# ENVIRONMENTAL BENCHMARKING FOR IPC INDUSTRIES

## FINAL REPORT

Prepared for the Environmental Protection Agency
by
Clean Technology Centre, Cork Institute of Technology

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## ACKNOWLEDGEMENTS

This report has been prepared as part of the Environmental Research Technological Development and Innovation Programme under the Productive Sector Operational Programme 2000-2006. The programme is financed by the Irish Government under the National Development Plan. It is administered on behalf of the Department of the Environment and Local Government by the Environmental Protection Agency which has the statutory function of co-ordinating and promoting environmental research.

## DISCLAIMER



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Published by the Environmental Protection Agency, Ireland

PRINTED ON RECYCLED PAPER

ISBN:1-84095- to come 06/01/300
Price: IR£5/E6.35

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# Executive Summary

This project had the goal of developing the specification for a software tool that could facilitate a process of benchmarking and internal development of an environmental management system among licensees, in addition to assisting electronic reporting, taking into account the needs of companies and the EPA, the scope for performance indicators and the reporting obligations.

A detailed examination of reporting requirements was conducted. International literature on the use of environmental indicators and benchmarking was examined, along with existing software for environmental management systems. A response rate of 35% was achieved with a comprehensive survey of IPC licensed companies to determine current practice and attitudes.

There is merit in developing software to facilitate the mandatory reporting of data. This should be based on the model of a site tool for preparation of data to be subsequently uploaded to the EPA central system. The software should be relatively simple, to encourage rapid acceptance by licensees. Along with templates for environmental records and reporting an environmental management programme (EMP), there should be a scheduling tool and report generator. There is no benefit in developing extensive environmental management system support software. There are numerous commercial products available, yet the majority of licensees have installed or are maintaining a system without recourse to such software. A detailed specification is provided. The cost of developing a prototype site-tool, from scratch, is estimated at 3115 hours, equivalent to €185,000, assuming certain software and hardware pre-conditions at the test site. Adaptation of an existing commercial system is likely to be less expensive and involve less risk. A more detailed estimate and specification of the software could be achieved at a cost of approximately €20,000.

While the vast majority of licensees use environmental indicators, the average number of indicators used is 6, and these are generally the result of specification in the IPC licence. The existing level of indicator use and benchmarking practice is relatively modest among licensees. A few generic Operational Performance Indicators should be used across IPC industries: global warming contribution, contribution to ozone depletion, contribution to acidification, non-renewable primary energy input, total water use and total waste disposal. In view of the existing level of indicator usage, these should be introduced on a site-wide basis rather than by process or product, though process or product-specific values are more useful for management. Licensees should be encouraged to combine these with economic values to derive eco-efficiencies. A small number of generic Management Performance Indicators should be used: number of complaints on a particular aspect, percentage compliance with licence, percentage of preventive projects in the EMP, number of EMP targets achieved. If the use of indicators becomes more popular, and licensees demonstrate a willingness to share performance data, consideration should be given to introducing a benchmarking system based on experience with quality systems, e.g. a variant on New Mexico's Baldridge-based "Green Zia" categorisation system.

# 1 Introduction

The introduction of Integrated Pollution Control Licensing (IPCL) of industry has resulted in the generation of significant amounts of environmentally related data within companies. Much of this must be publicly reported to the EPA where it may be used for compliance monitoring. The data also provides an opportunity for companies to identify and quantify their significant environmental aspects, thereby contributing to better management. This improved management can bring environmental and economic benefits. A potential use of the data is to assess performance trends internally within the company, and to allow the sharing of key performance indicators between companies. Both of these activities facilitate continuous improvement through a process of benchmarking.

A software tool could facilitate this process of benchmarking and internal development of an environmental management system. This project consists of two parts:

Part I - the development of a specification for such a software tool, taking into account the needs of companies and the EPA, the scope for performance indicators and the reporting obligations.

Part II - the development and testing of the software.

This project has three main areas of study:

1. Effective and efficient reporting of mandatory, non-confidential data;
2. Examination of the potential for benchmarking;
3. Assessment of the usefulness of environmental management system support software.

## 1.1 Objectives of Part 1

The objectives of Part 1 of the project relate to the preparation of a specification for a software support tool which will address the following objectives:

(a) Support the production of mandatory IPC reports of both numerical and textual data in a defined format.

(b) Using defined benchmark criteria:

(i) provide internal (company-specific) performance measures in absolute and relative terms;

(ii) provide relative indicators of performance in combination with publicly reported data from other companies;

(iii) provide enhanced and extended benchmark ranking values in the event of data in excess of statutory reporting requirements being shared on a confidential or non-confidential basis;

(iv) contribute or participate in any international sharing of performance measures and best practice.

These criteria may be general to IPC companies or specific to a sector or sectors. Provision may also be made for the company to define its own indicators. This will allow prioritisation of areas within companies, the subsequent setting of objectives and targets and the formulation of programmes as part of environmental management systems.

(c) Support the implementation and maintenance of an environmental management system through the provision of document templates and task utilities.

### 1.2 Project Team

Part 1 of the project has been undertaken by the Clean Technology Centre, with the assistance of EMISoft A/S (Norway) and Valor & Tinge (Denmark). EMISoft provided support in relation to the software, and Valor & Tinge provided support in relation to the international applicability of environmental performance indicators.

### 1.3 Methodology

Detailed reviews of published literature and current Irish industrial practice have been undertaken to assess the potential and desired scope for such a tool. Particular consideration has been given to the international development of environmental performance indicators, e.g. ISO 14031/2 and corporate environmental reporting initiatives, e.g. WBCSD, GRI and their relevance to benchmarking sectors and companies licensed in Ireland. Published literature was reviewed after searches of the learned journals via database hosts, internet searches and existing CTC library material, supplemented by targeted enquiries to associates of CTC participating in relevant networks and projects. A survey of IPC licensees was carried out to establish a baseline on use of indicators, benchmarking, EMS and electronic reporting. Available environmental management software was identified and its applicability examined. Existing IPC licences, EMP reports, existing emissions self-monitoring reporting requirements, EPA monitoring regimes and the EPA Annual Environmental Report (AER) Guidelines were examined to develop a specification of EPA needs and wants. Recommendations were made on reporting to the EPA including software specifications to facilitate electronic data handling and report generation. The report ends with a summary of conclusions and recommendations.

## 1.4 Report Structure

The contents of this report have been structured as follows:

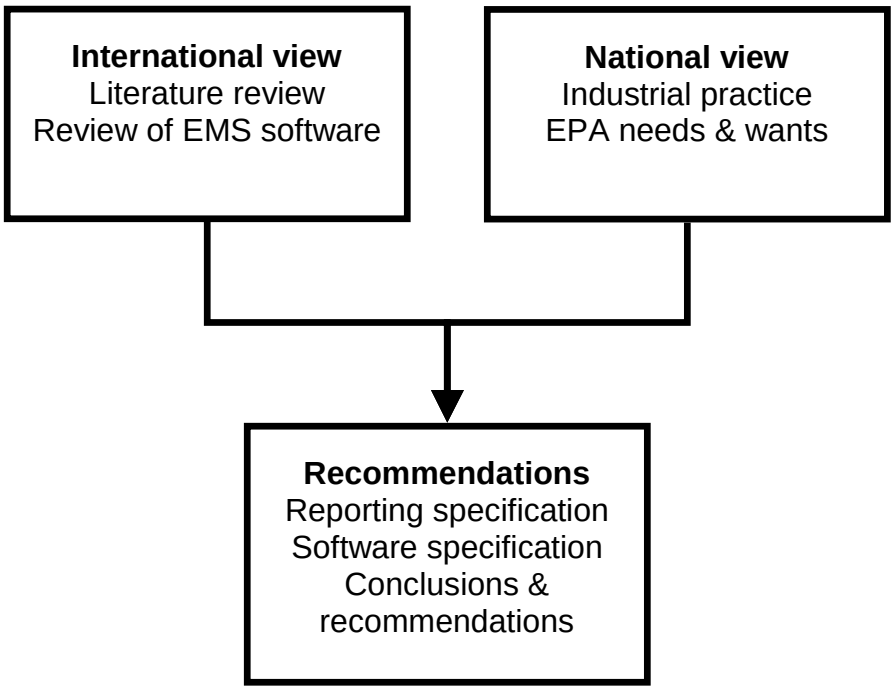



**Figure 1.1: Structure of Report**

# 2 Review of International Practice

## 2.1 Literature Review

The objective was to review existing and emerging international practice on environmental performance indicators and environmental benchmarking methodologies as well as related initiatives, projects, and programmes.

The literature review was achieved by conventional searches of learned journals via database hosts, Internet searches and existing CTC library material, but supplemented by targeted enquiries to associates of CTC participating in relevant networks and projects. During the search, phrases generally addressing the topic such as *environmental benchmarking, environmental performance indicators, sustainability*… were utilised and in later stages specific keywords for refining the search on particular guides, programs, etc such as *Green Zia* have been used.

### *2.1.1 Scope of literature examination*

The result of the literature collection is a conglomerate of articles, conference papers, books, dissertations, and reports whose content can be allocated to one or several of the following categories:

I. Benchmarking
II. Performance Measurement/Evaluation
III. Indicators/Metrics
IV. Reporting

Each of these categories can be related to the aspects

- Society
- Economy
- Environment

that are also known as the three dimensions of sustainable development (*Hart,1999)*. For example, literature concerning eco-efficiency indicators fall in *Category III* and can be linked to both *environment* and *economy* because the concept of these indicators reflects environmental and financial performance.

Additionally the scope of these three aspects is a further criterion for categorising the literature, which determines the system boundary of influence as follows:

- Global
- Regional
- Local
- Corporate

Both the three dimensions of sustainable development and the criteria of influence are applicable to all main categories.

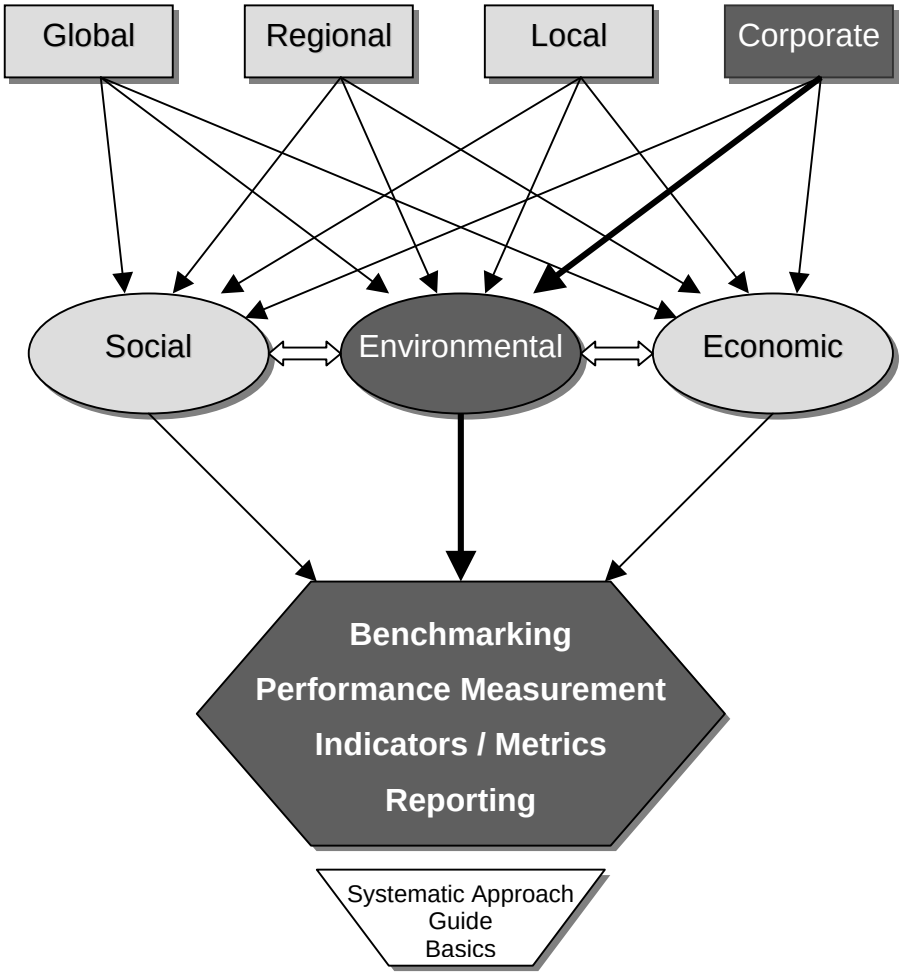



**Figure 2.1: Scope of literature**

As can be seen in Figure 2.1 there are numerous links showing the wide range of possible literature in this field. The dark grey marked items emphasises the literature of interest but a part of the project related literature also includes other areas shown in Figure 2.1.

The following pages discuss the applicability of the literature to the project's topic "environmental benchmarking in Ireland's IPC licensed industries" i.e. literature emphasising corporate environmental issues, with inter and intra sectoral scope.

### *2.1.2 Background*

Since the project is focused on Environmental benchmarking we should first ask: "What is Benchmarking?". The literature answers this question by means of a number of definitions (*Andersen et al., 1996; Camp, 1989; Zairi, 1998; Ahmad et al. 1999; and Bogan et al., 1994)* differentiating between types and processes of benchmarking.

According to the American Productivity & Quality Center (*APQC)*, *"Benchmarking is the practice of being humble enough to admit that someone else is better at something and wise enough to try to learn how to match, and even surpass, them at*

*it"*. A more technical definition from The Benchmarking Network™ says, *"Benchmarking is a performance measurement tool used in conjunction with improvement initiatives to measure comparative operating performance and identify Best Practice"*.

In the 1990's three distinctive types of benchmarking developed, namely (*Bogan et al., 1994)*:

- Process benchmarking: focuses on discrete work processes and work systems.
- Performance benchmarking: concentrates on aspects of technical quality, price, speed, and reliability.
- Strategic benchmarking: generally looks across different industrial or business sectors to determine the successful strategies that have elevated companies to the top.

The general process of benchmarking described in literature is a four-phased approach (*APQC; DOE, 1996)*:

1. *Planning*: during this phase the specific study focus area, key measures, and definitions are established and documented.
2. *Data Collection*: this phase has the objective of collecting qualitative data and learning from the best.
3. *Analysis*: analysing trends and identifying practices that enable and hinder superior performance.
4. *Action/Adaptation*: Adaptation and improvement resulting from the best practices identified.

Spendolini *(Spendolini, 1992)* expresses these steps focused on an organisation using performance indicators as follows:

1. Decide performance indicators that measure how well an organisation performs in an area.
2. Find out who is the best in this area.
3. Find out how good they are and analyse why.
4. Try to achieve their value of the performance indicators.

Other benchmarking methodologies may differ but 'the number and names of steps are not as important as the use of an integrated, systematic approach to benchmarking' (*APQC*).

The above-mentioned definition *"Benchmarking is a performance measurement tool used in conjunction with improvement initiatives to measure comparative operating performance and identify Best Practice"* contains some significant expressions that leads to further discussion and definitions. From this benchmarking definition the following questions arise regarding the environment:

- What is environmental performance?
- How can environmental performance be measured?
- What kinds of performance are comparable against each other?
- How can one build performance into a company's Environmental Management System (EMS)?

### *2.1.3 What is environmental performance?*

An answer to this question can be found in the draft version of ISO 14031 (*ISO, 1998)*, providing guidance on the design and use of environmental performance evaluation within an organisation: *"Environmental performance: results of an organisation's management of its environmental aspects"*, an additional note says: *"In the context of environmental management systems, results may be measured against the organisation's environmental policy, objectives and targets".* To supplement, ISO 14031 defines environmental aspect as an *"element of an organisation's activities, products or services that can interact with the environment"*.

Ellipson (*Mueller et al., 2001)* defines Environmental performance as "the impact of the company caused by its activities during a specific period measured in physical or synthetic units".

### *2.1.4 How can environmental performance be measured?*

A generally applied method is the use of indicators reflecting environmental performance which measure and monitor environmental aspects.

Because of the multi-dimensional nature of environmental performance various indicator concepts and frameworks have been developed depending on the authors' field of interest. The result is a jumble of indicator jargon that mixes similar terms with different, even contradictory, interpretations.

To help to understand the multi-dimensionality of environmental issues and current indicator concepts and frameworks the following indicator classification items are described below:

*a) Reflected issues*

*b) Quantitative – Qualitative*

*c) Macro level – Micro level*

d) *Generic – Specific*

*Reflected issues*

Indicators can be grouped according to broad areas of influence categories, and subsequently by the type of information related to specific categories – aspects. This categorisation system is applied to indicator frameworks to get a comparable picture of proposed indicators.

The International Organisation of Standardisation (*ISO, 1998)* developed three categories of indicator, one for making operational decisions, a second for assessing the condition of the local, regional, national, or global environment, and the third for making management decisions. These three categories of Operational Performance Indicators (OPIs), Environmental Condition Indicators (ECIs), and Management Performance Indicators (MPIs) can be seen as a pressure-state-response model of

business's impact on the environment – 'the *operations* of business impose *pressure* on the environment, which affect its *state* or *condition*, leading to a *response* through action by *management* to address the problem' (*Bennett et al., 1998*). For each category several subcategories of aspects with a number of example indicators are defined. (see Table 2.1)

The indicator framework presented by Bennett and James (*Bennett et al., 1998*) is in broad conformance with ISO 14031 except they introduce three new subcategories of ECI (receptor, sustainability, and proxy/risk indicators) and extend the MPI subcategory of community relations into a broader category of stakeholder indicators.

A framework of environmental indicators that can be used to communicate companies' environmental performance in EMAS Environmental Statements has been established by Marsanich *(Marsanich, 1998)* based on an analysis of a sample of 62 certified EMAS Environmental Statements. This framework proposes five categories of indicator, Environmental Management Indicators (EMIs) evaluating the effectiveness of the environmental management system, Environmental Absolute Indicators (EAIs) providing absolute information on the extent of the company's impact factors, Environmental Performance Indicators (EPIs) measuring environmental performance regardless of the fluctuations of the company's activity level, Potential Effect Indicators (PEIs) evaluating effects that company's activity could have on environment, and Environmental Effect Indicators (EEIs) similar to ISO 14031 condition indicators. (see Table 2.2)

Four categories of environmental performance indicators—materials use, energy consumption, non-product output, and pollutant releases—are recommended by the World Resources Institute (WRI) (*Ditz et al., 1997)* to help companies, regulators, communities, and others reach beyond the traditional focus on compliance, turning the spotlight instead on resource efficiency, pollution prevention, and product stewardship. (see Table 2.4)

A detailed framework of qualitative and quantitative indicators has been developed by Azzone (*Azzone et al.,1996)* defining four indicator categories. They point out the importance of implementing a group of qualitative indicators characterising company's aims and objectives towards environmental protection described in their environmental policy. The other three categories are State of the environment indicators showing companies' contribution to current national and European environmental problems, EMS indicators used to show companies' ability to manage their environmental problems in an effective manner and indicators assessing the environmental performance of products and processes. (see Table 2.3)

An indicators framework proposed by WBCSD (*Lehni et al., 2000)* for measuring eco-efficiency for businesses builds on WBCSD work initiated in 1992 and reflects the activities of other organisations in this field, such as ISO, NRTEE, CERES, and GRI. The framework includes a category Product or service value, which covers the economic dimension of their eco-efficiency concept and two environmental influence categories for product or service creation and use, which consider the eco-dimension of ecology. (see Table 2.5)

In a concept for Comparing Environmental Impact Data on Cleaner Technologies (CEIDOCT) (*Leffland et al., 1997*) four focus areas have been chosen for developing Environmental Performance Indicators (EPIs) on a national, regional and global scale. The four areas cover mineral resources consumption, energy consumption, dispersion of chemicals and biological resources consumption. Besides those EPIs, Technology

Specific environmental Indicators (TSIs) in the product and process dimension and Management Performance Indicators (MPIs) are recommended for inclusion when developing indicators for individual sectors or industries. (see Table 2.6)

The Global Reporting Initiative (*GRI, 2000*) proposes generally applicable and organisation-specific Environmental Performance Indicators (EPIs) focused on nine aspect areas as shown in Table 2.7.

Ellipson (*Mueller et al.,2001)* has identified five generic environmental performance indicators that they claim meet the test of global recognition and financial performance indicators for their eco-efficiency indicator concept. (see Table 2.8)

Based on a four sector studies – automotive, chemical, electronics, pulp and paper – and the experience of its members the U.S. National Academy of Engineering (NAE) (*National Academy of Engineering, 1999)* urges firms to develop indicators in Manufacturing and Product Use described in Table 2.9.

Thoresen suggests indicator categories for Product Lifecycle Performance, Environmental Performance of Manufacturing Operations, and Environmental Condition (*Thoresen, 1999).* The category of Product Lifecycle Performance implies the use of indicators to aid the development or selection of optimum product design or specification to satisfy customer needs. The category of Environmental Performance of Manufacturing Operations is concerned with making the optimum operational decisions "on-site", given a certain product design and/or process technology. Environmental Condition Indicators may describe environmental impacts from manufacturing operations and products on a local, regional and global scale. (see Table 2.10)

A set of industrial eco-efficiency indicators has been developed by Anite Systems (*Anite Systems, 1999*) under contract to Eurostat – DG Enterprise. The framework is based on the notion of economic performance and core environmental problems and the contribution of industries to both of these with respect to natural resources (materials, water, energy, and land) and with respect to pollutant releases and waste. (see Table 2.11)

| **Table 2.1** | | **ISO/FDIS 14031** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Environmental Condition Indicators[1] (ECIs) | Regional – National – Global | Thickness of the ozone layer |
| | Local – Regional | Concentration of a specific contaminant in groundwater or surface water |
| Management Performance Indicators (MPIs) | Implementation of policies and programs | Number of prevention of pollution initiatives implemented |
| | Conformance | Degree of compliance with regulations |
| | Financial performance | Costs that are associated with a process' environmental aspects |
| | Community relations[2] | Number of inquiries about environmentally related matters |
| Operational Performance Indicators (OPIs) | Materials | Quantity of water per unit or product |
| | Energy | Quantity of each type of energy used |
| | Services supporting the organisation's operations | Amount of hazardous materials used by contracted service providers |
| | Physical facilities and equipment | Total land area used for production purposes |
| | Supply and delivery | Average fuel consumption of vehicle fleet |
| | Products | Energy consumed during use of product |
| | Services provided by the organisation | Amount of fuel consumption (service: transportation) |
| | Wastes | Total waste for disposal |
| | Emissions | Quantity of specific emissions per year |

| **Table 2.2** | | **FEEM** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Environmental Management Indicators (EMIs) | Environment related investments and operational costs, and savings | Environment related investments / Total investments |
| | Implementation and integration of environmental policy and EMS | Number of managers with environmental responsibilities |
| | Relation with local communities, authorities and media | Number of environment related complaints |
| | Conformity with requirements | Degree of compliance with standards |
| Environmental Absolute Indicators (EAIs) | Water and raw material consumption | Total water consumption |
| | Energy and fuel consumption | Total energy consumption |
| | Air emission | Total CO2, SO2 |
| | Waste water | Total effluent volume |
| | Waste | Total waste generated |
| | Acoustic level | Maximum dB(A) |
| | Product | Mass of product or packaging that can be (or are) recycled |
| Environmental Performance Indicators (EPIs) | EMAS environmental issues | Normalised data referring them to its activity level (e.g. emission/production) |
| Potential Effect Indicators (PEIs) | Global warming | CO2 |
| | Acid rain | SOx |
| | Smog, acute respiratory disease | NOx |
| | Chronic toxicity | Metals |
| Environmental Effect Indicators (EEIs) | Chemical/physical condition of the environment | Concentration of pollutants in the water and atmosphere |
| | Effects on human beings, animal and plants | Evolution of local biodiversity, particularly plants micro-organisms |

[1] Bennet and James (1998) introduce three sub-categories of ECI: *receptor*, *sustainability*, and *proxy/risk* indicators

[2] Bennet and James (1998) extend the sup-category of *community relations* into a broader category of *stakeholder*

| **Table 2.3** | | **Azzone *et al.*** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Effect on the 'State of the Environment' | Emissions | Consumption of CFCs and halons |
| | Waste | Total amount of hazardous waste generated |
| | Energy | Total amount of energy consumption |
| | Transportation | Number of cars and/or distances |
| Corporate EMS | Commitment | No. and frequency of environmental audits |
| | Compliance | Number of environmental incidents |
| | Stakeholders | Number of accusations |
| Environmental Performance of Products and Processes | Input | Consumption of water |
| | Stock | Usable buildings which are owned, leased of otherwise occupied |
| | Output | Products or services the company produces |
| Environmental Policy | 21 aspects to be included as discussed by Brophy (1995) | |

| **Table 2.4** | | **WRI** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Environmental Performance Indicators (EPIs) | Materials use | Quantities and types of materials used |
| | Energy consumption | Quantities and types of energy used or generated |
| | Non-product output | Quantities and types of waste created before recycling, treatment, or disposal |
| | Pollutant Releases | Quantities and types of pollutants released to air, water, and land |

| **Table 2.5** | | **WBCSD** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Product/Service Value | Volume | Unit (e.g. number) sold |
| | Mass | Quantity (e.g. kilograms) sold |
| | Monetary | Net sales/Turnover |
| | Function | Product performance (e.g. laundry loads washed) |
| | Other potentially relevant information | Product price |
| Product/Service Creation Environmental Influence | Energy consumption | MJ energy used |
| | Materials consumption | Tons materials consumed |
| | Natural resources consumption | Tons consumed (e.g. water, wood, minerals) |
| | Non-product output | Tons SO2 emitted |
| | Unintended events | Number of accidental releases |
| Product/Service Use Environmental Influence | Product/service characteristics | Recyclability, bio-degradability |
| | Packaging waste | kg of solid waste |
| | Energy consumption | MJ energy used |
| | Emissions during use and disposal | Releases to land, water and air from use and disposal |

| **Table 2.6** | | **CEIDOCT** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Environmental Performance Indicators (EPIs) | Mineral resources consumption | Loss of mineral resources per unit from inputs and disposal stage |
| | Energy consumption | Energy consumption per unit measured as primary energy |
| | Dispersion of chemicals | Potential effects from chemicals per unit evaluated as scores |
| | Biological resources consumption | Area requirements per unit evaluated from cultivation and exploitation |
| Technology Specific environmental Indicators (TSIs) | Product dimension | Product quality |
| | Process dimension | Use of raw materials per unit of product |
| Management Performance Indicators (MPIs) | Training for increased environmental awareness and/or environmental management | MPIs are recommended to include but are outside the scope of the 1997 concept. |
| | Stage of environmental management | |
| | Environmental investment levels | |

| **Table 2.7** | | **GRI** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Environmental Performance Indicators (EPIs) | Energy | Total fuel use |
| | Materials | Use of recycled materials |
| | Water | Total water use |
| | Emissions, Effluents, and Waste | Quantity of waste returned to process (e.g. through recycling, reuse) |
| | Transport | Business travel (e.g. kilometres travelled) |
| | Suppliers | Number of incidences of non-compliance |
| | Products and Services | Percentage of product weight & volume reclaimed after use |
| | Land-Use/Biodiversity | Amount of land owned, leased, managed, or otherwise affected |
| | Compliance | Magnitude of penalties for non-compliance |

| **Table 2.8** | | **Ellipson** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Eco-efficiency Indicators | Depletion of non-renewable energy resources | Non-renewable primary energy input / value added |
| | Depletion of fresh water resources | Water use / value added |
| | Contribution to global warming | Global warming contribution / value added |
| | Depletion of ozone layer | Contribution to ozone depletion / value added |
| | Waste disposal | Waste disposed / value added |

| **Table 2.9** | | **NAE** |
|---|---|---|
| *Category* | *Aspect* | *Indicator – example, brief description* |
| Manufacturing Related Indicators | Pollutant releases | Includes: Air, Water and Solid |
| | Materials use/efficiency | Separated into hazardous/non-hazardous |
| | Energy use/efficiency | Broken down by resource: coal, gas, etc. |
| | Water use/efficiency | Processes water, cooling water |
| | Greenhouse gas emissions | $CO_2$ warming potential equivalents |
| | Percent reuse/recycle/disposal | Use of individual process inputs |
| | Packaging | Packaging per product |
| | Land use | Percent of land preserved |
| | Environmental incidents | Classified by violations, fines, etc. |
| | Health and safety | Hazardous waste handling |
| Product-Use Related | Pollutant releases | Includes: Air, Water and Solid |
| | Materials use/efficiency | Materials required for product use |
| | Energy use/efficiency | Energy requirements for product use |
| | Water use/efficiency | Water requirements for product use |
| | Greenhouse gas emissions | $CO_2$ equivalents |
| | End-of-life disposition | Units or amounts of product reused, recycled, or disposed off |

| **Table 2.10** | **Thoresen, J.** |
|---|---|
| *Category* | *Aspect* |
| Product Lifecycle Performance Indicators | Energy, materials, and resource consumption |
| | Distribution/Transportation |
| | Customer use |
| | Waste treatment |
| | Customer needs vs. lifecycle environmental impact |
| Management System Performance Indicators | Environmental management system performance |
| | Financial consequences of environmental action |
| Manufacturing Operations Performance Indicators | Energy planning |
| | Procurement planning |
| | Transport planning |
| | Production planning |
| | Production |
| Environmental Condition Indicators | Local – regional – global |

| **Table 2.11** | **Anite** |
|---|---|
| *Category* | *Aspect* |
| Environment Withdrawals Influence | Use of energy |
| | Use of natural resources |
| | Use of other materials |
| | Land use |
| Environment Releases Influence | Pollutant releases |
| | Waste generation/By-products |
| Economic Output | Value added |

*Quantitative – Qualitative*

The information conveyed through indicators can be expressed as qualitative or quantitative measures. The literature generally is focused on quantitative measures

whose terminology varies between different authors in terms of the basis of their calculation.

*Qualitative Measures*

According to Azzone (*Azzone et al., 1996*) qualitative measures describe intangible items or difficult to quantify variables such as the characterisation of the type of environmental strategy carried by the company.

Qualitative indicators can be evaluated using scoring systems such as a number scale 1-4 or A-D in connection with an explanation for the evaluation (e.g. 1: missing, 2: vague, 3: acceptable, 4: comprehensive or A: reactive, B: proactive).

*Quantitative Measures*

Azzone (*Azzone et al., 1996*) segregate quantitative measures into physical and financial. *Physical measures* can be expressed along a quantitative scale but do not refer to any economic based parameter, e.g. indicators pointing out air emissions, solid wastes, energy consumption, and wastewater resulting from production process. *Financial measures* are expressed in monetary units, e.g. environmental operating costs that the company must bear to ensure the working of clean technologies.

ISO 14031 *(ISO, 1998*) identifies five types of quantitative measures depending on the basis of their calculation:

- *Direct measures*: basic data or information, e.g. tonnes of contaminant emitted.
- *Relative measures*: data or information compared to or in relation to another parameter, e.g. tonnes of contaminant emitted per tonne of product manufactured.
- *Indexed*: data or information converted to units or to a form which relates the information to a chosen standard or baseline, e.g. contaminant emissions in the current year expressed as a percentage of those emissions in a baseline year.
- *Aggregated*: data or information of the same type, but from different sources, collected and expressed as a combined value, e.g. total tonnes of a given contaminant emitted from production of a product in a given year, determined by summing emissions from multiple facilities producing product.
- *Weighted*: data or information modified by applying a factor related to its significance.

The Global Reporting Initiative *(GRI, 2000)* distinguishes between absolute and relative figures. *Absolute figures* provide information on the size of a contribution to an overall effect. They can provide a linkage to the carrying capacity of an ecosystem or any natural or physical compartment, such as watershed or rainforest. Absolute figures can be expressed in any physical unit for a given period of operation.

*Relative figures* are ratios between two absolute figures of the same or of a different kind and can be classified by three types:

- *Productivity/Efficiency Ratios*: relate value to impacts, e.g. production volume per unit of waste (process eco-efficiency).

- *Intensity Ratios*: express an impact per unit of activity or unit of value, e.g. tonnes of SO2 emissions per unit of electricity (emission intensity).
- *Percentages*: ratio between two similar issues, with the same physical unit in the numerator and denominator, e.g. fraction of waste recycled per total waste (recycling percentage)

The CEIDOCT concept (*Leffland et al., 1997)* uses *normalisation* and *weighting* of indicators:

- *Normalisation* methods for individual sectors may be considered, such as

  $$\frac{annual\ emission\ or\ consumption\ of\ resources}{no.\ of\ product\ units\ or\ no.\ of\ employees}$$

  and are necessary in order to make indicators comparable between different technologies and different media.
- *Weighting* should be done as a basis for priority ranking and decision making, e.g. resource weighting $\frac{(normalised\ resource\ consumption) \circ annual\ production}{(total\ reserve)}$ .

Specific developed relative measures or ratios are known from literature as *eco-efficiency indicators*. Several initiatives and authors (*GRI, 2000; Lehni et al., 2000; Mueller et al., 2001; Anite Systems, 2001; and OECD, 1998*) propose eco-efficiency indicators for reporting company performance which link economic and environmental progress.

The WBCSD (*Lehni et al., 2000)* developed the following basic calculation for eco-efficiency indicators:

$$Eco-efficiency = \frac{product\ or\ sevice\ value}{environmental\ in fluence}$$

In this form an increasing efficiency ratio reflects a positive performance improvement.

The value element comes from indicators in the product/service value category shown in Table 5. The environmental influence element comes from indicators in the product/service creation and use environmental influence categories.

Ellipson (*Mueller et al., 2001*) defines eco-efficiency (in reverse to WBCSD) as:

$$Eco-efficiency = \frac{environmental\ performance}{financial\ performance}$$

Proposed eco-efficiency indicators reflecting five universally recognised environmental problems are shown in Table 2.8.

Generally speaking eco-efficiency indicators are calculated as a ratio of an economic and an environmental indicator.

A pilot study concerning eco-efficiency indicators for industry (*Anite Systems, 2001)* recommends that the selection criteria for economic and environmental indicators as components for the eco-efficiency indicators should be in line with the core issues in the political agenda.

Further examples of specific developed indicators are:

- PER: Index of Gross Eco-Efficiency (IGEE), Index of Net Eco-Efficiency (INEE)
- IPC Licensing: GrossWaMi, (Waste Management Index) Net on-siteWaMi, Net off-siteWaMi
- SAM Sustainability Group: Dow Jones Sustainability Group Index (DJSGI) (*Gian Carle).*

*Macro level – Micro level*

Indicators on a micro level reflect environmental performance on a company level. In this case indicators are used for goal setting, controlling the impact of company's activities, products and services on the environment, as well as for inter and intra sectoral benchmarking.

Indicators on a macro level are used to supply environmental performance from companies to stakeholders outside a company.

*Generic – Specific*

Several initiatives and organisations (*GRI, 2000; Lehni et al., 2000; Mueller et al., 2001; Anite Systems, 2001; and Berkhout et al., 2001)* distinguish between indicators that can be applied globally, by all enterprises, across all sectors – generally applicable indicators', and indicators that are more likely to be individually defined from one business to another – sector or business specific indicators.

### *2.1.5 What kind of performance is comparable?*

The answer depends on the level of comparability. There are the following levels of comparability for companies

- Comparability over time within a site
- Comparability between sites in a corporation
- Comparability between companies in same sector
- Comparability between companies in another sector

Although published literature mentions the importance of comparability there is still a lack of tangible answers.

Specific performance of facilities, individual production processes, environmental management, etc. can be compared over time within a site by means of trend data. On the other hand for comparisons of performance between sites in a corporation or companies in the same sector or in another sector it is important to recognise the inherent diversity of business and the change of product portfolios. In this case WBCSD points out that comparisons should be made only when the companies being compared provide the same product/service (e.g. electricity).

To make performance comparable across all sectors the use of generally applicable indicators is suggested. (*GRI, 2000; Lehni et al., 2000; Mueller et al, 2001).* For several of the generally applicable indicators there are internationally recognised methods for the transformation of data into common units.

Ellipson (*Mueller et al, 2001)* for example is using conversion factors to transform all the types of energy a company purchases (e.g. electricity, coal, fossil fuels etc.) into corresponding non-renewable primary energy to calculate the company's contribution to the problem of the depletion of non-renewable energy resources. In the same way they show the contribution of substances to global warming using the widely accepted concept of "global warming potential" as defined by the Intergovernmental Panel on Climate Change. However, for many other parameters, such as hazardous waste, there are no commonly agreed methods for this type of conversion.

Another common method to convert absolute performance data into comparable indicators is normalisation and/or aggregation. (*Leffland et al., 1997; GRI, 2000)* Aggregation of data has the disadvantage of losing specific information.

The CEIDOCT concept aggregates data from a life cycle analysis to higher levels in order to achieve a single environmental performance indicator in each environmental focus area for reporting environmental performance between various sectors. (*Leffland et al., 1997)*

Generally the use of ratio indicators allows comparisons of similar products or processes with each other and also helps relate the performance and achievements of one firm, business unit or organisation to another. (*GRI, 2000)*

Azzone's state of the environment indicators can be used for benchmarking the company within industries to show the level of performance the company is attaining. (*Azzone et al., 1996)*

Comparability is a critical component in business use of EPIs. Business can't benchmark their own performance over time or against others without this. This is especially important for corporations with multiple facilities operating across international boundaries. (*Ditz et al., 1997)*

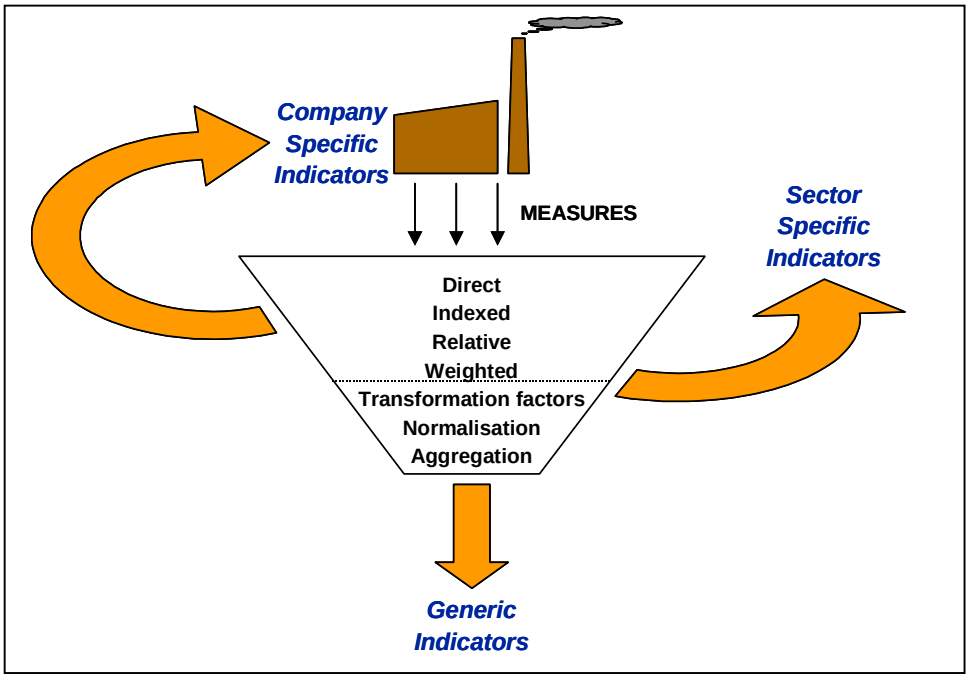



**Figure 2.2 How to make performance comparable?**

Environmental performance can be expressed by a multitude of measures. Figure 2.2 illustrates what kind of calculation method should be applied to company's measures to achieve company specific, sector specific or generic indicators. Measures are modified in the trapezoidal modification box (where the width is proportional to the number of indicators calculated and the height to the degree of modification). This means generic indicators for comparison between companies in different sectors have the highest degree of modification (which leads to a small number).

### *2.1.6 How can one build performance into a company's EMS?*

This question seeks to identify what systems in a company are necessary to put environmental performance and benchmarking into action.

Taking ISO's 14001 standard on environmental management systems into consideration Pojasek, (*Pojasek, R. B*) points out that *ISO 14001* is a conformance standard, not a performance standard. 'The standard is designed to make certain that an organisation's environmental management system conforms to the criteria set by the standard and measured in the conformity assessment'. A performance standard focuses on the efficiency and effectiveness of the program.

However he does not mention in this connection ISO's supplementary document *ISO 14031*. The central feature of ISO 14031 is a definition and detailed discussion of indicators that can be used to ascertain how effective a company's EMS is in

generating improvements in environmental performance. On the other hand, as Bennett and James identify, ISO 14031 has little to say about implementing environment-related performance measurement within companies and the trade-offs between different objectives which this involves. Furthermore ISO 14031 does not really address the scope of what is to be standardised and, once this is determined, definitions and measurement protocols. It also makes no reference to any public disclosure of environmental performance data.

An example of a performance standard can be found in the *National Environmental Performance Track* (*U.S. EPA, 2001)* program that has been developed by the U.S. EPA. This voluntary program is designed to recognise and encourage top environmental performers—those who go beyond compliance with regulatory requirements—to attain levels of environmental performance and management that benefit people, communities, and the environment. Facilities seeking entry into the program at the Achievement Track level—the first phase of the program—must have adopted an EMS. The Stewardship Track is the second phase and is currently under development (will be announced in Summer 2001). The Stewardship Track will be designed to encourage and recognise higher levels of environmental performance than those expected at the Achievement Track level.

Another example of a performance-based EMS program is *Green Zia* (*NMED, 2000).* This voluntary program, developed by the New Mexico Environment Department with the collaboration of the New Mexico Pollution Prevention Advisory Council, is based on the *Malcolm Baldrige Quality Model(NIST, 2000*). Green Zia is designed to help organisations of all sizes achieve environmental excellence through continuous environmental improvement. The Baldrige Criteria for Performance Excellence serve as a basis for organisational self-assessments.

Pojasek, R. B. proposes a Malcolm Baldrige supplement for any organisation wanting a performance basis for their EMS program. Using such a Malcolm Baldrige supplement approach will promote the development of best practices in the management of the EMS. Furthermore, the Malcolm Baldrige supplement will highlight environmental results, other interested party results and financial results of the EMS program. Results represent 325 of the 1,000 points in the Baldrige scoring system to emphasise the importance of a results-driven performance system. Finally Pojasek stresses that the Malcolm Baldrige supplement allows comparisons between a wide variety of different organisational types, since the focus is on the "how"—not on the "what"—of environmental management.

### *2.1.7 Related initiatives, case studies, organisations*

The following section provides information about initiatives, projects, and case studies whose objectives and targets include environmental benchmarking, performance improvement, and reporting on a corporate level as well as organisations and networks engaged in this field and might therefore be useful for a successful implementation of environmental benchmarking in Irish industries.

| Title | Origin | From/To Estd. | Description |
|---|---|---|---|
| Measuring Environmental Performance of Industry (MEPI) | UK | 1999/2001 | EC Research Programme<br>Key objective: to develop and apply quantitative indicators for comparing environmental performance of manufacturing firms in six industrial sectors. |
| Cleaner Technology Performance Indicators (CTPI) | Sweden | 1998/2000 | EC Research Programme<br>Focuses on the development of sector specific Cleaner Technology Performance Indicators for SME |
| Safety, Health and Environment Intra Industry Benchmarking Association (SHEiiBA) | Scotland | 1997 | It has been designed to encourage cross-sectoral exchanges of information and know-how of ways to improve performance and processes. |
| European Environmental Benchmarking Network (EEBN) | EU | | EEBN activities will focus on various dimensions of environmental benchmarking. |
| Case studies to investigate the use of ISO 14031 | | | Examples of Environmental Performance Evaluation undertaken by international companies are published in ISO 14032. |
| WBCSD Platform for Corporate Eco-efficiency Performance | | | Collection of company eco-efficiency profiles. The Performance Platform is a portal to more detailed data and contact information. |
| Global Environmental Management Initiative (GEMI) | USA | | Mission: to benchmark and share best practices on important EHS topics. |
| National Environmental Performance Track | US EPA | | Designed to recognise and encourage top environmental performers. |
| New Mexico's Green Zia Program | USA | | Designed to help organisations of all sizes achieve environmental excellence. |
| International Network for Environmental Management (INEM) | | | Aims to help companies improve their environmental and economic performance. |
| Environmental, Health & Safety Benchmarking Association | | | Association of environmental, health and safety managers to identify best business practices and compare operating performance. |
| NRTEE Eco-efficiency Program | Canada | | Program is proceeding with the testing of material and energy Eco-efficiency indicators. |
| IMPEL Comparison programme in Finland | | 2000 | Self-monitoring and electronic reporting of emission data. |

**Table 2.12 Environmental Benchmarking Initiatives**

A recently finished project on **Measuring Environmental Performance of Industry** (**MEPI**) (*Berkhout et al., 2001)* co-ordinated by SPRU - Science and Technology Policy Research at the University of Sussex, UK was funded under the fourth framework programme (Environment and Climate) of DG Research of the European Commission. The key objective was to develop and apply quantitative indicators to compare environmental performance of manufacturing firms in six industrial sectors (electricity generation, pulp and paper, fertilisers, book and magazine printing, textile finishing and computer manufacture) in six EU countries: the UK, the Netherlands, Germany, Austria, Belgium, and Italy. The development of the indicators is based on information in reports to regulators, corporate environmental reports (CERs) and declarations under schemes such as the EU Eco-Management and Auditing Scheme (EMAS).

An ongoing research project financed by the DG Research, European Commission, under the fourth framework programme - Environment and Climate, RTD focuses on the development of sector specific **Cleaner Technology Performance Indicators** (**CTPI**) to support the decision making process, and to overcome the data and information constraints that SMEs generally have. The methods that the project intends to use to develop indicators are Technology Assessment, Benchmarking, Process Optimisation, Cause Analysis and Technology Management. The industry sectors studied in the project are Olive oil, Textile wet processing, Lithographic printing, Wine production and Fisheries. The research project commenced in January 1998. The lead researcher of the project is Mr Shisher Kumra and project supervisor is Prof. Allan Johansson (International Institute For Industrial Environmental Economics (IIIEE) at Lund University, Sweden).

International industrial and service companies can join the **Safety, Health and Environment Intra Industry Benchmarking Association** (**SHEiiBA**) to benchmark their Safety, Health and Environmental performance across a range of key performance indicators. The scheme was launched in 1997 and is operated through Edinburgh-based Corporate Benchmarking Services. It has been designed to encourage cross-sectoral exchanges of information and know-how of ways to improve performance and processes. To facilitate the process of gathering, processing and disseminating information, the company has written its own software programme *Know-how Net*, which allows participants to answer questions on screen with either numerical or 'free text' answers.

Jonathan Bendit, the company's founder says "The real value of the exercise is not so much about comparing numbers but sharing successful practices and allowing people to network with each other – whatever the industry or country".

The **European Environmental Benchmarking Network** (**EEBN**) is an open network initiated by the European Commission (Directorate General Enterprise), together with the Fondazione Eni Enrico Mattei (Italy)(EEBN co-ordinator), the International Network for Environmental Management (INEM), the Technical University of Delft (The Netherlands), Groundwork Blackburn (United Kingdom) and the Confederation of Chemical Industry (Belgium). EEBN activities focus on various dimensions of environmental benchmarking and in particular cover issues such as environmental benchmarking for SMEs, environmental benchmarking and the financial community, environmental benchmarking and product/service development, and indicators for environmental benchmarking. As an example of their activities a workshop on 'Benchmarking as a tool to improve environmental performance'

(*FEEM, INEM, 2000)* was held in December 2000. Representatives from FEEM, INEM, CEFIC, 14000 & ONE SOLUTIONS LTD, and other industrial organisations discussed the state of the art of environmental benchmarking and the use of benchmarking as a tool in the chemical and textile industry.

**Case studies** to investigate the use of **ISO 14031** in real life have been carried out in Denmark. Seven pilots (Banestyrelsen, Frederiksborg Linnedservice A/S, Renholdningsselskabet af 1898 (R-98), McDonalds Danmark, Wewers Teglværker A/S, MD Foods and Toyota Risskov A/S) have tested ISO 14031 together with consultants from Deloitte & Touche, Rambøll, VKI and Ernst & Young. The pilots were found amongst companies with an EMS in place, companies currently implementing an EMS, and companies without an EMS. The investigation demonstrated that ISO 14031 is a powerful and useful instrument for detailing the requirements of ISO 14001, generating information on performance trends, and establishing simple environmental management systems.

The studies have also shown that environmental reporting in accordance with the ISO 14031 guidelines leads to **Green accounts** containing: baseline data, management comments and performance indicators. Green account (*Valor & Tinge, 2001)* is a term used in Denmark for a specific type of environmental report prepared by certain companies, under Danish laws.

The green accounts, with their recurring statement of environmental performance, were designed to stimulate companies to make an extra effort to enact ongoing improvements. The publication of the green accounts in itself entails a quality assurance and is intended to inspire self-management in the domain of environmental protection.

Further examples of Environmental Performance Evaluation undertaken by international companies are published in ISO 14032 (*ISO, 1999)*.

**WBCSD Platform for Corporate Eco-efficiency Performance** is a collection of company eco-efficiency profiles, which describe company performance with key value and environmental indicators, and with eco-efficiency ratios. The profiles are built from a uniformly structured set of data points of a company's actual performance and also include selected trend graphs of historic data and some targets.

With this collection, WBCSD gives its members a platform to present their eco-efficiency performance in an easily understandable and clearly structured way. With the direct link from the performance summaries shown here to Corporate Environmental or Sustainability Reports and company web sites, the Performance Platform is a portal to more detailed data and contact information.

A programme called **Envirowise** (Formerly the Environmental Technology Best Practice Programme) was re-launched in the UK under its new name on 1st November 2000. It seeks to improve environmental performance whilst increasing the competitiveness of UK industry by encouraging the take-up of good practice technology and techniques. Envirowise is jointly funded by DTI and DETR and is run on behalf of the Departments by the partnership of AEA Technology plc and NPL Management Ltd. The main themes of the Programme are the promotion of waste minimisation and the adoption of cost-effective cleaner technology.

An important strategic element of the U.S. **Global Environmental Management Initiative** mission of "business helping business" is to benchmark and share best practices on important EHS topics.

The **Global Reporting Initiative** (**GRI**) was established in late 1997 with the mission of developing globally applicable guidelines for reporting on the economic, environmental, and social performance, initially for corporations and eventually for any business, governmental, or non-governmental organisation (NGO). Convened by the Coalition for Environmentally Responsible Economies (CERES) in partnership with the United Nations Environment Programme (UNEP), the GRI incorporates the active participation of corporations, NGOs, accountancy organisations, business associations, and other stakeholders from around the world.

The US EPA's **National Environmental Performance Track** is designed to recognise and encourage top environmental performers—those who go beyond compliance with regulatory requirements to attain levels of environmental performance and management that benefit people, communities, and the environment.

The **New Mexico's Green Zia Program**, developed by the New Mexico Environment Department with the collaboration of the New Mexico Pollution Prevention Advisory Council, is based on the Malcolm Baldrige Quality Model. Green Zia is designed to help organisations of all sizes achieve environmental excellence.

INEM, the **International Network for Environmental Management** is a non-profit, non-partisan, world federation of national associations for environmental management and sustainable development. INEM aims to help companies improve their environmental and economic performance.

The **Environmental, Health & Safety Benchmarking Association™** is forming an association of environmental, health and safety managers to identify best business practices and compare operating performance.

The Canadian **NRTEE Eco-efficiency Program** is proceeding with the testing of material and energy Eco-efficiency indicators. A pilot project, Measuring Eco-efficiency in Business: Developing a Core Set of Eco-efficiency Indicators was carried out during 1997 and 1998. This expanded work will build on those results and will involve the active participation of a wider range of manufacturing sector companies. These companies will test the value of the energy and material intensity indicators to their businesses. They will refine the definitions, decision rules and complementary indicators.

The **IMPEL Comparison programme in Finland** (*IMPEL, 2000*) encompassed two themes: self-monitoring and electronic reporting of emission data (operators' periodic reporting to the authorities). The objective of the comparison programme was to show how self-monitoring, operator information gathering and processing systems and electronic reporting are interconnected and how a combination of these can enhance supervision and make it more transparent. The Finnish compliance monitoring and environment loading data system (VAHTI), the main purpose of which is to function as a tool for environmental inspectors in processing and monitoring permits, was presented.

## 2.2 EMS Software Tools Assessment

Eleven software tools were examined in order to determine their core elements and features. It was intended to identify what is available and useful to licensees in order to assess if there is a need to develop a specific new EMS application. It would also provide an insight into the functional needs of benchmarking software.

The software tools which were examined can be roughly categorised as:

- Tools supporting the assessment, implementation, or audit of an environmental management system.
- Tools for managing an environmental, quality, and health and safety management system.
- Tools for storing, analysing and reporting data.

In addition, two tools which are specific for assessing the significance of aspects and reporting on environmental performance were examined.

Table 2.13 lists examined software tools allocated to one of the categories mentioned above in terms of their main applicability. For the assessment demonstration versions were acquired.

| **EMS Assessment, Implementation and Audit Software** |
|---|
| ISO 14000 Software Series (GreenWare) |
| ISO 14001 isotop TimeSaver (Isotop) |
| EcoManager (Aspects) |
| EDICTS (Envirochem) |
| **EQS Management Software** |
| Envoy (Entropy International) |
| EQS Software (EQS Solutions) |
| **Data Collection, Analysing and Reporting Software** |
| EQWin (GemTeck Environmental Software Ltd.) |
| doCOUNT HSE (doCOUNT GmbH) |
| TEAMS (EMISOFT) |
| **Aspects Significance Assessment Software** |
| Significance Wizard (Entropy International) |
| **Environmental Performance Software** |
| Perform Software Series (GreenWare) |

**Table 2.13 Examined software tools**

### Summarised Software Features

On the one hand, each software tool examined has its unique features depending on its application field, and on the other hand there are features that can be found in most of the tools and therefore useful for any environmental management tool. The summarised features are listed in Table 2.14.

| Programming Features | Environmental Application Features |
|---|---|
| **Database System** | |
| Central Database | |
| Site Database | |
| **Customisable Modular System** | Scheduling module; Management, Resources, Communication, Monitoring, Corporate reporting, Administration, Help; Data warehousing; Command centre; etc. |
| **Data Management** | |
| Data Import and Export | |
| Data Control | |
| Data Querying | |
| **Document Management** | |
| Document Control (Security, Revision, etc.) | |
| Document Import and Export | |
| **Security and Access** | |
| **Drag-and-drop interface** | |
| **Integration with existing systems** | |
| **Predefined/Customisable Worksheets – Standard Templates** | EMS worksheets, SOPs, Management procedures, Records, Policy |
| **On-screen Guidance/Wizard** | ISO 14031 Guidelines, Guidelines for Company Reporting on Greenhouse Gas Emissions (DETR) |
| **Report filter/generator** | Strategic performance reports, Diagnostic performance reports, Comparative performance graphs, Cost allocation graphs, Report discussion document, Main process flowchart, Aspects graph and summary, operations summary, register of aspects & impacts |
| **Built-in Questionnaires and Checklists** | Aspects significance assessment |
| **Library System, Predefined Database** | Environmental indicator library, Database of common environmental aspects, Database of hazardous substances |

**Table 2.14 Software features**

*Database System*

A database system allows the tool to collect and manage the volumes of environmental data derived from Ireland's IPC licensed industries. Such a system could consist of a database for each company for site data and a central database with all data required by IPC licensing including additional voluntary data for benchmarking purposes.

*Customisable modular system*

A modular designed software tool has the advantage that tools, components and systems can be chosen depending on needs and the software itself can be extended for future requirements.

Regarding the benchmarking project the software tool could include besides other EMS relevant modules (aspects assessment module, monitoring module, etc.) a benchmarking module with sub modules for internal benchmarking and sectoral benchmarking.

In addition, a scheduling module which details works and reports could be included.

*Data Management*

Good data management includes several features such as the import and export of data from many different software systems, the ability to query a database, and to control the quality of data in terms of physical-units, numeric and non-numeric values.

*Document Management*

A document management system allows the control of documents in terms of document modification and manipulation by indicating a record's author, creation date, issue and version number, revision date and approver.

*Security and Access*

A security system enables individual user passwords to give users access to the entire system and to ensure unauthorised use. Increased security restricts access and user rights to specific sections, components, and documents and allows setting privileges such as read-only, amending or approving.

*Drag-and-drop Interface*

A drag-and drop interface is a useful feature for organising documents in the form of a tree. It enables the user to drag documents from one tree to another tree. For example adding aspects from an aspects tree to a process step tree.

*Integration with existing systems*

This means that software has the ability to create links with existing files in other software applications. Text documents, CAD diagrams, audio or video files or even other applications can be linked or uploaded to supplement records created in the system.

*Predefined/Customisable Worksheets – Standard Templates*

Prewritten documents help the licensee to save time and support data consistency within Irish industries. The software could include predefined worksheets covering common elements of an environmental management system, including standard templates for EPA needs and wants (Chapter 4).

Besides predefined worksheets, a tool to create customised documents without the need for programming knowledge should be included.

*On-screen Guidance/Wizard*

On-screen guidance, including specific examples such as the AER Guidelines, ISO 14031 Guidelines or Guidelines for Company Reporting on Greenhouse Gas Emissions (DETR), could be provided throughout the software, as well as an on-line help system for assistance with interpretation and understanding of the specific requirements of EMS standards.

*Report filter/generator*

A report filter has the ability to create reports from a database. Such a tool could include predefined filter settings for generating standard reports (e.g. AER) and the possibility to create customised reports with their own defined indicators. With this filter, reports could be generated on a monthly, quarterly, semi-annual and annual basis in the form of charts and text.

*Built-in Questionnaires and Checklists*

In general, questionnaires and checklists are useful to gather data. For example answering an aspect/impact questionnaire and selecting the severity from an option list could be used to assess the significance of aspects.

*Library System, Predefined Database*

The software could include an indicator library system to assist licensees in choosing appropriate indicators for their performance evaluation and predefined databases such as a database of environmental aspects or hazardous substances.

A short description of each software tool with a detailed breakdown of their unique features can be found in Appendix IV. For the purposes of this project demonstration software packages were assessed and vendor literature reviewed.

# 3 Industrial Practice

A survey was undertaken to determine practice and potential in Irish Industry in relation to electronic reporting, benchmarking and use of software support tools for reporting, and supporting environmental management systems.

A questionnaire (in Appendix V) was drafted, agreed with the EPA and circulated with an EPA cover letter to all IPC licencees and licence applicants on 15th March 2001, requesting a response by 30th March 2001. Questionnaires were sent to 538 IPC licencees and applicants for licences. Follow-up calls were made to companies who had not submitted questionnaires by the deadline of 30th March.

Companies that had indicated in the questionnaire that they performed environmental benchmarking across different sectors were called to determine how this was achieved.

Questionnaires were received from 186 IPCL sites. 16 of these 186 sites were licensed under 2 scheduled activities (e.g. 5.6 pharmaceutical manufacture and 11.1 hazardous waste incineration). This, in total, corresponds to a 35% response rate. The lowest response rate was from the intensive agriculture sector (10%). Correspondence was received on behalf of 7 licensees in the Intensive Agriculture Sector (6.2) that "these facilities are farms and not Industrial Practices as the survey is entitled". These 7 questionnaires were not completed and were not considered in the calculation of response rates, or entered into the database for analysis.

The terminology used in the assessment of the questionnaires requires explanation.

| | |
|---|---|
| Respondents: | This refers to the individual IPC sites that returned completed questionnaires. There were 186 respondents. |
| Percentage of Respondents: | This analysis of a question includes the respondents that did not answer that question (i.e. includes those that did not make a declaration). The sample size is 186. |
| Not all Respondents answered all the questions in the questionnaire. | |
| Percentages of Responses: | This refers to the percentage of respondents that answered a particular question. It excludes respondents that did not answer the question (and hence is a smaller sample size than 186 in some cases) |
| No Declaration: | Questions in questionnaires which were left unanswered (blank) |
| Filtering by Sector: | 16 of the 186 respondents are licensed in 2 IPC classes. When applying a filter by sector to questions, the answers given by these 16 companies are therefore considered twice (for each of their licensed sectors). |

**Table 3.1 Terminology**

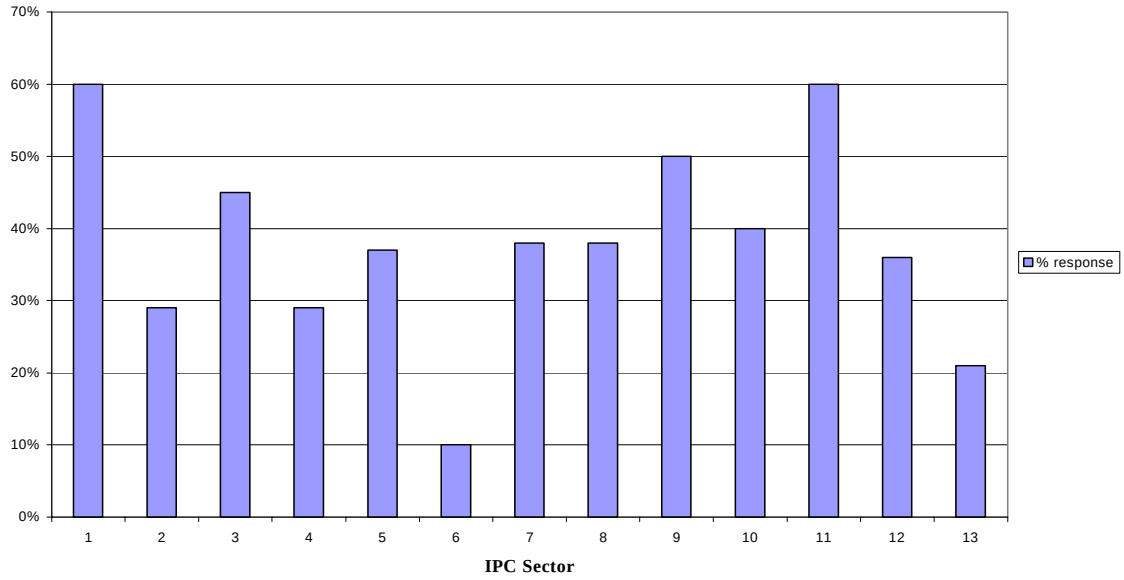



**Figure 3.1 Response by IPC Sector**

| Sector No. | % Response | EPA Act 1992, First Schedule Activities |
|---|---|---|
| 1 | 60% | Minerals and Other Materials |
| 2 | 29% | Energy |
| 3 | 45% | Metals |
| 4 | 29% | Mineral Fibres and Glass |
| 5 | 37% | Chemicals |
| 6 | 10% | Intensive Agriculture |
| 7 | 38% | Food and Drink |
| 8 | 38% | Wood, Paper, Textiles and Leather |
| 9 | 50% | Fossil Fuels |
| 10 | 40% | Cement |
| 11 | 60% | Waste |
| 12 | 36% | Surface Coatings |
| 13 | 21% | Other Activities |

**Table 3.2 Response by IPC Sector**

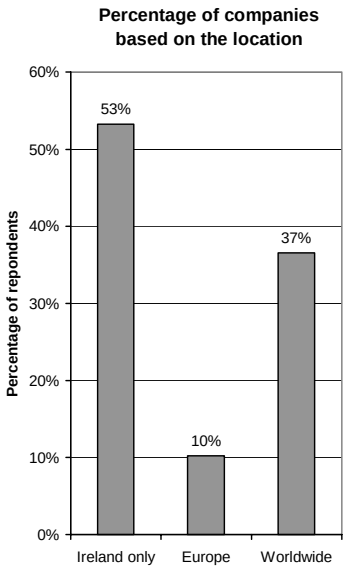



**Figure 3.2 Location**

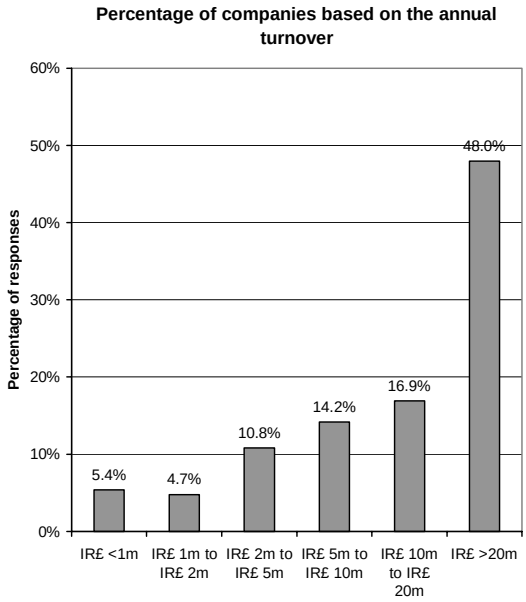



**Figure 3.3 Turnover**

## Percentage of Companies Based on Location

Over half of the respondents (53%) are indigenous companies. 10% of companies are European based while 37% of IPC licensees are part of worldwide corporations. There was a 100% response to this question.

## Percentage of Companies Based on Annual Turnover

This question was completed by 80% of the respondents. The distribution of responses may be seen in Figure 3.3. Approximately 21% of sites have a turnover of less than IR£5m., with one in ten sites having a turnover of less than IR£2m. Just under half (48%) indicated that site turnover exceeds IR£20m.

**Percentage of Companies Based on their Size and Location**

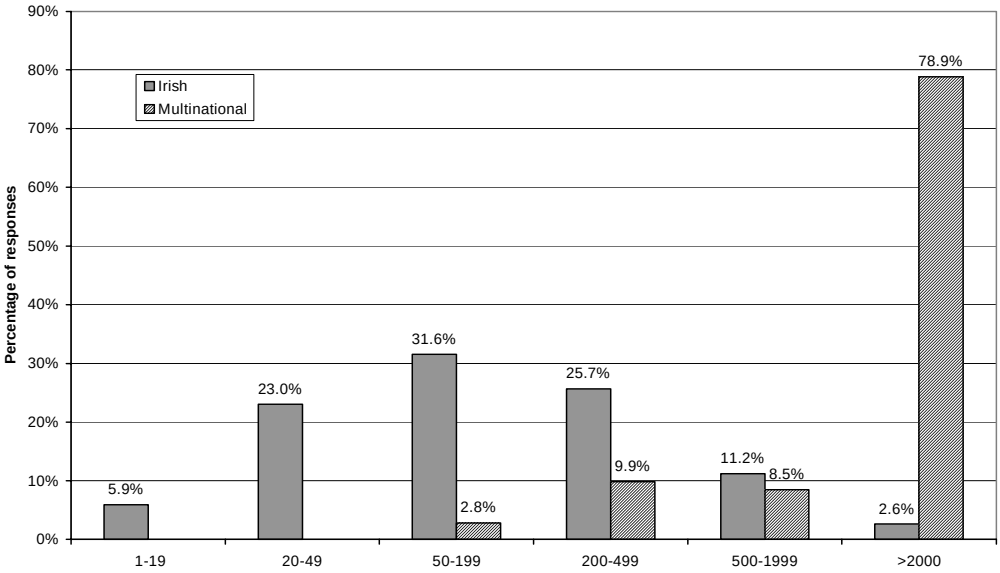



**Figure 3.4 Respondents by size and location**

An attempt was made to classify respondents by size and location. 92% of companies indicated the company size of their Irish operation. 38% of questionnaire respondents answered the question on company size globally. It can be seen from Figure 3.4 that Irish companies are smaller. The distribution of Irish companies based on size approximates a 'normal' distribution curve. 25.7% of Irish companies employ between 200 and 499 persons, with 31.6% employing between 50 and 199. 28.9% of Irish companies that are IPC licensed employ less than 50 persons.

## 3.1 ENVIRONMENTAL MANAGEMENT

### *3.1.1 Status and Outlook*

**What is the Status of EMS on Your Irish Site?**

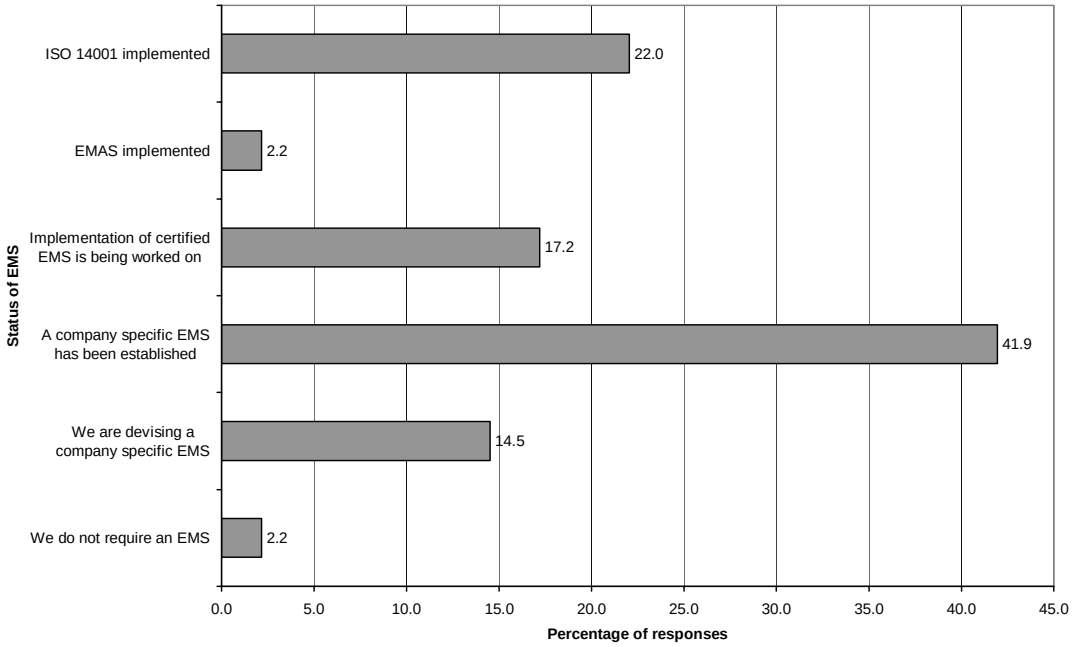



**Figure 3.5 EMS status at Irish site**

IPC licences issued since 1997 require a licensed activity to have an environmental management system (EMS). Licensees were questioned to determine the extent to which EMS's were implemented and certified. 4 companies are registered to EMAS (all 4 are also certified to ISO 14001). Activities licensed under Intensive Agriculture (6.2) do not require an EMS as a condition of their licence (2.2% of responses to this question indicated that an EMS was not required).

The following comments from respondents illustrate the effectiveness of the requirement for an EMS in the IPC licensing system:

"As detailed in targets and objectives and requirements of IPC licence"

"We use the IPC licence conditions to manage our environment"

"To comply with EPA requirements"

"The company specific system is based on IPC licence requirements and some aspects of ISO 14001"

"System based on ISO 14001 but not accredited. Company decision. No perceived benefit"

"EMS as per IPC Licence."

"EMS based on corporate requirements."

**Status of EMS Implementation**

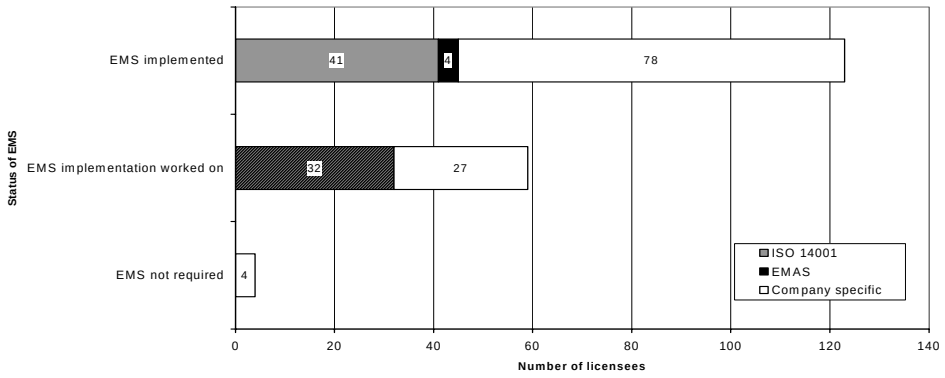



**Figure 3.6 Status of EMS Implementation**

41 sites (22% of respondents) are certified to ISO 14001. Combining this with the companies that have established a company-specific EMS, overall 66% of respondents have implemented an EMS at this stage. Of the remainder currently installing an EMS, it is interesting to note a slight bias in favour of ISO 14001 over an uncertified system.

### *3.1.2 Use of Software*

It is an objective of this project to assess the usefulness of EMS software to licencees. The following questions attempted to gauge this.

**Have You Used Computer Software to Assist in the Installation and/or Operation of Your EMS?**

| | Yes | No | No Declaration |
|---|---|---|---|
| EMS Installation | 5% | 93% | 2% |
| EMS Operation | 47% | 51% | 2% |

**Table 3.3 Use of Software in implementation and operation of EMS**

Very few respondents (5%) used computer software to assist in the installation of an EMS. Those companies that did use software used either MS Office or adapted a quality management system software tool (e.g. Q-pulse, Q-sys and QMX). Approximately half of respondents use software in the operation of their EMS, again MS Office, Lotus Notes or a quality management system software tool (e.g. Qumas) being used.

**What do you see as the advantages of a computer-based EMS?**

The following points, extracted from selected comments from respondents, summarise the main advantages of a computer-based EMS.

*Ease of reporting*

"Ease of reporting and standardize system from company to company"

"Reporting facilities and database for AER & EMP"

"Efficient reporting"

*Standardisation*

"Speeds up setting up, and standardisation"

"Structured approach to all aspects of environmental management"

"More efficient for producing reports and record keeping, better consistency for all IPC licences"

*Access*

"All staff on-site have access to computers, awareness, corrective actions and responsibilities should be easier to communicate"

"It is easily accessed, easily maintained & altered. It can be easily transferred via disc & electronic format"

"Access by all employees"

*Traceability*

"Traceability and access to information over a period of time, trending etc."

"Central access point, can be utilised by more than one person at once. Full traceability"

*Scheduling*

"Maintaining the schedule of reporting and proposals to the agency"

*Less paperwork*

"Highly organised and efficient - less paperwork"

*Pre-formatted templates*

"Pre-formatted templates improve time management constraints"

**What do you see as the barriers to having a computer-based EMS?**

The main disadvantages of a computer-based EMS, as summarised from selected respondent comments are:

*Security*

"Security of data and acceptability of all electronic reports"

*Cost*

"Cost of software, support and implementation stages are on-going support"

*Inflexibility*

"Activity/site specifications may be overlooked/omitted"

"Software being too broad and all encompassing, thereby trying to jump on to two stools, and falling between. Inflexible in its reporting capabilities and definitions of data fields to enter"

"For multi-national company, must be compatible with company specific system"

"Flexibility to modify to site requirements"

*Computer literacy*

"May prove daunting for computer illiterate personnel, i.e. not all employees have access to a computer"

"Ensure adequate training is provided"

*Compatibility with existing systems*

"EMS will have to reflect existing procedures, rather than trying to change them."

"Existing Excel and Access systems already can be used effectively. Little advantage in having to learn another one."

*Electronic signatures*

"Perhaps lack of signatures on documentation accepting responsibility"

"People "like" paper and it involves a culture change. For the Pharmaceuticals Industry there are regulatory issues with electronic signatures and these must be adequately addressed"

*Time constraints*

"Onerous setup, maintenance costs, necessity"

"Written reports would require typing - Time consuming"

*Hardware system reliability*

"Computer malfunction may not have ready access to relevant records etc. if required. This results in all EMS data having to be stored in hard copy as well as on computer."

*Blinkered Effect*

"'Cloning' of EMS may lead to an absence of structures, knowledge being built into the system"

"Blinkered effect - A standard system may not suit the needs of all companies. Also danger of restricting the approach to problem solving."

"Creating templates can restrict an overall appreciation and channel thoughts to what's on the template!"

**Which 3 of the Following Would be Most Useful to You?**

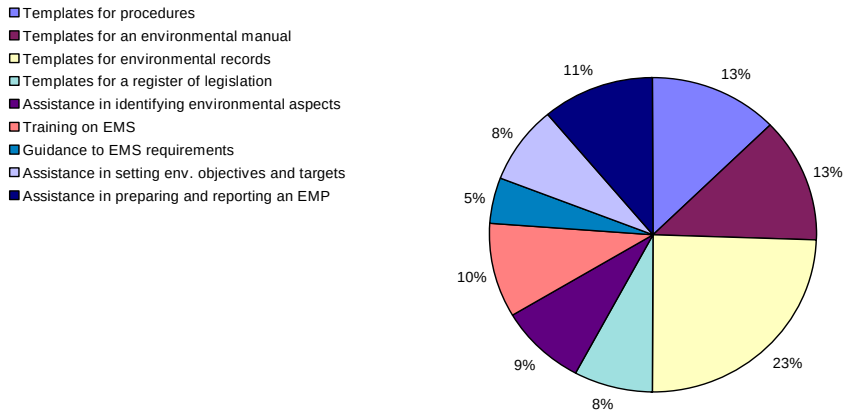



**Figure 3.7 Useful templates**

Templates for environmental records (23%) was the most useful application chosen for proposed computer software. Templates for procedures (13%) and an environmental manual (13%) were joint next most popular, followed by assistance in preparing and reporting an EMP (11%).

## 3.2 REPORTING

**Would the Following Additional Standard Templates be Useful to Your Company?**

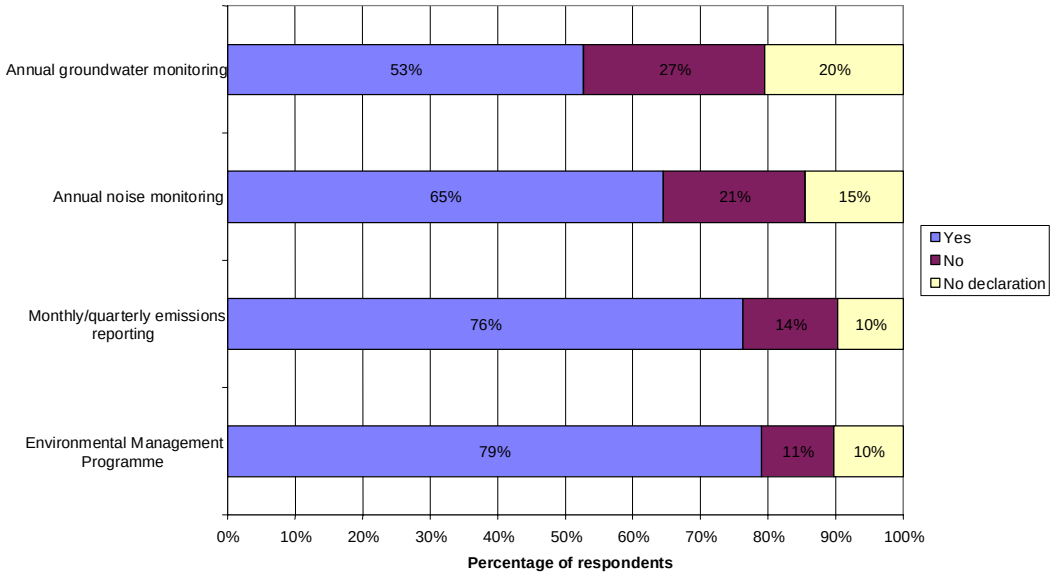



**Figure 3.8 Additional Standard Templates**

A standard template for an EMP is seen as the most useful electronic reporting tool. Not all sites have groundwater monitoring programmes, hence its lower scoring. Other templates proposed by licensees included waste reporting, energy management monitoring, mass balance templates and complaints/incidents reporting.

## Scheduling Software

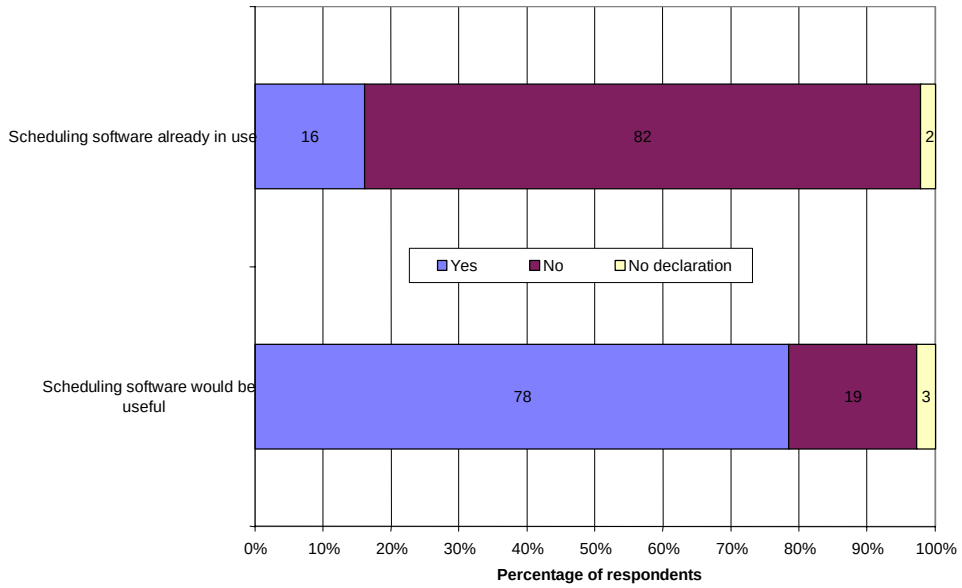



**Figure 3.9 Scheduling Software**

Currently approximately 1 in 6 licensees (16%) use scheduling software. However the majority of respondents (78%) see scheduling software as a useful tool.

## What recommendations would you have to streamline reporting?

The main recommendations to streamline reporting can be summarised as:

*Reduce frequency of reporting*

"If company has good performance history reduce frequency of reporting of exceptions and the annual report".

"Eliminate the duplication of routine results and the same data being reported in the PER and the AER".

"Give some thought to reporting by exception. The EPA may not have time/resources to review all data which are in compliance."

"Less reporting of trivial issues"

"Concise summaries rather than pages of raw data"

"Reporting monitoring data less frequently than monthly, e.g. quarterly or twice yearly."

"Summary data tables"

*Alter and restructure templates*

"User friendly templates and site database indices".

"Use of graphs, summarising data".

"We would like to be in a position to alter and restructure templates ourselves - to meet future requirements which may require us to report against new parameters."

"Flexible but comprehensive approach to templates"

*e-mail reports*

"EPA to set up on WWW for monthly reporting and companies with password to enter info would be on public file directly similarly with all written correspondence to EPA could be done via email".

"EPA should be willing to accept reports in PDF format via email"

"The possibility of e-mailing quarterly reports and emailed replies"

"E-mail to all companies when reports are due"

**What do you see as the barriers to reporting to the EPA via computer files?**

Confidentiality and security are seen as the two most significant barriers to reporting to the EPA via computer files. The format that the reports may take and concern with compatibility of existing software with EPA developed software was also an issue. Some of the relevant comments grouped under the aforementioned headings include:

*Confidentiality*

"Maybe confidentiality"

"Company reluctance to sanction publication of information on internet to be available to 'Worldwide' competitors"

*Security*

"Sign-off reports, security of data (prevent unauthorised changes)"

"Concern re: security/computer viruses validity of data re: legal requirements. Delay in submission of reports resulting from a network failure constituting a non-compliance"

"Electronic signatures, validation/verification of the data (note: corporate use electronic reporting and send a copy of the final data back for verification that the data they received was not corrupt or altered."

"Computer security, Legal interpretation issues"

"Never really sure if files are received intact"

"None, once certain criteria are adhered to such as specific email address and return email is sent from EPA to verify receipt of results"

*Compatibility*

"Ensuring company software systems are compatible with the EPA's"

"Common formats, virus transmission, access (or lack of) to email."

"Lack of internet connection. Fear of using a computer. The form to entry data to being too inflexible, and not very relevant to the licence holder"

"Lack of standard formats"

"This would only be acceptable on condition that it replaces completely the hardcopy method"

"Would need to be clearly defined as there is a temptation to want "everything" once electronic format is available, more is not always better."

"The relevant information may not be on computer and all information received by us in hard copy format e.g. noise survey air emission monitoring results etc"

"Extra time to record data into computer files, certain information may not fit properly in the correct context, need to be able to comment on certain results"

"None - Providing a standard format is established"

"Must allow sufficient scope for additional commentary/exceptions"

## 3.3 INDICATORS

Indicators of performance are a key to continuous improvement and a basic management tool. There has been much recent interest in deriving suitable indicators for business (WBCSD, GRI etc. reported extensively in Chapter 2). A detailed examination of indicators in use was undertaken.

**Are You Familiar with ISO 14031?**

| | Yes | No |
|---|---|---|
| ISO 14001 certified Cos. | 28.2% | 71.8% |
| others | 26% | 74% |

**Table 3.4 Familiarity with ISO 14031**

ISO 14031 – Environmental Management – Environment Performance Evaluation – Guidelines was introduced in 1998 but appears to have had little impact in Ireland. Only 1 in 4 respondents is familiar with it (25%). ISO 14001 certified companies (28.2%) were only slightly more aware of ISO 14031 than other companies (26%).

### *3.3.1 Number of Indicators Used by Licensees*

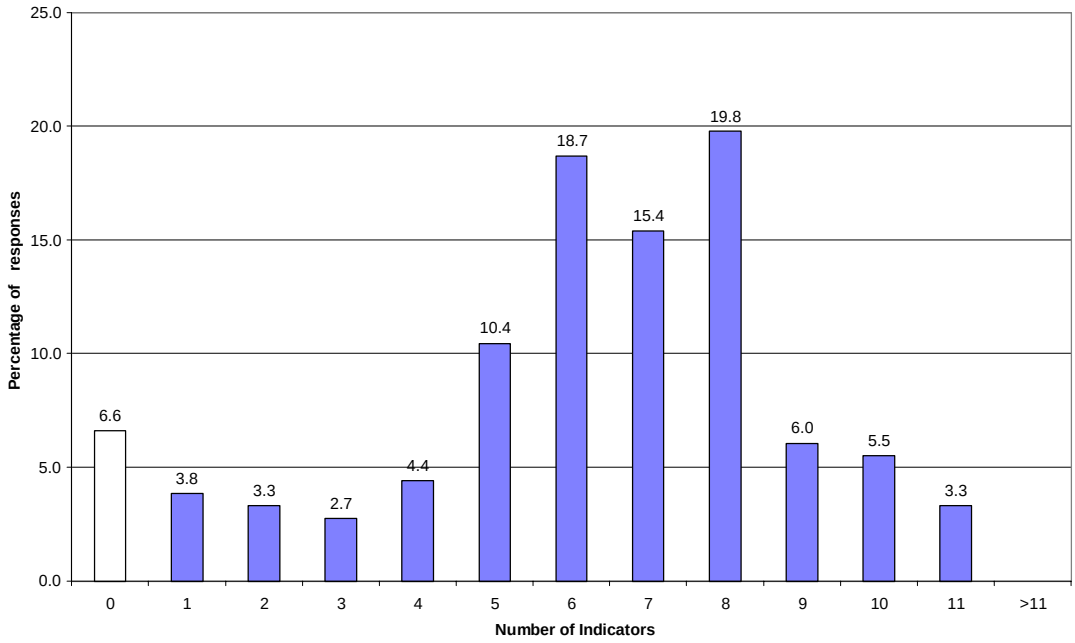



**Figure 3.10 Number of Indicators Used by Licencees**

The vast majority of IPC licensees (91.4%) use environmental performance indicators (EPIs). The average number of indicators used is 6 as shown in figure 3.10.

**Number of Indicators Used by Licensees – Irish Companies vs. Others**

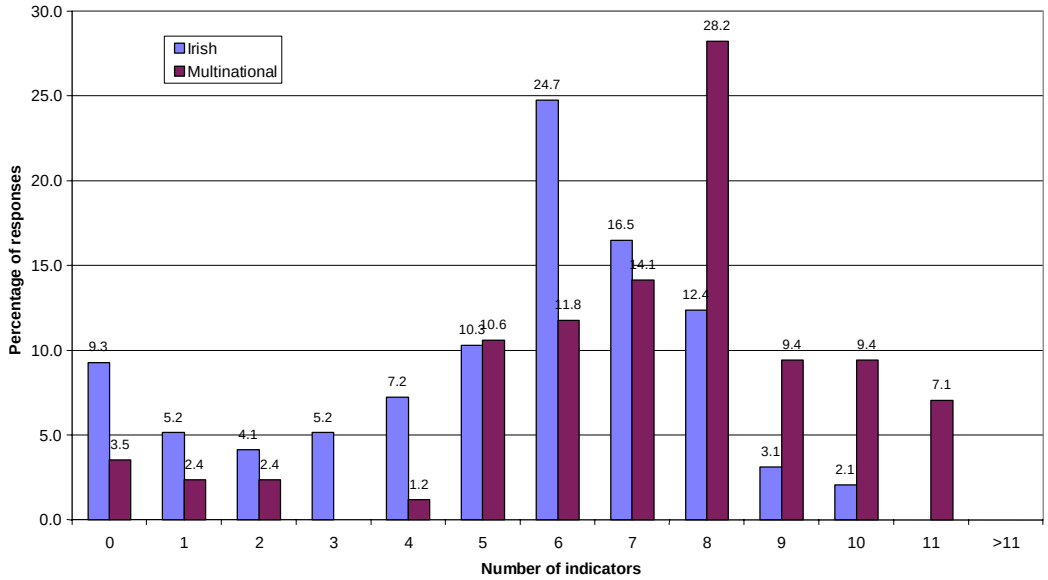



**Figure 3.11 Indicators used – Irish Companies v. others**

The mean number of indicators used by Irish companies is 5.7 while the mean of other companies is 7.4.

**Number of Indicators Used by Licensees with Certified EMS vs. Others**

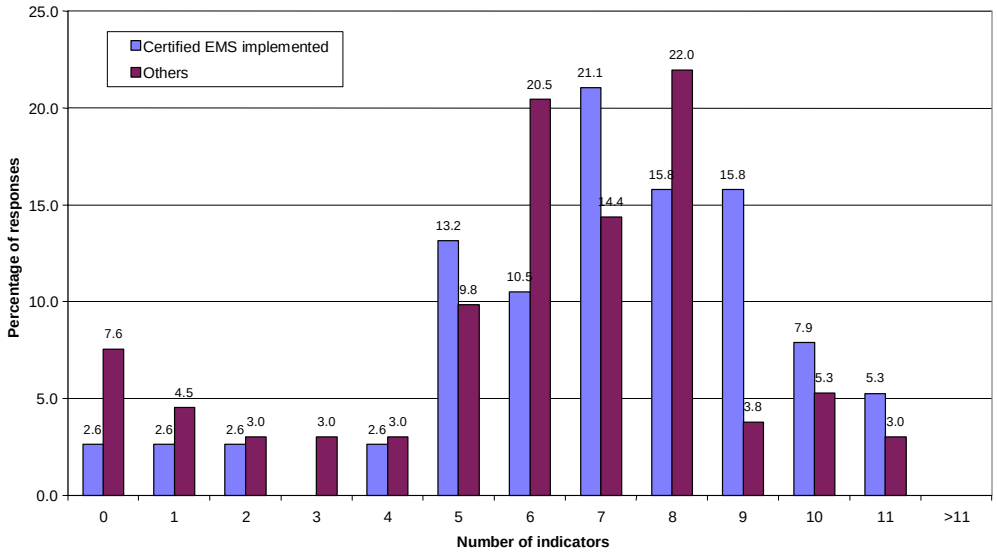



**Figure 3.12 Indicators used – certified EMS v. others**

Certified EMS companies use more indicators than non-certified companies. The mean number of indicators used by certified companies is 7.2 and is 6.5 for non-certified (weighted mean).

### *3.3.2 Which EPIs do IPC Licensed Companies Use?*

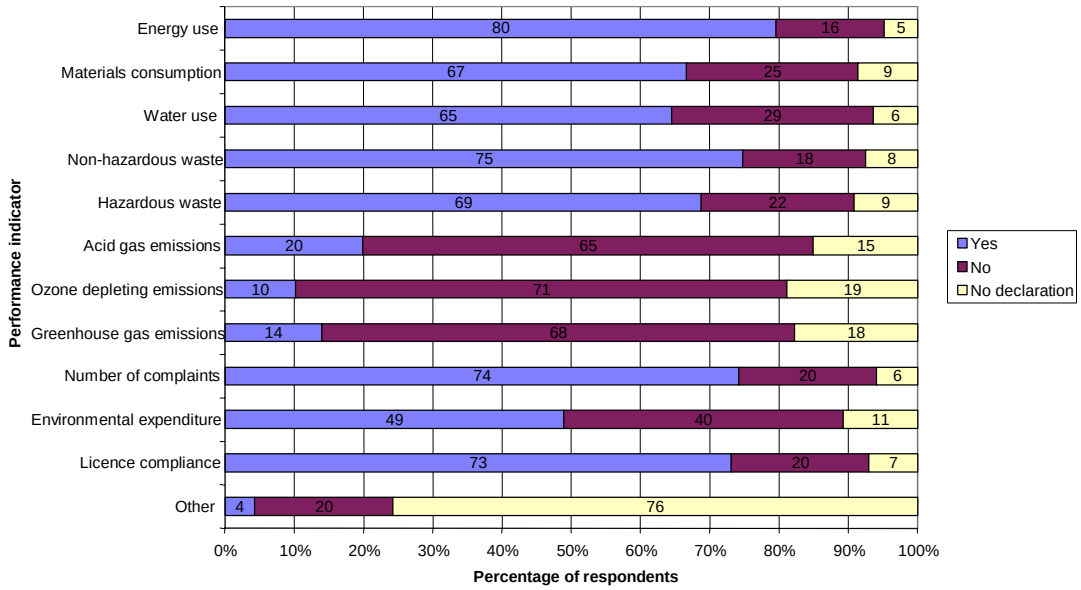



**Figure 3.13 Environmental Performance Indicators used**

The four most commonly used environmental indicators are energy use (80%), non-hazardous waste (75%), number of complaints (74%) and licence compliance (73%). Ozone depleting emissions (10%) and greenhouse gas emissions (14%) are surprisingly low in terms of use as indicators despite the international and national focus on global warming and climate change as the most significant environmental issue worldwide. Energy use may be considered as an indirect measure of greenhouse gas emissions, but energy source must also be considered.

## EPIs Used – Irish Companies vs. Multinationals

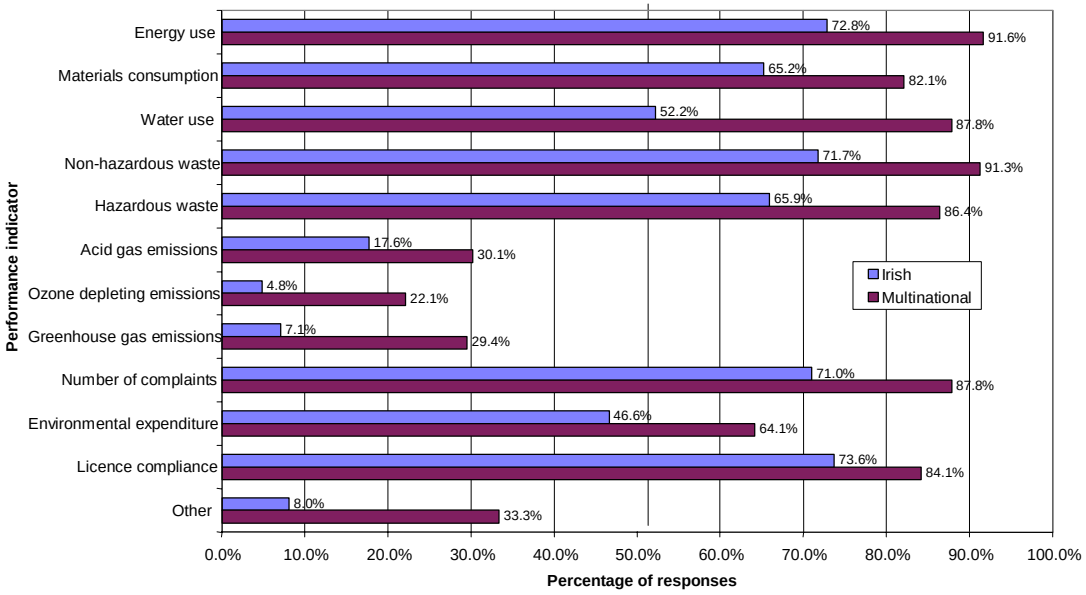



**Figure 3.14 EPIs used – Irish Companies v. multinationals**

Examination of Figure 3.14 shows that without exception, Irish Companies use indicators less than multinational companies. Of particular interest is the use of greenhouse gas emissions as a performance indicator, with multinationals who are more than 4 times more likely to use this measure. A similar pattern emerges for the use of ozone depleting emissions as a performance indicator, although overall both of those indicators are still relatively low in use (<30% in both cases).

**EPIs in Use – Certified EMS vs. Others**

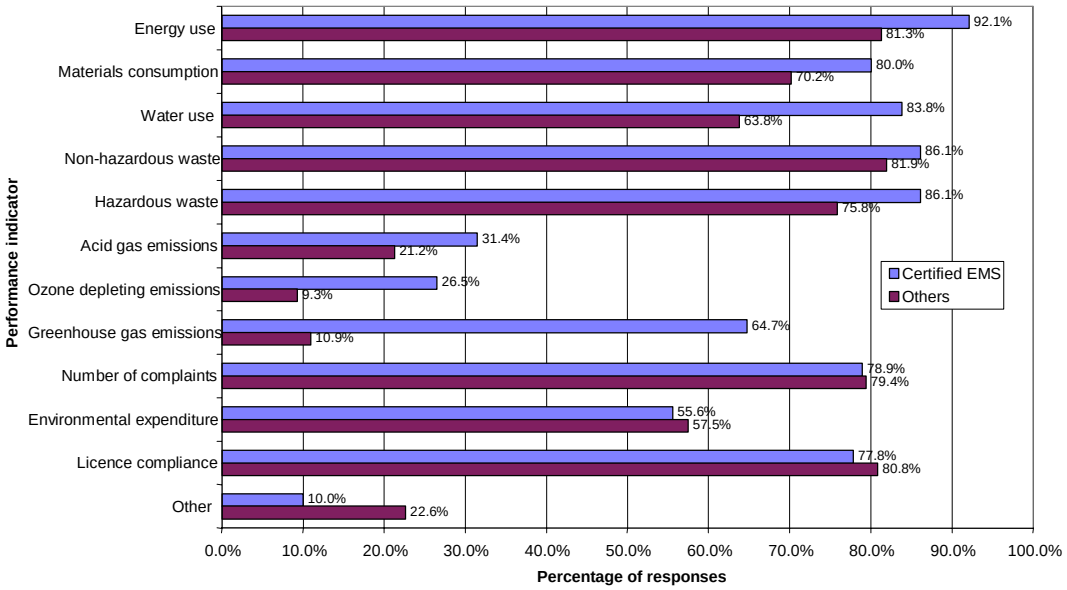



**Figure 3.15 EPIs used – Certified EMS v. others**

Companies with a certified EMS are more likely to use an indicator. This is most pronounced for the air emissions indicators.

### *3.3.3 Level of Detail*

Companies were asked to report on the level of precision they use in indicators.

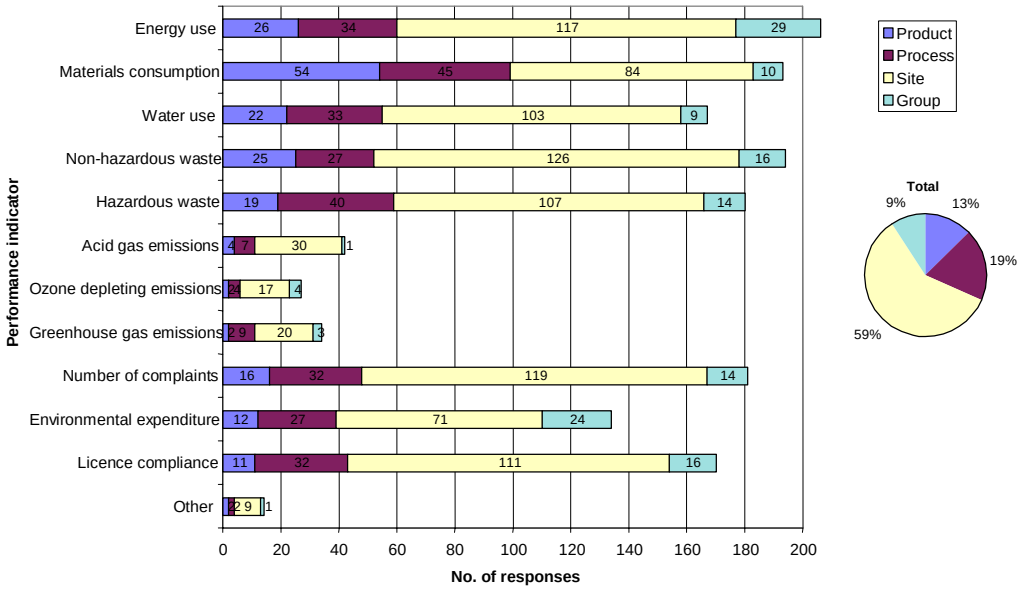



**Figure 3.16 Level of detail in use of indicators**

Use of indicators on a product (13%) or process (19%) basis is relatively low. The majority of indicators are used on a site-wide basis (59%). While this provides an overall performance picture, the lack of detail means that the identification of areas for improvement is more difficult. Less than 10% of respondents use indicators on a group-wide basis (facilitating performance comparisons between sites in the same group), hence benchmarking between sites is difficult.

## Do You Adjust for Production

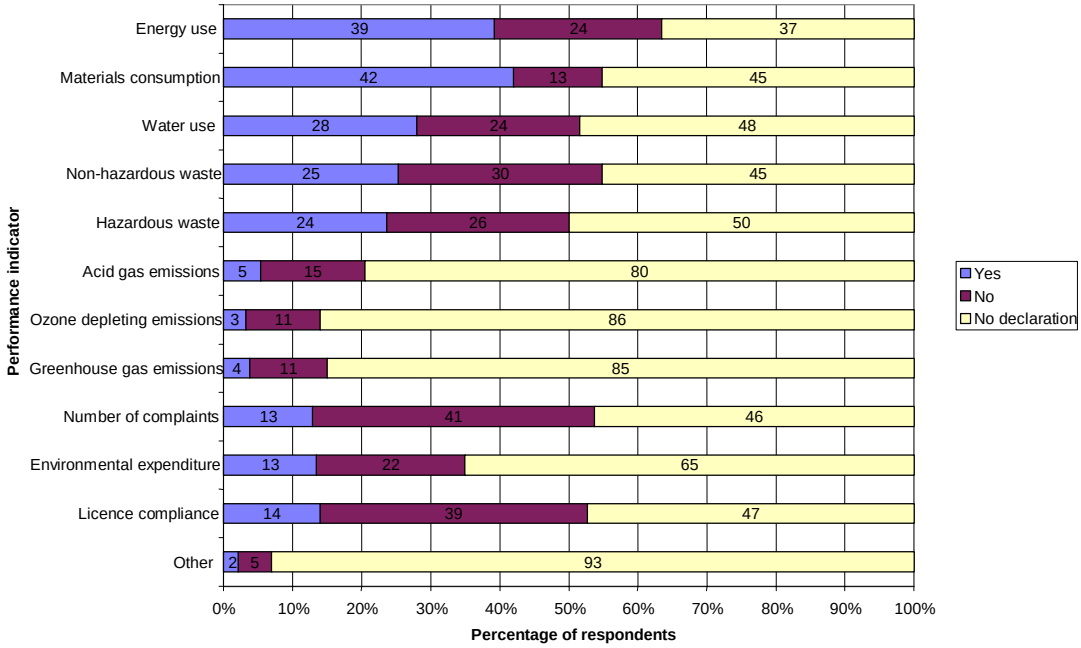



**Figure 3.17 Adjusting for production when using indicators**

Adjusting for production (normalising) is most commonly used for energy (39%) and materials consumption (42%). These indicators are commonly used in process /product efficiency analysis. Water use (28%) and waste generation (non-hazardous 25%, hazardous 24%) are also relatively popular indicators that are adjusted for production.

## Opinions on Use of Indicators

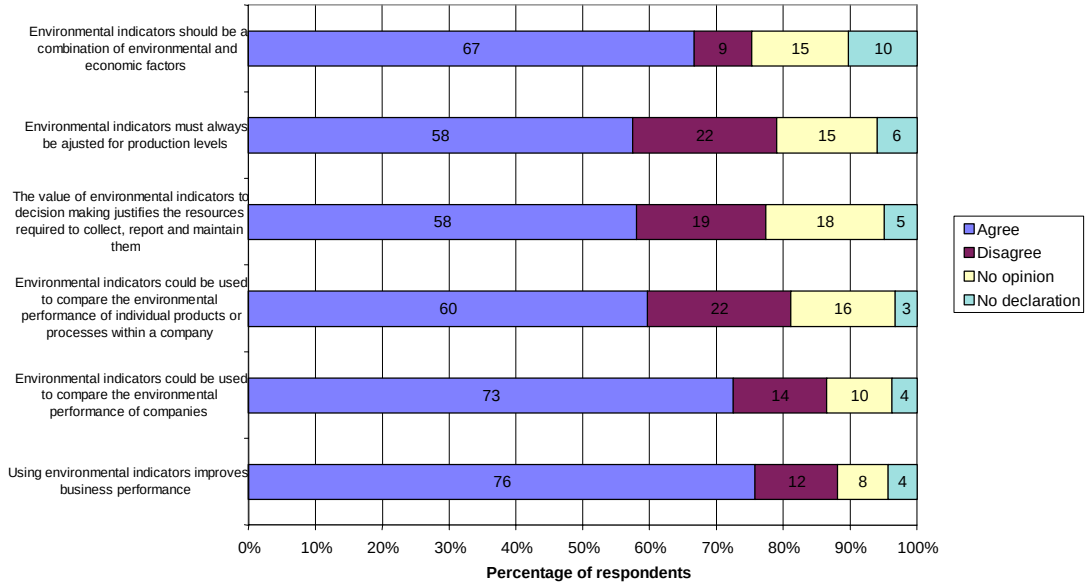



**Figure 3.18 Opinions on use of indicators**

The opinion most agreed with by respondents (76%) is that using environmental indicators improves business performance. This indicates a positive approach to the use of indicators by licensees. Looking at environmental performance at a process or product level and adjusting for production were the 2 opinions most disagreed with by respondents (22%). The combination of environmental and economic factors in environmental indicators had some favour.

**Do You Plan to Develop Your Use of Environmental Indicators?**

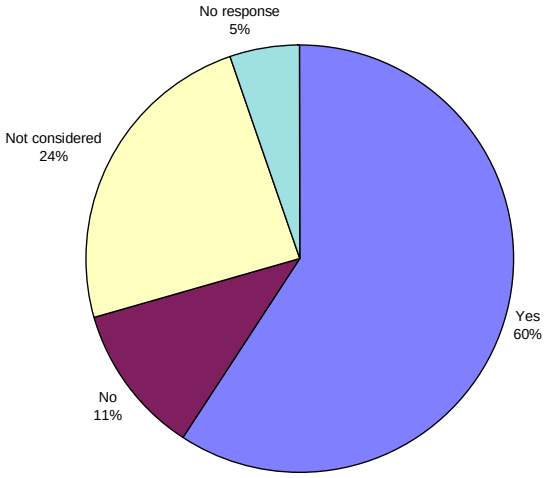



**Figure 3.19 Developing use of indicators**

The majority of licensees (60%) plan to develop their use of environmental indicators. Only 1 in 9 (11%) respondents answered in the negative.

One respondent commented that indicators currently measured at a site level will be examined at a product/process level and that they plan to link with production volumes to facilitate forecasting volume assessment for environmental impacts. Another respondent stated that environmental indicators will be incorporated into the EMS plan. One company has requirements for comprehensive indicator measurement and reporting. They will be conducting mass balances for all VOC's and highly hazardous substances. Energy usage per unit of production and waste to landfill per unit of production are being monitored by one licencee.

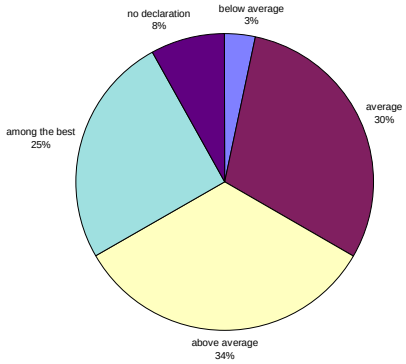
The need to reference indicators to products, process and volumes of production was also commented on. In the opinion of one respondent initially most of IPC requirements mean lots of monitoring. This takes up a lot of time resources. Indicators later become useful.

The Register of Impacts of one licencee was being updated with a view to normalising all performance data in terms of production.

## 3.4 BENCHMARKING

A primary purpose of this project is to assess the potential for benchmarking. To this end, existing experiences with benchmarking other activities as well as environmental benchmarking were examined.

**How Do You Rate Your Environmental Performance Relative to Comparable IPC Regulated Companies?**




The majority of companies (59%) saw themselves as being above average (34%) or among the best (25%). Difficulties in comparing companies with few/no competitors in Ireland were highlighted as a barrier to making a satisfactory decision. 3 in 10 companies saw themselves as average in terms of environmental performance with only 3 in 100 declaring their sites performance as below average.

**Figure 3.20 Performance rating**

**How do you arrive at this decision?**

Companies base their decisions on a number of factors including the following:

| Respondent Comments |
|---|
| *Having ISO 14001 makes certified companies better than non-certified rivals*<br>"We are one of the first companies in our class to achieve ISO 14001" |
| *Level of complaints/non-compliances – from EPA Report*<br>"From figures collated and "IPC licensing and Control" reports"<br>"By comparison with statistics from EPA annual reports"<br>"What is reported in the EPA newsletter"<br>"A combination of IPC licence audits and general environmental performance" |
| *Visits to other companies*<br>"Have visited other comparable operations"<br>"Have inspected other sites and comments from others whose regularly visit other sites (eg sales reps)"<br>"By visits to other IPC licensed companies and comparing what they have done with our improvements" |

| |
|---|
| *Industrial forum*<br><br>"Access EPA reports and networking with industries through formal channels"<br><br>"Meetings with other similar facilities"<br><br>"Based on EPA reports and on information gathered from other companies via sector (IPCMF) meetings"<br><br>"Communications with other facilities, consultants etc"<br><br>"Discussions at IBEC with similar companies" |
| *Study of other company AER's*<br><br>"Comparison of reports (AER's) from other sites"<br><br>"Compare company IPC AER with that of competitors/comparable companies" |
| *Formal benchmarking*<br><br>"By comparing results with fellow producers in Europe"<br><br>"Benchmarking against local companies of other companies within group"<br><br>"Benchmarking what our competitors are doing/not doing" |
| *Environmental Considerations in Plant Design*<br><br>"The factory is completely new and all environmental impacts were considered on building the site in terms of using water-based materials instead of solvent based ones, noise reduction, recycling of waste etc." |
| *Environmental Considerations in Plant Design*<br><br>"The factory is completely new and all environmental impacts were considered on building the site in terms of using water-based materials instead of solvent based ones, noise reduction, recycling of waste etc." |

These comments are largely qualitative. There is little formal benchmarking carried out by questionnaire respondents and very little use of quantitative indicators.

## Have You Benchmarked for Non-environmental Purposes?

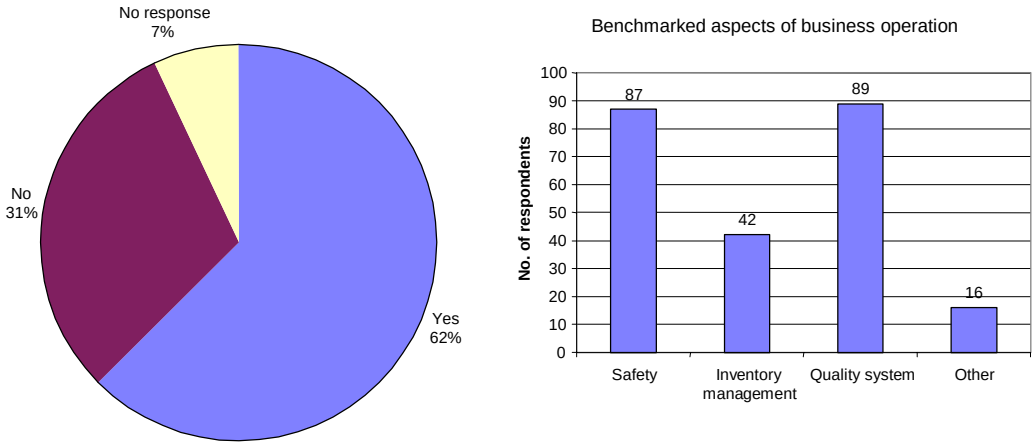



**Figure 3.21 Non-environmental benchmarking**

Nearly two-thirds (62%) of respondents have benchmarked for non-environmental purposes. Benchmarking for quality and safety are most common (48% and 47% of respondents respectively).

Some of the comments of respondents regarding benchmarking are:

"It can be difficult in getting comparable information. There is the danger of comparing apples with pears"

"Benchmarking of company performance carried out by Danish Meat Research Institute (D.M.R.I)"

"The corporation is committed to benchmarking as a strategy to improve business results." "This has been limited to benchmarking with the corporation/sector but this is changing to include other sectors over the next few years"

"Difficult to compare and use consistent applicable indicators"

## Have You Benchmarked for Environmental Purposes?

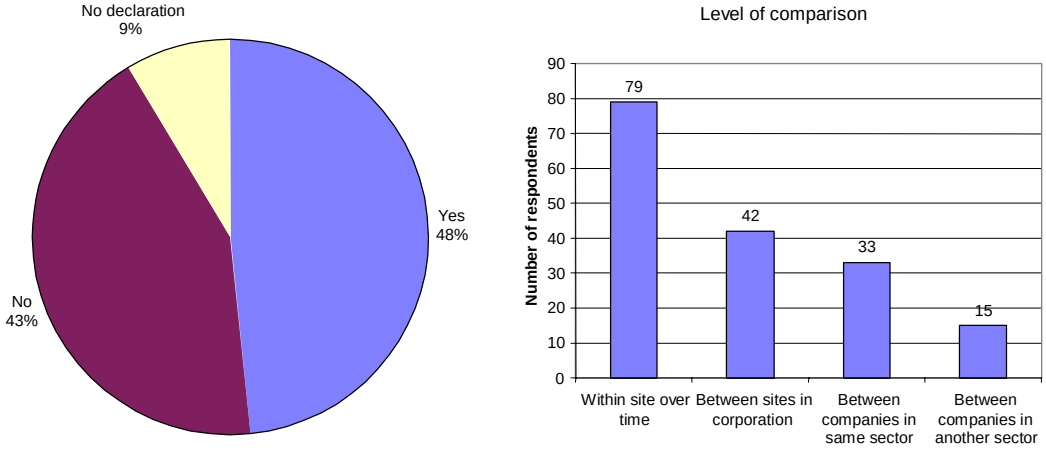



**Figure 3.22 Environmental Benchmarking**

This question interprets 'benchmarking' in its widest sense. There is a view that benchmarking applies to comparisons between sites or companies, rather than a solely internal reflection. Almost half of all respondents claim to have benchmarked for environmental purposes (48%). 79 licensees (42%) benchmark within the site over time. 42 respondents (22%) benchmark between sites in the same corporation while 33 licensees (18%) benchmark between companies in the same sector. 15 companies (8%) claim to have benchmarked between companies in another sector.

## Benchmarking – Irish Companies vs. Multinationals

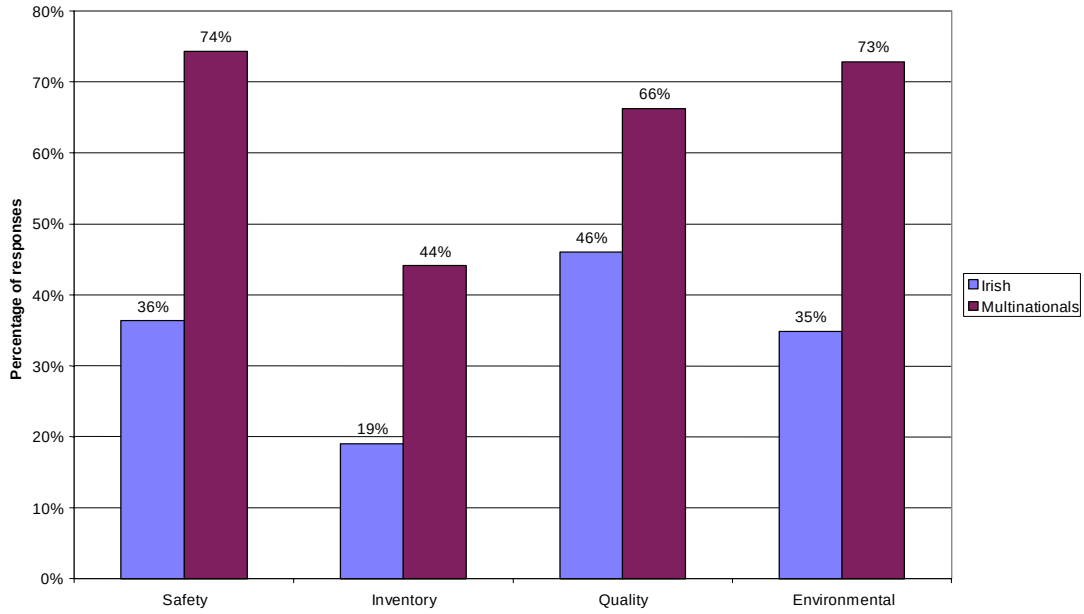



**Figure 3.23 Benchmarking – Irish Companies v. multinationals**

In general benchmarking is more commonly practiced amongst the multinational companies. It is more than twice as likely for benchmarking safety, inventory and environmental that it be carried out by multinational companies. Only quality benchmarking has a relatively high profile (46%) in Irish companies and it is still behind the multinationals at 66%.

## Benchmarking – Holder of ISO 14001 or EMAS vs. Others

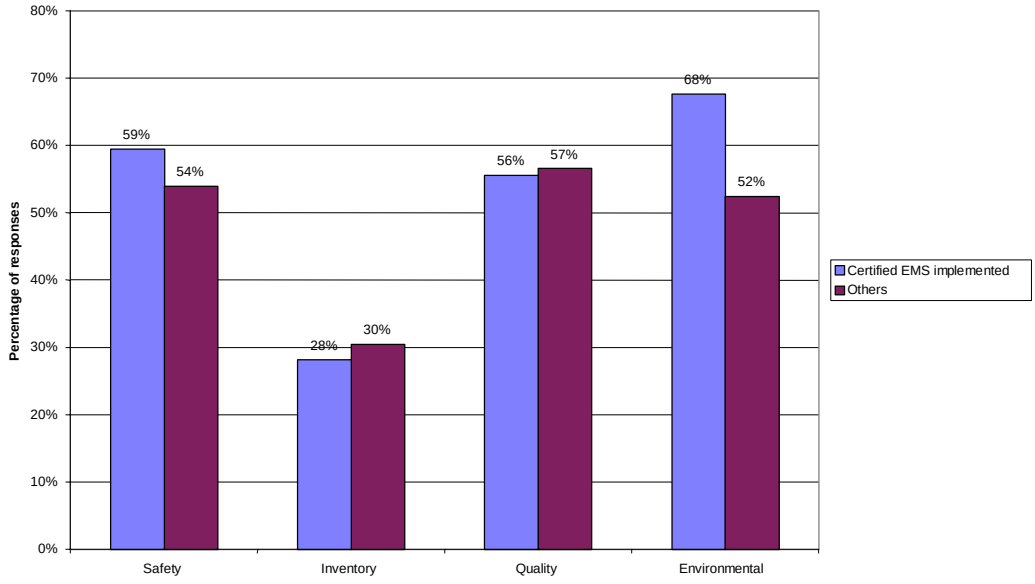



**Figure 3.24 Benchmarking – Certified EMS v. non-certified EMS**

Companies with certified EMS are more likely to be involved in environmental benchmarking than non-certified companies (68% versus 52%).

## Benchmarking in IPC Licensed Industries

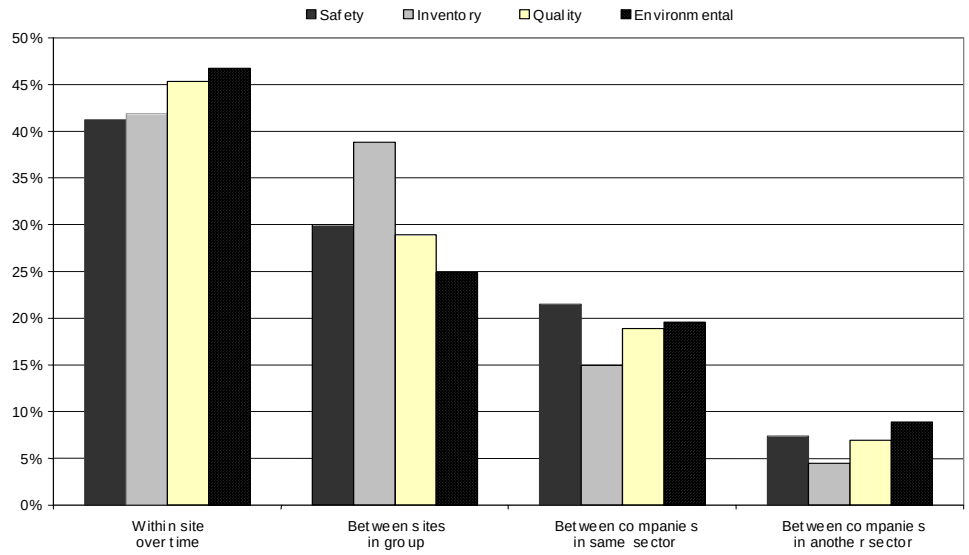



**Figure 3.25 Benchmarking in IPC Licensed Industries**

There is a similar pattern, as evidenced by the columns in the chart, across the four benchmarking groups of safety, inventory, quality and environmental when comparing all four site-wide, company-wide and industry-wide in terms of level of use.

## Environmental Benchmarking – Irish Companies vs. Multinationals

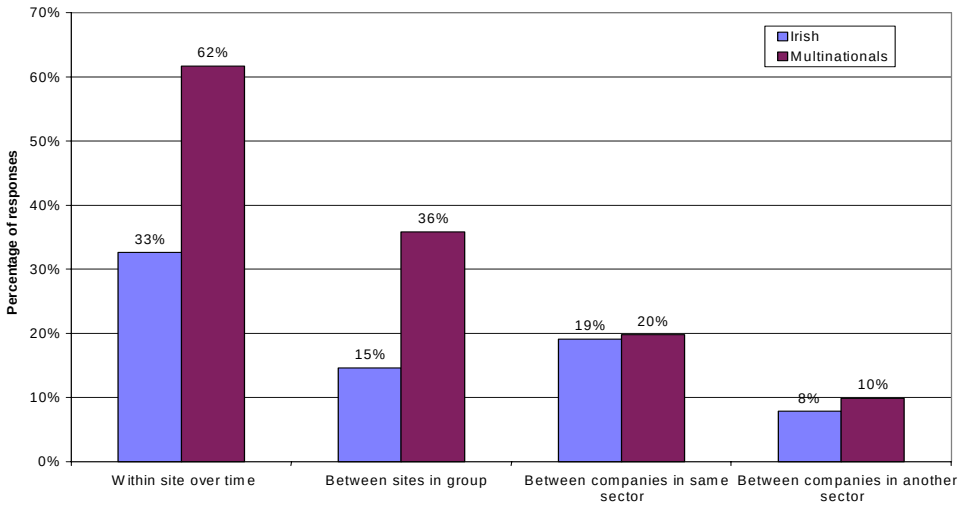



**Figure 3.26 Environmental Benchmarking – Irish companies v. multinationals**

33% of Irish companies benchmarked within the site compared with 62% of multinational companies.

## Environmental Benchmarking – Holder of ISO 14001 or EMAS vs. Others

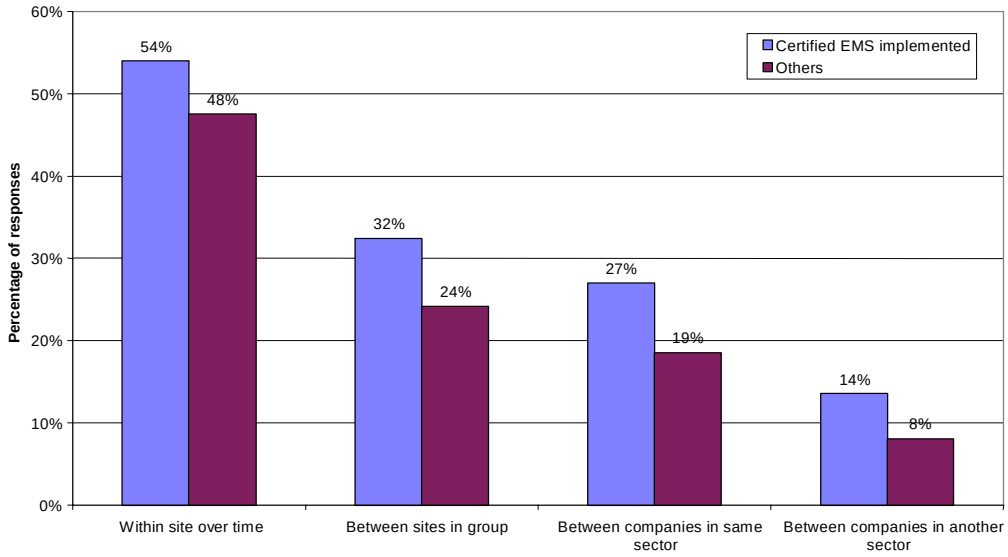



**Figure 3.27 Environmental Benchmarking – Certified EMS v. Non-certified EMS**

Companies with certified EMS participate in environmental benchmarking more than non-certified companies as can be seen from Figure 3.27.

## Have You Benchmarked for Environmental Purposes?

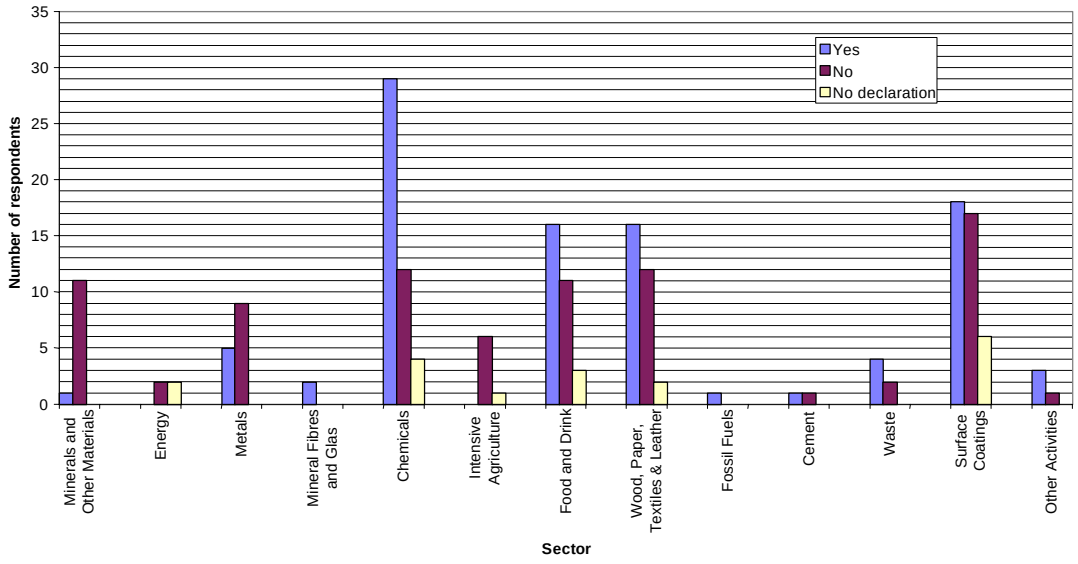



**Figure 28 Have you benchmarked for environmental purposes?**

In terms of number of respondents (29) and percentage of respondents within a sector (64%) the use of benchmarking is most prevalent in the chemicals sector.

**What are the advantages of benchmarking?**

Key advantages of benchmarking identified by respondents are:

- "Leads to best practice"
- "By examining leader, methods can be determined to reach the proposal goals"
- "Learn and adopt other companies achievements"
- "Insight into what is possible and practical"

| Respondent Comments |
|---|
| "Leads to best practice. Keeps you aware of progress" |
| "Continuous assessment of environmental performance" |
| "Helps to identify areas where improvements could be achieved by comparing performances within similar industries" |
| "Learn and adopt other companies achievements" |
| "Improves performance of company over time to the benefit of the environment, & usually economically also" |
| "To see if someone is doing the same thing but better and cheaper, and how to do the same" |
| "It gives a company a real indication of performance rather than relying on estimation" |
| "To see exactly where you are at and where you need to be" |
| "Insight into what is possible and practical" |
| "Gauge standard" |
| "Identifies area for improvement" |
| "By examining leader, methods can be determined to reach the proposed goals" |
| "Information on new technology, addressing issues and not reinventing information" |
| "Unambiguous data about the performance of an organisation even time which can be linked to other key business indicators and used in goal setting and action planning" |
| "Keeps companies on right road. Removes isolation" |

**What are the difficulties in benchmarking?**

The main difficulties in benchmarking identified by respondents are:

- "Comparing like with like"
- "Few or no companies in the same sector for comparative purposes."

| Respondent Comments |
|---|
| "May not be comparing like with like" |
| "There are not enough other Irish companies of similar size and industry to compare ourselves with" |
| "Similar industries may have variations in the types of processes, equipment and levels of automation employed in their operations" |
| "Getting appropriate information. Potential for spending great effort for little return" |
| "Comparable companies may be difficult to find so you may be benchmarking against companies with greater resources." |
| "Time restraints" |
| "Accurate, valid measurements" |
| "Making fair comparisons ("apples with apples") is very difficult the best solution has been to use simple broad measures" |
| "Agreeing what to benchmark and how to measure it consistently between sites and over time" |
| "Must ensure that any comparison that is made takes account of specific industry constraints, e.g. Standard for pharmaceutical companies may not be a reasonable or realistic goal for different industry sector" |
| "Difficult to compare like with like i.e. existing vs. new plant, small operation vs. large operation different assimilative capacity in ambient environmental" |

**Any further comments or suggestions you wish to make regarding benchmarking, EMS or reporting?**

| Respondent Comments |
|---|
| "Have you benchmarked your project? What are the Americans, Europeans and Australasians doing?" |
| "Will there be any anonymous listing of benchmarking performance indicators available from the EPA website which can be used for assessing performance" |
| "A standard reporting software package for IPC reporting (especially monthly reports) would be an excellent tool. This is the most time consuming activity and would give the greatest benefit." |
| "Managing EMS can and often do become more important than the processes they are supposed to control. I don't believe management systems are as 'Hands On' as they should be and most are cumbersome and required a lot of management time to operate." |

**Companies that benchmark between sectors on environmental matters**

15 companies had answered yes to the question: have you benchmarked for environmental purposes between companies in **another** sector?

All the companies were contacted and responses elicited from 7 of them. The companies were asked why they benchmarked with a different sector, how was this benchmarking process carried out, and what were the advantages/disadvantages. They were also asked what changes were made subsequently, what would assist them to benchmark in the future and what would assist other companies.

1. Company A – Wood Pulp Processor

The company compares the environmental performance of local companies with their own performance by looking at the Annual Environmental Reports in the EPA offices. Process improvement is the main driver for environmental improvement through the EMP. Trade magazines and equipment suppliers are sources of process/environmental information. The company benchmarks on environmental performance/best practice through its involvement in the Environmental Committee of the Wood Panels Industries Federation (Ireland/UK) and the Technical committee of its European federation counterpart. Resin suppliers pass on information on technical developments in other companies. On a corporate level the company has over 100 sister plants in the US with whom performance is compared. The site uses ESB in an energy consultancy role.

2. Company B – Meat Processor

Although Company B are using indicators they are not using them in a management context at the site. The respondent stated that the indicators may be used by a group co-ordinator to compare site performance within the group, although there was no feedback to site. He suggested that benchmarking would be useful in generating a performance league table and to indicate where improvements can be made in individual areas.

3. Company C – Electrical Household Goods Manufacturer

EMS training course attendees audited Company C's EMS and compared it against

- the ISO 14001 standard and
- the EMS training course attendees own company's performance.

Company C currently only measure energy as an environmental indicator. They are finding that despite a focus on energy through their environmental projects that even when normalising for production energy consumption is continuously increasing (this was attributed to using more energy intensive machinery and the 'Celtic Tiger effect', namely stepped increases in production output in parallel with national economic growth).

Company C Corporate has a system for measuring consumption which the respondent is not familiar with.

4. Company D - Refining

Company D concentrate on benchmarking against other companies in their own sector. There are 100 competitors in Western Europe. There is freely available published literature on environmental performance within the sector through an Industry grouping. Information is available on product quality, emergency planning, effluent and air emissions.

There is an industry survey every 2 years in the sector giving a country by country breakdown. This highlights areas where the refinery is better or worse than average. The main focus for the site is on energy and water consumption. Other benchmarking surveys are from a commercial standpoint but cover energy, safety and reliability from a cost perspective.

5. Company E - Lens Manufacturer

Company E is a member of an Environmental Club, which has had three meetings to date. The central topics of these meetings were ISO 14001, EPA AER Report and energy conservation (in conjunction with the Irish Energy Board). Future meetings are planned for individual member sites and benchmarking for comparative purposes is on the agenda.

Indicators already used by Company E include energy, air emissions, IPCL eco-index and solvent usage, to establish where they are versus the norm. Company E has had discussions on environmental matters with competitors in the same sector. The company is involved in benchmarking for quality, operator performance and training in its pursuit of 'World Class Performance'.

6. Company F - Engineering

Company F compare their ELVs (IPCL) with those of other companies in the same sector across Europe. Ideas for improvement and other environmental information comes from suppliers and sister companies in Europe. They compare limits and the methods of meeting them.

7. Company G - Inorganic Chemicals

Cross-compare targets and actual performance in other sector companies (e.g. noise limits and reduction programmes against noise surveys). The company looked at other sectors to see what companies are achieving, what fuels are used etc.

It can be seen from the responses that interpretation of the meaning and application of benchmarking varies from company to company. Environmental benchmarking is more than twice as likely to be carried out in multinational companies when compared with Irish companies. Having a certified EMS (ISO 14001 or EMAS) does not result in a significant difference in participating in environmental benchmarking when compared to non-certified companies. The next chapter focuses on opportunities for developing environmental benchmarking between IPC licensed companies using information already submitted to the EPA and identifying additional information that may be required. The electronic format that this information should be made available in is also introduced but is elaborated in Chapter 5, Reporting Recommendations.

# 4 Needs and Wants

An assessment of beneficiary needs and wants of the Agency and of the companies has been carried out.

## 4.1 EPA needs and wants

The objective of this section was to define EPA needs and wants with regard to reporting to the Agency to facilitate environmental benchmarking in IPC licensed industries. Existing IPC licences, EMP reports, existing emissions self-monitoring reporting requirements, EPA monitoring regimes and the EPA Annual Environmental Report (AER) Guidelines were examined to develop a specification of EPA needs and wants.

### *4.1.1 Existing Reporting Requirements*

*AER Submission of Summary Information in Electronic Form*

The EPA requires IPC Licensees to provide AER Summary Information in electronic format (from 2001).

The AER Summary Data Table is on the EPA website (www.epa.ie), through the IPC link of the Licensing Page. The table may be downloaded and emailed to IPCaer@epa.ie on completion, submitted on diskette or printed-off (least desirable option). The AER Summary Data Table requires the following information fields to be completed:

- Emissions to waters
- Emissions to air
- Boiler emissions to air
- Energy Consumption
- Waste produced (total waste, non-hazardous waste and hazardous waste)
- Water consumption
- Environmental complaints
- Environmental Management System Accreditation
- Information on each waste stream
- Pollution Emission Register

More detailed information on the AER Summary Data Table content is appended to this report (Appendix I) or can be viewed at http://www.epa.ie.

*Additional AER Reporting Requirements*

In addition to the requirement for submission of summary information in electronic format as described above, the AER also requires additional information to be provided in hard-copy format. The following summary of the AER report structure suggests electronic formats (where possible) for future reporting purposes.

### *4.1.2 AER Report Structure*

*Introduction*

Licence Register No. (this information is also required in electronic form in the AER Submission of Summary Information).

Name and location of the site (this information is also required in electronic form in the AER Submission of Summary Information).

Brief description of the Activities of the Site (this can easily be specified as a word document).

Company Environmental Policy (best provided as hard-copy of signed original).

Company Organisation Chart for Environmental Management (hard copy or a software tool could be specified).

*Summary Information* (as described previously, currently an electronic reporting option)

*Management of the Activity*

Schedule of Objectives & Targets (could be easily specified as Word/Excel file).

Environmental Management Programme (EMP) for the current year (could be easily specified as Word/Excel file).

EMP proposal for the following year (could be easily specified as Word/Excel file).

Pollution Emissions Register (PER) (already included in Summary Information Section of AER).

Other significant environmental aspects, audits or expenditure as appropriate.
*Licence Specific Reports*

Reports specified in the reporting schedule of the IPC licence.

Examples include:
- Noise survey
- Bund Integrity Testing
- Hydrogeological Investigation
- Toxicity Testing
- Residuals Management Plan
- Environmental Liabilities Risk Assessment
- Firewater Retention Study

This information is not requested in electronic format. Reports may be large but summaries could be specified as Word/Excel files.

### *4.1.3 Recurring Reporting Requirements*

IPC Licensees submit information on a recurring basis (e.g. monthly, quarterly, annual etc). Refer to Recurring Reports table in Appendix II. The recurring report structures are not standard. A cover page detailing the number of environmental complaints and licence non-compliances is an EPA requirement from the time when a licensee first applies for an IPC licence (this reporting requirement also applies to Air Pollution and Water Pollution Licences while an IPCL is determined). This is currently the only standardised format.

Proposed standard lists of parameters for wastewater discharges are provided in Appendix III, in addition to a monthly results template and a monthly results summary sheet.

Atmospheric emissions reporting requirements, based on EPA monitoring reports are provided in Appendix III along with TOC, TA Luft VOC, flue gas and particulates measurement tables. Monthly summary templates for process and boiler emissions to air are also provided.

Noise emissions recording and reporting, based on EPA monitoring reports, as well as materials and energy consumption and environmental complaints summary monthly templates are included in Appendix III.

The annual EMP report could be utilised as a source of useful Management Performance Indicators if a standardised tabular format were introduced for EMP reporting. A table in Appendix III is proposed for this purpose.

Ambient groundwater, air and surface water monitoring are IPCL recurring reports. A list of groundwater parameters is included in Appendix III. Ambient air and surface water are less common reporting requirements.

Templates for Hazardous Waste Disposal and Other Waste Disposal are provided in Appendix III.

# 5 Reporting Recommendations

## 5.1 Introduction

A very large range of environmental performance data is reported by licensees to the EPA. The aim of this chapter is to suggest how this data may be used in the preparation of generic performance indicators and in combining with measures of financial performance. Furthermore the chapter describes how indicators should be presented to facilitate comparison and interpretation between companies.

At the end of the chapter examples of management performance indicators are listed and an approach is shown on how to generate a key indicator of an EMP.

This section does not intend to give a complete set of indicators due to the variation of the business of licensees, but provides a core set that will be generally applicable.

## 5.2 Data reported by licensees

Existing licence requirements of the Annual Environmental Report (AER) demand the following data to be reported:

Operational Performance Indicators (OPIs)

| | | |
|---|---|---|
| • **Emissions**<br>o To Atmosphere<br>▪ Boiler<br>▪ Others<br>o To Waters<br>▪ Freshwater<br>▪ Sewer<br>▪ Sea | • **Energy Usage**<br>o Heavy Fuel Oil<br>o Light Fuel Oil<br>o Natural Gas<br>o Electricity<br>o Coal | • **Water Consumption**<br>o On-site groundwater use<br>o On-site surface water use<br>o Municipal water use |
| • **Pollution Emissions Fate**<br>o To Air<br>o To Liquid Effluent<br>o To Waste<br>o To Product<br>o To Recovery<br>o Treated | • **Waste Fate**: disposed of/recovered (method) – on-site/on-site<br>o Total<br>o Non-hazardous<br>o Hazardous | |

Management Performance Indicators (MPIs)

| | |
|---|---|
| • **Environmental Complaints**<br>o Odour<br>o Noise<br>o Water<br>o Air<br>o Procedural<br>o Miscellaneous | • **EMS Accreditation**<br>o EMAS<br>o ISO 14000<br>o Certification Pending |

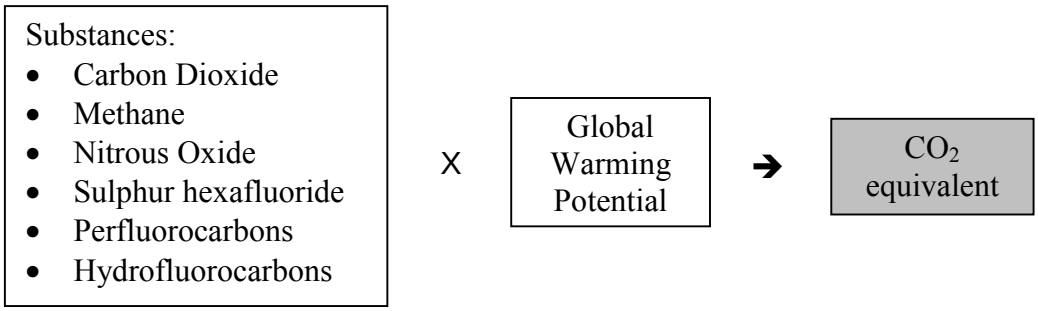
## 5.3 Generic Key Indicators

Faced with a wide range of performance data and the diversity of licensed companies, we have sought to identify a core set of generic indicators that will be generally applicable. In suggesting these we have been guided by international practice as recommended by bodies such as the World Business Council for Sustainable Development, the Global Reporting Initiative, and OECD and the various EPA reports on the state of Ireland's environment. We have also considered the results from the Survey of Industrial Practice and have therefore chosen to provide a small number of recommended parameters, rather than a more extensive range, that might be less likely to be adopted in the near-term. We recommend the following key indicators:

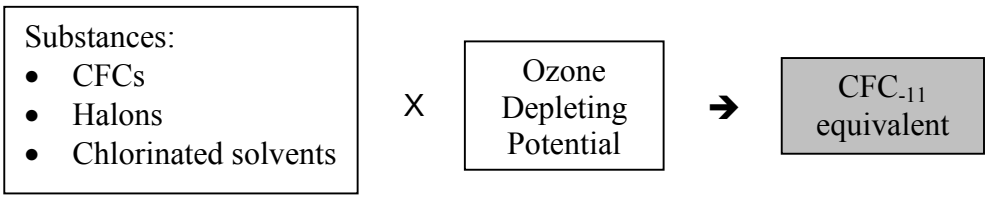
1. Global warming contribution
2. Contribution to ozone depletion
3. Contribution to acidification
4. Non-renewable primary energy input
5. Total water use
6. Total waste disposed of

The latter two of these may be subdivided, as shown below. The initial four indicators aggregate emissions of numerous substances, and hence a "conversion" or "transformation" step is required to achieve equivalent values.

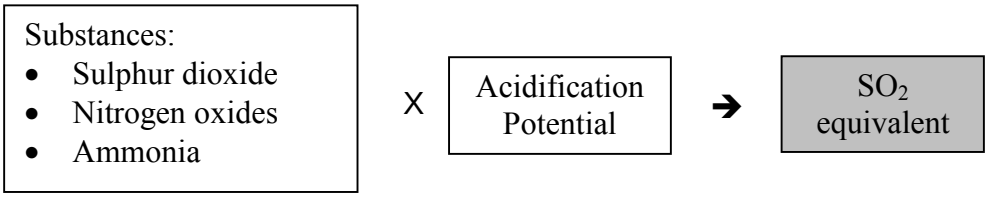
Global warming contribution:[3]




Contribution to ozone depletion:[4]




Contribution to acidification:[5]

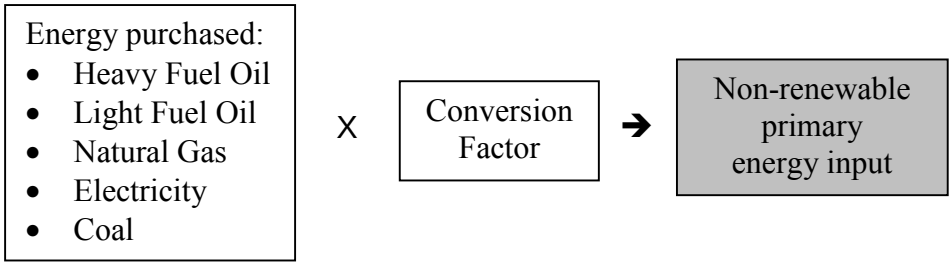



The results of the calculations above are a corresponding $CO_2$, $CFC_{-11}$ and $SO_2$ equivalent.

In addition a figure can be calculated from total energy consumption, which shows a company's depletion of non-renewable energy sources.

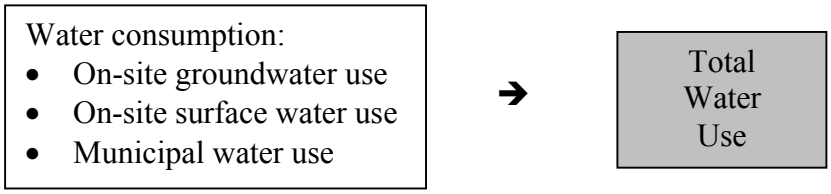
[3] Substances as defined in the Kyoto Agreement
Global Warming Potentials: $CO_2$: 1; $CH_4$: 21; $N_2O$: 270; $SF_6$: 23,900; PFC: 7000 to 9200; HFC: 140 to 9800
For more information see IPCC 1996 (Intergovernmental Panel on Climate Change)
[4] Substances and Ozone Depleting Potentials can be found in the Montreal Protocol 1987 and IPPC 1996
[5] Convention on Long Range Transboundary Air Pollution (LRTAP); EMEP/CORINAIR Atmospheric Emission Inventory Guidebook (Second edition)
Acidification Potentials: Ammonia: 1.88; NOx: 0.7; $SO_2$: 1 (From Eco-Indicator '95, RIVM (NL Environmental Ministry))

Non-renewable primary energy input:[6]

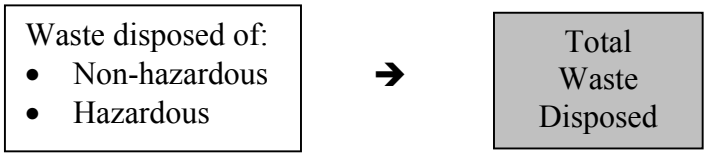



Further key indicators should be calculated from water usages and waste generation.

Total water use:




Total waste disposed of:[7]




In order to include the economic performance of a company Eco-efficiency indicators based on the recommendations of WBCSD, OECD, GRI should be calculated. The eco-efficiency concept represents a ratio of an environmental and economic indicator.

The following definition reflects the view of an environmentalist. It is also possible to calculate an eco-efficiency indicator as the reverse ratio.

$$Eco-efficiency\ indicator = \frac{environmental\ \ performance\ indicator}{financial\ \ performance\ indicator}$$

Equation 5.1

Eco-efficiency indicators: combining environmental and economic performance

[6] Conversion factors [kWh/kWh]: Heavy fuel oil: 1.3; Light fuel oil: 1.3; Natural gas: 1.27; Electricity from the grid (UCPTE): 3.07; Coal: 1.2
(Source: Ellipson – Standardised Eco-Efficiency Indicators; Jan 2001)

[7] This means all non-product output and therefore includes material that rapidly becomes (or might become) waste, e.g. packaging.

*Environmental performance:*

It is recommended to use the generic key indicators described above to reflect environmental performance.

*Financial performance:*

The financial performance measure should reflect the same scope as the environmental performance. This means if a licensee calculates environmental indicators considering the whole life-cycle of its products and services the appropriate financial indicator would be **sales** because

| Sales is a financial figure that accumulates value added over the whole life-cycle or value chain up to the point where the last company transfers it to the customer. |
|---|

However, in the majority of cases, where licensees will calculate environmental indicators from energy used, emissions produced and waste generated by their own activities alone, not considering environmental impacts from suppliers or customers, **value added** is the appropriate financial indicator. Value added is defined as:

| Value added = Sales – Costs of goods and services purchased |
|---|

Important note:

| A decrease of the eco-efficiency indicator (see Equation 5.1) indicates a positive trend. This is the case with environmental indicators which consider a decrease as positive. If reverse ratios have been used, with the same environmental indicator in the denominator of the ratio, an increase indicates a positive trend. |
|---|

## 5.4 Quantitative data presentation and interpretation methods:

Once indicators, whether environmental or eco-efficiency, have been calculated the question is how to present them for analysis in a meaningful and easily understandable way.

In this context meaningful means whether data should be shown as absolute figures at a particular time (e.g. waste generated, energy used, etc.) or their variation from one time to another (e.g. waste increase or decrease), whether indexed or again using absolute figures.

Both methods have their applicability depending on what performance criteria is to be compared. Absolute figures can be used to present and compare performance within a company or in rare cases between companies providing the same product/service. On the other hand when comparing performance between companies providing different products/services or performance of different aspects it is important to demonstrate improvement over a certain period. In this case the use of variance of indicators showing the progress within a particular time period is preferred.

In order to make raw data more understandable, charts are useful instruments to show trends of indicators and to compare several indicators at the same time.

The following visualisation methods are examples of how to present indicators for comparison and interpretation.

### *5.4.1 Eco-efficiency Indicators*

Eco-efficiency indicators are presented in a chart showing the variance of the environmental indicators along the x-axis and the appropriate financial indicators along the y-axis in order to show performance over a particular period (Figure 5.1). In this case, the starting condition, i.e. the base case, is represented by the centre of the diagram.

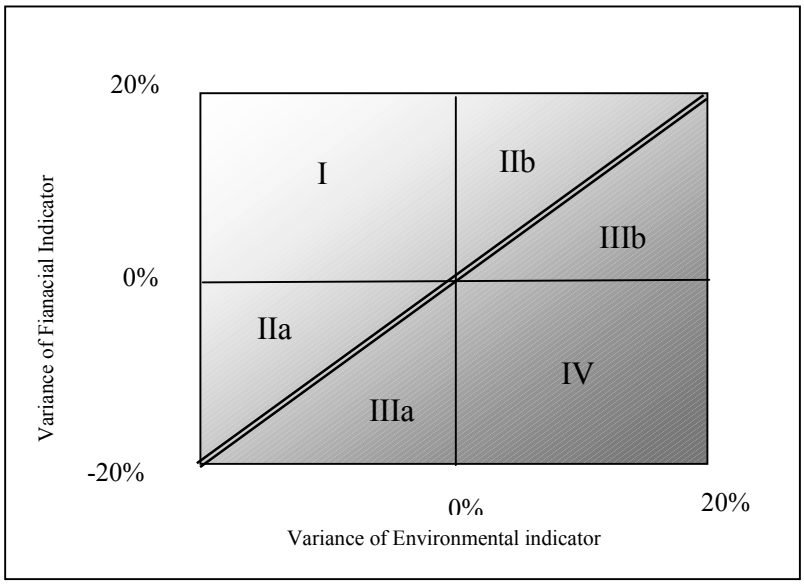



**Figure 5.1** Chart type to present Eco-efficiency.

Such a presentation form allows the following evaluation:

- Comparing several aspects: which one has performed better.
- Whether an eco-efficiency indicator has increased or decreased.
- How the environmental and financial performance of an aspect has been changed.

The shaded background of the chart allows comparison of performance of several aspects. Shading (or colours) can be used for interpretation of aspects relative to each other as:

| **Eco-efficiency** | |
|---|---|
| | Very good |
| | Good |
| | Poor |
| | Very poor |

The area below the diagonal of the chart (see Figure 5.1: areas III and IV) indicates a decrease in eco-efficiency, the area above (areas I and II) an increase.

In addition, it can be ascertained whether the economic and environmental performance has decreased or increased depending on whether the indicator is above or below the x-axis and left or right of the y-axis respectively.

| Area | | Environmental Indicator | Financial Indicator | Eco-efficiency Indicator |
|---|---|---|---|---|
| I | | ↑ | ↑ | ↑ |
| II | a | ↑ | ↓ | ↑ |
| | b | ↓ | ↑ | |
| III | a | ↑ | ↓ | ↓ |
| | b | ↓ | ↑ | |
| IV | | ↓ | ↓ | ↓ |

**Table 5.1** Characterisation of the areas in the eco-efficiency chart (see Figure 5.1).
↑ Positive trend ↓ **Negative trend**

Figure 5.1 summarises the trend of indicators depending on the chart area and it shows that the eco-efficiency indicator can decrease (considered positive) though one of the constituent indicators has a negative trend (Area II).

Figure 5.2 and 5.3 are examples of an internal and sectoral comparison of eco-efficiency respectively. From these the following statements can be made:

Concerning Figure 5.2

- The key indicator *$SO_2$ equivalent* has the worst eco-efficiency compared to the best the *$CO_2$ equivalent*.
- The eco-efficiency of the key indicators *Water use, Primary energy input, $CO_2$* and *$CFC_{-11}$ equivalent* has improved whereas *Waste disposed* and *$SO_2$ equivalent* has worsened.
- In all cases the financial indicator has improved as well as the environmental indicator for *Water use* and *$CO_2$ equivalent*.

Concerning Figure 5.3

- Sector 1 has performed best whereas sector 5 performed worst.
- Sector 1 and sector 4 have improved their eco-efficiency from 1999 to 2000.
- Sector 1 and sector 4 have improved both their financial and environmental indicator, sector 2 and sector 6 could improve the environmental indicator whereas for sector 3 and sector 5 both the financial and environmental indicator has worsened.

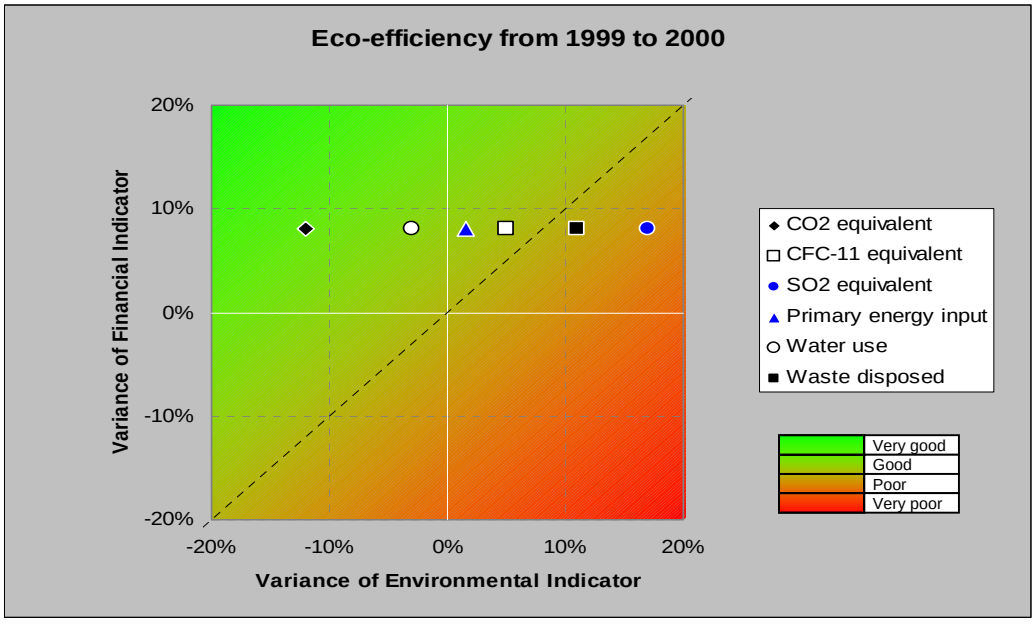



**Figure5.2** Example of a company internal comparison of the eco-efficiency of key performance indicators.

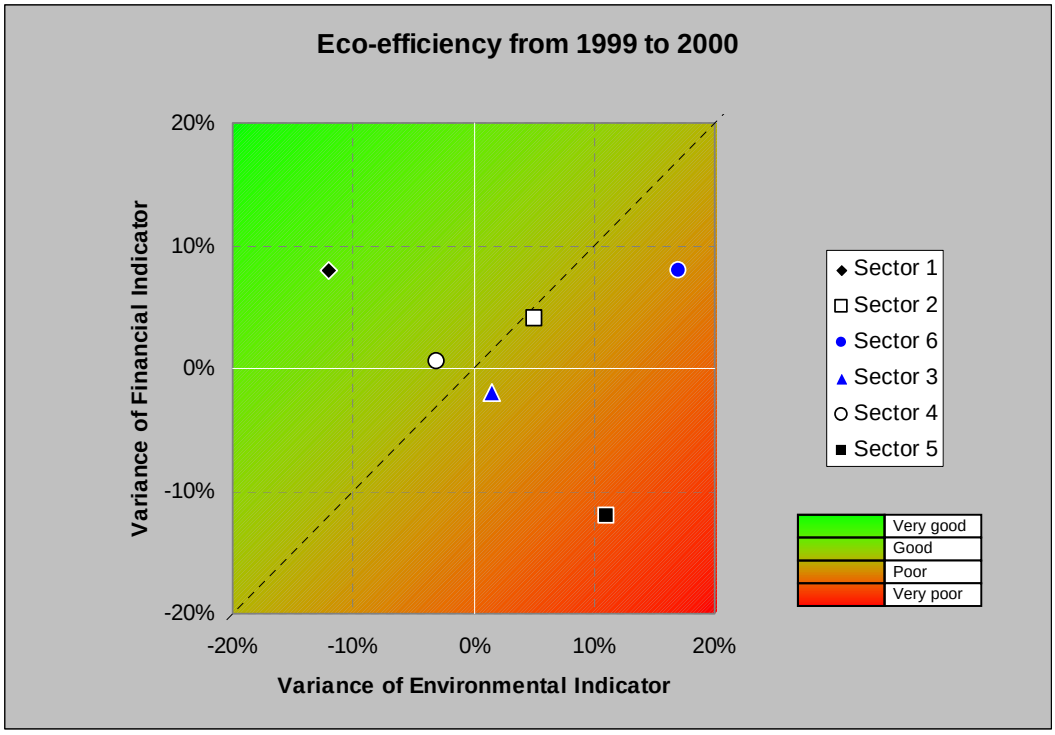
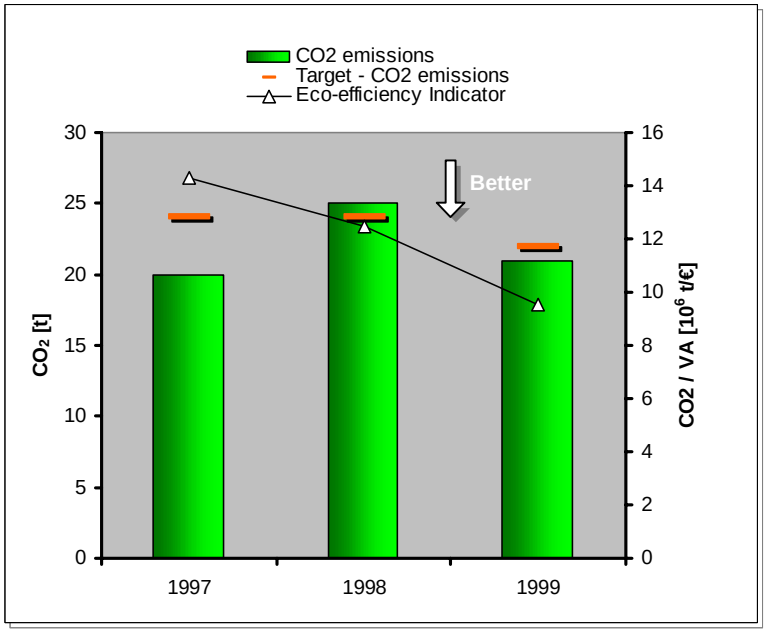



**Figure 5.3** Example of eco-efficiency comparison of an aspect e.g. $CO_2$ emissions between different sectors.

### *5.4.2 Environmental Performance Indicators*

Bar charts can be used to compare indicators from different reporting periods (e.g. annual, quarterly). It is recommended that indicators are reported for the current reporting period and at least two previous periods. Additional information such as targets, benchmarks, IPCL limits and appropriate eco-efficiency indicators should be implemented in the charts (see example charts below).

Information should be provided in absolute terms, as well as in ratio/normalised form whenever this assists communication. In addition, combine charts with an analysis of the current period based on questions answered.

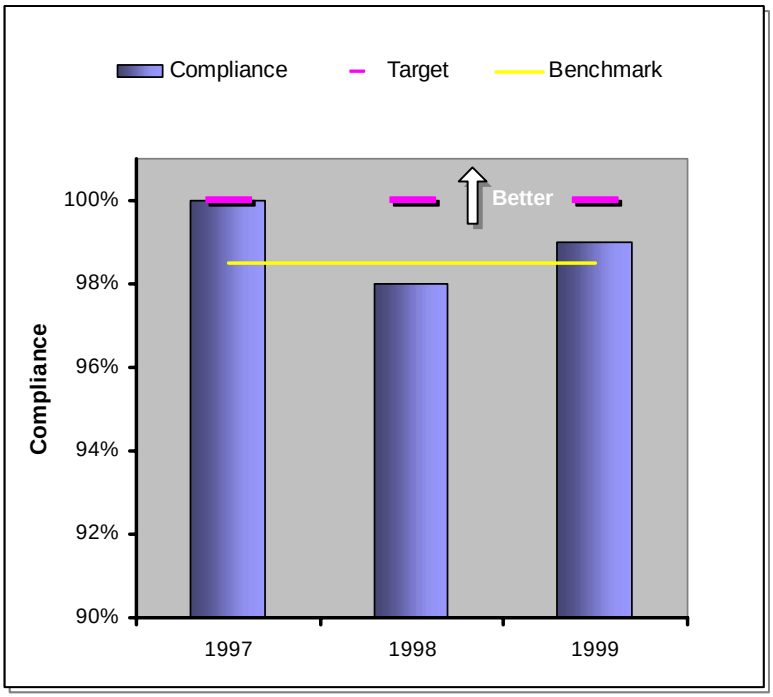



**Analysis: Year 1999**

*Why have emissions decreased or increased?*

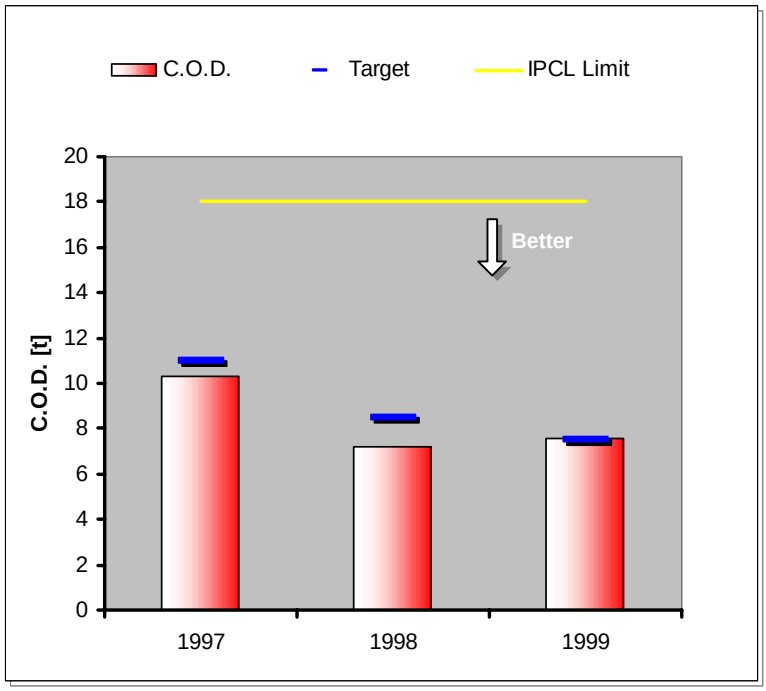
*Has the target been achieved? If not, why?*

*How did the eco-efficiency change?*




**Analysis: Year 1999**

*Reasons for non-compliance:*




**Analysis: Year 1999**

*Why has C.O.D. decreased or increased?*

*Has the target been achieved? If not, why?*

*Has the IPCL Limit been exceeded? If yes why?*

## 5.5 Management Performance Indicators

The annual EMP report could be used as a source of useful Management Performance Indicators if a standardised tabular format as proposed in Chapter 4 "EPA needs and wants" and included in Appendix III were introduced for EMP reporting. This format requires, amongst other information, the classification of projects according to a scheme shown below. Licensees could allocate their projects to this classification system and calculate an indicator on the basis of predefined modifiable scores as shown in Table 5.2. The calculated total figure could be used as a key indicator of the annual EMP report.

Additional sources of MPIs are existing reporting on environmental complaints, non-compliance and EMS accreditation.

This information should be used for creating MPIs such as:

- Number of complaints on the aspects: odour, noise, water, air, procedural and miscellaneous.
- % Compliance with licence.
- Percentage of preventive projects to overall number of projects.
- Number of EMP targets reached.

Further examples of management performance indicators are:

- Percentage of environmental investment to total investment.
- Number of environmental training hours per employee.

- Percentage of environmental training to total training.
- Number of achieved objectives and targets.
- Number of prevention of pollution initiatives implemented.
- Number of employees trained versus the number that need training.
- Number of environmental improvement suggestions from employees.
- Number of suppliers and contractors queried about environmental issues.
- Number of contracted service providers with an implemented or a certified environmental management system.
- Number of audits completed versus planned.
- Number of emergency drills conducted.
- Costs (operational and capital) that are associated with a product's or process' environmental aspects.
- Savings achieved through reductions in resource usage, prevention of pollution or waste recycling.
- Number of inquiries or comments about environmentally related matters.

A fuller list is presented in ISO 14031.

| Class | Sub | Description | No. of Projects | Score | Total Score |
|---|---|---|---|---|---|
| **A** | ***Prevention*** | | | | |
| | 1 | Training | | 40 | |
| | 2 | Process modifications | 1 | 40 | 40 |
| | 3 | Improved process control | | 40 | |
| | 4 | Improved yield | | 40 | |
| | 5 | Improved equipment | | 40 | |
| | 6 | Improved management | | 40 | |
| | 7 | Improved cleaning | | 40 | |
| | 8 | Materials substitution | | 40 | |
| | 9 | Materials reduction | 1 | 40 | 40 |
| | 10 | Energy reduction | | 40 | |
| | 11 | Fugitive emissions reduction | | 40 | |
| | 12 | Product change | | 40 | |
| | 13 | Reduced packaging | | 40 | |
| | | Total of class A: | 2 | | 80 |
| **B** | ***Recovery*** | | | | |
| | 1 | Training | 1 | 20 | 20 |
| | 2 | On-site re-use | | 20 | |
| | 3 | Off-site re-use | | 20 | |
| | 4 | On-site recycling | 1 | 20 | 20 |
| | 5 | Off-site recycling | | 20 | |
| | | Total of Class B: | 2 | | 40 |
| **C** | ***Treatment*** | | | | |
| | 1 | Training | 1 | 10 | 10 |
| | 2 | Improved treatment operation, e.g. collection | | 10 | |
| | 3 | Alternative treatment operation | | 10 | |
| | 4 | Off-site treatment | | 10 | |
| | | Total of Class C: | 1 | | 10 |
| **D** | ***Disposal*** | | | | |
| | 1 | Training | | 5 | |
| | 2 | On-site disposal | 1 | 5 | 5 |
| | 3 | Off-site disposal | | 5 | |
| | | Total of Class D: | 1 | | 5 |
| **E** | ***Other*** | | | | |
| | 1 | Environmental awareness training | 1 | 10 | 10 |
| | 2 | Calibration of monitoring equipment | | 5 | |
| | | Total of Class E: | 1 | | 10 |
| **F** | ***Life-cycle impacts*** | | | | |
| | 1 | Take-back of product at end of life | | 40 | |
| | 2 | Improved use mode, e.g. less dispersive usage | | 40 | |
| | | Total of Class F: | | | |
| | | **Total of all Classes:** | 7 | | **145** |

**Table 5.2** Project classification and scoring scheme.

# 6 Software Specification

## 6.1 Introduction

A wide range of "environmental" software products are available, namely EMIS (Environmental Management and Information Software), EHS (Environmental Health and Safety Software), LCA (Life Cycle Analysis Software) or EQS (Environmental Quality and Safety Software) systems. The different products in general deal with only some aspects of the techniques and knowledge one has to possess to help an organisation to manage an environmental data collection, reporting and benchmarking system. The present document focuses on the technical and functional prerequisites needed for a "software package" to achieve the following objectives:

In general

- To rationalise the data production and the communication between the licensees and the EPA.
- To increase the quality of reported data.

Specific

- To assist licensees in
  - Maintenance of their licence requirements, e.g. reporting;
  - tracking and evaluating environmental performance.
- To assist the EPA in
  - collection and administration of licence data to verify compliance;
  - preparation of reports to the public, EU, etc.

## 6.2 Alternatives

The above-mentioned requirements may be fulfilled by several hardware/software architectures. The following two alternatives should be taken into consideration:

*I. Site Tool – Central Tool*

*II. Browser – Central Tool*

These two systems differ mainly in the location of the executable software and data storage. The Site Tool – Central Tool system provides the licensee with their own executable software for reporting, performance evaluation and data management in the form of a Site Tool. In case of the Browser – Central Tool system the executable software and public data are located and stored at the EPA.

A more detailed description of each system and a comparison of advantages and disadvantages follows.

### *6.2.1 Site Tool – Central Tool*

Licensees use the Site tool to collect and store data on-site required by the licence conditions (Public data) and additional data such as environmental and financial data that may be confidential (Private data). They use the tool to report obligatory data to the EPA and create indicators for internal reporting and performance evaluation.

The Central tool at the EPA serves to administer all licence data, to assess compliance with IPC licence, and to look at key performance indicators and improvement trends over time. Using the Central tool in the future for reporting to the EU EPER Register (and other authorities) and reporting on benchmarks may also be considered.

Data is transmitted from the Site tool to the Central tool by Internet using the XML format.

The Site tool will be based on a relational database and on MS-Windows and could be developed as a multi-user application (Intranet). The Site tool should use the same data model as the Central tool or a subset of that model.

Licensee's use of a Site Tool – Central Tool System

*to report obligatory data to the EPA:*

- Licensee enters data manually or imports data from existing monitoring databases, spreadsheets etc.
- Licensee fills in report templates (e.g. Excel templates) prepared by the EPA.
- Reports are transformed into XML format (using Transformation macro), encrypted, and sent via Internet or email to the EPA.
- The Central Tool approves or rejects reports.

If there are changes in reporting requirements:

- Licensee can download report templates (e.g. Excel templates) from the EPA website or receive it via email.
- The EPA sends unique templates to licensees if the changes are licensee specific.

*to evalute environmental performance:*

- Private and public performance data can be evaluated using the Site Tool software.

### *6.2.2 Browser – Central Tool*

This solution would be to let the EPA handle a shared system that the licensees could enter data via the Internet.

In this system the executable software is located at the EPA server as a Central tool.

There are two possible alternatives:

*Variant A:* All data (public and private data) is stored permanently at the EPA. However Licensees have their private section to store confidential data, which cannot be accessed by the EPA without the permission of the licensee. In this case a third party (e.g. Deloitte & Touche, PWC, Ernst & Young, etc.) should certify security.

*Variant B:* Only public data is stored on the EPA server but licensees can temporarily upload data via the Internet to evaluate their environmental performance.

Data is uploaded as XML format or Excel file.

This system will be based on a relational database and web based technology.

Licensee's use of a Browser – Central Tool System

*to report obligatory data to the EPA:*

- Licensee downloads report templates (e.g. Excel templates) from the EPA website.
- Licensee compiles reports (in XML or Excel) using local software.
- Licensee logs on EPA server and uploads files.

*to evalute environmental performance:*

- Licensee can upload private data temporarily (Variant A) or permanently (Variant B).
- Licensee can create performance indicators and reports which can be printed or saved as (Excel) files for internal use.

### *6.2.3 Comparisons*

Regarding location of data and executable software from the view of the licensee:

| | Location of data | | Location of executable software |
|---|---|---|---|
| | **Public** | **Private** | |
| ***Site Tool – Central Tool*** | On-site | On-site | On-site |
| ***Browser – Central Tool*** | EPA | EPA Permanent[8]<br>EPA Temporary[9] | EPA |

Advantages and disadvantages regarding public and private data from the viewpoint of the licensee:

| | **Public Data** | **Private Data** |
|---|---|---|
| ***Site Tool – Central Tool*** | + familiar style of working<br>± local transformation of input information (Excel etc.)<br>– need for encryption | + total security<br>+ confidence<br>+ scope to explore/flexibility<br>+ familiar style of working<br>– no external comparison |
| ***Browser – Central Tool*** | + software maintenance<br>– need for encryption<br>– more complicated because multiple simultaneous users | + software maintenance<br>+ sharing of information<br>– confidence in security<br>– need for "stronger" encryption<br>– need for prolonged internet connection |

+.. positive feature
–.. negative feature
±.. uncertain

[8] Variant A: The EPA doesn't have access to private data without the licensee's permission. Third party should guarantee security.
[9] Variant B: The licensee can upload private data temporarily for performance evaluation purposes.

General advantages and disadvantages:

| | Advantages | Disadvantages |
|---|---|---|
| ***Site Tool – Central Tool*** | • Licensees feel confident concerning private data.<br>• Easier to "play" with.<br>• Increased functionality by implementing data ("cut and paste") from applications installed on the same PC. | • Distribution to each site.<br>• Installation on each site.<br>• Difficult to maintain software.<br>• Changes in PCs or personnel may complicate usage. |
| ***Browser – Central Tool*** | • Central software maintenance (everybody uses the same software version).<br>• Easier to implement the system.<br>• Less "vulnerability" because more independent of personnel changes, PC changes.<br>• High data consistency.<br>• Benchmarking easier to achieve. | • Licensees won't feel confident regarding private data.<br>• Need for "stronger" encryption.<br>• Licensees need Internet access.<br>• Licensees might store huge amount of private data. |

Who would prefer the *Site – Central* or the *Browser – Central* tool solution?

| Selection by | Reporting | Benchmarking / Performance | Main Benefit |
|---|---|---|---|
| Software people | Browser – Central | Browser – Central | Software maintenance |
| Licensee | Site – Central | Site – Central | Confidence in privacy |
| EPA Regulator | Either | Not directly interested, but might be allowed use "private" data for benchmarking in the future, hence<br>Browser – Central | Browser might have more potential for development? |

Regarding the comparisons above, there are pros and cons for both systems described.

The most significant aspects from the viewpoint of licensees will be the confidence in data security and the familiarity of working with a local installed software tool.

The software developer will, amongst other things, be concerned with the most efficient way of implementing the system and maintaining the software.

The EPA will require a software system that meets with the acceptance of the licensees in order to maximise the number of users.

Currently, as demonstrated by the industrial survey, a software system based on a **Site tool** is recommended due to the fact that the majority of the licensed companies are not sophisticated (in computer software terms) and are more sceptical in sharing confidential data (although the Browser – Central tool solution shows advantages in terms of software maintenance, data consistency and benchmarking purposes: data sharing between interested parties is easier to perform).

In the following sections, the technical and functional prerequisites needed for a Site tool – Central tool system are described.

Both the Site tool (used by licensees) and a Central tool (administrated by the EPA) have similar basic functions, such as storing and reporting data. The site tool is primarily focused on performance evaluation and compiling reports required by the EPA while the central tool concentrates on verifying the compliance of data from the licensees.

## 6.3 Functional Requirements - Site tool

### *6.3.1 Open System*

Licence requirements, environmental performance evaluation and benchmarking necessitate assembling and transmitting information from and to equipment (e.g. monitoring equipment) and institutions (e.g. EPA) – (storing on-line monitoring data, reporting to EPA, reporting templates from EPA, etc).

Therefore a software tool, which assists licensees in maintaining their licence requirements and benchmarking, must be able **to interact with other systems and formats**, e.g. data import and export from and to

- Spreadsheet forms
- Relational databases
- ERP systems (Enterprise Resource Planning systems)
- Monitoring equipment or data import and export in
- XML format.

The EPA could define their own XML standard for reporting and distribute this standard so that advanced companies could prepare their reports using this standard. Less advanced companies could receive a spreadsheet template that they fill in and submit.

Data should be submitted in electronic form via email or Internet.

In connection with an open system, security is of vital importance. Therefore it should be possible to set up user passwords, to restrict access and use rights to specific sections, components, and documents and to set privileges such as read only, amending or approving.

### *6.3.2 Quantitative Information*

In order to avoid erroneous data entry and misinterpretation of quantitative information the user interface should clearly indicate terms such as product, product composition, chemical components, measurement units, unit conversions, etc.

In this regard it is preferable to report mass units rather than volume units for gaseous emissions (where volume units are required then gas emissions should be entered as $Nm^3$ – normal cubic meter).

The software should be able to calculate equivalent values for e.g. Greenhouse gas emissions ($CO_2$ equivalent), Ozone depleting substances ($CFC_{-11}$ equivalent), Energy input (non renewable primary energy input), etc.

It should also be possible to model processes since a company may well know its consumption of diesel at a plant, but have no idea about the air emissions that this implies. Given a set of standard models in the software system less sophisticated industries may then be able to report indirectly on air emissions. Further implications of such a model library also implies storing of standard emission factor definitions in the system.

To relieve the software user from additional calculation the software should be able to convert numbers to different measurement units. However any reporting must conform to licence requirements.

### *6.3.3 Scheduling –Targets - Thresholds*

The software system should include a scheduling module, which details work and reports required under the IPC licence such as monitoring and reporting frequencies. It should remind the licensee of report deadlines and other relevant environmental management programme related target dates.

An EPA IPC licence states which substance(s) may be discharged and to where (air, soil, etc.). It also states what kind of measurement unit is involved (mass per time period - year, quarter, month, week or day) or concentration (e.g. mg Hg per tonne waste water). Licence limits should be stored and the system should alert the user if the report indicates an infringement of the permit.

### *6.3.4 Classification and Grouping*

In all environmental data management, including emissions to air, waste treatment etc., it is of crucial importance to have flexible ways to group and compare data. Classification codes are a means to achieve this; they serve as descriptors in a database and ensure that data from different sources is consistent.

A few examples will clarify this. The IPC Licence classification should be included. The EU EPER register demands that the production plant's processes are classified according to the NOSE-P code. The economic activity of the reporting sites should be given using the four-digit NACE code. In waste treatment the EU has introduced a six-digit waste code for hazardous waste. MARPOL, UN and the US have other waste code lists.

The point to make is that in order to benchmark and record non-compliances the software system should be able to add new classification codes to groups and compare

data. One thing for certain is that new ways of classifying data are invented all the time and it should be possible to add new classification lists in the software solution.

Another type of grouping that is important is grouping of substances, e.g. Green House Gases (GHG), consisting of carbon dioxide, methane and other gases. If a plant reports on the individual gases, the system should be able to define the substance group GHG and use it in benchmark analysis. It should also be possible to dynamically add new such groups.

The system should distinguish clearly between “dimensional” objects (names/labels) like time (year, quarter, month, week, day), county, factory, person, waste code etc. and “measurable” objects (numbers/quantities) like number of plants, tonnes of CO2 emitted etc. The dimensional objects form the basis for the way data (measurable objects) may be grouped, e.g. "tonnes of CO2 grouped by month and sector". It is the task of the report generator of the site tool to make this possible.

| Dimensional object | Measurable object | Reported as |
|---|---|---|
| Time (year) | Tonnes of waste | Tonnes of waste/year |
| person | Litres of water | Litres of water per person |

### *6.3.5 Data Quality*

In order to use environmental data in management and policy decisions it is of the utmost importance that data is **auditable**. This means that the person(s) entering data and accepting data is recorded. In a national system the license register number and the grid reference should be traceable for emissions and discharges entered. Once approved the data should be "frozen".

It is also mandatory that data is **complete.** If the EPA requires quarterly reporting of a substance such a number must exist for each quarter and if there is a zero emission of the substance for a quarter it is required that a zero is reported to the EPA system for that quarter. To secure data completeness a scheduling mechanism must be present, this means that the system must give an "alarm" for missing data. If there is no observation for a period it must also be possible to store this information in the system.

The data must also be **accurate** within agreed limits of deviation.

Examples of properties that a "NUMBER" stored in the database might have:

- Number of significant digits after the decimal point.
- Period that the number is reported for.
- Date the number was entered.
- Measurement unit
- Where from/to (soil, water, air etc.)
- What (emission factor, $CO_2$ substance, Chemical A from Producer B etc)
- What (substance group)
- Who (Plant ID, person reporting the data)
- Who (Permit ID)

Typing errors such as obviously too high or too low entered values and misspelled terms (e.g. chemical expressions: $SO_2$, measurement units: tons) which can lead to misinterpretation of results should be detected by the software and the system should call attention to the possible error.

An XML format definition would also help to obtain better quality since all "objects" then will have a precise definition. In order to demystify XML an example below shows what a report text file in the XML format may look like:

```
<EPA_Standard_Report>
  <Licensee>
    <period> 1.1.2001,31.12.2001 </period>
    <id> 014567899 </id>
    <company_name> Fugitives Ltd. </company_name>
    <env_reponsible> Patrick Wilde </env_reponsible>
    <Emissions>
      <Substance>
        <id> CO2 </id>
        <value> 123.4 </value>
        <unit> Tonnes </unit>
      </Substance>
      <Substance>
        <id> Hg </id>
        <value> 1.04 </value>
        <unit> Kg </unit>
      </Substance>
    </Emissions>
  </Licensee>
</EPA_Standard_Report>
```

### *6.3.6 Reports and Analysis*

In order to support licensees in reporting to the EPA the software system should be able to produce standard and ad hoc reports in a flexible and user-friendly way. This should be realised by the implementation of a report generator, which should also be able to calculate indicators for eco-efficiency, compliance reports, etc and export data to other systems. The system should be able to present results in the form of charts, tables and text.

A benchmarking system should easily be adaptable to new performance indicators and new ways to classify data (ref. section on grouping and classification above). Therefore the software should include an extendable indicator library for automatic insertion into reports.

### *6.3.7 Documentation*

The software should be able to retrieve documents and legislation in an easy way. This means it should be possible to link the software tool with an existing archive system. The software could, in addition, facilitate access to archive documents directly, to retrieve information for use in report generation.

### *6.3.8 User Interface*

In a situation where hundreds of organisations report data, differing in content (a power production plant has quite different discharges than a pig farm) it is important to display information in a way that is easy to traverse. One way to display such data is by using the well-known “tree” seen in Windows Explorer and other tools. Such an organisational structure will quickly be recognised by all users familiar with a PC. It is also important to be able to "filter" the tree to get only the organisational elements of interest. The navigation will be easier if elements in the tree can be classified using user-defined properties.

### *6.3.9 Templates*

With consideration to the industrial survey the Site tool should include templates for records and an environmental management programme.

Report templates as described in Chapter 4 should also be implemented.

## Functional Requirements - Central tool

Most of the above requirements for the Site tool will also be valid for the Central tool. The main functionality will be focused on collecting and administrating licence data to verify compliance. In this case important functional requirements are Grouping and Classification, Data quality and a mechanism to verify compliance.

Another requirement could be that the EPA system will act as the Irish National EPER register and hence be able to report the obligatory data to EU (ref. the EU call for tender: "Service contract to assist the Commission in the collection, storage and dissemination of data for the EPER register").

### 6.4 Technical Requirements

It is well known that an enormous amount of "standards" pop up both in the software and hardware "world" all the time. IT professionals have to deal with all these terms but in the following text, neutral terms are used and linked to concrete products only as examples.

The Central tool should as a minimum fit into the IT infrastructure of the EPA which can be described briefly as:

- Windows NT servers running on TCP/IP with SQL Server 7 database;
- All PC's are running Windows NT 4;
- All PC's have Office 97 installed;
- Microsoft Outlook and Microsoft Exchange are used as email tools.

The EPA will be upgrading to Windows 2000, Office 2000 and SQL Server 2000 (but not until 2002).

### *6.4.1 Data Storage*

Data storage is an extremely important aspect of the software system. Storing of data must be persistent and have a well-behaved recovery from fault situations. It must be possible for several users to manipulate the data in a secure way. It must be possible to move data from storage to new technologies when they arrive. Back-up procedures must exist. All data elements must be defined in a precise way.

Given these criteria it is concluded that data stored in spreadsheets or simple files will not fulfil the requirements. The most common way to fulfil such requirements is to use a commercially available relational database server (DB2, Ingres, Sybase, Oracle, SQL Server, Informix etc.). It is also possible to fulfil the requirements using object-based databases to store data using tailor made routines.

### *6.4.2 Physical network*

With the widespread usage of Internet and Intranets this choice is a simple one. The main obstacle is security, not the physical transportation of data. The solution provided should be able to document sufficient protection of data submitted over the Internet.

### *6.4.3 Operating system*

There are two major players in the OS war today "Windows" and "Unix". In the real world multi-tier applications have to deal with both platforms. In this project it is advised to play-safe in the sense that it should use either a browser and/or a PC with MS Windows as the client (workstation), while the "server" is the database server. Most database vendors are able to install their software on "Windows", "Unix" and other operative systems.

### *6.4.4 Programming platform*

There are many programming tools used in the software industry today and also many ways to construct modern software. One of the characteristics of modern software is that its architecture is modular and based on object-oriented principles. If that is the case it is much easier to move the software to other platforms if necessary. The most important feature is not the programming language used but the ability to comply with the underlying architecture. Again there are two main players "Oracle/SUN/Java/Corba" and "Microsoft.Net". Fortunately there exists crossover product to "glue" the "worlds" together. The EPA environmental benchmark vendor should be able to document how easily the product can be augmented with new functionality and adapted to future technologies.

## 6.5 COST – Site Tool

It is believed that a Site tool developed from scratch will be more expensive than adapting an existing commercial system. Below is a very rough cost estimate for a first experimental Site tool, developed from scratch, for a pilot installation. It is assumed that hardware and software to connect to the Internet is already established. It is also assumed that the site chosen for the pilot will participate in testing and provide PC's etc. It is also assumed that a database server is available in the network at the site chosen. If these costs are taken into consideration the budget should be increased by approximately 30 - 40 %. A yearly figure to maintain and enhance the

software should be set aside, and a yearly cost of about 15 - 20 % of the pilot cost is reasonable.

| | |
|---|---|
| Project administration | 500 hours |
| Make prototype design | 640 hours |
| Programming application server (probably COM+) | 800 hours |
| Programming data model | 200 hours |
| Programming stored procedures etc. | 200 hours |
| Write documentation and user manual | 400 hours |
| Develop XML import specification | 100 hours |
| Develop spreadsheet template | 35 hours |
| Testing, bug fix and revised functionality | 240 hours |
| SUM | 3115 hours |

Assuming a price per hour of £40 (€50.78) and adding £20,000 (€25,393) for travel and subsistence we will get a total amount of about £145,000 (€184,103) To get a better estimate one should first gather the "right" people, sketch dialogs, functions etc. in a two week project involving 3-4 people, at a cost of £12,000 to £16,000 (€15,236 to €20,314).

### 6.6 Risk Analysis

If a system is developed from scratch one will get a one off system with limited functionality (due to short time to delivery), consequently the risk of project failure is higher than doing a pilot phase with one or two commercially available system(s) (But if the right people and technology come together a new system might well surpass the older system).

The estimates in such projects will always be inaccurate, for instance, the skills and knowledge of the programming team will have major impact on results and time used. There is a serious risk of error in the time and cost estimates.

The number of ready-made modules will also have an impact. Using commercially available "building blocks" like report generators, ActiveX components etc. will bring the cost down and also the risk of failure will decrease.

Apart from this all the "classical" risk factors should be described and estimated.

If a tender is presented one should ask all bidders to describe and estimate the risks involved.

## 6.7 Check list

The following check list summarises functional and technical requirements described above and priorities the needs.

The bracketed number signifies the importance of the particular item:

[1] - mandatory functionality … [6] - relatively low importance.

### Functional requirements

### Open system

*Import data*

[1] Import data from spreadsheet forms (Excel 97/2000, Lotus123 Millennium)

□ Yes □ No

Comment: _____

[2] Import data from relational databases (Oracle, Sybase, DB2)

□ Yes □ No

Comment: _____

[3] Import data in XML format

□ Yes □ No

Comment: _____

[4] Import data from ERP systems (SAP, Oracle Financials)

□ Yes □ No

Comment: _____

*Export data*

[1] Export data to spreadsheets (Excel 97/2000, Lotus123 Millennium)

□ Yes □ No

Comment: _____

[4] Export data to relational databases (Oracle, Sybase, DB2)

□ Yes □ No

Comment: _____

[2] Export data in XML format

□ Yes □ No

Comment: _____

[4] Export data to ERP systems (SAP, Oracle Financials)

□ Yes □ No

Comment: _____

*User interface*

[1] Client program functions on PC with Windows 95, 98, NT and 2000

□ Yes □ No

Comment: _____

[5] Client program functions on MAC PC

□ Yes □ No

Comment: _____

[4] Client program functions with a browser (Internet Explorer, Netscape and Opera)

□ Yes □ No

Comment: _____

[3] Does the system handle many concurrent users?

□ Yes □ No

Comment: _____

**Quantitative information**

[1] All numeric values stored with a measurement unit?

□ Yes □ No

Comment: _____

[1] Possible to convert numbers between measurement units?

□ Yes □ No

Comment: _____

**Target and thresholds**

[1] Alarms on values exceeding defined thresholds?

□ Yes □ No

Comment: _____

**Grouping and classification**

[1] Possible to add user defined classifications?

□ Yes □ No

Comment: _____

[1] Possible to define a flexible organisational structure?

□ Yes □ No

Comment: _____

**Data quality**

[1] Routines to warn about missing data for a period?

□ Yes □ No

Comment: _____

[1] Routines to warn about input data outside "credible" limits?

□ Yes □ No

Comment: _____

**Reports and analysis**

[1] Does the software come with a flexible integrated report generator?

□ Yes □ No

Comment: _____

[1] May data recorded in different measurement units be converted and displayed in a common measurement unit using the report generator?

□ Yes □ No

Comment: _____

**Documentation and routines**

[4] Does the software handle documents?

□ Yes □ No

Comment: _____

[4] Does the software have functionality to interact with document storage systems?

□ Yes □ No

Comment: _____

**User interface**

[1] Does the software's user interface comply with a style guide?

□ Yes □ No

Comment on which: _____

**Templates**

[2] Templates for records

□ Yes □ No

Comment on which: _____

[2] Template for an environmental management programme

□ Yes □ No

Comment on which: _____

[1] AER template

□ Yes □ No

Comment on which: _____

[3] Templates for recurring reporting requirements

□ Yes □ No

Comment on which: _____

**Technical requirements**

**Data storage**

[1] Is the data stored in a relational database?

□ Yes □ No

Comment: _____

**Physical network**

[1] Are there any known problems with the components of the software in a tcp/ip network?

□ Yes □ No

Comment: _____

**Operative system**

[1] Does the client software work on MS Windows 95,98 and 2000?

□ Yes □ No

Comment: _____

[4] Does the client software work on browsers like Internet Explorer and Netscape?

□ Yes □ No

Comment: _____

**Programming platform**

[1] Does the product use object based programming principles?

□ Yes □ No

Comment: _____

[1] Is it possible to document that new functionality is relatively easy to add?

□ Yes □ No

Comment maintainability: _____

**Deployment**

[1] Does the product come on a CD ready for network installation?

□ Yes □ No

Comment: _____

# 7 Discussion

The introduction of Integrated Pollution Control Licensing (IPCL) of industry has resulted in the generation of significant amounts of environmentally related data within companies. Much of this must be publicly reported to the EPA where it may be used for compliance monitoring. The data also provide an opportunity for companies to identify and quantify their significant environmental aspects, thereby contributing to better management. This improved management can bring environmental and economic benefits. A potential use of the data is to assess performance trends internally within the company, and to allow the sharing of key performance indicators between companies. Both of these activities facilitate continuous improvement through a process of benchmarking.

The International Organisation of Standardisation (*ISO, 1998)* developed three categories of indicator, one for making operational decisions, a second for assessing the condition of the local, regional, national, or global environment, and the third for making management decisions. These three categories of Operational Performance Indicators (OPIs), Environmental Condition Indicators (ECIs), and Management Performance Indicators (MPIs) can be seen as a pressure-state-response model of business's impact on the environment – 'the *operations* of business impose *pressure* on the environment, which affect its *state* or *condition*, leading to a *response* through action by *management* to address the problem' (*Bennett et al., 1998*).

Chapter 2 of this report has extensively reviewed the literature on existing and emerging international practice on environmental performance indicators and environmental benchmarking methodologies. While sustainable development is accepted as requiring consideration of three dimensions: social, economic and environmental, most of the literature and current industrial practice relates to examining economic and environmental performance. Generally the use of ratio indicators allows comparison of similar products or processes with each other and also helps relate the performance and achievements of one firm, business unit or organisation to another. The ratio may be a combination of physical indicators (e.g. material or energy values, product units, time) or a combination of physical and economic indicators. The combination of physical and economic performance measures in a ratio gives a measure of "eco-efficiency". The extent of aggregation of the indicators used in these eco-efficiency ratios is dependent on the objectives in applying the measures. Indicators on a macro-level, e.g. site or sector-wide consumption of energy per unit added-value, may be appropriate to demonstrate environmental performance to stakeholders outside a company. However, indicators on a micro level, e.g. consumption of non-renewable energy in the manufacture of each product item, are used for goal setting, controlling the impact of a company's activities, products and services on the environment, as well as for inter and intra sectoral benchmarking. While the macro-level indicators are more generally available, the micro-level indicators are more useful for detailed management.

Comparability is a critical component in business use of environmental performance indicators. There is a growing international consensus that a small number of indicators are generally applicable across all enterprises and all sectors. While these are not yet universally accepted, the following generic key indicators are suggested:

- Global warming contribution
- Contribution to ozone depletion
- Contribution to acidification
- Non-renewable primary energy input
- Total water use
- Total waste disposed of

The latter two indicators may be sub-categorised by water source and by waste classification. The objective of these indicators is to reach beyond the traditional focus on compliance, turning the spotlight instead on resource efficiency, pollution prevention and product stewardship, while recognising the major global environmental problems. These may be combined with financial indicators that reflect product or service value, namely added-value or sales to provide eco-efficiency indicators. It should be noted that these are only a sub-set of the extensive range of possible measures, but are chosen to reflect the current state of indicator usage in Irish industry. They are at the macro-scale, i.e. aggregated, and comprehensive benchmarking would require the use of more precise measures. However, as was shown in Chapter 3, the usage of indicators in Irish industry is rather undeveloped.

These indicators are useful in assessing the *pressure* imposed by a business on the environment, i.e. they are Operational Performance Indicators. It is a concern to assess the Management Performance Indicators, i.e. the *response* through action by *management* to address the problem. Environmental Management Systems (EMS) are widely held to be the mechanism to integrate environmental issues into business management. However, there is a view that ISO 14001 is a conformance standard, rather then a performance standard. Nevertheless, ISO's supplementary document ISO 14031 provides a detailed discussion of indicators that can be used to ascertain how effective an organisation's EMS is in generating improvements in environmental performance. This provides a basic set of indicators that may be chosen to guide a performance-oriented environmental management system. There is some favourable experience with this approach in Denmark and there are numerous organisations proposing or offering a benchmarking or self-scoring methodology, based on a company's response to a set of questions with associated graded answers, e.g. SHEiiBA, EEBN. New Mexico has introduced a performance-based EMS programme entitled "Green Zia". This is based on the Malcolm Baldridge Quality Model. Adoption of this approach has great potential in the Irish context, however in the light of the results of the survey of industrial practice, we have chosen to adopt a limited approach and confine ourselves to basic indicators such as the level of environmental complaints, EMS accreditation and nature of projects identified in the company's environmental management programme. If benchmarking were to become more popular, we suggest that this approach be revisited, in particular the examination of the Baldridge-based "Green Zia" system, due to the favourable reception of quality initiatives in Ireland.

EMS software tools were examined to assess their usefulness for this project. They can be roughly categorised as:

- Tools supporting the assessment, implementation, or audit of an environmental management system.
- Tools for managing an environmental, quality, and health and safety management system.
- Tools for storing, analysing and reporting data.

In addition, two tools which are specific for assessing the significance of aspects and reporting on environmental performance were examined.

Core elements and features were identified and assessed for these tools, using demonstration versions and the vendor literature.

The main conclusions to be drawn from the assessment of environmental software products were:

- A wide range of environmental software products were available – EMS, EQS, data collection, analysing & reporting tools.
- Many ISO 14001 packages already existed.
- The survey of industrial practice quickly demonstrated that many companies had installed and were operating their management systems without recourse to dedicated EMS software.

Hence it was concluded that the development of a new software package for this application was unnecessary.

An extensive survey was undertaken to determine practice and potential inIrish industry in relation to electronic reporting, benchmarking and use of software support tools for reporting, and supporting environmental management systems. This is reported in detail in Chapter 3. There was a response rate of 35% to the survey. Over half of the respondents (53%) were indigenous companies, 10% of companies were European based while 37% of IPC licensees were part of worldwide corporations. Just under half (48%) of respondents indicated that site turnover exceeds IR£20m (€25.4m). 41 sites (of 186 respondents) were certified to ISO 14001. 4 of the 41 were also registered to EMAS. Of the 59 sites in the process of installing an EMS, there was a slight bias in favour of ISO 14001 (32 sites) over an uncertified system (27 sites). Comments from the respondents indicated that the IPC licence requirement for an environmental management system was a significant driver.

Just 5% of companies used computer software to assist in the installation of an EMS. 47% of respondents used software in the operation of their EMS. MS Office, Lotus Notes or a quality management system software tool were used rather than specific EMS software. The main advantages of a computer-based EMS were ease of reporting, standardisation, access, traceability, scheduling, less paperwork and the use of pre-formatted templates. The main disadvantages of a computer-based EMS, identified by respondents were security, cost, inflexibility, computer literacy within some companies, compatibility with existing systems, electronic signatures, time constraints, issues with hardware system reliability and the potential for pre-defined software to constrain consideration of all issues.

When asked about the most useful application for proposed computer software, in the context of an environmental management system, templates for environmental records were most favoured at 23%, followed by templates for procedures and an environmental manual as joint next most popular at 13%. When considering reporting, a standard template for an EMP was seen as the most useful electronic reporting tool. Currently approximately 1 in 6 licensees (16%) use scheduling software. However the majority of respondents (78%) saw scheduling software as a useful tool. The main recommendations to streamline reporting were to reduce frequency of reporting, alter and restructure templates and to e-mail reports. Confidentiality and security were seen as the two most significant barriers to reporting to the EPA via computer files. The format that the reports may take and concern with compatibility of existing software with EPA developed software was also an issue.

ISO 14001 certified companies (28.2%) were only slightly more aware of ISO 14031 than other companies (26%). The vast majority of IPC licensees (91.4%) used environmental indicators, while the average number of indicators used is 6. The mean number of indicators used by Irish companies is 5.7 while the mean of other companies was 7.4. Certified EMS companies used more indicators (7.2) than non-certified companies (6.5).

The four most commonly used environmental indicators are energy use (80%), non-hazardous waste (75%), number of complaints (74%) and licence compliance (73%). It should be noted that these are common requirements specified in IPC licences. Ozone depleting emissions (10%) and greenhouse gas emissions (14%) were surprising low in terms of use as indicators despite the international and national focus on global warming and climate change. However multinationals were more than 4 times more likely to use greenhouse gas emissions as an indicator compared to their Irish counterparts.

In terms of level of detail, use of indicators on a product (13%) or process (19%) basis was relatively low. The majority of indicators were used on a site-wide basis (59%). While this provides an overall performance picture, the lack of detail means that the identification of areas for improvement is more difficult. Less than 10% of respondents used indicators on a group-wide basis.

Adjusting for production (normalising) was most commonly used for energy (39%) and materials consumption (42%). These indicators were commonly used in process /product efficiency analysis. Water use (28%) and waste generation (non-hazardous 25%, hazardous 24%) were also relatively popular indicators that were adjusted for production.

The opinion most agreed with by respondents (76%) was that using environmental indicators improves business performance. This indicated a positive approach to the use of indicators by licensees. Looking at environmental performance at a process or product level and adjusting for production were the two opinions least favoured by respondents (22%). In the absence of such data, root-cause analysis is difficult. The majority of licensees (60%) planned to develop their use of environmental indicators.

Nearly two-thirds (62%) of respondents had benchmarked for non-environmental purposes. Benchmarking for quality and safety were most common (48% and 47% of respondents respectively).

Almost half of all respondents claimed to have benchmarked for environmental purposes (48%). 79 licensees (42%) benchmarked within the site over time. 42 respondents (22%) benchmarked between sites in the same corporation while 33 licensees (18%) benchmarked between companies in the same sector. 15 companies (8%) claim to have benchmarked between companies in another sector.

In general benchmarking was more commonly practiced amongst the multinational companies. It was more than twice as likely for benchmarking safety, inventory and environmental that it be carried out by multinational companies. Only quality benchmarking had a relatively high profile (46%) in Irish companies and it was still behind the multinationals at 66%. Companies with certified EMS were more likely to be involved in environmental benchmarking than non-certified companies (68% versus 52%).

33% of Irish companies benchmarked environmental performance within their site compared with 62% of multinational companies. Key advantages of benchmarking identified by respondents were that it leads to best practice, companies can learn and adopt other companies achievements and gain an insight into what is possible and practical. The main difficulties in benchmarking identified by respondents were in comparing like with like and the lack of similar companies in Ireland within their sector to facilitate comparison.

One may generalise that such benchmarking as is done is typically confined to a site at a very aggregated level. Hence root-cause analysis is difficult and improvement programmes may be poorly targeted. Much of the benchmarking is largely qualitative with little formal benchmarking and little use of quantitative indicators between companies. Many of the respondents have interpreted 'benchmarking' as an internal reflection process, without reference to other sites or companies. Comparison between companies may be reliant on examining the level of licence compliance or complaints reported in the EPA's own IPC licensing report or on loosely structured discussions. A small number of companies are or have engaged in structured benchmarking.

Reporting requirements for the EPA have been discussed in Chapter 4. Compliance monitoring is addressed in various reports already, e.g. Annual Environmental Report (AER) as well as existing emissions self-monitoring reporting requirements. These are consolidated into Appendices I and II. Further standardisation of reports is presented in Appendix III. In particular, the annual EMP report could be used as a source of beneficial Management Performance Indicators if a standardised tabular format were introduced as suggested.

In reviewing the international literature there is a temptation to be ambitious in recommending the use of indicators and the ensuing potential for benchmarking. However, this enthusiasm should be tempered by the evidence provided by the industrial survey. There is limited application of indicators and even less formal benchmarking. Furthermore, there is an expressed reluctance to use detailed indicators. Therefore, we believe it is better to introduce a limited range of indicators and have achieved something, than to be overly ambitious and achieve nothing. Operational Performance Indicators, at a "basic" level, may be satisfied by the limited set of six generic key indicators suggested earlier. They are aggregated, and from a company's perspective, macro-economic in their view. They will provide "headline" information, but require further investigation for improvement analysis. In order to

include the economic performance of a company Eco-efficiency indicators should be calculated.

Indicators should be shown as absolute figures at a particular time or as their variation from one time to another, whether indexed or again using absolute figures. Both methods have their applicability depending on what performance criteria are to be compared. Absolute figures can be used to present and compare performance within a company or in rare cases between companies providing the same product/service. On the other hand, when comparing performance between companies providing different products/services or performance of different aspects, it is important to demonstrate improvement over a certain period. In this case, the use of variance of indicators showing the progress within a particular time period is preferred.

Bar charts can be used to compare indicators from different reporting periods (e.g. annual, quarterly). It is recommended that indicators are reported for the current reporting period and at least two previous periods. Additional information such as targets, benchmarks, IPCL limits and appropriate eco-efficiency indicators should be implemented in the charts. Information should be provided in absolute terms, as well as in ratio/normalised form whenever this assists communication.

Eco-efficiency indicators can be presented in a chart showing the variance of the environmental indicators along one axis and the appropriate financial indicators along the other axis in order to show performance over a particular period

The adoption of Management Performance Indicators is less advanced in Irish industry. An extensive list is provided in ISO 14031, in addition to those that may be derived by a company itself. However, the following limited set of "basic" indicators could be easily adopted.

- Number of complaints on a particular aspect
- % Compliance with licence.
- Percentage of preventive projects to overall number of projects in the EMP.
- Number of EMP targets reached.

The appropriate specifications for software were discussed in Chapter 6. A primary question was whether the main computing power and data repository should lie in a central location (EPA) and be accessed via an internet browser or whether the data and its manipulation should lie mainly at the licensees site. Currently, as demonstrated by the industrial survey, a software system based on a **Site tool** is recommended due to the fact that the majority of the licensed companies are not sophisticated (in computer software terms) and are more sceptical in sharing confidential data. However the Browser – Central tool solution shows advantages in terms of software maintenance, data consistency and benchmarking purposes: data sharing between interested parties is easier to perform. The technical and functional prerequisites needed for this type of system have been described. The system must be able to interact with other systems and formats, yet retain security. Data should be verified on entry, should conform to a standard classification and be subject to transformation and audit. Licence limits should be stored and the system should alert the user if the report indicates an infringement of the permit. The software system should include a scheduling module, which details work and reports required under the IPC licence such as monitoring and reporting frequencies. It should remind the

licensee of report deadlines and other relevant environmental management programme related target dates. Report generation and analysis should be accommodated as well as linkage to a document archiving system. Templates should be provided as necessary both for data entry and mandatory reporting, though flexibility to provide in-house reports should be provided.

The cost of developing a prototype site-tool, from scratch, is estimated at 3115 hours, equivalent to €185,000, assuming certain software and hardware pre-conditions at the test site. Adaptation of an existing commercial system is likely to be less expensive and involve less risk. A more detailed estimate and specification of the software could be achieved at a cost of approximately €20,000.

# 8 Conclusions & Recommendations

This project has three main areas of study:

1. Effective and efficient reporting of mandatory, non-confidential data;
2. Examination of the potential for benchmarking;
3. Assessment of the usefulness of environmental management system support software.

The following principles have been adopted in shaping the conclusions and recommendations:

- Any change to the current practice must provide added value.
- Any change must be likely to be accepted and adopted by licensees in the short-term.
- The rapid pace of technological progress in hardware and software must be considered.

The suggested recommendations are based on the findings of the industrial survey and the identification of EPA needs and wants, informed by the understanding of international best practice.

1. There is merit in developing software to facilitate the mandatory reporting of data. This should be based on the model of a site tool for preparation of data to be subsequently uploaded to the EPA central system. This provides greater confidence in security for the licensees, at the expense of more difficult software maintenance. Detailed templates for the different reports are provided.
2. The software should be relatively simple, to encourage rapid acceptance by licensees. While the technical feasibility of more powerful and sophisticated software is not at issue, it should be considered that an extended period of acceptance could mean the software would be obsolete by the time it was commonly applied.
3. A standard template for an Environmental Management Programme should be prepared to facilitate electronic reporting and the derivation of associated Management Performance Indicators.
4. Respondents to the industrial survey favoured provision of templates for environmental records.
5. The software should have a report generator to facilitate data analysis by the licensee. This should be capable of calculating ratios, to be defined by the licensee, and the graphical presentation of data and derived values.
6. A scheduling tool would be a useful element of the software, to assist reporting and EMS management.
7. The cost of developing a prototype site-tool, from scratch, is estimated at 3115 hours, equivalent to €185,000, assuming certain software and hardware pre-conditions at the test site. Adaptation of an existing commercial system is likely to be less expensive and involve less risk. A more detailed estimate and specification of the software could be achieved at a cost of approximately €20,000.

8. While the vast majority of licensees use environmental indicators, the average number of indicators used is 6, and these are generally the result of specification in the IPC licence. Hence the existing level of indicator use and benchmarking practice is relatively modest among licensees. A cautious approach is recommended in promoting this practice. Operational Performance Indicators (OPIs) should have priority over Management Performance Indicators (MPIs), due to their greater initial acceptability.

9. A few generic Operational Performance Indicators should be used across IPC industries:

    (a) Global warming contribution
    (b) Contribution to ozone depletion
    (c) Contribution to acidification
    (d) Non-renewable primary energy input
    (e) Total water use
    (f) Total waste disposed of

    The latter two indicators may be sub-categorised by water source and by waste classification.

10. Looking at environmental performance at a process or product level and adjusting for production were the options least favoured by respondents to the survey. In view of the existing level of indicator usage, Operational Performance Indicators should be introduced on a site-wide basis rather than by process or product, though process or product-specific values are more useful for management. Licensees should be encouraged to combine these with economic values to derive eco-efficiencies.

11. A few generic Management Performance Indicators should be used across IPC industries:

    (a) Number of complaints on a particular aspect
    (b) % Compliance with licence.
    (c) Percentage of preventive projects to overall number of projects in the EMP.
    (d) Number of EMP targets reached.

12. The existence of ISO 14031 should be promoted to licensees, to encourage them to determine other Management Performance Indicators relevant to their operations.

13. If the use of indicators becomes more popular, and licensees demonstrate a willingness to share performance data, consideration should be given to introducing a benchmarking system based on experience with quality systems, e.g. a variant on New Mexico's Baldridge based "Green Zia" categorisation system.

14. There is no benefit in developing extensive environmental management system support software. There are numerous commercial products available, yet the majority of licensees have installed or are maintaining an EMS without recourse to such software.

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APPENDIX I

## EXISTING AER ELECTRONIC REPORTING REQUIREMENTS

AER Summary Data Table

**Summary Of Emissions**

Company:
Address:
Contact Name:
Telephone:
E-mail:
GPS Co-ordinates(4N,4E):
IPC Register Number:
IPC Class:
IPPC Class:
NOSE-P Code:
NACE CODES: (Section, Sub-Section, Division, Group, Class).

**Emissions to Waters** (Indicate with "X" if emissions are to Freshwater or Sewer or Sea)

| Parameter | Unit | Licensed emission | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Volume | $m^3$ | | | | | |
| Suspended Solids | Kg | | | | | |
| BOD | Kg | | | | | |
| COD | Kg | | | | | |
| Total Dissolved Solids | Kg | | | | | |
| Total Nitrogen | Kg | | | | | |
| Phosphate | Kg | | | | | |
| Toxicity | TU | | | | | |
| Hg | Kg | | | | | |
| Cd | Kg | | | | | |
| Pb | Kg | | | | | |
| Cr | Kg | | | | | |
| As | Kg | | | | | |
| Zn | Kg | | | | | |
| Cu | Kg | | | | | |
| Ni | Kg | | | | | |
| % Compliance | % | | | | | |
| Number of samples | | | | | | |

**Emissions to air**

| Parameter | Unit | Licensed emission | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Particulates | kg | | | | | |
| Sox | kg | | | | | |
| Nox | kg | | | | | |
| Co2 | kg | | | | | |
| TA Luft Class I | kg | | | | | |
| TA Luft Class II | kg | | | | | |
| TA Luft Class III | kg | | | | | |
| Total Organic (as C) | kg | | | | | |
| Non-Methane VOC | kg | | | | | |
| Ammonia | kg | | | | | |
| Total Heavy Metals | kg | | | | | |
| % Compliance | % | | | | | |
| Number of samples | | | | | | |

**Boiler Emissions to air**

| Parameter | Unit | Licensed emission | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Dust | kg | | | | | |
| Sox | kg | | | | | |
| NOx | kg | | | | | |
| CO2 | kg | | | | | |
| CO | kg | | | | | |

**Energy Usage**

| Energy Consumption | Unit | Sulphur Content | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Heavy Fuel Oil | $m^3$ | | | | | |
| Light Fuel Oil | $m^3$ | | | | | |
| Natural Gas | $m^3$ | | | | | |
| Electricity | MW | | | | | |
| Coal | kg | | | | | |

**Waste**

| **Total Quantity of waste produced in calendar year (tonnes)** | **1998** | **1999** | **2000** |
|---|---|---|---|
| Total quantity of waste disposed of on-site | | | |
| Total quantity of waste disposed of off-site | | | |
| Total quantity of waste recovered on-site | | | |
| Total quantity of waste recovered off-site | | | |

| **Quantity of non-haz. waste produced in calendar year (tonnes)** | **1998** | **1999** | **2000** |
|---|---|---|---|
| quantity of non-haz. waste disposed of on-site | | | |
| quantity of non-haz. waste disposed of off-site | | | |
| quantity of non-haz. waste recovered on-site | | | |
| quantity of non-haz. waste recovered off-site | | | |

| **Quantity of waste produced in calendar year (tonnes)** | **1998** | **1999** | **2000** |
|---|---|---|---|
| quantity of hazardous waste disposed of on-site | | | |
| quantity of non-hazardous waste disposed of off-site | | | |
| quantity of non-hazardous waste recovered on-site | | | |
| quantity of non-hazardous waste recovered off-site | | | |

**Environmental Complaints**

| | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|
| Complaints received | | | | |
| Complaints requiring corrective action | | | | |
| *Categories of Complaint* | 1998 | 1999 | 2000 | 2001 |
| Odour | | | | |
| Noise | | | | |
| Water | | | | |
| Air | | | | |
| Procedural | | | | |
| Miscellaneous | | | | |

**Water**

| | Unit | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| On-site groundwater use | $m^3$ | | | | |
| On-site surface water use | $m^3$ | | | | |
| Municipal water use | $m^3$ | | | | |

**Accreditation**

| | | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| EMAS (Yes/No) | | | | | |
| ISO 14000 (Yes/No) | | | | | |
| Certification Pending | | | | | |

| **Pollution Emissions Register** | | | | outputs | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant Name | CAS No. | Input | Gross Usage | Air | MOM | Liquid Effluent | MOM | Waste | MOM | Product | MOM | Recovery | Treated | Unaccounted |
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| **Information on each waste stream** | | | | | | |
|---|---|---|---|---|---|---|
| European Waste Catalogue Code | Hazardous (Yes/No) | Description of Waste | Quantity (Tonnes/year) | Method of Disposal Recovery | Location of Disposal/ Recovery | Name of Waste Disposal Recovery Contractor |
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APPENDIX II

## EPA IPC LICENCE RECURRING REPORTS

| No. | Recurring Reports | Frequency |
|---|---|---|
| 1. | Complaints | M |
| 2. | Noise monitoring programme | B, A |
| 3. | AER | A |
| 4. | Monitoring of emissions to sewer | Q, A, M, BM |
| 5. | Monitoring of surface water emissions | Q, M |
| 6. | Monitoring of emissions to atmosphere | Q, M |
| 7. | Monitoring of emissions to water | Q, M |
| 8. | Ambient surface water monitoring | A |
| 9. | Ambient groundwater monitoring | A, Q |
| 10. | PER proposal | A |
| 11. | EMP proposal | A |
| 12. | Schedule of environmental objectives & targets | A, 3 YI |
| 13. | Waste minimisation report | A |
| 14. | Ambient ammonia monitoring | M |
| 15. | Monitoring of noise emissions | M |
| 16. | Groundwater monitoring programme | A |
| 17. | Groundwater monitoring executive summary report | A |
| 18. | Ambient air monitoring results | M |

Key:

M = Monthly, B = Biennially, A = Annually, Q = Quarterly, YI = Yearly Intervals, BM = Bimonthly

APPENDIX III

## PROPOSED ADDITIONAL ELECTRONIC REPORTING REQUIREMENTS

- Wastewater Reporting Requirements
- Emissions to Waters , Monthly Results Sample Template
- Emissions to Waters , Monthly Summary
- Groundwater Reporting Requirements
- Atmospheric Emissions Reporting Requirements
- Atmospheric Emission measurement results
  Table: Results of Total Organic Carbon measurement
  Table: Results of TA.Luft Volatile Organics measurement
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- Emissions to air, monthly summary
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- Energy & Water Consumption
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  Water Consumption
- Environmental Complaints
- Noise Reporting Requirements
- Waste Emissions-Hazardous Waste Disposal
  Waste Emissions- Other Waste Disposal
- EMP Reporting Requirements
  Project classification scheme

# Wastewater Reporting Requirements

| **Parameters** | **Units** |
|---|---|
| | |
| On-Site | |
| Flow | $m^3$ |
| Temperature | $^0C$ |
| Free / Total Cl2 | mg/l Cl2 |
| | |
| **Physical** | |
| pH | pH units |
| Conductivity | mS/cm |
| Appearance | |
| Colour | mg/l Pt/Co |
| COD | mg/l O2 |
| BOD (ATU) | mg/l O2 |
| BOD | mg/l O2 |
| TOC | mg/l C |
| Suspended Solids | mg/l |
| Total Dissolved Solids | mg/l |
| | |
| **Inorganic** | |
| Ammonia | mg/l N |
| Nitrite | mg/l N |
| Nitrate-N | mg/l N |
| TON | mg/l N |
| Kjeldahl Nitrogen | mg/l N |
| Total Nitrogen | mg/l N |
| Orthophosphate (TRP) | mg/l P |
| Total P | mg/l P |
| Fluoride | mg/l |
| Chloride | mg/l |
| Bromide | mg/l |
| Nitrate (NO3) | mg/l NO3 |
| Sulphate | mg/l |
| Sulphide | mg/l S |
| | |
| **Miscellaneous** | |
| Cyanide | mg/l CN |
| Mineral Oil | mg/l |
| Anionic Detergents | mg/l as LAS or MBAS |
| Fats, Oil, Grease | mg/l |

| **Organics** | |
|---|---|
| | |
| Phenols | mg/l |
| "Effluent Screen" | ug/l |
| Specific Organics | ug/l |
| Permethrins | ug/l |
| Formaldehyde | mg/l |
| AOX (as Cl) | ug/l |
| Hydrocarbons | ug/l |
| | |
| **Metals** | |
| Aluminium | mg/l |
| Antimony | mg/l |
| Arsenic | mg/l |
| Beryllium | mg/l |
| Cadmium | mg/l |
| Chromium 3 | mg/l |
| Chromium 6 | mg/l |
| Chromium (Total) | mg/l |
| Cobalt | mg/l |
| Copper | mg/l |
| Gold | mg/l |
| Indium | mg/l |
| Iron | mg/l |
| Lead | mg/l |
| Manganese | mg/l |
| Mercury | µg/l |
| Molybdenum | mg/l |
| Nickel | mg/l |
| Palladium | mg/l |
| Selenium | mg/l |
| Silver | mg/l |
| Sodium | mg/l |
| Zinc | mg/l |
| Thallium | mg/l |
| Tin | mg/l |
| | |
| Total Heavy Metals | mg/l |
| List II metals | mg/l |
| | |
| Toxicity | Toxic Units |

**Emissions to Waters** , Monthly Results Sample Template

| **Parameter:** | Volume | COD | COD | BOD | BOD | pH | SS | SS | N | N | P | P | Tox | Metals | Metals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Units:** | m3/day | mg/l | kg | mg/l | kg | | mg/l | kg | mg/l | kg | mg/l | kg | | mg/l | kg |
| **Licence Limits:** | | | | | | | | | | | | | | | |
| Test Frequency | Day | Day | | Week | | Day | Day | | Week | | Week | | Year | Year | |
| **Effluent** | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | |
| … | | | | | | | | | | | | | | | |
| … | | | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | |
| **No. of samples** | | | | | | | | | | | | | | | |
| **% Compliance** | | | | | | | | | | | | | | | |
| **Max** | | | | | | | | | | | | | | | |
| **Min** | | | | | | | | | | | | | | | |
| **TOTAL** | | | | | | | | | | | | | | | |
| **Surface Water** | | | | | | | | | | | | | | | |
| Day | | | | | | | | | | | | | | | |

**Emissions to Waters** , Monthly Summary Sample Template

| Parameter | Concentration | Mass Emissions | Number of samples | % Compliance |
|---|---|---|---|---|
| Volume | | kg | | |
| Suspended Solids | mg/l | kg | | |
| BOD | mg/l | kg | | |
| COD | mg/l | kg | | |
| Total Dissolved Solids | mg/l | kg | | |
| Total Nitrogen | mg/l | kg | | |
| Phosphate | mg/l | kg | | |
| Toxicity | TU | | | |
| Hg | mg/l | kg | | |
| Cd | mg/l | kg | | |
| Pb | mg/l | kg | | |
| Cr | mg/l | kg | | |
| As | mg/l | kg | | |
| Zn | mg/l | kg | | |
| Cu | mg/l | kg | | |
| Ni | mg/l | kg | | |
| | | | | |

# Groundwater Reporting Requirements

| **Parameters** | **Units** |
|---|---|
| | |
| pH | pH units |
| Conductivity | mS/cm |
| Turbidity | FTU's |
| Colour | Hazen Units |
| TOC | mg/l C |
| Suspended Solids | mg/l |
| Total Dissolved Solids | mg/l |
| Ammonia as NH4 | mg/l N |
| Nitrite | mg/l N |
| Nitrate-N | mg/l N |
| Orthophosphate (TRP) | mg/l P |
| Chloride | mg/l |
| Chlorine | mg/l |
| Sulphate | mg/l |
| Copper | mg/l |
| Iron | mg/l |
| Lead | mg/l |
| Manganese | mg/l |
| Potassium | mg/l |
| Magnesium | mg/l |
| Calcium | mg/l |
| Sodium | mg/l |
| Zinc | mg/l |
| Alkalinity | mg/l (HCO3) |
| Water Hardness | mg/l |
| VOCs by headspace GC/MS | µg/l |
| | |

## Atmospheric Emissions Reporting Requirements

The following is a list of pollutants that EPA monitor. Those with an * are only done occasionally.

| | |
|---|---|
| | Gas flow |
| | Dust |
| * | Dust (metal content) |
| | combustion gases (SO2, NOx, CO and O2) |
| | Organic speciation using ATD/GCMS (refer to method definition) |
| | Organic speciation using charcoal/FID (refer to method definition) |
| * | Acetic acid |
| * | Acetal. MeOH, EtOH |
| | Total acids as HCl |
| | HF |
| | HCl |
| * | HBr |
| * | $H_2SO_4$ |
| | HCHO |
| * | NH3 |
| | Total organic carbon (as C) |
| | Moisture |

Any measurements that are made give rise to results in one of the following units:

| | |
|---|---|
| $mg/Nm^3$ | concentration |
| kg/hr | mass flow |
| $m^3/hr$ | volume flow |

The only corrections that EPA apply to raw data to generate reportable data are as follows:

| | |
|---|---|
| Pressure | |
| Temperature | |
| Oxygen | (on combustion sources only) |
| Moisture | (on combustion sources only) |

# Atmospheric Emission measurement results

## Table: Results of Total Organic Carbon measurement

| Sample ID | Time | Duration (mins) | Location (Vent ID) | Parameter | Concentration ($mg/Nm^3$) | Mass flow (kg/hr) |
|---|---|---|---|---|---|---|
| | | | | benzene<br>*Total of class A solvents*<br><br>chloroform<br>carbon tetrachloride<br>trichloroethylene<br>trichloroethylene<br>tetrachloroethylene<br>dichloromethane<br>**Total of class B solvents**<br><br>**Total Organics (as C)** | | |

## Table: Results of TA.Luft Volatile Organics measurement

classification refers to T.A. Luft, Federal Ministry for Environment, Bonn, 1986

| Sample ID | Time | Duration (mins) | Location (Vent ID) | Parameter | Concentration ($mg/Nm^3$) | Mass flow (kg/hr) |
|---|---|---|---|---|---|---|
| | | | | benzene<br>**TA.Luft Carcinogen Class III**<br><br>chloroform<br>carbon tetrachloride<br>1,2-dichlorbenzene<br>**TA.Luft Class I**<br><br>trichloroethylene<br>tetrachloroethylene<br>1,2-dichlorbenzene<br>tetrahydrofuran<br>toluene<br>chlorobenzene<br>cyclohexanone<br>m+p xylene<br>o-xylene<br>**TA.Luft Class II**<br><br>2-propanol<br>methyl-ethyl-ketone<br>cyclohexane<br>hexane<br>ethyl acetate<br>heptane<br>methyl-iso-butyl-ketone<br>ethanol<br>acetone<br>dichloromethane<br>**TA. Luft Class III**<br>**Total TA.Luft Organics**<br><br>TPA (as toluene)<br>ToPA (as toluene) | | |

Table: Results of Flue Gas and Oxygen measurement

| **Sample ID** | **Time** | **Duration (mins)** | **Location (Vent ID)** | **Oxygen (% v/v)** | **Parameter** | **Concentration ($mg/Nm^3$), dry gas, 3% reference oxygen** | **Mass flow (kg/hr)** |
|---|---|---|---|---|---|---|---|
| 1 | 13:46 | 32 | **Boiler 1** | **4.5** | $NO_x$ (as $NO_2$)<br>$SO_2$ | | |

Table: Results of Total Particulates and Oxygen measurement

| **Sample ID** | **Time** | **Duration (mins)** | **Location (Vent ID)** | **Oxygen (% v/v)** | **Volume flowrate ($Nm^3/hr$)** | **Particulates ($mg/Nm^3$), dry gas, 3% reference oxygen** | **Mass flow (kg/hr)** |
|---|---|---|---|---|---|---|---|
| 1 | 13:46 | 32 | **Mill 1** | **4.5** | | | |

**Emissions to air,** monthly summary sample template

| Parameter | Concentration | Mass Emissions | Number of samples | % Compliance |
|---|---|---|---|---|
| Particulates | $mg/Nm^3$ | kg | | |
| SOx | $mg/Nm^3$ | kg | | |
| NOx | $mg/Nm^3$ | kg | | |
| $CO_2$ | $mg/Nm^3$ | kg | | |
| TA Luft Class I | $mg/Nm^3$ | kg | | |
| TA Luft Class II | $mg/Nm^3$ | kg | | |
| TA Luft Class III | $mg/Nm^3$ | kg | | |
| Total Organic (as C) | $mg/Nm^3$ | kg | | |
| Non-Methane VOC | $mg/Nm^3$ | kg | | |
| Ammonia | $mg/Nm^3$ | kg | | |
| Total Heavy Metals | $mg/Nm^3$ | kg | | |
| | | | | |

**Boiler Emissions to air**

| Parameter | Concentration | Mass Emissions | Number of samples | % Compliance |
|---|---|---|---|---|
| Dust | $mg/Nm^3$ | kg | | |
| Sox | $mg/Nm^3$ | kg | | |
| Nox | $mg/Nm^3$ | kg | | |
| CO2 | $mg/Nm^3$ | kg | | |
| CO | $mg/Nm^3$ | kg | | |

## **Energy & Water Consumption** (sample templates)

**Energy Usage (per month)**

| Energy Consumption | Unit | Sulphur Content |
|---|---|---|
| Heavy Fuel Oil | $m^3$ | |
| Light Fuel Oil | $m^3$ | |
| Natural Gas | $m^3$ | |
| Electricity | MW | |
| Coal | kg | |

**Water Consumption *(per month)***

| | Unit |
|---|---|
| On-site groundwater use | $m^3$ |
| On-site surface water use | $m^3$ |
| Municipal water use | $m^3$ |

**Environmental Complaints per month** (sample templates)

| | Number |
|---|---|
| Complaints received | |
| Complaints requiring corrective action | |
| **Categories of Complaint** | |
| Odour | |
| Noise | |
| Water | |
| Air | |
| Procedural | |
| Miscellaneous | |

# Noise Reporting Requirements

1. Reporting frequency rather than Monitoring frequency (as in most IPC licences) is included because where continuous monitoring is required, the company is normally required to submit the results to the Agency on a monthly basis.

## 1. Noise Monitoring – Boundary, Noise Sensitive Locations (NSL's)

| Parameter | Units | Distance from source (m) | Reporting frequency Note 1, 2 | Comment | Meteorological Conditions Note 3 |
|---|---|---|---|---|---|
| $L_{eq,}$ T, $LF_{10,}$ $LF_{90}$ | dB(A) | Variable | monthly | where T = 15, 30, or 60 minutes | Should be noted |
| | | | | | |
| Tonal component | dB(L, A), subjective | Variable | monthly | Should be noted | |
| Impulsive characteristics Note 4 | subjective assessment | Variable | monthly | Should be noted | |

Note 1: Continuous noise monitoring at the NSL's can be required, in some cases noise monitoring will be triggered by the exceedence of a pre-defined noise level.

Note 2: Day time measurements and night-time measurements may be required on alternate months.

Note 3: Wind direction, wind speed (m/s), and temperature ($^0$C) should be recorded

Note 4: $L_{(A)\ MaxP} - L_{Aeq}$ can be used, but it is normally a subjective assessment

## 2. Noise and Vibration Monitoring - Boundary, Noise Sensitive Locations

| Parameter | Units | Distance from source (m) | Reporting frequency Note 1 | Meteorological Conditions Note 2 |
|---|---|---|---|---|
| Peak Particle Velocity (PPV) | (mm/s) | Variable | Monthly, quarterly | Should be noted |
| Peak Vector Sum | (mm/s) | Variable | Monthly, quarterly | " |
| Air overpressure | dB(L) $_{max.\ peak}$ | Variable | Monthly, quarterly | " |

Note 1: The level of noise and vibration monitoring required is normally dependent on the frequency of blasting operations, typically once a week.

Note 2: Wind direction, wind speed (m/s), and temperature ($^0$C)

**WASTE EMISSIONS - Hazardous Waste Disposal** (per month; sample template)

| Waste material | EWC Code | Main source[1] | Quantity | | Further treatment (Method, Location & Undertaker) | Recovery, reuse or recycling (Method, Location & Undertaker) | Final disposal (Method, Location & Undertaker) |
|---|---|---|---|---|---|---|---|
| | | | Tonnes / month | $m^3$/month | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

1 A reference should be made to the main activity / process for each waste.

**WASTE EMISSIONS - Other Waste Disposal** (per month; sample template)

| Waste material | EWC Code | Main source[1] | Quantity | | Further treatment (Method, Location & Undertaker) | Recovery, reuse or recycling (Method, Location & Undertaker) | Final disposal (Method, Location & Undertaker) |
|---|---|---|---|---|---|---|---|
| | | | Tonnes / month | $m^3$/month | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

1) A reference should be made to the main activity / process for each waste.

## EMP Reporting Requirements

The annual EMP report could be utilised as a source of useful Management Performance Indicators if a standardised tabular format were introduced for EMP reporting. The following table is proposed (additional information e.g. Gantt Charts can be appended):

| Project No. | IPC Licence Condition No. | Relationship to Objectives & Targets | Reason for undertaking project | Project Classification (see over) | Project Summary | Designation of Responsibility | Time frame | Target reached y/n | % complete |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
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| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

*Project classification scheme*

| Class | Sub | Description |
|---|---|---|
| **A** | ***Prevention*** | |
| | 1 | Training |
| | 2 | Process modifications |
| | 3 | Improved process control |
| | 4 | Improved yield |
| | 5 | Improved equipment |
| | 6 | Improved management |
| | 7 | Improved cleaning |
| | 8 | Materials substitution |
| | 9 | Materials reduction |
| | 10 | Energy reduction |
| | 11 | Fugitive emissions reduction |
| | 12 | Product change |
| | 13 | Reduced packaging |
| **B** | **Recovery** | |
| | 1 | Training |
| | 2 | On-site re-use |
| | 3 | Off-site re-use |
| | 4 | On-site recycling |
| | 5 | Off-site recycling |
| **C** | **Treatment** | |
| | 1 | Training |
| | 2 | Improved treatment operation, e.g. collection |
| | 3 | Alternative treatment operation |
| | 4 | Off-site treatment |
| **D** | **Disposal** | |
| | 1 | Training |
| | 2 | On-site disposal |
| | 3 | Off-site disposal |
| **E** | **Other** | |
| | 1 | Environmental awareness training |
| | 2 | Calibration of monitoring equipment |
| **F** | **Life-cycle impacts** | |
| | 1 | Take-back of product at end of life |
| | 2 | Improved use mode, e.g. less dispersive usage |

APPENDIX IV

## EMS Assessment, Implementation and Audit Software

This material is drawn from vendor literature and an examination of demonstration versions of each software package.

ISO 14000 Software Series (GreenWare)

The GreenWare ISO 14000 software series is an integrated electronic system for assessing, implementing and auditing an environmental management system (EMS) that meets the requirements of ISO 14001.

**1. ISO 14000 Assessment software** for use by companies in evaluating the performance of their environmental management systems with respect to meeting the requirements of ISO 14001;

**2. ISO 14000 Implementation software** to assist companies in establishing and maintaining an environmental management system that meets the requirements of ISO 14001; and

**3. ISO 14000 Audit software** for use by both external environmental auditors and companies' internal auditors in auditing companies' environmental management systems for ISO 14001 registration audits or self-declaration purposes.

*GreenWare's ISO 14000 software products include the following unique features:*

- a **document management** and control system
- **full customisation**, report-writing and word-processing capabilities
- **document revision** and tracking, including milestones
- special **diagnostic features** to evaluate document completion and status
- user-specific **document security**, verification and EMS password protection
- **data linkages** and scoring
- **customisable views** for draft, final, manual and electronic documents
- clear **on-screen guidance** and instruction with context-specific ISO 14000 help
- **time and costs tracking**
- **integration with groupware**, e.g., Microsoft ® Outlook TM

*Document Management*

To assist companies in organising and maintaining the integrity of their data, GreenWare's ISO 14000 software includes a document management system. The

Document Manager allows users to organise their documentation in any manner desired, and to link to documents in other programs such as Word and Excel, and on the Internet. With this system, companies can automatically control, store and access all necessary information from one central location. In addition, companies can integrate the software with their existing documentation such as standard operating procedures.

*Customisation Tool*

GreenWare's ISO 14000 software contains a document customisation toolset that combines full word-processing and spreadsheet capabilities with features such as special-purpose cells for inputting information, numerical calculations and logical dependencies, radio buttons, pop-up menus and automatic data linkages between documents.

The toolset also serves as a report writer that allows users to create their own customized documentation and reports of desktop-publishing quality based on expert rules embedded in the software without the need for custom programming.

*Document Revision*

The software includes features for advanced document comparison with milestones to identify different versions of documents and redlining.

*Document Diagnostics*

An important aspect of GreenWare's ISO 14000 software is its ability to investigate and evaluate the status of documents. This "diagnostic" feature enables users to generate a series of diagnostics that automatically identify discrepancies, missing and/or incomplete information and preparer/reviewer status for every document, including worksheets, checklists, forms and reports. This tool assists both document preparers and reviewers in ensuring the accuracy of document content.

*Document Security*

Another important feature of GreenWare's ISO 14000 software is its sophisticated user protection and tracking system that allows companies to control documents and reports in terms both of user access and document modification and manipulation. The system has an extremely high level of granularity, such that access and use rights can be assigned to specific reports and to sections within reports. Users also can be required to sign off on any document in order to create an audit trail for each document. As an additional control to ensure data integrity, through the use of a password protection feature a user may be prevented from altering the information in any document.

*Customizable Document Views*

Documents can be viewed in draft and final form, as well as printed out for manual completion in the field or on-site.

*On-screen Guidance*

On-screen guidance, including specific EMS examples, is provided throughout the software, as well as an extensive on-line help system to assist users in working through the process.

*Time and Costs Tracking*

Each software product includes a time and costs tracking worksheet (see also above under ISO 14000 Audit software) that allows companies to record and calculate assessment, implementation and audit fees and expenditures, and compare actuals to budgets, including variances.

*Integration with Groupware*

GreenWare ISO 14000 software can be integrated with the Microsoft® Outlook™ messaging and collaboration system, including Exchange Server, for calendar, contact and task management features in a full collaborative groupware environment. GreenWare is also developing a set of tools that will allow users to create web-based interfaces for data entry and reporting from any number of locations using the Internet.

**ISO 14000 Assessment software**

Complete interactive worksheets for each section of ISO 14001 with GreenWare's ISO 14000 Assessment software to generate a gap analysis report automatically, with comparative performance and cost allocation graphs, overall percentage of requirements met, not met, and partially met, detailed recommended actions, persons responsible, start and end dates, priorities and costs.

Features:

- Assessment questionnaire
- Automatically generated gap analysis report
- Comparative performance graphs
- Cost allocation graphs

*Assessment Questionnaire*

Identifies all the requirements of an EMS specified by ISO 14001, provides context specific help for each section of ISO 14001, including additional guidance about the requirements of the standard.

*Gap Analysis Report and Action Plan*

Based on the results of questionnaires, the software automatically generates a report that summarizes the current status of the EMS in terms of meeting every single ISO

14001 requirement. The report also allows users to make recommendations and prepare a detailed action plan that identifies priorities, implementation costs, persons responsible and start and completion dates to ensure that the ISO 14001 requirements are met. This report is fully customisable and includes automatically generated comparative performance and cost allocation graphs.

*Comparative performance graphs*

Compares by ISO section the total number of requirements met by the organisation in the current period to the total number of requirements in ISO 14001, and, if available, the total number of requirements met in the previous period.

*Cost allocation graphs*

Summarises the estimated implementation costs for the actions recommended to meet the ISO 14001 requirements.

**ISO 14000 Implementation Software**

Work through a series of comprehensive, linked and interactive worksheets with GreenWare's ISO 14000 Implementation software to implement and improve your EMS to meet all the requirements of ISO 14001.

Features:

- Worksheets for
  - evaluating environmental aspects and impacts
  - setting objectives and targets
  - monitoring performance
  - identifying non-conformance
  - developing environmental management programs
- Implementation schedule and status report
- Standard operating procedures
- EMS document control

*EMS worksheets*

These worksheets provide guidance, detailed instructions and procedures for implementing each of the components of an EMS specified by ISO 14001. They also include guidance for implementing an environmental management system based on ISO 14004, Environmental management systems–General guidelines on principles, systems and supporting techniques.

*Implementation schedule and status report*

Implementation status reports and schedules can also be generated automatically from the worksheets for each section of ISO 14001, including actions, start and end dates, persons responsible, priorities and status.

*Standard operating procedures*

Users can document all of their standard operating procedures relating to implementation and operation of the EMS.

*EMS document control*

All EMS documentation generated by the software includes document control and revision tracking features to meet the requirements of ISO 14001.

**ISO 14000 Audit Software**

A set of comprehensive, detailed audit procedures and tests for every ISO 14001 requirement can be systematically followed. All procedures and tests are automatically linked to a customisable audit report.

The ISO 14000 Audit software consists of three main areas: audit planning and administration, including assessment of audit risk, (2) audit working papers, and (3) audit report and related reporting documentation.

Features:

- Planning and administration worksheets
- Assessment of audit risk
- Audit working papers
- Audit report

*Planning and administration worksheets*

These worksheets allow auditors to create an audit plan and document the status of their audit procedures, as well as prepare a detailed time and expenditures budget for the audit.

*Assessment of audit risk*

This allows determining those audit areas that are of highest risk in order to reduce the overall audit risk. The risk assessment model follows a methodology applied in financial auditing.

*Audit working papers*

These papers consist of detailed audit protocols and procedures for every single requirement of ISO 14001. All papers are linked to a series of in-depth audit tests. The protocols and tests are customisable, and built-in document control and verification features allow the auditor to control the integrity of information throughout the audit process.

*Audit report*

The results of the audit as documented by the auditor in the working papers are automatically linked to a comprehensive and customisable audit report. The reporting documentation includes standard documents such as an engagement and representation letter.

ISO 14001 isotop TimeSaver CD (Isotop)

The isotop TimeSaver CD is an interactive tool to produce the documentation required for your ISO 14001 Environmental Management System. A prewritten set of documents is specifically designed to adapt to an organisation.

*The isotop TimeSaver CD includes the following features:*

- Command center
- Implementation guide
- Environmental manual
- Management procedures
- Customisable Records
- Action tools
- Aspects significance assessment

*Command Centre*

Enables navigation between all isotop model documents and allows you create and save new versions.

*Implementation Guide*

Contains a Three Phase Plan for ISO 14001 implementation with full advice in 24 steps, including the isotop documents to use.

*Environment Manual*

Describes the core elements of the Environmental Management System and their interrelation. Contains a model Scope Statement and model Environmental Policy Statement.

*Management Procedures*

19 prewritten Management Procedures, each written to a standard format with statement of aim, responsibility, method, records and references.

*Customisable Records*

Support the implementation and operation of a Management System. Each Record includes a blank version to complete. The Record can be used as it is, or the format modified by exporting to a word processor.

*Action Tools*

11 comprehensive checklists to assist adaptation and implementation of the isotop Management Procedures. Containing over 400 suggestions for environmental issues and controls.

*Aspects significance assessment*

The software includes an aspects significance assessment of pollution and resource-use and makes a significance rating of the aspects.

EcoManager (Aspects)

The EcoManager is a solution for those wishing to establish an Environmental Management System in their organisation. It provides an integrated and accessible framework for all elements of the management system together with the means for carrying out many of the data intensive tasks.

*EcoManager includes the following features:*

- EMS worksheets
- Built-in questionnaires and checklists
- Significant aspects assessment
- Report generation and draft manual
- Automatically generated management program
- On-screen assistance
- Audit schedule
- Document control

*EMS worksheets*

The software includes worksheets for common elements of an EMS such as Preliminary review, Environmental policy, Planning, Implementation and operation, and Audit and review.

*Built-in questionnaires and checklists*

Questionnaires and checklists are provided to gather baseline data for the implementation of an EMS and to assess company's progress at a later date.

*Significant aspects assessment*

The software includes a standard methodology for deciding on likelihood and consequence for assessing the significance of environmental aspects. In order to determine whether the aspect is likely to have an impact on the environment and the consequence the aspect will have when it impacts on the environment, questions have to be answered.

*Report generation and draft manual*

Eco Manager provides one button generation of reports for EMS documentation and meetings and a built-in draft manual can be personalised for the organisation.

*Automatically generated management program*

A management program based on objectives and targets is automatically generated together with time scales and reminders for implementation.

*On-screen assistance*

Continuous on-screen assistance is available for program use instruction and detailed help screens are provided for assistance with interpretation and understanding of the specific requirements of the EMS standards.

*Audit schedule*

The software instantly produces an audit schedule using information already entered.

*Document control*

Built into every screen enabling specification of date, version and person responsible for each document.

<u>EDICTS (Envirochem)</u>

Environmental Data Information, Compliance and Tracking System

*Features:*

- Customisable system
- Data sharing
- Online policy and procedure manuals

- Built-in security
- Site and corporate reports
- ISO compliant and auditable
- On-site and/or online support

*Customisable system*

The system may be customised to specialised client requirements.

*Data sharing*

Online and network access permits operating staff and management at all levels to share environmental data, policies, procedures and reports… at any time, from any location.

*Online policy and procedure manuals*

Eliminate shelves full of out-of-date manuals.

*Built-in security*

It restricts access to those authorised to enter and use the system. It controls data changes to keep everyone current and connected online.

*Site and corporate reports*

The software manages information from multiple sites (unlimited number), and generates both site and corporate reports at will.

*ISO compliant and auditable*

EDICTS provides a framework and management tool for an ISO 14000 compliant and auditable EMS.

*On-site and/or online support*

Envirochem provides on-site and/or online support and services to maintain the system. Regular upgrades are available.

## EQS Management Software

Envoy (Entropy International)

Envoy provides an ISO 14001, EMAS, ISO 9001, and OHSAS 18001 compliant structure and an electronic template for a fully functional environmental, quality, and health and safety (EQS) management system. It is a web and intranet-based

management system that can be used at one site or a thousand sites for developing, implementing and maintaining an EQS.

*The Envoy software product includes the following features:*

- Certifiable implementation of ISO 14001, EMAS, ISO 9001 and OHSAS 18001
- Modular system
- Network application run from a single, central database
- Information sharing and communication
- Site flexibility with company-wide consistency
- Automatic document control
- Real-time reporting
- Link and upload
- Import data
- Customisable package
- Security and access
- Ongoing support and improvement

*Certifiable implementation of an EQS system*

Envoy enables certification to ISO 14001, ISO 9001 and OHSAS 18001.

*Modular system*

Envoy has been designed in a 'modular' fashion so that tools, components and management systems can be chosen depending on needs. In this way, an integrated system can be implemented in one go or successivly, beginning with one or two management modules. For example the Site Management module is the 'backbone' for each site and to that any or all of the additional modules for Environmental, Quality, Health and Safety Management, and Monitoring can be added. The system contains the main modules *Resources, Communication, Management, Monitoring, Corporate Reporting, Administration,* and *Help*. Each of these modules is subdivided into further sub-modules.

*Information sharing and communication*

Envoy provides areas for shared 'company-wide' information (Home, Resources, Communication, Help) as well as areas for information exclusively for site-specific users. Corporate documentation and Best Practice case studies can be shared by all users and the People Search function facilitates communication between the management professionals.

*Site flexibility with company-wide consistency*

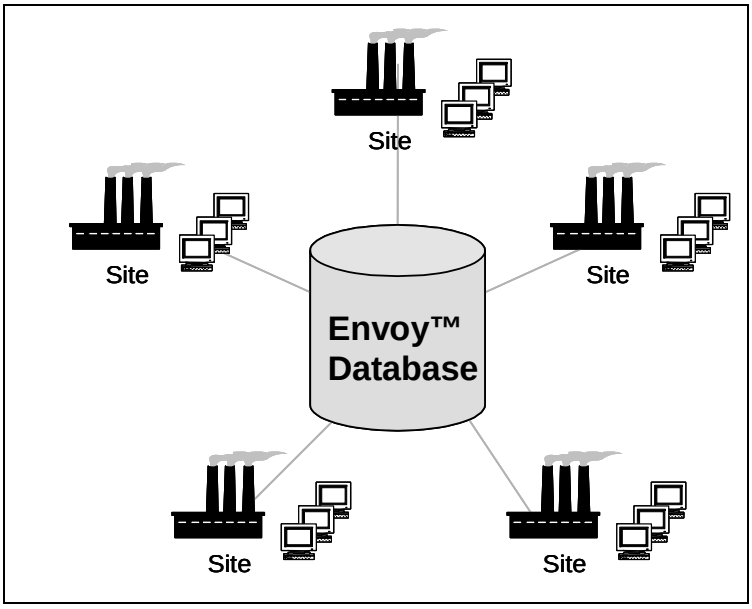
Each site is set up with its own management system to allow for site-level independence and flexibility, but all sites use the same framework, methodology and terminology to provide for a certain degree of consistency and comparability across all sites.

*Automatic document control*

The software can automatically take care of document control requirements by indicating a record's author, creation date, issue and version numbers, revision date and approver.

*Network application*

Envoy is a network application run from a single, central database. Data input is instantaneous and information access and reporting can be done in real-time from all or any sites. The software is available as a web-based EQS management solution accessible via the Internet on an annual subscription basis or as a corporate EQS management solution that can be purchased for installation and use on corporation's intranet.




*Real-time reporting*

Envoy can generate standard and customised reports in real-time for a single site, a group of sites, or all sites in the system.

*Link and upload*

Text documents, CAD diagrams, audio or video files or even other applications can be linked or uploaded to supplement records created in the system.

*Import data*

If there are similarities between site management systems, speed up development by importing information from one site to another.

*Customisable package*

Envoy can be customised for specific needs. This might be as simple as matching the corporate image, 'pre-loading' the existing management system information or it could be the development of new modules or even integration with existing files and applications that the company may already be using.

*Security and access*

Envoy protects data to ensure no one can get to it without permission. The flexible application security allows to give individual users access to the entire system, a group of sites, one site, or even only part of one site and to set their privileges to 'read only', 'report only', 'amend' or 'approve'.

*Ongoing support and improvement*

Entropy International offers on-line support, a supplemental Envoy User Guide, regular system upgrades and additional consulting and training.

EQS Software (EQS Solutions)

The software stores and organises information to operate a management system. It supports reporting, undertaking audits, updating documents and communicating actions.

*Key Features:*

- Modular system
- Integration with existing systems
- Document management
- Security
- Risk assessment

*Modular system*

The software organises information in four modules: environment, quality, health & safety, and management. The Environmental Module is designed to help the implementation and adoption of an effective environmental management system in compliance with ISO 14001 and EMAS. The Quality Module is designed to encourage the implementation and maintenance of an effective quality management system in compliance with ISO 9000. The Safety Module is designed to look after all the information related to health and safety at work for the company. Each of these modules operates in conjunction with the Management Module which organises information such as policy, objectives & targets, roles and responsibilities, communication, procedures, reports, training, auditing, management review, standards, regulations, and authorisations.

*Integration with existing systems*

The EQS Software has the ability to create links with existing files in other Windows applications using OLE 2.0.

*Document management*

EQS allows you to control, schedule and record the review, release, distribution and update of documents that relate to the management system. The Documents form provides information regarding the text, version number, changes and comments of documents.

*Security*

The security feature enables you to set up user passwords. Users can be restricted according to the function they need access to, or on a read-only basis. This feature allows data integrity to be controlled by the system supervisor.

*Risk assessment*

The software includes a risk assessment tool to determine the significant environmental effects or aspects that the organisation has.

## Data Collection, Analysing and Reporting Software

EQWin

A database system for storing, analysing, reporting and managing the volumes of analytical data derived from environmental monitoring programs. It is an environmental quality data management system for Windows.

*Product features:*

- Useable on any LAN supporting Windows
- No practical data storage limitation
- Data Input
- Data Querying, Analysis, Reporting and Graphing
- Regulatory compliance reporting

*Data Input*

- Data easily imported from spreadsheets or tab/comma-delimited text files (ASCII format).
- Allows for import of both numeric (quantitative) and non-numeric (qualitative) values.
- Maintains mathematical accuracy of the original data by using significant digits.
- Extensive data validation, referential integrity checking and screening procedures.
- Convention/custom handling and display of "<" values, for results below detectable limits.
- Supports calculated parameters and standards scripting language.

*Data Querying, Analysis, Reporting and Graphing*

- Query dialogue box, for querying of the database.
- Automated standard Quick-Reports, for ad-hoc reporting.
- Integrated custom report-writer for user-configured reports.
- Produces statistical summaries.
- Interactive time series and X-Y graphing facilities.
- Save custom reports and graphs as templates for repetitive reporting requirements.
- Data transferable into popular software for further analysis or presentation.

*Regulatory compliance reporting*

- Comparisons to regulatory standards done on the fly.
- Highlights non-compliant data against regulatory levels or user-defined objectives.
- All data 'out of specification' is flagged for user attention.
- Uniquely supports calculated standards (i.e. variables dependant on other data)

<u>doCOUNT HSE</u>

This data collection tool was developed by Novartis AG and is in use since 1997. With this tool relevant data-sets can be constructed and the collection over a simple or complicated organisation organised worldwide for each collection period. After entry of the data, these are validated in the system. Inconsistencies are corrected and documented. The tool enables analyses per evaluation period for an organisational unit or for a desired selection of organisational units within a complex organisational structure. In addition, it is possible to prepare any tables for different collection

periods. The tool histories the data and changes and developments can thus be analysed at any time.

*DoCOUNT fulfils the following features:*

- Objectives
- Modular system
- Site tool – Central tool
- Core/Optional data-set
- Organisation tree
- Data quality control
- Worksheet and various reports
- Performance documentation

*Objectives*

The software was developed with the following objectives

- Collection of HSE-data worldwide
- Consolidation of the collected data for any selected group of organisational units
- Flexible system for changes, either of the organizational structure and/or change of rules
- Worldwide user-connection online or offline
- Offline module with integrated database
- Database with a 'complete' data-set and historisation of data
- Flexibility to define individual 'core data-sets'
- Enhanced data quality
- Guarantee of the data consistency
- Efficient data reporting
- User friendliness

*Modular system*

The system is organised by a number of modules each designed for a particular functionality such as filtering data, organisational issues, customisation, etc.

*Site tool – Central tool*

The system consists of a 'site tool' and a 'central tool' and is based on a comprehensive central HSE-database.

The 'site tool' is distributed to the site HSE officers worldwide. It is a stand-alone program running on Wintel based PC's, using conventional hardware and software. The basic element is a database with the site data of the previous years, extracted from the central database. The site HSE-officer is responsible for the data input and interpretation of deviations compared to the previous year. With the 'site tool' the site HSE-officer documents the site situation with figures and text for all HSE-relevant issues.

The 'central tool' allows Corporate HSE to handle the database and set up the organisation and the necessary definitions. All the definitions and the organisation can be copied from the last collection period to the future period. Normally only a few changes in the definitions and the organisation are necessary for the new collection period. The 'central tool' allows also the sectorial HSE-officers to organize the yearly sectorial data collection and to import and validate the sectorial site data. One can report data as standard forms or 'various tables' with either single site data or consolidated data of any selected group of organisational units.

*Core/Optional data-set*

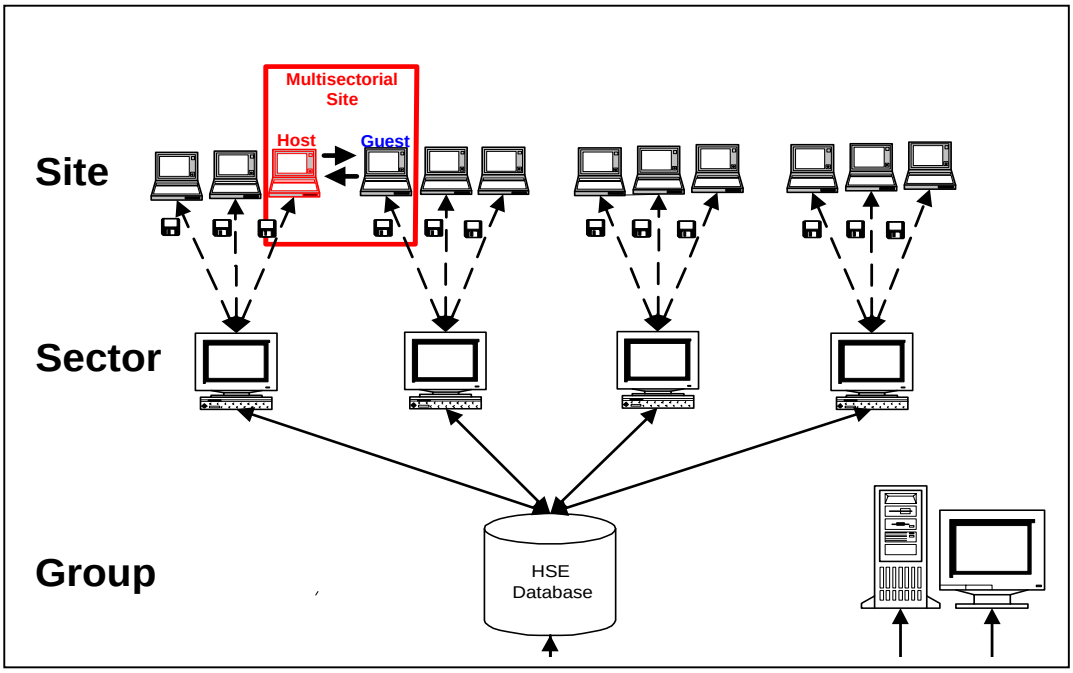
The system contains a 'complete' data-set that is necessary to describe the impact of the company's activities on Health, Safety and Environment. It distinguishes between the 'core data-set' and the remaining data, the 'optional data-set'. The 'tailor-made module' allows the definition of the 'core data-set' for any organisational unit of the overall organisation. This means the system has the flexibility to handle the 'complete data-set', but, to avoid inappropriate work in any organisational unit, the administrator or the sectorial HSE-officer can define individual data-sets.

To describe the 'complete' HSE data-set the program offers several worksheets. Each worksheet is a form, used for data input as well as for data output. The available worksheets are sorted by the following chapters:

HSE Key Figures, Comments, Material Flow, Packaging Material, Transport, HSE Financial Management, Consumption of Natural Resources, Health, Noise, Safety, Biosafety, Priority Substances, Waste Water Quality, Air Emissions, Non-hazardous Waste, Hazardous Waste, Soil and Groundwater, Forecast, Eco Balancing and Weighting, and Business Results.

*Organisation tree*

The 'organisation builder' allows the definition of new overall organisational units like groups, divisions, sectors, companies and new sites. Site is the lowest organisational unit in the overall organisation. One can inactivate and activate any previous defined organisational unit and within the organisation builder one can set up or change organisation trees with drag-and-drop.




*Data quality control*

Different measures are available to support an adequate data-culture:

- Input with physical-units usually used during the effective data collection. The program automatically converts this unit to the basic unit used for the consolidation.
- Representation of the figures with a constant number format with 3 significant figures and with the exponential representation.
- During the input process, the corresponding value for the previous year is visible.
- If defined, the new input value will be compared with the value for the previous year. If the deviation is larger than a defined threshold limit, the user must explain the difference.
- Crosschecks between any data-fields can be defined.
- The data-fields can be defined where the measurement method has to be specified.
- The data-fields can be defined where the absolute error has to be specified.
- Documentation of data changes in the central database.

*Worksheet and various reports*

'Worksheet report' and 'various report' are the two reporting modules available. With the 'worksheet report' one can represent the site figures or the consolidated figures for any selected organization with defined forms, like 'energy consumption', 'occupational accidents', etc. With the 'various report' module the user can set up any

table. It allows the representation of data over different periods, for different selected organizations, with absolute or relative values, represented as a difference to a defined column or a defined row. A simple graphical presentation is also available. All the results can be exported, including the text of the columns and rows, into a spreadsheet application.

*Performance documentation*

The Program doCOUNT HSE was developed primarily as a Site Tool. It allows the sites to document and "acCount" for their HSE performance. The program has different features depending on the purpose it serves:

• Site tool (data input, export, reports, evaluations, bar charts), including features for Country HSEO's

• Central tool (administering database, backup, maintenance), including Sector Management tool (data import, validation, reporting)

• Management Information tool (aggregated data as charts and/or tables for management, to be implemented)

• Public tool (aggregated data for communication to public, to be implemented)

## Aspects Significance Assessment Software

Significance Wizard (Entropy International)

The Significance Wizard is a software program that deals with the issue of significance and presents a procedure for assessing environmental aspects and impacts based on a flowchart of company's operations.

It comes with a number of checklists and questions to help to identify all of the aspects and impacts of operations. Identified aspects and impacts are then assessed for significance and presented in a number of printable ways.

*The Significance Wizard includes the following features:*

- ISO 14001 compliant procedure
- Flowchart of the business processes
- Checklist of questions
- Database of common environmental aspects
- Database of hazardous substances
- Numerous reports
- Export to common database and spreadsheet software programmes
- Drag-and-drop interface
- Aspect assessed for significance

*ISO 14001 compliant procedure*

The software provides an ISO 14001 compliant procedure for identifying and assessing the significance of environmental aspects and impacts.

*Flowchart of the business process*

The Significance Wizard produces an overall flowchart with the main processes and process steps which have been entered in a four steps procedure. This flowchart is part of the main screen and used for the aspect assessment.

*Checklist of questions*

The software includes a checklist of questions to help to identify environmental aspects within the organisation.

*Database of common environmental aspects*

The Significance Wizard includes a predefined database of environmental aspects and their impact descriptions which can be customise to be specific to the organisation.

*Database of hazardous substances*

A database of hazardous substances can be referenced during the assessment of significance.

*Numerous reports*

The software provides numerous reports for printing the results, including a main process flowchart, input/output flowchart for each process step, aspects graph and summary, operations summary, and a register of aspects & impacts.

*Export to common database and spreadsheet software programmes*

All reports can be exported to common database, spreadsheet, text editing, e-mail and html software packages.

*Drag-and-drop interface*

The main screen of the Significance Wizard shows the flowchart of the processes (entered main processes and process steps) on the left hand side, and the 'aspects source tree' on the right hand side. Aspects are added by dragging an aspect from the aspects source tree to a process step.

*Aspect assessed for significance*

Aspects must be assessed in order to produce a significance factor which allows to rank and manage them in the environmental management system as a whole. The significance factor is the result of the multiplication of two elements of an aspect, its impact and its severity, both of which are defined by answering the aspect impact questionnaire and selecting the severity from an option list respectively.

## Environmental Performance Software

GreenWare Perform Software Series

The GreenWare Perform product series provides companies with an integrated electronic system for recording, monitoring and reporting on their environmental performance. The software allows companies to record and monitor their environmental performance on an ongoing basis, and to produce intelligent reports on this performance for both internal and external purposes, including compliance. The environmental performance system can be integrated with companies existing financial information system.

To monitor and report on its environmental performance using this software, the company must identify the set of environmental measures that are relevant to its business and the environmental performance indicators that it wishes to use to track performance. The appropriate performance data can then be entered into the software database. Through the use of GreenWare Perform's standard data identification scheme ("mapping numbers"), the company will be able to generate a range of automatic and customisable environmental performance reports from the database. The company also can add new measures, such as material and energy inputs and outputs, to the system at any time to reflect its particular environmental performance requirements.

One of the most powerful features of GreenWare Perform is its ability to allow a company to use its own unique and pre-existing information systems for recording and monitoring its environmental performance. The information contained in the company's environmental performance recording and monitoring systems, including its database structure and data identification numbers, can be linked to GreenWare Perform's database through the software's mapping system. This unique system "maps" the data to a generic set of data identifiers embedded in the system. Once entered into the system, the data can be combined, consolidated, and grouped according to common characteristics and/or split up for reporting or other purposes.

The series includes the following three products:

**1. GreenWare Perform**

GreenWare Perform provides companies with an electronic system for recording and monitoring their environmental performance, and for producing performance reports for internal, external and compliance purposes. The software is compatible with the ISO 14000 environmental performance evaluation guidelines (ISO 14031), and fully integrated with GreenWare's ISO 14000 EMS Implementation software.

**2. GreenWare Greenhouse**

Modeled on GreenWare Perform, this specialized module allows companies to record, monitor and report on their greenhouse gas emissions to meet their Kyoto Protocol emission targets. It contains customized greenhouse gas performance measures, units and conversion rates, all automatically linked to emission reports for the six greenhouse gases in the Protocol.

**3. GreenWare Reporter**

Currently under development, this expert report generator will enable companies to create their own external sustainability reports based on the Global Reporting Initiative (GRI) Sustainability Reporting Guidelines for enterprise-level sustainability reports.

*GreenWare Perform Software Series include the following key features:*

- Progress Wizard to assist users in setting up an environmental performance system
- Summary Status report
- Strategic environmental performance reports relating to company strategies and objectives with drill down feature to access monthly or quarterly data for each indicator reported
- Report discussion issues documentation
- Optional diagnostic performance reports
- Indicator libraries
- Data quality model
- Detailed supporting analysis
- Performance mapping structure
- Data entry and journal system
- Data import and export
- Combination and consolidation of data from multiple sources and locations
- Expert report writer and customisation tool to create customised reports

- Document management
- User protection and tracking
- ISO 14001 EMS worksheets
- Data warehousing technology
- Optional financial components

*Progress Wizard*

The Progress Wizard is a workflow document that assists users in working through the various components of the software, and allows them to track their progress as they set up their environmental performance system. The workflow consists of three separate areas – Plan, Do, and Check. Each area and subsection prompts users for completion sign-offs that provide a visual status of their progress.

*Summary Status Report*

The Summary Status Report provides a bird's eye view of the company's overall environmental performance, risks and controls, and stakeholder reporting, with direct links to strategic performance reports and results. This summary may be customized by users and is intended to serve as a "roadmap" to the company's environmental performance system.

*Strategic Performance Reports*

All of the environmental performance information input directly or imported from a company's own information system is automatically linked to a set of pre-defined and fully customisable environmental performance reports. Strategic performance reports that can be generated include:

- Overall greenhouse gas emissions for all 6 gases in the Kyoto Protocol;
- Energy use reports on emissions from energy use on site;
- Transport-related reports on emissions from transportation activities, including fleet and freight transport;
- Specialist process reports on process-related emissions from production, manufacturing and other business operations such as mining and chemical manufacturing; and
- Air conditioning and refrigeration reports on emissions generated from leakages from these processes.

All reports may be generated on monthly, quarterly, semi-annual and annual bases. Comparative and trend reports also may be created to track environmental

performance over the time period. Consolidated reports on multiple products at various facilities and over different product stages can be created.

Additionally unique reports can be created using the report customisation tool. Further features of these reports are automatically generated variance calculations and graphs, ratio analysis, automatic unit and rate conversions.

*Report Discussion Issues*

This document allows users to link to all of the recommended actions and strategic opportunities that have been identified in their year-to-date environmental performance reports. Once linked, users can comment on and discuss the actions and opportunities relating to each report, as well as add issues relating to any of the reports to complete the environmental performance review process.

*Diagnostic Performance Reports*

Using the report templates provided in the software, users can create environmental performance reports that are diagnostic in nature. These reports generally would include additional supporting measures and indicators to those provided in the strategic, higher-level reports and would be created for use by different personnel in the company.

*Indicator Library System*

The software includes an indicator library system to assist users in setting up the performance reports. The system contains key environmental indicators for automatic insertion into reports, and users may create an unlimited number of their own libraries to improve organisation of their environmental metrics.

*Data Quality Analysis*

The software contains a sophisticated data quality assessment model and scoring system that allows users to evaluate the quality of each of their environmental measures and indicators in terms of its completeness, accuracy and verifiability. The model, which is optional for users, evaluates the data itself, as well as the company's control systems relating to data collection. The system consists of a data quality assessment checklist and scoring calculation that automatically produces a detailed data quality profile of each indicator being reported on. This system is completely optional and users may choose instead to exclude data quality from their reports or to enter a manual result.

*Detailed Supporting Analysis*

The automatically generated pre-defined reports include the analysis of data from different processes and products, such as quantities of greenhouse gas emissions from each source according to type of emission. Users may create their own analytical reports by specifying the different views that they require of the data.

*Performance Mapping Structure*

In addition to GreenWare Perform's standard environmental mapping structure based on the ISO 14000 environmental performance evaluation standard (ISO 14031, Environmental Performance Evaluation Guidelines), mapping numbers from the guidelines published in June 1999 by the Department of Environment, Transport and the Regions in the U.K. titled, Environmental Reporting: Guidelines for Company Reporting on Greenhouse Gas Emissions, have been included (see also "Strategic Performance Reports" and "Greenhouse Gas Module").

Users can also add their own map numbers easily, without having to change the overall structure and affecting existing indicators.

*Data Entry and Journal System*

GreenWare Perform includes a sophisticated data entry and journal system that allows users to create an audit trail for their data, and to organise this data into customisable journals based on data source types in order to meet their specific data collection protocols.

*Data Import and Export*

GreenWare Perform contains sophisticated data import and export capabilities, such that data can be directly imported and exported on an ongoing basis with real-time updating from many different software systems, including SAP. In addition, data can be imported in an ASCII file from any software package. Both methods allow users to import balances and detailed transactions if desired.

*Combination and Consolidation of Data*

GreenWare Perform's combination and consolidation technology allows companies to consolidate their environmental performance data from a virtually unlimited number of data sources, processes, products, facilities and locations around the world.

*Expert Report Writer and Customisation Tool*

GreenWare Perform's expert report writer and customisation tool allows users to create their own customized reports based on expert rules embedded in the system without the need for custom programming. These reports are created from the database to allow users to build environmental performance reports to present and monitor their data in a cohesive manner. In addition, normalized reports can be created easily, such that performance metrics can be compared and areas for improvement identified.

*Document Management*

The Document Manager allows users to organise their reports in any manner desired, and to link to documents in other programs such as Word and Excel, and on the Internet.

*User Protection and Tracking*

The protection and tracking system allows companies to control documents and reports in terms of both user access and document modification and manipulation. The system has an extremely high level of granularity, such that access and use rights can be assigned to specific reports, sections and even components within report sections. Users also can be required to sign off on any document in order to create an audit trail for each report.

*ISO 14001 EMS Worksheets*

Included with GreenWare Perform are a number of comprehensive worksheets covering the key components of an environmental management system, including identifying and evaluating environmental aspects, setting objectives and targets, developing environmental management programs, monitoring performance, and identifying non-conformances and corrective and preventive actions. These worksheets are based on the ISO 14001 international standard for environmental management systems, and are included as an optional component to assist companies in implementing and monitoring their environmental performance system.

*Data Warehousing Technology*

For users wishing to engage in broad-based performance benchmarking, both internally across facilities, and externally based on accepted industry benchmarks, GreenWare has developed a data warehousing module using Microsoft SQL server technology. This component allows companies to upload their environmental performance data to a central server. With user-defined queries, companies can then "download" the appropriate comparative performance metrics.

*Optional Financial Components*

GreenWare Perform can be configured to provide users with a full set of financial components for their performance system. These components include imports from major accounting packages, foreign exchange and currency conversions, adjusting journal entries and account split ups, income tax linkages, financial statements and integrated financial and performance measures.

APPENDIX V

## Survey of Industrial Practices

This questionnaire is being circulated to all IPC licensed companies. Its aims are to determine:
(i) Nature of existing environmental management systems and use of software support tools;
(ii) Attitudes to standardised reporting using software;
(iii) Experience of and attitudes to benchmarking.

The answers will be processed statistically. Space has been provided at the end of questions for any comments or further information that you would like to provide. Company names will be kept confidential and will not be reported in connection with specific answers.

**THANK YOU FOR COMPLETING THIS FORM. YOUR ASSISTANCE IS GREATLY APPRECIATED.**
**PLEASE RETURN BY 30th March 2001 TO:**
**Colman Mc Carthy (e-mail cmccarthy@cit.ie), phone 021 4344864, fax. 021 4344865**
**CLEAN TECHNOLOGY CENTRE,**
**UNIT 1,**
**MELBOURNE BUSINESS PARK,**
**MODEL FARM ROAD,**
**BISHOPSTOWN,**
**CORK**

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**CONFIDENTIAL SECTION**

Respondent

**Name:** Dr / Mr / Mrs / Ms .....

**Company**.....

**Department/Division:** ..... **Position:** .....

**Address:** ..... .....

..... **Tel:** ..... **Fax:** .....

**Email:** ..... **IPC Class:** ..... **IPC Licence #:** .....

## SECTION 1. BACKGROUND

**Q. 1** **Company is located in:** ❑ Ireland only ❑ Europe ❑ Worldwide

**Q.2** **Company size is in the range:**
(employees)

Ireland: ❑1-19 ❑ 20-49 ❑ 50-199 ❑ 200-499 ❑ 500-1999 ❑ >2000

Globally: ❑ 1-49 ❑ 50-199 ❑ 200-499 ❑ 500-1999 ❑ >2000

**Q.3** **The company annual turnover at the IPC licensed site is:**
(please tick the relevant box)

❑ <IR£ 1m ❑ IR£ 1m to IR£ 2m ❑ IR£ 2m to IR£ 5m

❑ IR£ 5m to IR£ 10m ❑ IR£ 10m to IR£ 20m ❑ IR£ >20m

## SECTION 2. ENVIRONMENTAL MANAGEMENT SYSTEM

**Q.4** **What is the status of Environmental Management Systems (EMS) on your Irish site?**

- ❑ ISO 14001 implemented
- ❑ EMAS implemented
- ❑ Implementation of certified EMS is being worked on
- ❑ A company specific EMS has been established
- ❑ We are devising a company specific EMS
- ❑ We do not require an EMS

Comments:

.....

.....

**Q.5** **Have you used specialised computer software to assist in the INSTALLATION of an EMS?**

❑ Yes ❑ No

**Q.6** **If yes to Q.5, which software** .....

**Q.7 Do you use computer software to assist you in the OPERATION of your EMS?**

❑ Yes ❑ No

**Q.8 If yes to Q.7, which software** .....

.....

**Q.9 Which 3 of the following, if provided as computer software, would be most useful to you?**

- ❑ templates for procedures
- ❑ templates for an environmental manual
- ❑ templates for environmental records (e.g. monitoring, audit, maintenance, calibration, training, complaints, and management review records)
- ❑ templates for a register of legislation
- ❑ assistance in identifying environmental aspects
- ❑ training on EMS
- ❑ guidance to EMS requirements
- ❑ assistance in setting environmental objectives and targets
- ❑ assistance in preparing and reporting an Environmental Management Programme

**Q.10 What do you see as the advantages of a computer-based EMS?**

Comments: .....

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**Q.11 What do you see as the barriers to having a computer-based EMS?**

Comments: .....

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## SECTION 3. REPORTING REQUIREMENTS

**Introduction**
The latest edition of the EPA IPC Licensing Guidance Note for Annual Environmental Report (AER) provides for summary reporting of environmental data, preferably as a computer file.

**Q. 12 Would the following additional standard templates be useful to your company?**

| | | |
|---|---|---|
| Environmental Management Programme | ❑ Yes | ❑ No |
| Monthly/quarterly emissions reporting | ❑ Yes | ❑ No |
| Annual groundwater monitoring | ❑ Yes | ❑ No |
| Annual noise monitoring | ❑ Yes | ❑ No |

Other (specify) .....

**Q.13 Would computer software for scheduling environmental work (monitoring, testing etc.) and reporting be useful to your company?**

❑ Yes ❑ No

**Q.14 Does your company already use scheduling software?**

❑ Yes ❑ No

**Q.15 If yes to Q.14., which software do you use?** .....

**Q. 16 What recommendations would you have to streamline reporting ?**

Comments: .....

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**Q. 17 What do you see as the barriers to reporting to the EPA via computer files?**

Comments: .....

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## SECTION 4 ENVIRONMENTAL INDICATORS

**Introduction**
Environmental indicators are measures that reflect environmental performance. They may be determined for a site as a whole, or determined for individual products or processes. They can be determined as an absolute value, e.g. cubic metres of water used on the site per year, number of licence breaches per annum or they can be adjusted to some measure of production level, e.g. water consumed per item, per employee, per value added.

**Q.18 Do you use any of the following indicators?**
If you answer "yes" to any indicator, please continue to the right to specify at which level of detail the indicator is determined.
If you answer "no" to the first column, skip to the next line.

| | Performance indicator | Do you use the indicator? | | Level of detail (tick all that apply) | | | | Do you adjust for production | |
|---|---|---|---|---|---|---|---|---|---|
| | | no | yes | Product | Process | Site | Group | no | yes |
| A | Energy use | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| B | Materials consumption | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| C | Water use | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| D | Non-hazardous waste | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| E | Hazardous waste | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| F | Acid gas emissions | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| G | Ozone depleting substance emissions | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| H | Greenhouse gas emissions | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| I | Number of complaints | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| J | Environmental expenditure | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| K | Licence compliance | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| L | Other (specify) | ❑ | ❑ ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |

**Q.19 Please indicate your opinion of the following statements.**

| | Agree | Disagree | No opinion |
|---|---|---|---|
| Using environmental indicators improves business performance | ❑ | ❑ | ❑ |
| Environmental indicators could be used to compare the environmental performance of companies | ❑ | ❑ | ❑ |
| Environmental indicators could be used to compare the environmental performance of individual products or processes within a company | ❑ | ❑ | ❑ |
| The value of environmental indicators to decision making justifies the resources required to collect, report and maintain them | ❑ | ❑ | ❑ |
| Environmental indicators must always be adjusted for production levels | ❑ | ❑ | ❑ |
| Environmental indicators should be a combination of environmental and economic factors. | ❑ | ❑ | ❑ |

**Q.20 Do you plan to develop your use of environmental indicators?**

❑ Yes ❑ No ❑ Not considered

Comments: .....

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**Q.21 Are you familiar with *ISO 14031 Environmental management – Environmental performance evaluation - Guidelines*?**

❑ Yes ❑ No

Comments: .....

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## SECTION 5 BENCHMARKING

**Introduction**
Benchmarking is the continuous search for best practices that result in enhanced performance in the company to which they are applied. It may be achieved by comparing performance within a company over time, with another related company, with a similar company in the same sector, or with an entirely different company.

**Q. 22 How do you rate your environmental performance relative to comparable IPC regulated companies?**

- ❑ below average
- ❑ average
- ❑ above average
- ❑ among the best

**How do you arrive at this decision?**

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**Q.23 Have you benchmarked for non-environmental purposes?**

If you answer "yes" to any aspect, please continue to the right to detail the extent of benchmarking.
If you answer "no" to the first column, skip to the next line.

| Aspects of business operation | | Have you benchmarked | | | Within site over time? | | Between sites in Group | | Between companies in **same** sector | | Between companies in **another** sector | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NO | yes | | no | yes | no | yes | no | yes | no | yes |
| A | Safety | ❑ | ❑ | ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| B | Inventory management | ❑ | ❑ | ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| C | Quality systems | ❑ | ❑ | ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |
| D | Other (specify) | ❑ | ❑ | ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |

Comments: .....

.....

**Q.24 Have you benchmarked for environmental purposes? Please tick all that apply.**

| | | | Within site over time? | | Between sites in corporation | | Between companies in **same** sector | | Between companies in **another** sector | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO | yes | | no | yes | no | yes | no | yes | no | yes |
| ❑ | ❑ | ➔ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ | ❑ |

**Q.25 What are the advantages of benchmarking?**

Comments: .....

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**Q.26 What are the difficulties in benchmarking?**

Comments: .....

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**Q.27 Any further comments or suggestions you wish to make regarding benchmarking, EMS or reporting?**

Comments: .....

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