:
Choices: Point Sources Only
Diffuse Sources Only
Point and Diffuse Sources
Releases are not estimated by Government Agency

Do Industry or Trade Associations Report Releases for Their Industry?
Choices: Yes
No

Users were asked to select from the following list which Industries are Required to Report Releases
Agriculture
Pulp and Paper Manufacturing
Wood Products
Fossil Fuel Extraction and Processing
Petroleum Refining and Related Industries
Energy Production
Extraction and Use of Metallic Ores
Extraction and Use of Non-metallic Ores
Manufacture of Expendable Consumer Goods
Manufacture of Appliances
Manufacture of Transportation Equipment
Primary Chemical (organic and inorganic) Manufacturing
Chemical and Pharmaceutical Manufacturing
Textile and Leather Goods
Waste Disposal (solid and liquid)
Other - Space to comment

Users also asked to list other Government Agencies that report release data and the categories covered.

Box 2
Survey Questions

Box 2

1. Origin of Method:
   Choices:
   - Developed by a Government Programme
   - Developed by another Government or International Agency
   - Developed by an Industry Group
   - Developed by a Trade Association
   - Developed by Academia or a Consulting Group
   - Available in the Open Literature
   - Independent Certification Organisation
   - Other - with space to specify.

continued

2. Documentation of the Method
   Choices:
   - Documented in a Published and Peer Reviewed Journal
   - Specified by a Government Report/Guidance Manual
   - Unpublished Government Protocol
   - Each Government or International Group Develops Specific Methods
   - Other – with space to specify.

3. Availability of the Method
   Is the documentation available? Yes or No
   Please describe the general features of the method.
   Are you willing to share the method with other OECD countries? Yes or No

4. Type of Method
   Choices:
   - Emission Factor
   - Calculation Model
   - Mass Balance
   - Periodic Monitoring applied to all sources in the Category
   - Continuous Monitoring
   - Survey with Statistical Sampling
   - Non-statistical Survey
   - Survey of all Sources
   - Engineering Judgement
   - Other – with space to specify

5. Data for Method Based on
   Choices:
   - Population
   - Sales or Value Added
   - Tax Receipts
   - Land Use
   - Process Throughput
   - Physical Characteristics of the Source
   - Chemical Characteristics of the Source
   - Periodic Monitoring
   - Continuous Monitoring
   - Number of Production Units
   - Number of Employees
   - Other – with space to specify

6. Level of Aggregation
   Choices:
   - Release Estimated at National Level
   - Release Estimated at Sub-national or Regional Level
   - Release Estimated at Facility Level
   - Release Estimated at Process/Operation Level
   - Other – with space to specify

Box 2

7. Types of Chemical Reported
   Indicate major categories not individual pollutants

8. Frequency of Reporting
   Choices: Per year, per month, per day *etc*.
   Does your PRTR programme specify a regular reporting cycle?
   Are different source categories subject to different cycles?
   Is reporting triggered by some other condition or event? Permit condition, *etc*.
   Other – with space to specify

9. Opportunity to provide general comments.

ANNEX 2: AUSTRALIA

Point of Contact	Panna Patel
Address:	NPI Section
	Environment Australia
	GPO Box 787
	Canberra ACT 2601
Telephone:	+61 2 6250 0767
Fax:	+61 2 6250 0365
E-mail:	Panna.patel@ea.gov.au

Guidance documents:
Industry handbooks, which give information on release estimation methods for the following industries (see below).

Industry handbooks

Industry handbooks are guidance documents to assist industries in estimating their emissions of the National Pollutant Inventory (NPI) pollutants. A total of 77 handbooks covering the majority of the industry sectors have been published and three more are being finalised. In addition, several Emission Estimation Technique (EET) Manuals are under revision. All the handbooks are available from the NPI industry handbook site.

The NPI Guide, along with one or more EET Manuals, forms part of the handbooks. The Guide, which has recently been revised, helps industry reporters to determine whether or not they are required to report to the NPI.

NPI Industry Handbooks

These handbooks incorporate those Emission Estimation Technique (EET) Manuals regarded as "core" to the industry or sector for which they have been produced.

Industry Handbook	EET Manuals
Adhesive Tapes	Pressure-sensitive Tapes & Labels, Fuel & Organic Liquid Storage
Alumina Production	Alumina Refining, Combustion in Boilers, Mining, Sewage & Wastewater Treatment
Aluminium Smelting	Aluminium Smelting, Combustion in Boilers, Mining, Sewage & Wastewater Treatment
Animal and Bird Feed Manufacture	Animal and Bird Feed Manufacture
Appliance, Machinery & Electrical Equipment Manufacture	Appliance, Machinery & Electrical Equipment Manufacture
Bakery Product Manufacturing	Bread Manufacturing, Combustion in Boilers, Combustion Engines
Basic Iron and Steel Manufacturing	Iron and Steel Production, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Mining, Fossil Fuel Electric Power Generation
Basic Non-Ferrous Metal Manufacture	Non-Ferrous Metal Manufacture

Industry Handbook	EET Manuals
Basic Non-ferrous Metal Manufacturing: Nickel Concentrating, Smelting & Refining	Nickel Concentrating, Smelting & Refining, Fugitive Emissions Combustion in Boilers, Combustion Engines, Fossil Fuel Electric Power Generation, Fuel & Organic Liquid Storage, Sewage & Wastewater Treatment
Battery Manufacturing	Lead Acid Battery Manufacturing, Combustion Engines
Beer & Malt Manufacturing	Beer Manufacturing, Combustion in Boilers, Combustion Engines
Cement & Lime Manufacturing	Cement Manufacturing, Lime & Dolomite Manufacturing, Combustion Engines
Ceramic Product Manufacturing	Bricks, Ceramics, & Clay Product Manufacturing, Combustion Engines
Chemical Product Manufacture	Chemical Product Manufacture
Computers and Electronic Equipment Manufacturing	The Electronics & Computer Industry, Fuel & Organic Liquid Storage
Concrete Product Manufacturing	Concrete Batching & Concrete Product Manufacturing, Fugitive Emissions
Confectionery Manufacture	Confectionery Manufacture
Copper Concentrating, Smelting & Refining	Copper Concentrating, Smelting & Refining
Dairy Product Manufacturing	Dairy Product Manufacturing, Combustion in Boilers, Combustion Engines, Sewage & Wastewater Treatment, Fugitive Emissions
Defence Facilities	Defence Facilities
Dry Cleaners & Laundries	Dry Cleaning, Combustion in Boilers, Fuel & Organic Liquid Storage
Electricity Supply	Fossil Fuel Electric Power Generation, Combustion Engines, Fuel & Organic Liquid Storage, Fugitive Emissions
Explosives Detonation	Explosives Detonation
Explosives Manufacturing	Explosives Manufacturing, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage
Ferroalloy Production	Ferroalloy Production
Fertiliser Manufacturing:	Phosphate Manufacturing, Ammonium Sulfate Manufacturing, Synthetic Ammonia Manufacturing, Urea Manufacturing (Ammonium Nitrate), Sewage & W/water Treatment, Fugitive Emissions
Food Manufacturing: Snack Foods & Prepared Meals	Snack Foods Roasting & Frying, Coffee Roasting, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage
Fruit & Vegetable Processing	Fruit & Vegetable Processing, Combustion Engines, Combustion in Boilers
Fugitive Emissions	Fugitive Emissions
Furniture Manufacturing	Furniture & Fixtures Manufacturing, Combustion in Boilers
Gas Supply	Gas Supply
Glass & Glass Product Manufacturing	Glass & Glass Fibre Manufacturing, Combustion Engines, Fugitive Emissions
Hospitals	Hospitals

Industry Handbook	EET Manuals
Hot Mix Asphalt Manufacturing	Hot Mix Asphalt Manufacturing, Combustion in Boilers, Fuel & Organic Liquid Storage, Fugitive Emissions
Inorganic Industrial Chemical Manufacturing	Inorganic Chemicals Manufacturing, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Sewage & Wastewater Treatment, Fugitive Emissions
Intensive Livestock (Beef Cattle)	Beef Cattle Feedlots
Intensive Livestock (Pig Farming)	Pig Farming
Iron and Steel Casting and Forging, & Steel Pipe and Tube Manufacturing	Ferrous Foundries, Combustion Engines
Lead Concentrating, Smelting & Refining	Lead Concentrating, Smelting & Refining
Leather Tanning & Fur Dressing	Leather Tanning & Finishing, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Sewage & Wastewater Treatment
Log Sawmilling, Timber Dressing, & Wood Product Manufacturing	Timber & Wood Product Manufacturing, Combustion in Boilers, Combustion Engines, Fugitive Emissions
Maritime Operations	Maritime Operations
Meat & Meat Product Manufacturing	Meat Processing, Combustion in Boilers, Combustion Engines, Sewage & Wastewater Treatment
Medicinal & Pharmaceutical Product Manufacturing	Medicinal & Pharmaceutical Product Manufacturing, Fuel & Organic Liquid Storage
Metal Coating and Finishing	Surface Coating, Galvanising, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Electroplating and Anodising, Fugitive Emissions
Mining (includes coal, iron ore, bauxite, copper ore, gold, nickel ore, silver-lead-zinc ore, & metallic mineral ore)	Mining, Combustion in Boilers, Fossil Fuel Electric Power Generation, Explosives Detonation
Mining of Non-Metallic Minerals	Mining and Processing of Non-metallic Minerals, Combustion in Boilers, Combustion Engines, Fossil Fuel Electric Power Generation, Fuel & Organic Liquid Storage, Fugitive Emissions, Sewage & Wastewater Treatment
Motor Vehicle Manufacturing	Motor Vehicle Manufacturing, Ferrous Foundries, Non-ferrous Foundries, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Galvanising, Electroplating and Anodising, Surface Coating
Non-ferrous Metal Casting	Non-ferrous Foundries, Combustion Engines
Non-Metallic Mineral Product Manufacture	Non-Metallic Mineral Product Manufacture
Non-Petroleum Industrial Gases	Non-Petroleum Industrial Gases
Oil and Fat Manufacturing (vegetable oils only)	Vegetable Oil Processing Industry, Combustion Engines, Fuel & Organic Liquid Storage, Vegetable Oil Processing Industry
Oil and Gas Extraction	Oil & Gas Exploration and Production
Organic Industrial Chemical Manufacturing	Organic Chemical Processing Industries, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Sewage & Wastewater Treatment

Industry Handbook	EET Manuals
Paint and Ink Manufacturing	Paint and Ink Manufacturing, Combustion Engines, Fuel & Organic Liquid Storage, Organic Chemical Processing Industries
Paper & Paper Product Manufacturing	Pulp & Paper Manufacturing, Combustion in Boilers, Combustion Engines, Sewage & Wastewater Treatment, Fugitive Emissions
Petroleum & Coal Product Manufacturing	Oil Recycling
Petroleum Product Wholesaling	Fuel & Organic Liquid Storage
Petroleum Refining	Petroleum Refining
Plastic Product Rigid Fibre Reinforced Manufacturing	Fibreglass Product Manufacturing, Surface Coating
Precious Metal Manufacturing : Gold Ore Processing	Gold Ore Processing, Combustion in Boilers, Combustion Engines, Fossil Fuel Electric Power Generation, Fuel & Organic Liquid Storage, Sewage & W/water Treatment, Fugitive Emissions
Printing, Publishing and Services to Printing	Printing, Publishing & Packaging, Combustion Engines, Fuel & Organic Liquid Storage
Railway Equipment Manufacturing & Railway Yard Operations	Railway Yard Operations, Ferrous Foundries, Non-ferrous Foundries, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Surface Coating, Electroplating & Anodising, Fugitive Emissions
Rubber Product Manufacture	Rubber Product Manufacture
Seafood Processing	Seafood Processing, Combustion in Boilers, Sewage & Waste water Treatment
Sewerage and Drainage Services	Sewage & Wastewater Treatment
Shipbuilding	Shipbuilding, Repair & Maintenance, Ferrous Foundries, Non-ferrous Foundries, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Electroplating & Anodising, Computers and Electronics
Soft Drink Manufacture	Soft Drink Manufacture
Solvent Recycling	Solvent Recycling, Fuel & Organic Liquid Storage
Structural & Fabricated Metal Product Manufacture	Structural & Fabricated Metal Product Manufacture
Sugar Manufacturing	Sugar Milling & Refining, Combustion in Boilers, Combustion Engines
Surface Coating	Surface Coating, Combustion Engines, Fuel & Organic Liquid Storage, Fugitive Emissions
Textile Product Manufacturing	Textile & Clothing Industry, Combustion in Boilers, Combustion Engines, Fuel & Organic Liquid Storage, Sewage & Wastewater Treatment
Tobacco Product Manufacture	Tobacco Product Manufacture
Waste Disposal Services: Landfills	Municipal Solid Waste Landfills, The Landfill Area Based Spreadsheet (LABS), Combustion Engines
Waste Disposal Services: Sewage Sludge & Biomedical Waste Incineration	Sewage Sludge & Biomedical Waste Incineration

Industry Handbook	EET Manuals
Water Supply	Potable Water Treatment
Wine & Spirit Manufacturing	Wine & Spirit Manufacturing, Combustion Engines, Sewage & Wastewater Treatment
Wool Scouring	Wool Scouring, Sewage & W/water Treatment
Zinc Concentrating, Smelting & Refining	Zinc Concentrating, Smelting & Refining

Aggregated Emissions (AED) Handbooks

These handbooks provide guidance to the jurisdictions to estimate aggregated emissions from diffuse sources. These are also available from the NPI Internet website.

Aggregated Emissions from Aircraft
Aggregated Emissions from Tropical Aquaculture
Aggregated Emissions from Architectural Coating
Aggregated Emissions from Barbeques
Aggregated Emissions from Cutback Bitumen
Aggregated Emissions from Prescribed Burning and Wildfires
Aggregated Emissions from Domestic/Commercial Solvents and Aerosol
Aggregated Emissions from Dry Cleaning
Aggregated Emissions from Domestic Gaseous Fuel Burning
Aggregated Emissions from Domestic Lawn Mowing
Aggregated Emissions from Motor Vehicles
Aggregated Emissions from Motor Vehicle Refinishing
Aggregated Emissions from Paved and Unpaved Roads
Aggregated Emissions from Printing and Graphical Arts
Aggregated Emissions from Railways
Aggregated Emissions from Service Stations
Aggregated Emissions from Commercial Ships/Boats and Recreational Boats
Aggregated Emissions from Domestic Solid Fuel Burning
Aggregated Emissions from Fuel Combustion (Sub-Threshold)
Aggregated Emissions from Use of Industrial Solvents

SUBSTANCES

The substances for which reports are currently required are:

Acetone	Methanol
Arsenic and compounds	Methyl ethyl ketone
Benzene	Methyl isobutyl ketone
1,3-Butadiene (vinyl ethylene)	Methyl methacrylate
Cadmium and compounds	Nickel carbonyl
Carbon monoxide	Nickel subsulphide
Chromium (vi) compounds	Oxides of nitrogen
Cobalt and compounds	Particulate matter 10.0um
Cyanide (inorganic) compounds	Polycyclic aromatic hydrocarbons
1,2-Dibromoethane	Sulfur dioxide
Dichloromethane	Sulfuric acid
2-Ethoxyethanol	Tetrachloroethylene
2-Ethoxyethanol acetate	Toluene (methylbenzene)
Ethylene glycol (1,2-ethanediol)	Toluene – 2,4-diisocyanate
Fluoride compounds	Total nitrogen
Glutaraldehyde	Total phosphurus
Lead and compounds	Trichloroethylene
Mercury and compounds	Xylenes(individual or mixed isomers)

This listing has expanded to 90 substances from 1 July 2001. Explanations for the substances, *e.g.* PAHs, and the list to be introduced from 2001, are on the website.

Summary of the Survey Response from Australia

The Australian PRTR system is called the National Pollutant Inventory (NPI). Individual facilities are required to provide release estimates for 36 listed substances or groups of substances, if there is a guidance manual covering that industry. For the first year of the NPI, 23 industry sectors reported, for the second year, approximately 80 industry sectors were covered. The following list of industries are exempted from individual reporting:

- mobile sources outside of the facility;
- establishments that engage in retail sales of petroleum products;
- dry cleaning facilities that employ fewer than 20 people;
- scrap metal processing facilities that do not reprocess batteries or smelt any metal; and
- most (that is, non-intensive) agricultural activities.

Government facilities are also required to report to the NPI unless reporting the required information would pose a threat to national security.

The Australian PRTR programme requires the use of one of the estimation methods provided in the industry guidance manuals, unless government approval is given for using another technique. When emission factors are an estimation option, the reference manual provides those which are appropriate for the process. Many of the emission factors are based on the emission factors provided by the US EPA (AP-42). Estimates are reported on an annual basis and represent the total release for the preceding year ending 30 June.

Estimates of diffuse or mobile source emissions into certain airsheds and nutrient emissions into certain water catchments are also provided.

ANNEX 3: BELGIUM

Point of Contact:	Helga Pien
Address:	Flemish Environment Agency Department of Air, Environment and Communication Team Air Emission Inventory Office: Dr. De Moorstraat 24-26, 9300 Aalst – Belgium Mail: A. Van de Maelestraat 96, 9320 Erembodegem - Belgium
Telephone:	+32 53 72 67 19
Fax:	+32 53 72 66 79
E-mail:	h.pien@vmm.be

General guidance documents/tools:

Informative inventory report (background information on air emissions reported to LRTAP) (http://cdr.eionet.europa.eu/be/un/UNECE_CLRTAP_BE/envtx93zq)

National inventory report (descriptive and numerical information for all greenhouse gases)(http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php)

E-PRTR report on practice and measures *(Reporting questionnaire relating to Regulation (EC) No 166/2006 with some interesting links to regional websites)* (http://cdr.eionet.europa.eu/be/eu/eprtrpam/envtzmy9a)

Industry/process specific guidance documents/tools:

Chemical specific guidance documents/tools:

Other related documents/tools:

ANNEX 4: CANADA

Point of Contact:	François Lavallée
Address:	National Pollutant Release Inventory Pollutant Inventories and Reporting Division Environment Canada 200 Sacré-Coeur, 10th Floor Gatineau (QC) Canada K1A 0H3
Telephone:	+1-819-994-4073
Fax:	+1-819-953-2347
E-mail:	francois.lavallee@ec.gc.ca

Summary of NPRI Facility Reporting Guidance Tools and Information

- General NPRI Reporting Tools can be found at: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=6DE7F8BC-1
- Facility Guidance for reporting information on Fuel Combustion, Fugitive Emissions and Other Sources can be found at: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=6DE7F8BC-1#n6
- Industry/process specific guidance documents/tools, including 25 sector-specific estimation tools can be found at: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=65A75CDF-1
- Pollutant-specific guidance documents/tools:
  - Mercury: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=C2C24B2E-1
  - Phosphorus: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=46C694F1-1
  - Total Reduced Sulphur: www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=AAECF4F6-1
  - Criteria Air Contaminants: www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=3B695DF5-1

Canada's PRTR reporting guidance for facilities, including release estimation techniques is published on the National Pollutant Release Inventory (NPRI) web pages at the following URL: (www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=65A75CDF-1). General and sector-specific guidance updated periodically and is currently available for the following (approximately 25) sectors:

- Alumina and Aluminum
- Animal Food Manufacturing
- Asphalt Plants
- Base Metal Smelting
- Breweries
- Cement Manufacturing
- Chemicals Manufacturing
- Defence Services
- Electric Power Generation, Transmission and Distribution

- Grain Handling
- Iron, Steel and Ilmenite Smelting
- Iron Ore Pellets
- Lime Manufacturing
- Mining (Related material can be found in the Iron Ore Pellets, and Potash sections)
- Motor Vehicle Manufacturing
- Natural Gas Transmission, Distribution and Storage
- Oil Sands
- Petroleum Product Terminals
- Petroleum Refining
- Potash Mining
- Printing and Related Support Activities
- Upstream Oil and Gas
- Waste Treatment and Disposal
- Wastewater
- Wood Manufacturing and Pulp (including Pulp and Paper, Sawmills, Wood Preservation, and Woodworking)

ANNEX 5: DENMARK

Point of Contact:	Mette Skovgaard
Address:	Environmental Protection Agency Department of Development and Data Strandgrade 29 1401 Copenhagen K Denmark
Telephone:	+45 32 66 01 00
Fax:	
E-mail:	msk@mst.dk

Guidance Documents:
1. Guidelines for the Discharge of Industrial Effluent into Sewerage DS (- 2399 Effluence)
2. Control Computation on Effluence Data (- Bek. 637)

Summary of the Survey Response

The government of Denmark collects release information for several industrial and non-industrial sectors. Releases to air and water are estimated for both point and diffuse sources. The survey response did not indicate if any methods are applied for releases to land.

In the Danish programme, most manufacturing sources report their releases through local municipal or county level agencies. This information is then passed through to the national government. The reporting frequency is determined by the conditions of the permits managed by the municipal and county agencies. Reporting is required by industry representatives in the energy and waste disposal sectors.

The survey indicates that there is a specific set of air pollutants that are of interest in some of the agricultural source categories, and that all relevant air and water pollutants are of interest in the other industry sectors. The target pollutants in agriculture are:

Sulphur dioxide (SO_2) Oxides of nitrogen (NO_x)
Carbon monoxide (CO) Carbon dioxide (CO_2)
Nitrous oxide (N_2O) Methane (CH_4)
Ammonia (NH_3)
Non-methane volatile organic compounds (NMVOC)
HFC's, PFC's and SF_6 (greenhouse gases and stratospheric ozone depleting compounds)
Heavy metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc)
Dioxin/Furan
Polycyclic aromatic hydrocarbons (PAH)

The survey response indicates that estimates of releases to air are dependent on calculations based on some subset of monitoring data, or directly on emission factors. The estimates for water releases are all dependent on surveys that use statistical sampling to select the survey recipients and the survey results are applied ultimately to periodic monitoring data.

Guidance manuals are available for air releases and water releases. The guidance for air releases is based on the Industrial Air Pollution Control Guidelines. Guidance for estimating water releases is provided in two reports, *Guidelines for Discharge of Industrial Effluent to Sewage* and *Control Computation of Effluence Data*. The air industrial guidelines are available directly through the Internet. The water effluent guidance documents can be obtained directly from the Danish EPA.

ANNEX 6: FRANCE

Point of Contact:	Jean-Pierre Fontelle
Address:	CITEPA
	10, Rue du Faubourg Poisonniere
	75010 Paris
Telephone:	+33 1 44 83 68 83
Fax:	+33 1 40 22 04 83
E-mail:	CITEPA@COMPUSERVE.COM

Guidance Documents:
1. EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook

Summary of the Survey Response

The French survey response was prepared by the Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique (CITEPA). In addition to CITEPA, the Institut Français de l'Environnement and the French Ministry of Industry are responsible for reporting releases to the environment. The survey submitted by CITEPA only addressed releases to air.

In addition to government reporting, CITEPA indicated that the following industries are responsible for reporting their releases:

Pulp and paper manufacturing
Wood products
Fossil fuel extraction and production
Petroleum refining and related industries
Energy production
Extraction and use of metallic ores
Manufacturing of expendable consumer goods
Manufacturing of appliances
Manufacturing of transportation equipment
Primary chemical (organic and inorganic) manufacturing
Chemical and pharmaceutical manufacturing
Textiles and leather goods industry
Waste disposal

To estimate releases to air, CITEPA acts as the national reference centre. Most methods refined for unique requirements for France have been documented but not published. The IPCC and EMEP/CORINAIR methods are also widely accepted and used. The French survey response also indicated that it is willing to share methods with other countries and agencies. The French PRTR system is designed and maintained to estimate releases at the national and sub-national level, and reporting occurs once a year.

The French survey response indicated that reporting occurs for at least five types of chemicals, including:

Pollutants/chemicals that lead to acidification

Pollutants/chemicals that react with sunlight (photochemistry)

Greenhouse gas substances

9 heavy metals

9 Persistent organic pollutants (POPs)

Persistent organic pollutants include dioxins, furans, polycyclic aromatic hydrocarbons (PAHs) and various pesticides.

ANNEX 7: JAPAN

Point of Contact:	Takehiko Fukushima
Address:	Ministry of the Environment 1-2-2 Kasumigaseki Chiyoda ku Tokyo 100-8975
Telephone:	+81 3 5521 8260
Fax:	+81 3 3580 3596
E-mail:	ehs@env.go.jp

Point of Contact:	Satoshi Ohta
Address:	Ministry of Economy, Trade and Industry (METI) 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901
Telephone:	+81 3 3501 0080
Fax:	+81 3 3580 6347
E-mail:	prtr-meyasubako@meti.go.jp

General guidance documents/tools:
- Manual for PRTR Release Estimation Methods
- PRTR Release Estimation System

Industry/process specific guidance documents/tools:
- Paper Industry
- Light Metal Product Industry
- Metal Heat Treatment Industry
- Automobile Maintenance Industry
- Hot-Dip Industry
- Electroplating Industry
- Asbestos Industry
- Cement Fiberboard Industry
- Iron Casting Industry
- Die Casting Industry
- Aluminium Alloy Manufacturing Industry
- Can Manufacturing Industry
- Valve Manufacturing Industry
- Laundry & Dry Cleaning Industry
- Industrial Cleaning Industry
- Housing Manufacturing Industry
- Non-Ferrous Casting Industry
- Aircraft Maintenance Industry
- Automobile Chemical Manufacturing Industry

- Adhesive Tape Manufacturing Industry
- Fiber-Reinforced Plastic Manufacturing Industry
- Painting Processes
- Gasoline Service Stations (SS)
- Corrugated Packaging Industry
- Forging Industry
- Cemented Carbide Tool Industry
- Bonded Adhesive Products Manufacturing Industry
- 18-Liter Can Manufacturing Industry - Switchgear and Controlgear Manufacturing Industry
- Chemical Industry
- Petroleum Industry
- Automobile Manufacturing Industry
- Auto parts Manufacturing Industry
- Electric and Electronic Manufacturing Industry
- Paint Manufacturing Industry
- Printing Ink Manufacturing Industry
- Mining
- Optical Glass Manufacturing Industry
- Iron and Steel Production Industry
- Fiberboard and Particleboard Manufacturing Industry
- Adhesive Manufacturing Industry
- Textile Finishing Industry
- Refractory Manufacturing Industry
- Battery Manufacturing Industry
- Arc Welding Industry
- Manufacture of Gas
- Printing Industry
- Production of Electricity
- Aluminium Products Industry
- Rubber Manufacturing Industry
- Wire Products Manufacturing Industry
- Marine Equipment Manufacturing Industry
- Sewerage Business
- Waste Disposal Business

Chemical specific guidance documents/tools:

Other related documents/tools:

ANNEX 8: NETHERLANDS

Point of Contact:	D. J. de Vries
Address:	Ministry of Transport, Public Works and Water Management RIZA Afdelig EMN P.O. Box 17 8200 AA
Telephone:	+31 (0) 320 298536
Fax:	+31 (0) 320 298514
E-mail:	hdvries@riza.rws.minvenw.nl Pieter.VanDerMost@imh-hi.dgm.minvrom.nl

Point of Contact:	Pieter van der Most or Jan van der Plas
Address:	Ministry of Housing, Spatial Planning and the Environment Inspectorate for the Environment/IPC 680 8, Rijnstraat P.O. Box 30945, 2500 GX The Hague, The Netherlands
Telephone:	+31 70 3394606 / 31 70 3394322
Fax:	+31 70 3391298
E-mail:	Pieter.vanderMost@IMH-HI.DGM.minvrom.nl Jan.vanderPlas@imh-hi.dgm.minvrom.nl

Guidance Documents:

1. PER Methods Handbook (for all sources reported in 1994)
2. National Target Group Monitoring Protocols (in development for point and diffuse sources)
3. Series of Special Reports for specific categories
4. Assessment of the Pollutant Emission Register in the Netherlands

Summary of the Survey Response

Two survey responses were received from the Netherlands. One survey was received from the Ministry of Transport, Public Works and Water Management and provided information on release estimation methods used for water pollutants. The second survey was received from the Ministry of Housing, Spatial Planning and the Environment and provided information on estimating releases to all environmental media.

The Netherlands has a well established system for reporting releases to all media, and the data that are generated by that reporting system are used in many sophisticated environmental management activities. Both surveys indicate that all major industries are required to prepare reports detailing their releases to all media for both point and diffuse sources. Each facility is covered by a permit and the reporting activity is

a condition of the permit. The results of the release reporting activities are used to determine compliance with the permit conditions.

All facilities that are larger than a specified size (the specific size limitation was not provided in the survey responses) are required to report their releases. Approximately 300 of the largest facilities, which include chemical production facilities, energy producing facilities, petroleum refineries, and sewage treatment plants, are required by law to submit an annual report on operations that includes information on releases. The report is made available to the government and the general public. In addition, several hundred other facilities also complete similar annual reports under agreements between the government and the industry sectors (*e.g.* chemicals, paper products and dairy products). The formal reporting programme is co-ordinated by the Ministry of Housing, Spatial Planning and the Environment.

The methods used in the reporting programme have been developed by the government agencies. There is a general guidance document known as The PER Methods Handbook and several industry and category specific guidance documents. Many of these documents are available and can be shared with other OECD countries, although many of these are only available in Dutch.

For most large facilities, water effluents are estimated by periodic monitoring of concentrations and flow rate in effluent streams. The smaller facilities are often treated collectively as diffuse sources and the government estimates releases for these collective diffuse sources by extrapolation (calculation model), emission factors, or through surveys using statistical sampling. The calculation for these diffuse sources is frequently dependent on process throughput, value added, or number of employees.

Estimates for all of the large sources are reported at the facility level. The estimates for the aggregate diffuse sources are represented at regional levels. These data are combined to form regional and national summaries.

There is a core list of approximately 50 particular chemical species that are targeted by the reporting programme. Individual facilities are required to report specific chemical species that are determined to be of interest at the facility. The list of targeted chemicals for each facility is defined in the permit.

The Netherlands has developed an extensive series of documents on estimation methods, primarily on estimation methods for diffuse sources. Just recently a guidance document that describes methods used for mainly non-industrial diffuse sources was developed. Work is also proceeding on a separate guidance document for small and medium-sized enterprises. This work, which represents primarily extrapolation of information gathered from the large companies, was considered to be useful as a first step. It was stressed that a significant amount of fine-tuning is needed to develop accurate methods for specific applications and for individual countries.

ANNEX 9: NORWAY

Point of Contact:	Lars Petter Bingh
	Øyvind Hetland
Address:	Climate and Pollution Agency PO Box 8100 Dep. 0032 Oslo, Norway
Telephone:	47 22 57 34 00
Fax:	47 22 67 67 06
E-mail:	lpb@klif.no
	oyh@klif.no

Guidance Documents:

1. Environmental Related Standards Prepared by the Norwegian Standard Association (ISBN: 82 457 00363)

Summary of the Survey Response

The Climate and Pollution Agency administers the PRTR system. The PRTR-system includes an electronic reporting system, two databases where data is stored and a national PRTR-website. Norwegian PRTR-data is also reported to the European PRTR website, E-PRTR.

Reporting system

The reporting system is depending on the various sectors included in the PRTR-system. The industry has been the core of the PRTR-system, where data has been collected since 1992. In general, the reporting system is not designed with a set of thresholds for either specific pollutants or production capacities. The facilities have to report all pollutants that represent a significant risk of being a threat to the environment when emitted from the facility. The Climate and Pollution Agency prepares guidance material for the facilities to enable them to assess the issue properly. Some land-based polluting activities are not defined as industry. They are for instance landfills, waste-water treatment plants and aqua-culture facilities, and have separate reporting systems.

Experts at the Climate and Pollution Agency monitor and check the data reported from the facilities. Once all errors have been corrected and the data have been found to be of sufficient quality, the data are transferred to an internal database. The validation is to make sure that the reported data is in compliance with the permit, and to ensure that all pollutants are included in the reports and that the numbers are correct. The electronic reporting scheme has some automatic validations to improve the data quality from the facilities.

The annual reporting takes place in February, and the reports have to be sent to the Climate and Pollution Agency or the County Governors by March 1st every year. Normally the data for the industry sector is published the following summer. Both industry, landfills and offshore petroleum industry follow this schedule.

Release estimation techniques applied for point sources

Any industrial facility whose activities result in releases to the environment is required to obtain a discharge permit under the Norwegian Pollution Control Act. All facilities required to obtain discharge permits must report releases to the Climate and Pollution Agency.

One important obligation in the permit is for all facilities to have a monitoring programme. The monitoring programme shall include all substances the facility need to report. For each substance the programme must include all measurements devices included in the measurements, how calculations are done, what standards applied and uncertainties. The description of our expectations to the monitoring programme is important to understand how RET is applied for point sources in Norway. The expectations to the monitoring programme are described in the following. The text is available as guidance to the facilities. For more complex facilities, we expect them to apply the Guidance to Uncertainties of Measurements (GUM) to undertake the calculations of uncertainties.

Requirements and expectations for the monitoring program

All facilities should have a monitoring program in relation to the requirements of the authorities have set in the permit.

The measurement program shall include: all substances that are specifically regulated by limits in the permit or regulations, other substances that are reporting entities. This is described further in the Climate and Pollution Agency's Guidance to the facilities' PRTR-reporting. The guide is posted on www.klif.no .

The measurement program must describe and justify: the sampling frequency to ensure representative samples of the various steps for measurements:

1. methods of flow measurement

2. sampling

3. analysis

4. calculation and reporting of emissions

The pollution authorities expect that the measurement program:

- is based on a thorough assessment of all emissions and variations in emissions (for example, by different operating conditions,
- abnormal operating conditions, when plants are in operation and when the production volume or raw materials changes)
- has a scale that ensures that the results reflect the actual emissions
- describes the methods used for sampling
- describes the rate of participation in ring tests and action limits of deviation from true values
- describe the frequency of third party inspection indicates which laboratories facilities use when emission measurements carried out by external actors
- describes the calculation and reporting of the results of emission measurements are included in the company's internal control system
- describes how the measurement and calculation program be established, and who has the responsibility to prepare and to implement it.

Representative samples

Facilities have to choose sampling frequency to ensure that the standard deviation is sufficiently low so that the samples are representative. This shall be based on knowledge about variations in the processes and emissions. Therefore, it may be necessary to perform a higher number of measurements for a period, in order to determine the frequency.

Calculation of uncertainty

Facilities should consider the uncertainty contributions of the different steps in the calculations or measurements, the importance of these contributions and to what extent they may differ from the actual emissions. Next, facilities must consider the need for changes in the measurements og calcualtions to reduce uncertainty. Such an assessment must include the discharge impact on the environment, as well as whether reductions are possible and costs associated by reducing the uncertainty further.

Each company must determine if they have sufficient expertise to estimate the uncertainties and the need for changes in the measurements, or if they need external assistance from consultants.

1. Volume

The measurement program should include information about:

- measurements of volume flows like water quantities or gas streams. These must be conducted in a place and in accordance with recognized standards or recommendations from the suppliers of measurement equipment. Any errors in the results due to incorrect measurement should be determined.

- the uncertainties listed for the instruments they use and whether the instruments chosen are sufficiently accurate to indicate the measured volume of procedures for calibration, maintenance and cleaning, and how the results changed by deviations from the procedures

- Ensure that the flow measuring devices are placed at the right spot to be able to deliver a representative measurement in accordance with the standard. Any errors in the results due to incorrect measurements should be determined.

2. Samples

Facilities should define and describe, among other things:

- what standards they use, any given uncertainty for the methods they use and evaluate whether the methods selected, provide sufficient accuracy

- the spot where the equipment for sampling are located to achieve representative sampling

- volume of the samples. It is important to ensure sufficient sample material so that it is possible to calculate emissions. This is most important if concentrations are close to the detection limit.

- duration of the measurement periods to ensure representative samples

- how samples are handled until they are analysed

- how any deviation from the standards affect the results calculate the uncertainty contribution from sampling

3. Analyses

When an external laboratory is conducting the analyses, the facilities shall use the stated uncertainty of the laboratory.

4. Calculation of emissions

In the measurement program, the facilities shall describe briefly the methods used to calculate emissions associated with both emission limits and the total annual emissions. Only days of operation are to be included in the calculation of mean values. If there are significant emissions taking place at days without operation, such days are to be included when the mean calculated.

Unless otherwise specified in the permit, the enterprise shall calculate the emissions per unit produced (specific discharge) compared to net production (production approved for sale).

Execution of measurements

Firms shall use laboratories / services that are accredited for the service, if it is carried out by external services.

Measuring equipment used in emission measurements must be checked, calibrated and maintained regularly in accordance with standards or specifications from equipment suppliers. Facilities must be able to document procedures for inspection and calibration with the calibration and maintenance history of the measuring equipment.

It is important that proper selection of sample bottles, preservation, storage and processing of samples before analysis. Errors in any of this can easily destroy the samples and give wrong results.

If the continuous measuring instruments are out of service due to failure or maintenance, the authorities expect that the facilities have alternative methods for determining emissions during this period.

The company shall review and ensure the quality of all the results from emission measurements - even if there are consultants who carry out the measurements.

Release estimation techniques applied for diffuse sources

Diffuse sources are determined as part of the Norwegian emission inventory. The emissions estimated for the diffuse sources are calculated by multiplying the activity data figures with the emission factors.

For instance for transports: Activity data relevant for the transport sector can be annual fuel consumption for private cars.

Emission factors are established by researching the kinds and amounts of pollutants from combustion of fuels in a car engine. This is combined with information about the composition of the vehicle fleet in Norway. Then a representative amount of emissions from the vehicle fleet can be calculated for a specific year by combining emission factors and activity data.

The Emission Inventory is compiled and maintained by the Climate and Pollution Agency together with Statistics Norway. The Climate and Pollution Agency is responsible for developing emission factors

and for collecting information from point sources. Statistics Norway is responsible for drawing up data models to model the emissions and to collect activity data. Statistics Norway also does the final calculations by applying the data model.

The data for the transport sector is published about one year after the collection of the data. Emissions that occurred in 2010 will be published at the beginning of 2012.

Methods are described in the Norwegian emission inventory, documentation reports available under the heading publications and articles.

http://www.ssb.no/english/subjects/01/04/10/

ANNEX 10: SPAIN

Point of Contact:	Iñigo de Vicente-Mingarro
Address:	PRTR-España, Spanish Register of Emissions and Pollutant Sources
	Ministry of Agriculture, Food and Environmental Affairs of Spain
Telephone:	+34 7499121
Fax:	+34 7499140
E-mail:	info@prtr-es.es

General guidance documents/tools:
www.en.prtr-es.es/fondo-documental/documentos-prtr,15499,10,2007.html

Industry/process specific guidance documents/tools:
www.en.prtr-es.es/fondo-documental/documentos-de-mejores-tecnicas-disponibles,15498,10,2007.html .
www.en.prtr-es.es/fondo-documental/metodos-de-medicion-y-calculo,15500,10,2007.html

Chemical specific guidance documents/tools:
www.en.prtr-es.es/fondo-documental/metodos-de-medicion-y-calculo,15500,10,2007.html

Other related documents/tools:
www.en.prtr-es.es/fondo-documental/legislacion,15453,10,2007.html .
www.en.prtr-es.es/fondo-documental/manuales-prtr-y-otros-documentos,15501,10,2007.html

Besides the indicated links, the EMEP/EEA air pollutant emission inventory guidebook, is used in many cases as a guidance to estimate emissions to air. Other methodologies/standards from, such as EPA and/or other International Conventions (IPCC, OSPAR, etc.) are also used to estimate/calculate emission data.

ANNEX 11: SWEDEN

Point of Contact:	Dr. Niklas Ricklund
Address:	Swedish Environmental Protection Agency
	106 48 Stockholm
	Sweden
Telephone:	Exchange: +46 10 698 10 00
	Direct: +46 10 698 10 56
Fax:	
E-mail:	niklas.ricklund@swedishepa.se

General guidance documents/tools:

General information from the Swedish EPA (in English): www.swedishepa.se/In-English/Start/State-of-the-environment/Emission-data/Hazardous-substances/

Industry/process specific guidance documents/tools:

Swedish portal for environmental reports (in Swedish): https://smp2.naturvardsverket.se/Default.aspx - Contains supportive information and links to guidance documents on Swedish regulation regarding reporting of emissions.

Chemical specific guidance documents/tools:

Other related documents/tools:

ANNEX 12: SWITZERLAND

Point of Contact:	Hans Peter Saxer
Address:	Swiss Agency for the Environment, Forests and Landscape CH-3003 Bern Switzerland
Telephone:	+41 31 32 293 84
Fax:	+41 31 32 479 78
E-mail:	hanspeter.saxer@buwal.admin.ch

Guidance Documents: No guidance documents were identified

Summary of the Survey Response

The Swiss government carried out a pre-pilot PRTR project between 1995 and 1996. Information was gathered from 5 chemical companies that included a total of 17 facilities. The objective of the project was to obtain experience that would be used later to define the features of the comprehensive programme. It was not the objective of the pre-pilot project to harmonise the estimation methods used by the companies, or to develop a single method.

Five solvents were selected for reporting in the pre-pilot project, based upon the large volumes in which they are produced and used. These included:

Acetonitrile
Bisphenol-A
Dichloromethane
Chlorobenzene
Pyridine

According to the Swiss PRTR survey response, the chemical companies that were involved in the PRTR pre-pilot project fell into three categories: fertiliser fabrication, fabrication of pharmaceuticals and pesticides, and other manufacture of finished chemicals.

The release estimation techniques, which were developed by the five chemical companies used in the pre-pilot project, were not documented, and are therefore not available. The Swiss government did indicate that the predominant release estimation techniques were: mass balance, non-statistical surveys, periodic monitoring and engineering judgement. The Swiss pilot project was extended in 1999. No further information on the implementation of a national PRTR in Switzerland was provided in the survey. Currently, a new pilot project is underway with results expected in 2002.

ANNEX 13: UNITED KINGDOM

Point of Contact: Nicholas Obe
Address: Defra
5F
Industrial Pollution
Ergon House
Horseferry Road
Telephone: +44 207 238 5304
Fax:
E-mail: Nicholas.obe@defra.gsi.gov.uk

Guidance Documents:

Regulators in the UK have various guidance documents which are publicly available. These are too numerous to mention here so links are provided instead. Also, for details of estimation techniques for diffuse sources to air, links are provided:

In England and Wales:

- General reporting guidance can be found at: www.environment-agency.gov.uk/business/topics/pollution/101829.aspx . The sites holds information on how to report releases and transfers for sectors covered by the E-PRTR Regulation and the Pollution Inventory.
- Sector guidance notes including combustion, food and drink, cement and lime, chemicals etc, can be found at : www.environment-agency.gov.uk/business/topics/pollution/32290.aspx .

In Scotland:

- General operator guidance: www.sepa.org.uk/air/process_industry_regulation/pollutant_release_inventory/operator_guidance.aspx
- Methodologies: www.sepa.org.uk/air/process_industry_regulation/pollutant_release_inventory/methods_and_methodologies.aspx

In Northern Ireland:

- www.doeni.gov.uk/niea/ni_prtr_guidance_notes_2.pdf

In addition, for diffuse sources to air, the UK's National Atmospheric Emissions Inventory (NAEI) holds a wealth of data on techniques, methods, etc:

- NAEI: http://naei.defra.gov.uk/ . From the link, it is possible to access a variety of information at the site.

UK PRTR website can be accessed at: http://prtr.defra.gov.uk/

Summary

In the UK, the competent authorities are the environmental regulators: in England and Wales, the Environment Agency is the responsible for what are considered to be the larger, or potentially more polluting, installations. Defra and the Welsh Assembly Government, via a local authority direction (to approximately 400 LAs in England and Wales), collect information from the comparatively and potentially less polluting installations. In Scotland, the Scottish Environment Protection Agency (SEPA) is responsible for all installations. In Northern Ireland, the Department of Environment (NIEA) is the competent authority. The off-shore sector reports to the Department for Energy and Climate Change (DECC).

The UK PRTR website holds information for over 4500 sites for each year since 2007. 91 pollutants are covered as well as data on waste transfer within and out of the country. Sectors covered can be found in Annex I of the EU E-PRTR Regulation. Thresholds apply for the majority of the sectors as well as pollutants. Under the EU Regulation, it is the responsibility of the operator to compile the information and send it to the appropriate regulator annually at a date prescribed in a legal notice. All of the information is collected electronically and over 90 percent is collected using a website report portal. While the operators have a responsibility to ensure the information submitted is credible, complete and consistent, regulators also carry out quality assurance steps.

Although the UK PRTR is the main inventory of releases and waste transfers, some regulators have their own inventories which, sin some instances, go beyond the UK PRTR and have different thresholds. For example, the Environment Agency (EA) in England and Wales has also runs the Pollution Inventory while SEPA (in Scotland) runs the Scottish Pollution Release Inventory. Nothern Ireland has a similar inventory to the EA.

ANNEX 14: UNITED STATES

Point of Contact:	Stephen C. DeVito
Address:	TRI Program (Mail Code 2844T) U.S. Environmental Protection Agency 1200 Pennsylvania Ave., NW Washington, DC 20460
Telephone:	+1 202 566-0755
Fax:	
E-mail:	devito.steve@epa.gov

Guidance Documents:

1. Section 313 Emergency Planning And Community Right-To-Know Act, Guidance for Chemical Distribution Facilities (Version 1.0) USEPA TRI Form R Guidance Document, 1997;

2. Look-up Tables for Estimating Toxic Release Inventory Air Emissions from Chemical Distribution Facilities (March, 1999).

3. RCRA, Superfund & EPCRA Hotline Training Module, Introduction to Toxic Release Inventory: Estimating Releases (EPCRA 313;40 CFR Part 372), USEPA Solid Waste and Emergency Response (5305W) EPA745-B97-004 (Updated June 1997)

4. US Chemical Manufacturing Association, Improving Air Quality: Guidance for Estimating Fugitive Emissions from Equipment. CMA Order# 018026 (1988)

5. American Petroleum Institute, various publications including:

- Evaporation Loss from External Floating Roof Tanks, Technical Bulletin 2517 (1989)
- Evaporation Loss from Fixed Roof Tanks, Technical Bulletin 2518 (1991)
- Evaporation Loss from Internal Floating Roof Tanks, Technical Bulletin 2519 (1990)

6. The US EPA provides several resources that are useful in estimating releases to air and water including:

AP-42 and its Supplements; Compilation of Air Emission Factors
Factor Information Retrieval System (FIRE); electronic listing of air emission factors, including factors that are not part of AP-42
Fugitive Dust Emissions; Guidance on estimating fugitive dust emissions
LANDFILL Model; Estimation model for air emissions from landfills
TANKS3.2; Estimation model for breathing and working losses from organic liquids storage tanks
WATER8 & CHEMDAT8; Estimation model for air emissions from wastewater collection and treatment systems
CHEM9; Predictive system to calculate chemical properties for over 1000 individual chemicals

7. EPA documents on the sources of particular toxic chemicals and information on how to estimate releases of air pollutants from the main sources of those pollutants. These documents are called locating and estimating documents and cover the pollutants listed below:

arsenic	benzene
1,3 butadiene	cadmium
carbon tetrachloride	chlorobenzenes
chloroform	chromium
cyanide	dioxins/furans
epichlorohydrine	ethylene dichloride
ethylene oxide	formaldehyde
lead	mercury
methyl chloroform	methyl ethyl ketone
methylene chloride	nickel
perchloroethylene	trichloroethylene
phosgene	polycyclic organic materials
styrene	toluene
vinylidene chloride	xylenes

8. Various documents detailing issues and concerns for estimating water releases from point sources

9. The following special guidance manuals are available for assistance in pre-manufacture notice provisions of the US EPA TRI programme:

[Newspaper Printing]
[Manufacture and Use of Paper Dyes]
[Waterborne Wood Preservatives using Pressure Treatment]
[Spray Coating Furniture]
[Fabric Finishing]
[Surfactants in Industrial/Commercial Laundries]
[Manufacture and Use of Fragrances]
[Manufacture and Use of Printing Inks]
[Formulation of Latex/Emulsion Coatings]
[Transformer Manufacturing]
[Application of Chemicals in Enhanced Oil Recovery]
[Application of Chemicals in Well Casing and Cementing]
[Auto Spray Coating]
[Printed Circuit Card Assembly using Conformal Coatings]
[Manufacture of Printed Circuit Boards]
[Film Deposition in Integrated Circuit Fabrication]
[Wet Cleaning Processes in Integrated Circuit Fabrication]

Summary of the Survey Responses

The United States Environmental Protection Agency (US EPA) has overseen a release reporting system since 1990. This programme is known as the US Toxic Release Inventory (TRI) database. The programme started with requirements for all industries in the manufacturing and chemical sectors to report all releases of a set of listed chemicals. Facilities were required to report on an annual basis their releases to air, water and land if they used more than 5 short tonnes (4,545 kilograms) of any one of the listed chemicals, or 12.5 short tonnes (11,364 kilograms) of any listed chemicals in a year. Over the years, the

programme has been expanded to include additional source categories and currently it includes all of the categories listed in the survey with the exception of agricultural activities and fossil fuel extraction processes. The list of chemicals that must be reported has grown to approximately 640 specific chemicals and chemical classes.

Release estimates are to be reported annually and the estimates represent releases for a one-year period and a one-day period. Estimates are prepared for point sources only and represent the facility level. Industries can use any form of activity data available to them to complete their report.

The TRI programme does not identify or recommend specific estimation methods. The only mandate in the programme is that the affected facilities must report their releases on an annual basis. The data collected in the programme are made available to the public. Each facility is given complete flexibility in choosing a method to use, and all reasonably documented methods are allowed. A check in the table signifies methods that have been discussed in guidance manuals, and the survey has indicated that these are the most common methods applied for that source category. The code *ma* is used to signify *method allowed* to indicate that any of the potential estimation methods is allowed in the TRI system.

The US EPA's TRI programme makes available a large amount of industry specific or chemical specific guidance manuals and assistance documents to help industries meet these reporting requirements. Many of these documents are listed below. These manuals can be obtained directly from the following website: www.epa.gov/tri/guide_docs/index.htm .

Industry Specific / Process Specific Guidance

- Electricity Generating Facilities (February 2000) (148 pp);

- Metal Mining Facilities (January 1999) (112 pp);

- Coal Mining Facilities (February 2000) (146 pp);

- Pressed Wood & Laminated Products Industry (August, 2001,164 pp);

- EPCRA Section 313 Industry Guidance: RCRA Subtitle C TSD Facilities and Solvent Recovery Facilities (January 1999) (134 pp);

- Food Processors (September 1998) (160 pp);

- Spray Application and Electro-deposition of Organic Coatings (December 1998) (173 pp),

- Tables for Estimating TRI Air Emissions from Chemicals Distribution Facilities. (78 pp)

- Rubber and Plastics Manufacturing (August 10, 2000) (208 pp);

- Printing, Publishing, and Packaging Industry (June 2000) (162 pp);

- Textile Processing Industry (June 2000) (165 pp);

- Leather Tanning and Finishing Industry (April 2000) (179 pp);

- Semiconductor Industry (July 1999) (187 pp);

- Petroleum Terminals and Bulk Storage Facilities (February 2000) (109 pp).

Chemical Specific Guidance

- Lead and Lead Compounds: Guidance for Reporting Releases and Other Waste Management Quantities of Toxic Chemicals: Lead and Lead Compounds (December 2001) (216 pp);

- Mercury and Mercury Compounds (August 2001) (49 pp);

- Polycyclic Aromatic Compounds (PACs) (August 2001) (40 pp)

- Pesticides and Other Persistent Bioaccumulative Toxic (PBT) Chemicals (August 2001) (33 pp);

- Aqueous Ammonia (December 2000) (17 pp),

- Nitrate Compounds (December 2000) (15 pp),

- Hydrochloric Acid Aerosols (December 1999) (31 pp);

- Sulfuric Acid Aerosols (March 3, 1998 Revision) (21 pp);

- Certain Glycol Ethers (December 2000) (209 pp);

- Chlorophenols (November 2005 update) (6 pp);

- Nicotine and salts (June 1999) (15 pp),

- Polychlorinated alkanes (June 1999) (14 pp)

- Strychnine and salts (June 1999) (18 pp),

- Warfarin and salts (June 1999) (6 pp),

- EBDC (Ethylenebisdithiocarbamic Acid, Salts and Esters Category and List of Mixtures that Contain the Individually listed Chemicals:

- Maneb, Metiram, Nabam, and Zineb) (September 2001) (43 pp).

- Guidance for Reporting Toxic Chemicals within the Dioxin and Dioxin-like Compounds Category (December, 2000) (78 pages).

The default emission factors in the guidance document were developed from three primary references:

- EPA's Database of Sources of Environmental Releases of Dioxin-Like Compounds in the U.S., EPA/600/P-98/002B, September, 2000.
- The Inventory of Sources of Dioxin in the U.S., (EPA/600/P-98/002Aa);
- Estimating Exposure to Dioxin-Like Compounds; Volume 2: Sources of Dioxin-Like Compounds in the U.S. (EPA/600-00/001, Draft Final, Sept, 2000 (23 pp).

ANNEX 15: SUMMARY OF INFORMATION FROM REPORTING INDUSTRIES THAT RESPONDED TO THE SURVEY

It is to be noted that this Annex may not be fully updated from the first edition of this document published in 2002. Before contacting an organisation, readers should check whether a change of information in this Annex is made.

Summary of Information Submitted by the Australian Aluminium Council:

Point of Contact:	Tony Puclin
Address:	Australian Aluminium Council
	PO Box 3761
	Manuka ACT 2602
Telephone:	+61 2 62957300
Fax:	+61 2 62957514
E-mail:	aac@aluminium.org.au

Guidance Documents:
Reference Manuals for Alumina Production and Aluminium Production

The Australian Aluminium Council stated that the aluminium industry has to report releases to the environment from activities associated with the production of alumina, and aluminium metallurgical processing activities. Each facility estimates its own emissions, and emissions estimates may be calculated at the unit process/operation level for some substances.

The survey indicates that the government agency Environment Australia has published "Emission Estimation Technique" manuals to assist with the reporting to the National Pollutant Inventory (NPI). The Australian government, in association with industry and private consultants, has developed these manuals. The survey also indicates that many of the methods are based upon United States EPA methods. The Australian guidance documents are listed in the summary description of the survey response provided by the Australian government.

To estimate releases from the aluminium metallurgy and the production of alumina, a wide array of estimation techniques can be used. The survey did not specifically state which ones should be used, but it did indicate that the accuracy of the estimation could vary substantially depending on the process and substance.

Over 90 substances are reportable to the NPI. The Australian Aluminium Council referred to the following chemicals in its survey:

- specific organic chemicals
- PM_{10}
- volatile organic compounds (VOC)
- NO_x
- polycyclic aromatic hydrocarbons (PAHs)

Reporting to the NPI is required on an annual basis, but the survey indicates that the programme has not been fully implemented yet. A threshold based on use or production of a substance triggers reporting to the NPI.

Summary of Information Submitted by BASF Germany:

Point of Contact:	Dr. Hansjoerg Siegle
Address:	BASF Aktiengesellschaft
	DUU/L Z 75
	D 67056 Ludwigshafen
Telephone:	+49 621 6049296
Fax:	+49 621 6049022
E-mail:	hansjoerg.seigle@basf-ag.de

Guidance Documents: Government Reports, including: Technical Instructions for Air (TA-Luft) and 11.BlmSchV

BASF Germany completed a survey providing information on release estimation methods that are applied to 29 individual source types within 5 major source sectors. The methods that BASF uses to estimate releases to air, water and land are based upon German DIN standards, and they are publicly available. BASF was not specific in identifying techniques used in estimating releases to air. It reported that multiple methods are used which are based upon the physical characteristics of the sources. For land and water releases, BASF reported that it used "analysis" as its primary approach for estimating releases. This response was interpreted to indicate that measurement based estimation methods are applied for water and land releases.

According to the BASF survey, the German government has developed a list of chemicals of concern based upon the estimated release magnitude. BASF is required to report individual chemicals that are present in the list, some of which are:

- heavy metals with strong impact on the environment
- ammonium
- cyanide
- AOX (no further explanation was provided)

The BASF survey indicated that facilities are required to report their releases on a yearly basis. In addition, if a landfilled chemical is subject to a new permitting condition (*i.e.* a new waste type) it will be subject to reporting.

The guidance documents that BASF uses to estimate its pollutant releases are publicly available. The documents mentioned in the survey include German Industry Standards and various technical instructions (ex. Technische Anleitung) for air, water and land releases. BASF has indicated that all guidance documents are publicly available on the Internet at: http://www.umwelt-online.de

Summary of Information submitted by the Japanese Chemical Industry Association:

It is to be noted that the following information shows JCIA's activities before the implementation of the PRTR system in Japan (2001).

Guidance Documents: JCIA PRTR Manual

The Japanese Chemical Industry Association (JCIA) reported releases from point sources to air, water and land for over 150 primary chemical manufacturing facilities. It is assumed that this reporting was included as part of the Japanese PRTR pilot project. The JCIA has developed its own PRTR guidance manual that provides documentation for the methods used to estimate releases. This manual has been made available, and the JCIA has indicated that it is willing to share the information it contains. The survey response from the Japanese government indicates that the documentation of selected methods is in Japanese. The JCIA survey did not indicate if their documentation was available in languages other than Japanese.

The JCIA survey showed that it uses periodic monitorings as its primary method for estimating releases from the primary chemical industry to all media. Release estimates are subsequently aggregated at the national level, and reporting occurs on a yearly basis.

As a requirement of the PRTR programme, a list of chemicals for which reporting is mandatory has been developed by industry. It is based upon environmental and health risks posed by individual pollutants, such as:

- carcinogens;
- chemicals that exhibit chronic toxicity; and
- chemicals that exhibit eco-toxicity.

The survey indicates that in some cases the amount of the chemicals produced may trigger reporting in the PRTR system.

Summary of Information Submitted by Merck and Company, Inc. (USA):

Point of Contact:
Address: WS2F-20
Merck and Company, Inc.
PO Box 100
Whitehouse Station
New Jersey 08889
Telephone: 908 423 6860
Fax: 908 735 1109
E-mail:

Guidance Documents:
Various EPA reference documents and internal methods developed by Merck facilities

Merck and Company submitted a survey for its operations in the US. The Merck survey indicates that it is primarily engaged in the production of pharmaceuticals, biocides, pesticides and herbicides. As the Merck facility is located in the United States, it is subject to reporting its releases to the U.S. EPA's Toxic Release Inventory (TRI). As such, it is required to estimate and report releases of the set of TRI chemicals to air, water and land.

Merck reports that it has a very complex manufacturing facility that has numerous emissions points. As the US TRI system allows for various release estimation techniques, Merck reports that each reporter has the freedom to choose the most appropriate method based on individual circumstances. This means that two similar sources, even at the same site, could have their emissions estimated by different techniques.

Each release estimation methodology used by Merck typically has some sort of basis document, such as EPA's 1978 *Reasonably Available Control Technology for the Pharmaceutical Industry Guidance* document. The reporter at each facility independently develops other methods, such as material balances. The documents developed by the U.S. EPA are publicly available to interested parties.

The U.S. EPA has published a list of chemicals for which reporting to the TRI is mandatory. Merck has indicated that it reports mostly individual chemicals, and that reporting for groups of chemicals (such as pesticides) is uncommon.

ANNEX 16: INTERNATIONAL RESOURCES

It is to be noted that this Annex may not be fully updated from the first edition of this document published in 2002. Before contacting an organisation, readers should check whether a change of information in this Annex is made.

European Environment Agency

Much of the relevant information described below is available on the following EEA web site (www.eea.eu.int/). EEA is responsible for the compilation of regular State of the Environment Reports for Europe which are increasingly being built around key indicators and follow the DPSIR causal chain: Driving Force = socio-economic activities; Pressures = emissions, waste generation, land use; State = *e.g.* concentrations in water, deposition; Impact on ecosystems, health; and Responses=policy actions.

The most recent reports were *Environment in the EU at the Turn of the Century* (www.eea.europa.eu/publications/92-9157-202-0) and the first Yearly Indicator Report (Environmental Signals 2000) (www.eea.europa.eu/publications/signals-2000) and the Transport and Environment indicator report. All these main EEA reports contain much information on air emissions, waste generation and emissions to water. The more detailed and most recent data are available in the EEA data warehouse that can be accessed through the web site as follows : www.eea.europa.eu/publications#c9=all&c14=&c12=&c7=en&c11=5&b_start=0

In particular there is much data available on emissions to air, under the headings:

- acidification
- tropospheric ozone
- climate change

The EEA funds European Topic Centres that perform specific tasks for the EEA and that work on many parts of the EEA work programme. Relevant for PRTRs are, in particular, ETC work on air emissions, inland water and (possibly) waste. One of the ETC's tasks is to assist countries to compile and report data to international organisations; another task is to maintain and make data and information accessible. The ETC's have their own web sites that can be accessed through EEA's web site:

www.eionet.europa.eu/

http://acm.eionet.europa.eu/

http://icm.eionet.europa.eu/

These web sites contain technical information sites on specific methodologies, software tools, workshops, *etc*, not contained in EEA's web. However, the most recent and up-to-date data are generally available through the EEA Data Service mentioned above.

Another very relevant EEA activity is co-operation with the UNECE Task Force on Emission Inventories and Projections (TFEIP). Over the past years, this Task Force, through expert panels on

transport, energy, agriculture, industry, and nature, produced a first edition of the joint *EMEP/CORINAIR Atmospheric Emission Inventory Guidebook* in 1996, and recently a second edition (November 1999, web publication www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep ; early 2000 printed publication). This Guidebook contains the most up-to-date, best available and scientifically sound information on methodologies to measure and/or estimate emissions to air. An annual workshop evaluates new information. The most recent workshop, organised jointly between UNECE/TFEIP and EEA/ETC-AE, took place in Rome in May 2000, and included 150 participants. Further updates of the Guidebook in the coming years will be prompted by new information on PM (PM2.5/PM10) and, possibly, on emissions to water.

For more information on TFEIP please contact the chairmen Mike Woodfield: mike.woodfield@aeat.co.uk

Furthermore, it is useful to mention the recently adopted European Commission Decision on a European Pollutant Emission Register (EPER) for large stationary emission sources, under the IPPC Directive (Integrated Pollution Prevention and Control). The EPER will be based on combining national emissions registers that will be implemented and report to the Commission for the first time in 2003, and then on a 3-year basis. The first Commission report will be available in 2004. EEA assists the Commission in the development of the EPER and is interested in dissemination of the final results on its web site.

EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook

This document provides a listing of emission factors and methodologies for air pollutants. Methods are available for the following categories:

Combustion in energy and transformation industries
Non-industrial combustion plants
Combustion in manufacturing industry
Production processes
Extraction and distribution of fossil fuels
Solvent and other product use
Road transport
Other mobile sources and machinery
Waste treatment and disposal
Agriculture and forestry
Nature

Documents on methods applicable to the source categories listed above are available at: www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep

Additional sections for the EMEP/CORINAIR Guidebook

Methods are available for the following categories:

Coke oven furnaces and coke oven (door leakage and extinction)
Sinter plants
Primary copper production
Secondary zinc production
Secondary aluminium production
Cement
Electric furnace steel plant
Oil and gas extraction, first treatment and loading
Gasoline distribution
Solvent use
Paint application
Metal degreasing
Preservation of wood
Underseal treatment of vehicles and vehicle dewaxing
Domestic solvent use
Road transport
Gasoline evaporation from cars
Shipping activities
Air traffic
Incineration of domestic or municipal wastes
Cremation

Cultures with fertilisers
Cultures without fertilisers
Manure management
Use of pesticides
Soils
Forests
Forest and other vegetation fires
Natural grasslands and other vegetation
Animals and humans
Volcanoes
Gas seeps
Lightning
Wetlands

CollectER Background

CollectER (Collect Emission Register) is a tool for national air emission experts to help them to update national emission inventories and to prepare appropriate emission data for international obligations. The programme CollectER includes the following main functions:

- it collects data, produced by air emission activities of area and point sources
- it stores these data in an emission inventory (bottom up as well top down) following the national territorial split; and
- it enables local reporting, as well as the transfer of national data for the central database of the European Topic Centre on Air Emissions.

A downloadable version of the CollectER programme can be found at:
http://acm.eionet.europa.eu/country_tools

ReportER Reporting Emissions Register

ReportER (Reporting Emission Register) is a software tool for national experts on air emissions. The current version of the ReportER software tool enables national experts to create a set of IPCC reports and UNECE/LRTAP reports based on the national emission inventory data stored in the CollectER annual inventory databases. The basic features implemented in version 1.1 of the ReportER software are:

- the IPCC report to automatically generate "overview" sheets of aggregate emissions divided into the IPCC sectors of economic activities; and
- calculation of aggregate emissions for UNECE/LRTAP reporting.

A downloadable version of the ReportER programme can be found at:
http://acm.eionet.europa.eu/country_tools

TrainER (Train Emission Register)

This document is a training tool with a sample database for national air emission experts to help them learn to use the new CORINAIR software tools. It:

- describes the basics of the system;
- gives an over all picture of the inventorying process as supported by the software;
- gives step by step guidance for inventory data collection using CollectER and ReportER for a virtual country called Middle Earth; and
- introduces a limited number of activities, demonstrates updating data, and adding new sources (emission factors are taken from existing (CollectER) inventories available at ETC/AE as of mid-April 1998).

A downloadable version of the TrainER programme can be found at:
http://acm.eionet.europa.eu/country_tools

Computer Programme to Calculate Emissions from Road Transport (COPERT)

COPERT is an Microsoft Windows* software programme designed to enable the user to calculate emissions from road traffic. Emissions from internal combustion engines used in off road applications are also covered. The emissions calculated include all major pollutants (CO, NO_x, VOC, PM) and several more (N_2O, NH_3, SO_2). In addition, fuel consumption results are computed. A detailed methodology can be found with the software application.

The development of COPERT was funded by the European Environment Agency (EEA), in the framework of the activities of the European Topic Centre on Air Emissions. It is used by the EU for the compilation of the CORINAIR emission inventories. In principle, COPERT methodology can be applied for the calculation of traffic emission estimates at a relatively high aggregation level, both temporally and spatially, *i.e.* on a yearly basis for NUTS 0. However, it has been shown that the methodology can also be used with a sufficient degree of certainty at a higher resolution, *i.e.* for the compilation of urban emission inventories with a spatial resolution of 1x1 km^2 and a temporal resolution of 1 hour.

The methodology developed is largely based on the work of a working group established to design COPERT; however, it draws its main principles from two ongoing European activities which both aim to harmonise emission factors and national methodologies developed over the last few years:

- the action COST 319 on the Estimation of Emissions from Transport; and
- MEET (Methodologies to Estimate Emissions from Transport), a European Commission (Directorate for Transport) sponsored project in the framework of the 4th Framework Programme in the area of Transport.

A downloadable version of the COPERT programme can be found at:
http://acm.eionet.europa.eu/country_tools

COST 319 Estimation of pollutant emissions from transport

Background documents and emission factors and calculation models for estimating air emissions from transport sources.

A downloadable version of the COST319 programme can be found at: http://cordis.europa.eu/cost-transport/src/cost-319.htm

Intergovernmental Panel on Climate Change (IPCC)

The IPCC maintains an Internet site at which guideline and methodology documents for emissions and sinks of green house gases can be retrieved.

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Good Practice Guidance for Land Use, Land-Use Change and Forestry
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

These can be accessed at: www.ipcc-nggip.iges.or.jp/public/index.html.

World Health Organisation

The World Health Organisation provides details on a wide range of chemicals. The information can be accessed via the Internet at: www.who.int/en

The WHO has produced a guidebook on estimation methods, *PRTR and Emission Estimation Models*, at: www2.unitar.org/cwm/publications/cbl/prtr/pdf/cat5/eemodels.pdf.